STOCK ASSESSMENT AND FISHERY EVALUATION REPORT

for the

SCALLOP FISHERY off ALASKA

Prepared by

The Scallop Plan Team

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Executive Summary

The Scallop Plan Team met in Kodiak, AK on February 22th, 2017 to review the status of the weathervane scallop stocks, to discuss additional issues of importance to scallop management, and to compile the 2017 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 were Quinn Smith (Chair), Jim Armstrong (Vice-Chair), Ryan Burt, Scott Miller, and Ben Williams.

New Information in the 2017 SAFE

- 2016 Statewide weathervane scallop survey overview given in the "Weathervane Stock Assessment". Details provided in accompanying ADF&G report.
- Round weights included in addition to meat weights in several of the harvest and CPUE tables & figures
- Fishing area specific standardized CPUE added:
    - Standardizing CPUE (controlling for variables that affect catch aside from population abundance) is difficult, though standardized data are presented in some sections of this document. This standardization is an initial effort and needs to be fully evaluated.
        - Standardization was done with generalized additive models (GAMs) of the form: $\boldsymbol{log(cpue) = f_1(depth) + f_2(lon, lat) + f_3(bed) + year_i + vessel_j + \epsilon_{ij}}$ where f is a smoothing function, year and vessel are categorical variables and bed is incorporated as a random effect.
- Explanation of OY/MSY/OFL determination shown in "Stock Status Determination" section
- Report from the ADF&G Pathology Laboratory on apicomplexan parasites in Alaska scallops included as Appendix 2.

Total scallop harvest off Alaska in the 2015/16 season was 264,532 lb (120 t) of shucked meats, which is 22.8% of ABC/ACL (1.161 million lb; 527 t). Area-specific harvest limits (areas depicted in Figure 1-1, area-specific harvest in Table 3-4) were met in a little over half of the fishing areas, specifically the Yakutat, Kodiak NE, Unimak Bight, and Bering Sea Districts. Areas that were closed or where fishing was abandoned by the fleet due to poor catch rates include the following: Prince William Sound beds remained closed. Fishing in District 16 was poor, prompting the fleet to harvest less than 5% of the GHL. Managers closed Shelikof after 54% of the GHL has harvested due to catch rates below the minimum performance standard. The Kodiak Southwest district was closed with 44% of the GHL caught due to hitting the Tanner crab bycatch cap. The preliminary total catch estimate for the 2016/17 season is 233,009 lb (106 t) of shucked meats. This is 20.1% of the ABC of 1.161 million lb (527 t).

The SPT recommends that the annual catch limit (ACL) for scallops in the 2017/18 season be continued as the maximum ABC control rule equal to 90% of the statewide OFL, which includes discards for which a 20% discard mortality rate will be applied. The SPT will evaluate total catch in the 2018 SAFE report

for the 2016/17 fishing year to determine if ABC has been exceeded. Overfishing of scallop stocks in Alaska waters is not occurring.

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.

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.

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.

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.

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, including 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.

In the original FMP, optimum yield (OY) was established as a range from 0 to 1.1 Mlbs (~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 Mlbs (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 Mlbs (562 t) with the upper end reflecting *average* rather than *maximum* catch. Most recently, in 2012, under Amendment 13, OY was re-defined as 0 to 1.29 Mlbs (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.

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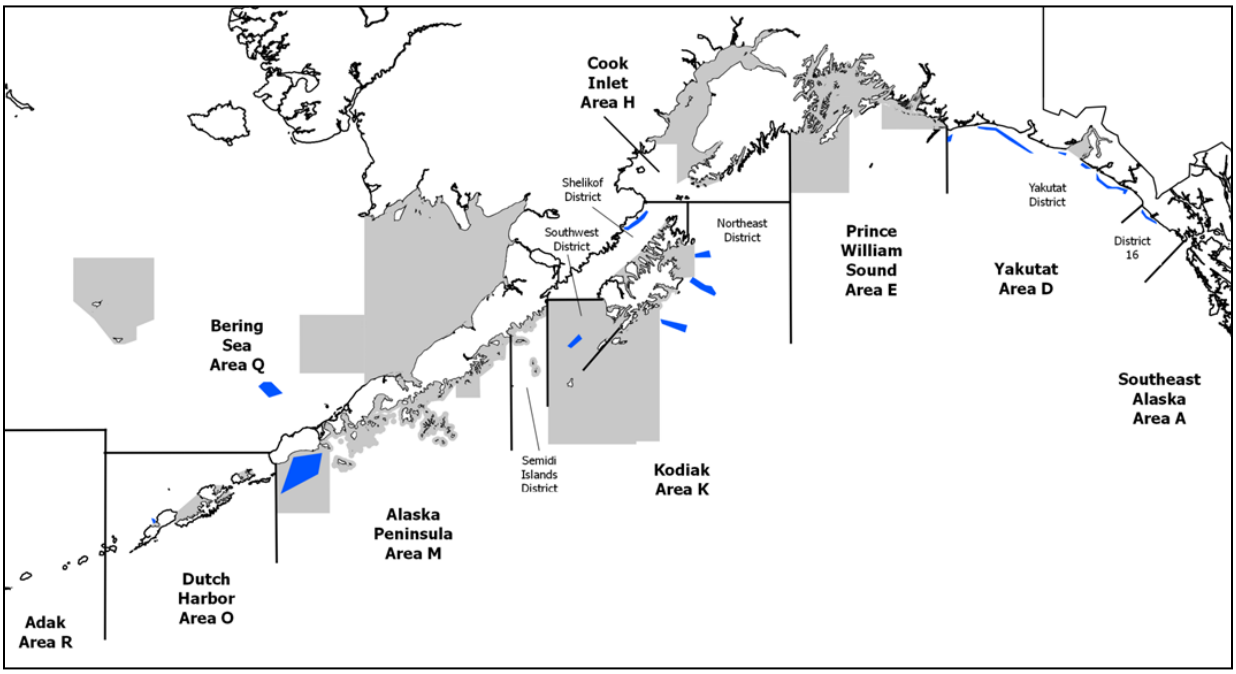

Figure 1-1 Map showing Alaska scallop fishery registration areas. General areas of effort are overlaid by blue polygons. Exploratory fisheries in waters normally closed to scallop fishing (gray shading) have been opened by ADF&G Commissioner's Permit in the Kodiak Southwest District and Alaska Peninsula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

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2. Weathervane Scallop Stock Assessment

A functional stock assessment model for weathervane scallops in Alaska does not exist, although efforts to develop an age-structured 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 locations within a given bed are non-random and gear does not select all shell sizes.

Fishery Independent Survey

In the areas that are surveyed by the State, biomass can be estimated and harvest rates are applied to the biomass estimates to determine a given area's GHL. Five beds were surveyed in in the ADF&G Statewide dredge survey in 2016; two near Kayak Island in the Prince William Sound Area (PWS), and three in the Shelikof District northwest of Kodiak Island. Abundance estimates of large (≥100mm) scallops were 12.2 million and 6.7 million individuals in PWS and Shelikof, respectively. A scallop meat weight to round weight conversion was established for each bed and used to calculate meat weight GHLs.

Using a 5% annual exploitation rate, the Prince William Sound Area and Shelikof District estimated GHLs ranged from 13,766 lbs (95% CI 6,321-22,824) to 14,164 lbs (10,398-18,422), respectively. A 10% annual exploitation rate increased estimated GHLs to 27,531 lbs (12,641-42,649) and 28,347 lbs (20,798-36,846) for Prince William Sound and Shelikof District, respectively. The CVs from the survey met the target of 20% for the KSH1 bed and was close for the EK1 bed. The CVs for the other three beds sampled were higher than desired and sample sizes may need to be increased for those beds in future surveys. Full details of the survey are given in Williams et al 2017.

Stock Status Determination

Scallop abundance is estimated for only portions of two of the nine scallop 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.

Overfishing is the level of catch that exceeds OFL, with OFL for Alaska scallops being equivalent to OY and MSY. Currently, OY/MSY/OFL is defined statewide as a range to 0 to 1.29 M lb of meats and

includes estimated discards. The reference period for defining the upper range for OY/MSY/OFL is 1990-1997 excluding 1995 (Table 2-1). Overfishing of the scallop stocks in waters off Alaska is not occurring.

Figure 2- 1 shows statewide scallop catch in relation to historic OY/MSY/OFL levels. Since 1996, catches have averaged from 39% to 66% of OY (Table 2-2). 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 2-1 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.

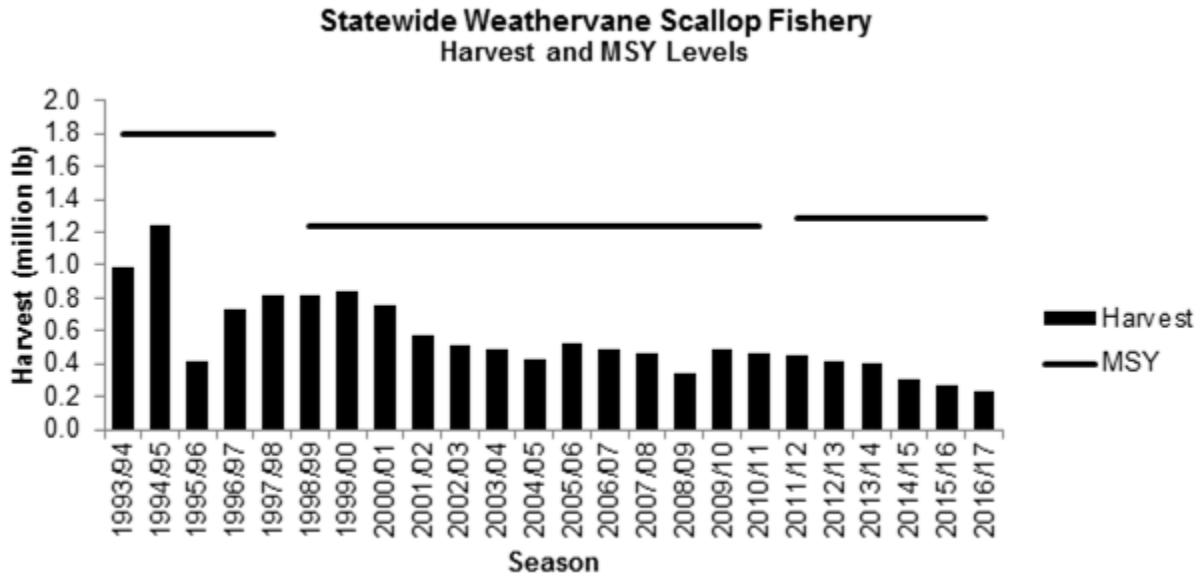

Figure 2-1 Statewide scallop harvest (lb shucked scallop meats) and MSY levels from FMP.

Table 2-2 Alaska weathervane scallop harvest and OY/MSY/OFL, 1993/94 - 2016/17 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	488,059	1,240,000	39
2010/11	459,759	1,240,000	37
2011/12	456,058	1,290,000	35
2012/13	417,551	1,290,000	32
2013/14	399,134	1,290,000	31
2014/15	308,888	1,290,000	24
2015/16	264,532	1,290,000	20
2016/17 [a]	233,009	1,290,000	18

[a] PRELIMINARY data subject to change.

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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: Federal 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 measures for 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. Originally, seven Federal 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 on the two LLPs with 6-foot dredge restrictions to also be able to use 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. Except for vessels affected by Amendment 10, the State allows all other vessels to operate a maximum of 2 dredges that are each 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 FMPs. The MSA further includes a requirement that the Council's specification of ACL may not exceed the fishing level recommended by the SSC. NMFS's National Standard 1 Guidelines state that the ABC is the fishing level recommendation from the SSC that is most relevant to ACLs. For scallops off Alaska, ACL=ABC.

A maximum ABC control rule was established in Amendment 13 (2011) defining ABC (1.161 Mlb) equal to 90% of the OFL (1.290 Mlb) with OFL and the catch measured against OFL including both retained and discarded scallops. The OFL is considered to be a conservative estimate due to the fact that there are areas of known scallop beds that are not included in the catch calculation as they are currently closed to fishing although they have supported historic harvests in the past.

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. EC species generally are not retained for any purpose, although *de minimis* amounts might occasionally be retained.

ACL recommendation for the 2017/18 Scallop fishing season

The SPT recommends that the annual catch limit (ACL) for the 2017/18 weathervane scallop catch specifications be established as the maximum ABC control rule equal to 90% of the statewide OFL, which includes discards. This equates to an ABC equal to 1.161 million pounds of shucked meats understanding that this will include all catch including discards for which a 20 percent discard mortality rate will be applied. The SPT will evaluate total catch (including discards) against this statewide ACL level in the 2018 SAFE report for the 2016/17 fishing year to determine if this ACL has been exceeded.

Catch in relation to ACLs

A summary of the 2015/16 season total catch in relation to the area-specific GHLs (retained catch), discards by area, and average CPUE are in Table 4-1. Total catch is compared against the ACL which is applied statewide. Preliminary retained catch from the 2016/17 fishery is provided in Table 4-2 but discard estimates are not yet available for comparison. This information will be provided in the 2018 SAFE report. Final catch in relation to the ACL for 2016/17 will be provided in the 2018 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.

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

Table 3-3 Bycatch of King crabs by Area/District in the 2015/16 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	NA (Closed)	
Cook Inlet	30	1
Kodiak Northeast District	25	0
Kodiak Shelikof District	50	0
Kodiak Southwest District	50	0
Alaska Peninsula Unimak Bight District	50	0
Dutch Harbor	20	0
Bering Sea	500	68
Statewide total	725	69

NE: not established; NA: not applicable

Table 3-4 Bycatch of *Chionoecetes* crabs by Area/District in the 2015/16 Alaska weathervane scallop fishery.

Area/District	Chionoecetes bycatch cap	Est number crab	Est weight (lb)[a]
Yakutat District	NE	1,906	25
Yakutat District 16	NE	0	0
Prince William Sound	NA (Closed)		
Cook Inlet	3,933	331	39
Kodiak Northeast District	93,929	26,560	3,612
Kodiak Shelikof District	19,107	2,593	1,264
Kodiak Southwest District	12,000	15,879	4,006
Alaska Peninsula Unimak Bight District	12,000	5,994	748
Dutch Harbor	10,000	326	83
Bering Sea *C. bairdi*	260,000	21,405	18,233
Bering Sea *C. opilio* and hybrids	300,000	8,330	6,521
Statewide total	710,969	83,324	34,531

NE: not established; NA: not applicable

[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.

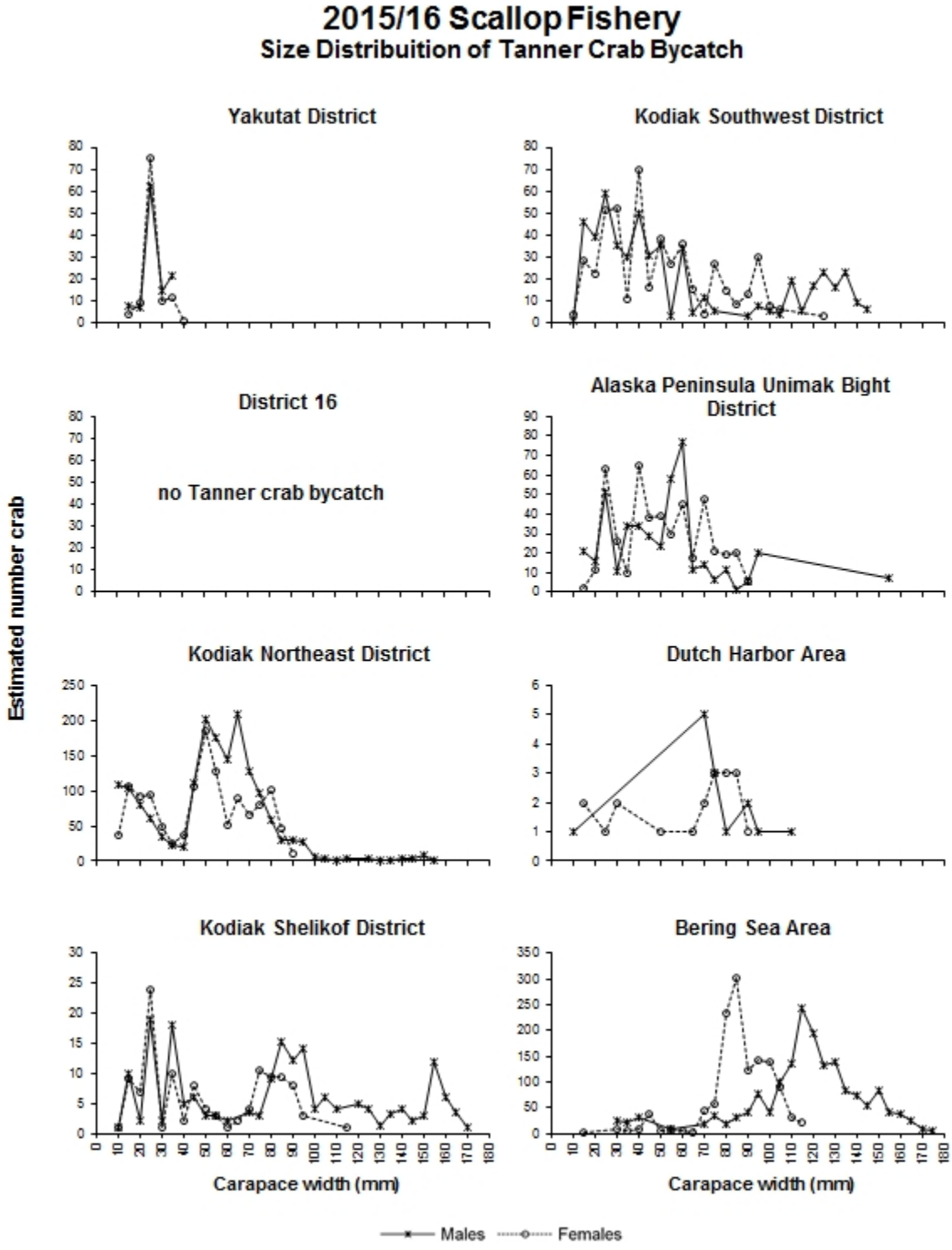

Figure 3-1 Tanner crab carapace width distributions by management unit from catch sampling during the 2015/16 scallop fishery.

4. Regional Fishery Performance

The 2015/16 season statewide Guideline Harvest Level (GHL) for weathervane scallops was 342,500 lb of shucked meats. Of this GHL 264,532 lb were retained with an additional 6,973 lb of estimated discard mortality for a total take of 271,505 lb of shucked meats (Table 4-1).

Table 4-1 GHLs and summary statistics from 2015/16 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	120,000	119,820	47	3,169
Yakutat District 16	0-35,000	25,000	870	21	34
Prince William Sound	0-50,000	closed	0		
Cook Inlet	10,000-20,000	10,000	9,485	20	215
Kodiak Northeast District	0-300,000 for whole Kodiak Area	55,000	55,577	45	1,981
Kodiak Shelikof District		75,000	40,290	30	1,100
Kodiak Southwest District[b]		25,000	10,950	39	143
Alaska Peninsula Unimak Bight District[b]	0-100,000	15,000	15,000	50	172
Dutch Harbor	0-110,000	10,000	5,040	32	74
Bering Sea	0-300,000	7,500	7,500	28	85
Statewide total		342,500	264,532	40	6,973

[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 2016/17 Alaska weathervane scallop fishery.

Area/District	GHL (lb scallop meats)	Retained catch (lb scallop meats)
Yakutat District	120,000	120,140
Yakutat District 16	5,000	240
Prince William Sound	6,300	6,360
Cook Inlet	10,000	3,982
Kodiak Northeast District	55,000	24,410
Kodiak Shelikof District	25,000	25,126
Kodiak Southwest District[a]	25,000	25,110
Alaska Peninsula Central District[a]	7,500	0
Alaska Peninsula Unimak Bight District[a]	15,000	15,016
Dutch Harbor	10,000	5,050
Bering Sea	7,500	7,575
Statewide total	286,300	233,009

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

Southeast Region

District 16

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. Preliminary 2016/17 scallop harvest in District 16 was the second lowest on record after the 2007/08 season (Table 4-3, Figures 4-1, 4-2). The fleet cited continued poor densities and product quality as the reasons for the low harvest numbers. 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 it may be that the product quality issues are due to marginal habitat.

Table 4-3 Yakutat District 16 scallop fishery summary statistics, 2000/01 - 2016/17.

Season	Vessels (N)	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	14	13	635	34
2008/09	2	21,000	20,986	207,251	423	50	490	1,259
2009/10	2	25,000	13,591	210,006	498	27	437	1,745
2010/11	1	25,000	2,655	31,266	83	32	370	468
2011/12	1	25,000	1,826	21,978	59	31	361	51
2012/13	1	25,000	26,713	335,178	734	36	452	1,019
2013/14	2	25,000	25,110	313,000	634	40	494	708
2014/15	2	25,000	9,140	108,803	413	22	257	256
2015/16	1	25,000	870	10,512	41	21	255	34
2016/17[d]	1	5,000	240	NA	12	20	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.

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, beginning in the 2014/15 season, combined with reports of poor fishery performance from the fleet a decrease in harvest pressure appeared necessary. Harvest had averaged 11,200 lb of shucked meats over the past 10 seasons. 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 2015/16 season (Table 3-4), likely due to the very limited effort.

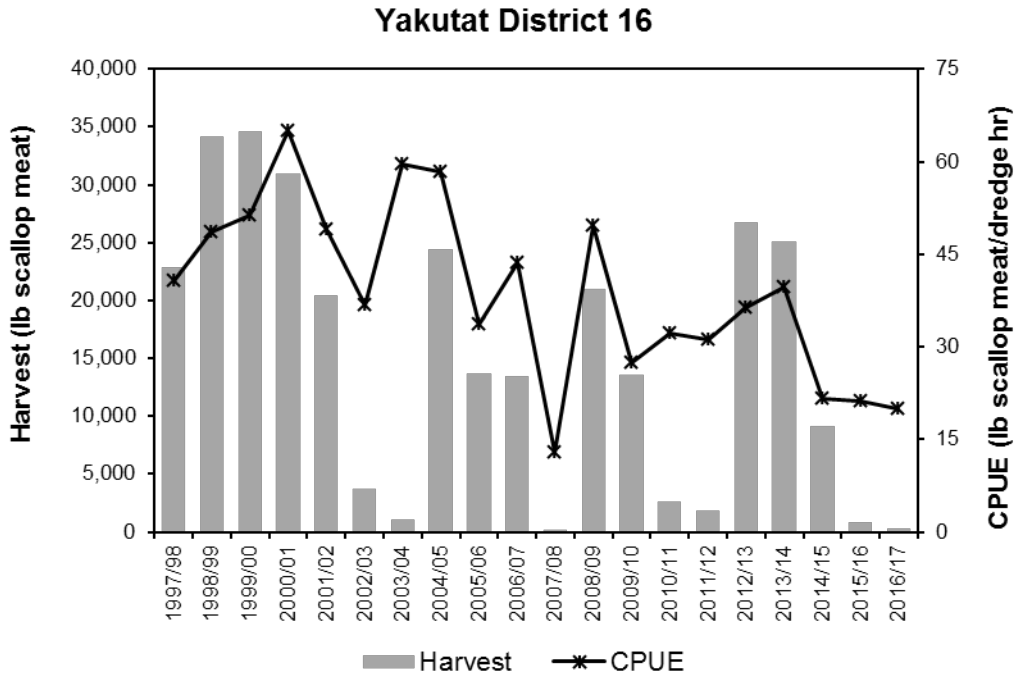

Figure 4-1 Yakutat District 16 Scallop Harvest and CPUE, 1997/98 - 2016/17 seasons

Table 4-4 District 16 catch summary for the 2009/10-2015/16 season for raw and standardized round weight CPUE.

	Raw CPUE			Standardized CPUE		
Year	Median	Mean	SD	Median	Mean	SD
2009/10	463.8	490.1	263.0	411.5	414.9	34.2
2010/11	401.6	420.6	206.3	422.5	415.8	33.9
2011/12	362.0	409.4	214.7	346.1	359.9	42.4
2012/13	475.8	494.9	201.8	378.5	358.4	48.5
2013/14	576.6	533.9	255.9	470.3	461.5	37.6
2014/15	304.3	304.3	113.7	379.5	366.0	45.1
2015/16	291.0	304.6	155.2	484.2	461.9	78.6

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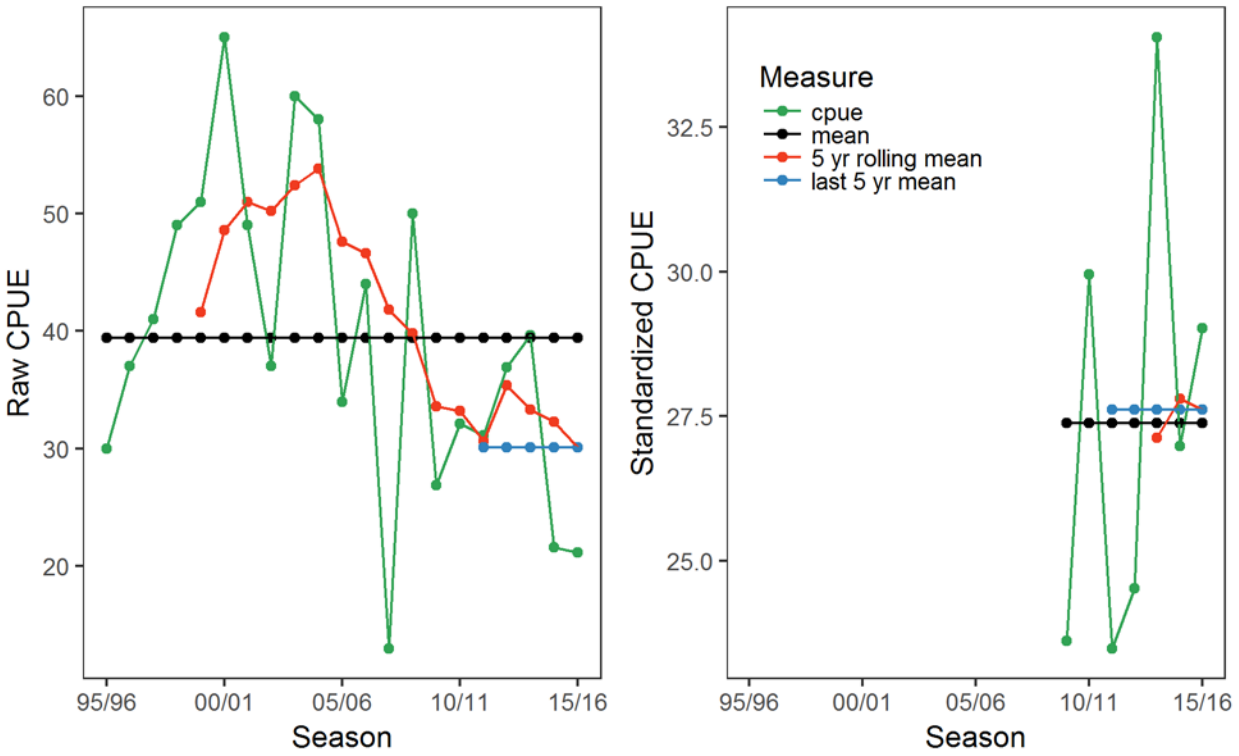

Figure 4-2 Yakutat District 16 Scallop raw and standardized (when available) meat CPUE, 1995/96 - 2015/16 seasons.

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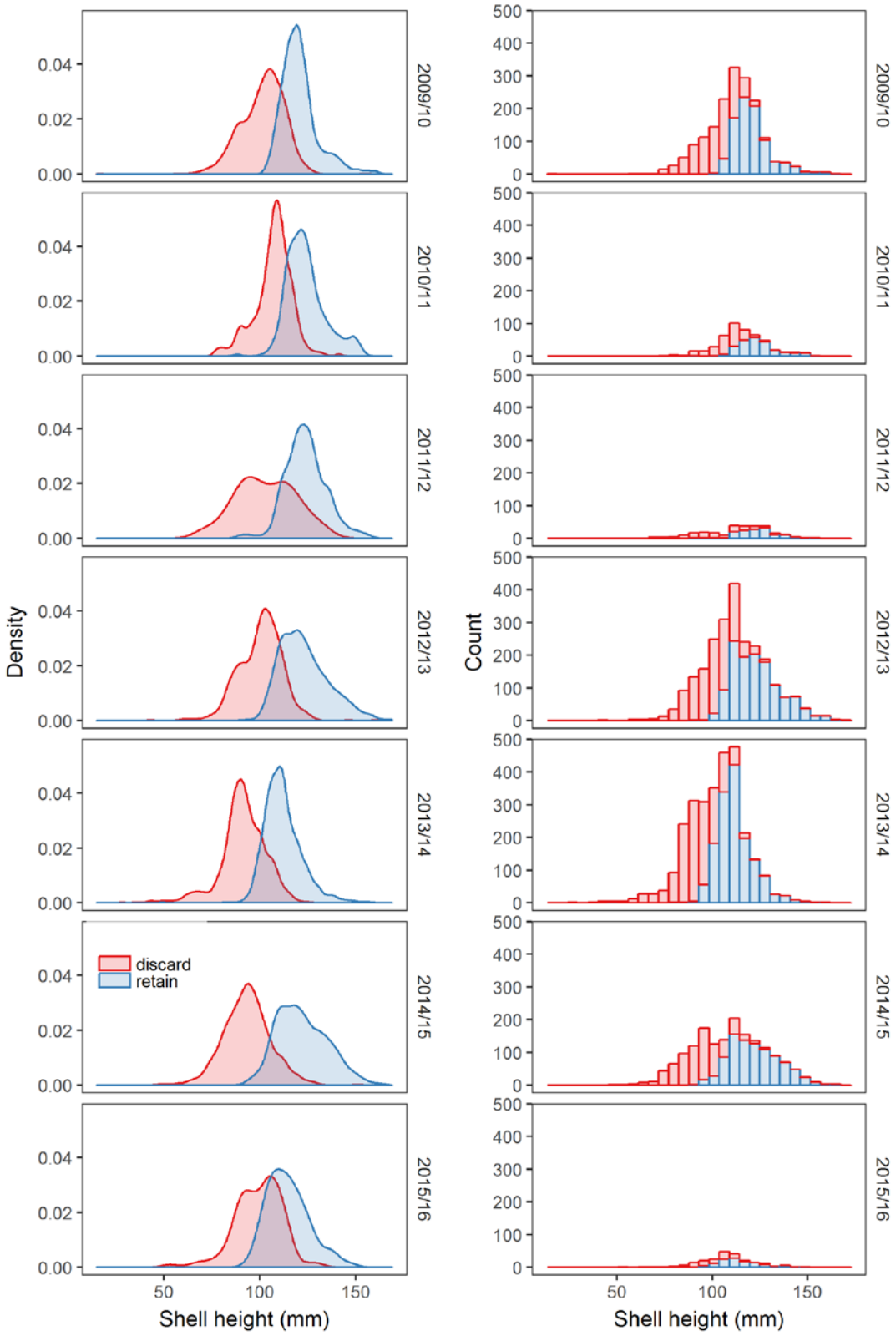

Figure 4-3 Yakutat District 16 retained and discarded shell heights by density and count for the 2009/10-2015/16 seasons.

Yakutat

The 2016/17 season was the 5th season at a reduced GHL in Yakutat. This GHL reduction appears to have been effective as CPUE has shown general increases since its introduction (Figures 4-4, 4-5). Based on preliminary harvest and effort from the 2016/17 season CPUE is up 68% 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 - 2016/17.

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	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	3,358	48	577	6,940
2004/05	2	200,000	86,950	1,262,499	2,134	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	150,950	1,771,229	2,817	54	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	157,868	2,317,273	3,936	40	589	10,985
2010/11	3	160,000	156,436	2,087,228	3,490	45	610	10,216
2011/12	3	160,000	156,338	2,386,748	4,594	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	2391	51	644	3,770
2014/15	3	120,000	120,216	1,446,693	2,732	44	529	2,861
2015/16	2	120,000	119,820	1,684,050	2,530	47	666	3,169
2016/17[d]	2	120,000	120,140	NA	2,092	57	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 2015/16 Yakutat fishery, 119,820 lb of scallop meats were retained and an estimated 15,845 lb, or approximately 11.7%, were discarded, Discards increased bey approximately 10% from the 2014/15 season, but were still well below the 10 year mean of 20.2%. Using a 20% discard mortality estimate 3,169 lb of scallop meat weight was lost to discard mortality in the 2015/16 season (Table 4-5).

Estimated shell height distributions in Area D show a slight decrease in the range of scallop sizes in the 2015/16 season, with an apparent prerecruit pulse in the 70mm range from the previous season now in the 80mm range. 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).

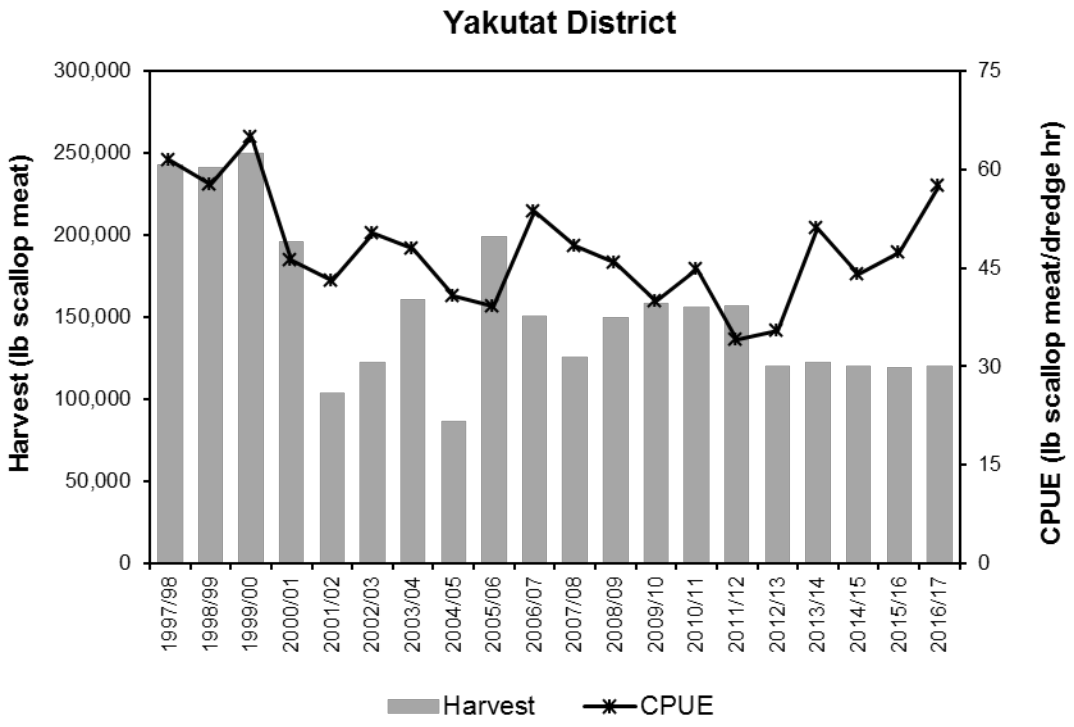

Figure 4-4 Yakutat Area D Scallop Harvest and CPUE, 1997/98 - 2016/17 seasons.

Crab Bycatch estimates calculated from 2015/16 Yakutat observer samples were 1,906 Tanner crabs (Table 3-4), and 31 Dungeness crabs estimated Yakutat Tanner crab bycatch decreased 10% from the 2014/15 season and 90% from the 2013/14 season. Carapace width (CW) of Tanner crabs sampled by observers ranged from about 10mm to 40mm, with vast the majority in the 20-30mm range (Figure 3-1).

Table 4-6 Yakutat District catch summary for the 2009/10-2015/16 season for raw and standardized round weight CPUE.

	Raw CPUE			Standardized CPUE		
Year	Median	Mean	SD	Median	Mean	SD
2009/10	634.2	642.2	260.4	581.7	590.1	90.3
2010/11	622.0	663.0	252.9	629.3	616.4	85.2
2011/12	557.6	569.2	202.4	538.2	539.9	71.2
2012/13	516.2	546.1	228.1	538.2	527.9	71.0
2013/14	694.7	692.9	260.8	651.0	640.2	89.3
2014/15	557.8	565.8	204.1	509.6	509.9	70.3
2015/16	687.8	715.5	242.7	672.5	672.6	93.2

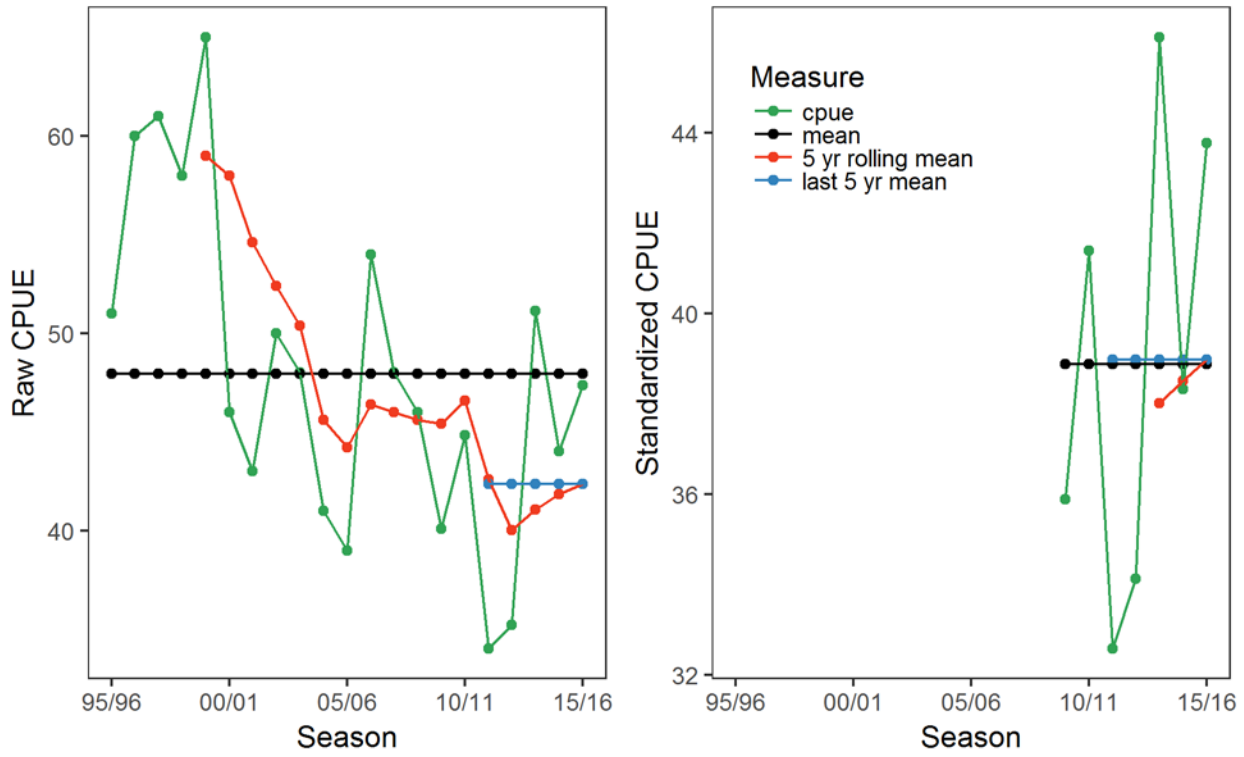

Figure 4-5 Yakutat District Scallop raw and standardized (when available) meat CPUE, 1995/96 - 2015/16 seasons.

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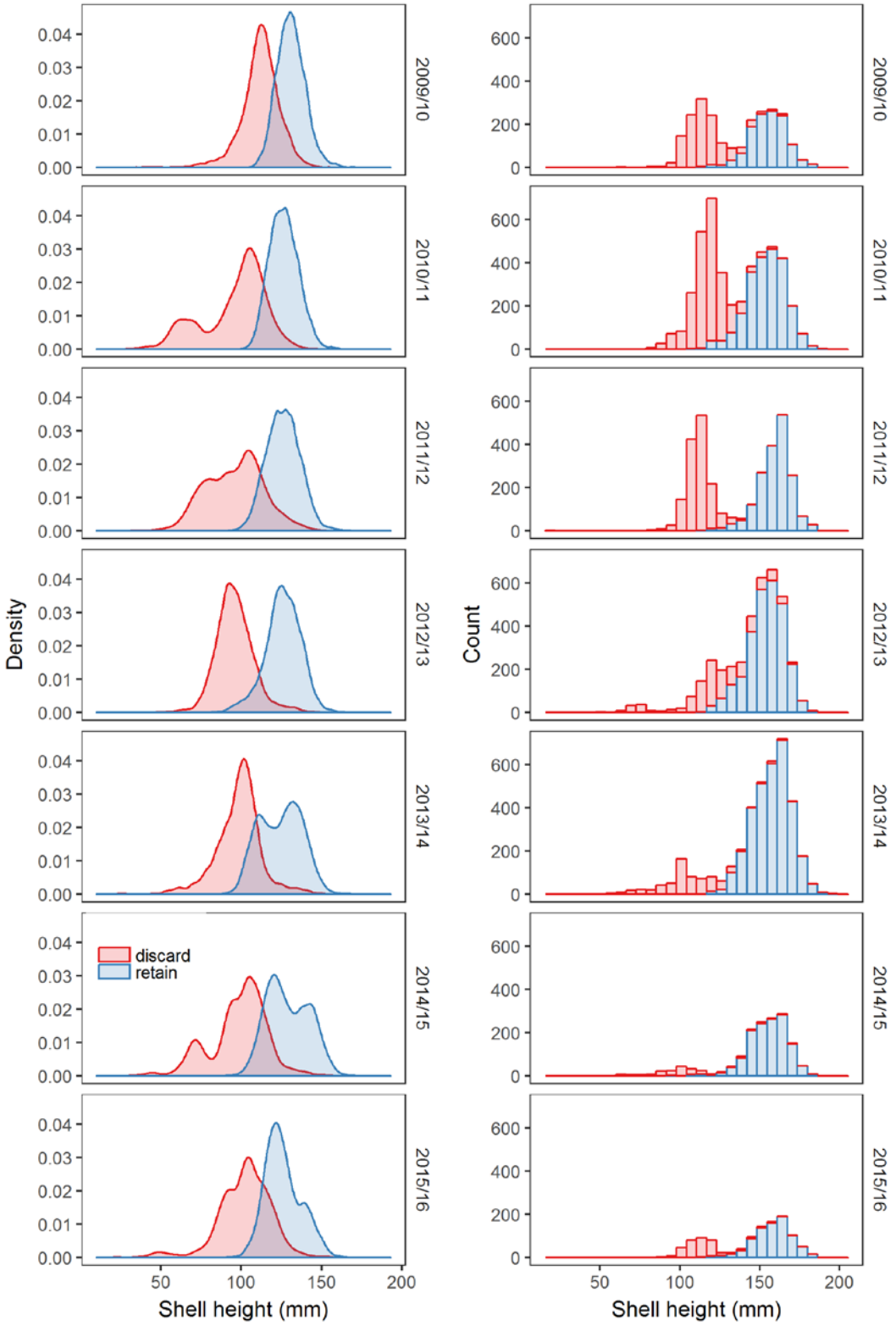


Figure 4-6 Yakutat District retained and discarded shell heights by density and count for the 2009/10-2015/16 seasons.

Central Region

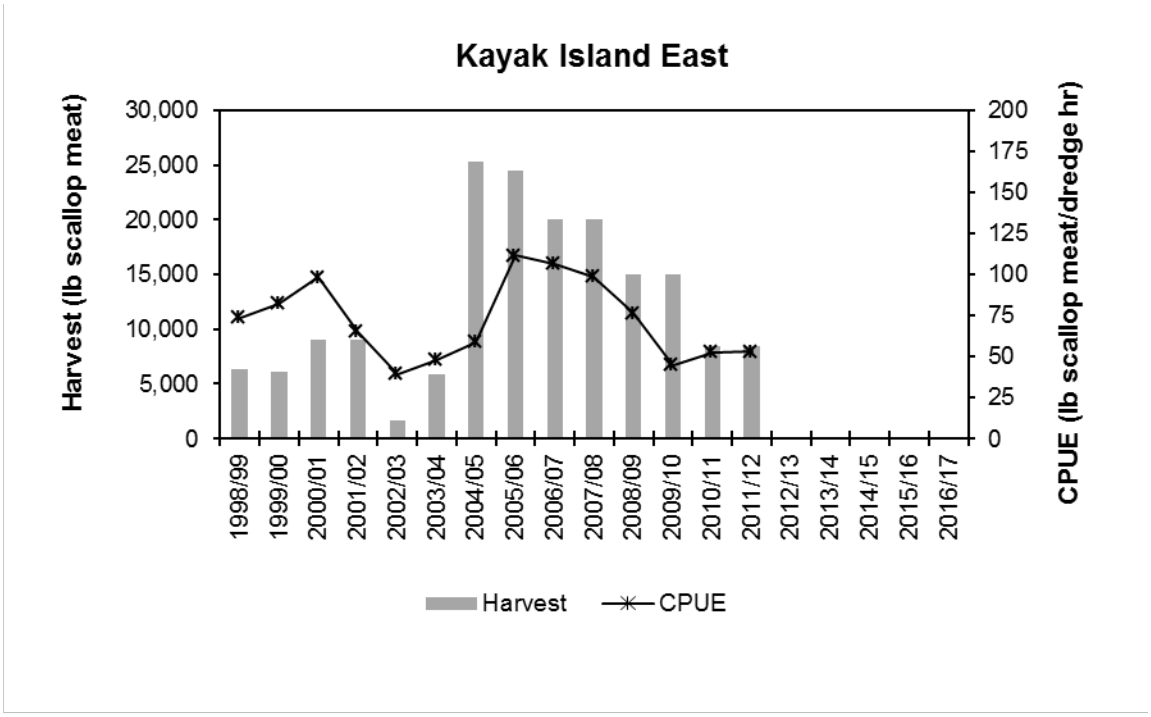
Kayak Island

In 2016/17 the Kayak Island weathervane scallop fishery in the Prince William Sound Area (PWS, Area E) opened for the first time since 2011. The Kayak Island scallop fishery has a guideline harvest range (GHR) of zero to 50,000 lb of shucked scallop meats, season dates of July 1 through February 15, and is open in the Eastern Section of the Outside District of PWS. The guideline harvest level (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 West Kayak (WKS, West bed) and East Kayak (EKS, East bed) subsections marked by Cape St. Elias. The season was closed in the WKS for the 2010/11 season after historically low levels of abundance and biomass were observed in the survey and remained closed through the 2015/16 season. The season was closed in the EKS for the 2012/13 season following a sharp decline in survey estimates of abundance and biomass and has remained closed through the 2016/17 season. The most recent survey was completed in April 2016 and results showed increased abundance and biomass in the WKS, a continued trend since 2014. The survey also showed a continued decline of abundance and biomass in the EKS with historic low levels. The 2016/17 season opened July 1 in the WKS with a GHL of 6,300 lb and closed at 12:00 noon August 30 when the GHL was achieved. The season remained closed in the EKS. One vessel participated in the 2016/17 fishery and harvested 6,360 lb for a CPUE of 57 lb/hr, slightly below the CPUE of 59 lb/hr for the 2009/10 season, the last time the WKS was open.

The EKS was last open from July 31 through August 5 of the 2011/12 season when one vessel made 91 tows to harvest 8,460 lb of scallop meats (Table 4-7). The CPUE was 53 lb/hr, just slightly higher than the previous season's CPUE in the EKS. The CPUE remained well below the average between 1999/2000 and 2010/11 of 90 lb/hr. The observer sampled 17 of 91 tows made during the 2011/12 season. Using the observer information, catch estimates were 139,345 lb of whole scallops retained and 11,469 lb whole scallops discarded, for a discard rate of 7.6%.

Shell height distributions provided by the statewide observer program show that the 2011/12 harvest was comprised primarily of scallops between 125 and155 mm in shell height, with very few small scallops caught and discarded.

There were no Tanner crab, Dungeness crab, or halibut encountered in sampled dredges during the 2011/12 season (Table 3-4); although this was unusual, the onboard observer was highly experienced and scallop observer program staff has no reason to question these results.



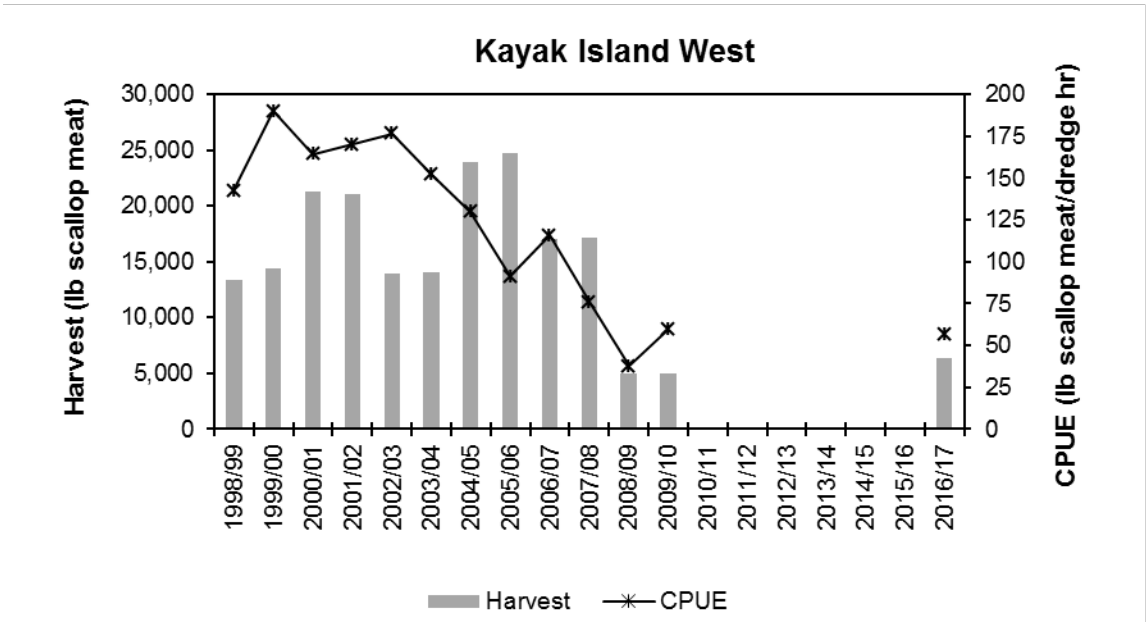


Figure 4-7 Prince William Sound Scallop Harvest and CPUE, 1996/97 - 2016/17 seasons.

Table 4-7 Commercial harvest of weathervane scallops from Kayak Island beds, 1995/96 - 2016/17.

		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[b]	1	Closed				6,300	6,360	112	57	6,300	6,360	112	57

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

[b] PRELIMINARY data subject to change

Kamishak Bay
Fishery overview

In 2016, the Kamishak District weathervane scallop fishery in the Cook Inlet (CI) Area was open for a second year in a row, following a two-year closure, and the GHL was set at the lower bound of the GHR or 10,000 lb, the same as in the 2015 season. The GHR is 10,000 to 20,000 lb of shucked meats for the Kamishak District in CI, specified by state regulation, with season dates of August 15–October 31. The GHL is set based on the Kamishak Bay ADF&G dredge survey estimates of abundance and biomass. The survey was last conducted in May 2015 when only the north bed was surveyed. The 2015 survey produced a higher total scallop estimate than the 2013 survey, however, there was a concentration of small scallops found in the southern part of the north bed. In order to conserve scallops in the southern portion of the north bed and the south bed, waters of the Kamishak District south of 59° 18.50' N. lat. remained closed for the 2015 and 2016 seasons. The south bed has been closed 10 out of the last 12 seasons, and when it was open for the 2005 and 2006 seasons, there was no effort. One vessel participated in the 2016 fishery and harvested 3,982 lb of scallops including 86 lb of deadloss, less than half of the 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). The lowest CPUE for the fishery was in 2006 when the fishery was closed in season with a CPUE of 5 lb/hr.

One vessel participated in the 2015 fishery with a harvest of 9,269 lb shucked meats and estimated 216 lb of deadloss for a total catch of 9,485 lb and an average fishery CPUE of 21 lb/hr (Table 4-8). The CPUE decreased during the course of the fishery from an average of 26 lb/hr during the first trip to 17 lb/hr on the fourth trip.

There was an increase in average shell height in 2015 while there was a decrease in average age compared to 2012, the last year the fishery was open (Figure 4-9). Retained scallops from 2015 observed tows had an average shell height of 160 mm compared to 155 mm in 2012. Discarded live (small) scallops had an average shell height of 119 mm, an increase from 101 mm in 2012. Age data from the 2015 fishery shows a range in age from 4 to 20 years for harvested scallops with an average age of 11 years. Age data from 2012 indicated an age range 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 statewide observer program observers onboard, although department observers must be accommodated upon request. Typically, at least half of trips are observed by regional sampling staff. ADF&G placed an observer on two of the four fishery trips in 2015 to collect data on scallop catch, discards, crab bycatch, and catch composition; the observer sampled 135 of 435 total tows. This information was used to calculate deadloss, a discard rate (by weight) of 2.3%, and an average meat recovery of 9.6%. The occurrence of weak meats was observed in the commercial fishery. In 2015, 708 scallops were sampled for meat quality during observed trips and 36 scallops or 5.1% had weak meats. This was higher than in 2012 when 2.7% of scallops sampled had weak meats.

Crab bycatch levels in 2015 were set at 3,933 Tanner crab and 30 king crab (Tables 3-2 & 3-3). Crab bycatch reported on skipper logbooks was 1 king crab (Table 3-3) and 331 Tanner crab (Table 3-4). The largest crab catch in a single tow was 107 Tanner crab reported during the unobserved fourth trip. Observed crab bycatch was corroborated by skipper logbooks.

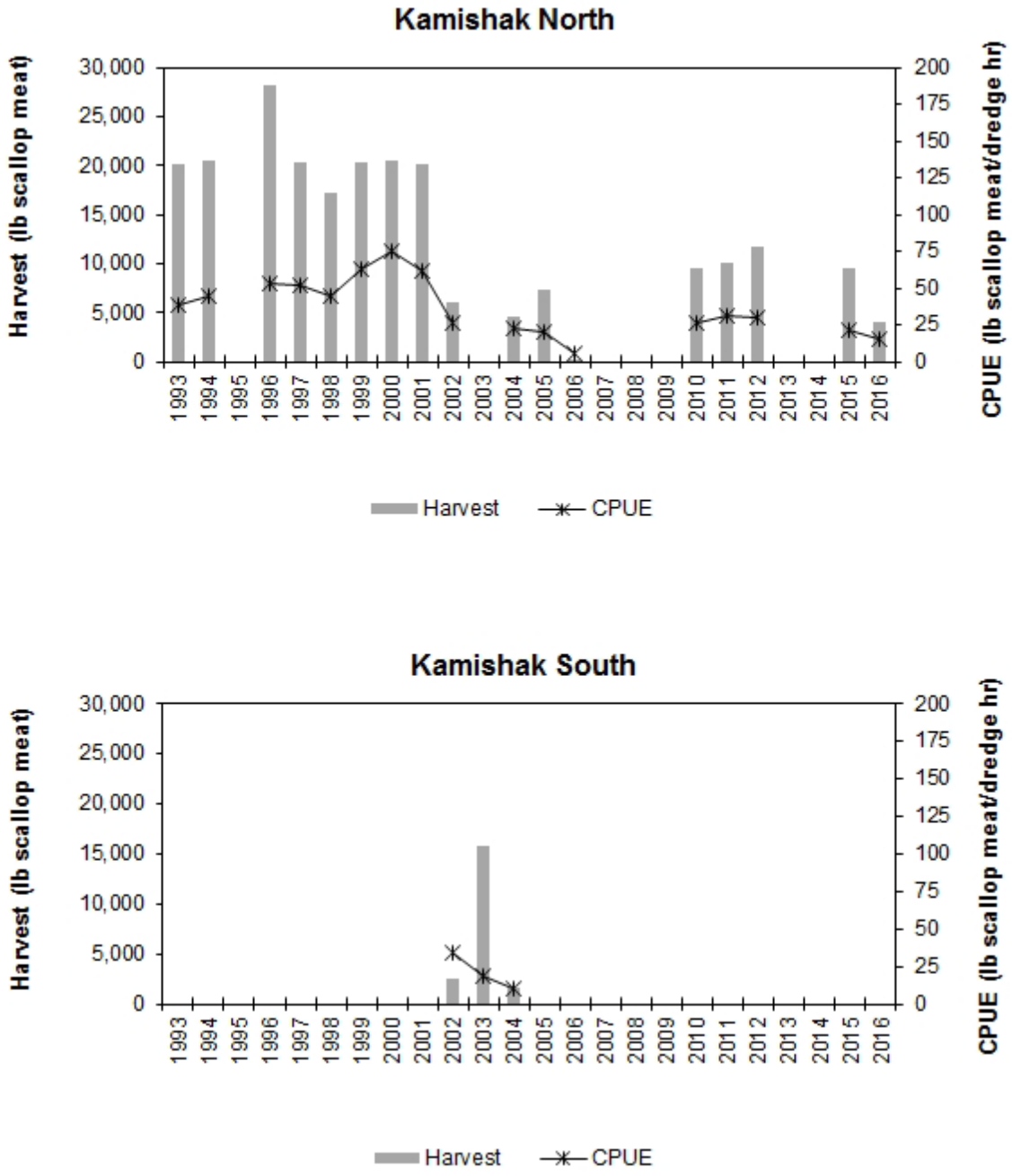


Figure 4-8 Cook Inlet Scallop Harvest and CPUE, 1993 - 2016 seasons.

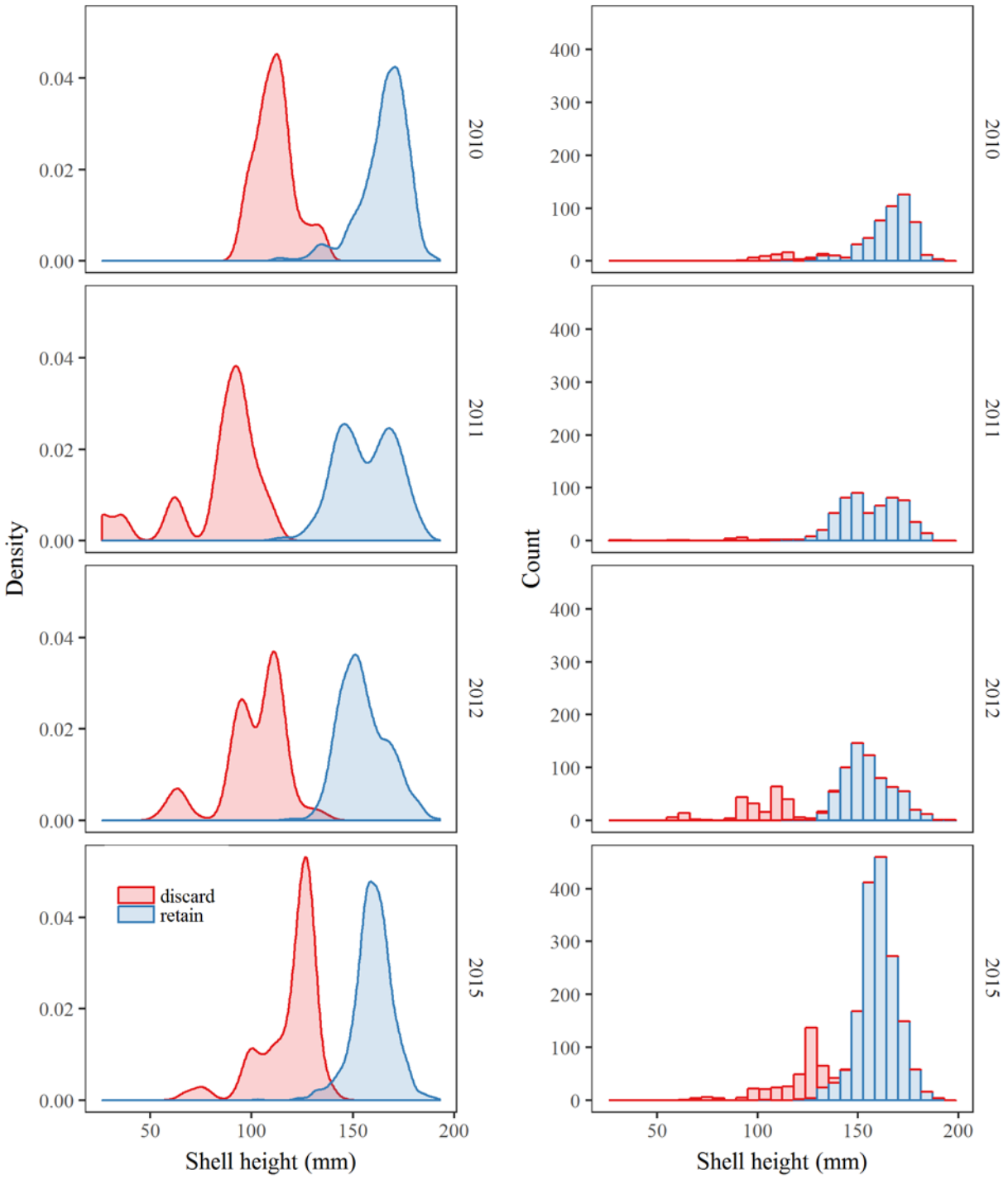


Figure 4-9 Cook Inlet retained and discarded shell heights by density and count for the 2010-2012 and 2015 seasons.

Table 4-8 Cook Inlet, Kamishak District scallop fishery summary statistics, 1993 - 2016.

		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)
1993	3	20,000	20,115	528	38					20,000	20,115	528	38
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[b]	1	10,000	3,982	271	15	Closed				10,000	3,982	271	15

Confidential data voluntarily released by vessel operators

[b] PRELIMINARY data subject to change.

Westward Region

Kodiak Registration Area

Kodiak Northeast

The 2016/17 season was the 4th season with the current 55,000-pound GHL in the Northeast District. Based on preliminary harvest and effort from the 2016/17 season the CPUE of 23 pounds of meats/dredge hour is the lowest since the initial exploration of the area (Table 4-9; Figures 4-10 & 4-11).

Table 4-9 Kodiak Northeast District scallop fishery summary statistics, 1993/94 - 2016/17.

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[d]	2	55,000	24,410	NA	1,072	23	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 2015/16 Northeast District fishery, 55,577 lb of scallop meats were retained with a CPUE of 43 pounds of meats/dredge hour. Catch per unit effort decreased 39.2% from the 2014/15 season (Figure 4-10). In addition to the retained catch an estimated live scallop equivalent of 9,905 lb of meats were discarded, for an estimated discard rate of 17.8% of the total meat weight caught, a 5.9% decrease from the 2013/14 season. Using a 20% discard mortality estimate, 1,981 lb of scallop meat weight was lost to discard mortality in the 2015/16 season (Table 4-9). Average estimated Northeast District scallop meat discard for the last 10 seasons was 11,320 lb or 17.4% of total catch.

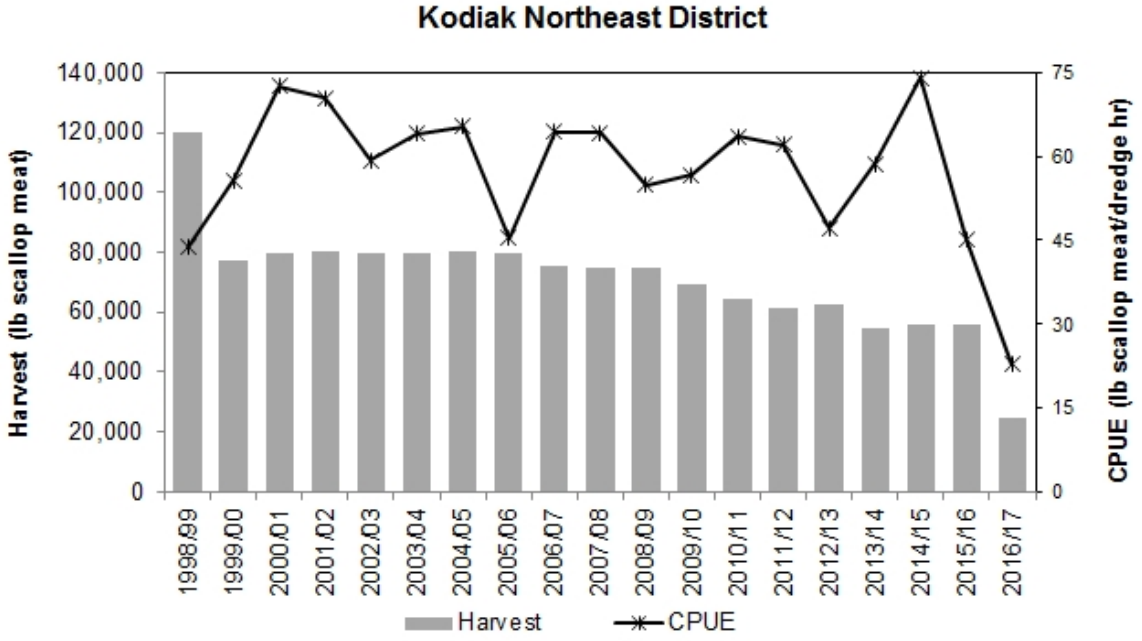


Figure 4-10 Kodiak Northeast District Harvest and CPUE, 1998/99 - 2016/17 seasons.

Estimated shell height distributions in Northeast District show an increased range of scallop sizes in the 2015/16 season. Whether these changes are due to growth rates, fleet behavior, or an increase in prerecruit scallops is not known. The bulk of the retained scallops remain in the 125–175 mm shell height (SH) range (Figure 4-12).

Beginning with the 2010/11 season, abundance in some Northeast District scallop beds showed signs of decline. In response, a minimum performance standard (MPS) was established for statistical area 525630 (45 lb meats/dredge hour) based upon the lowest CPUE observed in this statistical area (2005/06 season). At that time, an MPS was also established for scallop bed 2 (43 lb meats/dredge hour), also based upon the lowest CPUE observed in that area (2005/06 season). The MPS for statistical area 525702 is 52 lb meats/dredge hour and has been in place since 2003/04 which is the lowest CPUE observed in this statistical area (Table 3-1).

Crab bycatch estimates calculated from 2015/16 Northeast District fishery observer samples were 26,560 *Chionoecetes bairdi* Tanner crab (Table 3-4). Estimated Northeast District Tanner crab bycatch increased 27.1% from the 2014/15 season. Carapace width of Tanner crabs sampled by observers ranged from approximately 10mm to 155mm, with the majority in the 40–90mm range (Figure 3-1).

Table 4-10 Kodiak Northeast District catch summary for the 2009/10-2015/16 season for raw and standardized round weight CPUE.

	Raw CPUE			Standardized CPUE		
Year	Median	Mean	SD	Median	Mean	SD
2009/10	646.7	723.4	348.8	579.6	666.4	161.7
2010/11	649.8	684.1	371.4	540.0	615.3	200.2
2011/12	578.8	686.5	424.8	537.4	583.3	226.2
2012/13	579.0	604.2	288.7	577.3	547.8	163.2
2013/14	489.7	616.5	447.3	522.6	520.0	162.7
2014/15	934.6	917.0	385.9	838.4	828.6	150.3
2015/16	486.3	495.0	216.4	439.8	449.0	102.9

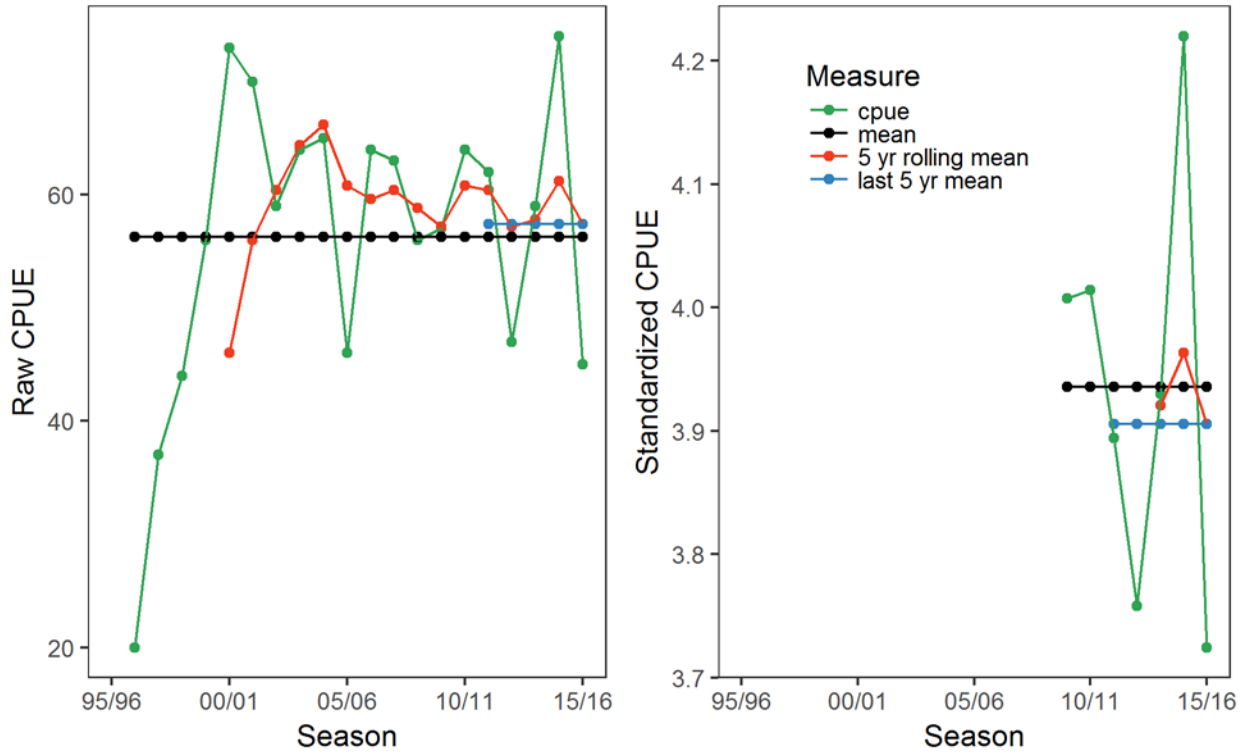


Figure 4-11 Kodiak Northeast District Scallop raw and standardized (when available) meat CPUE, 1995/96 - 2015/16 seasons.

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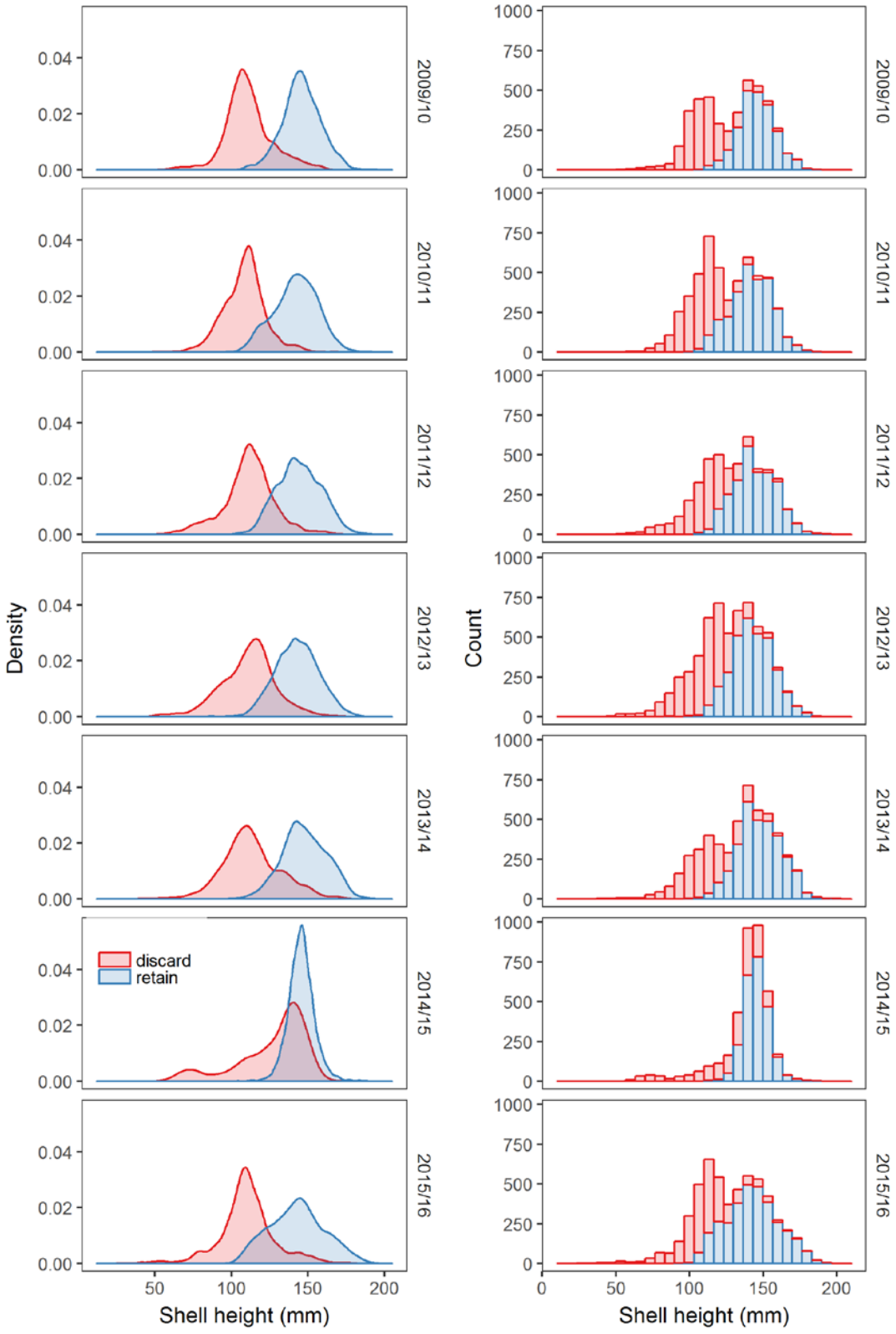

Figure 4-12 Kodiak Northeast District retained and discarded shell heights by density and count for the 2009/10-2015/16 seasons.

Shelikof

The 2016/17 season was the 2nd consecutive season with GHL reductions in the Shelikof District; the 2016/17 GHL was set at 25,000 pounds, down 76.2% from the 2014/15 season GHL (105,000 pounds). Based on preliminary harvest and effort from the 2016/17 season the CPUE of 31 pounds of meats/dredge hour is similar to the historic low of 30 pounds of meats/dredge hour observed in 2015/16 (Table 4-11; Figure 4-13).

Table 4-11 Kodiak Shelikof District scallop fishery summary statistics, 1993/94 - 2016/17.

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	169,877	1,667,958	3,496	49	477	7,132
2010/11	4	170,000	171,076	1,887,354	3,508	49	539	8,623
2011/12	4	135,000	136,491	1,432,441	2,437	56	590	2,618
2012/13	4	105,000	106,051	990,580	2,001	53	497	2,575
2013/14	4	105,000	106,099	910,919	2,469	43	369	1,162
2014/15	3	105,000[1]	66,138	648,361	1,628	41	400	962
2015/16	3	75,000[2]	40,290	447,037	1,322	30	338	1,100
2016/17[d]	2	25,000	25,126	NA	813	31	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 2015/16 Shelikof District fishery, 40,290 lb of scallop meats were retained with a CPUE of 30 pounds of meats/dredge hour (Figure 4-13). Catch per unit effort decreased 26.9% from the 2014/15 season. In addition to the retained catch an estimated live scallop equivalent of 5,500 lb of meats were discarded, for an estimated discard rate of 13.7% of the total meat weight caught, a 6.4% increase from the 2013/14 season. Using a 20% discard mortality estimate, 1,100 lb of scallop meat weight was lost to discard mortality in the 2015/16 season (Table 4-11). Average estimated Shelikof District scallop meat discard for the last 10 seasons was 18,650 lb or 16.3% of total catch.

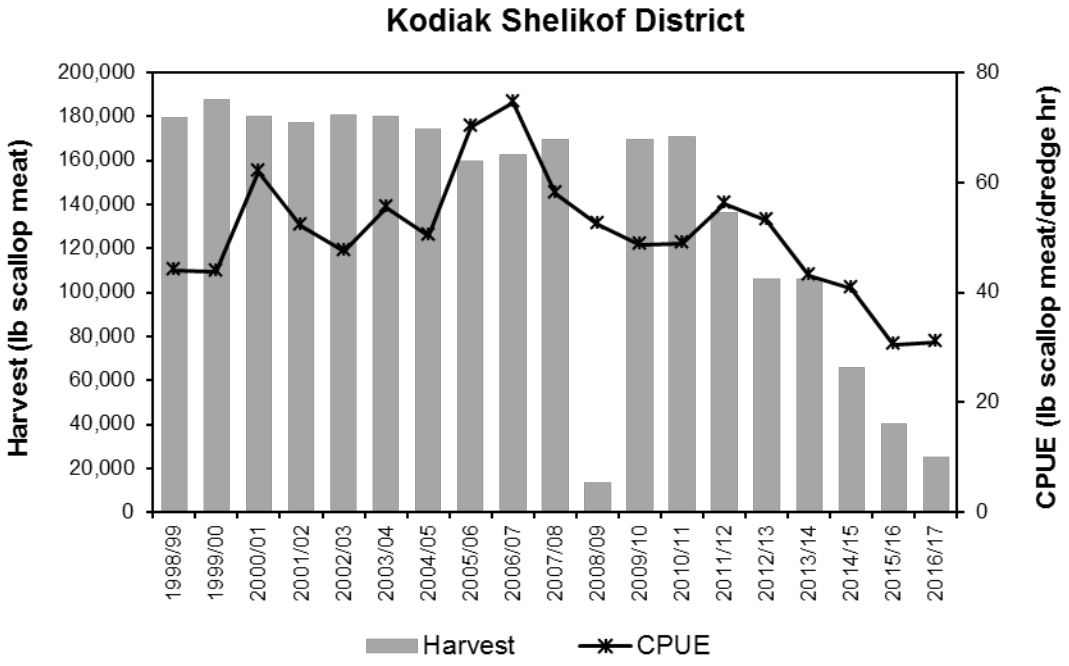

Figure 4-13 Kodiak Shelikof District Harvest and CPUE, 1998/99 - 2016/17 seasons.

Estimated shell height distributions in Shelikof District show a similar range of scallop sizes in the 2015/16 season, relative to prior seasons, with some signs of recruitment in the smaller size classes. The bulk of the retained scallops remain in the 125–175 mm shell height (SH) range (Figure 4-15).

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).

Crab bycatch estimates calculated from 2015/16 Shelikof District fishery observer samples were 2,593 *Chionoecetes bairdi* Tanner crab (Table 3-4). Estimated Shelikof District Tanner crab bycatch decreased 88.6% from the 2014/15 season. Carapace width of Tanner crabs sampled by observers ranged from approximately 20mm to 170mm, with the size frequency of sampled crab being well distributed across the range (Figure 3-1).

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Table 4-12 Kodiak Shelikof District catch summary for the 2009/10-2015/16 season for raw and standardized round weight CPUE.

	Raw CPUE			Standardized CPUE		
Year	Median	Mean	SD	Median	Mean	SD
2009/10	524.7	522.3	158.1	486.7	496.8	53.6
2010/11	586.1	589.4	215.1	540.7	546.0	56.9
2011/12	627.2	641.0	231.5	590.9	597.2	73.7
2012/13	519.7	543.1	164.5	508.5	518.2	54.8
2013/14	422.0	421.7	135.5	399.9	401.6	50.4
2014/15	428.7	452.6	141.6	427.0	430.8	42.4
2015/16	372.3	382.1	125.7	359.7	361.1	41.2

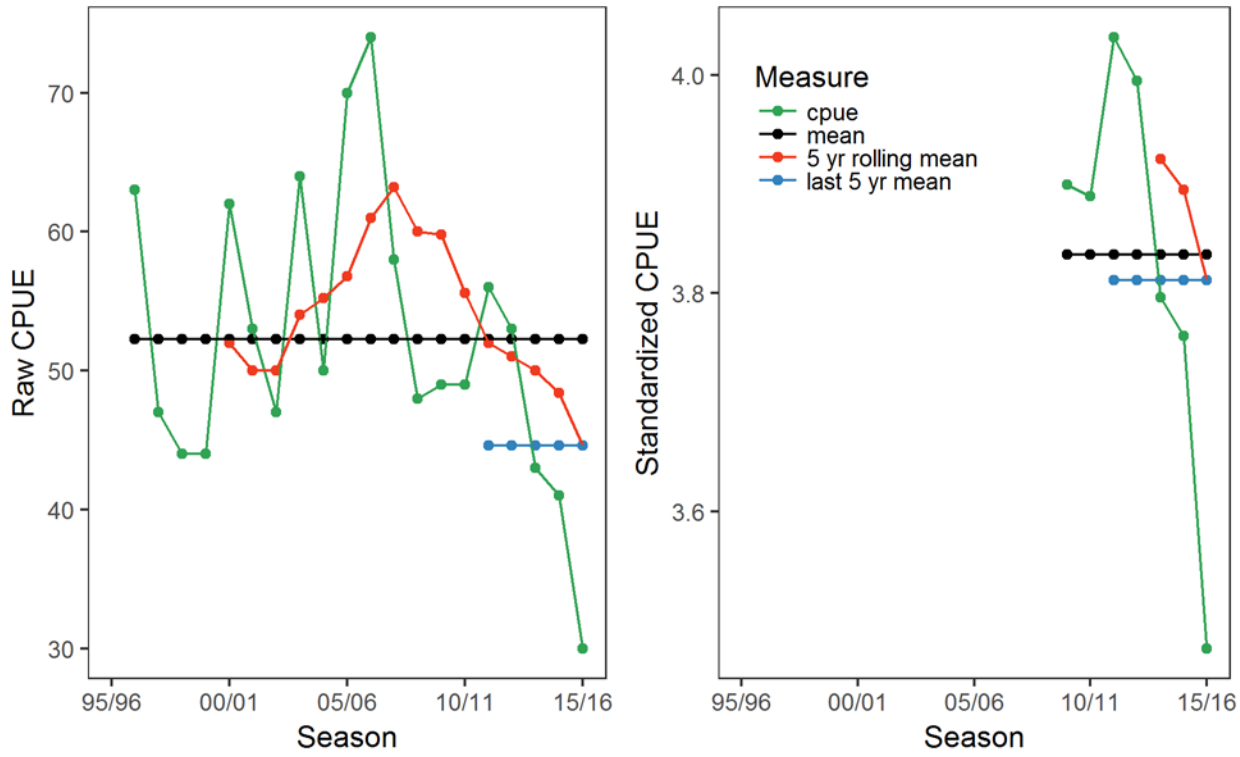

Figure 4-14 Kodiak Shelikof District scallop raw and standardized (when available) meat CPUE, 1995/96 - 2015/16 seasons.

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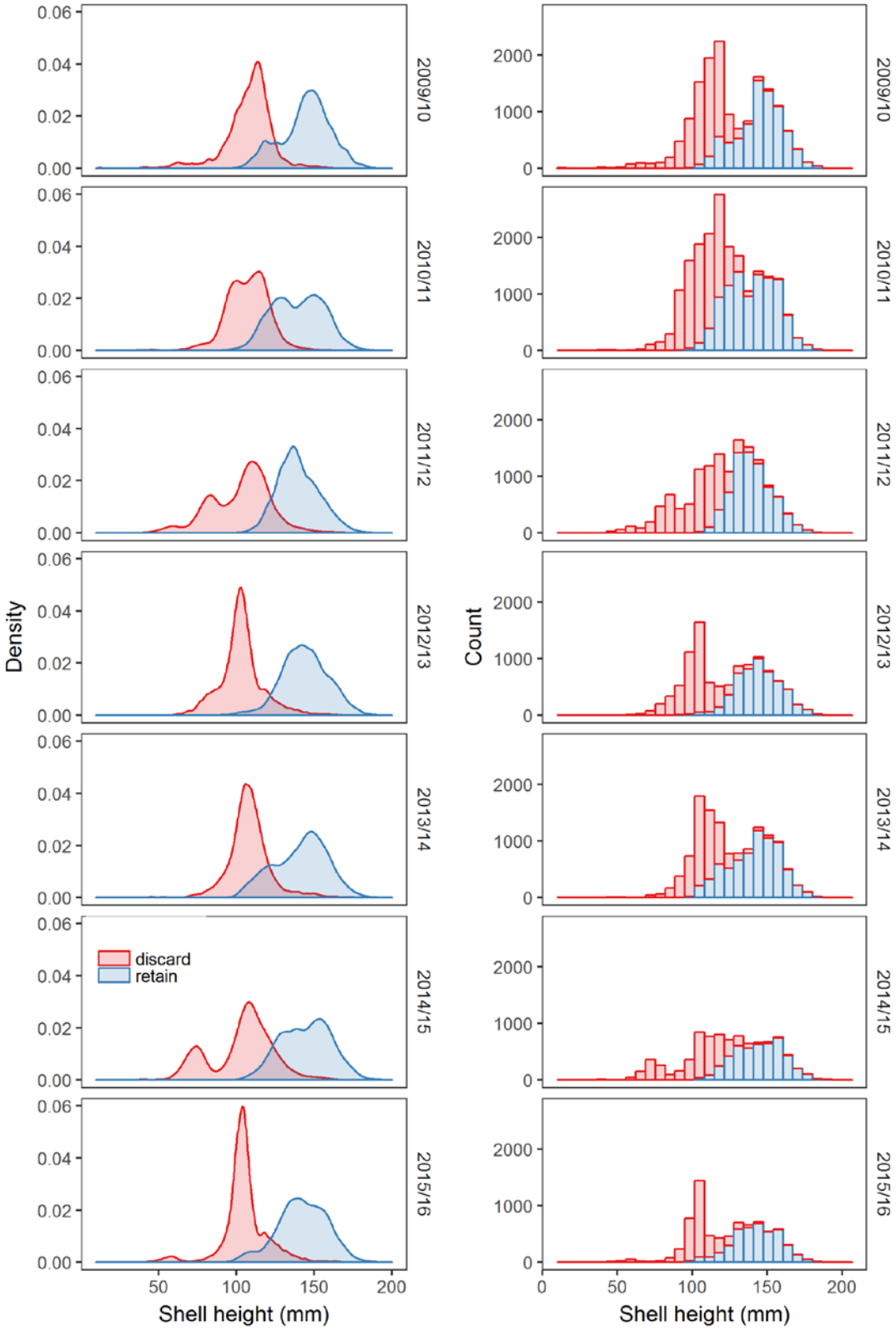

Figure 4-15 Kodiak Shelikof District retained and discarded shell heights by density and count for the 2009/10-2015/16 seasons.

Kodiak Southwest

The 2016/17 season was the 8th consecutive season at the current 25,000-pound GHL in the Southwest District. Based on preliminary harvest and effort from the 2016/17 season the CPUE of 56 pounds of meats/dredge hour is the highest since this district opened to exploratory fishing in 2009/10 (Table 4-13; Figure 4-16).

Table 4-13 Kodiak Southwest District scallop fishery summary statistics, 2009/10 - 2016/17.

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	670	37	389	312
2013/14	2	25,000	20,340	230,033	526	39	437	301
2014/15	2	25,000	24,993	310,921	559	45	561	193
2015/16	1	25,000[1]	10,950	149,947	281	39	533	143
2016/17[d]	1	25,000	25,110	NA	448	56	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

In the 2015/16 Southwest District fishery, 10,950 lb of scallop meats were retained with a CPUE of 39 pounds of meats/dredge hour (Figure 4-16). Catch per unit effort decreased 13.3% from the 2014/15 season. In addition to the retained catch an estimated live scallop equivalent of 715 lb of meats were discarded, for an estimated discard rate of 6.5% of the total meat weight caught, a 2.6% increase from the 2013/14 season. Using a 20% discard mortality estimate, 143 lb of scallop meat weight was lost to discard mortality in the 2015/16 season (Table 4-13). Average estimated Southwest District scallop meat discard for the last 5 seasons was 1,155 lb or 6.3% of total catch.

Estimated shell height distributions in Southwest District during the 2015/16 season were similar to previous seasons. The bulk of the retained scallops remain in the 125–175 mm shell height (SH) range (Figure 4-18).

The 2015/16 fishery closed, prior to harvesting the full GHL, when the Tanner crab bycatch cap of 12,000 crab was exceeded. There is no MPS established for the Southwest District.

Crab bycatch estimates calculated from 2015/16 Southwest District fishery observer samples were 15,879 Tanner crab (Table 3-4). Estimated Southwest District Tanner crab bycatch increased 21.2% from the 2014/15 season. Carapace width of Tanner crabs sampled by observers ranged from approximately 10mm to 145mm, with the majority in the 15–60mm range (Figure 3-1).

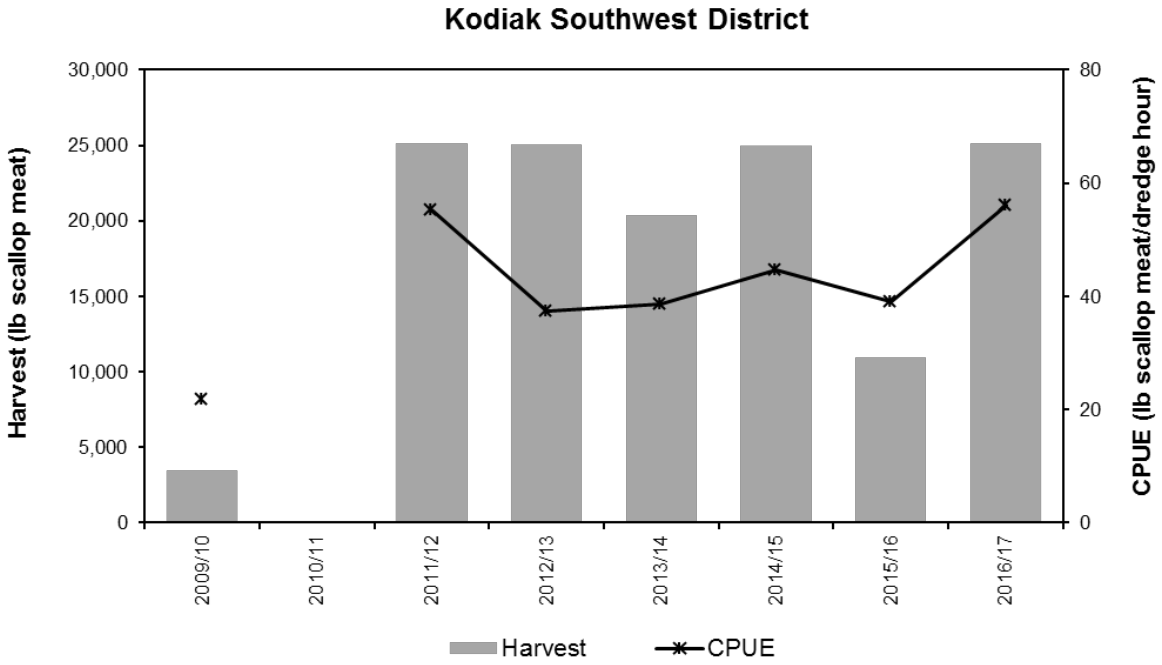

Figure 4-16 Kodiak Southwest District Harvest and CPUE, 2009/10 and 2011/12 - 2016/17 seasons.

Table 4-14 Kodiak Southwest District catch summary for the 2009/10-2015/16 season for raw and standardized round weight CPUE.

	Raw CPUE			Standardized CPUE		
Year	Median	Mean	SD	Median	Mean	SD
2009/10	432.2	392.8	220.9	358.6	357.0	167.8
2010/11	closed					
2011/12	835.0	821.8	304.9	766.7	765.2	168.0
2012/13	409.4	435.9	188.3	428.2	414.5	78.6
2013/14	397.5	458.1	247.7	395.6	420.6	133.9
2014/15	603.2	593.0	229.4	573.5	547.7	115.5
2015/16	562.4	582.0	245.8	534.0	539.9	87.6

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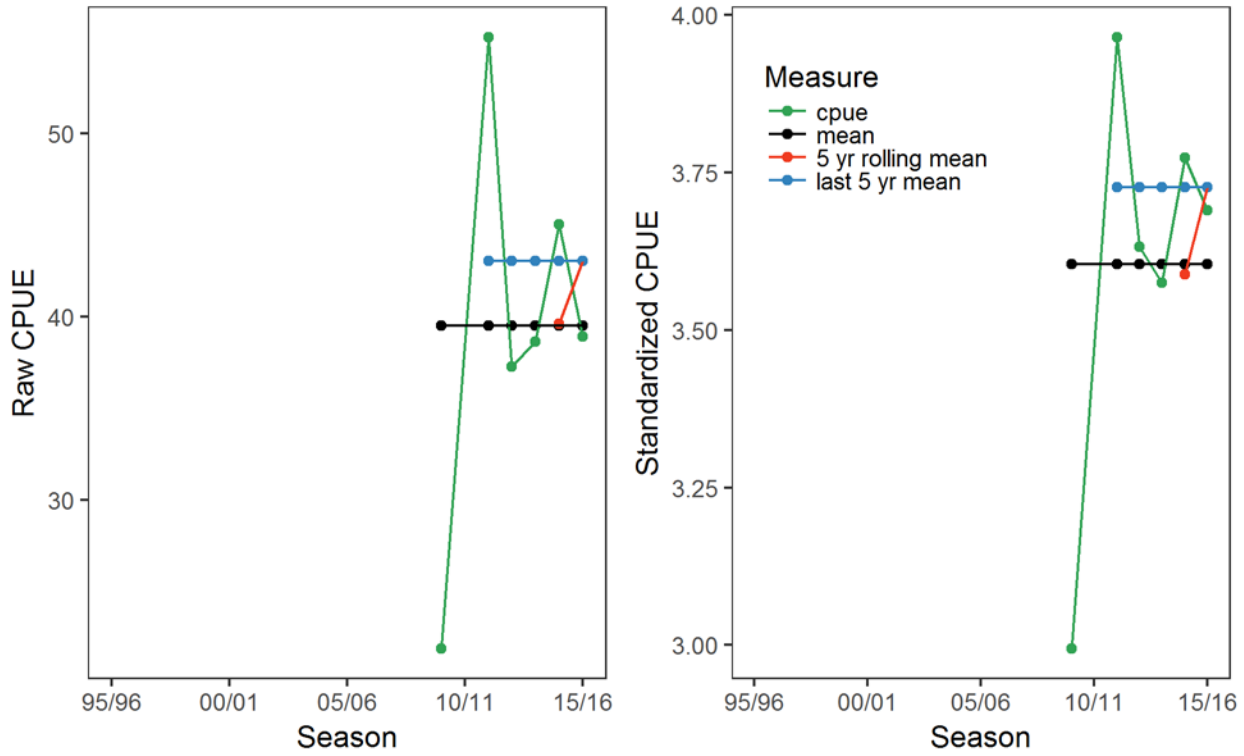

Figure 4-17 Kodiak Southwest District Scallop raw and standardized (when available) meat CPUE, 2009/10 - 2015/16 seasons.

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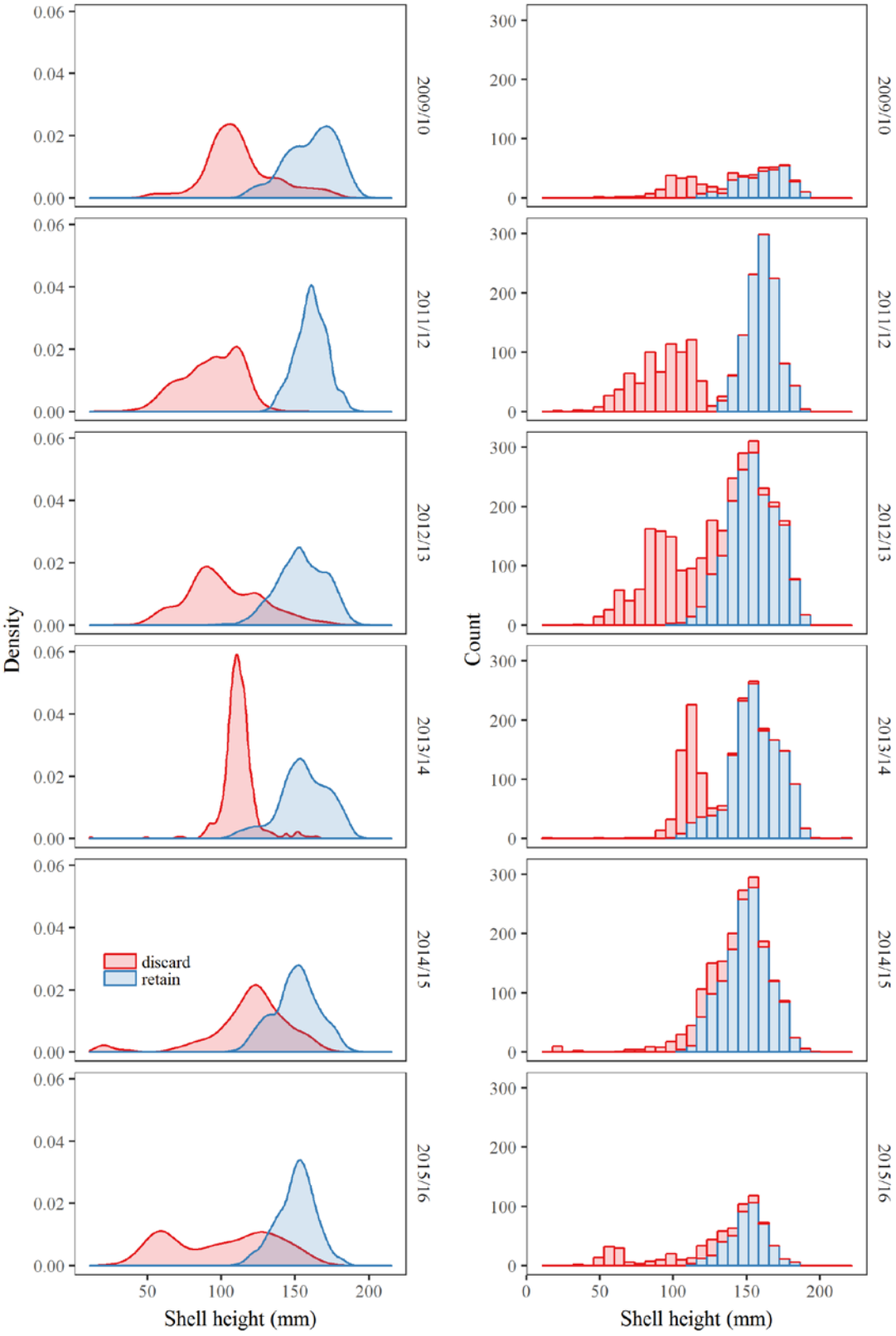
Density
Count
2009/10
2011/12
2012/13
2013/14
2014/15
2015/16
discard
retain
Shell height (mm)
Shell height (mm)

Figure 4-18 Kodiak Southwest District retained and discarded shell heights by density and count for the 2009/10-2015/16 seasons.

Alaska Peninsula Registration Area

The 2016/17 season was the 5th consecutive season with a 15,000-pound GHL in Unimak Bight District of the Alaska Peninsula Area. The Unimak Bight District has been fished annually since 2012/13 under the provisions of a Commissioner Permit issued by ADF&G. Based on preliminary harvest and effort from the 2016/17 season, the CPUE of 44 pounds of meats/dredge hour is the lowest since 2012/13 (Table 4-15; Figure 4-19).

Table 4-15 Alaska Peninsula Area scallop fishery summary statistics, 1993/94 – 2016/17

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	190,257	302	50	630	172
2016/17[d]	1	15,000[1]	15,016	NA	345	44	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 2015/16 Unimak Bight District fishery, 15,000 lb of scallop meats were retained with a CPUE of 55 pounds of meats/dredge hour (Figure 4-19). Catch per unit effort decreased 3.8% from the 2014/15 season. In addition to the retained catch an estimated live scallop equivalent of 860 lb of meats were discarded, for an estimated discard rate of 5.7% of the total meat weight caught, a 5.1% decrease from the 2013/14 season. Using a 20% discard mortality estimate, 172 lb of scallop meat weight was lost to discard mortality in the 2015/16 season (Table 4-15). Average estimated Unimak Bight District scallop meat discard for the last 4 seasons was 1,705 lb or 11.3% of total catch.

Estimated shell height distributions in Unimak Bight District show a decreased range of scallop sizes in the 2015/16 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 4-21).

There is no MPS established for Unimak Bight District. During the 2015/16 season, Tanner crab bycatch in Unimak Bight District was well below the cap of 12,000 crab; therefore, the fishery remained open until the full GHL was harvested.

Crab bycatch estimates calculated from 2015/16 Unimak Bight District fishery observer samples were 5,994 Tanner crab (Table 3-4). Estimated Unimak Bight District Tanner crab bycatch decreased 57.7% from the 2014/15 season. Carapace width of Tanner crabs sampled by observers ranged from approximately 15 mm to 155 mm, with the majority in the 20–80 mm range (Figure 3-1).

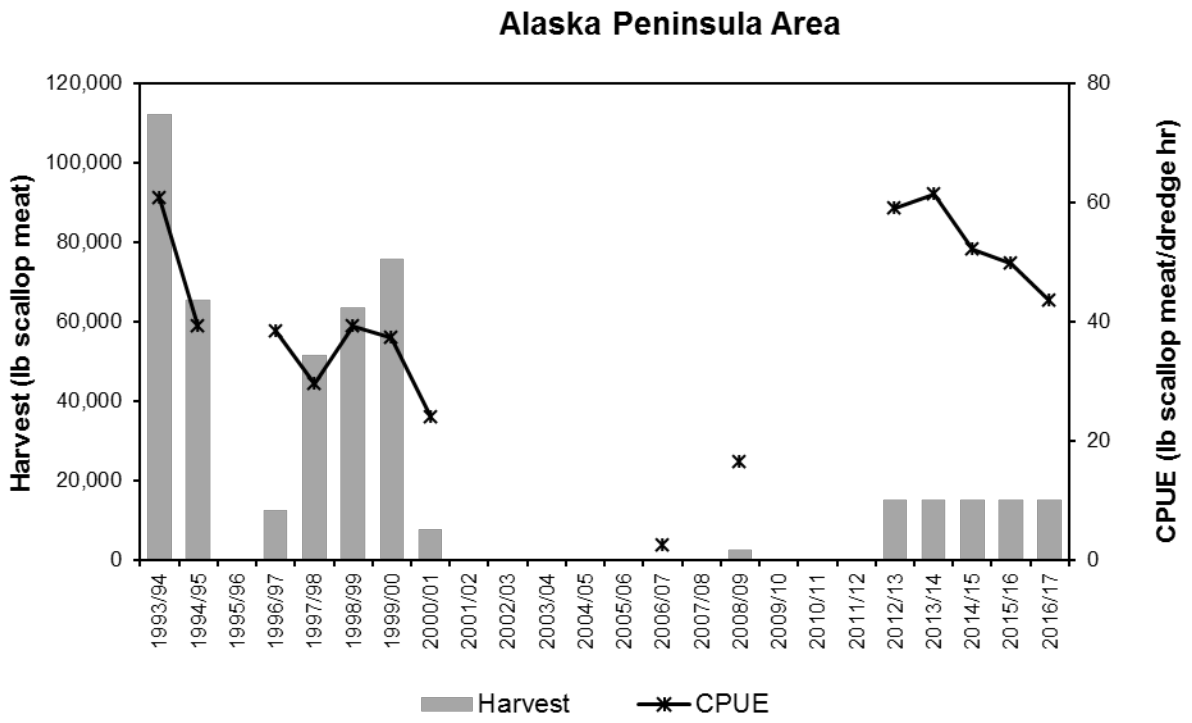

Figure 4-19 Alaska Peninsula Area harvest and CPUE, 1993/94 - 2016/2017 seasons.

Table 4-16 Alaska Peninsula Area catch summary for the 2012/13-2015/16 season for raw and standardized round weight CPUE.

	Raw CPUE			Standardized CPUE		
Year	Median	Mean	SD	Median	Mean	SD
2012/13	736.2	862.1	631.2	715.6	713.3	391.5
2013/14	768.0	891.9	525.1	738.6	798.9	302.4
2014/15	856.8	873.7	426.5	863.0	781.9	270.9
2015/16	686.2	667.9	230.1	641.7	629.7	140.8

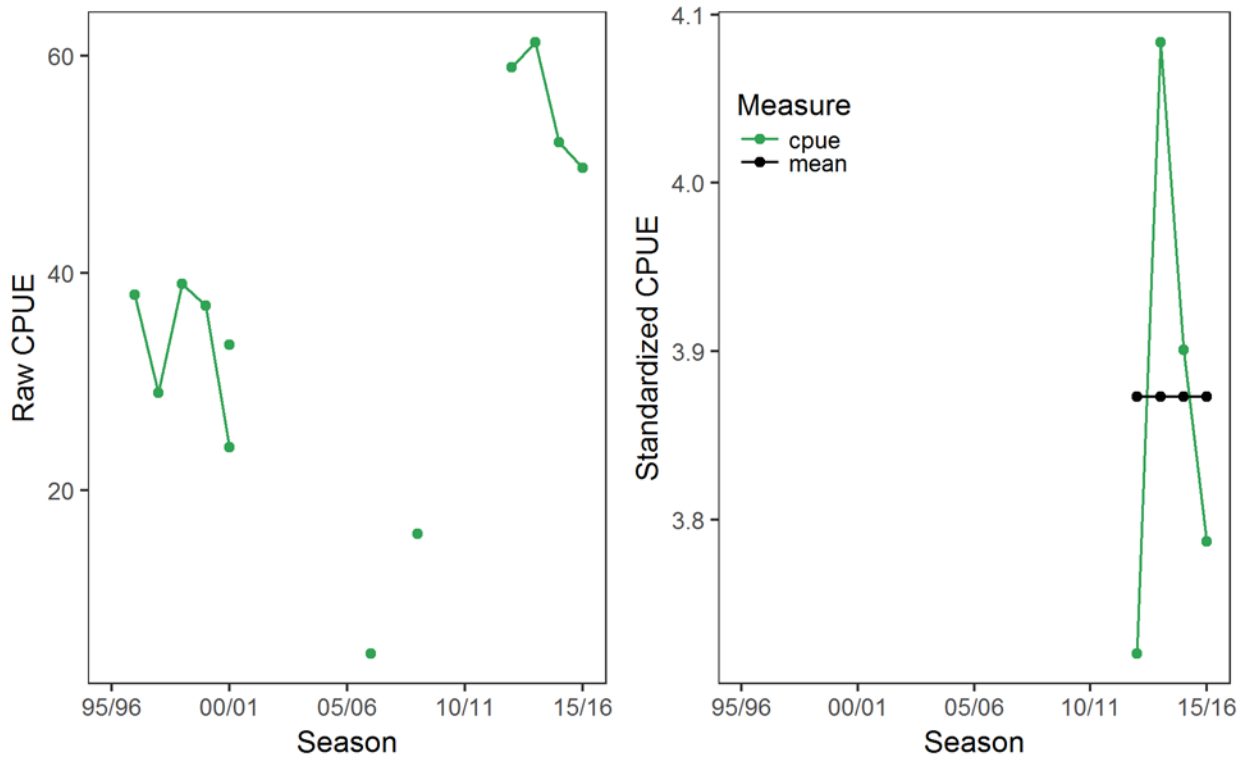

Figure 4-20 Alaska Peninsula Area Scallop raw and standardized (when available) meat CPUE, 1995/96 - 2015/16 seasons.

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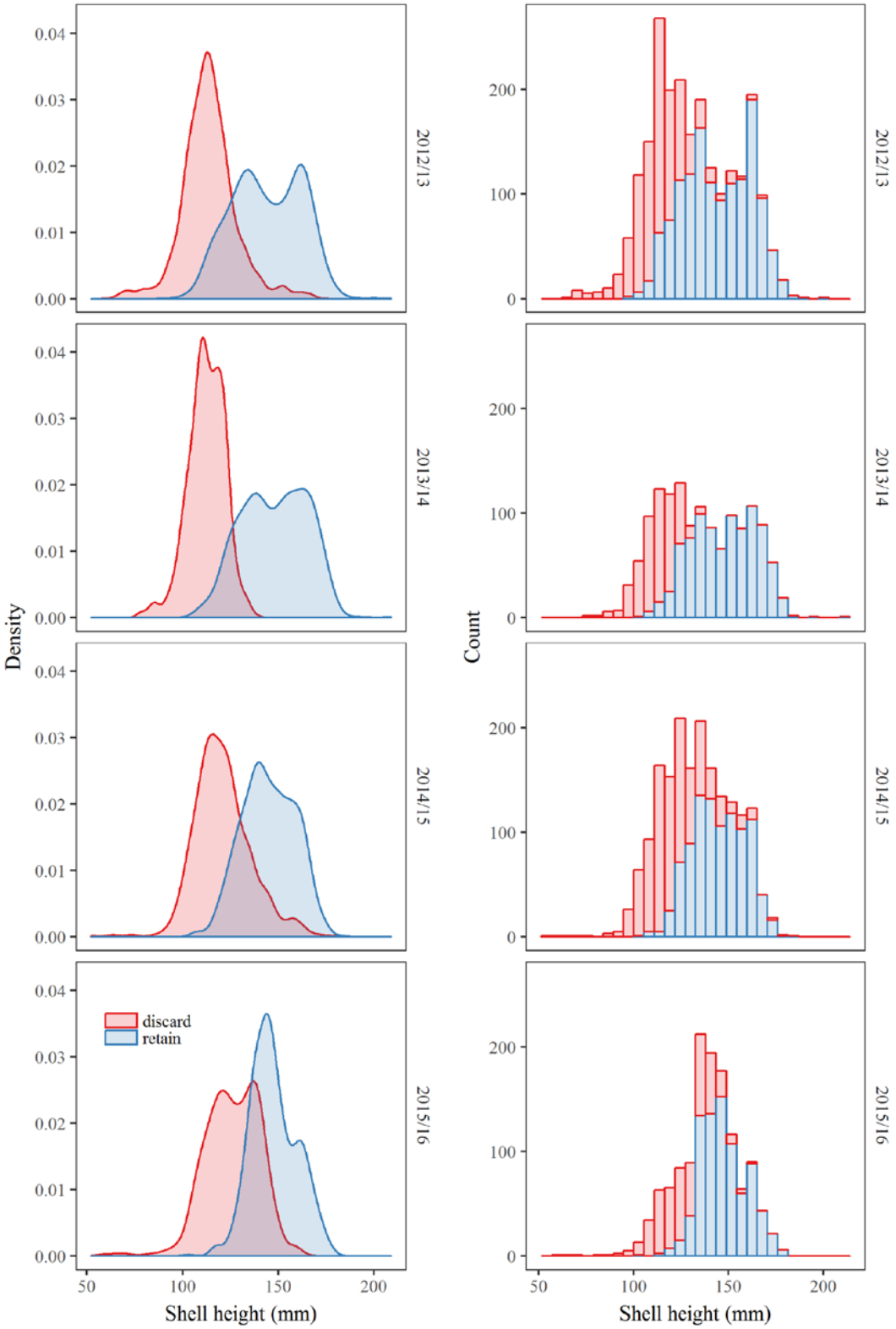

Figure 4-21 Alaska Peninsula Area retained and discarded shell heights by density and count for the 2012/13-2015/16 seasons.

Bering Sea Registration Area

The 2016/17 season was the 2nd season with a reduced GHL in the Bering Sea Registration Area (BSRA). Based on preliminary harvest and effort from the 2016/17 season the CPUE of 28 lb of shucked meats per dredge hour is up slightly over 2015/16 however it remained near the historical low observed in 2014/15 (Table 4-17).

Table 4-17 Bering Sea Area scallop fishery summary statistics, 2000/01 - 2016/17.

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	48,855	595,602	1,275	38	467	1,059
2010/11	2	50,000	50,100	547,302	971	52	563	1,336
2011/12	2	50,000	50,275	529,235	984	51	538	563
2012/13	1	50,000	50,045	564,275	943	53	612	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	104,715	307	25	341	85
2016/17[d]	1	7,500	7,575	NA	275	28	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 2015/16 BSRA fishery, 7,500 lb of scallop meats were retained with a CPUE of 25 lb of shucked meats per dredge hour. Meat weight CPUE increased 4% from the 2014/15 season (Figure 4-22), but remains 52% lower than the 2011/12 and 2012/13 seasons. In addition to the retained catch an estimated live scallop equivalent of 425 lb of meats were discarded, for an estimated discard rate of 5.7% of the total meat weight caught, a 0.1% decrease from the 2014/15 season. Using a 20% discard mortality estimate, 85 lb of scallop meat weight was lost to discard mortality in the 2015/16 season (Table 4-17). Average estimated BSRA scallop meats discarded for the last 10 seasons was 3,633 lb or 0.9% of the total catch.

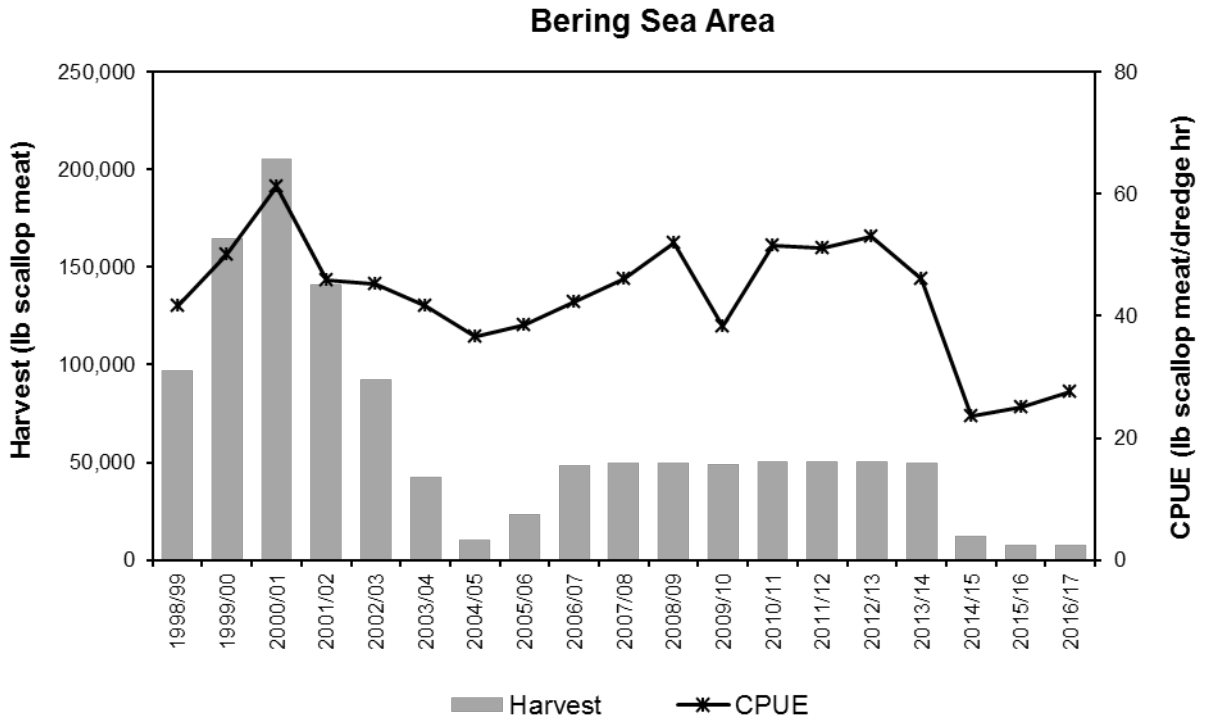

Figure 4-22 Bering Sea Area scallop harvest and CPUE, 1998/99 - 2016/17 seasons.

Estimated shell height distributions in BSRA show a decreased range of scallop sizes in the 2014/15 and 2015/16 seasons. Whether these changes are due to growth rates, disease, fleet behavior, or a decrease in prerecruit scallops is not known. The bulk of the retained scallops remain in the 150–200 mm shell height range (Figure 4-24).

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 2015/16 season CPUE was 25 lb of shucked scallop meats per dredge hour, well below the MPS (Table 3-1). During the 2015/16 and 2016/17 seasons the fishery was allowed to continue despite low CPUEs to gather data following an apparent disease event first observed in 2014/15.

Crab Bycatch estimates calculated from 2015/16 BSRA fishery observer samples were 2,960 Tanner crab and 1,107 snow crab (Table 3-4). Estimated BSRA Tanner crab bycatch increased 15% from the 2014/15 season. Carapace width of Tanner crabs sampled by observers ranged from 20mm to 180mm, with the majority in the 80-130mm range. Estimated BSRA snow crab bycatch increased 9% from the 2014/15 season. Snow crab CW sampled by observers ranged from 30mm to 150mm, with the majority in the 70-110mm range (Figure 3-1).

Table 4-18 Bering Sea Area catch summary for the 2009/10-2015/16 season for raw and standardized round weight CPUE.

	Raw CPUE			Standardized CPUE		
Year	Median	Mean	SD	Median	Mean	SD
2009/10	509.3	519.5	153.2	495.6	494.1	46.1
2010/11	621.8	619.2	196.8	589.3	583.6	73.2
2011/12	578.5	593.7	135.2	591.5	579.1	51.3
2012/13	655.7	661.0	158.3	652.7	645.3	82.9
2013/14	570.6	567.8	127.1	556.3	555.6	55.4
2014/15	483.5	481.9	94.8	472.4	473.2	38.4
2015/16	418.1	389.8	79.6	389.6	382.1	33.2

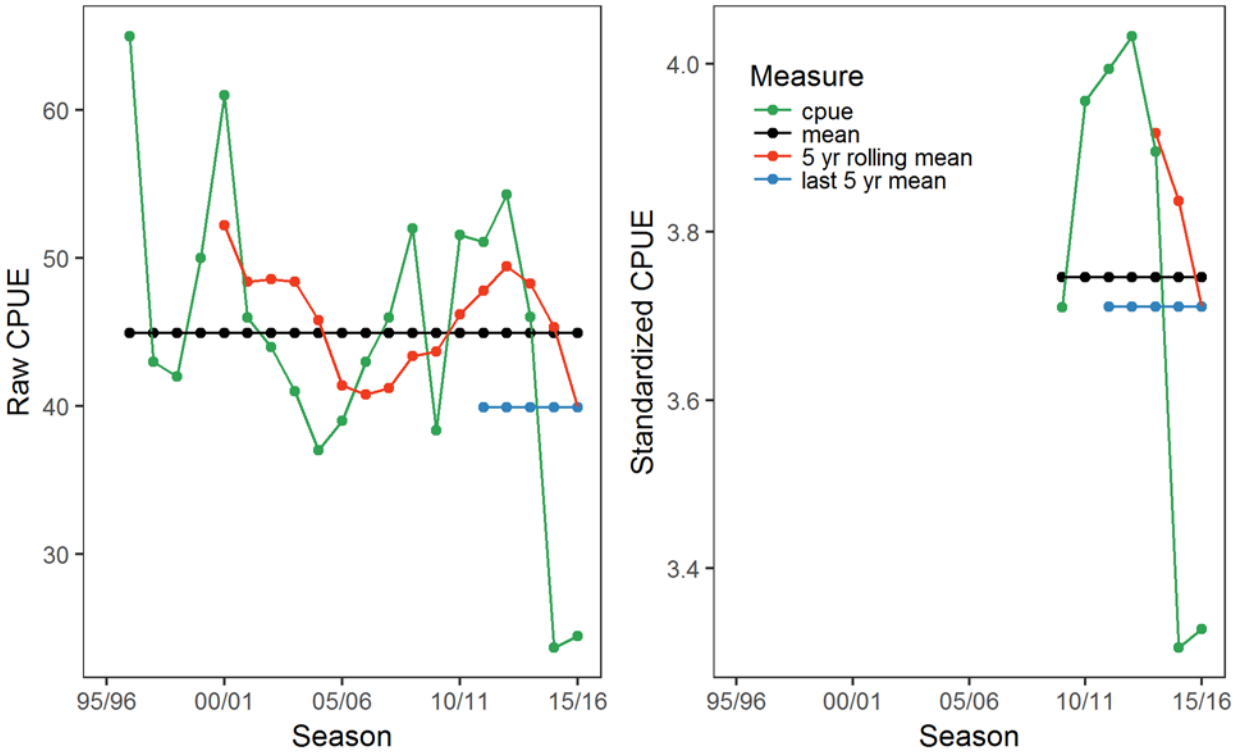

Figure 4-23 Bering Sea Area raw and standardized (when available) meat weight CPUE, 1995/16 - 2015/16 seasons.

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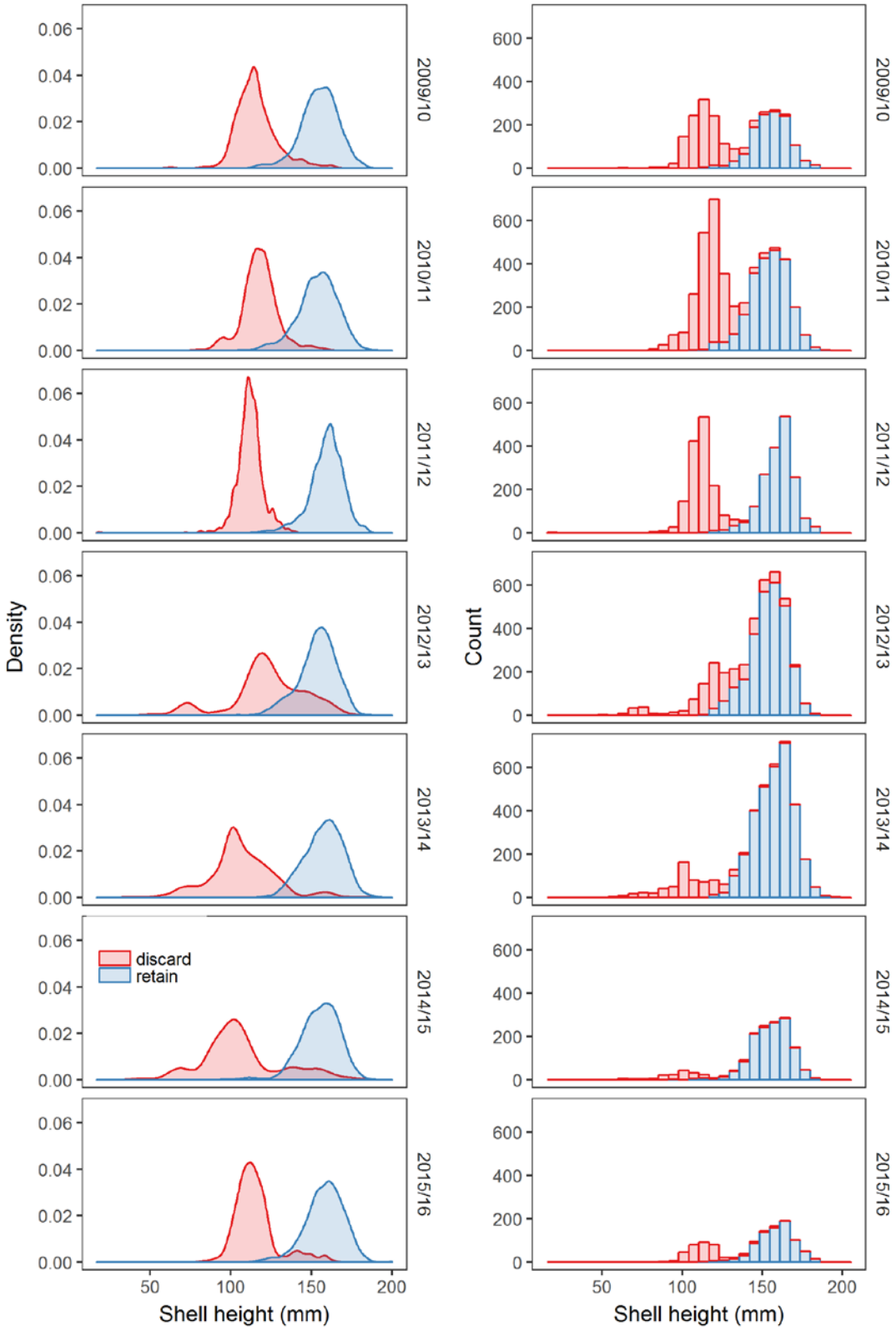

Figure 4-24 Bering Sea Area retained and discarded shell heights by density and count for the 2009/10-2015/16 seasons.

Dutch Harbor Registration Area

The 2016/17 season was the 2nd season at an increased GHL in the Dutch Harbor Registration Area (DHRA). This increase reflects the reopening of the Pacific Ocean side of the DHRA. Based on preliminary harvest and effort from the 2016/17 season CPUE is up 50% from the 2015/16 low (Table 4-19, Figure 4-25). All harvest occurred in the Bering Sea subarea of the DHRA. Fishing effort occurred in the Pacific Ocean subarea of the DHRA however no scallops were retained.

Table 4-19 Dutch Harbor Area scallop fishery summary statistics, 1993/94 - 2016/17.

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		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	41,700	83	68	510	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	74	71	563	85
2015/16	1	10,000	5,040	43,628	157	32	278	74
2016/17[d]	1	10,000	5,050	NA	105	48	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 2015/16 DHRA fishery, 5,040 lb of scallop meats were retained with a CPUE of 32 lb of shucked meat per dredge hour. Catch per unit effort decreased 55% from the 2014/15 season and remains 58% lower than the combined 2011/12 and 2012/13 seasons (Figure 2-26). In addition to the retained catch an estimated whole weight of 370 lb were discarded, for an estimated discard rate of 7.3% of the total meat weight caught, a 0.9% decrease from the 2013/14 season. Using a 20% discard mortality estimate 74 lb of scallop meat weight was lost to discard mortality in the 2015/16 season (Table 4-19). Average estimated DHRA scallop meats discard for the last 8 seasons was 744 lb or 1.6% of the total catch.

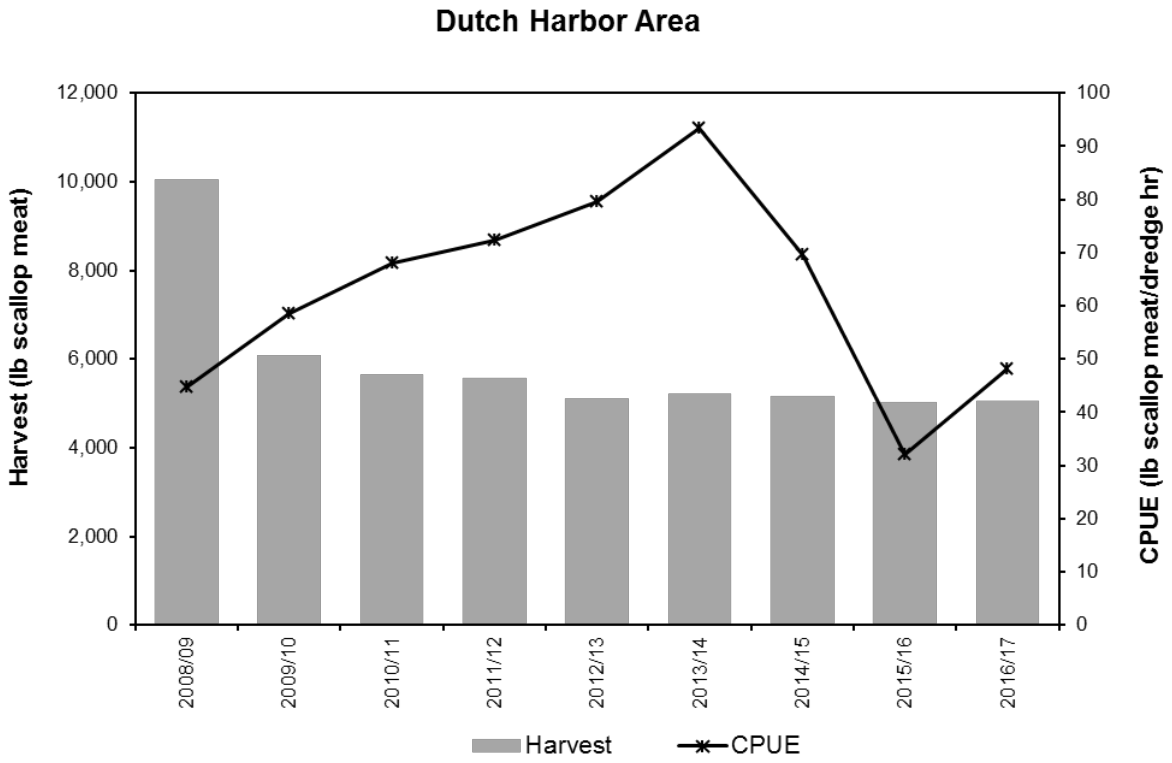

Figure 4-25 Dutch Harbor Area Scallop Harvest and CPUE, 2008/09 - 2016/17 seasons.

Estimated shell height distributions in the DHRA show a decreased range of scallop sizes in the 2015/16 season. Whether these changes are due to growth rates, fleet behavior, or a decrease in prerecruit scallops is not known. The bulk of the retained scallops remain in the 150–180 mm shell height range Figure 4-27).

Crab bycatch estimates calculated from 2015/16 DHRA fishery observer samples were 326 Tanner crab (Table 3-4), a 69% decrease from the 2014/15 season. Carapace width of Tanner crab sampled by observers ranged from 10 mm to 110 mm, with the majority in the 70-90 mm range (Figure 3-1).

Table 4-20 Dutch Harbor Area catch summary for the 2009/10-2015/16 season for raw and standardized round weight CPUE.

	Raw CPUE			Standardized CPUE		
Year	Median	Mean	SD	Median	Mean	SD
2009/10	412.7	523.9	362.4	325.9	485.7	306.0
2010/11	556.4	550.3	347.4	648.9	506.2	238.1
2011/12	579.7	615.4	344.0	590.1	538.4	220.9
2012/13	671.6	643.2	367.2	631.1	538.8	222.6
2013/14	848.4	846.6	183.7	818.7	825.8	35.5
2014/15	591.0	606.9	164.7	620.9	586.5	84.8
2015/16	335.8	299.2	126.1	330.3	290.2	102.0

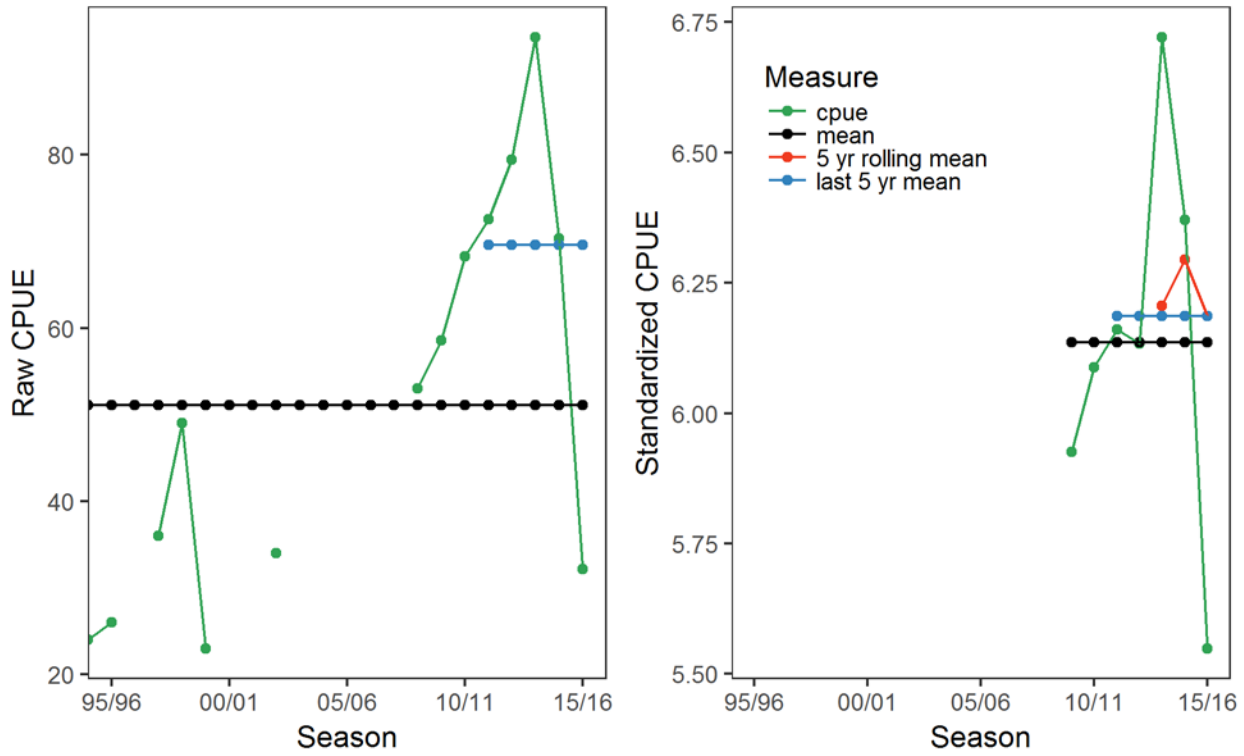

Figure 4-26 Dutch Harbor Area scallop raw and standardized (when available) meat CPUE, 1995/96 - 2015/16 seasons.

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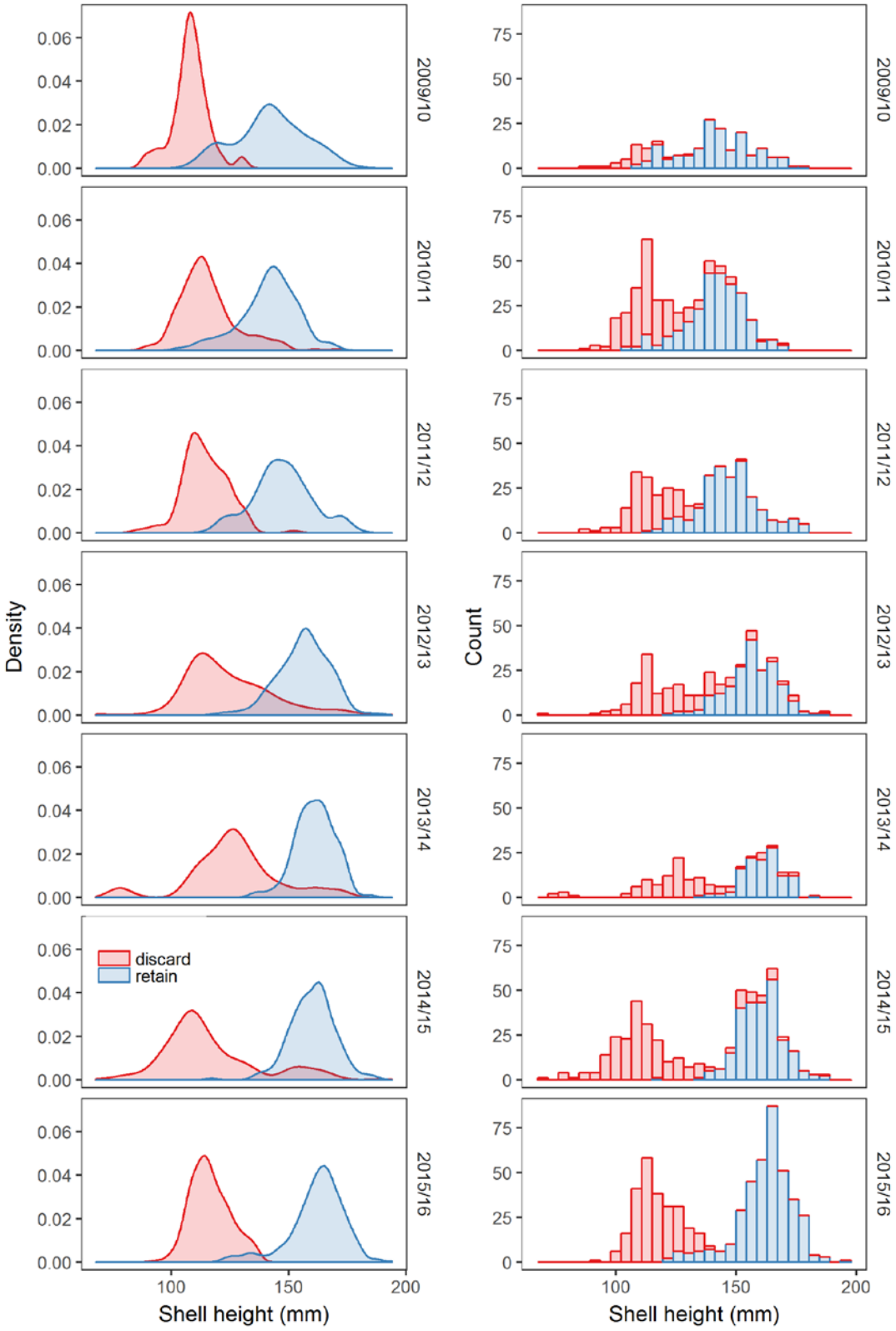

Figure 4-27 Dutch Harbor Area retained and discarded shell heights by density and count for the 2009/10-2015/16 seasons.

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.

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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 2. 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. Since 2000, no more than 8 vessels have participated, and in recent years no more than 4 vessels have participated.

Table 5-1 provides the statewide average price per pound of landed scallop meats, as well as an inflation adjusted price and total value. Inflation adjustment is made to 2016 values using the Producer Price Index for the prepared frozen shellfish industry tabulated by the U.S. Bureau of Labor Statistics. 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 2016 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 State fish tax revenue collected from all participants in the scallop fishery through 2015. Note that the 2015 price is used as a proxy for the 2016/17 seasonal value.

The majority of the scallop meats that are landed have been processed (shucked) and frozen at sea and their value represents gross revenue at the first wholesale level. However, some shucked meats are delivered fresh to dockside processors who then freeze and market the scallops at the first wholesale level (pers. comm, Bill Harrington, February 2013). Thus, although landed price is often referred to as an ex-vessel price, it is actually primarily a first wholesale price in that the landed product is a primary processed product. As a result, gross revenue is identified as first wholesale gross revenue here.

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 scallop price has increased in each year, until 2016, and reached $12.39 per pound of shucked meats in 2014 before declining slightly to $12.22 per pound of shucked meats in 2015.

The historical variability in Alaska scallop prices is likely due to market factors that are driven by the much larger U.S. east coast sea scallop fishery, as well as by import markets. However, in recent years, the Alaska Scallop Association has made considerable progress in its marketing efforts and has been able to maintain an upward trend in the prices it receives for the scallops landed by the three vessels that are associated with the cooperative. The present strength in Alaska scallop prices is expected to continue, and may be enhanced by market forces as landings of east coast scallops are expected to decline in the coming years (pers. comm, Jim Stone, February 2013). Operators of the fourth vessel presently fishing Alaska scallops report receiving a price similar to the statewide average price for 2012 (pers. comm, Bill Harrington, February 2013). The ten year average nominal price is $9.72 per pound.

Table 5-1 Annual statewide commercial weathervane scallop real wholesale values, 1993/94 - 2016/17.

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	1.52	$7.83	$7,690,580
1994/95	15	1,240,775	$5.79	1.50	$8.69	$10,800,614
1995/96	10	410,743	$6.05	1.36	$8.23	$3,371,558
1996/97	9	732,424	$6.30	1.33	$8.38	$6,131,183
1997/98	9	818,913	$6.50	1.25	$8.13	$6,633,261
1998/99	8	822,096	$6.40	1.05	$6.72	$5,537,576
1999/00	10	837,971	$6.25	1.14	$7.13	$5,972,245
2000/01	8	750,617	$5.50	1.19	$6.55	$4,925,997
2001/02	6	572,838	$5.25	1.16	$6.09	$3,496,555
2002/03	6	509,455	$5.25	1.14	$5.99	$3,038,736
2003/04	4	492,000	$5.25	1.17	$6.14	$3,023,618
2004/05	5	425,477	$5.50	1.35	$7.43	$3,169,430
2005/06	5	525,357	$7.58	1.37	$10.38	$5,445,993
2006/07	4	487,473	$7.86	1.29	$10.14	$4,929,912
2007/08	4	458,313	$5.94	1.38	$8.20	$3,763,074
2008/09	4	342,434	$6.34	1.31	$8.31	$2,838,334
2009/10	3	487,018	$6.48	1.18	$7.65	$3,728,136
2010/11	3	468,426	$8.35	1.18	$9.85	$4,603,000
2011/12	4	455,330	$10.39	1.15	$11.95	$5,459,250
2012/13	4	418,548	$10.63	1.01	$10.74	$4,507,553
2013/14	4	399,134	$12.25	1.08	$13.23	$5,286,569
2014/15	4	308,888	$12.39	1.07	$13.26	$4,083,674
2015/16	3	264,532	$12.22	1.00	$12.22	$3,232,581
2016/17c	2	233,009	$12.22	1.00	$12.22	$2,847,370
10-Year Average	4	383,563	$9.72		$10.76	$4,034,954

[a] lb of shucked scallop meats are reported by the State Observer Program.
[b] uses the Bureau of Labor Statistics, Industry Index through 2016.
[c] preliminary

First wholesale revenue in this fishery has varied considerably over the period as both prices and landings have varied. The peak value in the fishery, occurred in 1994/95 season when inflation adjusted $10.8 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 lbs. down to a low in 2016/17 of 233,009 lb. The total real first wholesale revenue of a little more than $2.8 million in the 2008/09 season was the lowest revenue total since 1995; however, with increased prices in recent years the total revenue increased to just nearly $5.5 million in 2011/12, and has declined to $2.8 million in 2016/17 when the lowest catches since 1995 were taken. The ten year average real first wholesale value is just over $4 million.

Crew Usage and Wages

Scallop vessels in the Alaska weathervane scallop fishery are allowed, by State of Alaska regulation, to carry 12 crew including the skipper. In the past, prior to formation of the scallop cooperative and when many more vessels participated, it was commonplace for vessels to carry the maximum allowed crew. This was largely due to the fact that, even under the license limitation program, there was still a "race for fish" approach of attempting to capture as much of the unallocated GHL as possible in the shortest time possible. To do this, a vessel would use the full complement of crew allowed by regulation in order to speed up the processing time (shucking, freezing, and packaging) and allow continued deployment of the gear, especially in instances of high CPUE (Pers. Comm. Jim Stone and Brendan Harrington, March 2012).

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

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

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

Port of Landing and Impacts on Communities

At the present time all Alaska scallop harvests are landed in ports within Alaska. The vessels that fish within the Alaska Scallop Association make landings of frozen product in several ports including, but not limited to, Dutch Harbor, Kodiak, Yakutat, Juneau, and Sitka (pers. comm, Jim Stone, February 2013). Given that these landings are often made by a single vessel in a port, these landings are confidential. In addition to the cooperative vessels, one vessel makes landings of fresh product in Homer and Kodiak. However, these

landings are made to too few processors for the data to be released due to confidentiality restrictions. Thus, it is not possible to release landings by port. Furthermore, there is no economic data collection program in place to collect vessel expenditure data while vessels and crew are in port. Unfortunately, the limits of confidentiality and limited expenditure data make it difficult to establish the potential importance of this fishery to dependent communities.

There have been several developments in this fishery with regard to the permanent location of vessels and with maintenance and repair of these vessels. All three cooperative associated vessels, that are presently fishing, are now permanently home ported in Kodiak. In addition, the one non-cooperative vessel presently fishing is also permanently home ported in Kodiak.

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

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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: http://www.fakr.noaa.gov/npfmc/SAFE/SAFE.htm.

Commercial concentrations of weathervane scallops occur along the Alaska coast in elongated beds oriented in the same direction as prevailing currents. Image data from ADF&G CamSled tows show that benthic habitats where scallop fishing occurs in the Bering Sea, eastern GOA, and Shelikof Strait, consist predominately of fine sediments (silt, mud, and sand), with heavy sediment clouds regularly suspended by tidal currents. Areas of harder bottom and larger sediments are found inshore 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 is currently is a 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-target scallop stocks. No commercial harvests have been documented for scallop species other than weathervane scallops in waters off Alaska since at least 1992 (C. Russ, ADF&G, Homer, pers. Comm.). Major fishery development is not anticipated for non-weathervane scallops but market potential does exist for both "pink and rock" scallops. The spatial distribution of non-weathervane scallop species is not well defined, although these species currently compose a relatively minor component of catches in both NMFS and ADF&G surveys. In conjunction with the EA for amendment 12, data on capture of non-target scallop species was derived from ADF&G and NMFS trawl surveys for the years 1998–2008 (M. Stichert, ADF&G, Kodiak; M. Spahn, ADF&G, Homer; and R. Foy, NMFS, Kodiak, all pers. comm.). Trawl surveys are conducted in Region 1 only by NMFS and in Regions 2 and 4 by both ADF&G and NMFS. Among all ADF&G surveys, all non-

target scallops were recorded as *Chlamys* sp. Although data extrapolated to area-swept estimates were not available for the ADF&G surveys, and these trawl surveys are not designed to assess non-target scallop species, surveys catches of non-target scallops were relatively minor (Table 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

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

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

Ecosystem Effects on the Stock

Little is known about how changes in marine ecosystems affect the Alaska scallop stock. The fishery began in the 1960s, but data from the period before inception of the observer program in 1993 are scarce. Hence, there is no basis for comparison of stock dynamics in response to, for example, the 1977 regime shift.

Fishery Effects on the 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). Because the fishery footprint is confined to these areas and because many areas of similar habitat are closed to scallop dredging, we expect the effects of the scallop fishery on the GOA and Bering Sea ecosystems to be minor.

Predators: Little is known about scallop predators. Plankton feeders probably eat a large amount of floating larvae. Small weathervane scallops have been found in the stomachs of flounders, 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. Gorgonian (hard) corals are infrequently encountered by scallop observers; since 1996, corals have been observed in only 11 of the 15,836 tows sampled for catch composition and bycatch. Summaries of haul composition sampling by area are presented in observer reports prepared by ADF&G (e.g., Rosenkranz and Burt, 2009).

For example, during the 2000/01–2007/08 seasons, the most frequently caught species or items in the statewide scallop fishery by weight were weathervane scallops and scallop shells (84%), 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 2015/16 season is shown in Table 6-2.

Table 6-2 Summary of results from scallop observer haul composition sampling (% by weight) during the 2015/16 season.

Area/District	weathervane scallops	shells/ debris	basket/ brittle stars	*Pycnopodia* seastar	All other seastars	Skates [b]	Flatfish	*Chionoecetes* crabs [c]
Yakutat District	80.3	6.7	3.7	2.5	1.2	2.5	1.1	0
Yakutat District 16	73.8	1.8	9.9	4.8	5.0	0.4	0.9	0
Prince William Sound	Closed							
Cook Inlet	77.4	14.8	0	0	3.9	0.3	0.4	0
Kodiak Northeast	65.5	4.5	2.4	9.3	0.7	3.0	8.7	0.4
Kodiak Shelikof	66.6	11.6	0	7.3	0.2	5.4	2.8	0.3
Kodiak Southwest	58.7	2.2	23.7	0.2	0.2	4.5	2.2	1
Alaska Peninsula	87.0	4.0	0.8	0	0.2	1.1	1.5	0.3
Dutch Harbor Area	79.0	5.7	0.9	1.8	1.3	0.5	4.9	0.4
Bering Sea Area	63.6	2.5	17.3	0	0.1	0.6	1.7	10.4

[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.

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8. Appendices

Appendix 1: Response to Comments from SSC

2016 SSC comments:

Comment 1: The SSC appreciates the reasoning for a moratorium on aging during the 2016/17 season while aging protocols are being worked out. However, **the SSC recommends collecting specimens for aging in 2016/17** for subsequent aging once the protocols are developed.

Response: Specimens for aging are being collected during the moratorium from survey-caught scallops as well as fishery dependent sampling.

Comment 2: Development of an aging protocol should be a high priority. Ideally, this work should include an age validation study confirming that rings are formed annually and a study of precision of age estimates among readers. An outcome could be that an age determination is precise up to some age beyond which age estimates become imprecise. If so, **the aging protocol might specify to stop counting once some maximum count is attained after which a plus group is formed.** Such a stopping point for age determinations could speed up, and reduce the costs of, processing of specimens, yet still provide valuable data for development of age-structured assessment models.

Response: The aging protocol is currently being finalized. Methods for characterizing precision among readers are part of that protocol. Age validation, using O18 and a benthic temperature model, has been added to the Scallop Plan Team's suggested research priorities.

Comment 3: The **SSC had been looking forward to development of an age-structured stock assessment for Kamishak Bay scallops for many years and was disappointed to hear that ADF&G staffing issues have prevented progress**. In addition to direct application to fishery management, experience with age-structured scallop assessments will become even more important as the statewide scallop assessment program becomes operational. Given the lack of progress and ongoing agency staffing issues, a graduate student research project may be a practical approach to develop and implement such a model.

Response: The ADF&G is in the process of hiring a Biometrician II. Once on board, the new hire will be responsible for advancing the age-structured assessment model for scallops. Quite a bit of work needs to be done on the model, which will have to be robust to highly variable M, including major die-off events, as well as highly variable size-at-age.

Comment 4: With regard to the SSC's 2015 Comment 1, the SSC appreciates plans to collect new observer data on meat weight, shell height, and discards. However, the other part of the SSC's comment was for the Scallop Plan Team to consider the potential merits of estimating CPUE based on numbers of retained scallops in the catch rather than based on meat weight. Also along these lines, during the Scallop Plan Team meeting, Jim Stone asked about the potential to **manage scallops based on number of animals harvested rather than pounds of shucked meats**. The SSC encourages the Scallop Plan Team to explore this possibility in the future. The SSC looks forward to more complete responses to some of the SSC's other previous comments after results from the data-limited symposium become published.

Response: At the 2017 SPT meeting, Ben Williams presented on sampling round weight vs. meat weight and numbers. The relationship between meat weight and round weight varies within and across months, however, round weight is directly convertible to N. Additionally, measuring round weight is far more practical than

counting each scallop that comes aboard, especially on a commercial vessel. Catch per unit effort is now presented in both round-weight and meat-weight, as well as in both standardized and unstandardized forms in the 2017 SAFE. Alaska Department of Fish and Game staff intends to continue to collect whole weight vs meat weight data in both the preseason survey and observer program in order to build a robust data set for examining the best way to back calculate from meat weight to whole weight. As to the data-limited workshop, the event - a joint meeting of the crab and scallop plan teams - never took place, as it was awaiting the publication of the Lowell-Wakefield Proceedings.

Comment 5: The SSC appreciates short summaries of recent and ongoing research reported in the Appendices. These Appendices should be cited in the body of the SAFE document so that the reader is aware of them. The Appendices included an exploratory analysis of relationships between fishery CPUE and scallop abundance estimates from dredge surveys. In many cases, fishery CPUE tracked trends in survey abundances fairly well with some exceptions (e.g., negative correlation for Kayak Island east). **The SSC looks forward to more thorough analyses of these relationships including data from planned survey expansions in the future. Understanding such relationships could improve the use of survey and fishery data in fishery management. The SSC also looks forward to further development of the discard mortality rates introduced in the Appendices.**

Response: The SPT discussed the issue of plotting survey and fishery CPUE together for consideration of correspondence between the two. This can be done for the Central District, for which there are uninterrupted time series. A pilot study was conducted by ADF&G on discard mortality. The SPT will look into the results and prepare a summary. The existing assumption discard mortality is 20% and informal reports from the pilot study suggest much lower mortality.

Comment 6: The SSC appreciates revisions to **research recommendations** undertaken by the Scallop Plan Team. The SSC offers a few additions. First, development of a statewide survey program elevates the need to estimate survey catchability, which may vary among areas with bottom type and other factors. Second, as scallop fisheries in many areas suffer from declining CPUE, the SSC feels that research into metapopulation structure should be a priority to understand the degree of connectedness among scallop beds. Next generation genetic tools should be brought to bear on this question.

Response: These research priorities were added to the Council's research priorities during their June 2016 review. As a result of SPT discussion at their 2017 meeting, the first suggestion was retained, but the second and third suggestion were observed to overlap with an existing research priority (see below).

Comment 7: Future SAFE documents would be improved with the addition of the following: (1) a section that highlights new information since the last SAFE report, (2) expansion of the Executive Summary to include OFL and ABC recommendations, (3) a list of tables and figures in the SAFE, and (4) historical catches that show the derivation of MSY estimates.

Response: These recommendations have been incorporated into the current SAFE.

Comment 8: The SSC requests some clarifications in next year's SAFE. On the top of p. 4, please clarify that no vessels have fished to date in the state waters open access fishery. On p. 16, please indicate the catchability coefficient that is used to calculate abundance from dredge surveys. On the bottom of p. 39, weights are given in round weights. Please equate these to meat weights for comparison. In particular, how does a round weight of 205,950 lb relate to the 15,000 lb GHL (meat weight)?

Response: These recommendations have been incorporated into the current SAFE.

Comment 9: There are a number of typos in the SAFE. For example, Figure 1-1 appears twice on p. 5 and there are two versions of Figure 1-7 on p. 17 and p. 20. The paragraph in the middle of p. 5 begins with an incomplete sentence, the last sentence on p. 16 is incomplete, the figure caption on p. 17 is missing, and Table 2-2 and 1-1 cited in the middle of p. 51 should be Table 1-2 and 1-3. There are other typos.

Response: These recommendations have been incorporated into the current SAFE.

2015 SSC comments:

Comment 1: The majority of scallop GHLs are based on fishery-dependent observer data. Therefore, validation of fishery-dependent CPUE as an index of local abundance is important. The SSC thought that calculating CPUE in units of shucked meats might introduce more variability than a CPUE based on the number of scallops. The SSC also noted that fluctuations in meat weights and condition might be a good area of research to identify environmental conditions in addition to its application to scallop management. **The SSC recommends that analysts review the processes that may influence fishery CPUE and compare CPUE based on shucked meats versus number of scallops per hour of dredging during the workshop planned for 2015/16.** However, we recognize that a reliable index of abundance may not be available from observer data alone.

Response: An index of abundance derived from observer data is currently being evaluated and will be presented in the 2017 SAFE. Further, changes to observer sampling protocols are being implemented during the 2016/17 fishing season to specifically address fluctuations in meat weight. These changes will establish so called “special hauls”. During these hauls the sampling program will change slightly. First, is a request for vessel captains to record the dredge start and stop times as accurately as possible. This request arose because fishing time is often rounded to the nearest 5 minute interval in logbooks that can skew estimates of CPUE. Second, observers will be responsible for sampling and collecting scallops for meat weight, shell height, and aging. The collection of meat weight is to address a current data gap, whereby the round weight of retained scallops is recorded before they are shucked and a retained meat weight is recorded after they are shucked. However there is no record of discards in the shucking shack. As the management of this species is based upon retained meat weight this scenario could lead to substantially different exploitation rates (number of scallops) that may not be reflected in the amount of meat retained.

Comment 2: The SSC was concerned about the potential loss of fishery-independent surveys (e.g. Kamishak Bay and Kayak Island), staff positions, and expertise due to state budget problems. Although the current wholesale value of $4.5 million dollars in the scallop fishery precludes large expenditures for monitoring and providing management advice, the SSC thought several factors should be taken into consideration in determining the appropriate level of research expenditures. The current lack of fishery-independent data has likely kept harvests well below sustainable levels. Better data would lead to more confidence in the assessments and likely increase GHLs. Consequently, the loss of survey data from the Central Region will necessarily result in a more conservative approach to management of these stocks, reducing future permissible GHLs in some areas.

The SSC notes that survey results from the Central Region provide a baseline to assess the quality of indices of abundance derived from observer CPUE and evidence for demographic isolation of adjacent scallop beds from the observed lack of correlation in recruitment. Because of the critical nature of this survey, the SSC suggests alternative means of continuing surveys be investigated, such as a cost-recovery model to fund fishing vessels for the survey (e.g. a research set-aside approach has been successful in the Northeast). The SSC also strongly supports further development and potential implementation of the CamSled technology as a potentially cost-efficient survey methodology.

Response: The SPT agrees with the need for fishery independent surveys.

Comment 3: The SSC considers continued development of the age-structured assessment approach as an urgent priority for the Council. Because of differences in growth among regions, location-specific survey data might be required to apply the model outside of the Kamishak and Kayak Island regions. There are several lines of evidence that suggest that the stock is composed of regional meta-populations including: (a) regional differences in growth rate, age composition (possibly an indicator of regional differences in recruitment or mortality), and morphology; (b) weak evidence of genetic partitioning between the Bering Sea and GOA populations; and c) age samples show uncorrelated recruitment in adjacent scallop beds. **The SSC recommends that alternative management methods suited to a metapopulation structure, such as rotating harvest among scallop beds, be considered during the planned workshop in 2015/16.**

Response: The SPT agrees that location-specific survey data might be required to apply the model outside of the Kamishak and Kayak Island regions. As the surveys are conducted in new areas area specific metric will be developed.

As of writing only one paper from the Lowell-Wakefield data poor workshop has been received by the editors. Once all papers are in the SPT will review the report and consider alternative management approaches.

2014 SSC comments:

Comment 1: The SSC appreciates the SPT's continued application of the stock structure template to weathervane scallops. The template provides several lines evidence that suggests that the stock is composed of regional meta-populations including: (a) regional differences in growth rate, age composition (possibly an indicator of regional differences in recruitment), and morphology; and (b) weak evidence of genetic partitioning between the Bering Sea and GOA populations. **This evidence suggests that although current harvest practices are consistent with local area management, further refinement of the stock delineations for the purposes of setting the OFL and ABC for this species should be considered during the proposed workshop in 2015.**
Response: These issues are anticipated to be addressed as part of the data-limited workshop.

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

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

Comment 4: It was confusing to read the document's descriptions that jump back and forth among multiple districts within the areas. For example in Section 3.2 on the Yakutat Registration Areas, the text jumps back and

forth between District 16 and the rest of the Yakutat region (referred to as Area D). The SSC recommends that each of the beds or districts within a registration area be discussed completely before moving on to the next district.
Response: These changes were made to the 2014 SAFE report.

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

Response: A cursory examination using a DCAC model was done in 2015. Results showed that estimates of sustainable yields were closely tied to GHL levels, likely due to several changes in GHLs over time. Other methods for examining sustainable yields will be explored as time allows.

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Appendix 2: ADF&G Pathology Lab Report on Apicomplexan Parasites in Alaskan Scallops

ACCESSION NO: 2016-0045

ALASKA DEPARTMENT OF FISH AND GAME

DIVISION OF COMMERCIAL FISHERIES - FISH PATHOLOGY SECTION

333 RASPBERRY ROAD, ANCHORAGE, AK 99518-1599 - Phone (907) 267-2244/Fax 267-2194

REPORT OF LABORATORY EXAMINATION

LOT (YEAR, STOCK, SPECIES): Alaska weathervane scallops, *Patinopecten caurinus*

FACILITY: ADF&G Kodiak

CONTACT PERSON/ADDRESS: Ryan Burt, 351 Research Ct., Kodiak, AK 99615

SAMPLE DATE: 6/24/15-11/25/15 **DATE SAMPLE RECEIVED**: 12/16/15

SPECIMEN TYPE: Adductor muscle **LIFE STAGE**: Adult
WILD: Yes

NUMBER OF SAMPLES: 180 **STATE**: Formalin and ethanol fixed

HISTORY/SIGNS: Fisherman and others involved in the scallop industry have encountered scallops with abnormal adductor muscles that have been colloquially named as “weak meats”. The muscle of affected scallops has been described as having a dark brownish coloration, stringy texture and will occasionally slip off the shell at processing facilities. Brenner et al. (2012) examined scallop meat quality using chemical and physical parameters and concluded that the condition was most likely caused by nutritional stress. However, infectious diseases were not investigated in that study. Last year scallops with “weak meats” were submitted for diagnostic evaluation and an apicomplexan parasite was associated with this condition (Acc. No. 15-0035). As a follow up to that work, these samples are being submitted to obtain an estimate on the prevalence and geographic distribution of this parasite that may be associated with the “weak meats” condition, which reduces the quality and marketability of scallops.

Gross observations on muscle quality were only made on samples taken from Kamishak Bay. At that location, 8 scallops appeared to have normal muscle tissue, but 2 (#’s 162 & 164) were assessed as having “weak meats”. One sample from the Bering Sea (#59) was noted to have the viscera accompany the muscle during removal. Shell height, sex, and percent of shell infestation by *Polydora* were recorded at all sites (Table 1). Samples were fixed in formalin at sea, but were not transferred to ethanol for long term storage. A small subsample of muscle from each scallop was fixed in ethanol for potential DNA testing.

The table below summarizes the catch data.

District	Date	Lat.	Long.	Depth (fathoms)	Sample Nos.
Northeast Kodiak	6/24/2015	573804	1515008	72	1 - 10
Northeast Kodiak	7/1/2015	565295	1524817	55	11 - 20
Unimak Bight (AK Pen)	9/12/2015	543018	1634333	50	21 - 30
Bering Sea Side (Dutch Harbor)	9/28/2015	532112	1683050	48	31 - 40
Bering Sea	9/27/2015	553482	1651089	58	41 - 50 and 80
Bering Sea	9/26/2015	554573	1650626	58	51 - 60
Bering Sea	9/25/2015	553194	1650281	58	61 - 70
Bering Sea	9/20/2015	552376	1643501	55	71 - 79
Shelikof Kodiak	7/20/2015	583993	1531853	55	81 - 90
Shelikof Kodiak	7/30/2015	582438	1535159	62	91 - 100
Yakutat	8/11/2015	595636	1422130	40	101 - 110
Yakutat	8/12/2015	595463	1434944	54	111 - 120
Yakutat	8/30/2015	594322	1414122	41	121 - 130
Yakutat	8/31/2015	592610	1394317	41	131 - 140
Yakutat	9/2/2015	590421	1383029	38	141 - 150

Yakutat (D16)	9/30/2015	583907	1375251	40	151 - 160
Kamishak Bay, Cook Inlet	8/21/2015	591862	1531035	27	161 - 170
Southwest Kodiak	11/25/2015	563262	1552950	46	171 - 180

REASON FOR SUBMISSION: Surveillance of apicomplexan parasite associated with reduced product quality

FINAL REPORT DATE: 6/28/16

CLINICAL FINDINGS

HISTOPATHOLOGY: 6µ sections, hematoxylin and eosin stains. Besides an abundance of sand and silt embedded in the tissue, samples were also improperly stored in formalin that resulted in dull staining. Some samples also contained brown-black granular deposits that were interpreted as artifacts. Post-mortem autolysis was evident in all samples, especially on the periphery of tissue sections.

Table 1 summarizes parasite prevalence and intensity by region. There was an overall prevalence of 82.2% (148/180), with a range among fishing districts from 68.8% to 100%. Overall mean intensity of infection based on the number of parasite foci/section was 9.3, with mean intensities ranging from 5.4-29.2 by sample location. Samples from Bering Sea Side (Dutch Harbor) and Southwest Kodiak had the most severe infections; some sections contained more than 60 parasite foci.

Parasite foci varied greatly in size, from 1-2 single intracellular organisms diffusely scattered to large distinct foci containing aggregates of 50-100+ organisms that obliterated the cell and displaced tissue. The latter were more associated with a chronic inflammatory response and granuloma-like formation (Figure 1). Myonecrosis (Figure 2) and fibrosis (Figure 3) were also observed.

Several stages of the parasite included the common oval to vermiform shaped zoites with vacuolated cytoplasm and stippled nuclear chromatin (Figure 4), a large sporocyst-like or meront-like stage lined with many oval to curved zoites forming a rosette-like convoluted network (Figure 5), and a macrogamont stage (Figure 6). The latter is involved in sexual gamogony.

Incidental findings included one sample with a metazoan parasite that resembled a nematode and one sample with a section of attached mantle that was infested with 17 *Trichodina*.

DIAGNOSIS: Widespread occurrence of this apicomplexan parasite with varied levels of infection intensities, the higher of which are more likely to be associated with gross tissue changes

COMMENTS/RECOMMENDATIONS: The prevalence and geographic distribution of this parasite in Alaskan weathervane scallops appears to be widespread. The parasite was also detected in archived samples from 2002 (Acc. Nos. 03-0023 and 03-0049), so it is likely that this organism is endemic but has not been formally described because the parasitic fauna of marine invertebrates is greatly understudied.

A similar apicomplexan has been described from Iceland scallops, *Chlamys islandica*, queen scallops, *Aequipecten opercularis*, and king scallops, *Pecten maximus* from Iceland and the UK (Kristmundsson et al., 2011) and Atlantic sea scallops from the Atlantic waters of Canada and the US (Inglis and Stokesbury, 2014). The parasite from those hosts and localities was confirmed to be the same species based on rDNA sequencing (Kristmundsson et al., 2015, Inglis and Stokesbury, 2014). Interestingly, Iceland scallops have been recorded in the North Pacific (Brand, 2006), so it is possible that the same parasite species or one that is closely related also infects Alaskan weathervane scallops. The subset of samples collected and fixed in ethanol in the present case can be used for molecular studies to test this hypothesis.

As with many parasite-host associations, the intensity of infection can have a greater impact than simply the presence of the organism. Unfortunately, gross observations of meat quality were not gathered from most of the submitted samples to evaluate this paradigm. Studies on the impact of the apicomplexan parasite in Atlantic scallop species has shown that meat quality is inversely related to infection intensity where there is a transition from white meat in mildly or uninfected scallops, to brown in moderate infections, to eventually gray with muscle detachment in severe cases (Inglis and Stokesbury, 2014). An epizootic of the Atlantic scallop parasite has been strongly associated with mortality and stock decline where maturing scallops with high infection intensities had reduced adductor muscle and gonadal indices (Kristmundsson et al., 2015).

As with the Atlantic scallop parasite, a macrogamont stage was found to infect Alaskan weathervanes, indicating that the lifecycle of this parasite is monoxenous – i.e., completed in one host and is directly transmitted. This is consistent with the high prevalence across a broad geographic range. Since this parasite appears to be directly transmissible it would be advisable to refrain from discarding offal back into the sea on fishing grounds. However, this may not be practical or economically feasible without some incentive program. Treating the offal prior to discarding at sea could also be considered, but again this carries a cost. The group studying the Atlantic scallop parasite is evaluating a freshwater soak to decrease parasite viability and transmission prior to discarding and methods to categorize meat color and quality (Inglis and Stokesbury, 2014). Management of this disease is likely to be difficult because of probable habitat influences on infection levels. If no management strategies can be used to control this issue, then perhaps lesser grade scallops could be sold to an alternative market for use as a flavoring surimi paste as done with imitation crab meat.

Future direction with this work could include additional sampling of scallops from an area with high infection (e.g., Dutch Harbor or Southwest Kodiak) to examine for this parasite in tissues other than adductor muscle; obtain gross photographs and assessment of those samples to correlate with infection severity; evaluate additional organoleptic testing of normal and affected meats for grading of product quality; collaborate with the researchers in the Atlantic to determine the relatedness of the Alaskan parasite by rDNA sequencing; and continue ongoing discussions regarding potential management strategies, if any.

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FISH HEALTH INVESTIGATOR: J. Ferguson

TECHNICAL ASSISTANCE: I. Dickson

Table 1. Summary of the prevalence and mean intensity of infection (parasite foci/section) of apicomplexan parasite in present case. Field data on *Polydora* infestation and mean shell height for each district are also presented.

District	Prevalence	Mean intensity of parasite foci (range)	Polydora prevalence & mean intensity (% coverage)	Mean shell height, mm (range)
Northeast Kodiak	80% (16/20)	5.4 (1-16)	15% (11.7)	136.4 (100-155)
Shelikof Kodiak	100% (20/20)	10.2 (1-30)	5% (2)	141.1 (106-177)
Southwest Kodiak	90% (9/10)	22.6 (3-36)	20% (11.5)	153.8 (120-182)
Unimak Bight (AK Pen)	80% (8/10)	7.1 (1-16)	0	154.9 (127-173)
Bering Sea Side (Dutch Harbor)	100% (10/10)	29.2 (12-64)	0	163.6 (152-181)

Bering Sea	87.5% (35/40)	5.7 (1-14)	30% (4.5)	160.1 (121-181)
Yakutat & D16	68.3% (41/60)	6.8 (1-26)	51.7% (9.8)	124.5 (102-162)
Kamishak Bay (Cook Inlet)	90% (9/10)	6.2 (1-10)	100% (54.4)	158.4 (148-169)

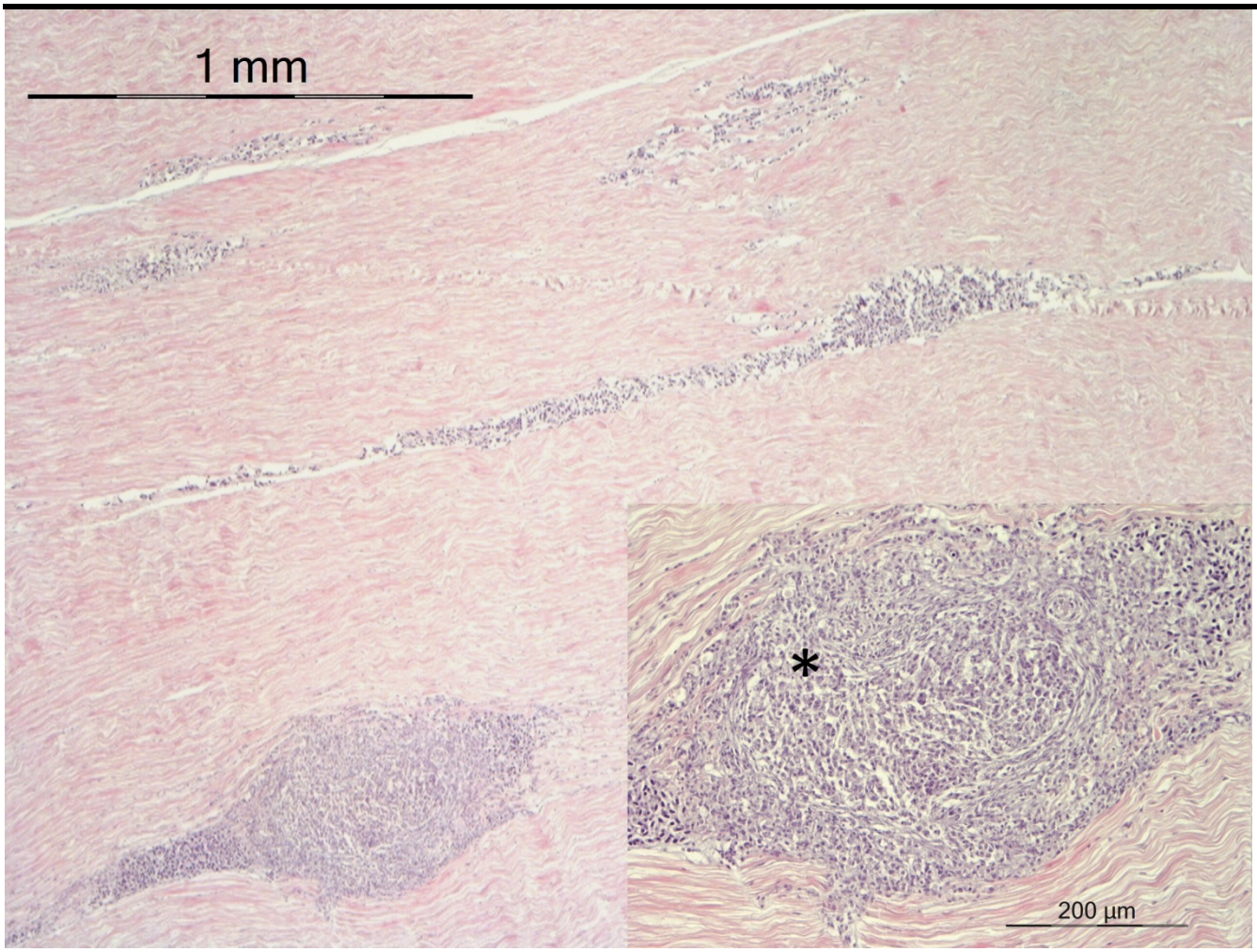

Figure 1. Massive, disseminated apicomplexan infection in scallop adductor muscle. There are several large foci containing many parasites, inset shows a chronic inflammatory response that resembles a granuloma (*).

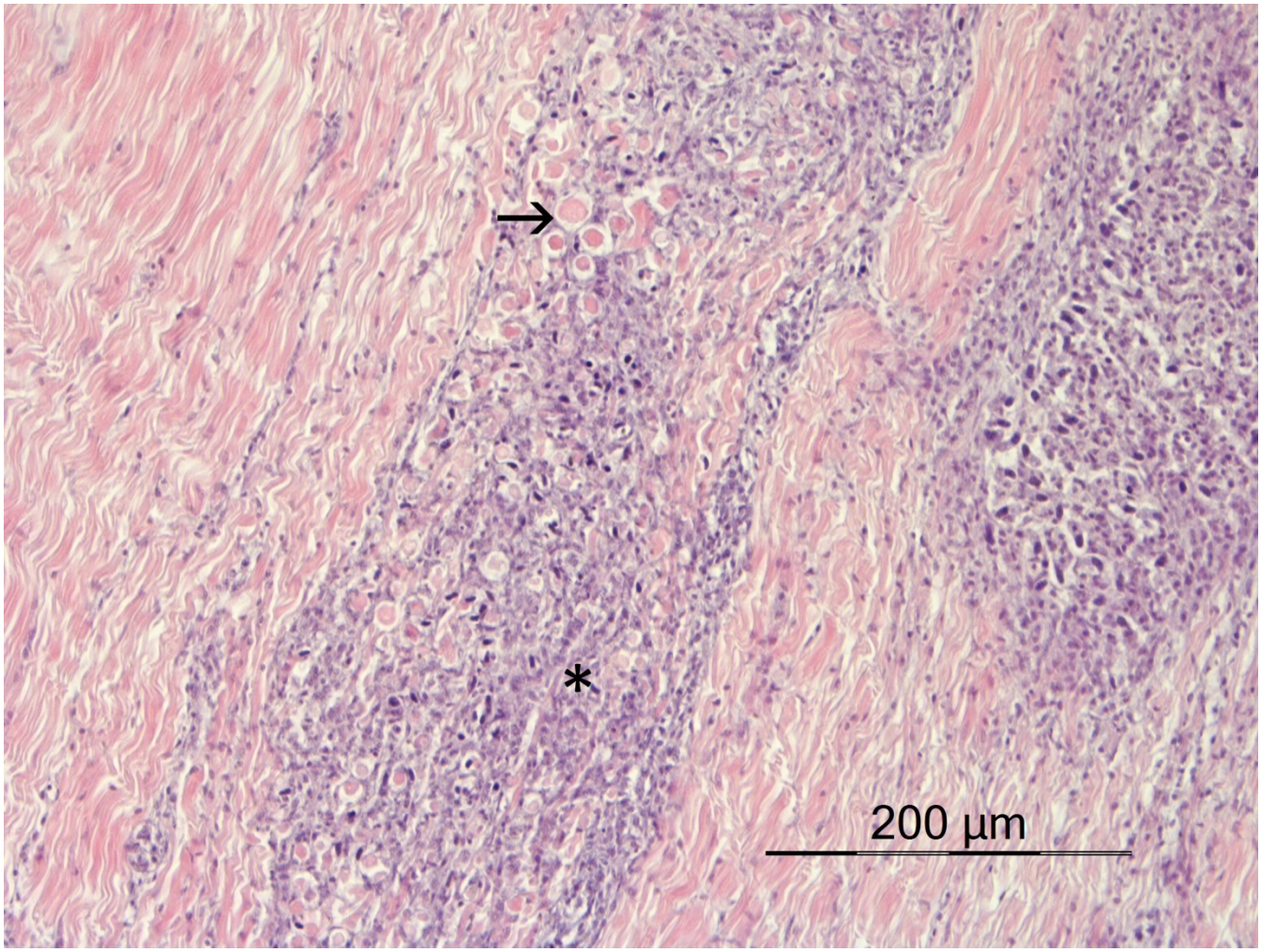

Figure 2. Histopathology of scallop muscle infected with apicomplexan parasite showing severe myositis (*) and myonecrosis (arrow).

Figure 3. Histopathology of scallop adductor muscle infected with apicomplexan parasite associated with fibrosis (f).

Figure 4. Scallop adductor muscle showing several oval to vermiform shaped apicomplexan parasites with vacuolated cytoplasm and stippled nuclear chromatin, which were occasionally found within host hemocytes (arrow).

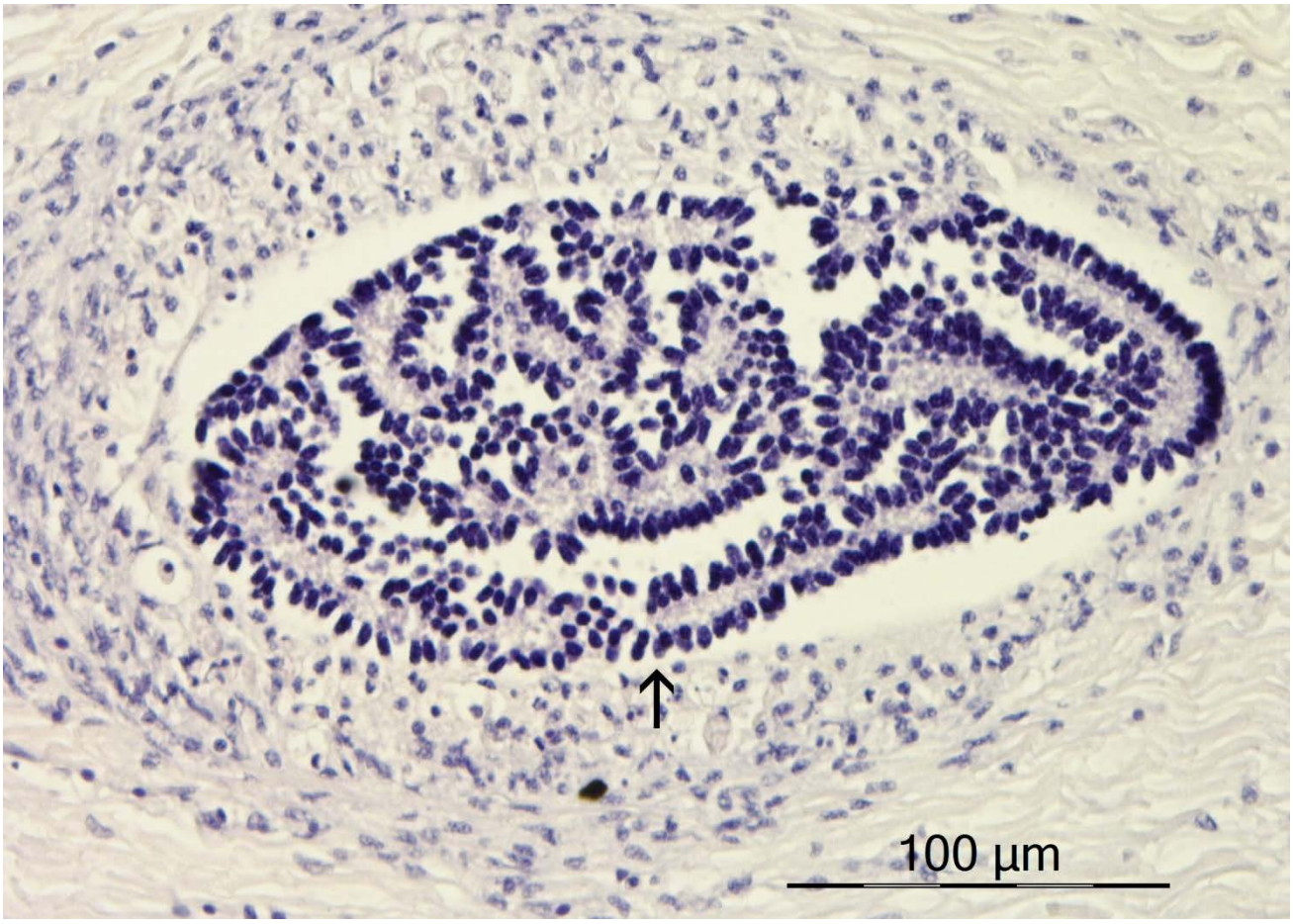

Figure 5. Histopathology of scallop adductor muscle showing a sporocyst-like or meront-like stage of the apicomplexan parasite. Many oval to curved sporozoites or merozoites (arrow) form a rosette-like convoluted network. This particular example was associated with a chronic inflammatory response, which was not always the case.

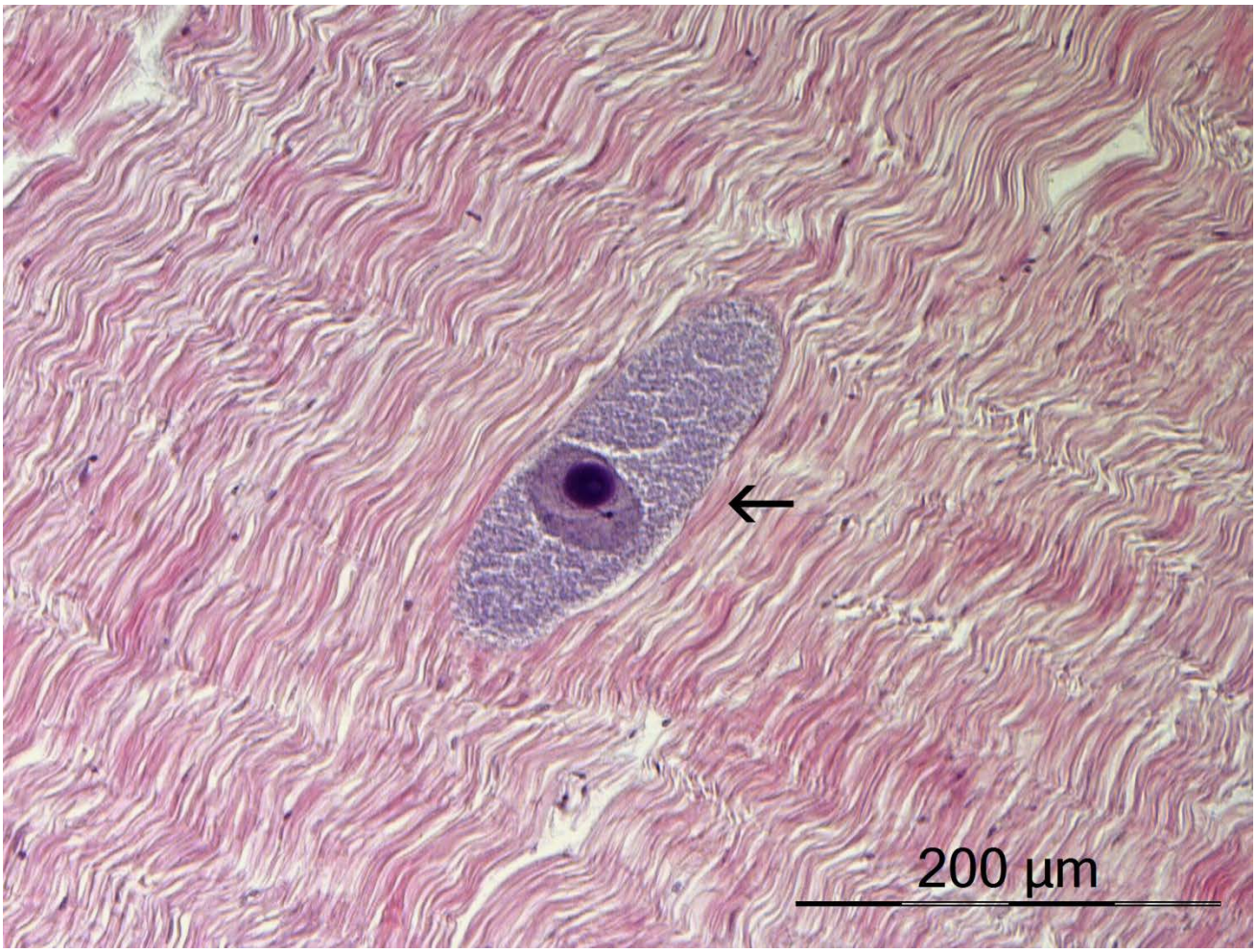

Figure 6. Scallop adductor muscle showing a macrogamont stage (arrow) of the apicomplexan parasite, which is involved in sexual gamogony.

Appendix 3: Weathervane Scallop Stock Structure

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

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

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; 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.

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