Stock Assessment and Fishery Evaluation Report
for the
WEATHERVANE SCALLOP FISHERY
off Alaska

Compiled by

The Scallop Plan Team

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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 and analytical information used in fishery management such as guideline harvest levels (GHLs) and harvest strategies. This report was prepared by the Scallop Plan Team (SPT,) who members 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 (NPFMC). The SAFE report is presented to the NPFMC on an annual basis and is also available to the public.

The Scallop Plan Team met in Kodiak on February 17th, 2016 to review the status of the weathervane scallop stocks, to discuss additional issues of importance in scallop management, and to compile the annual SAFE report. The Plan Team review was based on presentations by staff of the NPFMC, NMFS, and ADF&G with opportunity for public comment and input. Members of the Plan Team who compiled the report were Quinn Smith (chair), Jim Armstrong, Ryan Burt, Ken Goldman, Scott Miller, and Ben Williams.

The scallop fisheries in Alaska's Exclusive Economic Zone (EEZ; from 3 to 200 miles offshore) are jointly managed by the state and federal government under the FMP. Most aspects of scallop fishery management are delegated to the State of Alaska (State), while limited access and other federal requirements are under jurisdiction of the federal government. The FMP was initially developed by the NPFMC under the Magnuson Stevens Act (MSA) and approved by NMFS on July 26, 1995. The NPFMC has updated and adopted 15 amendments to the FMP, the most recent 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. Scallop registration areas used by ADF&G in management of the fishery and general fishing locations are shown in Figure 1-2.

In 1996, optimum yield (OY) was established as 0 to 1.8 million lb of shucked scallop meats (Scallop FMP 3.1.1.2). A more conservative approach was taken in 1998, when OY was defined as 0 to 1.24 million lb of shucked scallop meats. Under Amendment 13 to the Scallop FMP, OY was redefined in 2012 to 0 to 1.29 million lb of shucked meats to include known discards over the time frame for which the upper end of the OY range was defined. Annual statewide scallop harvests have not exceeded OY since OY was first established in 1996, and scallop stocks in Alaska waters show not indication of being overfished.

Stock Status 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 of a stock that accounts for the scientific uncertainty in the estimate of OFL and any other specified scientific uncertainty and is set to prevent, the OFL from being exceeded. The ABC is set below the OFL.

ABC Control Rule is the specified approach in the five-tier system for setting the maximum permissible ABC for weathervane scallops. It sets the maximum statewide ABC at 90 percent of the OFL, providing a 10 percent buffer to account for scientific uncertainty in the estimation of the OFL.

Annual catch limit (ACL) is the level of annual catch of a stock that serves as the basis for invoking accountability measures. For weathervane scallops, the ACL will be set at the ABC.

Guideline harvest level (GHL) means the preseason estimated level of allowable fish harvest which will not jeopardize the sustained yield of the fish stocks. A GHL may be expressed as a range of allowable harvests for a species or species group for each registration area, district, subdistrict, 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 means a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY.

B_{MSY} stock size is the biomass that results from fishing at constant F_{MSY} and is the minimum standard for a rebuilding target when a rebuilding plan is required.

Minimum stock size threshold (MSST) is one half the B_{MSY} stock size.

Optimum yield (OY) is the amount of scallop meat which will provide the greatest overall benefit to the nation, with particular reference to food production and recreational activities. The OY is specified on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factors. The national standard 1 guidelines (50 CFR 600.310) state that the most important limitation on the specification of OY is that the choice of OY, and the conservation and management measures proposed to achieve it, must prevent overfishing. If a stock or stock complex becomes overfished, OY provides for rebuilding to the MSY level.

Overfishing Limit (OFL) due to the absence of an estimate of the statewide weathervane scallop spawning biomass, the default OFL is the MSY.

Overfishing Control Rule($F_{overfishing}$) is defined as any rate or level of fishing mortality that jeopardizes the capacity of the fishery to produce MSY on a continuing basis.

Executive Summary

Harvest for the 2014/15 season was 308,888 lb of shucked meats. This is 27% of the ABC of 1.161 million lb. The full GHL was harvested in 55% of fishing areas. Meat yield in District 16 was poor, prompting the fleet to harvest less than half the GHL. Both Prince William Sound and Cook Inlet beds remained closed. Managers closed Shelikof after 60% of the GHL has harvested due to Tanner crab bycatch exceeding bycatch caps. Vessels quit fishing in the Bering Sea area voluntarily due to low CPUE and signs of high natural mortality throughout the scallop bed.

Preliminary harvest for the 2015/16 season is 263,934 lb of shucked meats. This is 20% of the ABC of 1.161 million lb.

In collaboration with the NPFMC, ADF&G is currently reviewing and reorganizing the statewide scallop assessment program. Changes include expanded survey areas for the 2016 survey including portions of Yakutat, Prince William Sound, and Shelikof, as well as modifications to onboard observer sampling protocols. These changes will provide fishery managers better data tools to manage the fisheries.

1 Weathervane Scallop Fishery and Management

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

Scallop License Limitation Program

Commercial weathervane scallop fishing in federal waters off Alaska is limited by a Federal license limitation program (LLP), while participation in state waters (0-3 nautical miles) was limited by a vessel-based limited entry program until the 2014 season when it became open access. The LLP limits participation in the statewide scallop fishery in Federal waters to nine vessels.

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

Participating in the Scallop fishery in Alaska state waters (0-3 nautical miles) is no longer limited by a vessel-based limited entry program. The limited entry statute expired in 2013 and was not renewed by the Alaska State Legislature.

Four vessels with 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

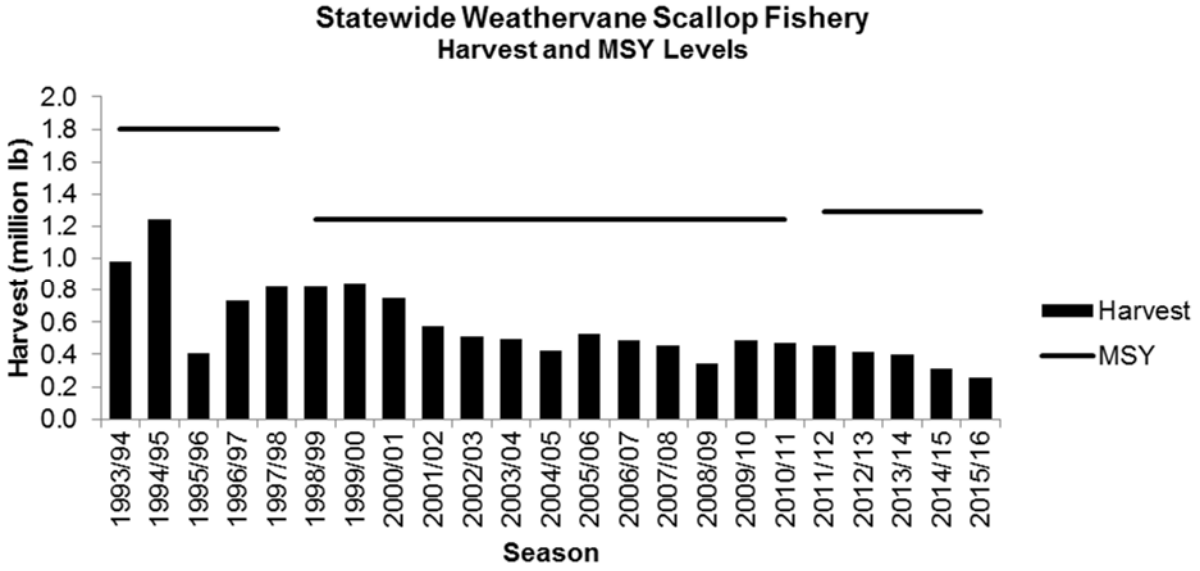
In May 2000, six of the nine LLP owners formed the North Pacific Scallop Cooperative under authority of the Fishermen's Cooperative Marketing Act, 48 Stat. 1213 (1934), 15 U.S.C. Sec. 521. The cooperative is self-regulated and is neither endorsed nor managed by ADF&G or NMFS. The cooperative regulates individual vessel allocations within the 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. More information on the voluntary scallop cooperative can be found in the EA/RIR/IRFA for Amendment 10 to the Scallop FMP.

Overfishing Definition

Overfishing is a level of fishing mortality that jeopardizes the long-term capacity of a stock or stock complex to produce Maximum Sustained Yield (MSY) on a continuing basis. MSY is defined as the largest long-term average catch that can be taken from a stock under prevailing ecological and environmental conditions. Amendment 6 to the scallop FMP established MSY for weathervane scallops at 1.24 million lb of shucked meats based on the average catch from 1990 – 1997 excluding 1995. Optimum Yield (OY) was defined as 0 – 1.24 million lb, and the overfishing control rule was defined as a fishing rate in excess of the natural mortality rate, which has been estimated as $F_{overfishing} = M = 0.13$ (12% per year) statewide. OY was redefined in 2012 to 0 to 1.29 million lb of shucked meats to include known discards over the time frame for which the upper end of the OY range was defined. Catch towards the OFL is a total catch and thus includes discards.

At this time, abundance is estimated for only two of the nine registration areas and a determination of MSST cannot be made.



shows statewide scallop catch and MSY levels both prior to amendment 6 and following inception of the new MSY level in 1996. Since 1996, catches have averaged from 39% to 66% of MSY (Table 1-1). Control rules for other Alaskan scallop species have not been developed as no commercial harvests occur. Catch by individual registration area is shown in Table 1-2 and Table 1-3.

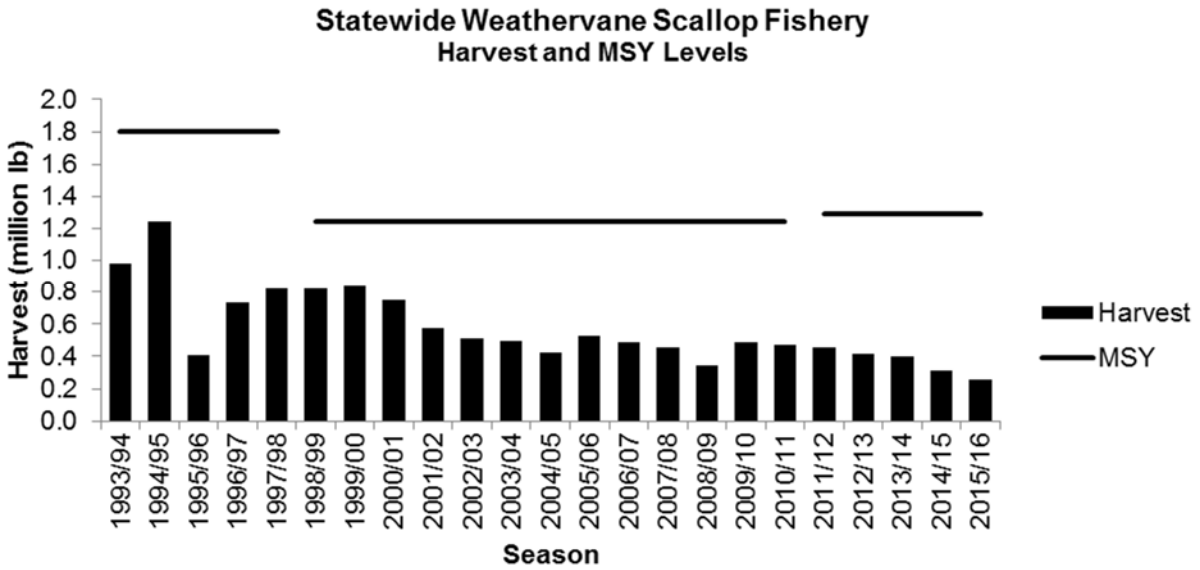


Figure 1-1 Statewide scallop harvest (lb shucked scallop meats) and MSY levels from FMP.

Table 1-1 Alaska weathervane scallop harvest and MSY from FMP, 1993/94 - 2015/16 seasons.

Season	Harvest (lb meat)	MSY	% MSY
1993/94	984,583	1,800,000	55
1994/95	1,240,775	1,800,000	69
1995/96	410,743	1,800,000	23
1996/97	732,424	1,800,000	41
1997/98	818,913	1,800,000	45
1998/99	822,096	1,240,000	66
1999/00	837,971	1,240,000	68
2000/01	750,617	1,240,000	61
2001/02	572,838	1,240,000	46
2002/03	509,455	1,240,000	41
2003/04	492,000	1,240,000	40
2004/05	425,477	1,240,000	34
2005/06	525,357	1,240,000	42
2006/07	487,473	1,240,000	39
2007/08	458,313	1,240,000	37
2008/09	342,434	1,240,000	28
2009/10	488,059	1,240,000	39
2010/11	459,759	1,240,000	37
2011/12	456,058	1,290,000	35
2012/13	417,551	1,290,000	32
2013/14	399,134	1,290,000	31
2014/15	308,888	1,290,000	24
2015/16 [a]	254,665	1,290,000	20

[a] PRELIMINARY data subject to change.

Registration Areas

The State of Alaska Scallop Fishery Management Plan established nine scallop registration areas in Alaska for vessels commercially fishing scallops (Figure 1-2). 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.

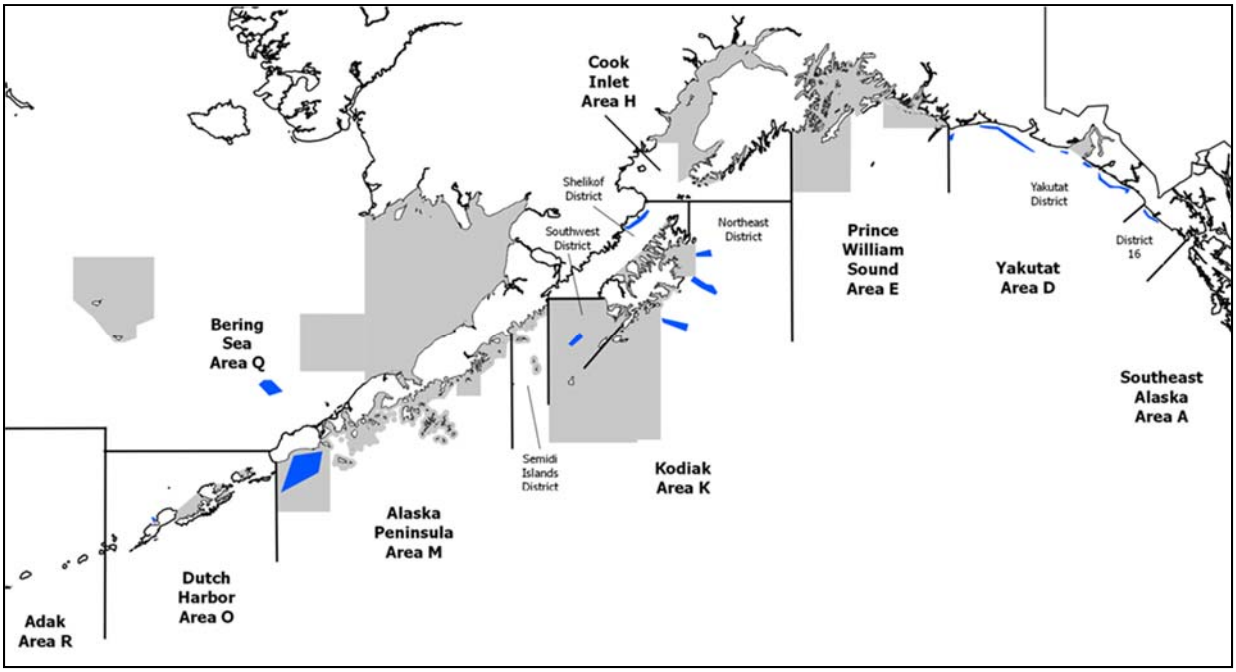


Figure 1-2 Map showing Alaska scallop fishery registration areas. General areas of effort are overlaid by blue polygons. Exploratory fisheries in waters normally closed to scallop fishing (gray shading) have been opened by ADF&G Commissioner's Permit in the Kodiak Southwest District and Alaska Peninsula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

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 spawning periods; achieve the highest possible product quality; limit gear conflicts with other fisheries; and 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 and are typically announced by ADF&G approximately one month prior to the season opening date.

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.

Recent fishery performance

Table 1-2 GHLs and summary statistics from 2014/15 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	120,353	44	2,861
Yakutat District 16	0-35,000	25,000	9,140	22	256
Prince William Sound	0-50,000	closed	0		
Cook Inlet	10,000-20,000	closed	0		
Kodiak Northeast District	0-300,000 for whole Kodiak Area	55,000	55,659	74	1,327
Kodiak Shelikof District		105,000	66,138	40	962
Kodiak Southwest District[b]		25,000	24,973	45	193
Kodiak Semidi Islands District[b]		7,500	20	6	0
Alaska Peninsula Unimak Bight District[b]	0-100,000	15,000	15,000	52	325
Dutch Harbor	0-110,000	5,000	5,160	70	85
Bering Sea	0-300,000	50,000	12,445	24	144
Statewide total		407,500	308,888	44	6,154

[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 1-3 GHLs and preliminary catch from the 2015/16 Alaska weathervane scallop fishery.

Area/District	GHL (lb scallop meats)	Retained catch (lb scallop meats)
Yakutat District	120,000	119,820
Yakutat District 16	25,000	870
Prince William Sound	closed	0
Cook Inlet	10,000	9,486
Kodiak Northeast District	55,000	55,609
Kodiak Shelikof District	75,000	39,876
Kodiak Southwest District[a]	25,000	10,950
Alaska Peninsula Central District[a]	7,500	0
Alaska Peninsula Unimak Bight District[a]	15,000	15,000
Dutch Harbor	10,000	5,040
Bering Sea	7,500	7,500
Statewide total	350,000	263,934

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

Southeast Region

District 16

Preliminary 2015/16 scallop harvest in District 16 was the second lowest in record after the 2007/08 season (Table 1-4). The fleet cited poor product quality and low meat fullness 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.

Overall CPUE in District 16 has been declining since the 2000/01 season; it is difficult to parse out an explanation. Effort is highly variable in the area with years with practically no harvest and relatively low CPUE, immediately followed by a season of high harvest and relatively high CPUE, making inter-annual variation analyses difficult. However when the four most recent seasons with roughly equivalent catch and effort (2004/05, 2008/09, 2012/13, 2013/14) were examined there is a clear decreasing trend in CPUE (Figure 1-3). However the increase in CPUE from the 2012/13 to the 2013/14 season may be a sign of increasing health.

Table 1-4 Yakutat District 16 scallop fishery summary statistics, 1993/94 - 2014/15.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	1	35,000	NA			
1994/95	7	35,000	22,226	408	54	
1995/96	6	35,000	33,302	1,095	30	
1996/97	2	35,000	34,060	917	37	2,667
1997/98	4	35,000	22,890	561	41	547
1998/99	2	35,000	34,153	702	49	422
1999/00	2	35,000	34,624	674	51	963
2000/01	3	35,000	30,904	476	65	854
2001/02	2	35,000	20,398	417	49	815
2002/03	2	35,000	3,685	100	37	211
2003/04	2	35,000	1,072	18	60	18
2004/05	2	35,000	24,430	419	58	332
2005/06	2	35,000	13,650	407	34	597
2006/07	2	21,000	13,445	309	44	415
2007/08	1	21,000	180	6	30	34
2008/09	2	21,000	20,986	423	50	1,259
2009/10	2	25,000	11,791	439	27	1,745
2010/11	1	25,000	2,655	83	32	468
2011/12	1	25,000	1,777	57	31	51
2012/13	1	25,000	25,255	684	37	1,019
2013/14	2	25,000	25,510	634	40	708
2014/15	2	25,000	9,140	423	22	256
2015/16[b]	1	25,000	870	41	21	NA

[a] *Calculated from round weight discard estimates assuming 20% mortality for discarded scallops and meat recovery of 8.3% from observer experiments.*

[b] PRELIMINARY data subject to change.

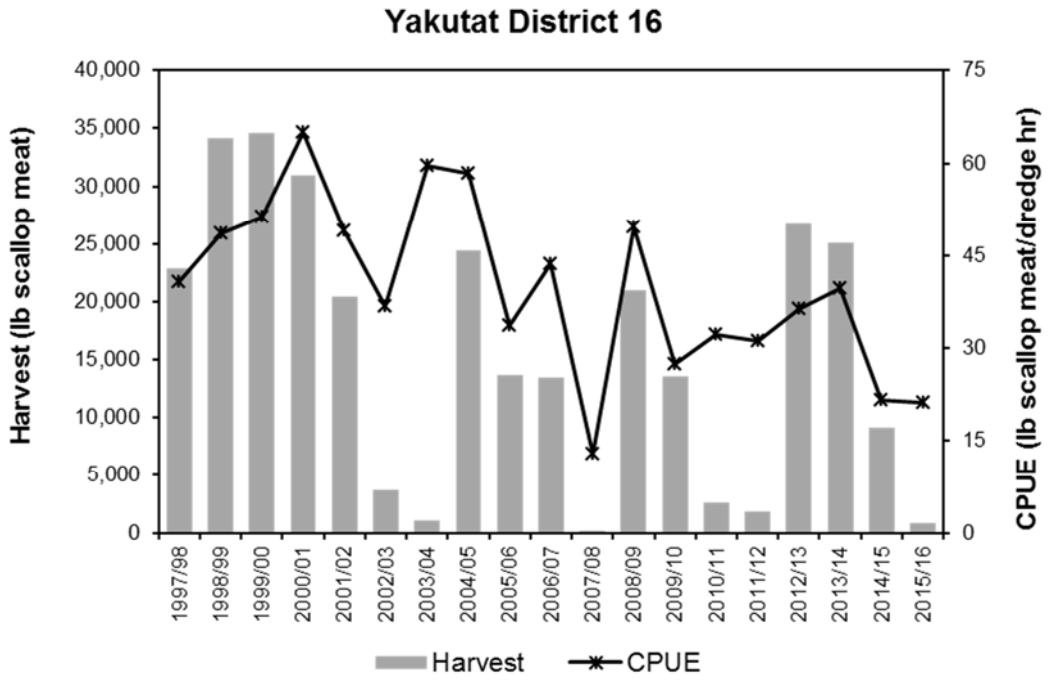


Figure 1-3 Yakutat District 16 Scallop Harvest and CPUE, 1997/98 - 2015/16 seasons.

Estimated shell height distributions in Yakutat District 16 are not yet available for the 2015/16 season. However the 2014/15 season samples show an increased range of scallop sizes compared with the 2013/14 season, with an apparent increase in harvest of >130mm scallops (Figure 1-4), making the size range very similar to the 2012/13 season. Whether this variation is due to growth rates, fleet behavior, or changed in cohort sizes is not known.

In the 2014/15 Yakutat District 16 fishery, 9,140 lb of scallop meats were retained and an estimated 1,280 lb were discarded, for an estimated discard rate of 14.0% of the total meat weight catch. Using a 20% discard mortality estimate (NEFSC 2007) 256 lb of scallop meat weight was lost to discard mortality in the 2014/15 season (Table 1-4). The highly variable fishing pressure and meat quality in Yakutat District 16 makes year to year examination of discard rates difficult. Variation in discard proportion during recent seasons is apparent in SH plots from resampling (Figure 1-4).

Crab Bycatch estimates calculated from 2014/15 Yakutat District 16 observer samples were 306 Tanner crabs, and no Dungeness crabs. Estimated crab bycatch decreased 86% from the 2013/14 season. Carapace width of Tanner crabs sampled by observers ranged from about 10mm to about 70mm, with 90% in the 20-50mm range (Figure 1-23).

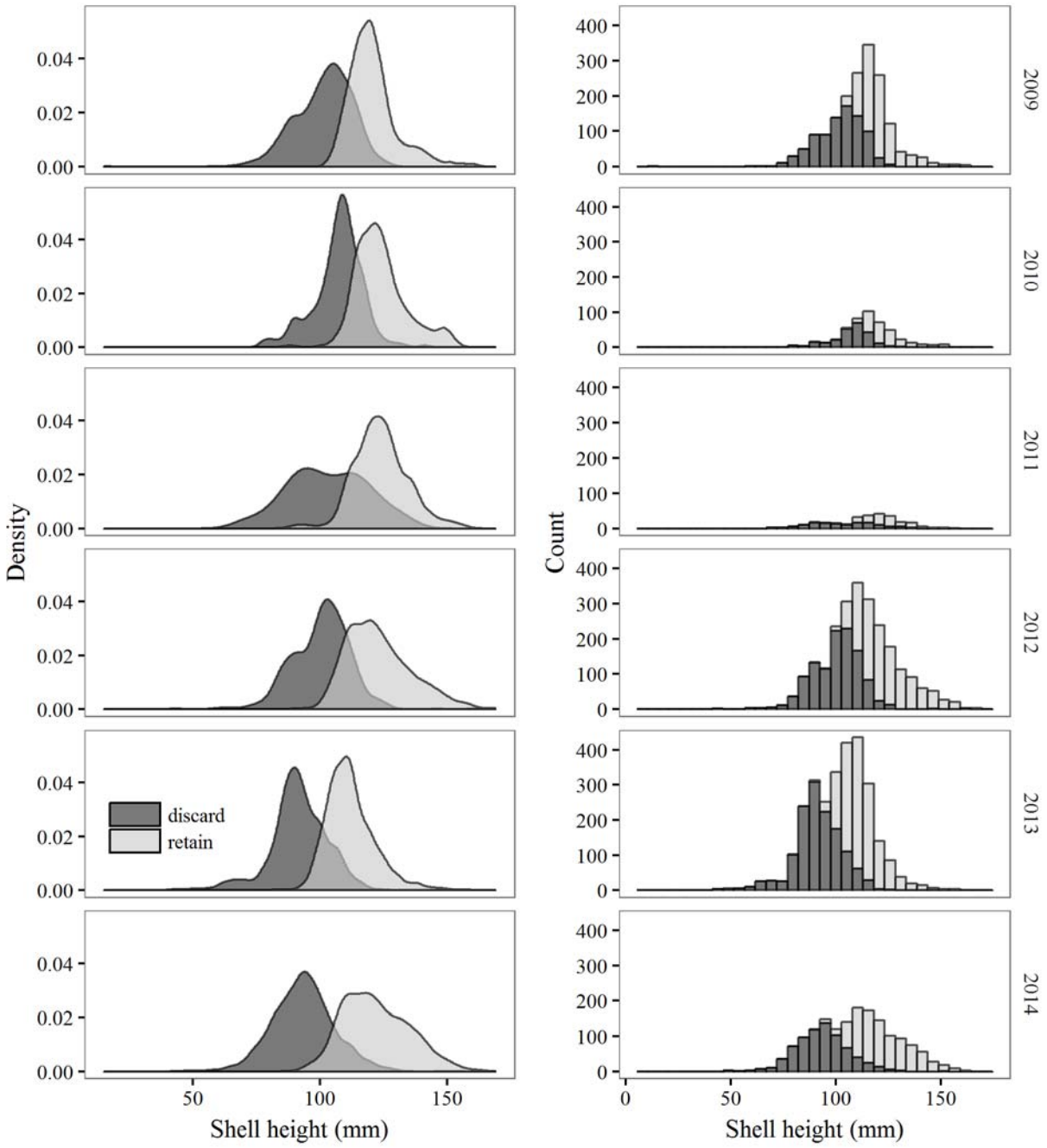


Figure 1-4 Estimated scallop shell height distributions from the 2009/10 - 2014/15 Yakutat District 16 fishing seasons. The left pane shows the shell heights distribution for all of the hauls, the right pane shows the number of shells sampled at a given height.

Yakutat

The 2015/16 season was the 4th season at a reduced GHL in Yakutat. This GHL reduction appears to have been effective as CPUE has shown general increases since its introduction (Figure 1-5). Based on preliminary harvest and effort from the 2015/16 season CPUE is up 41% from the 2011/12 low.

In the 2014/15 Yakutat fishery, 120,353 lb of scallop meats were retained and an estimated 14,305 lb were discarded of, for an estimated discard rate of 11.9% of the total meat weight catch a 3.5% decrease from the 2013/14 season. Using a 20% discard mortality estimate 2,861 lb of scallop meat weight was lost to discard mortality in the 2014/15 season (Table 1-5). Average estimated Area D scallop meats discard for the last 10 seasons was 38,544 lb or 26.5% of total catch. Variation in discard proportion during recent seasons is apparent in SH plots from resampling (Figure 1-6).

Table 1-5 Yakutat Area D scallop fishery summary statistics, 1993/94 - 2015/16.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours[a]	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	7	250,000	139,057	1,999	70	
1994/95	10	250,000	246,862	4,130	60	
1995/96	8	250,000	237,417	4,730	50	
1996/97	4	250,000	238,736	4,438	54	5,226
1997/98	4	250,000	243,810	3,956	62	5,295
1998/99	8	250,000	242,929	4,154	58	4,795
1999/00	3	250,000	249,681	3,840	65	9,416
2000/01	3	250,000	195,699	4,241	46	10,401
2001/02	2	200,000	103,800	2,406	43	4,809
2002/03	2	200,000	122,718	2,439	50	6,326
2003/04	2	200,000	160,918	3,360	48	6,940
2004/05	2	200,000	86,950	2,132	41	3,869
2005/06	2	200,000	199,351	5,089	39	6,988
2006/07	2	150,000	150,041	2,817	53	6,715
2007/08	2	150,000	125,960	2,601	48	9,184
2008/09	3	150,000	150,289	3,286	46	7,361
2009/10	2	160,000	158,225	3,946	40	10,985
2010/11	3	160,000	156,575	3,495	45	10,216
2011/12	3	160,000	156,463	4,598	34	10,303
2012/13	3	120,000	118,140	3,354	35	8,706
2013/14	3	120,000	122,290	2,391	51	3,770
2014/15	3	120,000	120,353	2,736	44	2,861
2015/16[b]	2	120,000	119,820	2,513	48	NA

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

[b] PRELIMINARY data subject to change.

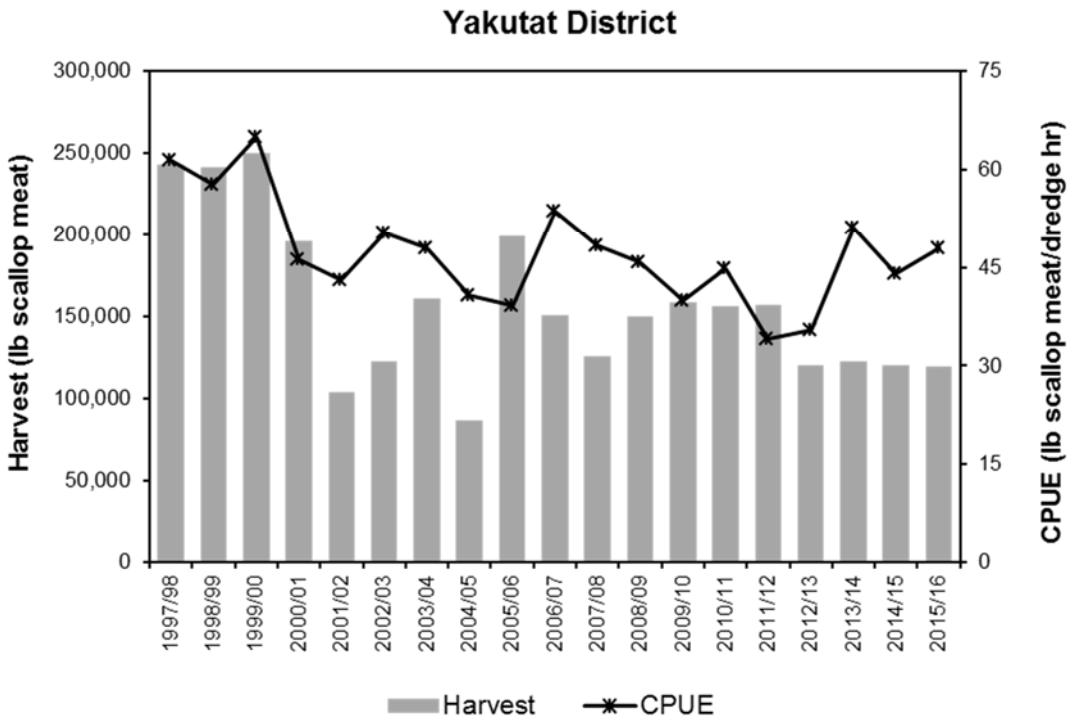


Figure 1-5 Yakutat Area D Scallop Harvest and CPUE, 1997/98 - 2015/16 seasons.

Estimated shell height distributions in Area D show an increased range of scallop sizes in the 2013/14 and 2014/15 seasons, with apparent prerecruit pluses in the 70mm and 10mm ranges (Figure 1-6). Whether these changes are due to growth rates, fleet behavior, or an increase in prerecruit populations is not known. The bulk of the retained scallops remain in the 115–150 mm shell height (SH) range.

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 1-6).

CPUE is tracked throughout the season 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 will 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.

Crab Bycatch estimates calculated from 2014/15 Yakutat observer samples were 2,119 Tanner crabs, and 29 Dungeness crabs. Estimated Yakutat Tanner crab bycatch decreased 90% from the 2013/14 season. Carapace width (CW) of Tanner crabs sampled by observers ranged from about 10mm to about 50mm, with the majority in the 10-30mm range.

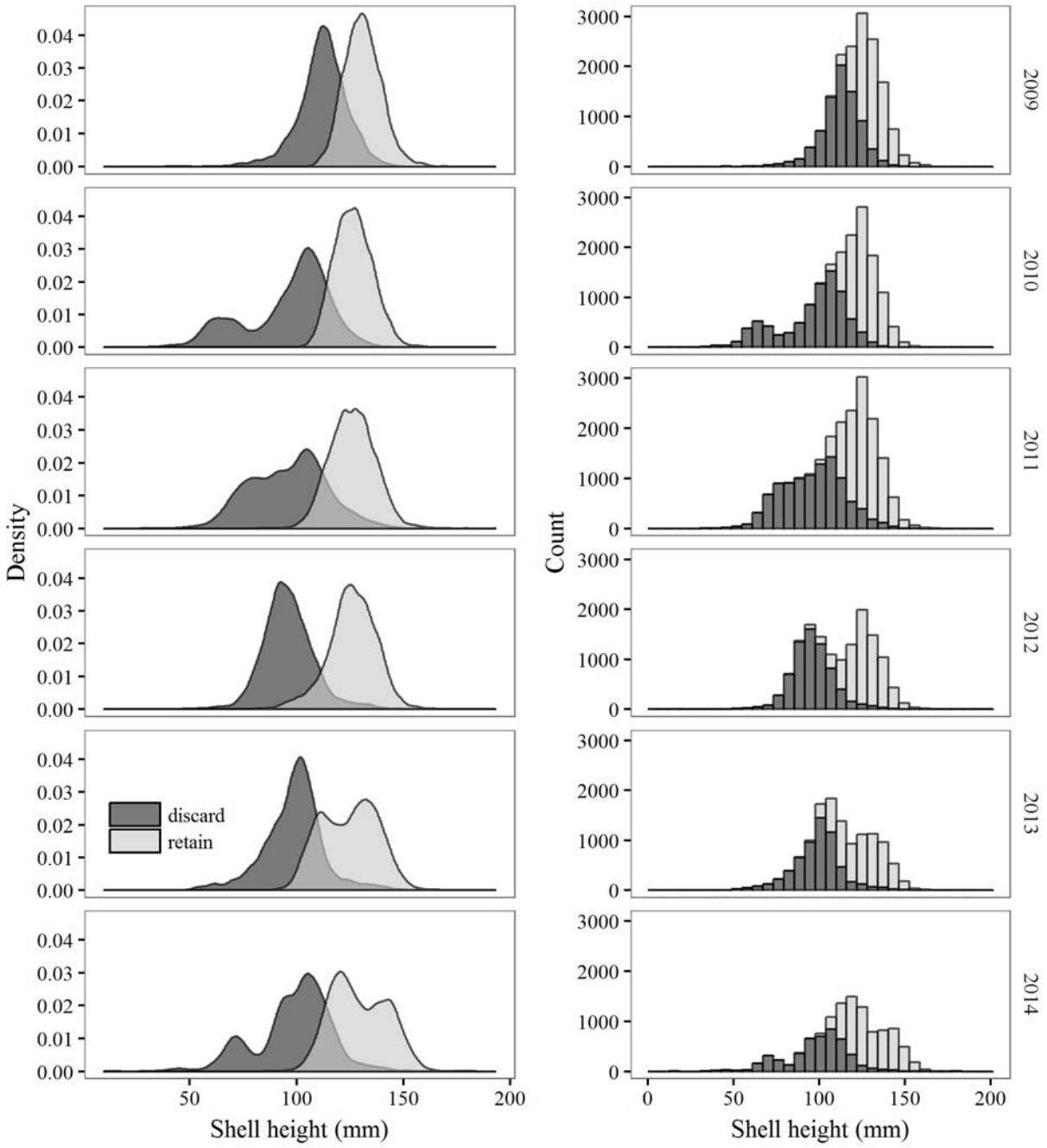


Figure 1-6 Estimated scallop shell height distributions from the 2009/10 - 2014/15 Yakutat Area D fishing seasons. The left pane shows the shell heights distribution for all of the hauls, the right pane shows the number of shells sampled at a given height.

Central Region

Data from Central Region's biennial fishery independent scallop surveys are used to set GHLs, which are in effect for the subsequent two seasons. Determination of an appropriate harvest rate, and corresponding GHL, are based on available biological data. The current method of setting harvest limits for the Central Region commercial weathervane scallop fishery adheres to the recommendation that *F* be less than *M*, creating conservative and sustainable harvest limits. The Central Region typically applies a 0.05 harvest rate to the survey estimated biomass, and uses whole weight to meat weight conversions to assign the GHL for each area (Gustafson and Goldman 2012). The department chose to use an exploitation rate that was either below or at the low end of estimates of natural mortality (Restrepo et al. 1998) to provide for fishing yet allowing for recruitment to the adult portion of the bed to increase the biomass. Natural mortality estimates for weathervane scallops in Alaska have been reported to range from 0.04 to 0.25 (Kruse 1994, Kruse et al. 2005) with a median of 0.15 (Kruse 1994). Estimates of natural mortality from Kamishak Bay in Central Region were estimated at 0.19 (Bechtol et al. 2009). To accomplish the previously stated goals, the department chose the exploitation rate of 0.05 to apply to biomass data to set the GHL, and to consistently apply this level of exploitation until such time as biomass levels increase and allow for greater harvest.

The fishery typically remains open until the GHL is achieved. However, through its emergency order authority the department may close a season or area in response to declines in fishery CPUE or even apparent die-offs as occurred at Kamishak in 2002. Additionally, in setting GHLs the department may consider other aspects of the survey results such as a narrow size or age distribution or truncation of sizes, or ages observed within an area to assist in the final management decision.

The Cook Inlet fishery is managed by Jan Rumble and Elisa Russ from the Homer office and the Kayak Island fishery is managed by Jan Rumble and Maria Wessel from the Cordova office.

Kayak Island
Fishery overview:

Recent seasons (2012/13 - 2015/16)

Because of the decline in survey abundance and biomass, and commercial CPUE, the department closed the East Kayak Subsection (EKS) fishery in 2012. Because the survey abundance and biomass decreased further in 2014, the EKS will remain closed at least until the area is next surveyed in 2016 (Table 1-6).

Due to the record low abundance surveyed in 2010 and the commensurate declining trend in the west section commercial CPUE, the department closed the West Kayak Subsection (WKS) commercial fishery in 2010. Because the 2014 survey abundance and biomass were still well below the levels surveyed prior to 2008, the WKS will remain closed at least until the area is next surveyed in 2016 (Table 1-6).

2011/12 Season summary

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

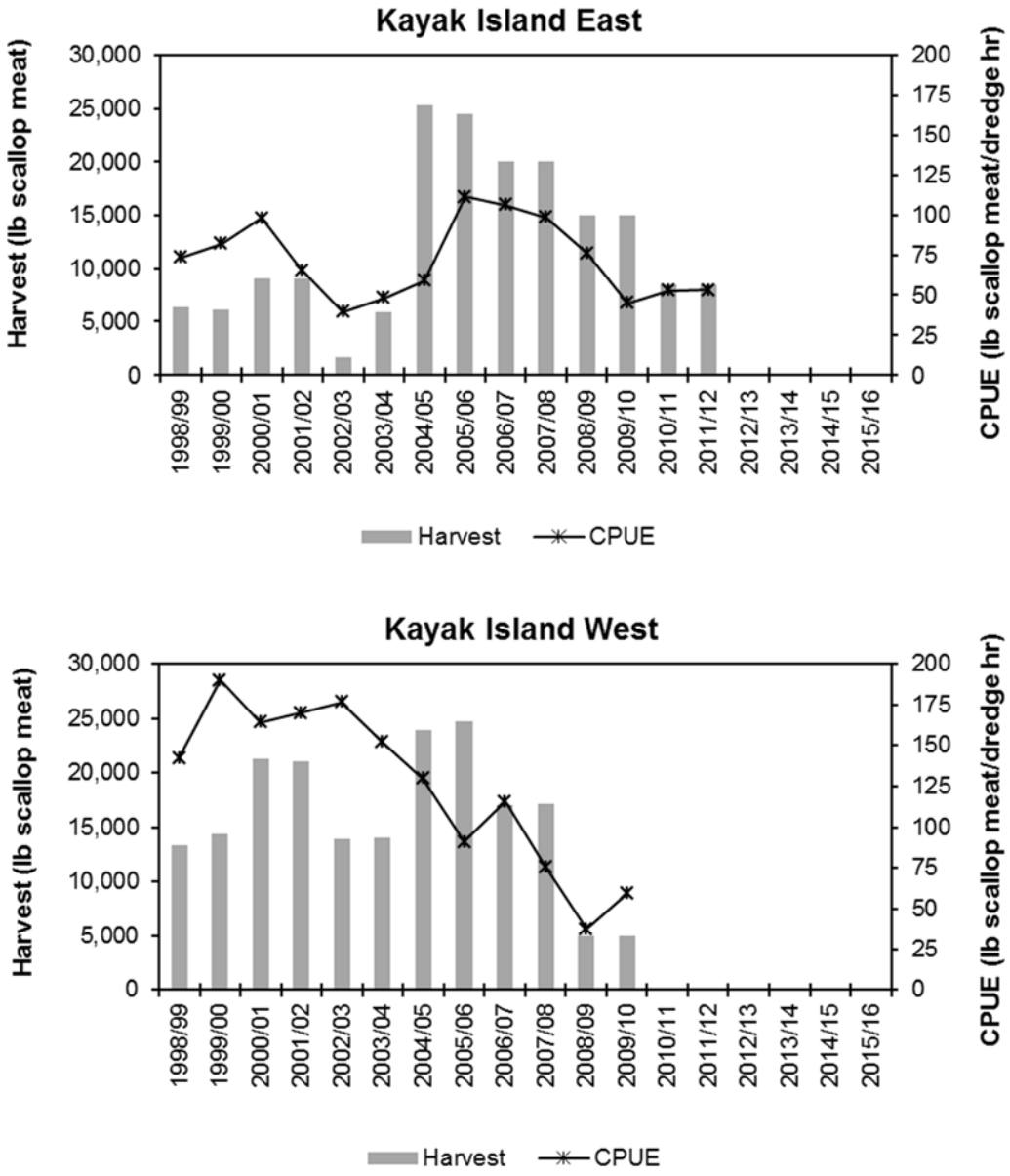


Figure 1-7).

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

Plots of shell height distributions from resampling observer measurements provided by the statewide observer program (Figure 1-8) show that the 2011/12 harvest was comprised primarily of scallops 125–155 mm SH, with very few small scallops caught and discarded. The range of shell heights caught in the fishery has been consistent over the years.

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

Table 1-6 Commercial harvest of weathervane scallops from Kayak Island beds, 1992 - 2015/16.

		East Bed				West Bed				Total Both Beds			
Season	Number 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)
1992	4									64,000	208,836	NA	NA
1993	7									50,000	63,068	638	99
1994/95		Closed				Closed				Closed			
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			

[a] *Separate GHLs were established for the east and west beds in 2008*

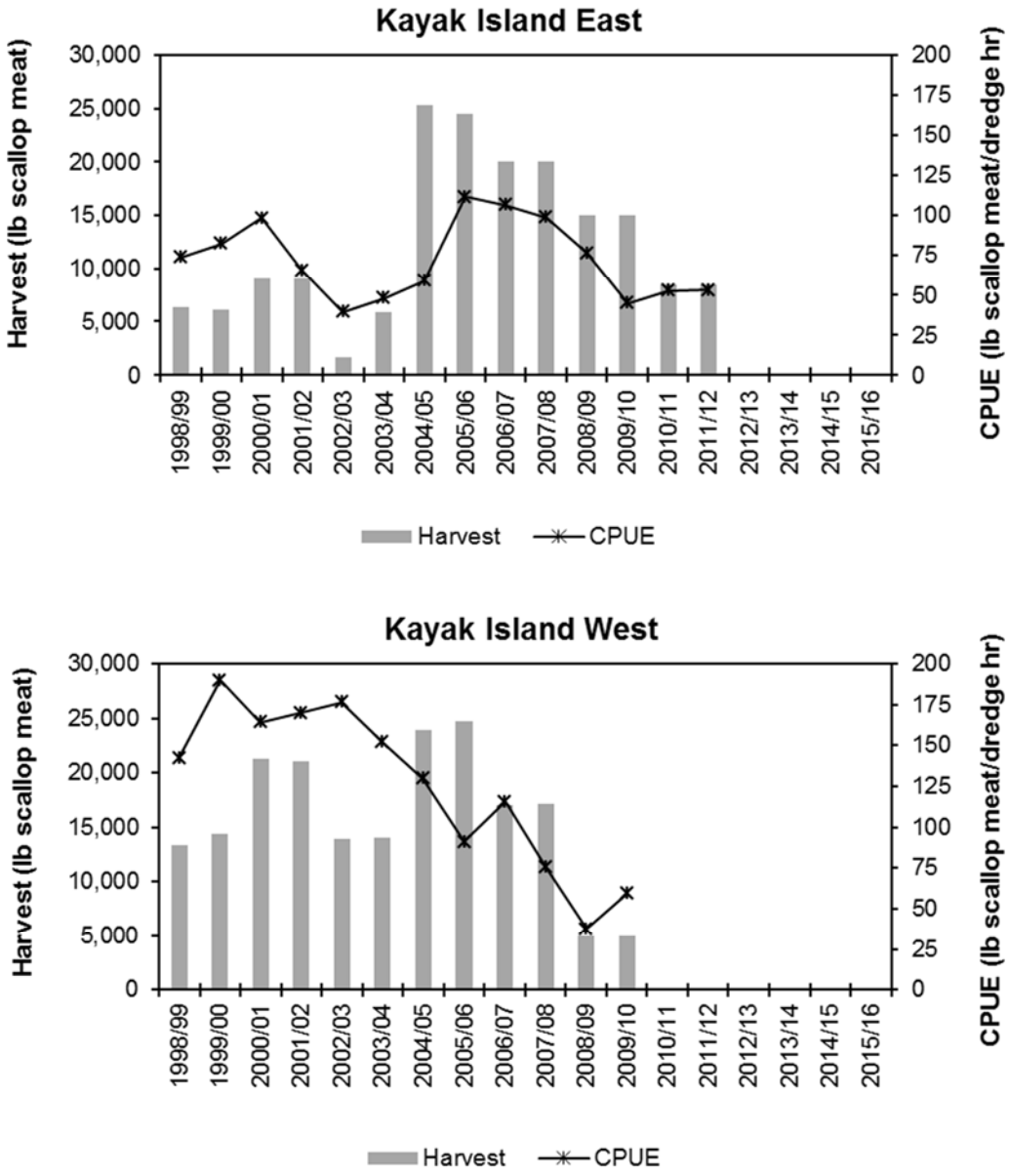


Figure 1-7 Prince William Sound Scallop Harvest and CPUE, 1996/97 - 2015/16 seasons.

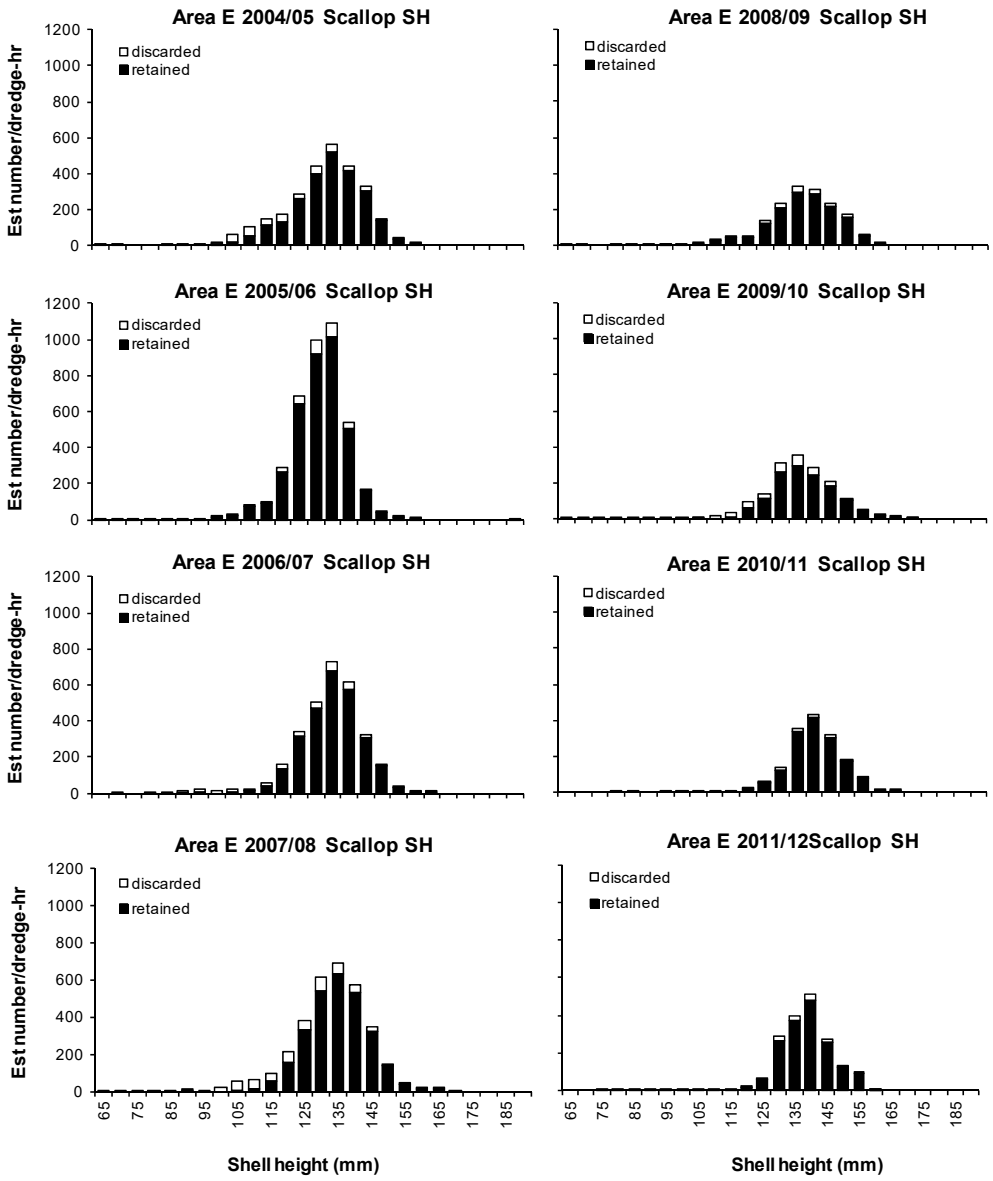


Figure 1-8 Estimated scallop shell height distributions from the 2004/05 - 2011/12 Prince William Sound fishing seasons.

Kamishak Bay

Fishery overview

The GHR specified by state regulations for the Kamishak District is 10,000 to 20,000 lb of shucked meats, with a season dates of August 15–October 31. Harvest peaked in 1996 with five vessels harvesting 28,228 lb of shucked meats with catch rates of 53 lb/hr. Participation and CPUE in this small fishery have varied widely (Table 1-7, Figure 1-9). The fishery was closed in 1995 due to regulatory not biological issues, therefore the manager decided that an additional 8,000 lb harvest was allowable during

the 1996 season since the survey that year indicated the Kamishak north bed was healthy. Allowing an additional harvest resulted in only a 3% harvest rate being applied; less than the 5% harvest rate is typically applied when stocks fall within the GHR. Harvest has typically occurred only in the north bed, with only three years of harvest in the south bed (2002-2004). In response to exploratory commercial fishing effort in the south bed in 2002, ADF&G began surveying the south bed in 2003. The fishery has been closed in the south bed since 2005 after a poor fishery performance in 2004, except for two years when no effort occurred. Until the closure in 2013, the fishery in the north bed was relatively stable for the previous three years, which followed a three-year period of no effort (2007-2009), however, CPUE was still considerably lower (29 lb/hr average) than peak years of the fishery between 1993 and 2001 when CPUE averaged 54 lb/hr, with the highest CPUE in 2000 at 75 lb/hr.

2015 Season summary

For the 2015 season, the department opened the majority of the north bed in Kamishak Bay to prosecute a commercial scallop fishery. In 2015, the department only surveyed the north bed and results produced a higher total scallop estimate than 2013. The age composition in 2015 showed more small scallops caught than the 2013 survey. There was a concentration of small scallops found in the southern part of the north bed. In order to conserve scallops in the south bed and the southern portion of the north bed, waters south of 59° 18.50' N. lat. remained closed for the 2015 season.

The department applied a 5.5% exploitation rate to biomass results for the north bed to develop a guideline harvest level. This result exceeded the lower limit of the GHR (10,000 lb) which falls between the regulatory range required to open the fishery. With current information including some recruitment, age and shell height data along with higher abundance, this exploitation rate was appropriate.

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 a fishery CPUE of 21 lb/hr (Table 1-7). The CPUE decreased during the course of the fishery from an average of 26 lb/hr the first trip to 17 lb/hr the fourth trip. Deadloss was calculated using 100% mortality rate on crushed or broken discarded scallops and a 20% mortality rate on discarded live (small) scallops using observed discard rates. The 20% mortality rate on live discarded scallops was implemented in 2011 in response to ACL requirements.

ADF&G placed an observer on two of the four fishery trips to collect data on scallop catch, discards, crab bycatch, and catch composition. The observer sampled 135 of 435 tows made during the 2015 season and observer data was used to calculate deadloss, a discard rate (by weight) of 2.3%, and an average meat recovery of 9.6%.

The vessel operator must collect a minimum of 100 scallop top valves from each trip per regulation 5 AAC 38.327 Kamishak Bay District Scallop Management Plan, and when an observer is onboard, additional shell height data and shells for age determination are collected. There was an increase in average size in 2015 compared to 2012 for both retained and discarded scallops sampled from observed tows and shell height frequency is plotted in Figure 1-10. 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 has not yet been fully processed and will be reported in the 2017 SAFE report.

The occurrence of weak meats was determined in the commercial fishery in 2015 and 2012. In 2015, 708 scallops were sampled for meat quality during observed trips, of which 36 (5.1%) were weak meats. In 2012, a lower percentage of 2.7%, 9 out of 338 scallops, had weak meats.

Crab bycatch levels were set at 3,933 Tanner crab and 30 king crab. Crab bycatch reported on skipper logbooks was 331 Tanner crab and 1 king crab, and the largest crab catch in a single tow was 107 Tanner crab reported during the unobserved fourth trip. Observed crab bycatch corroborated skipper logbooks.

Table 1-7 Cook Inlet, Kamishak District scallop fishery summary statistics, 1983 - 2013.

		North Bed				South Bed				Total Both Beds			
Season	Number Vessels[b]	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb per dredge hr)	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)
1992													
1993	3	20,000	20,115	528	38					20,000	20,115	528	38
1994/95	4	20,000	20,431	458	45					20,000	20,431	458	45
1995/96		Closed											
1996/97	5	28,000	28,228	534	53					28,000	28,228	534	53
1997/98	3	20,000	20,336	395	52					20,000	20,336	395	52
1998/99	1	20,000	17,246	390	44					20,000	17,246	390	44
1999/00	3	20,000	20,315	325	63					20,000	20,315	325	63
2000/01	3	20,000	20,516	275	75					20,000	20,516	275	75
2001/02	2	20,000	20,097	325	62					20,000	20,097	325	62
2002/03	3	20,000	6,045	235	26		2,546	76	34	20,000	8,591	311	28
2003/04	2	Closed				20,000	15,843	896	18	20,000	15,843	896	18
2004/05	3	6,500	4,519	198	23	13,500	1,598	166	10	20,000	6,117	364	17
2005/06	2	7,000	7,378	372	20	Closed				7,000	7,378	372	20
2006/07	1	7,000	50	10	5	Closed				7,000	50	10	5
2007/08	0	7,000	0			5,000	0			12,000	0		
2008/09	0	7,000	0			5,000	0			12,000	0		
2009/10	0	14,000	0			Closed				14,000	0		
2010/11	1	14,000	9,460	365	26	Closed				14,000	9,460	365	26
2011/12	1	12,500	9,975	324	31	Closed				12,500	9,975	324	31
2012/13	1	12,500	11,739	392	30	Closed				12,500	11,739	392	30
2013/14		Closed				Closed				Closed			
2014/15		Closed				Closed				Closed			
2015/16		10,000	9,485	459	21	Closed				10,000	9,485	459	21

[b] Confidential data voluntarily released by vessel operators

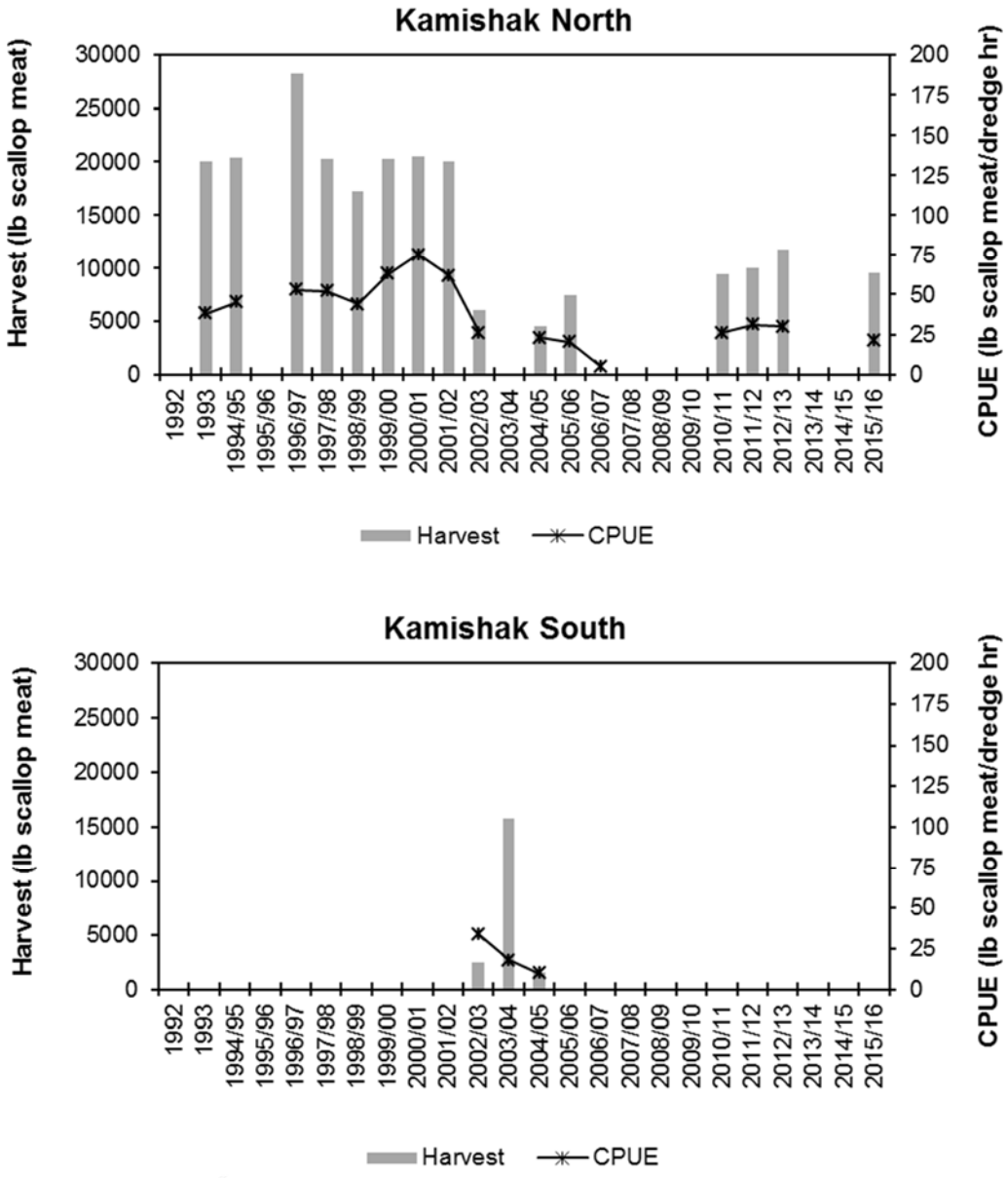


Figure 1-9 Cook Inlet Scallop Harvest and CPUE, 1993 - 2015/16 seasons.

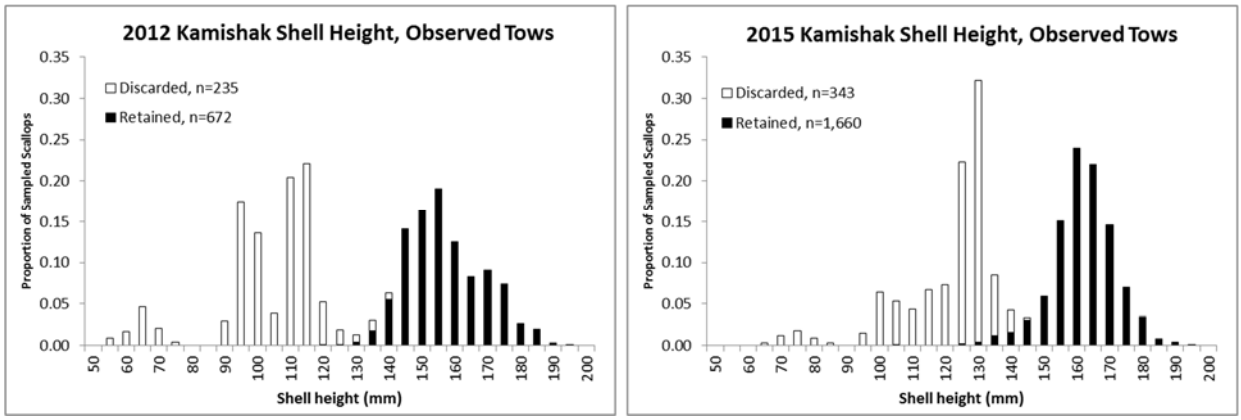


Figure 1-10 Shell height distribution in 2015 observed tows from Kamishak District, Cook Inlet Area

Westward Region

Kodiak Registration Area

Kodiak Northeast

Harvest levels for the weathervane scallop fishery in the Northeast District are set by reviewing fishery-dependent data collected from the onboard observer program. Data available consist of effort (dredge hrs), size frequency of retained and discarded scallops (discarded scallops are smaller size than retained scallops and indicate recruitment trends), harvest location and depth. ADF&G tracks catch per unit effort (CPUE) by vessel throughout the season.

Large portions of the Kodiak Registration Area that contain scallops are closed to scallop dredging. These closures were recommended by ADF&G and adopted by the Alaska Board of Fisheries over 30 years ago due to concerns about red king crab bycatch and gear conflicts.

The management program employs an overall guideline harvest level for the district, coupled with in-season tracking of CPUE against predetermined CPUE benchmarks in an effort to distribute effort and reduce localized depletion. The management program annually reviews recent fishery performance against historical trends in the fishery. Prior to 1999, weathervane scallop harvests in the Northeast District were not constrained by a GHL (Table 1-9). The 1999/00 season was the first in which a GHL was established. The 1999/00 season GHL was based on 75% of the average harvest from the 1997/98 and 1998/99 seasons, and further reduced by 5,000 lb as a precautionary approach; the initial GHR range was 0-75,000 lb.

The 2014/15 Northeast District GHL was 55,000 pounds. Scallop harvest totaled 55,659 pounds from three vessels (Table 1-9). The 2014/15 Northeast District fishery CPUE of 74 lbs meat/dredge hour was the highest on record since the 1993/14 season. Since the 1999/00 season, CPUE has remained relatively stable, generally ranging between 55 and 65 lbs meat/dredge hour (Figure 1-10). Tanner crab bycatch (16,322 crab) was below the 2014/15 bycatch cap of 256,466 Tanner crab.

Table 1-8 Kodiak Northeast District scallop fishery summary statistics, 1993/94 - 2015/16.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	10	NA	155,187	6,940	22	NA
1994/95	7	NA	35,207	1,773	20	NA
1995/96		closed				
1996/97	3	NA	11,430	581	20	175
1997/98	3	NA	95,858	2,604	37	874
1998/99	4	NA	120,010	2,749	44	4,000
1999/00	3	75,000	77,119	1,384	56	2,380
2000/01	4	80,000	79,965	1,101	73	2,382
2001/02	3	80,000	80,470	1,142	70	2,286
2002/03	2	80,000	80,000	1,350	59	3,497
2003/04	2	80,000	79,965	1,248	64	2,384
2004/05	2	80,000	80,105	1,227	65	5,522
2005/06	3	80,000	79,990	1,759	45	4,408
2006/07	2	90,000	75,150	1,168	64	2,842
2007/08	2	90,000	75,105	1,170	64	4,264
2008/09	3	90,000	74,863	1,363	55	2,328
2009/10	1	75,000	69,360	1,222	57	2,541
2010/11	3	65,000	64,475	1,015	64	1,804
2011/12	4	70,000	61,209	986	62	2,014
2012/13	4	60,000	62,496	1,322	47	2,086
2013/14	4	55,000	54,926	935	59	1,457
2014/15	3	55,000	55,659	752	74	1,327
2015/16[b]	3	55,000	55,609	1,234	45	NA

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

[b] *PRELIMINARY data subject to change.*

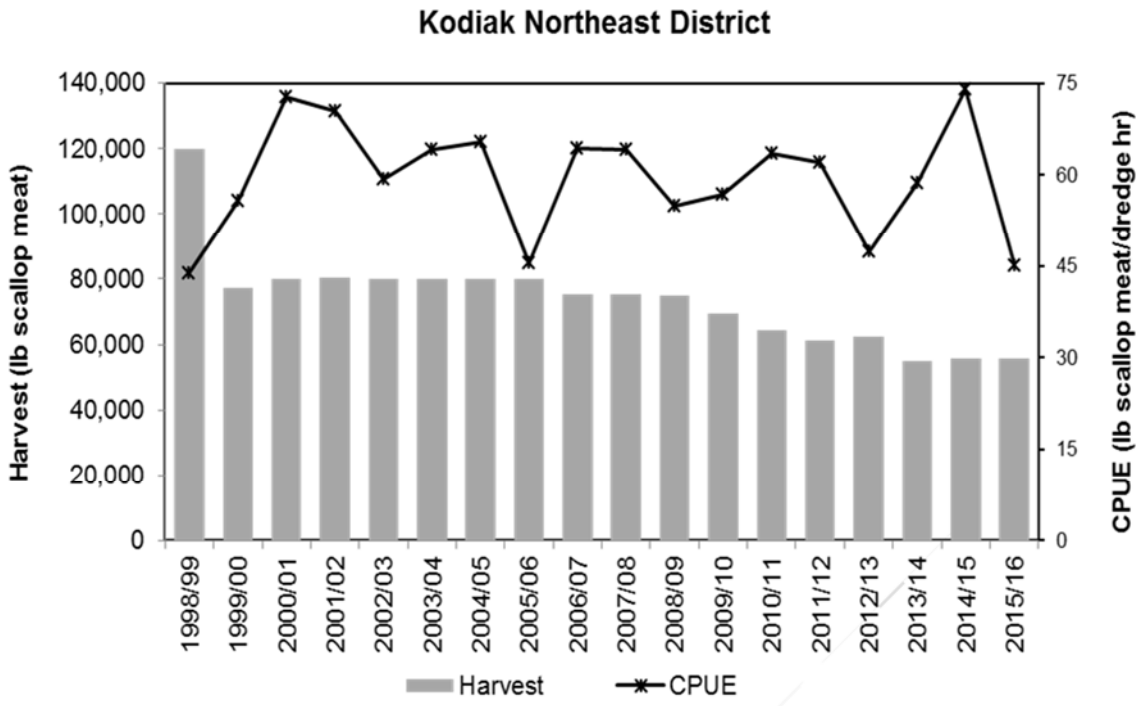


Figure 1-11 Kodiak Northeast District Harvest and CPUE, 1998/99 - 2015/16 seasons.

Scallop shell height (SH) histograms from the Northeast District observer data (Figure 1-12) show the little sign of recruitment. Size composition data shows scallops between 130 and 150 cm predominated the 2014 catch sample suggesting an aging population.

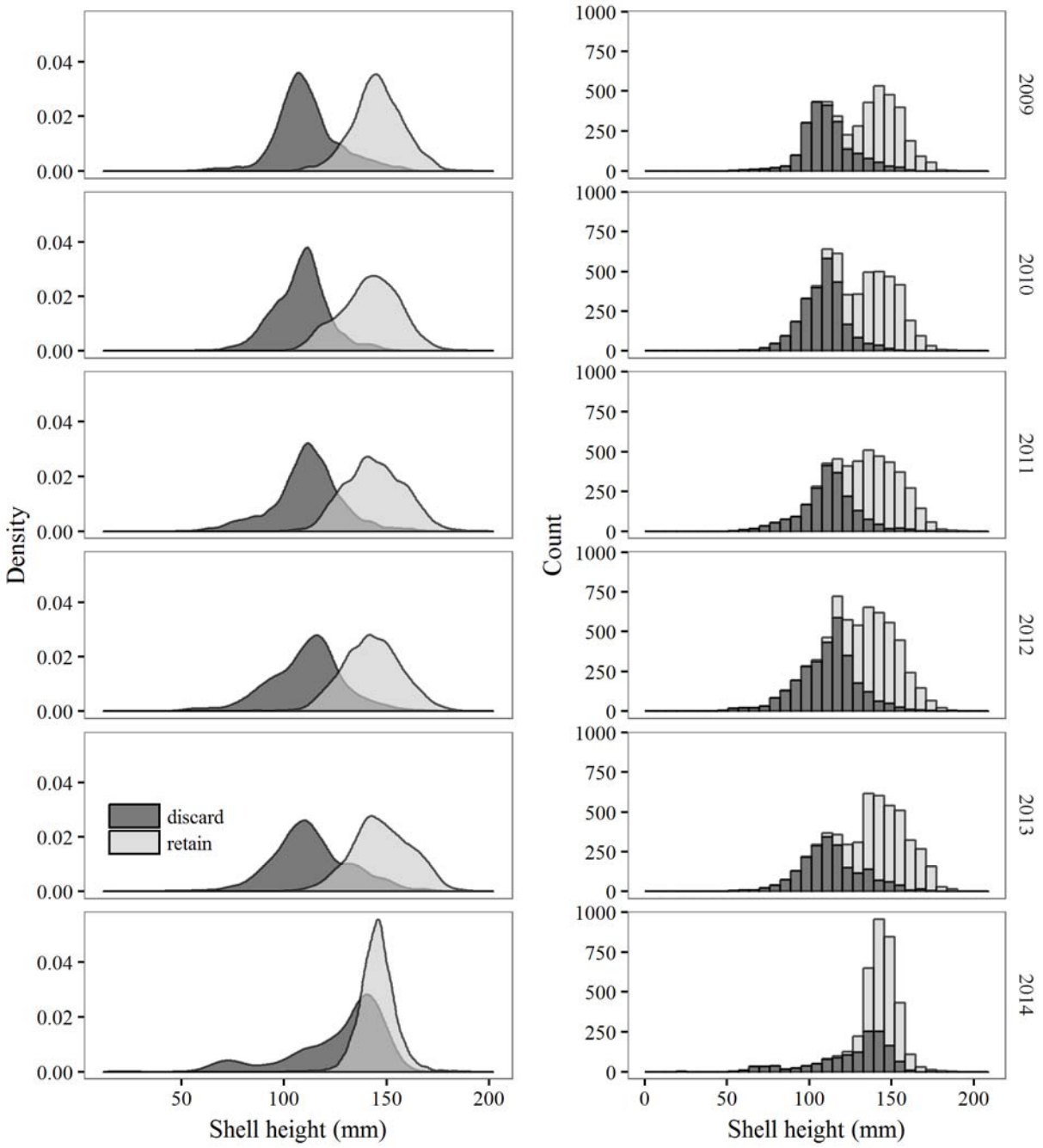


Figure 1-12 Estimated scallop shell height distributions from the 2009/10 - 2014/15 Kodiak Northeast District fishing seasons. The left pane shows the shell heights distribution for all of the hauls, the right pane shows the number of shells sampled at a given he

Beginning with the 2010/2011 season, staff recognized abundance in some Northeast District scallop beds may be declining. In response, staff established a MPS for statistical area 525630 (45 lb/hr) based upon the lowest CPUE observed in this statistical area (2005/06 season). At that time, a MPS was also established for scallop bed 2 (43 lb/hr), also based upon the lowest CPUE observed in that area (2005/06

season). The MPS for statistical area 525702 is 52 lb/hr and has been in place since 2003/04 which is the lowest CPUE observed in this statistical area (2002/03 season).

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

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

Shelikof

Similar the Northeast District, managers use fishery dependent data and information obtained through the observer program to establish Shelikof District GHLs and manage harvests in-season.

The 2014/15 Shelikof District GHL totaled 105,000 pounds and was apportioned 100,000 pounds east of 154° W. long. and 5,000 pounds west of 154° W. long The 2014/15 Shelikof District scallop harvest totaled 66,138 pounds with a cumulative CPUE of 41 lbs meat/dredge hour (Table 1-10). Despite lowering the GHL twice since the 2010/11 season, the 2014/15 cumulative CPUE is lowest since the district was managed for a GHL (Figure 1-13). CPUE was low from the outset of the season and managers closed the fishery after 60% of the GHL had been harvested. Estimated Tanner crab bycatch was 51,593 crab which exceeded the 42,144 Tanner crab cap. The high Tanner crab bycatch may have constrained traditional fishing practices and influenced fishing behavior, resulting in a conservative and less efficient fishing approach by vessel operators. Despite low CPUE, the Shelikof District scallop harvest continues to comprise a wide range of size classes (Figure 1-14). Scallops that first appeared in the 2010/11 fishery have continued to progress and contribute to the 2014/15 fishery.

Table 1-9 Kodiak Shelikof District scallop fishery summary statistics, 1993/94 - 2015/16.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	5	NA	105,017	2,491	42	NA
1994/95	11	NA	314,051	8,662	36	NA
1995/96		closed				
1996/97	3	NA	219,305	3,491	63	4,018
1997/98	4	NA	258,346	5,492	47	1,900
1998/99	8	NA	179,870	4,081	44	4,409
1999/00	6	180,000	187,963	4,304	44	5,907
2000/01	5	180,000	180,087	2,907	62	2,621
2001/02	4	180,000	177,112	3,398	52	4,880
2002/03	3	180,000	180,580	3,799	48	10,120
2003/04	2	180,000	180,011	3,258	55	8,209
2004/05	2	180,000	174,622	3,467	50	8,883
2005/06	2	160,000	159,941	2,280	70	4,767
2006/07	3	160,000	162,537	2,183	74	4,789
2007/08	3	170,000	169,968	2,937	58	7,685
2008/09	2	170,000	13,761	263	52	658
2009/10	3	170,000	169,877	3,496	49	7,132
2010/11	4	170,000	171,076	3,508	49	8,623
2011/12	4	135,000	136,491	2,437	56	2,618
2012/13	4	105,000	106,051	2,001	53	2,575
2013/14	4	105,000	106,099	2,469	43	1,162
2014/15	3	105,000	66,138	1,628	41	962
2015/16[b]	3	75,000	39,876	1,313	30	NA

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

[b] *PRELIMINARY data subject to change.*

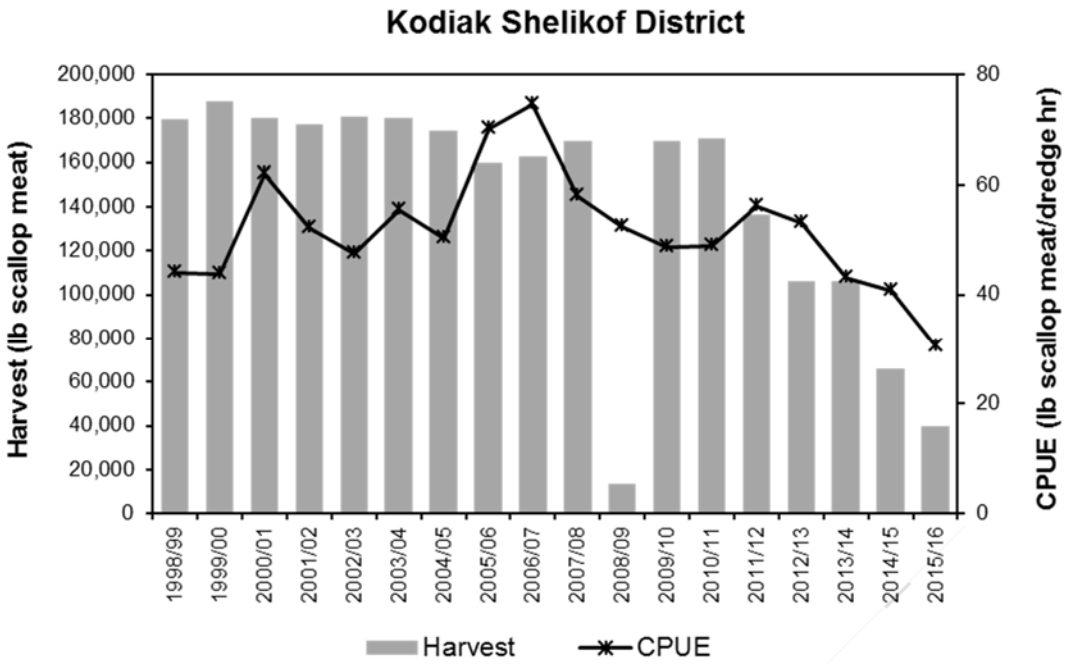


Figure 1-13. Kodiak Shelikof District Harvest and CPUE, 1998/99 - 2015/16 seasons.

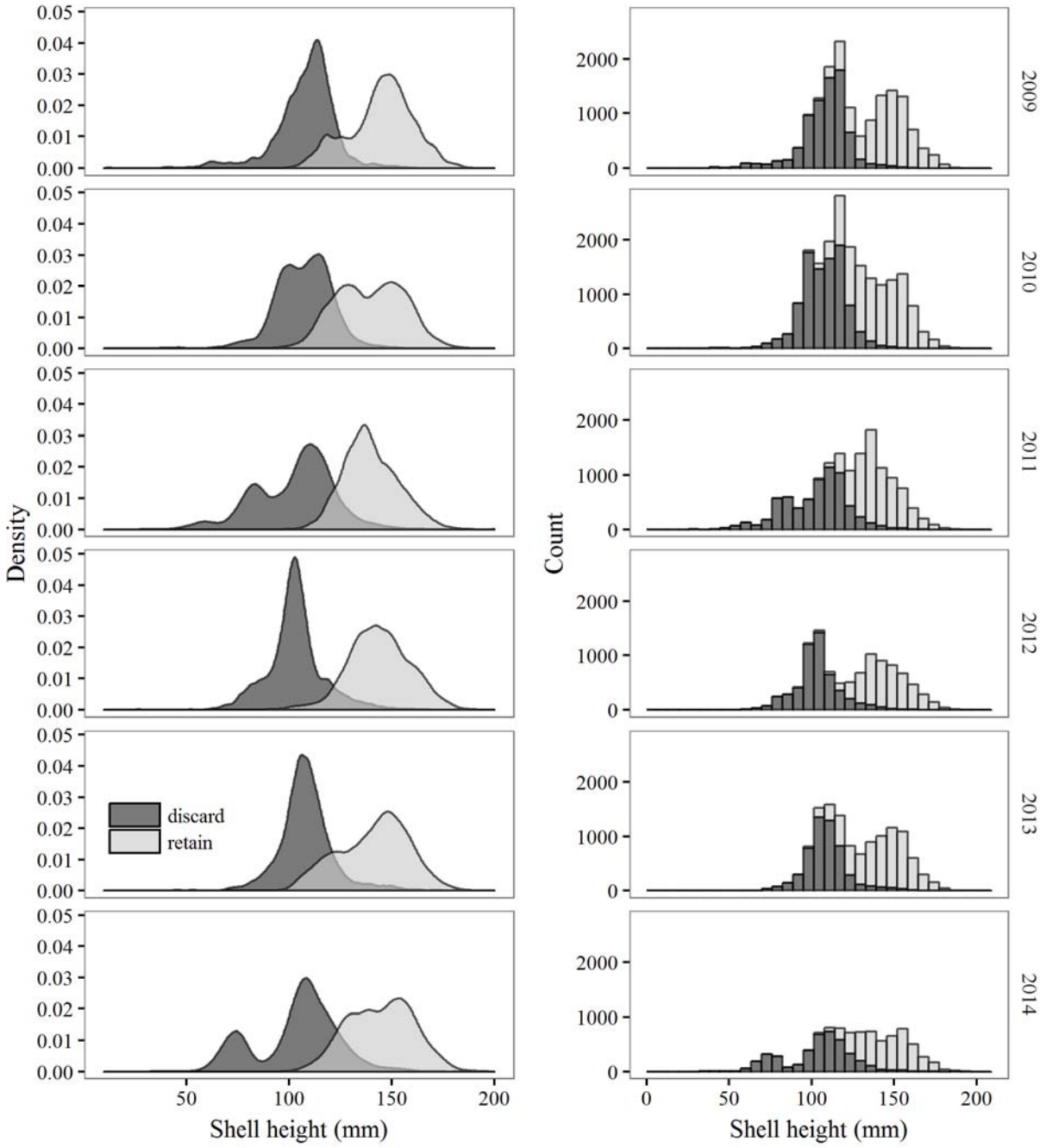


Figure 1-14. Estimated scallop shell height distributions from the 2009/10 - 2014/15 Kodiak Shelikof District fishing seasons. The left pane shows the shell heights distribution for all of the hauls, the right pane shows the number of shells sampled at a given heig

Kodiak Southwest

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

Participation in this area is allowed only by ADF&G commissioner's permit as specified in 5 AAC 38.420 Fishing Seasons for Scallops in Registration Area J. During the board meeting, managers recommended an initial 25,000 pound GHL for the Southwest District and encouraged participants to distribute effort to help delineate scallop beds.

The 2014/15 season was the sixth season since the BOF opened this area for exploratory fishing and the fifth season with effort. Two vessels harvested 24,973 pounds of shucked scallop meat (Table 1-10). Cumulative CPUE was 46 lbs meat/dredge hour which was the second highest since the area reopened. Distribution of effort has increasingly concentrated to the point where in 2014/15 the entire harvest was taken from a single delineated bed with in the area. Continued evaluation of future fishery performance will guide staff in determining if this level of consolidated harvest can be maintained. Measured shell height from retained and discarded scallops shows that large scallops with SH >140 mm comprised the bulk of the harvest, with few small scallops encountered (Figure 1-16). The 2014/15 Tanner crab bycatch totaled 17,952 crab which exceeded the bycatch limit of 12,000 Tanner crab. This overage was primarily due to a single event mid-way through the GHL where one vessel captured a significant number of juvenile Tanner crab in a single tow. The resulting daily bycatch estimate once expanded across unsampled tows for the day was approximately 9,000 crab. The vessel notified management staff immediately after the tow and moved away from the area. After consideration, staff concluded the tow in question was not representative of previous daily bycatch rates and not likely predictive of expected bycatch through the remainder of the GHL. For these reason staff allowed the fishery to continue with the understanding that should another spike occur or if daily bycatch rates increased above average levels the fishery would close.

Table 1-10 Kodiak Southwest District scallop fishery summary statistics, 2009/10 - 2015/16.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
2009/10	1	25,000	3,480	159	22	76
2010/11	0	25,000	0			
2011/12	1	25,000	25,110	455	55	364
2012/13	2	25,000	25,014	670	37	312
2013/14	2	25,000	20,340	526	39	301
2014/15	2	25,000	24,993	559	45	193
2015/16[b]	1	25,000	10,950	280	39	NA

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

[b] PRELIMINARY data subject to change.

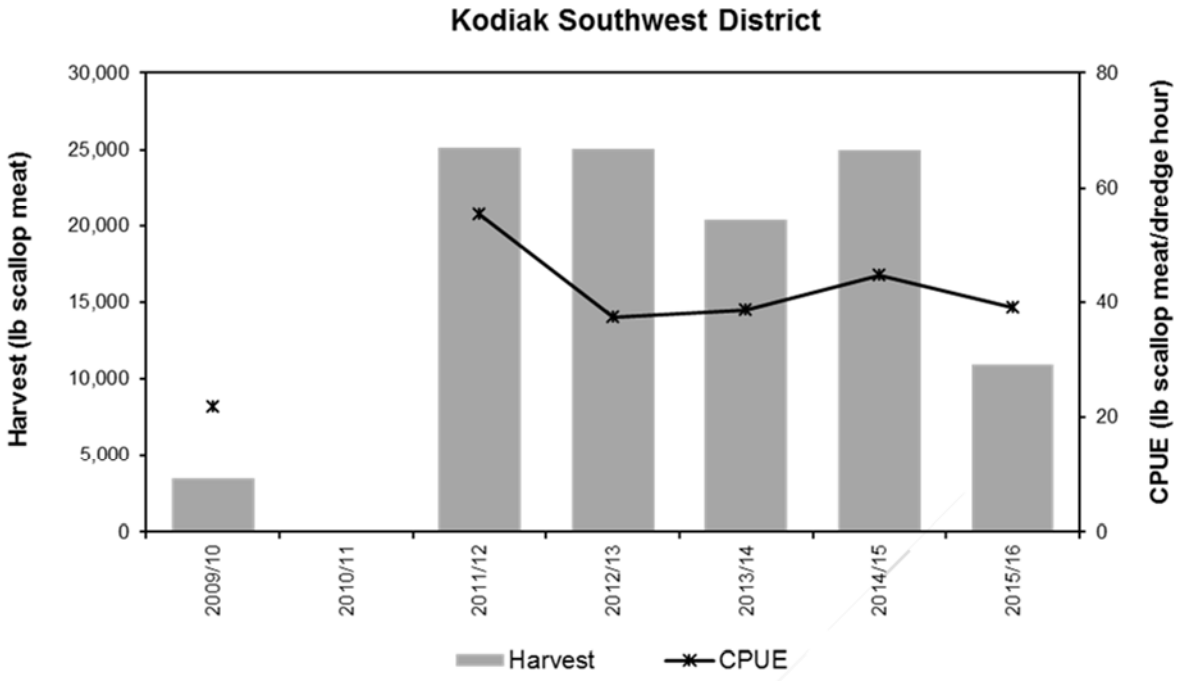


Figure 1-15 Kodiak Southwest District Harvest and CPUE, 2009/10 and 2011/12 - 2015/16 seasons.

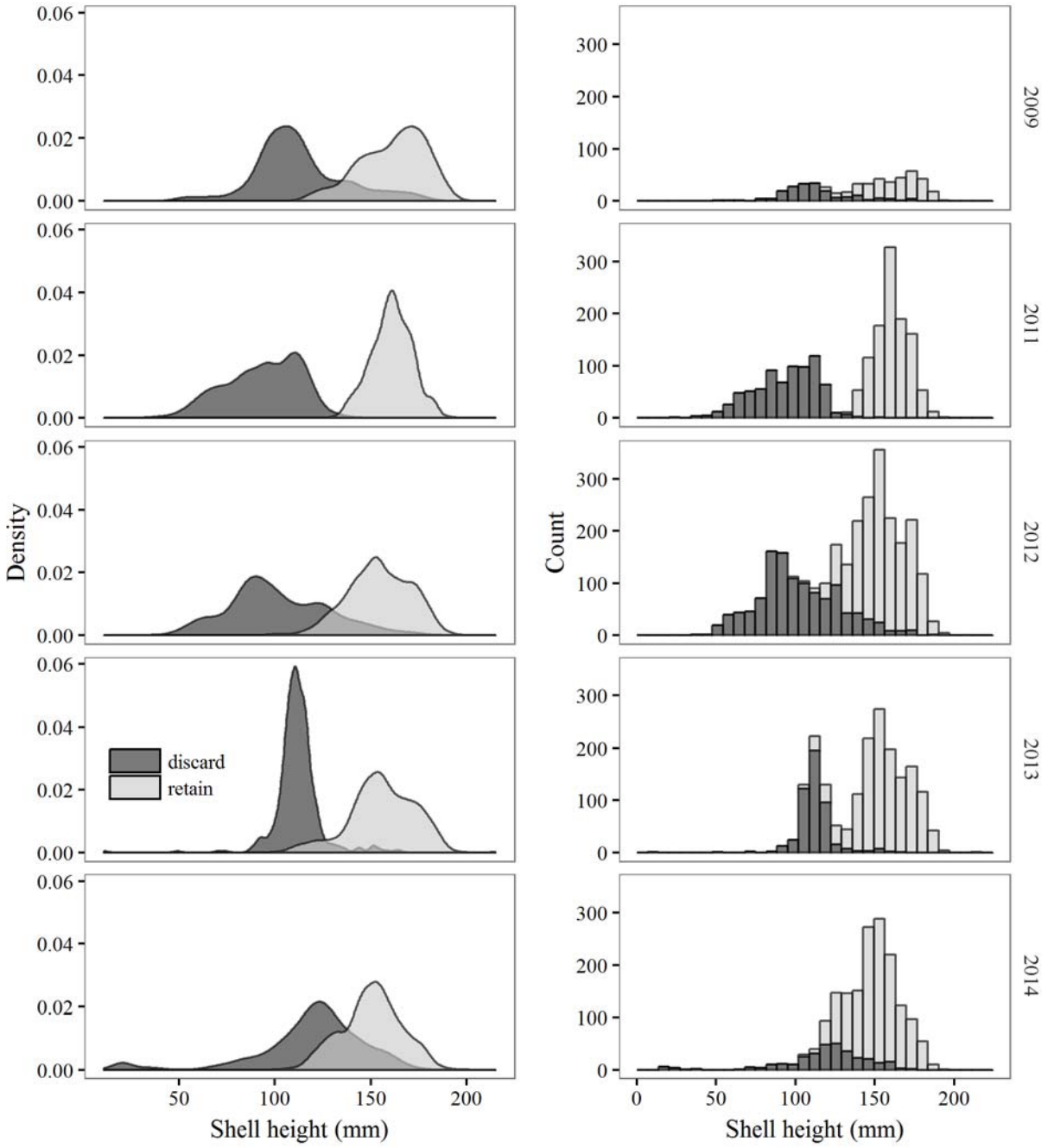


Figure 1-16 . Estimated shell height distributions from the exploratory 2009/10 and 2011/12 - 2014/15 Kodiak Southwest District scallop fisheries. The left pane shows the shell heights distribution for all of the hauls, the right pane shows the number of shells sampled at a given height.

Semidi Islands

Traditional scallop fishing areas of the Semidi Islands District are located in state waters that were closed to scallop dredging by the Alaska Board of Fisheries in 2000 (Figure 1-1). Offshore waters of the district remain open to fishing; marginal exploratory effort occurred during the 2013/14 season but no scallops were retained (Table 1-11).

Table 1-11 Kodiak Semidi Islands District scallop fishery summary statistics, 1993/94 - 1999/00 and 2013/14.

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

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

Alaska Peninsula Registration Area

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

Beginning in 2009/10, the Alaska Peninsula Area east of Unimak Bight was closed for a period of five years to allow stocks to recover (Table 1-13). Preceding the closure was a period of low effort (2003/04 to 2008/09) and another 2-year (2001/02-2002/03) closure period. Only 155 pounds of scallops have been harvested in the core Alaska Peninsula scallop beds since the 2001/02 season. The Alaska Peninsula Area between 160° W long. and 161° W long. reopened in 2014/15 with a conservative GHL of 7,500 pounds to assess if recruitment of younger scallops occurred in this area during the extended closure period. No effort occurred during 2014/15. Future harvest opportunity in the Alaska Peninsula Area east of Unimak Bight will be based on review of age composition and fishery performance data from future harvest.

Table 1-12 Alaska Peninsula scallop fishery summary statistics, 1993/94 – 2015/16

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	8	NA	112,152	1,847	61	NA
1994/95	7	NA	65,282	1,664	39	NA
1995/96		closed				
1996/97	2	200,000	12,560	327	38	136
1997/98	4	200,000	51,616	1,752	29	703
1998/99	4	200,000	63,290	1,612	39	794
1999/00	5	200,000	75,535	2,025	37	1,087
2000/01	3	33,000	7,660	320	24	83
2001/02		closed				
2002/03		closed				
2003/04		closed				
2004/05		closed				
2005/06	0	20,000	0			
2006/07	2	25,000	155	64	2	15
2007/08	0	10,000	0			
2008/09		10,000	2,460	151	16	75
2009/10		closed				
2010/11		closed				
2011/12		closed				
2012/13[b]	1	15,000	15,040	255	59	541
2013/14[b]	1	15,000	15,155	247	61	325
2014/15[b]	2	15,000	15,000	288	52	325
2015/16[b,c]	1	15,000	15,000	293	51	NA

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

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

[c] PRELIMINARY data subject to change.RELIMINARY data subject to change.

In March 2012, the BOF opened federal waters south of Unimak Island between Cape Pankof and Scotch Cap Light to scallop fishing under the authority of a commissioner permit. Unimak waters had been previously closed to scallop fishing since the 1975 in response to declining red king crab stocks. An

initial 15,000 pound GHL was established for the 2012/13 season and carried through the 2015/16 season. During the 2014/15 season two vessels harvested 15,000 pounds of scallops with a CPUE of 52 lbs/dredge hour (Table 1-13, Figure 1-17). Shell height data from the 2014/15 harvest indicate the stock has a broad range of age classes represented in the sampled catch (Figure 1-18). The 2014/15 Tanner crab bycatch totaled 13,914 crab, which was the highest since the fishery reopened in 2012/13 and exceeded the cap of 12,000 Tanner crab. Given the limited history of scallop fishing in this area, meaningful comparisons of fishery performance or stock status over time are unavailable.

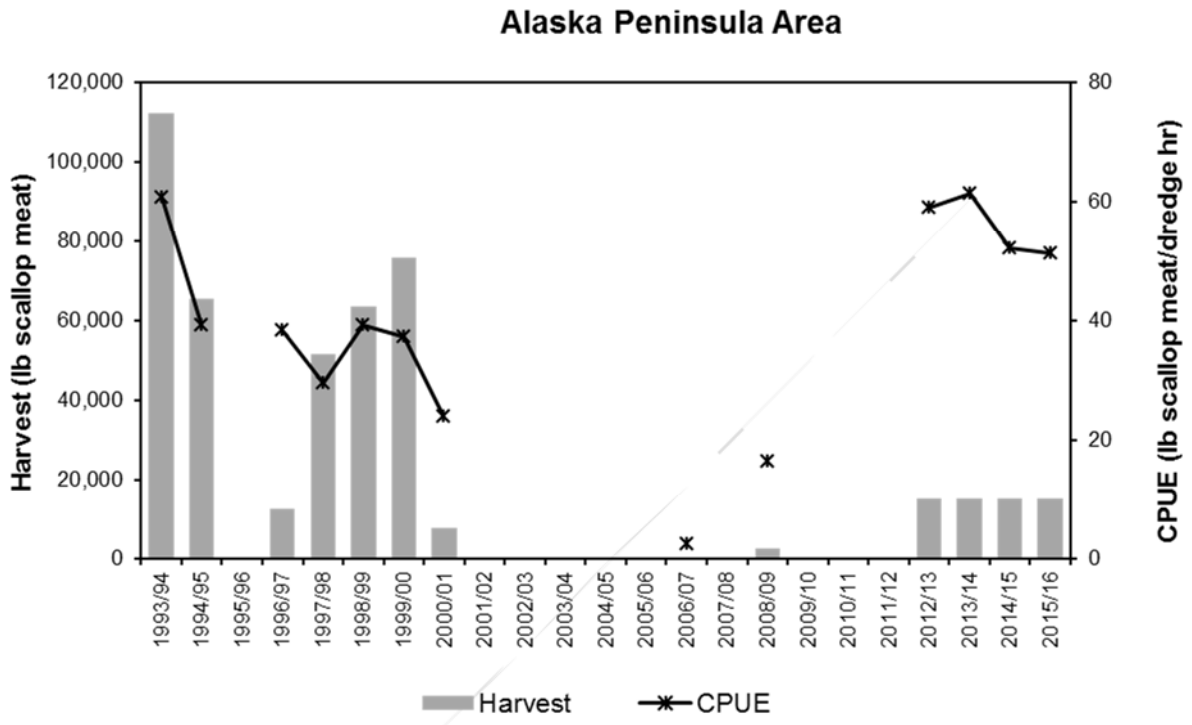


Figure 1-17 Alaska Peninsula harvest and CPUE, 1993/94 - 2015/2016 seasons.

With two observers aboard the vessel, each working a 12 hour shift, 77 hauls (31%) were sampled for scallop catch and crab bycatch. A subset of 39 of the 77 sampled hauls, or 51%, were additionally sampled for haul composition. The results of the sampling effort provided an estimated total retained scallop round weight of 205,950 lbs., with 29,382 round pounds estimated to have been discarded. Discards accounted for about 12.5% of the catch, with 3.4% intact at discard, and 9.1% having broken shells at discard. Shell height measurements of 1,342 retained scallops ranged from 125mm to 170mm, while shell heights of 887 discarded scallops ranged from 65mm to 130mm (Figure 1-18). Visual shell ageing indicates that there may be three fairly distinct age groups in the Unimak Bight area: one group that is 3 to 5 years old, a group that is 6 to 9 years old, and a third group that is 12 to 17 years old.

During the 2013/14 season one vessel harvested 15,155 pounds of scallops for a CPUE of 61 lb/hr (Table 1-13, Figure 1-17). Given the limited history of scallop fishing in this area, meaningful comparisons of fishery performance or stock status over time are unavailable.

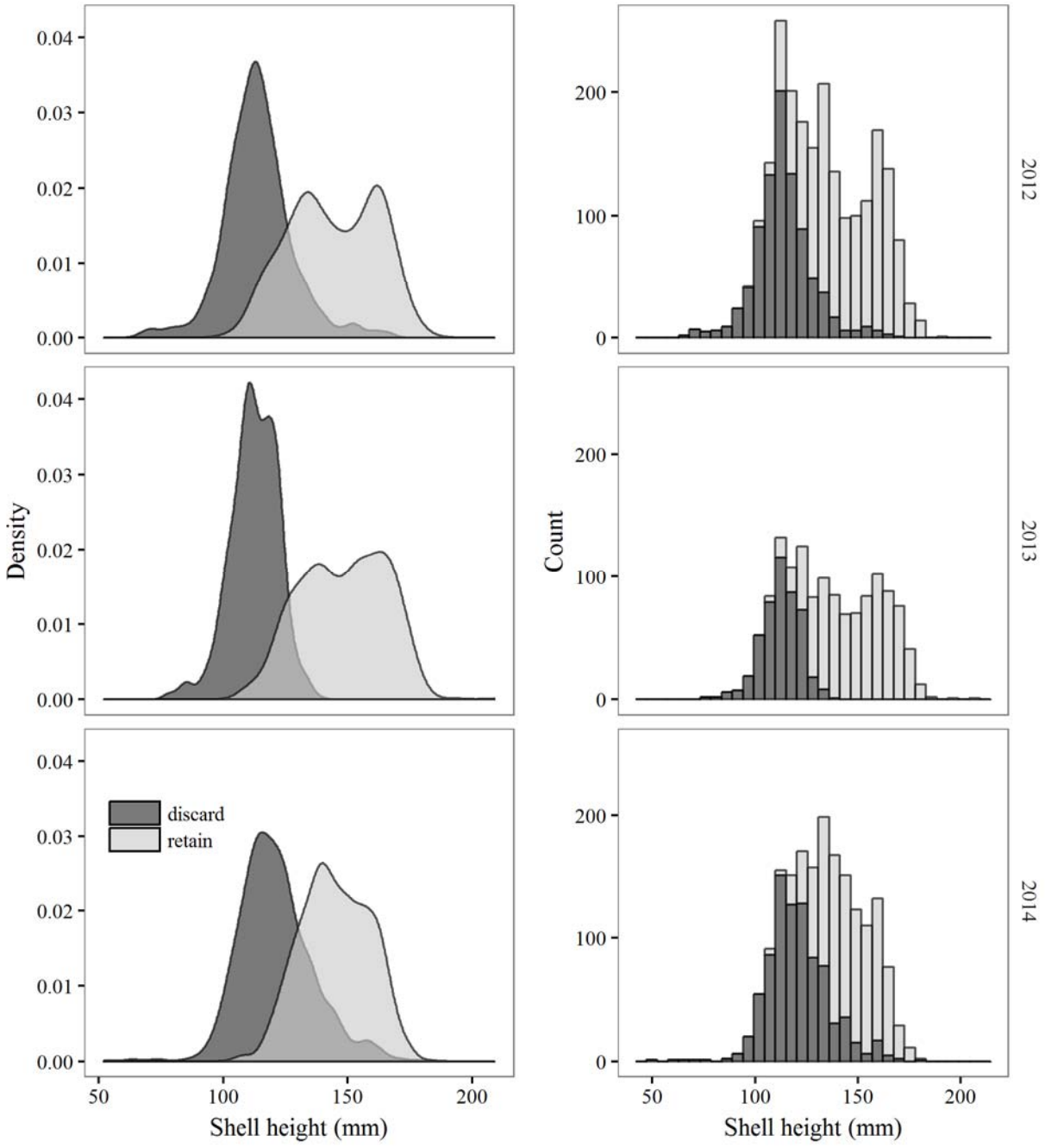


Figure 1-18 Estimated shell height distributions from the 2012/13 - 2014/15 Alaska Peninsula Unimak Bight District scallop fisheries. The left pane shows the shell heights distribution for all of the hauls, the right pane shows the number of shells sampled at a given height.

Bering Sea Registration Area

Prior to the 1996/97 season, weathervane scallop fisheries in the Bering Sea Registration Area (BSRA) were unconstrained by a GHL (Table 1-13). Once established, early GHL ranges were set with upper bounds of 400,000 to 600,000 lb of shucked scallop meat. Annual harvests never exceeded half the upper bound of the GHL range. Through the 1990s, the BSRA was often closed in-season due to reaching Tanner crab bycatch limits.

Table 1-13 Bering Sea Area scallop fishery summary statistics, 1993/94 - 2015/16.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	9	NA	284,414	5,764	49	NA
1994/95	8	NA	505,439	11,113	45	NA
1995/96		closed				
1996/97	1	600,000	150,295	2,313	65	296
1997/98	2	600,000	97,002	2,246	43	699
1998/99	4	400,000	96,795	2,319	42	2,330
1999/00	2	400,000	164,929	3,294	50	1,249
2000/01	3	200,000	205,520	3,355	61	1,789
2001/02	3	200,000	140,871	3,072	46	1,393
2002/03	2	105,000	92,240	2,038	45	1,008
2003/04	2	105,000	42,590	1,020	42	627
2004/05	1	105,000	10,050	275	37	103
2005/06	1	50,000	23,220	602	39	318
2006/07	1	50,000	48,246	1,138	42	995
2007/08	2	50,000	49,995	1,084	46	901
2008/09	1	50,000	49,995	962	52	1,067
2009/10	1	50,000	48,855	1,275	38	1,059
2010/11	2	50,000	50,100	971	52	1,336
2011/12	2	50,000	50,275	984	51	563
2012/13	1	50,000	50,045	943	53	716
2013/14	2	50,000	49,989	1,086	46	400
2014/15	2	50,000	12,445	525	24	144
2015/16[b]	1	7,500	7,500	307	24	NA

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

[b] *PRELIMINARY data subject to change.*

The upper bound of the BSRA weathervane scallop GHL was adjusted downward to 200,000 lb beginning with the 2000/01 season (Figure 1-19). That level was retained for the following season when CPUE dropped by approximately 25% and total harvest was 70% of the upper limit of the GHL range. In response to diminishing fishery performance during the 2000/01 and 2001/02 seasons, managers set a GHL range of zero to 105,000 lb of shucked scallop meat for the 2002/03 and 2003/04 seasons. The 2002/03 season performed reasonably well, but catch rates and overall catch continued to decrease in 2003/04.

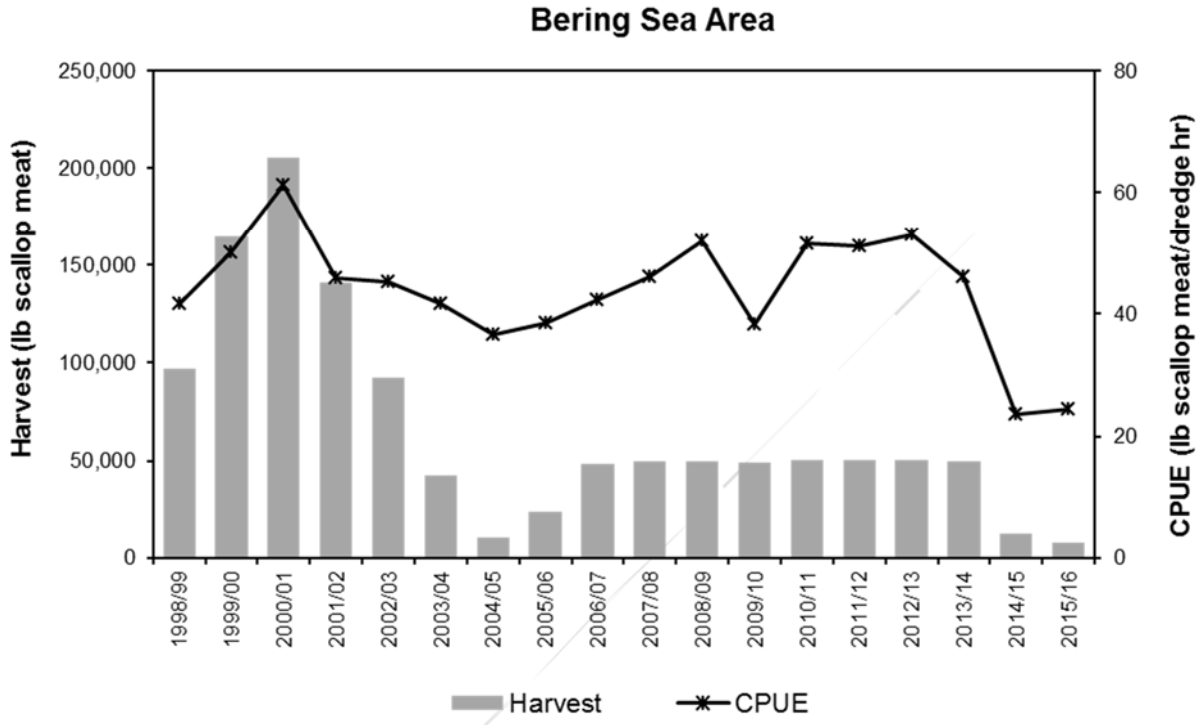


Figure 1-19. Bering Sea Scallop Harvest and CPUE, 1998/99 - 2015/16 seasons.

Experimental video survey tows conducted in 2003 showed scallops distributed over a wide, poorly defined area at low densities. BSRA scallop density was low enough to raise concerns for reproductive potential of the stock. The absence of smaller size scallops during the video survey is partially confounded by shell height data from the commercial fishery indicating periodic recruitment events (Figure 1-20).

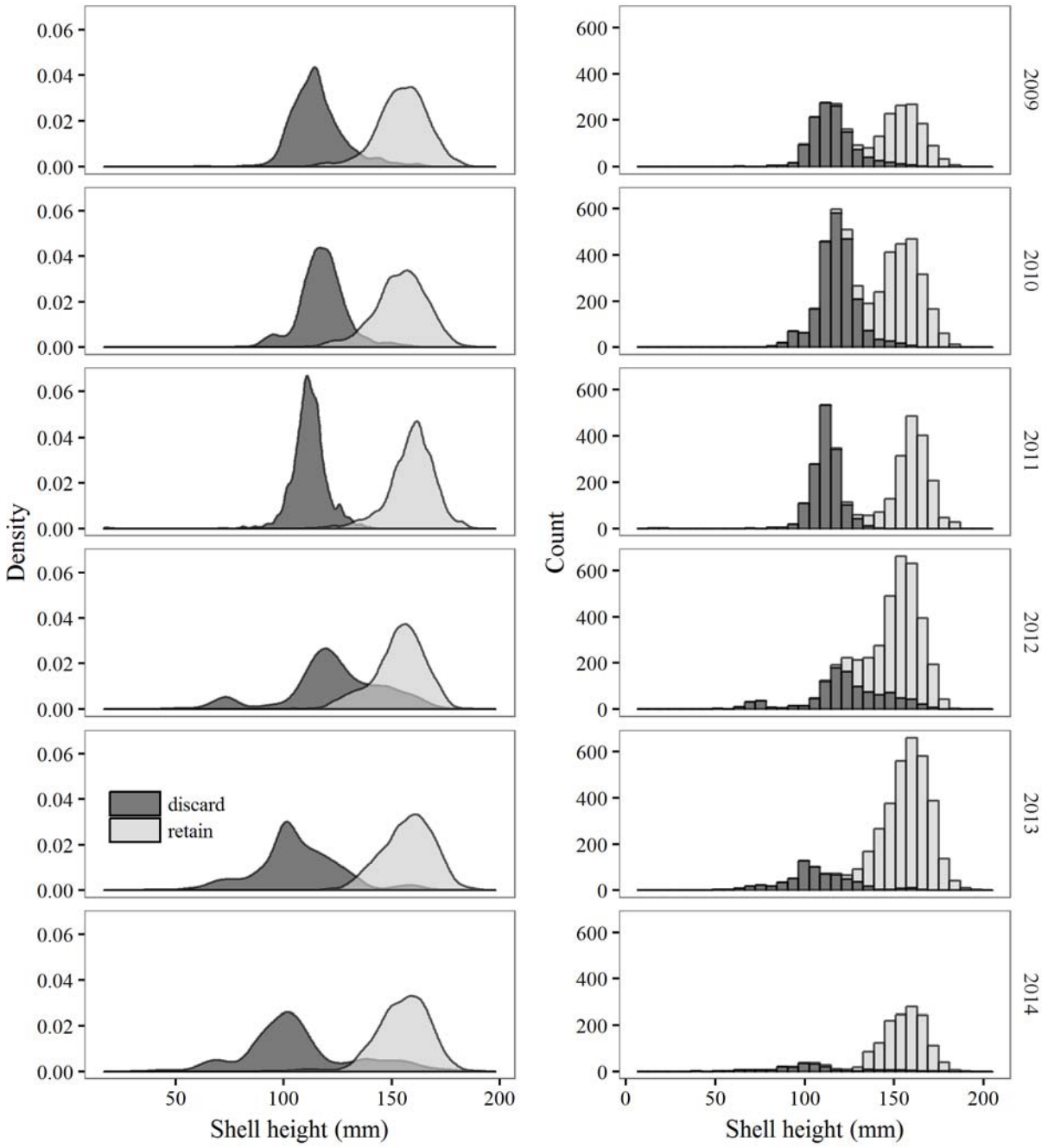


Figure 1-20. Estimated scallop shell height distributions from the 2009/10 - 2014/15 Bering Sea fishing seasons. The left pane shows the shell heights distribution for all of the hauls, the right pane shows the number of shells sampled at a given height.

In addition to the incorporation of video survey data into the stocks assessment process, the 2003/04 season was the first in which managers established a CPUE threshold below which the fishery would be closed. The threshold was set at the CPUE level of the 2002/03 season, or 44 lb/hr. The CPUE threshold

was not met during both the 2003/04 and 2004/05 seasons thereby triggering fishery closures before the GHL was achieved.

Prior to the 2005/06 season, the upper bound of the GHL range was further reduced to 50,000 lb. Overall, since the mid-2000s, fishery performance has improved. Season average CPUE levels are above the threshold, the upper bound of the GHL range, which has been 50,000 lb since the 2004/05 season, is regularly met, and scallop shell-height data shows moderate recruitment (Figure 1-20).

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

For the 2014/15 season, a GHL of 50,000 lb shucked scallop meat was established for the BSRA. Two vessels participated in the fishery and completed 330 tows (307 dredge hours), harvested 12,445 lb shucked scallop meat with and overall fishery CPUE of 24 lb/hr (Table 1-13). Observers measured shell height of 1,554 retained and discarded scallops; retained scallops were between 95 mm and 188 mm shell height (Figure 1-20). Observers sampled 68 (20.6%) of the 330 tows. From these data, using a 20% discard mortality rate estimate, an estimated 144 lb of scallop meats were lost to discard mortality, or 1.2% of the total meat weight retained. Estimated bycatch during the season was 25,910 Tanner crab (bycatch capped at 260,000 Tanner crab), 10,328 snow crab (bycatch capped at 300,000 snow crab), and 23 king crab (bycatch capped at 500 king crab) (Table 1-18).

The two participating vessels quit fishing voluntarily due to low CPUE and signs of high natural mortality throughout the scallop bed. Fishermen and observers both reported high numbers of scallops in which the scallop meat slid off the shell or ripped in half when shucked. The current 50,000 pound GHR upper bound appears to be unsustainable under prevailing conditions in the BSRA.

Dutch Harbor Registration Area

The first landings of weathervane scallops from the Dutch Harbor Registration Area (DHRA) occurred in 1982; however, GHL ranges were not established until 1993. The initial DHRA GHL range was zero to 170,000 lb of shucked scallop meat and was lowered to a range of zero to 110,000 lb of shucked scallop meat for the 1998/99 and 1999/00 seasons (Table 1-14; however, the DHRA scallop fishery failed to meet preseason performance expectations, catch rates were often less than half that observed on other more productive scallop beds, and annual harvests consistently fell short of even half of the upper bound of the GHL range.

Table 1-14 Dutch Harbor Area scallop fishery summary statistics, 1993/94 - 2015/16.

Season	Number vessels	GHL (lb meat)	Catch (lb meat)	Dredge hours[a]	CPUE (lb meat per dredge hr)	Discard Mortality (lb meat)[a]
1993/94	2	170,000	38,731	838	46	NA
1994/95	3	170,000	1,931	81	24	NA
1995/96	1	170,000	26,950	1,047	26	NA
1996/97	0	170,000	0			
1997/98	1	170,000	5,790	171	34	402
1998/99	4	110,000	46,432	1,025	45	636
1999/00	1	110,000	6,465	273	24	93
2000/01		closed				
2001/02		closed				
2002/03	1	10,000	6,000	184	33	94
2003/04		closed				
2004/05		closed				
2005/06		closed				
2006/07		closed				
2007/08		closed				
2008/09	1	10,000	10,040	225	45	706
2009/10	1	10,000	6,080	104	59	45
2010/11	1	10,000	5,640	83	68	70
2011/12	1	10,000	5,570	77	73	56
2012/13	1	5,000	5,100	64	79	59
2013/14	1	5,000	5,225	56	94	96
2014/15	1	5,000	5,160	74	71	85
2015/16[b]	1	10,000	5,040	152	33	NA

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

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

The DHRA was reopened to commercial fishing for weathervane scallops during the 2008/09 season with a GHL range of zero to 10,000 lb of shucked scallop meat, the same as that applied in setting the 2002/03 GHL. Fishery performance improved during the 2008/09 season (Figure 1-21: the upper limit of the GHL range was met, catch per unit of effort was among the highest on record, catches showed reasonable

spatial and temporal distribution, and size-frequency data indicated potential for future scallop recruitment.

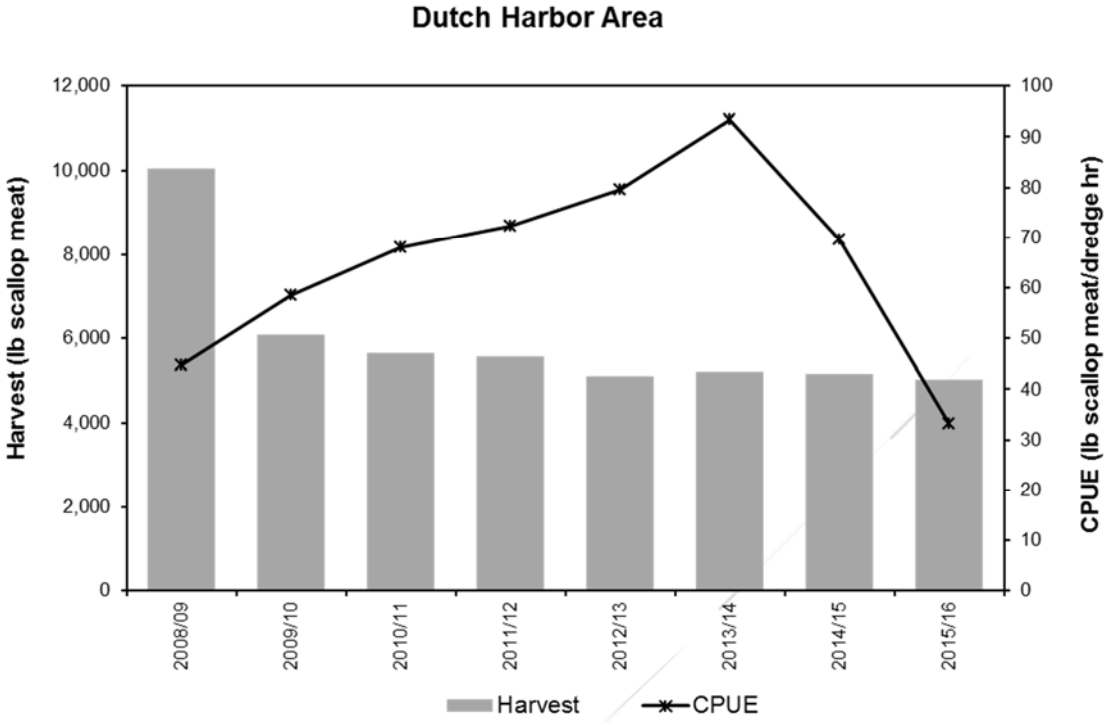


Figure 1-21. Dutch Harbor Area Scallop Harvest and CPUE, 2008/09 - 2015/16 seasons.

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

Due to the poor fishery performance in the Pacific Ocean, ADF&G implemented a 3-yr closure on the Pacific Ocean side. For the 2012/13 to 2014/15 seasons, the DHRA GHL for the Bering Sea side was 5,000 lb of shucked scallop meats. One vessel participated each season. The 2014/15 harvest was 5,160 pounds of shucked scallop meats with a CPUE of 71 lb/hr. All harvest from 2012/13 to 2014/15 came from the same bed outside Inanudak Bay. (Table 1-15). The onboard observer sampled 13

(22.8%) out of 57 hauls during the 2014/15 season. From these data, using a 20% discard mortality rate estimate, an estimated 85 lb of scallop meats were lost to discard mortality, or 1.6% of the total meat weight retained. Estimates of bycatch during the season were 1070 Tanner crab (bycatch capped at 5,000 Tanner crab).

Bering Sea – Inanudak Bay

The onboard observer measured 120 retained and 108 discarded scallop shells from the 2013/14 season. Retained scallops were 135 to 184 mm shell height. Average shell height of retained and discarded scallops was 161 mm and 127 mm, respectively (Figure 1-22).

Pacific Ocean

Closed for the 2013/14 season.

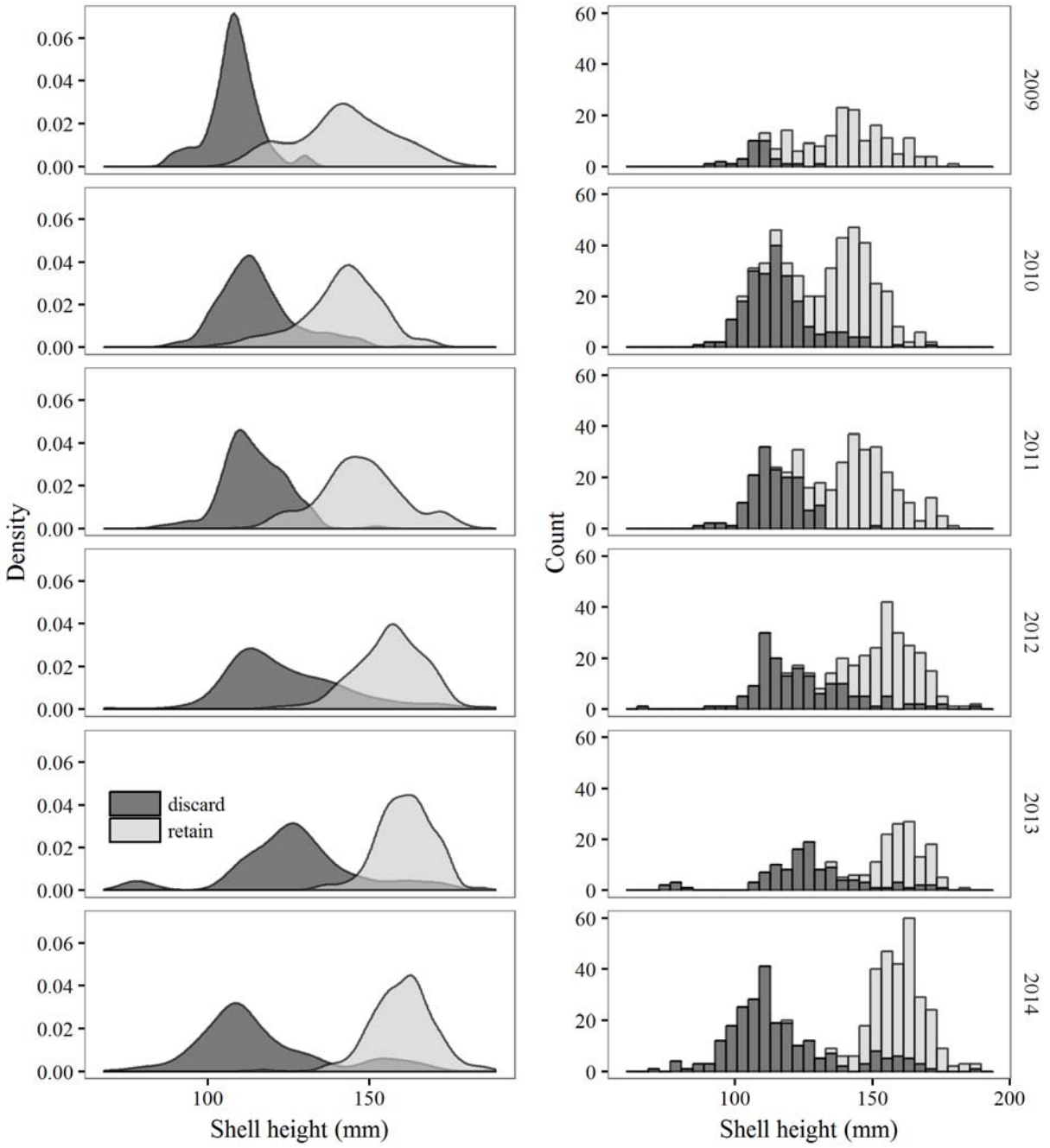


Figure 1-22 Estimated scallop shell height distributions from the 2009/10 - 2014/15 Dutch Harbor Area, Bering Sea side, fishing seasons. The left pane shows the shell heights distribution for all of the hauls, the right pane shows the number of shells sampled at a given height.

Adak Registration Area

Scallops were first harvested from the Adak Registration Area (ARA) in 1979 with subsequent fishing periods in 1992 and 1995; all harvest information from the ARA is confidential due to limited participation in the fishery. Bathymetry of the Aleutian Islands, along with a narrow continental shelf

edge, provides limited scallop habitat; however, a major scallop bed was known to occur on Petrel Bank, an area of important red king crab habitat. To protect red king crab habitat on Petrel Bank, and reduce red king crab bycatch mortality, waters between 51° 30′ N lat and 54° 30′ N lat, and between 179° W long and 179° E long were closed to commercial scallop fishing in 1991.

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

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 1-15).

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 1-15 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 Distict		
Combined North/South Bed	47	2003/04
Bristol Bay-Bering Sea	43	2004/05 - 2009/10[a]

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

Annual Catch Limits

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

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

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

Accountability measures were established such that the sum of the annual GHLs for each scallop management area be established by the State of Alaska at a level sufficiently below the ACL so that the sum of the estimated discard mortality in directed scallop and groundfish fisheries as well as the directed

scallop fishery removals does not exceed the ACL. Anytime an ACL is exceeded the overage will be accounted for through a downward adjustment to the GHL during the fishing season following the overage.

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

ACL recommendation for the 2016/17 Scallop fishing season

The SPT recommends that the annual catch limit (ACL) for the 2016/17 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 2017 SAFE report for the 2015/16 fishing year to determine if this ACL has been exceeded.

Catch in relation to ACLs

A summary of the 2014/15 season total catch in relation to the area-specific GHLs (retained catch), discards by area, and average CPUE are in Table 2-2. Total catch is compared against the ACL which is applied statewide. Preliminary retained catch from the 2015/16 fishery is provided in Table 1-1 but discard estimates are not yet available for comparison. This information will be provided in the 2017 SAFE report. Final catch in relation to the ACL for 2015/16 will be provided in the 2017 Scallop SAFE report.

Crab Bycatch Limits

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

In the Kodiak, Alaska Peninsula, and Dutch Harbor Registration Areas, the CBLs are set at 0.5% or 1.0% of the total crab stock abundance estimate based on the most recent survey data. Statewide CBLs by region are shown in Table 1-16. 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 1-16 Statewide crab bycatch limits in percentage of crab abundance estimates (where available) or number of crabs.

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

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

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

CBLs in the Bering Sea (registration Area Q) have evolved from fixed numbers in 1993 to a three tier approach used in the current fishery. In 1993, Bering Sea CBLs were set by ADF&G to allow the fleet adequate opportunity to explore and harvest scallop stocks while protecting the crab resource. CBLs were established at 260,000 *Chionoecetes spp*. and 17,000 red king crabs. In 1995, ADF&G recommended that CBLs be established at 0.003176 percent of the best available estimate of C. opilio (snow crab) and

0.13542 percent of the best available estimate of Tanner crab abundance in Registration Area Q. That equated to about 300,000 snow and 260,000 Tanner crabs based on 1994 crab abundance estimates in Registration area Q. In Amendment 1 of the federal scallop FMP, the NPFMC approved the CBLs established by ADF&G. The NPFMC also recommended that king crab bycatch limits be set within a range of 500 to 3,000 annually. Beginning with the 1996/97 fishing season ADF&G took a conservative approach and set the red king crab limit in Registration Area Q at 500 red king crabs annually.

From the 1996/97 through 1998/99 fishing seasons the CBL for *Chionoecetes spp*. in the Bering Sea was established annually by applying the percentages established for snow and Tanner crab limits in Amendment 1 of the FMP. In 1998, consistent with the Tanner crab rebuilding plan in the Bering Sea, crab bycatch limits were modified.

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

Bycatch of snow crabs, Tanner crabs, and red king crabs by scallop fisheries are shown in Table 1-17. 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 1-23 for 2013/14 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 1-17 Bycatch of King crabs by Area/District in the 2014/15 Alaska weathervane scallop fishery.

Area/District	King crab bycatch cap	Est number crab	Est weight (lb)[a]
Yakutat District	NE	0	0
Yakutat District 16	NE	0	0
Prince William Sound	NA (Closed)		
Cook Inlet	NA (Closed)		
Kodiak Northeast District	25	0	0
Kodiak Shelikof District	50	5	
Kodiak Southwest District	50	9	
Kodiak Semidi Islands District	NE	0	0
Alaska Peninsula Unimak Bight District	50	0	0
Dutch Harbor	10	0	0
Bering Sea	500	23	
Statewide total			

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.

Table 1-18 Bycatch of Chionoecetes crabs by Area/District in the 2014/15 Alaska weathervane scallop fishery.

Area/District	Chionoecetes bycatch cap	Est number crab	Est weight (lb)[a]
Yakutat District	NE	2,119	14
Yakutat District 16	NE	306	17
Prince William Sound	NA (Closed)		
Cook Inlet	NA (Closed)		
Kodiak Northeast District	256,466	19,368	1,835
Kodiak Shelikof District	42,144	22,783	4,226
Kodiak Southwest District	12,000	12,521	885
Kodiak Semidi Islands District	NE	0	0
Alaska Peninsula Unimak Bight District	12,000	14,161	1,674
Dutch Harbor	5,000	1,070	186
Bering Sea *C. bairdi*	260,000	25,910	23,752
Bering Sea *C. opilio* and hybrids	300,000	10,328	10,413
Statewide total	887,610	108,566	42,972

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.

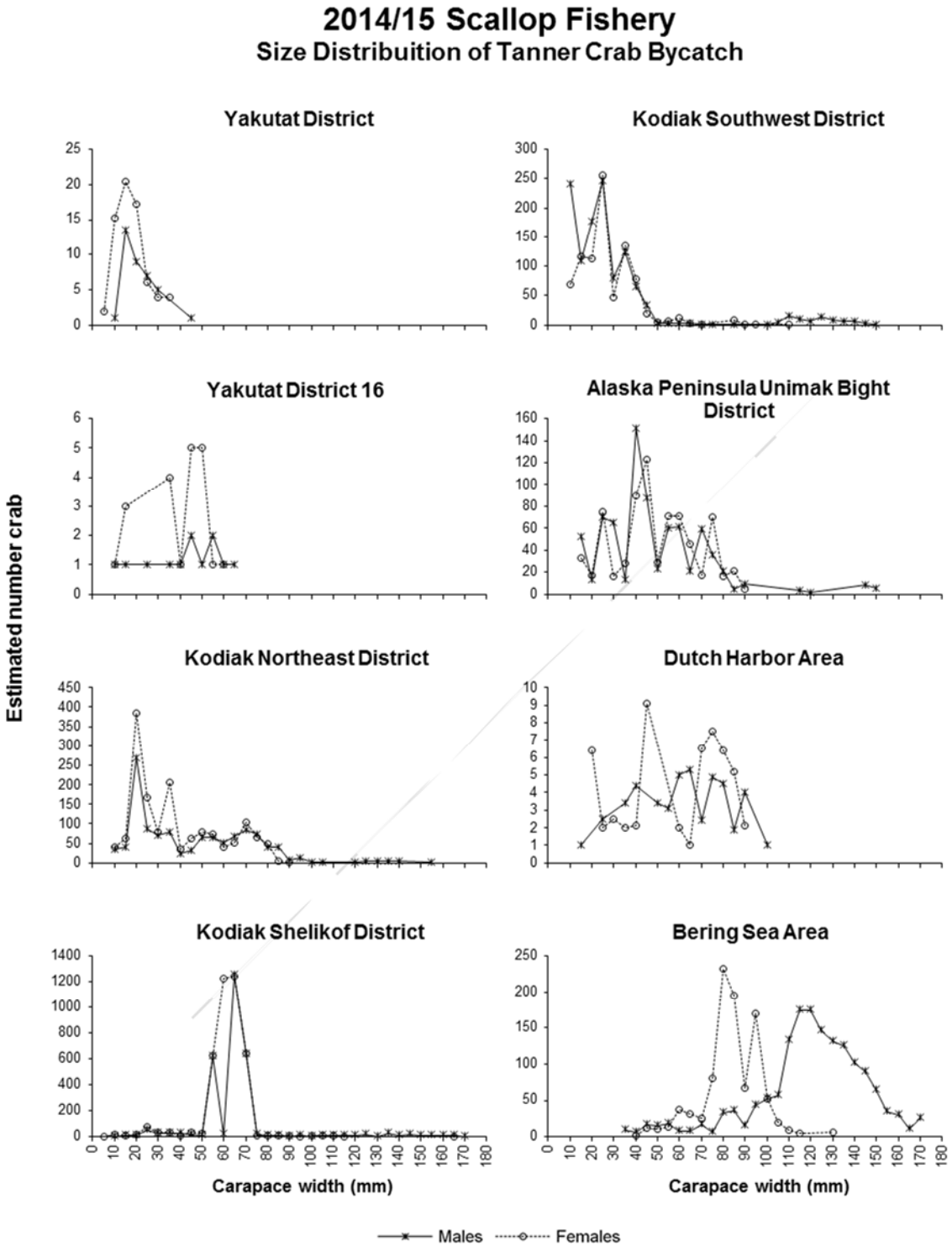


Figure 1-23 Tanner crab carapace width distributions by management unit from catch sampling during the 2014/15 scallop fishery.

2 Weathervane Scallop Stock Assessment

Weathervane scallop stock assessment data are gathered via the scallop observer program and fishery independent surveys conducted by ADF&G. The scallop observer program data are the primary information source for setting GHLs in in areas outside of PWS and Cook Inlet. These data sets consist of time series of scallop harvest and fishing effort, including CPUE, fishing locations, size and age composition of the catch, discard of scallops, and crab bycatch. Spatially explicit catch and effort data that cannot be presented in the SAFE report due to confidentiality constraints are examined by ADF&G staff each year when GHLs are set. As of 2015, fishery independent surveys have been only been conducted and used to set GHLs for Kayak Island (Area E) and Cook Inlet (Area H) (Figure 2-1). Beginning in 2016 a survey is planned that will encompass portions of the Southeast and Westward regions as well.

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

Fishery Independent Survey Expansion

The protocols for the fishery independent dredge survey have been updated and the geographic extent will be expanded. Only beds in the Kamishak Bay and Kayak Island areas have been surveyed to date. Starting in April 2016 the survey will expand into portions of the Yakutat and Shelikof areas. Specific details and the survey operational plan can be found in Appendix 5.

Observer Program Updates

Alaska regulations allow ADF&G to require observers on all trips of all vessels fishing scallops in both state and federal waters. The purpose of the onboard scallop observer program is to collect biological and fishery data and monitor bycatch. Observers are briefed by ADF&G staff on sampling protocols prior to deployment and debriefed when a trip concludes.

Scallop observers are responsible for sampling dredge hauls and recording data on scallop catch, discards, general catch composition and crab and halibut bycatch. Detailed logbooks completed by vessel operators are reviewed by observers and submitted to ADF&G. Observers send summary reports to ADF&G fishery managers three times per week or more frequently during the season by radio or email. Data are entered, stored, and maintained by ADF&G staff in Kodiak. Observer data are used for in-season management and in setting seasonal GHLs (see below). Scallop observer data are released to the public in reports prepared by ADF&G (e.g., Rosenkranz and Burt, 2009).

Onboard observer coverage is funded by industry through direct payments to independent contracting agents. Scallop observers are trained by ADF&G staff in Kodiak. Observer training and deployment manuals are prepared by ADF&G staff.

Observer cost for vessels limited to a single 6-ft dredge in federal waters was addressed in Amendment 10, section 6.8 of the Scallop FMP. The Council determined that given existing observer requirements and their associated costs, the single 6-ft dredge restriction created a disproportionate economic hardship when fishing in federal waters (70 FR 39965). Amendment 10 allows two vessels to fish with two 10-ft dredges to capture a larger share of the total catch, thus allowing them to offset observer costs and perhaps enhance their economic viability.

Two changes are proposed for observer sampling for the 2016 season. The first change is a correction to the sampling protocols for shell age and length collection. Bias has been observed in the sampling of scallop shells, whereby larger shells are retained at a greater rate than they are found in the commercial fishery catch. To alleviate this bias more shells will be retained and their collection will be explicitly random. The increase in number of shells retained is to accommodate for shells that cannot be accurate aged (e.g., chipped edge). Previously there have been few, if any, smaller discarded shells collected. These will be retained using the same methods and at the same rates as larger discarded shells for ageing. Fewer discarded shells have been measured for shell height than retained shells. These will now be sampled at the same rate.

The second proposed change to observer sampling protocols is the establishment of "special sites". At these sites 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 which 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 substantial exploitation rates (number of scallops) that may not be reflected in the amount of meat retained. Ten percent of observer sampled dredges will be special sites. For each trip a random number between 1 and 10 will be drawn to determine which haul to sample as a special site. Every 10^{th} haul thereafter will be sampled as a special site.

Current Stock Status by Region

Southeast Region

Stock assessment and management of this fishery relies solely on fishery dependent (observer) data. Therefore, in-season management is precautionary given the lack of biomass information. Separate GHLs are assigned for Yakutat and District 16, both of which fall into Scallop Registration Area D. Southeast shellfish management staff annually reviews the most recent scallop observer data. Data considered when adjusting GHLs include: total harvest and CPUE for the entire registration area; total harvest and CPUE by scallop bed; daily CPUE versus cumulative catch in each bed where effort occurred; and shell height histograms for Area D and District 16. Management staff also set CPUE benchmarks for some areas prior to the season, and if CPUE falls below the benchmark level during fishing, management staff meets to review in-season observer data and the fishery may be closed or allowed to continue. The GHLs are set prior to each fishing season based on these data. There are no crab bycatch limits in Scallop Registration Area D. The fishery is managed by Quinn Smith (Douglas office).

Central Region

Stock assessment and management of Central Region scallop fisheries are based on data from fishery independent surveys. ADF&G conducts biennial dredge surveys for weathervane scallops in the Kamishak District of the Cook Inlet Management Area and near Kayak Island in the Prince William Sound Management Area (Figure 2-1 and Figure 2-2). Data from these surveys are used to set GHLs for two scallop beds at each location. In the Kamishak District fishery vessels are limited to a single 6 ft dredge, and the onboard observer requirement has been waived, but ADF&G staff is regularly deployed as observers when fishing occurs to track fishery performance and provide some in-season management capability. The Kayak Island abundance estimates have been adjusted using a dredge efficiency of 0.83 since 2006, which is based upon the relative efficiency from a small amount of dredge/video comparison work conducted in 2004.

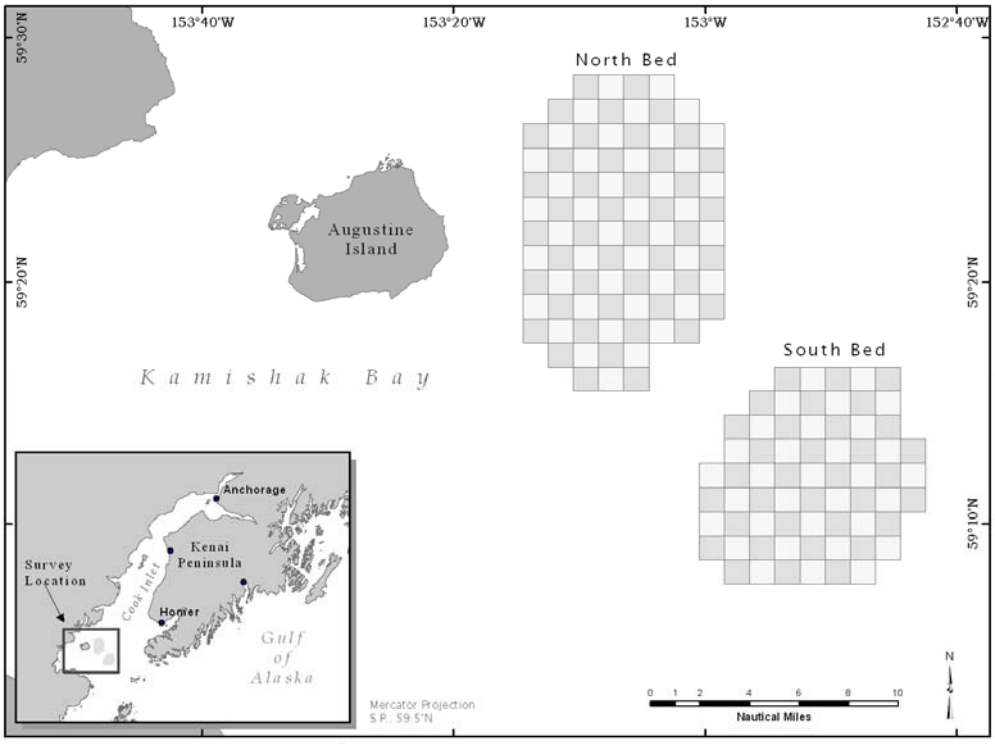


Figure 2-1 Location of surveyed scallop beds at Kamishak Bay and checkerboard sampling grid utilized since 2007.

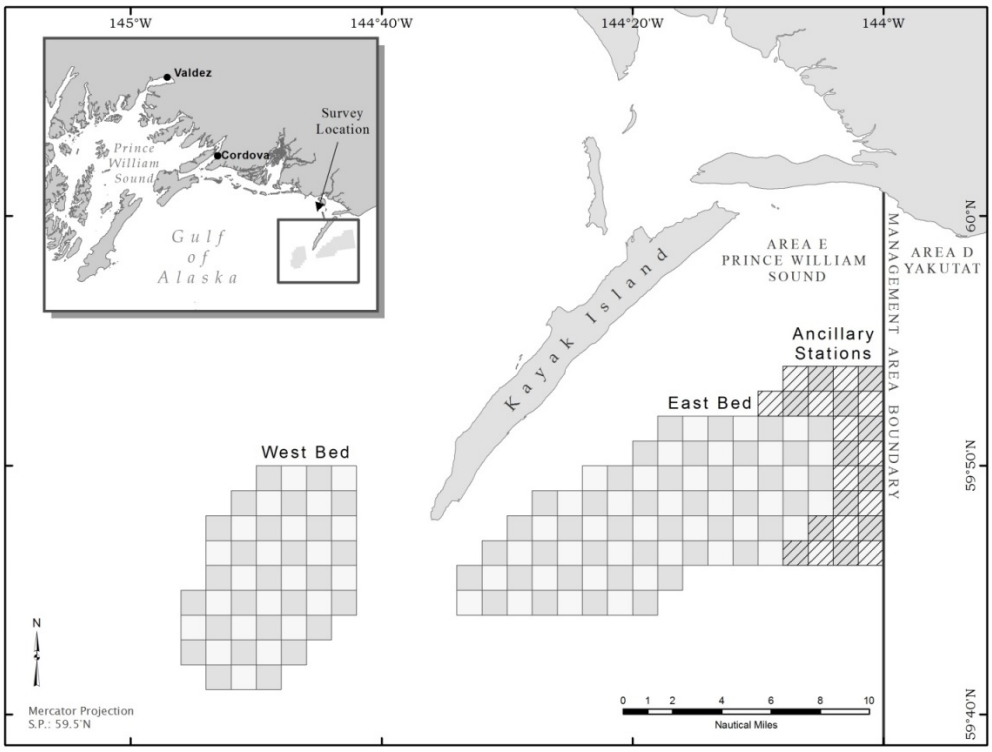


Figure 2-2 Location of surveyed scallop beds at Kayak Island and checkerboard sampling grid utilized since 2007.

Surveys prior to 2007

From 1996 through 2006, this systematic survey design was accompanied by an adaptation for delineating the edge of the scallop beds. Sampling stations were defined by overlaying a checker-board grid of 1.0 nmi^2 squares over a chart of the study area A systematic design was used in which every other station was designated for sampling after the primary sampling unit (light or dark squares) was randomly selected to give an equal probability of selecting either set of grid cells. The vessel skipper, in cooperation with the project leader, determined the specific tow location within each sample station based on weather, wind direction and sea state. The dredge was towed for a distance of approximately 1.0 nmi within each sample station. To delineate the scallop bed margin, stations (light or dark) were added when catches along the edge of the initial sampled stations exceeded a threshold level of 20 lb/nm. The edge of a scallop bed was considered delineated when catch in a given station was below the threshold amount.

Surveys since 2007

The 2007 Kamishak Bay and 2008 Kayak Island surveys were set to standardized areas (Figure 2-1 and Figure 2-2), which continue to be used (Gustafson and Goldman 2012). Ancillary stations are conducted outside these standardized areas as time and funding permit to look for changes in bed size or shape.

Kayak Island

The Kayak Island survey took place from May 4-14, 2014. All dark colored grid stations within the previously delineated east and west beds were sampled. An additional 12 stations were surveyed extending from the eastern margin of the east bed to the state's boundary between Central and Southeast

Regions, to explore an area where more fishing effort has been directed in recent years. These ancillary stations were not used for estimating abundance in either of the main beds as they were exploratory to see if the bed size/shape had changes and did not yield abundances higher than 20 lb/nm.

In the east bed, both abundance and biomass have decreased every year since record highs in 2004, and the 2014 estimates were the lowest in the history of the survey (Table 2-1). In addition, commercial CPUE within the East Section trended downward from 2005 until the fishery was closed in 2012. The age frequency distribution of scallops caught in the east bed in 2014 was bimodal with peaks at 6 and 13 years (Figure 2-3). The progression of these relatively strong cohorts is easily discernible in the time series of the survey.

Scallop catches were low in the east ancillary stations with none of the 12 stations surveyed in 2014 exceeding the 20 lb/nm threshold previously used to delineate the main east and west beds. Furthermore, of the three east ancillary stations surveyed in 2012, only one exceeded the threshold, a catch of 23.1 lb/nm directly adjacent to the main bed. The age distribution of scallops caught in the east ancillary stations was unimodal with a peak at 14 years (Figure 2-5).

In the west bed, abundance has increased in both 2012 (+40%) and 2014 (+150%) compared to the record low in 2010. Biomass in the west bed increased (+83%) in 2014 from the record low in 2012, however like abundance, it remained well below the levels surveyed prior to 2008. The age distribution of scallops caught in the west bed was unimodal with a peak at 5 years (Figure 2-4).

Table 2-1 Summary of systematic estimates for weathervane scallop survey in Kayak Island 1996 -2014, using a standardized area of 78.9 nm2 east bed and 48.6 nm2 west bed. The dredge was 8 feet wide and weighed ~1600 lb, ring size 4 inches inside diameter, and lined with 1.5 inch stretch 24 thread nylon mesh.

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

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

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

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

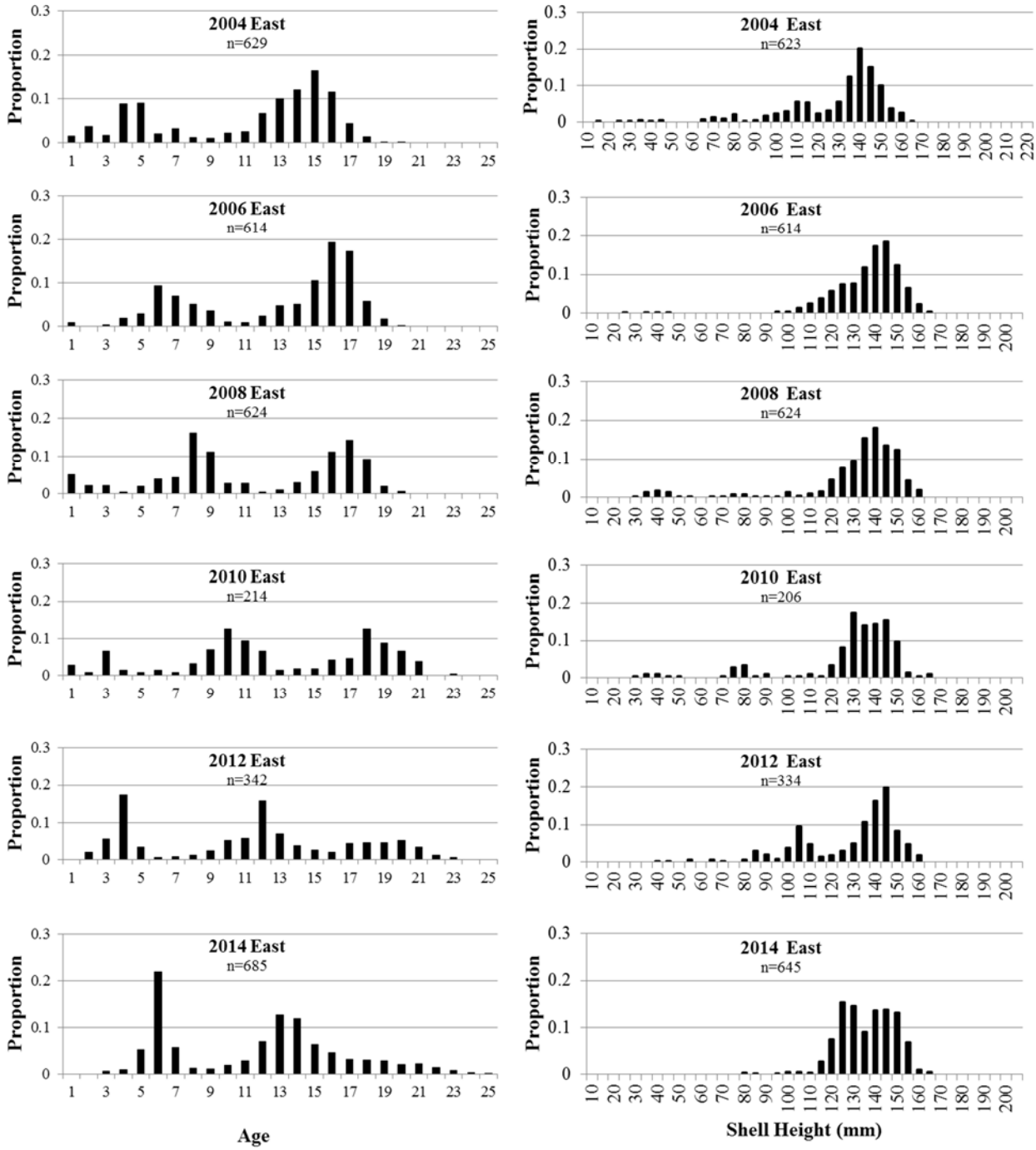


Figure 2-3 Comparison of survey age and shell height distributions, Kayak east bed, 2004 – 2014.

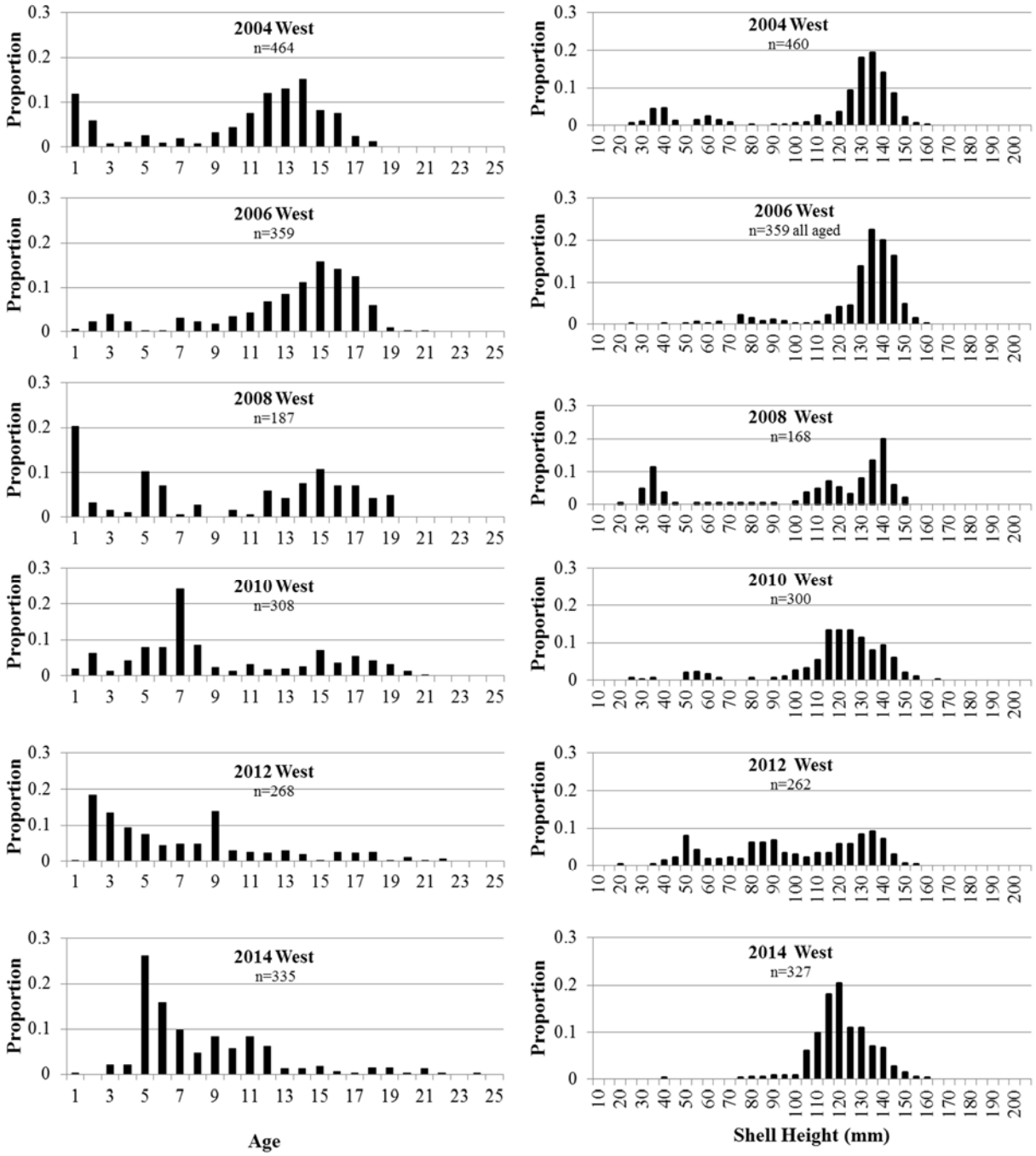


Figure 2-4 Comparison of age and shell height distributions, Kayak west bed, 2004 - 2014.

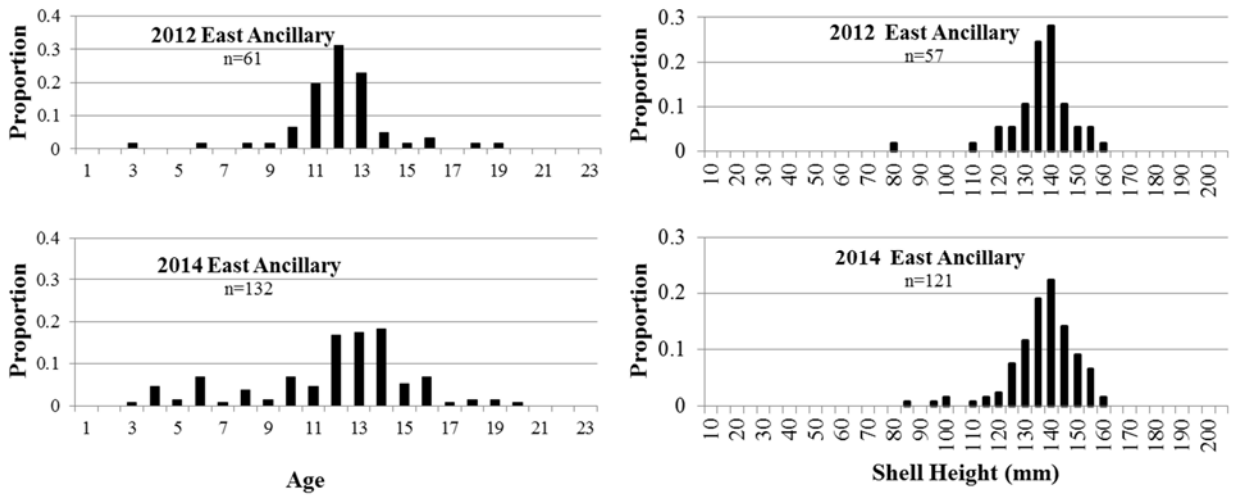


Figure 2-5 Comparison of age and shell height distributions Kayak east ancillary stations, 2012 - 2014.

Kamishak Bay

The Kamishak Bay survey took place from April 26-30, 2015. A total of 45 successful 1nm 8' dredge tows were conducted during the survey; only the north bed was surveyed. Results showed a slight increase in abundance and biomass in the north bed (Table 2-2). Total catch in the north bed was 1,420 weathervane scallops weighing 689 kg (1,519 lb). Mean abundance among all stations was 31.5 scallops/nm (±27.2 SD). Mean catch by weight among all stations fished was 15.3 kg/nm (33.7 lb/nm) (±13.2 SD). Age distributions from 2005-2015 scallops collected during the Kamishak dredge survey are found in Figure 2-6 and Figure 2-7.

Table 2-2 Summary of systematic estimates for weathervane scallop survey in Kamishak Bay 1996 -2013, using a standardized area of 90.2 nm2 North Bed and 68.0 nm2 South Bed and Arc GIS distance for estimates. The dredge was 8 feet wide and weighed ~1600 lb, ring size 4 inches inside diameter, and lined with 1.5 inch stretch 24 thread nylon mesh.

Survey Year	Number stations sampled	Mean catch kg/nm	Estimated abundance		95% CI	CV	Scallop density (scal/m^2)	Average weight (g/scal)	Estimated biomass q =1.0 (kg meat)	Estimated biomass q =0.83 (kg meat)
				North Bed						
1996	26	60.0	15,674,085	±	4,921,324	0.15	0.05	262	351,141	
1999	41	67.1	12,115,707	±	3,032,424	0.12	0.04	380	300,950	
2001	37	62.9	9,980,638	±	2,708,305	0.13	0.03	431	274,801	
2003	31	26.2	4,120,643	±	948,209	0.11	0.01	435	110,137	
2005	38	22.7	3,535,142	±	795,020	0.11	0.01	439	101,483	
2007	43	26.4	5,094,047	±	978,442	0.10	0.02	354	139,580	
2009	43	20.5	3,701,402	±	808,379	0.11	0.01	379	97,408	117,359
2011	45	17.2	2,885,639	±	540,212	0.09	0.01	409	94,188	113,479
2013	43	12.6	1,937,665	±	371,769	0.10	0.01	447	63,120	76,049
2015	45	15.3	2,158,783	±	391,685	0.09	0.01	485	72,252	87,051
				South Bed						
2003	28	59.7	9,434,220	±	2,467,551	0.13	0.04	327	221,258	
2005	29	16.2	3,935,459	±	1,069,549	0.13	0.02	212	60,881	
2007	31	23.5	5,988,540	±	1,648,559	0.13	0.03	202	97,851	
2009	23	9.2	2,757,557	±	1,179,705	0.21	0.01	172	18,146	21,863
2011	16	13.9	2,799,128	±	1,642,687	0.28	0.01	254	62,428	75,214
2013	32	8.4	1,913,247	±	716,715	0.18	0.01	227	26,064	31,402
2015	0	-	-		-	-	-	-	-	-

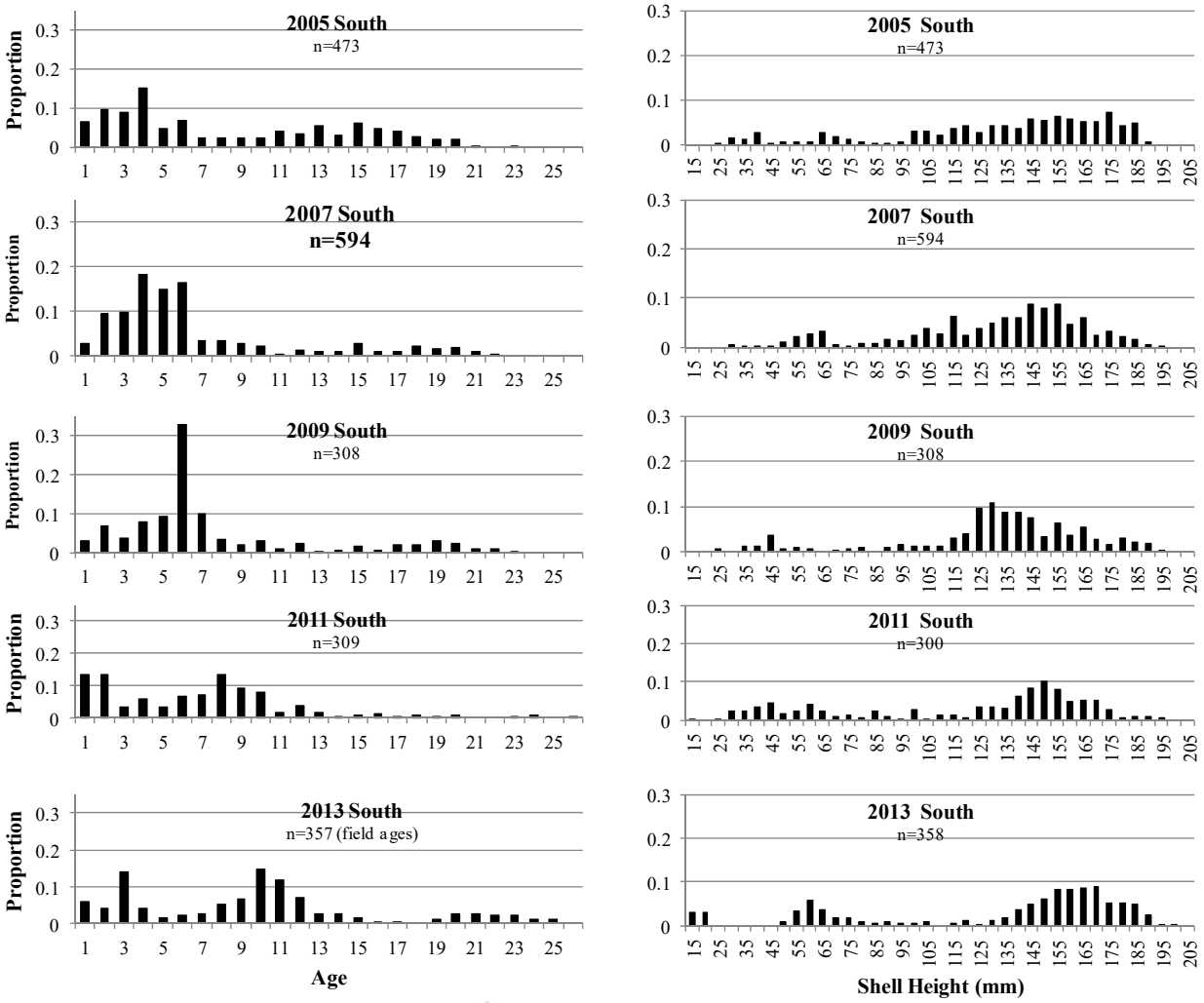


Figure 2-6 Comparison of ages and shell height distribution, Kamishak south bed, 2005 - 2013. Note: The south bed was not surveyed during the 2015 survey

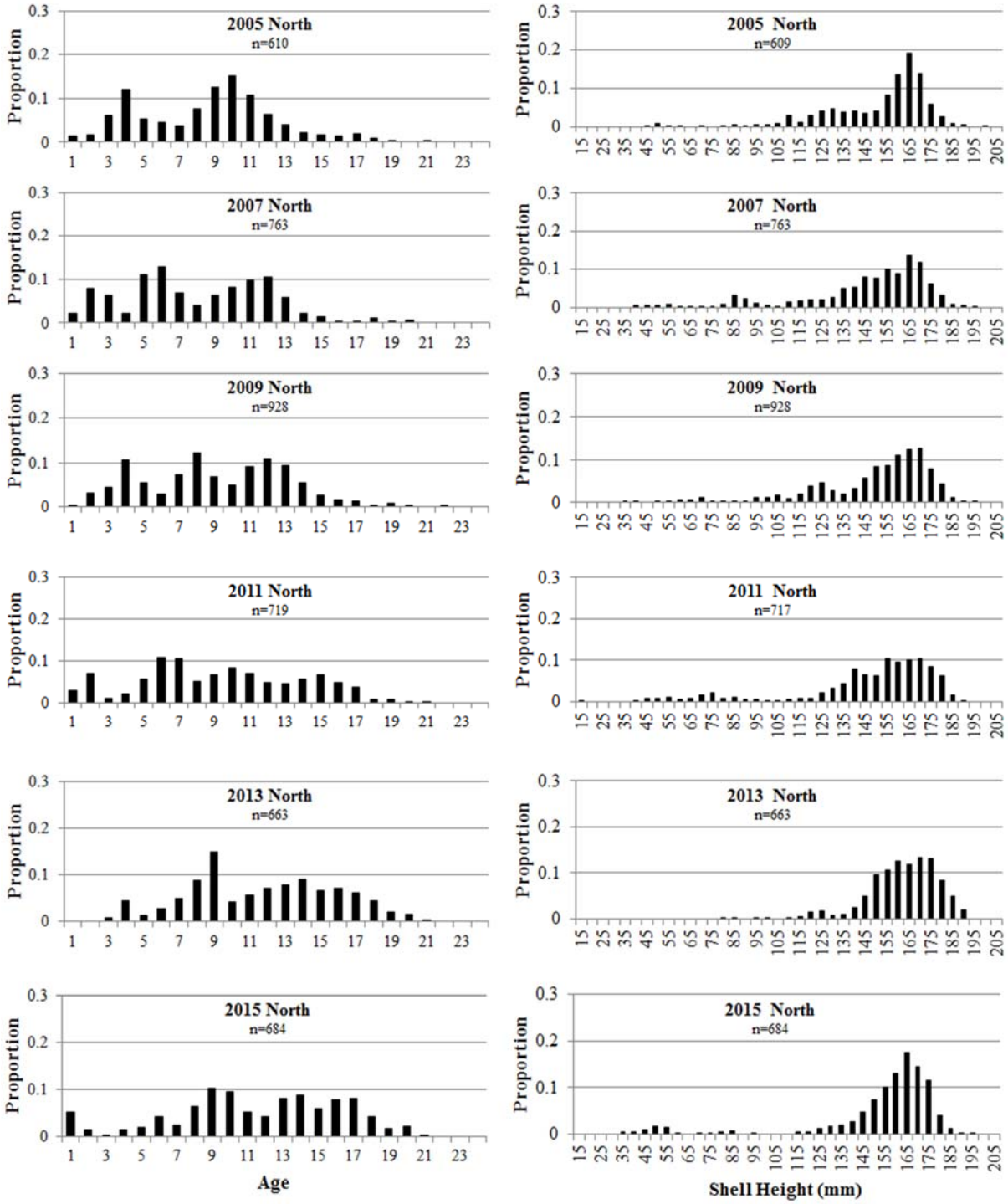


Figure 2-7 Comparison of ages and shell height distributions, Kamishak north bed, 2005 - 2013.

Westward Region

Fishery independent scallop stock assessment surveys are not conducted in Westward Region. ADF&G manages scallops in the Westward Region without annual estimates of biomass or abundance. Therefore, in-season management is precautionary given the lack of biomass information. GHLs are reviewed and updated annually after recent observer-collected data are reviewed. In some instances, ADF&G has developed GHLs for specific statistical areas. This action reduces the likelihood of localized depletions by spreading the fishing effort out over a larger area. An area, district, section or portion thereof may close to fishing before or after the GHL has been reached if principles of management and conservation dictate such action. Management staff also set CPUE benchmarks for some areas prior to the season, and if CPUE falls below the benchmark level during fishing, management staff meets to review in-season observer data and the fishery may be closed. In the Westward region, crab bycatch and scallop CPUE are closely monitored during the season, and scallop harvest may be stopped due to high crab bycatch or poor fishery performance.

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

Response to comments from SSC

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 substantial 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.

3 Economics

An overview of Alaska weathervane scallop harvest and wholesale revenue is presented in Table 3-1. 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 in recent years due to the Federal LLP and formation of a voluntary marketing association. The Federal LLP limits the participation to 9 permit holders. Since 2000, no more than 8 vessels have participated, and in recent years no more than 4 vessels have participated.

Table 3-1 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 2015 values using the Producer Price Index for Intermediate Commodities 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 2015 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 2014. Note that the 2014 price is used as a proxy for the 2015/16 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 in recent years. After trending downward to $5.25 per pound in the early to mid-2000s, nominal scallop prices increased to $7.86 by the 2006/07 season. However, in the 2007/08 season the nominal scallop price declined significantly to $5.94 per pound of shucked meats. Since the 2007/08 season, nominal scallop price has increased in each year and reached $12.39 per pound of shucked meats in 2014.

The historical variability in Alaska scallop prices are likely due to market factors that are driven by the much larger U.S. east coast sea scallop fishery, as well as by import markets. However, in recent years, the Alaska Scallop Association has made considerable progress in its marketing efforts and has been able to maintain an upward trend in the prices it receives for the scallops landed by the three vessels that are associated with the cooperative. The present strength in Alaska scallop prices is expected to continue, and may be enhanced by market forces as landings of east coast scallops are expected to decline in the coming years (pers. comm, Jim Stone, February 2013). Operators of the fourth vessel presently fishing Alaska scallops report receiving a price similar to the statewide average price for 2012 (pers. comm, Bill Harrington, February 2013). The ten year average nominal price is $9.30 per pounds

Adjusted price has fluctuated considerably during the past. After trending upwards from $8.86 in 1993/94 to $9.55 in 1996/97, adjusted price then fell steadily to $6.10 in 2003/04, rebounded to $11.00 by 2006/07, and then fell to $7.82 in 2007/08. Since 2007/08, adjusted price has steadily trended upwards

along with nominal price and has exceeded $12.00 per pound in each of the last five seasons. The ten year average real price is $10.90 per pound.

Table 3-1 Statewide Commercial Weathervane Scallop Real Wholesale Value, 1993/94—2015/16.

Year	Vessels	Catch (lb shucked meats)[a]	Nominal Average Price / lb	Inflation Factor[b]	Real Average Price/lb	Real Wholesale Value
1993/94	15	984,583	$5.15	1.72	$8.86	$8,721,436
1994/95	15	1,240,775	$5.79	1.63	$9.44	$11,710,062
1995/96	10	410,743	$6.05	1.60	$9.68	$3,975,992
1996/97	9	732,424	$6.30	1.52	$9.55	$6,994,075
1997/98	9	818,913	$6.50	1.36	$8.83	$7,235,022
1998/99	8	822,096	$6.40	1.27	$8.16	$6,706,966
1999/00	10	837,971	$6.25	1.08	$6.73	$5,638,632
2000/01	8	750,617	$5.50	1.17	$6.42	$4,815,676
2001/02	6	572,838	$5.25	1.22	$6.41	$3,670,724
2002/03	6	509,455	$5.25	1.19	$6.24	$3,180,987
2003/04	4	492,000	$5.25	1.16	$6.10	$3,001,925
2004/05	5	425,477	$5.50	1.20	$6.59	$2,802,134
2005/06	5	525,357	$7.58	1.39	$10.50	$5,517,137
2006/07	4	487,473	$7.86	1.40	$11.00	$5,360,114
2007/08	4	458,313	$5.94	1.32	$7.82	$3,583,127
2008/09	4	342,434	$6.34	1.41	$8.96	$3,069,784
2009/10	3	488,059	$6.48	1.34	$8.67	$4,229,532
2010/11	3	459,759	$8.35	1.21	$10.09	$4,639,124
2011/12	4	456,058	$10.39	1.20	$12.51	$5,704,225
2012/13	4	417,551	$10.63	1.18	$12.55	$5,239,400
2013/14	4	399,134	$12.25	1.04	$12.68	$5,060,520
2014/15	4	308,888	$12.39	1.00	$12.39	$3,827,122
2015/16[c]	4	263,934	$12.39	1.00	$12.39	$3,270,142
10-Year Average	4	408,160	$9.30		$10.90	$4,398,309

a Lb. of shucked scallop meats are reported by the State Observer Program.
b uses the Bureau of Labor Statistics, Intermediate Commodities Producer Price Index through 2015.
c preliminary

First wholesale revenue in this fishery has varied considerably over the period as both price and landings have varied. The peak value in the fishery, occurred in 1994/95 season when inflation adjusted $11.7 million was earned. Since that time, real total first wholesale revenue in the fishery has fluctuated with prices, and the reduction in landed pounds. Overall, the total value has trended downward as landings have fallen from more than 1.2 million lb down to a low in 2015/16 of 263,934 lb. The total real first wholesale revenue of a little more than $3 million in the 2008/09 season was the lowest revenue total since 1993; however, with increased prices in recent years the total revenue increased to just over $5

million in 2013/14, and was $3.3 million in 2015/16 when the lowest catch since 1993 was taken. The ten year average real first wholesale value is $4.4 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.

4 Ecosystem Components

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

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

Ecosystem Component

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 4-1. Data on non-target species was summarized according to whole weight (lb). In Region 1, catches of non-target scallops by the NMFS survey in odd-numbered years from 1999 to 2007 averaged 1 lb annually. For Region 2, ADF&G catches among either annual trawl surveys averaged 22 lb (whole weight; CV = 84%) annually, ranging from <1 to 53 lb, whereas NMFS surveys caught an average of 4 lb annually. For Region 4, annual catch of *Chlamys* among ADF&G trawl surveys ranged from 3 to 109 lb, averaging 35 lb (CV = 97%), whereas NMFS survey catches averaged 70 lb (CV = 50%) annually.

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

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

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

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

Ecosystem Effects on the Stock

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

Fishery Effects on Ecosystem

The Alaska weathervane scallop fishery occurs in continental shelf waters at depths 40–150 m in three main areas: the eastern Gulf of Alaska between Prince William Sound and Cape Spencer; around Kodiak Island; and in the eastern Bering Sea (Figure 1-2). Because the fishery footprint is confined to these areas and because many areas of similar habitat are closed to scallop dredging, we expect the effects of the scallop fishery on the GOA and Bering Sea ecosystems to be minor.

Predators: Little is known about scallop predators. Plankton feeders probably eat a large amount of floating larvae. Small weathervane scallops have been found in the stomachs of flounders and crabs, starfish, shell boring worms and sponges may also be scallop predators. Twenty-arm sea stars and giant octopus are known predators of weathervane scallops.

Bycatch: Scallop fishery bycatch is closely monitored by the onboard observer program (see Section 1). Bycatch in the scallop fishery includes prohibited species such as red king crab, Tanner crab, snow crab, and Pacific Halibut, other commercially important species of fish and invertebrates, miscellaneous non-commercial species, and natural and man-made debris. Crab bycatch in the scallop fishery is highest in the Bering Sea, although this accounts for a small proportion of total Bering Sea crab bycatch.

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

For example, during the 2000/01–2007/08 seasons, the most frequently caught species or items in the statewide scallop fishery by weight were weathervane scallops and scallop shells (84%), twentyarm sea stars *Pycnopidia helianthoides* (4%), natural debris (kelp, wood, etc., 3%), and several species of skates (2%). A summary of results of select species encountered during scallop observer haul composition sampling (% by weight) during the 2013/14 season is shown inTable 4-2.

Table 4-2 Summary of results from scallop observer haul composition sampling (% by weight) during the 2014/15 season.

Area/District	weathervane scallops	shells/ debris	sea stars	skates [b]	flatfish	basket/ brittle stars	*Chionoecetes* crabs [c]
Yakutat District	78.5	5.4	4.5	3.6	1.1	4.2	0
Yakutat District 16	74.5	6.9	6.1	2.6	3.2	2.9	0.1
Kodiak Northeast District	77.7	3.7	10.7	1.6	3.4	0.1	0.1
Kodiak Shelikof District	65.2	11.4	6.7	6.9	3.3	0.1	0.5
Kodiak Southwest District [a]	49.3	5.1	0.1	3.8	2.2	32.7	0.2
Alaska Peninsula Unimak Bight District [a]	79	5.6	0.2	1.3	1.2	6.1	0.5
Dutch Harbor Area	70.5	17.7	3.6	0.4	3.3	0.4	0.4
Bering Sea Area	73.5	4.2	0.1	3.3	2	3.7	8.2
Statewide Total	73.4	6.3	6.1	3.6	2.3	4	0.4

[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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6 Appendices

Appendix 1: Weathervane Scallop Stock Structure

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

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Table 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).
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.

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

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
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 2: 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 in-season actions duplicated by the federal system (Barnhart, 2003).

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

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

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

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

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

Appendix 3: Ongoing and new Assessment research

Appendix 3.1: CamSled Image Analysis

The Alaska Department of Fish and Game began experimenting with underwater video methodology for scallop stock assessment following a 1999 workshop on the weathervane scallop (*Patinopecten caurinus*) fishery in Alaska (ADF&G and University of Alaska Fairbanks 2000). Well-documented variability in scallop dredge efficiency and size selectivity (e.g., Caddy, 1968, 1989) prompted them to focus on video technology, which can provide direct observations of benthic organisms such as scallops that allow estimation of abundance without estimation of catchability coefficients (Quinn and Deriso, 1999). A collaboration between the commercial fishing industry and Wood's Hole Oceanographic Institution scientists led to the first use of machine vision cameras and Ethernet technology in fisheries research through development of HabCam, which has been used to image Georges Bank scallop fishing grounds from a scallop fishing vessel since 2004 (Howland et al., 2006). By recommendation of the HabCam team, ADFG purchased a GigE camera and assembled a network-based benthic imaging system, CamSled, that was initially deployed from the *R/V Pandalus* in the eastern Gulf of Alaska during June 2006. Further improvements were made before using the system for the first survey of two scallop fishing areas in the vicinity of Kodiak Island, Alaska, during June 2007 (Rosenkranz et al. 2008). CamSled is towed at about 4 km/h and takes images at a rate of 5 frames per second. When deployed, the system acquires a stream of high resolution images of the seafloor that are stored on computer hard disks. The stream is data intensive, with 18,000 images requiring 72 gigabytes digital storage collected each hour. To date, over 5 million images have been collected with the system.

Beginning in 2013, the Fisheries, Aquatic Science and Technology (FAST) Lab at Alaska Pacific University entered into a cooperative effort with Alaska Department of Fish and Game staff in Kodiak to analyze images collected using the CamSled (Coop Agreement 14-059). Areas currently being processed include Chiniak Gully North Bed, Chiniak Gully South Bed, and Christmas Tree. Each survey area is partitioned into 1km^2 grid cells and the first 50 consecutive images (termed a 'station') collected within each grid are analyzed. Images are manually analyzed and annotated in a custom web-based application (developed by Ric Shepard, ADFG Kodiak), which writes data to a structured query language (SQL) database for storage. The application allows researchers to examine stored images and annotate scallops and other benthic species with the mouse by clicking-and-dragging to create on-screen bounding boxes, with drop-down menus used for species identification. In each image analysts count and measure scallops, and identify the macrobenthos and sediment types present. These data are aggregated at the "station" level. Image analysts are trained for several weeks using standard protocols and a training image set prior being assigned a real image set. Analysts processing rates vary between 40-50 images/person/hour.

As of late January 2016, 97,712 images were processed, including over 53,000 images in Chiniak Gully North, 28,000 images in Chiniak Gully South, and 15,000 images in Christmas Tree areas (56%, 52% and 39% of respective area images). Barnabas and Albatross images are available but have not been processed. A preliminary analysis of the 44,500 images sampled in Chiniak Gully North as of October 2015 is provided as an example. We estimate that there were about 45 million scallops occupying about 4% of the 1081 km^2 assessed. Scallops density was very low (0.04 scallops /m) overall, and low (0.08 scallops /m^2) in transects where at least 1 scallop occurred. On average 87% of the images at a station contained mud, 20% had shell debris and 42% had sea whips (Tables 6-2 and 6-3). Efforts are currently

focused on finishing image analysis for Chiniak Gully North, followed by Chiniak Gully South and Christmas Tree, before further statistical analyses are integrated into reports. A FAST Lab Graduate Student (Victoria Batter) will be using completed data for her master's thesis "Weathervane scallop (*Patinopecten caurinus*) species distribution modeling".

Table 6-2 Weathervane scallops density (individuals m-1) per station and mean prevalence per station of other key features in CamSled images

Metric	Feature	Mean	±95%ci
Density	Weathervane Scallops	0.04	0.005
Prevalence	Mud	87.1%	1.40%
	Sand	4.0%	1.17%
	Gravel	0.15%	0.20%
	Cobble	0.01%	0.02%
	Boulder	0%	0.00%
	Bedrock	0%	0.00%
	Shell debris	20.3%	2.23%
	Shell hash	2.9%	0.55%
	Anemone	4.2%	0.59%
	Basket star	4.5%	0.58%
	Brittle star	8.9%	1.63%
	Chlamys scallops	4.5%	0.47%
	Hermit crabs	14.8%	0.91%
	Metridium	2.9%	0.38%
	Sea whips	42.3%	2.09%
	Shrimp	8.6%	0.66%
	Weathervane Scallops	3.8%	0.40%

Table 6-3 Abundance of Weathervane scallops and area occupied (m2) by other key features in CamSled images

Metric	Feature	Mean	±95%ci
Abundance	Weathervane Scallops	45,080,000	5,379,379
Area Occupied (km^2)	Mud	886.9	14.21
	Sand	40.2	11.91
	Gravel	1.5	2.00
	Cobble	0.1	0.18
	Boulder	0.0	0.00
	Bedrock	0.0	0.00
	Shell debris	207.0	22.67
	Shell hash	29.0	5.63
	Anemone	42.7	5.98
	Basket star	46.1	5.89
	Brittle star	90.8	16.63
	Chlamys scallops	45.7	4.83
	Hermit crabs	150.6	9.28
	Metridium	29.5	3.90
	Sea whips	430.6	21.30
	Shrimp	87.9	6.71
	Weathervane Scallops	38.7	4.09

Appendix 3.2: Discard Mortality

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

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

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

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

Twelve individual strings of gear consisting of five cages each were set. Gear strings consisted of an anchor at each end of the string with 10 fathoms between the anchors and the nearest cage. Each cage had 5 fathoms of line between them and a buoy line that extended to a surface float from one of the anchors. Scallops were placed into their cages based on size (small, medium and large). Each cage was wrapped in a 1¼" stretch mesh bag (size 18 thread) to prevent sea star predation while allowing water flow through the cages so scallops could filter feed while enclosed. Upon retrieval of the cages, each scallop was measured again and its condition assessed as live or dead. Condition was assessed by the animal's response to attempting to open the scallop if the shell is closed or pushing the shell closed if it is agape. Negative (or no) response was deemed a mortality.

Examination of the discard mortality data has been conducted. There were 393 scallops used in the study of which 363 were placed in the cages leaving 30 that were placed in totes on deck (from categories D. E and F). Twenty six of the 363 scallops (7.16%) placed in the cages died, while 18 out of the 30 placed in totes on deck (60%) died after 24 hrs, but indications were that all of those scallops would have died after not too much longer (i.e. eventual 100% mortality). The combined mortality from both groups is 11.12%. An initial estimate of overall survey mortality using these results and expanding them to the approximately 3,500 scallops examined for shell damage on the survey provides on overall estimate of survey mortality of 8.16% (with lower and upper 95% CI of 6.03% and 10.28%, respectively).

Appendix 3.3: Shell Boring Worms

Declining trends in abundance of scallops in Kamishak Bay raised questions about the role of worms in scallop declines. A portion of the scallop shells collected during the ADFG dredge surveys in Kamiskak Bay are retained for ageing. Agency staff began recording the intensity of shell boring worms (percent of individual shell bored) using the ¼ shall approach. In 2012, APU partnered with ADFG staff in Homer to retroactively process shells in more detail and to assess the prevalence (percent of infected shells) and intensity of shell boring worms and mud blisters from catalogued samples. Left shells were individually placed inside up on a light board. The back lit images were captured using an Aver Media Avervision 300p document camera fixed at a height of 48cm. Images were analyzed using Image J Software. The total area of the shell, area of the total infestation and area of mud blistering were measured in pixels using polygon selections. The camera was calibrated using a 5 x 5 mm fixed grid and all shell measurements were converted to cm^2.

To date, 4,318 of 8,500 shells have been fully processed (imaged and analyzed). All shells from the years 1996, 1998 and 1999 are complete. Shell boring worm prevalence ranged from 48.9% in 1996 to 83.6% in 2001 in the north bed; mean intensity was lowest in 2011 (1.7%) and highest in 2009 (13.2%) (Table 6-4, Figure 6-1 and Figure 6-2). In this region, mud blister prevalence ranged from 12.7% (1996) to 47.5% (2005); mean intensity of mud blisters ranged from 1.6% (1996) to 11.7% (2005) (Table 6-5, Figure 6-1 and Figure 6-2). In the south bed, shell boring worm prevalence ranged from 44.0% in 2007 to 60.5% in 2009; mean intensity ranged from 1.8% (2007) to 6.6% (2003) (Table 6-4 Figure 6-3 and Figure 6-4). Mud blister prevalence in this area ranged from 3.8% (2011) to 22.2% (2005) with mean intensities between 0.1% (2011) and 1.1% (2005) (Table 6-5, Figure 6-3 and Figure 6-4).

In 2013, samples of shell boring worms were obtained during the ADFG Kamishak Bay dredge survey to attempt a species identification. Dr. Jerry Kudenov (Professor of Biological Science at University of Alaska – Anchorage, Invertebrate Ecology, Systematics, & Microscopy) examined these specimens and determined them to be of the genus *Polydora*.

A full analysis of shell boring worm and mud blister prevalence and intensity as they relate to year, scallop size and scallop age will be done after the remaining shells have been imaged and processed.

Table 6-4 Prevalence and Intensity of shell boring worms in scallops from Kamishak Bay

			Shell Boring		
Bed	Year	N	Prevalence	Intensity	SD
North	1996	1081	48.9%	2.7%	8.22%
	1998	418	56.0%	5.4%	14.01%
	1999	673	79.3%	4.2%	11.39%
	2001	304	83.6%	7.0%	13.16%
	2003	356	75.8%	5.1%	10.55%
	2005	362	79.8%	9.4%	35.77%
	2007	211	76.3%	10.6%	19.28%
	2009	365	80.8%	13.2%	22.21%
	2011	129	65.1%	1.7%	5.26%
South	2003	77	50.6%	6.6%	14.69%
	2005	65	55.4%	2.2%	4.49%
	2007	234	44.0%	1.8%	7.44%
	2011	43	60.5%	4.0%	18.80%

Table 6-5 Prevalence and Intensity of mud blisters in scallops from Kamishak Bay

			Mud Blister		
Bed	Year	N	Prevalence	Intensity	SD
North	1996	1081	12.7%	1.6%	6.27%
	1998	418	15.1%	2.1%	6.49%
	1999	673	20.5%	2.9%	7.81%
	2001	304	19.4%	3.0%	7.86%
	2003	356	32.6%	6.8%	12.38%
	2005	362	47.5%	11.7%	16.66%
	2007	211	38.4%	11.4%	21.42%
	2009	365	37.0%	8.0%	13.11%
	2011	129	15.5%	4.3%	11.57%
South	2003	77	12.8%	0.5%	2.08%
	2005	65	22.2%	1.1%	3.76%
	2007	234	7.8%	0.3%	2.01%
	2011	43	3.8%	0.1%	0.96%

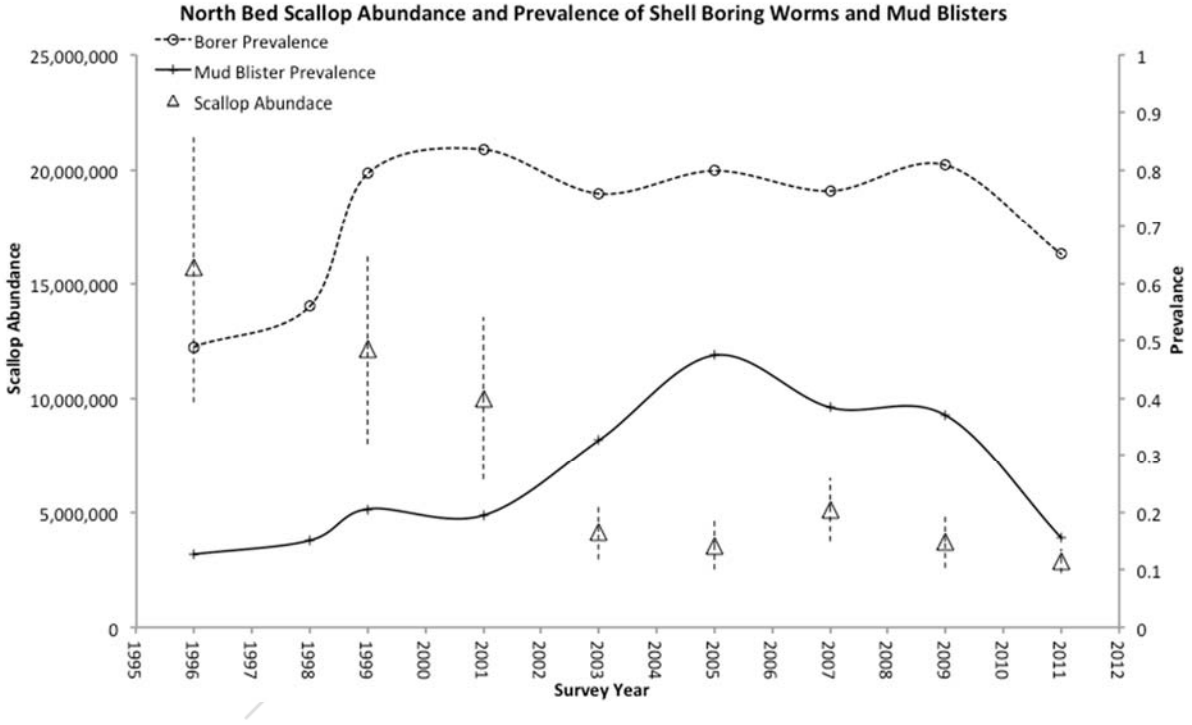


Figure 6-1 Prevalence of shell boring worms and mud blisters relative to scallop abundance (± 95%CI) in scallops from the north bed of Kamishak Bay

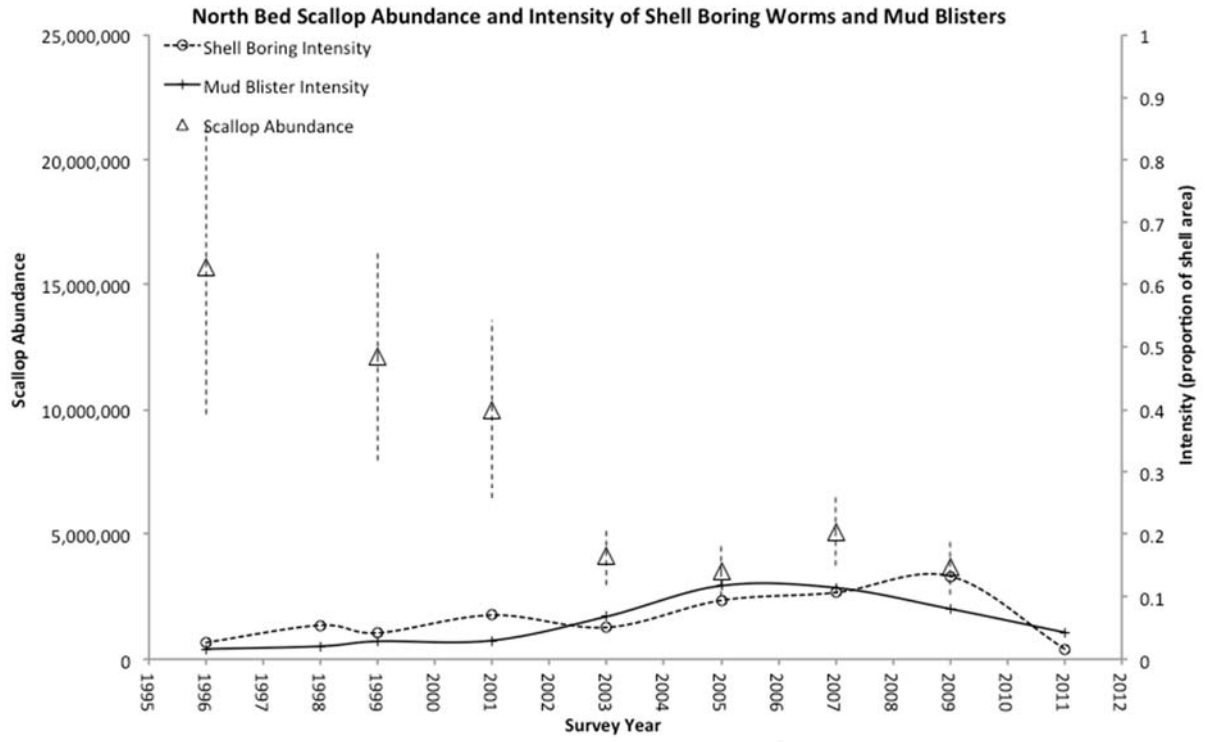


Figure 6-2 Mean intensity of shell boring worms and mud blisters relative to scallop abundance (± 95%CI) in scallops from the north bed of Kamishak Bay

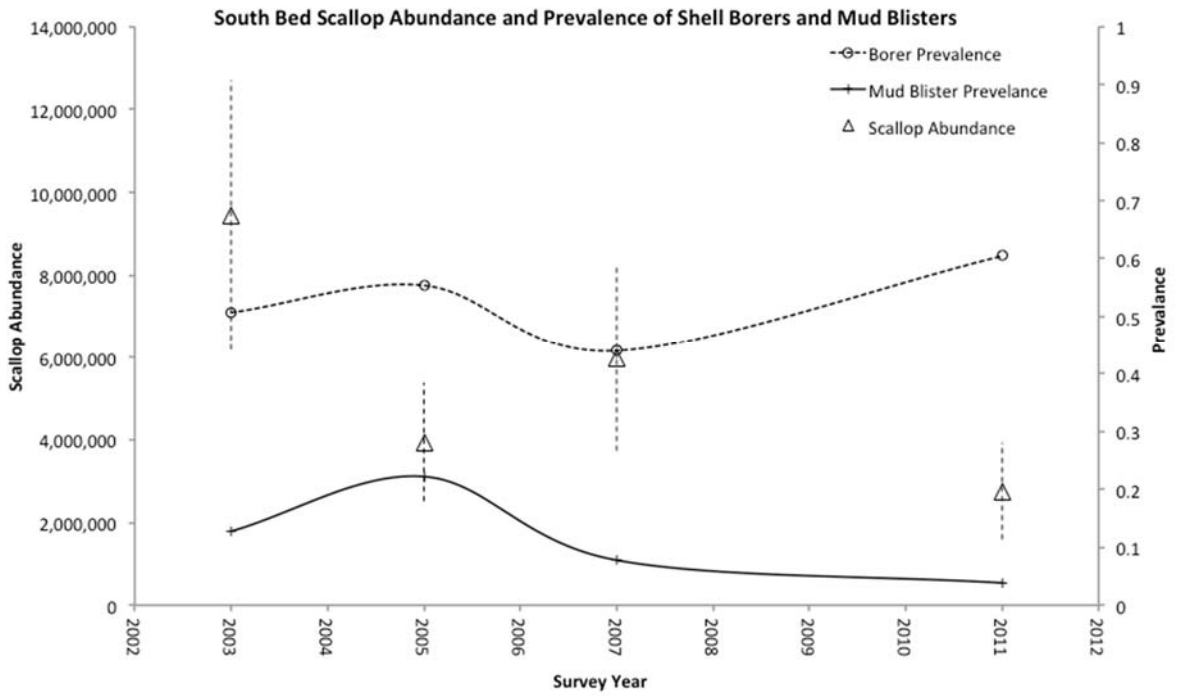


Figure 6-3 Prevalence of shell boring worms and mud blisters relative to scallop abundance (± 95%CI) in scallops from the south bed of Kamishak Bay

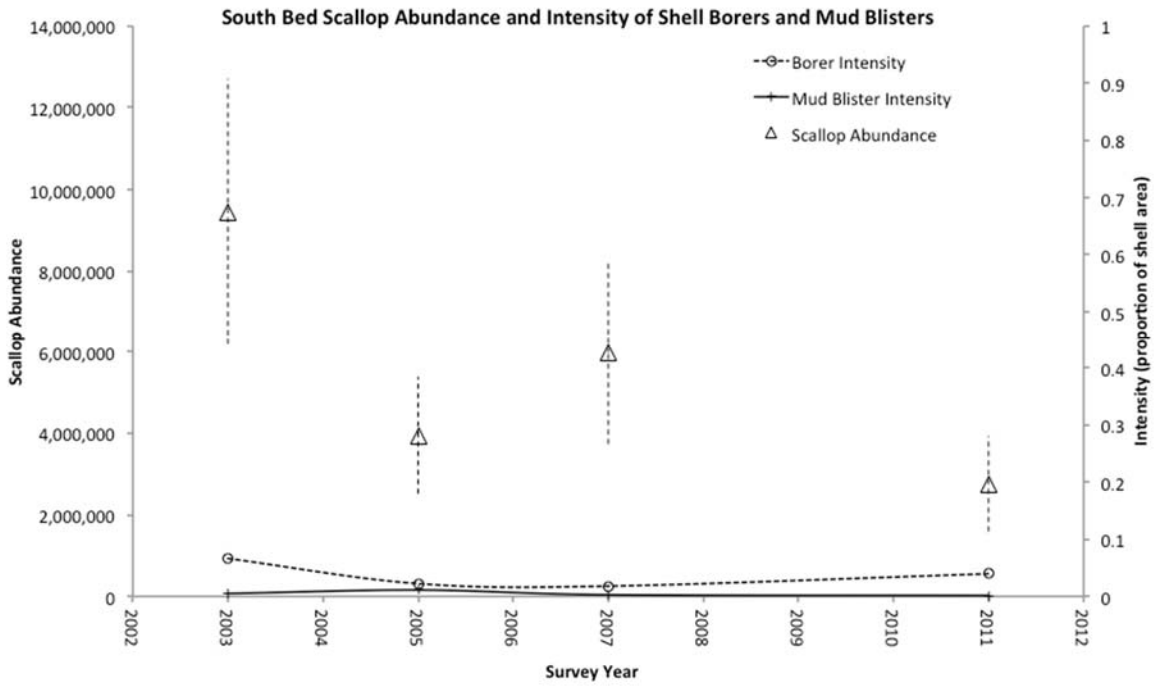


Figure 6-4 Mean intensity of shell boring worms and mud blisters relative to scallop abundance (± 95%CI) in scallops from the south bed of Kamishak Bay

Appendix 3.4: Summary of 2014 Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis.

In 2014, a Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis was conducted to gather socioeconomic information about the Alaska weathervane scallop fishery (Glass, et al., 2015). The participant group consisted of industry members, fishery managers, biologists, and "others". Within the "others" category were those who could not be classified in the first three categories, including members of coastal communities affected by the fishery. Participants were interviewed from communities in Alaska, including Anchorage, Cordova, Juneau, Kodiak, Homer, and Yakutat. One participant was interviewed in Seattle, Washington, where many scallop vessels were formerly home-ported. Respondents were asked to answer questions from a single questionnaire, developed by the authors, and were interviewed in person, over the phone, or in writing.

The questionnaire focused on five SWOT themes: social, technological, economic, environmental, and regulatory. Social aspects included questions related to stakeholder perceptions of weathervane scallop fishery impacts on Alaskan coastal communities, as well as current and historical changes in public perception of the fishery. Technological questions involved vessel technology, industry efficiency, gear types, and bycatch avoidance e anything related to harvesting, processing, and market delivery. Economic questions addressed the value and stability of the weathervane scallop market, market competition, industry expansion, aquaculture, and latent permits. Environmental aspects addressed the biology of scallops and their habitat, including meat condition, bycatch species, climate change, and respondents' perceptions of the sustainability of the fishery. Regulatory aspects included fishery management and legislation, including expected outcomes of the LEP program expiration. Results and discussion of this study are broken out categorically regarding public perceptions, marketing, efficiency, expansion, cooperative versus non-cooperative member views, LEP expiration, environmental impacts, and research needs and data gaps. Various responses and themes revealed in responses are discussed under each category.

This analysis served as a vehicle to solicit the opinions of those involved with the weathervane scallop industry in Alaska as a means to identify, clarify, and offer potential solutions to current socioeconomic issues, as well as to foster a more comprehensive dialogue about future fishery options among fishery participants, policy makers, scientists, fishery managers, community members, and other stakeholders. Many topics were not controversial, but others elicited a diversity of opinions. With few exceptions, divergent opinions were not identifiable to particular stakeholder groups; they were sometimes associated with a geographic region, but mostly reflected individual opinions. This perhaps unique result highlights the ability for weathervane scallop stakeholders to work harmoniously and may underpin what is generally believed to be a successful fishery management program. In part, this is reflected in the very cooperative relationship between fishery managers and the scallop industry, which exhibits significant self-regulation. Some of the more strongly held differences of opinion (e.g., severity of bycatch, home ports of the fleet) are biased in part with misinformation, which indicates that resolution may be possible through improved education and communication. Because scallop fishery stakeholders are not generally polarized by stakeholder group, the authors are optimistic about the ability of this fishery to address future challenges, of which there are many. Crossroads include a bifurcation in management in state and federal waters with the sunset of the state's LLP program, stock conservation concerns and associated declining GHLs, bycatch and potential long-term dredging impacts, product quality, evaluation of efficacy of long-standing area closures, regional distribution of seafood products from this fishery, and data limitations on

stock assessment and management. Based on synthesis of results from the SWOT analysis, the authors recommend the following actions to help shape the future weathervane scallop fishery in Alaska:

1. Given split management between an open access fishery in state-waters and an LLP fishery in federal waters, improved in-season communication among state and federal fishery managers will be essential to prosecute an orderly joint fishery and to assure that that combined catches do not exceed annual catch limits.

2. Scallop fishery managers should consider newly developed toolkits for assessment and management of data-limited fisheries (e.g., Newman et al., 2014). Moreover, it may be possible to expand dredge surveys to other areas using commercial vessels under a cooperative cost-recovery program (i.e., sale of survey catches) to defray costs.

3. Reporting of fishery bycatch can be improved. Bycatch data could be made more readily available at a reduced cost by implementing electronic data entry by onboard observers. Moreover, expanding bycatch reporting from the current method (see Rosenkranz and Spafard, 2013), such as plotting trends in bycatch of certain taxa over time, should allay concerns and/or identify specific bycatch issues to be addressed.

4. If new bycatch issues emerge, a bycatch avoidance and advisory program could be developed, patterned after one developed to reduce bycatch of yellowtail flounder (Limanda ferruginea) in the U.S. east coast sea scallop fishery (O'Keefe and DeCelles, 2013).

5. Conduct follow-up interviews with fishery stakeholders to prioritize and rank research needs. One proposed method is the analytical hierarchy process, which has already been demonstrated effectively in Alaska (Saaty, 1986; Wadsworth et al., 2014). These prioritizations should be developed in conjunction with research priorities developed annually by the Scientific and Statistical Committee of the North Pacific Fishery Management Council.

6. Given limited agency funding, significant advancements on research priorities requires engagement of academic researchers and involvement of the fishing industry. Successful cooperative scallop research programs in New Zealand (Hughey et al., 2000; Mincher, 2008) and Canada (Stevens et al., 2008) provide examples of how industry involvement in research can lead to both economic and ecological benefits.

7. Mapping benthic marine resources and habitats off Alaska could enable significant gains in fishery economic efficiency, reduced bycatch, and decreased habitat effects, as reported off Atlantic Canada (Kostylev et al., 2003; Taylor, 2003).

Given the crossroads in the weathervane scallop fishery in Alaska, the authors believe they have contributed to next steps in strategic planning by identifying current and potential future issues, along with perspectives and options offered by a diversity of stakeholders. Moreover, the above implementation strategy is intended to help assure meaningful next steps. Ultimately, decisions about the future management of this fishery are a matter of public policy.

Appendix 3.5: Comparison of Survey and Fishery CPUE

Kayak Island

The SSC requested that the statistical relationship between fishery-independent surveys and commercial fishery CPUE be examined. Survey abundance and fishery CPUE were plotted by year and the initial look showed that harvest and survey data appear to track reasonably well. However, since both abundance and biomass estimates are produced and the commercial fishery harvest is based on biomass estimates; survey estimated biomass of whole scallops to fishery CPUE were compared. As with survey abundance estimates, biomass estimates of whole scallops appears to track reasonably well with the fishery CPUE (Figure 6-5). Results from the 1998 and 2002 dredge surveys were included for presentation, and even though they also appear to track well with the commercial fishery they were not included in any statistical analysis as data for both years were compromised: In 1998, a lighter dredge was used due to the loss of the original survey dredge in Kamishak Bay, and after completion of the 2002 survey it was discovered that the dredge liner from the lighter dredge was used and warp scope lengths from the lighter dredge were used.

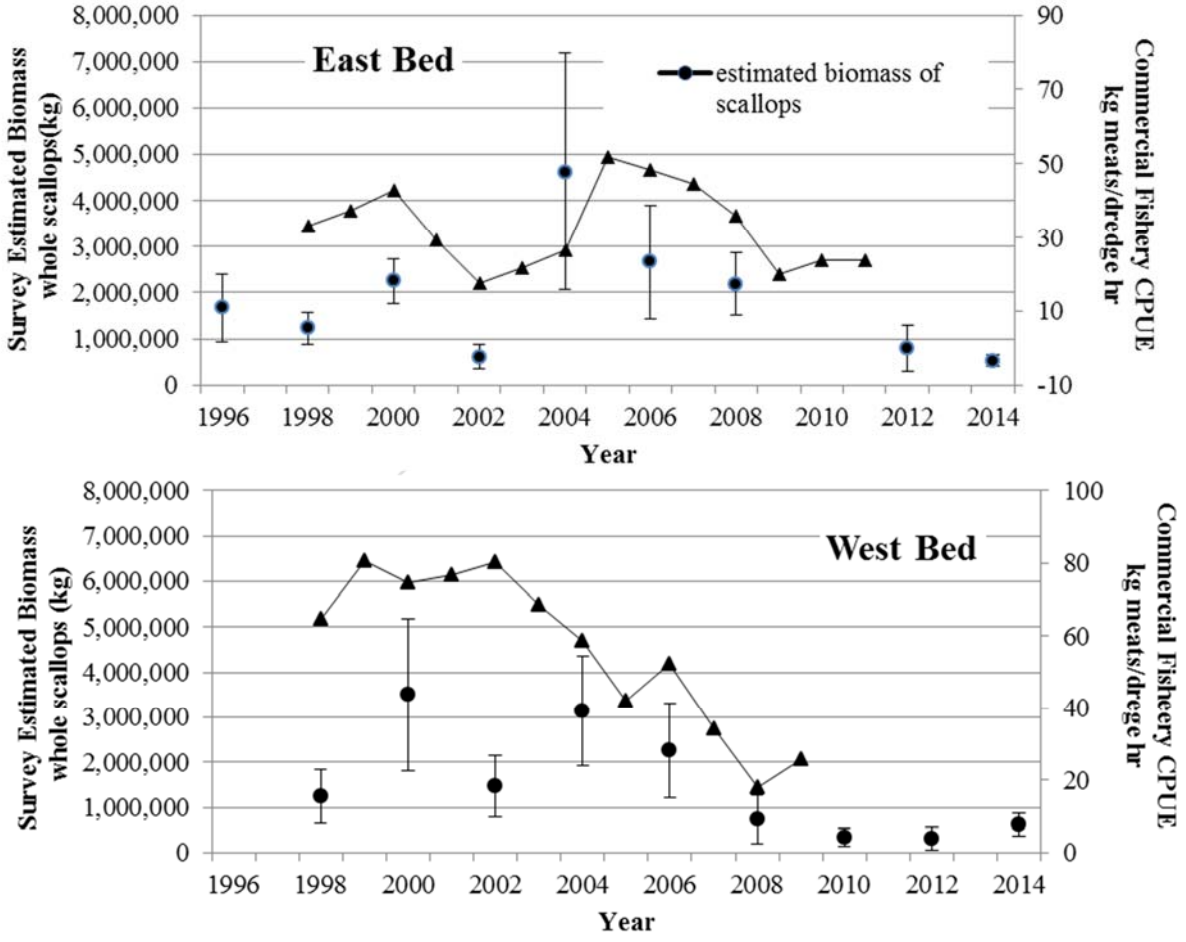


Figure 6-5 Comparison of fishery-independent survey biomass (kg whole scallops) to commercial fishery CPUE, 1996 - 2012. Asterisks indicate compromised survey data that were not used in statistical analysis (see text).

Linear regression of east bed fishery CPUE (kg meats/dredge hour) compared to survey estimated biomass of whole scallops (kg) (Figure 6-6), had a negative correlation with an R^2 of 0.55. This is caused by the 2004 data point, which if removed provides an R^2 of 0.80. While the 2000, 2006 and 2008 data show high correlation to the survey biomass data, one would not know this if attempting to use in a forecasting manner. Linear regression of west bed fishery CPUE compared to survey estimated biomass of whole scallops (kg), shows a positive relationship (Figure 6-7) and a strong correlative relationship to survey data ($R^2 = 0.96$). Thus with the exception of the 2004 east bed data, the estimated survey biomass appears to correlate well with the fishery CPUE in seven out of eight surveys where data are available to compare.

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

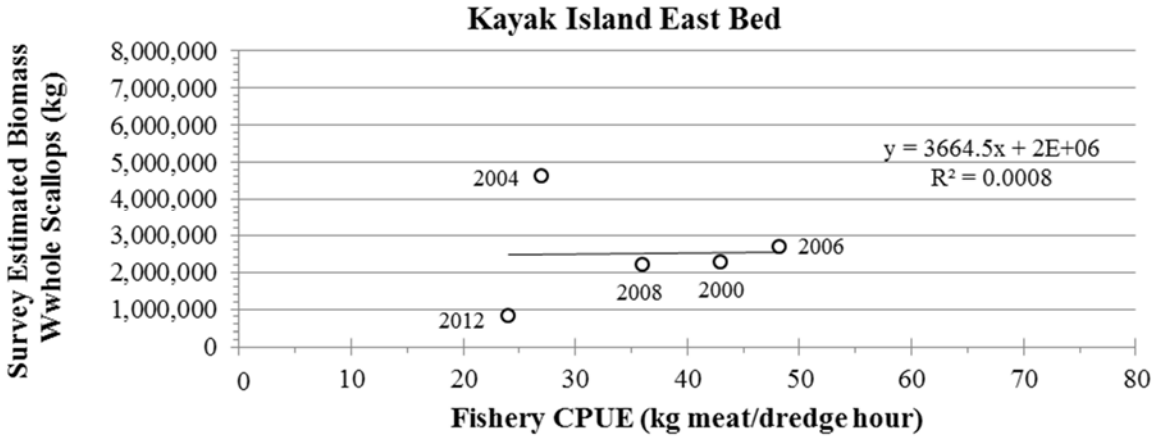


Figure 6-6 Linear regression of Kayak east bed fishery CPUE and survey estimated biomass with survey year shown (n=4; P=0.259; Std. Error=944,049).

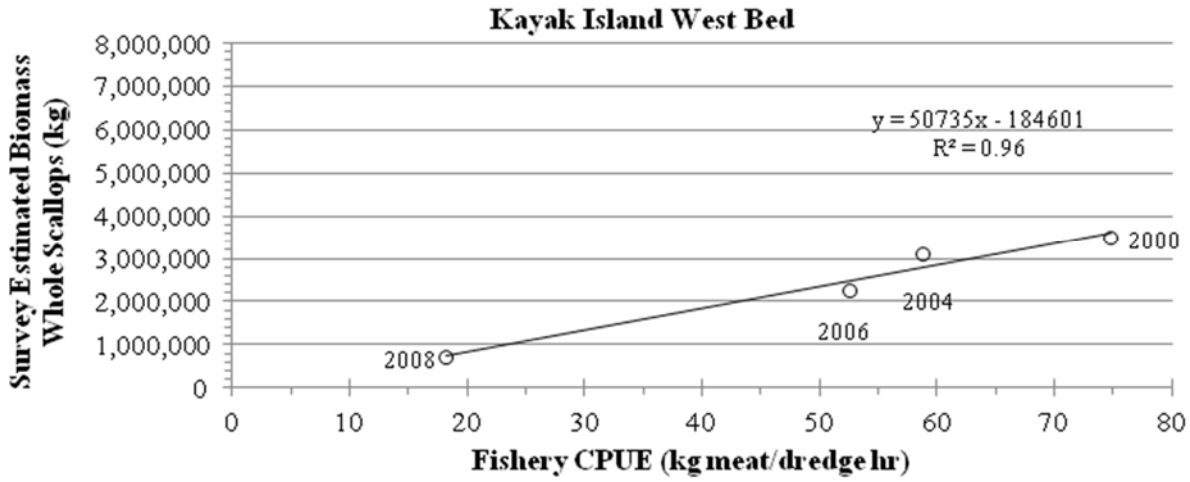
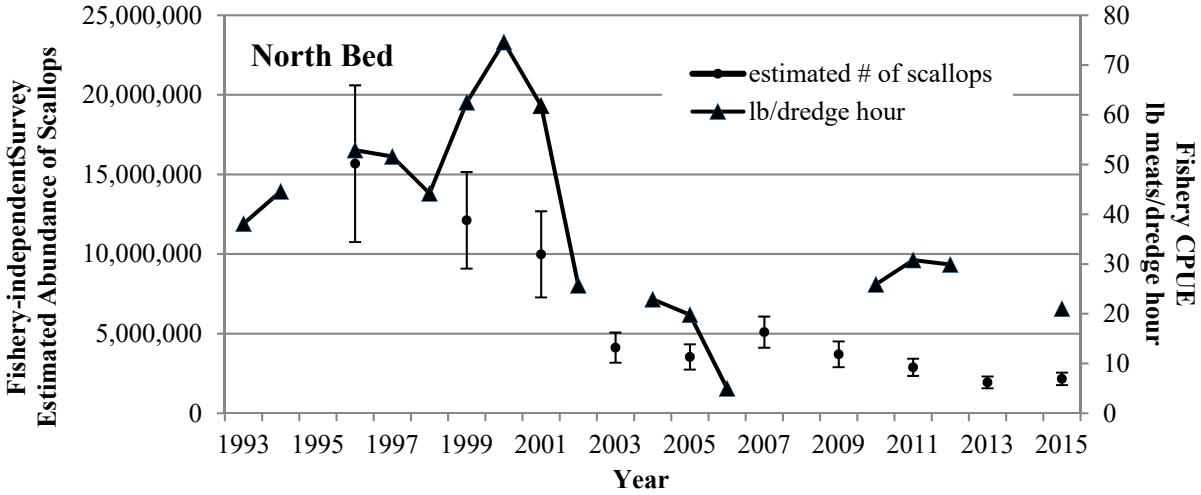


Figure 6-7 Linear regression of Kayak west bed fishery CPUE and survey estimated biomass with survey year shown (n = 4; P=0.019; Std. Error=296,459.4).

Kamishak Bay

As with Kayak Island, Central Region staff also examined the relationship between fishery-independent surveys and commercial fishery CPUE for Kamishak Bay. Comparing the biomass of whole scallops to fishery CPUE was examined because this fishery is a biomass fishery (Figure 6-8). Results indicate that the survey estimated biomass and fishery CPUE in the north and south bed at Kamishak Bay show the same trends. Linear regression of the north bed fishery CPUE (kg meat/dredge hr) compared to survey estimated biomass of whole scallops (kg) had a strong relationship (Figure 6-9). Homer management shellfish biologists will continue to examine the relationship between fishery CPUE and survey information. We support the NPFMC, SSC's goal to see if these relationships can be used to shed light on the validity of CPUE-based indices being used in all other Regions of the state.



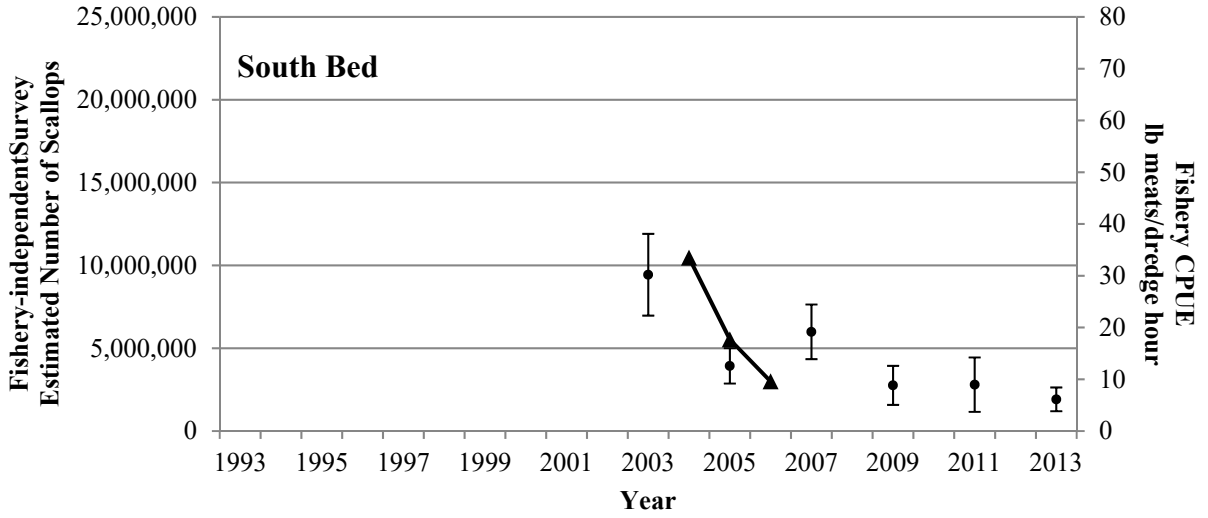


Figure 6-8 Comparison of fishery-independent survey biomass estimates (kg whole scallops) to commercial fishery CPUE, 1993 - 2015.

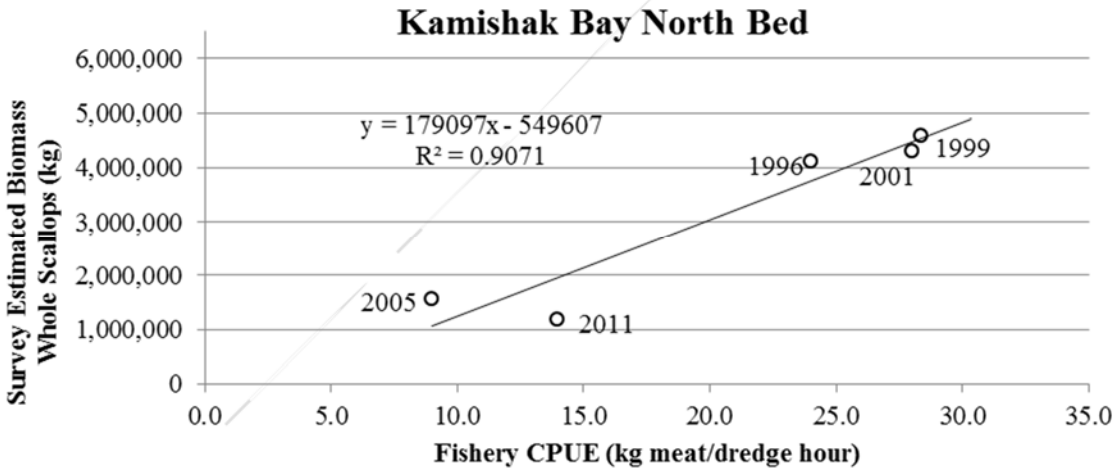


Figure 6-9 Linear regression of Kamishak Bay North bed fishery CPUE and survey estimated biomass with survey year shown (n = 5; P=0.012; Std. Error=578,093.4).

Appendix 3.6: Weak Meats

During the 2009 Scallop Plan Team Meeting "weak meats" were discussed. Weak meats are characterized by the adductor muscle coming off the shell when the viscera are pulled off the shell in the shucking process. These meats are off color, with a stringy consistency that makes them unacceptable for marketing by the industry.

In 2009 a collaborative study between ADF&G and the Kodiak Seafood and Marine Science Center (UAF) was done on scallops from the Yakutat area that the fishermen term "weak meats". This study looked at differences in scallop meat quality using chemical and physical parameters and results showed that it seemed most likely that the condition was caused by nutritional stress. The Yakutat scallops from the 2009 study were not inspected for diseases and/or parasites however.

In January 2015, the captain of the F/V Provider informed ADF&G that he was seeing "weak meats" in Bering Sea scallops he was catching so samples were collected and sent to the ADF&G Anchorage Pathology Lab for analysis of any evidence of diseases and/or parasites. The results showed that the scallops were infected with an apicomplexan-like parasitic organism. To further evaluate the geographic extent and infection rates of this parasite, a sampling effort was initiated in July 2015 to collect samples from select locations across the state, from Yakutat to the Bering Sea. As of the end of November 2015, 180 scallop adductor muscles fixed in 10% formalin and 180 scallop adductor muscle tissue pieces preserved in 95% ethanol have been collected by scallop observers and sent to the ADF&G Anchorage Pathology Lab for analysis.

Sampling for weak meats has been incorporated onto age-height-sexual maturity sampling protocols in the fishery independent surveys. The prevalence of weak meats by count amongst all sampled scallops is shown in Table 6-6.

Table 6-6 Prevalence of weak meats in sampled catch during fishery independent scallop surveys

Year	Kamishak Bay				Kayak Island			
	North Bed		South Bed		East Bed		West Bed	
	n	% Weak	n	% Weak	n	% Weak	n	% Weak
2010					191	5.8	284	2.5
2011	665	11.4	202	5.0				
2012					314	12.4	149	1.3
2013	668	9.9	410	2.9				
2014					643	3.7	332	1.2
2015	679	22.7						