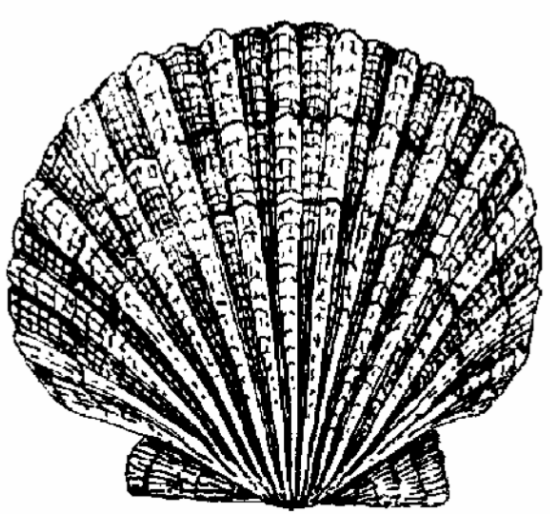
STOCK ASSESSMENT AND FISHERY EVALUATION REPORT

FOR THE SCALLOP FISHERY OFF ALASKA

March 5, 2024

Prepared by:

The Scallop Plan Team



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Definitions

The FMP contains the following stock status definitions:

Acceptable Biological Catch (ABC) is a level of annual catch of a stock that is set below the OFL and accounts for the scientific uncertainty in the estimate of OFL as well as any other scientific uncertainty. The maximum ABC is calculated from the ABC control rule. Annually, the Council's Scientific and Statistical Committee will set a statewide ABC for the weathervane scallop fishery prior to the beginning of the fishing season. The Scientific and Statistical Committee may set an ABC lower than the maximum ABC, but it must provide an explanation for setting the ABC below the maximum ABC.

ABC Control Rule is the specified approach for setting the maximum ABC for weathervane scallops. The ABC control rule calculates a maximum statewide ABC at 90 percent of the OFL, providing a 10 percent buffer to account for scientific uncertainty in estimation of the OFL.

Annual Catch Limit (ACL) is the level of annual catch that, if exceeded, invokes reactive accountability measures. For weathervane scallops, the ACL is set equal to ABC. B_{MSY} is the total weight of the stock, i.e., biomass (B) that results from fishing at F_{MSY} and is the minimum standard for a rebuilding target when a rebuilding plan is required.

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

F_{MSY} Control Rule is a harvest strategy based on fishing mortality (F) which would be expected to result in a long-term average catch approximating MSY. Guideline Harvest Level (GHL) is specified by the State and represents the pre-season estimated level of harvest that will not jeopardize the sustained yield of a stock. GHL may be expressed as a range of allowable harvests for each State registration area, district, sub-district, or section.

Maximum Sustainable Yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions. The long-term average stock size obtained by fishing year after year at this rate under average recruitment may be a reasonable proxy for the MSY stock size, and the long-term average catch so obtained is considered a reasonable proxy for

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

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

Overfishing Limit (OFL) is the catch above which overfishing is occurring and in the absence of an estimate of the statewide weathervane scallop spawning biomass, the default OFL is the MSY.

Executive Summary

1. **Stock**: Weathervane scallop (*Patinopecten caurinus*) in waters off Alaska. Status of other Alaska scallop stocks are detailed in the Ecosystem Component section of time document.
2. **Catches**: Early landings of Alaska weathervane scallops occurred during the late-1960's near Kodiak Island. The fishery expanded rapidly to the eastern Gulf of Alaska (GOA)(i.e., Yakutat) and catches peaked in 1969 (1.85 mil lb; 839 t), then decreased through 1978. A smaller, more stable fishery occurred throughout the 1980's and the fishery expanded along the Aleutian Islands and to Prince William Sound. During the early-1990's fishery participation nearly doubled and scallop landings quickly rose to a second peak in 1992 (1,785,673 lb; 810 t shucked meats). Following a precipitous decline in the mid-1990's, scallop catches slowly decreased until the 2013/14 season whereafter landings in the Bering

Sea and Kodiak Shelikof beds sharply dropped, with the lowest statewide harvest level on record (aside from the 2020 COVID-19 pandemic) occurring during the 2016/17 season (229,009 lb; 104 t). There has been modest increase in catches following improved fishing performance in Kodiak Shelikof and Kodiak Northeast in 2021 (298,770 lb; 136 t) and 2022 (329,095 lb; 149 t). Statewide landings during the 2023/24 season totaled 318,647 lb (145 t) shucked meats.

3. **Stock Biomass**: Estimates of the full stock biomass are not available. ADF&G has performed dredge surveys in the Cook Inlet (Area H) and Prince William Sound (Area E) registration areas since 1996. Survey protocols were standardized and expanded to the Kodiak (Area K) and Yakatut (Area D) registration areas in 2016. The survey now alternates between major districts within registration areas in the western GOA (i.e., Kodiak Northeast, Kodiak Shelikof, Cook Inlet) and eastern GOA (i.e., Prince William Sound, Yakutat) on a biennial cycle. Bering Sea (Area Q), Dutch Harbor (Area O), and Alaska Peninsula (Area M) registration areas, as well as Area K districts west of Kodiak Shelikof has never been sampled by the dredge survey. ADF&G Dredge Survey results are listed in Table 3.

4. **Management performance**: No overfished determination has been made for this stock, thus stock status is "unknown". Two vessels participated in the 2023/24 fishery, resulting in 318,647 lb (145 t) retained shucked meats and an estimated 9,465 lb (4.3 t) discard mortality. Overfishing did not occur in the 2023/24 season, or any previous season in the time series (Figure 2).

Table 1: Management quanities for the statewide Alaska weathervane scallop fishery during the previous five seasons. All weights represent schucked meats. Total catch includes estimated discard removals assuming 20% handling mortality.

Season	Combined GHL	Retained Catch (lb)	Total Catch (lb)	OFL (mil lb)	ABC (mil lb)
2019/20	267,500	229,945	246,900	1.284	1.156
2020/21	277,500	222,560	234,662	1.284	1.156
2021/22	345,500	298,770	311,978	1.284	1.156
2022/23	375,500	329,095	345,689	1.284	1.156
2023/24	374,700	318,647	328,112	1.284	1.156
2024/25				1.284	1.156
2025/26				1.284	1.156

Season	Combined GHL	Retained Catch (t)	Total Catch (t)	OFL (t)	ABC (t)
2019/20	121	104	112	582	524
2020/21	126	101	106	582	524
2021/22	157	136	142	582	524
2022/23	170	149	157	582	524
2023/24	170	145	149	582	524
2024/25				582	524
2025/26				582	524

5. **Basis for the OFL**: OY is established as a range from 0 - 1.284 million lb (582 t) schucked meats. The upper limit of OY is based on the average retained catch from 1990 - 1997 (excluding 1995), plus an estimate of discard mortality during that time period. In lieu of an estimate of spawning biomass, OFL is set such that max OFL = OY. OFL will be set at 1.284 mil lb (582 t) for the 2024/25 and 2025/26 seasons.

6. **Basis for the ABC recommendation**: The maximum ABC control rule is defined as max ABC = 90% of OFL = 1.156 million lb (524 t). ABC will be set at 1.156 mil lb (524 t) for the 2024/25 and 2025/26 seasons.

A. Summary of Major Changes

1. Changes in Management of the Fishery

The Guideline Harvest Limit (GHL) for the West Kayak Island subsection of Area E (Prince William Sound) decreased from 8,000 lb (3.62 t) shucked meats to 7,200 lb (3.27 t), reducing the statewide total from 375,500 lb (170 t) to 374,700 lb (169.9 t).

2. Changes to the Input Data

There are no changes to data informing the current OFL and ABC. Retained catch and total fishing mortality have been updated through the 2023/24 season. New ancillary data include 2023/24 fishery observer data and 2023 ADF&G dredge survey estimates (see Section D for details).

3. Changes in Assessment Methodology

Harvest specifications continue to be determined using the average total catch approach described in the FMP and section E of this document. An alternative approach is described in Appendix B.

4. Changes in Assessment Results

None.

B. Responses to Comments

SSC April 2023

Comment: "*The SSC concurred with the SPT that collecting reatined-not-landed (RNL) meat data via the observer program would be valuable, if feasible, and recommended work on estimating RNL be a priority.*"

Response: There were no changes to observer protocols for the 2023/24 season, and the assessment author was unable to make progress on RNL meats estimation given the currently available data during this assessment cycle. The ADF&G Scallop Observer Program will consider if RNL meat data collection can be accommodated with current sampling duties.

Comment: "*The SSC appreciates ongoing efforts to recover 1992 - 2008 fishery data to better inform the CPUE index and size compositions supplied to the model.*"

Response: ADF&G staff have made some progress in partitioning fish ticket data from 1990 - 2008 by district, but no progress has been made regarding observer data pre-2008.

Comment: "*The SSC appreciates this work and concurs with the author and SPT recommendation to carry forward (stock synthesis) models 23.0a3 and 23.3 for review in the next full assessment. This is based on overall fit to the data and retrospective analysis.*"

Response: The author recommended shelving development of an age-structured model in favor of pursuing data limited approaches that could be used to assess a greater proportion of the stock.

Comment: "*Staff provided a summary of ongoing efforts to revise the Scallop FMP to remove language requiring that specifications be set annually and allow for a biennial or triennial schedule. The SSC reiterates its support for such an amendment.*"

Response: Amendment 18 is finalized, and the SPT recommends setting harvest specifications on a biennial cycle.

C. Introduction

1. Scientific Name

Weathervane scallop, (*Patinopectan carinus*), in waters of Alaska. Although the FMP covers all scallop stocks off the coast of Alaska, including reddish scallop (*Chlamys rubida*), spiny scallop (*Chlamys hastata*), and rock scallop (*Crassadoma gigantea*), the weathervane scallop is the only commercially targeted stock at this time. Status of other Alaska scallop stocks are detailed in the Ecosystem Component section of this document.

2. Distribution

Weathervane scallop inhabit waters 2 - 300 m depth in the northeastern Pacific Ocean as far west as the Aleutian Islands, Alaska and Bering Sea to as far south as Point Reyes, California. Scallop habitat generally consists of clayey silt to gravely mud substrates (Turk 2001).

3. Stock Structure

Alaska weathervane scallops are considered a single stock under the FMP (NPFMC 2014), though the State of Alaska manages the stock as nine registration areas, each containing various management districts or subdistricts (Figure 1). Scallops tend to form dense aggregations in discrete 'beds' that parallel the direction of the prevailing current. Gaffney et al., (2010) observed genetic homogeneity among several nuclear and mitochondrial genetic markers along much of the GOA and southeastern Bering Sea. There is little knowledge of larval connectivity, though it is assumed that connectivity throughout the GOA is facilitated from east to west by the Alaska Coastal Current.

4. Life History

Knowledge of weathervane scallop early life history is mostly borrowed from other, similar scallop species. Weathervane scallops are dioecious, and maintain an approxiamtely 50:50 sex ratio within beds. Scallops in the western GOA grow faster and larger than those in the eastern GOA (Ignell and Haynes 2000). Sexual maturity takes place between ages 3 - 4 yr or 74 - 128 mm shell height in Kodiak and 73 - 92 mm in Yakutat (Hennick 1970). Gonads are observed full (i.e., ripe) between February - May, with spawning typically occurring in May - June. Gonad recovery to the next full state takes approximately six months. Spawn timing is thought to influence intra-annual fluctuation in abductor muscle weight (i.e., meat weight) at size (Hennen and Hart 2012). Fertilized eggs settle to the bottom where they develop into veliger larvae. Veligers swim in the water column and feed on microplankton for several weeks before settling to the bottom. Age is determined by the formation of concentric annual growth rings formed on the upper valve. The first annulus is formed during the second year of life (about 17 mm shell height) and subsequent annuli are laid on an annual basis. Weathervane scallops are long-lived, with ages commonly observed in the 20's and as old as 28 years (Hennick 1973).

5. Fishery History

An Alaskan weathervane scallop fishery was first established near Kodiak Island in 1967 following decline in fishing opportunity for red king crab (*Paralithodes camtschaticus*). In 1968 the fishery expanded to Yakutat and 19 vessels landed 1.68 mil lb (761 t) shucked meats. The fleet included both specialized scallop vessels from New England and local vessels converted from other fisheries. The fishery peaked in 1969, with 1.85 mil lb (839 t). Interest in the fishery declined rapidly through 1973, with only 5-7 landing approximately 1.16 mil lb (527 t) annually. Early observer data suggested a lesser proportion of older ($\geq$ 7 yr) scallops in catches compared to the fishery's inaugural years. Landings further decline through the mid-1970's, averaging only

~306,000 lb (139 t) yr^{-1} taken from Kodiak and Yakutat. The observer program was discontinued through this period and no data other than landings were collected (Kaiser 1986; Kruse et al., 2005).

Overcapitalization of the New England sea scallop (*Placopecten magellanicus*) renewed interest in Alaska weathervane scallops and more stable fishery occurred throughout the 1980's. During this period, the fishery began expanding outward from Yakutat and Kodiak areas, though Kodiak beds still accounted for nearly half of scallop landings. During the early-1990's exploration of previously unfished beds resulted in a rapid increase in fishery participation, landings, and ex-vessel revenue. Following a second peak in landings in 1992 (1,785,673 lb; 810 t shucked meats), ADF&G drafted an interim fishery management plan (FMP) that introduced new fishery management measures aimed at ensuring the long-term viability of the stock amid conservation concern surrounding increasing effort and harvest (Kruse et al., 2005). The early-1990's also saw greater specialization of scallop vessels and an increase in onboard freezing of shucked meats. New regulations curtailed landings between 1993-1994 and the fishery was closed for most of 1995 by NMFS after a loophole in state management jurisdiction was exploited by a single vessel operating in federal waters (> 3 mi from shore) after the GHL set by ADF&G was met. The fishery rebounded and reached its most recent peak in landings in 1999 (838,046 lb; 380 t). In 2000, the NPFMC implemented a license limitation program and most vessel owners formed a fishery cooperative. Throughout the 2000's fishery participation became more consolidated and scallop catches slowly decreased until the 2013/14 season, whereafter landings in the Bering Sea and Kodiak Shelikof beds sharply dropped. The lowest statewide harvest level on record (aside from the 2020 COVID-19 pandemic) occurred during the 2016/17 season (229,009 lb; 104 t). There has been modest increase in catches following improved fishing performance in Kodiak Shelikof and Kodiak Northeast in 2021 (298,770 lb; 136 t) and 2022 (329,095 lb; 149 t). Statewide landings during the 2023/24 season totaled 318,647 lb (145 t) shucked meats.

6. Management History

Management of the Alsaka weathervane scallop fishery by the State of Alaska began in 1968 with the introduction of fishing seasons, gear restrictions, and closure areas. Initially a small survey and at-sea observer program were initiated for the collection of biological data, but were discontinued in the 1970's. After rapidly increased landings and ensuing conservation concern in the early 1990's, ADF&G declared the scallop fishery a "High-impact Emerging Fishery" and developed an interim FMP in 1993. A refined FMP was formally adopted in 1994 (Kruse 1994). The 1994 FMP established the current registration areas, crew limits, new gear restrictions, guideline harvest ranges (GHRs), and fishing seasons. During this time, a mandatory industry-funded onboard observer program began for collection of scallop biological data and monitoring of crab bycatch. In 1995, a single vessel exploited a loophole in federal-state management jurisdiction which results in over-harvest of area E. NMFS adopted an emergency measure closing the fishery and established the federal FMP (NPFMC 2014). The FMP established optimum yield (OY) as a range from 0 to 1.1 million lb (~500 t) of shucked scallop abductor muscles (meats) with the upper end being based on the historic high in landings since 1993.

6.1 Amendments to the FMP

Amendment 1 to the FMP established a joint federal and state management regime, in which federal regulations mirrored most state regulations as a temporary measure until changes to the Magnuson-Stevens Act allow the NPFMC to delegate management of the scallop fishery in federal waters to the State of Alaska. Amendment 1 also increased the upper limit of OY to 1.8 million lb (816 t) to account for historic landings in state waters. The fishery re-opened in federal waters on August 1, 1996. In 1997, Amendment 2 to the FMP established a temporary moratorium on new vessels entering the fishery through June, 2000. Eighteen vessels qualified for permits during this period. Amendment 3 to the FMP (1998) officially delegated management of the fishery in federal waters to the State of Alaska. The NPFMC adopted the current license limitation program (LLP) in June, 2000 (FMP Amendment 4). The LLP allowed nine licenses, two of which were limited to a single 6 ft dredge. Gear restrictions on these two licenses were removed by Amendment 10 in 2004. Amendment 6 to the FMP (1999) revised OY as 0 to 1.24 million lb (562 t), with the upper limit defined as the the average retained catch between 1990 - 1997, excluding 1995 (Free-Sloan 2007; Table 2). Amendment 7 and 9 to the FMP identified several habitat areas of particular concern that are closed to scallop dredging

(i.e., bottom-contact fishing). Optimum yield was further refined by Amendment 13, which increased the OY upper limit by 44,000 lb (1.284 million lb) to account for all sources of fishing mortality during the reference period based on a proxy estimation (Balsiger et al., 2011). Amendment 13 also established that the overfishing limit (OFL) be set equal to the maximum sustainable yield (MSY; the upper limit of OY) and specified an acceptable biological catch (ABC) control rule that allows a maximum ABC of 90% of the OFL. Annual catch limit (ACL) of weathervane scallops was set so that ACL = ABC, and state guideline harvest levels (GHLs) must be set so that retained catch and estimated discard mortality be no greater that the ACL/ABC. Amendment 15, approved on October 31, 2012, revised EFH descriptions and identifications by species and updated life history, distribution, and habitat association information based on information from the EFH 5-year review. Amendment 16, approved on October 8, 2014, designated six areas of skate egg concentration as Habitat Areas of Particular Concern (HAPC). The HAPC designations for the six areas of skate egg concentration in the BSAI are intended to highlight the importance of this EFH. Amendment 17, approved on September 17, 2021, revised the language surrounding the bycatch reporting methodology to meet the goals of the MSA. Amendment 18, approved on January 19, 2024, revised the timing for developing the SAFE report and harvest specification setting process to allow more flexibility and remove the annual SAFE production and specification setting process requirement.

6.2 ADF&G Management Measures

6.2.1 Registration Areas and Districts The Alaska Scallop Fishery Management Plan (5 AAC 38.076) established nine scallop registration areas in Alaska for vessels commercially fishing scallops (Figure 1). These include the Southeastern Alaska Registration Area (Area A); Yakutat Registration Area (Area D), which was previously divided into the YAK and D16 Districts; Prince William Sound Registration Area (Area E), which is subdivided into the East (EKI) and West Kayak Island (WKI) Subsections; Cook Inlet Registration Area (Area H), which is subdivided into the Northern, Central, Southern, Kamishak Bay (KAM), Barren Islands, Outer and Eastern Districts; Kodiak Registration Area (Area K), which is subdivided into the Northeast (KNE), Shelikof (KSH), Southeast (KSE), Southwest (KSW), and Semidi Islands Districts (KSEM); Alaska Peninsula Registration Area (Area M), which is subdivided into the West Chignik (WC), Central (C), and Unimak Bight (UB) 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. Since 2018/19, beds adjacent to the Karluk River have been managed as part of the KSW district, instead of the KSH district. Fishery statistics have been adjusted back to 2009/10 to account for this change.

6.2.2 Seasons The regulatory fishing season for weathervane scallops in Alaska outside of the Area H is July 1 through February 15 (5 AAC 38.167, 5 AAC 38.220 & 5 AAC 38.420). The regulatory fishing season for weathervane scallops in the KAM District of Area H is August 15 through October 31 (5 AAC 38.320). These seasons were developed to limit fishing during scallop spawning periods, to achieve the highest possible product quality, to limit gear conflicts with other fisheries, and to increase vessel safety. Scallop fishing in any registration area in the state may be closed by emergency order prior to the end of the regulatory season.

6.2.3 Guideline Harvest Ranges 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 ADF&G in 1993 under the interim FMP. Regulatory GHRs were set at 0 - 250,000 lb (113 t) for Area D; 0 - 50,000 lb (23 t) for Area E; 10,000 - 20,000 lb (4.5 - 9 t) for the KAM District of Area H; 0 - 400,000 lb (181 t) for Area K; and 0 - 170,000 lb (77 t) for Area O. 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 1996 re-opening of the weathervane scallop fishery, the State of Alaska established GHRs for non-traditional registration areas including: 0 - 200,000 lb (91 t) for Area M; 0 - 600,000 (272 t) lb for Area

Q; 0 - 35,000 lb (16 t) for District 16 (Area D); and 0 - 75,000 lb (34 t) for Area R. The combined total of the upper limits from traditional and non-traditional areas was 1.8 million lb (816 t), which was defined as MSY in Amendment 1 to the FMP.

To accommodate the new definition of OY in Amendment 6 of the FMP, regulatory GHR ceilings were reduced by the State of Alaska from 400,000 lb (181 t) to 300,000 lb (136 t) in Area K; fromm 200,000 lb (91 t) to 100,000 lb (45 t) in Area M; from 170,000 lb (77 t) to 110,000 (50 t) in Area O; and from 600,000 lb (272 t) to 300,000 lb (136 t) in Area Q. Hence, the regulatory GHR ceiling written into Alaska regulatory code is also 1.24 million lb.

6.2.4 Minimum Performance Standards Following concern over declining harvest within Area K during the 2002/03 season, an in-season minimum performance standard (MPS; formerly 'benchmark') was established prior to the 2003/04 season to gauge fishery performance and support in-season fishery closures, if warranted. CPUE of shucked meats is tracked throughout the season by management area and compared to the MPS standard. If the in season cumulative CPUE is less than or equal to the MPS 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 MPS the fishery may continue toward the upper end of the GHL with continued monitoring. This approach has been applied to management areas, major beds within management areas, and statistical reporting areas depending upon the level of concern. It is important to clarify that the MPS is not viewed as a management goal, but rather a low mark around which to base conversation on in-season management actions. ADF%G uses MPS for the KNE and KSH Districts of Area K and Area D (below).

Area	MPS (mt / dregde hr)	Basis Year	Reference Time Series
D (Yakutat)			
Yakutat	34	2011/12	1998/99 - 2013/14
K (Kodiak)			
KNE (Northeast)	46	2005/06	2000/01 - 2009/10
KSH (Shelikof)	47	2002/03	2000/01 - 2009/10
Q (Bering Sea)			
Q	43	2005/06	2000/01 - 2009/10

6.2.5 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 State of Alaska Board of Fisheries and the NPFMC under Amendment 1 to the FMP. Since that time definitions of CBLs have undergone minor changes. In Areas K, M, O, and Q the CBLs for *Chionoecetes* crabs are determined as a rate of crab per pound of scallop GHL, whereas bycatch limits for red king crab (*Paralithodes camtschaticus*; RKC) are fixed. ADF&G uses different rates in Areas K and M depending on whether estimates of Tanner crab mature male biomass from recent trawl surveys are above (larger bycatch rate) or below (lower bycatch rate) a Tanner crab harvest strategy threshold (5 AAC 35.507). Rates applied to determine CBLs vary by scallop harvest area (below). In Areas H and E, the CBL for Tanner crab is set at 0.5% of area swept estimates of crab caught during the most recent scallop dredge survey, while the CBL is fixed at 30 crab for Area H only. Crab bycatch limits are not used in area D. Time series of bycatch limits and crab bycatch totals since 2009/10 season are in Tables (16 - 23).

Registration Area	RKC[a] (number of crab)	Tanner crab (*C. bairdi*) (crab / lb)	Snow crab (*C. opilio*) (crab / lb)
K (Kodiak)	25	0.5 or 0.6	
M (Alaska Peninsula)	25	0.5 or 0.6	
O (Dutch Harbor)	10	0.75	
Q (Bering Sea)	100	2.5	1.5

6.2.6 State Water Vessel Limitation Participating in the Scallop fishery in State of Alaska waters (0-3 nmi) had been limited by a vessel-based limited entry program until State limited entry expired in 2013 and

was not renewed by the Alaska State Legislature. To date, no additional state-only vessels have participated in the open access state water fishery.

D. Data

1. Historic Catch Data

Fish ticket data have been previously used to document retained catch in the early years of the fishery (Kruse et al. 2005; Free-Sloan 2007). From 1985 until 2008, retained scallop meat weight harvested during scallop fisheries was stored within the State of Alaska shellfish fish ticket database and not directly connected with other data collected by the scallop observer program. Errors and omissions are common within this data because the data were reviewed independently by staff among ADF&G regions and lacked a standardized comprehensive review by a statewide coordinator familiar with the fishery and participants. After researching the fish ticket database, scallop observer databases, historic annual management reports, emergency orders, news releases, trip logs, vessel registrations and speaking with vessel operators, errors in the fish ticket data from 1990 to 2008 were identified. Scallop observer program staff worked with staff at ADF&G Headquarters as well as within the Southeastern, Central, and Westward Regions to correct the errors. A summary of retained scallop meat weight harvest data by registration area and district has been compiled from 1990-2008.

2. ADF&G Scallop Observer Program

ADF&G established the current at-sea observer program for the scallop fishery in 1993 under 5 AAC 38.076 (g). Earlier, at-sea observers were utilized intermittently for targeted collection of biological data. ADF&G has always required 100% observer coverage, except in Area H, where the fishery has historically been prosecuted by smaller vessels. Scallop observers principally collect information on the retained catch, as well as discard and bycatch rates to satisfy requirements of the Magnuson-Stevens Act and support regulatory enforcement. In addition, observers have collected a suite of biological data including shell height compositions of the retained and discarded catch, individual meat weights and gonad condition, shells for aging, and condition of discarded scallops. Data gathered through the observer program comprise the primary information source for ADF&G in setting harvest limits.

In 2009, ADF&G made changes to how observers recorded data at sea and subsequently, the program's data management practices. These changes no longer required observers to summarize data at sea and shoreside ADF&G staff began curating raw data in a local database. The current scallop observer database only contains data from 2009 - present. Data collected from 1993 - 2008 requires considerable reformatting, rescue of data from original paper data forms and current quality assurance/quality control procedures applied before it is used in conjunction with data from 2009 - present. As a result, only prior estimates of retained round and meat biomass, discards, and nominal CPUE are available for 1993 - 2008.

Vessel fishing logbooks track haul specific data from both observer sampled and non-sampled hauls including location, duration, retained catch (i.e., in units of bushels of whole scallops), and crab bycatch. These data are paired with daily observer collected catch sampling data to estimate haul specific retained catch in units of round biomass and associated CPUE. Haul specific retained meat biomass is obtained by apportioning totals from the vessel's daily meat weight production log to fishing logbook data. Daily meat weight production logs are used by ADF&G as the primary data source for tracking retained catch towards area GHLs. Time series of area specific GHL, estimated retained catch, discard mortality, and CPUE are in Tables 4 - 15.

3. ADF&G Dredge Survey

ADF&G dredge surveys began in Area H and and Area E. The program's inaugural surveys were conducted in Kamishak Bay in 1984 (Hammarstrom and Merritt 1985) and around Kayak Island in 1996 (Bechtol et al., 2003). Since 1996 biennial surveys have continued in these areas (Gustafson and Goldman 2012), enabling ADF&G to (1) delineate the primary scallop beds; (2) estimate scallop abundance and biomass within them; (3) characterize bed composition using age and shell height data; and (4) estimate catch rates of non-target species, particularly Tanner crab. In 2016, ADF&G expanded the dredge survey to other commercially

important harvest areas (Smith et al., 2016). Surveys from 2016 – 2018 sampled beds within Kodiak Shelikof (KSH) and Northeast (KNE) Districts, Area E, and Area D somewhat irregularly. Since 2019, ADF&G has standardized existing survey efforts and focused on sampling all actively fished beds in the eastern GOA (Areas E and D) or western GOA (KSH, KNE, and Area H) on a biennial basis. Complete details of the survey area, survey design, sampling protocols, and data analysis are found in Burt et al., (2021).

The 2023 ADF&G dredge survey sampled seven beds between the YAK District (Area D) and the EKI and WKI subsections of Area E. The portion of the EK1 bed that lies within the YAK District was not sampled due to logistic restraints. Abundance and biomass of exploitable-sized scallops ($\geq$ 100 mm shell height) increased overall in the YAK District, and slightly decreased in WKI and EKI. Abundance and biomass of pre-recruit-sized scallops ($<$ 100 mm) decreased among all beds except WKI (Hopkins et al., *in prep*). Estimates from the 2023 survey are in Table 3, and full details of survey results are in Hopkins et al., (*in prep*). ADF&G dredge survey data are not currently used for computation of OFL/ABC.

E. Analytical Approach

1. History of Modelling Explorations

Bechtol (2000) used fishery and ADF&G dredge survey data to develop an age-structured assessment model of the Kamishak Bay portion of the stock from 1983 – 1997. This model was updated using newer survey age compositions and catch data through 2012 (Zhang 2014). Exploration of a Kamishak catch-at-age model was again furthered by Zheng (2018), and Jackson and Zheng (2022) using Stock Synthesis (Methot and Wetzel 2013). Scallop modelling using Stock Synthesis was continued for Kodiak Shelikof District by Jackson (2023). While results of model explorations in Kamishak and Shelikof Districts were promising, extension of these models to the broader stock is unlikely due to the disparity in data availability among districts and the resources necessary for model development. Appendix B explores using ADF&G drede survey and fishery CPUE data in a state-space random walk model (REMA; Sullivan et al. 2023) as a data-limited approach for assessing this stock.

2. Current Approach

MSY stock size and allowable catch limits for the full stock have been based on historic catches since 1996 (NPFMC 2014). A reference period from 1990 - 1997, excluding 1995 reflects the prevailing ecological conditions and a time when the fishery was fully capitalized. Since 1996, MSY has been revised to 1) use average total catch as opposed to maximum (Amendment 6; NPFMC 1998) and 2) incorporate bycatch fisheries (Amendment 13; Balsiger et al., 2013).

F. Harvest Specifications

1. Calculation of the OFL

The original FMP established optimum yield (OY) as a range from 0 to 1.1 million lb (499 t) of shucked meats with the upper end being based on the historic high in landings since 1993. Under Amendment 1, in 1996, the upper end for OY was increased to 1.8 million lb (816 t) to account for historic State water landings. A more conservative approach was taken in 1999, when OY was re-defined as 0 to 1.24 million lb (562 t) with the upper end reflecting average rather than maximum catch. The reference period for defining the upper range for OY is 1990-1997 excluding 1995 (Free-Sloan 2007; Table 2). Most recently, in 2012, under Amendment 13, OY was re-defined as 0 to 1.284 million lb (582 t) of shucked meats to include estimated discard mortality (39,680 lb; 18 t) in the directed fishery, groundfish fisheries, and agency surveys over the reference time frame, assuming 20% handling mortality. Balsiger et al., (2013) details accounting of total scallop mortality in the directed fishery and bycatch fisheries as computed at the time.

2. Calculation of the ABC

The ABC control rule calculates a statewide maximum ABC at 90% of the OFL, which provides a 10% buffer to account for scientific uncertainty in the estimation of the OFL. The recommendation is to set ABC at the maximum allowable, or 1.156 million lb (524 t) shucked meats.

G. Data Gaps and Research Priorities

H. Ecosystem Components

1. Ecosystem Component Stocks

In Amendment 13 to the FMP established an 'Ecosystem Component' for non-target scallop stocks. Stocks contained under this category of the FMP are stocks which are not the subject of a directed fishery, including: rock scallops *Crassadoma gigantea*, pink scallops *Chlamys rubida*, and spiny scallops: *Chlamys hastata*, *Chlamys behringiana*, and *Chlamys albida*. For these stocks annual catch limits are not required to be annually specified.

No commercial harvests have been documented for scallop species other than weathervane scallops in waters off Alaska since at least 1992, but there are currently low-level personal use/subsistence fisheries for some of these species. Should a target fishery become desirable for any of these species, either as a whole complex or by individual stock grouping, an FMP amendment would need to be initiated by the Council to move the stock 'into the fishery' under the FMP and ACLs annually specified. 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 (von Szalay and Raring 2017; Markowitz et al., 2023).

2. Fishery Effects on Ecosystem

2.1 Effects on Benthos

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

2.1 Effects on Bycatch Species

Scallop fishery bycatch is closely monitored by the ADF&G Shellfish Observer Program. Bycatch in the scallop fishery includes prohibited species such as red king crab, Tanner crab, snow crab, and Pacific halibut *Hippoglossus stenolepis*, other commercially important species of fish and invertebrates, miscellaneous non-commercial species, and natural and man-made debris. Weathervane scallops predominate the catch composition by a large margin (~90-95%) (Figure 3). Crab bycatch in the scallop fishery is highest in the Bering Sea, although this accounts for a small proportion of total BSAI crab bycatch. Non-crustacean benthic invertebrates make up the largest proportion of bycatch in the Gulf of Alaska (Figure 3).

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Tables

Table 2: Statewide landings from 1990 to 1995 as summarized by Free-Sloan (2007).

Season	Retained catch (lb)	Retained catch (t)
1990	1,488,737	675
1991	1,136,649	516
1992	1,753,873	796
1993	1,511,539	686
1994	1,256,736	570
1995	351,023	159
1996	728,424	330
1997	802,383	364

Table 3: Estimated abundance (N), round biomass (t), meat biomass (t), and associated CVs of exploitable-sized ($\geq$ 100 mm shell height) and pre-recruit scallops ($<$ 100 mm shell height) by bed, from the 2023 ADF&G Dredge Survey.

Shell Height $\geq$ 100 mm		Abundance		Round Biomass		Meat Biomass	
District	Bed	N	CV	t	CV	t	CV
West Kayak Is. (WKI)	WK1	5,325,185	0.31	992	0.30	53.5	0.30
East Kayak Is. (EKI)	EK1	2,138,574	0.17	585	0.20	41.6	0.19
Yakutat (YAK)	YAK1	6,938,249	0.20	1,283	0.18	66.2	0.21
	YAK2	12,576,025	0.16	2,373	0.16	93.2	0.21
	YAK3	4,411,808	0.15	869	0.15	67.9	0.13
	YAK4	13,363,442	0.19	1,928	0.19	104.2	0.21
	YAK5	3,227,592	0.39	554	0.38	36.5	0.38

Shell Height $<$ 100 mm		Abundance		Round Biomass	
District	Bed	N	CV	t	CV
West Kayak Is. (WKI)	WK1	2,933,414	0.45	86.8	0.45
East Kayak Is. (EKI)	EK1	372,686	0.16	11.4	0.17
Yakutat (YAK)	YAK1	799,331	0.19	37.2	0.20
	YAK2	2,025,499	0.34	58.4	0.28
	YAK3	54,205	0.40	2.3	0.37
	YAK4	3,649,828	0.24	165.1	0.25
	YAK5	159,633	0.49	6.9	0.40

Table 4: Area D (Yakutat) fishery statistics from 1990 - present. Statistics pre-2009 are based on preliminary analysis of historic fish ticket data. Round weight catch pre-2009 is estimated assuming meat weight catch is 10% of round weight catch. Discard handling mortality was assumed 20%.

		Retained Catch		Discard	Dredge	CPUE	CPUE
Season	GHL	Meat (lb)	Round (lb)	Mortality (lb)	Hrs	(Meat)	(Round)
1990		590,934	5,909,340				
1991		442,388	4,423,880				
1992		1,068,303	10,683,030				
1993	160,000	289,101	2,891,010		1,999	145	1,446
1994/95	285,000	280,673	2,806,730		4,262	66	659
1995/96	285,000	275,793	2,757,930		5,807	47	475
1996/97	285,000	272,796	2,727,960	7,893	4,899	56	557
1997/98	285,000	265,830	2,658,300	5,842	4,517	59	589
1998/99	285,000	275,831	2,758,310	5,217	4,894	56	564
1999/00	285,000	284,305	2,843,050	10,379	4,514	63	630
2000/01	235,000	226,603	2,266,030	11,255	4,717	48	480
2001/02	235,000	124,198	1,241,980	5,624	2,823	44	440
2002/03	235,000	126,403	1,264,030	6,537	2,539	50	498
2003/04	235,000	161,990	1,619,900	6,958	3,376	48	480
2004/05	235,000	111,380	1,113,800	4,201	2,553	44	436
2005/06	235,000	213,001	2,130,010	7,585	5,496	39	388
2006/07	171,000	163,486	1,634,860	7,130	3,126	52	523
2007/08	171,000	126,140	1,261,400	9,218	2,615	48	482
2008/09	171,000	171,275	1,712,750	8,620	3,709	46	462
2009/10	185,000	170,016	2,514,992	13,966	4,385	39	574
2010/11	185,000	159,268	2,160,484	11,901	3,578	45	604
2011/12	185,000	158,210	2,378,995	11,344	4,653	34	511
2012/13	145,000	143,395	1,987,648	11,503	4,038	36	492
2013/14	145,000	147,400	1,852,695	5,042	3,025	49	612
2014/15	145,000	129,493	1,583,493	2,774	3,159	41	501
2015/16	145,000	120,690	1,704,274	3,656	2,571	47	663
2016/17	125,000	120,380	1,634,704	5,024	2,109	57	775
2017/18	145,000	145,080	1,819,772	8,150	2,899	50	628
2018/19	145,000	145,083	1,768,845	3,972	2,267	64	780
2019/20	155,000	144,245	1,986,687	11,282	3,293	44	603
2020/21	145,000	141,455	1,882,573	9,757	3,001	47	627
2021/22	145,000	145,010	1,976,880	6,765	2,455	59	805
2022/23	145,000	128,210	1,786,638	8,797	1,902	67	939
2023/24	145,000	145,270	1,815,838	4,512	2,077	70	874

Table 5: Area E (Prince william Sound) fishery statistics from 1990 - 1999. After 2000, Area E was managed as East and West Kayak Island Subsections. Statistics are based on preliminary analysis of historic fish ticket data. Round weight catch pre-2009 is estimated assuming meat weight catch is 10% of round weight catch. Discard handling mortality was assumed 20%.

		Retained Catch		Discard	Dredge	CPUE	CPUE
Season	GHL	Meat (lb)	Round (lb)	Mortality (lb)	Hrs	(Meat)	(Round)
1993	50,000	63,068	630,680				
1994/95							
1995/96	50,000	48,280	482,800				
1996/97							
1997/98	17,200	18,000	180,000				
1998/99	20,000	19,650	196,500		179	110	1,096
1999/00	20,000	20,410	204,100		149	137	1,367

*Landed Catch for 1995/96 doesn't include illegal fishing by one vessel.

Table 6: EKI (East Kayak Island) Subsection fishery statistics from 2000 - present. Statistics are based on preliminary analysis of historic fish ticket data. Round weight catch pre-2009 is estimated assuming meat weight catch is 10% of round weight catch. Discard handling mortality was assumed 20%. EKI has been closed since the 2012/13 season.

		Retained Catch		Discard	Dredge	CPUE	CPUE
Season	GHL	Meat (lb)	Round (lb)	Mortality (lb)	Hrs	(Meat)	(Round)
2000/01	9,000	8,998	89,980		92	98	983
2001/02	9,000	9,060	90,600		140	65	649
2002/03	6,000	1,680	16,800		43	39	394
2003/04	6,000	5,910	59,100		123	48	480
2004/05	26,000	25,350	253,500		430	59	590
2005/06	26,000	24,435	244,350		219	112	1,116
2006/07	20,000	20,010	200,100		188	106	1,064
2007/08	20,000	20,015	200,150		203	99	988
2008/09	15,000	15,030	150,300		197	76	763
2009/10	15,000	15,005	237,062	563	339	44	700
2010/11	8,400	8,445	133,502	191	161	52	828
2011/12	8,400	8,460	134,129	224	162	52	830

Table 7: WKI (West Kayak Island) Subsection fishery statistics from 2000 - present. Statistics are based on preliminary analysis of historic fish ticket data. Round weight catch pre-2009 is estimated assuming meat weight catch is 10% of round weight catch. Discard handling mortality was assumed 20%.

		Retained Catch		Discard	Dredge	CPUE	CPUE
Season	GHL	Meat (lb)	Round (lb)	Mortality (lb)	Hrs	(Meat)	(Round)
2000/01	21,000	21,268	212,680		129	164	1,643
2001/02	21,000	21,030	210,300		124	170	1,699
2002/03	14,000	13,961	139,610		79	177	1,766
2003/04	14,000	14,070	140,700		92	152	1,521
2004/05	24,000	23,970	239,700		185	130	1,298
2005/06	24,000	24,781	247,810		272	91	911
2006/07	17,000	17,005	170,050		147	116	1,157
2007/08	17,000	17,090	170,900		225	76	759
2008/09	5,000	5,010	50,100		134	37	374
2009/10	5,000	4,980	77,571	568	87	57	892
2010/11	Closed						
2011/12	Closed						
2012/13	Closed						
2013/14	Closed						
2014/15	Closed						
2015/16	Closed						
2016/17	6,300	6,360	102,506	175	112	57	913
2017/18	6,300	6,330	88,328	258	102	62	864
2018/19	6,300	6,420	85,467	530	133	48	643
2019/20	Closed						
2020/21	Closed						
2021/22	8,000	8,170	113,329	96	66	124	1,714
2022/23	8,000	8,130	108,687	157	86	94	1,259
2023/24	7,200	7,380	93,815	62	75	99	1,257

Table 8: Area H (Cook Inlet) fishery statistics from 2000 - 2017. Statistics are based on preliminary analysis of historic fish ticket data. Round weight is estimated assuming meat weight catch is 10% of round weight catch. Discard handling mortality was assumed 20%. Area H has been closed since 2017.

		Retained Catch		Discard	Dredge	CPUE	CPUE
Season	GHL	Meat (lb)	Round (lb)	Mortality (lb)	Hrs	(Meat)	(Round)
1990					0		
1991					0		
1992					0		
1993	20,000	20,115	201,150		528	38	381
1994/95	20,000	20,431	204,310		458	45	446
1995/96					0		
1996/97	28,000	28,228	282,280		534	53	529
1997/98	20,000	20,336	203,360		395	51	515
1998/99	20,000	17,247	172,470		390	44	442
1999/00	20,000	20,315	203,150		325	63	625
2000/01	20,000	20,516	205,160		275	75	746
2001/02	20,000	20,097	200,970		325	62	618
2002/03	20,000	8,591	85,910		311	28	276
2003/04	20,000	15,843	158,430		896	18	177
2004/05	20,000	6,117	61,170		364	17	168
2005/06	7,000	7,384	73,840		372	20	198
2006/07	7,000	50	500		10	5	50
2007/08	12,000				0		
2008/09	12,000				0		
2009/10	14,000				0		
2010/11	14,000	9,460	94,600		365	26	260
2011/12	12,500	9,975	99,750		324	31	310
2012/13	12,500	11,739	117,390		392	30	300
2013/14	Closed						
2014/15	Closed						
2015/16	10,000	9,485	94,850		459	21	210
2016/17	10,000	3,982	39,820		271	15	150
2017/18	10,000				0		

Table 9: KSH (Kodiak Shelikof) District fishery statistics from 1990 - present. Statistics pre-2009 are based on preliminary analysis of historic fish ticket data. Round weight catch pre-2009 is estimated assuming meat weight catch is 10% of round weight catch. Discard handling mortality was assumed 20%.

		Retained Catch		Discard	Dredge	CPUE	CPUE
Season	GHL	Meat (lb)	Round (lb)	Mortality (lb)	Hrs	(Meat)	(Round)
1990		449,841	4,498,410				
1991		464,405	4,644,050				
1992		256,142	2,561,420				
1993		156,118	1,561,180		2,491	63	627
1994/95		314,051	3,140,510		8,662	36	363
1995/96							
1996/97		219,305	2,193,050	4,018	3,491	63	628
1997/98		258,346	2,583,460	1,900	5,492	47	470
1998/99		179,870	1,798,700	4,409	4,081	44	441
1999/00	180,000	187,963	1,879,630	5,907	4,304	44	437
2000/01	180,000	180,087	1,800,870	2,621	2,907	62	619
2001/02	180,000	177,112	1,771,120	4,880	3,398	52	521
2002/03	180,000	180,580	1,805,800	10,120	3,799	48	475
2003/04	180,000	180,011	1,800,110	8,209	3,258	55	553
2004/05	180,000	174,622	1,746,220	8,883	3,467	50	504
2005/06	160,000	159,941	1,599,410	4,767	2,280	70	701
2006/07	160,000	162,537	1,625,370	4,789	2,183	74	745
2007/08	170,000	169,968	1,699,680	7,685	2,937	58	579
2008/09	170,000	13,761	137,610	658	263	52	523
2009/10	170,000	170,021	1,710,147	6,358	3,496	49	489
2010/11	170,000	167,293	1,843,528	6,923	3,407	49	541
2011/12	135,000	136,491	1,433,618	2,314	2,438	56	588
2012/13	105,000	106,040	994,397	2,296	2,001	53	497
2013/14	105,000	104,725	903,518	1,443	2,449	43	369
2014/15	105,000	62,556	612,125	734	1,548	40	395
2015/16	75,000	35,626	430,207	1,011	1,188	30	362
2016/17	25,000	20,606	264,873	873	719	29	368
2017/18	25,000	20,870	211,277	740	481	43	439
2018/19	25,000	21,701	239,700	2,973	416	52	577
2019/20	20,000	20,125	248,914	2,296	380	53	656
2020/21	40,000	40,060	409,155	999	433	93	945
2021/22	80,000	80,215	863,788	3,630	754	106	1,145
2022/23	100,000	99,970	975,847	3,995	923	108	1,058
2023/24	100,000	100,285	966,526	3,316	969	103	997

Table 10: KNE (Kodiak Northeast) District fishery statistics from 1990 - present. Statistics pre-2009 are based on preliminary analysis of historic fish ticket data. Round weight catch pre-2009 is estimated assuming meat weight catch is 10% of round weight catch. Discard handling mortality was assumed 20%.

		Retained Catch		Discard	Dredge	CPUE	CPUE
Season	GHL	Meat (lb)	Round (lb)	Mortality (lb)	Hrs	(Meat)	(Round)
1990		239,656	2,396,560				
1991		39,943	399,430				
1992		133,712	1,337,120				
1993		186,840	1,868,400		6,940	27	269
1994/95		35,207	352,070		1,773	20	199
1995/96							
1996/97		11,430	114,300	175	581	20	197
1997/98		95,858	958,580	874	2,604	37	368
1998/99		120,010	1,200,100	4,000	2,747	44	437
1999/00	75,000	77,119	771,190	2,380	1,384	56	557
2000/01	80,000	79,965	799,650	2,382	1,101	73	726
2001/02	80,000	80,470	804,700	3,497	1,142	70	705
2002/03	80,000	80,000	800,000	2,384	1,350	59	593
2003/04	80,000	79,965	799,650	5,522	1,248	64	641
2004/05	80,000	80,105	801,050	4,408	1,227	65	653
2005/06	80,000	79,990	799,900	2,842	1,759	45	455
2006/07	90,000	75,160	751,600	4,264	1,168	64	644
2007/08	90,000	75,105	751,050	2,328	1,170	64	642
2008/09	90,000	74,863	748,630	2,541	1,363	55	549
2009/10	75,000	69,410	834,953	2,396	1,222	57	683
2010/11	65,000	64,475	671,348	1,444	1,015	64	661
2011/12	70,000	61,209	671,789	1,734	986	62	681
2012/13	60,000	62,496	744,678	1,895	1,322	47	563
2013/14	55,000	54,926	526,629	1,257	934	59	564
2014/15	55,000	55,659	679,578	1,060	752	74	904
2015/16	55,000	55,577	636,996	1,668	1,228	45	519
2016/17	55,000	24,401	292,815	538	1,096	22	267
2017/18	55,000	14,190	136,297	418	349	41	391
2018/19	15,000	15,150	154,337	1,147	260	58	593
2019/20	15,000	15,070	165,696	932	206	73	806
2020/21	15,000	15,095	180,966	671	194	78	934
2021/22	30,000	30,295	279,451	2,123	294	103	949
2022/23	40,000	40,040	386,144	1,735	310	129	1,244
2023/24	40,000	40,385	411,129	1,318	544	74	755

Table 11: KSW (Kodiak Southwest) District fishery statistics from 2009 - present. Discard handling mortality was assumed 20%. All estimates include beds adjacent to the Karluk River that were managed as KSW since 2018/19. GHLs prior to 2018/19 do not reflect these beds.

		Retained Catch		Discard	Dredge	CPUE	CPUE
Season	GHL	Meat (lb)	Round (lb)	Mortality (lb)	Hrs	(Meat)	(Round)
2009/10	25,000	3,480	62,241	75	159	22	392
2010/11	25,000	3,783	50,987	546	100	38	508
2011/12	25,000	25,110	348,142	335	455	55	766
2012/13	25,000	25,025	261,291	312	672	37	389
2013/14	25,000	21,715	244,884	374	549	40	446
2014/15	25,000	28,555	354,597	305	636	45	558
2015/16	25,000	15,614	208,334	204	417	37	500
2016/17	25,000	29,624	501,480	566	558	53	898
2017/18	25,000	29,200	384,499	1,737	441	66	871
2018/19	30,000	33,319	398,928	1,991	510	65	782
2019/20	35,000	35,010	449,584	1,740	636	55	707
2020/21	35,000	25,950	361,366	675	589	44	613
2021/22	35,000	35,080	536,435	593	630	56	851
2022/23	35,000	35,030	484,498	931	517	68	938
2023/24	35,000	25,327	337,358	258	400	63	844

Table 12: KSE (Kodiak Southeast) District fishery statistics from 2018 - present. Discard handling mortality was assumed 20%.

		Retained Catch		Discard	Dredge	CPUE	CPUE
Season	GHL	Meat (lb)	Round (lb)	Mortality (lb)	Hrs	(Meat)	(Round)
2018/19	15,000	469	3,551	2	60	8	60
2019/20	15,000				0		
2020/21	15,000				0		
2021/22	15,000				0		
2022/23	15,000				0		
2023/24	15,000				0		

Table 13: Area M (Alaska Peninsula) fishery statistics from 1993 - present. Statistics pre-2009 are based on preliminary analysis of historic fish ticket data. Round weight catch pre-2009 is estimated assuming meat weight catch is 10% of round weight catch. Discard handling mortality was assumed 20%.

		Retained Catch		Discard	Dredge	CPUE	CPUE
Season	GHL	Meat (lb)	Round (lb)	Mortality (lb)	Hrs	(Meat)	(Round)
1993					1,847	71	710
1994/95					1,664	39	392
1995/96					0		
1996/97	200,000	12,560	125,600	136	327	38	384
1997/98	200,000	51,616	516,160	703	1,752	29	295
1998/99	200,000	63,290	632,900	794	1,612	39	393
1999/00	200,000	75,610	756,100	1,087	2,025	37	373
2000/01	33,000	7,660	76,600	83	320	24	239
2001/02	Closed				0		
2002/03	Closed				0		
2003/04	Closed				0		
2004/05	Closed				0		
2005/06	20,000				0		
2006/07	25,000	155	1,550	15	64	2	24
2007/08	10,000				0		
2008/09	10,000	2,460	24,600	75	151	16	163
2009/10	Closed				0		
2010/11	Closed				0		
2011/12	Closed				0		
2012/13	15,000	15,040	217,607	531	255	59	853
2013/14	15,000	15,155	193,106	339	247	61	781
2014/15	22,500	15,000	227,381	367	294	51	775
2015/16	22,500	15,000	207,991	180	308	49	676
2016/17	22,500	15,013	202,806	207	345	43	587
2017/18	22,500	15,250	181,646	469	328	47	555
2018/19	22,500	8,905	119,458	732	264	34	452
2019/20	15,000	5,740	63,937	518	118	49	542
2020/21	15,000				0		
2021/22	15,000				0		
2022/23	15,000	7,560	84,492	684	214	35	395
2023/24	15,000				0		

Table 14: Area O (Dutch Harbor) fishery statistics from 1993 - present. Statistics pre-2009 are based on preliminary analysis of historic fish ticket data. Round weight catch pre-2009 is estimated assuming meat weight catch is 10% of round weight catch. Discard handling mortality was assumed 20%.

		Retained Catch		Discard	Dredge	CPUE	CPUE
Season	GHL	Meat (lb)	Round (lb)	Mortality (lb)	Hrs	(Meat)	(Round)
1993	170,000	39,346	393,460		838	47	470
1994/95	170,000	1,931	19,310		81	24	238
1995/96	170,000	26,950	269,500		1,047	26	257
1996/97	170,000				0		
1997/98	170,000	5,790	57,900	402	160	36	362
1998/99	110,000	46,432	464,320	636	941	49	493
1999/00	110,000	6,465	64,650	93	278	23	233
2000/01	Closed				0		
2001/02	Closed				0		
2002/03	10,000	6,000	60,000	94	184	33	326
2003/04	Closed				0		
2004/05	Closed				0		
2005/06	Closed				0		
2006/07	Closed				0		
2007/08	Closed				0		
2008/09	10,000	10,040	100,400	706	225	45	446
2009/10	10,000	6,080	54,882	42	104	59	528
2010/11	10,000	5,640	42,177	65	83	68	506
2011/12	10,000	5,570	45,513	51	77	73	593
2012/13	5,000	5,100	37,730	54	64	79	588
2013/14	5,000	5,225	44,572	89	56	94	798
2014/15	5,000	5,160	41,323	78	73	70	563
2015/16	10,000	5,040	45,215	69	157	32	288
2016/17	10,000	5,050	39,181	26	104	48	376
2017/18	10,000	285	2,250	1	24	12	93
2018/19	5,000	325	3,571	1	24	14	152
2019/20	5,000	2,625	24,739	64	131	20	189
2020/21	5,000				0		
2021/22	10,000				0		
2022/23	10,000	2,620	32,482	97	132	20	247
2023/24	10,000				0		

Table 15: Area Q (Dutch Harbor) fishery statistics from 1993 - present. Statistics pre-2009 are based on preliminary analysis of historic fish ticket data. Round weight catch pre-2009 is estimated assuming meat weight catch is 10% of round weight catch. Discard handling mortality was assumed 20%.

		Retained Catch		Discard	Dredge	CPUE	CPUE
Season	GHL	Meat (lb)	Round (lb)	Mortality (lb)	Hrs	(Meat)	(Round)
1993					5,764	105	1,051
1994/95					11,113	45	455
1995/96					0		
1996/97	600,000	150,295	1,502,950	296	2,313	65	650
1997/98	600,000	97,002	970,020	699	2,246	43	432
1998/99	400,000	96,795	967,950	2,330	2,319	42	417
1999/00	400,000	164,929	1,649,290	1,249	3,294	50	501
2000/01	200,000	205,520	2,055,200	1,789	3,355	61	613
2001/02	200,000	140,871	1,408,710	1,393	3,072	46	459
2002/03	105,000	92,240	922,400	1,008	2,038	45	453
2003/04	105,000	42,590	425,900	627	1,020	42	418
2004/05	50,000	10,050	100,500	103	275	37	366
2005/06	50,000	23,220	232,200	318	602	39	386
2006/07	50,000	48,246	482,460	995	1,138	42	424
2007/08	50,000	49,995	499,950	901	1,084	46	461
2008/09	50,000	49,995	499,950	1,067	962	52	520
2009/10	50,000	48,921	603,386	1,078	1,275	38	473
2010/11	50,000	50,100	548,274	1,434	972	52	564
2011/12	50,000	50,275	530,103	619	984	51	539
2012/13	50,000	50,045	564,787	758	943	53	599
2013/14	50,000	49,989	561,255	422	1,086	46	517
2014/15	50,000	12,445	226,888	159	525	24	432
2015/16	7,500	7,500	107,337	93	307	24	350
2016/17	7,500	7,575	108,191	133	275	28	393
2017/18	7,500	7,535	105,668	78	316	24	334
2018/19	7,500	7,540	125,978	75	357	21	353
2019/20	7,500	7,130	106,177	123	365	20	291
2020/21	7,500				0		
2021/22	7,500				0		
2022/23	7,500	7,535	110,073	197	331	23	333
2023/24	7,500				0		

Table 16: EKI (East Kayak Island) District crab bycatch limits and associated bycatch estimates by season.

	Tanner crab	
Season	CBL	Bycatch (N)
2009/10	8,700	50
2010/11	1,643	34
2011/12	1,643	0

Table 17: WKI (West Kayak Island) District crab bycatch limits and associated bycatch estimates by season. Bycatch limits have not been used since 2018/19.

	Tanner crab	
Season	CBL	Bycatch (N)
2009/10	2,700	278
2010/11	Closed	
2011/12	Closed	
2012/13	Closed	
2013/14	Closed	
2014/15	Closed	
2015/16	Closed	
2009/10	2,700	278
2016/17	1,561	189
2017/18	1,600	75
2018/19	1,600	12
2019/20	Closed	
2020/21	Closed	
2021/22		191
2022/23		0
2023/24		55

Table 18: KSH (Kodiak Shelikof) District crab bycatch limits and associated bycatch estimates by season.

	Tanner crab		King crab	
Season	CBL	Bycatch (N)	CBL	Bycatch (N)
2009/10	25,000	15,933	96	0
2010/11	26,400	17,495	7	0
2011/12	28,636	24,388	134	0
2012/13	80,540	17,104	175	0
2013/14	27,450	19,761	50	1
2014/15	42,144	50,232	50	5
2015/16	19,107	2,031	50	0
2016/17	43,477	3,645	50	0
2017/18	63,926	3,628	50	0
2018/19	12,500	2,680	25	0
2019/20	10,000	1,438	25	0
2020/21	20,000	1,308	25	0
2021/22	40,000	10,818	25	0
2022/23	50,000	13,854	25	0
2023/24	60,000	19,444	25	46

Table 19: KNE (Kodiak Northeast) District crab bycatch limits and associated bycatch estimates by season.

	Tanner crab		King crab	
Season	CBL	Bycatch (N)	CBL	Bycatch (N)
2009/10	217,000	43,809	7	0
2010/11	169,925	27,793	13	0
2011/12	147,956	28,499	8	0
2012/13	50,874	48,550	7	0
2013/14	49,124	22,431	25	1
2014/15	256,466	16,415	25	0
2015/16	93,929	24,342	25	0
2016/17	20,816	9,124	25	0
2017/18	19,388	5,463	25	0
2018/19	9,000	8,825	25	0
2019/20	9,000	3,507	25	0
2020/21	9,000	951	25	0
2021/22	18,000	1,565	25	0
2022/23	24,000	423	25	0
2023/24	24,000	6,241	25	0

Table 20: KSW (Kodiak Southwest) District crab bycatch limits and associated bycatch estimates by season.

	Tanner crab		King crab	
Season	CBL	Bycatch (N)	CBL	Bycatch (N)
2009/10	12,000	8,623	50	15
2010/11	12,000	334	50	0
2011/12	12,000	10,175	50	14
2012/13	12,000	8,932	50	12
2013/14	12,000	10,744	50	11
2014/15	12,000	19,781	50	9
2015/16	12,000	13,231	50	0
2016/17	12,000	8,117	50	8
2017/18	12,000	6,702	50	2
2018/19	18,000	1,858	25	1
2019/20	17,500	10,870	25	5
2020/21	17,500	6,750	25	67
2021/22	21,000	8,462	25	14
2022/23	21,000	8,141	25	0
2023/24	21,000	20,469	25	0

Table 21: Area M (Alaska Peninsula) crab bycatch limits and associated bycatch estimates by season.

	Tanner crab		King crab	
Season	CBL	Bycatch (N)	CBL	Bycatch (N)
2012/13	12,000	8,045	50	0
2013/14	12,000	3,312	50	0
2014/15		13,398		0
2015/16		6,336		0
2016/17		3,870		0
2017/18		5,053		0
2018/19	11,250	4,914	50	0
2019/20	7,500	10,415	50	0
2020/21	7,500		50	
2021/22	8,250		50	
2022/23	8,250	993	50	0
2023/24	9,000		50	

Table 22: Area O (Dutch Harbor) crab bycatch limits and associated bycatch estimates by season.

	Tanner crab		King crab	
Season	CBL	Bycatch (N)	CBL	Bycatch (N)
2009/10	10,000	26	10	0
2010/11	10,000	909	10	0
2011/12	10,000	617	10	0
2012/13	5,000	746	10	0
2013/14	5,000	1,206	10	0
2014/15	5,000	1,037	10	0
2015/16	10,000	326	20	0
2016/17	10,000	271	20	2
2017/18	10,000	8	20	0
2018/19	5,000	306	10	0
2019/20	5,000	885	10	0
2020/21	7,500		50	
2021/22	8,250		50	
2022/23	7,500	4,826	20	0
2023/24	9,000		50	

Table 23: Area Q (Bering Sea) crab bycatch limits and associated bycatch estimates by season.

	Tanner crab		Snow crab		King crab	
Season	CBL	Bycatch (N)	CBL	Bycatch (N)	CBL	Bycatch (N)
2009/10	260,000	27,998	300,000	31,022	500	106
2010/11	130,000	61,791	300,000	18,998	500	33
2011/12	65,000	17,504	300,000	13,509	500	135
2012/13	65,000	36,070	300,000	15,720	500	75
2013/14	260,000	88,655	300,000	29,254	500	19
2014/15	260,000	24,943	300,000	9,868	500	23
2015/16	260,000	22,339	300,000	8,355	500	68
2016/17	260,000	11,571	300,000	68,103	500	35
2017/18	65,000	7,323	300,000	4,565	500	0
2018/19	65,000	16,287	300,000	2,156	500	0
2019/20	65,000	15,138	300,000	3,406	500	0
2020/21	7,500				50	
2021/22	8,250				50	
2022/23	18,750	12,130	11,250	1,550	100	0
2023/24	9,000				50	

Figures

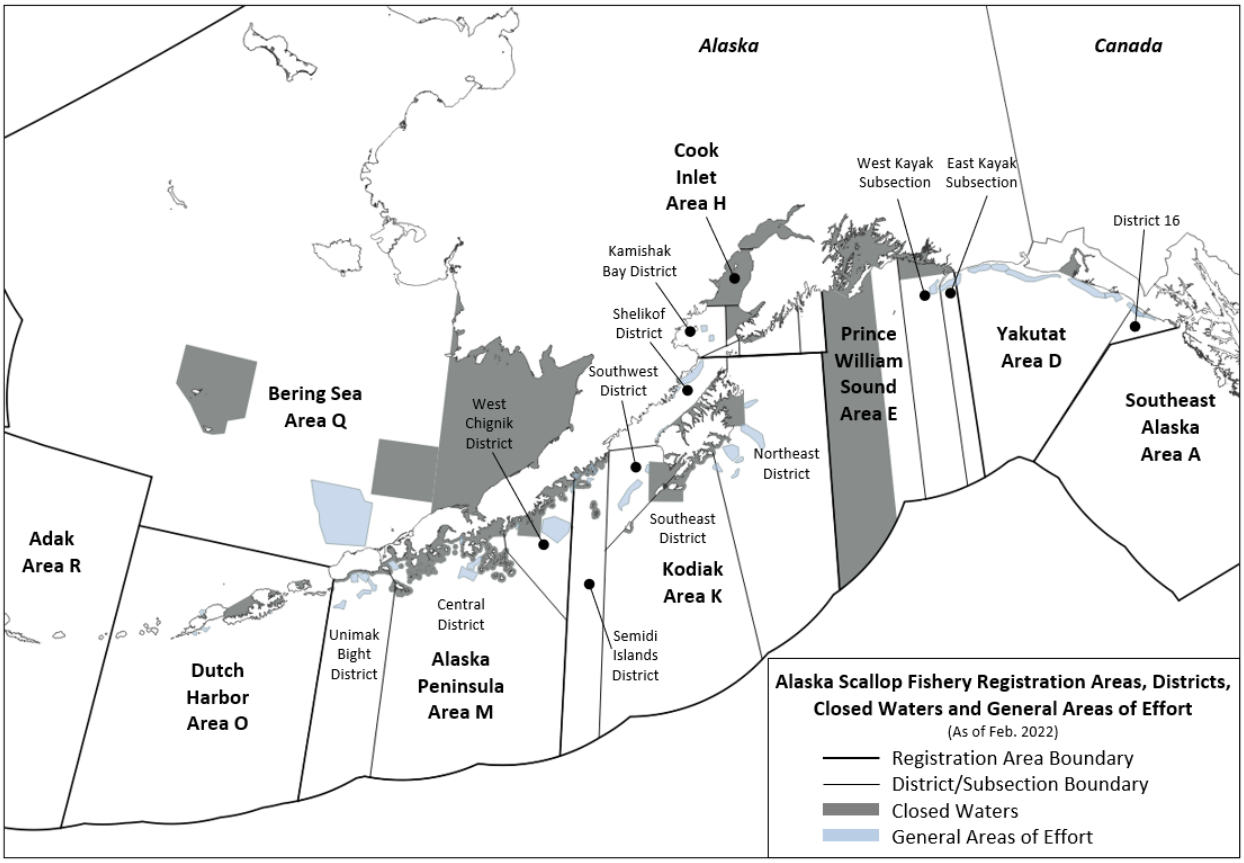

Figure 1: Alaska scallop fishery registration areas. General areas of effort are overlaid by blue polygons. Exploratory fisheries in waters normally closed to scallop fishing (gray shading) have been opened by ADF&G Commissioner's Permit in the Alaska Peninsula Unimak Bight District during past seasons.

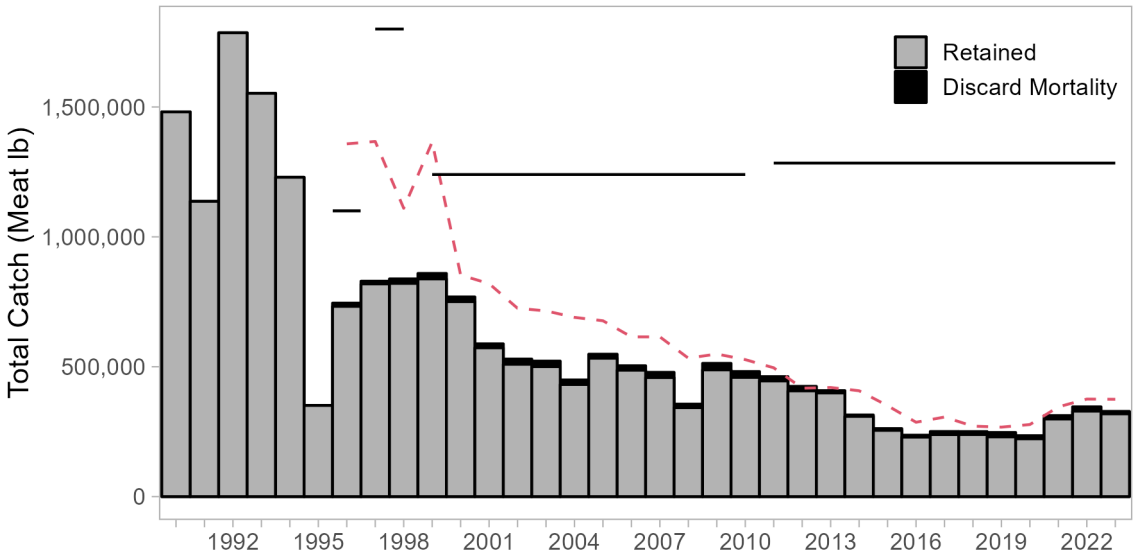

Figure 2: Statwide total catch estimates from 1990 - 2023. OFL is indicated by solid horizontal lines. The red dashed line indicates the statewide cumulative GHL.

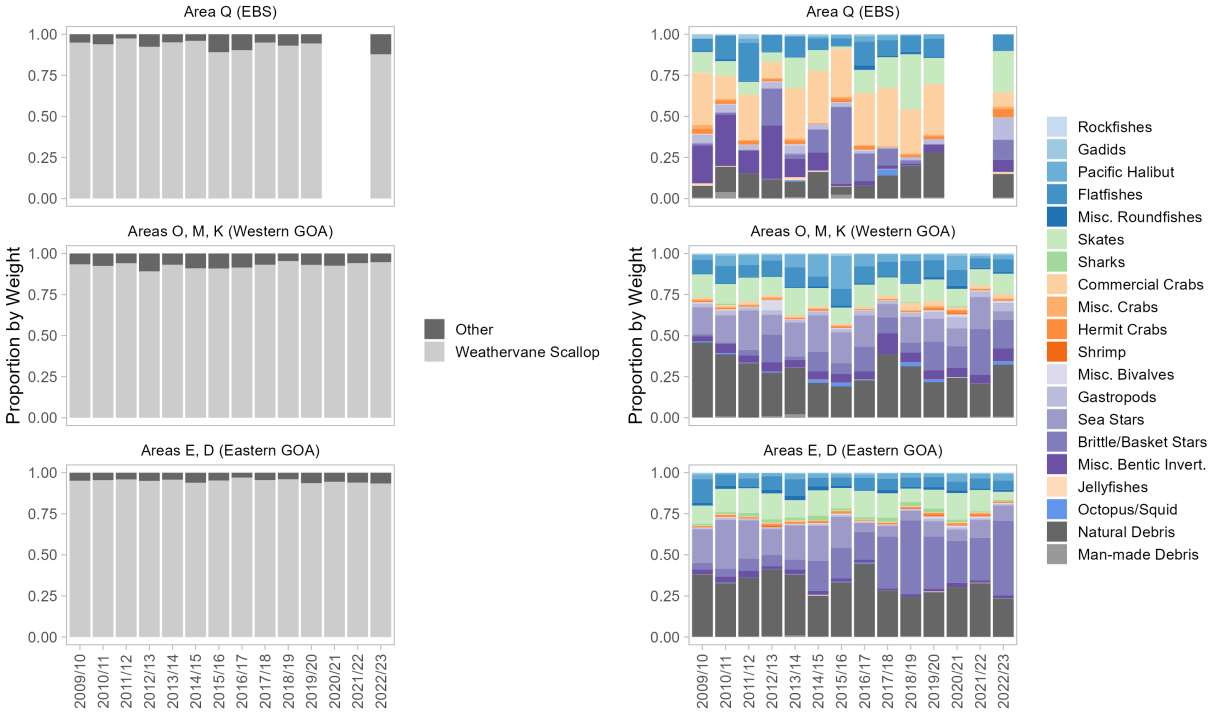

Figure 3: Proportion of directed scallop fishery catch as the target species or all other bycatch species (left) and the proportion of bycatch by taxonomic group (right) by ecoregion.

Appendix C: Draft Weathervane Scallop Assessment using a Combination of Data-Limited Harvest Control Rules

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Purpose

Previous efforts to develop an age-structured population dynamics model for weathervane scallops (*Patinopectan carinus*) have been promising (Zheng 2018; Jackson 2023), though extension of these models to the broader stock is unlikely. Complex integrated assessment models require considerable resources for model development, review, and continued research. Development of stock-wide assessment is made more complicated by large disparities in data availability throughout the stock and spatially explicit life history traits like growth, size-at-maturity, and (likely) natural mortality. Though sufficient observer and recent survey data are available for key portions of the stock, data-limited approaches are likely better suited for the Alaska weathervane scallops given resources allocated to stock assessment, management needs, and economic benefit of the fishery.

Here, I explore a simple, state-space random walk model (REMA; Sullivan et al., 2022) using ADF&G dredge survey biomass estimates from 2016 - 2023 and fishery catch-per-unit-effort (CPUE) data on a portion of the stock comprising ~ 80% of annual landings. I then present an avenue for estimating a stock-wide overfishing limit that combines data-limited harvest control rules based on the surveyed and non-surveyed portions of the stock, and discuss various issues and limitations with the approach.

Modelling approach

Data

Survey biomass

Observed ADF&G dredge survey biomass was estimated for sampled beds in the Kodiak Shelikof (KSH), Kodiak Northeast (KNE), Prince William Sound (E), and Yakutat (YAK) districts by methods described in Burt et al., (2021). In the absence of a clear size at maturity estimate by district, exploited biomass (shell height $\geq$ 100 mm) was used as a proxy. Scallops in most districts likely mature at a slightly smaller size (Hennick 1970). Round biomass was used as opposed to meat weight biomass, since meat weight at size is known to vary between surveys, likely due to fluctuation in survey and reproductive timing (Hennen and Hart 2012). Observed district biomass computed as the sum of bed biomass estimates. Biomass of beds that were not surveyed in a given year that other beds in the district were, were filled in with predicted values of a weighted linear model in the form of

$$\ln(B_{t,j}) = Year_t + Bed_{b,j} + \epsilon \tag{1}$$

with weights equal to the inverse of the coefficient of variation (CV) on $B_{t,j}$. Since the EK1 bed spans the boundary between the E and YAK districts, EK1 was modeled with the YAK District. Samples that included only the EKI portion of EK1 in 2016 were removed from analysis. The beds KSH2 and KSH3 (Kodiak Shelikof District), and KNE4 (Kodiak Northeast District) were also removed from analysis since they were

only surveyed once, and contribute only a marginal proportion of biomass in each district. Biomass estimates by bed and district from 2016 - 2023 are listed in Table 1.

Fishery CPUE index

Fishery CPUE indices were derived from at-sea observer data from the 2009/10 - 2023/24 seasons. CPUE was defined as the total round weight of the catch per dredge-hour. Prior to analysis, fishery log-book data were filtered so that core data only included hauls that employed 13 or 15 ft dredges and adequate dredge performance. Zero catches were removed since they are typically rare and indicate poor gear performance. Hauls were also limited to the inner 95% of CPUE and depth.

CPUE standardization models were fit using general additive models (GAM) as implemented in the R package *mgcv* (Wood 2004). All models assumed a Gamma error distribution with log-link. Null models by district included only year (of season opening) as an explanatory variable

$$\ln(CPUE_i) = Year_{y,i} \tag{2}$$

The full scope of models evaluated included vessel, depth, dredge width, month and bed. Bed was not included for WKI District, since it only contains a single bed. Depth was fit as a thin plate regression spline, with smoothness determined by generalized cross-validation (Wood 2004). All other variables were fit as factors. The effects of variable addition were evaluated by forward and backward stepwise selection. The addition of a new variable was considered significant if CAIC (Anderson et al., 1998) decreased by at least two per degree of freedom lost and deviance explained (R^2) increased by at least 0.01. The best model forms by district are listed in Table 2. The marginal effects of selected covariates are in Figures 1 - 3.

The standardized CPUE index was extracted from the models as the year coefficient (β_i) with the first level set to zero and scaled to canonical coefficients (β'_i) as

$$\beta'_i = \frac{\beta_i}{\bar{\beta}} \tag{3}$$

where

$$\bar{\beta} = \sqrt[n_j]{\prod_{j=1}^{n_j} \beta_{i,j}} \tag{4}$$

and n_j is the number of levels in the year variable (Table 3). Nominal CPUE was scaled by the same method for comparison (Figure 4).

State-space random walk model, REMA

The REMA R package (Sullivan et al., 2022) was developed as a consensus version of the state-space random walk model used to estimate biomass for data-limited stock assessments by the NPFMC Groundfish Plan Team since 2013. REMA underwent a favorable Center for Independent Experts review in 2023. In this model, observed survey biomass by scallop management district ($B_{t,j}$) is related to the latent state variable ($\hat{B}_{t,j}$; true district biomass) by

$$\ln(B_{t,j}) = \ln(\hat{B}_{t,j}) + \epsilon_{B_j} \tag{5}$$

where $\epsilon_{B_j} \sim \mathcal{N}(0, \sigma^2_{ln(B_{t,j})})$ and $\sigma_{ln(B_{t,j})}$ is the standard error of log-transformed survey biomass approximated using the CV of $B_{t,j}$. The process model estimates $\hat{B}_{t,j}$ as

$$\ln(\hat{B}_{t,j}) = \ln(\hat{B}_{t-1,j}) + \eta_{t-1,j} \tag{6}$$

where $\eta_{t,j} \sim \mathcal{N}(0, \sigma^2_{PE})$ and σ^2_{PE} is process error variance. Process error variance was estimated as being pooled among districts and separately for each district. District biomass ($\hat{B}_{t,j}$) is estimated as a random effect. Total biomass among districts is the sum of district biomass estimates and associated standard error is estimated via the delta method.

Scallop fishery catch per unit effort (CPUE) has been used a proxy for a biomass index by scallop fishery managers since the beginning of the fishery. Here, annual CPUE index by district ($I_{t,j}$) is fitted using the equation

$$\ln(I_{t,j}) = \ln(\hat{I}_{t,j}) + \epsilon_{I_j} \tag{7}$$

where $\epsilon_{I_j} \sim \mathcal{N}(0, \sigma^2_{ln(I_{t,j})})$ and $\sigma_{ln(I_{t,j})}$ is the standard error of the CPUE index approximated using the CV of $I_{t,j}$. Predicted CPUE index $\hat{I}_{t,j}$ is related to $\hat{B}_{t,j}$ by the scaling parameter, q_j.

$$\hat{I}_{t,j} = q_j e^{\hat{B}_{t,j}} \tag{8}$$

Since CVs associated with annual CPUE index were unrealistically low, extra standard error (σ_τ) was estimated so that

$$\sigma_{ln(I_{t,j})} = \sqrt{\ln((\frac{\sigma_{I_{t,j}}}{I_{t,j}})^2 + \sigma_\tau + 1)} \tag{9}$$

Extra standard error was estimated as a single parameter shared among districts or separately by district, $\sigma_{\tau,j}$. REMA is fit using marginal maximum likelihood estimation as implemented in Template Model Builder (TMB; Kristensen et al., 2016). More details of the REMA model can be found on GitHub (REMA GitHub).

REMA model scenarios

The following model parameterizations were evaluated:

- **24.0**: Base REMA model with four strata (KSH, KNE, WKI, YAK), a fishery CPUE index, shared σ^2_{PE} and σ_τ;
- **24.1**: 24.0, with σ^2_{PE} estimated by stratum and a prior on σ^2_{PE} for WKI (see Results for explanation);
- **24.2**: 24.1, with an emphasis factor of 0.5 on fishery CPUE index likelihood component (following Echave et al., 2021);
- **24.3**: 24.2, with σ_τ estimated by stratum.

Harvest control rules

Biological reference points for surveyed areas were estimated using the tier 4 F_{OFL} control rule as specified in the fishery management plan for Bering Sea/Aleutian Islands (BSAI) king and Tanner crab (NPFMC 2023).

$$F_{\text{OFL}} = \begin{cases} 0 & \frac{B_{prj}}{B_{\text{MSY, proxy}}} \leq 0.25 \\ \frac{M(\frac{B_{prj}}{B_{\text{MSY, proxy}}} - \alpha)}{1-\alpha} & 0.25 < \frac{B_{prj}}{B_{\text{MSY, proxy}}} \leq 1 \\ M & B_{prj} > B_{\text{MSY, proxy}} \end{cases} \tag{10}$$

Here, $B_{\text{MSY, proxy}}$ was defined as the average predicted biomass since the standardization of the observer program (2009 - 2023) and $\alpha = 0.1$. Instantaneous natural mortality rate (M) was set to 0.13 yr^{-1} (Kruse and Funk 1995) as specified in the FMP. Current biomass (B_{prj}) is the predicted biomass in the last year of the model projected from the time of the survey (May 1) to the end of the fishery. Fishing occurs throughout the season depending on year and district, so for simplicity catch was assumed to occur as a pulse fishery at the approximate midpoint of the regulatory season (Nov 1). The time period between the survey and the fishery is $\tau_{sf} = 0.504$.

$$B_{prj} = \hat{B}e^{-M\tau_{sf}} - C_T \tag{11}$$

The overfishing limit (OFL) of the surveyed portion of the stock (OFL_s) in units of meat weight is computed as

$$\text{OFL}_s = \gamma B_{prj}(1 - e^{-F_{\text{OFL}}}) \tag{12}$$

with round biomass was converted to meat biomass using $\gamma = 0.1$ (NPFMC 2014). The overfishing limit for non-surveyed areas OFL_{ns} was computed under a total-catch harvest control rule so that OFL is equal to the average total catch from either the FMP reference period (1990-94; 1996-97) or the 2009-2023 reference period used for $B_{\text{MSY, proxy}}$. Since there is no observer coverage in Area H (Cook Inlet), discard mortality was estimated based on the average ratio of discards to retained catch by year. In years prior to the observer program (1990 - 1994), discard mortality was estimated based on the average discard ratio by district (Table 4). The OFL for the full stock was the sum of OFLs for surveyed and non-surveyed areas.

$$\text{OFL} = \text{OFL}_s + \text{OFL}_{ns} \tag{13}$$

Results and discussion

Model estimation

All REMA models successfully converged with satisfactorily low gradient components. Model 24.1 was unable to estimate a non-zero process error variance for WKI without a prior, which was based on the model 24.1 estimate run through 2022, so that $P_r(\ln \sigma^2_{PE,\ WKI}) \sim \mathcal{N}$(-1.64, 0.38). Models 24.0 and 24.1 preferentially fit CPUE data over survey biomass despite extra error on CPUE data. This is presumably due to data availability in the early half of the time series. Both models 24.0 and 24.1 fit CPUE data near exactly (Figure 5). Estimated extra standard error was much smaller for models 24.0 and 24.1, than models 24.2 and 24.3 (Table 5). Naturally, fits to survey biomass were better for models 24.2 and 24.3 (i.e., models with less emphasis on CPUE data), especially in KSH and YAK (Figure 6). Variation in predicted biomass was more attenuated for models 24.2 and 24.3, as would be expected from a long-lived, mostly sessile population. Total biomass remained stationary from 2009 until the time series low in 2017, and then steadily increased to a peak in 2022 before leveling off (Figure 7).

Although, Akaike Information Criterion (AIC) suggests model 24.1 is the best model (Table 6), model 24.2 is the recommended choice. Model 24.2 fits the survey biomass data better, which is preferred, since survey biomass is a more reliable indicator of stock trends. Fishery data in this analysis are used more as an auxiliary index of abundance for years when survey data are lacking. Additonally, model 24.2 results in an expected biomass trajectory that better aligns with the biology of the stock and lack of data in the first half of the time series.

Reference points

Biological reference points were only computed for the surveyed portion of the stock using model 24.2. Terminal year biomass projected to the conclusion of the 2023/24 fishery was B_{prj} = 11,133 t (24.54 mil lb) round weight. Average predicted biomass for the time series (i.e, $B_{\text{MSY, proxy}}$) was 9,601 t (21.17 mil

lb) round weight, thus stock status was greater than 1, so $F_{\text{OFL}} = M = 0.13$. The overfishing limit of the surveyed portion of the stock was estimated to be OFL_s = 136 t (0.3 mil lb) shucked meats (Table 7).

Using different reference periods for the non-surveyed portion of the stock resulted in substantially different average total catch estimates. The period from 1990 - 1997, excluding 1995, resulted in a total catch OFL_{ns} = 156 t (0.34 mil lb) shucked meats, while the period of the standardized observer program (2009 - 2023) resulted in OFL_{ns} = 29 t (0.06 mil lb) shucked meats (Table 7). The more recent reference period likely better captures the current productivity of the non-surveyed portions of the stock, which have become non-core to the fishery since they were prospected in the mid-1990s. Since 2009, fishing west of Kodiak (Area K) in the Alaska Peninsula (Area M), Dutch Harbor (Area O), or Bering Sea (Area Q) has primarily only been done by the *F/V Ocean Hunter*, *F/V Arctic Hunter*, and *F/V Polar Sea* as was convenient before vessels switched to BSAI groundfish fisheries. Fishing performance of Area Q has not recovered following a steep decline in 2014/15 concurrent with observations of "weak meats" (Ferguson etal., 2021), and interest in fishing west of Area K has waned since the 2020/21 season. Further, the Kodiak Southwest District (KSW) has become a somewhat major contributor to stock-wide harvests averaging ~ 13% of landings since 2016, though it has only been fished consistently since 2009 (Figure 8).

Conclusions

REMA makes good use of available survey biomass estimates, is able to accommodate multiple survey areas, and does not require a disproportional amount of analyst time and resources. That said, REMA does not use size composition data that are ubiquitous among districts in which there have been fishery observers or surveys. Development of a simplified statistical catch-at-length model may make better use of the full suite of data, but again, it would be important to balance assessment efforts with the scope of management needs.

Dividing the stock into (relatively) data-rich and data-poor areas may be the only path to a better informed reference point calculation. It is unlikely that ADF&G could expand the dredge survey to non-core areas west of Area K, and fishery data in those areas are sparse, when available. Further, interpreting fishery data from such a small fleet (i.e., currently two vessels, one in non-core areas) is difficult as vessels maintain a small footprint which shifts from year to year, and individual fishing behaviors are more apparent in the data. Data-rich (i.e., surveyed) areas could satisfy information necessary to utilize the BSAI king and Tanner crab tier 4 F_{OFL} control rule which requires: 1) a reliable biomass estimate, 2) a target biomass $B_{\text{MSY, proxy}}$, and 3) an estimate of natural mortality rate, M. The control rule determines the maximum fishing mortality rate based on the current productive capacity of the stock (i.e., mature biomass) relative to the target level and closes the fishery when stock status is below a specified threshold. The maximum allowable fishing mortality increases along a ramp as stock status approaches the target level and caps at $F_{\text{OFL}} = M$ when stock status is greater than 1 (i.e., $B > B_{\text{MSY, proxy}}$) (NPFMC 2023). The difficulty in using this approach for weathervane scallops is defining an appropriate $B_{\text{MSY, proxy}}$. Survey data are only available to 2016 from major harvest areas, though the fishery began in earnest during the early 1990s. Fishery observer data go back as far as 1996, but data become less reliable prior to standardization of the observer program in 2009. The current analysis assumes that the scaling parameter, q, that relates fishery CPUE to survey biomass remains constant for the full 2009 - 2023 time series, and thus can be used to predict biomass pre-2016, though that may be less likely for fishery data from 1996 - 2008. Determining when the reference period for $B_{\text{MSY, proxy}}$ should end is also difficult, as the fishery is currently rebounding from a rut in the mid-2010s, thus there is not a clear steady state in the available time series. Defining $B_{\text{MSY, proxy}}$ as the time series average, as done here, may not be a suitable long-term biomass target since $B_{\text{MSY, proxy}}$ would slowly decrease whilst allowing fishing should biomass take on a continued downward trajectory, so long as stock status remained above threshold. On the other hand, fishing opportunity may be not fully exploited should a period of intense productivity result in an increasing $B_{\text{MSY, proxy}}$.

The current analysis suggests that fishing at 2023/24 GHLs (combined 374,700 lb) during the next season would be overfishing, but this analysis may be conservative for several reasons. Here, I used exploitable biomass (100 mm shell height) as a proxy for mature biomass. Scallops become vulnerable to commercial gear at 100 mm, though size at 50% retention is typically 10 - 30 mm larger (Jackson, *unpublished data*). Hennick (1970) described the onset of maturity occurring between ages 3 - 4 yr or 74 - 128 mm shell height

in Kodiak and 73 - 92 mm in Yakutat. ADF&G is currently re-evaluating size-at-maturity and qualitative gonad scoring using histological analysis on scallops collected in the Kodiak and Yakutat Areas, though results are not yet available. Defining productive capacity of the stock as mature biomass as opposed to exploitable biomass would presumably result in a larger harvestable surplus. The current estimate of natural mortality is also somewhat dated. Kruse and Funk (1995) estimated M using various methods, including age data collected by Kaiser (1986) and Hennick (1973), and settled on a median value of $M = 0.13$, which is currently used in the FMP (NPFMC 2014). Estimation of M using more recent age, growth, and catch data would be a useful comparison. Naturally, if M were larger than 0.13 (as assumed by Zheng 2018; Jackson 2023) the computed OFL would also be larger.

Survey analysis has long used a dredge efficiency of 0.83 (Gustafson and Goldman 2012), though the basis for this coefficient is undocumented and the survey dredge it applied to was retired in 2022. Re-visiting this analysis in the future with the CamSled and new survey dredges may be prudent, although assuming full gear efficiency could be used as a conservative measure. Lastly, most inside waters are closed to dredging (SAFE Figure 1), yet several of these areas contain scallop beds. The ADF&G large-mesh trawl survey catches scallops of exploitable size in closed areas of the western GOA (Jackson 2021). The extent to which closed area beds contribute to the fished population is unknown. Excluding this portion of the population in stock assessment would be wise until better knowledge of connectivity exists.

Tables

Table 1: Survey round biomass estimates (tonnes) and CV (in parentheses) by district from 2016 - 2023.

Year	KSH	KNE[a]	WKI	YAK[b,c]
2016	1,082 (0.13)		1,031 (0.38)	
2017	870 (0.14)	635 (0.28)		4,585 (0.15)
2018	1,234 (0.11)			6,002 (0.12)
2019			865 (0.37)	6,805 (0.1)
2020	3,655 (0.18)	1,192 (0.4)		
2021			1,244 (0.3)	5,833 (0.2)
2022	4,524 (0.2)	2,657 (0.46)		
2023			992 (0.3)	7,592 (0.19)

[a]KNE1, KNE5, YAK3 were not surveyed in 2017
[b]YAK4, YAK5 were not surveyed in 2018
[c]YAK1, YAK2 were not surveyed in 2019

Table 2: Residual degrees of freedom, AIC, and R^2 for the best model for each District.

K. Shelikof Form	Residual DF (Δ DF)	AIC (Δ AIC)	R^2 (Δ R^2)
Year + Month + Dredge Width + s(depth)	9,517.59	123,241	0.52
+ Vessel	-3.24	-103.69	0.007
+ Bed	-1.97	-31.65	0.003

K. Northeast Form	Residual DF (Δ DF)	AIC (Δ AIC)	R^2 (Δ R^2)
Year + Month + Dredge Width + s(depth) + Bed	4,655.85	64,623	0.47
+ Vessel	-3.02	12.02	0.002

West Kayak Is. Form	Residual DF (Δ DF)	AIC (Δ AIC)	R^2 (Δ R^2)
Year	296	4,439	0.33
+ Dredge Width	-0.00	-0.00	0.000
+ s(depth)	-8.58	-7.12	0.128
+ Month	-0.00	-0.00	-0.000
+ Vessel	-0.00	-0.00	-0.000

Yakutat Form	Residual DF (Δ DF)	AIC (Δ AIC)	R^2 (Δ R^2)
Year + Bed + Vessel + Dredge Width + s(depth)	21,378.62	288,325	0.25
+ Month	-5.96	-118.10	0.006

Table 3: Fishery round biomass CPUE index and CV (in parentheses) by district from 2009/10 - 2022/23.

Season	KSH	KNE	WKI	YAK
2009	0.891 (0.01)	1.124 (0.03)	1.035 (0.05)	0.758 (0.01)
2010	0.918 (0.01)	0.895 (0.04)		0.801 (0.01)
2011	0.978 (0.01)	0.996 (0.02)		0.704 (0.01)
2012	0.832 (0.01)	0.791 (0.03)		0.815 (0.01)
2013	0.75 (0.02)	0.739 (0.03)		1.027 (0.01)
2014	0.669 (0.02)	1.176 (0.03)		0.877 (0.01)
2015	0.661 (0.02)	0.765 (0.03)		1.035 (0.01)
2016	0.594 (0.03)	0.403 (0.07)	0.871 (0.05)	1.314 (0.01)
2017	0.689 (0.03)	0.493 (0.07)	0.77 (0.05)	1.04 (0.01)
2018	0.878 (0.02)	0.494 (0.09)	0.725 (0.06)	1.196 (0.01)
2019	1.186 (0.02)	1.739 (0.03)		1.028 (0.01)
2020	1.674 (0.01)	1.553 (0.03)		1.02 (0.01)
2021	1.817 (0.01)	2.054 (0.02)	1.446 (0.04)	1.14 (0.01)
2022	1.789 (0.01)	2.156 (0.02)	1.161 (0.04)	1.221 (0.01)
2023	1.958 (0.01)	1.616 (0.02)	1.182 (0.04)	1.288 (0.01)

Table 4: Retained catch, estimated discard mortality, and total catch (retained + discard M) in units of tonnes of shucked meats by season from 1990 - present. Discard mortality was based on discard ratios by year for Area H and by district from 1990-1994.

Season (start year)	Retained (t)	Discard Mortality (t)	Total Catch (t)
1990	91.04	3.12	94.16
1991	86.14	1.90	88.04
1992	53.83	0.04	53.87
1993	388.97	6.61	395.58
1994	271.91	4.15	276.05
1995	12.22	0.45	12.67
1996	103.82	0.65	104.47
1997	82.05	1.08	83.12
1998	102.28	1.89	104.17
1999	121.68	1.32	122.99
2000	106.00	1.06	107.06
2001	73.01	0.92	73.93
2002	48.46	0.63	49.09
2003	26.50	0.59	27.10
2004	7.33	0.15	7.49
2005	13.88	0.24	14.12
2006	21.98	0.46	22.44
2007	22.68	0.41	23.09
2008	28.35	0.84	29.19
2009	26.53	0.54	27.07
2010	31.29	1.19	32.48
2011	41.25	0.51	41.75
2012	48.51	0.85	49.36
2013	41.77	0.55	42.32
2014	27.74	0.41	28.15
2015	23.88	0.30	24.18
2016	27.78	0.45	28.23
2017	23.71	1.04	24.75
2018	22.93	1.27	24.20
2019	22.91	1.11	24.02
2020	11.77	0.31	12.08
2021	15.91	0.27	16.18
2022	23.92	0.87	24.79
2023	11.49	0.12	11.61

Table 5: Parameter estimate and standard error (in parentheses) by model scenario.

Parameter	24.0	24.1	24.2	24.3
σ^2_{PE}	0.247 (0.033)			
$\sigma^2_{PE,\ \text{KNE}}$		0.444 (0.088)	0.324 (0.105)	0.313 (0.116)
$\sigma^2_{PE,\ \text{KSH}}$		0.175 (0.035)	0.295 (0.079)	0.275 (0.081)
$\sigma^2_{PE,\ \text{WKI}}$		0.189 (0.045)	0.159 (0.053)	0.159 (0.053)
$\sigma^2_{PE,\ \text{YAK}}$		0.161 (0.032)	0.127 (0.057)	0.11 (0.045)
$\sigma_{\tau,\ \text{KNE}}$				0.385 (0.146)
q_{KNE}	9.12e-04 (1.89e-04)	9.06e-04 (1.85e-04)	9.52e-04 (2.34e-04)	9.81e-04 (2.79e-04)
q_{KSH}	6.06e-04 (4.39e-05)	6.11e-04 (3.97e-05)	5.78e-04 (7.80e-05)	5.83e-04 (6.98e-05)
q_{WKI}	0.001 (1.81e-04)	0.001 (1.76e-04)	0.001 (2.10e-04)	0.001 (2.11e-04)
q_{YAK}	1.82e-04 (1.27e-05)	1.80e-04 (1.10e-05)	1.82e-04 (2.30e-05)	1.83e-04 (1.69e-05)
σ_τ	0.068 (0.047)	2.68e-06 (0.092)	0.222 (0.052)	
$\sigma_{\tau,\ \text{KNE}}$				0.385 (0.146)
$\sigma_{\tau,\ \text{KSH}}$				0.179 (0.083)
$\sigma_{\tau,\ \text{WKI}}$				0.223 (0.133)
$\sigma_{\tau,\ \text{YAK}}$				0.13 (0.048)

Table 6: Objective function, number of parameters, and AIC by model scenario.

Model	NLL	N. Parameters	AIC	Δ AIC
24.1	2.634	9	23.3	0.0
24.0	6.112	6	24.2	0.9
24.2	19.655	9	57.3	34.0
24.3	17.494	12	59.0	35.7

Table 7: Management quantities based on a combination of $B_{\text{MSY, proxy}}$ and total catch harvest control rules.

(t)			Surveyed Stock				Non-Surveyed Stock		Total
Model	$\hat{B}_{2023}$	B_{prj}	$B_{\text{MSY, proxy}}$	$\frac{B_{prj}}{B_{\text{MSY, proxy}}}$	F_{OFL}	OFL_s	Ref. Period	OFL_{ns}	OFL
24.2	13,529	11,138	9,598	1.16	0.13	136	1990-97	156	292
							2009-23	27	163

(mil lb)			Surveyed Stock				Non-Surveyed Stock		Total
Model	$\hat{B}_{2023}$	B_{prj}	$B_{\text{MSY, proxy}}$	$\frac{B_{prj}}{B_{\text{MSY, proxy}}}$	M	OFL_s	Ref. Period	OFL_{ns}	OFL
24.2	29.83	24.56	21.16	1.16	0.13	0.30	1990-97	0.34	0.64
							2009-23	0.06	0.36

Figures

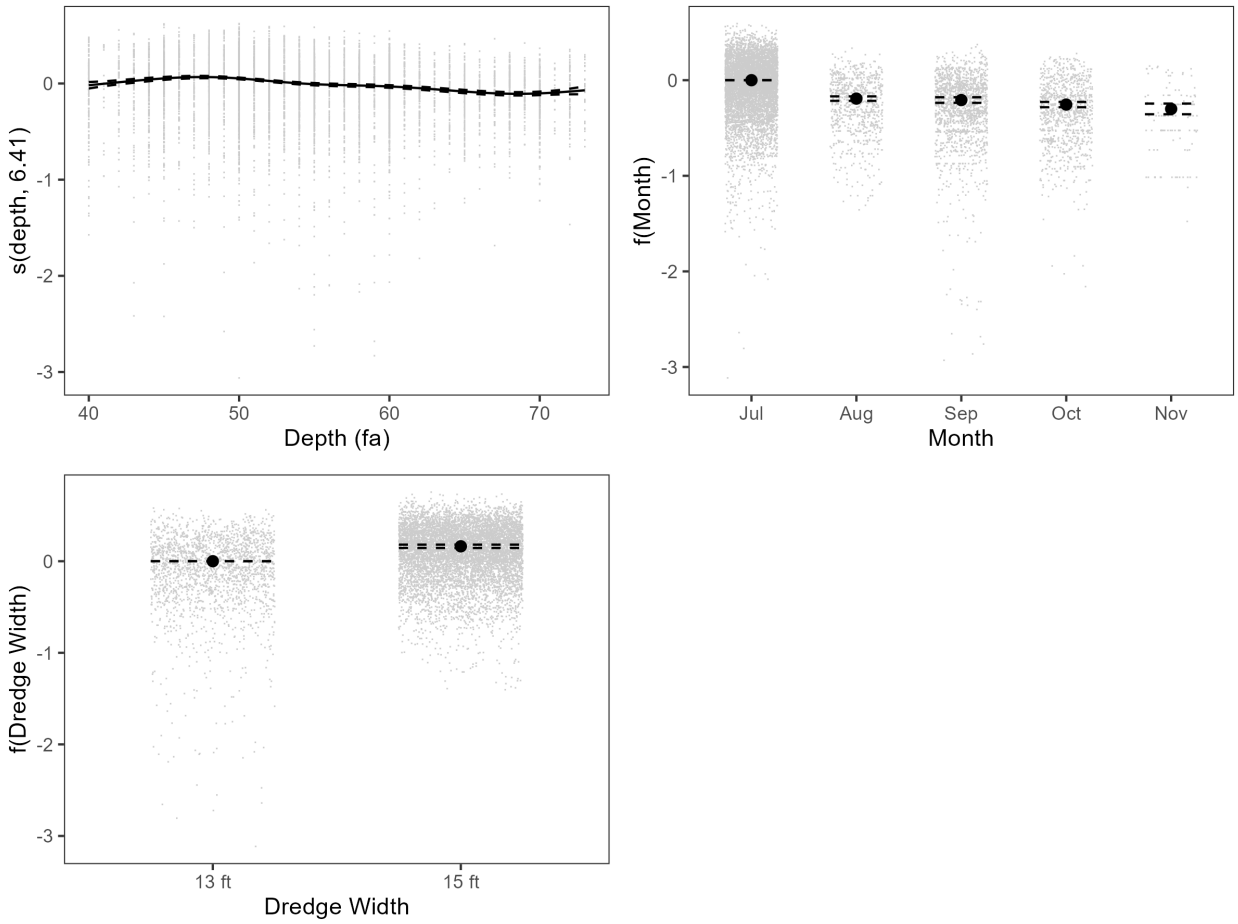

Figure 1: Marginal effects of month, dredge width, and a smooth spline on depth with associated partial residuals for the best model fit to CPUE in the KSH District. Dashed lines indiciate 95% confidence intervals.

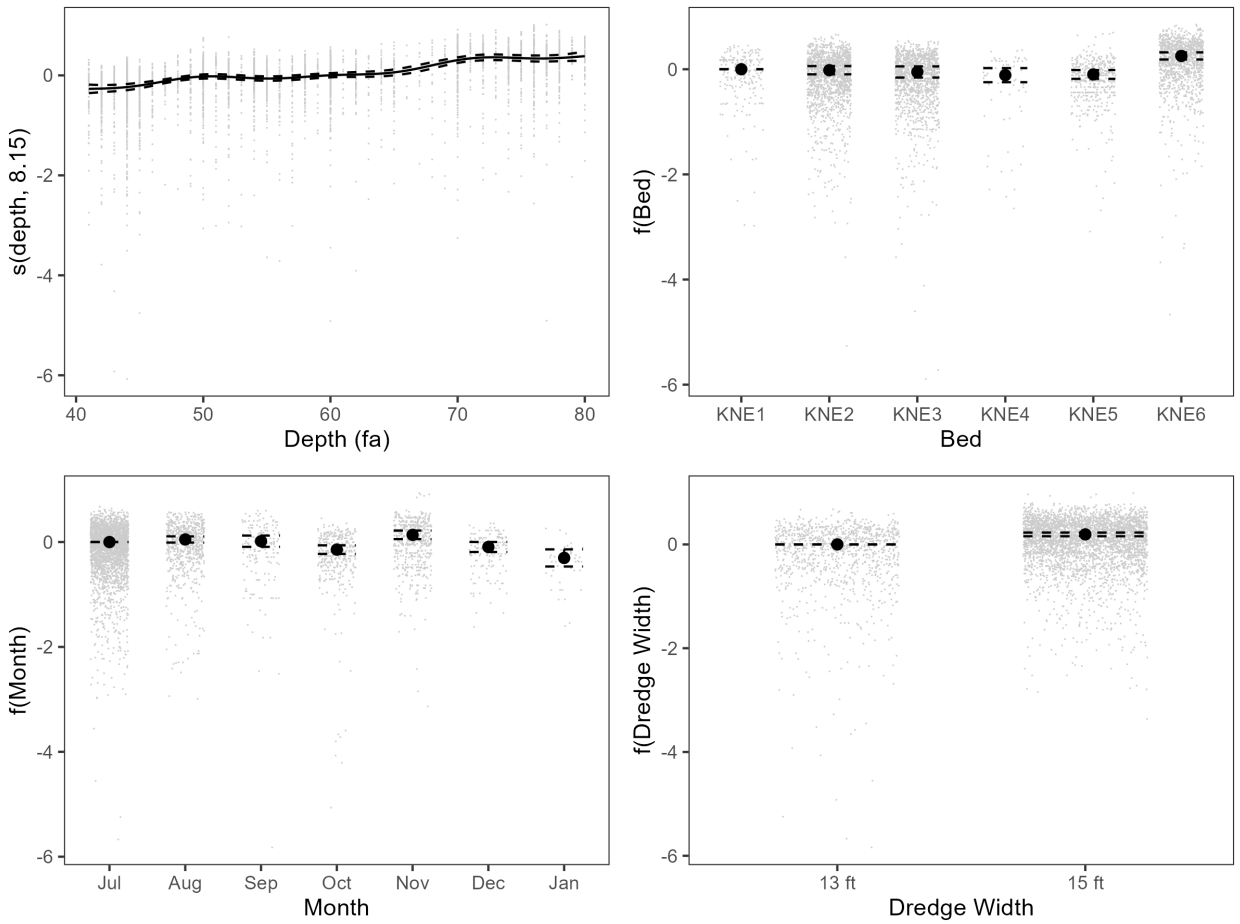

Figure 2: Marginal effects of month, dredge width, bed, and smooth spline on depth with associated partial residuals for the best model fit to CPUE in the KNE District. Dashed lines indiciate 95% confidence intervals.

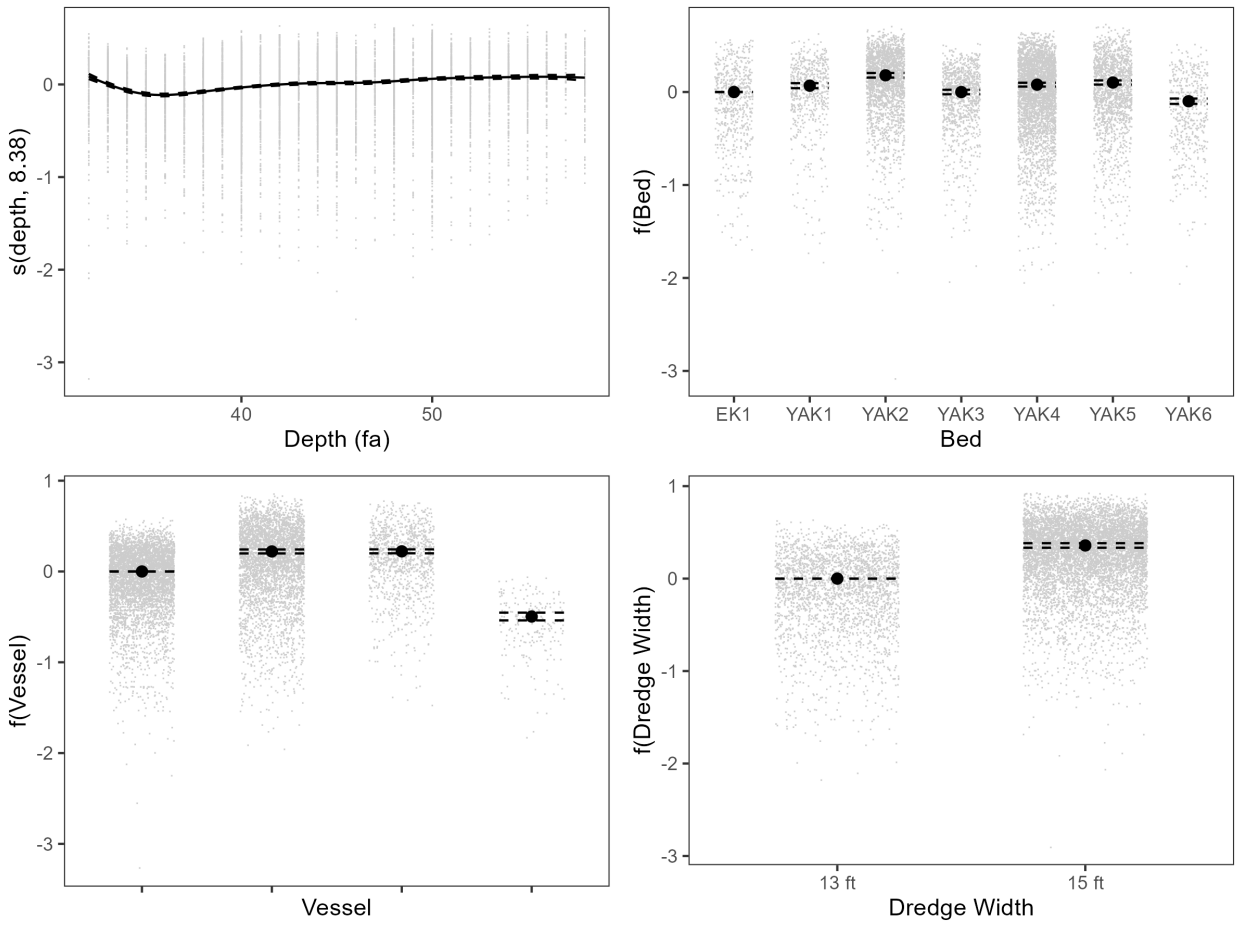

Figure 3: Marginal effects of vessel, dredge width, bed, and smooth spline on depth with associated partial residuals for the best model fit to CPUE in the YAK District. Dashed lines indiciate 95% confidence intervals.

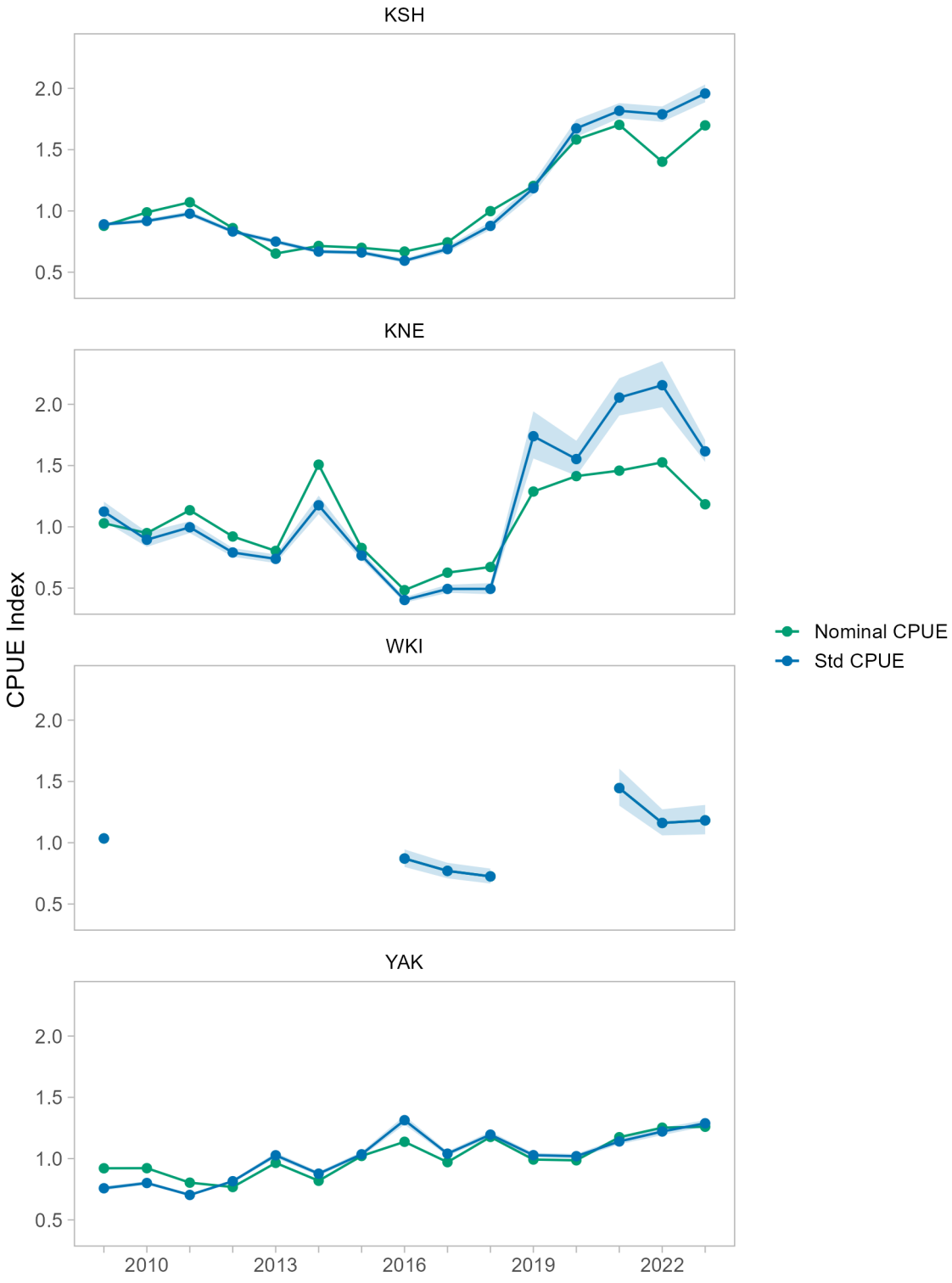

Figure 4: Standardized and nominal fishery CPUE indices by district from 2009-2023.

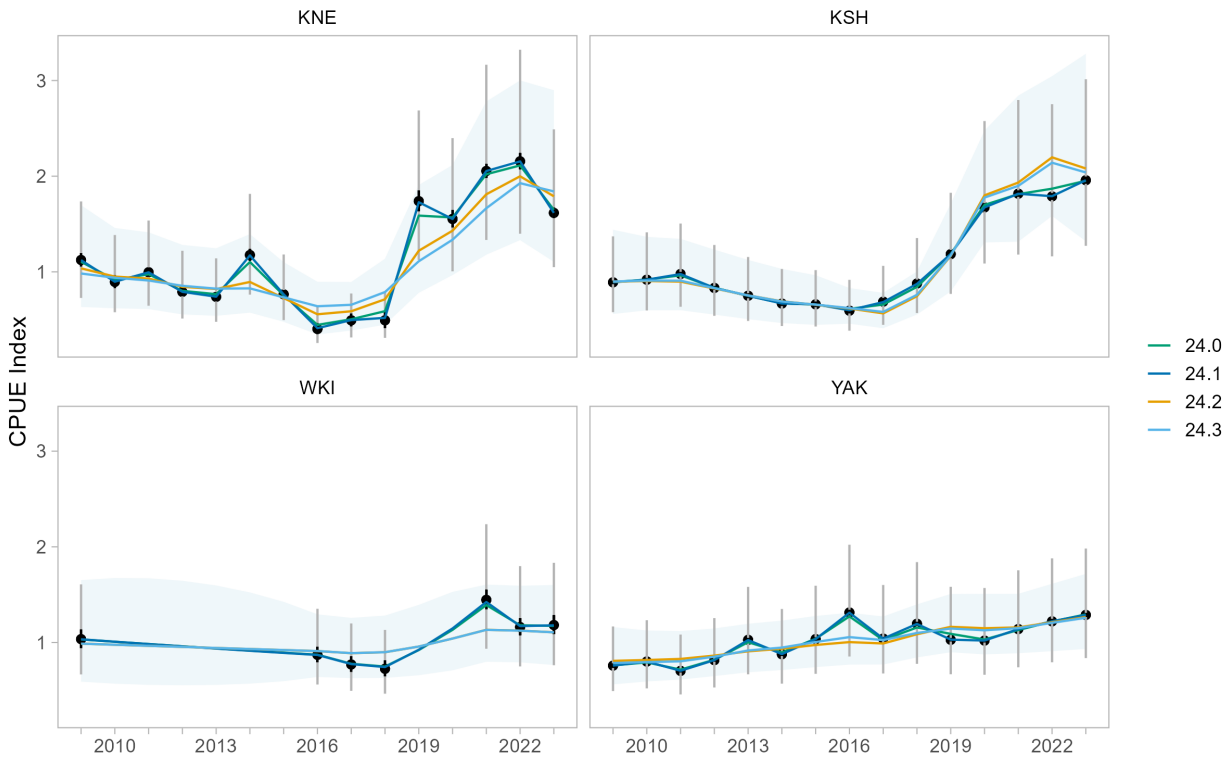

Figure 5: Fits to fishery CPUE index. Blue shaded area represents a 95% confidence band for predicted values and grey error bars indicate observed 95% confidence intervals based on estimated additional standard error for model 24.2.

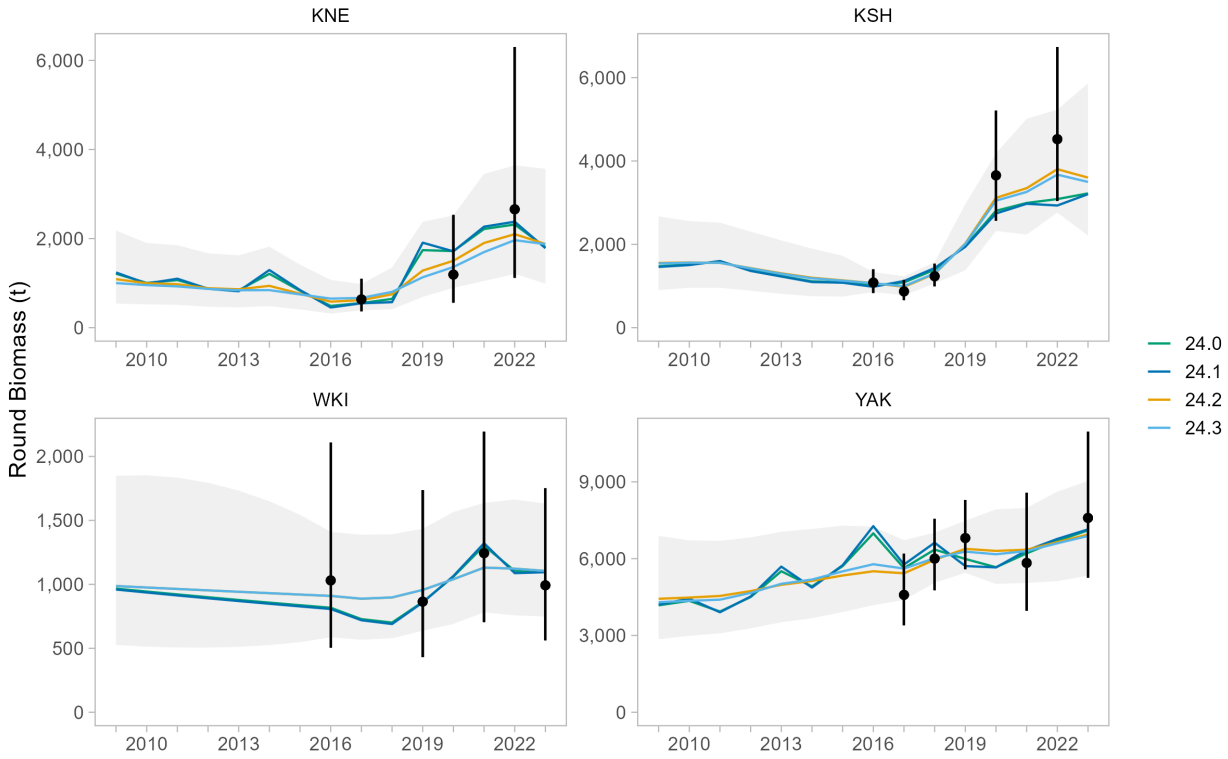

Figure 6: Fits to survey round biomass. The grey shaded area represents a 95% confidence band for predicted values for model 24.2.

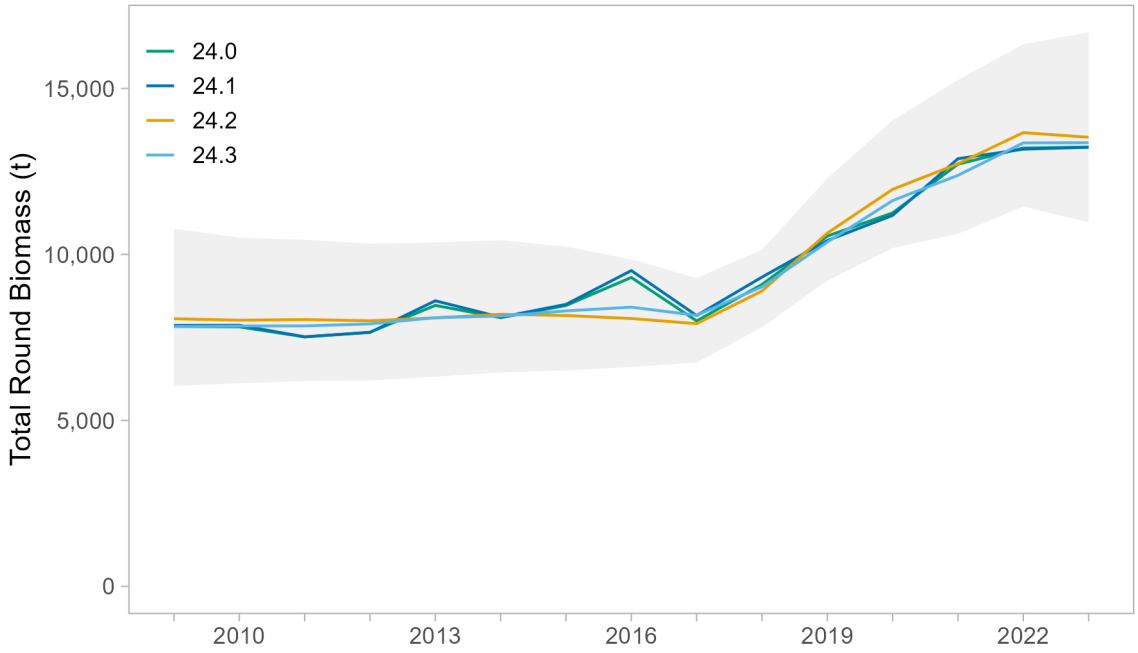

Figure 7: Predicted total round biomass among all surveyed districts. The grey shaded area represents a 95% confidence band for model 24.2.

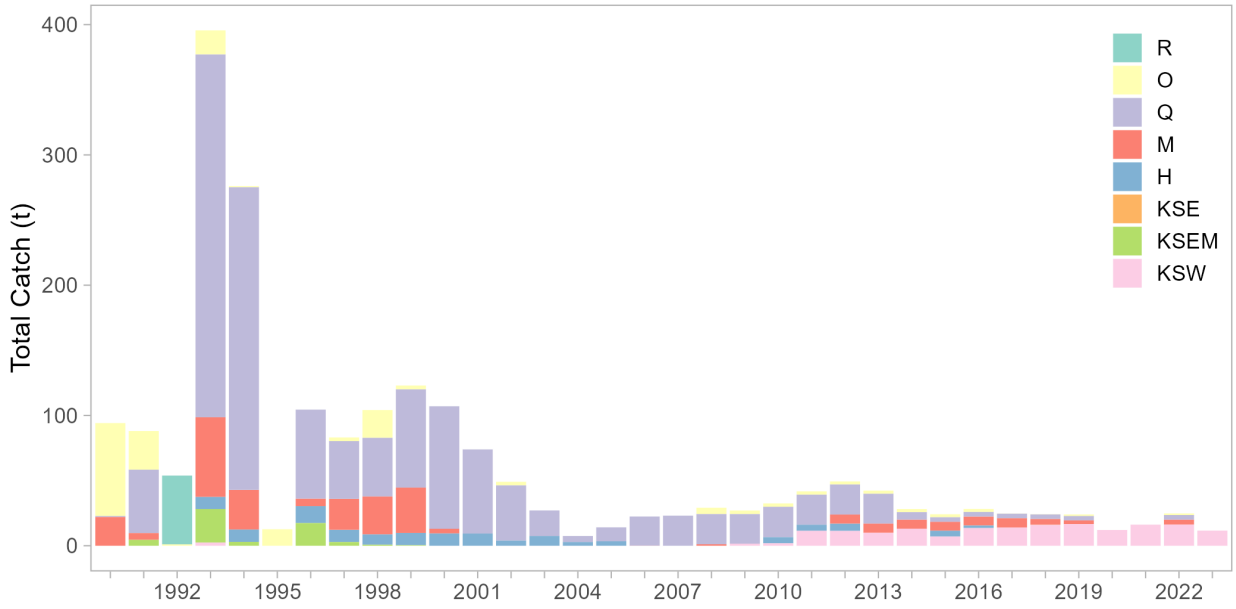

Figure 8: Total catch (tonnes of shucked meats) from 1990 - 2023 by district for non-surveyed districts.

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Appendix A: Socioeconomic Considerations in the Scallop Fishery Off Alaska

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A1.1 Introduction

This chapter provides an update of available economic information in an attempt to identify factors that have contributed to major changes in the Alaska scallop fishery over time. Thus, the analyst is limited to landings, price, value, ownership, and basic marketing data and does not have access to current vessel operational costs, crew shares, or other economic information. Nonetheless, every effort has been made to utilize data submissions from industry for past analyses to highlight likely current conditions in the fishery.

The following overview of the management history of the fishery is largely excerpted from information presented in Appendix A of the current Scallop Fishery Management Plan (NPFMC, 2009) and incorporates that discussion and information sources identified in that discussion here by reference.

A1.2 History of the Alaska Weathervane Scallop Fishery

Fishery Management History

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.

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.

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.

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 (NPFMC 1999). 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. These changes ushered in a new era in the scallop fishery off Alaska. The successes of the early exploratory years had now necessitated stock and effort management measures and capacity reduction.

NPFMC's preferred alternative for Amendment 4 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 (NPFMC 2005).

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 had 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. In the years since, several vessel owners have obtained scallop permits but to date, none have participated in the fishery.

Historic Fishery Participation, Catch, and Revenue Pre License Limitation Program

Commercial fishing effort first took place in Alaska during 1967 when two vessels harvested weathervane scallops from fishing grounds east of Kodiak Island and made six landings totaling less than 1,000 pounds of shucked meats. By the following year, 19 vessels including New England scallopers, converted Alaskan crab boats, salmon seiners, halibut longliners, and shrimp trawlers, entered the fishery.

As shown in, Table A2.1 an additional 17 vessels entered the fishery in 1968 and the 19 vessels that participated made 125 landings totaling 1,677,268 pounds of shucked meats. In 1969, 19 vessels continued harvesting scallops and made 157 landings totaling 1,849,947 pounds of shucked meats. The 1969 fishery had the largest number of landings and the largest pound total in the history of the fishery. first wholesale value of the 1969 catch was just over $1.5 million (inflation adjusted value would exceed $6.6 million[1]). However, this level of harvest and effort was not to be sustained.

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

Table A1.1 Historic Statewide Commercial Weathervane Scallop Statistics, 1967-2019/20.

Year	Vessels	Landings[a]	Catch (lb meats)[b]	Average Price/lb	Wholesale Value	Real Wholesale Value
1967	2	6	778[c]	$0.70	$545	
1968	19	125	1,677,268	$0.85	$1,425,678	
1969	19	157	1,849,947	$0.85	$1,572,455	
1970	7	137	1,440,338	$1.00	$1,440,338	
1971	5	60	931,151	$1.05	$977,709	
1972	5	65	1,167,034	$1.15	$1,342,089	
1973	5	45	1,109,405	$1.20	$1,331,286	
1974	3	29	504,438	$1.30	$655,769	
1975	4	56	435,672	$1.40	$609,941	
1976	7	21	264,788	$1.59	$421,013	
1977-79			No Fishery			
1980	8	56	616,717[c]	$3.60	$2,220,181	
1981	18	101	924,441	$4.00	$3,697,764	
1982	13	120	913,996	$3.25	$2,970,487	
1983	5	30	192,310	$5.00	$961,550	
1984	6	52	383,512	$4.00	$1,534,048	
1985	7	47	615,564	$4.00	$2,462,256	
1986	8	74	667,258	$4.25	$2,835,847	
1987	4	54	599,947[d]	$3.45	$2,069,817	
1988	4	47	341,070	$3.68	$1,255,138	
1989	7	55	534,763	$3.87	$2,069,533	
1990	9	144	1,481,136	$3.43	$5,080,296	
1991	6	136	1,136,649	$3.82	$4,341,999	
1992	8	136	1,785,673	$3.96	$7,071,265	
1993[e]	7	51	568,077	$5.15	$2,925,597	
1993/94	15	111	984,583	$5.15	$5,070,602	$7,491,342
1994/95	15	104	1,240,775	$5.79	$7,184,087	$10,520,805
1995/96	10	29	410,743d	$6.05	$2,484,995	$3,737,433
1996/97	9	30	732,424	$6.30	$4,614,271	$6,419,856
1997/98	9	31	818,913	$6.50	$5,322,935	$7,028,704
1998/99	8	35	822,096	$6.40	$5,261,414	$5,945,280
1999/00	10	22	837,971	$6.25	$5,237,319	$5,297,194
2000/01	8	20	750,617	$5.50	$4,128,394	$4,779,911

Year	Vessels	Landingsa	Catch (lb meats)b	Average Price/lb	Wholesale Value	Real Wholesale Value
2001/02	6	26	572,838	$5.25	$3,007,400	$3,495,463
2002/03	6	28	509,455	$5.25	$2,674,639	$3,059,055
2003/04	4	32	500,379	$5.25	$2,626,990	$2,707,200
2004/05	5	22	431,594	$5.50	$2,373,767	$2,674,427
2005/06	3	35	532,741	$8.02[f]	$4,272,583	$5,525,127
2006/07	3	21	486,564	$7.78[f]	$3,785,468	$4,916,922
2007/08	4	21	458,313	$5.94	$2,722,379	$3,499,537
2008/09	4	20	342,434	$6.34	$2,171,032	$3,009,430
2009/10	3	31	488,059	$6.48	$3,162,622	$3,807,175
2010/11	3	37	459,759	$8.35	$3,838,988	$4,269,364
2011/12	4	26	456,058	$10.39	$4,738,443	$5,678,577
2012/13	4	24	417,551	$10.63	$4,438,567	$4,488,507
2013/14	4	20	399,134	$12.25	$4,889,392	$4,988,904
2014/15	4	24	308,888	$12.39	$3,827,122	$4,050,401
2015/16	3	20	264,316	$12.22	$3,229,942	$3,152,920
2016/17	2	17	233,003	$12.53	$2,919,528	$3,017,693
2017/18	2	8	238,710	$11.54	$2,754,713	$2,782,610
2018/19	2	13	238,973	$11.26	$2,690,836	$2,690,836
2019/20	2	17	229,955	$11.26	$2,589,293	$2,589,293
2020/21	2	8	227,270	$10.43	$2,370,426	$2,370,426
2021/22	2	10	298,755	$11.06	$3,304,230	$3,304,230
2022/23	2	15	329,095	$13.56	$4,462,528	$4,462,528
2023/24	2		318,647			
10 year average	2	15	268,782	$11.85	$3,334,725	$3,770,910

(notes continued next page)

(Continued from Table 1 previous page)
Sources: ADF&G fish ticket data, and Alaska Department of Revenue annual fish prices through 2016, Industry provided prices, 2017-2021, preliminary estimated price for 2021/22.
[a] Prior to and including 1995, number of landings equals number of fish tickets. After 1995, the number of landings equals number of deliveries (off-loads). A delivery typically includes multiple tickets, normally one per week.
[b] Pounds of shucked scallop meats.
[c] Unshucked scallop deliveries were converted to shucked meats using a 10 percent conversion factor.
[d] Includes illegal harvest.
[e] January 1 through June 30
[f] estimated by fresh product ex-vessel price and limited first wholesale product value data.

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

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

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

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

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

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

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

Catch statistics shown in table 1 for the 1993-942 season indicate participation by 15 vessels making 111 landings of a total of 984,583 pounds of shucked meats. Total first wholesale value was just over $5 million in 1993-94. The 1994-95 season also had participation by 15 vessels making 104 landings totaling 1,240,775 pounds. Total first wholesale value in 1994-95 was nearly $7.2 million, the highest nominal value in history.

A1.3 Economic Performance in the LLP Fishery

An overview of Alaska weathervane scallop harvest and wholesale revenue and real wholesale value is presented in Table 1
. Vessel participation in this fishery has declined since the late 1990s due to the Federal LLP and formation of a voluntary marketing association which will both be discussed in detail below. The Federal LLP limits the participation to 9 permit holders. In the early 2000s as many as 8 vessels have participated; however, since 2014 no more than 4 vessels have participated. In each of the past four years two vessels have participated, as the harvest levels have fallen to historically low levels.

[2] The seasons established in the management plan extend into the first three months of the following year.

1 provides estimated statewide commercial Weathervane scallop landings and value from 1993/94 to present. Total real gross first wholesale revenue is calculated by multiplying landed pounds of meats by the adjusted price. Adjusted price converts the landed prices by year-to-year 2019 values to allow for comparisons in current dollar values, after accounting for inflation. The statewide scallop price used here is calculated by the Alaska Department of Revenue (ADOR), Division of Taxation, and is an average of all the reported annual State fish tax revenue collected from all participants in the scallop fishery as reported on Commercial Operators Annual Report submissions.

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

Nominal Alaska scallop prices have shown considerable variability over time and have increased dramatically since the mid-2000s. After trending downward to $5.25 per pound in the early to mid-2000s, nominal scallop prices increased to $7.86 by the 2006/07 season. However, in the 2007/08 season the nominal scallop price declined significantly to $5.94 per pound of shucked meats. Since the 2007/08 season, nominal Alaska Weathervane scallop price has trended upward and reached $12.53 per pound of shucked meats in 2016/17 but fell to $11.54 in 2017/18 and $11.26 in 2018/19 and 2019/20. Prices declined in the first of the Covid-19 pandemic to $10.43 in 2020/21, but have rebounded to an estimated $11.06 in 2021/22 and $13.56 in 2022/23. Industry provided price data is not yet available for 2023/24 but will be incorporated prior to this document being presented to the Council.

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 relatively high prices it receives for the scallops landed by the three vessels that are associated with the cooperative. However, the strength in Alaska scallop prices have faced market pressure in the in recent years as indicated by declines in U.S. commercial sea scallop average price per pound from $12.52 per pound in 2014 to $12.00 per pound in 2016 and below $10 per pound as supply expanded in 2017 but has risen to $12.18 in 2018, declined to $9.39 in 2019 and rebounded to $10.53 by 2021. Largely due to a sharp decline in Atlantic Sea Scallop landings, there was a dramatic increase to $15.08 per pound in 2023. The average price per pound of imported scallop products declined from $7.11 to $6.40 between 2015 and 2017 and continued declines to $5.24 and 5.93 in 2018 and 2019 respectively, and to $5.35 in 2020 before rebounding to $5.86 in 2021 and declined significantly to 3$ per pound in 2023. Please see section 4 for further discussion of competing scallop markets.

First wholesale revenue in this fishery has varied considerably over the period as both price and landings have varied. The peak value in the fishery, occurred in 1994/95 season when inflation adjusted $10.5 million was earned. Since that time, real total first wholesale revenue in the fishery has fluctuated with prices, and the reduction in landed pounds. Overall, the total value has trended downward as landings have fallen from more than 1.2 million pounds down to a preliminary low in 2019/20 of 229,955 pounds. The total real first wholesale revenue of less than $2.4 million in 2020/21 is lowest revenue total historically. The 2021/22 fishery earned $3.3 million as catch and prices both increased. Price data for 2024 is not yet available; however, landings were slight less and there have been high inflationary pressures so an

evaluation of these factors will be completed once industry provides an estimated average first wholesale price.

Port of Landing and Impacts on Communities

At the present time all Alaska scallop harvests are landed in ports within Alaska. However, during the 2020-21 fishery one scallop vessel transited from Seattle to the fishing grounds and back to offload at Fishermen's Terminal in Seattle due to Covid 19 quarantine (pers. Comm, Jim Stone, via e-mail February 25, 2022). 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 would normally be confidential; however, Amendment 4 included provisions for confidentiality waivers for LLP holders. In addition to the cooperative vessels, one vessel has made landings of fresh product in Homer and Kodiak in the past decade. However these landings are made to too few processors for the quantity and value to be released due to confidentiality restrictions, as shore based processors do not provide confidentiality waivers. Thus, it is not possible to release landings by port on fresh product that is then processed or sold directly. 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.

Table A2.2 below provides historic port landings from 1990 through 2023/23. Not included in this table are single deliveries to Juneau (2011/12, Ketchikan (1990) and Whittier (2006/07, two deliveries to Petersburg in 1990, 3 deliveries to Pelican (1990) and Seldovia (2003/04, 2004/05) and four deliveries to single deliveries to Seattle (2001/02, 2002/03, 2018/19, 2020/21)

Recent landings data shows that 15 or fewer total landings have occurred in each year, and they have occurred in Dutch Harbor, Homer, Kodiak, Yakutat, and recently Seattle due to Covid 19 quarantine protocols. Kodiak is presently receiving a majority of the landings.

The ADF&G office in Kodiak (Ryan Burt) has researched difficulties with reporting landing by port of frozen at sea product since formation of the LLP program. In that process, several historic landings spreadsheets were located and fish ticket data was preliminarily reviewed to provide the landing by port for the past three seasons. ADF&G staff have begun to develop a plan to try to recover the landings data and will use the following process to recover the data as time permits:

- Create a dedicated Access database for this project
- Download select columns of scallop fish ticket data from the State's fish ticket system and import into Access database
- Import spreadsheets of historic fish ticket data from the Kodiak office file server and import into Access database
- Using the unique fish ticket numbers, create data queries to compare these data sets against each other to determine what data is useful from the fish ticket and/or spreadsheet data
- If port of landing cannot be recovered from the fish ticket and/or spreadsheet data, a request (listing unique fish ticket numbers) may need to be submitted to Information Services in Juneau so staff there can physically retrieve select archived fish tickets

- Assign Kodiak staff to go through these retrieved fish tickets to recover port of landing data
- Create queries to summarize the data as needed for incorporation into analysis

Considerable progress was made on these tasks in 2022 and 2023 with the result being port landing counts from 1990 through 2022/23, with 2023/24 data pending. The results of these queries are presented in table A2.2 below.

Table A1.2 Scallop Landings by port, 2019-2022.

Year/ Season	Port of Delivery										
	Bellingham	Cordova	Dutch Harbor	Floating Catcher Processor	Homer	Kodiak	Seward	Sitka	Unknown	Yakutat	Grand Total
1990		1	12		2	62	5	8	1	22	116
1991			13			46		24		17	100
1992		6	8			46	1	15		28	104
1993		1	27		11	50	3	6		4	105
1994			22		8	35	4	2		4	75
1995		1	1		2	6	2	2		3	17
1996/97					9	13	5			4	31
1997/98		1	10		5	14	4			6	40
1998/99		1	4		12	10	6			9	42
1999/20		1	4		3	11	6			3	30
2000/01	15	3	2		3	6	4			2	35
2001/02	2		5	2	5	7	3			4	29
2002/03	1		5	2	7	8		1		4	29
2003/04	1		2	2	12	10				3	31
2004/05	1		1		5	11	1			1	20
2005/06	1	6	1	3	5	9				5	33
2006/07	1		2	1	5	7				2	18
2007/08			3		5	8			2	4	22
2008/09									16		16
2009/10			2		2	8			15		27
2010/11			2		11	12			5	6	36
2011/12			3		4	13			2		23
2012/13			3		5	9		1	2		20
2013/14		1	1		1	9		2	4		19

Year/ Season	Port of Delivery										
	Bellingham	Cordova	Dutch Harbor	Floating Catcher Processor	Homer	Kodiak	Seward	Sitka	Unknown	Yakutat	Grand Total
2015/16			1		1	7		1	6		16
2016/17			1			10			3	1	15
2017/18			1			4				4	9
2018/19					2	6			2	2	13
2019/20			1		1	5				3	10
2020/21						5				2	8
2021/22						9				2	11
2022/23			1			10			1	3	15
Grand Total	**22**	**25**	**141**	**10**	**130**	**477**	**44**	**63**	**61**	**148**	**1139**

Source: ADF&G Kodiak Scallop Program Office, 2023

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 (Stone, Jim, public testimony at the 2018 Scallop Plan Team meeting February 2018). 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.

A1.4 License Limitation Program Permit Ownership, Consolidation, and Current Participation

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

Under these conditions, vessel operators are constrained by the inefficiency of the day trip and external market forces dictating the value of their catch. Thus, operators would look to reduce inefficiencies, reduce operating costs, and attempt to capture processing value added that was being captured by the shoreside processing sector. Operators might even attempt to improve value by increasing quality. It can be argued that fresh frozen (at sea) product may be superior to product that is iced for a period of time before being consumed and/or frozen. The result of these forces appears to be the entrance of catcher processors (CPs) into the scallop fishery. That this began to happen should be no surprise. It was around this time that the CP fleet began to expand in several of the Bering Sea fisheries for many of the same reasons. This practice expanded over the next several seasons. By the time the vessel moratorium was imposed in 1997 there were 18 vessels included under the moratorium.

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

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

registration area. This analysis estimates the number of vessels that could breakeven in the fishery under a series of price and landings scenarios. The analysis is based on operating cost and revenue data provided voluntarily by fishery participants. Table 3 presents the analysis.

Table A1.3 Number of Vessels that Could Breakeven Under Various Price and Landings Scenarios (recreated from Regulatory Impact Review for Amendment 4 to the North Pacific Scallop FMP).

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

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

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

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

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

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

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

costs of travel to and from the east coast, or vessel caretaking costs during the off-season, and idle vessel time. These factors likely contributed to these three vessels not fishing under the cooperative and limiting participation.

Another consideration is that the Kamishak beds traditionally fished by the two primarily cook inlet vessels have been closed for some time. The south bed has been closed since the 2008/09 season, while the north bed was last open for fishing during the 2017/18 season. During the 2017/18 season, the GHL was 10,000 lb shucked meats, and no vessels participated in the fishery. The Kamishak District remained closed for the 2021/22 season. Further, the outside waters adjacent to the Kenai peninsula and outside of Prince William Sound are fished via a Commissioner's permits, as the area have very limited scallop beds, necessitating enhanced management of harvests. These restrictions, combined with the gear restrictions (maximum of 20 foot total dredges) may have significantly contributed to the elimination of active participation in the scallop fishery by LLP holders that previously had operated out of Homer and Seward, and likely caused reductions in deliveries to historic scallop ports of Homer, Seward, and Cordova. All vessels that historically fished these areas have been sold or lengthened and repurposed.

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

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

The data provided by Provider Inc. and Ocean Hunter/ Ocean Fisheries LLC in 2003 indicate a non-labor cost ratios of 59 percent and 57 percent for Provider and Ocean Hunter respectively. However, these non-labor cost ratios include fees of $157,493 paid by Provider Inc. and $87,097 in fees paid by Ocean Hunter. Thus, these two cooperative vessels were able to maintain the same, or slightly lower, cost ratio inclusive of leases paid to other cooperative members totaling $244,516. Overall revenue for the remaining vessels increased with fewer vessels fishing, and it is likely that payments to labor, including owner shares, increased with greater overall revenue and similar non-labor cost ratios.

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

In contrast, the Alaska Commercial Fisheries Entry Commission (CFEC) Limited Entry Scallop permit, which was allowed to sunset in 2014 and no longer exists, was specifically attached to a vessel. Thus, through 2013, to fish in both Federal and State waters, one had to have a Federal LLP and would need to use the actual vessel assigned the CFEC Limited Entry permit if also fishing in State waters. However, if one wanted to fish only in Federal waters they could use any vessel so long as it was under the MLOA of that LLP and was not an American Fisheries Act (AFA) vessel (sideboarded by State statue). Alternatively, if an individual or entity were to purchase a Federal LLP, they would not be required to actually fish the LLP, nor would they then have need of a CFEC Limited Entry licensed vessel.

Starting in 2002, the members of the cooperative wishing to remain in the fishery formed several Alaska corporations with shared ownership, purchased the interest of those who no longer wished to remain in the fishery, and consolidated operations on three vessels. There was one additional original cooperative member, Forum Star Inc. The vessel Forum Star was an AFA eligible vessel and has been permitted as such since 2000. Under Amendment 8 to the FMP authority was delegated to the State of Alaska to set an AFA sideboard in the scallop fishery. The State set a limit of approximately 35,000 pounds (Barnhart, 2006) at present stock levels, on that vessel making its active participation in scalloping likely not profitable.

In 2005, Forum Star Inc. and its Scallop LLP were purchased by American Seafoods LLC, also an AFA entity. If the LLP held by American Seafoods LLC remains in the control of an AFA entity, it will continue to be restricted by the AFA sideboard. It is, however, important to note that the LLP itself is not AFA endorsed. This means that it could presumably be sold to a non-AFA entity. As long as a vessel no longer than 97' (the MLOA allowed under Federal Scallop LLP #002) with no AFA endorsement is used with LLP #002, the AFA sideboard restriction would not apply. Thus, an existing scallop operation could buy this LLP and use it on a 97 foot non-AFA vessel under current federal regulations (50 CFR 679.4, 50 CFR 679.7). Alternatively, an existing entity would not have to use it at all as just holding the second permit means more scallop harvest for the remaining vessels.

Table 4 provides a summary of LLP holdings and changes in those holdings over time separately for independent operators and for cooperative members. The three LLPs not associated with cooperative members have also gone through several permit transfers and organizational changes. LLP #003, and the vessel Kilkenny that has most recently been used to fish that LLP, is presently identified in State permit records as owned by Atlantic Cape Fisheries Inc. of New Jersey. Atlantic Capes has not fished that LLP since it was purchased.

LLP #004 was originally registered to Max G. Hulse, and was transferred to Scott Hulse in 2018. The vessels historically utilized by the Hulse family have been lengthened and re-purposed and would no longer be eligible to fish the LLP. As of 2022, Scott Hulse has transferred the LLP to Ty Babb of Maine. Mr. Babb did not participate in the Scallop Plan Team meeting in February of 2022 and his intentions for fishing scallops in Alaska are unknown. He is also a registered Bristol Bay salmon permit holder.

Finally, LLP #006 was most recently transferred to EWT LLC, which was an Alaska LLC with ownership by U.S. East coast scallop interests. However, EWT LLC was involuntarily dissolved by the State of Alaska either due to non-filing of renewal and/or nonpayment of fees. EWT LLC is, however, registered in New Bedford, Massachusetts. The vessel historically used to fish this LLP has been sold by the original LLP holder and is not owned by EWT LLC interests. Thus, none of these three original LLPs are currently directly associated with vessel ownership but could be used on any vessel that meets the MLOA restrictions and gear restrictions for the LLPs.

Also shown in Table 4 are the present owners of LLPs associated with the Alaska Scallop Cooperative. The information provided includes corporate and individual ownership percentages which will be discussed further below. At present, there are effectively two cooperative associated vessels fishing in the statewide fishery outside the Cook Inlet registration area: Ocean Hunter, and Provider. However, Arctic Hunter LLC recently replaced the Arctic Hunter with the Polar Sea, thus, the cooperative has three vessels, all homeported in Kodiak, that are prepared to fish scallops and these are the only known vessels owned by entities that also own LLPs.

Table 4 provides the ownership percentages of Alaska Weathervane Scallop LLPs, by Alaska Corporation. Alaska corporate records available online include the ownership percentages of each identified owner and they are presented in Table 4 as well(ADOC, 2023). Several of the identified owners of LLPs that are associated with the Alaska Scallop Cooperative are Washington based corporate

entities. Table 6 provides available information from Washington corporate records online regarding the individuals who own these Washington corporations, (State of Washington, 2022). Unfortunately, Washington State does not publicly identify ownership percentages. For this analysis, it is assumed that a single identified governor of a Washington corporation holds 100 percent ownership, and when two governors are identified it is assumed they each hold equal 50% shares. Table 5 identifies these individuals and the assumptions regarding their ownership shares.

Utilizing the Alaska corporate LLP ownership percentages and the ownership percentages of individual owners of the Washington corporations identified in Alaska corporate records it is possible to assign ownership shares of each LLP to the individual owners and to tabulate cumulative ownership shares of Alaska Weathervane scallop LLPs attributable to Alaska Scallop Cooperative members. This ownership attribution is provided in Table 6 for each cooperative member, individually, and shows that the highest level of cumulative ownership shares, under the assumptions described above, is 110%, or the equivalent of 1.1 LLP. LLP ownership limitations enacted when the LLP was established allow up to two LLP to be owned by one individual.

Table A1.4 Federal Scallop LLP Holder History and Current Activity.

LLP	Original Holder	MLOA	Current Holder	Restrictions	Corporate Ownership and Homestate	Vessel Historically Used	Fished in 2015-2022
Independent Operators							
003	Hogan, Thomas C.	75	Atlantic Capes Fisheries LLC	2 dredges with 20' max. combined width	Atlantic Capes Fisheries Inc: Daniel Cohen (100%) in good standing, Cape May NJ	**Kilkenny**: Owned by Atlantic Cape Fisheries Inc,	no
004	Hulse, Max G. et al.	79	Ty W. Babb	2 dredges with 20' max. combined width	Transferred to Scott D. Hulse in 2018, transferred to Ty W. Babb in 2021, corporate status unknown.	**La Brisa / Wayward Wind**: Vessels rebuilt (lengthened) and re-purposed	no
006	Oceanic Research Services	70	EWT LLC	none	EWT LLC: Eric Orman (66.67%) Warren Alexander (33.33%) New Bedford, MA	**Artic Storm**: sold	no
Alaska Scallop Association Members							
002	Forum Star Inc.	97	American Seafoods Co., LLC	State Imposed AFA Sideboard	American Seafoods Group, LLC (100%), in turn owned by ASG Parent LLC (100%) Delaware, Operations Seattle WA	**Forum Star** (owned by Forum Star LLC, which is 100% owned by American Seafoods Company LLC)	no
005	Ocean Fisheries LLC	102	Arctic Hunter LLC	none	Egil Mikkelsen, Glenn Mikkelsen, James Stone, John Lemar, Stein Nyhammer (20% each), Lakewood, WA	Artic Hunter, Replaced by **Polar Sea** (owned by Arctic Hunter LLC)	yes
007	Pursuit, Inc.	101	Ocean Fisheries LLC	none	Festus Fisheries Inc (WA). (20%) Mikkelsen Fisheries Inc (WA). (40%) Stein Enterprises Inc. (WA) (20%), Stone Maritime Inc (WA). (20%), Tacoma, WA	**Pursuit** (no longer documented)	no
008	Provider, Inc.	124	Provider Fisheries LLC	none	Egil Mikkelsen (20%), Glenn Mikkelsen (20%), James Stone (25%), John Lemar (25%), Tom Minio (10%) Lakewood, WA	**Provider** (owned by Provider Fisheries LLC)	yes
009	Carolina Boy, Inc.	95	Ocean Fisheries, LLC	none	Festus Fisheries Inc(WA). (20%) Mikkelsen Fisheries Inc(WA). (40%) Stein Enterprises inc. (WA) (20%), Stone Maritime Inc(WA) (20%), Lakewood, WA	**Ocean Hunter** (owned by Ocean Fisheries LLC)	yes
010	Carolina Girl, Inc.	96	Alaska Scallop Fisheries , LLC	none	Egil Mikkelsen (20%), Glenn Mikkelsen (20%), James Stone (25%), John Lemar (25%), Tom Minio (10% each), Kodiak, AK	**Carolina Girl** (no longer documented)	no

Source: https://alaskafisheries.noaa.gov /and https://myalaska.state.ak.us/business/sosb

Table A1.5 Ownership Interest of Washington Corporations.

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

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

Table A1.6 Cooperative Member LLP Ownership Attribution.

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

Effects of Fleet Consolidation

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

Fleet consolidation undoubtedly has a direct effect on the number of crew and operator positions in the fishery. At the time of the vessel moratorium, 18 vessels qualified and likely employed at least 216 crew members (12, including operator, cooks, mechanics, etc. per vessel). However, crew earnings and data linking crew members to vessels do not exist. It is impossible to say, using presently available data, exactly how many crew were employed or the amount of their crew shares. Similarly, it is impossible to determine how many crew were locally (Alaska Residents) acquired or available. In any event, the Federal LLP effectively reduced the number of crew positions, including operators etc., to 108. The fleet consolidation that has occurred under the cooperative, and due to declining guideline harvest levels, has further reduced crew positions to no more than 24. It is possible; however, that the crew shares earned by these crew members are higher than what was earned in the past.

Fishery 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 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.

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

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. The figure below is an example of the potential crew shares within the cooperative over time. This example assumes 42 percent of revenue goes to crew shares (based on industry provided data from two cooperative vessels) and that each vessel participating utilizes the maximum of 12 crew (position numbers shown on left axis). This example does not account for differentiation in crew compensation based on position (Captain vs. deck and plant crew) or experience. What this example does illustrate is that potential crew shares within the cooperative have fluctuated with landings, price, and the number of positions. However, with the cooperative's ability to reduce overcapitalization by utilizing two of its three associated vessels it appears that potential crew compensation has stabilized and possibly increased with the 2021/22 and 2022/23increase in GHL and wholesale prices. The ability of the cooperative to manage capacity may also be influenced by the fact that one associated boat only participates in the scallop fishery, while owners of the other two boats and associated scallop LLPs are known to be participants in the BSAI crab rationalization program fisheries.

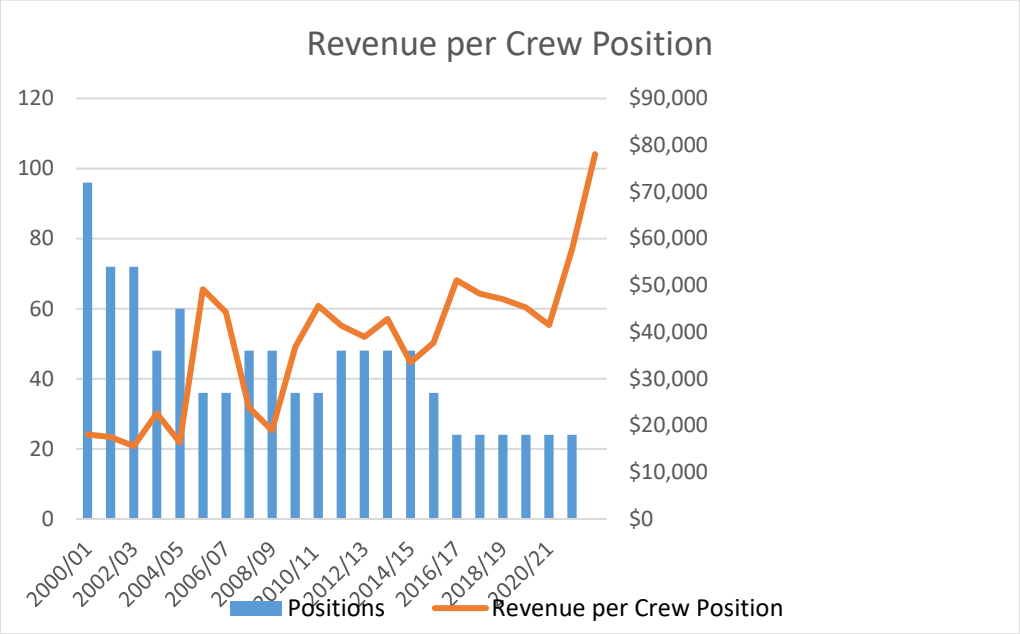

Figure A1.1 Potential Cooperative Revenue per Crew Position, 2000-2021.

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

Fleet consolidation has also affected deliveries to several Alaska ports. Information on scallop deliveries to ports from 1990-2023 (ADF&G 2023) show that, since formation of the cooperative and associated fleet consolidation, scallop landing have occurred in several ports and the location of landings has varied over the years. Cordova, Dutch Harbor, Homer, Kodiak, Sitka and Yakutat have all had landings in between 2012 and 2017; however occasional past landings in Alaska ports of Juneau, Ketchikan, Pelican, Petersburg, Sand Point, Seldovia, Seward and Whittier are not presently occurring. Also of note is that past landings made outside of Alaska to ports in Bellingham, and Seattle had not occurred since 2008 and not by any of the present members of the Alaska Scallop Association, except for a single Covid-19 related delivery to Seattle in 2021.

Scallop harvests are taxed in different ways depending on where they are caught and on where they are landed. Scallops caught in State of Alaska waters are subject to the Fishery Business Tax, while scallops caught in Federal waters of the Exclusive Economic Zone are subject to the Resource Landings Tax. The Alaska Department of Revenue requires scallop-fishing entities to record both where scallops were harvested as well as where they were landed. Additionally, there are local taxes, such as Kodiak's Natural Resources Severance tax for fish products harvested with in the Kodiak borough. These local taxes vary by community. Tax data for this fishery is not available due to confidentiality.

All of the vessels that participate in this fishery, at present, are homeported in Alaska ports and, as discussed above, pay both Alaska Business taxes and Resource Landings taxes and any applicable local taxes in landing ports and their home port (e.g. sales tax). From 2017-2019 the two vessels fishing made

between 8 and 17 landings per year in ports of Yakutat, Homer, Kodiak and Dutch Harbor. While all of the effects of consolidation mentioned above have negative consequences for some fishery participants and fishing communities, it is likely that the overall effect of fleet reduction is improved profitability for the remaining participants given that the harvest level is at historic lows.

A fundamental question is whether another vessel could fish in the Alaska Scallop Fishery profitably. Table 7 decomposes the breakeven analysis from the Amendment 4 Regulatory Impact Review and re-specifies those breakeven levels using present harvest and price ranges. Doing so imposes the same fixed cost ratios as were used in the Amendment 4 analysis and data from vessels that, with the exception of the Provider, do not currently participate in the fishery. With that limitation duly noted, application of present price of $11.00 to $11.50 and just over 200,000 pounds of harvest roughly 1.2 vessels would breakeven under present fishery and market conditions assuming cost ratios are similar to the past. It is likely that the members of the Alaska Scallop Cooperative have achieved some cost efficiencies since this breakeven analysis was conducted as evidenced by their two vessels currently operating.

In addition, Appendix B to the analysis of Amendment 10 to the Scallop FMP (NPFMC 2005) contains cost and breakeven data from 2003 for the Provider and Ocean Hunter, both of which are presently active in the fishery. That data, though limited to an average of two vessels shows that breakeven levels of income from 2003, inflation adjusted to 2019 values using the U.S. Gross Domestic Product Implicit Price Deflator, also suggests that fewer than two vessels would breakeven under current price and landings values.

Table A1.7 Number of Vessels that Could Breakeven Under Current Price and Landings Scenarios (recreated from Regulatory Impact Review for Amendment 4-10 to the North Pacific Scallop FMP).

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

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

A2.5 Scallop Market Conditions

In the domestic U.S. market, Alaska weathervane scallops are similar to Atlantic sea scallops; however, they tend to be smaller and sweeter to the palate. Table 8 compares total landings and value of Alaska weathervane scallops with Atlantic sea scallops from 1990 through 2023 and with imports of all scallop products from 1990 through December of 2023. These data show that Atlantic sea scallop harvest is consistently orders of magnitude larger than weathervane scallop harvests off Alaska.

There are some intuitive conclusions that can be made from the data presented in Table 8 and from the price trends displayed in Figure 2. First, domestic markets are dominated by Atlantic sea scallop production and scallop imports. For example, in 2021, an estimated 43.3 million pounds of Atlantic Sea Scallops were landed in the United States, down from a decade high of nearly 61 million pounds in 2019. Additionally, 55.4 million pounds of scallop products were imported into the United States, which is a considerable increase over the 36.5 million pounds imported the previous year. Imports have continued to rise with 55.4 Million pounds imported in 2022 and a more than four times increase to 232.5 million pounds in 2023. This compares to just under 300,000 pounds of Alaska Weathervane scallop landings in 2021/22 and 2022/23 Even in the highest production year of 1994, the 1.2 million pounds of Alaska Weathervane scallop landings made in that year compare to 16.8 million pounds of Atlantic Sea scallop landings and 56.8 million pounds of imported scallop products.

Second, prices of weathervane scallops track closely to those of Atlantic sea scallops. Thus, it is highly likely that domestic market price is dominated by the relationship between quantity supplied in the Atlantic sea scallop fishery and domestic market demand as well as by substitution of imported scallop product. Figure A2.2 provides a very clear picture of the relationship between Sea scallop prices and Alaska Weathervane scallop prices. These data appear to show that Alaska Weathervane scallop price declines tend to lag U.S. Sea scallop price declines and, at least since formation of the Alaska Scallop Association, have tended to slightly lead market price increases.

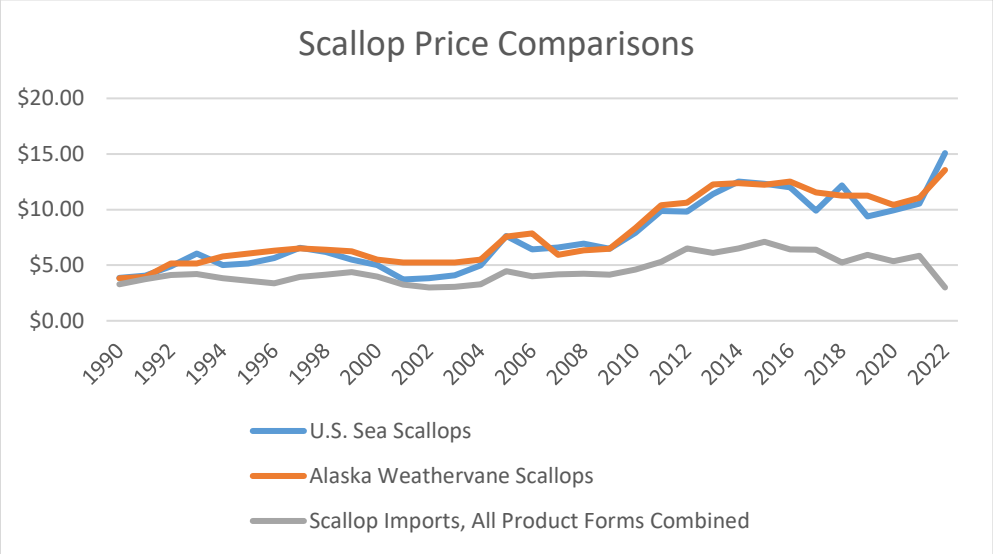

Figure A1.2 Scallop Price Comparisons, 1990-2023.

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

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

Another important factor in scallop market is imports of scallop products. Unfortunately, available import data commingles imports of several small scallop species (e.g. pink, calico, bay etc.) with larger scallop varieties such as sea scallops and weathervane scallops. However, as these products are substitutes for one another, although not perfectly, the imports of these other species may influence domestic market prices.

The conclusion that can be drawn from the data presented in Table 8

Table is that the wholesale price of weathervane scallops is likely heavily influenced by domestic supply and import supply. This suggests that North Pacific harvesters have little market power to negotiate prices, except based on quality and taste preferences, and are likely price takers in the wholesale market.

It may also be possible that inflationary pressures have pushed 2023/24 prices to levels possibly exceeding Atlantic Sea Scallop; however, the dramatic increase in imports produced a significant decline in import prices to $3 per pound thus some negative pressure may be occurring due to substitution of low cost imported products. Complete price data is not presently available but will be included in this documents prior to presentation to the Council.

Table A1.8 US Scallop Landings and Value versus Scallop Imports and Value, 1990-2023.

Year	U.S. Sea Scallops			Alaska Weathervane Scallops*			Scallop Imports, All Product Forms Combined		
	Millions of Pounds	Value ($ millions)	Av. $/lb	Millions of Pounds	Value ($ millions)	Av. $/lb	Millions of Pounds	Value ($ millions)	Av. $/lb
1990	38.6	$149.1	$3.87	1.1	$4.3	$3.82	40.0	$131.6	$3.29
1991	37.9	$153.7	$4.05	1.8	$7.1	$3.96	29.7	$111.4	$3.76
1992	31.3	$153.4	$4.90	0.6	$2.9	$5.15	38.8	$160.2	$4.13
1993	16.1	$97.1	$6.04	1.0	$5.1	$5.15	52.1	$219.2	$4.21
1994	16.8	$84.1	$5.01	1.2	$7.2	$5.79	56.8	$216.9	$3.82
1995	17.4	$89.8	$5.16	0.4	$2.5	$6.05	48.4	$174.8	$3.61
1996	17.5	$98.8	$5.64	0.7	$4.6	$6.30	58.8	$198.8	$3.38
1997	13.6	$89.5	$6.56	0.8	$5.3	$6.50	60.3	$238.1	$3.95
1998	12.1	$75.1	$6.19	0.8	$5.3	$6.40	53.2	$221.1	$4.16
1999	22.0	$121.0	$5.49	0.8	$5.2	$6.25	44.6	$194.7	$4.37
2000	32.2	$160.9	$5.00	0.8	$4.1	$5.50	54.1	$214.8	$3.97
2001	46.4	$172.6	$3.72	0.6	$3.0	$5.25	40.0	$130.0	$3.25
2002	52.7	$202.1	$3.84	0.5	$2.7	$5.25	49.0	$146.7	$3.00
2003	56.0	$229.1	$4.09	0.5	$2.6	$5.25	52.9	$161.9	$3.06
2004	64.1	$320.0	$4.99	0.4	$2.3	$5.50	45.3	$149.4	$3.29
2005	56.6	$432.5	$7.64	0.5	$4.0	$7.58	51.4	$229.8	$4.47
2006	60.1	$386.3	$6.43	0.5	$3.8	$7.86	60.8	$243.3	$4.00
2007	58.5	$386.0	$6.60	0.5	$2.7	$5.94	56.6	$236.8	$4.18
2008	53.4	$370.1	$6.93	0.3	$2.2	$6.34	57.8	$244.8	$4.24
2009	57.9	$375.6	$6.48	0.5	$3.2	$6.48	56.3	$233.0	$4.14
2010	57.5	$455.7	$7.92	0.5	$3.8	$8.35	51.9	$238.5	$4.60
2011	59.2	$585.1	$9.89	0.5	$4.7	$10.39	56.8	$300.4	$5.29
2012	56.9	$559.0	$9.82	0.4	$4.4	$10.63	34.5	$224.7	$6.52
2013	41.0	$466.8	$11.39	0.4	$4.9	$12.25	60.9	$371.9	$6.11
2014	33.8	$423.7	$12.52	0.3	$3.8	$12.39	60.7	$394.4	$6.50
2015	35.7	$439.7	$12.32	0.3	$3.2	$12.22	49.3	$350.2	$7.11
2016	40.5	$486.0	$12.00	0.2	$2.9	$12.53	51.0	$328.5	$6.43
2017	53.8	$532.9	$9.90	0.2	$2.8	$11.54	41.3	$264.5	$6.40
2018	60.1	$732.0	$12.18	0.2	$2.8	$11.26	46.5	$243.6	$5.24
2019	60.7	$570.1	$9.39	0.2	$2.7	$11.26	35.3	$208.9	$5.92
2020	48.9	$486.2	$9.94	0.2	$2.4	$10.43	36.5	$195.4	$5.35
2021	40.0	$421.4	$10.53	0.3	$3.3	$11.06	55.4	$324.4	$5.86
2022	43.3	$671.8	$10.53	0.3	$4.5	$11.06	55.4	$324.4	$5.86
2023	31.8	$479.60	$15.08	0.3	$3.2	$13.56	232.6	$697.1	$3.00

*Sources: NMFS Data at https://www.fisheries.noaa.gov and ADF&G Fish Ticket data. * Seasonal data is displayed as annual data for comparison with annual sea scallop landings. n/a= data for 2019/20 Atlantic US Sea scallop fishery is not yet available.*

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