DRAFT FOR INITIAL REVIEW

Environmental Assessment/Regulatory Impact Review for Proposed Amendment to the Fishery Management Plan for Groundfish of the Bering Sea / Aleutian Islands Management Area

Groundfish Area Closures within the Bristol Bay Red King Crab Stock Assessment Area

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For further information contact: Sam Cunningham, North Pacific Fishery Management Council
1007 W 3rd Avenue, Suite 400, Anchorage, AK 99501
(907) 271-2809

Andrew Olson, National Marine Fisheries Service, Alaska Region
P. O. Box 21668, Juneau, AK 99802-1668
(907) 586-7221

Abstract: This Environmental Assessment/Regulatory Impact Review analyzes proposed management measures that would apply exclusively to participants in the Federal groundfish fisheries in the Bering Sea/Aleutian Islands Fishery Management Plan area. The measures under consideration include action alternatives that would (either/both) close the Red King Crab Savings Area to all commercial groundfish fishing gears, or close NMFS Area 512 to fishing for Pacific cod with pot gear if indicator values of Bristol Bay red king crab abundance are below an established threshold. The purpose of these considered actions is to address low levels of stock abundance and recruitment that resulted in directed red king crab fishery closures in two of the three most recent fishing years through the reduction of crab fishing mortality in groundfish fisheries. The Council is considering alternatives that could contribute to stock abundance and promote the achievement of optimum yield in the directed Bristol Bay red king crab fishery while minimizing negative impacts to affected groundfish fisheries as well as non-crab prohibited species that may also be encountered by groundfish gears in the regulated Fishery Management Plan area. This document includes a discussion of the trawl gear performance standard regulation that pertains to seafloor contact in the BSAI directed pollock fishery.

List of Acronyms and Abbreviations

Acronym or Abbreviation	Meaning
AAC	Alaska Administrative Code
ABC	acceptable biological catch
ADF&G	Alaska Department of Fish and Game
AFA	American Fisheries Act
AFSC	Alaska Fisheries Science Center
AKFIN	Alaska Fisheries Information Network
BBRKC	Bristol Bay red king crab
BS	Bering Sea
BSAI	Bering Sea and Aleutian Islands
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Council	North Pacific Fishery Management Council
CP	catcher/processor
CPT	BSAI Crab Plan Team
CPUE	catch per unit effort
CV	catcher vessel
E.O.	Executive Order
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIS	Environmental Impact Statement
EM	Electronic monitoring
ESP	Ecosystem and Socioeconomic Profile
FE	Fishing Effects model
FMP	fishery management plan
FR	*Federal Register*
ft	foot or feet
GOA	Gulf of Alaska
HAL	hook-and-line
IRFA	Initial Regulatory Flexibility Analysis
IPA	Incentive Plan Agreement
lb(s)	pound(s)
LBA	length-based analysis
LLP	license limitation program

Acronym or Abbreviation	Meaning
LOA	length overall
m	meter or meters
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MMPA	Marine Mammal Protection Act
t	tonne, or metric ton
NAO	NOAA Administrative Order
NEPA	National Environmental Policy Act
NMFS	National Marine Fishery Service
NOAA	National Oceanic and Atmospheric Administration
NPFMC	North Pacific Fishery Management Council
NPT	non-pelagic trawl gear
Observer Program	North Pacific Groundfish and Halibut Observer Program
OLE	NMFS Office of Law Enforcement
PSC	prohibited species catch
PPA	Preliminary preferred alternative
PSEIS	Programmatic Supplemental Environmental Impact Statement
PTR	pelagic trawl gear
RFA	Regulatory Flexibility Act
RIR	Regulatory Impact Review
RKC	Red king crab
RKCSA	Red King Crab Savings Area
RKCSS	Red King Crab Savings Subarea
SAFE	Stock Assessment and Fishery Evaluation
SDM	Species distribution model
Secretary	Secretary of Commerce
TAC	total allowable catch
TLAS	BSAI trawl limited access sector
U.S.	United States
USFWS	United States Fish and Wildlife Service
VMS	vessel monitoring system

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Executive Summary

This Environmental Assessment/Regulatory Impact Review (EA/RIR) analyzes proposed management measures that would apply exclusively to participants in the Federal groundfish fisheries in the Bering Sea/Aleutian Islands (BSAI) Fishery Management Plan (FMP) area. The measures under consideration include action alternatives that would (either/both) close the Red King Crab Savings Area (RKCSA) to all commercial groundfish fishing gears, or close NMFS Reporting Area 512 to fishing for Pacific cod with pot gear if indicator values of Bristol Bay red king crab (BBRKC) abundance are below an established threshold. The purpose of these considered actions is to address low levels of stock abundance and recruitment that have resulted in directed crab fishery closures in two of the three most recent fishing years (2021/22 and 2022/23) through the reduction of crab fishing mortality in groundfish fisheries. The Council is considering alternatives that could contribute to stock abundance and promote the achievement of optimum yield in the directed BBRKC fishery while minimizing negative impacts to affected groundfish fisheries as well as non-crab prohibited species that may also be encountered by groundfish gears in the regulated FMP area. This document also includes a discussion of the trawl gear performance standard regulation that pertains to seafloor contact in the BSAI directed pollock fishery, as well as an evaluation of potential opportunities, trade-offs, and challenges related to the establishment of dynamic closure areas.

Purpose and Need

The Council established the following purpose and need statement in December 2022 (motion).

> *The Bristol Bay red king crab (BBRKC) stock has declined and is currently at low levels, resulting in a closure to the directed fishery in 2021/22 and 2022/23. Estimated recruitment has been extremely low during the last 12 years and the projected mature biomass is expected to decline during the next few years. The best available science indicates the cause of the decline is a combination of factors related to continued warming and variability in ocean conditions.*
>
> *Given the poor recruitment and low stock status of BBRKC, the Council intends to consider management measures focused on reducing BBRKC mortality from groundfish fishing in areas that may be important to BBRKC and where BBRKC may be found year-round, which may help increase stock abundance and promote achievement of optimum yield from the directed BBRKC fishery while minimizing negative impacts to affected groundfish fleet operations as well as target and PSC species.*

Alternatives

Alternative 1: No action (status quo)

Alternative 2: Implement an annual closure of the Red King Crab Savings Area (RKCSA) to all commercial groundfish fishing gears. The existing closure for non-pelagic trawl gear is not changed under Option 1. Option 2 modifies the trigger to close the Red King Crab Savings Subarea (RKCSS) for non-pelagic trawl.

The closure would be in effect:

Option 1: If ADF&G does not establish a total allowable catch (TAC) the previous year for the Bristol Bay red king crab fishery.

Option 2: If the total area-swept biomass for BBRKC is less than 50,000 mt.

Suboptions (apply to either Option):

Suboption 1: Exempt hook-and-line gear from the closure

Suboption 2: Exempt pot gear from the closure

Alternative 3: Implement a closure of NMFS Reporting Area 512 to fishing for Pacific cod with pot gear.

The closure would be in effect:

Option 1: If ADF&G does not establish a total allowable catch (TAC) the previous year for the Bristol Bay red king crab fishery.

Option 2: If the total area-swept biomass for BBRKC is less than 50,000 mt.

Note: Alternatives 2 and 3 could be selected individually or in combination.

Economic and Social Impacts

Tables ES-1 and ES-2 provide a high-level overview of the proportion of BS groundfish activity that has occurred in the RKCSA or in the BBRKC fishery area (ADFG Area T) across four gear groups: hook and line (HAL), non-pelagic trawl (NPT), pot, and pelagic trawl (PTR). Figure ES-1 summarizes recent trends in Pacific cod pot gear participation in the RKCSA and NMFS Area 512 to the east; the figure shows a reduction in effort within the RKCSA and a concurrent increase in Area 512. The increase in fishing within Area 512 is largely supported by tender vessels that take catch in that relatively eastern fishing area to processors that would be outside the range of catcher vessels (Unalaska/Dutch Harbor, King Cove, Akutan, and Port Moller).

The only gear sector that has increased fishing in the RKCSA during the analyzed period is the pelagic trawl (pollock) fishery. This trend is partially driven by pollock catch rates at certain times of year (pollock A season) and partially driven by competing needs to fish in areas with lower salmon and herring bycatch, as well as other constraints like seasonal catch limits in other preferred pollock fishing areas (e.g., Steller Sea Lion Conservation Area closer to Unalaska). The non-pelagic trawl sector has fished less in the RKCSS portion of the RKCSA in recent years, but is still engaged in proximate areas (shown as ADFG Area T in Table ES-1). The Pacific cod pot sector had historically fished in the RKCSA during the B season, but has moved effort to other areas (notably including Area 512) in recent years – partly in an effort to reduce fishing mortality of BBRKC, as a substantial number of pot cod participants have a direct harvesting stake in the BBRKC fishery. HAL CPs have generally moved out of the RKCSA in recent years but have also maintained a presence in "Area T". Without a tight RKC bycatch constraint and relatively low RKC bycatch overall compared to other gears, HAL effort tends to follow Pacific cod CPUE and it is possible that participation in the RKCSA could return to previous levels if a cold regime pushes their target south. HAL CVs operate at a small scale in the BS and have not fished in the RKCSA dating back to current NMFS catch accounting records beginning with 2003.

Because the actions would close areas but not directly curtail fishing seasons or catch limits, economic impacts are primarily viewed through the lens of "revenue at risk" as opposed to "forgone revenue" because target species that cannot be caught in the newly closed areas could theoretically be recovered elsewhere. The analysis of Alternative 1 provides a baseline for the value of fisheries in the potentially affected areas and their connections to communities through vessel ownership and shore-based processing. Loss of that revenue and associated downstream economic benefits represents an unlikely maximum adverse impact from closed areas. Fisheries would likely shift effort to other areas but not at some cost of efficiency, productivity, product quality, time value of labor, and other opportunity costs. The ability to relocate effort is constrained by the presence of other fisheries already operating there, operational constraints for CVs that deliver shoreside, the presence of target catch in fishable aggregations, and the presence of other non-target species that must be minimized according to the National Standards and to avoid triggering additional constraining regulations.

In general, when fishing effort moves because of regulation, an efficiency loss occurs because if that area was optimal or preferred, the fishery would already have been there.

Table ES-1 Estimated metric tons of groundfish in the RKCSA, the remainder of ADFG Area T, and the entire Bering Sea – 2013 through 2023

Gear	Area	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Average 2013-2023
Hook and Line	RKCSA	10,849	3,257	876	1,042	4,266	7,283	31	26	0	576	0	2,564
	Other Area T	74,956	56,754	48,689	37,287	31,786	22,161	12,842	5,770	3,996	20,087	16,006	30,030
	BS Total	156,576	162,391	167,716	167,251	164,982	137,753	114,108	95,778	75,206	100,641	96,236	130,785
	RKCSA % of T	12.6%	5.4%	1.8%	2.7%	11.8%	24.7%	0.2%	0.5%	0.0%	2.8%	0.0%	5.7%
	RKCSA % of BS	6.9%	2.0%	0.5%	0.6%	2.6%	5.3%	0.0%	0.0%	0.0%	0.6%	0.0%	1.7%
Non-Pelagic Trawl	RKCSA	20,865	21,890	10,801	15,183	7,731	2,592	2,222	2,126	1,075	37	124	7,695
	Other Area T	284,872	289,069	230,070	258,974	236,948	200,175	193,398	212,924	172,301	181,613	138,110	218,041
	BS Total	395,559	387,461	314,749	334,208	310,944	313,229	299,129	300,284	240,701	306,416	275,594	316,207
	RKCSA % of T	6.8%	7.0%	4.5%	5.5%	3.2%	1.3%	1.1%	1.0%	0.6%	0.0%	0.1%	2.8%
	RKCSA % of BS	5.3%	5.6%	3.4%	4.5%	2.5%	0.8%	0.7%	0.7%	0.4%	0.0%	0.0%	2.2%
Pot	RKCSA	3,256	2,974	2,914	910	520	459	611	1,202	107	0	0	1,178
	Other Area T	20,861	19,136	20,509	26,053	29,514	28,461	29,699	19,878	16,020	20,880	21,795	22,982
	BS Total	31,346	40,428	39,001	48,233	47,078	40,744	42,435	33,312	26,567	40,532	38,372	38,913
	RKCSA % of T	13.5%	13.5%	12.4%	3.4%	1.7%	1.6%	2.0%	5.7%	0.7%	0.0%	0.0%	5.0%
	RKCSA % of BS	10.4%	7.4%	7.5%	1.9%	1.1%	1.1%	1.4%	3.6%	0.4%	0.0%	0.0%	3.2%
Pelagic Trawl	RKCSA	3,304	44,442	33,867	34,302	82,003	82,771	91,451	19,595	73,581	98,896	108,145	61,123
	Other Area T	402,298	589,011	372,251	822,226	825,858	764,712	811,838	567,783	470,478	448,353	352,167	584,271
	BS Total	1,248,176	1,257,200	1,294,677	1,318,531	1,332,718	1,346,413	1,383,976	1,244,946	1,052,338	796,389	917,975	1,199,394
	RKCSA % of T	0.8%	7.0%	8.3%	4.0%	9.0%	9.8%	10.1%	3.3%	13.5%	18.1%	23.5%	9.8%
	RKCSA % of BS	0.3%	3.5%	2.6%	2.6%	6.2%	6.1%	6.6%	1.6%	7.0%	12.4%	11.8%	5.5%

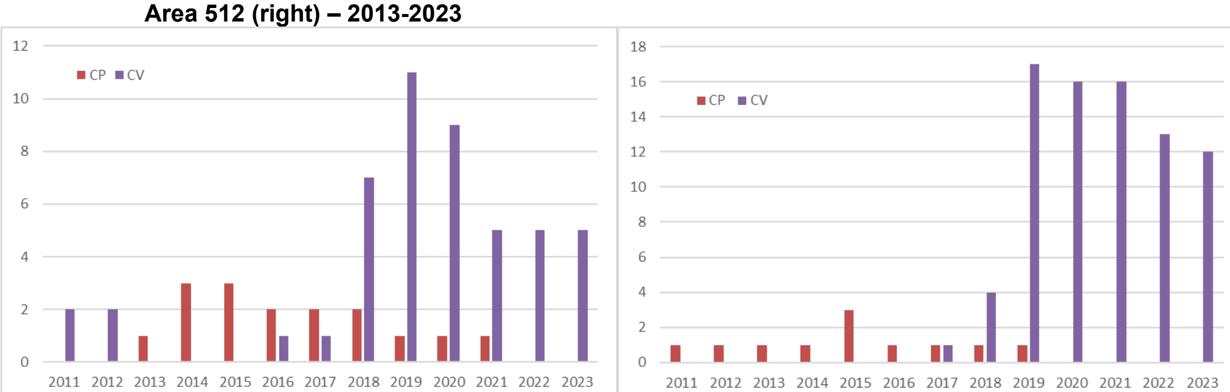
Note: The RKCSS is part of the RKCSA; any NPT catch reported as “RKCSA” occurred within the RKCSS.
Source: NFMS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Table ES-2 Groundfish catch (metric tons) by gear type and area (entire Bering Sea, RKCSA), and season (2013-2023)

Gear		Area	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Average 2013-2023
Hook and Line	Jan-May	Bering Sea	80,600	78,383	75,719	78,932	78,696	63,353	56,614	50,124	36,988	45,316	45,740	62,770
		RKCSA %	0	2.8%	1.1%	0.1%	2.3%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	1.5%
	Jun-Dec	Bering Sea	75,976	84,008	91,997	88,319	86,286	74,400	57,493	45,654	38,218	55,325	50,495	68,016
		RKCSA %	26.0%	25.9%	11.7%	17.1%	8.9%	3.5%	3.9%	4.1%	2.8%	0.1%	0.2%	9.5%
	Total	Bering Sea	156,576	162,391	167,716	167,251	164,982	137,753	114,108	95,778	75,206	100,641	96,236	130,785
		RKCSA %	6.9%	2.0%	0.5%	0.6%	2.6%	5.3%	0.0%	0.0%	0.0%	0.6%	0.0%	1.7%
Non-Pelagic Trawl	Jan-May	Bering Sea	220,490	226,432	177,914	193,910	179,356	182,938	185,182	192,251	147,298	172,658	162,251	185,516
		RKCSA %	9.0%	9.6%	6.1%	7.8%	4.3%	1.4%	1.2%	1.0%	0.7%	0.0%	0.1%	3.7%
	Jun-Dec	Bering Sea	175,069	161,028	136,835	140,299	131,588	130,292	113,947	108,033	93,403	133,758	113,343	130,690
		RKCSA %	0.6%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.1%
	Total	Bering Sea	395,559	387,461	314,749	334,208	310,944	313,229	299,129	300,284	240,701	306,416	275,594	316,207
		RKCSA %	5.3%	5.6%	3.4%	4.5%	2.5%	0.8%	0.7%	0.7%	0.4%	0.0%	0.0%	2.2%
Pot	Jan-May	Bering Sea	21,342	29,989	28,336	37,109	35,285	29,819	27,646	24,438	21,215	30,049	29,306	28,594
		RKCSA %	6.4%	1.6%	0.1%	0.0%	0.0%	0.0%	0.0%	4.9%	0.5%	0.0%	0.0%	1.2%
	Jun-Dec	Bering Sea	10,004	10,439	10,665	11,124	11,793	10,925	14,789	8,874	5,352	10,483	9,066	10,320
		RKCSA %	19.0%	23.9%	27.0%	8.2%	4.4%	4.2%	4.1%	0.0%	0.0%	0.0%	0.0%	8.2%
	Total	Bering Sea	31,346	40,428	39,001	48,233	47,078	40,744	42,435	33,312	26,567	40,532	38,372	38,913
		RKCSA %	10.4%	7.4%	7.5%	1.9%	1.1%	1.1%	1.4%	3.6%	0.4%	0.0%	0.0%	3.2%
Pelagic Trawl	Jan-May	Bering Sea	505,804	503,038	511,554	522,019	570,185	587,820	602,363	578,913	466,884	354,637	407,394	510,055
		RKCSA %	0.7%	8.6%	6.6%	2.8%	14.4%	14.0%	14.9%	3.4%	15.8%	27.9%	26.5%	12.3%
	Jun-Dec	Bering Sea	742,372	754,162	783,123	796,512	762,533	758,593	781,613	666,034	585,455	441,752	510,580	689,339
		RKCSA %	0.0%	0.1%	0.0%	2.5%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.3%
	Total	Bering Sea	1,248,176	1,257,200	1,294,677	1,318,531	1,332,718	1,346,413	1,383,976	1,244,946	1,052,338	796,389	917,975	1,199,394
		RKCSA %	0.3%	3.5%	2.6%	2.6%	6.2%	6.1%	6.6%	1.6%	7.0%	12.4%	11.8%	5.5%
All Gears	Jan-May	Bering Sea	828,237	837,842	793,523	831,970	863,522	863,929	871,805	845,726	672,385	602,659	644,691	786,935
		RKCSA %	3.8%	8.1%	5.7%	3.6%	10.6%	9.9%	10.6%	2.7%	11.1%	16.4%	16.8%	9.0%
	Jun-Dec	Bering Sea	1,003,421	1,009,638	1,022,621	1,036,253	992,200	974,210	967,843	828,594	722,427	641,319	683,485	898,365
		RKCSA %	0.7%	0.5%	0.3%	2.1%	0.3%	0.7%	0.2%	0.0%	0.0%	0.1%	0.0%	0.4%
	Total	Bering Sea	1,831,657	1,847,480	1,816,143	1,868,223	1,855,722	1,838,139	1,839,648	1,674,320	1,394,812	1,243,978	1,328,176	1,685,300
		RKCSA %	2.1%	3.9%	2.7%	2.8%	5.1%	5.1%	5.1%	1.4%	5.4%	8.0%	8.2%	4.5%

Source: NFMS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Figure ES-1 Vessel participation in Pacific cod fishing by pot gear vessels in the RKCSA (left) and NMFS Area 512 (right) – 2013-2023



Relocating effort for trawl vessels is constrained by an existing combination of time/area closures. For example, there is no opportunity to fish farther east due to the Nearshore Bristol Bay Trawl Closure. That fact at least ensures that Alternative 2 would not push trawl effort further into Bristol Bay in areas that are understood to be of high importance to the BBRKC stock. Selection of Alternative 2 without Alternative 3 presents some possibility that more pot cod effort would move east into Bristol Bay, with the caveat that pot cod effort has been low and declining in the RKCSA in recent years due to voluntary measures (Figure ES-1). The pot cod fishery is likely the most at risk of forgoing historical revenues under a paired RKCSA/512 closure, relative to other gear fisheries that would experience a closure to an area that – with the exception of pollock trawl – they have recently avoided or deemphasized. Closing two Bristol Bay region pot fishing areas also creates the highest likelihood that groundfish fishing mortality of BBRKC will decrease, but at a cost to an identifiable set of over 60 ft CVs (and the communities to which they deliver and are linked through vessel ownership). Those over 60 ft CVs are already under pressure from cod TACs that are somewhat lower than historical averages, and the closure of alternative fisheries (i.e., crab) to which they might otherwise turn. It is noted that BBRKC stock experts do not attribute the BBRKC decline and poor recruitment exclusively – or even primarily – to groundfish fishing mortality, so it is not possible to gauge whether the cost to groundfish participants will be compensated by benefits to the crab resource and those who benefit from viable crab fisheries.

Recovering fishing revenues by switching to other fisheries is a choice that is not universally available either by regulation or practicality. Participation in many Alaska fisheries is limited by the License Limitation Program and various rationalization programs. In addition to that, many vessels in the affected pot cod fisheries were already partly reliant on the crab fisheries whose recent closures contributed to the Council's purpose and need.

Analysis of Groundfish Effort Distribution and Bycatch Effect of Area Closures

The Council requested an expansion of the PSC-impact analysis and to incorporate it into the main document, to include the entirety of the past 10 years, and to analyze the impacts under Alternative 3 in addition to Alternative 2. The Council also requested that the analysts incorporate SSC recommendations as practicable, which included a recommendation to predict changes in PSC with a richer and better-integrated model of effort displacement across fleets. To comply with both of those recommendations, a full expansion of the previously conducted analysis, referred herein as the "PSC Rate Approach," was conducted and a new method, referred herein as the "CPUE-Based Approach," was additionally developed using high-resolution maps of targeted groundfish catch per unit effort (CPUE) to predict where redistributions of effort would likely occur in closure scenarios under the action alternatives. In many cases, both approaches estimated an increase in the PSC levels when fleets were displaced from the RKCSA under Alternative 2. Specific to RKC, the displacement of NPT from the RKCSS under Alternative 2 led to estimated reductions of RKC PSC, while other species evaluated were estimated to increase. The displacement of pot gear from the RKCSA under Alternative 2 also led to estimated increases in RKC PSC, while its displacement from Area 512 (Alternative 3) led to estimated decreases in RKC PSC. Results for other PSC species (i.e., salmon, herring, halibut, and other crab species) are reported in Section 3.3 of the document. Full, tabular results and the effort maps used for the CPUE-Based Approach are reported in Appendix 2 (attached separately to the February 2024 Council agenda).

Environmental Impacts

The EA (Section 5) evaluates the potentially affected environment and the degree of the impacts of the alternatives and options on the various resource components. Any effects of the alternatives on the resource components would be caused by changes in the location of groundfish fishing. The EA focuses on the principal groundfish species that are targeted with trawl, pot, and/or hook-and-line gear in the eastern Bering Sea (BS) region containing the RKCSA and NMFS Area 512: pollock, Pacific cod, yellowfin sole, and northern rock sole. For prohibited species, the EA focuses on BBRKC, but the document as a whole considers a range of prohibited species that includes salmon (Chinook and non-Chinook), herring, and Pacific halibut (refer to Section 3.3 and Appendix 2 analysis of PSC impacts). The EA covers seabirds as a species that is commonly associated with impacts from hook-and-line gear deployment (and trawl gear to a lesser extent), as well as habitat impacts of groundfish gear and its importance to red king crab throughout various stages of their life history.

Target species

Pacific cod is a directed fishery for pot and HAL gear, and a commercially retained non-target species for pelagic trawl. Non-pelagic trawl CVs directed fish for Pacific cod (TLAS sector). Non-pelagic trawl CPs (A80) are allocated Pacific cod and it is a commercially important species for them, but also a constraining quota allocation so often A80 vessels plan to catch their cooperative allocations of Pacific cod as a secondary species to flatfish like yellowfin sole and rock sole. Yellowfin sole and rock sole are described here because, of the groundfish species targeted by the non-pelagic trawl sector, they are the most likely to be targeted around the RKCSA/SS.

As detailed in the 2023 SAFE Reports, none of the target stocks of EBS pollock (Ianelli et al. 2023), Pacific cod (Barbeaux et al. 2023), yellowfin sole (Spies et al. 2023), and northern rock sole (McGilliard et al. 2023) are overfished or subject to overfishing, and none are approaching overfishing. As a result, the fisheries under Alternative 1 (status quo) are likely to remain unchanged. Alternative 2 may redistribute groundfish gears from the RKCSA/SS to elsewhere in the EBS. In particular, pelagic trawls targeting pollock, pot and HAL gear targeting Pacific cod, and non-pelagic trawl gear targeting yellowfin and northern rock sole would be displaced under Alternative 2. Pot gear targeting Pacific cod would be displaced from Area 512 under Alternative 3. None of the alternatives are expected to impact the status of these stocks, because the current harvest specifications process for setting TACs and managing harvests within the limits would continue.

Bristol Bay Red King Crab

The red king crab (RKC) in the Bristol Bay area is assumed to be a separate stock from RKC outside of this area. BBRKC mate from January to March for primiparous (individuals bearing first offspring) and from April to June for multiparous RKC females. Mature males and females molt within the same mating time period, whereas juvenile crab may molt several times per year as they grow and can molt at different times during a year.

The BBRKC population was fairly stable until 2010 when the mature female population began to decline. The population experienced a brief uptick in abundance from 2014 to 2015, before continuing to decline (Zacher et al. 2023). 2021 and 2022 abundance estimates were the lowest two abundances on record since 1995. Both years were below the State of Alaska harvest strategy threshold of 8.4 million mature female crab to hold a directed fishery. As a result, the directed fishery was closed for the 2021/22 and 2022/23 seasons. In 2023, the abundance estimate exceeded the harvest strategy threshold of 8.4 million mature female allowing for a directed fishery to occur, which opened at a TAC of 2.15 Mlb for the 2023/24 season, for the first time in 2 years.

The effects of the alternatives on BBRKC may include potential changes in prohibited species catch (PSC) and predation impacts by groundfish. The redistribution of pot vessels out of the RKCSA/SS in Alternative 2 and Area 512 in Alternative 3 may impact the amount of RKC PSC by pot vessels. The estimated changes in RKC PSC under the three scenarios of displacement (RKCSA/SS, Area 512, or both) are displayed in Section 3.3 and Appendix 2. Changes occurred primarily in the B Season, where the displacement of POT gear from the RKCSA led to PSC increases in some years, while the displacement from Area 512 or both RKCSA and Area 512 often led to estimated decreases in RKC PSC. The redistribution of effort and potential reduction in RKC PSC if both Alternative 2 and 3 are selected as a preferred alternative suggests a benefit to BBRKC. Although, there are several other variables to consider that may impact the stock aside from PSC.

Based on the NMFS bottom trawl survey, observed RKC catch within the RKCSA and Area 512 contain higher proportions of RKC compared to other areas in Bristol Bay and the NBBTCA (excluding Area 512 and the RKCSA) (Figure ES-2, Table ES-3). The RKCSA/SS continues to be an important area for

BBRKC, and likely provided additional conservation measures for the stock when it was implemented in 1996 as a large proportion of BBRKC of all age and sexes occupied this area. While there is no quantitative assessment on the relative importance of the RKCSA and Area 512, Figure ES-2 does provide a metric to determine the proportion of RKC in these areas, and may act as a way to infer potential BBRKC reliance on habitat in these areas, or areas in which additional fishing pressure may impact the stock.

Alternative 2 may provide some benefit to stock and reduced PSC and gear encounters, and subsequent unobserved mortality in years where the stock population is low. While work is needed to better quantify unobserved mortality and its impact to the stock, the removal of bottom-contact gears in the RKCSA/SS would presumably reduce the unobserved mortality by fishing gear from this particular area. Alternative 3 would likely provide benefit to the BBRKC stock as it would reduce RKC PSC in this area, which may provide additional conservation measures given the proportion of RKC in the areas. Specifically, Area 512 contains a high proportion of immature males, females, and mature females (Table ES-3). Reduction in fishing pressure in this area by the Pacific cod pot sector may provide benefit to crab, as they are expected to molt multiple times a year and may be more susceptible to interactions with gear. Similar to the disturbance of habitat, it is reasonable to assume that reduced unobserved mortality in the area may lead to a higher proportion of late juvenile RKC from within the area to survive to a reproductive, harvestable size and to recruit into the fishery. However, with reduced fishing pressure by the Pacific cod pot fleet, it is possible that there is increased predation, and it is difficult to determine the magnitude of predation at this time, and the subsequent effect that would have on the stock.

If the Pacific cod HAL and pot fleets are prohibited from the RKCSA/SS under Alternative 2, this may lead to higher predation by Pacific cod within the RKCSA/SS. Similarly, Alternative 3 may result in higher predation by Pacific cod within the shallow waters of Area 512, which tend to harbor large numbers of juvenile BBRKC (Figure ES-2). However, these future predator-prey dynamics are unknown, and may be offset by the reduced PSC and unobserved mortality attributed to these gears.

It is likely that the considered action alternatives would affect the BBRKC stock in some positive ways but the extent of each type of impact is unquantified due to numerous uncertainties. Some areas of potential effect, like changes in unobserved mortality or changes in predation on BBRKC by Pacific cod, are not extensively quantified in available data and peer reviewed resources. Removing trawl gear from the RKCSA/SS would likely reduce unobserved mortality overall because trawl fishing would be displaced to areas farther from the core stock area, but the magnitude of the potential stock effect has a wide range that includes very low potential impacts as well as high. The effect of removing predators in the eastern Bristol Bay through groundfish fishing is likely positive for BBRKC based on correlative patterns, but the specific effects on RKC maturation and recruitment have not been extensively studied to the analysts' knowledge. Permanently removing non-pelagic trawl gear from the RKCSS would likely benefit BBRKC, but that conclusion is also qualified by the fact that non-pelagic trawl gear might adapt by fishing in areas farther south and west that were – at previous times – thought to be just as important to BBRKC stock health and RKC life history. In summary, it is likely that the action alternatives would provide some benefits to the BBRKC stock, but it is not possible to measure the magnitude of the impact to the stock.

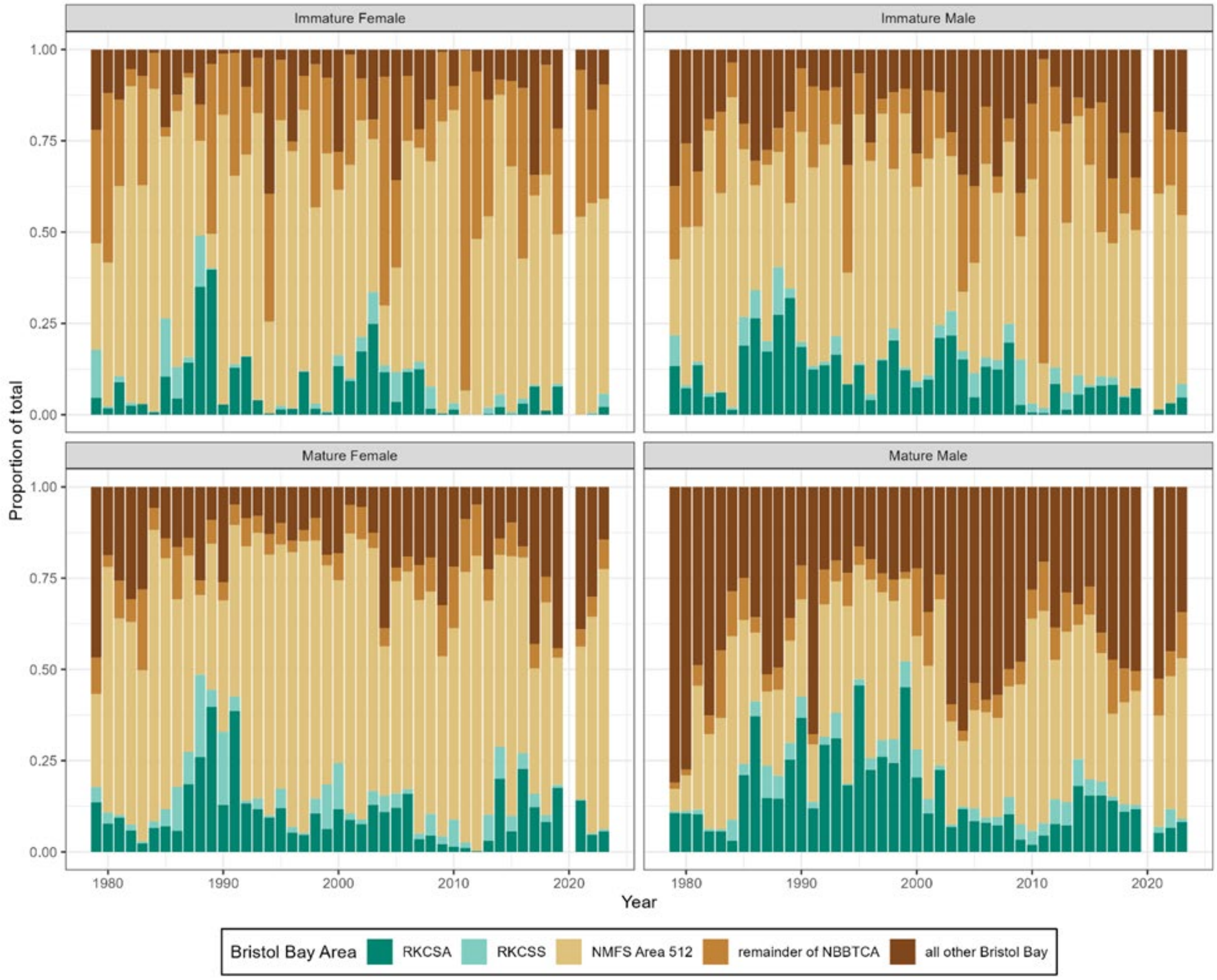


Figure ES-2 Proportion of RKC caught in the NMFS trawl survey (1978-2023) in RKCSA, RKCSS, NMFS Area 512, the remainder of the NBBTCA and all remaining areas of the Bristol Bay management area broken out by life stage. Numerical values of proportions are presented in Table ES-3.

Table ES-3 Proportion of RKC caught in the NMFS trawl survey (1978-2023) in RKCSA, RKCSS, NMFS Area 512, the remainder of the NBBTCA and all remaining areas of the Bristol Bay management area.

Sex/maturity category	Area	Mean proportion	Minimum proportion	Maximum proportion
Immature Female	RKCSA	0.07	0	0.40
	RKCSS	0.02	0	0.16
	NMFS Area 512	0.55	0.07	0.88
	remainder of NBBTCA	0.24	0.01	0.93
	all other Bristol Bay	0.12	0.00	0.40
Immature Male	RKCSA	0.11	0	0.32
	RKCSS	0.03	0	0.13
	NMFS Area 512	0.49	0.12	0.85
	remainder of NBBTCA	0.17	0.03	0.83
	all other Bristol Bay	0.20	0.03	0.39
Mature Female	RKCSA	0.11	0	0.40
	RKCSS	0.04	0	0.23
	NMFS Area 512	0.58	0.22	0.81
	remainder of NBBTCA	0.07	0.03	0.22
	all other Bristol Bay	0.19	0.05	0.47
Mature Male	RKCSA	0.16	0.02	0.46
	RKCSS	0.03	0	0.09
	NMFS Area 512	0.33	0.06	0.58
	remainder of NBBTCA	0.08	0.02	0.19
	all other Bristol Bay	0.40	0.16	0.81

Seabirds

The action alternatives under consideration are not expected to differ from the status quo in terms of impacts on seabirds. The possibility of closing the RKCSA to multiple groundfish gear types (Alternative 2) is most likely to result in the same gear being deployed elsewhere at similar rates of fishing effort. The analysts are not aware of data that would predict that seabird interactions would be different in the areas to which fishing effort might be displaced, and the areas to which effort might shift are already prosecuted with groundfish gear and thus are considered in existing analyses of the impacts of groundfish fishing on seabirds. Alternative 3 relates only to pot gear, which is not highlighted as a gear type with significant seabird interaction, so any changes in effort patterns as a result of selecting that alternative would not be expected to have a direct effect on seabirds.

Habitat

The effects of fishing on habitat depend on the intensity of fishing, the distribution of fishing with different gears across habitats, and the sensitivity and recovery rates of specific habitat features. The analysts focus on crab habitat because the considered action alternatives are designed to potentially benefit the BBRKC stock by restricting some groundfish gears from areas that coincide with areas that are understood to be important to the stock. This analysis is the first time that habitat occupied maps for BBRKC are shown broken apart by life stage, and an additional Legal male encounter rate map for Fall BBRKC legal males is presented to better detail BBRKC habitat by life stage and season. Nearly all of the total area potentially affected by the actional alternatives are within the top 25% area occupied habitat for BBRKC and overlaps by habitat occupied by mature males, mature females and immature males and females.

The effects of the alternatives on habitat would be potentially redistributing the areas where gear contact with the seafloor may impact BBRKC habitat. It is reasonable to assume that with less physical damage to EFH, undisturbed habitat may provide greater predator refuge for these late juvenile crabs, allowing a higher proportion of crabs from within the area to survive to reproductive/harvestable size than under a disturbed state.

If Alternative 2 has the effect of reducing trawl effort rather than displacing it (through lower TAC utilization because a groundfish fishery is less productive in other areas at certain times of year) then there could be a net effect on seafloor habitat overall. Whether those areas to which effort would have been displaced but was not would be considered BBRKC habitat is unknown but less likely as trawl gear is likely to move west and/or south due to existing closed areas, sea ice, and target species distributions throughout the year. On the other hand, if Alternative 2 has the effect of increasing total fishing effort by causing less effective fishing and fishing intensifies in areas outside the RKCSA and area 512 that are still within BBRKC "hotspots" for areas occupied, there may be a more substantial effect on habitat. Such as the area just north of the RKCSA in Zone 1 exhibits areas of high bottom contact. It is likely that potential habitat disturbances here may affect habitat occupied for the BBRKC stock and have trickle down effects to the population as a whole. The UFMWG report notes the need for work to better quantify gear-seafloor interactions. A better understanding of gear-seafloor interactions will aid in better determining fishing effects on area-specific habitat and subsequent interactions with crab on the seafloor.

Management Considerations

Monitoring

Neither of the action alternatives are expected to alter the aspects of monitoring for the groundfish fisheries involved. This section summarizes monitoring for AFA Pollock, Amendment 80, Pacific cod pots, Pacific cod HAL, and the PCTC program. With the exception of Pacific cod pot CVs, all of the fisheries described in this section are in the full coverage category. Some CVs have participated in electronic monitoring since 2020. The AFA pollock, Amendment 80, and Pacific cod HAL fisheries are all required to have at least one lead level 2 observer, provide an observer sampling station, weigh groundfish on a NMFS-certified scale, and comply with pre-cruise meeting notifications. The Amendment 80 fleet is additionally required to have at least two observers for each day, and is allowed to participate in halibut deck sorting (50 CFR 679.120), which allows halibut to be sorted on the deck of trawl CPs when operating in non-pollock groundfish fisheries off Alaska.

Management

The action alternatives would require regulatory changes to 50 CFR 679. Alternative 2 would implement an annual closure of the RKCSA to all or a subset of commercial fishing gears. This may be addressed under the BSAI closures listed at § 679.22, which currently prohibits trawl gear other than pelagic trawl gear. Alternative 3 would implement a closure of Area 512 to fishing for Pacific cod with pot gear under various options and would be achieved by amending the current regulations at § 679.22(a)(1).

Enforcement

Because regulations for closed areas are based on gear type, OLE requires clear definitions of the gears to enforce closures, gear restrictions, and performance standards.

As the Council examines the efficacy of the existing trawl performance standard at fulfilling FMP management objectives, OLE proposes potential options and downstream regulatory implications to making the existing performance standard more effective, as well as other options Council could consider for achieving those objectives. If an objective is to keep trawl gear off the bottom all or a portion of the time, one approach would be developing new applications of existing technologies that can record seafloor contact. Further development of those technologies, and consideration of which parties might be responsible for primary bottom contact data collection, would be needed. Any such action would require regulatory changes to Part 679. The enforceability of the trawl performance standard is addressed in Section 8 of this document.

Comparison of Alternatives for Decision-making

Table ES-4 Summary of environmental impacts

	Alternative 1 (No Action)	Alternative 2	Alternative 3
Groundfish	Status quo. No impacts to stock status of Pollock, Pacific cod, yellowfin sole, or northern rock sole expected (Section 5.2.2).	No impacts to stock status of Pollock, Pacific cod, yellowfin sole, or northern rock sole expected (Section 5.2.2). Redistribution of pelagic trawl vessels may influence spatial effort for Pollock (Section 5.2.2.1). Redistribution of pot and HAL vessels may influence spatial effort for Pacific cod (Section 5.2.2.2). Redistribution of non-pelagic trawl vessels may influence spatial effort for yellowfin sole (Section 5.2.2.4) and northern rock sole (Section 5.2.2.3).	No impacts to stock status of Pollock, Pacific cod, yellowfin sole, or northern rock sole expected (Section 5.2.2). Redistribution of pot vessels may influence spatial effort for Pacific cod (Section 5.2.2.2).
BBRKC	Status quo	Redistribution of pot vessels away from the RKCSA/SS may decrease BBRKC PSC depending on where effort is relocated (Section 5.3.3). No possibility of HAL CP sector restarting effort in the RKCSA if target Pacific cod stock distribution reverts southward. Redistribution of pelagic (and non-pelagic) trawl gear may reduce unobserved mortality of juvenile and adult BBRKC within the RKCSA (RKCSS for non-pelagic) but the total effect is unknown due to uncertainty about areas of displaced effort; any resulting net decrease in effort may benefit the BBRKC stock. Action alternatives likely provide some benefits to BBRKC stock but magnitude is unquantified due to uncertainty about links between the stock status and factors like fishing mortality (eg. PSC), unobserved mortality, habitat effects, and groundfish predation (Section 5.3.3).	Redistribution of pot vessels away from Area 512 may decrease BBRKC PSC depending on where effort is relocated (Section 5.3.3).
Seabirds	Status quo	No changes in seabird impacts expected (Section 5.4.1).	No changes in seabird impacts expected (Section 5.4.1).
Habitat	Status quo	Spatial redistribution of groundfish gear may shift seafloor disturbance away from RKC EFH hotspots in the RKCSA (Section 5.5.4). Unknown whether any displaced trawl effort would occur in areas with benefits to BBRKC that are less well known. Trawl gear is restricted from shifting eastward (NBBTCA).	Spatial redistribution of pot gear may shift seafloor disturbance away from RKC EFH hotspots in Area 512 (Section 5.5.4).

Table ES-5 Summary of economic impacts

	Alternative 1	Alternative 2	Alternative 3
Groundfish Harvesters	Status quo. Low activity in the RKCSA relative to historical levels for all gear sectors other than pelagic (pollock) trawl. Increased CV effort in the Area 512 pot cod fishery due in part to tendering and additional processing capacity in the region during the two most recent years. Trawl harvest activity constrained by existing area management measures (pelagic and non-pelagic), a potentially binding RKC PSC limit in Zone 1 (non-pelagic), and PSC limits for other species (salmon, halibut, herring).	Most impactful to pelagic (pollock) trawl. Pollock trawl catch likely to shift west and/or south during the portion of the A season after vessels move north from the SCA. Likely loss in efficiency and potentially fish size and/or product quality on CPs. Reduced flexibility to avoid salmon and herring PSC. Non-pelagic trawl sector (mainly A80 CPs) lose a future opportunity for the flexibility afforded by occasional opportunities to fish in the RKCSS, but that area is currently closed under Alt. 1 due to lack of BBRKC fishery. Less flexibility in balancing competing bycatch constraints of RKC, halibut, and Pacific cod. Likely lower catch of roe-season flatfish in/near RKCSS. Less future flexibility for HAL CP sector, but low near-term impact relative to Alt. 1. Low impact on pot cod CPs/CVs relative to recent patterns, but potentially larger impact on CVs if paired with Alt. 3.	Likely loss in efficiency and relatively high likelihood of forgone catch if unwilling to revert effort to the RKCSA (or not allowed to under Alt. 2).
Groundfish shore-based processors and communities	Status quo.	Marginal impact on entities and linked communities associated with AFA pollock CVs that deliver shoreside, as that sector would be most likely to have to accept marginal losses in efficiency and productivity by relocating fishing during a certain point in the year (of the CV fisheries). Community stakeholders in the at-sea pollock sector (including CDQ) also likely to see less than optimal fishing returns at certain points in the year (A season).	Localized impact on processing entities and communities linked to vessel ownership and crew. Pacific cod pot CVs deliver through tenders to some ports other than Unalaska, Akutan, and King Cove that are likely more reliant on pot cod to remain open.
BBRKC fishery	Status quo.	Potential for indirect benefit if it is the case that pelagic trawling in the RKCSA is a significant, actionable factor in BBRKC stock status via direct unobserved mortality and/or habitat impact. That conclusion has not been reached by the science community or in this document.	Potential for indirect benefit if it is the case that fishing mortality from cod pots is a significant, actionable factor in BBRKC stock status. That conclusion has not been reached by the science community or in this document.

Additional Requested Information: Dynamic Approaches through “Framework Agreements”

The Council’s June 2023 motion requested further exploration of actions that could be implemented through framework agreements for the pot CV sector and trawl sectors that would have similar goals to the proposed alternatives to reduce BBRKC mortality in the RKCSA and Area 512, respectively, but would be more dynamic and responsive to seasonal spatial distribution of BBRKC and focus avoidance on discrete areas of relatively higher female BBRKC abundance.

For the pot cod sector, stakeholders were interested in an approach that limits the ability to fish east of a certain longitude to vessels that are signed on annually to an RKC bycatch minimization plan. That plan would be administered by a non-governmental third-party, likely with communication and approval from NMFS and/or annual reporting/review at the Council. The goal is to hold participants to gear, monitoring, and other standards that are updated for best practices and new scientific information more rapidly than gear or area restriction regulations can be implemented through the Council/NMFS process. Participants who do not join the agreement annually could still fish Pacific cod with pot gear, but only west of whatever boundary is established (farther from key RKC habitat and population densities). Some areas of the proposal in need of further development are how to structure the agreement and establish a third-party that is qualified and representative of a diverse constituency that includes cod and crab stakeholders (and do so without public cost burden), whether the current partial coverage monitoring program could accommodate industry interest in carrying more observers in the pot fishery, and how real-time enforcement of fishery regulations would be managed without delegating that responsibility to a non-governmental organization.

Trawl stakeholders' general feedback on the notion of framework agreements centered around a desire to replace static exclusionary boundaries with dynamic time-area closures, similar to the hotspot system under salmon incentive plan agreements. Trawl vessels balance the need to catch quality groundfish efficiently while also avoiding and minimizing bycatch of species like salmon, crab, and halibut. Dynamic area closures could create opportunities to optimize both PSC avoidance and groundfish fishing if sufficient cooperative protocols are in place and if information about crab distribution is adequate. A key challenge lies in the fact that pelagic trawl gear is designed not to retain crab, thus pollock vessels would have less real-time feedback on crab presence from their own hauls. That challenge could be approached through enhanced scientific data collection – a high bar to set for a nascent series of winter crab surveys that do not have certain future funding or operational support – or the use of proxy data from other fisheries. A hurdle with using proxy data is that different groundfish gear sectors do not necessarily overlap spatially and temporally in terms of fishing footprint, and some gear sectors already avoid Bycatch Limitation Zone 1 due to low sideboard limits and thus would not contribute to inter-fleet data sharing. Using proxy data from the pot cod fishery may also be hindered by relatively lower observer coverage and less rapid reporting of that data back to the fleets. The continuation of a winter crab survey seems foundational to any dynamic area management program, and the timing of that survey effort and analysis is equally important. Other key outstanding scientific questions are whether it is most beneficial to minimize gear interaction with crab, which segments of the crab population are most important (and where are they located at key times), and whether habitat preservation (vis-à-vis area restrictions) provides more, less, or different benefits to the BBRKC stock.

1 Introduction

This document is an Environmental Assessment/Regulatory Impact Review (EA/RIR) that analyzes proposed management measures that would apply exclusively to participants in the Federal groundfish fisheries in the Bering Sea/Aleutian Islands (BSAI) Fishery Management Plan (FMP) area. The Council outlined its rationale for requesting this analysis at its December 2022 meeting in a motion that is reflected in the purpose and need statement below. The measures under consideration include action alternatives that would (either/both) close the Red King Crab Savings Area (RKCSA) to all commercial groundfish fishing gears, or close NMFS Reporting Area 512 (Area 512) to fishing for Pacific cod with pot gear if indicator values of Bristol Bay red king crab (BBRKC) abundance are below an established threshold. Suboptions to the alternative closing the RKCSA would determine the groundfish gears that are included in the potential closure (trawl, hook-and-line, pot).

The purpose of the considered actions is to address low levels of stock abundance and recruitment that have resulted in directed crab fishery closures in two of the three most recent fishing years (2021/22 and 2022/23) through the reduction of crab fishing mortality in groundfish fisheries. The Council is considering alternatives that could contribute to stock abundance and promote the achievement of optimum yield in the directed BBRKC fishery while minimizing negative impacts to affected groundfish fisheries as well as non-crab prohibited species that may also be encountered by groundfish gears in the regulated FMP area.

An EA/RIR provides assessments of the environmental impacts of a proposed action and its reasonable alternatives (the EA), the benefits and costs of the alternatives, the distribution of impacts, and identification of the small entities that may be affected by the alternatives (the RIR). This EA/RIR addresses the statutory requirements of the Magnuson Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act, 16 U.S.C. 1801, *et seq*.), the National Environmental Policy Act, Presidential Executive Order 12866, and some of the requirements of the Regulatory Flexibility Act. An EA/RIR is a standard document produced by the North Pacific Fishery Management Council (Council) and the National Marine Fisheries Service (NMFS) Alaska Region to provide the analytical background for decision-making.

Under the Magnuson-Stevens Act (MSA), the United States has exclusive fishery management authority over all marine fishery resources found within the exclusive economic zone (EEZ). The management of these marine resources is vested in the Secretary of Commerce (Secretary) and in the regional fishery management councils. In the Alaska Region, the North Pacific Fishery Management Council (Council) has the responsibility for preparing FMPs and FMP amendments for the marine fisheries that require conservation and management, and for submitting its recommendations to the Secretary. Upon approval by the Secretary, NMFS is charged with carrying out the Federal mandates of the Department of Commerce with regard to marine and anadromous fish.

The groundfish fisheries in the EEZ off Alaska are managed under the FMP for the BSAI. The proposed action under consideration would amend this FMP and Federal regulations at 50 CFR 679. Actions taken to amend FMPs or implement regulations governing these fisheries must meet the requirements of applicable Federal laws, regulations, and Executive Orders.

The considered action alternatives would not directly regulate the directed fishery for BBRKC. For reference, however, king crab stocks in the BSAI are co-managed by the State of Alaska and NMFS through the Crab FMP (NPFMC 2023b) with management delegated to the State with federal oversight. The Crab FMP divides management measures into three categories: (1) fixed in the Crab FMP and require an amendment to change, (2) frameworked in the Crab FMP which the State can change as outlined in the FMP, and (3) at the discretion of the State of Alaska. The crab management measures that fall into each of these three categories are described in Section 3 of the Crab FMP.

The Council received an initial review EA/RIR in June 2023 (NPFMC 2023a). No changes were made to the purpose and need statement, and the only change to the action alternatives were for purposes of clarification (see Section 2). The Council's June 2023 motion directed the analysts to bring additional information that could help gauge the likelihood/frequency that the area closure(s) in the action alternatives would come into effect, and present the best possible understanding – given the state of knowledge on RKC life-history – of potential benefits to the crab stock. The June 2023 motion also directed the analysts to maintain a section of this document that discusses the trawl gear performance standard regulation pertaining to seafloor contact in the BSAI pollock fishery, though that is not currently part of the action alternatives under consideration (see Section 8).

The Council also requested continued consideration of approaches that could address the purpose and need through "framework agreements" that might be more dynamic, flexible, and responsive to seasonal spatial distribution of RKC. Such approaches could be more targeted in avoiding discrete areas with relatively higher female RKC abundance and could be more quickly adapted to changes in the species distribution due to environmental factors or advances in understanding of seasonal crab distribution. The Council specified that its interest in framework ideas was for the groundfish trawl and pot CV sectors. Framework approaches are not currently captured in the area-closure action alternatives before the Council. The Council's consideration of the merits and challenges associated with a dynamic framework approach extends back to the series of 2022 discussion papers on the topic of BBRKC (NPFMC 2022a, 2022b) and was most recently compiled and reviewed in Appendix 1 of the June 2023 initial review EA/RIR (NPFMC 2023a). This document augments that discussion with the results of staff outreach to groundfish and crab fishery participants that has occurred since the last Council review (see Appendix 4).

This document is a revision to the June 2023 EA/RIR (NPFMC 2023a). The content remains the same – with additions – but the organization has been modified in some respects based on Council feedback and interest received in June 2023. Because the discussion of the BSAI trawl gear performance standard is not directly tied to the alternatives under consideration, that section is shifted from Section 4 in the previous draft to Section 8 in this document. Appendix 2 in the previous draft contained an initial analysis of fishing location displacement resulting from the considered area closures and impacts they might have on various crab and non-crab PSC species. That analysis has been expanded per the direction of the Council and the SSC, and is now included in the Description of Fisheries (Section 3.3) and directly referenced in the analyses of economic/social and environmental impacts (Sections 4 and 5, respectively). A full compendium of the data tables and figures for that analysis is included here under Appendix 2 (attached separately). The discussion of framework approaches to dynamic avoidance of female BBRKC was Appendix 1 in the previous draft; the Council directed staff to further explore that topic and to incorporate direct feedback from fishery participants; because that discussion is not directly linked to the alternatives under consideration, it is included here as Appendix 4.

Additional "roadmap" information for this document is provided at the end of Section 1.2 (History of this Action at the Council).

1.1 Purpose and Need

The Council adopted the following purpose and need statement to originate this action in December 2022 (motion). The Council considered this action at its June 2023 meeting and did not alter the purpose and need statement.

> *The Bristol Bay red king crab (BBRKC) stock has declined and is currently at low levels, resulting in a closure to the directed fishery in 2021/22 and 2022/23. Estimated recruitment has been extremely low during the last 12 years and the projected mature biomass is expected to decline during the next few years. The best available science indicates the cause of the decline is a combination of factors related to continued warming and variability in ocean conditions.*

Given the poor recruitment and low stock status of BBRKC, the Council intends to consider management measures focused on reducing BBRKC mortality from groundfish fishing in areas that may be important to BBRKC and where BBRKC may be found year-round, which may help increase stock abundance and promote achievement of optimum yield from the directed BBRKC fishery while minimizing negative impacts to affected groundfish fleet operations as well as target and PSC species.

The long-term BBRKC biomass trend is illustrated in Figure 5-2 of this document, as published in the 2023 DRAFT NOAA Technical Memorandum on the Eastern Bering Sea Continental Shelf Trawl Survey (Zacher et al. 2023[1]). The time trend in area-swept biomass estimates based on the trawl survey is shown in Figure 2-1 of this document, as it relates to Option 2 that could apply under either of the action alternatives. The BBRKC population was relatively stable after the sharp fall in the early 1980s until around 2010 when the mature female population began to decline from the trend level of the preceding ~25 years.

The mature female abundance estimates calculated using the trawl survey data in 2021 and 2022 were the lowest two abundances on record since 1995, which was the last time the BBRKC directed fishery had been closed prior to 2021. The length-based analysis (LBA) conducted by the State of Alaska provided abundance estimates in 2021 and 2022 that were below the State's harvest strategy threshold of 8.4 million mature female crab to hold a directed fishery. As a result, the directed fishery was closed for the 2021/2022 and 2022/2023 seasons. In 2023, the LBA provided an abundance estimate that exceeded the harvest strategy threshold of 8.4 million mature females, allowing for a small directed fishery to occur. The 2023/24 BBRKC fishery TAC and catch, relative to previous years in the rationalized fishery era, are reported in Table 3-52. Both the area-swept and LBA abundance estimates based on the 2023 trawl survey represented increases over 2021 and 2022. The 2023 LBA estimate was 3.8% higher than 2021 and 1.9% higher than 2022; the 2023 area-swept estimate was 33.3% higher than 2021 and 4.9% higher than 2022.[2] The difference in LBA and area-swept estimation is described in Section 2.2.2 of this document. 2023 trawl survey results are detailed in Section 5.3 (EA).

NMFS has conducted annual trawl surveys of the eastern BS since 1968. Estimated mature RKC biomass was at its peak in the mid-1970s but declined precipitously in the early 1980s. Abundance increased from the mid-1980s until about 2007. Mature females were estimated to be roughly four times more abundant in 2007 than in 1985; mature males were roughly twice as abundant in 2007 than in 1985. Abundance has generally declined since 2010. The most recent survey estimates show a directional increase but not necessarily at a levels that alleviate the risk of directed fishery restrictions, related groundfish fishery restrictions, or affects the near-term outlook as reported in the stock assessment. The most recent stock assessment states that "the near future outlook for the BBRKC stock is a steady to declining trend. […] Due to lack of recruitment, mature and legal crab may continue to decline next year in the presence of fishing pressure. Even with the closed [sic] of the directed fishery the past two seasons both recruitment and abundance of male and female crab have held steady, showing only small increases or decreases, and without evidence of better recruitment. The increase in females in this year's survey would be promising, but it is confounded by the contribution of one large tow to the increase instead of an increased catch throughout Bristol Bay. Current crab abundance is still low relative to the late 1970s, and without favorable environmental conditions, recovery to the high levels of the late 1970s is unlikely." (Palof 2023, p.25).

In October 2022, the Alaska Fisheries Science Center (AFSC) released a statement on Alaska crab stock declines – specifically BBRKC and BS snow crab.[3] The purpose of the statement was to address questions about how NOAA Fisheries collects and analyzes ecosystem-based data to inform managers

[1] The "draft" version available for this analysis was published on August 30, 2023.
[2] See Table 23 in Palof 2023 (p.55).
[3] B. Foy, AFSC. October 2022. https://www.fisheries.noaa.gov/news/statement-alaska-crab-stock-declines.

about recent stock declines, and thus is not meant to account for fishing effects on crab stocks. The statement partially reads: "Recent declines in Bristol Bay red king crab fisheries are part of a 50+ year history of highly variable stock abundance that included previous fishery closures. […] Climate change will continue to present challenges to our understanding of marine ecosystems in Alaska and elsewhere." In relation to BS snow crab, the statement noted that a 2019 marine heatwave was responsible for numerous marine ecosystem changes that likely affected adult and juvenile crab survival in ways that include disease, migration, and predation patterns, and that improved understanding of the factors behind population declines is the focus of ongoing research. The analysts mention this because it is similar to the ongoing work cited in this document via the BBRKC stock assessment (Palof 2023) and the BBRKC Ecosystem and Socioeconomic Profile (ESP) (Fedewa and Shotwell 2023). Additional information on the BBRKC stock and ongoing studies of RKC life-history and ecosystem/habitat interactions are included in Section 5 of this document (EA).

1.2 History of this Action at the Council

In October 2021 (finalized in a subsequent, related motion in December 2021) the Council tasked staff to prepare a discussion paper providing information on four topics related to BBRKC biology and management. The Council's initiation of the first discussion paper – presented in April 2022 (NPFMC 2022a) – was responsive to the decline in the BBRKC stock and its culmination in the first BBRKC directed fishery closure for the 2021/22 season. In April 2022 the Council passed a motion requesting additional information that was presented in October 2022 (NPFMC 2022b).

Citing historically low abundance of BBRKC, the Alaska Bering Sea Crabbers (ABSC) sent a letter to NMFS in September 2022 requesting consideration of an emergency rule that would close the RKCSA and RKCSS to all fishing gears from January 1, 2023 to June 30, 2023 to protect BBRKC and their habitat at a time of low abundance. In a letter dated September 29, 2022, NMFS requested Council input on this request for emergency action. The NMFS letter to the Council as well as ABSC's petition for emergency action can be found under the NMFS Report on the Council's October 2022 meeting agenda (Agenda item B2; directly linked here).[4]

After reviewing the second BBRKC discussion paper (NPFMC 2022b) at the October 2022 meeting, the Council passed a motion stating that it would review an analysis of the emergency rule request at the December 2022 meeting. That analysis is referenced in this document as NPFMC 2022c. That October motion included the following introductory statement:

> The Council acknowledges the current low stock status for several key BSAI crab species and the impact it is having on harvesters, processors, and communities dependent on commercial crab fisheries. Science indicates changes in the ecosystem and temperature are the primary driver of poor crab recruitment and low abundance, which furthers the need for a comprehensive ecosystem-based approach in crab assessments, research, and management.

The October 2022 motion also encouraged continued research and testing on (1) pot gear modifications, soak times and handling practices that reduce unintended mortality of crab PSC, (2) the interactions of pelagic trawl gear with the sea floor and crab to inform gear modifications to reduce unintended mortality of crab PSC and impacts on benthic habitat, and (3) methods to gather data on interannual and seasonal distribution of crab, such as additional surveys and tagging studies.

The October 2022 motion acknowledged information that the Council had received from fishing industry participants outlining voluntary measures that could be taken in 2023 (and beyond) to avoid BBRKC and reduce crab mortality in non-directed fisheries as well as to reduce discard mortality in the directed fishery. The Council encouraged all sectors to implement those voluntary measures during the 2023

[4] NMFS solicited written public comments on the emergency rule petition. Those comments can be viewed at www.regulations.gov under Docket ID NOAA-NMFS-2022-0111.

fishing seasons and report back to the Council on the efficacy of those actions and further ongoing plans at its December 2023 meeting. Eight representatives of groundfish and crab fishery participants provided oral and/or written testimony to the Council at that 2023 meeting. Publicly submitted comment letters and visual slide presentations from that testimony period are available under the B8 Agenda Item from the December 2023 Council Agenda. Key themes of the mortality-reduction measures included decreased fishing effort in the RKCSA, additional communication between vessels about encounters with RKC, relocating fishing areas when RKC were present in catch, and best-handling practices for crab when encountered. Testifiers representing the groundfish fisheries described various ongoing cooperative research projects such as enhancing gear design for crab avoidance (pot gear), gear-seafloor interaction estimation (pelagic trawl gear), and stomach content analysis to determine predation rates of Pacific cod on RKC (HAL gear). Representatives of the directed crab fishery noted efforts to establish best practices for crab handling, measures to reduce “rail dumps” (instances where pots are picked with no retention due to quota limitations), and shorter soak times for pots. The cooperative research efforts referenced in this testimony are described further in Sections 5.3.1 and 5.5.4 of the EA.

In December 2022, the Council reviewed the emergency rule analysis (NPFMC 2022c) and passed a motion declining to recommend emergency rulemaking to the Secretary of Commerce. The Council’s rationale for its decision regarding the emergency rule request is stated in the motion. The Council focused its rationale on the specific criteria for an emergency rule[5] – particularly that the precipitating event be “unforeseen” and that the event can be addressed through emergency regulations for which the immediate benefits outweigh the value of the public, deliberative normal rulemaking process. The Council offered the alternatives currently under consideration as a potential way to take more durable steps with the benefit of the fullest extent of available information.

In January 2023, NMFS issued a decision letter notifying the Council that it had denied the petition requesting the closure of the RKCSA to all fishing gears from January through June of 2023. NMFS also issued a media release providing the rationale for the denial. NMFS reiterated its concern with the ongoing impacts of low crab abundance on fishermen and communities, and a commitment to increasing the resiliency of the fishery. The rationale cited in the letter to the Council included:

> “NMFS agrees with the Council that the low abundance and declining trend of mature female Bristol Bay red king crab represent serious conservation and management problems. Our analysis suggests that while the proposed closure would provide some potential red king crab savings and some habitat benefits through reduced bottom contact by trawl gear, there is considerable uncertainty regarding the level of benefit for red king crab. If implemented […] the proposed closure would be effective for only a portion of a single fishing season, limiting the potential benefits. Additionally, the analysis identified potential adverse impacts to other prohibited species, as well as economic implications for all impacted sectors. Therefore, we cannot conclude that the proposed emergency regulations would measurably address the low abundance and declining trend of mature female Bristol Bay red king crab or that the immediate benefits of emergency rulemaking outweigh the value of advance notice, public comment, and deliberative consideration of the impacts that would occur through the normal rulemaking process.”

Though not directly related to the considered action alternatives, it is noted that in December 2022 the Secretary of Commerce approved fishery disaster declarations for several fisheries, including the 2021/22 and 2022/23 BBRKC fisheries. The BBRKC disaster assistance requests for the two most recent seasons

[5] Authorization for the Secretary of Commerce to promulgate regulations to address an emergency is defined in statue at Section 305(c) of the MSA. Under that section, a Council may also request that the Secretary promulgate emergency regulations. NMFS's Policy Guidelines for the Use of Emergency Rules provide that an emergency must exist and that NMFS have an administrative record justifying emergency regulatory action and demonstrating compliance with the Magnuson-Stevens Act and the National Standards (see NMFS Procedure 01-101-07 (March 31, 2008) and 62 FR 44421, August 21, 1997). These criteria are discussed throughout the December 2022 emergency rule analysis (NPFMC 2022c), particularly in Section 2.4 of that document.

were submitted by the Governor of Alaska.[6] With a positive disaster declaration, the fishery is eligible for disaster assistance from NOAA, pending the availability of Congressionally appropriated funds. Disaster assistance funds often take one or more years to become available for disbursal to eligible recipients. A declared fishery may also qualify for disaster assistance from the Small Business Administration – i.e., the Economic Injury Disaster Loan program that provides bridge-type loans to provide operating funds for a short duration.[7] In May 2023, the Secretary of Commerce announced that the U.S. Congress had appropriated disaster relief funds that cover the 2021/22 and 2022/23 BBRKC and BS snow crab fisheries. The amounts are reported as $94.5 million for 2021/22 and $96.6 million for 2022/23. ADF&G issued a press release announcing the funds on May 19, 2023; the release did not specify the proportion of each amount that would be apportioned to the BBRKC fishery.

The Council and its advisory bodies received a first initial review draft of this EA/RIR at the June 2023 meeting. Upon review, the Council and SSC requested additional information and a second initial review. The Council's full motion and the SSC's report from June 2023 are included in this document as Appendix 1. Some of the prompts (bullet points) in the June 2023 motion asked for "information", "discussion", "enhanced discussion", description of potential rationale, "and discussion of trade-offs" related to the triggers for annual area closures that comprise the Options under the action alternatives (Alts. 2 & 3). These prompts are most directly addressed in Section 2.4, in consultation with BBRKC stock assessment authors (as instructed). Many of the related prompts relate to the state of knowledge about the BBRKC stock and the BS ecosystem; those are generally addressed in Sections 5.3 and 5.5. The Council also requested enhanced analysis of the "PSC rate analysis" that was presented as Appendix 2 of the June 2023 EA/RIR (NPFMC 2023a). That work, and a parallel analysis of a CPUE-based approach suggested by the SSC in its June 2023 final report, is provided in full in Appendix 2 to this document (attached separately) and incorporated into the body of this document as a synopsis in Section 3.3. The Council prompted further information about cooperative research effort to study BBRKC winter/spring location through a novel pot sampling effort; this is addressed in Section 5.3.1. That section provides a high-level overview of other ongoing research or proposed research. Section 5.5.4 describes a different developing cooperative research effort directed towards modernized descriptions of pelagic trawl gear, which might inform future work related to groundfish gear interactions with the seafloor. This document provides updated work using the best existing assessment tool for gear-seafloor interactions in the BS and BBRKC management area (i.e., a portion of the Fishing Effects Model workflow) in Section 5.5.3. Finally, the Council requested further exploration of "actions that could be implemented through framework agreements" for the pot CV and trawl sectors that could promote dynamic avoidance of areas with relatively higher female BBRKC abundance, which was previously introduced in Appendix 1 of the June 2023 EA/RIR. That discussion is incorporated as Appendix 4 of this document, and is informed by direct feedback to the analysts from groundfish fishery participants since the Council's last review.

1.3 Description of Management Area

Figure 1-1 shows the NMFS reporting areas that comprise the Bering Sea and Aleutian Islands FMP area. The Aleutian Islands reporting areas are 541, 542, and 543; all other areas numbered in Figure 1-1 make up the Bering Sea FMP area. The areas that could be directly affected by the alternatives considered in this analysis are contained in NMFS Areas 509, 516, and 512 (see Figure 1-2). The RKCSA spans parts of Areas 509 and 516 (Alternative 2). Alternative 3 would affect the authorized use of fishing gear in Area 512.

[6] See letters to the Secretary on March 3, 2022 and October 21, 2022).
[7] Relevant legislation (including MSA sections 312(a) and 315) and resources related to fishery disaster assistance are available here.

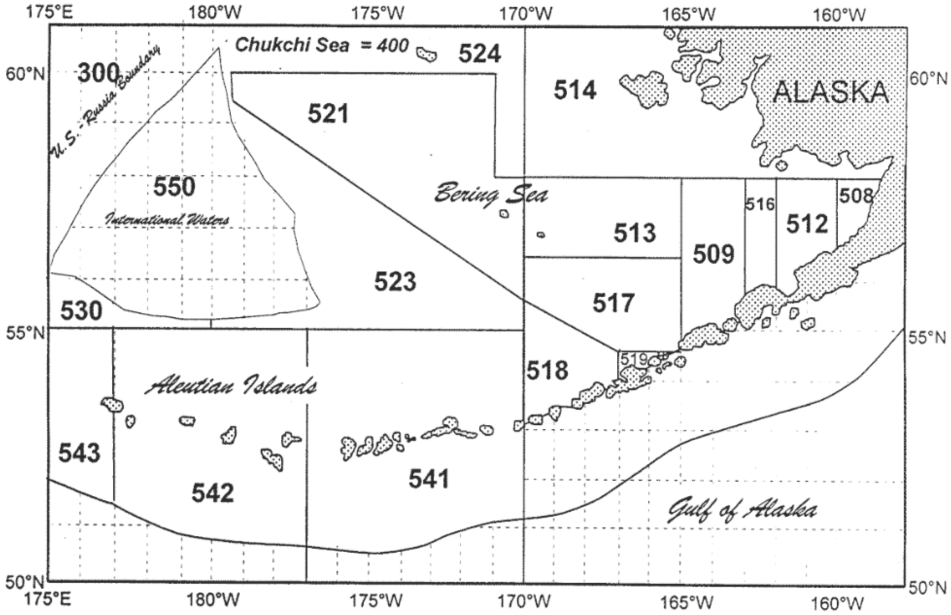


Figure 1-1 Bering Sea and Aleutian Islands reporting areas (Figure 1 to 50 CFR Part 679)

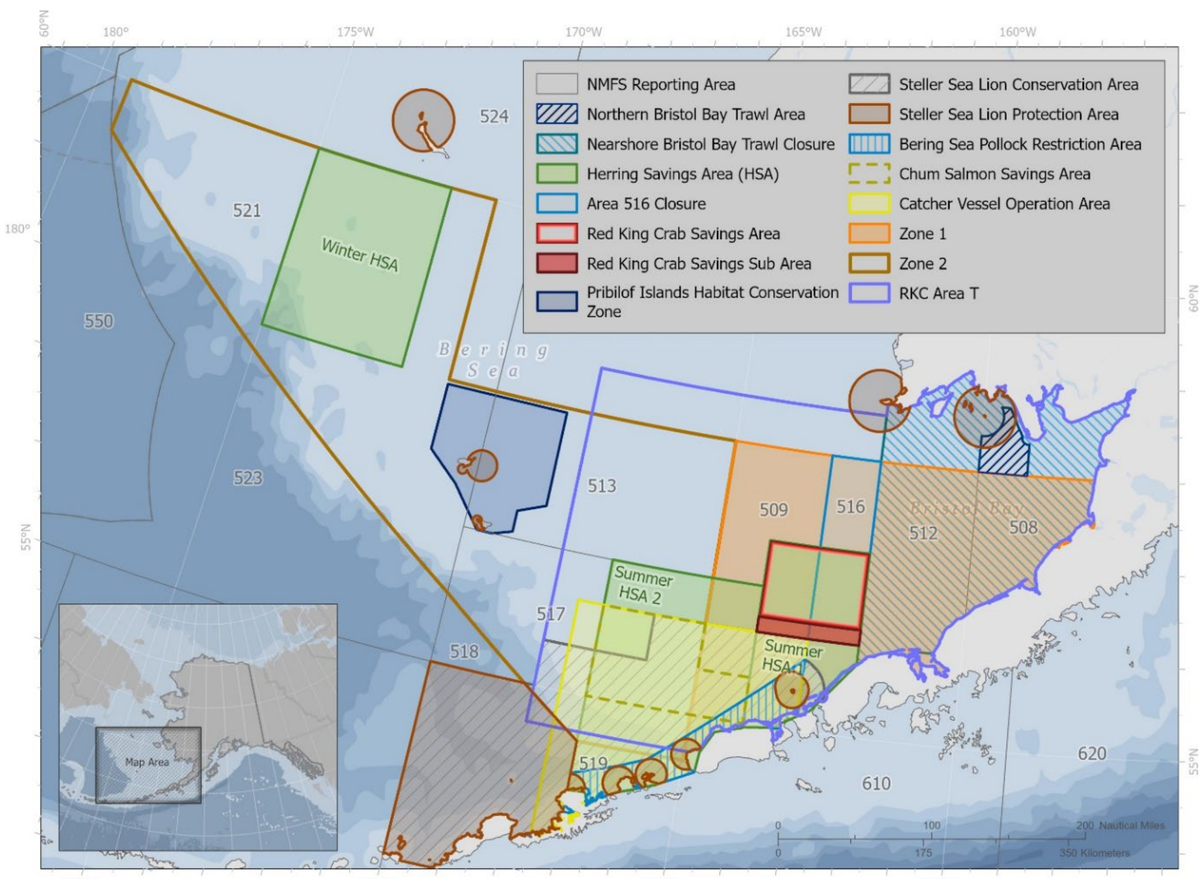


Figure 1-2 Red king crab protection measure and other relevant groundfish management boundaries in the Bering Sea (Map created by B. Holycross, PSMFC, in consultation with NPFMC and AKFIN staff, Dec. 2024)

Figure 1-2 shows the State of Alaska's BBRKC management area (Area T; purple outline) as well as the RKCSA (red outline) that is contained within NMFS Reporting Areas 509 and 516. Additional history on the establishment of the RKCSA and the FMP amendments referenced in Figure 1-2 is included in Section 2.1 of this document.[8] Federal regulations at 679.22(a)(3) and Figure 11 to Part 679 define the RKCSA as located between 56° 00.0' N and 57° 00.0' N lat. and between 162° 00.0' W and 164° 00.0' W. long. The RKCSA is also defined in the BSAI Groundfish FMP at Section 3.5.2.1.3. Most of the RKCSA is closed to non-pelagic trawl gear year-round, in all years. For groundfish, the area is open to pelagic trawl gear, pot gear, and HAL gear with the exception that Area 516 is closed to *all* trawl gear (including pelagic trawl) from March 15 through June 15.

The RKCSS (red shaded) is a 10 nm north latitude section that lies within the RKCSA and is defined as "*the portion* of the RKCSA located between 56° 00.0' N and 56° 10.0' N lat." The RKCSS portion of the RKCSA may be open to non-pelagic trawl gear when the Regional Administrator of NMFS, in consultation with the Council, determines that a guideline harvest level for BBRKC has been established (i.e., a directed BBRKC fishery was open during the fall crab season of the preceding year). The non-pelagic trawl sector is restricted to a maximum subapportionment of its Zone 1 RKC PSC limit that can be taken in the RKCSS; no more than 25% of the sector's annual PSC limit can come from that area.

The Nearshore Bristol Bay Trawl Closure Area (NBBTCA) is closed to all trawling year-round, except for a subarea near Togiak (Northern Bristol Bay Trawl Area) that is open to trawling from April 1 through June 15 each year.[9] The rationale for closing this area to trawl gear was the protection of juvenile RKC habitat and rearing habitat. The subarea that is open in the spring is prosecuted for flatfish by non-pelagic trawl vessels. Under a voluntary agreement with the Togiak community, the non-pelagic trawl sector ceases fishing in the subarea one week earlier than the regulatory closure (June 7) to minimize interactions with halibut.

Crab Bycatch Limitation Zone 1 and Zone 2 denote areas with specific crab PSC limits that are subapportioned through harvest specifications to certain gears and directed fisheries. Directed groundfish fisheries may be closed throughout the zone by inseason action if an RKC PSC limit is met. PSC limits are established for BBRKC and Tanner crab in Zone 1; Zone 2 has as PSC limit for Tanner crab. The regulatory effects of the Zone 1 crab PSC limits are described in more detail in Sections 3.1.1 and 3.1.2 of this document.

Other areas depicted in Figure 1-2 are shown to help the reader visualize the overlapping spatial and temporal restrictions on groundfish fishing in the Bering Sea, and are described in greater detail in Section 3.1. Those management boundaries include: Steller sea lion protection areas, the Steller Sea Lion Conservation Area (SCA), the Pribilof Islands Habitat Conservation Zone (PIHCZ), the Bering Sea Pollock Restriction Area, the Catcher Vessel Operational Area (CVOA), and the Chum Salmon Savings Area (CSSA). They variously address conservation of crab, salmon, herring, and marine mammals either directly or through minimizing direct interaction with benthic habitat. Other management measures that cannot be depicted, such as temporary area closures imposed by fishing cooperatives (e.g., "rolling hotspots" in the pollock fishery) are described in Section 3.1.1.

NMFS website on Steller sea lion protection measures provides a similar map view that is more geographically expansive but does not include some of the boundaries and area definition that are specific to the action under consideration here (e.g., RKCSA, Trawl Bycatch Limitation Zones). That map can be directly accessed here.[10] The areas shown there as "No Pollock Trawl" correspond to the "Steller Sea lion

[8] Original implementing rationale for bycatch limitation Zones 1 & 2 and the seasonal trawl closure in Area 516 can be found in the implementing rules for BSAI Amendments 10 and 12 (51 FR 45349, December 18, 1986, BSAI Amendment 12 54 FR 19199, May 4, 1989); original rationale for the RKCSA/SS, the nearshore Bristol Bay trawl closure area, and the Northern Bristol Bay seasonal trawl area can be found in the implementing rule for BSAI Amendment 37 (61 FR 65985, December 16, 1996) and are also discussed in Dew 2010.

[9] See FMP Section 3.5.2.1.4 and § 679.22(a)(9).

[10] Last accessed Jan. 2024.

Protection Areas" shown in brown hash-marks in Figure 1-2, above. In regulation, Steller sea lion protection areas are defined in Table 4 (to 50 CFR 679) for pollock fisheries restrictions, Table 5 for Pacific cod fisheries restriction, and Table 6 for Atka mackerel fisheries restrictions.[11] Table 12 to 50 CFR 679 defines 3nm "no groundfish fishing sites" that protect Steller sea lion rookeries and haulouts.

1.4 EA and RIR requirements

Environmental Assessment

There are four required components for an environmental assessment. The need for the proposal is described in Section 1.1 and the alternatives are described in Section 2. The probable ecological impacts of the proposed action and alternatives are addressed in Section 5, and social and economic impacts in Section 4. A list of agencies and persons consulted is included in Section 9.

Regulatory Impact Review

The preparation of an RIR is required under Presidential Executive Order (E.O.) 12866 (58 FR 51735, October 4, 1993). The requirements for all regulatory actions specified in E.O. 12866 are summarized in the following Statement from the E.O.:

> *In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.*

As part of the RIR analysis, the need for the proposal is described in Section 1.1, and the alternatives in Section 2. Section 3 provides a description of the fisheries affected by this action, Section 4 analyzes the economic and social impacts of the proposed alternatives, including the impacts on small entities, and Section 6 addresses the management considerations relevant to the alternatives under consideration.

E.O. 12866 requires that the Office of Management and Budget review proposed regulatory programs that are considered to be "significant." A "significant regulatory action" is one that is likely to:

- Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local or tribal governments or communities;
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in E.O. 12866.

[11] Atka mackerel is a target species and a fishing location choice factor for the non-pelagic trawl sector, but is not prosecuted in the area of interest for this action.

1.5 Documents Incorporated by Reference in this Analysis

1.5.1 Environmental Analyses

This impact assessment relies heavily on the information and evaluation contained in previous environmental analyses, and these documents are incorporated by reference. The documents listed below contain information about the fishery management areas, fisheries, marine resources, ecosystem, social, and economic elements of the groundfish fisheries. They also include comprehensive analysis of the effects of the fisheries on the human environment and are referenced in the analysis of impacts throughout this document.

Alaska Groundfish Harvest Specifications Final Environmental Impact Statement (NMFS 2007).

This EIS provides decision makers and the public an evaluation of the environmental, social, and economic effects of alternative harvest strategies for the federally managed groundfish fisheries in the GOA and the Bering Sea and Aleutian Islands management areas and is referenced here for an understanding of the groundfish fishery. The EIS examines alternative harvest strategies that comply with Federal regulations, the Fishery Management Plan (FMP) for Groundfish of the GOA, the Fishery Management Plan (FMP) for Groundfish of the BSAI Management Area, and the Magnuson-Stevens Fishery Conservation and Management Act. These strategies are applied using the best available scientific information to derive the total allowable catch (TAC) estimates for the groundfish fisheries. The EIS evaluates the effects of different alternatives on target species, non-specified species, forage species, prohibited species, marine mammals, seabirds, essential fish habitat, ecosystem relationships, and economic aspects of the groundfish fisheries. This document is available from https://alaskafisheries.noaa.gov/fisheries/groundfish-harvest-specs-eis.

Bristol Bay Red King Crab Stock Assessment (Palof 2023)

The annual BSAI Crab SAFE reports review recent research and provide estimates of the biomass of each species and other biological parameters. They also describe how the status of a crab stock is determined based on a system of five tiers that stocks fall into based on the amount of information that can be generated in the stock assessment. The BBRKC assessment for 2023 is accessible at: https://meetings.npfmc.org/CommentReview/DownloadFile?p=78aaa3ef-6ade-46a7-a7ee-8106f2e15404.pdf&fileName=BBRKC_2023_SAFE.pdf. Previous year's BBRKC assessments or assessments for other crab species are accessible at https://www.npfmc.org/library/safe-reports/.

The most recent available economic status reports (Econ SAFEs) for the BSAI king and Tanner crab fisheries are for 2022 and 2023. The 2022 Crab Econ SAFE report was available throughout the development of this document. The 2023 Crab Econ SAFE became available in January 2024 and was utilized by the authors of this analysis to the extent possible. The 2023 report was presented to the Crab Plan Team in January 2024 but has not been reviewed by the Council's SSC as of the time of writing.

2022 Crab Econ SAFE accessible at:
https://meetings.npfmc.org/CommentReview/DownloadFile?p=398785e2-d50b-49f4-bb64-c5f4834a93d1.pdf&fileName=D4%20Crab%20Economic%20SAFE%202022.pdf.

2023 Crab Econ SAFE (as posted on Jan. 10, 2024) accessible at:
https://meetings.npfmc.org/CommentReview/DownloadFile?p=fe125735-f369-43df-8874-7205bf0bc146.pdf&fileName=Economic%20SAFE.pdf.

Appendix C to the BBRKC SAFE chapter is the "Ecosystem and Socioeconomic Profile of the Bristol Bay Red King Crab Stock – Report Card" (ESP).

The BBRKC ESP is referenced in this document as Fedewa and Shotwell, 2023, and can be accessed directly at https://meetings.npfmc.org/CommentReview/DownloadFile?p=0bee9d67-e35a-4775-974f-34c24c118e7a.pdf&fileName=BBRKC%20ESP%20Report%20Card%202023%20.pdf.

Stock Assessment and Fishery Evaluation (SAFE) Reports for the Groundfish Resources of the BSAI and GOA (NPFMC 2022d)

Annual SAFE reports review recent research and provide estimates of the biomass of each species and other biological parameters. The SAFE report includes the acceptable biological catch (ABC) specifications used by NMFS in the annual harvest specifications. The SAFE report also summarizes available information on the ecosystems and the economic condition of the groundfish fisheries off Alaska. This document is available from http://www.afsc.noaa.gov/refm/stocks/assessments.htm. At the time of writing, the 2023 BSAI Groundfish SAFE report is not available at the site linked above, but draft chapters published in November 2023 are accessible via https://www.npfmc.org/library/safe-reports/.

Final Programmatic Supplemental Environmental Impact Statement (PSEIS) on the Alaska Groundfish Fisheries (NMFS 2004)

The PSEIS evaluates the Alaska groundfish fisheries management program as a whole and includes analysis of alternative management strategies for the GOA and Bering Sea/Aleutian Islands (BSAI) groundfish fisheries. The EIS is a comprehensive evaluation of the status of the environmental components and the effects of these components on target species, non-specified species, forage species, prohibited species, marine mammals, seabirds, essential fish habitat, ecosystem relationships, and economic aspects of the groundfish fisheries. A Supplemental Information Report (NPFMC and NMFS 2015) was prepared in 2015 which considers new information and affirms that new information does not indicate that there is now a significant impact from the groundfish fisheries where the 2004 PSEIS concluded that the impact was insignificant. The PSEIS document is available from https://alaskafisheries.noaa.gov/node/33552, and the Supplemental Information Report from https://alaskafisheries.noaa.gov/sites/default/files/sir-pseis1115.pdf.

1.5.2 Preceding NPFMC/NMFS Discussion Papers and Analysis on BBRKC (2022/23)

This document draws heavily on a series of BBRKC informational/discussion papers and an analysis conducted for the review of an emergency rule petition. Those documents contain a wealth of information that is excerpted or repurposed throughout this document but their entire contents are not reproduced here. Those documents and their attachments, as presented to the Council, are incorporated by reference. Documents and attachments can be accessed directly from the Council's electronic agendas:

- April 2022 discussion paper (NPFMC 2022a): Agenda item D1, available at: https://meetings.npfmc.org/Meeting/Details/2854
- October 2022 discussion paper (NPFMC 2022b): Agenda item D2, available at: https://meetings.npfmc.org/Meeting/Details/2946
- December 2022 emergency rule request review (NPFMC 2022c): Agenda item C1, available at: https://meetings.npfmc.org/Meeting/Details/2964

The Council and its Scientific and Statistical Committee (SSC) reviewed a draft of this Initial Review at the June 2023 meeting (NPFMC 2023a). The June 2023 SSC Report and Council motion provided direction for analytical updates throughout this document; they are also printed in this document as Appendix 1.

2 Description of Alternatives

NEPA requires that an EA analyze a reasonable range of alternatives consistent with the purpose and need for the proposed action. The alternatives were designed to address low levels of BBRKC stock abundance and recruitment that have resulted in directed crab fishery closures. The Council's objective is the reduction of crab mortality in groundfish fisheries in areas that may be important to BBRKC and where BBRKC may be found year-round, while minimizing negative impacts to directly regulated groundfish fisheries as well as non-crab prohibited species that may also be encountered by groundfish gears in the BSAI FMP area.

The Council adopted the following alternatives for analysis in December 2022. Alternative 2 was modified for clarity in June 2023 (see motion). The Council could select either or both action alternatives (Alternatives 2 & 3). The action alternatives are not mutually exclusive.

Alternative 1: No action (status quo)

Alternative 2: Implement an annual closure of the Red King Crab Savings Area to all commercial groundfish fishing gears. The existing closure for non-pelagic trawl gear is not changed under Option 1. Option 2 modifies the trigger to close the Red King Crab Savings Subarea for non-pelagic trawl.
The closure would be in effect:
- Option 1: If ADF&G does not establish a total allowable catch (TAC) the previous year for the Bristol Bay red king crab fishery.
- Option 2: If the total area-swept biomass for BBRKC is less than 50,000 mt.
- Suboptions (apply to either Option):
  - Suboption 1: Exempt hook-and-line gear from the closure
  - Suboption 2: Exempt pot gear from the closure

Alternative 3: Implement a closure of NMFS Reporting Area 512 to fishing for Pacific cod with pot gear.
The closure would be in effect:
- Option 1: If ADF&G does not establish a total allowable catch (TAC) the previous year for the Bristol Bay red king crab fishery.
- Option 2: If the total area-swept biomass for BBRKC is less than 50,000 mt.

Staff note: The modification of Alternative 2 (June 2023 motion linked above) clarified that selection of Option 2 represents an additional circumstance where the RKCSS could be closed to non-pelagic trawl gear. The Red King Crab Savings Subarea (RKCSS) is an area defined within the regulatory boundary of the RKCSA (see Section 1.3). The RKCSS is already closed to non-pelagic trawl gear when a BBRKC TAC was not established in the previous calendar year. Selecting Option 2 as the trigger means that the RKCSS could be closed to non-pelagic trawl gear in a year when the preceding BBRKC directed fishery was opened by the State of Alaska but the area-swept biomass threshold (50,000 mt) was not met.

This section of the document describes each alterative and also provides a section that is responsive to further information and points of clarification that the Council included in its June 2023 motion (where relevant to how the Options under the action alternatives could be formed or considered in the context of available information) – Section 2.4. Section 2.5 provides a brief comparison of alternatives in tabular form. Section 2.6 documents that, at the present stage, there are no alternatives (or options) that the Council has previously considered but are not being analyzed further.

2.1 Alternative 1 – No Action

Selection of the No Action alternative would maintain existing area restrictions that apply to certain groundfish gears. Some of those restrictions apply only at certain times of year. However, the action alternatives only propose to change the status of closure or non-closure regulations that are in place on a year-long basis. Alternative 2 would close the RKCSA to pelagic trawl gear and/or pot gear and/or HAL gear throughout the year (some or all, depending on suboptions selected). Alternative 3 would implement a year-long closure to Pacific cod pot gear in NMFS Reporting Area 512. This section describes current management in the areas that are identified in the action alternatives and provides brief history on when and why those measures were put in place. The areas discussed below were illustrated in Figure 1-2.

Alternative 3 is taken first because the description of status quo is simple. Alternative 3 would only directly regulate pot gear used to directed fish for Pacific cod in an area (512) that has no special measures for that gear beyond the NMFS inseason authorities that keep cod sectors within their annual TAC allocations. Due to that relatively straight-forward status quo, no additional history is added here. Under Alternative 1, the annual management measures that implement the programmatic goals of the BSAI Groundfish FMP would remain in place. Federally permitted vessels with Bering Sea Pacific cod pot gear endorsements would be able to conduct directed fishing for Pacific cod in any BS Federal waters or open parallel (state) waters as long as the seasonally apportioned TAC for their vessel length (e.g., over/under 60' LOA) and operational type (e.g., CP/CV) has not been taken. Pot gear is not subject to crab and other PSC limits, and there are no areas within the Bristol Bay region of the Bering Sea where Federally permitted vessels with the proper gear endorsements are not allowed to deploy pots.

Alternative 2 would expand the restrictions that apply within the RKCSA to additional gear sectors. To prepare the reader to consider that alternative relative to No Action, the remainder of this subsection provides a baseline of what relevant area-management measures are in place. Some of the measures that are specific to the impact analysis of a certain gear sector – particularly the pelagic trawl (AFA pollock) sector – are noted and described in Section 3.1.

The RKCSA was first established by emergency rule in 1995 and closed the area to non-pelagic trawl gear (60 FR 4866, January 25, 1995). The purpose of the emergency rule was to conserve mature female RKC. The abundance estimate derived from the NMFS survey had declined from 14.2 million in 1993 to 7.5 million in 1994 (mature males had declined from 7.3 million to 5.5 million). The 1994 survey estimate meant that mature females had fallen below the 8.4 million crab threshold to open the BBRKC fishery, as established in the Crab FMP.

In September 1995 the Council adopted Amendment 37 to the BSAI FMP, closing the RKCSA from January 20 to March 31 each year. However, prior to Amendment 37 being implemented, NMFS closed the RKCSA by inseason adjustment from January 20 to March 31, 1996 (60 FR 63451, December 11, 1995). An important difference from the 1995 emergency rule was that the inseason adjustment closed the area to *all* trawl gear types. The preamble to the 1996 inseason adjustment included the following rationale concerning a prohibition on pelagic trawl gear: "... *NMFS is prohibiting the use of all trawl gear in the RKCSA for the effective period in 1996 because requirements for increased observer coverage cannot be implemented under this inseason adjustment to assure that the crab performance standard will be met. Unlike the emergency rule (60 FR 4866, January 25, 1995), the pelagic trawl gear component is unable to fish in the closed area. However, under the proposed Amendment 37 the pelagic trawl gear component would be exempt from a closure of the RKCSA.*" At the time, the closure was anticipated to protect approximately 90 percent of mature female RKC. (Note that the "crab performance standard" and its history is further discussed in Section 4 of this document.)

The Council continued to express concern about low abundance of crab stocks and the impending opening the RKCSA to some trawl gear (pelagic), resulting in a recommendation at the January 1996 Council meeting for an extension of the 1996 inseason adjustment that closed the RKCSA to all trawling until June 15, 1996 (61 FR 8889, March 6, 1996) to further protect BBRKC during the molting and mating period. This decision was also taken in the context that Amendment 37 had not yet been implemented in regulation. Based on information provided at the June 1996 meeting, the Council recommended expanded management measures under Amendment 37 to protect declining BBRKC stocks. In brief, the final rule implementing Amendment 37 closed portions of Bristol Bay, adjusted the PSC limit for RKC in Zone 1 of the Bering Sea, and required full observer coverage for trawl gear in specified areas (61 FR 65985, December 16, 1996).

As noted in Section 1.3, Area 516, which encompasses the eastern portion of the RKCSA, is closed to both pelagic and non-pelagic trawl gear from March 15 through June 15 each year (679.22(a)(2)). This remains a relevant restriction for the current BS pollock fishery that dictates how vessels move throughout the region during the A season. The regulation dates to BSAI FMP Amendment 12 (54 FR 19199, May 4, 1989). The proposed rule for Amendment 12 frames the seasonal restriction on pelagic trawl gear in Area 516 as a time-targeted westward extension to the year-round closure of an area that is more or less analogous to today's NBBTCA (see Figure 1-2). BSAI FMP Amendment 10 (51 FR 45349, December 18, 1986) had closed the area south of 58° 00.0' N lat. and between 160° 00.0' W and 162° 00.0' W. long. to all trawl fishing. The rationale in Amendment 10 was that that area "contains the highest concentrations of red king crab [… and] the closure will protect about 70 percent of the mature female red king crab spawning stock according to NMFS scientists." The rationale in the rule for Amendment 12 notes that "the red king crab stock continues at depressed populations levels and this area [160° to 162° W] is considered to be the principal locus of the stock. The seasonal extension of the closed area [into Area 516] is intended to provide additional protection to red king crabs, especially females during a critical molting and mating period when their shells are soft and more vulnerable to damage by trawl gear. This measure is based on a 1988 scientific survey of red king crab distribution, which indicates a significant movement of red king crabs, especially mature female animals, into this area."[12]

The RKC PSC limit for trawl fishing in Zone 1, which is most relevant to the BBRKC stock, is set in harvest specifications based on criteria established in regulation at 679.21(e)(1)(i) and is described in Section 3.6.2.1.1 of the BSAI Groundfish FMP (Zone 1 is depicted in Figure 3-18 of the FMP and in Figure 1-2 of this document). The criteria are the estimated abundance of mature females (greater than 89 mm carapace length) and the effective spawning biomass. There are three Zone 1 RKC PSC limit steps in regulation based on the criteria: 197,000 crab, 97,000 crab, and 32,000 crab; these steps are illustrated in Figure 1 of the BBRKC SAFE (Palof 2023, p.56). The total Zone 1 PSC limit is 197,000 crab if the number of mature females is greater than 8.4 million and the effective spawning biomass is greater than or equal to 55 million lbs. The limit is 97,000 crab if mature females are greater than the 8.4 million threshold and the effective spawning biomass is between 14.5 and 55 million lbs. The limit is 32,000 crab if mature females are below the 8.4 million threshold or effective spawning biomass is less than or equal to 14.5 million lbs. The Zone 1 PSC limit was reduced from 197,000 to 97,000 in 2012 as a result of effective spawning biomass falling below the 55 million lbs. threshold. The number of mature females also went down in 2012 but did not fall below 8.4 million. The Zone 1 PSC limit remained at 97,000 from 2012 until 2022. The Zone 1 PSC limit was set at 32,000 crab in 2022 and 2023 due to mature female abundance below the 8.4 million crab threshold and effective spawning biomass below the 14.5 million lbs. threshold. As of writing, the 2024/25 BSAI Groundfish Harvest Specifications tables are in draft format not yet published in the Federal Register. NMFS Alaska Region Office has informed the analysts that Table l7 of the forthcoming harvest specifications will reflect a Zone 1 PSC limit of 97,000 RKC based on the State of Alaska's harvest strategy, as reflected in Table 2-1. When published, the 2024/25 harvest specification tables will be available at https://www.fisheries.noaa.gov/alaska/sustainable-fisheries/alaska-groundfish-harvest-specifications. The 2024 Zone 1 RKC PSC limit is at the level that

[12] Both Amendments 10 and 12 included an exception to the trawl closure area for Pacific cod fishing in "an area south of a line approximating the 25-fathom isobath" provided that an RKC PSC limit for the Pacific cod fishery was not exceeded. The primary trawl fisheries of the era that were affected by the eastern Bristol Bay trawl closure, according to the published rules, was yellowfin sole and other flatfish.

was in effect from 2012 through 2021, up a step from the level in effect during 2022 and 2023 (32,000 RKC) but below the maximum Zone 1 PSC limit that was last in effect during 2011 (197,000 RKC).[13]

The total Zone 1 PSC limit has historically been apportioned to the CDQ PSQ reserve (10.7% of the limit), the Amendment 80 (A80) sector, and the BSAI Trawl Limited Access sector (TLAS) where the TLAS apportionment was subapportioned to directed fisheries for yellowfin sole, Pacific cod, and pollock/Atka mackerel/other. With the new implementation of the Pacific Cod Trawl Cooperative (PCTC) program for the 2024 groundfish year, the apportionment of Zone 1 RKC PSC to the directed cod trawl fishery has changed but the aggregate "TLAS" amount of the total Zone 1 PSC limit is proportionately consistent with prior years. In other words, the 2024 "TLAS total" shown in Table 2-1 is equal to the PSC limit for prior years when the total limit was 97,000 RKC.

CDQ PSQ can be used for directed fishing with any gear type. Part of the total limit that would have been apportioned to A80 annually is not apportioned to any sector or gear and remains unused; this was part of the designed implementation of the A80 program as a bycatch reduction mechanism. The TLAS limit applies to all trawling by non-A80 vessels, including both pelagic and non-pelagic gear. The TLAS limit is subapportioned to three directed fishery categories for purposes of inseason PSC monitoring and management: (1) yellowfin sole, (2) Pacific cod, and (3) a combined category consisting of pollock, Atka mackerel and "other" species ("other" includes skates, sharks and octopuses). That third fishery category generally encompasses the fishing that occurs with pelagic trawl gear. The recent historical apportionment of annual trawl PSC limits is shown in Table 2-1. Estimated PSC use across these sectors is reported in Table 3-4 (Section 3.2).

Under Alternative 1, the non-pelagic trawl gear sector – largely comprised of the A80 non-pollock trawl cooperative – is permitted to fish within the RKCSS portion of the RKCSA under certain conditions that are set annually. When the BBRKC directed fishery is open, the non-pelagic trawl sector may take up to 25% of the annual Zone 1 RKC PSC limit in the RKCSS (679.21(e)(3)(ii)(B)(2)).[14] If the amount of Zone 1 RKC PSC apportioned to the A80 sector is less than 25 percent of the total Zone 1 limit, the effective RKC PSC limit for the A80 sector would be its annual PSC apportionment. The non-pelagic trawl sector may operate in the RKCSS when the BBRKC stock is sufficient for the State of Alaska to have established a GHL fishery in the previous year. If the stock is insufficient, NMFS and the Council will not specify an RKC PSC limit for that gear in that area and, thus, NMFS closes the RKCSS to directed fishing with non-pelagic trawl gear. Closure of the RKCSS to non-pelagic trawl gear was the case for the 2022 and 2023 groundfish seasons but will not be the case in 2024. Table 15 in the 2023/24 BSAI groundfish harvest specifications laid out the regulations that resulted in the most recent RKCSS non-pelagic trawl closure of 2023.[15]

When a Zone 1 RKC PSC limit is reached, NMFS closes directed fishing with non-pelagic trawl gear for that species category. For example, if TLAS reaches the PSC limit for the yellowfin sole directed fishery (e.g., 23,338 crab in 2021 and 2024; 7,700 crab in 2022 and 2023) then Zone 1 would be closed to non-pelagic trawling in the directed fishery for yellowfin sole. Yellowfin sole could still be retained up to the MRA when fishing with non-pelagic gear in other open directed fisheries. If TLAS reaches the PSC limit

[13] For harvest strategy control rule, see Figure 2 on page 56 in Palof 2023 (BBRKC SAFE Report).
[14] Zone 1 and Zone 2 RKC PSC limits were established under BSAI Amendment 10. The limits have been modified over time, including under Amendments 12, 37, and 57. A comprehensive history of BSAI Groundfish FMP amendments (through 2016) is provided by the NPFMC through the Amendment Action Summaries document (May 2016), available at: https://www.npfmc.org/wp-content/PDFdocuments/fmp/BSAI/BSAIGFAmActionSumm.pdf.
[15] Footnote 4 to Table 15 reads: "Section 679.21(e)(3)(ii)(B) establishes criteria under which an annual red king crab bycatch limit must be specified for the RKCSS if the State has established a GHL fishery for red king crab in the Bristol Bay area in the previous year. Based on the final 2022 NMFS trawl survey data for the Bristol Bay red king crab stock, the State of Alaska closed the Bristol Bay red king crab fishery for the 2022/2023 crab season. NMFS and the Council will not specify the red king crab bycatch limit for the RKCSS in 2023, and pursuant to 679.21(e)(3)(ii)(B)(1) directed fishing for groundfish is prohibited for vessels using non-pelagic trawl gear in the RKCSS for 2023."

for the pollock/Atka/other category (e.g., 197 crab in 2021 and 2024; 65 crab in 2022 and 2023) the directed fishery for that category is closed for non-pelagic trawl gear. Notably, this closure does not directly impact where vessels fishing for pollock can fish because pollock vessels must use pelagic trawl gear by regulation, Atka mackerel are not targeted in Zone 1, and directed fishing for "other species" (skates/shark/octopus) is never open. In effect, the pollock fishery is treated differently with respect to RKC PSC closures for Zone 1. The directed pollock fishery is already not permitted to use non-pelagic gear and thus it is effectively not subject to non-pelagic trawl closures. This specific handling of the pollock/Atka/other category went into effect under FMP Amendment 57 (65 FR 31105, May 16, 2000). The Council's purpose and need for Amendment 57 was focused on bycatch minimization and the action also included PSC limit reductions for halibut, RKC, opilio crab, and Tanner crab.

Table 2-1 Zone 1 red king crab prohibited species catch limits for trawl gear, 2010-2024

Year	A80 Limit	A80 Not Allocated	CDQ	TLAS Pollock/Atka/Other	TLAS Pacific Cod	TLAS Yellowfin	TLAS Total	Total
2010	98,920	23,204	21,079	400	6,000	47,397	53,797	197,000
2011	93,432	28,692	21,079	400	6,000	47,397	53,797	197,000
2012-2021	43,293	16,839	10,379	197	2,955	23,338	26,489	97,000
2022-2023	14,282	5,555	3,424	65	975	7,700	8,739	32,000
2024	43,293	16,839	10,379	197	2,955*	23,338	26,489	97,000

* Beginning in 2024, the TLAS Pacific cod apportionment becomes subapportioned as a result of PCTC implementation. Footnote 3 to Table 17 in 2024/25 BSAI Harvest Specifications reads: "[BSAI Groundfish FMP] Amendment 122 established the Pacific Cod Trawl Cooperative (PCTC) Program that further apportioned the BSAI trawl limited access sector Pacific cod PSC limits between AFA CPs, PCTC A and B-season, and open access C-season (§ 679.131(c)(1)(i) and (ii)). In 2025 and every year thereafter, NMFS will apply a 25 percent reduction to the A and B season trawl CV sector halibut PSC apportionment after the Council recommends and NMFS approves the BSAI trawl limited access sector's PSC limit apportionments to fishery categories. The crab PSC limits are reduced for the A and B season trawl CV PSC limit by 35 percent each year to determine the overall PCTC Program (§ 679.131(d)(1)(iii)). Any amount of the PCTC Program PSC limit remaining after the B season may be reapportioned to the trawl CV limited access fishery in the C season. Because the annual halibut PSC limit for the PCTC Program is not a fixed amount established in regulation and, instead, is determined annually through the harvest specification process, NMFS must apply the reduction to the A and B season apportionment of the trawl CV sector apportionment to implement the overall PSC reductions under the PCTC Program."

2.2 Alternative 2 – Annual Closure of RKCSA to All Groundfish Gears

Alternative 2 would implement an annual closure of the RKCSA to all commercial groundfish fishing if a triggering threshold (Option 1 or Option 2) is met during the preceding year. If Alternative 2 is selected, the Council must choose one of the two trigger options that would determine the status of the RKCSA on an annual basis. Alternative 2 contains two suboptions. Suboption 1 would exempt hook-and-line (HAL) gear from the RKCSA closure; Suboption 2 would exempt pot gear from the RKCSA closure. The Council could choose either/both/none of the suboptions. If no suboption is selected then the closure, when in effect, applies to all commercial groundfish gears. If only Suboption 1 is selected then the closure applies to all trawl gear and pot gear. If only Suboption 2 is selected then the closure applies to all trawl gear and HAL gear. If both suboptions are selected then the closure applies only to trawl gear (NPT and PTR).

As noted in the introduction to Section 2, this alternative would not create any new circumstance where use of non-pelagic trawl gear is permitted in the RKCSS when it would *not have been permitted* under the No Action alternative. The selection of Option 1 as the annual trigger would effectively maintain the status quo for non-pelagic trawl gear – i.e., the area is not open to that gear if ADF&G has opened a directed BBRKC fishery in the preceding crab season. The selection of Option 2 could result in the RKCSS being closed to non-pelagic trawl gear in years when it would not have been closed under the No

Action alternative. This could occur if a directed BBRKC fishery had been open in the preceding crab season but the area-swept biomass for BBRKC in the preceding summer trawl survey was less than 50,000 mt. In other words, the Council's intention is that the non-pelagic trawl sector could only operate in the RKCSS if the conditions of both Alternative 2 and regulations at 679.21(e)(3)(ii)(B)(1) – i.e., BBRKC fishery open in previous year – are met.

2.2.1 Option 1 – BBRKC not open for directed fishing in the previous year

If the Council selects Option 1, the RKCSA would only be open to groundfish fishing with pelagic trawl gear, pot gear, and HAL gear if the State of Alaska (ADF&G) opens a directed fishery for BBRKC in the previous year. Under the Crab FMP, the commercial BBRKC fishery is not opened when it is at or below the critical biomass threshold of 25% Biomass at Maximum Sustainable Yield (B_{MSY}). ADF&G will also close a directed crab fishery if it does not meet certain thresholds outlined in the State's harvest strategy regulations for that stock (5 ACC 34.816; see p.42 in the link provided). The ADF&G Commissioner also has the authority to close the BBRKC fishery to account for additional uncertainties that might not be covered in the thresholds and review process outlined in the Crab FMP (5 AAC 34.040).

The term "previous year" means that if, for example, Alternative 2 had been in effect when the 2021/22 BBRKC fishery was ordered closed in 2021 then the RKCSA would have been closed to certain gears in the 2022 Federal BSAI groundfish fisheries. Historically, the BBRKC fishery has been closed for the 1983/84, 1994/95, 1995/96, 2021/22, and 2022/23 seasons because the number of mature females in the stock was estimated to be lower than the threshold of 8.4 million. Had Alternative 2 been in place with the Option 1 trigger, the RKCSA would have been closed to certain commercial groundfish gears in 1984, 1995, 1996, 2022, and 2023. The directed BBRKC fishery was open in the 2023/24 crab season (harvest occurred in November 2023; as a result, the RKCSA would not have been closed to groundfish gears in 2024.

BBRKC specifications and the State of Alaska's determination of whether the fishery will open typically occurs in October so it is expected that the Council would know the status of Alternative 2 Option 1 when groundfish harvest specifications are reviewed through the Plan Teams and final Council recommendations are made at the December Council meeting.

HAL and/or pot gear could be exempted from the area closures defined by Alternative 2 if Suboptions 1 and/or 2 are selected. For example, if both suboptions are selected then the RKCSA area closure defined by Alternative 2 would only apply to pelagic trawl gear. If only Suboption 1 is selected then the RKCSA area closure defined by Alternative 2 would apply to pelagic trawl gear and pot gear.

2.2.2 Option 2 – Total area-swept biomass for BBRKC is less than 50,000 mt

If the Council selects Option 2, the RKCSA would only be open to groundfish fishing with pelagic trawl gear, pot gear, and HAL gear if the NMFS/AFSC Eastern Bering Sea (EBS) trawl survey from the preceding calendar year resulted in a total area-swept biomass estimate for BBRKC of greater than or equal to 50,000 mt. "Total" indicates that the metric would be based on the sum of both male and female area-swept biomass estimates. The EBS trawl survey typically occurs in June. The area-swept estimate would be known to the Council by the fall of the year prior to when a closure under Alternative 2 might be in effect – i.e., when groundfish harvest specifications for the following year are being considered as part of the annual Groundfish Plan Team process. As with Option 1, HAL or pot gear could be exempted from Option 2 if Suboptions 1 or 2 are selected.

Area-swept biomass is the estimated biomass determined by the trawl survey sampling design methods. The EBS trawl survey is divided into sampling grids with one trawl tow performed in each grid to sample fish, crab, and other surveyed organisms. For crab, individuals in the sample from each grid are identified to the species level, measured, and given an approximate biomass based on established length-weight relationships. The sampled biomass is then expanded to cover the entire survey grid using a density applied to the grid area. In this case, "expansion" would be applying the biomass of crab per the unit of area that was sampled (towed) to the total area of the grid. That estimate is the area-swept biomass for a particular grid. All grid estimates are added together across the relevant area to calculate the total area-swept biomass.[16]

The time series of total estimated area-swept survey biomass is reported in Table 23 of the BBRKC SAFE (Palof 2023). Figure 2-1, below, charts the annual estimates over the history of the survey in relation to the 50,000 mt threshold defined for Option 2 (2020 excepted). There are 49 estimates of area-swept biomass dating back to 1975. Presuming that the value for 2020, when no survey was conducted, would have been less than 50,000 mt, the total biomass estimate was below the threshold in 13 of 49 years: 1983, 1985-1986, 1992, 1994-1996, and 2018-2023. Aside from 2014, the total area-swept estimate has been lower than 100,000 mt since 2009. The estimate was in the 60-70,000 mt range from 2011 through 2016 (excepting 2014), was at 53,000 mt in 2017, and has been below the threshold since then. The lowest values in the time series occurred from 2018 to 2021 (~28,500 mt). As noted in Section 1.1 of this document, the near-future outlook for the BBRKC stock is a steady to declining trend (Palof 2023, p.25).

Figure 2-1 highlights survey years that were followed by the state closing the directed BBRKC fishery (orange points). For example, 1994 is highlighted in the figure because the BBRKC fishery was closed for the 1994/95 season. Note that not all instances where total area-swept biomass was less than 50,000 mt were followed by the state closing the fishery per its harvest strategy regulations (e.g., 1985, 1992, 2018, 2019, and 2023). There are several reasons why the BBRKC fishery would be open in years when total area-swept biomass was estimated at less than 50,000 mt. First, "total" area-swept biomass includes both males and females, but the Federal control rule in the Crab FMP for setting an ABC is based solely on males. Moreover, the percentage split of males/females is not the same in every year, so looking at total area-swept biomass might miss the relationship between the male estimate and fishery management. Second, the State of Alaska's BBRKC harvest strategy (5 ACC 34.816) is based on length-based analysis (LBA) abundance estimates – described briefly below – which are stock assessment model outputs and are not the same as the area-swept survey estimate. The State's harvest strategy has two steps: that mature female abundance and effective spawning biomass are above certain thresholds, and then applying a harvest rate to mature male abundance based on the female abundance thresholds that were reached (or not reached). Third, the Federal rules (Crab FMP) to close the BBRKC fishery are based on metrics derived from the stock assessment model which, again, are different from the area-swept survey estimate. The Crab FMP would close the fishery if the stock is less than 25% of B35% (35 percent of estimated unfished biomass, or the proxy B_{MSY}).

[16] Area-swept estimates are not expected to match the final modeled population estimates reported in the annual SAFE report for individual stocks because the stock assessment models include additional populations dynamics information (Zacher et al. 2023, p.3).

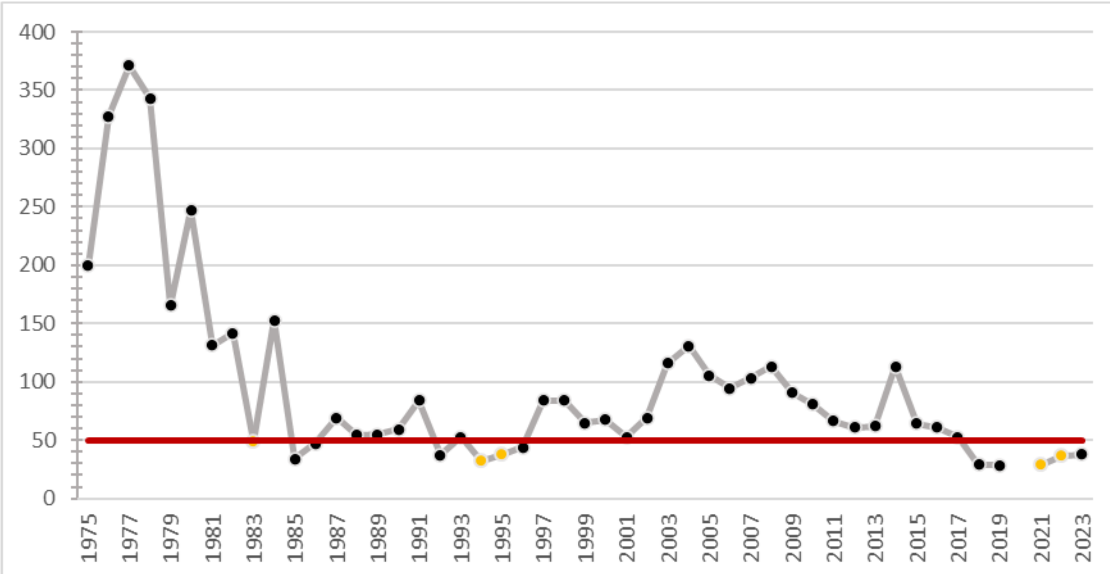


Figure 2-1 Total survey biomass "area-swept" estimate (mt), 1975-2023; survey years preceding a BBRKC directed fishery closure are highlighted in orange (Data sources: Palof & Siddeek 2022, Table 9a; Palof 2023, Table 23)

The area-swept biomass estimates have the longest track record but are methodologically different from the LBA abundance estimates that were developed by ADF&G in 1994 and have been used to manage the directed BBRKC fishery and to set crab bycatch limits in groundfish fisheries since 1995 (Palof 2023, p.14). LBA model output is used to estimate the populations model specifications like the OFL. The LBA estimates incorporate multiple years and multiple data sources into each point estimate (for further information on LBA methodology, see Zheng et al. 1995). In addition to being a different method from the area-swept estimate, the time-series of LBA estimates changes annually as that model is run and "re-estimates" past years. LBA estimates are typically higher than area-swept estimates, but that relationship may vary depending on population dynamics as they are understood when the model is run each year. For example, a high point-estimate seen in the trawl survey might not directly translate into the LBA-based abundance estimate if the model does not see evidence that those crab are likely to be recruiting into the fishery-size segment of the population. The time series of LBA abundance estimates for mature males and mature females are shown in Figure 5-2 in this document (from Zacher et al. 2023).

2.3 Alternative 3 – Annual Closure of NMFS Area 512 to Pacific Cod Fishing with Pot Gear

Selecting Alternative 3 would mean that pot gear cannot be used to directed fish for Pacific cod in Area 512 throughout the year in any year when the triggering threshold is met. The BS Pacific cod pot gear fishery is described in Sections 3.1.3 and 3.2.3. Fishing for Pacific cod with pot gear is not limited on an area-basis. Access to the Pacific cod pot fishery is only limited by the requirement to hold License Limitation Program (LLP) license endorsed for Pacific cod and the appropriate gear and FMP area (i.e., Bering Sea), and by the allocation of annual non-CDQ TAC to subsectors based on vessel length and operational type (i.e., CP, CVs ≥ 60' LOA, and CVs < 60' LOA). Annual TAC allocations to those sets of length/type vessel categories were established under BSAI FMP Amendment 85.

If the Council selects Alternative 3, one of the two triggering mechanisms described in the preceding subsection (Option 1 or Option 2) must be selected. The triggering mechanism option is necessary to determine when an Area 512 annual closure would be in effect. If both action alternatives are selected, the

Council could choose the same triggering mechanism as for Alternative 2 or a different one as long as a rationale is established for why the trigger should not be the same.

2.4 Further Discussion of Action Alternatives and Metrics

Upon its first review of these alternatives in June 2023, the Council posed a series of questions/topics for further discussion by the analysts (see bullets in June 2023 motion). The Council raised these questions to better understand the likelihood that the action alternatives would address the stated purpose and need directly, and to clearly lay out the state of knowledge about any causal relationship between groundfish fishery bycatch in certain areas and the status of the BBRKC stock. This subsection addresses several of those questions (*paraphrased below*), as informed by consultation with BBRKC stock assessment experts (ADF&G). While much of the following discussion focuses on the limitations of available assessment models in providing firm conclusions, this document does not represent a conclusion that groundfish fishing effort in the RKCSA is unrelated to BBRKC stock health. Rather, this discussion is a transparent assessment of the available information and its responsible application with respect to the mechanism (trigger annual area closure) defined in the current set of alternatives.

> *Summarize the biological consequences (stock-level impacts) of different levels of PSC in the RKCSA/RKCSS and NMFS Area 512 at current levels of BBRKC abundance.*

Relative to the RKC population in the Bristol Bay region (Area T), crab bycatch levels in the groundfish fisheries have been low such that it does not have a measurable impact on the modeled crab population trajectory (mature male biomass or the resulting OFL). The most recent analysis of this question was published by BBRKC stock assessment author J. Zheng and reviewed by the Council in February 2021 (see p.30, here). In terms of removals with respect to the BBRKC stock model, the directed crab fishery has a larger effect than bycatch in groundfish fisheries.

The marginal effect of groundfish bycatch could be important in times of low crab abundance. The BBRKC assessment model is not equipped to determine whether there is a measurable bycatch effect during particular times of low crab abundance, or to quantify any such effect. In theory, removals in the context of small crab population levels would be more detrimental if those removals directly affected mature females or disturbed larval supply or larval retention within Bristol Bay. Cooperative research that will improve the understanding of direct and indirect fishing effects on mature female BBRKC and recruitment in general is underway, including studies of RKC location in the winter and spring, and dynamics in the early RKC life-stages such as larval settlement (see Section 5.3.1).

Previous analyses of the effect of RKC bycatch on the BBRKC stock have not had the data or peer-reviewed approaches that would be necessary to account for unobserved fishing mortality. Thus, any effect of unobserved fishing mortality is not captured in the modeled population. Sources of unobserved mortality might include groundfish and crab effort that is unobserved (presently assumed to be the same as observed fishing), gear-crab interactions that occur on the sea floor, and habitat impacts. An example of a potential knowledge gap stemming from the assumption that observed bycatch represents unobserved bycatch is whether different aspects of the RKC population are more or less affected by unobserved mortality. If unobserved mortality disproportionately affects female crab or small crab that are not caught in the annual trawl survey, the stock assessment would not be able to account for any population-level effects of unobserved fishing mortality. The initial progress of the Council's Unobserved Fishing Mortality Working Group (UFMWG) is described in Section 5.3.1 of this document and was presented to the Crab Plan Team in January 2024.[17]

The BBRKC assessment model accounts for growth rates, frequency of molting, size at sexual maturity, and population size composition on an annual basis. Biological variables that cannot be accounted for in

[17] https://meetings.npfmc.org/CommentReview/DownloadFile?p=518db49a-3d5a-4265-a4e2-2bf4958c9217.pdf&fileName=UFMWG%20Report.pdf.

the assessment, given available data, include egg/clutch condition, reproductive potential at the individual animal level (e.g., whether larger males/females produce more larvae or mate more successfully), and recruitment relationships with ecosystem conditions. The peer-reviewed stock assessment reflects population dynamics but does not incorporate climate or ecosystem variables at this time. Relevant climate/ecosystem metrics are reported annually in the BBRKC Ecosystem and Socioeconomic Profile, or ESP (see Fedewa and Shotwell, 2023). It is difficult to assess the marginal impact of groundfish fisheries on the BBRKC stock without a complete understanding of the ecosystem-recruitment relationship. The ESP shows some significant correlations between ecosystem dynamics and stock trends. Most of the relationships to ecosystem indicators are likely to affect the larval and juvenile crab life stages. Crab in those life stages are not captured in the trawl survey. As a result, the relationship between environmental indicators and BBRKC population health – from which the direct effect of bycatch could be isolated – is a developing field of knowledge and presently relies on assumptions that do not support a direct answer to this Council question.

> *Evaluate the relative importance of the RKCSA/RKCSS and Area 512 with respect to the entire BBRKC stock.*

Determining the relative importance of a particular geographical area to a crab stock requires conclusions about which aspects of the stock (e.g., life-stages, sex) are limiting population recovery and growth. The BBRKC stock assessment and survey data do not presently support a simple conclusion to these complex questions. The Council's prompt also indirectly poses the question of whether the RKCSA's importance to the BBRKC stock remains the same as it was when the area was originally defined in the mid-1990s. To be responsive to the Council's question, the analysts describe the information that would be needed and the most similar information that is presently available. Section 5.3.1 of this document describes new and ongoing research that may bridge these knowledge gaps in the future.

One piece of available information is a comparison of how many RKC are found in the RKCSA versus other parts of the stock area. Fishery-dependent data would be biased towards males and animals that have recruited into the fishery. To compare across areas *and* different sex and maturities, the best source of information is the summer trawl survey. This information is naturally limited by the fact that the survey only tells the reader about where crab are in June and only records animals of a size that can be captured by the trawl survey net. Figure 5-5 in Section 5.3 reports survey data (1978 through 2023) across males/females and mature/immature, by area. The areas are defined as the RKCSA, RKCSS, NMFS Area 512, the part of the NBBTCA that is not part of Area 512 ("remainder"), and the rest of the Bristol Bay management area (Area T). The data show that the recent annual surveys are capturing crab in all four sex/maturity categories within the RKCSA/SS, but at a lower relative proportion to what the survey was capturing in that area in the late 1980s and 1990s.

In the judgement of the stock experts, quantifying the impact of implementing the RKCSA (relative to no RKCSA in place over the last ~30 years) is hindered by a large number of covariant factors. Here, the stock experts describe the type of information that would be needed to draw a conclusion along those lines. Unfortunately, certain pieces of this information are not available retrospectively. However, describing them here could inform future data collections and analysis that could give some caveated estimate of effects over a more recent span of years (all occurring in the period after the RKCSA was implemented). Necessary information spanning pre- and post- time of estimated effect would likely include:

- Understanding of gear footprint and gear interactions – similar to the Fishing Effects model – inside and outside of the RKCSA boundary;
- Crab spatial distribution and movement data throughout the year (as compared to only from the summer trawl survey and the directed crab fishery), and comparison of intra-annual movement patterns across years (not assuming that crab use the RKCSA the same across years or environmental regime shifts);

- Understanding of the causes of recruitment variability so that general environmental conditions can be disaggregated from the effect of the RKCSA on the entire population;
- Observer data on bycatch (AKFIN prefers to rely on bycatch data from 2003 through present; prior to 2003, groundfish fishery bycatch estimation methodologies are somewhat more diverged).

At the time of implementation, the effect of the RKCSA was not designed to be tested and the necessary data collections were not in place. Designing future tests would be a difficult but more approachable task if hypotheses for metrics that would be proxy for the impact of any future closures were defined. For example, analysis of the effect of any future closure might be based on differences in fishing mortality on females, reduced gear-seafloor interactions, or other metrics that are more measurable than the broad goals outlined in the purpose and need statement.

Given the knowledge and data limitations described above, the best available answer to this Council prompt is likely based on the stock experts' professional conclusions based on the information at hand. As communicated to the authors of this document, the relative importance of the considered closure areas cannot be quantified but may be evaluated relative to other factors that drive BBRKC stock health. The size of the considered areas relative to the entire stock area would suggest that the effect the RKCSA has on the stock is positive but not as great as the effects of recruitment variability (causes not fully understood), environmental adversity, and predation. As present, this conclusion relies on assumptions about the relative importance of various factors that influence crab stock outcomes at various stages in their life cycle.

It is likely the case that the most effective area closures are defined by specific goals – e.g., reducing interaction with females, males, or juveniles. Targeting such a closure, however, requires improved knowledge of where different elements of the BBRKC population are throughout the year and how stable or dynamic those distributions are across years in an evolving Bristol Bay environment. That type of approach, and the ability to evaluate its effectiveness after the fact, will be aided by the type of seasonal data newly being pursued with winter/spring crab distribution sampling projects.

> *Describe the likelihood that the BBRKC stock is above a 50,000 mt area-swept trigger over the next 10-15 years, given the most likely projected ecosystem conditions, and discuss the merits of an area-swept trigger (Option 2) compared to a crab-closure based trigger (Option 1).*

The area-swept estimate is considered by the stock assessment experts to be akin to a "minimum" of RKC in Bristol Bay. A key feature of the area-swept biomass trigger is that those numbers are direct data outcomes of the trawl survey and are thus not going to change retrospectively over time as a result of changes in the LBA assessment model and hindcast adjustments. Because the area-swept value is not dependent on model output, it is a metric that provides a consistent data source reflecting contemporary management conditions for each year.

The stock projections that are done in the assessment only generate some outputs of the modeling process, such as mature male biomass estimates. The model does not estimate future area-swept survey abundance or female crab abundance. As a result, the best available tool for gauging the near- to medium-term stock level does not generate some of the information that would count toward a 50,000 mt trigger. Because the sex-ratio of males to females is not constant across years, one could not take the model projections and scale them up to then predict a future area-swept biomass level (as it relates to the trigger). The model projections depend on variability in the assessment and assumptions about recruitment and directed/non-directed fishing pressure. Furthermore, the model projections do not currently consider ecosystem considerations or predictions about future ecosystem conditions.

Figure 2-2 shows the 15-year stock projection (mature male biomass) from the base model used in the BBRKC assessment (see Palof 2023). These projections assume that future recruitment would be similar to the recent low recruitment period of the last decade. The assessment model generally does not predict ecosystem changes; ecosystem changes are considered as part of a suite of factors that inform future recruitment assumptions in the model, but the ecosystem-stock projection relationship is not predicted. This figure is the best available information to reflect the direction of the stock at different assumed levels of fishing pressure, but it is not a direct answer to the Council's prompt. The values on the y-axis would not count females, which *are* part of the area-swept estimates. As noted above, it is not possible to translate from the MMB estimate to an area-swept estimate because of the inconsistent sex-ratio in the survey and the fact that the model is not predicting ecosystem conditions. The solid lines in the figure represent the average of 10,000 model simulations[18]; shaded areas represent a 95% confidence interval around the mean trajectory. The four colors represent different levels of fishing pressure. F=0 represents no directed fishing or RKC bycatch in groundfish fisheries. As noted above, bycatch removals are low relative to directed fishing pressure such that a "bycatch-only" model run would not be appreciably different from F=0. F=0.25 would be fishing near the OFL for the BBRKC stock, which is roughly indicative of the average of the last five years when there was a directed fishery. F=0.167 is shown because it is approximately the fishing level for the most recent previous season with a directed fishery (2020/21). F=0.083 represents approximately one-third of the OFL fishing level, which is approximately the demarcation where fishing pressure below that amount results in a projection of MMB remaining steady or increasing given the low recruitment levels observed in the last 10 years. As noted above, there is not a direct translation that can be made from these MMB projections and future years of area-swept biomass estimates for the entire BBRKC population from the trawl survey. The projections reflect the status of the stock as it was known in fall 2023 and the assumed growth and population parameters that are part of the peer-reviewed assessment model.

As new types of information become available in the future – like attribution of recruitment limitations to certain environmental metrics or future work on fishery interactions with small crab that are not catchable in the trawl survey (as being discussed by the UFMWG) – the trajectories shown in Figure 2-2 might look different. Even if that were the case, model projections of MMB will not map directly onto the area-swept abundance estimate.

[18] For a given fishing mortality level, each iteration of the model simulation uses a "randomly drawn" recruitment value to represent incoming crab.

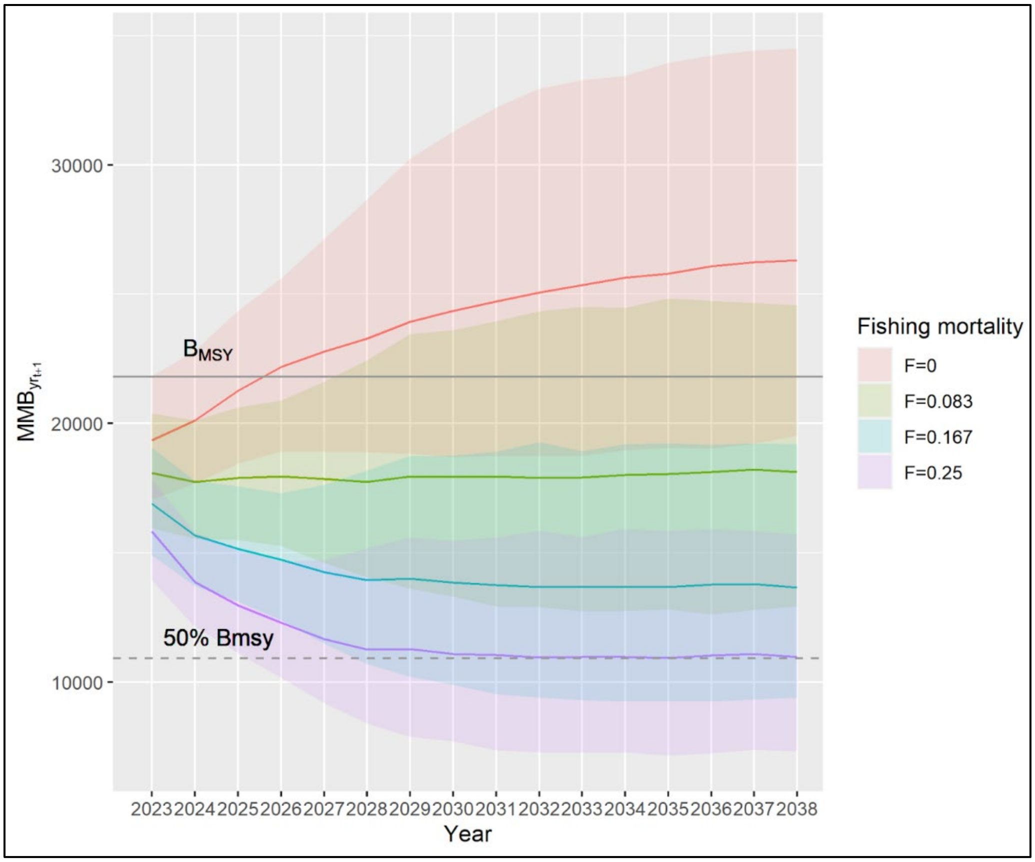


Figure 2-2 Mature male biomass (MMB) projections (15 years) for BBRKC under different levels of fishing pressure (K. Palof, ADF&G, Nov. 2023)

2.5 Comparison of Alternatives

The tables in this section summarize the alternatives and potential environmental or economic impacts at a high level (PTR = pelagic trawl gear; NPT = non-pelagic trawl gear; HAL = hook-and-line). The Council may select both or either of the action alternatives (Alternatives 2 & 3). For each action alternative, the Council must select a “trigger” option (Option 1 or 2). Under Alternative 2, the Council may select no suboption (all gears are prohibited from the RKCSA), both suboptions (only trawl gear is prohibited from the RKCSA), or either suboption (trawl gear plus [HAL or pot] gear is prohibited from the RKCSA).

Table 2-2 Summary of alternatives

Alternative 1	Alternative 2	Alternative 3
No action (status quo)	Close RKCSA to commercial groundfish fishing (all gears)	Close NMFS Area 512 to Pacific cod fishing with pot gear
RKCSA is open to groundfish fishing with PTR/POT/HAL gear. RKCSA is closed to NPT except in RKCSS portion, and only during years when the preceding BBRKC directed fishery was open. Area 512 is open to directed fishing for Pacific cod with pot gear.	RKCSA (and RKCSS) is closed to PTR/NPT/POT/HAL gear year-round if: **Option 1**: BBRKC fishery was closed in preceding year **Option 2**: Total area-swept biomass estimate <50,000mt Gears may be exempted from Alt. 2 action: **Suboption 1**: HAL gear **Suboption 2**: Pot gear	Pot gear is not authorized for directed Pacific cod fishing in Area 512 if: **Option 1**: BBRKC fishery was closed in preceding year **Option 2**: Total area-swept biomass estimate <50,000mt

Table 2-3 Summary of environmental impacts

	Alternative 1 (No Action)	Alternative 2	Alternative 3
Groundfish	Status quo. No impacts to stock status of Pollock, Pacific cod, yellowfin sole, or northern rock sole expected (Section 5.2.2).	No impacts to stock status of Pollock, Pacific cod, yellowfin sole, or northern rock sole expected (Section 5.2.2). Redistribution of pelagic trawl vessels may influence spatial effort for Pollock (Section 5.2.2.1). Redistribution of pot and HAL vessels may influence spatial effort for Pacific cod (Section 5.2.2.2). Redistribution of non-pelagic trawl vessels may influence spatial effort for yellowfin sole (Section 5.2.2.4) and northern rock sole (Section 5.2.2.3).	No impacts to stock status of Pollock, Pacific cod, yellowfin sole, or northern rock sole expected (Section 5.2.2). Redistribution of pot vessels may influence spatial effort for Pacific cod (Section 5.2.2.2).
BBRKC	Status quo	Redistribution of pot vessels away from the RKCSA/SS may decrease BBRKC PSC depending on where effort is relocated (Section 5.3.3). No possibility of HAL CP sector restarting effort in the RKCSA if target Pacific cod stock distribution reverts southward. Redistribution of pelagic (and non-pelagic) trawl gear may reduce unobserved mortality of juvenile and adult BBRKC within the RKCSA (RKCSS for non-pelagic) but the total effect is unknown due to uncertainty about areas of displaced effort; any resulting net decrease in effort may benefit the BBRKC stock. Action alternatives likely provide some benefits to BBRKC stock but magnitude is unquantified due to uncertainty about links between the stock status and factors like fishing mortality (eg. PSC), unobserved mortality, habitat effects, and groundfish predation (Section 5.3.3).	Redistribution of pot vessels away from Area 512 may decrease BBRKC PSC depending on where effort is relocated (Section 5.3.3).
Seabirds	Status quo	No changes in seabird impacts expected (Section 5.4.1).	No changes in seabird impacts expected (Section 5.4.1).
Habitat	Status quo	Spatial redistribution of groundfish gear may shift seafloor disturbance away from RKC EFH hotspots in the RKCSA (Section 5.5.4). Unknown whether any displaced trawl effort would occur in areas with benefits to BBRKC that are less well known. Trawl gear is restricted from shifting eastward (NBBTCA).	Spatial redistribution of pot gear may shift seafloor disturbance away from RKC EFH hotspots in Area 512 (Section 5.5.4).

Table 2-4 Summary of economic impacts

	Alternative 1	Alternative 2	Alternative 3
Groundfish Harvesters	Status quo. Low activity in the RKCSA relative to historical levels for all gear sectors other than pelagic (pollock) trawl. Increased CV effort in the Area 512 pot cod fishery due in part to tendering and additional processing capacity in the region during the two most recent years. Trawl harvest activity constrained by existing area management measures (pelagic and non-pelagic), a potentially binding RKC PSC limit in Zone 1 (non-pelagic), and PSC limits for other species (salmon, halibut, herring).	Most impactful to pelagic (pollock) trawl. Pollock trawl catch likely to shift west and/or south during the portion of the A season after vessels move north from the SCA. Likely loss in efficiency and potentially fish size and/or product quality on CPs. Reduced flexibility to avoid salmon and herring PSC. Non-pelagic trawl sector (mainly A80 CPs) lose a future opportunity for the flexibility afforded by occasional opportunities to fish in the RKCSS, but that area is currently closed under Alt. 1 due to lack of BBRKC fishery. Less flexibility in balancing competing bycatch constraints of RKC, halibut, and Pacific cod. Likely lower catch of roe-season flatfish in/near RKCSS. Less future flexibility for HAL CP sector, but low near-term impact relative to Alt. 1. Low impact on pot cod CPs/CVs relative to recent patterns, but potentially larger impact on CVs if paired with Alt. 3.	Likely loss in efficiency and relatively high likelihood of forgone catch if unwilling to revert effort to the RKCSA (or not allowed to under Alt. 2).
Groundfish shore-based processors and communities	Status quo.	Marginal impact on entities and linked communities associated with AFA pollock CVs that deliver shoreside, as that sector would be most likely to have to accept marginal losses in efficiency and productivity by relocating fishing during a certain point in the year (of the CV fisheries). Community stakeholders in the at-sea pollock sector (including CDQ) also likely to see less than optimal fishing returns at certain points in the year (A season).	Localized impact on processing entities and communities linked to vessel ownership and crew. Pacific cod pot CVs deliver through tenders to some ports other than Unalaska, Akutan, and King Cove that are likely more reliant on pot cod to remain open.
BBRKC fishery	Status quo.	Potential for indirect benefit if it is the case that pelagic trawling in the RKCSA is a significant, actionable factor in BBRKC stock status via direct unobserved mortality and/or habitat impact. That conclusion has not been reached by the science community or in this document.	Potential for indirect benefit if it is the case that fishing mortality from cod pots is a significant, actionable factor in BBRKC stock status. That conclusion has not been reached by the science community or in this document.

2.6 Alternatives Considered but not Analyzed Further

This document comprises a second initial review of the alternatives put forward by the Council in December 2022. The first initial review occurred in June 2023 (NPFMC 2023a). There are no alternatives that were considered in previous analyses that are not described in this EA/RIR. The breadth of informational topics and management approaches that the Council, its advisory bodies, and the public discussed during the development of this suite of alternatives can be found in the April 2022 (NPFMC 2022a) and October 2022 (NPFMC 2022b) discussion papers. As described in Section 1.2, the Council previously considered an emergency rule request that sought the closure of the RKCSA and RKCSS to all fishing gears from January 1 to June 30, 2023. The Council did not recommend implementation of emergency rulemaking at that time, and NMFS denied the petition. The analysis of that emergency rule petition is cited here by reference as NPFMC 2022c.

3 Description of Fisheries

3.1 Affected Groundfish Fisheries

This section describes the BS groundfish fisheries that are prosecuted at a meaningful scale in either the RKCSA or NMFS Area 512 and thus could be impacted by the action alternatives under consideration. Four "fisheries" are defined here, based primarily on gear type but also on directed fishery (principal target species): pelagic trawl (pollock), non-pelagic trawl (flatfish and Pacific cod), pot (Pacific cod), and HAL (Pacific cod). Throughout the BSAI as an FMP region, these gears – excepting pelagic trawl – are also used to target other species. For example, non-pelagic trawl gear is used for rockfish/POP and Atka mackerel, but that activity does not generally occur in the management areas of interest to this action. Pot and HAL gears are used to target IFQ species (sablefish and halibut) in the BSAI region but, again, not typically in the Bristol Bay area. Management of these four fishery groupings is complex in many respects and this overview description does not go into every detail of allocations and apportionments. Rather, this section covers area-based management measures relevant to the eastern BS and – where applicable – PSC and other non-target catch limitations that may affect where participants have the option to look for clean and productive fishing.

Figure 3-1 provides a generalized overview of when certain fisheries are open and when they tend to be prosecuted, compared to the period of the calendar year when BBRKC molting and mating occurs. The figure does not capture much of the nuance of timing and targeting within the non-pelagic trawl (A80) sector, which is a multi-species sector with subsets of participants who split off to different areas at points throughout the year depending on the species quotas that a vessel or company has access to within the A80 cooperative. Additional narrative description of that sector is provided in Section 3.1.2. The dates shown roughly in some months mark season openings or transitions for certain species. For example, trawl fisheries open on January 20 as opposed to January 1 for other gears. April 1 is identified because it delineates the A and B seasons for Pacific cod allocated to non-pelagic trawl fishing. May 1 is identified because it is the regulatory opening date for arrowtooth/Kamchatka flounder and Greenland turbot directed fishing by some A80 trawl vessels and non-trawl CPs. BSAI season dates are defined clearly in regulation at 679.23(e), though the regulatory dates do not always match when the a fishery is prosecuted. Participants will delay starting a fishery after the opening or try to complete the fishery early for a variety of reasons; some of those might include waiting for target species to aggregate, the development of roe content, fishing in times of perceived lesser non-target catch (e.g., salmon or halibut), or avoiding times when whale depredation is thought to be more intense. Vessels will also plan their BS participation around parts of their business plans that take them elsewhere – like to the AI, the GOA, the U.S. west coast, or to a port for scheduled shipyard time.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
BBRKC Mating/Molting	~ Males molting		~Females molting/mating									
Pelagic Trawl Pollock	20-Jan					10-Jun			B Season			
Non-Pelagic Trawl	20-Jan			1-Apr	1-May	10-Jun						31-Dec
Pot Cod and CP Pot ≥ 60ft	1-Jan					10-Jun			B Season			31-Dec
HAL & Pot Cod < 60ft												
HAL CP*	1-Jan					10-Jun			B Season			31-Dec

Legend: Light Blue = Open Fishery, Dark Blue = Open and Active Fishery; Figure is intended as a general guide to the reader
* HAL CVs have not fished since 2009

Figure 3-1 Generalization of selected BSAI commercial groundfish seasons (50 CFR 679.23)

In terms of an economic status report on the groundfish fisheries of the BS, this document incorporates the most recent available Groundfish Economic SAFE report (2022) by reference (Abelman et al. 2023). That report includes data through 2021. The forthcoming 2023 Groundfish Economic SAFE would be similarly lagged and provide data through 2022. This document does not serve as a replacement for the broad economic and market analysis of BS groundfish fisheries that would be contained in an Economic SAFE and is not meant to front-run what that analysis would be. Nevertheless, for contextual understanding of the contemporary state of Bering Sea groundfish fisheries' economic outlook, the analysts can offer general statements supported by the regional seafood marketing body. The Alaska Seafood Marketing Institute (ASMI) – a public-private partnership between the State of Alaska and the Alaska seafood industry – published a public letter in October 2023 describing market challenges across a broad array of Alaska fisheries, including but not limited to groundfish.[19] ASMI states that Alaska seafood is "subject to numerous geopolitical, trade inequity, and economic factors" that are not directly controlled by the participants (harvesters, processors, and distributors) within the state. The letter cites supply and demand imbalances domestically and abroad, large harvests by overseas product competitors with low relative currency valuations (e.g., Russia), and trade conflict with a major U.S. export receiver (China) resulting in a substantial drop in export volume to a traditionally key market. While facing drops in revenue, Alaska processors, exporters, and fishermen are facing higher operating costs due to domestic inflation for labor/materials/shipping/storage, high interest rates, high fuel prices, and labor supply shortfalls. Shipping volume and costs to some traditional Transpacific trading partners remain affected by logistical challenges that stem from the COVID-19 pandemic. U.S. products that are reprocessed internationally before entering the global market as finished goods are being forced to compete directly with seafood products that originate from countries that sell primary seafood products at lower prices and denominated in a weaker currency than the US dollar. High interest rates have affected processors' ability to finance operations and continue needed investment to support vessel fleets and crews. Simultaneously, hold-over product inventories resulting from the supply-demand imbalance has devalued the asset that these Alaska fishery participants are producing. While primary producers are generally receiving lower prices while facing higher costs, retail product prices on the global market remain steady or high which has further affected demand by consumers in inflationary economies – including but not limited to the U.S. – who may be reducing spending in certain categories.

ASMI's letter refers to this constellation of factors as "an economic squeeze not seen for decades or longer". Alaska's fishing industry business news in 2023 bears this out. The Council will be aware of publicly stated delays in planned capital investment, temporary cessation of certain shoreside processing operations, assets for sale, publicly signaled interest in private financial partnerships, and exploration of company mergers and/or acquisitions. In short – absent a contemporary peer reviewed BSAI groundfish economic status report from AFSC – the analysts can conclude that the BS groundfish market faces systematic headwinds that leave it presently more vulnerable than usual to marginal changes in operational costs, product quality/value, and net revenue.

3.1.1 Pelagic Trawl (American Fisheries Act pollock)

Before 1999, the Bering Sea directed pollock fishery had been a managed open access fishery. In 1998, Congress enacted the American Fisheries Act (AFA) to rationalize the fishery by limiting participation and allocating percentages of the Bering Sea directed pollock fishery TAC among sectors of the fishery – inshore (CV), offshore (CP), and mothership. After deducting an incidental catch allowance (ICA)[20] and 10 percent of the TAC for the Community Development Quota (CDQ) program, the AFA allocates 50 percent of the remaining TAC to the inshore catcher vessel sector; 40 percent to the catcher processor sector; and 10 percent to the mothership sector. That allocated non-CDQ TAC is the directed fishing allowance for eligible AFA participants.

The AFA allowed for the development of pollock industry cooperatives. Ten such cooperatives were developed as a result of the AFA: seven inshore co-ops (currently six), two offshore co-ops, and one

[19] Accessible at https://www.alaskaseafood.org/news/extraordinary-circumstances/ (Jan. 2024); also published in *National Fisherman Magazine*, Oct. 2023.
[20] The NMFS Regional Administrator annually determines the ICA amount to cover pollock catch in other fisheries. In recent years, the ICA has been roughly 4% of the non-CDQ TAC.

mothership co-op. Eighty-five CVs are eligible to be in the inshore co-ops. Twenty CPs and five CVs are eligible for the offshore co-ops. The CPs in the offshore sector have one cooperative and the offshore-eligible CVs have their own cooperative. Three motherships are eligible to operate in the AFA fishery and 19 CVs are eligible to fish the mothership sector allocation.

In rationalizing the Bering Sea pollock fishery, the AFA gave the industry the ability to respond more deliberately and efficiently to market demands than the "race for fish" previously allowed. The AFA also gave the fishery the means to compensate for Steller sea lion conservation measures that, beginning in 1992, created fishery exclusion zones around sea lion rookeries and haulout sites and implemented gradual reductions in seasonal proportions of the TAC taken in Steller sea lion critical habitat.

As of January 1, 2000, all vessels and processors wishing to participate in the non-CDQ Bering Sea pollock fishery are required to have valid AFA permits on board the vessel or at the processing plant. AFA permits also limit the take of non-pollock groundfish, crab, and prohibited species, as governed by AFA "sideboard" provisions.

The annual BS pollock fishery is divided into two seasons: the A season opens on January 20 and typically ends in April; the B season opens on June 10 and typically runs through the end of October. The A season fishery has historically focused on roe-bearing females, and is concentrated north and west of Unimak Island and along the 100-meter contour between Unimak and the Pribilof Islands. "A" season pollock also provides other primary products such as surimi and fillet blocks but yields on those products are lower than in the B season when pollock carry a lower roe content and are thus primarily processed for surimi and fillet blocks. The B season fishery generally occurs farther west, farther from Bristol Bay.[21]

The times and areas in which vessels using pelagic trawl gear can fish for pollock in the BS – and thus areas in and around the RKCSA – are partially dictated by a series of Council/NMFS actions that have accumulated over years. The present state of management boundaries affecting opportunities to fish is depicted graphically in Figure 1-2 (Section 1.3). Those actions, individually, protect certain species, habitats, or access to fishing grounds for other sectors. Cumulatively they create a starting point from which the pollock fishery navigates the fishing year and addresses real-time factors that may be variable from year to year, such as where CPUE or roe content is good, where salmon or herring bycatch rates are lowest, and when/where other gear types may be on the grounds. Some of those factors are driven environmentally; for instance, the extent of the BS "cold pool" or the presence of sea ice may influence the distribution of pollock and also the location of other gear groups at a given time.

Here, below, the analysts list some of these measures that were depicted in Figure 1-2 but not described in detail. Others were detailed previously in Sections 1.3 and 2.1 of this document (e.g., Trawl Bycatch Limitation Zones and the seasonal trawl closure of Area 516 in Section 2.1). Another useful summary was provided in Section 4.3.4 of the December 2022 emergency rule analysis (NPFMC 2022c).

The NBBTCA (described in Section 2.1) prevents all trawling in areas including NMFS Areas 508, 512, and parts of 514. (There is a seasonal exception that applies only to non-pelagic trawl gear around Togiak, as described in Section 1.3.) The all-trawl exclusion extends westward to Area 516 from March 15 to June 15 (see Section 2.1).

The Catcher Vessel Operational Area (CVOA) is defined in Figure 2 to 50 CFR 679 as well as BSAI Groundfish FMP Section 3.5.2.1.5 and §679.22(a)(5). The CVOA affects when and where certain types of trawl activity can occur. Unless directed fishing for CDQ pollock, CPs may not fish in the CVOA during the pollock B Season (June 10 through November 1). The CVOA overlaps Bycatch Limitation Zone 1 by

[21] The seasonal location and westward shifting of the pelagic trawl (pollock) fishery, as it relates to the Bristol Bay region, is illustrated in an animation of estimated pelagic trawl bottom contact (by month) shown in Appendix 2 to the April 2022 BBRKC discussion paper (NPFMC 2022a) and an attachment to the Council's April 2022 agenda (link). Note that these materials do not provide a full view of the geographical extent of the fishery – just the part that overlaps the BBRKC areas of interest to this action.

two degrees of longitude (between 165 W and 163 W) and south of 56 N latitude. Given that only non-CDQ CP vessels are restricted, this time/area closure does not completely preclude interactions between pelagic trawl gear and RKC.

Within the CVOA lies the Chum Salmon Savings Area (CSSA), defined at §679.22(a)(10) and in BSAI Groundfish Section 3.5.2.1.2 (Figure 9 to 50 CFR 679). The CSSA was established by emergency rule in 1994, having been identified as an area with high rates of chum salmon bycatch in the early 1990s. Prior to 2007, the area was closed to all trawling during the month of August when chum salmon bycatch was typically highest. In 2007, Amendment 84 specified that the CSSA would apply only to vessels directed fishing for pollock with trawl gear. If a limit of 42,000 non-Chinook salmon was reached at any point from August 15 through October 14, the area would remain closed through October 14 (any non-Chinook salmon encountered within the CVOA accrued to the 42,000 non-Chinook salmon limit). Under present regulations, the CSSA does not apply to vessels fishing for pollock that are operating under an incentive plan agreement (IPA). In practical terms, the CSSA remains in regulation as a back-stop measure should vessels or CDQ groups that fish for pollock not be governed by an IPA and thus not participate in the rolling hotspot system for chum salmon avoidance. The Chum Salmon Savings Area has not been closed since 2004 and all vessels and CDQ groups have participated in an IPA since 2011. Chum salmon bycatch management was incorporated into the IPAs by Amendment 110.

The Bering Sea Pollock Restriction Area closes waters close to the AI chain to directed Federal pollock fishing during the A Season (679.22(a)(7)(ii)). This season-area closure is part of the suite of Steller sea lion protection areas defined at 679.22(a)(7). This A Season closure runs as far east as the boundary between NMFS Areas 509 and 516 (see Figure 1-2).

The Steller sea lion conservation area (SCA) closes a subarea of the BS to directed fishing for pollock between 170°00' W. longitude and 163°00' W. longitude, as depicted in Figure 1-2 (679.22(a)(7)(vii)). The SCA spans part of four different reporting areas: the southern portion of 509 (just below the RKCSA), the southern portion of 517, most of 518, and all of 519. Part of the SCA is within the BBRKC stock area (Area T). The SCA was established to ensure localized depletion of Steller sea lion prey (i.e., pollock) did not occur in this area during the winter months. No more than 28% of each BS pollock sector's annual directed fishing allowance may be taken from the SCA before April 1 (§679.20(a)(5)(i)(C)). If the NMFS Regional Administrator determines that the allowance within the SCA will be reached for AFA CPs, CDQ, or AFA motherships before April 1, then that sector will close in the SCA until April 1. For the AFA inshore sector, NMFS will close vessels greater than 99 ft LOA in the SCA before April 1 to accommodate fishing in the SCA by CVs less than or equal to 99 ft LOA. If the SCA allowance is reached before April 1 then the SCA will close until April 1 to all vessels in the AFA inshore sector.

Herring Savings Areas (HSA) were established under BSAI Groundfish Amendment 16 as management measures to reduce Pacific herring bycatch in the groundfish trawl fisheries in the Bering Sea EEZ (56 FR 15063; April 15, 1991). These measures include a PSC limit framework and a series of timed area closures triggered by the attainment of the herring PSC limit of one percent of the herring spawning biomass. Section 3.6.2.2.3 of the BSAI Groundfish FMP states the areas where a closure would be in effect depending on the time of year. Relevant to the areas involved in this action, the Summer HSAs would be most likely to affect pollock fishing location choices (i.e., the eastern extent of where the pollock fleet might fish in the B season). The three areas and their timed closures are shown in Figure 1-2 and Figure 3-2 (below, with dates). The herring PSC limit is published in the annual harvest specifications. The herring PSC limits are not further apportioned between the Amendment 80, BSAI trawl limited access sector (TLAS), and CDQ programs. The limit also does not have seasonal apportionments. However, they are apportioned during the harvest specifications process to the trawl directed fishing categories (§679.21(e)(3)(iv)(B-F)). For example, when the midwater pollock fishery category reaches its specified PSC limit the Herring Savings Areas are closed to directed fishing for pollock with (pelagic) trawl gear.[22]

Herring Savings Areas have had PSC closures for the pollock trawl fishery in two years dating back to 2010. In 2012 the Winter HSA closed on October 1 until March 1. In 2020, Summer HSA1 was closed from June 15 through July 1. Also in 2020, the Winter HSA was closed from September 1 through March 1 of the following year.

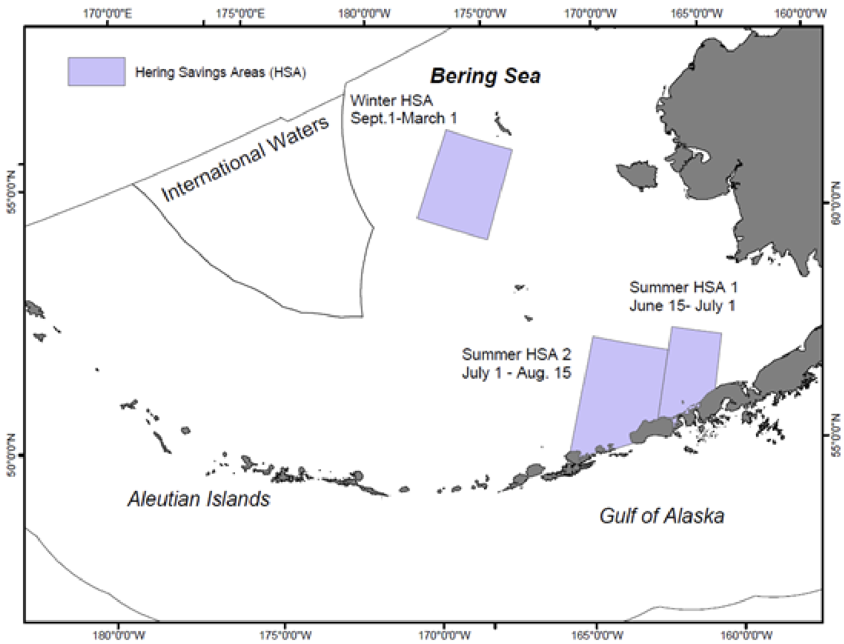


Figure 3-2 Herring Savings Areas

The Pribilof Islands Habitat Conservation Zone (PIHCZ) is an area closed to all trawling and fishing with pot gear throughout the year (see Figure 1-2). The PIHCZ is described in Section 3.5.2.1.1 of the BSAI Groundfish FMP, at 679.22(a)(6), and in Figure 10 to 50 CFR 679. This closure area affects the fishing location choices available to the pelagic trawl fleet later in the year as effort typically shifts west and north along the BS slope.

Bycatch Limitation Zone 1 (Zone 1) for RKC was first established by Amendment 10 in 1987 for yellowfin sole and other flatfish fisheries. Zone 1 was extended in Amendment 12 in 1989 to include all trawl fisheries. Zone 1 encompasses four BS areas: 508, 509, 512, and 516. All of these areas are within the BBRKC stock area. BSAI Amendment 37 was adopted in 1997. It established an RKC PSC limit based on stair-step abundance-based thresholds that use modeled survey estimates of mature female BBRKC abundance and effective spawning biomass from the BBRKC stock assessment (e.g., Palof 2023). Those thresholds were modified in 2000 by BSAI Amendment 57 and are the thresholds currently in regulation. A closure of directed fishing in Zone 1 is triggered for a groundfish trawl sector if its PSC limit is reached based on RKC taken in that area. The Zone 1 PSC limit for RKC is set in harvest specifications based on criteria established in regulation at 679.21(e)(1)(i) and is described in Section 3.6.2.1.1 of the BSAI Groundfish FMP (Zone 1 depicted in Figure 3-18 of the FMP). Section 2.1 of this document describes the stair-step PSC limit control rule, which is currently at its lowest level – a total Zone 1 RKC PSC limits of 32,000 crab.

[22] The "midwater pollock fishery" is defined at 50 CFR 679.21(b)(1)(ii)(B)(*1*) as "Fishing with trawl gear during any weekly reporting period that results in a catch of pollock that is 95 percent or more of the total amount of groundfish caught during the week."

Table 2-1 showed that the Zone 1 RKC PSC limit that applies to "pollock/Atka/other" category declined from 197 crab annually in 2021 to 65 crab in 2022 and 2023, and has returned to 197 crab in 2024. While that is a notably small allowable number of RKC PSC given the total catch volume of the pollock fishery, Table 3-4 shows that the estimated PSC level for pelagic trawl gear peaked at 39 in 2017 (2010-2022) and has been estimated at fewer than 20 RKC annually since then. From a management perspective, it is important to note that when the "TLAS pollock/Atka/other" RKC PSC limit for Zone 1 is reached, regulations close fishing for *non-pelagic gear* in that harvest specifications species category. If, for example, the TLAS sector reached its RKC PSC limit for the Pacific cod directed fishery (2,954 crab in 2021; 975 crab in 2022 and 2023) then Zone 1 would be closed to non-pelagic trawling in the directed fishery for Pacific cod. If the pollock/Atka/other category were to exceed 65 RKC, the directed fishery would be prevented from using non-pelagic trawl gear. The pollock fishery is already not permitted to use non-pelagic trawl gear *and thus it is effectively not subject to such a gear-specific closure* under the RKC PSC limit. This specific handling of the pollock/Atka/other category went into effect under BSAI Amendment 57.

The pelagic trawl gear sector is also regulated by a gear performance standard for how many crab may be onboard a pollock vessel at any particular time (679.7(a)(14)). As requested by the Council, this regulatory constraint, its purpose, and its efficacy are discussed in greater detail in Section 8 of this document.

The reader may find it useful to think of the typical pollock trawl season as a narrative when considering how the pelagic trawl fleet navigates these regulatory restrictions and also accounts for where desirable pollock are found in that year and where prohibited species are being encountered, in real-time. CPs and CVs have different constraints. In the most general of terms, CVs are tethered closer to the ports where they deliver. CPs are not constrained in that way but may have other considerations like seeking fish size that meet the needs of the at-sea product mixes that they intend to produce. In a typical year, the A season begins closer to Unalaska for the operational efficiency and because that part of the SCA tends to have good pollock fishing and is limited in the amount that can be taken prior to April 1. The pollock fleet typically fishes the RKCSA area after non-pelagic trawl vessels would have been in the RKCSS for the flatfish roe season. It was noted in testimony to the Council (December 2022) that pollock vessels do not typically focus on the area directly west of the RKCSA because of the relatively shallow depth that has less optimal pollock. Rather, vessels often move from the Unalaska/SCA area through the RKCSA and then jump west toward the Pribilof Canyon area. AFA CPs have avoided an area east of the Pribilof Islands in some recent years due to higher herring bycatch rates. By contrast, in recent years, fishing in the RKCSA has yielded good pollock CPUE, and herring and salmon PSC rates that are lower than in the SCA. Pollock vessels may sometimes deemphasize the eastern half of the RKCSA (Area 516) as it often results in higher rates of flatfish incidental catch that is not desired. Pollock vessels that are not able to fish in the RKCSA during the period after which the SCA is closed to larger vessels might also be constrained by Steller sea lion rookeries. Proximity to SSL rookeries is reported to result in lower pollock flesh quality (parasites). Pollock vessels must also navigate area choices in the context of sea ice extent for that year. In years when the sea ice and/or cold pool is farther south, there may be less incentive to fish as far north as the RKCSA.

The B season entails the additional constraint of the CVOA for CP vessels that are not fishing CDQ pollock. Pollock CPs may be hesitant to fish in the CVOA during the B season if encountering catch composition that takes them out of the "midwater pollock" target would require their CDQ harvest partner to cover catch with other quotas. More typically, pollock CPs fish farther west during the B season – around Zemchug Canyon or south and west of the Pribilof Islands (outside of the PIHCZ). Given that general direction of effort, it is unlikely that pollock CPs would want to fish in the area of the RKCSA during the B season because it is far out of the way of preferred fishing grounds for that time of year. This is evident in Table 3-2, which shows low pelagic trawl catch in the RKCSA after May.

The fishing location choices available to the pollock trawl fishery at any given time are also partly dictated by the rolling hotspot (RHS) monitoring program. Briefly, the RHS system was developed as part of incentive plan agreements (IPA) under which participating pollock cooperative members utilize real-time spatial catch/bycatch third-party data management and internal accountability measures to minimize bycatch with dynamic tools while remaining under various forms of an overall PSC cap on Chinook salmon. While RHS frees the pollock fleet from static spatial boundaries in some cases, they entail a set of fishing constraints that may be unpredictable in how they align with the timing and location of quality pollock and other static management boundaries that are not superseded by pollock inter-cooperative agreements (e.g., RKCSA, SCA). The April 2022 BBRKC discussion paper's description of "incentive approaches" in other fisheries included an example of rolling hotspot monitoring and time-area closures imposed within the pollock CV cooperatives based on real-time bycatch rates that was made publicly available through testimony to the Alaska House of Representatives Fisheries Committee in 2017 (NPFMC 2022a, Figure 5-1, p.34). The pollock CV sector intercooperative manager (United Catcher Boats) provided the analysts with more recent examples of RHS closures (red) and advisory areas (yellow) that have been implemented from 2018 through 2023, by pollock A and B Seasons (Figure 3-3 and Figure 3-4). These figures overlay RHS closure areas for a series of years; annual figures would show a smaller number of closures, but clearly clustered around certain areas as shown by the overlaps. The intercooperative managers report RHS closures to the Council annually as part of IPA reports.[23] Figure 3-3 includes the SCA boundary because, as noted above, pollock sectors are limited in how much of their directed fishing allowance can be caught in that area prior to April 1 (no more than 28%). Pollock operators consider their inside-SCA versus outside-SCA fishing decisions with respect to that seasonal limit in addition to RHS closures to minimize salmon bycatch.

[23] The 2023 closures (shown) will be reported to the Council as part of the Inshore IPA Report at the April 2024 Council meeting.

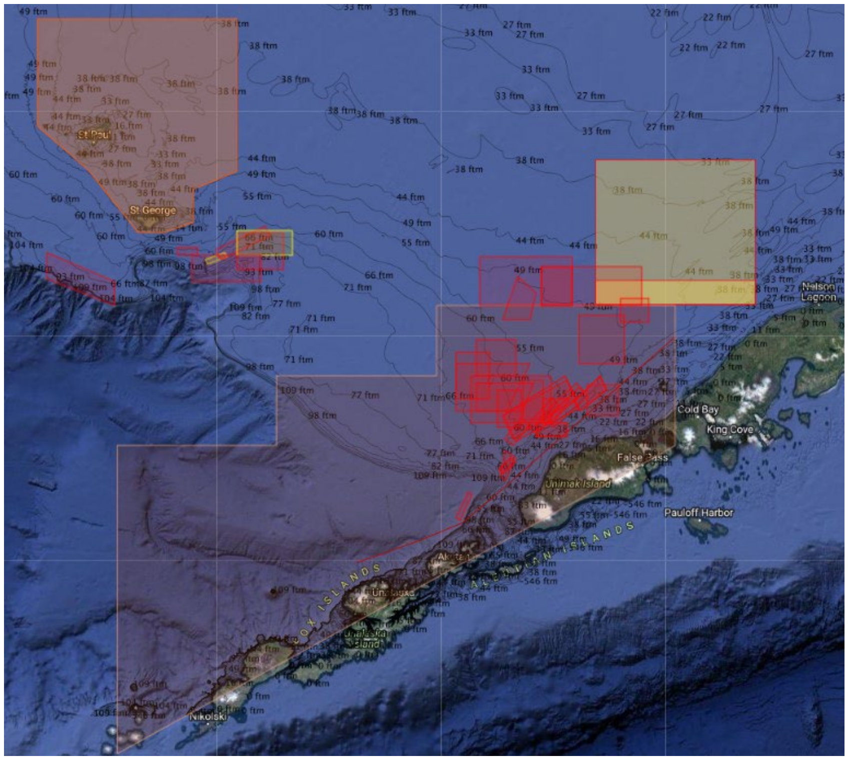


Figure 3-3 A Season Pollock trawl CV rolling hot spot closures (red) and advisories (yellow), 2018-2023. Grey shaded area shows the Steller sea lion conservation area. Red line along the AI chain shows the BS pollock restriction area. RKCSA/SS shaded in yellow. (Source: S. Zagorski, UCB; Nov. 2023, pers. comm.)

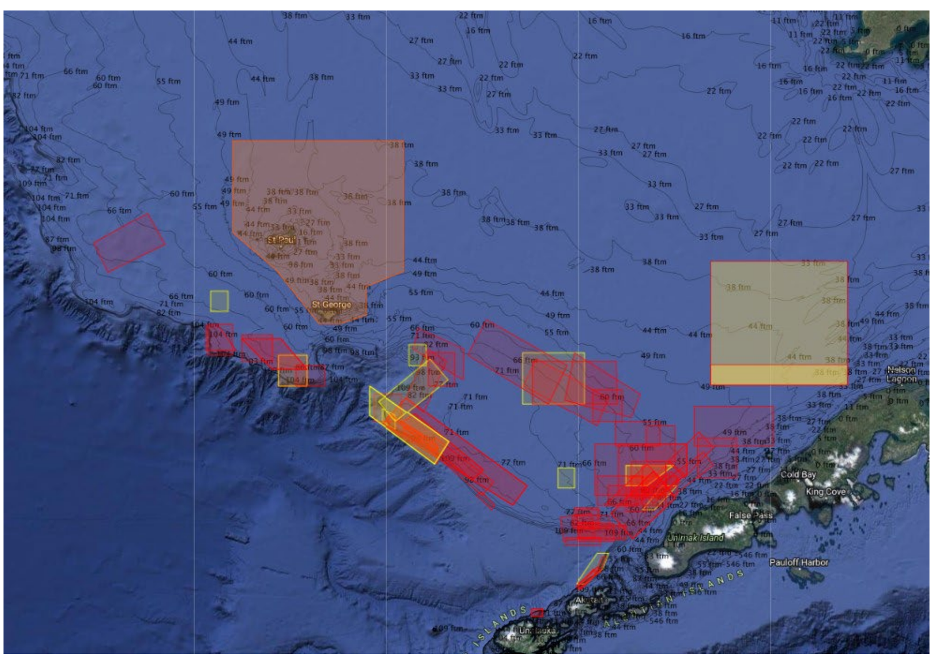


Figure 3-4 B Season Pollock trawl CV rolling hot spot closures (red) and advisories (yellow), 2018-2023. RKCSA/SS shaded in yellow. (Source: S. Zagorski, UCB; Nov. 2023, pers. comm.)

3.1.2 Non-Pelagic Trawl

The non-pelagic trawl gear group that could be affected under Alternative 2 includes the "Amendment 80" sector (CPs) and non-pollock "trawl limited access sector" (TLAS) CVs.[24] Under existing regulations, these vessels are only permitted to fish in the RKCSS portion of the RKCSA, and only in years when the directed BBRKC fishery was open in the preceding season.

Amendment 80 Sector

Amendment 80 to the BSAI Groundfish FMP, implemented in 2008, facilitated the formation of fishery cooperatives for trawl CPs that are not eligible under the AFA to participate in directed pollock fisheries. A80 originally allocated five BSAI non-pollock trawl groundfish species to permit holders that formed a cooperative within the non-AFA trawl CP sector. The A80 sector is allocated a portion of the TAC for Pacific ocean perch (POP) in the AI, Atka mackerel, yellowfin sole, rock sole, and flathead sole in the BSAI, as well as an allowance of PSC quota for halibut and crab. Allocations were derived from the catch history of 28 original qualifying CPs from 1998 through 2004. Later, BSAI Amendment 85 allocated 13.4% of BSAI Pacific cod to the A80 sector. Other eligible permit holders initially participated in a limited access fishery for the balance of the catch allocated to the sector (allocation derived from the catch history of entities that did not participate in the initial cooperative. Currently, since 2017, all A80 harvest occurs within a single cooperative; no A80 quota is allocated to the limited access fishery.

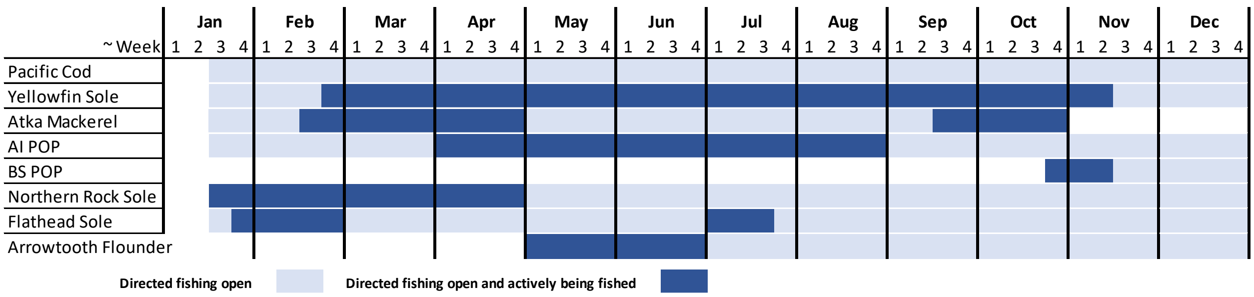
Figure 3-5 shows a generalization of the typical BSAI non-pollock groundfish seasons for the species allocated to the A80 sector and several that are important unallocated catch (e.g., arrowtooth flounder and BS Pacific ocean perch). The A80 trawl fisheries generally open on January 20 and close on December 31.[25] For the A80 sector Pacific cod is – broadly speaking – an allocated, constraining non-target species that is encountered in multiple aspects of the sector's operations. A80 vessels might have trips that are recorded as directed fishing for Pacific cod in certain circumstances. However, in many cases, they are caught as an expected and commercially valuable incidental species along with other targeted groundfish. This is in contrast to other BSAI groundfish sectors like the hook-and-line CP (HAL CP) sector and the trawl CV limited access sector (TLAS), both of which target Pacific cod primarily.

The other non-pollock groundfish species highlighted in Figure 3-5 are mainly targeted by A80 vessels (except yellowfin sole, which is also targeted by the TLAS). The figure reflects the A80 sector's revealed preference for catching particular species at different points during the calendar year. For example, some flatfish species are more desirable or more valuable when roe is present – e.g., northern rock sole. In some cases, the sector might focus on a particular flatfish species when fish aggregation and CPUE are expected to be higher. Lower value species such as arrowtooth flounder might show up as "actively fished" during gap periods between more valuable species as vessels seek to keep their platforms productive while also retaining valuable secondary species within regulatory limitations. Finally, the reader should note that the non-pollock/non-cod species include both flatfish (soles) and roundfish (e.g., Atka mackerel and POP). These flatfish and roundfish are both allocated to A80 companies on the basis of qualifying historical catch associated with individual permits and, while intra-sector transfers are possible, companies' portfolios are not necessarily balanced between the two types of species in a uniform manner. The figure should not imply that any A80 company would have an unrestricted choice to make between yellowfin sole, rock sole, flathead sole, Atka mackerel, AI POP or Pacific cod at a given point during the year. A80 companies vary in the A80 permits that they control, the number of CPs they own, whether or not they own the CVs with which they partner in the TLAS fisheries (vertical

[24] For a more extensive background on the A80 sector, the reader is directed to Section 3.3 of NPFMC 2022e (Final EIS for BSAI Amendment 123 – Abundance-Based Management for the Halibut PSC Limit. That document also includes a detailed description of how, in recent years, A80 participants have managed their suite of allocated and unallocated fishery access opportunities under various constraints of target and bycatch allocations as well as management and environmental change or uncertainty (see Section 3.3.3 in NPFMC 2022e).

[25] Directed fishing for the complex of arrowtooth flounder, Kamchatka flounder, and Greenland turbot – which are not allocated A80 species – does not open until May 1.

integration), and – importantly – the portfolio of groundfish species and PSC limits available to them each year. The reader may refer to Figures 3-14 and 3-15 in NFPMC 2022e for visual depictions of how the flatfish/roundfish quota breakdown was distributed across 22 active A80 permits and 5 A80 companies in 2020.[26] Roughly speaking, 15 of 22 active A80 permits had quota allocations that are more than 50% flatfish (yellowfin sole, rock sole, flathead sole). For the other seven, Atka mackerel, AI POP and Pacific cod accounted for more than 50%. On a company level, two of five companies could be generally described as majority-flatfish-dependent in terms of revenue, two that were more dependent on the combination of roundfish and Pacific cod, and one that was more evenly balanced (citing 2010-2019 data). This overview does not include vessels' or companies' activity in the GOA as part of their overall revenue picture. The reader is again referred to Section 3.3. of NPFMC 2022e for greater detail.



Derived from: https://www.fisheries.noaa.gov/alaska/resources-fishing/federal-fishery-seasons-alaska (Last accessed Dec. 2023; last updated 4/2/2019)

Figure 3-5 Typical seasons for selected A80 target fisheries

The area that is potentially affected under Alternative 2 (RKCSS) is utilized mainly for flatfish fishing (e.g., yellowfin sole, rock sole), so companies that are more reliant on those species and have fewer opportunities to fish roundfish or quotas designated in the AI might be relatively more at risk of forgone opportunities if catch that used to occur in the RKCSS cannot be made up elsewhere in the BS. BS flatfish reliant A80 companies would presumably work to replace the fishing that historically occurred in the RKCSS in other parts of the BS (Zone 1 or otherwise) without encountering amounts of constraining species like Pacific cod or crab/halibut PSC that would foreclose the opportunity to fish flatfish (i.e., yellowfin sole) in the eastern BS later in the year.

Participants in the A80 sector are linked to other groundfish fisheries to varying degrees. Since 2010, the A80 fleet has consisted of 17 to 20 active CP vessels. A subset of A80 companies or vessels also have direct linkages to CDQ groups through harvest partnerships or to the TLAS sector through CV vessel ownership or at-sea processing relationships for CV catch. Four to eight A80 CPs have participated in the CDQ fishery in a given year since 2010. Since 2010, nine A80 CPs acted as motherships taking at-sea deliveries from TLAS CVs. In recent years, Council/NMFS action has limited the number of CPs that can receive deliveries of TLAS Pacific cod (BSAI Amendment 120, 84 FR 70064, December 2019), and the set of CVs that can deliver TLAS yellowfin sole to CPs that are acting as motherships (BSAI Amendment 116, 83 FR 49994, October 2018). Only one A80 CP is allowed to receive TLAS Pacific cod deliveries (as is one AFA CP). Eight CVs are able to deliver TLAS yellowfin sole to CPs acting as motherships. The majority of those eight CVs are owned by A80 companies that also own the CP mothership to which they would likely deliver. Together, these changes governing at-sea processing of CV catch limit revenue diversification opportunities for the A80 sector.

As noted above, A80 cooperatives receive an exclusive allowance of crab PSC that may not be exceeded while harvesting groundfish in the BSAI. Those PSC cooperative quotas are assigned to the cooperative in an amount proportionate to the groundfish quota shares held by its members – which currently includes

[26] Current year quota share holdings by owner/species is publicly available through the NMFS website under Permits and Licenses Issued >> Amendment 80 Program >> Quota Share Holders (2023) (https://www.fisheries.noaa.gov/alaska/commercial-fishing/permits-and-licenses-issued-alaska).

all eligible A80 licenses. The cooperative structure allows A80 vessel operators to better manage PSC rates than operators who must race to harvest groundfish as quickly as possible before PSC causes a fishery closure. Cooperative members manage crab PSC rates primarily by choosing when and where to fish, which is part of a complex balancing of trade-offs between the likelihood of catching other PSC species (e.g., halibut), preserving quotas of allocated A80 species for later in the year (e.g., yellowfin sole or Pacific cod), and ensuring that areas that they rely on later in the year are not closed to them (e.g., crab bycatch limitation Zone 1). By using real-time information shared within the cooperative or gear modification best practices, A80 vessel operators may be able to harvest more of their target groundfish species and improve revenues that would otherwise be forgone if areas limited by PSC are closed.

As described in Sections 2.1 and 3.1.1, non-pelagic trawl gear is subject to an RKC PSC area closure in Zone 1 under the limits shown in Table 2-1. The A80 sector PSC limit for RKC in Zone 1 had been at 43,293 crab from 2012 through 2021, but was decreased to 14,282 crab in 2022 and 2023. This PSC limit is not apportioned seasonally. Had the A80 RKC PSC limit for Zone 1 been at the current level since 2010, the sector would have experienced a Zone 1 closure in all years except for 2018 and 2022 (Table 3-4). A80 RKC PSC was 9,700 in 2018 and 1,903 in 2022.

Trawl Limited Access Sector

Groundfish catch by CVs using non-pelagic trawl gear falls within the TLAS fishery. TLAS fishing within the RKCSA was infrequent and relatively small scale throughout the analyzed period. From 2013 through 2019, five CVs used non-pelagic trawl gear in the RKCSS, and none have been active in the area since then. The vessels that did fish in the RKCSS since 2013 totaled 167 mt, 164 mt of which was in the yellowfin sole target fishery. TLAS CV activity in the RKCSS was essentially two vessels in 2013 (catch total confidential), one vessel in 2015 confidential, and what would appear to be two isolated test tows in 2016 and 2019. The catch data from this activity is folded into the non-pelagic trawl gear group data presented in the tables in the following section.

The TLAS fishery is made up of AFA CPs that catch and process limited access groundfish and CVs that deliver to both shoreside and at-sea (mothership) processors. The primary species for this sector (not including BS pollock) are Pacific cod and yellowfin sole. RKC PSC limits are apportioned annually to the TLAS sector with no seasonal limits. These are primarily TAC-driven, competitive fisheries where lower PSC limits have a fairly direct link to shortened fisheries. If productive fishing areas are closed at important times of aggregation or periods when these multi-fishery platforms are not required by their business plans to be elsewhere, forgone revenues might not be recoverable in the form of a harvest allocation that can be returned to – acknowledging the operational cost and crew disruptions of fishing longer, at different times, or in different locations than had been optimally planned.

The non-pollock groundfish caught by AFA CPs accrue to allocations for TLAS. TLAS CVs break down generally into AFA and non-AFA subcategories, as defined by whether they are members of cooperatives with secure BS pollock allocations. TLAS CVs vary in their access to fisheries outside of the BSAI. Some CVs trawl in the GOA, others spend part of the year off the U.S. west coast (i.e. whiting fisheries), and others mainly rely on BSAI non-pollock fishing. Those distinctions do not break down strictly on AFA/non-AFA lines. In general, CVs with access to cooperatively managed fisheries such as AFA pollock or the Central GOA Rockfish Program face a different set of decisions about when to fish and how to respond to constraints like low Pacific cod TAC or PSC limits for RKC or halibut. Access to cooperative quota for other fisheries insulates some TLAS CVs from overall business risk if the Pacific cod or YFS fishery were to close prematurely relative to past expectations.

The fishery in which a TLAS CV begins the season depends on whether it is an AFA or non-AFA vessel. Some CVs have contracts with, or are owned by, companies that operate CPs as motherships, opening up opportunities for YFS and AI POP/Atka mackerel that other CVs do not have. When trawl gear opens on January 20, AFA CVs choose between BS pollock or trawl Pacific cod/YFS. In years prior to cod rationalization, vessels began the season in the cod fishery because of its increasingly competitive nature where the TAC may be taken relatively quickly and harvest opportunities were not secured by a catch share program. Roughly 74% of the annual trawl CV Pacific cod TAC is allocated to the A season, January 20 to April 1. Catch rates and TAC utilization have tended to be greater early in the calendar year, making the A season the focal point of the fishery and demanding competitive participation when it is open. The trawl CV cod fishery has been both spatially and temporally confined under a limited access management regime. Within those confines, the cod fishery has experienced pressures from participation; for example, AFA vessels without a cod sideboard exemption (lower historical cod dependency) fishing at increased effort levels. This fishery has recently reached a new status quo with the implementation of the Pacific Cod Trawl Cooperative Program (PCTC) under BSAI Groundfish Amendment 122 (88 FR 53704, Aug. 2023[27]) that allocates Pacific cod harvest quota to qualifying LLP license holders and processors in the trawl CV sector.

Historically, AFA CVs that begin in cod might move into the pollock fishery when roe content is optimal. Non-AFA CVs begin with a choice between trawl CV Pacific cod and yellowfin sole; some vessels may fish yellowfin sole until cod CPUE becomes established. CVs that have GOA trawl endorsements but also fish BS Pacific cod are typically making a choice between BSAI trawl CV cod or A/B season pollock and A season Pacific cod in the GOA. If the BSAI trawl CV Pacific cod season closes on TAC in February or early March, CVs could filter back to the YFS fishery or go to the GOA for B season pollock. Some CVs that are not GOA-endorsed go to the AI for Atka mackerel and POP after the cod TAC is taken. For BSAI-focused CVs that are vertically integrated, the decision about where to fish outside of the early Pacific cod season is dictated by where their mothership market is fishing.

CVs that participate in the Pacific whiting fishery will typically be down on the west coast by May 15. Non-whiting CVs that remain in the BS would either return to pollock fishing for the B season on June 10 (AFA) or might get a mothership market for summer cod or yellowfin sole, if open. The TLAS yellowfin sole fishery might dissipate by June or July due to either the TAC being taken, low CPUE in the summer, or low market demand during that time of year. Other opportunities for CVs during the summer months include tender contracts in salmon fisheries and research charters.

AFA CVs tend to wind down their season by finishing their pollock quota in September before Chinook salmon bycatch rates are expected to increase. Opportunities for non-AFA CVs in the late summer and fall are mostly limited to Pacific cod until November 1 and yellowfin sole. In some years the TLAS yellowfin sole is closed on TAC in June and thus not available later in the year. As noted above, the number of CVs that can deliver yellowfin sole offshore has been curtailed. That rule (BSAI Amendment 116) was, in part, motivated by concern that increasing participation in the TLAS yellowfin sole fishery might drive up halibut PSC usage, thus closing the fishery and impacting CPs that depended on TLAS harvest and deliveries as a source of non-pollock revenue. Now, under existing regulations, CVs that cannot deliver to CPs can still deliver yellowfin sole shoreside if the fishery is open and they possess the necessary refrigerated seawater system to make that delivery. Some TLAS CVs participate in the fall Pacific whiting fishery on the west coast. The timing of that fishery may depend on when AFA CPs finish their BS B-season and can move south to make an offshore whiting market.

The CV TLAS directed fishery for yellowfin sole currently has a Zone 1 RKC PSC limit of 7,700 crab and the TLAS fishery for Pacific cod has a limit of 975 crab, down from 23,338 crab and 2,954 crab respectively. As shown in Table 3-4, the TLAS Pacific cod fishery would only have exceeded the current limit in 2011 (1,971 crab) and the TLAS yellowfin sole fishery would not have exceeded the current limit in any of the reported years. The 2022 fishing year was markedly lower in terms of RKC PSC across all categories that are subject to the Zone 1 limit, in large part due to the groundfish trawl sectors moving

[27] See relevant analyses and Final Rule implementation documents here.

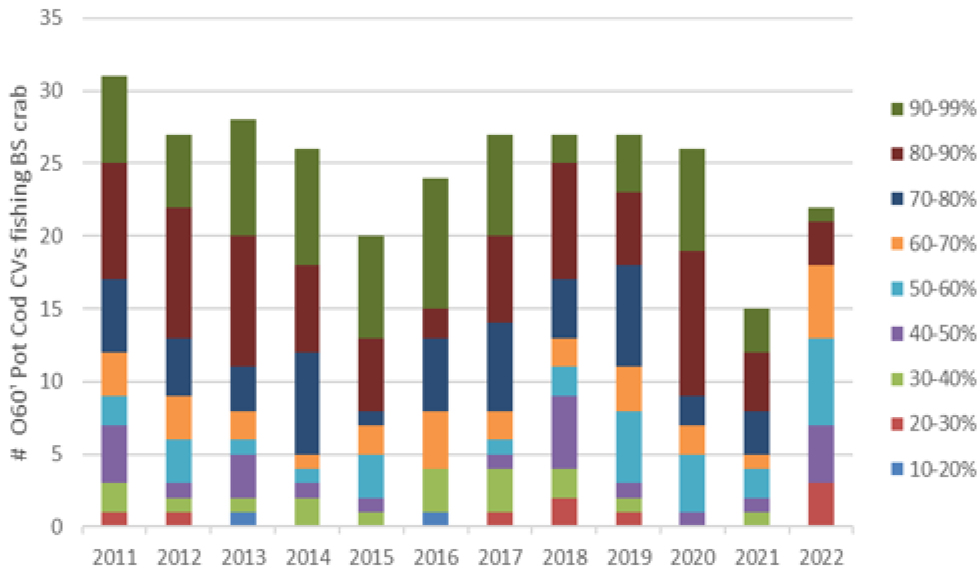
away from the area out of caution for having the area close, and because they found good flatfish fishing outside of Zone 1 in that particular year.

3.1.3 Pacific Cod Pot Gear

The BSAI Pacific cod TAC is allocated across areas (BS, AI) and gears (e.g., pot, HAL, trawl), and has seasonal apportionments in many instances. For the pot cod sector, Pacific cod TAC is allocated separately to CPs, CVs ≥ 60' LOA, and CVs < 60' LOA. The annual catch limit for CPs and CVs ≥ 60' LOA is seasonally apportioned into an A season (Jan 1 – June 10) and a B season (September 1 – December 31). The A season is apportioned 51% of the annual non-CDQ TAC and the B season is apportioned 49% (see example of Table 8 in 2023/24 BSAI Harvest Specifications).[28]

The October 2022 discussion paper established that cross-participation between the pot cod fishery and BS crab fisheries is common, though not universal, and occurring along a spectrum of relative revenue dependency (NPFMC 2022b, Section 1.5). Vessels that target both crab and Pacific cod have direct interests in the ongoing health of crab stocks. These cod/crab vessels were primarily CVs ≥ 60' LOA, along with a small number of cod CPs. (Cod CPs have become largely inactive in the most recent years.) No cod CVs of less than 60' LOA participated in BS crab fisheries. As noted in testimony to the Council throughout 2022 and 2023, at least some of the O60 cod CVs voluntarily avoided fishing in the RKCSA, especially during the A season that overlaps the generally understood RKC molting/mating period. This gear sector's avoidance of the RKCSA during the first part of the year when crab molting and mating occurs is evident in the seasonal catch tables reported in Section 3.2. Figure 3-7 shows that CVs had increased overall participation in the RKCSA starting around 2018 but reduced effort in the years coinciding with BBRKC closures. Since 2011, the total number of O60 pot cod CVs fishing in the BS annually ranged from 23 to 39. The percentage of those vessels that also fished rationalized BS crab in the same year was as high as 96% and typically over 75% (percentages have dipped to between 65% and 73% since directed BBRKC closures first occurred in the 2021/22 season). The total number of pot cod participants is determined by both the state of the cod fishery and, in many cases, the state of crab stocks when vessels depend on both crab and cod income to sustain a business operation. Figure 3-6 shows that the count of O60 pot cod CVs fishing crab had been stable between 20 and 30 until reduced lack of crab fishing opportunities impacted participation in 2021; 2022 reflected a modest rebound in participation but with more vessels showing a diminished proportion of total revenue coming from crab. The color scale shows that most of the initial drop-off in participation from the peak was in the vessels that generated less than 40% of their total revenues from crab. The cross-participating vessels that have historically depended on crab for half or more of their gross activity appeared more likely to remain invested in both fisheries as much as possible. The revenue diversification of the vessels that participated in 2022 might be showing that cross-participating vessels are remaining active in crab fisheries but generating less revenue.

[28] There is a state-managed Pacific cod fishery in the Dutch Harbor subdistrict (DHS) that is open to pot and jig gear for vessels that are 58' LOA or less. Management details can be found in the 2023 DHS Pacific cod fishery management plan. The latest details available for this fishery are in the announcement of the 2024 DHS GHL for pot gear on 12/12/2023 (link). The DHS lies significantly west of NMFS Area 512, and the size restriction means that it is not a likely spill-over fishery for effort that might be displaced from Federal waters under Alternative 3.



# O-60 PCod pot CVs	33	29	31	31	23	25	34	34	35	39	23	30
% fished BS Crab	94%	93%	90%	84%	87%	96%	79%	79%	77%	67%	65%	73%

Figure 3-6 Participation (# vessels) in Bering Sea crab fisheries by Pacific cod pot gear CVs ≥ 60 feet and proportion of revenues (legend) from directed crab fishing, 2011-2022. Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Three to five pot cod CPs fished BS Pacific cod pots during the last ten years. Since 2016, two of the four-to-five pot cod CPs that were active also fished for crab in a given year. At least one pot cod CP has participated in the BS crab fishery in every year since 2011. For whichever two pot cod CPs were active in the crab fishery in a given year, those vessels derived at least 60% of their total gross Alaska fishing revenues from BS crab in that year. This qualitative assessment, as limited by confidentiality, reflects that there is typically a segment of the relatively small pot cod CP sector that is directly invested crab stocks, including BBRKC.

Subsections below break out Pacific cod pot gear participation that occurred specifically in the RKCSA and Area 512, in reference to Alternative 2 and 3, respectively.

RKCSA

Pot cod vessels have operated in the RKCSA during each year from 2011 through the present. Prior to that CVs had operated in the area during the 2006 through 2008 period (1, 2, and 7 vessels in each year, respectively). Figure 3-7 shows the number of vessels active in the area by operational type (CP/CV) since 2011. The figure reflects both an increase in pot cod activity within the RKCSA, by the metric of vessel-count, and a shift from CPs to CVs. While slightly more pot CVs might be recorded as having caught Pacific cod in the RKCSA in the most recent years, Table 3-19 would indicate that the fleet's relative reliance on that area in terms of catch volume and value is at its lowest point during the analyzed period.

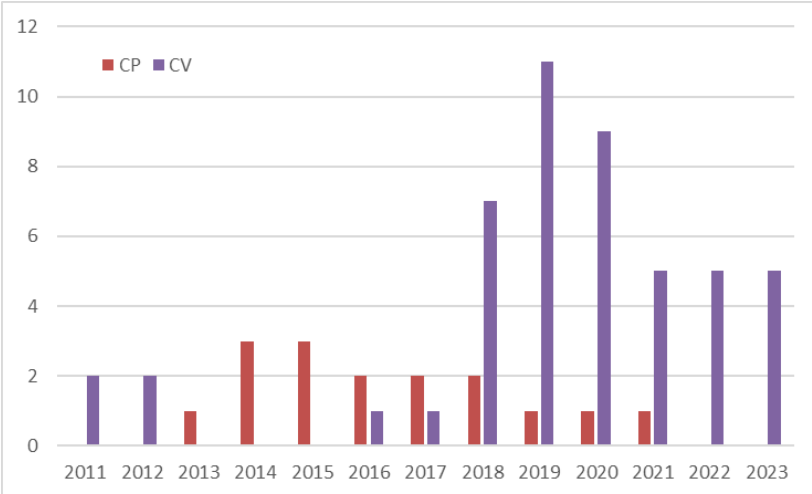


Figure 3-7 Number of vessels fishing Pacific cod with pot gear in the RKCSA, by operational type (2011-2023)

Area 512

Area 512 lies inside the NBBTCA and, as such, only vessels using non-trawl gear fish for groundfish (i.e., cod) in this area. Pot cod vessels have operated in Area 512 during each year from 2011 through the present. Prior to that, two CVs operated in Area 512 in 2007 and 2008, no vessels operated between 1998 and 2007, and between one and four vessels had operated annually from 1995 through 1997. Figure 3-8 shows the number of vessels active in the area by operational type (CP/CV) since 2011. No CDQ fishing for Pacific cod with pot gear has occurred in Area 512 during the period analyzed (since 2011).

Similar to the RKCSA, the figure for Area 512 reflects both an increase in activity within Area 512 and a shift from CPs to CVs. The majority of CVs active in this area are over 60’ LOA. Since 2011, U60 CVs have only been active in the area in 2019-2022. The number of those smaller CVs has always been less than three (i.e., confidential data as a length-based grouping). In 2022 only one U60 CV fished in the area. The predominance of harvest by the O60 fleet is likely due to the relatively distant nature of the fishing grounds from ports like Unalaska, necessitating larger vessels.

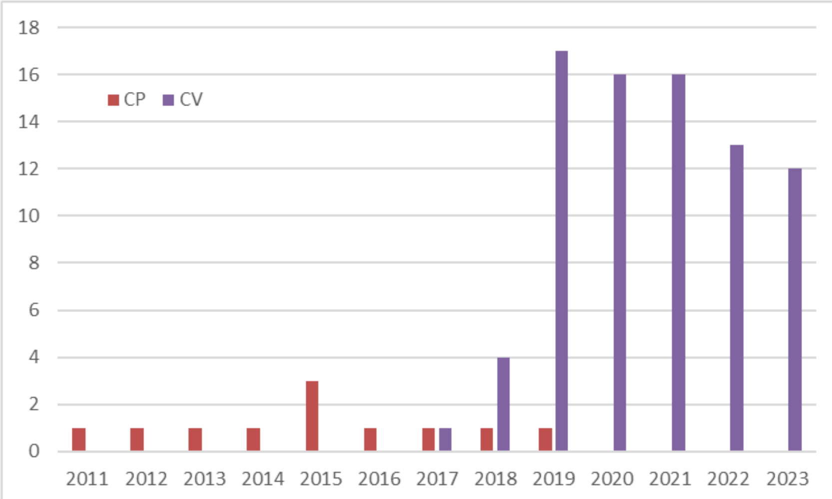


Figure 3-8 Number of vessels fishing Pacific cod with pot gear in NMFS Area 512, by operational type (2011-2023)

Many of these larger vessels delivered to tenders during recent years. Section 3.2.3 provides data on tender utilization by pot cod CVs in the BS region overall and in Area 512 in particular. Since 2018, tenders have become the primary way for CVs in Area 512 to sell their catch (70% to 95% of catch going through tenders; Table 3-23). The availability of tender buyers would seem to suggest that smaller vessels could prosecute this area. The fact that they largely have not done so could reflect the need to deploy more pots to be economical in this area, or could reflect that U60 vessels have different options like state-waters GHL fisheries that are restricted to the smaller vessel class. Tender utilization can make the fishery difficult for inseason management due to hurdles their use can create in the timeliness of data and additional steps needed to deploy monitoring at the vessel level. For the fleet, tender utilization can open up areas that might not be economical without them due to distance from processing ports. On the other hand, the economics of the fishery that makes tendering a viable additional cost to bear (additional vessels, crew, and fuel involved that all must be paid for out of the catch value) may be sensitive to market price changes or to input costs increases. If margins are narrow increasing or maintaining tender operations could be an area where costs are cut. An area-fishery combination that is not accessible without tenders is relatively more at risk of losing economic viability from year to year.

3.1.4 Pacific Cod HAL Gear

The BSAI HAL CP sector is primarily focused on the Pacific cod fishery. The HAL CP vessel count in the Pacific cod target peaked at 36 in 2010. The number of FLC vessels had been in the low-20s in recent years but only 17 fished in 2021 and 19 fished in 2022.

The Pacific cod TAC for the HAL CP sector is divided in to two seasons: A season runs from January 1 to June 10; B season runs from June 10 to December 31. The sector's annual cod quota is divided roughly evenly between the two seasons and is typically harvested at or near capacity (roughly 95% of TAC).[29] The even A/B season Pacific cod TAC split underlines that this sector is a year-round operation for many vessels. Some HAL CP sector vessels generate revenues from secondary species such as Greenland turbot, IFQ sablefish, and GOA Pacific cod.

In general, HAL CP managers design their season around the amount of cod their company/vessel plans to catch, as influenced by TAC levels and operational constraints. The amount of fishing a vessel intends to do affects annual plans for how many crews to rotate through the vessel and when it might build shipyard time into its calendar. Skippers' decisions about where to fish are based around not only CPUE

[29] https://alaskafisheries.noaa.gov/fisheries-catch-landings

but also predicted or observed product recovery rates. Individual platforms will approach product recovery and optimal fishing differently depending on wholesale markets and their vessel's ability to produce ancillary cod products. In contrast to the trawl sectors, HAL CP operators must also weigh bait costs as a factor in the quality and profitability of a fishing area. Markets for ancillary products can become saturated, leading to inseason shifts in the profile of a profitable fishing area when considering operational costs.

The January through March period is key for longline CPs. That period typically exhibits higher CPUE, better market demand, good flesh quality (product recovery), and lower bycatch rates for halibut that could be – though have not been in the past - constraining. Fishery participants report that halibut bycatch rates are often lower in the northern part of the BS relative to the Pribilof Islands, Bristol Bay, and the "slime bank" north of Unimak Island. However, the ability to fish in the more northern fishing grounds can be restricted by weather and ice during the early part of the year.

As the remaining Pacific cod TAC is depleted over the course of the season – or if a bycatch constraint such as halibut PSC emerges – a multi-vessel company would likely rotate its less technically efficient or financially productive platforms out of the fishery. Depending on markets and fish size, these might be the vessels that are less able to generate ancillary products. The Pacific cod HAL CP sector is under an annual halibut PSC (mortality) cap that was 648 mt in 2023 (from a total BSAI non-trawl halibut PSC limit of 710 mt). As shown in Table 3-11, the sector has been below that cap during the analyzed period and a very small amount of its halibut PSC occurred in the RKCSA. From 2013 to 2018 when the HAL CP sectors halibut PSC in the BS area was higher than the more recent years, halibut bycatch mortality in the Area T portion of the BS accounted for less than half of the total PSC.

As the calendar year progresses, NMFS inseason managers can reallocate Pacific cod TAC to other sector allocations including the HAL CP fishery from sectors where it would have gone unharvested. For that reason, the cooperative has an incentive to manage its activity (including bycatch of species like halibut) so that emergent opportunities in October, November or December can be utilized.

No HAL CV activity has occurred in the RKCSA throughout the time period analyzed throughout most of this document, and none was reported by AKFIN looking as far back as 2003 which is the starting point for most Catch Accounting System data that are currently used.

3.1.5 Halibut/Sablefish IFQ

The Halibut/Sablefish IFQ Program fishery does occur in the BSAI region but no IFQ catch has been recorded in the RKCSA or NMFS Area 512 during the analyzed period (2013-2023). Given that fact, IFQ Program participants are not considered directly regulated under the considered action alternatives. Indirect effects might include a change in the usage of fishing grounds outside of the RKCSA and Area 512 if other vessels change their spatial fishing patterns. To place IFQ fishing in the BS FMP area in terms of scale, the October 2022 Council RKCSA discussion paper reported that IFQ fishing in the BS FMP area accounted for a total of between 1,764 mt and 2,596 mt on an annual basis between 2013 and 2022, compared to average annual total BS HAL gear catch of ~131,000 mt and total BS pot gear catch of ~38,000 mt (NPFMC 2022b, Section 1.3 and Table 1-2).

3.2 Target Catch, Non-Target Catch, and Revenues in Groundfish Fisheries

This section begins with a series of tables that reports groundfish catch across each gear type that is potentially regulated by Alternative 2 (RKCSA closure). In some cases, the series of tables breaks out groundfish catch seasonally as a proxy for pollock and Pacific cod A/B seasons as well as the period of the year during which RKC are understood to be molting and mating in the eastern region of Bristol Bay. Harvest patterns – as relates to the RKCSA (and Area 512 in the case of Pacific cod pot gear) – are described in Sections 3.2.1 through 3.2.4 with additional tables that show vessel participation and gross revenues.

RKC PSC is reported in Table 3-4 for the trawl sectors that are subject to Bycatch Limitation Zone 1. The following subsections supply supporting information as relevant to particular sectors, with additional detail in the Pacific cod pot gear fishery as it is potentially directly regulated under Alternative 3 (Area 512 closure). Following Table 3-4, additional tables show the gear-sector levels of PSC for other non-target species of interest in this analysis.

Table 3-1 summarizes groundfish catch by gear sector from 2013 through 2023. The table reports total groundfish catch (retained and discarded) in the BS FMP area and then subsets catch that occurred in the BBRKC stock area (Area T) and the RKCSA. The RKCSA is completely contained within the boundaries of Area T, and Area T is completely contained within the BS area. The estimated catch totals for each of those three area definitions (BS, Area T, RKCSA) are not additive; adding them would duplicate catch records. As an area of particular interest, catch in the RKCSA is reported as a percentage of catch in Area T and a percentage of catch in the BS to show its relative scale for each gear/year combination. Catch reported for “Other Area T” reflects what was occurring around the RKCSA more proximately, to differentiate from areas farther west. The metric of catch used is “groundfish basis weight” (GBW), which is the number of metric tons of groundfish catch that is used to estimate PSC based on observer data. GBW does not match perfectly to total catch as reported in the NMFS Catch Accounting System (CAS), but it is a useful measure for assessing the reliance of the various groundfish gear sectors on certain identifiable areas and subareas within the Bering Sea.

Table 3-1 Estimated metric tons of groundfish (“basis weight”) in the Bering Sea FMP area, RKC Area T, and the RKCSA – 2013 through 2023

Gear	Area	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Average 2013-2023
Hook and Line	RKCSA	10,849	3,257	876	1,042	4,266	7,283	31	26	0	576	0	2,564
	Other Area T	74,956	56,754	48,689	37,287	31,786	22,161	12,842	5,770	3,996	20,087	16,006	30,030
	BS Total	156,576	162,391	167,716	167,251	164,982	137,753	114,108	95,778	75,206	100,641	96,236	130,785
	RKCSA % of T	12.6%	5.4%	1.8%	2.7%	11.8%	24.7%	0.2%	0.5%	0.0%	2.8%	0.0%	5.7%
	RKCSA % of BS	6.9%	2.0%	0.5%	0.6%	2.6%	5.3%	0.0%	0.0%	0.0%	0.6%	0.0%	1.7%
Non-Pelagic Trawl	RKCSA	20,865	21,890	10,801	15,183	7,731	2,592	2,222	2,126	1,075	37	124	7,695
	Other Area T	284,872	289,069	230,070	258,974	236,948	200,175	193,398	212,924	172,301	181,613	138,110	218,041
	BS Total	395,559	387,461	314,749	334,208	310,944	313,229	299,129	300,284	240,701	306,416	275,594	316,207
	RKCSA % of T	6.8%	7.0%	4.5%	5.5%	3.2%	1.3%	1.1%	1.0%	0.6%	0.0%	0.1%	2.8%
	RKCSA % of BS	5.3%	5.6%	3.4%	4.5%	2.5%	0.8%	0.7%	0.7%	0.4%	0.0%	0.0%	2.2%
Pot	RKCSA	3,256	2,974	2,914	910	520	459	611	1,202	107	0	0	1,178
	Other Area T	20,861	19,136	20,509	26,053	29,514	28,461	29,699	19,878	16,020	20,880	21,795	22,982
	BS Total	31,346	40,428	39,001	48,233	47,078	40,744	42,435	33,312	26,567	40,532	38,372	38,913
	RKCSA % of T	13.5%	13.5%	12.4%	3.4%	1.7%	1.6%	2.0%	5.7%	0.7%	0.0%	0.0%	5.0%
	RKCSA % of BS	10.4%	7.4%	7.5%	1.9%	1.1%	1.1%	1.4%	3.6%	0.4%	0.0%	0.0%	3.2%
Pelagic Trawl	RKCSA	3,304	44,442	33,867	34,302	82,003	82,771	91,451	19,595	73,581	98,896	108,145	61,123
	Other Area T	402,298	589,011	372,251	822,226	825,858	764,712	811,838	567,783	470,478	448,353	352,167	584,271
	BS Total	1,248,176	1,257,200	1,294,677	1,318,531	1,332,718	1,346,413	1,383,976	1,244,946	1,052,338	796,389	917,975	1,199,394
	RKCSA % of T	0.8%	7.0%	8.3%	4.0%	9.0%	9.8%	10.1%	3.3%	13.5%	18.1%	23.5%	9.8%
	RKCSA % of BS	0.3%	3.5%	2.6%	2.6%	6.2%	6.1%	6.6%	1.6%	7.0%	12.4%	11.8%	5.5%

Note: The RKCSS is part of the RKCSA. Non-pelagic trawl gear is only permitted within the RKCSS, and only under certain annual conditions (Section 1.3). The reader can assume that any NPT catch reported as “RKCSA” occurred within the RKCSS.
Source: NFMS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Table 3-2 Groundfish basis weight (metric tons) by gear type and area (entire BS, RKCSA), and season (2013-2023)

Gear		Area	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Average 2013-2023
Hook and Line	Jan-May	Bering Sea	80,600	78,383	75,719	78,932	78,696	63,353	56,614	50,124	36,988	45,316	45,740	62,770
		RKCSA %	0	2.8%	1.1%	0.1%	2.3%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	1.5%
	Jun-Dec	Bering Sea	75,976	84,008	91,997	88,319	86,286	74,400	57,493	45,654	38,218	55,325	50,495	68,016
		RKCSA %	26.0%	25.9%	11.7%	17.1%	8.9%	3.5%	3.9%	4.1%	2.8%	0.1%	0.2%	9.5%
	Total	Bering Sea	156,576	162,391	167,716	167,251	164,982	137,753	114,108	95,778	75,206	100,641	96,236	130,785
		RKCSA %	6.9%	2.0%	0.5%	0.6%	2.6%	5.3%	0.0%	0.0%	0.0%	0.6%	0.0%	1.7%
Non-Pelagic Trawl	Jan-May	Bering Sea	220,490	226,432	177,914	193,910	179,356	182,938	185,182	192,251	147,298	172,658	162,251	185,516
		RKCSA %	9.0%	9.6%	6.1%	7.8%	4.3%	1.4%	1.2%	1.0%	0.7%	0.0%	0.1%	3.7%
	Jun-Dec	Bering Sea	175,069	161,028	136,835	140,299	131,588	130,292	113,947	108,033	93,403	133,758	113,343	130,690
		RKCSA %	0.6%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.1%
	Total	Bering Sea	395,559	387,461	314,749	334,208	310,944	313,229	299,129	300,284	240,701	306,416	275,594	316,207
		RKCSA %	5.3%	5.6%	3.4%	4.5%	2.5%	0.8%	0.7%	0.7%	0.4%	0.0%	0.0%	2.2%
Pot	Jan-May	Bering Sea	21,342	29,989	28,336	37,109	35,285	29,819	27,646	24,438	21,215	30,049	29,306	28,594
		RKCSA %	6.4%	1.6%	0.1%	0.0%	0.0%	0.0%	0.0%	4.9%	0.5%	0.0%	0.0%	1.2%
	Jun-Dec	Bering Sea	10,004	10,439	10,665	11,124	11,793	10,925	14,789	8,874	5,352	10,483	9,066	10,320
		RKCSA %	19.0%	23.9%	27.0%	8.2%	4.4%	4.2%	4.1%	0.0%	0.0%	0.0%	0.0%	8.2%
	Total	Bering Sea	31,346	40,428	39,001	48,233	47,078	40,744	42,435	33,312	26,567	40,532	38,372	38,913
		RKCSA %	10.4%	7.4%	7.5%	1.9%	1.1%	1.1%	1.4%	3.6%	0.4%	0.0%	0.0%	3.2%
Pelagic Trawl	Jan-May	Bering Sea	505,804	503,038	511,554	522,019	570,185	587,820	602,363	578,913	466,884	354,637	407,394	510,055
		RKCSA %	0.7%	8.6%	6.6%	2.8%	14.4%	14.0%	14.9%	3.4%	15.8%	27.9%	26.5%	12.3%
	Jun-Dec	Bering Sea	742,372	754,162	783,123	796,512	762,533	758,593	781,613	666,034	585,455	441,752	510,580	689,339
		RKCSA %	0.0%	0.1%	0.0%	2.5%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.3%
	Total	Bering Sea	1,248,176	1,257,200	1,294,677	1,318,531	1,332,718	1,346,413	1,383,976	1,244,946	1,052,338	796,389	917,975	1,199,394
		RKCSA %	0.3%	3.5%	2.6%	2.6%	6.2%	6.1%	6.6%	1.6%	7.0%	12.4%	11.8%	5.5%
All Gears	Jan-May	Bering Sea	828,237	837,842	793,523	831,970	863,522	863,929	871,805	845,726	672,385	602,659	644,691	786,935
		RKCSA %	3.8%	8.1%	5.7%	3.6%	10.6%	9.9%	10.6%	2.7%	11.1%	16.4%	16.8%	9.0%
	Jun-Dec	Bering Sea	1,003,421	1,009,638	1,022,621	1,036,253	992,200	974,210	967,843	828,594	722,427	641,319	683,485	898,365
		RKCSA %	0.7%	0.5%	0.3%	2.1%	0.3%	0.7%	0.2%	0.0%	0.0%	0.1%	0.0%	0.4%
	Total	Bering Sea	1,831,657	1,847,480	1,816,143	1,868,223	1,855,722	1,838,139	1,839,648	1,674,320	1,394,812	1,243,978	1,328,176	1,685,300
		RKCSA %	2.1%	3.9%	2.7%	2.8%	5.1%	5.1%	5.1%	1.4%	5.4%	8.0%	8.2%	4.5%

Source: NFMS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Table 3-3 Groundfish basis weight (metric tons) by gear type and area (entire BS, RKCSA), and season (2013-2023)

		2013			2014			2015		
Gear	Area	Jan-May	Jun-Dec	Total	Jan-May	Jun-Dec	Total	Jan-May	Jun-Dec	Total
HAL	RKCSA	7,304	3,545	10,849	2,205	1,052	3,257	801	75	876
	Other Area T	40,734	34,222	74,956	29,824	26,931	56,754	25,105	23,583	48,689
	BS Total	80,600	75,976	156,576	78,383	84,008	162,391	75,719	91,997	167,716
NPT	RKCSA	19,764	1,101	20,865	21,717	173	21,890	10,786	15	10,801
	Other Area T	138,698	146,175	284,872	163,666	125,403	289,069	138,749	91,321	230,070
	BS Total	220,490	175,069	395,559	226,432	161,028	387,461	177,914	136,835	314,749
Pot	RKCSA	1,359	1,897	3,256	483	2,491	2,974	35	2,879	2,914
	Other Area T	15,809	5,053	20,861	16,908	2,228	19,136	17,914	2,594	20,509
	BS Total	21,342	10,004	31,346	29,989	10,439	40,428	28,336	10,665	39,001
PTR	RKCSA	3,304		3,304	43,351	1,091	44,442	33,867		33,867
	Other Area T	175,650	226,649	402,298	316,423	272,588	589,011	72,033	300,218	372,251
	BS Total	505,804	742,372	1,248,176	503,038	754,162	1,257,200	511,554	783,123	1,294,677

		2016			2017			2018		
Gear	Area	Jan-May	Jun-Dec	Total	Jan-May	Jun-Dec	Total	Jan-May	Jun-Dec	Total
HAL	RKCSA	72	970	1,042	1,841	2,425	4,266	979	6,304	7,283
	Other Area T	22,695	14,592	37,287	23,899	7,887	31,786	13,819	8,341	22,161
	BS Total	78,932	88,319	167,251	78,696	86,286	164,982	63,353	74,400	137,753
NPT	RKCSA	15,076	106	15,183	7,657	74	7,731	2,582	10	2,592
	Other Area T	157,459	101,515	258,974	147,213	89,736	236,948	137,694	62,481	200,175
	BS Total	193,910	140,299	334,208	179,356	131,588	310,944	182,938	130,292	313,229
Pot	RKCSA		910	910		520	520		459	459
	Other Area T	22,259	3,794	26,053	23,351	6,163	29,514	20,140	8,322	28,461
	BS Total	37,109	11,124	48,233	35,285	11,793	47,078	29,819	10,925	40,744
PTR	RKCSA	14,650	19,651	34,302	81,988	15	82,003	82,399	372	82,771
	Other Area T	279,846	542,380	822,226	377,261	448,597	825,858	473,851	290,861	764,712
	BS Total	522,019	796,512	1,318,531	570,185	762,533	1,332,718	587,820	758,593	1,346,413

		2019			2020			2021		
Gear	Area	Jan-May	Jun-Dec	Total	Jan-May	Jun-Dec	Total	Jan-May	Jun-Dec	Total
HAL	RKCSA		31	31		26	26			
	Other Area T	11,953	890	12,842	5,238	531	5,770	1,200	2,796	3,996
	BS Total	56,614	57,493	114,108	50,124	45,654	95,778	36,988	38,218	75,206
NPT	RKCSA	2,214	8	2,222	1,850	276	2,126	1,075		1,075
	Other Area T	126,551	66,847	193,398	137,065	75,860	212,924	114,305	57,996	172,301
	BS Total	185,182	113,947	299,129	192,251	108,033	300,284	147,298	93,403	240,701
Pot	RKCSA		611	611	1,202		1,202	107		107
	Other Area T	18,487	11,212	29,699	13,317	6,561	19,878	12,534	3,486	16,020
	BS Total	27,646	14,789	42,435	24,438	8,874	33,312	21,215	5,352	26,567
PTR	RKCSA	89,956	1,494	91,451	19,595		19,595	73,581		73,581
	Other Area T	499,189	312,649	811,838	428,707	139,076	567,783	242,788	227,690	470,478
	BS Total	602,363	781,613	1,383,976	578,913	666,034	1,244,946	466,884	585,455	1,052,338

		2022			2023		
Gear	Area	Jan-May	Jun-Dec	Total	Jan-May	Jun-Dec	Total
HAL	RKCSA		576	576			
	Other Area T	6,367	13,721	20,087	5,923	10,083	16,006
	BS Total	45,316	55,325	100,641	45,740	50,495	96,236
NPT	RKCSA	37		37	124		124
	Other Area T	118,297	63,317	181,613	123,590	14,519	138,110
	BS Total	172,658	133,758	306,416	162,251	113,343	275,594
Pot	RKCSA						
	Other Area T	15,264	5,616	20,880	16,314	5,480	21,795
	BS Total	30,049	10,483	40,532	29,306	9,066	38,372
PTR	RKCSA	98,896		98,896	108,145		108,145
	Other Area T	247,109	201,245	448,353	244,839	107,328	352,167
	BS Total	354,637	441,752	796,389	407,394	510,580	917,975

Source: NFMS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Table 3-4 reports RKC PSC estimates for all trawl sectors that occur in the part of the BS designated as Bycatch Limitation Zone 1 (see Figure 1-2). The fishery-level Zone 1 PSC limit apportionments that apply when the total Zone 1 RKC PSC limit is 97,000 crab (shown in Table 2-1) have not been reached in any year. However, the lower limits that were in place for 2022 and 2023 would have been reached in some of the years since 2010, and would have resulted in an in-season area closure for non-pelagic trawl gear from the RKCSS. Examples of closure years that would have occurred under the low-limit scenario are A80 in all years except 2015, 2018, 2022 and 2023 (Zone 1 limit of 14,282 RKC), CDQ in 2011, 2017 and 2020 (Zone 1 limit of 3,424 RKC), and TLAS Pacific cod in 2011 (Zone 1 limit of 975 RKC). The TLAS pollock/Atka/other category – which encompasses the pelagic trawl gear (pollock) fishery – would not have met the lowest Zone 1 PSC limit of 65 RKC in any year. The limit of sixty-five animals is a small number for any species in the context of trawling, and it is easy to imagine that this limit could be met but, as noted above, reaching the limit would not directly require vessels targeting pollock to move out of Zone 1. The previous version of this analysis (NPFMC 2023a) reported a version of Table 3-4 that was updated through May 2, 2023. The only trawl RKC PSC that occurred in Zone 1 after that date was 81 crab, all attributed to the A80 sector. This small marginal change reflects that, in the BS groundfish trawl fisheries as presently prosecuted, most interaction with RKC in the eastern BS region occurs early in the calendar year.

Table 3-4 Zone 1 red king crab prohibited species catch estimates for trawl gear (2010-2023)

Year	A80	CDQ†	TLAS Pollock/Atka/ Other	TLAS Pacific Cod	TLAS Yellowfin	TLAS Other Flatfish	Total
2010	54,479	779	22	0	0	0	55,280
2011	31,304	3,634	0	1,971	1,366	0	38,276
2012	24,164	2,605	0	0	102	123	26,996
2013	22,537	2,425	15	0	69	140	25,186
2014	26,586	1,457	0	85	92	0	28,220
2015	12,615	62	0	51	6	20	12,754
2016	21,442	430	6	547	842	58	23,325
2017	27,143	3,722	39	280	3,626	245	35,055
2018	9,799	1,936	14	199	778	12	12,739
2019	20,775	2,051	18	466	1,604	119	25,033
2020	32,474	6,301	9	175	3,034	762	42,755
2021	16,397	1,867	17	25	892	0	19,198
2022	1,903	477	13	0	773	0	3,166
2023	2,512	567	15	140	1,446	101	4,781

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.
† CDQ red king crab PSC is reported for trawl gear only.
Note: “TLAS Other Flatfish” shows PSC that occurred on trips (CV) or hauls (CP) where the target assigned by NMFS CAS based on predominant species caught does not fit the three categories for which a PSC limit is apportioned (e.g., rock sole, flathead sole, plaice). These CAS “targets” likely occur in the directed fishery for yellowfin sole. Accruing this crab PSC to an apportioned limit has not previously been an issue due to the large gap between historical TLAS yellowfin sole PSC limits and use, but it is possible that apportionments would need to be closely tracked when PSC limits are at their lowest levels, as in 2022 and 2023. NMFS uses its knowledge of the fishery and the real-time activity of non-pelagic trawl vessels on which PSC occurred to accrue PSC accurately with regard to limits that would close NPT fishing in Zone 1.

Table 3-5 through Table 3-14 report on PSC levels in the BS groundfish fisheries by gear type (pelagic trawl, non-pelagic trawl, pot, and hook-and-line) for red king crab, Chinook salmon, non-Chinook salmon, halibut, and herring. PSC estimates for 2013 through 2023 are derived from AKFIN's comprehensive database, and have been defined by area to suit the alternatives under consideration. The tables that show multiple areas (e.g., Table 3-5) nest areas from top to bottom, meaning that adding a column vertically would result in double-counting. For example, 'RKCSA' should not be added to 'Other Area T', and so on. 'BS Total' represents the total amount of PSC that occurred in the BS FMP subarea. 'RKCSA' is synonymous with the regulatory definition of the area. In the case of non-pelagic trawling (NPT), any PSC should be assumed to have occurred within the RKCSS portion of the RKCSA. 'Other Area T' represents PSC that occurred withing the BBRKC stock management boundary (Area T) but was not in the RKCSA (see Figure 1-2). 'Other Area T' could be in any direction surrounding the RKCSA, though for trawl gears it could not have been to the east due to the NBBTCA closure (Figure 1-2). 'Total Area T' is a subtotal of 'RKCSA' and 'Other Area T'. Any PSC that occurred outside of Area T contributes to the 'BS Total'.

Table 3-5 and Table 3-6 show the annual and seasonal estimates of RKC PSC in the BS by gear category from 2013 through 2023. The season-split is made at the end of May, roughly reflecting the earlier part of the year when RKC molting and mating are thought to mainly occur and the later part of the year when RKC may be more mobile and hard-shelled (see Section 5.3). The top line for each gear group in Table 3-5 shows that the sectors that have tended to bring RKC onboard have limited their fishing in the area in the more recent years (graphical depictions of area-specific effort by gear sector are included in Appendix 2 to this document). In terms of gross RKC numbers in the Bering Sea, the Pacific cod pot gear fishery has recorded the largest amount and RKC bycatch tends to occur in the latter part of the year. This is not surprising, as the other gear groups are designed not to be retentive of crab that are encountered. The drop-off of pot gear RKC bycatch within the RKCSA in recent years is indicative of the fact that the sector has increasingly stayed out of the area.

Table 3-5 Red King Crab PSC (# of animals) by gear type, area (RKCSA, Zone 1, Area T, and entire BS) – 2013-2023

Gear	Area	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Avg.
HAL	RKCSA	5,452	4,173	1,006	3,896	5,527	9,180	0	2		124		2,669
	Other Area T	7,057	11,698	5,464	4,936	2,228	10,029	19	6	0	143	86	3,788
	Total Area T	12,509	15,870	6,470	8,833	7,755	19,209	19	8	0	267	86	6,457
	BS Total	12,737	16,721	7,177	9,732	8,184	19,518	95	61	226	904	655	6,910
NPT	RKCSA	6,821	12,979	3,704	8,163	2,285	796	1,890	2,187	533	0	4	3,578
	Other Area T	19,935	18,518	14,617	30,023	54,386	21,146	57,001	57,310	34,307	7,425	9,375	29,459
	Total Area T	26,756	31,496	18,321	38,185	56,671	21,942	58,891	59,497	34,840	7,425	9,380	33,037
	BS Total	31,497	32,221	19,903	41,004	59,527	30,109	69,597	64,390	40,500	8,590	13,135	37,316
POT	RKCSA	6,280	17,619	61,213	14,514	384	12,516	953	249	97			10,348
	Other Area T	65,231	66,513	53,554	7,551	20,618	252,237	42,356	14,546	260,363	105,153	80,801	88,084
	Total Area T	71,511	84,132	114,767	22,065	21,002	264,753	43,309	14,795	260,459	105,153	80,801	98,431
	BS Total	93,138	136,667	177,722	22,427	30,053	291,184	46,102	20,793	281,903	146,759	91,921	121,697
PTR	RKCSA	0	7	0	2	20	5	23	3	18	7	5	8
	Other Area T	0	0	0	4	3	9	2	7	9	7	10	5
	Total Area T	0	7	0	6	23	14	25	10	27	14	15	13
	BS Total	0	7	0	6	23	14	25	10	27	14	15	13
All Gear	RKCSA	18,553	34,777	65,923	26,574	8,216	22,497	2,866	2,440	647	131	10	16,603
	Other Area T	92,223	96,729	73,635	42,514	77,234	283,421	99,379	71,869	294,679	112,728	90,272	121,335
	Total Area T	110,776	131,506	139,558	69,089	85,451	305,918	102,244	74,310	295,326	112,860	90,281	137,938
	BS Total	137,372	185,616	204,802	73,168	97,787	340,825	115,819	85,254	322,656	156,267	105,726	165,936

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Table 3-6 Red King Crab PSC (# of animals) by gear type and season in the RKCSA – 2013-2023

	HAL			NPT			POT			PTR			All Gears		
Year	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*
2013	3,982	1,470	5,452	6,649	172	6,821	1,458	4,822	6,280				12,089	6,464	18,553
2014	2,414	1,759	4,173	12,922	57	12,979	414	17,205	17,619	7		7	15,756	19,021	34,777
2015	889	117	1,006	3,704		3,704	105	61,108	61,213				4,698	61,225	65,923
2016	65	3,831	3,896	7,762	400	8,163		14,514	14,514	0	2	2	7,828	18,747	26,574
2017	971	4,556	5,527	2,160	125	2,285		384	384	20		20	3,151	5,065	8,216
2018	448	8,732	9,180	790	6	796		12,516	12,516	5		5	1,243	21,253	22,497
2019				1,814	76	1,890		953	953	23		23	1,837	1,029	2,866
2020		2	2	1,552	635	2,187	249		249	3		3	1,803	637	2,440
2021				533		533	97		97	18		18	647	0	647
2022		124	124							7		7	7	124	131
2023				4		4				5		5	10	0	10
Avg.	797	1,872	2,669	3,445	134	3,578	211	10,137	10,348	8	0	8	4,461	12,142	16,603

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Table 3-7 through Table 3-10 report estimates of Chinook and non-Chinook salmon by gear category during the analyzed period. Salmon bycatch data are reported in many places throughout the Council process but these views are tailored to what is occurring within the RKCSA/SS boundary and the adjacent areas within the BBRKC management area (Area T) in comparison to the total amount in the BS FMP subarea. The majority of salmon PSC occurs in the trawl sectors. With respect to the alternatives under consideration, these tables show the amount that has occurred in the RKCSA and adjacent areas and, for bycatch within the RKCSA, the relative split between the two parts of the calendar year. This information – and PSC information for halibut and herring, below – is utilized in the analysis of fishing effort relocation described in Section 3.3. During the analyzed years, Chinook PSC within the RKCSA was heavily weighted toward the first part of the year (Table 3-8). The same was true for non-Chinook salmon aside from an outlier year in 2016 (Table 3-10). Relative to the entire BS management area, salmon bycatch in Area T accounted for a high percentage of the BS total. Those data reflect the location of trawl fishing effort and also have implications for what might be expected under a trawl area-closure for the RKCSA.

Table 3-7 Chinook PSC (# of animals) by gear type and area (BS, Area T, RKCSA) – 2013-2023

Gear	Area	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Avg.
HAL	RKCSA		6	0			0						1
	Other Area T		13	30	19	10	12	0		10		1	9
	Total Area T		20	30	19	10	12	0		10		1	9
	BS Total		34	67	44	30	63	22	21	16	7	9	28
NPT	RKCSA		148	402	570	85	85	16	21				121
	Other Area T	1,132	1,941	5,238	8,233	2,880	2,016	3,696	906	837	346	1,795	2,638
	Total Area T	1,132	2,089	5,640	8,803	2,965	2,101	3,711	927	837	346	1,795	2,759
	BS Total	2,792	2,349	6,598	9,601	4,768	2,679	5,903	1,921	1,692	682	1,963	3,722
POT	RKCSA												0
	Other Area T												0
	Total Area T												0
	BS Total												0
PTR	RKCSA	4	260	893	289	2,269	482	1,699	131	555	504	1,296	762
	Other Area T	8,641	10,862	6,478	10,358	20,243	9,738	18,808	18,640	7,577	5,113	9,404	11,442
	Total Area T	8,645	11,122	7,371	10,647	22,512	10,220	20,507	18,771	8,132	5,617	10,700	12,204
	BS Total	13,036	15,037	18,329	21,926	30,076	13,731	24,985	32,203	13,784	6,337	11,855	18,300
All Gear	RKCSA	4	414	1,295	859	2,354	567	1,715	152	555	504	1,296	883
	Other Area T	9,773	12,817	11,745	18,610	23,133	11,766	22,504	19,546	8,424	5,459	11,200	14,089
	Total Area T	9,777	13,231	13,040	19,469	25,487	12,333	24,218	19,698	8,979	5,963	12,496	14,972
	BS Total	15,828	17,419	24,993	31,571	34,874	16,473	30,910	34,145	15,492	7,026	13,826	22,051

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Table 3-8 Chinook PSC (# of animals) by gear type and season in the RKCSA – 2013-2023

	HAL			NPT			POT			PTR			All Gears		
Year	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*
2013										4		4	4		4
2014	6		6	148		148				260		260	414		414
2015		0	0	402		402				893		893	1,295		1,295
2016				570	0	570				261	28	289	831	28	859
2017				85		85				2,269		2,269	2,354		2,354
2018		0	0	85		85				481	1	482	566	1	567
2019				16		16				1,390	2	1,392	1,406	2	1,408
2020				21		21				131		131	152		152
2021										143		143	143		143
2022										437		437	437		437
2023										1,296		1,296	1,296		1,296
Avg.	0.6	0.0	0.6	120.6	0.0	120.6	0.0	0.0	0.0	687.7	2.8	690.5	808.9	2.8	811.7

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Table 3-9 Non-Chinook Salmon PSC (# of animals) by gear type and area (BS, Area T, RKCSA) – 2013-2023

Gear	Area	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Avg.
HAL	RKCSA	0	1			12	5		0		7		2
	Other Area T	61	139	31	65	56	9	0	0	15	12		35
	Total Area T	61	141	31	65	69	14	0	0	15	19		38
	BS Total	181	288	134	252	207	198	318	135	47	100	69	175
NPT	RKCSA		17	13	75								10
	Other Area T	850	3,229	1,738	1,886	1,161	7,220	3,163	320	1,693	105	58	1,947
	Total Area T	850	3,246	1,751	1,961	1,161	7,220	3,163	320	1,693	105	58	1,957
	BS Total	966	4,137	3,606	2,747	1,884	12,077	6,340	1,088	2,663	1,220	1,115	3,440
POT	RKCSA												0
	Other Area T												0
	Total Area T												0
	BS Total												0
PTR	RKCSA		25	184	1,114	58	5	522	1	11	4	67	181
	Other Area T	90,399	106,484	158,611	251,955	303,939	169,726	142,762	75,368	323,126	167,432	55,157	167,724
	Total Area T	90,399	106,509	158,795	253,069	303,997	169,731	143,284	75,369	323,137	167,436	55,224	167,905
	BS Total	125,316	219,442	237,752	343,001	467,678	295,092	348,023	343,626	546,042	242,375	112,302	298,241
All Gear	RKCSA	0	44	197	1,189	70	10	522	1	11	11	67	193
	Other Area T	91,310	109,852	160,380	253,906	305,156	176,955	145,925	75,688	324,834	167,549	55,215	169,706
	Total Area T	91,310	109,896	160,577	255,095	305,226	176,965	146,447	75,689	324,845	167,560	55,282	169,899
	BS Total	126,463	223,867	241,491	346,000	469,769	307,367	354,681	344,849	548,752	243,695	113,486	301,856

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Table 3-10 Non-Chinook Salmon PSC (# of animals) by gear type and season in the RKCSA – 2013-2023

	HAL			NPT			POT			PTR			All Gears		
Year	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*
2013		0	0										0	0	0
2014		1	1	17		17				3	22	25	20	23	44
2015				13		13				184		184	197	0	197
2016				75	0	75				2	1,112	1,114	77	1,112	1,189
2017		12	12							58		58	58	12	70
2018		5	5							3	2	5	3	7	10
2019			0							415		415	415	0	415
2020		0	0							1		1	1	0	1
2021										11		11	11	0	11
2022		7	7							4		4	4	7	11
2023										67		67	67	0	67
Avg.	0.0	2.4	2.4	9.5	0.0	9.5	0.0	0.0	0.0	68.0	103.3	171.3	77.5	105.7	183.2

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Table 3-11 through Table 3-14 report halibut and herring PSC rate estimates by gear category during the analyzed period. The annual amount of halibut PSC that occurred in the RKCSA/SS declined in line with gear groups reducing effort in that area in aggregate (Table 3-1). The proportion of total BS halibut PSC that occurred in the RKCSA/SS was low relative to the Area T total. For trawl gear, which accounted for the majority of the halibut PSC reported in these tables, Area T did account for more than half of BS halibut bycatch mortality. The vast majority of that halibut mortality occurred in the first part of the year, which reflects the timing and location of effort. Herring PSC also accrues mainly to the trawl sectors, and primarily to pelagic trawl gear. Roughly half of BS herring PSC in the pelagic trawl gear sector occurred in Area T but very little of it occurred in the RKCSA, indicating that areas to which pelagic trawl effort might be displaced could result in higher herring rates. This potentiality is further analyzed in Section 3.3 and Appendix 2 of this document.

Table 3-11 Halibut mortality (metric tons) by gear type and area (BS, Area T, RKCSA) – 2013-2023

Gear	Area	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Avg.
HAL	RKCSA	18	7	2	4	6	9	0	0		1		5
	Other Area T	288	169	119	82	61	43	22	7	12	48	47	82
	Total Area T	306	175	121	86	67	52	22	7	12	50	47	86
	BS Total	530	449	310	218	183	125	77	80	67	147	138	211
NPT	RKCSA	88	167	96	95	21	17	15	14	11	0	1	48
	Other Area T	2,023	2,037	1,282	1,426	1,138	1,138	1,472	1,015	835	1,098	902	1,306
	Total Area T	2,111	2,204	1,378	1,522	1,158	1,155	1,488	1,029	846	1,098	903	1,354
	BS Total	2,623	2,666	1,714	1,897	1,535	1,753	2,053	1,404	1,206	1,799	1,541	1,835
POT	RKCSA	1	1	0	0	0	0	0	0	0			0
	Other Area T	1	1	1	1	1	0	2	2	3	9	3	2
	Total Area T	1	1	1	1	1	0	2	2	3	9	3	2
	BS Total	4	4	3	3	2	1	3	3	8	21	8	6
PTR	RKCSA	2	19	10	1	24	7	29	2	32	42	15	17
	Other Area T	118	84	19	32	40	34	53	50	69	78	18	54
	Total Area T	119	103	29	32	65	41	82	52	102	120	33	71
	BS Total	212	157	112	91	80	49	98	86	109	123	37	105
All Gear	RKCSA	108	193	107	100	52	33	44	17	43	43	16	69
	Other Area T	2,429	2,291	1,421	1,541	1,240	1,215	1,549	1,074	920	1,234	970	1,444
	Total Area T	2,537	2,484	1,528	1,641	1,291	1,248	1,593	1,090	963	1,277	986	1,513
	BS Total	3,368	3,276	2,139	2,209	1,801	1,928	2,231	1,573	1,389	2,092	1,724	2,157

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Table 3-12 Halibut mortality (metric tons) by gear type and season in the RKCSA – 2013-2023

	HAL			NPT			POT			PTR			All Gears		
Year	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*
2013	9.65	8.01	17.66	81.77	6.07	87.84	0.06	0.49	0.55	1.60		1.60	93.08	14.57	107.66
2014	2.79	3.73	6.52	166.30	0.89	167.19	0.02	0.53	0.55	18.97	0.02	18.99	188.09	5.17	193.25
2015	1.50	0.33	1.84	95.55	0.04	95.59	0.00	0.15	0.15	9.90		9.90	106.95	0.53	107.48
2016	0.83	3.44	4.27	94.30		94.30		0.02	0.02	0.01	0.24	0.25	95.15	3.69	98.84
2017	1.03	5.31	6.35	20.05	0.77	20.82		0.02	0.02	24.35		24.35	45.43	6.10	51.53
2018	1.99	6.90	8.88	16.77	0.04	16.82		0.00	0.00	0.60		0.60	19.35	6.95	26.30
2019		0.02	0.02	15.16	0.18	15.34				28.79		28.79	43.94	0.20	44.14
2020		0.12	0.12	0.16	3.24	3.40				2.15		2.15	2.31	3.36	5.67
2021				10.51		10.51				32.30		32.30	42.81		42.81
2022		0.01	0.01	0.14		0.14				41.74		41.74	41.88	0.01	41.89
2023				0.58		0.58				15.31		15.31	15.88		15.88
Avg.	1.62	2.53	4.15	45.57	1.02	46.59	0.01	0.11	0.12	15.97	0.02	16.00	63.17	3.69	66.86

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Table 3-13 Herring PSC (metric tons) by gear type and season (BS, Area T, RKCSA) – 2013-2023

Gear	Area	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Avg.
HAL	RKCSA			0.00									0
	Other Area T			0.00	0.00		0.00	0.00	0.00	0.00	0.02	0.01	0
	Total Area T			0.00	0.00		0.00	0.00	0.00	0.00	0.02	0.01	0
	BS Total	0.12		0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0
NPT	RKCSA	0.01	0.01	0.04	0.01	0.02	0.15	0.06	0.16	0.00	0.00	0.00	0
	Other Area T	2.24	19.09	37.85	51.15	33.14	41.95	53.01	33.06	119.08	42.95	219.87	59
	Total Area T	2.25	19.10	37.89	51.16	33.16	42.11	53.06	33.22	119.09	42.95	219.88	59
	BS Total	29.12	27.14	42.60	62.66	58.59	67.53	81.93	73.19	170.92	47.42	238.38	82
POT	RKCSA												-
	Other Area T										0.00		0
	Total Area T										0.00		0
	BS Total										0.00		0
PTR	RKCSA		0.04	0.01	1.12	0.03	0.24	0.19	0.02	0.02	7.48	163.87	16
	Other Area T	24.65	112.06	753.39	725.81	442.13	205.68	696.99	1,546.84	1,207.94	1,463.41	1,798.20	816
	Total Area T	24.65	112.10	753.40	726.93	442.16	205.92	697.17	1,546.86	1,207.96	1,470.88	1,962.08	832
	BS Total	958.92	159.36	1,486.58	1,430.87	962.76	473.36	1,100.06	3,860.87	1,707.46	1,702.97	3,073.25	1,538
All Gear	RKCSA	0.01	0.05	0.05	1.14	0.05	0.39	0.24	0.18	0.03	7.48	163.87	16
	Other Area T	26.89	131.15	791.24	776.95	475.27	247.63	750.00	1,579.90	1,327.02	1,506.38	2,018.09	876
	Total Area T	26.90	131.20	791.29	778.09	475.32	248.03	750.24	1,580.08	1,327.05	1,513.86	2,181.96	891
	BS Total	988.16	186.50	1,529.18	1,493.53	1,021.35	540.90	1,182.00	3,934.05	1,878.38	1,750.42	3,311.64	1,620

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Table 3-14 Herring PSC (metric tons) by gear type and season in the RKCSA – 2013-2023

	HAL			NPT			POT			PTR			All Gears		
Year	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*	*Jan-May*	*Jun-Dec*	*Total*
2013					0.01	0.01							0.00		0.01
2014				0.01		0.01				0.00	0.03	0.04	0.01	0.03	0.05
2015		0.00	0.00	0.04	0.00	0.04				0.01		0.01	0.05	0.00	0.05
2016				0.00	0.01	0.01				0.07	1.05	1.12	0.08	1.06	1.14
2017				0.02		0.02				0.03	0.00	0.03	0.05	0.00	0.05
2018				0.15		0.15				0.21	0.02	0.24	0.37	0.02	0.39
2019				0.06		0.06				0.03	0.15	0.19	0.09	0.15	0.24
2020				0.16		0.16				0.02		0.02	0.18	0.00	0.18
2021				0.00		0.00				0.02		0.02	0.03	0.00	0.03
2022										7.48		7.48	7.48	0.00	7.48
2023				0.00		0.00				163.87		163.87	163.87	0.00	163.87
Avg.	0.00	0.00	0.00	0.04	0.00	0.04	0.00	0.00	0.00	15.61	0.11	15.73	15.65	0.12	15.77

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

3.2.1 Pelagic Trawl

The pelagic trawl gear sector has operated within the RKCSA in each year since 2013 (beginning of analyzed period). Between 0.3% (2013) and 12.4% (2022) of total BS pelagic trawl sector catch has occurred in the RKCSA on an annual basis during that period, peaking at around 90,000 mt in 2018 and 2019. Total BS pelagic trawl catch ranged from around 800,000 mt (2022) to 1.35 million mt (2017-19) during that period (Table 3-1). Nearly all of the sector's catch that occurs in RKCSA takes place in the A season (Table 3-3).

The pelagic trawl sector is estimated to have a small number of RKC PSC in the BS. All recorded PSC occurs within the BBRKC stock area (Area T) and generally occurred within the RKCSA during the A season (Table 3-5 and Table 3-6). Pelagic trawl PSC of Chinook salmon in the BS ranged from 13,036 in 2013 to 32,203 fish in 2020. On average, 65% of this catch occurred within Area T; 4% occurred in the RKCSA (Table 3-7 and Table 3-8). For Non-Chinook salmon, on average, 56% of PSC by the pelagic trawl sector gear occurred within Area T and less than 1% occurred within the RKCSA (Table 3-9 and Table 3-10). On average 67% of BS halibut PSC in the pelagic trawl sector occurred within Area T and

15% was in the RKCSA, primarily during the A season (Table 3-11 and Table 3-12). A small amount of the pelagic trawl sector's herring PSC occurred within the RKCSA, but 52% of total BS herring PSC occurred within Area T (Table 3-13 and Table 3-14).

The pelagic trawl fishery is highly selective for pollock as a proportion of total catch. From 2018 through 2023, pelagic trawl gear caught over 97% pollock throughout all BSAI areas, including in the RKCSA. Within the BS FMP area during that period, 33% of total pollock catch occurred in Area 509, 31% occurred in Area 517, and 22% occurred in Area 521. Area 516 (including the eastern portion of the RKCSA) accounted for 4% of pollock catch. No other BS area accounted for more than 5% of pollock catch.

The top 20 other species that were recorded in pelagic trawl catch during the same period were – by rank, descending – Pacific cod, jellyfish, Pacific ocean perch, squid, herring, sablefish, flathead sole, rock sole, non-Chinook salmon, skates, Atka mackerel, yellowfin sole, arrowtooth flounder, halibut, shark, northern rockfish, Chinook salmon, and sea stars. Red king crab ranks low in terms of species that are recorded onboard pelagic trawl vessels, as evident from Table 3-5.

Non-target catch of other species of interest – in terms of pollock fishing effort that might be displaced if the RKCSA is closed to pelagic trawl gear throughout the year – include salmon (Chinook and non-Chinook) and herring. From 2018 through 2022, Area 517 accounted for 44% of herring bycatch in the pelagic trawl sector, 58% of non-Chinook salmon bycatch, and 36% of Chinook salmon bycatch. The relatively high volumes make sense because Area 517 was where 31% of pollock catch occurred. By comparison, however, Area 509 accounted for 33% of pollock catch and lower rates of herring and non-Chinook salmon (14% of herring, 9% of non-Chinook salmon, but 44% of Chinook salmon). Table 3-15 shows how non-target catch of these three species are distributed across the areas where pelagic trawl gear is used. Note that columns do not sum vertically; the area-distribution of pollock catch is shown as a proxy for effort. The table suggests that the catch of a non-target species is often proportional to pollock effort. Some areas stand out. For example, incidence of herring bycatch outpaced pollock effort in Areas 513 and 519. Chinook salmon bycatch as a percentage of its total was higher than pollock in 509 and 519. Non-chinook salmon bycatch, as a percentage of its total, was concentrated in Area 517. Additional data on area-specific PSC rates is shown in Appendix 2.

Within the RKCSA, specifically, the top ten non-target species caught were (in descending order) jellyfish, Pacific cod, rock sole, yellowfin sole, flathead sole, skates, sea star, halibut, arrowtooth flounder, and herring. On a rate basis, the most notable observation is that non-Chinook salmon were caught at roughly one-tenth the rate that they were in other areas.

Table 3-15 Area-distribution of selected non-target species for the BS pollock fishery, by NMFS Area (2018-2023)

	509	513	514	516	517	519	521	524	523	Total
Herring	14%	11%	0%	0%	44%	12%	19%	1%	0%	100%
Chinook Salmon	44%	1%	0%	2%	36%	5%	10%	0%	1%	100%
Non-Chinook Salmon	9%	1%	0%	0%	58%	6%	23%	2%	2%	100%
Pollock	33%	2%	0%	4%	31%	5%	22%	3%	1%	100%

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA.

Table 3-16 reports the number of vessels that fished in the BS FMP area with pelagic trawl gear by operational type (CP/CV) and the number that also fished in the RKCSA during the 2018 through 2023 period. Revenue estimates are reported in gross first wholesale for CPs and ex-vessel for CVs. Revenue estimates are not additive across the values reported for the BS and RKCSA; revenue data are not yet available for 2023.

Table 3-16 Vessel count and gross revenues (millions of 2022$) for pelagic trawl sector fishing in the BS FMP area and the RKCSA (2018-2023)

	CP				CV			
	Bering Sea		RKCSA		Bering Sea		RKCSA	
	Wholesale ($MM)	# Vessels	Wholesale ($MM)	# Vessels	Ex-Vessel ($MM)	# Vessels	Ex-Vessel ($MM)	# Vessels
2018	677.5	14	75.1	14	246.5	83	24.5	68
2019	755.8	14	87.4	13	224.6	82	14.8	65
2020	709.7	14	19.1	12	268.8	85	4.2	43
2021	675.4	13	67.2	13	240.3	83	5.0	38
2022	578.0	13	110.0	13	222.5	81	12.5	56
2023	unk.	13	unk.	13	unk.	75	unk.	64

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA.
'unk.' = data unknown at the time of writing.

A subset of AFA CPs and CVs also participate in fisheries off the U.S. west coast (Table 3-17). For context in terms of revenue dependency, AKFIN can analyze gross revenues derived from "Washington/Oregon/California" fishing in ex-vessel terms. From 2013 through 2022, the number of CPs that participate in Alaska AFA pollock fisheries and also west coast groundfish fisheries was nine in all years except for 10 in 2020 and 2021. The number of AFA CVs with west coast groundfish revenues ranged from 12 to 17. West coast gross revenue in ex-vessel terms for these 9 or 10 CPs, in aggregate, ranged from $13.5 million (2015) to $31.0 million (2022) in inflation-adjusted 2022 dollars. The average annual value was $25.6 million. While ex-vessel revenue estimates for CPs may be imperfect, AKFIN's methodology is consistent across regions and thus the comparison still provides a sense of relative revenue magnitude from BSAI fishing versus west coast fishing for this sector. The average annual value for AFA CVs fishing in the west coast region was $8.7 million.

Table 3-17 Gross revenues (millions of 2022$) and vessel count for AFA vessels while participating in U.S. west coast (WA, OR, CA) groundfish fisheries (2013-2022)

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
CP	# Vessels	9	9	9	9	9	9	9	10	10	9
	Ex-Ves. $MM	27.8	30.9	13.5	25.6	29.0	23.4	27.5	18.3	28.7	31.0
CV	# Vessels	15	15	12	14	14	15	17	17	13	14
	Ex-Ves. $MM	13.2	12.0	3.6	11.1	9.4	9.9	9.4	3.5	5.6	9.6

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA.

3.2.2 Non-Pelagic Trawl

Groundfish catch with non-pelagic trawl gear in the RKCSS has decreased during the analyzed period (Table 3-1 through Table 3-3). Almost all of the non-pelagic trawl activity that did occur in the region was in the first part of the calendar year. As such, most of the sector's RKC PSC also occurred in the first part of the year (Table 3-6).

The sector's Chinook and non-Chinook salmon PSC was relatively low in the RKCSS and mainly occurred during the A season (none since 2020). The majority of salmon PSC that did occur was encountered in Area T (Table 3-7 through Table 3-10). Halibut PSC mortality was relatively low in the RKCSS and mainly occurred during the first part of the year. Most of the gear sector's halibut PSC in the BS, overall, occurred in the first half of the year (Table 3-11 and Table 3-12) and most of it was in the area coinciding with Area T, but not in the RKCSS.

Table 3-18 reports the number of vessels that fished in the BS FMP area with non-pelagic trawl gear by operational type (CP/CV) and the number that also fished in the RKCSS portion of the RCKSA during the 2018 through 2023 period. Revenue estimates are reported in gross first wholesale for CPs and ex-vessel for CVs. Revenue estimates are not additive across the values reported for the BS and RKCSA; revenue data are not yet available for 2023. Non-pelagic trawl CVs would be TLAS vessels targeting Pacific cod and yellowfin sole. Note that NPT CPs include up to three non-A80 CPs (AFA CPs) in each year, which is why the vessel count is more than the typical 17 to 20 A80 vessels active in recent years. NPT CV vessels include both AFA and non-AFA TLAS vessels that fish Pacific cod and yellowfin sole. AFA CVs utilize non-pelagic trawl gear when not directed fishing for pollock because it allows vessels to fish on bottom while reducing expected bycatch of benthic species like halibut and crab relative to gear without raised features.

Table 3-18 Vessel count and gross revenues (millions of 2022$) for non-pelagic trawl sector fishing in the BS FMP area and the RKCSA/SS (2018-2023)

	CP				CV			
	Bering Sea		RKCSA		Bering Sea		RKCSA	
	Wholesale ($MM)	# Vessels	Wholesale ($MM)	# Vessels	Ex-Vessel ($MM)	# Vessels	Ex-Vessel ($MM)	# Vessels
2018	320.9	23	3.0	8	37.2	59	-	0
2019	289.0	23	2.0	10	32.8	56	*	1
2020	235.1	21	1.0	9	28.9	52	-	0
2021	169.8	21	0.5	6	16.1	50	-	0
2022	274.9	20	-	0	25.6	53	-	0
2023	unk.	19	-	0	unk.	53	-	0

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA.
'unk.' = data unknown at the time of writing.

3.2.3 Pacific Cod Pot Gear

Historically, groundfish pot fishing that occurred in the RKCSA has tended toward the latter part of the year (B season), though in the most recent years the pot sector has reduced effort in the Savings Area overall (Table 3-2).

Table 3-19 summarizes vessel participation and gross revenues for the BS FMP area as a whole and the RKCSA. Revenue estimates are reported in gross first wholesale for CPs and ex-vessel for CVs. Revenues are not additive across the BS and RKCSA fields; revenue data are not yet available for 2023.

Table 3-19 Vessel count and gross revenues (millions of 2022$) for groundfish pot gear sector fishing in the BS FMP area and the RKCSA (2018-2023)

	CP				CV			
	Bering Sea		RKCSA		Bering Sea		RKCSA	
	Wholesale ($MM)	# Vessels	Wholesale ($MM)	# Vessels	Ex-Vessel ($MM)	# Vessels	Ex-Vessel ($MM)	# Vessels
2018	8.0	4	*	2	33.4	64	3.5	7
2019	7.4	4	*	1	38.6	72	1.8	11
2020	4.0	4	*	1	29.0	83	1.2	9
2021	4.1	3	*	1	20.2	57	0.4	5
2022	6.8	3	-	0	34.3	59	0.4	5
2023	unk.	3	-	0	unk.	49	unk.	5

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA.
'unk.' = data unknown at the time of writing.

The analysts examined catch of all species in the BSAI pot cod fishery for five recent complete years (2018 through 2022) by NMFS reporting area to illustrate which species are found in cod pots and whether that varies according to the area fished. Any difference – or lack thereof – in catch composition by area could be relevant to alternatives that preclude fishing in certain areas. Figure 1-1 and Figure 1-2 show where these numbered NMFS reporting areas lie in relation to one another. In summary, Area 508 is the easternmost part of Bristol Bay. Area 512 – notable in reference to Alternative 3 – is directly to the west of Area 508. Together, Areas 508 and 512 comprise the Nearshore Bristol Bay Trawl Closure area (along with the southern part of Area 514). Areas 516 and 509 lie progressively west from Area 512; the RKCSA (Alternative 2) lies within those two areas. Areas 513 and 517 lie westward from the west end of Unimak Island and extend toward the Pribilof Islands. Area 519 lies south of Area 517 and can be generally described as a triangle with the edges being the Aleutian chain, a line north from Unalaska Island, and line east to Unimak Island. Area 518 completes the rest of the BS area along the AI chain until the AI FMP area begins with Area 541.

The BSAI Pacific cod pot fishery is highly selective for cod, and no other species are retained in any significant amounts. During the most recent five years, Pacific cod accounted for 93.4% of total retained and discarded catch in the pot cod directed fishery across the entire BSAI region (111,392 mt out of 119,224 mt during the five-year period). Including the AI FMP area in the following summary does not affect the region-wide description of catch composition since cod were similarly dominant in Areas 541/542/543, and top-ranked non-target species were the same with the exception of yellowfin sole which was rarer in the AI. The BS FMP area accounted for 95% of total BSAI pot cod harvest. By area, 29% of BSAI cod catch was in Area 509, 19% in 512 and 517, 12% in 519, and 7% in 516 with lesser percentages in the remaining areas. Notably, less than 1% of pot cod harvest occurred in Area 508, suggesting that the eastern extent of Bristol Bay is not suitable for cod fishing with pots and/or that fishing in that area is not economically viable due to its distance from processing or tendering operations. This is notable because the nearshore Bristol Bay region may be particularly valuable area for reproduction, larval transport, and early life stages for RKC (see Daly et al. 2020 as well as the most recent EFH map for RKC and updates on BBRKC tagging studies in Sections 5.5.2 and 5.3.1 of this document).

Table 3-20 ranks the top ten species by area in terms of total catch in the BS for the 2018 through 2022 period. Areas are ordered by the proportion of total Pacific cod catch. Cells containing "0.00" indicate that some catch was estimated in a very small amount. Catch data are not broken out by CP/CV because there was very little CP activity in the areas directly regulated by the action alternatives during this recent period (see Figure 3-8), and because the analysts have no rationale to suspect that vessels of different operational types fishing in the same reporting area would encounter a different mix of target/non-target species. Looking only at the BS areas, Pacific cod accounted for 94.6% of total catch. Red king crab ranked third, just ahead of octopus, in terms of non-cod species (911 mt, or 0.8% of total catch), behind yellowfin sole and sculpin. The areas that contain the RKCSA (509 and 516) ranked first and fifth in terms of cod catch while Area 512 ranked second. Area 512 accounted for 51% of RKC non-target catch in this fishery (469 mt). Areas 509 and 516 ranked third and second, respectively, behind Area 512 in terms of RKC catch (13% and 16% of BS total). The next ranked area in terms of RKC was Area 519 (11%), after which there is a substantial drop in percentage terms for the western areas (517, 513, 518, 521, and 524). It seems apparent that RKC encounter tails off farther from eastern Bristol Bay, with the exception that few RKC were reported in Area 508 where there was very little pot cod fishing. Note that non-target catch of crab is estimated here in tons, which is not how crab are typically accounted in PSC-limited fisheries but is suitable for comparing across areas since the estimation methodology is the same for each area.

Table 3-20 Ranked catch composition in the Bering Sea Pacific cod pot fishery, by NMFS reporting area (2018-2022, cumulative metric tons). Areas 509 and 516 are highlighted (light blue) because they contain the RKCSA (regarding Alternative 2); Area 512 is highlighted (dark blue) because it is the area directly regulated under Alternative 3.

Species	509	512	517	519	516	524	521	513	514	508	518	BS Total
Pacific Cod	32,242	20,763	20,647	13,706	7,792	3,806	3,529	1,884	1,038	84	73	105,563
Yellowfin Sole	265	778	52	75	204	142	9	37	48	2	22	1,633
Sculpin	358	135	117	438	30	29	48	20	3	0	74	1,253
Red King Crab	121	469	39	104	146	0.0	0.2	21	0.1	0.2	10	911
Octopus	279	3	63	440	5	0.0	7	2	0.1	0.0	94	893
Sea Star	147	107	17	64	46	3	3	2	5	0.1	23	416
Other Flatfish	71	281	8	24	15	0.0	0.4	3	1	0.0	1	405
Snow Crab	128	39	23	62	45	0.2	21	4	1	0.0	19	342
Sablefish	2	0.0	25	66	1	0.0	0.0	0.2	2	0.0	1	97
Tanner Crab	20	0.5	3	14	0	30	18	3	2	0.0	4	95

Source: NFMS Alaska Region Catch Accounting System, data compiled by AKFIN

For Area 512 specifically, Pacific cod accounted for 91.7% of total catch and RKC ranked second (2.1%) in non-cod species behind yellowfin sole (3.4%). The only other species to account for more than 1% of Area 512 total catch was “other flatfish” (1.2%). After that, non-target species rank in order: sculpin, sea star, snow crab, flathead sole, miscellaneous crabs, and arrowtooth flounder. In tons, the cumulative amount of snow crab catch in Area 512 was 39.4 mt and the cumulative amount of Tanner crab was 0.5 mt. Tanner crab tended to appear in pot cod fishing that occurred farther west (though still in small amounts). As evident in Figure 3-8, there was less pot cod effort in Area 512 in the years prior to 2018 (total of 3,904 mt of Pacific cod from 2013 through 2017). During that period, RKC still ranked second in non-cod catch behind yellowfin sole; 155 mt of RKC were reported in the area for those years, which makes up a higher percentage of the smaller amount of cod catch. From 2013 through 2022, Area 512 always ranked as the BS reporting area with the highest proportion of RKC catch composition in the pot cod fishery. That proportion was highly variable, peaking at 7.9% in 2014. The unweighted annual average proportion for Area 512 was 2.9%; the proportion was less than 1% in three of those 10 years (including 0.26% in 2020).

On a seasonal basis, the proportion of Area 512 total pot cod fishery catch that was RKC has been higher in the latter half of the year (i.e., B season). From 2013 through 2022, the unweighted annual average proportion of total Area 512 pot cod catch that was RKC was 3.5% in the B season, compared to 0.8% RKC in the A season (RKC were only recorded in the Area 512 A season in half of the years (2014, 2018, 2019, 2021, and 2022). The %RKC for the A season was above 0.35% just once (3.2% in 2018), while the %RKC for the B season ranged from 0.26% in 2020 to 11.2% in 2014. The B season %RKC was above 5% in four years, but below 1% in four years. The seasonal proportion of Area 512 pot cod catch that is RKC may not be indicative of crab presence in the area or of any difference in fishing practices because the pot cod fishery in Area 512 is highly skewed to the B season. The B season accounted for 87% of total annual catch from 2013-2022.

The analysts also looked at pot cod catch records that took place in the RKCSA – a subset of Areas 509 and 516. From 2018 through 2022, Pacific cod made up 94.3% of total catch in the area (9,364 mt) and, again, yellowfin sole (2.4%, or 234 mt) and RKC (1.6%, or 159 mt) ranked as the top non-target species by volume. The cumulative amount of RKC taken in pot cod gear in the RKCSA was roughly one-third of the amount taken in Area 512. After yellowfin sole and RKC, the next non-target species ranked were snow crab (0.49%), sculpin (0.38%), "other flatfish" (0.25%), sea stars (0.24%), and octopus (0.12%). Estimated cumulative weights for those species over the five-year period were 50 mt and descending to 14 mt. From 2013 through 2022, the B season accounted for 81% of total annual catch. Since 2018 – which are the years most reflective of current fishing effort in the area – RKC made up less than 1/10th of a percent of total catch volume in the RKCSA pot cod fishery during the A season, and roughly 2% of total catch in the area during the B season.

3.2.3.1 Use of Tender Vessels (BSAI and by area)

Table 3-21 and Table 3-22 report the use of tenders for Pacific cod pot CV catch throughout the BSAI and in reporting areas of interest from 2013 through 2023.[30] Those tables compare total pot cod CV catch to tendered catch by vessel size group and by the A/B seasons. Across the board, tendering activity has increased substantially since approximately 2019. The increase was in both the number of vessels delivering to tenders (# tenders) and the percentage of catch volume that went through tenders to an inshore processor. On a BSAI-wide basis, the trend was similar for both O60 and U60 CVs. Tendering activity tracked total activity in that it was more prevalent in the A season.

Table 3-21 BSAI Pacific cod pot CV vessel count, number that delivered to a tender, and catch delivered to tenders, total and by vessel size (2013-2023)

					O60				U60			
Year	Total Ves. Ct.	# Tenders	Tender Wt. (mt)	%Tot. Wt	Total Ves. Ct.	# Tenders	Tender Wt. (mt)	%Tot. Wt	Total Ves. Ct.	# Tenders	Tender Wt. (mt)	%Tot. Wt
2013	62	12	3,086	9%	37	7	1,639	8%	25	6	1,447	10%
2014	59	12	3,557	8%	38	9	1,468	8%	21	4	2,089	9%
2015	51	9	4,389	11%	29	5	910	5%	22	5	3,480	18%
2016	60	11	5,299	11%	33	2	341	2%	27	10	4,958	17%
2017	69	19	7,439	15%	43	11	1,660	8%	26	9	5,779	20%
2018	82	28	9,040	19%	42	11	4,225	20%	40	18	4,815	18%
2019	86	59	15,499	32%	43	25	6,196	34%	43	35	9,303	31%
2020	102	72	18,289	46%	47	33	6,862	44%	55	40	11,427	47%
2021	75	55	21,834	63%	31	23	7,073	54%	44	33	14,761	68%
2022	86	56	28,515	62%	42	27	11,181	58%	44	30	17,434	65%
2023	77	46	27,941	66%	36	19	9,103	58%	41	28	18,838	71%

30 The source for all tables in this subsection is: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA.

Table 3-22 BSAI Pacific cod pot CV vessel count, number that delivered to a tender, and catch delivered to tenders, total and by season (2013-2023)

					A Season				B Season			
Year	Total Ves. Ct.	# Tenders	Tender Wt. (mt)	%Tot. Wt	Total Ves. Ct.	# Tenders	Tender Wt. (mt)	%Tot. Wt	Total Ves. Ct.	# Tenders	Tender Wt. (mt)	%Tot. Wt
2013	62	12	3,086	9%	55	12	3,086	12%	25			
2014	59	12	3,557	8%	56	12	3,557	11%	20			
2015	51	9	4,389	11%	38	9	4,389	16%	33			
2016	60	11	5,299	11%	50	11	5,299	14%	37			
2017	69	19	7,439	15%	65	19	7,439	18%	33			
2018	82	28	9,040	19%	78	25	6,216	18%	39	5	2,824	21%
2019	86	59	15,499	32%	82	45	10,073	30%	46	23	5,426	38%
2020	102	72	18,289	46%	92	59	12,458	40%	47	27	5,830	65%
2021	75	55	21,834	63%	61	50	19,813	68%	40	15	2,021	35%
2022	86	56	28,515	62%	70	52	24,530	70%	43	19	3,958	38%
2023	77	46	27,941	66%	65	46	22,846	70%	35	11	5,095	52%

Table 3-23 focuses on Area 512. Tendering activity did not begin there until 2018 so data are not reported for prior years. As soon as tendering began in Area 512, it became the dominant form of fish buying regardless of the season. As noted below, most of the tendered cod from Area 512 has gone to King Cove. Dutch Harbor and the inshore floating processors sector combine to make up a substantial share, while Port Moller emerged in 2021 and 2022 as one of the top recipients from that area. Other localities that received tendered cod catch from Area 512 included False Pass, Kodiak, and Akutan. Specific percentages cannot be reported by individual communities where there are fewer than three processing entities taking deliveries from an area where tendered catch amounts are reported (i.e., Area 512). Due to the remoteness of Area 512 from Unalaska and King Cove, fishing without tenders could be dependent on whether inshore processors are operating in False Pass or Port Moller.

Table 3-23 Area 512 Pacific cod pot CV vessel count, number that delivered to a tender, and catch delivered to tenders – by vessel size and by season (2018-2023); weight in metric tons

					O60			U60			A Season			B Season		
Year	Total Ves.	# Tenders	Tender Wt.	%Tot. Wt	Total Ves.	# Tenders	%Tot. Wt	Total Ves.	# Tenders	%Tot. Wt	Total Ves.	# Tenders	%Tot. Wt	Total Ves.	# Tenders	%Tot. Wt
2018	5	4	1,644	67%	5	4	67%							4	4	69%
2019	18	18	3,863	70%	16	16	72%	2	2	44%				17	17	76%
2020	15	16	3,770	95%	14	14	95%	2	2	100%	2	2	100%	16	16	95%
2021	16	17	3,100	76%	15	15	73%	1	1	59%	6	6	74%	13	13	72%
2022	13	13	3,357	70%	11	11	71%	2	2	56%	3	3	83%	13	13	67%
2023	12	13	6,379	95%	12	12	94%	1	1	100%	11	11	91%	8	8	98%

Table 3-24 Pacific cod pot CV vessel count, number that delivered to tenders, and percentage of catch delivered to tenders by area (SW to NE), 2018-2023 in aggregate

	518	519	517	513	509	516	512	508
Total Vessel Count	45	74	47	8	79	26	34	1
Num. Delivered to Tenders	18	40	29	3	60	18	33	1
% Tot. Wt. Delivered to Tenders	72%	39%	29%	3%	51%	48%	77%	93%

Over the 2018 through 2023 period, the communities to which tendered Pacific cod were delivered were, in descending order, Inshore Floating Processors (37%), King Cove (28%), Dutch Harbor/Unalaska (21%), False Pass (6%), Akutan (4%), Port Moller (2%), Kodiak (1%), and Sand Point (<1%). Of the communities with less tender landings, False Pass was active in 2019 and 2020, Akutan was active in all years since 2019 including 2023A, Port Moller was active in the 2021 and 2022 B seasons, Kodiak was active in the 2020 B season and the 2022 A season, and Sand Point was active only in the 2019 A season.

The share of tendered catch by area also varied by community. The small amount of tendered catch in Area 508 all went to Dutch Harbor in the 2020 B season. Area 512 stands out in that over half of tendered catch from that area went to King Cove. The rest of Area 512 tendered catch was spread across the communities that ranked higher with the most going to Dutch Harbor, but notably almost all of the Area 512 tendered catch that went to Port Moller (2021 and 2022 B seasons) came from Area 512. This would indicate that there is substantial interest in tendering to Port Moller when that plant is operating for Pacific cod. Area 516 tendered catch went primarily to King Cove. Area 509 tendered catch went primarily to Dutch Harbor and the inshore floating processor sector in combination, but King Cove took roughly one-third of its tendered cod catch from Area 509. Most of the tendered catch going to Akutan came from Area 509. It is notable that there was much catch to go around from Area 509, which made up roughly 40% of tendered catch volume during the 2018-2023A period. Tendered catch from Areas 517, 518 and 519 went primarily to Dutch Harbor and the inshore floating processor sector in combination, with King Cove receiving most of the remainder.

Although data from the most recent years shows a strong interest in tendering pot cod from the eastern portion of the Bristol Bay region, the future availability of tender markets is not guaranteed. The current market challenges facing Alaska groundfish fisheries described at the beginning of Section 3 are reportedly causing processors to reduce their tender fleets due to cost or temporarily closing processing operations altogether. Processors might reduce demand for fish due to hold-over inventories, or use tenders to store fish. Cod tenders can be operated at relatively lower cost with less crew than a salmon tender because catch does not need to be sorted, but this means that the tender vessel and its crew might receive a lower rate. Also, the cod fishery offers a less reliable opportunity to crew-up compared to salmon. In the salmon fishery, tenders have a guaranteed season whereas a cod tender could be idled unexpectedly if the fleet stops fishing due to reduced demand from processing buyers.[31]

3.2.3.2 Revenues in NMFS Area 512

Table 3-25 shows the percentage of gross revenues derived from Pacific cod pot gear harvest in Area 512 relative to total revenue in all Alaska fisheries for the vessels that were active in the area from 2013 through 2022 (revenue data for 2023 are unavailable at the time of writing). Vessel counts are grouped by the proportion of total revenues derived from Area 512 pot cod. The table reflects the fact that the area is now mostly prosecuted by the O60 CV fleet and that the area-fishery's importance has increased for a small number of vessels. Since 2019, at least one O60 CV has relied on the area's pot cod fishery for 40% or more of total annual gross revenue. Until 2022, the majority of vessels active in the area generated less than 20% of revenue from that fishing. Revenues and vessel counts for pot cod fishing in this area are also extensively reported in the tables in Section 3.4.1.2, below.

Data confidentiality restrictions prevent the reporting of annual gross revenue estimates by vessel group (CPs, CVs ≥ 60' LOA, and CVs < 60' LOA) due to low numbers of CPs or U60 CVs operating in Area 512 during most years. It can be reported that 82% of total gross revenues from pot cod fishing in the area (estimated at the ex-vessel level) were attributed to the O60 CV sector over the 2013 through 2022 period. CPs have not been active in Area 512 since 2019, so looking at the 2020 through 2022 period may be more reflective of current participation in the area; during that time, O60 CVs account for 93% of gross ex-vessel pot cod revenue with the remainder coming from U60 CVs. In 2015 was the sole year when CP revenues in Area 512 were reportable, and gross first wholesale revenue was estimated at roughly $900,000. U60 CV revenue for Area 512 has not been reportable (three or more vessels) during the analyzed period. O60 CV revenue in Area 512 has been reportable since 2018. Aggregate gross annual revenue from the area for that group of vessels ranged between $2.1 and $4.7 million (inflation adjusted 2022$).

[31] O. Lone, Dec. 2023. Pers. Comm.

If pot cod fishing is prohibited in Area 512 under Alternative 3, it is likely that fishing effort will be redistributed to other BS areas rather than forgone completely. Also, data from recent Pacific cod harvests might not be a perfect predictor of future harvests or market conditions. Given those caveats, historical data may help gauge the maximum adverse revenue impact ("revenue at risk") for each segment of the pot cod fleet. As noted in Table 3-25, most of the pot cod vessels that have fished Area 512 exceed the length restrictions for the state-waters cod fisheries, so any redistributed effort would most likely occur in other Federal cod areas, in crab fisheries (if open, but limited by rationalized quota holdings), or to the Gulf of Alaska. Cross-participation in crab fisheries was noted in Section 3.1.3.

Table 3-26 shows revenue dependence on Area 512 Pacific cod pot fishing in the context of other cod fishing, vessels' aggregate revenues from crab fisheries, and total fishing revenues in the five most recent years. The rows in the table aggregate vessels by the reported location of vessel ownership residence, as necessary to maintain data confidentiality. The columns in the table are not additive; revenues from Area 512 are included in revenues from Pacific cod across all areas. Many of the vessels in the O60 sector participate in crab fisheries and have derived a substantial portion of their revenue from those fisheries when they are open. In general, revenue from Pacific cod in Area 512 is not the primary revenue source for the active participants from the O60 sector, but the relative importance of Area 512 cod catch will vary by vessel. Furthermore, in years when directed crab fisheries are closed, vessels are likely more dependent on cod revenues. The cumulative revenue impacts from closing Area 512 to pots, combined with BBRKC directed fishery closures, are partly determined by the quality of cod fishing opportunities in other areas and whether those areas are operationally viable for CVs that must deliver shoreside or have a tender vessel market.

Table 3-25 Number of vessels targeting Pacific cod in Area 512 and associated percentage of total gross revenue from Area 512 pot cod fishing (revenue data for 2023 are unavailable at the time of writing)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
U60 VESSELS	21	15	21	21	22	27	30	35	25	18	20
AREA 512 VES	0	0	0	0	0	0	2	2	1	2	1
0-10%								1		1	-
10-20%							2		1		-
20-30%								1		1	-
O60 VESSELS	31	31	23	25	34	34	35	39	23	30	22
AREA 512 VES	0	0	0	0	0	5	15	14	15	11	11
0-10%						3	4	5	5	1	-
10-20%							7	4	7		-
20-30%							3	3	2	3	-
30-40%						2		1		3	-
40-50%							1	1	1	1	-
50-60%										2	-
60-70%										1	-
CP VESSELS	3	4	4	4	4	5	4	5	4	3	0
AREA 512 VES	1	1	3	1	1	1	1				
0-10%		1	2			1					
10-20%	1		1								
20-30%				1	1						
40-50%							1				

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT

Table 3-26 Revenue sources for O60' Pacific cod pots catcher vessels that operated in Area 512, ex-vessel revenues from 2018-2022 in millions of real (inflation-adjusted) 2022$

Geography	Annual Average Ex-Vessel Gross Revenues from 512 Pacific cod	Annual Average Ex-Vessel Gross Revenues from Pacific cod	Annual Average Ex-Vessel Revenues from All Crab	Annual Average Total Ex-Vessel Revenues from All Areas, Gears, and Species Fisheries
Homer/Kodiak/Anchor Point/Anchorage	$0.9	$1.3	$2.5	$4.4
Washington/Other States	$1.2	$2.0	$15.4	$18.4
Grand Total	$2.0	$3.4	$18.0	$25.9

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT

3.2.4 Pacific Cod HAL Gear

Table 3-1 shows that overall BS groundfish catch in the HAL sector declined over the analyzed period. While likely unrelated to that trend, the amount of HAL gear catch in the RKCSA has gone to near zero. It was noted in October 2022 testimony to the Council that reduced effort in the RKCSA is related to the movement of target species (cod) to the north, but it is possible that effort could resume in the Savings Area if cod distributions revert. Taken together, Table 3-1 and Table 3-5 show that PSC of RKC with HAL gear does occur and generally tracks fishing effort.

Table 3-27 summarizes vessel participation and gross revenues for the BS FMP area as a whole and the RKCSA. Revenues are not additive across the BS and RKCSA fields.

Table 3-27 Vessel count and gross revenues (millions of 2022$) for groundfish HAL gear sector fishing in the BS FMP area and the RKCSA (2018-2023)

	CP				CV			
	Bering Sea		RKCSA		Bering Sea		RKCSA	
	Wholesale ($MM)	# Vessels	Wholesale ($MM)	# Vessels	Ex-Vessel ($MM)	# Vessels	Ex-Vessel ($MM)	# Vessels
2018	234.1	25	7.8	6	0.8	6	-	0
2019	188.0	23	-	0	1.1	8	-	0
2020	135.2	20	*	2	0.9	11	-	0
2021	116.1	17	-	0	*	2	-	0
2022	179.2	19	*	2	0.1	5	-	0
2023	unk.	18	-	0	*	1	-	0

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA.
‘unk.’ = data unknown at the time of writing.

3.3 Historical Analysis of Groundfish Effort Distribution and Bycatch

3.3.1 PSC Rate Approach

In June 2023, staff reported on estimated changes in halibut, salmon, and crab PSC caught by groundfish fleets if displaced from the RKCSA between 2020 and 2022. This approach was based on PSC rates defined as the amount of PSC per metric ton of groundfish caught, and is referred to here as the “PSC Rate Approach.” In June 2023, the Council requested that staff incorporate that analysis into the EA/RIR, expand the timeframe to include the past 10 years, and analyze the impacts under Alternative 3 in addition to Alternative 2. The following section includes this expanded analysis between 2013 and 2022, by season, including the comparison of Alternatives 2 and 3 as it relates to pot gear. A complete description of the methods of this approach can be found in Appendix 2. Briefly, PSC changes are estimated by multiplying the PSC rate of areas displaced to, and then subtracting the PSC from the displaced area (e.g., RKCSA) that would have no longer been caught. For each year and season, the areas displaced to represent a ‘maximum’ scenario, where statistical areas with the highest average PSC rates were chosen as groupings of equal size to the areas displaced from (e.g., RKCSA, Area 512, or both).

3.3.2 CPUE-Based Approach

Also in June 2023, the SSC recommended additional steps to more accurately portray the likely range of costs and benefits of the proposed alternatives, and the Council requested staff to incorporate their recommendations as practicable. The SSC recommendations included the development of a richer and better-integrated model of effort displacement across the fleets, and using the predicted spatial effort reallocation to estimate key outcome variables such as the changes in PSC. To follow this recommendation, a new “CPUE-Based Approach” was developed to displace historical effort toward new areas having the highest catch per unit effort (CPUE) of targeted groundfish. This approach represents a more likely scenario under the assumption that high catch rates of the targeted groundfish would attract the displaced effort. Per the SSC recommendation, the predicted spatial effort reallocation was then used to estimate the change in PSC by multiplying the displaced effort by the PSC CPUE in the new areas, and subtracting the PSC from the displaced area (e.g., RKCSA) that would have no longer been caught. Finally, staff presented the results of this approach to industry experts to receive feedback on the likelihood of the modeled effort relocation. This analysis is presented over the past 10 years (2013-2022), by season.

3.3.2.1 Catch and Effort

Estimates of groundfish catch and effort to develop spatial CPUEs were obtained from the National Marine Fisheries Service's Catch-in-Areas (CIA) by gear type. The CIA relies on vessel monitoring system (VMS) tracks at the haul level, and contains an outlier filtering based on probable vessel speeds. For this analysis, only hauls with a performance rating showing no issue were utilized. Additionally, because we were only interested in rates, only observed hauls were utilized. For the trawl fisheries, to remove any hauls that were immediately retrieved and not representative of fishing, a final step removed a number of hauls with an effort of fewer than 10 minutes. This was determined to be the minimum time needed to consider all components of the net in the water following the beginning of the deployment time (i.e., time the codend first enters the water). For all fleets, catch represents the retained groundfish weight of a haul in tons.

Effort was presented in time (minutes) for the PTR and NPT gears, and as the number of pots or hooks for POT and HAL gears. The distributions of efforts used by year and season can be found in Appendix 1. Effort was limited to trips occurring in the Bering Sea during the time series and consisted of trip targets of Pollock (PTR) and Pacific cod (HAL, POT). For NPT, all trips targeting either rock sole or Pacific cod were included, as industry representatives noted that some vessels target species on a haul-by-haul basis. However, since the CIA only reports the target at the trip level, these two species were grouped to capture the most likely effort in the RKCSS as suggested by industry experts. Catcher processors (CPs) and catcher vessels (CVs) are aggregated in this analysis, as CVs have had low effort in this area during the time series (as with NPT, POT, and HAL), or did not differ in spatial catch (as with PTR).

3.3.2.2 Displacement Locations

The efforts displaced were based on the gear included in each alternative. For PTR, NPT, and HAL, effort was displaced from the RKCSA only (Alternative 2). For pot gear, the effort is displaced by three scenarios – displacement from the RKCSA (Alternative 2), displacement from Area 512 (Alternative 3), and displacement from both the RKCSA and Area 512. Displaced effort was distributed evenly to the new grid cells. For example, 100 minutes of effort distributed to four new grid cells would result in each of the four new areas receiving 25 minutes of effort.

The displaced efforts were distributed to a selection of grid cells having the highest groundfish CPUE under the assumption that high catch rates would attract the displaced effort. For all gears displaced from the RKCSA, the selected high CPUE areas consisted of the highest four CPUE grids (roughly equal to the area of the RKCSA), while the Pot gear was displaced to eight new grids (roughly the area of Area 512), or 12 new grids (roughly the area of both the RKCSA and Area 512).

Areas of high catch rates were determined through a selection of weighted mean groundfish CPUEs, which were developed as a product of mean CPUE and the total area covered per statistical area. An example is represented for PTR in Figure 3-9. In this way, the chance that a small area (sometimes a single pixel) of high CPUE resulted in the selection of a statistical area that may not be able to absorb the displaced effort was minimized. Annual mean values per season in the time series (2013-2022) represent the full spatial scale of the fisheries.

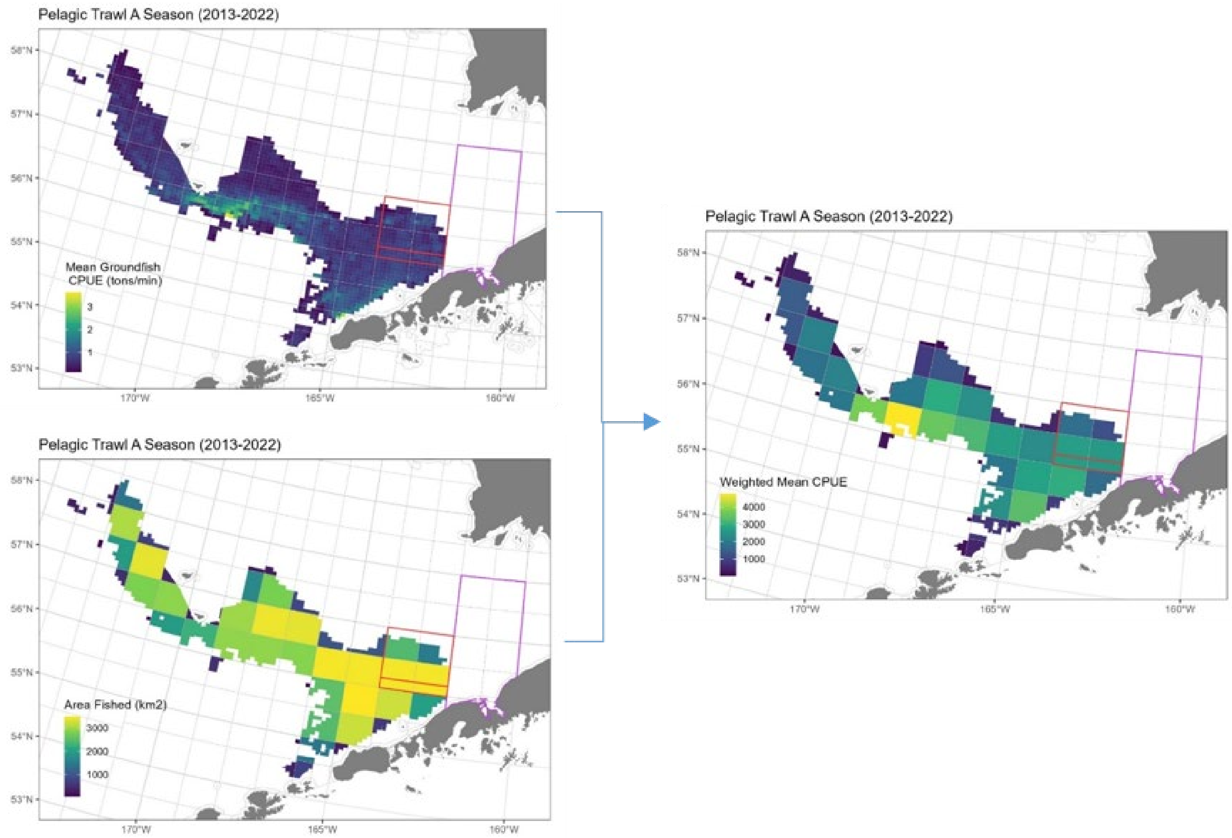


Figure 3-9 Example process of estimating weighted mean CPUE (right) by multiplying mean spatial CPUE (top left) and the area fished (bottom right) of each statistical area.

3.3.3 Results

The results of both the PSC Rate Approach and CPUE-Based Approach are reported for halibut, salmon, and crab based upon the gear type used (PTR, NPT, POT, and HAL). These results provide a summary of the main findings, including a comparison to the PSC caught in each fleet across the Bering Sea in the years and seasons analyzed. A complete list of tables and figures relating to the estimates of each method are provided in Appendix 2 to this document (attached separately).

3.3.3.1 Pelagic Trawl: Alternative 2

<u>Chinook salmon</u>

The displacement of PTR from the RKCSA was estimated to increase the A season Chinook PSC in most years under both approaches (Figure 3-10). Under the PSC Rate Approach, the peak 2016 A season displacement estimated a PSC increase of 15,580 fish (a 93% increase over that year's Chinook PSC by PTR in the Bering Sea), while the CPUE-Based Approach estimated a peak of 8,548 fish in 2021 (a 90% increase).

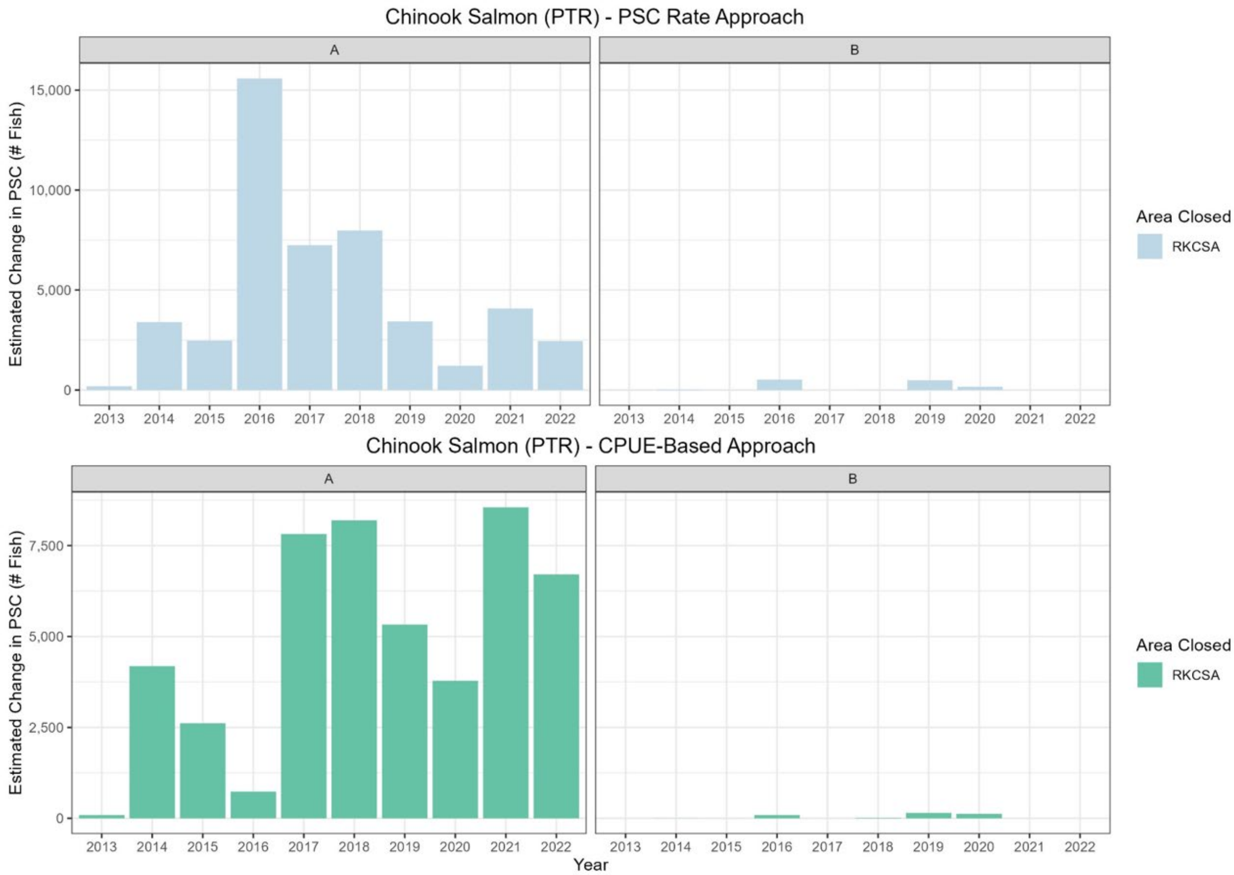


Figure 3-10 Estimated change in Chinook salmon PSC in PTR gear by year and season if displaced from the RKCSA based on the PSC Rate Approach (top) and CPUE-Based Approach (bottom).

Non-Chinook salmon

The displacement of PTR gear from the RKCSA was estimated to increase non-Chinook salmon PSC in some years, primarily during the B season (Figure 3-11). Similar peaks occurred between the PSC Rate and CPUE approaches in 2016 and 2020, with the PSC Rate Approach estimating higher increases in both cases. The peak 2016 B season was estimated to increase by 41,474 fish (a 12% increase compared to the Bering Sea non-Chinook PSC in PTR in that year and season) by the PSC Rate Approach, and by 26,153 fish by the CPUE-Based Approach (a 7.7% increase).

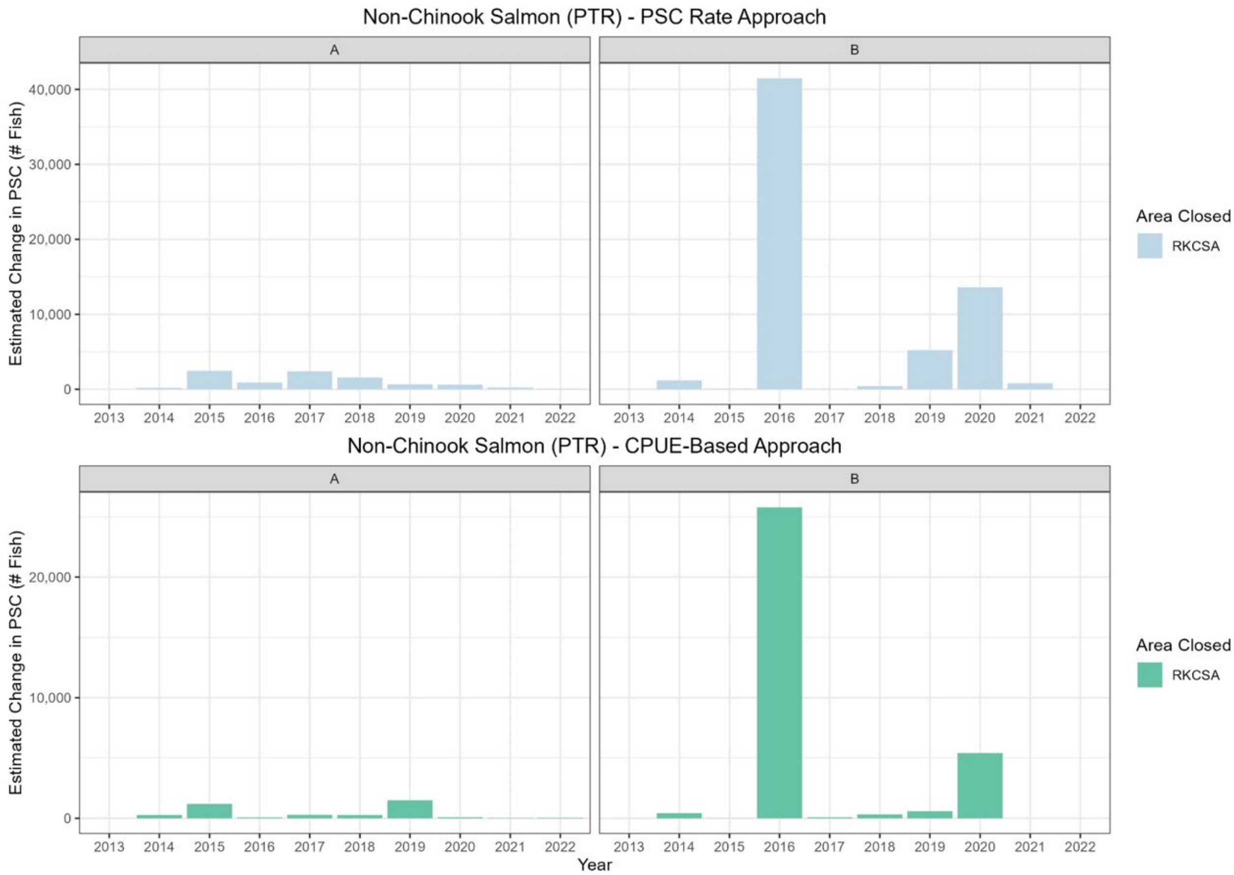


Figure 3-11 Estimated change in non-Chinook salmon PSC in PTR gear by year and season if displaced from the RKCSA based on the PSC Rate Approach (top) and CPUE-Based Approach (bottom).

Pacific Herring

The displacement of PTR gear from the RKCSA was estimated to increase Pacific herring PSC in most years of the A Season (Figure 3-12). In general, the PSC Rate Approach estimated greater increases, and the trends of two approaches differed in certain years. Under the PSC Rate Approach, the peak 2017 A season PSC was estimated to increase by 2,388 mt (a 913% increase compared to that year and season's Bering Sea herring PSC in PTR), while the CPUE-Based Approach estimated a peak increase of 526 mt in 2019 (a 251% increase).

Figure 3-12 Estimated change in Pacific herring PSC in PTR gear by year and season if displaced from the RKCSA based on the PSC Rate Approach (top) and CPUE-Based Approach (bottom).

3.3.3.2 Non-Pelagic Trawl: Alternative 2

<u>Red King Crab</u>

The displacement of NPT from the RKCSS led to estimated changes in red king crab PSC primarily in the A Season (Figure 3-13). Under the PSC Rate Approach, years of high and low estimates alternated, while the CPUE-Based Approach estimated decreases ranging from 209 crabs in 2017 to 7,874 crabs in 2014 (a 30% decrease over that year and season's Bering Sea red king crab PSC by NPT).

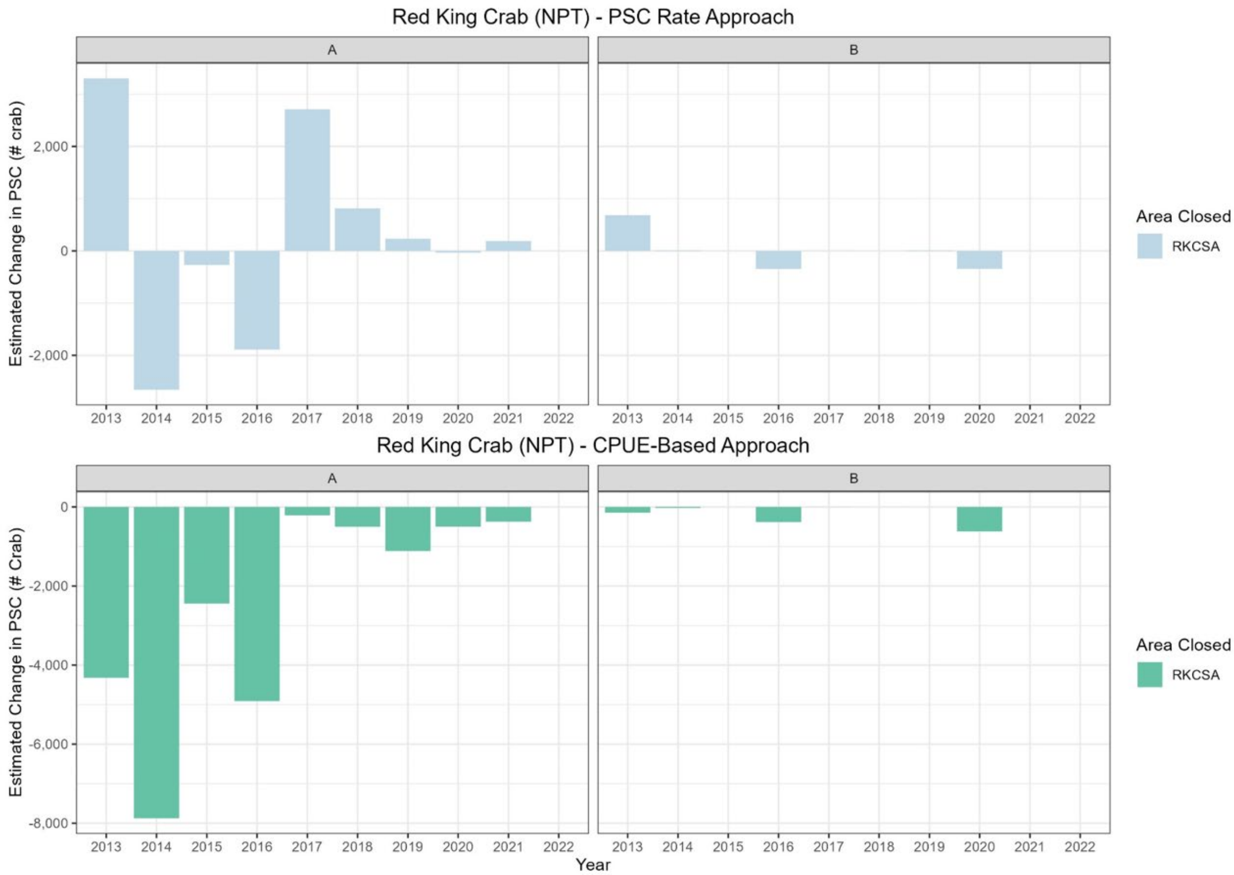


Figure 3-13 Estimated change in red king crab PSC in NPT gear by year and season if displaced from the RKCSA based on the PSC Rate Approach (top) and CPUE-Based Approach (bottom).

<u>Opilio Crab</u>

The displacement of NPT from the RKCSS led to increases in Opilio PSC, primarily in the A Season (Figure 3-14). Under the PSC Rate Approach, the large peak in the 2014 A Season was the result of a high catch of groundfish within the RKCSS that year was applied to high PSC rates north of the Pribilof Islands, an area where NPT effort has not historically targeted rock sole or Pacific cod (Appendix 2). A more likely scenario, the CPUE-Based Approach estimated a peak increase of 9,678 crabs in 2014 (a 7.5% increase over that year and season's Bering Sea Opilio PSC by NPT).

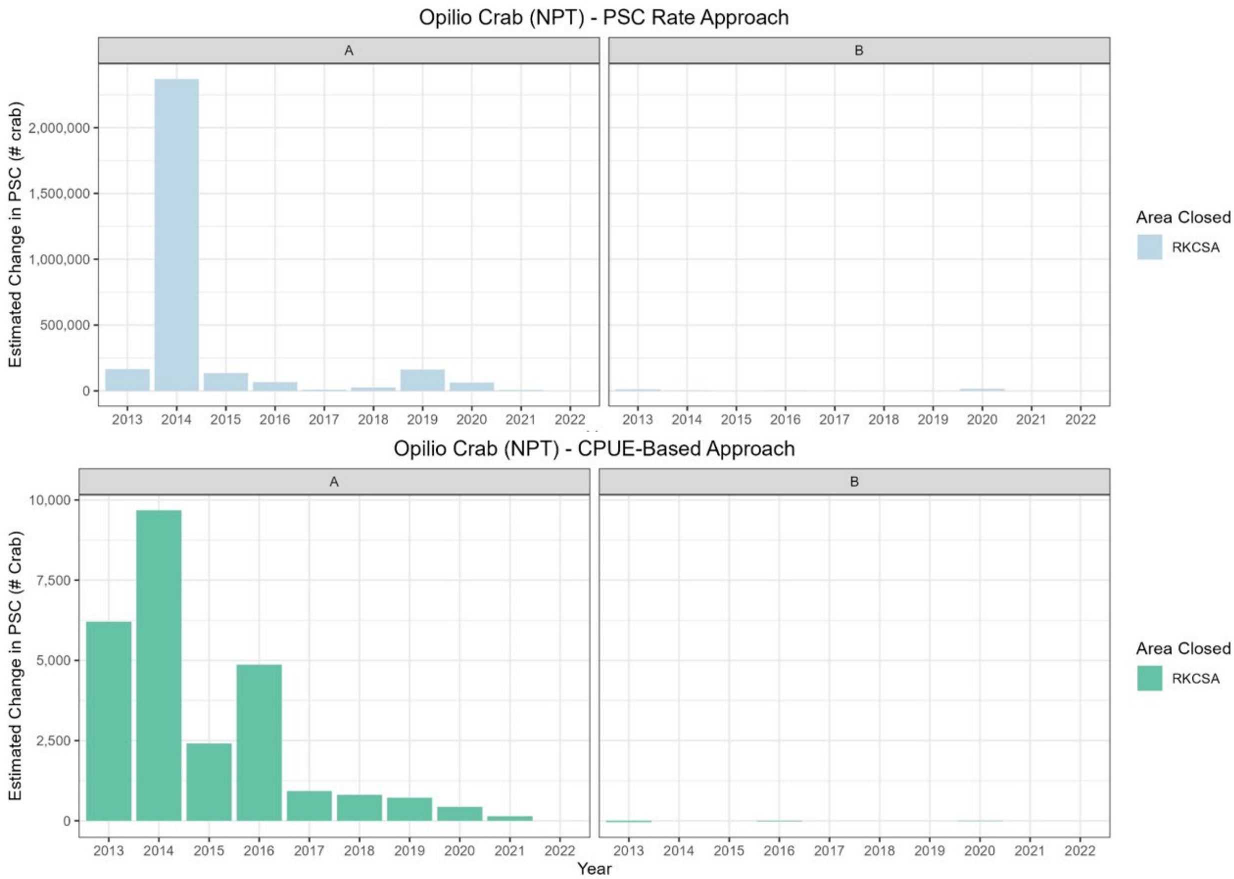


Figure 3-14 Estimated change in Opilio crab PSC in NPT gear by year and season if displaced from the RKCSA based on the PSC Rate Approach (top) and CPUE-Based Approach (bottom).

<u>Bairdi Crab</u>

The displacement of NPT from the RKCSS generally led to increases in Bairdi PSC in the A Season (Figure 3-15). The overall trends between the approaches were similar, with the PSC Rate Approach resulting in higher estimates of increases. The PSC Rate Approach estimated a peak increase of 163,540 crabs in 2016 (a 264% increase over that year's Bering Sea Opilio PSC by NPT) compared to a peak increase of 11,350 crabs in 2017 (a 4% increase) in the CPUE-Based Approach.

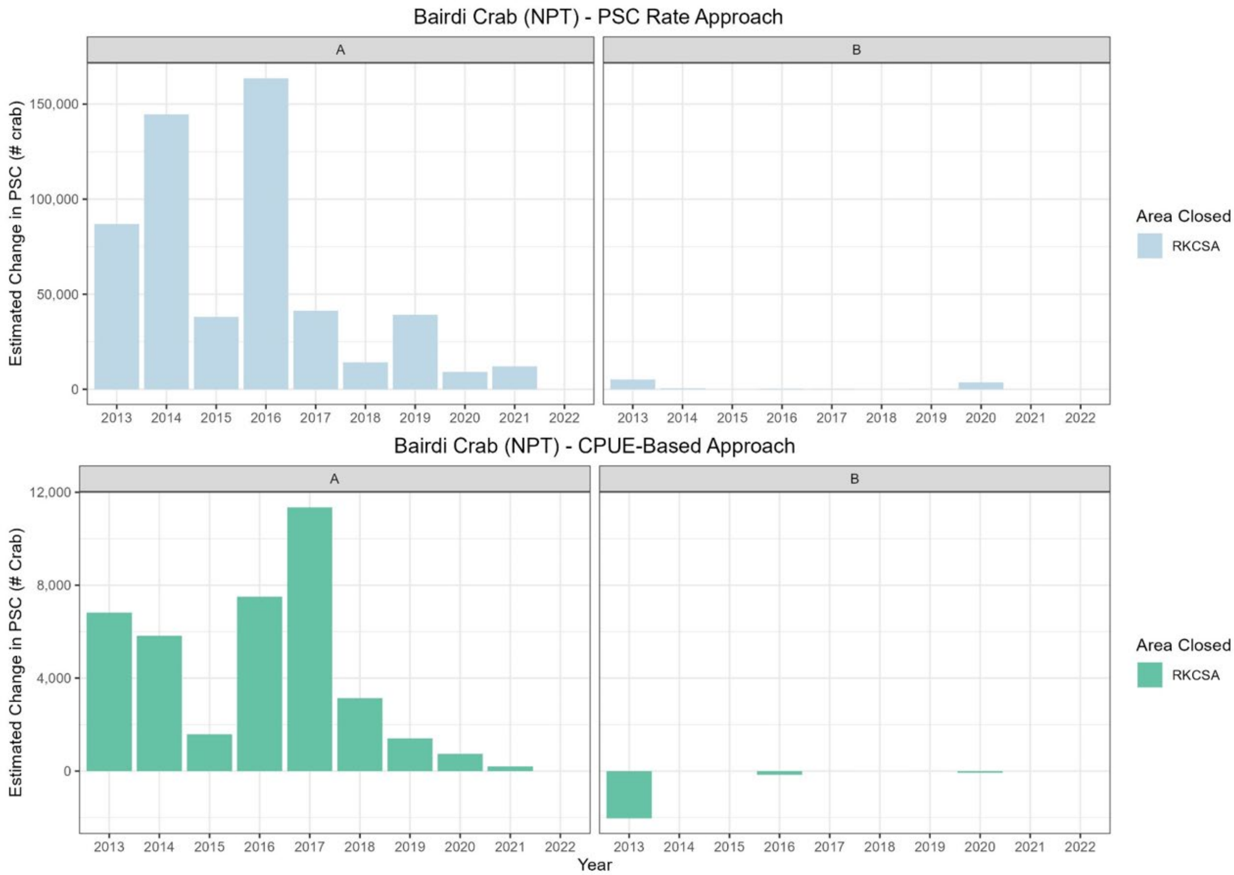


Figure 3-15 Estimated change in Bairdi crab PSC in NPT gear by year and season if displaced from the RKCSA based on the PSC Rate Approach (top) and CPUE-Based Approach (bottom).

<u>Halibut</u>

The displacement of NPT from the RKCSS generally led to increases in Halibut PSC in the A season (Figure 3-16). Both approaches estimated similar trends, with the PSC Rate Approach estimating a greater magnitude of increases. Both approaches identified a peak increase in 2014 where the PSC Rate Approach estimated an increase of 1,876 mt (a 123% over that year's Bering Sea halibut PSC by NPT) and the CPUE-Based Approach estimated an increase of 175 mt (an 11.5% increase).

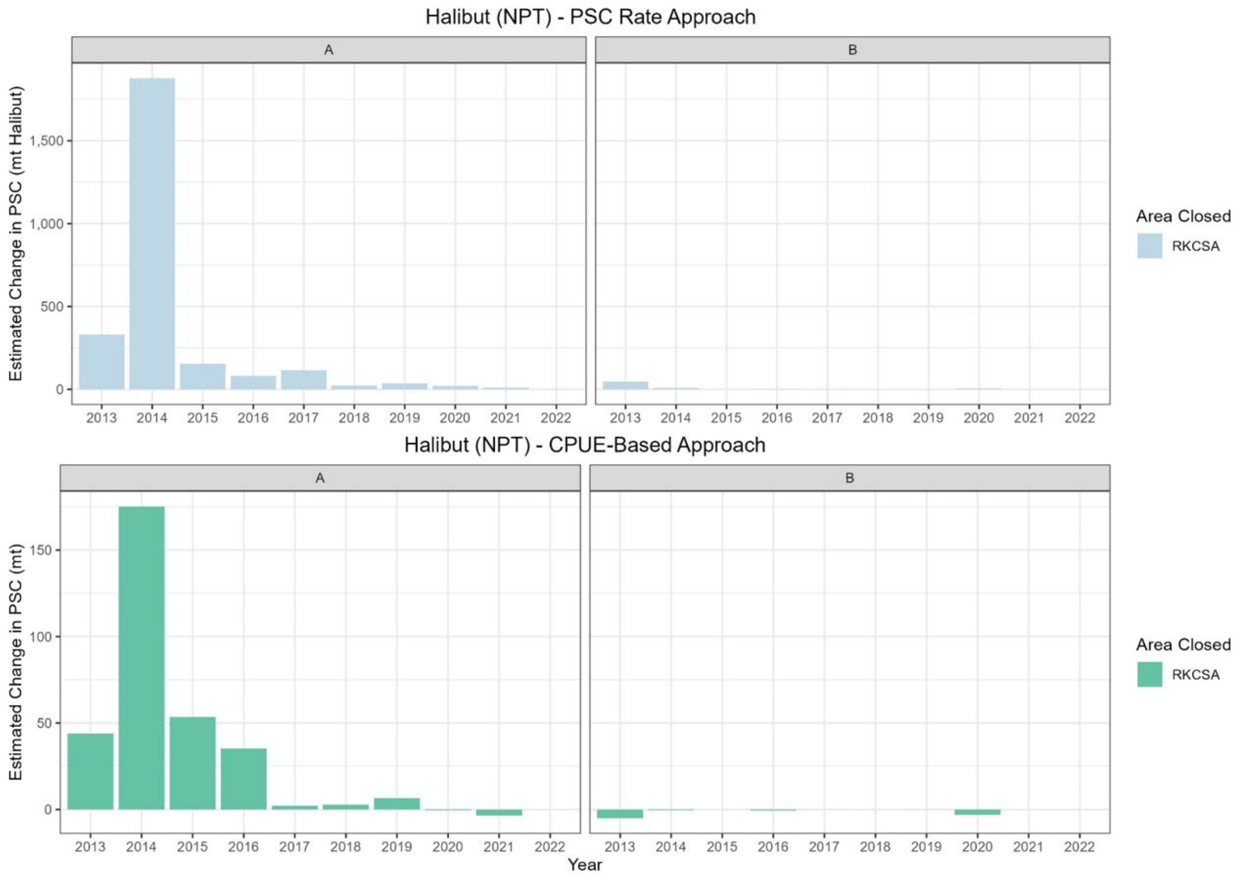


Figure 3-16 Estimated change in Halibut PSC in NPT gear by year and season if displaced from the RKCSA based on the PSC Rate Approach (top) and CPUE-Based Approach (bottom).

3.3.3.3 Pot Gear: Alternatives 2 and 3

<u>Red King Crab</u>

Estimated changes in red king crab PSC under the three scenarios of displacement (RKCSA, Area 512, or both) occurred primarily within the B season, with similar trends between the PSC Rate Approach and CPUE-Based Approach (Figure 3-17). In both approaches, PSC was estimated to increase in most years when displaced from the RKCSA, and decrease when displaced from Area 512 or both areas. When displaced from the RKCSA, the CPUE-Based Approach estimated larger increases than the PSC Rate Approach, with a peak estimate of 372,619 crabs in 2015 (a 230% increase from that year and season’s Bering Sea RKC PSC in POT). These increases appear in part due to the movement into Area 512, which had high PSC CPUEs in that year (Appendix 2). Displacement from Area 512 generally resulted in reduced PSC, peaking at a reduction of 166,550 crabs in the PSC Rate Approach and 215,888 crabs in the CPUE-Based Approach. When displaced from both areas, the estimated reductions largely mirrored that of the Area 512 displacement.

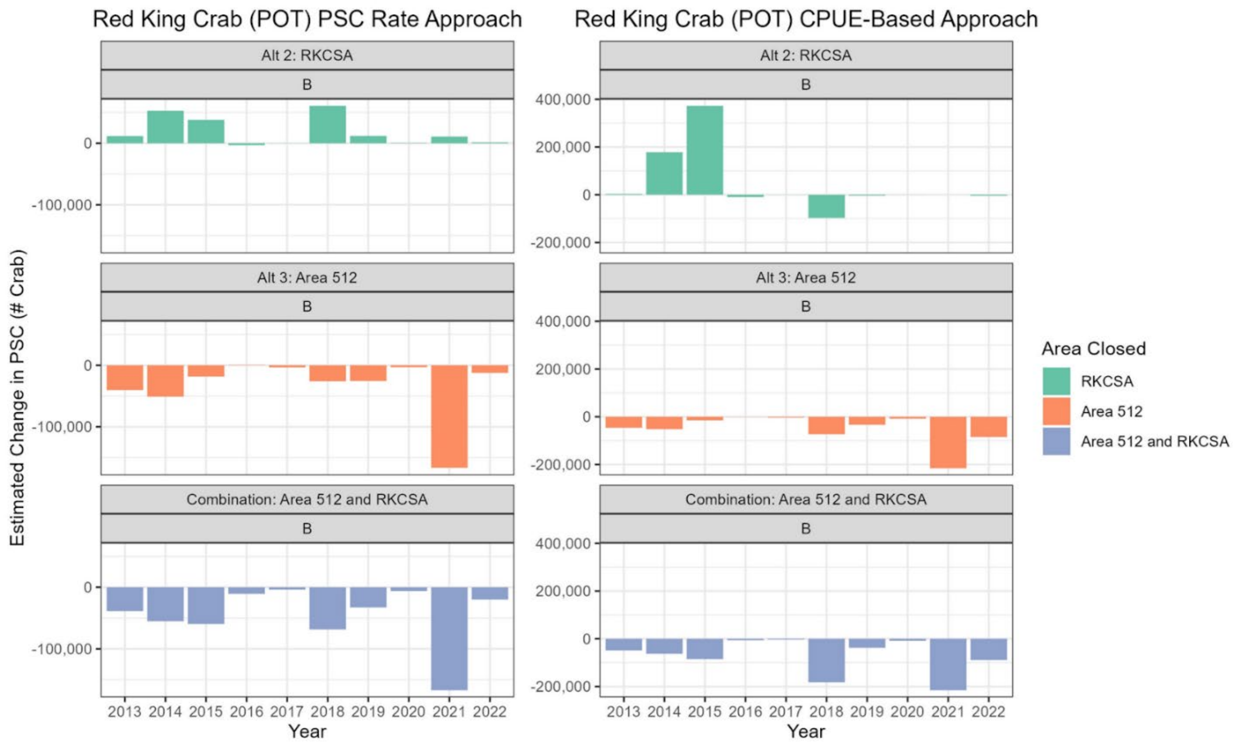


Figure 3-17 Annual B season estimated changes in red king crab PSC in POT gear if displaced from the RKCSA, Area 512, or both, based on the PSC Rate Approach (left) and CPUE-Based Approach (right).

<u>Opilio Crab</u>

The estimated changes in Opilio PSC under the three scenarios of displacement (RKCSA, Area 512, or both) were similar between the two approaches, estimating increases in the B season, with the PSC Rate Approach resulting in greater magnitudes (Figure 3-18). Depending on the year, there appeared to be an additive effect on the increase in PSC when displaced from both areas. In the PSC Rate Approach, a peak increase was estimated in 2019 at an additional 58,685 crabs (a 609% increase of that year and season's Bering Sea Opilio PSC by POT), while the CPUE-Based Approach estimated a peak increase of 47,141 crabs in 2018 (a 140% increase).

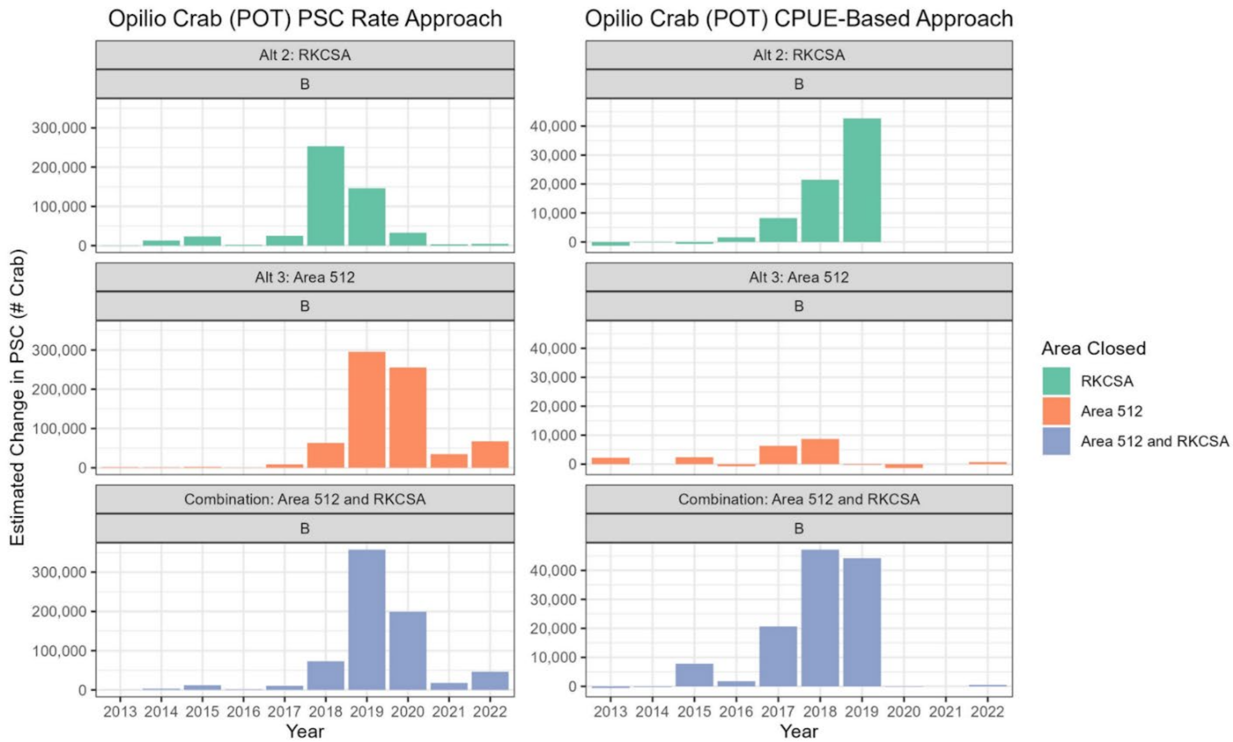


Figure 3-18 Annual B season estimated changes in Opilio PSC in POT gear if displaced from the RKCSA, Area 512, or both, based on the PSC Rate Approach (left) and CPUE-Based Approach (right).

Bairdi Crab

The estimated changes in Bairdi PSC under the three scenarios of displacement (RKCSA, Area 512, or both) were similar in magnitude and trends between the two approaches, with fluctuating years of increases and decreases when displaced from the RKCSA or Area 512, but trending as decreases when displaced from both (Figure 3-19). When displaced from both areas, the CPUE-Based Approach estimated the largest decrease of 114,678 crabs in 2018 (an 80% decrease of that year and season's Bering Sea Bairdi PSC by POT).

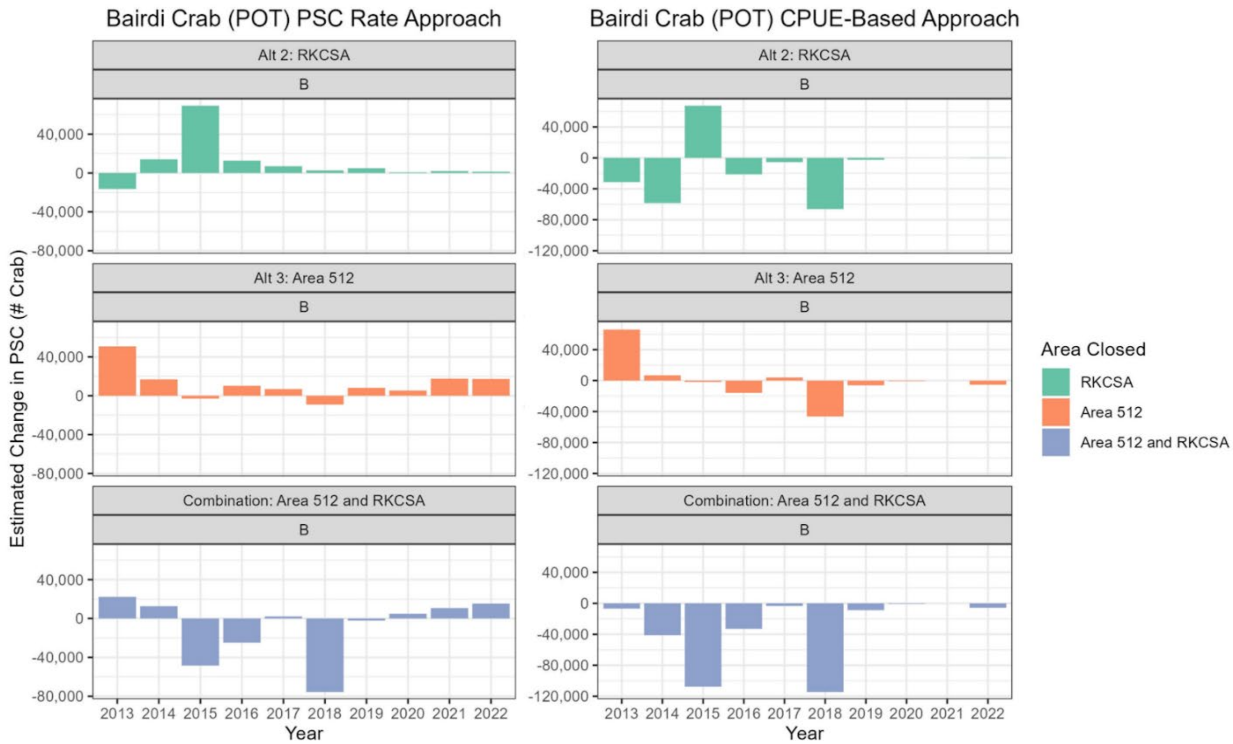


Figure 3-19 Annual B season estimated changes in Bairdi PSC in POT gear if displaced from the RKCSA, Area 512, or both, based on the PSC Rate Approach (left) and CPUE-Based Approach (right).

3.3.3.4 Hook-and-Line: Alternative 2

<u>Halibut</u>

The displacement of HAL gear from the RKCSA generally led to increases in Halibut PSC, with both approaches estimating similar trends across the A and B seasons (Figure 3-20). In most years, the changes were small (under 15 mt). Both approaches identified similar increases, with the PSC Rate Approach estimating a higher magnitude of 86 mt in the 2018 B season (a 131% increase of that year and season's Bering Sea halibut PSC from HAL).

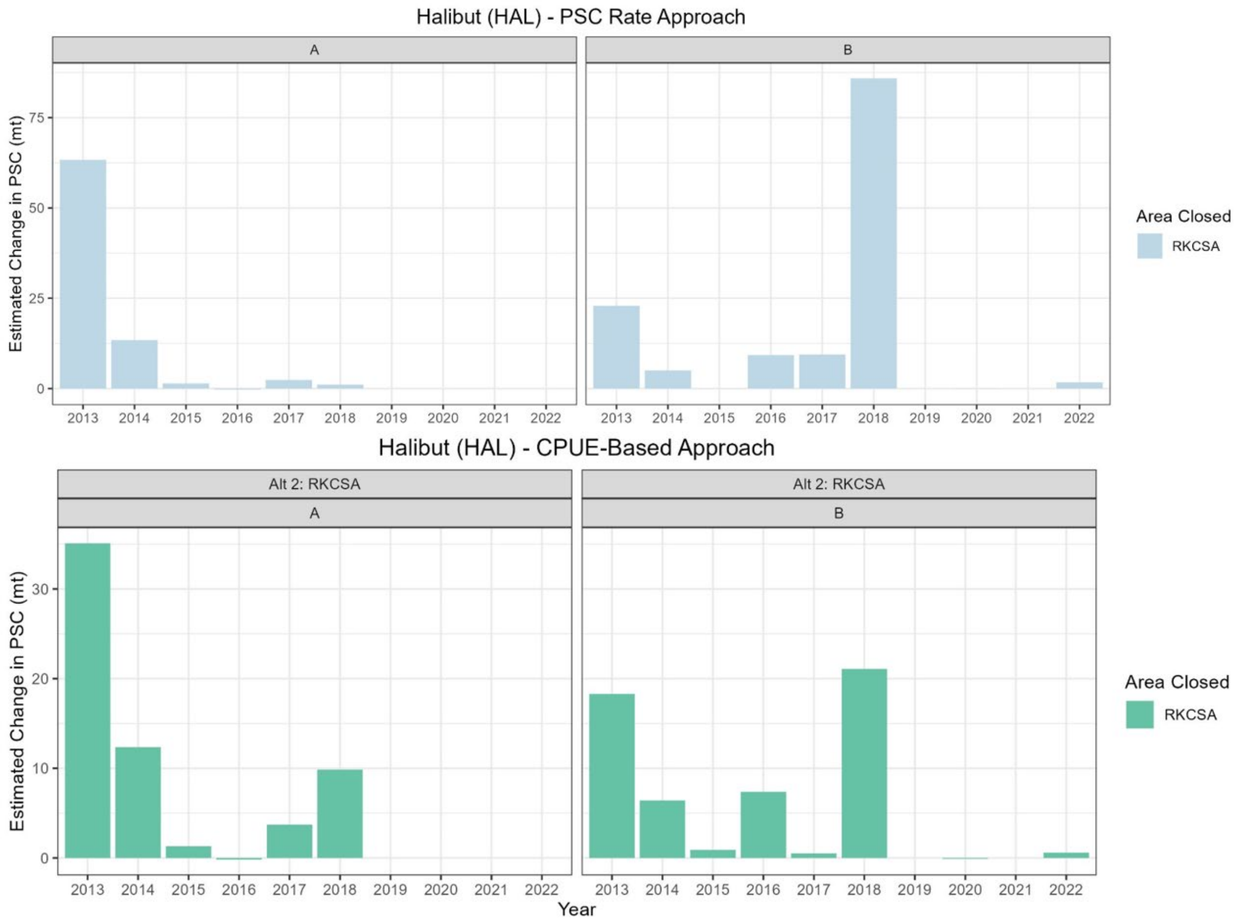


Figure 3-20 Estimated change in Halibut PSC in HAL gear by year and season if displaced from the RKCSA based on the PSC Rate Approach (top) and CPUE-Based Approach (bottom).

3.3.4 Discussion

The PSC Rate and CPUE-Based approaches resulted in similar trends in PSC change among the species, gears, and alternatives. In many cases, both approaches estimated an increase in the PSC of species that were evaluated when fleets were displaced from the RKCSA under Alternative 2. The PSC Rate Approach often estimated higher magnitudes of change. This was not surprising due to the maximum PSC rates used to calculate the changes, resulting in an effective 'worst-case scenario' of displacement into high PSC areas. This, of course, does not account for the likelihood of the displacement actually occurring in those locations. The analysts recognize that the modeled approach is naïve in certain ways to how fishery participants would behave when faced with the real-time feedback of fishing in a new ("displaced") location and finding undesirable or impermissible bycatch rates in that area. Vessel operators are probably not as likely as the results suggest to redistribute the full amount of their effort to an area that is merely substituting one negative bycatch outcome for another. That said, vessel operators are balancing multiple objectives (target catch/quality/CPUE, timing, and various non-target groundfish and PSC species constraints) so the marginal decisions they make when faced with suboptimal choices can be directed by the regulatory incentives that are established by the regulations and the FMP.

By displacing actual effort (in minutes, pots, or hooks) toward productive fishing grounds, the CPUE-Based Approach provided a more likely scenario of each displacement but includes several caveats as well. The approach cannot account for the existing conditions of voluntary avoidance of certain areas (i.e., RKCSA), operational constraints (e.g., CVs preferring not to run as far north unless required to avoid salmon or because the seasonal cap on fishing in the SCA has been met), and regulatory restrictions on certain fisheries that either prevent or disincentivize them from putting effort in and around the RKCSA (e.g., Zone 1 PSC limits, and allocations of other constraining species that might be encountered in the BBRKC management region). For example, pelagic trawl fishery participants consulted by the analysts were able to look at draft versions of the “high-CPUE” areas and quickly conclude that they would not have fished there in certain years due to high reported incidence of Chinook salmon PSC (see, for example, Figure A2-32 in Appendix 2). According to NPT sector representatives, the NPT effort inside the RKCSS has been low at times due to low Pacific cod allocations. That low effort correlated with smaller estimated changes in effects. In all analyzed years, NPT effort was low or zero in the RKCSS during the latter portion of the year, so the analysts do not ascribe any analytical value to “B Season” results for that gear sector (see Table A2-13 in Appendix 2, for example). Regardless of allocation amounts, there may be years when effort is low simply because the target species was not present or aggregated in the RKCSS at the necessary time so NPT vessels moved to other areas. Also, in a multi-species sector like NPT there is nuance to the target mix during the first portion of the year and it is not safe to assume that a specific target (like rock sole with roe) could be caught in a different area at the same time with the same economic benefit.

According to public testimony, some O60 Pacific cod pot CVs have voluntarily avoided fishing in the RKCSA during recent A seasons, which also affects the baseline for evaluating a change in effect. Analytical limitations also included the high proportion of unobserved hauls in the pot fishery, which resulted in fewer “modeled” pots being displaced under the CPUE-Based Approach than the number of pots that were actually fished.

By analyzing annual data divided into “A” and “B” seasons, the analysis of effort naturally captures underlying operational and environmental constraints in where vessels might redistribute effort because high-CPUE areas would not exist without a history of fishing in that area during that time of year. That said, there will always be some imprecision in circumstances where the CPUE-Based Approach might indicate that, for example, pelagic trawl effort that occurred in the RKCSA during February could be displaced northwest toward the Pribilof Islands where, in fact, participants would say pollock are not aggregated there until late March.

The areas of high groundfish CPUE might not always be where the fishery will go, as competing goals often include seeking higher quality fish or the avoidance of other PSC species. The semiannual-level data shown in Appendix 2 and in the preceding results section recognizes annual variability in external factors like sea ice extent from the north and product quality that may be related to water temperature for certain target species. Participants in the HAL CP sector noted that some operators might choose to fish at a lower CPUE if flesh quality is higher. Participants in the pelagic trawl CP sector similarly related that effort is not equated to CPUE, and that bycatch rates, fish size, or fish quality are often preferred to catch volume per tow. Vessels might also avoid higher CPUE areas due to gear congestion on the grounds.

The conclusions of the paired analyses are illustrated in the series of results figures in Section 3.3.3. Specific to RKC, which is the focus of the purpose and need statement, the displacement of NPT from the RKCSS under Alternative 2 led to estimated reductions of RKC PSC, while other species evaluated were estimated to increase. The displacement of pot gear from the RKCSA under Alternative 2 also led primarily to estimated increases in RKC PSC, while its displacement from Area 512 (Alternative 3) led to estimated decreases in RKC PSC. RKC PSC impacts for PTR and HAL gear were not evaluated with these approaches due to the low incidence of PSC for that species.

3.4 Communities and Inshore Groundfish Processing

This section summarizes participation, revenues, and relative dependency across communities that participated in the pollock and Pacific cod groundfish fisheries that occur in either the RKCSA or the Pacific cod pot fishery in Area 512. This section provides the type of data that is often included in a social impact assessment (SIA) for an EIS. The section is generally divided into subsections of tables that show the participation/revenue/dependency metric summaries for the harvesting sector (or harvesting/processing in the case of CPs) and tables that show the shore-based processing sector. SIA-type tables are based on eLandings data sourced by AKFIN from the State of Alaska's Commercial Fisheries Entry Commission (CFEC); CFEC updates its annual data in late spring, thus 2023 data are not included in most of the tables below.

Where the analysts can be more specific to the areas of interest under the action alternatives, tables break out community linkages for the subset of vessels that participated in either the RKCSA or Area 512 during the analyzed period. Using historical data means that the analysts are not accounting for vessels or processors that were not involved in catch and/or processing from one of these areas during the analyzed period but that might wish to do so in the future. Activity patterns in the RCKSA are fairly well-established and cover a wide range of fisheries, so – all else equal – the recent past should be a good proxy for near- to medium-term desired participation in that area. The Area 512 Pacific cod pot fishery has had more recent shifts in participation (increased participation overall, and particularly a shift towards O60 pot CVs delivering to tender vessels). That might signal that the area-fishery is either more volatile in terms of resource availability (catchability), processor availability, market strength, or fleet interest in the context of other fishing opportunities for these vessels (e.g., declining opportunities in direct crab fisheries).

An analysis of potentially forgone tax revenue is not included in this document under the presumption that closing the RKCSA and/or Area 512 to groundfish gears would shift fishing effort to other areas rather than cause it to be forgone completely. While it is possible that total revenues might be lower, all else equal, the analysts are not able to make a direct linkage between the inability to fish in the RKCSA/512 at certain desired times and a specific marginal change in total gross revenues for a gear sector over the course of a year. Gross fishing revenues vary annually for a variety of factors. In the case that the revenues reported in Section 3.2 decrease, tax revenues that accrue to the State of Alaska and the localities where fish are landed will also decrease. Potential tax revenues are typically estimated at 3.5% of estimated ex-vessel value. That levy represents the sum of the Fisheries Resource Landing Tax (AS 43.77) for CPs or the Fisheries Business Tax for CVs (AS 43.75), as well as the Seafood Marketing Assessment.[32] The Fisheries Business Tax is collected primarily from the licensed shoreside processors who purchase fish from CVs.

[32] In addition to these state taxes, some communities have developed local tax programs related to the fishing industry. These include taxes on raw fish transfers across public docks, fuel transfers, extraterritorial fish and marine fuel sales, and fees for bulk fuel transfer, boat hauls, harbor usage, port and dock usage, and storing gear on public land. There is no one source for data on these revenue streams; however, most communities self-report them in their annual municipal budgets collected by the Alaska Division of Community and Regional Affairs. Most local raw fish taxes are levied at 2.0% with a range from 1.5% to 3.5%.

3.4.1 Harvesting Vessels

3.4.1.1 RKCSA

Table 3-28 Catcher Vessels Targeting Federal Groundfish in the RKCSA by Community of Vessel Historical Ownership Address and Fleet, 2013-2022

Fleet	Community	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Annual Average 2013-2022 (number)	Annual Average 2013-2022 (percent)	Total Unique Vessels 2013-2022 (number)
AFA Mothership Catcher Vessels	Anchorage	0	0	0	0	0	0	0	0	0	1	0.1	0.97%	1
	Kodiak	0	1	0	0	1	1	1	1	1	0	0.6	5.83%	1
	Seattle WA	0	12	2	14	11	12	13	8	12	12	9.6	93.20%	15
	Fleet Total	0	13	2	14	12	13	14	9	13	13	10.3	100.00%	15
AFA Shoreside Catcher Vessels	Anchorage/Wasilla AK	0	0	0	0	0	0	0	0	0	3	0.3	0.83%	3
	Kodiak AK	0	2	1	1	1	1	2	1	1	0	1.0	2.75%	3
	Newport OR	1	0	1	2	2	7	1	2	2	2	2.0	5.51%	9
	Anacortes WA	0	0	2	2	2	2	2	2	2	2	1.6	4.41%	2
	Neah Bay WA	0	0	1	0	0	0	0	0	0	0	0.1	0.28%	1
	Seattle WA	3	15	8	40	41	50	52	34	26	41	31.0	85.40%	62
	Vancouver WA	0	1	1	1	0	0	0	0	0	0	0.3	0.83%	1
	Washington Total	3	16	12	43	43	52	54	36	28	43	33.0	90.91%	65
	Fleet Total	4	18	14	46	46	60	57	39	31	48	36.3	100.00%	76
Pot Vessels*	Anchorage	0	0	0	0	0	1	1	1	0	0	0.3	5.66%	1
	Homer	0	0	0	0	0	1	1	0	1	2	0.5	9.43%	3
	Kodiak	0	0	0	0	0	1	1	1	0	0	0.3	5.66%	2
	Alaska Total	0	0	0	0	0	3	3	2	1	2	1.1	20.75%	6
	Cascade Locks	0	0	0	0	0	0	0	1	0	0	0.1	1.89%	1
	Clackamas	0	0	0	0	0	1	1	1	0	0	0.3	5.66%	1
	Milton Freewater	0	0	0	1	1	1	1	1	1	1	0.7	13.21%	1
	Oregon Total	0	0	0	1	1	2	1	2	1	0	0.8	15.09%	3
	Bremerton	0	0	0	0	0	0	1	1	0	0	0.2	3.77%	1
	Dear Park	0	0	0	0	0	0	1	0	0	0	0.1	1.89%	1
	Mill Creek	0	1	1	1	1	1	0	0	0	0	0.5	9.43%	1
	Mount Vernon	0	0	0	0	0	1	0	0	0	0	0.1	1.89%	1
	Seattle	1	1	2	1	2	2	4	4	4	1	2.2	41.51%	12
	Vancouver	0	0	0	0	0	0	0	0	0	1	0.1	1.89%	1
	Washington Total	1	2	3	2	3	4	6	5	4	2	3.2	60.38%	17
	Other States	0	0	0	0	0	0	1	1	0	0	0.2	3.77%	2
	Fleet Total	1	2	3	3	4	9	11	10	6	4	5.3	100.00%	28
Grand Total (Unique)		**5**	**26**	**18**	**56**	**57**	**77**	**77**	**53**	**44**	**60**	**47.3**	**100.00%**	**110**

Notes: Due to catcher vessel ownership movement between communities over the years shown, total unique catcher vessels per community may not sum to state or grand totals. Vessels may participate in both AFA Mothership and AFA Shoreside fleets.
* Includes 4 Pot vessels that also operated as CPs.
Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-29 Catcher/Processors Targeting Federal Groundfish in the RKCSA by Community of Vessel Historical Ownership Address and Fleet, 2013-2022

Fleet	Community	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Annual Average 2013-2022 (number)	Annual Average 2013-2022 (percent)	Total Unique Vessels 2013-2022 (number)
AFA Catcher Processors	Anchorage AK	0	1	1	1	1	1	1	1	1	1	0.9	7.14%	1
	Seattle WA	7	15	12	10	13	13	12	11	12	12	11.7	92.86%	16
	Fleet Total	7	16	13	11	14	14	13	12	13	13	12.6	100.00%	17
Hook and Line Catcher Processors	Anchorage AK	2	2	1	1	1	2	0	1	0	1	1.1	16.42%	3
	Petersburg AK	0	0	0	1	0	0	0	0	0	0	0.1	1.49%	1
	Seattle/Lynden WA	14	13	8	4	9	4	0	1	0	2	5.5	82.09%	20
	Fleet Total	16	15	9	6	10	6	0	2	0	3	6.7	100.00%	24
A80 Catcher Processors	Seattle WA	11	15	14	13	10	8	9	7	5	0	9.2	83.64%	15
	Rockland ME	3	3	3	3	2	0	1	2	1	0	1.8	14.29%	4
	Fleet Total	14	18	17	16	12	8	10	9	6	0	11.0	87.30%	18
Grand Total		**37**	**49**	**39**	**33**	**36**	**28**	**23**	**23**	**19**	**16**	**30.3**	**100.00%**	**59**

Note: Due to vessel ownership movement between communities over the years shown, total unique catcher vessels per community may not sum to state or grand totals.
Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-30 CV Ex-Vessel Values from Federal Groundfish in the RKCSA by Community of Vessel Historical Ownership Address and Fleet, 2013-2022 (values in 2022 dollars)

Fleet	Community	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Annual Average 2013-2022 (dollars)	Annual Average 2013-2022 (percent)
AFA Mothership CVs	Fleet Total	0	4,571,320	84,086	3,370,297	5,243,301	6,866,153	2,811,422	1,634,647	2,236,641	3,677,127	3,049,499	100.0%
AFA Shoreside CVs	Alaska	0	*	*	*	*	*	*	*	*	*	316,859	4.0%
	Oregon	*	*	*	*	*	*	*	*	*	*	199,540	2.5%
	Washington	*	*	*	9,654,356	9,090,863	21,182,018	15,750,654	3,776,172	3,549,057	*	7,458,259	93.5%
	Fleet Total	173,426	3,476,377	1,010,690	9,929,022	10,109,455	22,756,176	16,126,050	4,164,438	4,096,693	7,904,250	7,974,658	100.0%
Pot Vessels	Alaska Total	0	0	0	*	*	*	*	*	*	*	426,445	32.3%
	Washington	*	*	1,633,748	*	*	*	*	*	*	*	738,383	55.9%
	OR/Other States	0	0	0	*	*	*	*	*	*	*	155,124	11.8%
	Fleet Total	*	546,264	1,633,748	417,577	472,036	3,962,542	2,280,779	3,140,364	371,119	303,749	1,319,952	100.0%
Grand Total		*	**8,593,962**	**2,728,524**	**13,716,896**	**15,824,791**	**33,584,870**	**21,218,251**	**8,939,450**	**6,704,454**	**11,885,125**	**13,688,480**	

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-31 CP Wholesale Values from Federal Groundfish in the RKCSA by Community of Vessel Historical Ownership Address and Fleet, 2013-2022 (values in 2022 dollars)

Fleet	Community	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Annual Average 2013-2022 (dollars)	Annual Average 2013-2022 (percent)
AFA Catcher Processors	Fleet Total	3,001,344	40,257,177	39,395,240	26,587,878	79,074,968	75,052,039	87,386,000	18,876,858	67,234,584	91,291,850	52,815,794	100.0%
Hook and Line Catcher Processors	Alaska	*	*	*	*	*	*	0	*	0	*	422,598	19.0%
	Washington	*	*	*	*	*	*	0	*	0	*	1,800,448	81.0%
	Fleet Total	14,218,519	5,108,996	730,362	1,233,868	5,260,494	9,501,300	0	*	0	*	2,223,046	100.0%
Grand Total		**17,219,864**	**45,366,173**	**40,125,602**	**27,821,746**	**84,335,462**	**84,553,339**	**87,386,000**	*	**67,234,584**	*	**55,038,840**	

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-32 Ex-Vessel Value Diversificaton for CVs Targeting FMP Groundfish in the RKCSA, 2013-2022 (millions of 2022 real dollars)

Fleet	Community	Annual Average Number of Vessels	Annual Average Ex Vessel Value from RKCSA Only	Annual Average Total Ex Vessel Value from All Area, Gear, and Species Fisheries	RKCSA Value as a Percentage of Total Ex-Vessel Value Annual Average
AFA Mothership Catcher Vessels	Fleet Total	10.3	3,049,499	62,456,748	4.9%
AFA Shoreside Catcher Vessels	Alaska	1.3	316,859	12,605,631	2.5%
	Oregon	2.0	199,540	19,714,917	1.0%
	Washington	33.0	7,458,259	252,809,917	3.0%
	Fleet Total	36.3	7,974,658	285,130,466	2.8%
Pot Vessels	Alaska Total	1.1	426,445	9,395,285	4.5%
	Washington	3.2	738,383	37,052,816	2.0%
	OR/Other States	1.0	155,124	8,462,183	1.8%
	Fleet Total	5.3	1,319,952	54,910,285	2.4%
Grand Total		47.3	**12,344,109**	**402,497,498**	**3.1%**

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-33 First Wholesale Value Diversificaton for CPs Targeting FMP Groundfish in the RKCSA, 2013-2022 (millions of 2022 real dollars)

Fleet	Community	Annual Average Number of Vessels	Annual Average First Wholesale Value from RKCSA Only	Annual Average Total Wholesale Value from All Area, Gear, and Species Fisheries	RKCSA Value as a Percentage of Total Wholesale Value Annual Average
AFA Catcher Processors	Fleet Total	12.6	52,815,794	796,022,323	6.6%
Hook and Line Catcher Processors	Alaska	1.2	422,598	20,928,861	2.0%
	Washington	5.5	1,800,448	157,518,335	1.1%
	Fleet Total	6.7	2,223,046	178,447,196	1.2%
Grand Total		19.3	**55,038,840**	**974,469,518**	**5.6%**

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-34 Ex-Vessel Value Diversification for Communities with Vessels Operating in the RKCSA, 2013-2022 (2022 real dollars)

Fleet	Community	Annual Average Number of Vessels	Annual Average Number of All Commercial Fishing Vessels in those Same Communities	Annual Average 2013-2022 (dollars)	Annual Average Total Ex-Vessel Revenues from All Areas, Gears, and Species Fisheries for the Community Fleet	RKCSA Ex-Vessel Revenue as a Percentage of Total Community Ex-Vessel Revenue Annual
AFA Mothership Catcher Vessels	Total	10.3	643.5	3,049,499	853,554,254	0.4%
AFA Shoreside Catcher Vessels	Alaska	1.3	324.7	316,859	150,147,324	0.2%
	Oregon	2.0	23.5	199,540	33,707,252	0.6%
	Washington	33.0	374.4	7,458,259	799,208,013	0.9%
	Fleet Total	36.3	722.6	7,974,658	983,062,589	0.8%
Pot Vessels	Alaska Total	1.1	813.1	316,859	315,630,334	0.1%
	Washington	3.2	14.7	199,540	15,794,699	1.3%
	OR/Other States	1.0	330.1	7,458,259	738,960,236	1.0%
	Fleet Total	5.3	1157.9	7,974,658	1,070,385,270	0.7%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-35 First Wholesale Value Diversification for Communities with Vessels Operating in the RKCSA, 2013-2022 (millions of 2022 real dollars)

Fleet	Community	Annual Average Number of Vessels	Annual Average Number of All Commercial Fishing Vessels in those Same Communities*	Annual Average 2013-2022 (dollars)	Annual Average Total First Wholesale Value from All Areas, Gears, and Species Fisheries for the Community Fleet*	RKCSA Ex-Vessel Revenue as a Percentage of Total Community Ex-Vessel Revenue Annual
AFA Catcher Processors	Fleet Total	12.6	393.6	52,815,794	1,853,092,100	2.9%
Hook and Line Catcher Processors	Alaska	1.2	476.4	422,598	112,402,092	0.4%
	Washington	5.5	265.7	1,800,448	1,884,939,163	0.1%
	Fleet Total	6.7	742.1	2,223,046	1,997,341,255	0.1%

* Wholesale Value is for FMP Groundfish, Vessel Count is for all Vessels
Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

3.4.1.2 Area 512

Table 3-36 Vessels Targeting Pacific Cod with Pot Gear in Area 512 by Community of Vessel Historical Ownership Address and Fleet, 2013-2022

Community	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Annual Average 2013-2022 (number)	Annual Average 2013-2022 (percent)	Total Unique Vessels 2013-2022 (number)
Homer	0	0	0	0	0	0	3	1	3	3	1.0	14.7%	4
Kodiak	0	0	0	0	0	0	2	1	2	1	0.6	8.8%	3
Alaska Total	0	0	0	0	0	0	5	2	5	4	1.6	23.5%	7
Clackamas	0	0	0	0	0	0	1	1	0	0	0.2	2.9%	1
Milton Freewater	0	0	0	0	0	1	1	1	1	1	0.5	7.4%	1
Reedsport	0	0	0	0	0	0	1	1	0	0	0.2	2.9%	1
Oregon Total	0	0	0	0	0	1	3	3	1	1	0.9	13.2%	3
Bremerton	0	0	0	0	0	0	0	1	0	0	0.1	1.5%	1
Dear Park	0	0	0	0	0	0	0	1	0	1	0.2	2.9%	1
Mill Creek	0	0	1	0	0	0	0	0	0	0	0.1	1.5%	1
Seattle	1	1	2	1	1	4	8	6	7	2	3.3	48.5%	13
Vancouver	0	0	0	0	0	0	0	1	1	1	0.3	4.4%	1
Washington Total	1	1	3	1	1	4	8	9	8	4	4.0	58.8%	17
Other States	0	0	0	0	0	0	2	1	0	0	0.3	4.4%	2
Grand Total	**1**	**1**	**3**	**1**	**1**	**5**	**17**	**16**	**14**	**9**	**6.8**	**100.0%**	**28**

Note: Due to catcher vessel ownership movement between communities over the years shown, total unique catcher vessels per community may not sum to state or grand totals.
Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-37 Ex-vessel value estimates for pot vessels targeting Pacific cod in Area 512 by Community of Vessel Historical Ownership Address, 2013-2022 (values in 2022 dollars)

Community	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Annual Average 2013-2022 (number)	Annual Average 2013-2022 (percent)
Alaska Total	0	0	0	0	0	0	1,435,507	*	*	*	412,049	20.9%
Washington	*	*	415,090	*	*	*	2,885,503	2,183,959	1,825,746	1,011,257	1,197,516	60.6%
Oregon/Other States	0	0	0	0	0	*	1,261,210	*	*	*	366,331	18.5%
Grand Total	*****	*****	**415,090**	*****	*****	**2,217,850**	**5,582,220**	**3,588,301**	**3,483,783**	**2,831,615**	**1,975,897**	**100.0%**

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-38 Ex-Vessel Revenue Diversificaton for CVs Targeting FMP Groundfish with Pots in Area 512, 2013-2022 (millions of 2022 real dollars)

Geography	Annual Average Number of Vessels	Annual Average Ex-Vessel Revenues from Groundfish Pots in 512	Annual Average Total Ex-Vessel Revenues from All Area, Gear, and Species Fisheries	512 Value as a Percentage of Total Ex-Vessel Value Annual Average
Alaska	1.6	412,049	8,651,592	4.8%
Washington	4.0	1,197,516	43,163,678	2.8%
OR/Other States	1.2	366,331	9,814,433	3.7%
Total	6.8	1,975,897	61,629,703	3.2%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-39 Revenue Diversification for Communities with Pot CVs Operating in 512, 2013-2022 (millions of 2022 real dollars)

Community	Annual Average Number of Vessels	Annual Average Number of All Commercial Fishing Vessels in those Same Communities	Annual Average Ex-Vessel Revenues from Groundfish Pots in 512	Annual Average Total Ex-Vessel Revenues from All Areas, Gears, and Species Fisheries for the Community Fleet	512 Pot Ex-Vessel Revenue as a Percentage of Total Community Ex-Vessel Revenue Annual
Alaska Total	1.6	628.8	412,049	232,243,649	0.2%
Washington	4.0	308.8	1,197,516	744,127,999	0.2%
OR/Other States	1.2	10.3	366,331	12,257,716	3.0%
Grand Total	6.8	1132.2	1,975,897	988,629,364	0.2%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

3.4.2 Shore-based Processing

The analysts note that revenue and dependency tables for processing plants that operate in the inshore sector – i.e., taking deliveries from vessels at plants on land or stationary floating processors in the inshore component – are reported as wholesale values converted from the ex-vessel value estimates of landed catch. This is a fairly new algorithmic estimation process for AKFIN and has been implemented at the request of the Council. Revenue data tables that are redacted for confidentiality even at the level of "Dutch Harbor versus Other" could be confidential because a limited number of CPs participated in the catch in the defined area, thus showing total shore-based processing revenue would reveal estimated wholesale revenues for the CPs included in revenue totals for the area in other parts of this document.

3.4.2.1 RKCSA

Pacific cod pot gear

Table 3-40 Shore-Based Processors Accepting Pot Gear Pacific Cod from the RKCSA by Community of Operation, 2013-2022 (number of processors)

Community	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Annual Average 2013-2022 (number)	Annual Average 2013-2022 (percent)	Unique Processors 2013-2022 (number)
Dutch Harbor	5	5	3	4	4	4	2	5	2	0	3.4	39.5%	7
Akutan	2	3	3	3	2	2	2	1	1	1	2.0	23.3%	3
False Pass	0	0	0	0	0	0	1	0	1	0	0.2	2.3%	1
King Cove	1	2	2	2	2	2	2	2	0	1	1.6	18.6%	3
Kodiak	1	1	1	2	0	1	0	0	0	0	0.6	7.0%	2
Port Moller	0	0	0	0	0	0	0	0	0	1	0.1	1.2%	1
St. Paul Island	1	1	1	1	1	1	1	0	0	0	0.7	8.1%	1
Other	5	7	7	8	5	6	6	3	2	3	5.2	60.5%	11
Grand Total	10	12	10	12	9	10	8	8	4	3	8.6	100.0%	18

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-41 First Wholesale Revenues for Shore-Based Processors Accepting Pot Gear Pacific Cod from the RKCSA by Community of Operation, 2013-2022 (thousands of real first wholesale dollars)

Community	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Annual Average 2013-2022 (thousands)	Annual Average 2013-2022 (percent)	Unique Processors 2013-2022 (number)
Dutch Harbor	*	*	*	*	*	*	*	*	*	*	$384	22.42%	7
Other	*	*	*	*	*	*	*	*	*	*	$1,328	77.58%	11
Grand Total	*	*	*	*	*	*	*	*	*	*	$1,712	100.00%	18

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-42 Revenue Diversificaton for Shore-Based Processors Accepting Pot Gear Pacific Cod from the RKCSA by First Wholesale Revenue, 2013-2022

Geography	Annual Average Number of Processors	Annual Average First Wholesale Revenues from RKCSA Pot Cod Only (millions 2022 real $)	Annual Average Total First Wholesale Revenues from All Area, Gear, and Species Fisheries	Pot Pacific Cod from the RKCSA First Wholesale as a Percentage of Total First Wholesale Revenue Annual Average
Dutch Harbor	3.4	$0.4	$58.3	0.66%
Other	5.2	$1.3	$74.7	1.78%
Grand Total	8.6	$1.7	$133.0	1.29%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-43 Revenue Diversificaton for Communities with Shore-Based Processors Accepting Pot Gear Pacific Cod from the RKCSA by First Wholesale Revenue, 2013-2022

Geography	Annual Average Number of Processors	Annual Average Number of All Commercial Fishing Processors in those Same Communities	Annual Average First Wholesale Revenues from RKCSA Pot Cod Only (millions 2022 real $)	Annual Average Total First Wholesale Revenues from All Areas, Gears, and Species Fisheries for the Community Fleet (millions 2022 real $)	Pot Cod from the RKCSA First Wholesale Revenue as a Percentage of Total Community First Wholesale Revenue Annual Average
Dutch Harbor	3.4	7.4	$0.4	$589.0	0.07%
Other	5.2	13.5	$1.3	$968.8	0.14%
Grand Total	8.6	20.9	$1.7	$1,557.7	0.11%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

<u>AFA Pollock (pelagic trawl)</u>

Table 3-44 Shore-Based Processors Accepting AFA Pollock from the RKCSA by Community of Operation, 2013-2022 (number of processors)

Community	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Annual Average 2013-2022 (number)	Annual Average 2013-2022 (percent)	Unique Processors 2013-2022 (number)
Dutch Harbor	1	3	1	3	3	3	4	4	4	5	3.1	58.5%	5
Akutan	1	1	1	1	1	1	1	1	1	1	1.0	18.9%	1
King Cove	0	1	1	1	1	1	1	1	1	1	0.9	17.0%	2
Sand Point	0	0	0	1	0	1	0	0	1	0	0.3	5.7%	1
Other	1	2	2	3	2	3	2	2	3	2	2.2	41.5%	4
Grand Total	2	5	3	6	5	6	6	6	7	7	5.3	100.0%	9

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-45 First Wholesale Revenues for Shore-Based Processors Accepting AFA Pollock from the RKCSA by Community of Operation, 2013-2022 (thousands of real first wholesale dollars)

Community	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Annual Average 2013-2022 (thousands)	Annual Average 2013-2022 (percent)	Unique Processors 2013-2022 (number)
Dutch Harbor	*	*	*	$22,270	*	$39,762	*	*	$4,616	*	$14,059	71.57%	5
Other	*	*	*	$2,598	*	$12,301	*	*	$3,669	*	$5,586	28.43%	4
Grand Total	*	*	$2,758	$24,869	$20,951	$52,063	$42,484	$9,177	$8,285	$32,136	$19,645	100.00%	9

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-46 Revenue Diversificaton for Shore-Based Processors Accepting AFA Pollock from the RKCSA by First Wholesale Revenue, 2013-2022

Geography	Annual Average Number of Processors	Annual Average First Wholesale Revenues from RKCSA AFA Pollock Only (millions 2022 real $)	Annual Average Total First Wholesale Revenues from All Area, Gear, and Species Fisheries	AFA Pollock from the RKCSA First Wholesale as a Percentage of Total First Wholesale Revenue Annual Average
Dutch Harbor	3.1	$14.1	$94.3	14.92%
Other	2.2	$5.6	$109.8	5.09%
Grand Total	5.3	$19.6	$204.0	9.63%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-47 Revenue Diversificaton for Communities with Shore-Based Processors Accepting AFA Pollock from the RKCSA by First Wholesale Gross Revenue, 2013-2022

Geography	Annual Average Number of Processors	Annual Average Number of All Commercial Fishing Processors in those Same Communities	Annual Average First Wholesale Revenues from RKCSA AFA Pollock Only (millions 2022 real $)	Annual Average Total First Wholesale Revenues from All Areas, Gears, and Species Fisheries for the Community Fleet (millions 2022 real $)	AFA Pollock from the RKCSA First Wholesale Revenue as a Percentage of Total Community First Wholesale Revenue Annual Average
Dutch Harbor	3.1	7.4	$14.1	$589.0	2.39%
Other	2.2	3.9	$5.6	$553.5	1.01%
Grand Total	5.3	11.3	$19.6	$1,142.4	1.72%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

3.4.2.2 Area 512

Table 3-48 Shore-Based Processors Accepting Pot Gear Pacific Cod from Area 512 by Community of Operation, 2013-2022 (number of processors)

Community	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Annual Average 2013-2022 (number)	Annual Average 2013-2022 (percent)	Unique Processors 2013-2022 (number)
Dutch Harbor	6	4	3	1	4	3	1	4	1	0	2.7	42.2%	8
Akutan	2	3	1	0	2	1	1	1	1	1	1.3	20.3%	3
False Pass	0	0	0	0	0	0	1	1	1	0	0.3	4.7%	1
King Cove	2	2	2	0	2	2	1	1	1	1	1.4	21.9%	3
Kodiak	0	0	0	0	0	0	0	1	0	0	0.1	1.6%	1
Port Moller	0	0	0	0	0	0	0	0	1	1	0.2	3.1%	1
Sand Point	1	1	0	0	1	0	0	0	0	0	0.3	4.7%	1
St. Paul Island	0	0	0	0	0	0	0	1	0	0	0.1	1.6%	1
Other	5	6	3	0	5	3	3	5	4	3	3.7	57.8%	11
Grand Total	11	10	6	1	9	6	4	9	5	3	6.4	100.0%	19

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-49 First Wholesale Revenues for Shore-Based Processors Accepting Pot Gear Pacific Cod from Area 512 by Community of Operation, 2013-2022 (thousands of real first wholesale dollars)

Community	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Annual Average 2013-2022 (thousands)	Annual Average 2013-2022 (percent)	Unique Processors 2013-2022 (number)
Dutch Harbor	*	*	*	*	*	*	*	$2,138	$917	$0	$483	12.56%	8
Other	*	*	*	*	*	*	*	$5,038	$5,433	$10,727	$3,363	87.44%	11
Grand Total	*	*	*	*	*	*	*	$7,177	$6,350	$10,727	$3,846	100.00%	19

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-50 Revenue Diversificaton for Shore-Based Processors Accepting Pot Gear Pacific Cod from Area 512 by First Wholesale Revenue, 2013-2022

Geography	Annual Average Number of Processors	Annual Average First Wholesale Revenues from Area 512 Pot Cod Only (millions 2022 real $)	Annual Average Total First Wholesale Revenues from All Area, Gear, and Species Fisheries	Pot Pacific Cod from Area 512 First Wholesale as a Percentage of Total First Wholesale Revenue Annual Average
Dutch Harbor	2.7	$0.5	$58.3	0.83%
Other	3.8	$3.4	$119.2	2.82%
Grand Total	6.4	$3.8	$177.6	2.17%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

Table 3-51 Revenue Diversificaton for Communities with Shore-Based Processors Accepting Pot Gear Pacific Cod from Area 512 by First Wholesale Gross Revenue, 2013-2022

Geography	Annual Average Number of Processors	Annual Average Number of All Commercial Fishing Processors in those Same Communities	Annual Average First Wholesale Revenues from Pot Cod from Area 512 Only (millions 2022 real $)	Annual Average Total First Wholesale Revenues from All Areas, Gears, and Species Fisheries for the Community Fleet (millions 2022 real $)	Pot Cod from Area 512 First Wholesale Revenue as a Percentage of Total Community First Wholesale Revenue Annual Average
Dutch Harbor	2.7	7.4	$0.5	$589.0	0.08%
Other	3.8	15.4	$3.4	$1,057.6	0.32%
Grand Total	6.4	22.8	$3.8	$1,646.6	0.23%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT.

3.5 Local and Traditional Knowledge and Subsistence

When preparing this analysis, staff used the Local Knowledge (LK), Traditional Knowledge (TK), and Subsistence search engine to look for sources of information containing LK and TK specific to BBRKC, pollock, and Pacific cod in the Bristol Bay region (https://lktks.npfmc.org/). The search engine contains scientific articles in peer-reviewed journals, white papers, archival references, and other sources of information related to LK, TK, the social science of LK and TK, and subsistence information. No results based on LK or TK from the BBRKC fleet or communities substantially engaged in, or dependent on, BBRKC were returned. Likewise, no results for BS pollock or Pacific cod fishing were returned.[33]

LK is based on the observations and experience of local people in a region with significant in-situ expertise related to particular species, environments, and practices (Martin et al., 2007). In regard to crab fishing, LK holders such as long-term crab skippers or crew members may be some of the earliest observers of environmental and/or fishery changes because of their long-term experience working and harvesting specific areas (Johannes & Nies 2007). The Alaska Bering Sea Crabber's Association (ABSC) has conducted a "skipper survey" for snow crab that has been reviewed by the CPT and the Council's SSC. A similar skipper survey for RKC was in a pilot phase when the BBRKC fishery took place in 2020/21 season, and had been reviewed by the CPT and SSC at that stage. With the fishery closed for the two following seasons, the survey was not administered. ABSC informed the analysts that a BBRKC skipper survey was administered after the 2023/24 season concluded in November 2023. The results of that survey were reviewed at the January 2024 CPT meeting, after this writing. ABSC communicated to the analysts that, in its judgement, the 2023/24 skipper survey results would not substantially add to the LK information that was available to the Council during its June 2023 review of this action, and thus they

[33] A reader may submit suggestions of sources for LK, TK, the social science of LK and TK, and information about the subsistence way of life to npfmc.lktks@gmail.com. That information could assist in the preparation of future Council review documents.

are not summarized here. The primary reason behind that judgment is that the skipper survey data collection was focused on information that would benefit the stock-specific ESP for BBRKC. The reader is referred to the January 2024 CPT report for any summation of that discussion that may be provided there, and information will be added to this document – as appropriate – for its next iteration. The skipper survey did not contain any questions specific to the relative importance of the RKCSA to the stock, though it is reasonable to anticipate that surveyed crab skippers would have a positive view of groundfish limitations in that area.

Some of the issues raised in the snow crab skipper survey that might eventually be reproduced or reflected in repeated future BBRKC surveys include concerns about the limited availability of alternative fishing targets for the fleet and high operating costs (e.g., fuel) causing communities that are substantially engaged in or dependent on RKC fishing or shoreside processing to experience overall negative impacts. Also, when a commercial BBRKC fishery is not open, there could be an effect on personal, non-subsistence use of the crab fishery by eliminating opportunities for crew members to “home pack” RKC.

The most recent literature review on subsistence fishing in the Bristol Bay region was published by the ADF&G Division of Subsistence in 2012 (Holen and Lemons). That study defined 27 communities as part of the Bristol Bay region, some of which are relatively far from Bristol Bay itself (e.g., the Iliamna Lake area, Port Alsworth, and Nondalton; see Figure 1 in Holen and Lemons 2012). For 18 communities in the region that participated in a systematic household survey between 2005 and 2010, the 2012 report found that salmon made up 56% of subsistence harvest by weight and non-salmon fish made up an additional 9%. Land mammals such as moose and caribou ranked second behind salmon at 23% of total weight harvested. Marine invertebrates – presumably including crab – were grouped with marine mammals, birds/eggs, and wild plants to make up 12% of total weight. Pacific cod was included in the set of species that made up “non-salmon fish,” alongside grayling, burbot, dolly varden, trout, pike, smelt, whitefish, herring, starry flounder, halibut, sculpin, capelin, and yellowfin sole.

ADF&G Division of Subsistence typically targets a frequency of comprehensive or targeted subsistence surveys in the range of every 10 years. ADF&G’s Community Subsistence Information System (CSIS) online dashboard[34] reflects that the majority of communities in the Bristol Bay region are just beyond that frequency as of the writing of this document, and so the information available in Holen and Lemon (2012) represents the best available at the region level. Within this region, ADF&G Subsistence has roughly six community surveys that have either begun within the last year or are planned to begin within the next year as the division maintains its periodic update of the data for this region. The analysts were advised by ADF&G Subsistence staff that while the 2012 report contains the best available estimates of use and harvest, it does not represent the full variation in harvest/use across communities and households. That variation is especially likely to occur for species with low/moderate harvest levels, or where overall year-on-year variation might be high. The authors of this document would categorize red king crab in the low/moderate use category for this particular geographic region.

The analysts looked at publicly available CSIS data on all communities in the Bristol Bay region for estimates of subsistence use of crab (unspecified), red king crab, and Pacific cod. No entries in the data set identified pollock as a species of use. The data report returned sporadic information from 15 surveyed years dating from 1984 through 2019 (irregular intervals). CSIS provides a data field that estimates “community harvest in pounds”.

Estimated use of RKC only appeared in 2007, 2010, and 2018 survey data. The total estimated weight across those years was roughly 950 lbs., with 847 coming from the 2010 estimate. Only about 35 pounds were reported with the flag “non-commercial” gear (Port Heiden, in 2018). That might imply that most RKC is coming from “home pack” in the commercial RKC fishery. It is also notable that Port Heiden is

[34] Accessible via: https://www.arcgis.com/apps/dashboards/92e01809c7104c699425d5aed0167842; select “Legend” to see the status of the most recent survey by community. General information from/about CSIS is available at: https://www.adfg.alaska.gov/sb/CSIS/.

the only community in the region identified in the dashboard map (footnoted above) that has had a comprehensive subsistence survey in the last five years. The analysts cannot rule out that other communities that were not recently surveyed have some similar small amount of non-commercially-derived RKC use. For the unspecified crab field, total estimated pounds was roughly 1,900. Over 1,100 lbs. of that total was attributed to Dillingham in a 2010 survey (not specified as either commercial fishery retention – i.e., home pack – or non-commercial). Since that survey, only roughly 70 lbs. appears in the 2018 data (again from the Port Heiden survey). The analysts communicated directly with staff of Bristol Bay Economic Development Corporation (BBEDC; the regional CDQ group) and were informed that residents are not known to participate in subsistence or personal use fishing for red king crab.[35] The reason given was that waters within range of the typical small personal vessels were too shallow to find mature crab for retention.

"Cod" (unspecified) shows up in the CSIS data for the region in annual amounts that were 225 lbs. or fewer. The total amount over all the surveys dating back to 1984 is estimated at 927 lbs. Retention from Pacific cod commercial fisheries (home pack) was never more than 20 lbs. (again coming from the recent Port Heiden survey in 2018). Most of the other reported cod in the surveys come from Twin Hills and Togiak and are sometimes reported as "rod and reel" catch. It is possible that other coastal communities within the region catch Pacific cod with non-commercial gear in years/communities that are not surveyed. It is reasonable to assume that the amounts are in the range of a few dozen pounds to the low 100s of pounds in a given year.

3.6 Bristol Bay Red King Crab Fishery

This section provides a brief overview of the BBRKC directed fishery, the harvest and value from the fishery, and cites sources that characterize the direct community connections to the commercial fishery. Summary data, supplied by ADF&G, are provided dating from the start of the rationalized BS crab fisheries the 2005/06 crab season.

King crab stocks in the BSAI are co-managed by the State of Alaska and NMFS through the Crab FMP (NPFMC 2023b) with management delegated to the State with federal oversight. The Crab FMP divides management measures into three categories: (1) fixed in the Crab FMP and require an amendment to change, (2) frameworked in the Crab FMP which the State can change as outlined in the FMP, and (3) at the discretion of the State of Alaska. The crab management measures that fall into each of these three categories are described in Section 3 of the Crab FMP. The State of Alaska is responsible for determining and establishing the GHL/TAC under the framework in the FMP. Harvest strategies for the Bristol Bay RKC fishery have changed over time. Two major management objectives for the fishery are to maintain a healthy stock that ensures reproductive viability and to provide for sustained levels of harvest over the long term. In attempting to meet these objectives, the GHL/TAC is coupled with size-sex-season restrictions. Only males of ≥ 6.5 inches carapace width (equivalent to 135mm CL) may be harvested and no fishing is allowed during molting and mating periods. Specification of TAC is based on a harvest rate strategy. A brief history of the State of Alaska's BBRKC stock management is provided in Section C-6 of the most recent BBRKC stock assessment (Palof 2023, p.11). The mature harvest rate, which is a function of both the effective spawning biomass and the abundance estimate for mature females (see Palof 2023, Figure 2) also determines the Zone 1 RKC trawl PSC limit, which was first described in Section 2.1 of this document.

Table 3-52 reports the annual BBRKC catch limit (TAC, in pounds), harvest (pounds), vessel participation (# vessels), average CPUE (legal crab per pot lift), and ex-vessel value (real $/lb. adjusted to 2022$). CDQ groups are allocated 10% of the BBRKC catch limit. Harvest, participation, and effort data are provided by ADF&G. Ex-vessel value estimates are taken from the data source used in the BSAI Crab

[35] S. Ricci (BBEDC). Pers. comm. Dec. 2023.

Economic SAFE.[36] The overall BBRKC TAC trend shows a clear decline from roughly 16 to 20 million pounds per year during the first five years of the rationalized program to less than five million pounds in all years that the fishery has been open since 2018/19. After two years of fishery closure, the 2023/24 TAC of 2.15 million pounds was the lowest during the span of the rationalized fishery. The TAC utilization rate (harvest including deadloss divided by TAC) has been over 99 percent in every year. Deadloss percentages are consistently very low – exceeding 1% only in 2014/15 and 2015/16 and never exceeding 1.8%. In the three most recent BBRKC fishery years (2019/20, 2020/21, and 2023/24) deadloss was 0.2% or less. Predictably, with lower levels of available harvest and catch, vessel participation and the number of landings has declined. These gross-level participation factors collectively result in less overall economic production from the fishery in terms of employment, total revenue, and resource taxes to name a few factors. CPUE does not display a discernable trend but has varied annually between the mid-teens and mid-thirties. The range of annual average crab weight has been consistent and narrow, which reflects the harvest restrictions based partially on a minimum size requirement. The ex-vessel value estimates shown in the table are standardized to 2022$ and thus reflect a real increase in marginal unit value since the inception of the rationalized fishery, although gross harvest value is substantially below its peak in the 2008/09 and 2010/11 crab season (Figure 3-21).

From 2005 through 2021, the number of crab buyers remained consistent between 15 and 18 annually. The number of shoreside crab processors (facilities) was as high as 18 but was nine or 10 from 2018 through 2020. The most recent Crab Economic SAFE report does not include buyer and processor counts from the 2023/24 BBRKC fishery (see Table 1.1 in Garber-Yonts et al. 2024). Prior to crab rationalization, the number of buyers for BBRKC ranged from 22 to 28 and the number of processors ranged from 20 to 25 (1998 through 2004).

[36] Data for 2021/22 available through AKFIN Reports Dashboard: https://reports.psmfc.org/akfin/f?p=501:950 (last accessed 1/4/2024). Ex-vessel value data for 2023/24 are provided directly by the author of the Crab Economic SAFE (B. Garber-Yonts, 2024) and are an AFSC “nowcast” estimate that may be updated in the future as COAR and EDR data for the 2023/24 BBRKC season become available.

Table 3-52 BBRKC directed fishery summary statistics, 2005/06 through 2023/24

					Number of				Average		
Season	Fishery	TAC[a]	Harvest[a,b]	Deadloss[a]	Vessels	Landings	Crab[b]	Pots lifted	CPUE[c]	Weight[a,d]	Value[e]
2005/06	IFQ	16,496,100	16,478,458	77,507	89	264	2,460,843	99,599	25	6.7	
	CDQ	1,832,900	1,830,877	8,781	13	32	271,720	15,345	18	6.7	
	Total	18,329,000	18,309,335	86,288	89	296	2,732,563	114,944	24	6.7	$6.53
2006/07	IFQ	13,974,300	14,064,683	99,320	81	187	2,212,925	64,692	34	6.4	
	CDQ	1,552,700	1,552,133	18,907	13	26	242,693	7,414	33	6.4	
	Total	15,527,000	15,616,816	118,227	81	213	2,455,618	72,106	34	6.4	$5.40
2007/08	IFQ	18,344,700	18,327,780	131,954	74	246	2,817,895	101,739	28	6.5	
	CDQ	2,038,300	2,038,285	8,430	10	35	321,441	11,475	28	6.3	
	Total	20,383,000	20,366,065	140,384	74	281	3,139,336	113,214	28	6.5	$6.11
2008/09	IFQ	18,327,600	18,303,012	160,812	77	254	2,765,282	124,737	22	6.6	
	CDQ	2,036,400	2,026,390	12,351	15	35	301,004	15,200	20	6.7	
	Total	20,364,000	20,329,402	173,163	78	289	3,066,286	139,937	22	6.6	$7.00
2009/10	IFQ	14,408,100	14,331,803	111,467	70	210	2,277,434	107,058	21	6.3	
	CDQ	1,600,900	1,600,851	10,740	11	23	259,787	11,463	23	6.2	
	Total	16,009,000	15,932,654	122,207	70	233	2,537,221	118,521	21	6.3	$6.24
2010/11	IFQ	13,355,100	13,349,929	99,612	65	236	2,157,355	118,458	18	6.2	
	CDQ	1,483,900	1,483,900	7,262	10	18	241,135	13,169	18	6.2	
	Total	14,839,000	14,833,829	106,874	65	254	2,398,490	131,627	18	6.2	$9.76
2011/12	IFQ	7,050,600	7,050,195	30,155	62	150	1,151,945	41,086	28	6.1	
	CDQ	783,400	783,399	1,913	9	11	127,109	4,080	31	6.2	
	Total	7,834,000	7,833,594	32,068	62	161	1,279,054	45,166	28	6.1	$13.48
2012/13	IFQ	7,067,700	7,064,536	28,783	64	127	1,044,048	34,866	30	6.8	
	CDQ	785,300	785,299	1,267	9	14	113,316	3,293	34	6.9	
	Total	7,853,000	7,849,835	30,050	64	141	1,157,364	38,159	30	6.8	$10.16
2013/14	IFQ	7,740,000	7,740,479	60,587	62	144	1,117,452	41,695	27	6.9	
	CDQ	860,000	859,997	2,162	10	12	125,253	4,232	30	6.9	
	Total	8,600,000	8,600,476	62,749	63	156	1,242,705	45,927	27	6.9	$8.93
2014/15	IFQ	8,987,400	8,987,942	94,514	63	144	1,350,092	52,749	26	6.7	
	CDQ	998,600	999,067	6,728	9	15	148,445	6,312	24	6.7	
	Total	9,986,000	9,987,009	101,242	63	159	1,498,537	59,061	25	6.7	$8.15
2015/16	IFQ	8,976,600	8,972,564	177,969	63	141	1,350,438	44,485	30	6.6	
	CDQ	997,400	997,400	4,864	8	11	147,345	3,523	42	6.8	
	Total	9,974,000	9,969,964	182,833	64	152	1,497,783	48,008	31	6.7	$9.71
2016/17	IFQ	7,622,100	7,619,801	35,414	62	138	1,130,101	30,461	37	6.7	
	CDQ	846,900	846,900	5,706	8	10	123,866	2,665	46	6.8	
	Total	8,469,000	8,466,701	41,120	63	148	1,253,967	33,126	38	6.8	$13.07
2017/18	IFQ	5,940,900	5,940,822	22,991	61	129	867,043	44,029	20	6.9	
	CDQ	660,100	660,100	1,889	8	13	97,550	4,213	23	6.8	

					Number of				Average		
Season	Fishery	TAC[a]	Harvest[a,b]	Deadloss[a]	Vessels	Landings	Crab[b]	Pots lifted	CPUE[c]	Weight[a,d]	Value[e]
	Total	6,601,000	6,600,922	24,880	61	142	964,593	48,242	20	6.8	$10.83
2018/19	IFQ	3,877,200	3,877,222	26,668	54	111	544,368	27,995	19	7.1	
	CDQ	430,800	430,724	907	8	10	62,053	2,727	23	6.9	
	Total	4,308,000	4,307,946	27,575	55	121	606,421	30,722	20	7.1	$11.98
2019/20	IFQ	3,417,300	3,411,869	7,542	56	105	477,210	31,803	15	7.1	
	CDQ	379,700	379,700	1,332	8	11	54,119	2,655	20	7.0	
	Total	3,797,000	3,791,569	8,874	56	116	531,329	34,458	15	7.1	$13.44
2020/21	IFQ	2,383,200	2,382,736	3,691	47	85	389,829	18,426	21	6.1	
	CDQ	264,800	264,138	214	7	10	43,653	1,818	24	6.1	
	Total	2,648,000	2,646,874	3,905	47	95	433,482	20,244	21	6.1	$13.66
2021/22	No Commercial Fishery										
2022/23	No Commercial Fishery										
2023/24	IFQ	1,935,000	1,929,108	4,504	31	68	290,475	14,376	20	6.6	
	CDQ	215,000	215,000	120	4	7	31,866	1,318	24	6.7	
	Total	2,150,000	2,144,108	4,624	31	75	322,341	15,694	21	6.7	$9.69*

[a] In pounds; [b] Deadloss included; [c] Number of legal crab per pot lift; [d] Retained catch; [e] Average price per pound (2022$).
Sources: ADF&G; AKFIN Reports Dashboard\CRSAFEEXEC01.
*2023/24 BBRKC ex-vessel value is an estimate provided by AFSC and sourced to the 2023 Crab Economic SAFE (Section 4.9, p. 124 in Garber-Yonts et al. 2024).

Whereas Table 3-52 reports only sold weight and ex-vessel values, Figure 3-21 includes the first wholesale step in the value chain. Figure 3-21 shows the year-on-year trend in nominal and inflation-adjusted total value for the BBRKC directed fishery (2022$) for the years since the crab rationalization program was implemented. Despite the generally increasing unit value of BBRKC product and stable size for legally retained crab, the total value of the fishery has been driven down by reduced harvest availability. Figure 3-22 illustrates that the unit value of BBRKC has generally increased in real-dollar terms over the life of the crab rationalization program. Figure 3-22 also reflects that the value-added at the first processing stage of the product has been relatively stable over the life of the program. Both ex-vessel and first wholesale values are affected by a range of internal and external factors, and ex-vessel payments are one of many costs to the primary processor so the difference in the two value estimates does not represent net profit for processors. Nevertheless, the difference in the trends has held steady at a relationship of first wholesale unit values being roughly 75-85% greater than ex-vessel values, with a range of 68% on the low end to 95% on the high end. In other words, despite the complexity of the BBRKC microeconomy, the real-dollar-denominated total value of the fishery's production appears to be driven mainly by harvest levels. Unit values, in real terms, had marginally increased through the 2020/21 crab fishing year but not enough to compensate for greatly reduced production. The Crab Economic SAFE report authors have supplied an in-year estimate of the ex-vessel value of BBRKC for the recently concluded 2023/24 fishery ($9.69/lb. ex-vessel). That estimate represents a steep decline relative to trend in annual value from the program's inception to the fishery closures in 2021 and 2022. Ex-vessel values for Alaska crab species that were open to fishing actually reached peak levels in 2021. As with other Alaska seafood products, king crab prices have recently been affected by adverse "domestic and international market conditions and ongoing socio-political pressures" (Garber-Yonts et al. 2024, p.12). As a premium crab product, BBRKC may remain at higher prices relative to other species but is still exposed to trends in consumer demand and household spending on seafood post-pandemic lockdowns, as well as hold-over inventories of competing seafood products that have depressed prices throughout the sector. A in-season trade press article from November 2023 identified BBRKC as a potential bright spot among Alaska seafood products, even if at lower price levels that in previous years. That article cited advanced prices of $8.00 per pound prior to post-season market adjustments, which is in line with the "nowcast" value of $9.69 per pound cited in Table 3-52.[37] A more complete market synopsis for the recently completed BBRKC fishery will be available in future iterations of this document.

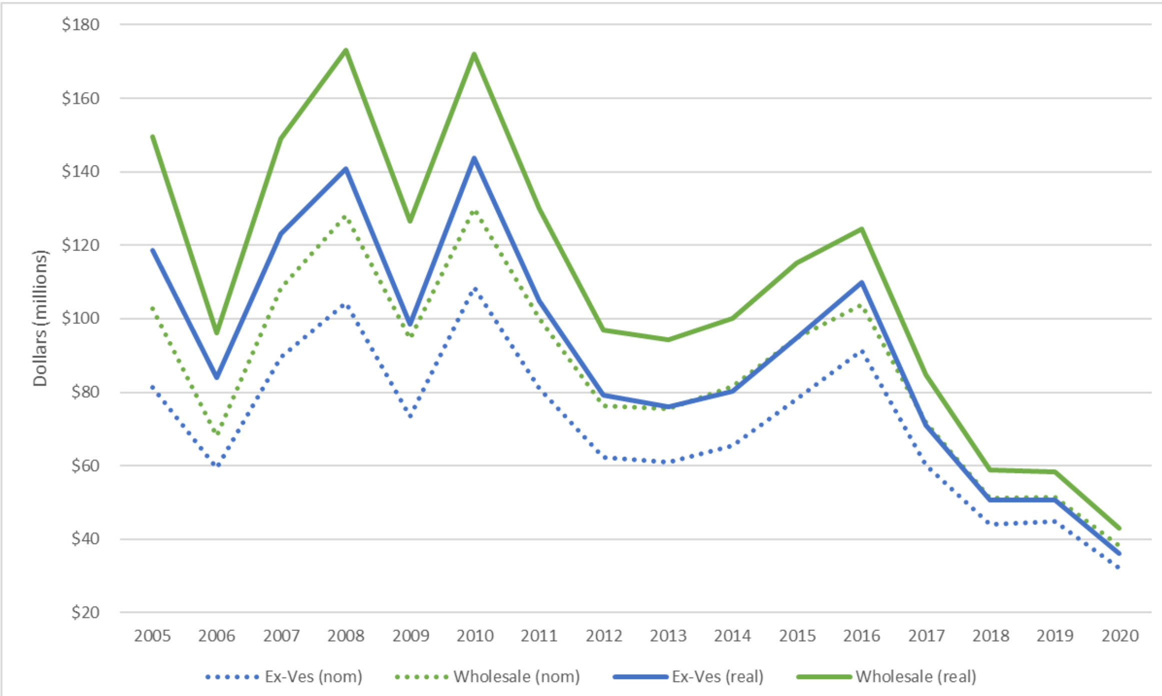


Figure 3-21 Nominal and inflation-adjusted (real) total annual ex-vessel and first wholesale value estimates for the BBRKC directed fishery, 2005/06 through 2020/21 ($millions); real dollar estimates adjusted to 2022$

Source: AKFIN Reports Dashboard\CRSAFEEXEC01, available at: https://reports.psmfc.org/akfin/f?p=501:950:4258490717691 (last accessed Jan. 2024).

[37] Undercurrent News: "Prices for Bristol Bay red king crab could be bright spot as other fisheries struggle". Nov. 13, 2023.

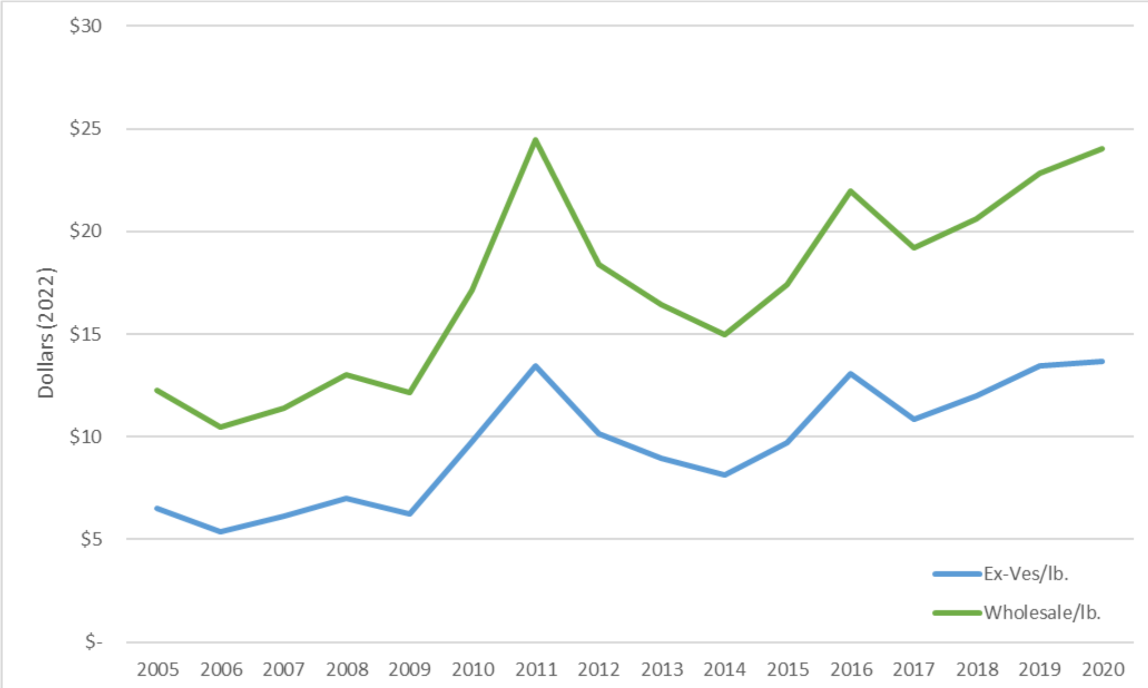


Figure 3-22 Average annual ex-vessel and first wholesale value per pound in the BBRKC directed fishery, 2005/06 through 2020/21; real dollar estimates adjusted to 2022$
Source: AKFIN Reports Dashboard\CRSAFEEXEC01, available at: https://reports.psmfc.org/akfin/f?p=501:950:4258490717691 (last accessed Jan. 2024).

The most recent Economic SAFE report for BSAI king and Tanner crab fisheries states that, as a result of recent BBRKC fishery closures and a simultaneous closures of Bering Sea snow crab fishery, "the BSAI crab industry, dependent communities, and other stakeholders currently face the prospect of a prolonged period of income and employment loss as a result of trends and closures in these and other crab fisheries. The scope and scale of structural changes within the crab industry and extended community that may ultimately be precipitated by the immediate crisis are unknown and difficult to anticipate with any clarity" (Garber-Yonts et al. 2024, p.68). In addition to the Crab SAFE report, the reader is directed to the AFSC's Human Dimensions of Fisheries Data Explorer, which provides access to data, data visualizations, and other tools for understanding the economic and sociocultural dimensions of Alaska fisheries. These resources have been developed by, in or in collaboration with, the AFSC Economics and Social Science Research Program (ESSRP), which collects and analyzes economic and sociocultural data to support the conversation and management of Alaska marine resources. Through that portal, the reader can also access the most recent iteration of the Annual Community Engagement and Participation Overview (ACEPO), which includes data through 2021.[38] ACEPO reports community-level engagement in harvesting and processing of groundfish and crab, producing indices that take into account the volume of landings, revenues, vessel counts, and the number of vessel owners or processors/buyers. ACEPO also provides "regional quotients" (RQ) that measure the share of a particular fishery landed in a specific community or by vessel owners from that community (at-sea or CP/mothership activity is treated as its own aggregate "community of practice". This section notes which communities are most engaged in the BSAI crab fisheries but does not report harvest/processing volume and value from ACEPO since those values are aggregated across many crab fisheries in the region, not just BBRKC.

[38] Data availability through 2021 is as of the time of writing. Updates are anticipated in the near future and will be reflected in future drafts.

The BBRKC directed fishery has included between 31 and 89 vessels annually during the years since the fishery was rationalized in 2005. The fishery is primarily prosecuted by CVs with one or two CPs participating in the fishery since 2009. Declining TAC likely drove declining vessel participation over the last decade. At its peak in 2010, the BBRKC fishery generated about $144 million in ex-vessel revenue and about $172 million in first wholesale value (2022$ inflation-adjusted).

Another way to gauge the value of the BBRKC fishery is from the Federal fisheries disaster determination request submitted by the Governor of Alaska in October 2022.[39] In accordance with NOAA guidance on disaster relief requests, ADF&G compared the previous five-year average value of the fishery to the year in which the disaster was being declared and used that to calculate the "loss" due to the closure. That calculation placed the forgone value of the BBRKC fishery at $50.70 million for 2021/22 and $34.26 million for 2022/23. Those estimates represent gross ex-vessel revenue, and thus do not account for value added at the gross first wholesale stage (processed crab, net of ex-vessel purchasing) and other losses in economic productivity.

From 2017 through 2020, the BBRKC fishery declined from 61 active vessels to 47. Thirty-one vessels participated in the 2023 fishery. The total number of crew positions fell from 419 to 333 with a median of six crew per vessel (Garber-Yonts et al. 2024, Table 1.2). Employment data for crab CPs is confidential due to a low number of vessels operating, but the reportable estimate from 2005 when six CPs participated was 12 crew per vessel.

After accounting for vessel operation costs and quota share royalties, total crew compensation ranged from $7.78 million in 2017 to $3.68 million in 2020 ($73,000 per vessel median in 2020, down from $115,000 in 2017). Captain's shares totaled $3.5 million in 2017 and $1.7 million in 2020 (median share falling from $52,000 to $35,000). The number of processing plants taking deliveries of BBRKC fell from eight to six over the analyzed period, and was down from a peak of 19 active plants across all BSAI crab fisheries in 2006. Total processing labor hours were approximately 81,000 in 2017 and 31,000 in 2020. Compensation data for the 2023/24 season are not available at the time of writing, and the 2020/21 crab season was the last time that the BBRKC fishery was open to directed fishing.

The geographic distribution of employment and labor income in the crab harvesting and processing sectors is important to assessing the associated economic effects of recent crab fishery closures and reduced catch limits on communities. Figures 1.8 and Table 1.4 in the 2023 Crab Economic SAFE report harvest and processing employment by community or region of residence, if known. From 2018 through 2022, across all BSAI crab fisheries, Alaska accounted for between 31% and 41% of crew positions, annually, while Washington accounted for between 30% and 39%. Oregon accounted for between 4% and 13%, California accounted for between 4% and 7%, and "other states/unknown" accounted for 14% to 18%. Processing labor by community of residence was less tilted towards Alaska residents (21% to 28%). The largest percentage grouping was for "other states/unknown" (27% to 47%). California residents were more likely to be involved in processing as opposed to harvesting (20% to 30% in processing) while Oregon residents were involved in processing labor at a low level (1% to 2%).

Ten percent of the TAC for each of the CR fisheries is allocated through the CDQ Program. CDQ group ownership of crab quota share in the BBRKC fishery has gradually increased through acquisition since the implementation of crab rationalization. As of 2022, the CDQ/nonprofit category holds roughly 22% of BBRKC quota across four entities (Figure 1.12 and Table 1.6 in Garber-Yonts et al. 2024). "Individuals" hold roughly 63% of the quota across 31 entities, down from 64% and 35 entities in 2021. CDQ groups typically lease or harvest crab quota on vessels wholly or partly owned by the CDQ groups, earning direct revenue or lease rates. At the time of the last CR Program review (2014/15 season) four groups held 50.8% of the catcher processor quota share and six groups held 19.1% of the catcher vessel owner shares in the CR Program (including their direct holdings, wholly owned subsidiaries and equity in other

[39] https://www.fisheries.noaa.gov/s3/2022-10/Bering-Sea-Bristol-Bay-Crab-Fishery-Disaster-Declaration-Request-1-.pdf

shareholding companies). At that time. three CDQ groups (including direct holdings, wholly owned subsidiaries and equity in other shareholding companies) held 32.7% of the BBRKC processor quota share. Similar to the CDQ allocations, these investments bring revenue to the groups which allow them to support their communities through projects that provide economic and social benefits to residents. In terms of pounds the BBRKC TAC allocation to CDQ groups was 215,000 lbs. in 2023/24, down from 264,138 in 2020/21. The 10% program allocation of the BBRKC TAC ranges from 10% (CBSFA) to 19% BBEDC.

The most recently available ACEPO report[40], cited above, identified one community as "highly" engaged in the harvesting sector of BSAI crab (undifferentiated by species) – the Seattle MSA. Communities with medium engagement included Kodiak, Homer, Anchorage, and Wasilla in Alaska, as well as two counties in Oregon and an "other Oregon" category. "Lower" engagement harvesting communities were primarily in Alaska with the exception of Bellingham, WA and "other Washington". The lower engagement communities in Alaska covered most known commercial fisheries along the coastline from southeast Alaska to Norton Sound and out to Adak and St. Paul Island. These communities can be viewed through the ACEPO link above. The "at-sea processing community" also ranked as lower engagement in BSAI crab. For the crab processing sector, Unalaska/Dutch Harbor and St. Paul Island ranked as highly engaged. Medium engagement communities included Akutan, King Cove, Nome, and the at-sea sector (includes stationary floating processors). The regional quotient of landing revenue was highest for Unalaska/Dutch Harbor, which is reported as 41% for the 2000-2021 period, peaking above 50% in 2007 but generally between 35 and 50% on an annual basis. From a trend perspective (through 2021) processing engagement in the at-sea sector was generally on the decline since crab rationalization, while St. Paul and King Cove showed the most upward trend. The leap in processing engagement for St. Paul occurred in 2008 and was sustained until 2022/23. Nome's processing engagement jumped up from 2013 through 2018 but declined noticeably in 2020 and 2021.

ACEPO also reports an estimate of fishery taxes generated in the BSAI crab fisheries. These taxes flow to both the State of Alaska and to the localities where the landings occur. For the 2012-2021 period, the report estimates annual fish taxes totaling between roughly $18 million and $26 million annually across Unalaska, St. Paul, Kodiak (Island Borough), King Cove, Akutan, Nome, and Anchorage. Over the period, the highest annual average tax levy was generated in Unalaska ($13.8 million), then dropping off to $3.4 million in St. Paul, $2.2 million in Akutan, $1.7 million in Kodiak, $620,000 in King Cove, $170,000 in Anchorage, and $37,000 in Nome.

As highlighted in the Crab 10-year program review (NPFMC 2017), there is substantial overlap in vessel participation in BBRKC, BS snow crab, and Tanner crab fisheries. It is rare for a vessel to only participate in BBRKC and many of the vessels that participated in the CR Program first targeted BBRKC and then snow crab when it was open. While BBRKC tended to generate the highest ex-vessel price per pound for crab, the high volume of snow crab able to be harvested under the TAC meant that fishery generated the greatest value of the rationalized crab fisheries since 2010 (Garber-Yonts et al. 2024; Figure 3.4). In addition to other crab species, some crab vessels participate in the Pacific cod pot fishery for vessels greater than 60 ft and some tender salmon in the summer (Figure 3-6). Limited diversity outside of crab fisheries means the that cumulative effect of the BBRKC and Bering Sea snow crab closures in 2022 and 2023 caused substantial difficulty for businesses reliant on BS crab.

[40] Accessed Dec. 2023.

4 Economic and Social Impacts

4.1 Methods for the Cost and Benefit Impact Analysis

This section considers potential impacts on the set of fisheries defined in this document that have – or have had – some level of groundfish participation in the RKCSA (Alternative 2) or NMFS Area 512 (Alternative 3). Analyses often focus on the quantification of potentially forgone gross revenues when alternatives are likely to result in less available harvest or seasons that are shortened by constraining hard cap bycatch limits. In those cases, fish that are not caught and processed do not generate revenue to direct participants or provide benefits to consumers or the people and places that are proximate to the people/entities that would have earned revenue through employment. The actions under consideration here, however, do not necessarily reduce the available harvest or the length of a season when they are in effect. The species being targeted by the directly affected groundfish fleets are found outside of the RKCSA and Area 512 and so there would be opportunities to shift effort in time and space. By definition, regulations that directly alter current practices that are freely chosen – within the existing management regime – make the business proposition more difficult, or riskier. Nevertheless, it is possible for catch targets to be attained, and failure to attain those targets will sometimes be difficult to assign directly to an area closure when they might also be explained in part by natural variation in the fishery or other constraints like bycatch limitations for species that are not involved in this action. For these reasons, this section generally takes the approach of thinking about "revenue at risk" rather than "forgone revenue in the event of an area closure". This approach has been used in other area-closure actions, as in certain elements of BSAI Amendment 91 (BSAI salmon bycatch management measures). Discussion of revenues at risk, like the value of catch that has historically been taken in the RKCSA, is supplemented with discussion of operational impacts and examples of how fleets forced to shift the time and area of fishing might be running towards other existing constraints with forgone revenue impacts that might be worse for them or encountering other bycatch species for which the Council has separate management objectives.

"Revenue at risk" is an upper bound estimate based on historical effort, landings, and gross value estimates. Taking any revenue impact estimate as an absolute projection would be assuming that no displaced catch could be made up by shifting effort, which is unlikely to be the case. The true impact on gross revenue – holding equal all other factors like contemporary market conditions and catch limits – is likely smaller than historically informed at-risk estimates.

The analysts acknowledge that looking only at gross revenues is not an ideal reflection of the expected economic impacts. However, estimation of effects on net revenues (profits) requires data on costs that are not available across all affected groundfish fisheries. Gross revenues serve as a best available proxy for economic earnings in these fisheries (or parts thereof). The Council's expectation is that the affected fleets will mitigate gross revenue loss by changing fishing locations. This document merely points out whether and to what extent that action is likely to be necessary based on historical reliance on the areas identified in the alternatives. The analysts are not able to retrospectively assess how productive these fisheries would have been if they had fished in different areas in the past under the fishing conditions of the time, nor is it predictable how fishing conditions will be different in the years after implementation of a new area closure. A reader could use full "revenue at risk" forgone as a maximum potential impact and scale back from there based on their own understanding of a fleet's ability to achieve harvest goals in different areas, or based on their understanding of how uniquely important fishing in a would-be closed area is to that fleet. If it is thought that the RKCSA or Area 512 are not critical to a fleet, then status quo economic outcomes are the best approximation of the closure impacts. If it is thought that the area is not critical but may become more important in the future due to other variations (e.g., environmental, or movement of target stocks), then a good approximation of negative impacts would be more than zero but closer to status quo than to maximum revenue at risk.

Unlike actions where the Council is choosing along a sliding scale of how binding an impact might be (e.g., a PSC limit control rule), the actions under consideration are framed as on/off switches based on factors that are outside of the control of any groundfish fishery participant (Options 1 and 2 in this action). Because those trigger options are exogenous factors, the effects of the actions are described as impacts that "may occur in some years" or "are likely to occur in most years given the state of the BBRKC stock outlook". There is no cause to analyze a sliding scale of impact likelihood based on reaction choices that the groundfish fisheries might make because those choices do not affect whether the closure will be in force for future years (unlike an incentive program in this way). Section 2.4 of this document outlines information hurdles that make it difficult to assign probabilities to closures being in effect in a given future year, but that section and other references to the most recent BBRKC SAFE (Palof 2023) would indicate that the action alternatives are more likely than not to be in effect in the *near* future if implemented.

The considered action alternatives are framed as a restriction rather than an incentive to modify fishing behavior. Mandated changes in behavior may often end up looking the same as incentive-driven changes, but they have the disadvantage of being a one-way change such that groundfish fleets could not revert to past practices if new information becomes available – e.g., it is learned that displacing effort from the RKCSA has worse impacts on protected or prohibited species than what was presumed about fishing in the RKCSA. The Council may weigh that accepting this disadvantage is the best way to meet its balance of management objectives with the imperfect knowledge available about the relative importance of the area to BBRKC.

The social impacts of each alternative are addressed in the section corresponding to impacts of the alternative rather than a standalone subsection. The affected groundfish fisheries – as defined in this document – are not uniformly subject to social data collections (e.g., economic data reporting, skipper surveys, etc.). Local, traditional, and subsistence resources for the primarily affected groundfish species (pollock and Pacific cod) are not extensive for the Bering Sea, nor is there much quantitative or qualitative subsistence reporting on red king crab in the Bristol Bay region (see Section 3.5). Moreover, summary statistics like number of crew per vessel (by gear fishery) or the distribution of vessel ownership locales (by gear fishery) are difficult to relate in a quantitative impact manner to the action alternatives because the analysts are not proposing that the action alternatives would directly result in a substantial number of vessels leaving their fisheries altogether. It is more likely that vessels will face a more operationally constrained fishery that is sometimes less efficient or productive (net of operating costs), but continue to fish in open areas. The broad and diverse array of potentially affected vessels – from smaller pot cod CVs to large AFA pollock or A80 trawl CPs – also differ in the response options available to them (the range is obviously broader under Alternative 2 as the RKCSA is currently at least open to more types of fishing operations). Many vessels can redeploy their vessel and crew to fisheries in other areas, like the AI, GOA, or west coast. The analysts did not find that the subset of any fishery fleet that had recent history in the RKCSA was uniquely tilted towards a locality of ownership or a preference for delivery port. The subsets of fleets that had fished in the RKCSA generally represented a random sample of that fleet's makeup. In other words, it was not found – for example – that trawl CVs that fished in the RKCSA tended to be domiciled in Oregon (or any other state in particular).

4.2 Economic Impacts of Alternative 1, No Action

The No Action alternative would allow BS groundfish fisheries to operate in the RKCSA and Area 512 to the extent they are currently allowed. The level of participation in the RKCSA varies across the groundfish fisheries, as shown in terms of groundfish catch in Table 3-1 (Section 3.2). Figure 3-8 (Section 3.1.3) and Table 3-25 (Section 3.2.3.2) show vessel participation and gross revenues for Pacific cod pot vessels in Area 512, respectively. In general terms, the only groundfish fishery where RKCSA participation has increased in recent years is the pelagic trawl (pollock) fishery. Other groundfish sectors with recently reduced harvest in the area do still rely on areas near the RKCSA based on the proxy of BBRKC fishery management Area T. By contrast, pot cod CVs have shown more participation in Area 512 over the past five years. That trend has potentially emerged as a result of more processing capacity in the eastern Bristol Bay/Aleutians East Borough region and the willingness of processors to use tender vessels to retrieve catch from what was previously a more remote fishing area relative to where shoreside processing was located. This analysis notes that the trend of tendering in the easter BS region is not certain to continue at recent levels, and nearby processing plants that could be reached by larger pot cod CVs without a tender may not be operating year-round in the foreseeable future.

In pairing with Table 3-1, the gross revenue tables for each groundfish fishery in Sections 3.2.1 through 3.2.4 give a sense of where maximum "revenue at risk" impact might begin. Table 3-16 (pelagic trawl) reported that pollock CPs recorded an average of roughly $80 million in annual gross wholesale revenue generated in the RKCSA from 2018 through 2022 (excluding $19 million in 2020 as part of the key period for pelagic trawl fishing in the RKCSA was heavily disrupted by the first days of COVID-19 safety and logistical challenges). In those non-2020 years, the RKCSA accounted for 9-13% of annual gross revenues for AFA CPs (highest proportion was in 2022). With the exception of 2020, all of the 13-14 active AFA CPs fished in the RKCSA. Table 3-16 shows that AFA CVs derived between 3-11% of annual gross ex-vessel revenues from the RKCSA since 2018 (proportion in 2022 was 7%). In 2018 and 2019 around 80% of AFA CVs fished in the area, though that proportion was 69% in 2022.

Table 3-18 (non-pelagic trawl) captures participation and revenues in the years since 2018 during which time the fleet has largely curtailed its activity in the RKCSS, but Table 3-1 shows that the fleet is still heavily engaged in other parts of Area T nearby. This is a case where recent vessel counts and revenues within the RKCSS might not be indicative of the future if other constraining factors that the A80 and TLAS fleets balance were to shift. But if using recent years as a proxy is of some value, barring non-pelagic gear from the RKCSS in more years would cost on the order of "several million dollars" spread over 6-10 vessels. Between 2013 and 2018, non-pelagic trawl catch in the RKCSS was three to ten times more (in weight) than in the recent years when the RKCSS was not closed by regulation. By simple extrapolation, a value of $1-3 million could be as high as $30 million from that area in 2022-adjusted dollars. Note that the status quo is no different from Alternative 2 for the non-pelagic sector in years when the BBRKC fishery is closed. If that is the norm for the immediate future, the status quo is a fair representation of Alternative 2 for that sector. Non-pelagic trawl CVs do not have a recent track record of fishing in the RKCSA, so the same can be said for those vessels but with even less perceived opportunity loss through the closure of the fishery. The non-pelagic fleets are the most potentially affected by the existing Zone 1 RKC PSC limit (see Section 3.2). Zone 1 encompasses the RKCSA/SS but includes the other parts of the eastern BS where non-pelagic trawling occurs. While there are scenarios where the non-pelagic sector might be indifferent towards Alternative 2, there would still be reasons for the sector to weigh RKC bycatch heavily among other factors that dictate their harvest patterns. This is potentially in contrast to the pelagic trawl sector, where attainment of the RKC PSC limit in the pollock/Atka/other category only closes the RKCSA to non-pelagic gear and thus does not directly curtail pollock fishing.

The pot gear fisheries are described with greater detail in Section 3 of this document because Pacific cod pot fishing is potentially affected by *both* action alternatives, and because there is a unique degree of overlap (non-universal) between pot cod participants and direct stakeholders in the BBRKC directed fishery. Table 3-19, Table 3-26 and Table 3-37 in Sections 3.2.3 and 3.3.1.2 show pot cod harvest revenues in the RKCSA and in Area 512, respectively (processing revenues are reported in Section 3.3.2.2). Table 3-19 shows recent pot cod CV harvest by 49 to 83 vessels in the BS area since 2018 but only 5 to 11 fishing in the RKCSA. RKCSA ex-vessel revenues ranged from roughly $300,000 in 2022 to $4 million in 2018, compared to BS-wide revenues ranging from $20.5 million in 2021 to $40.5 million in 2019. 2023 revenues are not reportable at the time of writing. Area 512 pot cod harvest revenues averaged roughly $2 million annually since 2013, but since 2019 participation/catch/revenues have all increased with a peak year estimate of $5.6 million in 2019 and roughly $3.5 million in each of 2020 and 2021 (Table 3-37). The pot cod CP sector is smaller (maximum four vessels since 2018 with total annual wholesale revenues topping at $8.9 million in 2018 and dipping to $4.1 million in 2021. One or two pot cod CPs fished in the RKCSA in 2018 through 2021 (revenues confidential). Activity in the pot cod CP fleet has declined from a low amount to near zero in the most recent years and, while the potential effects of the action alternative should still be considered with regard to that sector, the No Action outlook for that sector involves little or no active participation in the very near term.

Pot cod CVs have often avoided the RKCSA during the A season when crab are molting and mating, as evident in the Section 3.2 catch tables. Figure 3-7 showed that CVs had increased overall participation in the RKCSA starting around 2018 but have pulled back in the years coinciding with BBRKC closures. Section 3.1.3 gave evidence for participation overlap between larger pot cod CVs and directed crab fishing. The percentage of O60 pot CVs that fished crab since 2011 was as high as 96% and typically over 75%, though recently lower because fewer key crab fisheries are open (see Figure 3-6). Pot cod CP activity is more limited by confidentiality, but it can be qualitatively assessed that a segment of the small PC sector is directly invested in crab stocks, including BBRKC.

The analysts note that there are other entities or groups that are participatory stakeholders in both crab and groundfish. Examples include each of the six CDQ groups as well as vertically integrated private firms that own vessels inshore and offshore groundfish vessels, crab vessels, and processing facilities that take both finfish and shellfish.

As noted below, the HAL CP sector has had only small engagement in the RKCSA in recent years – six vessels (gross $7.8 million) in 2018, and two vessels in each of 2020 and 2022. Zero HAL CPs fished in the RKCSA in 2023. No HAL CVs have fished the area during the analyzed period.

From a seasonal perspective – to the extent that it was fished at all with non-pelagic gear in certain years – the RKCSA is clearly more important to the trawl sectors in the first half of the year (A season for pollock and cod; yellowfin sole and rock sole). Pot fishing in the area was not exclusively in the B season but was strongly tilted in that direction – likely some reflection of the partial overlap in cod and crab participation. There was no evident seasonal favor for fishing in the RKCSA with HAL gear when those instances did occur; vessels were likely following fish at times when the grounds were not preempted by other gears.

The natural environment will continue to play an important role in how fisheries occur – from stock status to fish aggregations (and CPUE). Under Alternative 1, the relative attractiveness and thus importance of the RKCSA to groundfish fleets is likely to evolve or move through cycles. For example, the pelagic trawl fishery might see more salmon, herring, or flatfish (all prohibited or undesired) in the RKCSA than they currently do, and thus would avoid the area anyway. By contrast, the HAL CP sector might see cod aggregations revert south towards the RKCSA and – given that RKC PSC is not a tight constraint on their directed fishery – increase fishing in that area. This could occur if cold water pushes Pacific cod south or if sea ice extent limits where the HAL vessels want to fish. The RKCSA has not been a key area for the HAL CP sector in recent years, but 10 years ago the fleet's catch in the area was more than ten-times its current level and the fleet still has a substantial amount of catch in Area T (though half or less than levels prior to 2018 – see Table 3-1). The non-pelagic trawl sector might find less favorable flatfish catch rates and halibut PSC rates farther west of the RKCSA in future years, and thus would have a reduced incentive to choose that area over historically relied-upon early season flatfish grounds in and around the RKCSS. These are just examples of how variation in ocean conditions and the distribution of non-groundfish/non-crab species might render recent history a less representative picture of how important and how utilized the RKCSA will be.

Table 3-52 in Section 3.5 gives a table overview of the BBRKC directed fishery harvesting and processing sectors in terms of participation, revenue, and unit price trends. BBRKC participants are experiencing a multi-level economic disaster (as declared by the Secretary of Commerce) from the joint closure of BBRKC and BS snow crab. The average value of the BBRKC fishery in the five years preceding the initial 2021/22 closure was estimated at roughly $55 million, not including ancillary economic effects through indirect shoreside business supports and the reverberation of crew wages in localities inside and outside of the Bering Sea region and Alaska as a whole. The most recent BBRKC ESP stated at if the current economic disaster persists, there is potential to "induce lasting structural changes in crab harvesting and processing sectors with associated changes from historical patterns of fleet fishing behavior (Fedewa and Shotwell 2023). The Council is already aware of crab-focused processing facilities in the BS region not currently operating, and ongoing difficulties associated with crewpersons unable to get sea days in the fishery to maintain quota privileges that they had accrued through active participation and investment. The BBRKC directed fishery was open for the 2023/24 season at a low catch level of 2.14 million pounds – roughly 0.5 million pounds less than the previous low season in 2020/21. Final revenue estimates for that fishery are not yet available.

4.3 Economic Impacts of Alternative 2

This section considers a year-round closure of the RKCSA with the preceding description of No Action as a baseline for comparison. The four gear fisheries – pelagic trawl, non-pelagic trawl, Pacific cod pots, and Pacific cod HAL – are discussed individually. In terms of impacts on groundfish harvesters, the analysts do not detect significant accumulations of effects as additional gears are barred from the RKCSA in a given year, so the reader can consider the Suboptions to carve-in or carve-out pot and HAL gear from the alternative on the individual case for each gear. There are certainly individual vessels that utilize more than one gear type (e.g., trawl CVs that use pot gear; pot CVs that use HAL gear as a CV; AFA CVs that use pelagic trawl gear for pollock and non-pelagic trawl gear for Pacific cod). However, it is often the case that the secondary gear a vessel uses is for IFQ fishing which has not occurred in the RKCSA and is thus not evaluated as a potential impact here. Also, as noted in the previous subsection and below, several of the gear fisheries considered in this document have deemphasized fishing in the RKCSA – at least in recent years. It is possible if not likely that a multi-gear harvest participant is affected in one of their fisheries to some extent, but unaffected in another.

It is also possible that a shoreside processing participant could experience an accumulation of effects from the application of Alternative 2 to more gears rather than fewer. However, again, the analysts find it unlikely that an individual processor is reliant on (exposed to) CV activity within the RKCSA across multiple gears to the point where the bundling of pot gear with trawl gear in the closure causes significant economic harm to a processing plant where "merely" excluding trawl CVs from the RKCSA would not have. (HAL CVs have not fished in the RKCSA and thus are not included in this consideration of shore-based processing impacts.)

The analysts cannot report on individual processing plants' fishery revenues and reliance, but the diversification tables in Section 3.3.2.1 show that catch from the RKCSA makes up a modest percentage of total shore-based processing revenues at the community combinations that are reportable under confidentiality restrictions. Table 3-42 and Table 3-43 report that during the analyzed period an average of 3.4 shore-based processors in Dutch Harbor and 5.2 plants in other Alaska communities derived an average of 0.66% and 1.78% of aggregate total revenues annually from Pacific cod caught with pot gear in the RKCSA. Compared to all fish processing revenue in Dutch Harbor and that set of "other" communities, RKCSA cod pots accounted for around 0.11% of annual total wholesale revenue on average. By comparison, Table 3-46 and Table 3-47 show that on average 3.1 shore-based processors in Dutch Harbor and 2.2 processors in other Alaska communities derived 14.92% and 5.09% of total wholesale revenue from AFA pollock caught in the RKCSA, respectively. That RKCSA-pollock delivered to shore plants made up an average of 2.39% of total Dutch Harbor processing revenue and 1.01% of the total revenue in the set of other communities. Those percentages are still small in terms of a theoretical loss that would threaten the viability of a plant, but they would be much more impactful that the revenue missing from RKCSA pot cod. The reader is reminded that these revenue estimates represent maximum potential "revenue at risk" and it is likely that much if not most of the pollock and cod referenced here would be recovered from fishing in other areas. The operational cost of doing so would fall on the vessels doing the harvesting. Adverse impacts on the processing component of these RKCSA-related fisheries likely would not occur unless vessels began to reduce overall effort and TAC utilization (i.e., volume of deliveries) declined as a result of the action. The analysts would describe that outcome as less likely than operational inefficiencies and other soft impacts on pollock and cod harvesters that are described below. Individual plant-level effect might vary depending on a plant's reliance on catch that comes specifically from the RKCSA. Based on the percentage of total BS area catch that comes from the RKCSA – or even the catch that comes from the Area T part of the BS, it is unlikely that a processor would be dependent on RKCSA pollock (Table 3-1). As a high-volume fishery, plants that are processing pollock are certainly taking deliveries from more than a localized area. It is more likely that a plant might see a dip in pollock deliveries during the specific time window when pelagic trawl fishing tends to occur in the RKCSA, and that would only be the case if catch is forgone rather than shifted to a different location south or west of the RKCSA.

Based on the data shown under Alternative 1 (Section 5.2), it is reasonable to conclude that the most likely fisheries to be directly affected by an RKCSA closure are A season pollock (CP and CV) and B season pot cod (CVs). The pot cod fleet had not fished in the RKCSA during the A season at more than a de minimis level since 2014 (Table 3-2). B season pot cod is similar to A season non-pelagic trawl activity in recent years in that the fleets have generally stayed out of the RKCSA – although for different reasons. For the pot cod fishery, the shift away from the RKCSA coincides with concern about the BBRKC stock and in the most recent years subsets of the diverse fleet have publicly stated internal fleet agreements to avoid the area. The shift of pots out of the RKCSA also coincides with increased effort in Area 512 that might not be viable without the emergence of tender operations in that area (see Section 3.2.3.1).

Potential direct impacts on the pelagic trawl fleets under Alternative 2 are the most notable in terms of revenue at risk as it is the only gear group where reliance on the RKCSA has actually increased during the analyzed period. Those potential impacts are, for all intents, contained to the A season (refer to Section 3.1.1 for a description of how the pelagic trawl fishery tends to move throughout the year and why fishing has not typically occurred in the RKCSA later in the year even though the eastern portion – Area 516 – is no longer closed to all trawl gear after June 15). Compared to other gear sectors, the pelagic trawl fisheries face a relatively complex mix of year-round or seasonal closed areas and constraining PSC species that are highly mobile and for which area-based encounter rates may be less predictable from year to year before fishing commences (e.g., salmon, herring). Existing area limitations are also described in Section 3.1.1. Compared to non-pelagic gear, the pollock fishery is less constrained by actual RKC bycatch (and Bycatch Limitation Zone 1) but it is perhaps more reliant on test-and-move fishing in terms of avoiding non-crab PSC and areas of fine-scale clean fishing may be more fleeting in the short term and require more options for spatial reactivity. Compared to the pot sector, pelagic (and non-pelagic) trawl gear is limited by more bycatch constraints and does not have the option to move east (e.g., Area 512) if the RKCSA is closed. It is likely that there would be some years when the pollock fleet would choose to fish less in the RKCSA even if it were open. Table 3-2 shows that A season PTR catch in the RKCSA was variable even in the relatively recent analyzed period (since 2013), with years showing A season catch in the RKCSA as a percentage of the entire BS as low as 1% in 2013 and 3% in 2016 and 2020 (though 2020 may have been a COVID-related anomaly). More typically in recent years, between 14% and 28% of A season pollock catch has occurred in the RKCSA. Years when the pelagic fleet might choose to fish less in the RKCSA might be related to sea ice extent, the cold pool, or local incidence of salmon and herring.

As noted in Section 3.1.3, the non-pelagic trawl fishery (mainly CPs) shifted effort outside of the RKCSS – although not entirely outside of Area T (Table 3-1). The non-pelagic trawl sector's incentive to fish in the RKCSS as opposed to other parts of Zone 1/Area T depend on catch rates of flatfish in the late winter or early spring and especially when certain species are bearing roe. In years when the RKCSS is open to non-pelagic gear, the sector's incentive to stay out of the RKCSS is mainly its sub-limit of the total Zone 1 RKC PSC limit (25% of the annual limit). Aside from that limit, the sector is following flatfish (CPUE) while avoiding hot spots of crab and halibut PSC and high rates of Pacific cod that could limit their ability to fish in Zone 1 (or at all) later in the year. It is important to note that not all non-pelagic trawl gear participants are equally reliant on flatfish fishing, so the marginal reduction in operational flexibility of more frequent RKCSS closures would fall more heavily on some participants than others. Companies with less access to fishing in other areas (e.g., AI, GOA) or for non-flatfish species have a higher risk of not being able to recover the revenue at risk. As noted in Section 3.1.3, TLAS fishing within the RKCSA was infrequent and relatively small scale throughout the analyzed period. From 2013 through 2019, five CVs used non-pelagic trawl gear in the RKCSS, and none have been active in the area since then. The direct effects of an RKCSS closure point more toward the A80 sector, but some TLAS CVs (especially non-AFA) do tend to fish where their offshore delivery markets (i.e., CPs) are fishing. Also, if the BSAI trawl CV Pacific cod fishery closes relatively early on TAC, TLAS CVs without access to fisheries in non-BS areas might return to the BS yellowfin sole fishery and might then experience more crowded grounds in the non-RKCSS area or an inability to fish in the Savings Subarea even if that is where fish are aggregated.

The HAL gear participants that would be most likely to fish in the RKCSA if external conditions change would be the HAL CPs (Freezer Longliners). Based on recent fishing patterns, HAL CPs are more likely to experience secondary effects like vessels that were formerly in the RKCSA moving into areas that HAL vessels have relied on to set large amounts of gear. This is a low to moderate risk in the near term unless HAL vessels are pushed south in certain years due to changing cod distributions. Competition for grounds from non-HAL CVs is less likely the farther north HAL vessels fish since most CVs are spatially constrained by distance to delivery ports on the Aleutian chain. The primary impact on the HAL sector under Alternative 2 would be a reduction in flexibility to adapt to natural variations in the location of their target species throughout the year.

Because Alternative 2 does not *necessarily* result in forgone catch, an important aspect of potential economic impacts is how the closure of the RKCSA in certain years might necessitate operational changes that could reduce the net benefits that harvesters derive from their fishing in the BS area and the benefits that flow to crew labor and consumers. Net economic benefits are gross benefits net of costs, and costs can be categorized as fixed costs and variable costs. Fixed costs do not change with the level of production; examples include the cost of having a vessel ready for production, debt payments, insurance, property taxes, depreciation, and the opportunity cost of using available resources for other economic activities. In the event that total production is lower under Alternative 2, fixed costs would be distributed across a smaller volume of product output. The more likely effect of an area closure – to the extent that it affects fishing choices in time and area – are variable costs. Examples of variable costs may include fuel/travel costs, time and productivity costs of learning new grounds (although fishing conditions often change from year to year to a certain extent, so this cost may already exist much as it would), lower CPUE productivity if fishing in less favored areas of aggregation, the cost of minimizing bycatch of other species if a vessel is pushed into areas where non-crab PSC species are more likely to occur, and the direct costs of gear conflict or time-costs avoiding them if grounds are more congested at certain times.

Safety-at-sea impacts may also occur if vessels have fewer options to avoid rough conditions or are simply fishing farther from port if a health/safety emergency were to occur.

If vessels are fishing in areas that would not be a first-choice, it is possible that the vessel is experiencing a marginal reduction in productivity in terms of CPUE efficiency, product quality, or both. Section 3.1.1 gave the example for the AFA pollock CP sector that fishing location is sometimes dictated by the pollock sizes needed to supply certain product lines in the fish plant. If available fishing locations allow the fleet to match typical TAC utilization rates, there may still be some loss to consumers if the fish caught in open areas are smaller or of lower quality. Similarly, Pacific cod unit values are impacted by flesh quality that could be influenced by fishing location, as ocean temperatures might affect the presence of parasites. Because the affected groundfish fisheries are producing into a world whitefish market, quality and marketability impacts have price effects that would not be compensated by instances of lower supply allowing prices to rise.

Productivity impacts in the form of less economically efficient fishing can also link to social impacts through reduced labor compensation for workers who are paid gross revenue shares. Reduced value of their labor time increases the opportunity cost of fishing relative to other employment they could have, and may result in less total income across all their modes of work and thus less contribution to local and regional economies that almost always reach outside of the Bering Sea region of Alaska.

CDQ affiliations always add depth and complexity to the consideration of social impacts because those organizations have both commercial and community-supporting missions, as well as stakeholder status in groundfish and crab harvesting/processing. The impacts of the alternatives described below do not have aspects that hinge on CDQ affiliation, and it was not found that vessels with CDQ ownership or harvest partnership affiliations were more or less likely to prosecute a small part of their business plan within the RKCSA. To the contrary, the ability to fish CDQ often provides additional flexibility that could soften the marginal restriction put in place under Alternative 2. For example, pollock CPs fishing during the B season can only fish in the CVOA when fishing CDQ. On the surface it would seem that CDQ affiliations might lessen the impacts associated with less operational flexibility. However, the analysts think that benefit might only present itself in extreme cases of limitation, as annual spatial/temporal fishing plans have developed to their current state because that state is optimal for finding the right fish at the right time for CPUE, markets, product quality, and bycatch minimization. In the example of pollock CPs fishing in the CVOA in the fall, it is better to have that option but pollock CPs tend to fish farther west during that season for reasons described in Section 3.1.1.

4.4 Economic Impacts of Alternative 3

Alternative 3 would close Area 512 to Pacific cod fishing with pot gear. Since roughly 2019, this area has had increased importance to the pot cod fleet, and is primarily prosecuted by O60 CVs. In recent years, the majority of this catch has been delivered to tender vessel that land the catch at shore-based processors or inshore floating processors in the Dutch Harbor/Unalaska community, King Cove, Akutan and, more recently, Port Moller. Processing activity for this fishery in communities other than Dutch Harbor/Unalaska and King Cove is more variable from year to year, and the near-term outlook as reported to the analysts by fishing and processing participants is not positive in terms of remote processors offering shoreside markets on a regular basis. Other communities that have received landings are noted in Sections 3.2.3.1 and 3.3.2.2. Table 3-48 through Table 3-50 show where processing from the Area 512 fishery has occurred since 2013. Compared to wholesale-level processing revenues of all species, Area 512 pot cod accounted for roughly 0.83% of annual average value in Dutch Harbor (average of 2.7 plant facilities per year) and 2.82% of total annual processing revenue in the other communities that were active in a given year (average of 3.8 plant facilities per year).

Table 3-36 through Table 3-39 in Section 3.3.1.2 show the community of ownership affiliations for CVs fishing pot cod in Area 512 since 2013 and a state-based decomposition of gross ex-vessel revenues. Over half of the vessels were linked through ownership to Washington, roughly a quarter to Alaska, and 13% to Oregon. Gross revenues were roughly proportionate to the number of participants (vessel count proportion). As a percentage of all ex-vessel fishing revenues, pot cod fishing in Area 512 accounted for roughly 3.2% by annual average. In the communities where these vessels are linked through ownership, pot cod fishing in Area 512 made up roughly 0.2% of total ex-vessel revenue production.

Using the revenue-at-risk thought model, Alternative 3 might carry the risk of a higher proportion of historical revenues being forgone (not recovered by fishing in other areas) if it is selected in combination with Alternative 2 (RCKSA closure). The only two NMFS areas with higher pot cod catch volume in recent years that Area 512 are 519 and 509. Area 509 encompasses the eastern half of the RKCSA.

Not all pot cod fishing in Area 509 is in the RKCSA, but a closure of that area would cumulatively restrict a substantial proportion of preferred pot fishing grounds. Area 519 accounts for a relatively high proportion of total catch but it is a small area that could conceivably reach a spatial congestion limit if spillover pot cod effort is redirected there. Alternative 3 would leave Area 508 – the most eastern region of Bristol Bay – open to pot fishing, but that area has never been heavily prosecuted for cod. That could be due to lower catch rates there, but likely also because of its distance from groundfish processors – even those using tender vessels – and because the inshore parts of Bristol Bay are also valued for their role as BBRKC habitat. As noted throughout this document, the pot cod sector has a relatively high degree of overlap with crab fishery participants, and it is likely that some portion of the cod fleet would hesitate to redirect effort into Area 508 for the same reasons that they have recently stood down from pot fishing in the RKCSA.

Tender utilization can open up areas that might not be economical without them due to distance from processing ports. On the other hand, the economics of a fishery that makes tendering a viable additional cost to bear (additional vessels, crew, and fuel involved that all must be paid for out of the catch value) may be sensitive to market price changes or to input costs increases. If margins are narrow, increasing or maintaining tender operations could be an area where costs are cut. An area-fishery combination that is not accessible without tenders is relatively more at risk of losing economic viability from year to year. Some of the cost and value factors that make tendering a viable economic choice are beyond the control of the direct participants (harvesters/processors); examples include TAC size, global product markets, and operating costs that have recently increased at a rate faster than product revenues (e.g., fuel, insurance, provisioning, crew travel, and shoreside labor costs that maintain a vessel). The additional cost of tendering is likely directly paid by processors but is shared if not passed on to the harvest side through the price paid to the harvester. Whether participants choose to continue fishing as long as revenue is greater than cost is an individual choice, but the fishery is less economically efficient the closer the cost of fishing gets to the gross revenue generated. In economic terms, fishing all the way to the break-even point where total costs equal total revenues is not optimal. A vessel (or a processor) with other revenue opportunities might choose to participate less in a fishery after the point at which *marginal* costs equals marginal revenue ("per fish"). To the extent that one area closure or paired area closures (Alt. 3 plus Alt. 2) increases operation costs, area closures increase the risk that vessels will leave the fishery.

Compared to pot CVs, the small number of pot cod CPs may be relatively less affected by an Area 512 closure since CPs have fewer operational constraints on where they can fish – though not wholly unaffected by higher operational costs farther afield – and because the small CP portion of the pot cod fleet stopped fishing in Area 512 as of 2019 (see Figure 3-8).

Given that most of the pot cod activity in Area 512 is on O60 CVs, it would not be possible for effort to spill over into the state-managed Dutch Harbor Subdistrict (DHS), which has a 58-foot vessel length cap. To the extent that effort redistribution occurs, it is likely to shift to other Federal areas. If the RKCSA is closed, it is likely that catch efficiency will be reduced given that most other areas have not been as preferred in the past. That efficiency loss entails similar downstream effects to those described under Alternative 2. Pot cod vessels may forgo BS pot cod catch if they have opportunities in the GOA or IFQ fishing. BS sablefish IFQ is commonly prosecuted with pot gear and has some existing overlap with the pot cod fleet but it is not a fully utilized fishery and would likely not recover all revenues forgone from the cod fishery. For reasons obvious from the context of this action, shifting effort to rationalized crab fisheries is not currently a viable way to recover any forgone cod revenues.

If the Pacific cod pot gear fishery in Area 512 is closed by Federal regulation amendment, it is likely that the State would close the parallel pot gear fishery inside state-waters adjacent to 512. That approach would be in keeping with a general policy to align crab protection measures across the State/Federal management boundary. The parallel waters fishery and its management is described on page 2 of the DHS management plan. One ancillary issue related to an Area 512 closure and state management is the existing permission for vessels directed fishing for RKC to fish a limited number of Pacific cod pots at the same time. ADF&G allows crab vessels to fish up to 10 cod pots; these pots are typically fished to catch bait for the crab pots.

If State managers mirror Federal regulations, it is possible that this option would be eliminated in the waters encompassed by Area 512. According to ADF&G staff, around 400 pots were used to fish for cod on vessels targeting rationalized crab on average over the past five years (that count is not exclusive to Area 512).

Table 3-20 shows that Area 512 has a high incidence of RKC bycatch compared to other areas (Section 3.2.3). The BBRKC assessment accounts for RKC mortality from groundfish fishing (in addition to retained and discarded mortality in the directed crab fishery). It is not possible to say that relocating pot cod effort from Area 512 to other areas would recover the BBRKC stock and recruitment trends without accounting for non-fishing factors that have contributed to the current status. Nevertheless, Area 512 stands out as an area where RKC PSC rates are elevated. The marginal contribution to BBRKC-dependent economies is likely positive but not quantified here.

4.5 Affected Small Entities (Regulatory Flexibility Act Considerations)

Section 603 of the Regulatory Flexibility Act (RFA) requires that an initial regulatory flexibility analysis (IRFA) be prepared to identify whether a proposed action will result in a disproportionate and/or significant adverse economic impact on the directly regulated small entities, and to consider any alternatives that would lessen this adverse economic impact to those small entities. NMFS prepares the IRFA in the classification section of the proposed rule for an action. Therefore, the preparation of a separate IRFA is not necessary for the Council to recommend a preferred alternative. This section provides information about the directly regulated small entities that NMFS will use to prepare the IRFA for this action if the Council recommends regulatory amendments.

This section also identifies the general nature of the potential economic impacts on directly regulated small entities, specifically addressing whether the impacts may be adverse or beneficial. The exact nature of the costs and benefits of each alternative is addressed in the impact analysis sections of the RIR and is not repeated in this section, unless the costs and benefits described elsewhere in the RIR differs between small and large entities.

Identification of Directly Regulated Entities

The entities that could be directly regulated under the action alternatives are any holders of a Federal groundfish LLP licenses endorsed fish in the BS FMP area.

Alternative 2 potentially regulates vessels that use pelagic trawl, non-pelagic trawl, pot, or HAL gear, and there is no special license endorsement needed to fish in the RKCSA (or RKCSS in the case of non-pelagic trawl gear), so the total set of potentially directly regulated entities is essentially the set of BS groundfish LLP license holders. The extent of license holders who are likely to be directly regulated can be winnowed down by assessing which vessels associated with these licenses have some recent history of fishing in the RKCSA with, for smaller vessels, is somewhat remote from delivery ports without support from a tender. Those vessel counts were supplied in Section 3.2 of this document. Other vessels that might have a BS groundfish LLP license endorsement but are unlikely to be directly regulated might be those whose only history in the BS is in the halibut/sablefish IFQ fishery, which has recorded any harvest in the RKCSA during the period analyzed since 2013 (see Section 3.1.5).

The maximum number of entities that would be directly regulated under Alternative 3 is smaller than the maximum under Alternative 2 and is a wholly contained subset of that group. By definition, all vessels with an endorsement to fish for Pacific cod with pot gear in the BS would be directly regulated under Alternative 2 in regard to fishing in the RKCSA. No special endorsement is needed to directed fish for pot cod in Area 512. The set of entities that is more likely to be directly regulated under Alternative 3 are those that have some history of fishing for Pacific cod with pots in Area 512. For recent years, those vessel counts are supplied in Table 3-25 in Section 3.2.3.1 of this document. Additional entities (vessels) that are not counted in Table 3-25 would be directly regulated if they wished to fish in that area but have not done so during the analyzed period; this number cannot be objectively quantified. While the analysts cannot say whether the amount of vessels interested in fishing Area 512 pot cod will be increasing, decreasing, or stable in the near-future, it is likely higher than it was 10 years ago as evident from the vessel count table. This increase in O60 CV activity in the area may be attributable to more tendering operations buying fish in the area (see Section 3.2.3.1).

Count of Small, Directly Regulated Entities

Under the RFA, businesses that are classified as primarily engaged in commercial fishing are considered small entities if they have combined annual gross receipts not in excess of $11.0 million for all affiliated operations worldwide, regardless of the type of fishing operation (81 FR 4469; January 26, 2016). If a vessel has a known affiliation with other vessels – through a business ownership or through a cooperative – these thresholds are measured against the small entity threshold based on the total gross revenues of all affiliated vessels. The small/non-small entity classifications below are based on 2022 revenue data. Those 2022 data are in a preliminary state at the time of this publication; the counts in this subsection will be reassessed for any revisions in subsequent iterations of this document. The analysts selected a longer time frame (2013-2022) to define the universe of vessels active or formerly active vessels that would be assessed in relation to the revenue threshold. Arguably, the alternatives under consideration could affect all AFA pollock vessels and all vessels with a pot gear or HAL gear endorsement for the BS management area.

This threshold is considered through 2022, but 2022 revenue data are in a preliminary review state at the time of writing and so the following counts will be revisited upon subsequent iterations of this document.

From 2013 through 2022, 151 vessels had a HAL/pot gear landing (Pacific cod) or a pelagic trawl landing (pollock) in the RKCSA from 2013 through 2022. There are 28 vessels that had a Pacific cod pot gear landing in NMFS Area 512 during that period (the count of vessels using pot gear in Area 512 overlaps the count of vessels that fished pot gear in the RKCSA, with 12 vessels that fall into both counts). For comparison, the total number of unique vessels that have fished groundfish with pelagic trawl gear, pot gear, or HAL gear in the BSAI during the 2013 through 2022 period is 525.

Of the 151 vessels that fished in the RKCSA, 11 are considered small entities. There are 22 vessels that previously participated and fished in the RKCSA but were not active in that area in 2022. Eight of the 11 small entities were active in the Pacific cod pot fishery and three were active in the pelagic trawl fishery.

Of the 28 vessels that fished for Pacific cod with pot gear in NMFS Area 512, seven were small entities. The 21 vessels in this grouping that were identified as non-small entities were categorized that way due to cooperative affiliations as part of the BS rationalized crab fishery (18), Freezer Longline Coalition (HAL CP Pacific cod cooperative; 2), or the Central GOA Rockfish Program (1).

Impacts to Small, Directly Regulated Entities

Impacts to "small" directly regulated entities will be fully described for final action based on the Council's refined alternatives. Small entities make up a minority of the fishing entities that have participated in the RKCSA and/or the Area 512 Pacific cod pot fishery. Broadly, these groundfish fishing entities would be adversely affected by the action alternatives in that they would have less available area to fish within the other regulatory and business constraints that they face annually. The net effect is likely closer to neutral in relation to pot cod vessels that fish in Area 512 (Alternative 3) since a segment of that fleet is also dependent on the medium-to-long term viability of the BBRKC stock for their overall business plan. There is no variation within the action alternatives/options that would be more/less adverse to the identified small entities. Each action alternative is a form of constraining groundfish fishing areas for the potential benefit of the BBRKC stock. The action alternatives are not differentiated by factors that would distinguish between small and non-small entities as defined by the SBA.

4.6 Alternatives with Respect to Net Benefit to the Nation

This section will be completed for the final action draft if the Council moves forward with consideration of one or both of the action alternatives, and a full analysis will be part of any proposed rule package.

5 Environmental Impacts

This chapter evaluates the potentially affected environment and the degree of the impacts of the alternatives and options on the various resource components. The socio-economic impacts of this action are described in Section 4 of this analysis.

Relevant information necessary to understand the affected environment for each resource component is summarized in the sections below. For each resource component, the analysis identifies the potential impacts of each alternative. If significant impacts are likely to occur, preparation of an EIS is required. Although an EA should evaluate economic and socioeconomic impacts that are interrelated with natural and physical environmental effects, economic and social impacts by themselves are not sufficient to require the preparation of an EIS (see 40 CFR 1508.14).

5.1 Resource Components Addressed in this Analysis

In considering the potential marginal impacts of the proposed action alternative, Table 5-1 shows the components of the human environment and whether the proposed action and its alternatives have the potential to impact that resource component and thus require further analysis. Extensive environmental analysis on all resource components is not needed in this document because the proposed action is not anticipated to have environmental impacts on all resource components.

Any effects of the alternatives on the resource components would be caused by changes in the location of groundfish fishing. This EA focuses on the principal groundfish species that are targeted with trawl, pot, and/or HAL gear in the eastern BS region (containing the RKCSA and NMFS Area 512). For prohibited species, this EA focuses on BBRKC but the document as a whole considers a range of prohibited species that includes salmon (Chinook and non-Chinook), herring, and Pacific halibut. Those non-BBRKC species are considered primarily through PSC rate maps shown in Appendix 2 and discussed in Section 3.3. This EA covers seabirds as a species that is commonly associated with impacts from HAL gear deployment (and trawl gear to a lesser extent). Habitat impacts are analyzed because the impacts of groundfish gear in the EBS area may affect structures and processes that are important to RKC throughout various stages of their life-history.

The impact on the human environment of the current regulations, as implemented through the FMP, were previously analyzed in the regulatory packages for actions including BSAI Groundfish FMP Amendments 10, 12, 37, 40, 41, and 57, which are incorporated by reference.

The action alternatives could result in a spatiotemporal redistribution of fishing effort as groundfish sectors alter fishing patterns to maximize their harvest opportunities to achieve economic and social value within those new constraints. It is assumed that groundfish sectors will prosecute the groundfish TAC available through annual harvest specifications to the extent they would under the no Action alternative, so the primary effect of the action alternatives is a spatial and/or timing change in fishing effort. Changes in the timing of fishing are also constrained by seasonal TAC apportionments and various existing seasonal closures that affect groundfish gear sectors. Spatial redistribution of groundfish effort has a fairly obvious impact on elements like habitat, but for components like seabirds, for which spatial impact resolution is not differentiated on such a fine scale, the marginal change in impacts is presumed to be minimal. The total amount of fishing effort deployed under the constraints of the action alternatives is likely to be similar to the recent years, but may be greater if the fishery is less efficient overall in terms of CPUE. A reduction or redistribution of fishing effort or greater fishing effort at lower CPUE could increase the duration of fishing in areas that remain open to groundfish gears. There may be more potential for incidental take or disturbances of other resource components, or more potential to affect abundance or availability of certain important habitat features compared to the status quo if increased fishing activity overlaps temporally and geographically with areas used by these other resource components.

There is already considerable interannual variability in the patterns of fishing across the BSAI groundfish sectors, as environmental conditions, aggregation of target species, and avoidance of PSC species have caused vessels to adjust their fishing patterns. Any spatial or temporal shift in fishing is unlikely to occur outside of the existing spatial or temporal footprint of the groundfish fishery as none of the proposed alternatives alter the number of fishery participants or directly propose changing the timing of the fishery. The fisheries analyzed are already constrained by resource and logistical availability.

Resource components that are not detailed in this document are presumed to have no impacts or limited impacts because the proposed actions are constrained by existing fishing regulations, harvest limits, and habitat protections as described in previous NEPA documents. Effects of groundfish fishing on these resource components are considered in the Final Programmatic Supplemental Environmental Impact Statement (PSEIS) on the Alaska Groundfish Fisheries (NMFS 2004) and the Alaska Groundfish Harvest Specifications Final Environmental Impact Statement (NMFS 2007). The 2023 Supplementary Information Report on Alaska Groundfish Harvest Specifications is incorporated here by reference.[41]

The social and economic impacts of this action relative to no action are discussed in Sections 3 and 4 of this document.

Table 5-1 Resources potentially affected by the proposed action and alternatives

Potentially affected resource component							
Groundfish (selected)	Prohibited Species (BBRKC)	Ecosystem Component Species	Marine Mammals	Seabirds	Habitat	Ecosystem	Social and Economic
Y	Y	N	N	Y	Y	N	Y

N = no impact anticipated by each alternative on the component.
Y = an impact is possible if each alternative is implemented.

5.2 Target Species

This section describes the status of four groundfish species that are the primary targets of the groundfish gears that operate in the eastern portion of the BSAI Groundfish FMP area, and in the RKCSA (and RKCSS) in particular. Those species are pollock, Pacific cod, yellowfin sole, and northern rock sole. Pollock is only a directed fishery for the pelagic trawl gear sector. Pacific cod is a directed fishery for pot and HAL gear, and a commercially retained non-target species for pelagic trawl. Non-pelagic trawl CVs directed fish for Pacific cod (TLAS sector). Non-pelagic trawl CPs (A80) are allocated Pacific cod and it is a commercially important species for them, but also a constraining quota allocation so often A80 vessels plan to catch their cooperative allocations of Pacific cod as a secondary species to flatfish like yellowfin sole and rock sole. Yellowfin sole and rock sole are described here because, of the groundfish species targeted by the non-pelagic trawl sector, they are the most likely to be targeted around the RKCSA/SS.

5.2.1 Species descriptions and status

5.2.1.1 Pollock

Walleye pollock (*Gadus chalcogrammus*; hereafter referred to as pollock) is a semi-pelagic schooling fish widely distributed in the North Pacific Ocean, with the largest concentrations found in the EBS. Alaska pollock is the dominant species in terms of catch in the BSAI region. Pollock in the BSAI are managed separately for the AIs, Bogoslof Island, and the EBS. Pollock stock assessments for the EBS are on an annual cycle while assessments for AIs and Bogoslof Island are on a biennial cycle with full assessments

[41] https://repository.library.noaa.gov/view/noaa/49144

in even years and partial assessments in odd years. Information on pollock in this section is taken from the 2023 Stock Assessment and Fisheries Evaluation (SAFE) Report, specifically sections on EBS pollock (Ianelli et al. 2023).

As detailed in the 2023 SAFE Report (Ianelli et al. 2023), the EBS pollock stock is neither overfished nor subject to overfishing and is not approaching overfishing. Since approximately 2014, the EBS entered a warm phase of unprecedented duration, with ecosystem effects on recruitment and fish condition. Low survey abundance estimates in 2021 were alleviated in 2022 with increased abundance, coinciding with data indicating that the 2018 year-class was one of the most abundant on record.

5.2.1.2 Pacific cod

Pacific cod (Gadus macrocephalus) is a transoceanic species, ranging from Santa Monica Bay, California, northward along the North American coast; across the Gulf of Alaska and Bering Sea north to Norton Sound; and southward along the Asian coast from the Gulf of Anadyr to the northern Yellow Sea; and occurring at depths from shoreline to 500 m (Ketchen 1961, Bakkala et al. 1984). Pacific cod is distributed widely over the EBS as well as in the AIs.

As detailed in the 2023 SAFE Report (Barbeaux et al. 2023), the EBS Pacific cod stock is neither overfished nor subject to overfishing, and is not approaching overfishing.

5.2.1.3 Yellowfin sole

Yellowfin sole (Limanda aspera) are one of the most abundant flatfish species in the EBS and currently is the target of the largest flatfish fishery in the world. Yellowfin sole are distributed in North American waters from off British Columbia, Canada, (approx. lat. 49◦N) to the Chukchi Sea (approx. lat. 70◦N) and south along the Asian coast off the South Korean coast in the Sea of Japan (approximately lat. 35◦N) (Spies et al. 2023). Their abundance in the AIs region is considered low to negligible.

As detailed in the 2023 SAFE Report (Spies et al. 2023), the EBS yellowfin sole stock is neither overfished nor subject to overfishing, and is not approaching overfishing.

5.2.1.4 Northern rock sole

Northern rock sole (Lepidopsetta polyxystra n. sp.) are distributed primarily on the EBS continental shelf and in much lesser amounts in the AIs region. Centers of abundance for rock soles occur off the Kamchatka Peninsula (Shubnikov and Lisovenko 1964), British Columbia (Forrester and Thompson 1969), the central Gulf of Alaska, and in the southeastern Bering Sea (Alton and Sample 1975). Adults exhibit a benthic lifestyle and seem to occupy separate winter (spawning) and summertime feeding distributions on the southeastern BS continental shelf. Northern rock sole spawn during the winter-early spring period of December-March. Recent research has identified a northern spawning area near the Pribilof Islands that appears to be particularly successful in years with warm bottom temperatures (Cooper et al. 2020).

As detailed in the 2023 SAFE Report (McGilliard et al. 2023), the northern rock sole stock is neither overfished nor subject to overfishing and is not approaching overfishing.

5.2.2 Effects on target species

5.2.2.1 Pollock

The effects of the EBS pollock fishery on the pollock stock are assessed annually in the EBS SAFE report (Ianelli et al. 2023) and were also evaluated in the Alaska Groundfish Fisheries Harvest Specifications EIS (NMFS 2007a). It is estimated that the EBS pollock fishery under the status quo is sustainable for pollock stocks (Ianelli et al. 2023).

The effects of the alternatives on pollock may include a redistribution of directed effort by the pelagic trawl vessels. Specifically, Alternative 2 may redistribute pelagic trawl vessels from the RKCSA/SS to elsewhere in the EBS. In general, though, the potential changes in pollock as a result of the alternatives are not expected to impact stock status. The pollock stock would not be overfished or experience overfishing as a result of the proposed alternatives because the current harvest specifications process for setting TACs and managing harvests within the limits would continue. Any potential impacts on prey availability and habitat are not likely to affect the sustainability of the stock.

5.2.2.2 Pacific cod

The effects of the EBS Pacific cod fishery on the Pacific cod stock are assessed annually in the EBS SAFE report (Barbeaux et al. 2023) and were also evaluated in the Alaska Groundfish Fisheries Harvest Specifications EIS (NMFS 2007a). It is estimated that the EBS Pacific cod fishery under the status quo is sustainable for Pacific cod stocks (Barbeaux et al. 2023).

The alternatives could result in a spatial redistribution of directed effort by the HAL and pot gear vessels. Alternative 2 may redistribute HAL and pot vessels from the RKCSA to elsewhere in the BS FMP subarea. Alternative 3 could redistribute pot gear vessels from Area 512 to elsewhere in the BS (refer to 3.3.2.2). In general, though, the potential changes in Pacific cod as a result of the alternatives are not expected to impact stock status. The Pacific cod stock would not be overfished or experience overfishing as a result of the proposed alternatives because the current harvest specifications process for setting TACs and managing harvests within the limits would continue. Any potential impacts on prey availability and habitat are not likely to affect the sustainability of the stock.

5.2.2.3 Yellowfin sole

The effects of the EBS yellowfin sole fishery on the yellowfin sole stock are assessed annually in the EBS SAFE report (Spies et al. 2023) and were also evaluated in the Alaska Groundfish Fisheries Harvest Specifications EIS (NMFS 2007a). The yellowfin sole stock is neither overfished nor subject to overfishing and is not approaching overfishing (Spies et al. 2022). It is estimated that the yellowfin sole fishery under the status quo is sustainable for yellowfin sole stocks.

The effects of the alternatives on yellowfin sole may include a redistribution of directed effort by the Amendment 80 fleet and TLAS vessels. Specifically, Alternative 2 may redistribute non-pelagic trawl vessels from the RKCSS to elsewhere in the EBS. However, the RKCSS portion of the RKCSA is only open to non-pelagic trawl gear when the NMFS, in consultation with the Council, determines that a TAC for BBRKC has been established. Due to the BBRKC fishery closure in 2021/22 and 2022/23, the RKCSS had been closed to non-pelagic trawl gear in 2022 and 2023. However, in 2023 the State of Alaska opened the BBRKC fishery; therefore, the Amendment 80 fleet is permitted to fish in the RKCSS for the 2024 season. It is undetermined whether the fleet will operate within the RKCSS, but the fleet intends to maintain voluntary crab avoidance measures, as described in the testimony received by the Council in December 2023 (see Section 1.2).

Spatial catch trends that did not incentivize non-pelagic trawl vessels to move east for yellowfin sole in the latter portion of the year – in avoidance of crab and halibut PSC and because of good fishing elsewhere – may not persist in all future years. In that case, the non-pelagic trawl fleet would have to focus on eastern BS areas that are not in the RKCSS and not to the east of the RKCSS (NBBTCA already closed to trawl gear year-round and NBBTCA – or “Togiak area” only open during a spring window of time). The analysts cannot predict where non-pelagic trawl vessels might find yellowfin sole along with suitable catch rates and low enough PSC or catch of constraining allocated groundfish like Pacific cod. If the non-pelagic trawl fleet, in aggregate, is searching for yellowfin sole at lower catch rates then overall fishing time could increase or less of the yellowfin sole TACs will be taken overall because fishing was not economical. The latter possibility could result in less aggregate fishing mortality for yellowfin sole.

In general, the potential changes in yellowfin sole as a result of the alternatives are not expected to impact stock status. The yellowfin sole stock would not be overfished or experience overfishing because the current harvest specifications process for setting TACs and managing harvests within the limits would continue. Any potential impacts on prey availability and habitat are not likely to affect the sustainability of the stock.

5.2.2.4 Northern rock sole

The effects of the EBS northern rock sole fishery on the northern rock sole stock are assessed annually in the EBS SAFE report (McGilliard et al. 2023) and were also evaluated in the Alaska Groundfish Fisheries Harvest Specifications EIS (NMFS 2007a). It is estimated that the EBS northern rock sole fishery under the status quo is sustainable for northern rock sole stocks (McGilliard et al. 2023).

The effects of the alternatives on northern rock sole may include a redistribution of directed effort by the Amendment 80 fleet. Specifically, Alternative 2 may redistribute non-pelagic trawl vessels from the RKCSS to elsewhere in the EBS. Due to the BBRKC fishery closures in 2021/22 and 2022/2023, the RKCSS has been closed to non-pelagic trawl gear in 2022 and 2023; however the RKCSS will be open to fishing in 2024 given the small BBRKC fishery for 2023/24. Vessels are likely to search for northern rock sole elsewhere in the BS (see Sections 3.2.2 and 3.3). For rock sole, it is likely that utilization would remain the same but be displaced to other area if possible and there would be less temporal redistribution of fishing effort because of historically valuable roe seasons for rock sole where the species has been traditionally targeted in or near the RKCSS. Unless areas outside the RKCSS simply do not have fishable aggregations of roe-bearing rock sole, the spatial and temporal effort shift would be as small as practicable for the non-pelagic trawl fleet that have historical reliance on rock sole.

Effects of Aggregate Past, Present, and Reasonably Foreseeable Actions on all Groundfish Target Species

Considering the direct and indirect impacts of the considered action alternatives, when added to the impacts of past and present actions previously analyzed in other documents that are incorporated by reference, the aggregate impacts of the action alternatives are determined at this stage to be not significant.

Aside from the potential actions described in this document, the analysts are not aware of other "reasonably foreseeable future actions" relating to groundfish gear use in the Bristol Bay region of the BS. Past and present actions – many of which were described in Sections 1.3 and 3.1 of this document – are responsible for a patchwork of restrictions on when and where trawl gear can be deployed in this region. Examples include the NBBTCA, the seasonal closure of Area 516 to all trawl gear, RKC PSC limits in Bycatch Limitation Zone 1, and the CVOA that restricts non-CDQ offshore sector pollock fishing during the B season (after June 10). None of those measures would be weakened or removed under the action alternatives.

5.3 Bristol Bay Red King Crab

RKC inhabit intertidal waters to depths >200 m of the North Pacific Ocean from British Columbia, Canada, to the BS, and south to Hokkaido, Japan, and are found in several areas of the AI, EBS, and the Gulf of Alaska. The State of Alaska divides the AIs and EBS into three management registration areas to manage RKC fisheries: AIs, Bristol Bay, and BS (ADF&G 2012). The Bristol Bay area includes all waters north of the latitude of Cape Sarichef (54°36' N lat.), east of 168°00' W long., and south of the latitude of Cape Newenham (58°39' N lat.) and the fishery for RKC in this area is managed separately from fisheries for RKC outside of this area. In other words, the RKC in the Bristol Bay area are assumed to be a separate stock from RKC outside of this area, notably the Bristol Bay Red King Crab (BBRKC) stock. The BBRKC stock is one of ten stocks jointly managed by the federal and state governance.

The BSAI King and Tanner Crab Fishery management plan (FMP) outlines the federal management for this stock.

RKC have a complex life history. Fecundity is a function of female size, ranging from tens of thousands to hundreds of thousands (Haynes 1968; Swiney et al. 2012). The eggs are extruded by females, fertilized in the spring, and held by females for about 11 months (Powell and Nickerson 1965). Fertilized eggs are hatched in the spring, most during April-June (Weber 1967). Primiparous females (first time breeders) are bred a few weeks earlier in the season than multiparous females (have bred before).

Larval duration and juvenile crab growth is dependent on temperature (Stevens 1990; Stevens and Swiney 2007). Male and female RKC mature at 5 to 12 years old, depending on stock and temperature (Stevens 1990; Loher et al. 2001) and may live more than 20 years (Matsuura and Takeshita 1990). Males and females attain a maximum size of 227 mm and 195 mm carapace length (CL), respectively (Powell and Nickerson 1965). Female maturity is evaluated by the size at which females are observed to carry egg clutches. Male maturity can be defined by multiple criteria including spermataphore production and size, chelae vs. carapace allometry, and participation in mating in situ (reviewed by Webb 2014). For management purposes, females >89 mm CL and males >119 mm CL are assumed to be mature for Bristol Bay RKC. Juvenile RKC molt multiple times per year until age 3 or 4; thereafter, molting continues annually in females for life and in males until maturity. Male molting frequency declines after attaining functional maturity.

King crab molt multiple times per year through age 3 after which molting is annual. At larger sizes, king crab (especially males) may skip molt as growth slows. Females grow slower and do not get as large as males. In Bristol Bay, 50% maturity is attained by males at 120 mm carapace length (CL) and 90 mm CL by females (about 7 years). RKC mate when they enter shallower waters (<50 m), generally beginning in January and continuing through June. Males grasp females just prior to female molting, after which the eggs (43,000 to 500,000 eggs) are fertilized and extruded on the female's abdomen. The female RKC carries the eggs for 11 months before they hatch, generally in April. RKC spend 2–3 months in pelagic larval stages before settling to the benthic life stage. Young-of-the-year crab (juveniles that are <1 year old) occur at depths of 50 m or less. They are solitary and need high relief habitat or coarse substrate such as boulders, cobble, shell hash, and living substrates such as bryozoans and stalked ascidians. Between the ages of two and four years, there is a decreasing reliance on habitat and a tendency for the crab to form pods consisting of thousands of crab. Podding generally continues until four years of age (about 65 mm), when the crab move to deeper water and join adults in the spring migration to shallow water for spawning and deep water for the remainder of the year. Mean age at recruitment is 8 to 9 years (NPFMC 2023b).

Specific to BBRKC, the best information available to the analysts indicates that the mating season primarily occurs from January to March for primiparous (individuals bearing first offspring) RKC females and from April to June for multiparous RKC females. Mating occurs at the same time as molting for mature females. Molting times for mature males are not as well described as for mature females.

Mature males are thought to molt once from January to March, whereas juvenile crab may molt several times per year as they grow and can molt at different times during a year. Large juveniles generally molt during the spring. Overall, the molting period for BBRKC ranges from January to June (Pers Comm J. Zheng, ADF&G, 2022; see also Table 2a in Fedewa et al. 2020).

Southwestern Bristol Bay has long been considered the most important area for larval release, since larvae released in that area are expected to drift into favorable juvenile habitat in nearshore Bristol Bay (McMurray et al. 1984, Armstrong et al. 1993, Dew and McConnaughey 2005). That hypothesis predicts increased settlement success in cold years when the female center of abundance is shifted southwest (Evans et al. 2012). That prediction is supported by observations that high year-class strengths in the 1970s occurred when the spawning stock was located in southern Bristol Bay (Armstrong et al. 1993). A recent study modeling larval trajectories under different climate scenarios suggests that southwestern Bristol Bay is not as favorable for hatching as previously hypothesized (Daly et al. 2020). Modeled larvae that hatched in central and nearshore Bristol Bay were more likely to settle in high-quality habitat and greater larval retention was found in warm years (Daly et al. 2020).

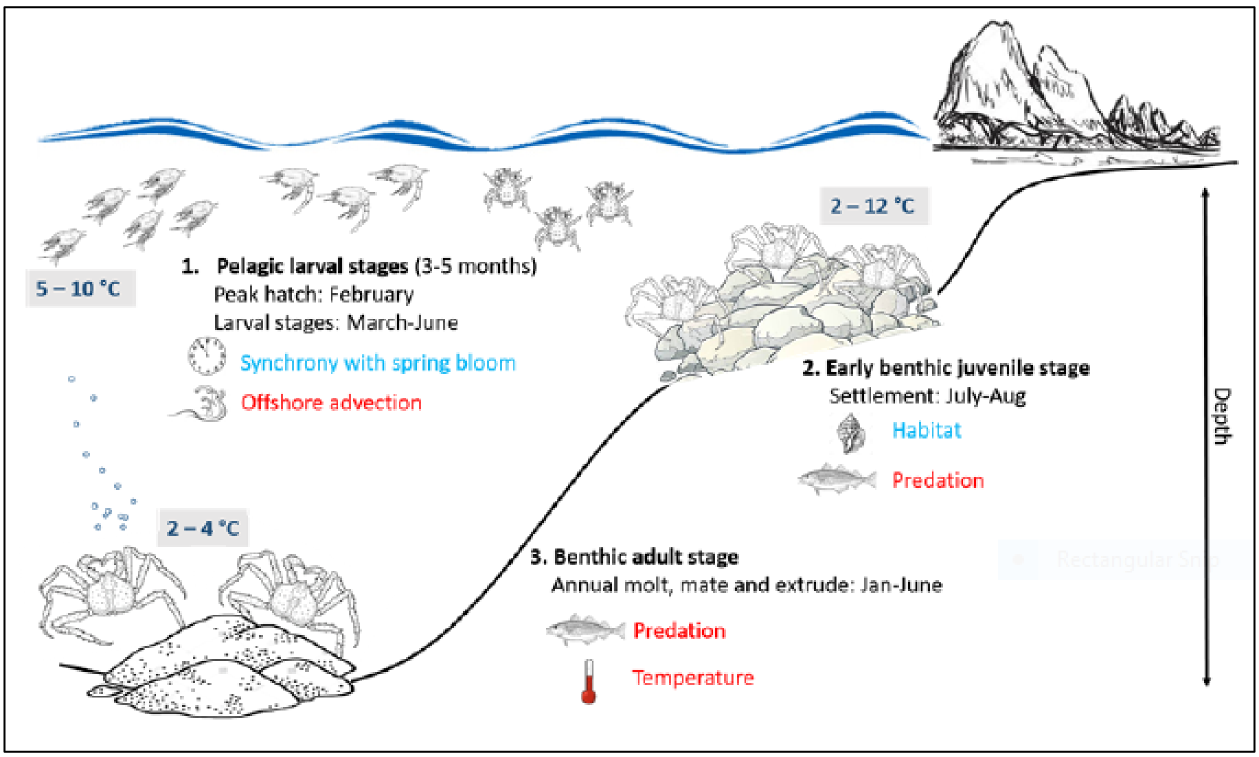


Figure 5-1 Life history conceptual model for BBRKC summarizing ecological information and key ecosystem processes affecting survival by life history stage. Thermal requirements by life history stage were determined from RKC laboratory studies. Red text means increases in process negatively affect survival, while blue text means increases in process positively affect survival. (Source: Fedewa et al. 2023 as Appendix C in Palof 2023)

The BBRKC population was relatively stable until 2010 when the mature female population began to decline. The population experienced a brief uptick in abundance from 2014-2015, before continuing to decline (Figure 5-2). The abundance estimate calculated for mature female BBRKC using the Trawl Survey data in 2021 and 2022 were the lowest two abundances on record since 1995. The length-based analysis (LBA) conducted by the State provided abundance estimates in 2021 and 2022 that were below the State of Alaska harvest strategy threshold of 8.4 million mature female crab to hold a directed fishery. As a result, the directed fishery was closed for the 2021/2022 and 2022/2023 seasons.

In 2023, the LBA provided an abundance estimate that exceeded the harvest strategy threshold of 8.4 million mature female allowing for a directed fishery to occur, which opened at a TAC of 2.15 Mlb for the 2023/24 season.

A high-level summary of the 2023 Trawl survey results for BBRKC are presented below (Zacher et. al, 2023). RKC were caught at 66 of the 136 stations in the Bristol Bay management district during the standard survey, and 100% of these crab were measured.

Legal Males

Estimated biomass of legal-sized male crab (± 95% CI) in 2023 was 14,127 ± 5,125 t (4.8 ± 1.7 million crab, Figure 1 2). This estimate is lower than the 2022 estimate and the previous 20-year average of 26,728 ± 5,880 t. The majority of legal males were concentrated around central Bristol Bay and Port Moller, and few legal males present along the northern Bristol Bay district boundary with centers of abundance further northeast than most other years (Figure 5-6). Forty-four percent of legal-sized males were new hardshell crab, while 40% were old shell, and 16% were very old shell. The distribution of legal males across Bristol Bay was fairly homogeneous in regard to shell condition, with only a weak trend of new hardshell crab in deeper waters and older shell crab closer to shore around Bristol Bay (Zacher et al. 2023).

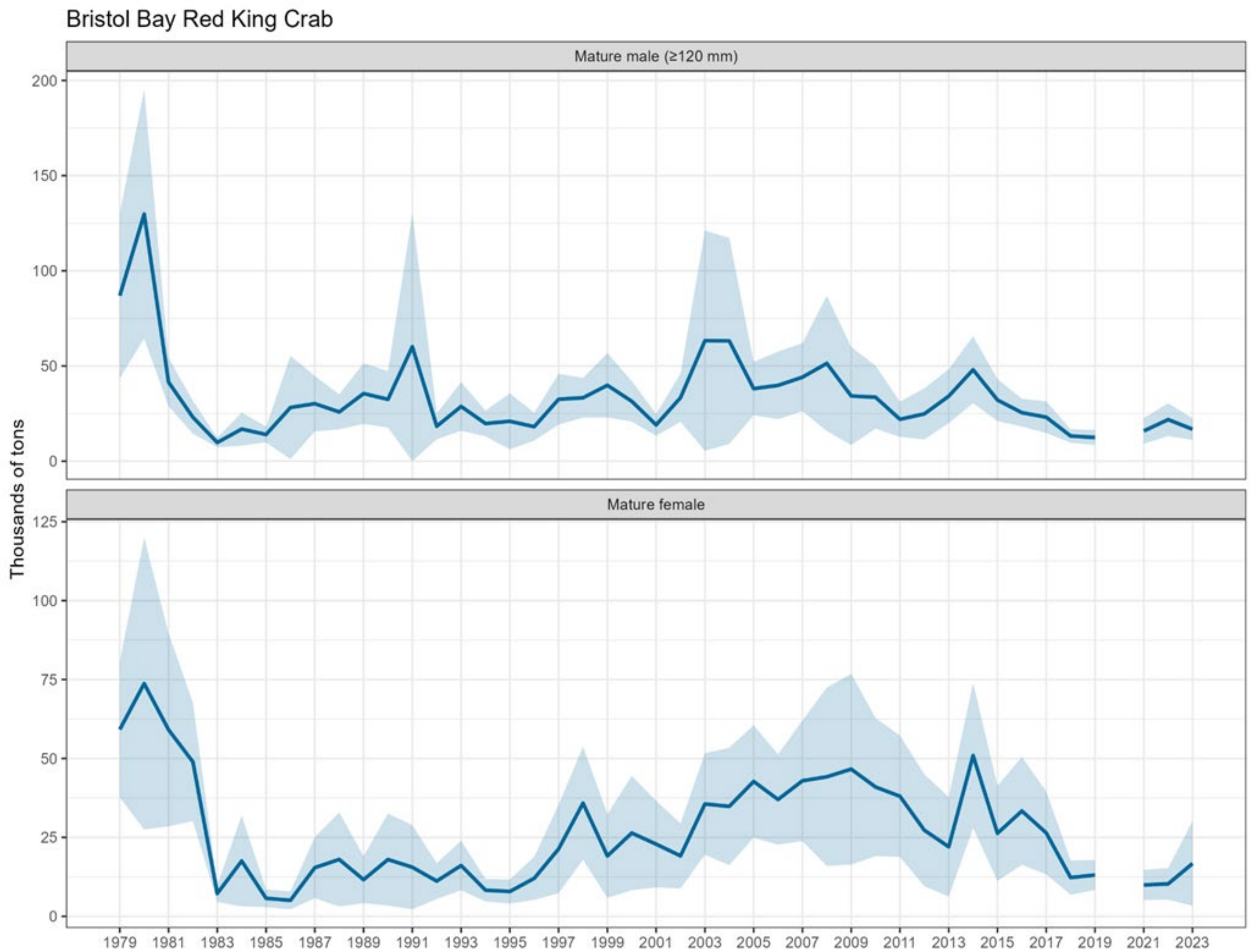


Figure 5-2 Historical biomass of mature female and mature male (carapace length ≥ 120 mm) RKC in the Bristol Bay District. In years when a subset of stations in Bristol Bay were resampled, the resample stations replaced data from the original stations for females. Source: Zacher et. al, 2023.

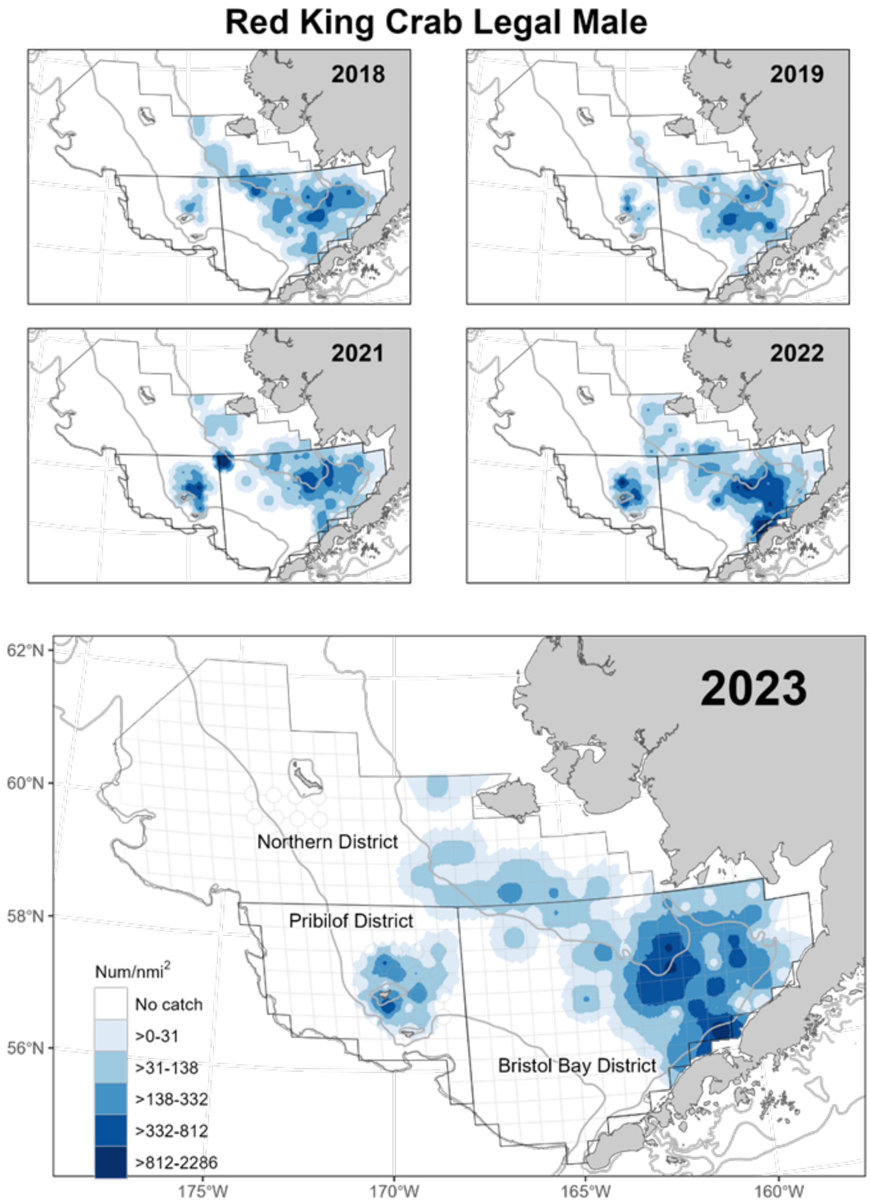


Figure 5-3 Estimated summer density of mature-sized (≥ 120 mm carapace length) male RKC for the past five survey years. Outlined areas depict state crab management districts. Red outline is the RKCSA and the diagonal hash is the RKCSS. Source: Zacher et. al, 2023.

BBRKC Females

The 2023 mature female RKC biomass estimate was 16,723 ± 13,381 t (11.0 ± 8.4 million crab, Figure 5-4) and the immature female biomass estimate was 690 ± 488 t (2.1 ± 1.3 million crab). The mature female biomass estimate in 2023 increased by 63% from the 2022 estimate, but was well below the 20-year average of 31,304 ± 6,222 t. Thirty-seven percent of mature female RKC were caught at one station north of Port Moller, but they were also found within central Bristol Bay below 50 m (Figure 5-4). Centers of abundance for mature females continued to be more south and east in 2022 and 2023 compared to 2021, but still slightly north of central Bristol Bay (Figure 5-4). Female abundance across all size classes remains low compared with historic values, with no strong signal of new recruitment. The 2023 center of abundance for mature females was average for the time series (Zacher et al. 2023).

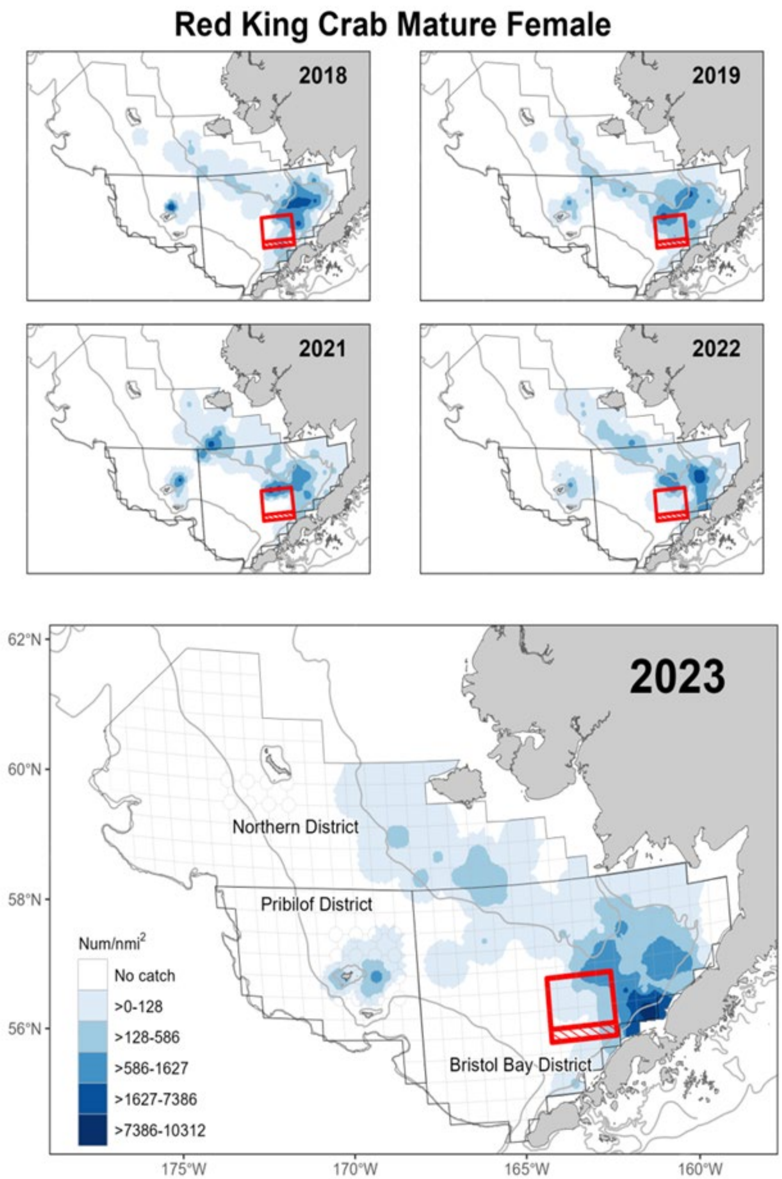


Figure 5-4 Estimated summer density of mature female RKC for the past five survey years. Outlined areas depict state crab management districts. Red outline is the RKCSA and the diagonal hash is the RKCSS. Source: Zacher et. al, 2023.

Recruitment

Estimated recruitment was high during the 1970s and early 1980s and has generally been low since 1985 (1979-year class). During 1984–2020, estimated recruitment was above the historical average (1976–2019 reference years) only in 1984, 1986, 1990, 1995, 1999, 2002, and 2005. Estimated recruitment was low during the last 12 years, and lowest during the eight most recent years. In a low recruitment regime, the projected mature male biomass would be expected to decline with fishing mortality (F) of 0.167–0.25 (see Figure 2-2).

The best available data on BBRKC stock distribution, which feeds into the stock assessment, comes from the 2023 trawl survey as reported in Zacher et al. (2023). Spatial distributions of RKC have fluctuated over the 1975–2023 time series. Centers of abundance for mature male and female RKC shifted north and east of the southwest Bristol Bay region from 1975–1987 (Figure 29 in Zacher et al. 2023). From 1988–

1991, mature female centers of abundance shifted slightly to the south before returning to the northeastern trend, while male centers of abundance remained in the northeast. Loher and Armstrong (2005) hypothesized that the shift during the late 1970s and early 1980s was due to warmer bottom temperatures. However, an alternative hypothesis suggests that the disappearance of the southwestern portion of the population near the Unimak region during the late 1970s and early 1980s was caused by trawl bycatch (Dew and McConnaughey 2005). In more recent years when the cold pool extended onto the Bristol Bay shelf area (from 2008 to 2012, and 2017), the distribution of mature females and males moved from the central area of Bristol Bay to nearshore areas along the Alaska Peninsula, supporting the temperature hypothesis (Chilton et al. 2010).

Figure 5-5 illustrates a time series of the NMFS bottom trawl survey showing the proportion of mature and immature male and female RKC that were observed in the survey in the RKCSA/SS, NMFS area 512, the remainder of the NBBTCA (outside of what is in Area 512), and the remaining Bristol Bay region. Figure 5-5 provides insight into potential RKC usage by sex and life stage across the time series. This may provide the Council with information surrounding the potential usage of the RKCSA/SS historically. Important caveats include that figure is based only on the summer trawl survey results while RKC are a mobile species and the proportion of RKC in areas may vary seasonally, as noted in the recent tagging work detailed in Section 5.3.1.

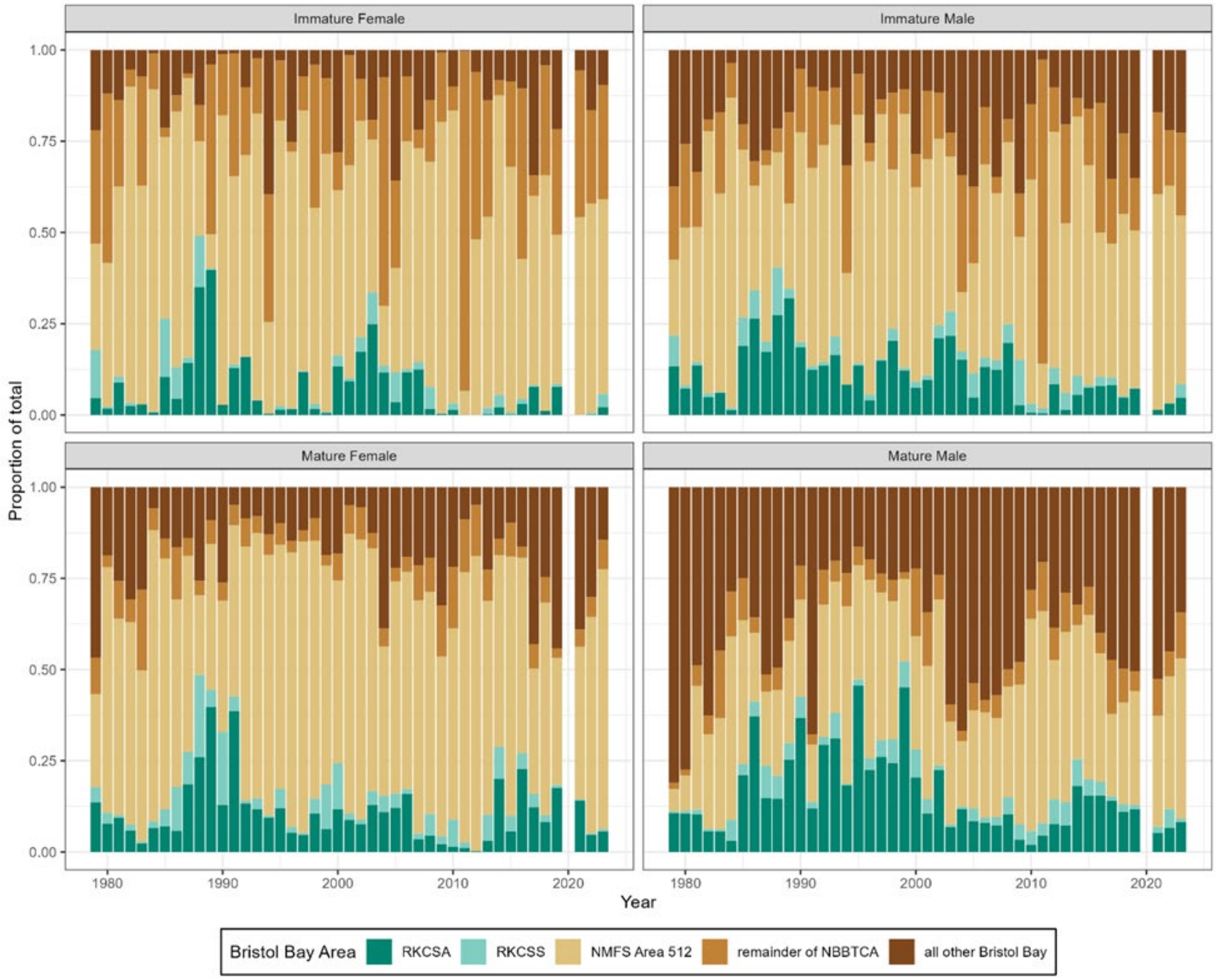


Figure 5-5 Proportion of RKC caught in the NMFS trawl survey (1978-2023) in RKCSA, RKCSS, NMFS Area 512, the remainder of the NBBTCA and all remaining areas of the Bristol Bay management area broken out by life stage. Numerical values of proportions are presented in Table 5-2.

Table 5-2 Proportion of RKC caught in the NMFS trawl survey (1978-2023) in RKCSA, RKCSS, NMFS Area 512, the remainder of the NBBTCA and all remaining areas of the Bristol Bay management area.

Sex/maturity category	Area	Mean proportion	Minimum proportion	Maximum proportion
Immature Female	RKCSA	0.07	0	0.40
	RKCSS	0.02	0	0.16
	NMFS Area 512	0.55	0.07	0.88
	remainder of NBBTCA	0.24	0.01	0.93
	all other Bristol Bay	0.12	0.00	0.40
Immature Male	RKCSA	0.11	0	0.32
	RKCSS	0.03	0	0.13
	NMFS Area 512	0.49	0.12	0.85
	remainder of NBBTCA	0.17	0.03	0.83
	all other Bristol Bay	0.20	0.03	0.39
Mature Female	RKCSA	0.11	0	0.40
	RKCSS	0.04	0	0.23
	NMFS Area 512	0.58	0.22	0.81
	remainder of NBBTCA	0.07	0.03	0.22
	all other Bristol Bay	0.19	0.05	0.47
Mature Male	RKCSA	0.16	0.02	0.46
	RKCSS	0.03	0	0.09
	NMFS Area 512	0.33	0.06	0.58
	remainder of NBBTCA	0.08	0.02	0.19
	all other Bristol Bay	0.40	0.16	0.81

Across the timeseries, the proportion of mature males that tend to utilize the RKCSA is greater than other age/sex classes. This is also evident given recent fishery trend where fishing effort primarily occurs in the RKCSA (Figure 5-6). There was a higher proportion of BBRKC in the RKCSA and Area 512, with a larger presence of crab in the RKCSA in the 1990's (Figure 5-5). In the last decade, immature males and females utilize Area 512 more than the RKCSA, with only small proportions of RKC found in the RKCSA in recent years (<20% across life stages). However, in 2023, there was an increased proportion of immature females and immature males in the RKCSS since 2017. Given the distribution observed in the 2023 NMFS trawl survey, it is likely that the immature males and females were in the southeast corner of the RKCSS (Zacher et. al, 2023).

Summer survey data shows that both male and female RKC utilize the RKCSA in June, although there have been higher densities of males in this region over the past five years (Figure 5-3 and Figure 5-4). In general, male RKC tend to occupy larger areas than female RKC in Bristol Bay (Palof 2023), compared with mature females, that are concentrated in the RKCSA/SS or Area 512. Across the time series, mature males and mature females occupy a larger proportion of the RKCSA (0.16) compared to immature males and immature females (Figure 5-5 and Table 5-2).

When the RKCSA was implemented in 1996, the proportion of males (mature and immature) in the RKCSA was much higher, nearing closer to 50% (Figure 5-5). Since then, the proportion of males in other reporting areas, and within the Bristol Bay management area has increased. Figure 5-5 shows the relative importance of the RKCSA, and potential increased importance of Area 512 for BBRKC with the average proportion of RKC being highest in this region across the time series with the proportion of RKC ranging from 33%-58% (Table 5-2). It is likely that when the RKCSA was implemented, it was effective in conserving BBRKC, as a much higher proportion of the population for BBRKC occupied the RKCSA/SS. Given the higher proportion of BBRKC in other areas of Bristol Bay in recent years, it may be worthwhile to consider additional management considerations for those areas in which higher proportions of BBRKC located, such as Area 512 or Zone 1.

Figure 5-6 shows the centers of fishing effort for the directed fishery for all years. All centers of effort by the directed fishery have occurred within the RKCSA (except for 2019).

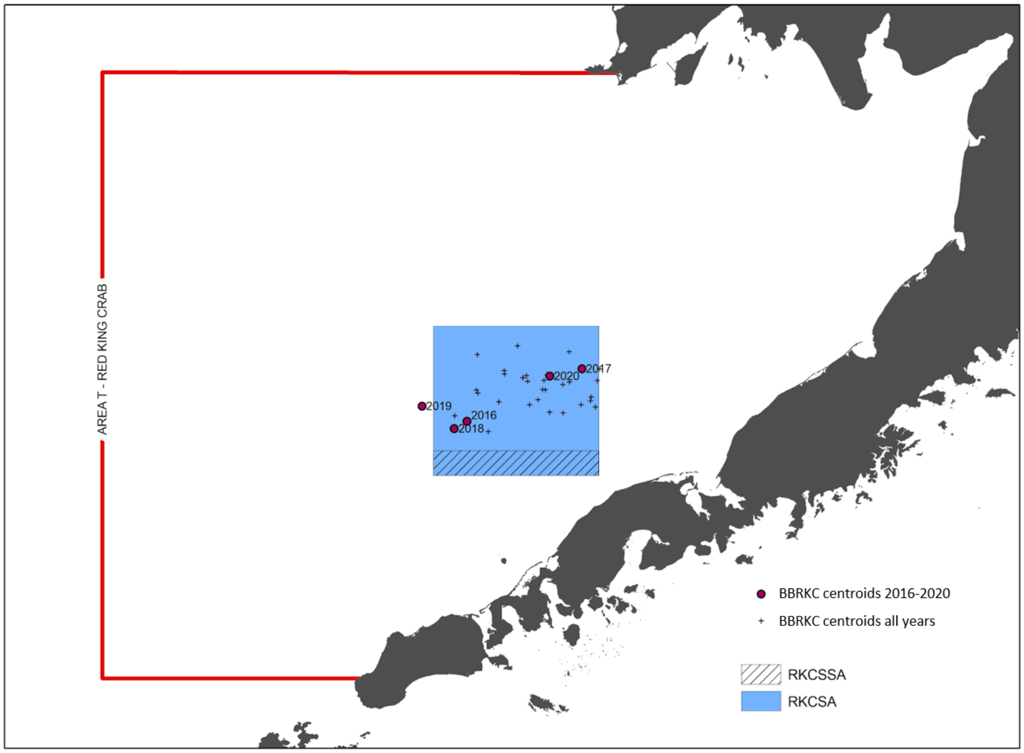


Figure 5-6 Centroids of fishing effort for the BBRKC directed fishery from 1980s to present with more recent years (2016-2020) highlighted by red circles. Data obtained from dockside interviews (1980s-2005) and daily fishing logs (2005-2022).

5.3.1 Recent and ongoing research on BBRKC spatial and temporal distribution

The movement patterns and location of BBRKC at critical points throughout the calendar year and annual life cycle are key to understanding potential impacts of management measures. The 2023 BBRKC stock assessment represents the extent of existing peer-reviewed knowledge of the stock (Palof 2023). This subsection serves as an update to the Council on recent and ongoing research on the seasonal movement of BBRKC. The following information reflects research conducted by NMFS, ADF&G and a cooperative research initiative led by NMFS, ADF&G, and the Bering Sea Fisheries Research Foundation (BSFRF). Recent work to better capture life history information for all BS crab, specifically BBRKC has been a top priority for scientists and managers alike. Knowledge gaps about location, movement, and sex distribution at certain times of year have been noted in recent Council documents (NPFMC 2022a, 2022b). Those gaps exist because primary data collection occurs during the NMFS summer trawl survey and during the directed BBRKC fishery that begins in October and targets legal male crabs.

The groundfish fisheries that would be regulated under the considered action alternatives occur during times of the year when RKC distribution is not well-known. Trawl activity in the Bristol Bay region occurs in the winter/spring and early fall. Vessels using pot gear to target Pacific cod are active in the region during the winter and fall but have recently stayed out of the RKCSA during the "A Season" (~January through April). The A Seasons for pollock and Pacific cod occur during the part of the annual cycle when RKC are molting and mating, and thus most vulnerable and potentially most productive for the population. Descriptive data on RKC sampled from trawl and Pacific cod pot fishery bycatch are not a substitute for systematic pot survey research because spatial and temporal fishing patterns are driven by targeting groundfish, avoiding closed areas and bycatch limitation zones, and minimizing encounter with various PSC and non-target species (e.g., crab, salmon, halibut, herring, and cod). Also, crab retention in trawl gear might not reflect all crab that come into contact with that gear on the seafloor, as noted in the UFMWG report, presented at the January 2024 CPT meeting.[42]

Spatial modeling effort has been ongoing to identify RKC distribution by utilizing the dataset available through the NMFS bottom trawl survey, the BSFRF survey, and fishery dependent data to better understand BBRKC distribution. The NMFS Kodiak Lab constructed dynamic species distribution models (SDMs) to model the distribution of BBRKC: (1) legal males in the fall; and (2) bycatch in non-pelagic trawl (NPT) groundfish fisheries during peak bycatch seasons (September-October, January-February, and April-May). Preliminary results of this work have been incorporated into this document (Section 5.5.2) and were presented to the CPT at its January 2024 meeting.

Early BS crab satellite tagging efforts began in 2017 with Tanner crab. Satellite tag use has expanded to other crab stocks in more recent years, including BBRKC. Pop-up/satellite tags are attached to the crab, release from the host animal, and ascend to the surface on a preprogrammed date. While on the host animal, tags record and archive environmental information such as temperature and depth data. Once at the surface, tag location and other stored data are transmitted to the ARGOS satellite system. The biological questions and associated deployment locations have varied from year to year, but all past efforts help inform whether management measures (including area closures/restrictions) – are being implemented in the most advantageous locations. At the beginning of the NMFS/ADFG/BSFRF collaboration, the primary focus was to collect information that could connect the summer trawl survey data to fall BBRKC fishery data (June/July to October movement of mature males). In 2021 and 2022, knowing the likelihood that the directed BBRKC fishery would not occur in the fall, tags were released on mature males during the summer trawl survey to be satellite-recovered in October when the fishery would normally have taken place, thus providing some continuity of seasonal movement data and data on potential migration patterns in and out of the BBRKC stock boundaries. There is a continued effort to better understand RKC movement, and ongoing work that began in June 2023 will continue for the 2024 season, and include ongoing efforts to investigate “Seasonal Movement of Female BBRKC in Relation to Management Boundaries and Life History". Tags will be deployed on mature BBRKC during the NMFS EBS survey, and will be programmed to release from crab and provide movement vectors in October 2024, January 2025, and April 2025. This will allow a better understanding of female movement and distribution in data poor seasons (Pers. Comm NMFS Kodiak Lab). The investigators continue to supply the CPT with data updates and comparisons of tag data to the trawl survey, BBRKC fishery-dependent data from the fall, and groundfish fishery crab bycatch data.[43]

Results from the recent tagging work detailed above for males and females observed movement in and out of the RKCSA. From the summer to the fall, males tagged in the core Bristol Bay region (east of 164°W) tended to move towards the RKCSA and where the BBRKC fishery occurs and into deeper waters. Male crabs that were west of the 164°W tended to move southwest into deeper waters. From fall into winter, crab west of the RKCSA “turn around” and move back east, generally crab do not continue to move into deeper waters this time of year, indicating a potential transitional period from movement into deeper waters to movement back toward shallow waters. From Oct-June, there is consistent movement from RKCSA into shallower waters toward the north and east (Pers. comm, L. Zacher). The reason for movement is unknown but could be driven by water temperatures as seen in Section 5.5.1 for habitat, and observed in the results of the Collaborative Pot Sampling Project – Phase 1, or “CPS1” (Loher et al., 2023), and a drive to find certain locations where they focus on annual reproduction. Tagging males over the fall-to-spring gap is relatively more challenging because of their earlier molt period (~Jan/Feb).

[42] January 2024 CPT meeting eAgenda.
[43] January 2023 CPT presentation on tagging results.

Female crabs generally moved eastward from the fall to the spring, either in the central Bristol Bay or nearshore along the peninsula. From June-Oct there is movement to the south and west, but do not move as far west as males. Females can be tagged for a longer period of time since they molt later in the spring. Neither the summer trawl survey nor recent tagging has shown a significant presence of female RKC near Unimak Island in an area that has historically been viewed as a “mating ground”. At present, a working hypothesis is that females move to spring mating/molting grounds in eastern Bristol Bay, both nearshore and offshore. Further tagging work is needed near the northern boundary of the BBRKC stock area (Area T) to help understand movement patterns between northern areas and those to the south (towards the RKCSA or the “core” stock areas). The reader should note that much of the research presented are in preparation for publication, and results may differ slightly from those presented above; although many of the trends are likely consistent. Broader conclusions about RKC life-history and time/area combinations of greatest importance will come from the principal investigators of the studies, the CPT, and other scientific advisory bodies (e.g., SSC).

An ongoing collaborative effort by ADF&G, NMFS and BSFRF to conduct a spring pot survey occurred for the first time in 2023. The investigators have drafted a report (Loher et al., 2023), and expanded upon the information presented in the previous analysis at the May 2023 CPT meeting. These results will have been reported and discussed at the January 2024 CPT meeting. The 2023 winter/spring BBRKC pot sampling project operated from March 18 through April 4,2023. Pots were set at 694 stations covering approximately 35% of the spatial extent of the BBRKC management district. The project caught a total of 10,191 RKC (2,367 female Figure 5-9; 7,824 male, Figure 5-8). Figure 5-7 shows where the pot survey occurred in relation to the RKCSA, and the spatial distribution and relative abundance of crab caught. Across all demographics, the majority of crab were caught within the NBBTCA: 66% of all RKC were captured in the NBBTCA and percentages by demographic ranged from low of 61.7% for legal-sized males to a high of 75.8% for mature females. For males, just under 20% of individuals were encountered in the RKCSA. For females, the proportion of crab captured inside the RKCSA was 17.4% for mature 35 individuals versus 7.6% for immature crabs. Overall, RKC were distributed throughout the survey area except in its southwestern corner (Figure 5-7).

Additionally, pop-up Archival Transmitting (PAT) tags were deployed on 100 mature-size male 17 RKC that had recently molted and were in a new hard-shell condition data retrieval set in early June 2023. There was a high degree of variability in direction of movement among individuals, but movement rates averaged 0.83 ± 0.50 km/day (0.45 ± 0.27 nmi/day), with a range of 0.08 to 2.53 km/day (0.04 to 1.37 nmi/day), and a prevailing overall trend of movement to the north and northeast (Loher et al., 2023).

This data provides a useful view outside of the typical summer trawl survey time period; however, the pot survey is still covering a small window of time and a period during which a portion of the male and/or female population could be molting or grasping. Additionally, the strong sex ratio (over 75% male) could be a reflection that the survey took place during a period when more females are typically molting; however, some males showed signs of having molted recently (brittle) which would indicate that males were underrepresented in the survey pots. The Council has requested exploration of measures that could focus crab reduction measures on discrete areas of relatively higher female BBRKC abundance.

The CPS1 report notes:

> "In order for such guidance to be effective, the data describing female distribution must be accurate to the greatest degree possible. If pots under-sample females in late winter and early spring, potentially due to pot-shyness associated with molting and mating, complications and inaccuracies could arise. The nature of those inaccuracies would depend on the effect of pot-shyness on inferred distribution patterns. For example, if pot-shy, molting females are distributed evenly throughout the underlying population, then the effect of under-sampling those individuals may simply be a down-scaling of apparent total abundance, but the data would still provide an accurate representation of relative distribution and the location of 'hotspots' that bycatch fisheries might avoid. However, if the distribution of pot-shy females is patchy, then the relative distribution inferred from pot sampling may be different than the true underlying distribution. At present, there is no way to infer from the existing data whether female catches in the current survey were proportional to their underlying distribution or departed from it; or, if catches were not fully representative of underlying spatial distribution, to what degree they may have failed to represent specific size class(es), shell, and clutch conditions." (Loher et al., 2023)

The full report summarizing the CPS1 results was presented to the CPT in January 2024. There is current funding for a second spring pot survey (CPS2) to occur in Spring 2024. There is no guarantee of funding beyond 2024, but it is expected that a similar approach taken for CPS1 will be used for CPS2 (Pers. comm. T. Loher). The investigators hope to address some of the underlying assumptions that are not met by a one-off survey and continue to grow the dataset of winter/spring distribution information for BBRKC. Data generated during the course of this survey have been made publicly available and may be accessed from the NMFS Alaska Fisheries Science Center Shellfish Assessment Program's GitHub site (https://github.com/AFSC-Shellfish-Assessment-Program/CPS1).

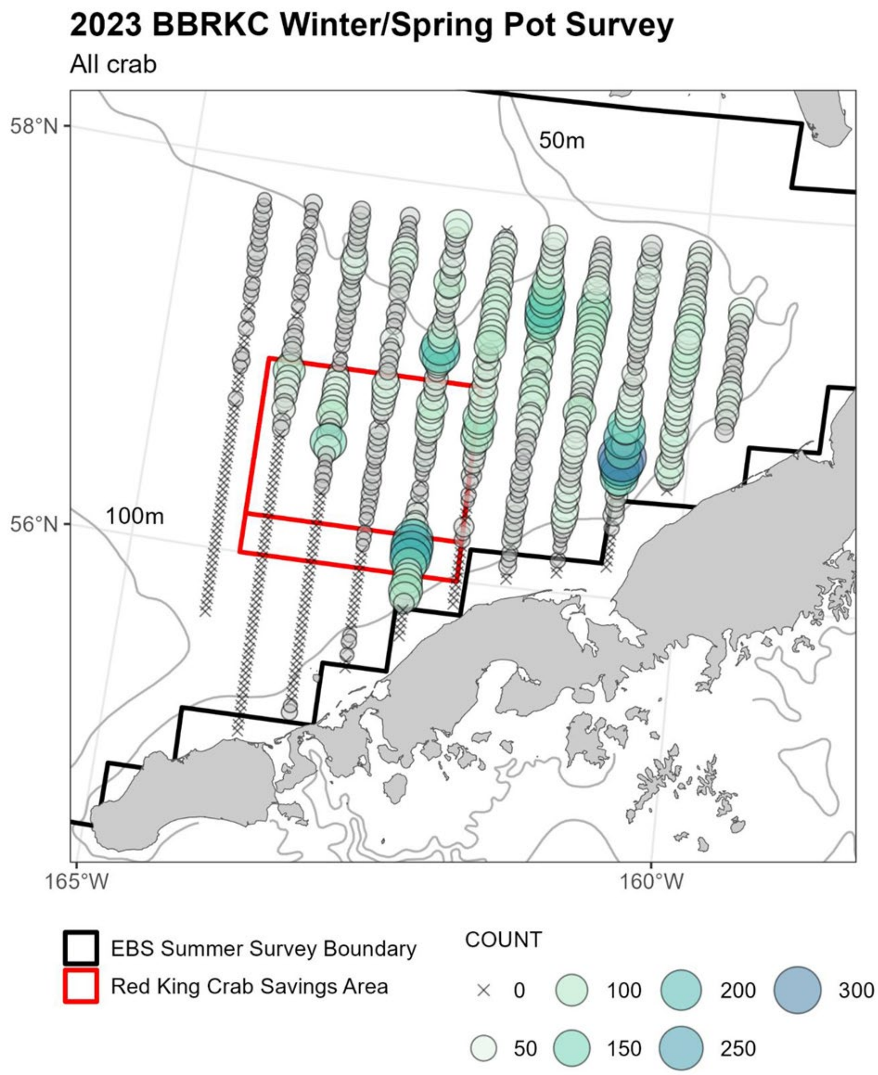


Figure 5-7 Spatial distribution and relative abundance of all red king crab (Paralithodes camtschaticus) captured during the 2023 Bristol Bay Cooperative Pot Sampling (CPS1) survey. Spot size is proportional to the number of crabs captured at each location, as indicated in the legend. (Loher et al., 2023).

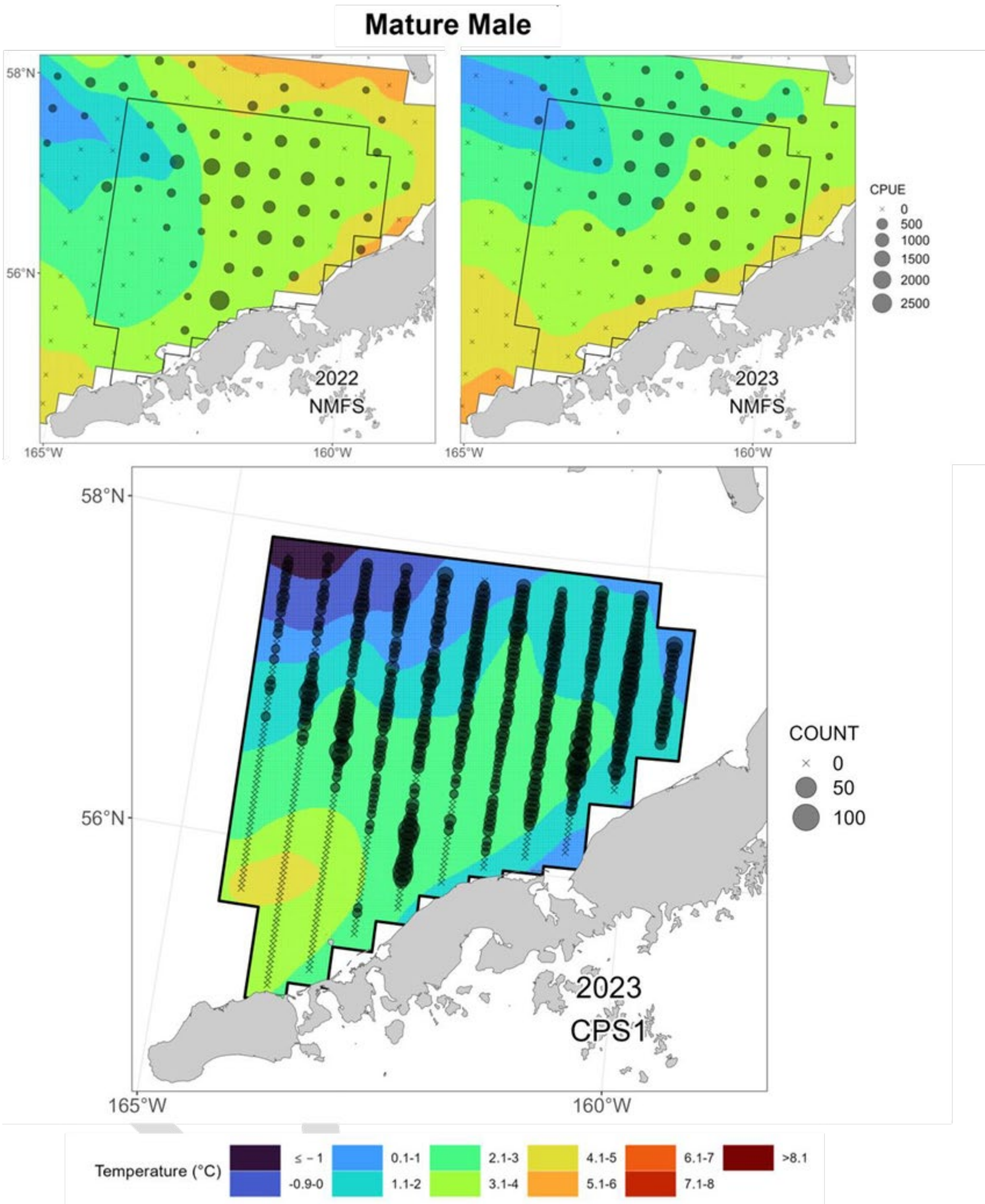


Figure 5-8 Lower panel: Spatial distribution and relative abundance of male red king crab (Paralithodes camtschaticus) ≥120 mm (4.7”) carapace length (i.e., mature-size) captured during the 2023 Bristol Bay (Alaska) Cooperative Pot Sampling (CPS1) survey. Spot size is proportional to the number of crabs captured at each location, as indicated in the legend. Abundance data are overlain on smoothed bottom temperatures obtained from temperature loggers placed inside the pots. Upper panels: mature-size male 1042 red king crab abundance and bottom temperatures observed during US National Marine Fisheries Service trawl survey data within the Bristol Bay District during the summers of 2022 and 2023. (Loher et al., 2023)

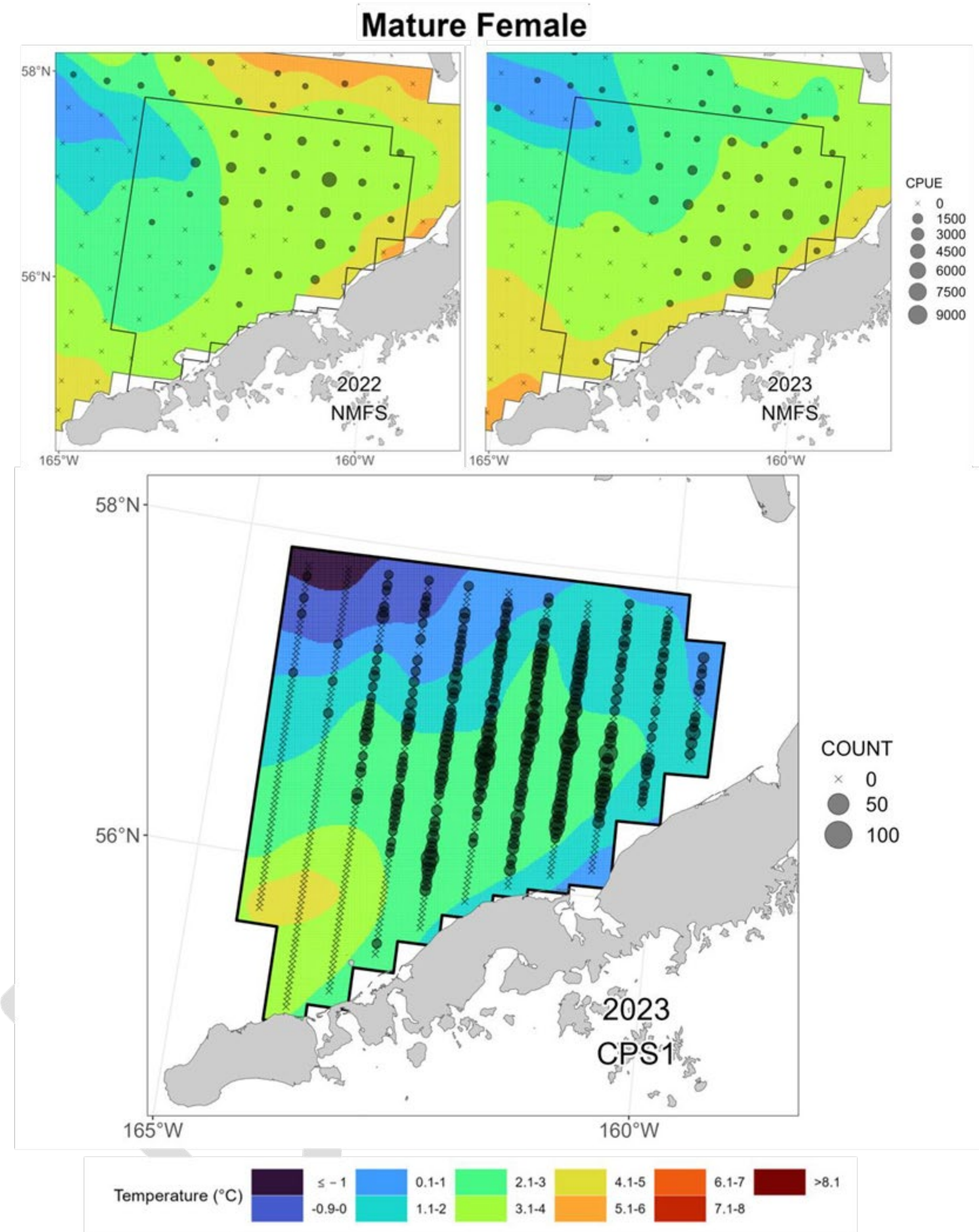


Figure 5-9 Lower panel: Spatial distribution and relative abundance of morphometrically-mature red king crab (Paralithodes camtschaticus) captured during the 2023 Bristol Bay (Alaska) Cooperative Pot Sampling (CPS1) survey. Spot size is proportional to the number of crabs captured at each location, as indicated in the legend. Abundance data are overlain on smoothed bottom temperatures obtained from temperature loggers placed inside the pots. Upper panels: mature female red king crab abundance and bottom temperatures observed during US National Marine Fisheries Service trawl survey data within the Bristol Bay District during the summers of 2022 and 2023. (Loher et al., 2023)

Unobserved crab mortality from trawl gear was discussed in detail in previous BBRKC discussion papers and analyses (NPFMC 2022a, NPFMC 2022b, NPFMC 2022c). The Council and its SSC has formed the UFMWG to consider how best to estimate magnitude of unobserved fishing mortality for crab. The UFMWG is an interagency group comprising NOAA staff, SSC, and CPT members. The UFMWG's objectives are to: 1) identifying data sources, major data gaps, and assumptions to estimate unobserved mortality for stock assessments and to improve understanding of the temporal/spatial extent across fisheries and gear types; and 2) provide research priority recommendations for ongoing and new projects. The UFMWG produced a preliminary report that was presented to the CPT in January 2024. The report provided the outcomes of the working group including a framework for how to estimate unobserved fishing mortality and a framework for including these estimations into stock assessments. The UFMWG did not produce original research on unobserved fishing mortality and there are no ongoing projects for the UFMWG at the moment, but detailed discussion of necessary research was established and may prove helpful for other agencies to reference when developing initiatives that could inform unobserved fishing mortality estimates.

5.3.2 Impact of Groundfish Predation on BBRKC

Predator guilds that are often associated with RKC predation include demersal groundfish, pelagic sockeye salmon, and conspecifics (i.e., cannibalism) (Davis et al 2000; Livingston 1988; Long et al. 2012; Wespestad et al. 1994). However, data on predation of RKC is sparse and few dedicated studies have occurred.

The most extensive RKC predation dataset available utilizes groundfish stomach analyses conducted annually by the AFSC-REEM program using samples obtained from the summer, grid-based EBS bottom trawl survey. Several fish predators are identified across the time series, these include skates, sculpin (plain, great, shorthorn and yellow Irish lord), cod, halibut, and soles (northern rock and yellowfin). The current dataset is unable to produce reliable estimates of predator consumption of BBRKC. However, Greater than 90% of RKC predation biomass is attributed to Pacific cod in summary analysis of this data (pers. comm. AFSC-REEM lab). Juvenile and adult RKC are an uncommon prey item during the summer survey, though likely biases exist due to survey spatial extent and crab vulnerability at timing of survey (e.g., density-dependent effects and few recently molted soft-shell crab).

Benthic predation is inferred to change with RKC size, habitat use, and behavior; driven ultimately by predator abundance, size, and feeding ecology in natural settings. Early benthic predation of juvenile RKC is thought to occur from smaller fish species such as greenling, sculpin, Northern rock sole, and yellowfin sole (Loher and Armstrong, 2000, Pirtle et al., 2012, Daly et al., 2013, Weems et al., 2020 NPRB Report). Predation on larger RKC (approx. age-2+) is attributed more to Pacific cod, halibut, and skates (Livingston, 1989, Zheng and Kruse, 2006). Survival of early-benthic-phase (age-0 to age-2) juvenile RKC increases with the complexity of physical structure in settlement habitats (Stoner, 2009; Pirtle et al., 2012), presumably to increase foraging opportunities while providing adequate cover (Pirtle and Stoner, 2010). Juveniles older than age-2 (approximately >25 mm carapace length) begin to display social-aggregative "podding" behavior as an antipredator defense strategy (Powell and Nickerson, 1965, Dew 1990). Throughout early life, juvenile RKC molt several times a year and thus ontogenetic shifts in behavior from crypsis to herd defense differentially protect crab during molting, foraging, and movement bouts at all size classes (Pirtle and Stoner, 2010; Powell and Nickerson, 1965). It is also generally assumed (i.e. anecdotal observations from scientists, observers, fishers and historical literature) that the bulk of predation occurs in the spring when adult crab are softshell during molting (Fedewa et al. 2020; Livingston 1988; Long et al. 2012; Wespestad et al. 1994; Zheng et al. 2021). Hardshell, large adult RKC are aggressive, armored keystone species with few natural predators in North Pacific benthic systems, as evidenced by their expanding invasive status in the North Atlantic (Boudreau and Worm 2012; Jørgensen et al. 2005).

Demersal groundfish predation has been hypothesized as a mechanism driving RKC recruitment variability. Previous studies indicate a strong negative relationship between Pacific cod biomass and RKC recruitment from the 1970s to early 2000s (Zheng and Kruse, 2006; Betchol and Kruse, 2010). Estimated RKC recruitment was high during the early period when harvests were at their maximum yet decreased post-1985 (1979 year-class) and are now at much lower levels. During this same period, there was strong evidence of a shift in benthic biomass and community structure in the BS. During this period, substantial increases in the abundances of walleye pollock, Pacific cod, rock sole, flathead sole, cartilaginous fishes (skates) and non-crab benthic invertebrates were observed, with increases in Pacific cod biomass documented as increasing 10 times previous estimates between the late 1970s and early 1980s (Conners et al. 2002; Zheng et al. 2021). Recruitment for BBRKC has declined to historically low levels since 2010 and specific determining factors remain unresolved (Zheng et al. 2021). Recently, there has been an increased interest in exploring the dynamics between groundfish presence and the relationship that has on RKC, including predator-prey dynamics.

Fish biomass indices can be used to cautiously approximate predation pressure applied by abundant groundfish species. Figure 5-10 and Figure 5-11 depict the mean CPUE of major predators of both juvenile and adult RKC. While these figures are not able to inform on actual levels of predation of RKC, they can serve as a proxy for predation with the assumption that as biomass of known predators of RKC increase, that predation of RKC is also likely to increase. Such a predation index for larval RKC is not possible at this time due to the limited number of groundfish diet studies available that overlap with RKC larval duration (i.e., spring/early summer).

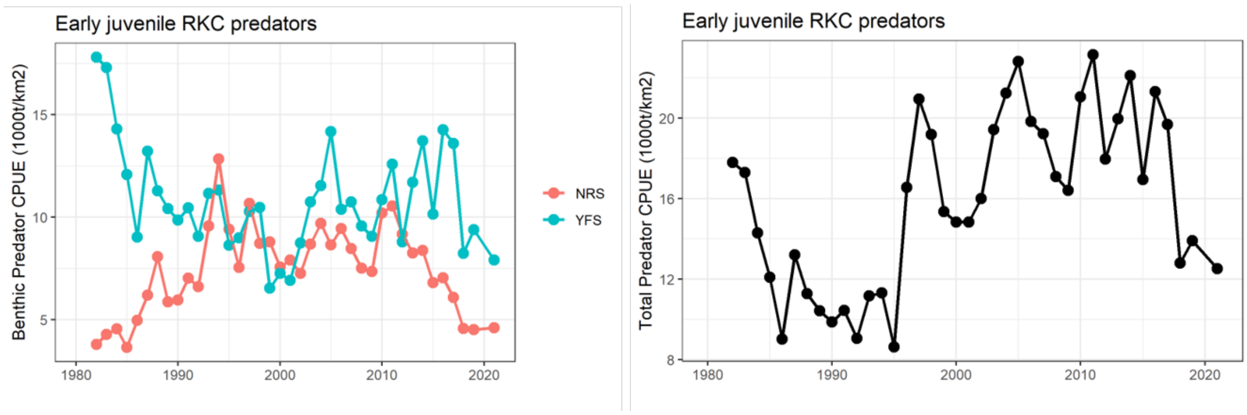


Figure 5-10 A time series of mean CPUE of major early benthic juvenile RKC predators, spatially subset within the BBRKC management area. The left plot breaks the time series down into predator guilds including northern rock sole and yellowfin sole. The plot on the right is the summed total predator mean CPUE of all predator guilds (source: Fedewa 2022).

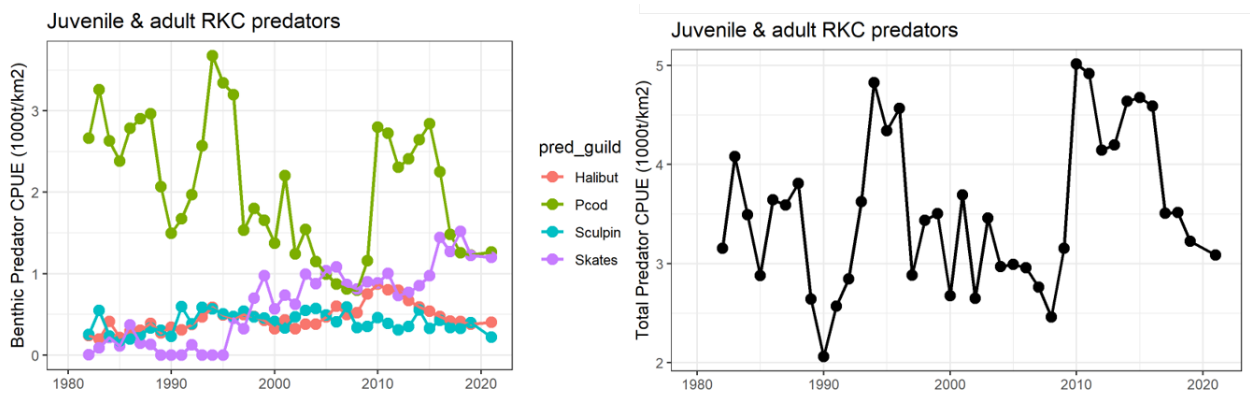


Figure 5-11 A time series of mean CPUE of major juvenile and adult RKC predators, spatially subset within the BBRKC management area. The left plot breaks the time series down into predator guilds including Pacific cod, halibut, Alaska skate and sculpin complex (staghorn sculpin, yellow Irish lord, shorthorn sculpin, great sculpin and plain sculpin). The plot on the right is the summed total predator mean CPUE of all predator guilds. Note that Pacific cod dominates this trendline (source: Fedewa 2022).

To better explore the predator-prey relationship between pacific cod and RKC, there is a planned collaborative research effort in 2024 by NMFS, the Freezer longline Coalition (FLC) and Alaska Bering Sea Crabbers (ABSC) to occur during the 2024 A season.[44] The 2024 project objectives are to collect, preserve, and analyze stomach contents of Pacific cod harvested by FLC vessels in A season 2024. The project will also evaluate the use of HAL CP vessels as platforms for collecting Pacific cod diet data, compare prey taxa consumed by Pacific cod in winter 2024 to representative taxa from summer data collections, evaluate spatial differences in prey taxa consumed by Pacific cod in a single A season, and characterize potential local and BS-wide impacts of Pacific cod predation on commercially important Chionoecetes and Lithodid crab species. The ongoing cooperative research may provide insight into the differences in cod predation rates on RKC during winter months and provide additional insight into predator-prey relationships and the relationship between Pacific cod and BBRKC.

Pelagic Bristol Bay sockeye salmon have also been documented as preying on larval and post-larval RKC. Best available data on sockeye salmon diet is from the NOAA Bering Arctic Subarctic Integrated Surveys (BASIS) in the EBS conducted semi-annually from August to September. This program deploys

[44] J. Armstrong (FLC) and J. Reum (AFSC). Personal communication, 2023.

large pelagic trawl nets at grid-based survey stations to study juvenile fish ocean ecology. For juvenile sockeye smolts (age 1 or age 2) entering the ocean in early summer, their dominant prey items include age-0 pollock, forage fish and euphausiids during late summer. Pelagic crustaceans are present in smolts diets, but are not a large percentage of the overall diet. In recent years (2011 - Current), however, other crustaceans (including a small proportion of decapods, the lowest taxonomic identification available that may include RKC) have made up a slightly higher proportion of juvenile sockeye diet (Figure 5-12). Decapods were only present in the diets of juvenile sockeye salmon during 2011, 2012, and 2016. Peak abundance of larval RKC in the middle domain of the southern Bering Sea occurs earlier than the BASIS surveys and the collection of the presented juvenile sockeye diet information. Previous studies that surveyed earlier in the year (i.e., July) have documented a higher percentage of crab larvae in sockeye salmon diet (Davis et al. 2000). Adult, returning sockeye are rarely caught in the survey due to the late timing of the BASIS survey, however adult sockeye do consume crab larvae when present and in high enough densities and return to Bristol Bay during peak larval periods. Recent data has shown that more juvenile sockeye are showing up in the NBS during late summer (Ormseth and Yasumiishi 2021). This could be in part due to warmer temperatures, as both juvenile sockeye and age-0 pollock are known to move farther north and increase in abundance in pelagic waters during warm years (Yasumiishi et al. 2020). Coinciding with recent warmer temperatures, Bristol Bay sockeye have returned to the bay in historic amounts over the past seven years (Figure 5-13). Recent significant increases in sockeye salmon runs and age-0 pollcok could apply significant predation pressure to dense aggregations of larvae and post-larval stage RKC and may be partially responsible for historically depressed RKC juvenile recruitment.

Figure 5-12 Diet proportions of juvenile sockeye salmon given as a stomach content index (%SCI) in the southeastern Bering Sea during late summer (Yasumiishi et al. In Revision).

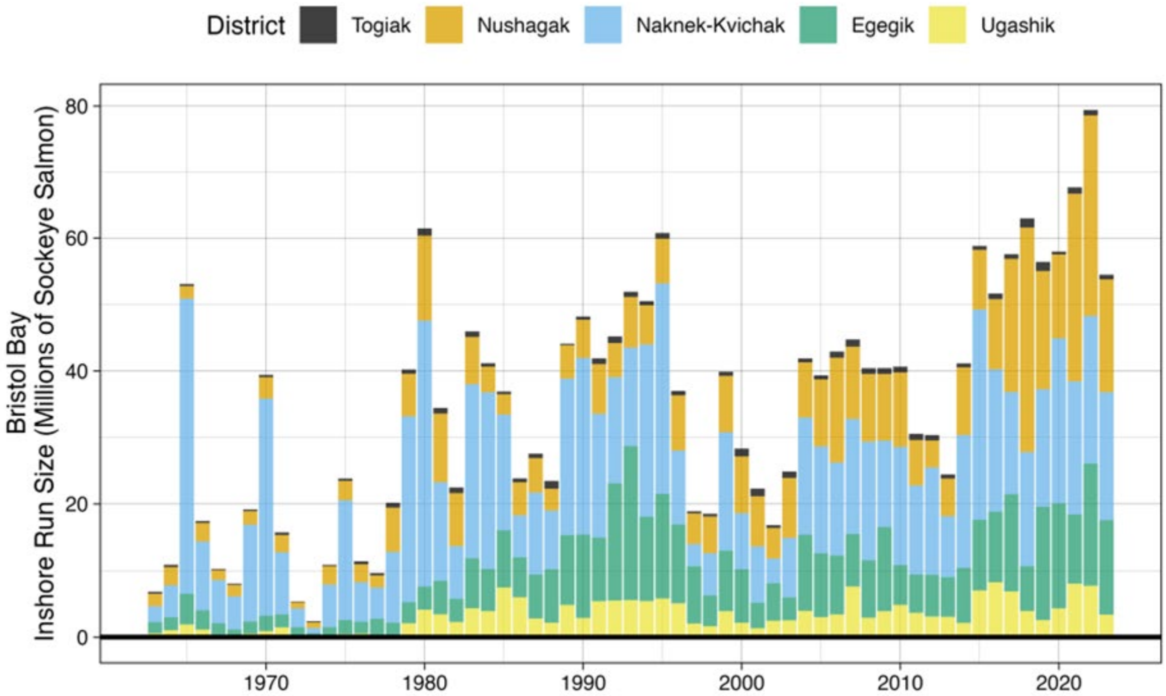


Figure 5-13 Inshore run size of Bristol Bay sockeye salmon by district (EBS Ecosystem Status Report (Siddon 2023, Figure 73)

Cannibalism may also be a contributing factor in BBRKC stock declines. As the stock has consolidated northward (Szuwalski et al. 2021), incidence of overlap of multiple age classes may increase as crabs inhabit a smaller area and competition increases. Uncertainty exists surrounding RKC cannibalism in nature, however. In laboratory studies, juvenile RKC have relatively high rates of cannibalism in both high density culture and small-scale experiments (Long et al. 2012, 2013). Crab are typically held together and in close proximity in the lab with multiple age classes present. Maintenance of lower culture densities, increased habitat complexity, lower temperatures and molting crab isolation generally ameliorate cannibalism and likely represent a more natural case-study of juvenile crab interactions and feeding behavior (Long et al. 2013; Stoner et al. 2010, 2013). Cannibalism may occur in the wild, yet it is not likely to occur at levels that would have population level impacts.

5.3.3 Effects on BBRKC

The effects of the alternatives on BBRKC would include potential changes in PSC and predation impacts by groundfish. The redistribution of pot vessels out of the RKCSA in Alternative 2 and Area 512 in Alternative 3 may impact the amount of RKC PSC by pot vessels (Section 3.3.3). The areas of highest PSC were consistently the eastern portion of the RKCSA within Area 512, suggesting a paired benefit to BBRKC if both Alternatives 2 and 3 were selected. The estimated changes in RKC PSC under the three scenarios of displacement (RKCSA/SS, Area 512, or both) are shown in Section 3.3.3. Changes occurred primarily in the B Season, where the displacement of POT gear from the RKCSA led to PSC increases in some years, while the displacement from Area 512 or both RKCSA and Area 512 often led to estimated decreases in RKC PSC. The redistribution of effort and potential reduction in RKC PSC if both Alternative 2 and 3 are selected as a preferred alternative suggests a benefit to the BBRKC stock. Although, there are several other variables to consider that may impact the stock aside from PSC.

The redistribution of groundfish catches through Alternatives 2 and 3 may additionally have the potential to affect predator-prey dynamics between groundfish and BBRKC. As mentioned in subsection above, the bulk of predation is attributed to Pacific cod (acknowledging that less predation data are available for salmon species like sockeye that are numerous in the Bristol Bay region). If the Pacific cod HAL and pot fleets are prohibited from the RKCSA/SS under Alternative 2, this may lead to higher predation by Pacific cod within the RKCSA/SS. Similarly, Alternative 3 may result in higher predation by Pacific cod within the shallow waters of Area 512, which is an area that tends to harbor large numbers of juvenile BBRKC (Figure 5-5 and Figure 5-14). However, these future predator-prey dynamics are unknown, and may be offset by the reduced PSC and unobserved mortality attributed to these gears.

Juvenile and adult RKC may benefit from reduced unobserved mortality within the RKCSA. While work is needed to better quantify unobserved mortality and its impact to the stock, the exclusion of bottom-contact gears from the RKCSA would presumably reduce unobserved mortality. As summarized in Section 5.5.3, some bottom contact occurs for all gear types. Similar to the disturbance of habitat, it is reasonable to assume that reduced unobserved mortality in the area may lead to a higher proportion of late juvenile RKC from within the area to survive to a reproductive, harvestable size and to recruit into the fishery.

At the June 2023 meeting, the SSC requested more information on the relative importance of the RKCSA and Area 512 to the stock. Authors conferred with subject matter experts, and it was noted that quantifying the relative importance of these areas are difficult as we a lack a metric to measure potential benefits to the stock across time. Relative importance of the RKCSA or Area 512 is also difficult to determine because it relies on information on which parts of the stock are limiting BBRKC recovery and population growth, which current research is still lacking. One way to investigate relative importance would be to determine how many RKC occupy each of these spaces using summer survey information. Figure 5-5 details the proportion of summer survey catch for BBRKC sex/maturity categories in the RKCSA and Area 512, and remaining NBBTCA and the remaining BBRKC management areas. Largely the RKCSA and Area 512 contain higher proportions of RKC. The RKCSA remains an important area for BBRKC, and likely provided additional conservation measures for the stock when it was implemented in 1996 as a large proportion of BBRKC of all age and sexes occupied this area. While there is no quantitative assessment on the relative importance of the RKCSA and Area 512, Figure 5-5 and Table 5-2 provide a metric to determine the proportion of RKC in these areas, and may act as a way to infer potential BBRKC reliance on habitat in these areas, or areas in which additional fishing pressure may impact the stock.

Alternative 2 may provide some benefit to stock and reduced PSC and gear encounters, and subsequent unobserved mortality in years where the stock population is low, and may require additional conservation measures. Alternative 3 would likely provide benefit to the BBRKC stock as it would reduce RKC PSC in this area, which may provide additional conservation measures given the proportion of RKC in the areas (Figure 5-5 and Table 5-2). Specifically, Area 512 contains a high proportion of immature males, females, and mature females. Reduction in fishing pressure in this area by the Pacific cod pot sector may provide benefit to immature crab, as they are expected to molt multiple times a year and may be more susceptible to gear encounters. However, with reduced fishing pressure by the Pacific cod pot fleet, it is possible that there is increased predation, and it is difficult to determine the magnitude of predation at this time, and the subsequent effect that would have on the stock. Additional predator-prey interactions may be altered under the proposed alternatives.

Additionally, Section 5.5.2 shows habitat occupied maps for BBRKC by life stages, further exemplifying the importance of the RKCSA and Area 512 for habitat refuge and habitat usage for mature and immature BBRKC. Given the information provided in this analysis, it can be assumed that the RKCSA and Area 512 act as an area that is important to BBRKC, and the effects under Alternative 2 or 3 would likely reduce gear interactions with crab. Although, it is difficult to measure the potential impacts on the stock as there are several other factors including environmental variability that may impact stock condition, as seen in the BBRKC ESP (Fedewa and Shotwell 2023).

The extent of factors like the effect of mobile (trawl) gear on habitat within the RKCSA are quantified in FE results but the extent to which any cumulative changes to the habitat area translate into BBRKC stock levels is not a direct linkage that is made in the EFH literature or the BBRKC stock assessment. Some areas of potential effect, like changes in unobserved mortality or changes in predation on BBRKC by Pacific cod, are not extensively quantified in available data and peer reviewed resources. Removing trawl gear from the RKCSA would likely reduce unobserved mortality overall because trawl fishing would be displaced to areas farther from the core stock area, but the magnitude of the potential stock effect has a wide range that includes very low potential impacts as well as high. The effect of removing predators in the eastern Bristol Bay through groundfish fishing is likely positive for BBRKC based on correlative patterns, but the specific effects on RKC maturation and recruitment have not been extensively studied. Permanently removing non-pelagic trawl gear from the RKCSS would likely benefit BBRKC, but that conclusion is also qualified by the fact that non-pelagic trawl gear might adapt by fishing in areas farther south and west that were – at previous times – thought to be just as important to BBRKC stock health and RKC life history. The analysts note that RKC mortality through estimated PSC across all gears is accounted for in the BBRKC stock assessment and, while it is generally agreed to be a factor, most experts who have testified before the Council or whose work is cited here (e.g., BBRKC SAFE and ESP) note that fishing mortality is certainly not the only factor in the stock decline and its weighting as a factor is uncertain. In summary, it is likely that the action alternatives would provide some benefits to the BBRKC stock, but it is difficult to determine the magnitude of the potential benefits.

Effects of Aggregate Past, Present, and Reasonably Foreseeable Actions on BBRKC

The following RFFAs are identified as likely to have an impact on BBRKC within the action area and timeframe. With low recruitment in recent years, the projected mature biomass is expected to decline during the next few years (Palof 2023), likely continuing the future potential for closed seasons. In their recent report, the Alaska Bycatch Review Task Force (ABRTF) made several management recommendations regarding BS crab. These recommendations included an evaluation of observer coverage and monitoring the directed crab and pot cod fisheries, an evaluations of hot spot areas for pot gear both inside and outside of state managed waters, an examination of the impact of retaining all legal crab in the directed crab fishery and counting toward IFQ, a new rationalization program for the over 60 pot cod vessels as a way to manage bycatch and prohibited species caps, review of the effectiveness of fixed open and closed areas for trawling, and a review for the BS trawl area crab PSC to be applied across the entire BS, instead of only the current sub-areas (ABRTF 2022).

Considering the direct and indirect impacts of the proposed action when added to the impacts of past and present actions previously analyzed in other documents that are incorporated by reference and the impacts of the reasonably foreseeable future actions listed above, the aggregate impacts of the proposed action are determined to be not significant as regards the determination of whether an EIS is required for these alternatives.

5.4 Seabirds

The June 2023 initial review draft (NPFMC 2023a) included a more in-depth summary of seabirds in the North pacific, and fishing impacts. In an effort to streamline the analysis, staff has summarized this section, recognizing the material and conclusions remain unchanged and can be referenced from previous Council analyses.

North Pacific waters support extremely large concentrations of seabirds. Over 80 million seabirds are estimated to occur in Alaska annually, including 40 million to 50 million individuals from the numerous species that breed in Alaska (USFWS 2009). In March of 2021, the USFWS finalized a new Biological Opinion (USFWS 2021) which superseded the 2015 Biological Opinion (USFWS 2015). In their 2021 Biological Opinion, USFWS concluded that the GOA and BSAI groundfish fisheries are not likely to jeopardize the continued existence of the short-tailed albatross, spectacled eider, or the Alaska-breeding population of Steller's eider; nor are they likely to result in the destruction or adverse modification of critical habitat of the spectacled or Steller's eider. In their 2021 Biological Opinion, USFWS anticipates take of up to six short-tailed albatross bi-annually (every 2 years); up to 25 spectacled eider every 4 years; and up to 3 Steller's eider from the Alaska breeding population every 4 years in the BSAI and GOA FMP areas using hook-and-line or trawl gear (combined). These incidental take limits apply starting in 2021. The 2021 Biological Opinion left in place most of the conservation measures that were specified in the previous 2015 Biological Opinion but did add new recommendations for vessel lighting. The 2021 Biological Opinion stipulates that NMFS will recommend that 1) to the maximum extent practicable vessels will minimize the use of external lighting at night and avoid the use of sodium lighting and other high-wattage light sources, except when necessary for vessel and crew safety and 2) all lights should be angled or shielded downward toward the surface of the water, except when necessary for safe vessel operation.

Trawl-induced seabird mortality is difficult to quantify because birds that strike the cables may fall into the water and go unobserved (Dietrich and Melvin 2007, NMFS 2020, Zador and Fitzgerald 2008). When discussing seabird bycatch attributed to trawl gear, it is important to remember that standard observer sampling does not account for all seabird mortality. This discussion focuses only on the numbers reported, which were generated from the standard observer sample, i.e., birds caught in the codend part of the net and brought aboard the vessel. A number of efforts are underway at AFSC FMA to better understand the amount of cryptic mortality related to trawl vessels and how to properly extrapolate that to provide a fleet-wide estimate.

HAL gear in the Pacific cod and sablefish IFQ fisheries account for roughly 85% of seabird bycatch in the BSAI (Tide and Eich 2022). Seabird bycatch related to trawl gear (CV and C/P combined) constitutes about 11% (range 4 to 24%) of the overall estimated 2011 through 2021 seabird bycatch. All Alaska region seabird bycatch data are based on extrapolations from observer data.

As seabirds fly and forage around vessels, they can become entangled in trawl gear or strike a vessel cable or the vessel itself. Seabirds are attracted to the CV's trawl net when it is being set and retrieved. There may also be some discard of whole fish as decks and equipment are washed or fish spill overboard while the codend is being emptied. Fishing mode and other vessel-related attributes also affect seabird attendance. One component of a North Pacific 2002 pilot electronic monitoring study indicated that bird attendance around CV's was infrequent or low during towing operations and was high only during setting or hauling of the net, while the net was on the surface (McElderry et al. 2004).

5.4.1 Effects on Seabirds

The action alternatives under consideration are not expected to differ from the status quo in terms of impacts on seabirds. The possibility of closing the RKCSA to multiple groundfish gear types (Alternative 2) is most likely to result in the same gear being deployed elsewhere at similar rates of fishing effort. The analysts are not aware of data that would predict that seabird interactions would be different in the areas to which fishing effort might be displaced, and the areas to which effort might shift are already prosecuted with groundfish gear and thus are considered in existing analyses of the impacts of groundfish fishing on seabirds. Alternative 3 relates only to pot gear, which is not highlighted as a gear type with significant seabird interaction, so any changes in effort patterns as a result of selecting that alternative would not be expected to have a direct effect on seabirds.

Effects of Aggregate Past, Present, and Reasonably Foreseeable Actions on Seabirds

Reasonably foreseeable future actions for seabirds include ecosystem-sensitive management; rationalization; traditional management tools; actions by other federal, state, and international agencies; and private actions, as described in Sections 8.4 and 9.3 of the Harvest Specifications EIS (NMFS 2007). Ecosystem-sensitive management, rationalization, and traditional management tools are likely to increase protection to seabirds by considering these species more in management decisions, and by improving the management of fisheries through the restructured Observer Program, catch accounting, seabird avoidance measures, and vessel monitoring systems. Changes in the status of species listed under the ESA, the addition of new listed species or critical habitat, and results of future Section 7 consultations may require modifications to groundfish fishing practices to reduce the impacts of these fisheries on listed species and critical habitat. Additionally, since future TACs will be set with existing or enhanced protection measures, we expect that the effects of the fishery on the harvest of prey species and disturbance will not increase in future years.

Any action by other entities that may impact seabirds will likely be offset by additional protective measures for the federal fisheries to ensure ESA-listed seabirds are not likely to experience jeopardy or adverse modification of critical habitat. Direct mortality by subsistence harvest is likely to continue, but these harvests are tracked and considered in the assessment of seabirds.

Considering the direct and indirect impacts of the proposed action when added to the impacts of past and present actions previously analyzed in other documents that are incorporated by reference and the impacts of the reasonably foreseeable future actions listed above, the aggregate impacts of the proposed action are determined to be not significant.

5.5 Habitat

This section of the EA is focused on habitat for RKC, particularly within the Bristol Bay region. The analysts focus on crab habitat because the considered action alternatives are designed to potentially benefit the BBRKC stock by restricting some groundfish gears from areas that coincide with areas that are understood to be important to the stock. Fishing operations may change the abundance or availability of certain habitat features used by managed fish species to spawn, breed, feed, and grow to maturity. These changes may reduce or alter the abundance, distribution, or productivity of species. The effects of fishing on habitat depend on the intensity of fishing, the distribution of fishing with different gears across habitats, and the sensitivity and recovery rates of specific habitat features.

In 2005, NMFS and the Council completed the EIS for EFH Identification and Conservation in Alaska (NMFS 2005). The EFH EIS evaluates the long-term effects of fishing on benthic habitat features, as well as the likely consequences of those habitat changes for each managed stock, based on the best available scientific information. The EFH EIS also describes the importance of benthic habitat to different groundfish species and the past and present effects of different types of fishing gear on EFH. Based on the best available scientific information, the EIS analysis concludes that despite persistent disturbance to certain habitats, the effects on EFH are minimal because the analysis finds no indication that continued fishing activities at the current rate and intensity would alter the capacity of EFH to support healthy populations of managed species over the long term. The EIS concludes that no Council managed fishing activities have more than minimal and temporary adverse effects on EFH for any FMP species, which is the regulatory standard requiring action to minimize adverse effects under the Magnuson-Stevens Act (50 CFR 600.815(a)(2)(ii)).

The Council and NMFS have updated available habitat information, and their understanding of the impacts of fishing on habitat, in periodic 5-year reviews of the EFH components in the Council FMPs (NPFMC 2010; NMFS 2010; NMFS 2016; NMFS 2023b). These 5-year reviews have not indicated findings different from those in the 2005 EFH EIS with respect to fishing effects on habitat, although new and more recent information has led to the refinement of EFH for Council-managed species. The Council completed the most recent 5-year review in early 2023. The 2023 EFH Review builds on the work from previous EFH reviews including the EFH roadmap, review process, and using species distribution models to map EFH and the Fishing Effects (FE) model in the evaluation of fishing effects to EFH. The Council took final action in December 2023 to update EFH information in the BSAI Groundfish, GOA Groundfish, BSAI Crab, Arctic, and Salmon FMPs as a result of the 2023 EFH 5-year Review.[45]

5.5.1 Prevailing Ecosystem Conditions

The effects of any selected alternative will occur within the context of prevailing ecosystem conditions, which are most recently characterized in the Ecosystem and Socioeconomic Profile (ESP) included in the 2023 BSAI Crab SAFE (Fedewa and Shotwell 2023). The June 2023 initial review analysis contained ESP updates from the 2022 BSAI Crab SAFE, the following section has been updated to reflect the results of the 2023 BSAI Crab SAFE for BBRKC. The ESP uses data collected from a variety of sources to generate ecosystem and socioeconomic metrics and indicators that may help explain trends for a given stock. The ESP authors provided the following summary of recent observations and considerations that went into their "report card" assessment of the ecosystem as it relates to the BBRKC stock.

In 2023 the ESP authors noted that bottom temperatures and cold-pool remained near-average. Summer bottom temperatures were well within the thermal range of juvenile and adult RKC. RKC have experienced a steady decline in bottom water pH in the past two decades, reaching 7.89 in 2022 and 7.91 in 2023. Continued declines to threshold pH levels of 7.8 could negatively affect juvenile RKC growth, shell hardening and survival. BBRKC recruitment remains well below the long-term average. In 2023, there were anomalously low levels of chlorophyll-a, which may indicate a less pronounced spring bloom, and poor feeding conditions for larval BBRKC. The mature female extent has remained above-average since 2019. The relatively large spatial footprint of mature females in recent years may be attributed to an increased use of habitats in central Bristol Bay.

The ESP authors summarize the ecosystem processes that may be important in identifying productivity bottlenecks and dominant pressures on the stock. During early larval stages, RKC survival is dependent on spatiotemporal overlap with high densities of diatoms, optimal environmental conditions for development and dispersal to suitable settlement habitat (Daly et al., 2018). Specific habitat requirements for juvenile RKC include physical structure and high relief to both evade predators (Stoner, 2009; Pirtle et al., 2012) and provide increased foraging opportunities (Pirtle and Stoner, 2010). Late juvenile and adult RKC are less reliant on complex structure, and instead, spatial distributions and migration timing are driven by bottom temperatures (Loher and Armstrong, 2005; Zheng and Kruse, 2006; Zacher et al., 2018).

With a focus on data for the most recent years prior to the 2023 ESP, it was found that overall trends in physical ecosystem indicators suggest a return to near-normal conditions in Bristol Bay with average bottom temperatures nearly 2°C colder than 2018-2019 heat conditions. A positive phase Arctic Oscillation index in winter 2022 may suggest favorable conditions for BBRKC productivity (Szuwalski et al., 2020), although continued declines in pH that are approaching a critical threshold for negative effects on growth and shell hardening remain concerning (Long et al., 2013). In 2022, the EBS bottom trawl survey indicated that reproductive cycles of mature female BBRKC were delayed due to relatively cold spring bottom temperatures in Bristol Bay (Zacher et al., 2022). Delayed spring hatching of RKC embryos relative to mid-May peak bloom timing may impact the spatiotemporal overlap between first-feeding larvae and preferred diatom prey, and larval retention may be reduced in relatively cold years (Daly et al., 2020). The Bristol Bay's 2022/23 sockeye run continues to hit historical high levels and may be indicative of increased predation on larval RKC in recent years.

Ecosystem indicator analysis findings are summarized in Table 1a of Fedewa et al. (2023). For physical indicators, all were neutral (indicating average conditions for the stock) except for spring pH levels (poor conditions for the stock). The extent of the cold pool and summer wind stress had relatively improved remained in neutral in 2023, after being low in 2021. Additional indicators proposed for the 2024 BBRKC ESP include: 1) BBRKC mature female clutch fullness, as a measure of fecundity or reproductive potential, 2) the ratio of RKC caught in the BBRKC management district and the Northern

[45] December 2023 EFH 5-year Review Omnibus amendment package analysis

district, as a measure for spatial distribution shifts northward outside of management boundaries, and 3) indicators that quantify overlap between crab and fishing gear during vulnerable life history periods, and metrics of vulnerable to these fishing gear interactions.

5.5.2 BBRKC Habitat

In the June 2023 initial review analysis (NPFMC 2023a), staff presented the recent results of the 2023 EFH 5-year Review species distribution model (SDM) EFH map for all RKC in the Bering Sea. For this iteration, staff, in conjunction with the Habitat Conservation Division (HCD) and the Alaska Fisheries Science Center (AFSC) Kodiak lab, has further refined the SDM habitat maps[46] to display area of occupied habitat by the life history stage within the BBRKC stock boundary (Figure 5-14), and a fall SDM encounter rate map for BBRKC legal males (Figure 5-16) to support Council decision making on the proposed action alternatives. Methodological approaches for the summer and fall SDMs can be found in Appendix 3. The habitat maps show areas where distribution data are available for the species as well as where habitat-related densities or relative abundance of the species are available. The area to focus on is the upper 50th percentile of the maps (yellow and green coloring), as this is representative of the upper 50th percentile of the area of occupied habitat (e.g., similar to the core EFH area (CEA) applied to the EFH fishing effects analysis). This analysis is the first time that occupied habitat maps for BBRKC are shown by life stage, and by season.

Summer SDM Maps

BBRKC summer core habitat area was largely within Zone 1, specifically the RKCSA and Area 512 (Figure 5-14). The area of occupied habitat for total crab extended roughly the eastern two thirds of the BBRKC stock boundary, primarily east of Unimak Island, covering 100% of both the RKCSA and Area 512. The core habitat area covered approximately 83% of the RKCSA and 93% of Area 512, while habitat hot spots covered 47% of the RKCSA and 59% of Area 512 (Figure 5-15). These areas represent locations of important habitat for the BBRKC life stages modeled (see Appendix 3), and there exists the potential for fishing-related habitat disturbance to impact the BBRKC stock. Particularly young of year life stages post-settled and early instars (< age 1) where crab are solitary and need high relief habitat or coarse substrate such as boulders, cobble, shell hash, and living substrates such as bryozoans and stalked ascidians (Section 5.3).

Examining summer core habitat area by BBRKC sex and life history stage provided greater ecological nuance to inform this analysis. Occupied habitat for females and immature males was more eastward than for mature males, with habitat hotspots mainly in the NE portion of the RKCSA, Area 512, and further east (Figure 5-14, Figure 5-15). Mature female habitat areas were absent in the westward portion of the RKCSA. However, predicted habitat areas for mature females occurred in the SE corner of the RKCSS, which may be important to note for potential interactions with NPT gear when they are permitted to fish in this area. Similar to immature crab, mature female habitat was largely in Area 512, with substantial overlap with immature crab habitat. Detailed methodology, results and model performance are reported in Appendix 3.

Fall SDM Maps

Figure 5-16 shows a first look at a seasonal Fall SDM for BBRKC legal males, as part of the ongoing research effort conducted by the Kodiak Lab (Section 5.3.1). Across the timeseries, sampling distribution hotspots and presence for legal male BBRKC in the fall were centered around the RKCSA, with some distribution occurring to the northwest and east into NMFS Area 512 (Figure 5-17). Legal males appear to largely be absent from the southwest corner of the RKCSA and the Bristol Bay management area.

[46] The SDMs in this analysis represent habitat use and distributions but are not legal EFH descriptions. Legal EFH definitions for BSAI crab can be found in the recent EFH omnibus amendment package from the December 2023 Council meeting (Agenda item C5, Appendix C).

Thus, encounter probability is higher in the northwest corner of the Bristol Bay management area than in the southwest.

The Fall RKC male sampling distribution (Figure 5-17) shows an absence of BBRKC in the southwest portion of the RKCSA. This is also consistent with the results of the CPS1 survey results (Figure 5-7) and Figure 5-16 where majority of legal males are in the RKCSA, absent the SW corner, north of the RKCSA in Zone 1, and Area 512. Detailed methodology, results and model performance are reported in Appendix 3.

Additional work on Fall encounter rate SDMs were presented at the January 2024 CPT meeting. These results also included a comparison of movement between warm and cold years exhibiting a potential temperature- dependent shift in movement of legal males in and out of the RKCSA. BBRKC legal males occupied more of the RKCSA during warm years versus cold years (January 2024 CPT presentation).

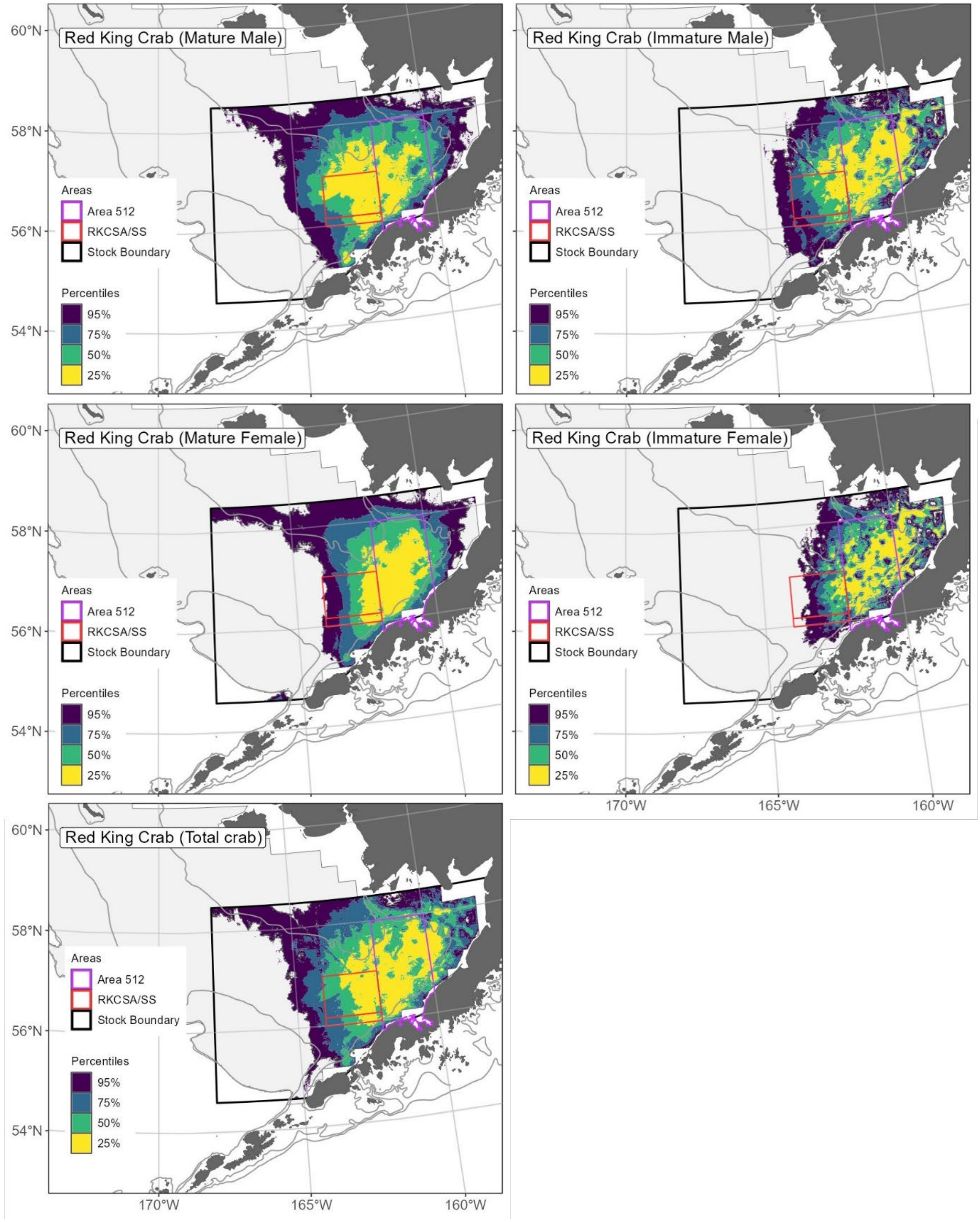


Figure 5-14 Maps of the area of occupied habitat from SDMs fitted to BBRKC distribution and abundance by sex and maturity stages. Colors are the top 25% (hot spots), top 50% (core area), top 75% (principal area), and top 95% of occupied habitat; polygons and lines indicate the BBRKC stock boundary, RKCSA/SS, Area 512, and 50 m, 100 m, and 200 m isobaths.

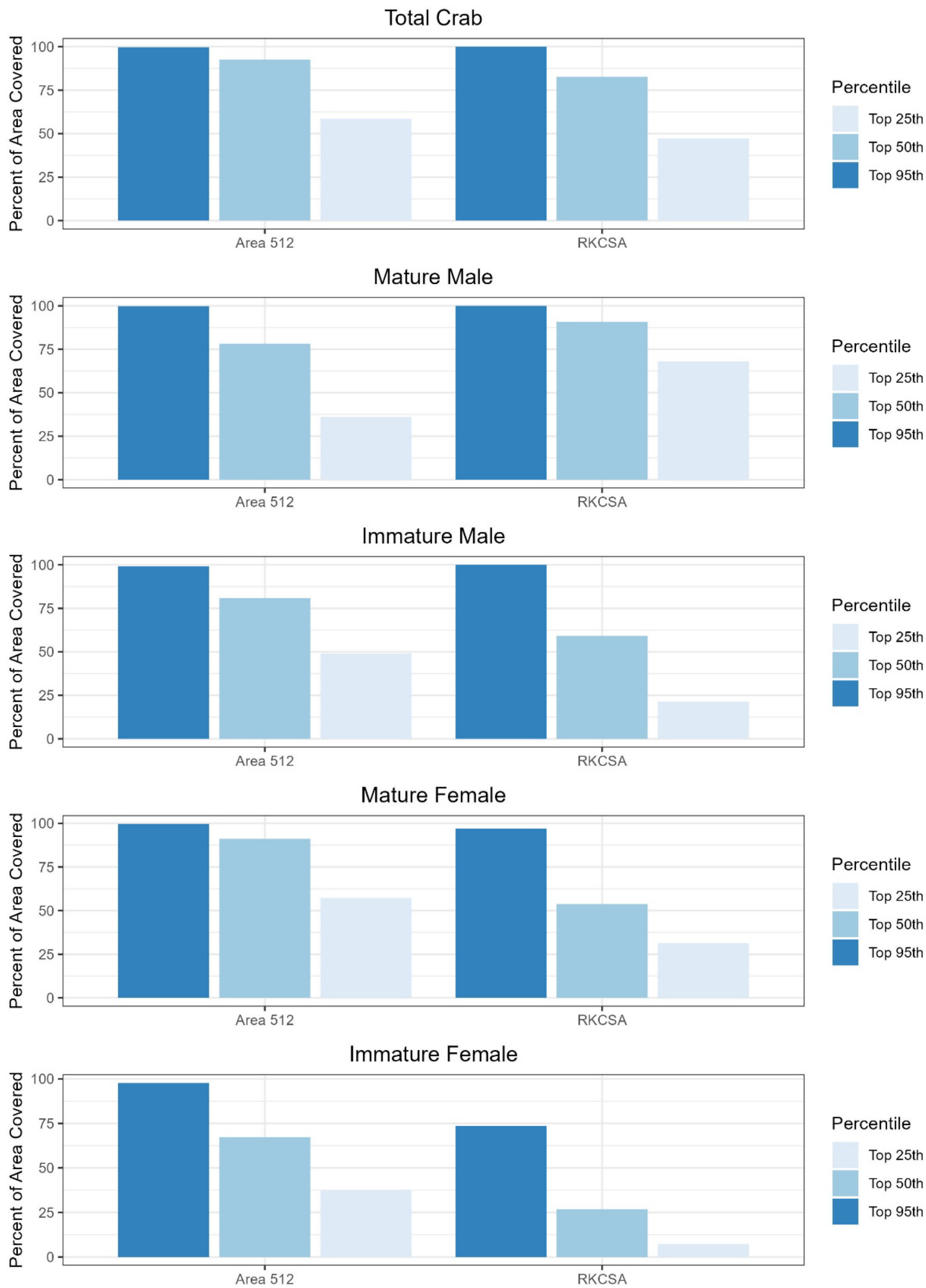


Figure 5-15 Percentage of area covered in each management area (RKCSA and Area 512) by top 95% (occupied habitat), top 50% (core area), and top 25% (hot spots) of habitat-related, model-predicted numerical abundance of BBRKC by sex and maturity stage.

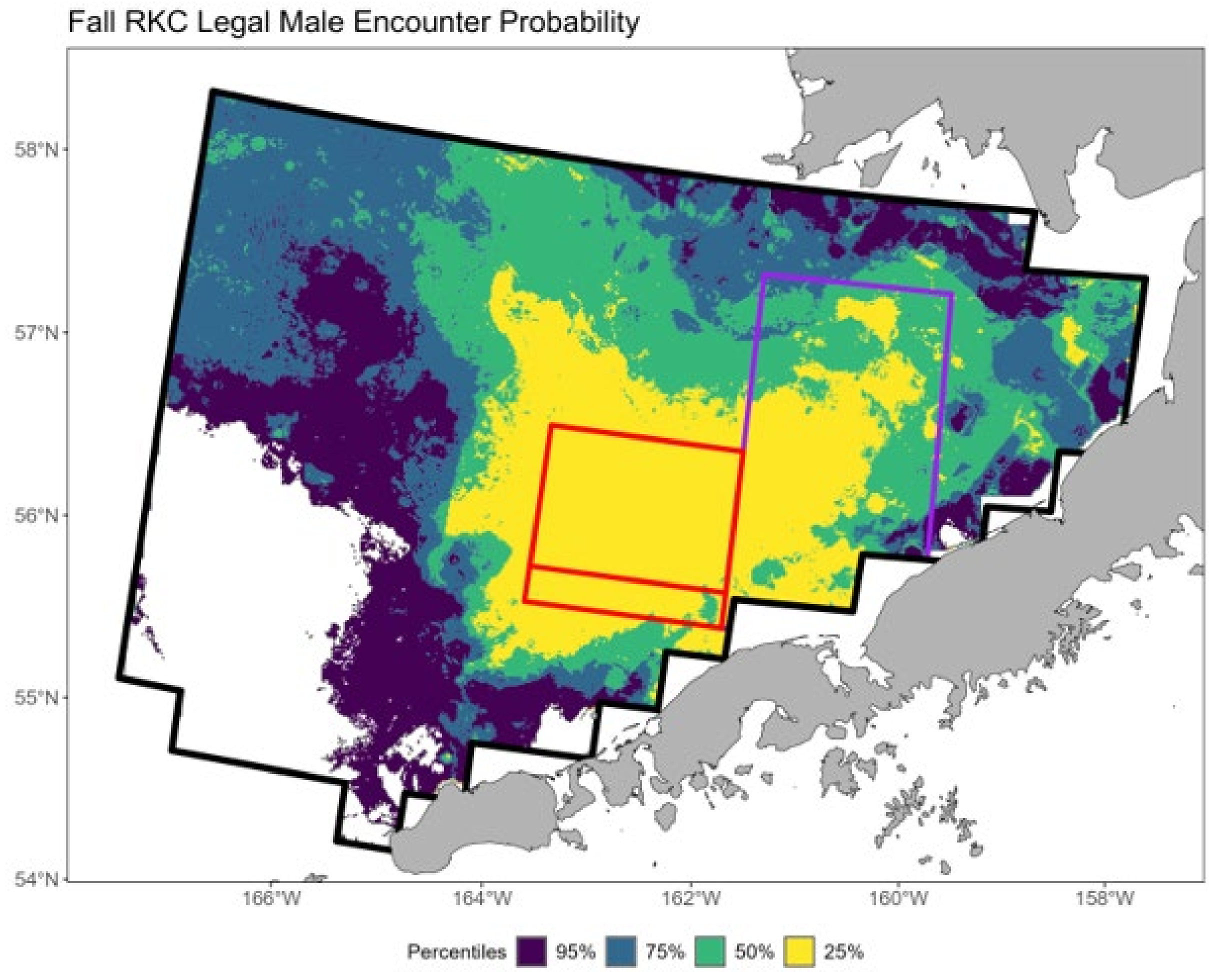


Figure 5-16 Encounter probability of legal male BBRKC in the fall based on percentiles calculated from model-predicted values of occurrence and abundance, averaged across the entire predicted timeseries (1998-2021, values for 2020 are not included due to the COVID-19 cancellation of the NMFS bottom trawl survey, a key data source for the models). Historical encounter "hotspots" are within the top 25% (yellow). Management boundaries include the Bristol Bay Management Area (black), the Red King Crab Savings Area and Subarea (red) and NMFS Area 512 (purple).

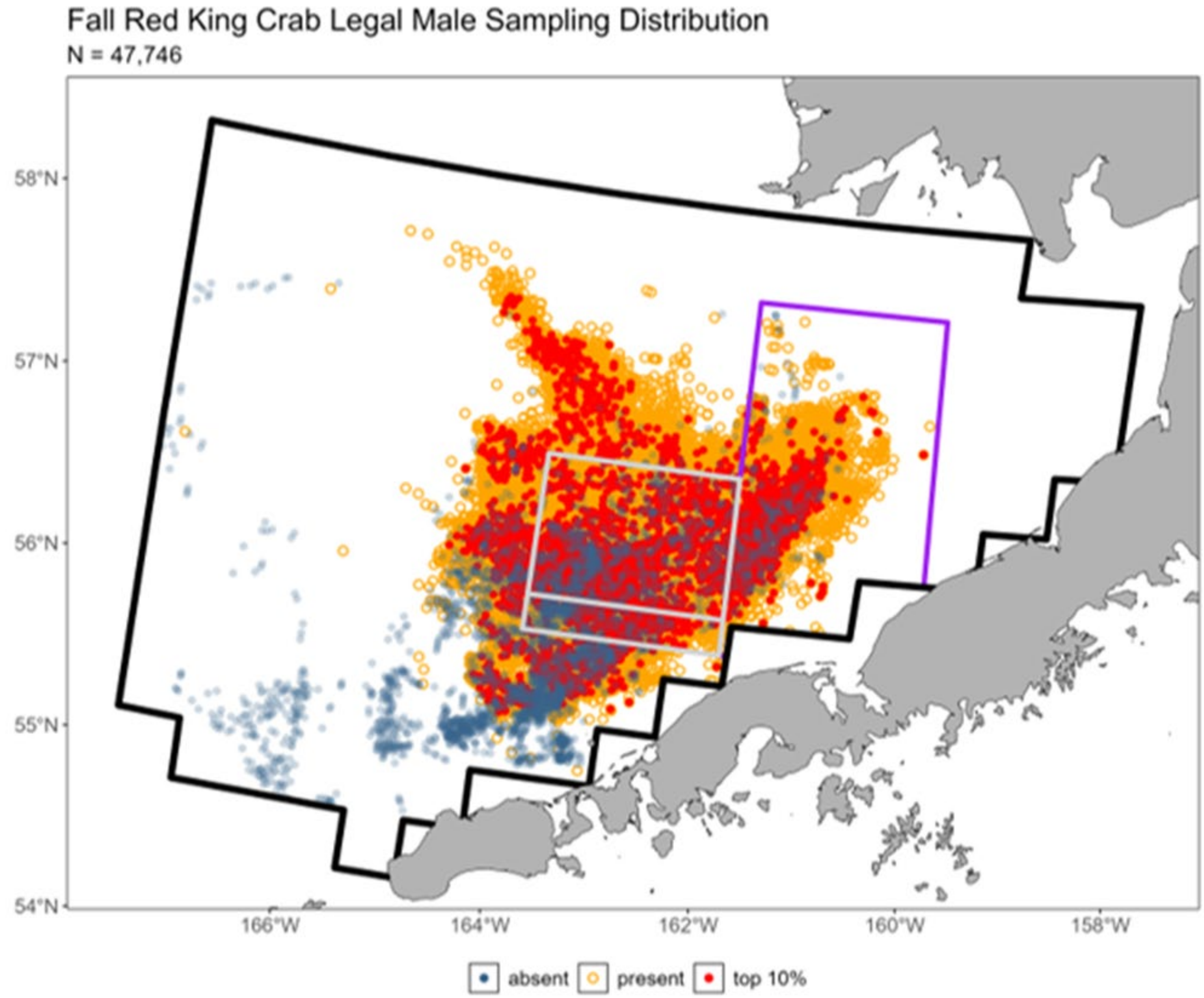


Figure 5-17 Sampling distribution of data derived from observer and directed fishery logbooks used to inform legal male BBRKC distribution models for fall across 1997-2021 (values for 2020 are not included due to the COVID-19 cancellation of the NMFS bottom trawl survey, a key data source for the models), with legal male presences (orange), absences (blue), and high-density points (catch per pot within 90th percentile) included along with management boundaries for the Bristol Bay Management Area (black), Red King Crab Savings Area and Subarea (grey) and NMFS Area 512 (purple).

5.5.3 Estimates of Seafloor Contact

The June 2023 BBRKC initial review (NPFMC 2023a), April 2022 BBRKC discussion paper (NPFMC 2022a) and the December 2022 emergency rule analysis (NPFMC 2022c) presented data visualizations of estimated bottom contact by groundfish gears that were developed from the workflow that the APU FAST lab uses to run the EFH FE model. This analysis provides updated FE output run on the upper 50% habitat occupied summer BBRKC maps by life stage (Section 5.5.2).

While the full FE model estimates cumulative habitat impacts accounting for substrate typology and resiliency, intermediate FE data products can be used to estimate bottom contact area for explicit locations and periods of time (unadjusted for net cumulative benthic effects). The metric presented here, and in past analyses gives a general understanding of year-to-year pressure on seafloor habitat. It does not account for whether certain animals are present when mobile or fixed groundfish gear are contacting the seafloor and, thus, it is important not to interpret bottom contact estimations as a proxy for direct impacts through capture or contact with non-target species that move and migrate, like BBRKC. In other words, estimated bottom contact area is not equivalent to bycatch, mortality, or impacts on the ability of BBRKC to reproduce and recruit into the fishery. Bottom contact area estimates characterize the historical fishing footprint and illustrate overlaps of fished/contacted areas and known habitat.

The full FE model uses spatially-explicit Vessel Monitoring System (VMS) gear tracks dating back to 2003 to estimate cumulative impacts on benthic habitat while accounting for the nature of the seafloor substrate and its ability to regenerate (Smeltz et al., 2019). The FE model utilizes parameters that estimate bottom contact based on tracks from all gear types with a gear-specific correction factor to account for how much, and how often, a gear's total span is contacting the seafloor. Those parameters were reviewed by the SSC in February 2022 (see October 2022 EFH Fishing Effects Discussion Paper.

The method behind the bottom contact estimates presented here and in the previous BBRKC discussion papers uses the same raw VMS gear tracks as the FE model and applies gear and location specific contact adjustments. This results in "bottom contact area (BCA, km^2)" estimates, which can also be presented as measures of "bottom contact area ratio (BCAR)" by relating the BCA to the size (km^2) of an area of interest. In Figure 5-18, below, each grid cell (pixel) represents the total BCA for the months of January, February, March and April (e.g., A Season, from 2020-2022). BCA is in absolute units of area. As a relative measure, BCAR is best used when comparing areas of differing size, whereas BCA is useful in understanding the total amount of effort in an area. When interpreting BCA, note that a grid cell depicting a 25 km^2 area (each pixel in Figure 5-18 maps) that registers 25 km^2 of swept area (green/blue color) does not indicate that every square kilometer in the cell was subject to bottom contact by fishing gear. Rather, that cell would indicate that cumulative total estimated bottom contact on a monthly basis amounted to more than 25 km^2. A grid cell that registers 5 km^2 of swept area (purple) also does not indicate that 20% of the 25 km^2 grid cell was contacted; in many cases, vessel tracks are overlapping. The color scale runs from pale yellow (least estimated bottom contact) to deep purple/violet (most estimated bottom contact). The darkest hues translate a BCA estimate of 50 or more km^2 swept area, generally indicated that much of the area was impacted and often by multiple tracks during a certain period of time.

The June 2023 initial review analysis showed maps from the December 2022 RKCSA Emergency rule analysis with average BCA for the A and B season for federal groundfish fisheries by gear type from 2015-2020 (for perspective on recent bottom contact). These analyses showed that cumulative impact of all gear types in the RCKSA was greater in the A season than in the B season which was largely driven by NPT and PTR gear. The total BCA decreased when comparing 2003-2010 to 2011-2020; that trend was driven by changes in bottom contact by NPT gear within the RKCSS portion of the RKCSA. However, the opposite trend was evident for PTR gear across the same time periods. HAL and POT gear were observed to have low BCA compared to PTR and NPT gear. HAL and POT gear generally had similar or higher BCA in the B season as compared to the A season. Given previous analyses have indicated more bottom contact in the A season, Figure 5-18 depicts the monthly BCA for the A season in 2020-2022, with BBRKC areas occupied by life stage present to represent spatial overlap. Animated images of BCA across the timeseries and additional images by month across the timeseries are linked on the February 2024 eAgenda under the C2 agenda item.

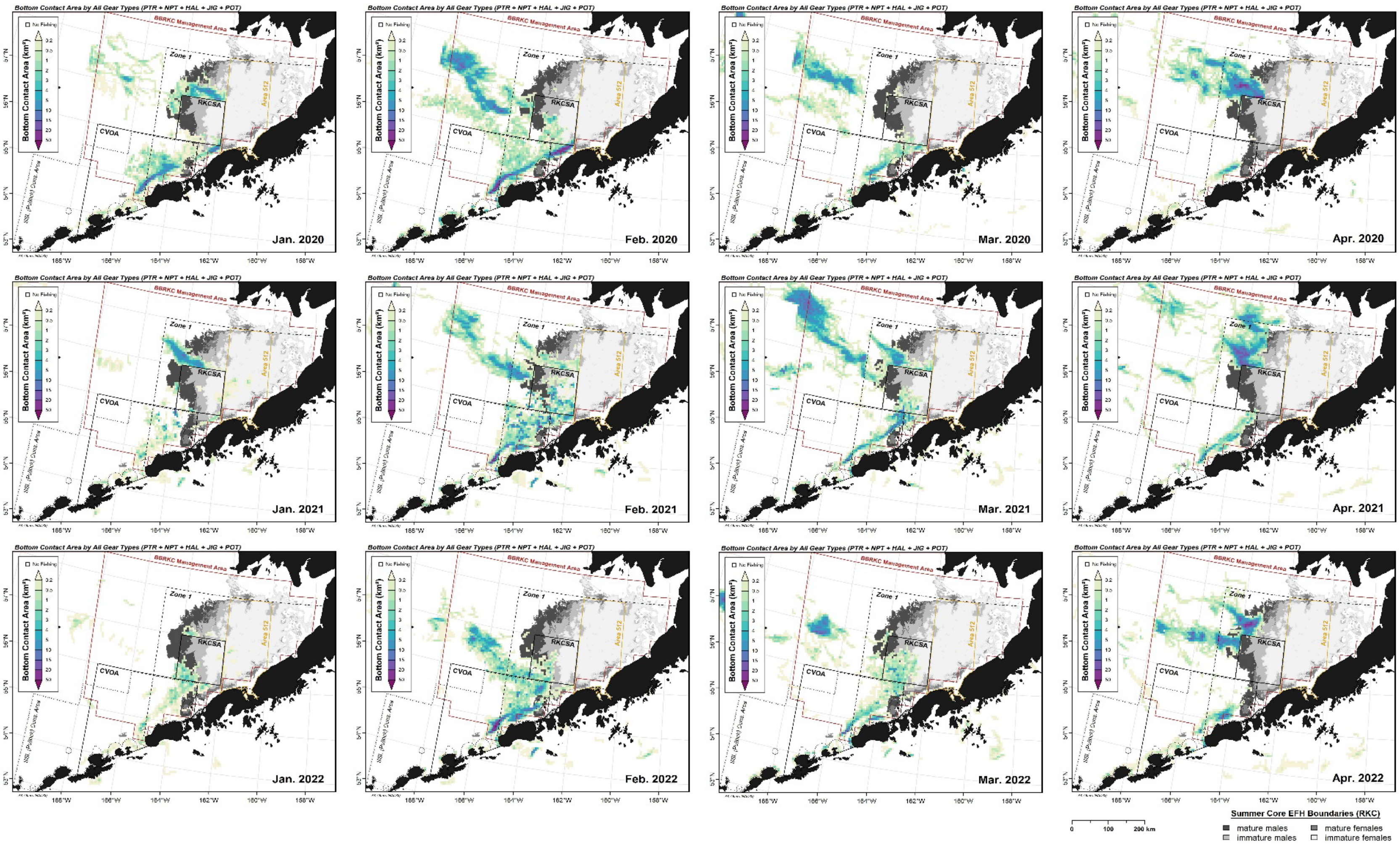


Figure 5-18 Total monthly bottom contact area (BCA) for all gear types in the A season from 2020-2022 overlayed with the summer SDM habitat occupied map by life stage to depict bottom contact overlap with BBRKC life stages. Life stages are depicted in gray scale as seen in the bottom right-hand corner. Areas outlines in the map include the Bristol Bay management area boundary (red), RKCSA (black) (including RKCSS), Area 512 (yellow), the catcher vessel operating area (CVOA) (black), and the stellar sea lion (SSL) conservation area (dotted line).

Bottom contact in the A season is typically occurring in the RKCSA and just north of the RKCSA within Zone 1. The RKCSA/SS exhibits the most bottom contact in February and March extending from the SW corner of the RKCSA into the center and eastward. The bottom contact within the RKCSA overlaps mainly with mature males, mature females, and some immature females and males depending on how far east into the RKCSA bottom contact occurs. The area north of the RKCSA, within Zone 1 exhibits the most bottom contact in recent years, overlapping mostly with mature male habitat. Bottom contact west of the RKCSA and Zone 1 does not appear to overlap with the core EFH area of BBRKC habitat.

To provide additional information about BCAR in the areas under the Alternative 2, RKCSA, and Alternative 3, Area 512, staff chose to present the BCAR all gear types separated within the BBRKC management area, Zone 1, the RKCSA (including RKCSS), and Area 512 (Figure 5-19). As a reminder, the RKCSA is closed to NPT gear except in the RKCSS portion, and only during years when the preceding directed fishery was open. Figure 5-19 displays BCAR on the left facing y-axis, and BCA on the right facing y-axis. For direct comparisons of bottom contact for regions that differ in sizes, BCAR is a useful estimate since it is a ration of the BCA within the region divided by the total area of the region. Across the time series, PTR and NPT gear exhibited the most bottom contact for the entire BBRKC management area, Zone 1 and the RKCSA, similar to previous analyses. However, within the RKCSA the proportion of NPT bottom contact within the area decreased to a BCAR of 0 in 2022, as a result of the directed fishery being closed and the RKCSS being closed to NPT fishing.

Within the BBRKC management area, Zone 1 and RKCSA, PTR had the highest ratio of bottom contact, and accounted for a majority of the bottom contact within the areas assessed, aside from Area 512. In 2022, the PTR accounted for all bottom contact within the RKCSA, but notably 2022 had the lowest BCAR within the RKCSA across the time series.

Area 512 had low ratios of bottom contact across all gear types. Given that much of the Pacific cod pot fishery operates within area 512, more research is necessary to compile when bottom contact is occurring and how much time pot gear is on the bottom, as shown by the preliminary report compiled by the UFMWG.[47] Despite low bottom contact area ratios in Area 512, it may be worthwhile to continue to consider the time on bottom for gear, and the potential lethality of the gear when looking into potential habitat disturbances in this region. These assumptions are not met by utilizing the FE model and would require further analysis.

[47] Directly available here, linked from the Jan. 2024 CPT agenda.

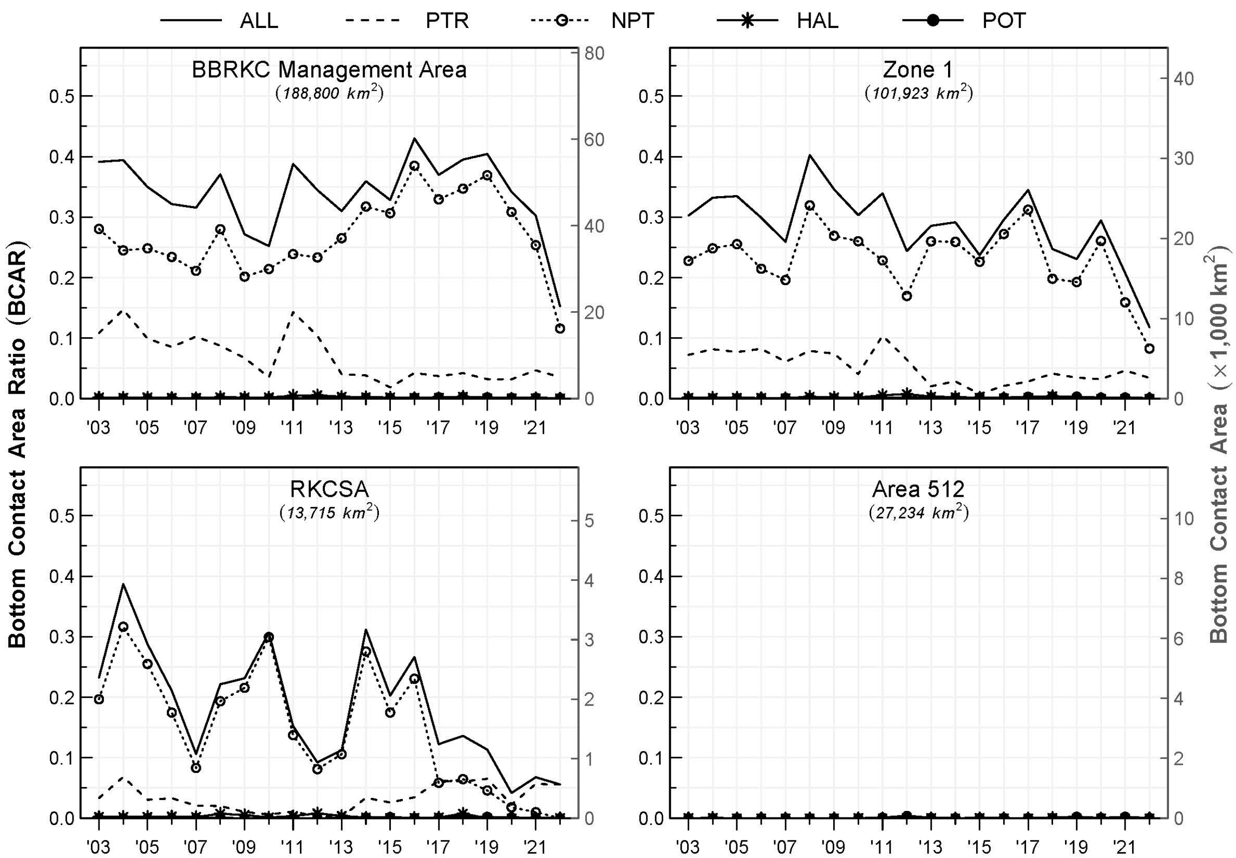


Figure 5-19 Estimated yearly bottom contact by gear type within the BBRKC stock boundary, Zone 1, RKCSA/SS, Area 512 from 2003-2022. Note the difference in y-axis scale between "Bottom Contact Area Ratio" on the left y-axis and "Bottom Contact Area" on the right y-axis. (Source: APU FAST Lab)

5.5.4 Effects of the Alternatives on Habitat

The Council's purpose and need for action notes that the BBRKC stock decline is due to a combination of factors. Habitat protection is a factor that – while not explicitly listed in the purpose and need – has been part of the Council's discussion of factors that could promote recruitment and optimum yield for BBRKC with the caveat that there is some uncertainty as to which habitat areas provide which stock benefits at points throughout BBRKC life-stages. This analysis, brought forward areas of occupied habitat for BBRKC by life stage and by season (Figure 5-14 and Figure 5-16), to help inform the Council of areas that may provide important benefit to RKC, specifically areas that may be important to immature and female BBRKC (Figure 5-15).

The effects of the alternatives on habitat would be potentially redistributing the areas where gear contact with the seafloor may impact RKC habitat. (See Section 3.3.3 and Appendix 2 for areas where there is potential for redistribution of fishing effort based two methods of analysis). The potential changes in habitat impacts as a result of the alternatives are minimal, if redistribution of effort from the RKCSA/SS under Alternative 2 or Area 512 under Alternative 3 shifts away from core habitat area for BBRKC. As seen in Figure 5-14, mature females and immature males and females occupy areas in the eastern RKCSA, Area 512 and east of Area 512. As discussed in Section 5.5.2, nearly all of the total area potentially affected by the actional alternatives are within the top 25% core habitat area) of BBRKC habitat occupied. Bottom contact occurring within the RKCSA during the A season (Figure 5-18), may overlap with molt-mate timing and therefore crab undergoing molt may be more susceptible to gear encounters during this time. Figure 5-18 exhibits overlapping bottom contact in the RKCSA in areas occupied by mature males, females and to a lesser extend immature males and females. The general depth and high presence of sponge habitat within the RKCSA/SS suggests it is likely most important to crabs to late juvenile (age-4) and older, providing an area of refuge for crabs which are soon to recruit into the fishery between ages 8 and 9. As seen in the work presented to the CPT in January 2024, legal male movement has been shown to change temporally, and may be correlated with temperatures. In moving forward with action, it may be beneficial for the Council to consider temperature as a variable that influences presence/absence of RKC within the RKCSA and surrounding areas. It is reasonable to assume that with less physical damage to sponges and the associated seafloor, undisturbed habitat may provide greater predator refuge for these late juvenile crabs, allowing a higher proportion of crabs from within the area to survive to reproductive/harvestable size than under a disturbed state.

If Alternative 2 has the effect of reducing trawl effort rather than displacing it (through lower TAC utilization because a groundfish fishery is less productive in other areas at certain times of year) then there could be a net effect on seafloor habitat overall. Whether those areas to which effort would have been displaced but was not would be considered BBRKC habitat is unknown but less likely as trawl gear is likely to move west and/or south due to existing closed areas, sea ice, and target species distributions throughout the year. On the other hand, if Alternative 2 has the effect of increasing total fishing effort by causing less effective fishing, the gross number of trawls occurring would likely increase – again with uncertainty about the location of that displaced, increased trawl activity.

If effort is not redistributed by rather intensifies in areas outside the RKCSA and Area 512 that are still within BBRKC core habitat areas and hotspots for areas occupied, there may be a more substantial population-level effect resulting from habitat disturbance to these areas. Such as, the area just north of the RKCSA in Zone 1 exhibits areas of high bottom contact (Figure 5-18). A presentation provided to the September 2023 CPT meeting on annual fishery performance, provided an visual depiction of overlap of NPT catch of flathead, rock and yellowfin soles (mt) with concurrent average rate of RKC bycatch (CPT 2023 Fishery Summary 2022/23, Slides 24/25). These images show higher amounts of RKC bycatch in the area just north of the RKCSA within Trawl Bycatch Limitation Zone 1 (see Figure 1-2). As seen in Figure 5-19 the proportion of bottom contact by NPT gear is higher in Zone 1 compared to other areas within the RKCSA and Area 512. The October 2022 FE discussion paper also showed this region displaying 25-66% habitat disturbance as a result of bottom contact (Zaleski et. al, 2023).

It is evident that the current fishing effort occurring in the area North of the RKCSA has high bottom contact, and high encounter rate with RKC. The Summer and fall habitat (Figure 5-14 and Figure 5-16) occupied maps show this area being an area of higher mature male, and legal male distribution, and likelihood of encounter with their upper 25% habitat occupied occurring in this area. It is likely that potential habitat disturbances here may affect BBRKC habitat in the area. Additionally, male crab are more sensitive to gear interactions during their molt-mate cycle (Jan-June), and as a result there may be more unobserved mortality may occur as a result of gear interactions. The effects of the alternatives would likely not change the impacts to habitat in this area, unless fishing effort is increased as a result of not being able to utilize the RKCSS. Should the Council choose to move forward with Alternative 2, and fishing effort is redistributed out of the RKCSS, there may be increased fishing activity in the area north of the RKCSA, this may result in additional bottom contact and subsequent habitat disturbance, which may have an impact on the habitat utilized by mature and legal male that largely occupy this area.

The 2023 UFMWG report acknowledges that more research is needed to adequately assess the magnitude of unobserved fishing mortality, specifically in gear-seafloor interactions as well as any crab encounters and mortality that may result from gear interactions. As presented in the B reports at the February 2024 Council meeting, ongoing cooperative work is being conducted by the APU FAST Lab and the pollock trawl fleet to better investigate gear-seabed interactions to inform fishery management. Specific elements of the workplan include: 1) cataloging gear specifications, 2) numerical simulations, and 3) gear-seabed contact field study design.

Cataloging gear specifications is included in the current FE model and will be expanded upon as a part of this work to include refinements that better detail the variation in gear configurations that reflect local fishing condition factors and best fishing practices. As reported in the voluntary crab avoidance measures during the 2023 fishing year (Section 1.2), there is ongoing work through the collaborative effort between APU FAST Lab and the pollock trawl fleet to generate scenario-based 3-dimensional gear visualizations (still images and videos) that will be used to illustrate potential interactions between the gear and the benthos. The investigators expect that project elements 1 and 2 (above) will elucidate the degree of variability in gears and fishing practices currently in use to guide the construction of a robust field sampling program that provides fishery-level pollock trawl-seabed interaction estimates in the future. For example, footrope contact sampling and monitoring are fundamental to estimating the influences of trawl gear design, materials, and fishing practices on time and area-specific fishing footprint, bottom contact, habitat effects, and unobserved crab mortality.[48] For greater detail, the reader is referred to the February 2024 Council B reports presentation linked above.

Effects of Aggregate Past, Present, and Reasonably Foreseeable Actions on Habitat

Aside from the potential actions described in this document, the analysts are not aware of other "reasonably foreseeable future actions" relating to groundfish gear use in the Bristol Bay region of the BS that are in an implementation phase. The Council is currently considering alternatives that may affect when and to what extent pelagic trawl gear is utilized in BSAI areas resulting in bycatch of non-Chinook salmon; any relevance of that issue to RFFAs for this action will be assessed in a subsequent iteration of this document as any potential salmon bycatch measures are further defined. Past and recent actions – many of which were described in Sections 1.3, 3, and 6 of this document – have created a patchwork of restrictions on when and where trawl gear can be deployed in this region. Examples include the NBBTCA, the seasonal closure of Area 516 to all trawl gear, RKC PSC limits in Bycatch Limitation Zone 1, the CVOA that restricts non-CDQ offshore sector pollock fishing during the B season (after June 10), the Chum Salmon Savings Area, and sea lion conservation areas. None of those measures would be weakened or removed under the action alternatives as presently defined.

The EFH 5-year review process will act as a tool to monitor long-term effects on RKC habitat in the BS. The EFH review occurs on a 5-year basis, as defined by the MSA guidelines for implementing the EFH Final Rule. The current EFH 5-year review cycle completed in 2023, thus the next 5-year review cycle would be up for review in 2028. The timing in the next iteration of the EFH 5-year review could provide a retrospective look on BBRKC crab habitat fluctuated from 2023 to 2028. There is also potential for hindcasting species' occupied habitat area (EFH) shifts over time with temporally dynamic SDMs (e.g., 5-year time steps) for BSAI RKC, where supplemental analysis could be conducted for RKC stocks such as BBRKC. Additional work on BBRKC utilization of habitat noted in Section 5.5.2 will also inform BBRKC habitat usage and potential implications of past, present and reasonably foreseeable actions.

Considering the direct and indirect impacts of the proposed action when added to the impacts of past and present actions previously analyzed in other documents that are incorporated by reference and the impacts of the reasonably foreseeable future actions listed above, the aggregate impacts of the proposed action are determined to be not significant.

[48] B. Harris (APU FAST Lab, pers. comm. Jan. 2024)

5.6 NEPA Summary

One of the purposes of an environmental assessment is to provide the evidence and analysis necessary to decide whether an agency must prepare an environmental impact statement (EIS). The Finding of No Significant Impact (FONSI) is the decision maker's determination that the action will not result in significant impacts to the human environment, and therefore, further analysis in an EIS is not needed. The Council on Environmental Quality regulations at 40 CFR 1508.27 state that the significance of an action should be analyzed both in terms of “context” and “intensity.” An action must be evaluated at different spatial scales and settings to determine the context of the action. Intensity is evaluated with respect to the nature of impacts and the resources or environmental components affected by the action. These factors form the basis of the analysis presented in this Environmental Assessment/Regulatory Impact Review.

This section will be completed for the final action draft.

6 Management Considerations

6.1 Monitoring

Neither of the action alternatives are expected to alter the aspects of monitoring for the groundfish fisheries involved. This section summarizes monitoring for AFA Pollock, Amendment 80, Pacific cod pots, Pacific cod HAL, and the PCTC program.

The North Pacific Observer Program is implemented by regulations at Subpart E of 50 CFR part 679 that authorize the deployment of observers and electronic monitoring (EM) to collect information necessary for the conservation and management of the BSAI and GOA groundfish and halibut fisheries. The information collected by observers provides the best available scientific information to manage the fisheries and to develop measures to minimize bycatch. Observers collect biological samples and fishery-dependent information on total catch and interactions with protected species. Managers use data collected by observers and electronic monitoring to monitor quotas, manage groundfish and prohibited species catch, and document and reduce fishery interactions with protected resources. Scientists use observer-collected data for stock assessments and marine ecosystem research.

Observer coverage refers to whether a vessel fishing with a federal fisheries permit is required to have fishing activity monitored as is outlined at 679.51(a). Monitored vessels are either in the full or partial coverage category. Vessels may be monitored by human observers or, in some cases, by EM systems.

Vessels and processors in the full coverage category have at least one observer present during all fishing or processing activity. The full coverage category includes the following:

- Catcher/processors (with limited exceptions)
- Motherships
- Catcher vessels participating in programs that have transferable prohibited species catch (PSC) allocations as part of a catch share program. These programs include Bering Sea pollock (both American Fisheries Act and Community Development Quota (CDQ) programs), the groundfish CDQ fisheries (CDQ fisheries other than Pacific halibut and fixed gear sablefish; only vessels greater than 46 ft LOA), PCTC, and the Central GOA Rockfish Program. Some exceptions exist for CVs delivering unsorted codends to a mothership.
- Catcher vessels using trawl gear that have requested placement in the full coverage category for all fishing activity in the BSAI for one year; and
- Inshore processors receiving or processing Bering Sea pollock.

All vessels and processors that are not in full coverage are in the partial coverage category and are assigned observer coverage according to the scientific sampling plan described in the Annual Deployment Plan (ADP). The ADP outlines the science-driven method for deployment of observers and EM systems using established random sampling methods to collect data on a statistically reliable sample of fishing vessels in the partial coverage category. Each year, the ADP describes the deployment strata and how vessels are assigned to specific partial coverage selection pools. Since 2020, the strata in the ADP have been:

- Observer trip-selection pools. There are three sampling strata for deployment of observers:
    - Hook-and-line vessels greater than or equal to 40 ft LOA,
    - Pot vessels greater than or equal to 40 ft LOA, and
    - Trawl vessels making a trip not covered by the EM EFP.
- EM fixed-gear, trip-selection pool: fixed-gear vessels that request to be in the EM pool that are approved by NMFS. EM is used for catch accounting of catch and bycatch.
    - Trawl EM trip-selection pool: vessels fishing under an Exempted Fishing Permit (EFP) to evaluate the efficacy of EM on pollock CVs using pelagic trawl gear.

- No-selection pool: fixed-gear vessels less than 40 ft LOA and vessels fishing with jig gear. These vessels have no probability of being selected for monitoring.

With the exception of Pacific cod pot CVs, all of the fisheries described in this section are in the full coverage category. The specifics of each program are described below.

AFA Pollock

AFA pollock CP and CV vessels are monitored in the full coverage category. Some CVs have participated in EM through an exempted fishing permit (EFP) since 2020 (NMFS 2022a). The EFP was issued in January 2020 to evaluate the efficacy of electronic monitoring systems and shoreside observers for pollock CVs using pelagic trawl gear in the eastern BS and GOA. Catch accounting for the vessel's catch and bycatch is done via eLandings reports and shoreside plant observers. In the BS, CVs participating in the Trawl EM EFP were required to have EM on 100% of pelagic trawl pollock trips and all EM deliveries were sampled shoreside by observers. In October 2022, the Council adopted a preferred alternative which would implement EM on pelagic trawl pollock catcher vessels and tenders delivering to shoreside processors in the BS and GOA and NMFS is currently developing the proposed rule for this action. Under the selected alternative, all Bering Sea participating CV vessels will continue to be under full coverage requirements: all trips will be monitored at-sea for compliance with maximum retention requirements using EM and all deliveries will be sampled by shoreside observers. CV vessels which do not participate will continue to be monitored through full coverage observers.

Non-Pelagic Trawl (Amendment 80)

The Amendment 80 fleet consists of CPs under the full coverage category. Amendment 80 vessels using trawl gear in the BSAI are required to have at least two observers for each day the vessel is used to catch, process, or receive groundfish, with more than two observers required if the observer workload restriction would otherwise preclude sampling as required. At least one observer must be endorsed as a lead level 2 observer. Amendment 80 vessels are required to weigh all catch on a NMFS-approved scale, except halibut sorted on deck by vessels participating in halibut deck sorting, provide an observer sampling station, comply with pre-cruise meetings, and meet a variety of operational line, belt flow, and spacing requirements at 679.93(b). The Amendment 80 fleet is allowed to participate in halibut deck sorting (679.120), which allows halibut to be sorted on the deck of trawl CPs when operating in non-pollock groundfish fisheries off Alaska.

Pacific Cod Pot Gear

The Pacific cod pot fishery has varying levels of observer coverage for CP and CV sectors. The Pacific cod pot gear fishery is conducted by pot CPs, O60 pot CVs, and the pot gear component of the "under 60-ft" (U60) pot/HAL CVs. Pot CPs are in the full coverage category, while pot CVs are assigned to the partial coverage category, with some participating in EM (NMFS 2022a). In recent years, the O60 CV sector has comprised the majority of vessels fishing in Area 512. There has been no CDQ fishing for Pacific cod with pot gear in Area 512 in recent years. Nevertheless, the analysts note that CDQ monitoring requires a lead level 2 observer, observer sampling station, and compliance with pre-cruise notifications with the Observer Program.

NMFS is currently developing a proposed rule to improve monitoring in the Pacific cod pot CP sector, where data collection errors have impacted catch estimates due to the sector's small number of active vessels and short seasons. Those proposed modifications are similar to what is currently required for CPs using pot gear to fish CDQ Pacific cod. Those requirements would include carrying a Level 2 observer, complying with pre-cruise meeting notifications, and requiring certification and testing standards for participants choosing any of the following voluntary monitoring options: observer sampling stations, motion-compensating platform and flow scales, or additional observers on the vessel (NMFS 2023).

Hook-and-Line Pacific Cod

The active HAL participants for Pacific cod in the BSAI include the HAL CP Sector. The HAL CP Sector are in the full coverage category. Vessels have the option of selecting one of two monitoring options when directed fishing for Pacific cod with HAL gear in the BSAI: (1) the 'Increased observer coverage option' and (2) the 'Scales option.' Under the first option, at least two observers must be aboard at all times, with at least one observer endorsed as a lead level 2 observer. Under the second option, all Pacific cod are required to be measured on a NMFS-approved scale, with testing, video monitoring, and electronic logbook requirements. Under both options, vessels are required to provide an observer sampling station and comply with pre-cruise meeting notifications.

Pacific Cod Trawl Cooperative

NMFS recently implemented the Pacific Cod Trawl Cooperative (PCTC) under Amendment 122 that is scheduled to begin in January 2024 and allocations would be harvested by trawl CVs. PCTC CVs are in the full coverage category. The PCTC Program would maintain the current observer coverage exception for CVs delivering unsorted codends to motherships specified at § 679.50(a). CVs in the full observer coverage category would be required to provide a functional and operational computer with NMFS-supplied software installed to facilitate the electronic entry of observer data collected on board the vessel. At the time of Program implementation, AFA CVs would be required to provide communications equipment necessary to facilitate the point-to-point communication necessary to transmit observer data to NMFS on a daily basis. For the first three years after implementation, the PCTC Program would exempt non-AFA CVs from the requirement to facilitate at-sea transmission of observer data. If a non-AFA CV has the necessary communication equipment already installed on the vessel prior to the end of the three-year exemption, the vessel would be required to allow the observer to use the equipment. After three years, all vessels would be required to comply with requirements for at-sea observer data transmission.

6.2 Management

Action Alternatives

The action alternatives would require regulatory changes to 50 CFR 679. Alternative 2 would implement an annual closure of the RKCSA to all or a subset of commercial fishing gears. This may be addressed under the BSAI closures listed at 679.22 which currently prohibits trawl gear other than pelagic trawl gear:

> **§ 679.22 Closures.**
>
> (a) *BSAI* —
>
> (1) ***
>
> (2) ***
>
> (3) *Red King Crab Savings Area (RKCSA).* Directed fishing for groundfish by vessels using trawl gear other than pelagic trawl gear is prohibited at all times, except as provided at §679.21(e)(3)(ii)(B), in that part of the Bering Sea subarea defined as RKCSA in Figure 11 to this part.

Alternative 3 would implement a closure of Area 512 to fishing for Pacific cod with pot gear under various options. This would be achieved by amending the current regulations at § 679.22(a)(1):

> **§ 679.22 Closures.**
>
> (a) *BSAI* —
>
> (1) *Zone 1 (512) closure to trawl gear.* No fishing with trawl gear is allowed at any time in reporting Area 512 of Zone 1 in the Bering Sea subarea.

Paperwork Reduction Act (PRA)

If necessary, any PRA implications of the action alternatives will be assessed prior to final action.

6.3 Enforcement

As the regulations for closed areas are based on gear type, OLE requires clear definitions of the gears to enforce closures. To add clarity to the pelagic trawl definition, NMFS recommends the Council consider regulatory revisions to the definition of "pelagic trawl gear" to clarify if the codend design is intended to be regulated, allow for gear innovation (e.g., Salmon excluders), and simplify compliance monitoring by removing outdated or unapplicable portions of the existing gear definition. The definition of pelagic trawl gear is addressed in a separate discussion paper that will be reviewed by the Council in February 2024 (see agenda item D1).

For trawl performance standard enforcement to be effective, OLE would require a tool that determines seafloor contact in accordance with FMP management objectives. If the objective is to keep trawl gear off the bottom all or a portion of the time, the best approach might be to require an existing technology that can quantify and record seafloor contact, or potentially include additional bottom dwelling species caught as bycatch to verify seafloor contact. Per the Council's request in the June 2023 motion, this document includes continued discussion of enforceability for the trawl gear performance standard (see Section 8).

6.4 Cost Recovery

Section 304(d) of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) authorizes and requires the collection of cost recovery fees for limited access privilege programs (LAPP) and the Western Alaska Community Development Quota Program. Cost recovery fees recover the actual costs directly related to the management, data collection, and enforcement of the programs. Section 304(d) of the Magnuson-Stevens Act mandates that cost recovery fees not exceed three percent of the annual ex-vessel value of fish harvested by a program subject to a cost recovery fee, and that the fee be collected either at the time of landing, filing of a landing report, or sale of such fish during a fishing season or in the last quarter of the calendar year in which the fish is harvested. In general, the total dollar amount of the annual fee is determined by multiplying the NMFS published fee percentage by the ex-vessel value of all landings under the program made during the fishing year.

Of the fisheries described in this section, NMFS manages the AFA Pollock, Amendment 80, and PCTC fisheries as LAPPs subject to cost recovery (81 FR 150, January 5, 2016 and 88 FR 53704, September 7, 2023). The AFA allocates the Bering Sea directed pollock fishery TAC to three sectors: inshore, catcher/processor, and mothership. Each sector has established cooperatives to harvest their pollock allocation. Only the inshore cooperative is responsible for paying a fee for that sector's Bering Sea pollock landed under the AFA, which is due on December 31 of the year in which the landings were made. For the Amendment 80 fishery, NMFS calculates a standard ex-vessel price for the six species allocated under Amendment 80: BSAI rock sole, BSAI yellowfin sole, BSAI Pacific cod, BSAI flathead sole, AI Pacific ocean perch, and BSAI Atka mackerel. The fee percentages for 2022 were 0.32 for the AFA inshore cooperatives and 0.87 for the Amendment 80 program (87 FR 73540, November 30, 2022). For the PCTC fishery, NMFS will assess a fee on the ex-vessel value of PCTC Program Pacific cod harvested by cooperatives in the BSAI. NMFS annually receives information used to calculate Pacific cod standard prices in the existing BSAI Pacific cod Ex-vessel Volume and Value Report, which is submitted in early November of each year. NMFS will use this existing data source to calculate standard prices used to determine the annual PCTC Program fishery value, which will be used to calculate the annual PCTC Program cost recovery fee percentage. PCTC Program landings will be made in the A and B seasons, which extends from January 20 to June 10 (88 FR 53704, September 7, 2023).

7 Magnuson-Stevens Act and FMP Considerations

7.1 Magnuson-Stevens Act National Standards

Below are the 10 National Standards as contained in the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). In recommending a preferred alternative at final action, the Council must consider how to balance the national standards.

A discussion of the Council's considered alternatives with respect to each National Standard will be prepare for final action.

National Standard 1 — Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.

National Standard 2 — Conservation and management measures shall be based upon the best scientific information available.

National Standard 3 — To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

National Standard 4 — Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be; (A) fair and equitable to all such fishermen, (B) reasonably calculated to promote conservation, and (C) carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

National Standard 5 — Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources, except that no such measure shall have economic allocation as its sole purpose.

National Standard 6 — Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

National Standard 7 — Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

National Standard 8 — Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities by utilizing economic and social data that meet the requirements of National Standard 2, in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

National Standard 9 — Conservation and management measures shall, to the extent practicable, (A) minimize bycatch, and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

National Standard 10 — Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

7.2 Section 303(a)(9) Fisheries Impact Statement

Section 303(a)(9) of the Magnuson-Stevens Act requires that a fishery impact statement be prepared for each FMP or FMP amendment. A fishery impact statement is required to assess, specify, and analyze the likely effects, if any, including the cumulative conservation, economic, and social impacts, of the conservation and management measures on, and possible mitigation measures for (a) participants in the fisheries and fishing communities affected by the plan amendment; (b) participants in the fisheries conducted in adjacent areas under the authority of another Council; and (c) the safety of human life at sea, including whether and to what extent such measures may affect the safety of participants in the fishery.

The EA/RIR prepared for this potential plan amendment constitutes the fishery impact statement. The likely effects of the proposed action are analyzed and described throughout the EA/RIR. The effects on participants in the fisheries and fishing communities are analyzed in Chapter 4). The effects of the proposed action on safety of human life at sea are evaluated in Section 6, and will be evaluated above under National Standard 10, in Section 7.1. Based on the information reported in this section, a determination will be made on whether to update the Fishery Impact Statement included in the FMP as the Council selects a (preliminary) preferred alternative.

The proposed action affects the groundfish fisheries in the EEZ off Alaska, which are under the jurisdiction of the North Pacific Fishery Management Council. Impacts on participants in fisheries conducted in adjacent areas under the jurisdiction of other Councils are not anticipated as a result of this action.

7.3 Council's Ecosystem Vision Statement

In February 2014, the following was adopted as Council policy:

Ecosystem Approach for the North Pacific Fishery Management Council

> ***Value Statement***
>
> The Gulf of Alaska, Bering Sea, and Aleutian Islands are some of the most biologically productive and unique marine ecosystems in the world, supporting globally significant populations of marine mammals, seabirds, fish, and shellfish. This region produces over half the nation's seafood and supports robust fishing communities, recreational fisheries, and a subsistence way of life. The Arctic ecosystem is a dynamic environment that is experiencing an unprecedented rate of loss of sea ice and other effects of climate change, resulting in elevated levels of risk and uncertainty. The North Pacific Fishery Management Council has an important stewardship responsibility for these resources, their productivity, and their sustainability for future generations.
>
> ***Vision Statement***
>
> The Council envisions sustainable fisheries that provide benefits for harvesters, processors, recreational and subsistence users, and fishing communities, which (1) are maintained by healthy, productive, biodiverse, resilient marine ecosystems that support a range of services; (2) support robust populations of marine species at all trophic levels, including marine mammals and seabirds; and (3) are managed using a precautionary, transparent, and inclusive process that allows for analyses of tradeoffs, accounts for changing conditions, and mitigates threats.
>
> ***Implementation Strategy***
>
> The Council intends that fishery management explicitly take into account environmental variability and uncertainty, changes and trends in climate and oceanographic conditions, fluctuations in productivity for managed species and associated ecosystem components, such as habitats and non-managed species, and relationships between marine species. Implementation will be responsive to changes in the ecosystem and our understanding of

> those dynamics, incorporate the best available science (including local and traditional knowledge), and engage scientists, managers, and the public.
>
> The vision statement shall be given effect through all of the Council's work, including long-term planning initiatives, fishery management actions, and science planning to support ecosystem-based fishery management.

Upon selection of a preferred alternative, this section will include the Council's rationale for how any action recommended to the Secretary of Commerce is consistent with this ecosystem approach to policy, and highlight evidence presented for that rationale to the extent that it is available.

8 Discussion: Trawl Gear Performance Standard

The Council's December 2022 motion that initiated this analysis included two requests for information that were distinct from the analysis of alternatives and options around which most of this EA/RIR is structured. The request for information relating to the trawl gear performance standard that is in regulation at 679.7(a)(14) is not something that is being analyzed relative to action/no action, but it is placed here to make a logical flow of information being presented to the reader. The Council's specific request was as follows:

> *The analysis should provide an expanded discussion of the performance standard applicable to vessels in the directed pollock fishery and the regulatory definition of pelagic trawl gear. The expanded discussion should include background on the rationale for and information used to establish the performance standard and gear definition to help evaluate whether the performance standard and gear definition are meeting Council objectives.*

In June 2023, the Council suggested that the pelagic trawl gear definition should be a separate analysis; it is therefore presented in discussion paper form at the February 2024 meeting (agenda item D1). The Council moved to continue to include the trawl performance standard in this initial analysis. This paper describes the background of the trawl performance standard in the BSAI and provides a brief analysis to determine whether Council objectives are being met.

8.1 Brief History of the Pelagic Trawl Performance Standard for the BSAI

8.1.1 Performance Standard

58 FR 39680 (July 26, 1993, effective Aug 19, 1993) originally introduced the performance standard for pelagic trawl gear into regulation. The performance standard for pelagic trawls prohibits a vessel in a directed pollock fishery using trawl gear from having onboard the vessel, at any particular time, 20 or more crab of any species that have a carapace width of more than 1.5 inches (38 mm) at the widest dimension (§679.7(a)(14)). Note that there are parallel prohibitions in the BSAI and GOA (§679.7(a)(14)(i) and (ii), respectively). The 20-crab threshold was established by reviewing observer data for halibut and crab bycatch in the 1991 trawl fisheries. At the time, there was a Vessel Incentive Program in place where a halibut bycatch rate greater than 0.1 percent was a violation for vessels participating in midwater trawl fisheries. Upon examination of bycatch, it was shown that when halibut bycatch rates doubled from 0.12 percent to 0.24 percent, the number of crab increased to 20 animals or more per groundfish haul. As a result of this review, it was determined that catch of 20 or more crab likely is the result of operating a trawl on the sea bed, whereas fewer than 20 crab might be expected when a pelagic trawl is deployed correctly.[49]

In March 2000, the Council was presented with the EA/RIR for Amendment 57. The preferred alternative stated: "In order to prevent fishermen from using pelagic gear to trawl on the bottom, a performance standard would also be employed, under which it would be unlawful for an owner or operator to have 20 or more crabs on board a vessel at one time." On June 15 of 2000, the Final Rule for Amendment 57 became effective, closing non-CDQ pollock in the BSAI to nonpelagic trawl, and establishing the trawl performance standard in the BSAI for all pelagic trawl pollock directed fishing.

[49] 58 FR 17198, April 1, 1993: "After reviewing the NMFS bycatch data, the Council agreed that a catch of fewer than 20 crabs might be expected when a pelagic trawl is deployed correctly, but that a catch of 20 or more crabs likely was the result of operating a trawl on the sea bed. Therefore, the Council recommended defining as a violation the possession of 20 or more crabs when caught by trawl gear when directed fishing with non-pelagic trawl gear is prohibited."

8.1.2 Trawl Performance Standard Workshop

At its June 2023 meeting, The Council requested additional evaluation of the trawl performance standard by OLE's Enforcement Committee. The Council "*Request[s] NMFS and the Enforcement Committee, in consultation with industry, identify ways to revise the pelagic gear performance standard to be enforceable.*" In order to seek consultation and feedback for potential options to improve enforceability of the standard, and potentially provide insight for inclusion into this analysis, Committee co-chairs opted to host a listening session in the form of a workshop on October 2, 2023. This outreach was structured as a workshop in order to accommodate public comment and open dialogue with fishery participants and representatives, which would not have been possible in the format of an Enforcement Committee meeting (which does not, under its current Terms of Reference, allow for public comment). The workshop was well attended (~70 in-person and virtual participants), and OLE received extensive feedback regarding revising the pelagic trawl performance standard, which was summarized for and presented to the Council in October. Council also clarified at the October 2023 meeting that this motion refers exclusively to the BSAI as it pertains to evaluating the trawl performance standard for this analysis.

8.1.3 Current Status of the Performance Standard

The performance standard requires both the count and measurement of crab species to prove a violation, with both tasks accomplished primarily at haulback by either enforcement personnel at the scene, or by observers who later report the violation. Because of the mandate to discard crab as Prohibited Species Catch (PSC), landing data has not historically yielded a violation, however Trawl Electronic Monitoring (TEM), currently fielded under an exempted fishing permit (EFP) across much of the AFA fleet, may prove a viable enforcement option if adopted as a regulatory program. Though a maximized retention model that monitors exclusively for discards, observers assigned to TEM associated processing facilities would be positioned to count and measure landed crab.

Staffing and resource constraints limit the number of haulbacks enforcement personnel can possibly monitor, leaving the observer program as the primary mechanism for detecting and reporting violations of the standard; based on a review of enforcement cases, OLE determined the only way it has historically learned about trawl performance standard violations has been from observers. Observers face numerous issues in obtaining the data necessary for a viable enforcement case, the most serious related to their safety, and their performance requires both sustained training and supportive written procedures prioritizing the task. Given the current regulatory language, OLE can only act on observer data collections where crab are in hand with accompanying measurements. In other words, extrapolated observer samples cannot be used for enforcement action.

For this analysis, the Observer Program provided input and review. There are a number of confounding factors that have resulted in very few actionable cases presented to OLE. Observer priorities emphasize random sampling; and collection of crab from outside composition samples is not the norm. Observer species composition data is limited to animals collected from the codend, however a review of observer statements of potential violations indicate that crabs are more often seen in other portions of the net. While the Observer Sampling Manual asks observers to collect additional information on crab when more than 20 are visible in a pollock haul, this is done in conjunction with an array of other sampling duties and is not the sole focus of an observer when a haul is retrieved. Observer data recording protocols are not designed to easily record crab sizes for animals collected non-randomly and outside samples. When OLE has received reports that the performance standard appeared have been exceeded, observers were often not able to reliably count or measure crab caught in the forward portions of the nets because of dangers on deck, limited view of the net during haulback, and challenges working with partial crab. Observers have reported safety concerns about collecting (or requesting crew collect) crab from the footrope, intermediate mesh, or otherwise outside the codend. When it was possible, accounting for these crab took a significant amount of effort, time, risk, and intrusion on deck. The wording in the TPS is difficult to interpret for observers because not all catch is visible "at any particular time." Vessels are required to discard prohibited species catch immediately with a minimum of injury, regardless of condition. This complicates determining the 20 or more crab "at any particular time" element of the violation type. Further, it complicates an observer's ability to count crab outside their samples, as they would need to request reasonable assistance to gain access to these crab prior to discard, as well as keep track of the number of crabs discarded from outside their samples. A few crab observed while dumping the catch does not indicate what an observer may find in the rest of the catch while sampling. When such crabs can be saved and made available to the observer, the observer may also report these crab as a presorted sample; however, this does not happen often due to the dangers of being on deck, and presorted samples are generally used for large organisms that cannot be weighed on observer scales. Finally, any crab data collections outside of observer species composition samples or presorted samples are not reported in observer data, except for statements (there is nowhere for observers to enter these data, nor are they transmitted to Fisheries Monitoring and Analysis division at sea).

In June, 2023, Council requested an expansion of observer statement analysis: "*To better understand and evaluate this issue, the discussion should also include a full time series of pelagic gear crab PSC after the large mesh introduction in 1993 and an accurate description of catch accounting issues for observers, including the number of annual violations in the same time period (1993 – 2023).*" In gathering data for this, analysts note that the observer statement database started in 1999, so statement data prior to 1999 are not available.

Since 1999, OLE received 38 observer statements recording 66 potential trawl performance standard violations in the BSAI, and none of the cases resulted in a monetary penalty. These reports were largely received during the timeframe when observers received specific training on collecting and measuring crab from outside species composition samples during the BS pollock trawl fisheries. Enforcement "action" was limited to 4 Compliance Assistance and 3 Written Warnings as a result of these reports due to challenges with evidence, observer limited access to crabs, crab size not recorded, and/or the requirement for "at any particular time, 20 or more."

- For 30/38 (79%) statements, crab came from forward of the codend (footrope, fishing line, large mesh, intermediate).
- 8 statements came from crab within the codend, and 6 (16%) from within the observers' species compositions samples.
- Other methods for enumerating crab listed in the statements included "estimates" and tallies of crab (neither of which allow for measurements of all crab).

Year	# Hauls w >/= 20 crab	# Statements/ Year	# Potential Violations/Year	Percent hauls reported to OLE	Compliance Assisatnce	Written Warning
1991	2675	NA	NA			
1992	1783	NA	NA			
1993	332	NA	NA			
1994	189	NA	NA			
1995	67	NA	NA			
1996	59	NA	NA			
1997	95	NA	NA			
1998	52	NA	NA			
1999	2	1	1	50.00%		
2000	7	1	3	42.86%		
2001	4	2	5	125.00%		
2002	16	1	1	6.25%		
2003	6	1	1	16.67%		
2004	33	1	2	6.06%		
2005	8	1	1	12.50%		
2006	14	0	0	0.00%		
2007	6	0	0	0.00%		
2008	25	0	0	0.00%		
2009	27	3	12	44.44%	1	
2010	41	5	10	24.39%		
2011	53	5	7	13.21%		
2012	37	7	7	18.92%		3
2013	42	1	1	2.38%		
2014	43	3	7	16.28%		
2015	46	3	5	10.87%	1	
2016	10	0	0	0.00%		
2017	2	0	0	0.00%		
2018	3	0	0	0.00%		
2019	1	0	0	0.00%		
2020	21	3	3	14.29%	2	
2021	5	0	0	0.00%		
2022	0					
2023	1	0	0	0.00%		
Sums	5705	38	66	14.57%	4	3

Figure 8-1 Time series between 1991 and 2023 for BSAI AFA pollock hauls where extrapolated observer species composition data indicates that 20 or more crab were caught. (note: all 2023 data are preliminary)

The extrapolated data show that the vessel *likely* caught over 20 crab, which if on board at "any particular time" would indicate a potential violation of the trawl performance standard. It should be noted that between 1993 and mid-2000, hauls with >20 crab may not have constituted a violation (this was triggered by nonpelagic trawl closures). Between 1999 and 2023, there were 453 hauls in the BSAI where extrapolated crab data indicated an observer could have witnessed a potential violation and filled out a statement for OLE (for reference, there were 329,941 total BSAI directed pelagic pollock hauls in the same timeframe). From 453 hauls, 66 occurrences (hauls with 20 or more crab) were reported via 38 observer statements, showing that of the *anticipated number of potential violation statements* expected by the data, OLE received statements for less than 15% of them (14.57%). Because extrapolated data come from observer species composition samples in the codends, and nearly 80% of observer statements report crab forward of the codend, the anticipated number of potential violations is certainly an underrepresentation of crab catch by the pelagic trawl fisheries in the BSAI. The seven actions by OLE resulting from investigations show that only 1.5% of potential violations expected by extrapolated data resulted in any action. This demonstrates that the current performance standard does not yield effective enforcement results, by accurately accounting for crab catch or discouraging or preventing bottom contact. Analysts also looked at the Pollock CV Trawl Electronic Monitoring Program landings data in the BSAI AFA pollock fisheries to see if more than 20 crab were offloaded at any time between 2020 and 2023; zero landings reported 20 or more crab landed. Future study of unobserved mortality will shed more light on actual crab mortality by the pelagic trawl pollock fishery.

8.2 Evaluation of Council Objectives

In implementing the pelagic trawl performance standard, the Council's original objective was "to reduce halibut and trawl bycatches by discouraging or preventing trawl operations on the sea bed" (58 FR 17196, April 1, 1993). To determine whether the performance standard is meeting Council objectives, a similar analysis to the 1991 analysis (Section 8.1.1) was conducted from 1991-2022 to measure whether the performance metric has contributed to reduced bycatch of halibut. Additionally, in June 2023, the Council requested in the new initial review, "To better understand and evaluate this issue, the discussion should also include a full time series of pelagic gear crab PSC after the large mesh introduction in 1993." For this analysis, the time series additionally shows the years 1991 and 1992, which include the earliest species-level observer data available from AKFIN. The numbers used in this section come from observer species composition samples taken from the sample population, which is the portion of the target population (i.e., all fish in the codend) that is physically available to the observer to be collected. For comparison across time periods, the number of crabs per haul are reported as a percentage of total hauls. For consistency with the 1991 analysis, only Tanner crabs are reported for this portion of the analysis, as nearly all of the total crab were Tanner.

8.2.1 Halibut Bycatch

The 2018-2022 mean proportion of halibut to groundfish (bycatch rates) were substantially lower overall, with no amount of halibut catches per haul resulting in a violation of the 0.1 percent bycatch rate used as a justification of the original performance standard (Figure 8-2). The bycatch rates of halibut further showed no clear correlation with the number of crab caught per haul.

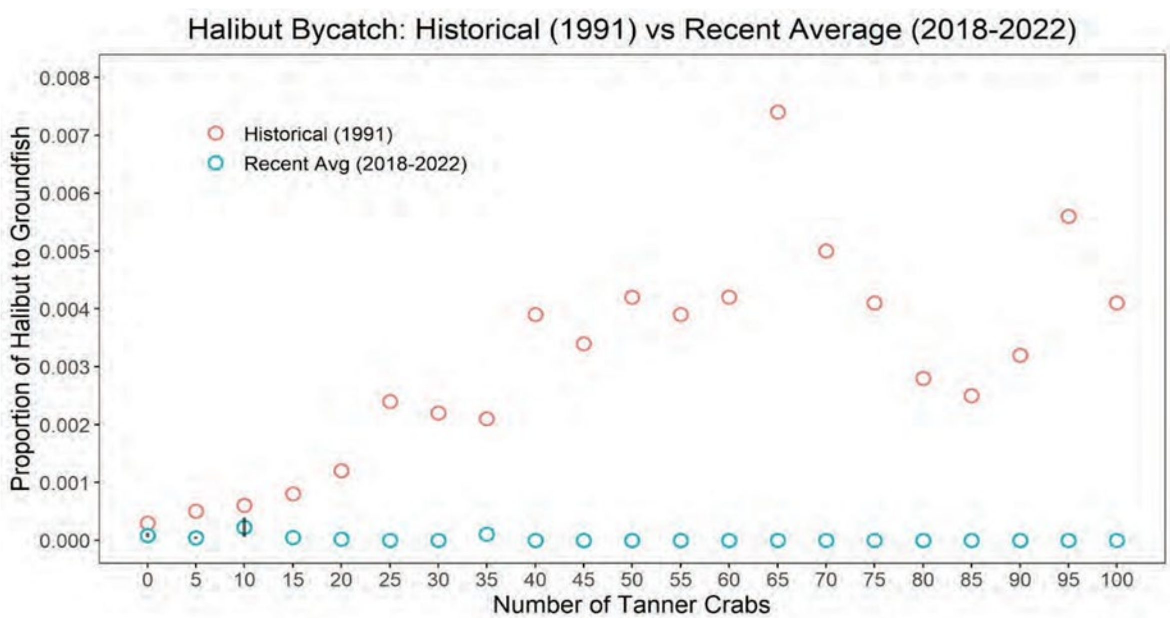


Figure 8-2 Halibut bycatch (as proportion of halibut to groundfish) for ranges of Tanner crab caught with pelagic trawl gear in the Bering Sea and Aleutian Islands Areas between historical (1991) and means of the recent (2018-2022) history.

8.2.2 Crab Bycatch

Figure 8-3 shows that pelagic trawl crab PSC has, in general, remained low through time, with the majority of hauls catching zero crabs. Since 1991, some general trends can be made. Between about 2000 and 2012, there is a noticeable decline in trips catching zero crabs, which appears to be driven by an increase in trips catching 5 or 10 crabs per trip. There is also a marked decline in trips catching over 100 crabs per trip.

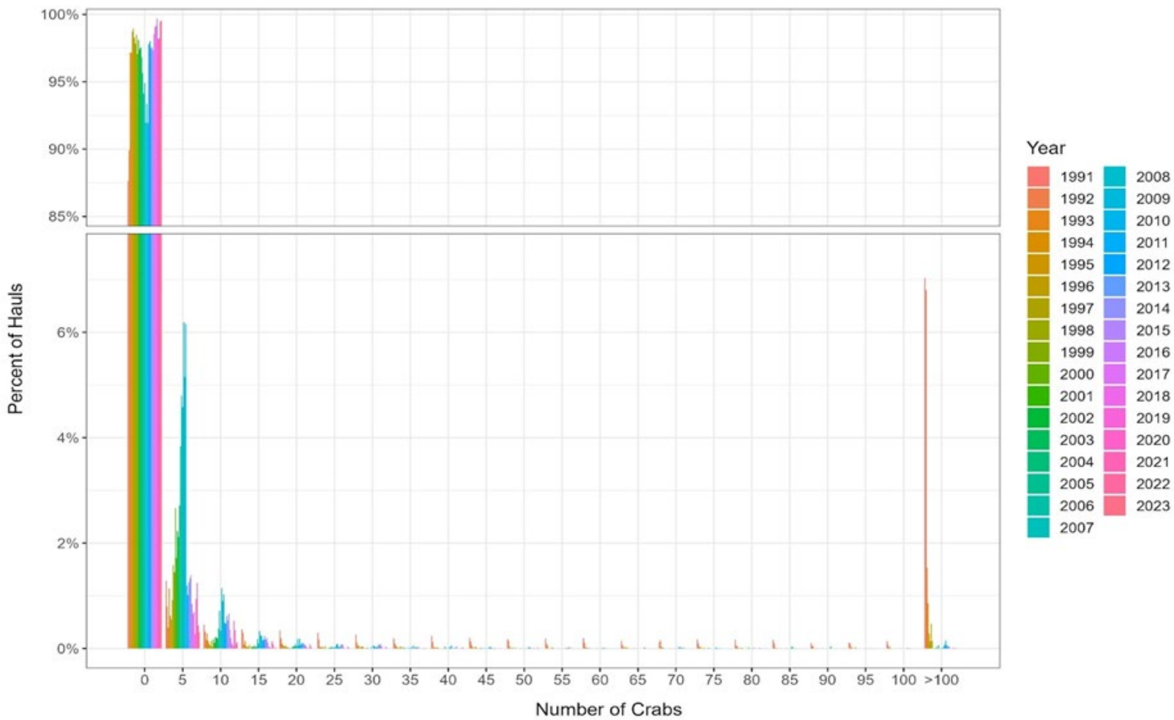


Figure 8-3 Percentage of hauls with ranges of crab caught with pelagic trawl gear in the Bering Sea and Aleutian Islands Areas between 1991 and 2023. Note: there is a y-axis scale break between roughly 6 and 90% to better visualize the lower values.

Note that this decline in crab bycatch is primarily based on observer species composition samples, which are samples taken from catch dumped out of the codend into the factory (for catcher processors) or on deck (for catcher vessels). However, of 38 observer statements written for potential trawl performance standard violations from 1999 through 2023, 79% of incidents were associated with crabs found in the nets forward of the codend and outside the observer sample population.

When summarized as hauls catching greater than 20 crabs (Figure 8-4, below), which would be in violation of the current 20-crab performance standard (acknowledging that prior to 2001, catches over 20 crab may not have been in violation if the nonpelagic trawl fishery was open), there does appear to be a decline in the percentage of hauls catching over 20 crab since 1993, which follows the same trend as the reduction in catches of over 100 crabs over time as mentioned above.

Analysts note that the current performance standard is not reactive to changes in crab abundance. With further declines in abundance, the likelihood of capture by pelagic trawl, already very low likely due to large mesh size, should further decrease with decreasing stock abundance.[50]

[50] EA/RIR Amendment 21, November 26, 1990: "The purpose of the large mesh sizes in back of the fishing line is to provide escape panels for halibut and crab in case the pelagic trawl contacts or comes near the seabed, resulting in a bycatch of halibut and crab."

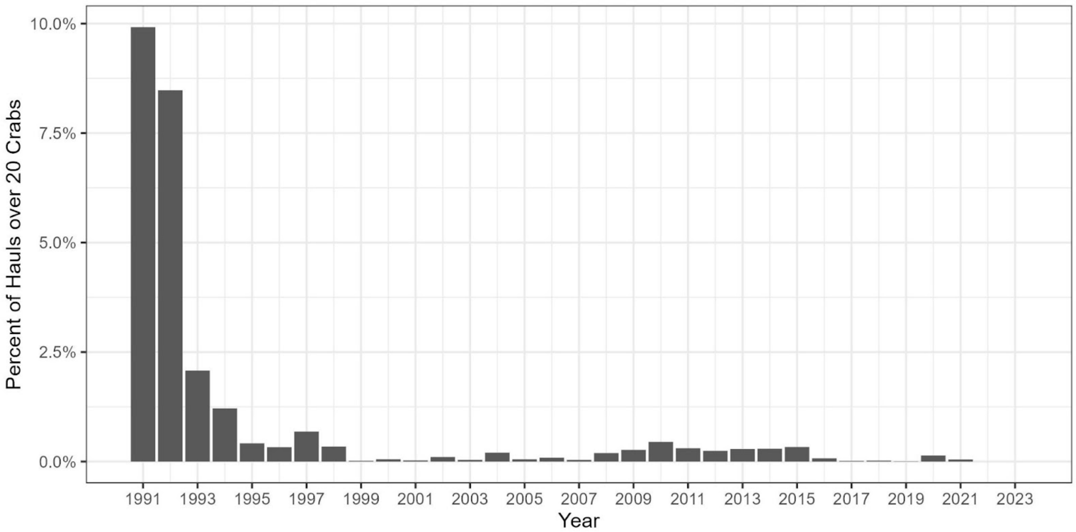


Figure 8-4 Percentage of hauls in observer species composition data catching over 20 crabs with pelagic trawl gear in the Bering Sea and Aleutian Islands Areas between 1993 and 2023.

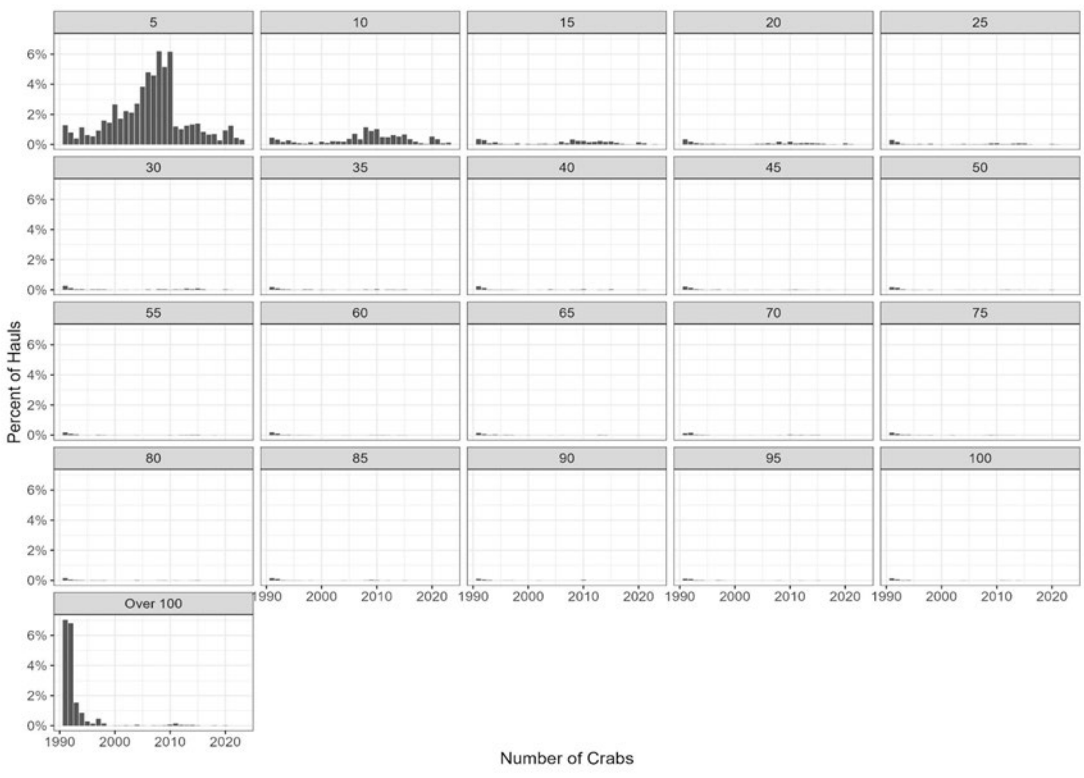


Figure 8-5 Breakdown of the percentage of hauls catching over 0 crabs with pelagic trawl gear in the Bering Sea and Aleutian Islands Areas between 1993 and 2023.

Without more detailed information, such as a historical census of trawl gear mesh sizes in use each year, it is difficult to determine how gear modifications over time have influenced catch rates of crab in pelagic trawl gear. However, some information can be gathered from the analyses conducted for each rule change that modified pelagic trawl gear (1991 through 2001). In the 1990 EARIR leading up to the 1993 regulations, it was estimated that 150 of the 205 overall vessels might have needed to make net modifications to meet the new rule, which required a panel of 1 meter meshes around the net for a distance of 10 meters from the fishing line. In the 1993 EARIR, it was noted that no increases in costs to fishermen would occur by implementing the revised definition of a pelagic trawl compared to the status quo alternative, because the configuration of pelagic trawls already used in the fishery were consistent with the definition.

Since then, industry has reported that increases to mesh sizes have occurred (to increase towing efficiency and decrease drag, allowing lower horsepower vessels to tow increasingly larger nets), but analysts do not have information regarding what exact changes were incorporated, to what extent across the pelagic trawl pollock directed fishing fleets, nor a time series of changes. It is therefore difficult to attempt to correlate crab bycatch with gear modifications.

8.3 Conclusions

Based on this analysis of observer data between 1991 and 2023, the reduced bycatch component of the Council's original objective to "reduce halibut and trawl bycatches by discouraging or preventing trawl operations on the sea bed when halibut and crab PSC allowances have been reached" appear to have been met. It is unlikely however that this reduced bycatch is due to the "discouraging or preventing trawl operations on the sea bed" component of this objective.

While the reduction in halibut and crab bycatch should undoubtedly be seen as a success in terms of bycatch management, the portion of this reduction that can be attributed to gear design is likely due in part to the increased mesh size and spacing used at the forward portion of the trawl, which (in addition to increasing towing efficiency and reducing drag) likely allows halibut and crab to escape before being captured in the codend, rather than a reduction in actual seafloor contact.[51] In 1991, the pelagic trawl regulations required the first section of the net to consist of 64-inch stretched mesh for a length of 10 meshes aft of the fishing line, head rope, and breast lines, resulting in an estimated minimum length of this section to be around 53 feet. Current regulations require this section to be at least half of a vessel's length overall (LOA), which based on current (2023) AFA vessels, equal approximately 146-ft for CPs (average LOA = 291 ft) and 61 ft for CVs (average LOA = 122 ft). Industry reports, confirmed via gear inspections by OLE, indicate that vessels commonly use mesh sizes greatly exceeding 64 inches, for sections up to three times the LOA, as these vessels have benefited from reduced drag and lower bycatch while sustaining desired catches. With such changes in the large mesh section of pelagic trawl gear, the performance standard as based on 1991 data may no longer be an appropriate standard for today's fishery.

Pelagic trawls are known to make substantial seafloor contact, which has implications for separate Council objectives, such as the intent of the red king crab savings area (RKCSA) to protect red king crabs and their habitat from the impact of bottom trawls (NMFS 1996). First established by emergency rule (60 FR 4866, January 25, 1995), the RKCSA prohibited nonpelagic trawl gear due to the desire to reduce king crab bycatch. It is important to note that starting in the following year (1996), pelagic trawl gear was also prohibited through inseason action (60 FR 63451, December 11, 1995) until full observer coverage was required by Amendment 37, effective January 1, 1997.

The Fishing Effects model (or parts of the FE model workflow) used in recent Council analyses for BBRKC (NPFMC 2022a, NPFMC 2022c) and EFH (NMFS 2017; NMFS 2023b) uses a contact adjustment of 20 to 60% seafloor contact for Bering Sea pelagic trawl CVs, 70 to 90% for BS pelagic trawl CPs in the A season, and 80 to 100% for BS pelagic trawl CPs in the B season (NMFS 2023b). As noted in Section 5.5 of this document, the seafloor contact area estimated by the FE model shows widespread coverage within the RKCSA. Additionally, a NMFS analysis showed that between 2013 and

[51] Proposed Rule FR 58061, April 1, 1993: "Fishing industry representatives emphasized that pelagic trawls were constructed to reduce drag during fishing operations by using large mesh openings or parallel lines behind the trawl opening. Mesh openings of at least one meter (3.3 feet) or parallel lines that are at least one meter apart accomplish the objective of reducing drag, but also result in reduced bycatch of halibut and crab."

2022, BS pelagic trawls captured derelict pots at an annual average rate of 9 to 21% in the CP sector, and 0 to 21% in the CV sector, with widespread spatial coverage (40 to 71%) of pot captures within the RKCSA in recent years (NPFMC 2022c). It is noted in Section 5.5.4 of this analysis that studies are forthcoming to improve seabed contact quantification in the pelagic trawl directed pollock fisheries, and the Council established a working group to examine and better measure unobserved crab mortality (UFMWG).

In the GOA, there is a gear restriction mandating 10% maximum seafloor contact for any pelagic trawl tow when nonpelagic trawling is closed (50 CFR 679.24(b)(3)). The difficulties with this are numerous. For example, is this threshold for 10% of each tow by bottom time exhibiting ANY seafloor contact, or 10% of the swept area (footrope contact)? Both would continue to present difficulties, as vessels are required to report when the net enters the water, instead of reaching fishing depth. Even given a future ability to measure this, more clarity would be required. Without improved capabilities to detect and quantify seabed contact through the development and application of existing or emerging technologies, it is currently impracticable to establish that threshold gear restrictions (such as that referenced) have been exceeded.

Based on the information in this analysis, the pelagic trawl performance standard is not an effective tool to limit seafloor contact for pelagic trawl gear.

8.4 Council Direction

If the Council is only concerned with achieving those objective of the pelagic trawl definition and performance standard to reduce the bycatch of halibut and crab, the current definition and performance standard appear to be meeting this objective. If, however, the Council is interested in achieving the operative objective of the performance standard, “by discouraging or preventing trawl operations on the sea bed,” based on the information in this analysis, the current pelagic trawl performance standard is not an effective tool to limit seafloor contact and an enforceable trawl performance standard is needed. Noting the substantial bottom contact by the gear type currently reported/defined as pelagic indicated by the FE model, the Council may wish to define and clarify new objectives specific to seafloor contact. For example, in the purpose and need statement adopted by the Council in December 2022, the main objective appears to be focused only on reducing BBRKC crab mortality:

> *Given the poor recruitment and low stock status of BBRKC, the Council intends to consider management measures focused on reducing BBRKC mortality from groundfish fishing in areas that may be important to BBRKC and where BBRKC may be found year-round, which may help increase stock abundance and promote achievement of optimum yield from the directed BBRKC fishery while minimizing negative impacts to affected groundfish fleet operations as well as target and PSC species.*

If the Council wishes to clarify new objectives to deter seafloor contact (as in the original objectives) in order to protect habitat beneficial to recruitment, and reduce unobserved mortality of BBRKC, a clarification to the purpose and needs statement would be beneficial to future analyses. These objectives may then be analyzed for potential modifications to the performance standard, gear definitions, electronic monitoring, spatial management, or other management measures.

OLE recommends the following be considered by the Council when contemplating future actions regarding the performance standard:

- Enforcement of any performance standard for pelagic trawl is fully reliant on the definition of the gear type. A gear definition that is enforceable is preferred to enable real-time enforcement at. Due to significant delays in referral of incidents for investigation, violations detected by observers and electronic monitoring could be considered a backstop to real-time enforcement.

    - Council could consider listing pelagic trawl under the definitions of "bottom contact gear" and "mobile bottom contact gear." This could provide direction and clarity on whether current and future areas closed to bottom contact and mobile bottom contact gear are focused on protecting critical habitat and sensitive benthic fauna, until the best available science can elucidate that the quantity and impact of bottom contact by pelagic trawl gear is not measurably deleterious.
- Consider whether to create a new standard for BBRKC, modify the existing standard for BSAI, or modify for both the BSAI and the GOA.
    - Any standard created specifically for the BBRKC Savings Area will likely have implications for vessels that fish on its periphery or both inside and outside the area during the same trip. It may be more effective to modify the existing standard for the BSAI, or for both the BSAI and GOA. Simple and uniform regulations promote understanding and voluntary compliance and avoid inadvertent noncompliance.
- Any changes the Council suggests for the trawl performance standard must take into account the Trawl Electronic Monitoring program. A significant portion of the BSAI AFA pollock catcher vessel fleet currently operate under the exempted fishing permit (EFP) and will likely move into the regulated program in 2025. Participants are exempted from PSC careful release requirements, and are in fact required to retain PSC under the maximized retention model. When published, the Final Rule may provide more insight into whether vessels may be exempted from the current trawl performance standard, which would further impact its effectiveness at meeting original Council objectives.
- To effectively limit contact with the seafloor by pelagic trawl gear, Council could consider a revised gear performance standard that includes modern technology integration to quantify bottom contact. Examples include cameras that allow real-time transmission/viewing in the wheelhouse and bottom contact sensors. Such technology could be utilized for electronic monitoring (EM) under regulatory programs, provided that these data could be made available to OLE. This is an emerging field in EM and may provide a potential path forward with proper testing and development similar to how we have implemented EM. Use of new or existing technologies to monitor gear contact with the seafloor would be a new use for this technology and would need to be further tested and analyzed to evaluate effectiveness.
    - If the Council were to recommend a threshold performance standard (e.g., bottom contact), further consideration by NMFS would be required to determine where the innovation of novel technology and its application, and the evidentiary burden, lie—i.e. how data are collected and provided to the agency. It might be necessary for primary data to be collected by fishery participants.
- Observer data related:
    - Retain existing standard and mandate retention for sampling by observers. If Council determines that crab remain a viable metric for elucidating bottom contact, consideration could be given to mandating retention (similar to salmon in American Fisheries Act pollock) until an observer can complete data collection. This would remain nonreactive to changes in abundance, would be intrusive to current fishery practices, and counter to releasing crab immediately and with a minimum of injury. This would require observer statements, changes to observer sampling, and potentially changes to observer data reporting. Depending on the latter, this might not require statement, but under current sampling protocols it would. Does not address "at any particular time" or careful release.
    - A proposed standard that continues to rely primarily on observer data for a performance standard may consider evaluating alternative data points that may better indicate bottom contact. For example, observers already collect data on pot

capture; these would not rely on observer statements to indicate a “violation.” Other benthic species found within observers’ species composition samples could likewise be utilized, given acknowledgement that those data are typically extrapolated, but would not rely on observer statements. Presence of crab and other benthic species forward of the codend (i.e., footrope, fishing line, large mesh, intermediate) could be utilized (e.g., crab, corals, sponges, sea pens and whips). These would continue to require a statement as they fall outside of observer reported data collections.

9 Preparers and Persons Consulted

Preparers

Sam Cunningham	NPFMC
Sarah Rheinsmith	NPFMC
Mason Smith	NMFS AKRO SF
Alex Perry	NOAA OLE
Michael Fey	AKFIN/PSMFC

Contributors

Kelly Cates	NMFS AKRO SF
Mary Furuness	NMFS AKRO SF
Josh Keaton	NMFS AKRO SF
Krista Milani	NMFS AKRO SF
Joshua Moffi	NMFS AKRO SF
Andrew Olson	NMFS AKRO SF
Steve Whitney	NMFS AKRO SF
Henry Tashjian	NOAA General Counsel
David Bryan	AFSC
Erin Fedewa	AFSC
Brian Garber-Yonts	AFSC
Shannon Hennessey	AFSC
Mike Litzow	AFSC
Jon Reum	AFSC
Emily Ryznar	AFSC
Ellen Yasumiishi	AFSC
Leah Zacher	AFSC
Asia Beder	ADF&G
Ben Daly	ADF&G
Ethan Nichols	ADF&G
Katie Palof	ADF&G
Sara Cleaver	NPFMC
Kate Haapala	NPFMC
Bradley Harris	Alaska Pacific University, FAST Lab
Felipe Restrepo	Alaska Pacific University, FAST Lab
Scott Smeltz	Alaska Pacific University, FAST Lab
Susie Zagorski	United Catcher Boats

Persons and Agencies Consulted

Ben Cheeseman	NOAA OLE
Nathan Lagerwey	NOAA OLE
Phillip Null	NOAA OLE
Jodi Pirtle	NMFS HCD
Jason Gasper	NMFS AKRO SF
Lisa Pfeiffer	NWFSC
Bryce McManus	NWFSC
David Koster	ADF&G Division of Subsistence

Beth Concepcion	Alaska Seafood Cooperative
John Gauvin	Alaska Seafood Cooperative
Chris Woodley	Groundfish Forum
Annika Saltman	Fisherman's Finest
Jason Anderson	O'Hara Corporation
Austin Estabrooks	At-Sea Processors Association
Stephanie Madsen	At-Sea Processors Association
Scott Goodman	Bering Sea Fisheries Research Foundation
Tim Loher	Bering Sea Fisheries Research Foundation
Madi Heller-Shipley	Bering Sea Fisheries Research Foundation
Jamie Goen	Alaska Bering Sea Crabbers
Cory Lescher	Alaska Bering Sea Crabbers
Ruth Christiansen	United Catcher Boats
Brent Paine	United Catcher Boats
Joel Peterson	Bristol Wave
Jim Armstrong	Freezer Longline Coalition
Chad See	Freezer Longline Coalition
Steve Martell	Sea State Inc.
Merrill Rudd	Sea State Inc.
Steven Ricci	Bristol Bay Economic Development Corporation
Steve Minor	
Oystein Lone	
Todd Hoppe	
Lance Farr	
Chris Vavrick	
Joe Oliver	
Phil Powell	
George Hall	
Dan Carney	
Dan Martin	
Scott Peny	

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Appendix 1 June 2023 Council Motion and Scientific & Statistical Committee Report

Council Motion – June 2023

The Council revises the alternatives as follows and requests staff incorporate additional information below for a second initial review, per the Scientific and Statistical Committee recommendation. Deletions are shown in ~~strikethrough~~ and additions are in **bold**.

Alternative 1: No action (status quo)

Alternative 2: Implement an annual closure of the Red King Crab Savings Area and Red King Crab Savings Subarea to all commercial groundfish fishing gears. The existing closure for non-pelagic trawl gear is not changed **under Option 1. Option 2 modifies the trigger to close the Red King Crab Savings Subarea for non-pelagic trawl.**

The closure would be in effect:

Option 1: If ADF&G does not establish a total allowable catch (TAC) the previous year for the Bristol Bay red king crab fishery.

Option 2: If the total area-swept biomass for BBRKC is less than 50,000 mt.

Suboptions (apply to either Option):

Suboption 1: Exempt hook-and-line gear form the closure

Suboption 2: Exempt pot gear from the closure

Alternative 3: Implement a closure of NMFS Reporting Area 512 to fishing for Pacific cod with pot gear.

The closure would be in effect:

Option 1: If ADF&G does not establish a total allowable catch (TAC) the previous year for the Bristol Bay red king crab fishery.

Option 2: If the total area-swept biomass for BBRKC is less than 50,000 mt.

Revise the analysis as follows:

- Consult with stock assessment authors to better summarize the biological consequences (stock-level impacts) of different levels of PSC in the RKCSA/RKCSS and Area 512 at current levels of BBRKC abundance.
- Include information to evaluate the relative importance of the RKCSA/RKCSS and Area 512 with respect to the entire BBRKC stock.
- Discuss potential for continuation of the 2023 winter pot sampling project.
- Enhance the analysis and discussion of tradeoffs to bycatch and fishing operations for the groundfish fisheries that would be affected by the action alternatives.
    - Incorporate the Appendix 2 analysis on halibut, salmon, and crab PSC into the EA/RIR; expand the analysis of PSC impacts to include PSC data from the past 10 years; and analyze PSC impacts under Alternative 3 in addition to Alternative 2.
    - Include analysis of tradeoffs for halibut bycatch that includes the Amendment 80 sector's historic use of the RKCSS based on years prior to 2020 when the total BBRKC PSC limit was set at 99,000 and 32,000 crabs.

  - Consult with groundfish fishery participants to gain local knowledge on fleet response to the action alternatives.

- Incorporate SSC recommendations as practicable for additional steps to more accurately portray the likely range and certainty of costs and benefits of the proposed alternatives.
- Describe rationale for 50,000 mt area-swept trigger and the likelihood of the BBRKC stock being above that threshold in the next 10 – 15 years given the most likely projected ecosystem conditions.
- Discuss tradeoffs and merits of 50,000 mt area swept trigger compared to current trigger for closure of the RKCSS to fishing by non-pelagic trawl gear.
- Further explore actions that could be implemented through framework agreements for the pot CV sector and trawl sectors. The actions would have similar goals to the proposed alternatives to reduce BBRKC mortality in the RKCSA and Area 512, respectively, but would be more dynamic and responsive to seasonal spatial distribution of BBRKC and focus avoidance on more discrete areas of relatively higher female BBRKC abundance.
- Remove the pelagic trawl gear definition discussion from Section 4 (to be addressed separately).
- Include information from ongoing and potential projects to address gear-seafloor interactions for all gear types and BBRKC distribution.
- Request NMFS and the Enforcement Committee, in consultation with industry, identify ways to revise the pelagic gear performance standard to be enforceable. Continue to incorporate this discussion into Section 4. To better understand and evaluate this issue, the discussion should also include a full time series of pelagic gear crab PSC after the large mesh introduction in 1993 and an accurate description of catch accounting issues for observers, including the number of annual violations in the same time period (1993–2023).

SSC REPORT – June 2023

The SSC's final report for the June 2023 meeting is available here. The RKCSA area-closure agenda item is covered beginning on page 21.

The SSC expresses its appreciation to the analysts for their efforts to assemble relevant information to inform the Council on an action with complex effects, with some ancillary considerations. The SSC appreciates the new methods integrated into this analysis, including improved estimates of wholesale values. The analysis addressed the Council's proposed alternatives relating to closing the RKCSA to several fleets, as well as a new gear performance standard designed to help address bottom contact from pelagic trawls, and an alternative industry-offered incentive plan program. **While the document is a good start, the SSC finds that this initial review analysis is not sufficient to inform Council decision-making at final action.**

A major challenge in preparing this analysis is that data and information related to many key questions on the effects of the proposed alternatives are not available. As a result, the analysis focuses on uncertainty in the characterization of costs and benefits. Specifically, the extent of unobserved fishing mortality in the RKCSA is unknown, and hence it is not possible to assess whether reducing these effects in the RKCSA could lead to material improvements in the BBRKC stock; this would be necessary to conclude whether the proposed action is likely to be a successful conservation measure. Similarly, there are key uncertainties in how displaced fleets would reallocate their effort outside the RKCSA, how total target harvest and associated crab and non-crab PSC (which may increase) would change, and how the time of fishing and total operating costs would change. **The SSC finds the current analysis treats these different uncertainties too similarly, deemphasizing available evidence that relocating effort will**

impose considerable financial costs that need to be weighed against an uncertain conservation benefit (or cost), and leaving the impression that costs are as likely to be either negligible or significant as benefits.

The SSC recommends the following additional steps to more accurately portray the likely range of costs and benefits of the proposed alternatives.

- **Develop a richer and better integrated model of effort displacement across the fleets.** Location choice responses to closed areas and PSC encounters in the pelagic trawl and Amendment 80 fleets have been extensively studied in the Bering Sea (e.g., Haynie et al. 2009[52]; Haynie and Layton 2010[53]; Chen et al. 2023[54]), using discrete choice models summarized in the FishSET tool at AFSC. These approaches can be adopted or, if estimation of these models is impracticable, published model coefficients can be used to predict effort reallocation based on revealed behavior. These models can be supplemented by local knowledge from the affected fleets.

- **Using the predicted spatial effort reallocation, estimate key outcome variables**. These include PSC catch of crab, Chinook, non-Chinook salmon, halibut and herring, impacts on crab EFH inside and outside the RKCSA, as well as the additional time fished, and the costs of additional time and fuel expended. For example, PSC harvest from predicted effort allocations can be calculated by updating the equations in Appendix 2 to:

$$\Delta PSC_{area} = \left(\frac{GF\cdot CPUE_{area}}{RKCSA\cdot GF\cdot Catch}\right)^{-1} \times PSC\cdot CPUE_{area} - RKCSA\cdot PSC$$

  where GF $CPUE_{area}$ is groundfish target catch (mt) per unit effort (e.g., trawl duration), RKCSA GF Catch is the groundfish target catch within the RKCSA, and PSC $CPUE_{area}$ is prohibited species catch (mt) per unit effort within an area that receives additional effort. RKCSA PSC is the current prohibited species catch within the RKCSA (mt).

- Improve the characterization of shore-based and inshore floating processors, as well as tendering activities.

- **Discuss the types of benefits that would potentially accrue to engaged and dependent communities**, including impacts on vulnerability, portfolio diversity, and the likely pattern of differential distribution of those benefits across communities, if there were to be a conservation benefit to the proposed action.

- The SSC extensively discussed ways to better characterize the likelihood that there would be a meaningful improvement in either stock levels or the likely reopening of the fishery as a result of the proposed action. The SSC notes that current PSC limits are on the order of 0.1% of total BBRKC abundance, and limits are rarely met. **The SSC suggests the analysts consult with stock**

[52] Haynie, A.C., Hicks, R.L. and Schnier, K.E., 2009. Common property, information, and cooperation: commercial fishing in the Bering Sea. Ecological Economics, 69(2), pp.406-413.
[53] Haynie, A.C. and Layton, D.F., 2010. An expected profit model for monetizing fishing location choices. Journal of Environmental Economics and Management, 59(2), pp.165-176.
[54] Chen, Y.A., Haynie, A.C. and Anderson, C.M., 2023. Full-Information Selection Bias Correction for Discrete Choice Models with Observation-Conditional Regressors. Journal of the Association of Environmental and Resource Economists, 10(1), pp.231-261.

assessment authors to better summarize the biological consequences of different levels of PSC at current levels of abundance, which may be reflected in already available analyses.

The SSC notes that continued improvement of ecological and socioeconomic data collections will help fill key information gaps in future analyses. Key information gaps in this analysis could have been significantly reduced with more robust ecological and socioeconomic data collections. For example, data on fuel cost and bait cost could illuminate the cost of displaced fishing effort, and information on crew residence could allow better association of the alternatives' effects on the harvest sector with individual communities.

The SSC suggests that, using existing data, conducting a retrospective evaluation of the RKCSA since its inception, as well as other past spatial management measures for crab conservation, would provide both performance metrics for the program and insight into how the RKCSA contributes to stock health.

In Section 4 of the document, the SSC notes that both the gear definition and the performance standard evaluations resulted in NMFS recommendations to the Council. The SSC appreciates the detailed review of the historical regulatory pelagic gear definition language and notes that additional examination of this language and its revisions over time would provide valuable perspectives that may expedite future efforts to incorporate technical gear terminology into regulation. It is notable that such language (e.g., applicability of flotation restrictions to specific sections of the gear) has impacts on both conservation and enforcement processes. Further, the SSC notes that there are additional lessons to be learned from the process leading to the current suite of AM80 gear regulations. For example, substantial gear research was conducted before the current gear regulations were adopted.

The SSC also finds the evidence used to justify NMFS recommendations for the application of modern technologies for evaluation of the pelagic trawl gear performance standard insufficient to inform the Council. Specifically, the analysis of gear-seabed contact detection technology is inaccurate and lacks an evaluation of the published literature, the expert knowledge of gear researchers and the local knowledge of the fishing industry. **The SSC recommends that the analysts apply the LKTKS on-ramps to integrate local knowledge provided by gear mensuration experts and the industry about the state of the art** in gear-seabed contact mensuration at the scales of the commercial fishery.

Appendix 2 PSC Impact Analyses (attached separately)

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Appendix 3 Species distribution model (SDM) maps, methodology, and results

The habitat maps presented in Section 5.5 exhibit the habitat area occupied by BBRKC during the summer based on the NMFS summer trawl survey, by life stage and encounter rates for legal male BBRKC in the fall. Both mapping approaches differ slightly in methodology. The specific approaches are detailed below in the following subsections to this appendix.

Appendix 3.1 Summer BBRKC SDM by Life Stage

NMFS uses species distribution models to map EFH for many species of Alaska crabs and groundfishes. In the 2023 EFH 5-year Review recently completed by the Council in December 2023, red king crab EFH was modeled as total crab across the fishery management unit of the BSAI King and Tanner Crab FMP in the eastern Bering Sea (Laman et al. 2022) and Aleutian Islands (Harris et al. 2022). During the Review, the reviewing stock assessment scientists, CPT, and SSC made recommendations for future work to consider mapping red king crab EFH by life history stage, as well as for separate stocks within the FMP area (Pirtle et al. 2023). This analysis conducted red king crab SDMs specific to the BBRKC stock boundary by sex and maturity stage to support Council decision making regarding spatial management considerations. It is important to note that the SDMs in this analysis represent habitat use and distributions but are not legal EFH descriptions.

Appendix 3.1.1 Methods

Model

The BBRKC SDMs were developed using a negative-binomial generalized additive model (GAM) following the methods of the 2023 EFH 5-year Review. A full description of these methods can be found in Laman et al. (2022). Briefly, environmental covariates were used to build GAMs fit to numerical abundance estimates of BBRKC, and subjected to covariate selection, k-fold cross-validation, and performance evaluation methods. The negative binomial GAM was chosen for this analysis over the SDM ensemble approach of the 2023 EFH Review, due to its higher performance over the other constituent models for red king crab.

Abundance Data

Abundance estimates of BBRKC were obtained from AFSC summer bottom-trawl surveys between 1982 and 2023. A complete description of the bottom-trawl survey can be found in Zacher et al. (2023). Briefly, crab collected in each tow are counted and weighed by species and sex, and maturity estimated morphologically in females, or by a carapace length cutoff of 120 mm in males. Specific to BBRKC, in years with colder than average bottom temperatures, a small number of standard Bristol Bay stations are resampled in late July and August, as the molt-mate cycle is delayed and not completed at the start of the survey in those years. For years when resampling is conducted, the abundance data used in the SDMs include only the female estimates at the resampled stations, consistent with the annual crab reports.

Environmental Covariates

Environmental covariates used in the GAMs were consistent with the red king crab models conducted in the 2023 EFH 5-year Review and included depth, bottom temperature, tidal maximum, bottom current, bottom current standard deviation, geographic position, sediment grain size, terrain slope, aspect, and curvature, bathymetric position index, and presence-absence of biogenic structures of sponge, coral, and sea whips. A complete description of these covariates and their development can be found in Laman et al. (2022). To create the BBRKC SDMs, the spatial environmental covariates were geographically masked to the BBRKC stock boundary (NPMFC 2021).

Maps

Habitat-related abundance predicted from the GAMs was used to map the area of occupied habitat for this analysis, similar to the methods for mapping EFH in the 2023 5-year Review (Laman et al 2022). The area of occupied habitat was mapped as population percentiles based on all areas where the BBRKC sex and maturity stage was predicted to be present, defined as having a model-estimated encounter probability greater than or equal to 5%. Four areas were identified containing 95%, 75%, 50%, and 25% of the occupied habitat. The definition of EFH area in Alaska is the area containing 95% of the occupied habitat (NMFS 2005). Each of the lower percentile areas describes a more focused partition of the total area. The area containing the upper 75% of occupied habitat is referred to as the principal habitat area. Similar to the EFH fishing effects analysis, the top 50% of occupied habitat is termed the core habitat area and is applied to the fishing effects analysis for the BBRKC stock area. The area of the top 25% of occupied habitat is referred to as habitat hot spots. Mapping habitat percentiles for subareas, similar to the EFH maps, helps demonstrate the heterogeneity of crab distributions by sex and maturity stage.

Appendix 3.1.2 Results

Model Performance

All models were considered at least “fair” by individual performance metrics. The best overall performance was consistent in the mature male and female models with “good” to “excellent” performance among all metrics. Root mean square error (RMSE) resulting from k-fold cross-validation showed better model performance (lower RMSE) in the individual sex and life history models (range 12.24-61.73) compared to the total crab model (118.79) (Table A3-1), suggesting greater ability of these models to accurately predict abundance by location. Area under the receiver-operator curve (AUC) values showed all models had “excellent” (AUC > 0.90) ability to discriminate presence and absence at location (Table 1). Regarding Poisson deviance explained (PDE), only the mature male and female models showed “good” performance (PDE 0.21-0.58), while the remaining models were considered “fair” (PDE 0.21-0.40). Finally, the total crab, mature male, and mature female models had “excellent” performance based on Spearman’ rank correlation coefficient ($p > 0.61$), suggesting a strong ability to accurately distinguish between high and low-density areas, followed by “good” performance in the immature female model and “fair” performance in the immature male model for this metric (Table A3-1).

Table A3-1 Performance metrics of each BBRKC SDM by sex and life history stage, as well as BBRKC total crab for comparison.

Model	RMSE	*p* (rho)	AUC	PDE
BBRKC: Mature Males	12.24	0.72	0.91	0.44
BBRKC: Immature Males	61.11	0.69	0.92	0.27
BBRKC: Mature Females	16.73	0.71	0.93	0.58
BBRKC: Immature Females	48.47	0.50	0.90	0.21
BBRKC: Total crab	118.79	0.80	0.93	0.38

Performance Metrics (Laman et al. 2022):
p (rho): < 0.20 (poor), 0.21–0.40 (fair), 0.41–0.60 (good), 0.61–0.99 (excellent)
AUC: < 0.70 (poor), 0.71–0.90 (good), 0.90–0.99 (excellent)
PDE: < 0.20 (poor), 0.21–0.40 (fair), 0.41–0.60 (good), 0.61–0.99 (excellent)

Model Comparisons

Total crab

Geographic position accounted for the greatest deviance explained in all models, likely due to the clustered nature (i.e., positive spatial autocorrelation) of the abundance distributions in each group. For total crab, geographic position explained roughly 69% of the deviance, and had a positive effect toward the center of Bristol Bay (Table A3-1; Figure A3-1). Following geographic position, slope explained roughly 6% of the deviance, which had a strong negative effect at greater slopes, bottom depth (~4.5%), with a peak positive effect near ~65 m, and *phi* (~4.5%), with a peak positive effect ~2.5 (Table A3-1; Figure A3-1).

The area of occupied habitat for total crab extended roughly the eastern two thirds of the BBRKC stock boundary, primarily east of Unimak Island, covering 100% of both the RKCSA and Area 512. The core habitat area covered approximately 83% of the RKCSA and 93% of Area 512, while habitat hot spots covered 47% of the RKCSA and 59% of Area 512 (Figure 5-15 in Section 5.5.2).

Mature Males
For mature males, the geographic position explained roughly 75.5% of the deviance, and had a positive effect toward the center of Bristol Bay (Table A3-1; Figure A3-2). Following geographic position, further deviance was explained by bottom current (~6.9%), where a positive effect occurred in the south/southwesterly direction, and bottom depth (~4.5%), where a positive effect peaked near 60 m (Table A3-1; Figure A3-2).

The area of occupied habitat for mature males was similar to total crab, covering 100% of both the RKCSA and Area 512. The core habitat area covered approximately 91% of the RKCSA and 78% of Area 512, and habitat hot spots covered 68% of the RKCSA and 36% of Area 512 (Figure 5-15 in Section 5.5.2).

Immature Males
For immature males, the geographic position explained roughly 62% of the deviance, and had a positive effect toward the general area of Bristol Bay (Table 1; Figure 3). Immature males and females had their second-highest deviance explained by slope (~13%), where a strong negative effect occurred with higher degrees of slope, and by bottom currents (~7%), where northwesterly currents had positive effects (Table A3-1; Figure A3-3).

The occupied habitat for immature males was slightly compressed to the east compared to the total crab model, still covering 100% of the RKCSA and 99% of Area 512. The top 50th percentile of occupied habitat (core) covered approximately 59% of the RKCSA and 81% of Area 512, while the top 25th percentile (hot spots) covered 21% of the RKCSA and 49% of Area 512 (Figure 5-15 in Section 5.5.2).

Mature Females
For mature females, geographic position explained roughly 60% of the deviance, and had a positive effect from the center of Bristol Bay south to the shoreline (Figure 4). Mature females had their second-highest percentages explained by bottom temperature (~13.5%), with a positive peak near 2.5° C, and by bottom current (~11%), where a positive effect occurred in the south/southwesterly direction (Figure A3-4).

The occupied habitat for mature females was slightly compressed to the east, still covering 97% the RKCSA and 100% of Area 512, but concentrated in core and hot spot habitats more toward Area 512. The top 50th percentile of occupied habitat (core) covered approximately 54% of the RKCSA and 91% of Area 512, while the top 25th percentile (hot spots) covered 31% of the RKCSA and 57% of Area 512 (Figure 5-15 in Section 5.5.2).

Immature Females
For immature males, the geographic position explained roughly 43.8% of the deviance, and had a positive effect toward the southeastern shore of Bristol Bay (Table 1; Figure 2). Immature females had their second-highest deviance explained by slope (~14.3%), where a strong negative effect occurred with higher degrees of slope (Table 1; Figure 5). Immature females also had explained deviance by bottom currents (~11%), where northwesterly currents had positive effects, by the standard deviation of bottom currents explained roughly 10% of the deviance, and had positive effects in the southwesterly direction (Table A3-1; Figure A3-5).

The occupied habitat for immature females was the most compressed to the east, covering 74% the RKCSA and 98% of Area 512. The top 50th percentile of occupied habitat (core) covered approximately 27% of the RKCSA and 67% of Area 512, while the top 25th percentile (hot spots) covered just 7% of the RKCSA and 37% of Area 512 (Figure 5-15 in Section 5.5.2).

Table A3-2 Covariates retained in the Bristol Bay Red King Crab species distribution model (SDM), the percent contribution to the ensemble deviance explained by each, and the cumulative deviance explained: phi = sediment grain size, SD = standard deviation, and BPI = bathymetric position index.

Covariate	Total crab	Male, Mature	Male, Immature	Female, Mature	Female, Immature
geographic position	68.86	75.52	62.05	60.33	43.79
slope	6.72	3.22	12.95	--	14.28
bottom depth	4.52	4.52	4.21	1.27	4.1
phi	4.48	2.38	2.33	5.73	4.62
bottom current	4.35	6.87	7.11	11.02	10.21
bottom temperature	2.99	2.78	1.96	13.48	3.86
sponge presence	2.83	1	2.03	1.87	2.27
tidal maximum	2.23	1.18	1.01	0.48	0.67
current SD	1.31	1.23	3.92	--	9.87
sea whip presence	0.52	--	1.76	0.51	--
aspect north	0.49	0.73	--	--	2.35
BPI	0.48	--	0.67	5.31	3.88
coral presence	0.22	0.18	--	--	0.11
aspect east	--	0.39	--	--	--
curvature	--	--	--	--	--

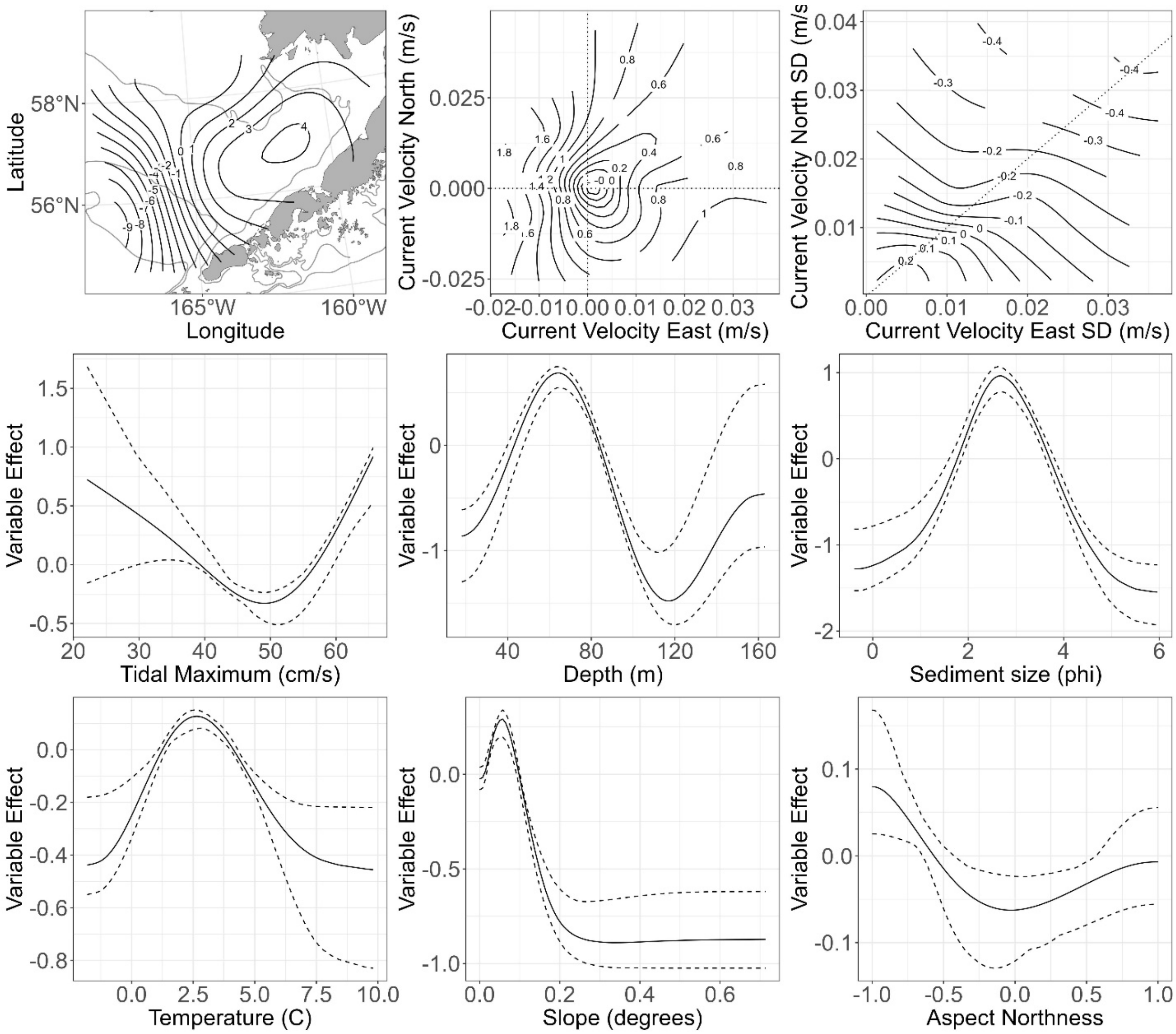

Figure A3-1 Effects plots for total BBRKC

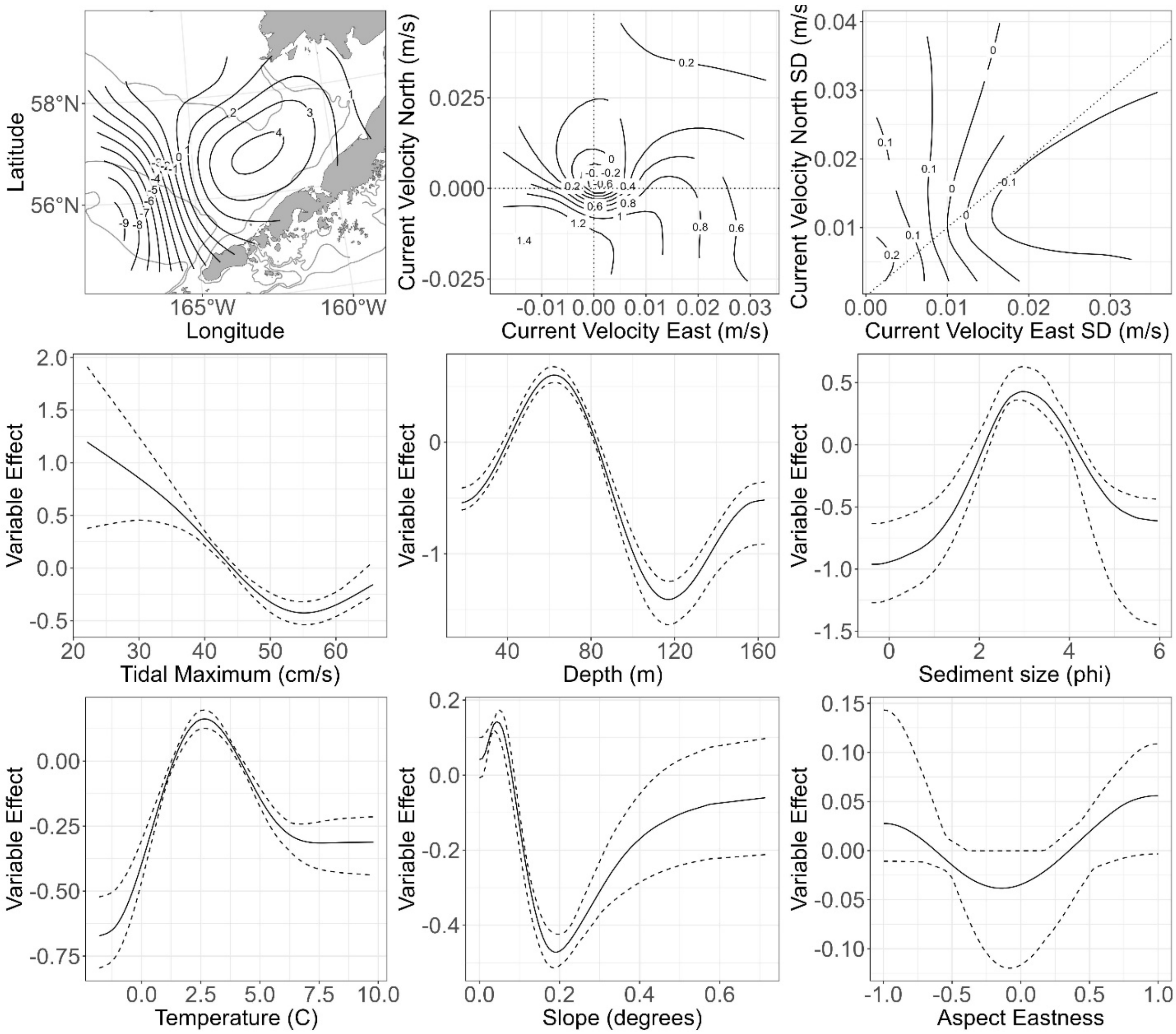

Figure A3-2 Effects plots for mature male BBRKC.

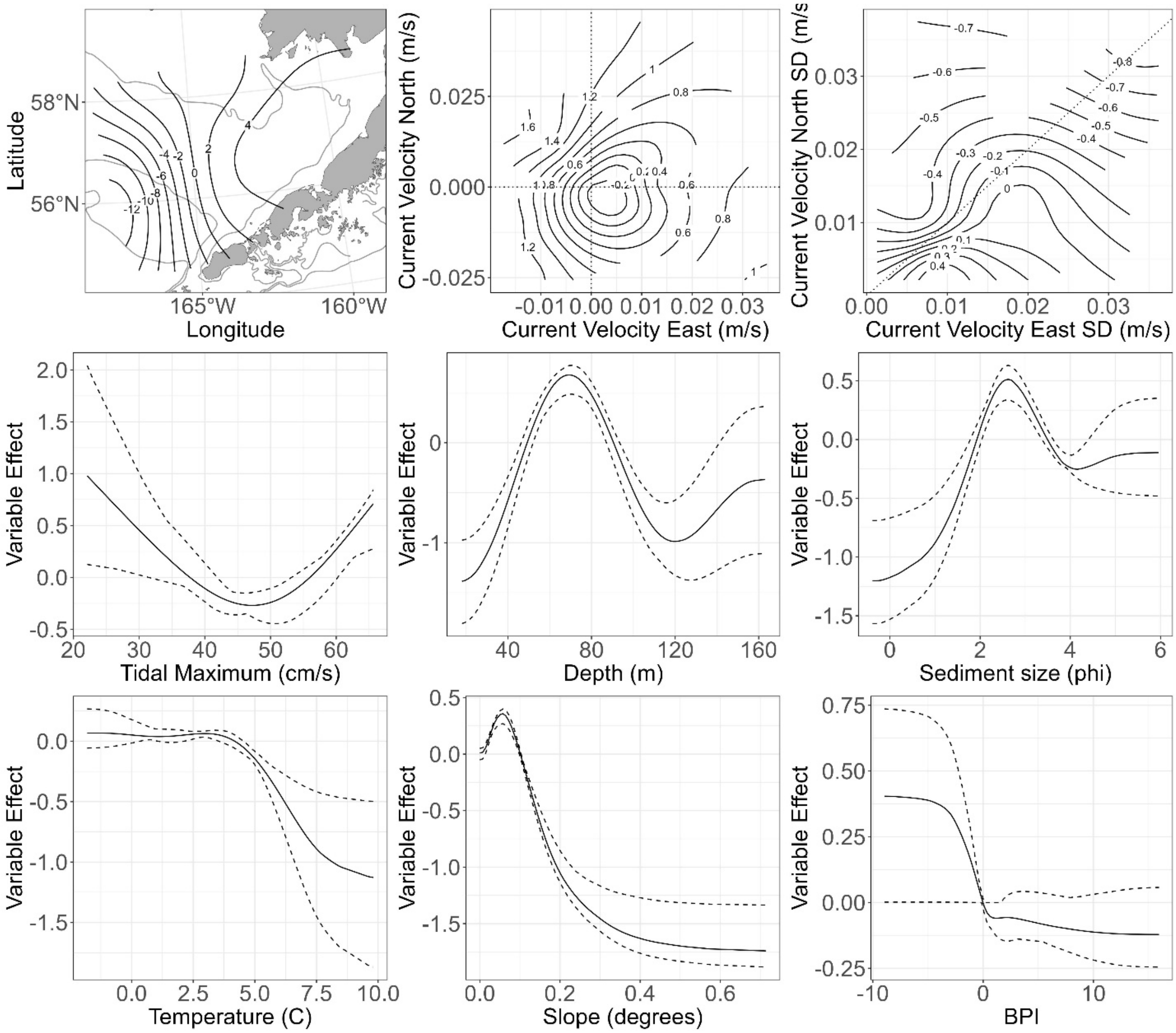

Figure A3-3 Effects plots for immature male BBRKC.

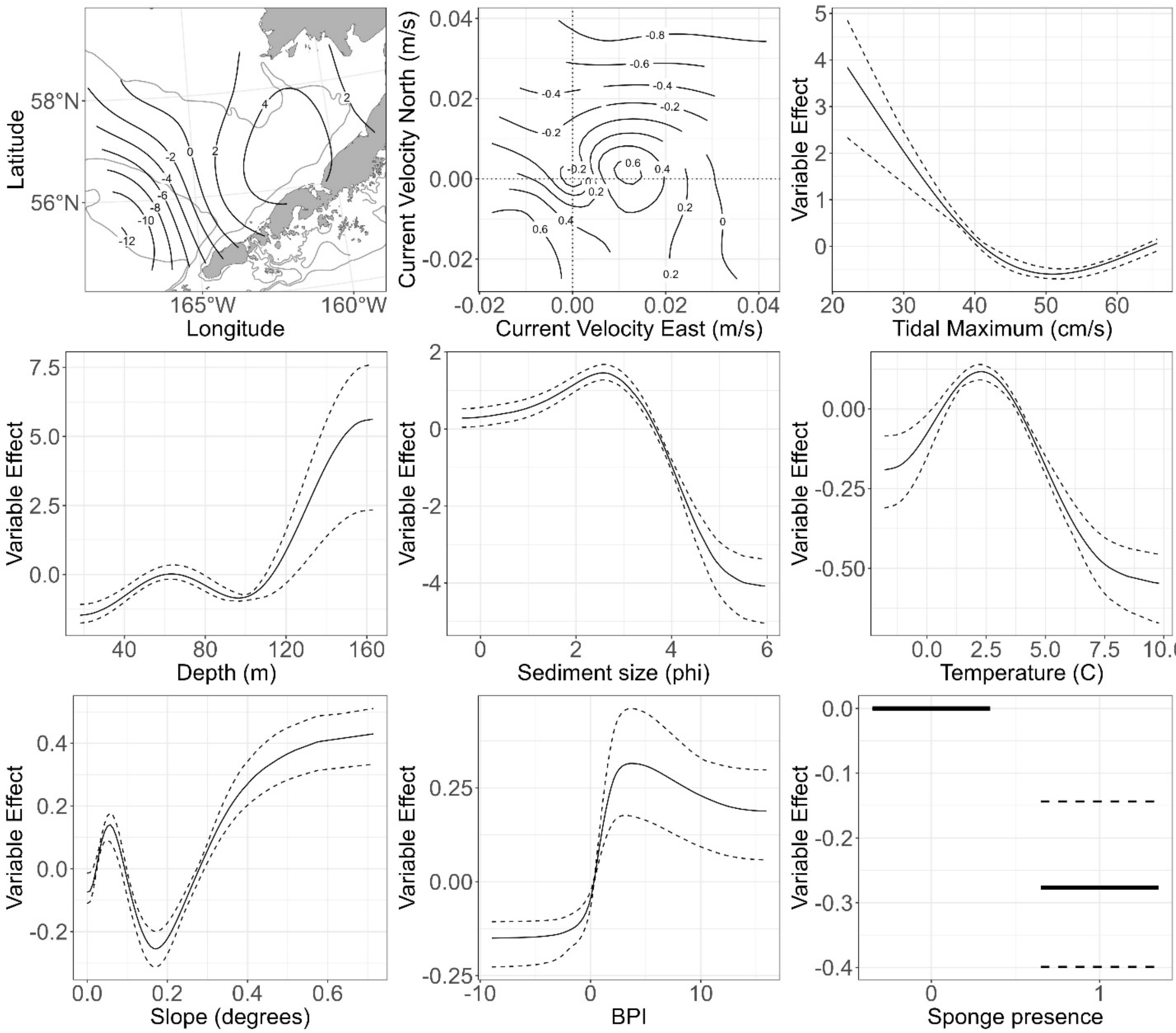

Figure A3-4 Effects plots for mature female BBRKC.

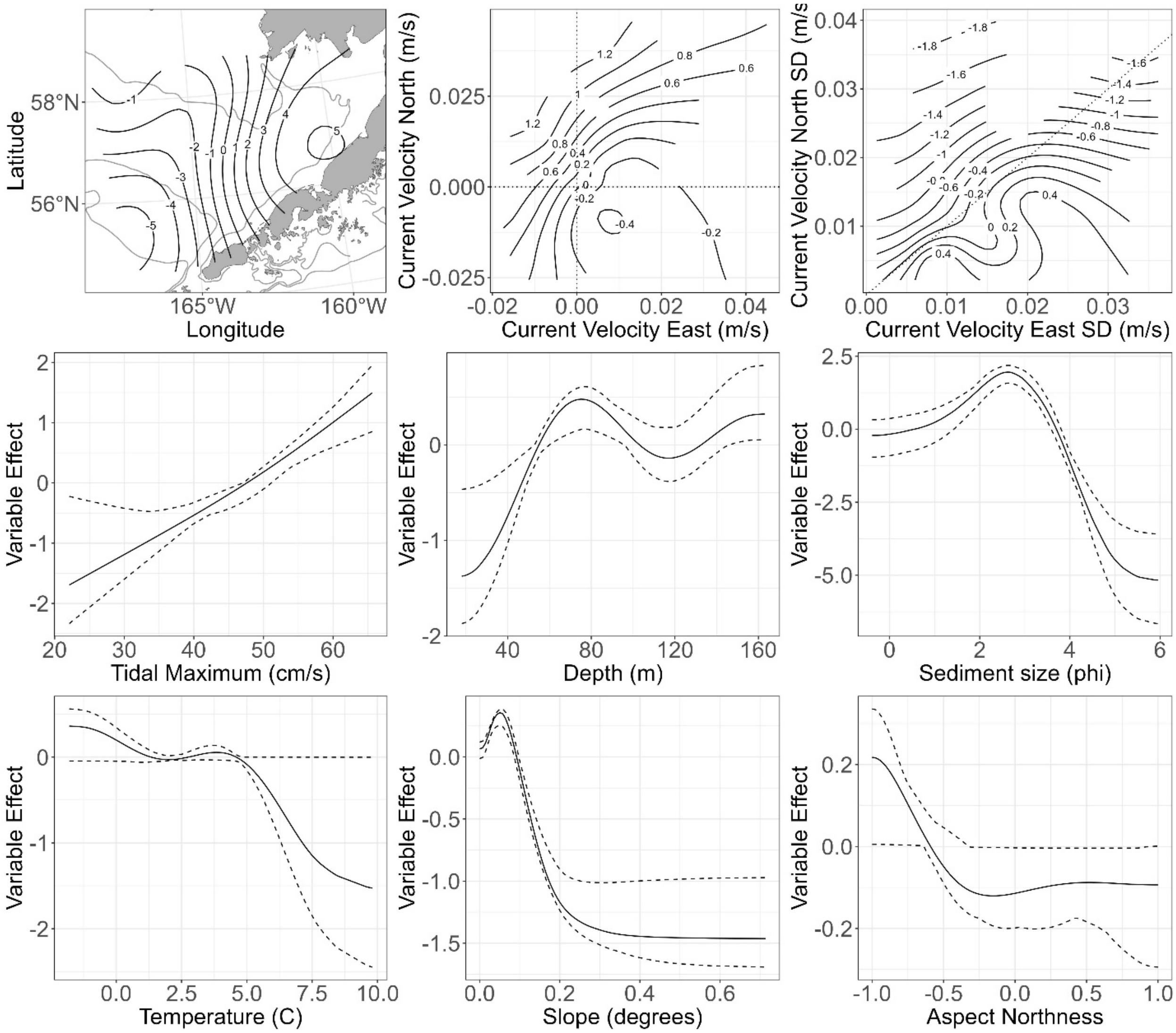

Figure A3-5 Effects plots for immature female BBRKC

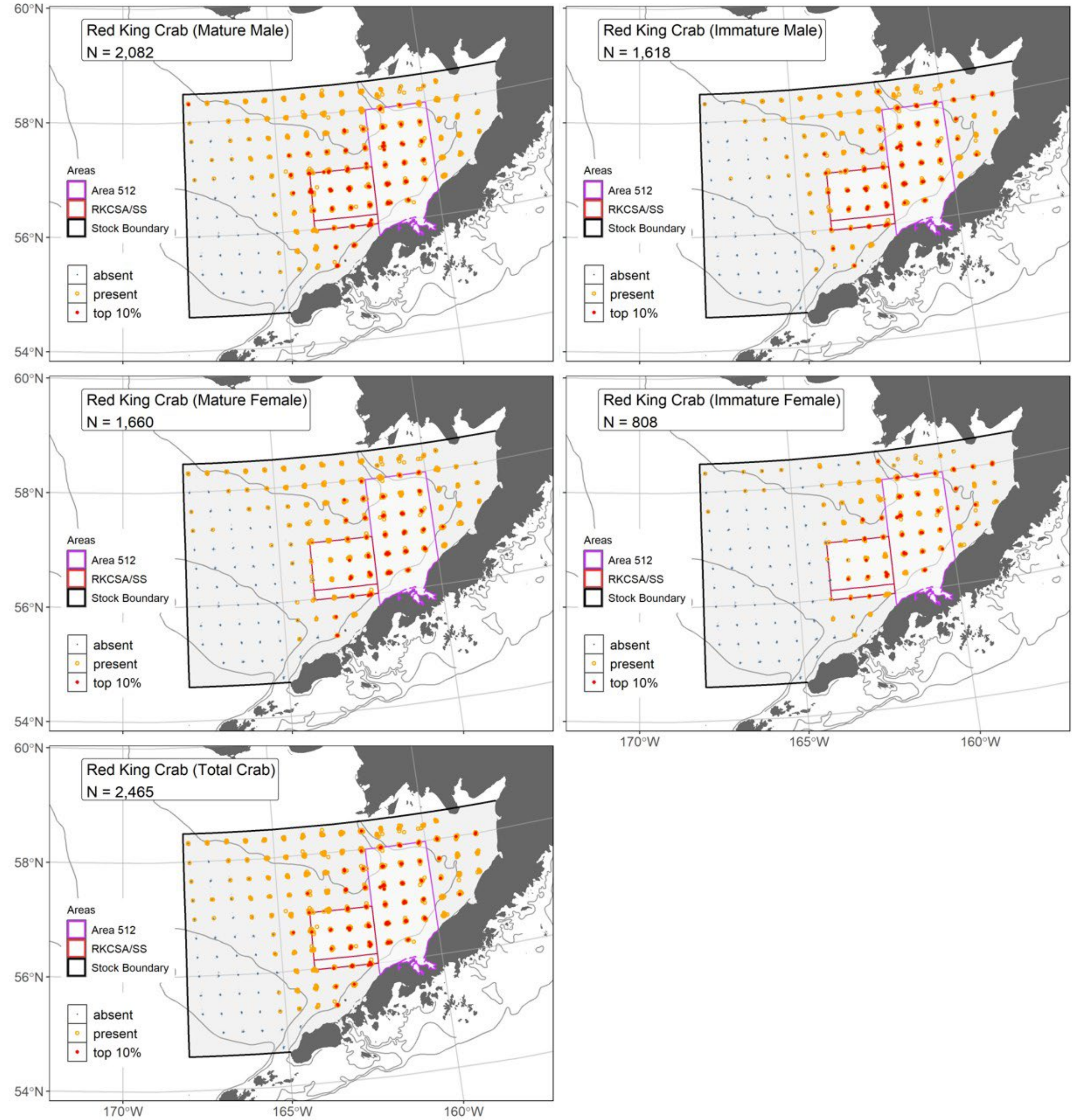

Figure A3-6 Distribution of Bristol Bay red king crab catches in AFSC RACE-GAP eastern Bering Sea (EBS) summer bottom trawl surveys of the EBS Shelf (1982–2023) with the 50 m, 100 m, and 200 m isobaths indicated; filled red circles indicate catches in the top 10% of overall abundance, open orange circles indicate presence in remaining catches, and blue dots indicate stations sampled where the animals were not present. Each datum at a station represents a year of sampling at that location; multiple years are overplotted at each station. Boundaries of the RKCSA and Area 512 are indicated in red and purple, respectively.

Appendix 3.2 Fall BBRKC Legal Male SDM

Appendix 3.2.1 Methods

Study area and relevant management boundaries

There are several boundaries relevant to BBRKC management and the purposes of this study. The BBRKC management boundary occurs between 168-158°W and 58.5-54.5°N and served as our study area extent. Within the management boundary, the Red King Crab Savings Area (RKCSA; 164˚-162˚W and 57˚-56.2˚N) is closed year-round to flatfish trawling, but the adjoining sub-area (RKCSSA; 164˚-162˚W and 56.2˚-56˚N) is open if there was a BBRKC directed fishery the previous year. Finally, NMFS statistical area 512 (162˚-160˚W and 58˚-56˚N) is open to all groundfish gear types but is currently being evaluated for groundfish fishery closures such as pot cod due to its potential as important red king crab habitat. Model outputs were evaluated in relation to these management boundaries (see below).

Response data

We used data on catch (counts per pot) of BBRKC legal males in the fall as the response variable for our models. Catch data were compiled from two sources: 1) observer data on BBRKC caught in the directed fishery and as bycatch in the tanner crab fishery, and 2) directed fishery logbook data. Observer data covered crab pot vessels sampled during 1997-2021 within the Bristol Bay management area, as there was no directed fishery for 2021/2022 and 2022/2023 seasons. These data were provided by the Alaska Department of Fish and Game and include total legal male catch per pot across all observed pots with and without red king crab. While on-board observers record detailed information on crab caught in individual pots, they only sample approximately 5% of pots on each vessel and 20% of vessels in the directed fishery (Fitch et al. 2014). Therefore, we supplemented observer data with daily fishing logbook (DFLs) entries from 2005-2020 collected by skippers of pot vessels. While DFLs are recorded as the mean catch of legal males across the entire pot string and therefore encompass a coarser resolution than individual pots sampled by observers, DFLs cover the entire fishery as opposed to the small subsample from the observer program. DFL data was processed following Zacher, Kruse, and Hardy (2018), which included calculating catch per pot as the average number of legal male crab caught in a string divided by the number of pots hauled in a string. In addition, we calculated the mid-latitude and longitude of each string by averaging the start and end coordinates of the string. Observer data was not processed in the same spatial resolution as DFLs (i.e., by pot string) because observers do not collect data on all pots in a string and finer-resolution information at the pot-level vs. pot-string level could be informative for BBRKC distribution. We removed duplicate entries in the combined DFL and observer dataset to avoid double-counting legal male occurrence. All data were filtered to only include fall months (September-November) for the purposes of this study. Data were visualized spatially using an extension of the *EFHSDM* package in R (Harris et al. 2023), where legal male presence, absence, and high-density points (90^{th} percentile) in relation to RKCSA and area 512 were plotted.

Model covariates

We included twelve environmental and biological covariates as candidate predictors for fall legal male distribution (Table 1; Fig. 1). Six of these predictors were temporally dynamic, which is important to consider given the observed yearly distribution shifts of BBRKC in the NMFS summer bottom trawl survey that static predictors alone may not capture in a modeling capacity. The Bering Sea is a marginal ice system with ecological dynamics that are largely driven by the presence or absence of winter sea ice (Mueter and Litzow 2008; Stabeno et al. 2012). Ice-covered areas are characterized by ice-associated primary production with high export to the benthos and cold summer bottom temperatures produced during ice formation, while areas without winter sea ice are characterized by open-water blooms that result in primary production that is retained in the pelagic zone and warm summer bottom temperatures (Hunt et al. 2002; Hunt et al. 2022). Variability in ice cover and temperature is associated with shifts in BBRKC distribution, which move from central Bristol Bay to more nearshore regions along the Alaska Peninsula in cold years (Evans et al. 2012). We captured these dynamics with data on sea surface temperature (SST) and ice cover data obtained from the ERA5 reanalysis (Hersbach et al. 2020), which were included in analysis as annually-resolved spatial rasters of two-month averages, with only January/February and March/April ice area fraction included as covariates due to low ice cover the rest of the year. Bottom temperature data were obtained from the NMFS summer bottom trawl survey and were interpolated via ordinary kriging into annually-resolved rasters of average temperature for the May-June survey period using code adapted from the *coldpool* R package (Rohan and Barnett 2023). Sediment grain size (phi) has been shown to drive the distribution and composition of red king crab benthic prey and predators, consequently influencing crab distribution (Falk-Petersen, Renaud, and Anisimova 2011; McGonigle and Collier 2014; Wieser 1959; McConnaughey and Smith 2000). Sediment was included in the models as a static raster derived from the EBSSED2 database and interpolated via ordinary kriging (Richwine, Smith, and McConnaughey 2018; Smith and McConnaughey 1999). Depth (meters) was also obtained from the NMFS summer bottom trawl survey and converted into a static raster via nearest neighbor interpolation, as RKC have shown sex- and season-specific associations with depth (Bright 1967; Chilton, Foy, and Armistead 2010; Dew 2008; Loher 2001). Slope (degrees of incline) is related to depth as it is the rate of bathymetry change, and it has been suggested that RKC may follow specific migratory routes related to topographic features such as slope (Aune et al. 2022; Anisimova and Lubin 2008). Slope was included as a static raster created using the Benthic Terrain Modeler in ArcGIS and derived from eastern Bering Sea bathymetry (Horn 1981; Walbridge et al. 2018). Current (meters sec^{-1}) has been shown to influence pelagic RKC larval transport and retention in Bristol Bay, which can ultimately affect adult distribution (Daly et al. 2020; McMurray et al. 1986). Current northings and eastings and respective standard deviations were included as static rasters that were averaged for the bottom five meters from the Bering10K ROMS output for summer months from 1982-2019 and interpolated using inverse distance weighting (Kearney et al. 2020). Maximum tidal current (centimeters second^{-1}) has also been shown to influence the dispersion and concentration of red king crab larvae in Bristol Bay (Hebard 1961) as well as the larval transport of other crab species such as Dungeness crab (Rasmuson and Shanks 2020). Tidal current maximum was included as a static raster that was modeled over a lunar year using an EBS-parameterized tidal inversion program (Egbert and Erofeeva 2002). In addition, the frequency of southeast and northwest winds has been tied to variability in eastern Bering Sea shelf circulation (Danielson et al. 2012), which in turn influences RKC transport and retainment (Daly et al. 2020). We aimed to capture the interaction between wind and current as well as the temporally dynamic nature of current that may not be encapsulated in a static raster by including the mean daily wind proportion in each direction (southeast and northwest) averaged across October-April and May-September for each year (not spatially resolved) from the ERA5 reanalysis (Hersbach et al. 2020), as these periods were determined as important for current direction reversal and stratification, respectively (Danielson et al. 2012).

The abundance of legal male BBRKC, as estimated by the NMFS summer bottom trawl survey, was also used as a covariate (Zacher et al. 2023; Markowitz et al. 2023) with the goal of determining if data for summer legal male distribution in this system can be informative for estimating distribution outside the summer season. Survey abundance estimates were converted into annual rasters via inverse distance weighting. Finally, BBRKC legal male bycatch abundance in groundfish fisheries may be informative for the underlying distribution of the population in the fall, as the majority of RKC bycatch occurs in non-summer months (Evans et al. 2012; Aydin et al. 2016). Total bycatch by month and year was calculated from groundfish observer data for yellowfin sole and rock sole non-pelagic trawl fisheries, as bycatch rates were determined to be highest in those fisheries (Ryznar and Litzow, *In prep*; NPFMC 2022a). These values were aggregated into a regular, 1 km^2 spatial grid and then averaged across fall months.

All spatial covariate rasters (SST, bottom temperature, ice area fraction, sediment, depth, slope, current and current SD, maximum tidal current, and BBRKC legal male survey and bycatch abundance) were aligned in resolution (1 km) and extent, and values of each were extracted at the spatial locations of legal male presence and absence points using the *terra* package in R (Hijmans 2023). All covariates were evaluated for collinearity using the R package *usdm* (Naimi et al. 2014), and any covariates with a variance inflation factor ≥5 (“highly collinear”) were globally excluded from analysis (Zuur et al. 2009).

Modeling approach

We used boosted regression trees (BRTs) to analyze fall BBRKC legal male distribution using the gbm package (Greenwell et al. 2022) in R v.4.2.2 (Team 2022). BRTs fit and combine many regression trees for prediction via boosting (Elith, Leathwick, and Hastie 2008) and are one of the top-performing SDM algorithms (Guisan et al. 2007; Elith and Graham 2009; García-Callejas and Araújo 2016). BRTs are specified using a combination of learning rate, which controls the contribution of each individual tree to the overall model, tree complexity, which adjusts the interaction complexity of the model, and bag fraction, which is the proportion of training data that is used in each iteration and controls boosting stochasticity. We selected BRT model parameters that allowed a minimum of 1000 trees to be fit, as recommended by Elith, Leathwick, and Hastie (2008).

BRTs were built in a delta model framework, which is a suitable method for modeling zero-inflated data and/or when species occurrence and abundance are believed to be influenced by separate processes (Martin et al. 2005; Elith et al. 2006; Brodie et al. 2020). In this framework, two different BRTs were fit: 1) to legal male presence/absence using a binomial distribution, and 2) to non-zero legal male abundance (count per pot) using a Poisson distribution. The prediction of the binomial BRT model produces continuous output values between zero (“absence”) and one (“presence”). To convert to binary values, model predictions below the mean predicted presence/absence (i.e., the threshold/hurdle) were converted to zero (“absence”) and predicted values greater than the threshold were converted to one (“presence”; sensu (Liu et al. 2005). Model-predicted abundance was then multiplied by the binomial presence/absence values to get predicted legal male abundance dependent on legal male occurrence.

To fit models for legal male fall distribution, we conducted k-fold cross validation by randomly subsetting 80% and 20% of the data into training and testing sets, respectively, at each cross-validation fold (k). This was repeated 10 times. For each k-fold, we fit both occurrence and abundance BRT models in the delta framework using the training data set and evaluated model performance using the testing data set via root-mean-squared-error (RMSE) for overall model performance (Hastie, Tibshirani, and Friedman 2009), Area-Under-the-Receiver-Operator-Characteristic-Curve (AUC-ROC) for the occurrence models, and Spearman’s rank correlation coefficient (ρ) and percent deviance explained (PDE) for abundance models. AUC-ROC estimates the probability that the model assigns a randomly chosen presence as a “presence” versus a randomly chosen absence observation, where values >0.8 are considered excellent (Hosmer and Lemeshow 2005). Spearman’s ρ compares model predicted values with observed values and measures the model’s ability to distinguish high and low abundance areas via rank correlation (Best and Roberts 1975; Zar 1984). While there is no global framework for what constitutes a better Spearman’s ρ, we utilized the framework where ρ values between 0.4-0.6 exhibit a strong correlation or “good” predictive ability and values >0.6 exhibit a very strong correlation or “excellent” predictive ability (Akoglu 2018). Finally, PDE represents the residual variance that is accounted for by the abundance model compared to a null Poisson model without any predictor terms. Higher values of PDE indicate that a model captures more residual variance than the null counterpart, whereas lower values indicate the simpler null model is acceptable. We utilized the same evaluation framework for PDE as Spearman’s, where values >0.6 exhibit excellent performance. We chose the training/testing subset iteration that resulted in the best performing occurrence and abundance models, as indicated by the lowest RMSE, highest AUC, highest Spearman’s ρ, and highest PDE.

To evaluate the most important covariates for legal male fall distribution, we utilized the BRT output of influential covariates to calculate the top five covariates by averaging relative influence (%) across occurrence and abundance model components. Finally, to evaluate the predicted responses to the top model covariates, we plotted fitted response curves to the top six influential covariates for occurrence and abundance model components.

To assess important habitat for BBRKC legal males in the fall, we utilized an extension of the EFHSDM package (Harris et al. 2023) to calculate and map model-predicted encounter probability hotspots within the Bristol Bay management area. Specifically, to evaluate historical habitat, we averaged predicted model spatial surfaces and calculated 95%, 75%, 50% and 25% percentiles across the entire timeseries. These percentiles were then plotted in relation to the RKCSA and NMFS Area 512. To evaluate whether important habitat changes through time, we followed the same methods as above but calculated and plotted percentiles by year for the last five years.

Appendix 3.2.2 Results

Across the timeseries, sampling distribution hotspots and presence for legal male BBRKC in the fall were centered around the RKCSA, with some distribution occurring to the northwest and east into NMFS statistical Area 512. Legal male absences were scattered throughout the RKCSA and area 512, but densely concentrated in the southwest corner of the Bristol Bay management area.

Delta model components (occurrence and abundance) generally performed well in out-of-sample predictive capacity with an AUC of 0.97 (“outstanding”), a Spearman’s ρ of 0.58 (“good”), and a PDE of 0.32 (“fair”). Three of the top five most influential covariates for fall legal male BBRKC distribution averaged between occurrence and abundance components of the delta model included temporally dynamic covariates (summer bottom temperature, November/December SST, July/August SST) whereas the other two were static across years (depth, maximum tidal current).

While the identity of the six most influential variables for predicting fall legal male distribution, as well as the shape of their response curves, generally aligned between presence/absence and abundance model components, there were some differences. Maximum tidal current and the northings direction of current were important predictors for predicting legal male occurrence but not abundance, whereas summer bottom temperature and legal male BBRKC summer survey abundance were important predictors for legal male abundance but not presence. The probability of legal male occurrence is predicted to be highest at depths between 60-80m, maximum tidal currents between 45-65 cm sec^{-1}, and the northings direction of current speeds between 0-0.05 m sec^{-1}. In addition, legal male occurrence sharply decreases at November/December temperatures greater than 5°C, roughly increased with increasing values of September/October SST, and sharply decreases at July/August temperatures greater than 13°C. Legal male abundance was predicted to be highest at summer bottom temperatures greater than zero and roughly decrease with increasing values of July/August and November/December SST. In addition, abundance is predicted to be greatest at depths between 55-95m, BBRKC legal male survey abundance between 0-160 individuals, and September/October SST between 6.5-11 °C.

Historical encounter probability hotspots (top 25%) for legal male BBRKC fall distribution were roughly centered around the RKCSA and extend into NMFS statistical Area 512. Encounter probability is also higher in the northwest corner of the Bristol Bay management area than the southwest. In addition, while encounter probability hotspots during the last five years remain centered around the RKCSA and area 512, the overall distribution changed through time. There was a higher probability of encountering legal male BBRKC in the fall in the eastern part of the Bristol Bay management area in 2016 and 2017, with encounter probability also increasing in the northwest after 2016.

Appendix 4 Framework Agreement Approaches for Trawl and Pot Sectors

The Council's June 2023 motion requested further exploration of "actions that could be implemented through framework agreements for the pot CV sector and trawl sectors [that] would have similar goals to the proposed alternatives to reduce BBRKC mortality in the RKCSA and Area 512, respectively, but would be more dynamic and responsive to seasonal spatial distribution of BBRKC and focus avoidance on more discrete areas of relatively higher female BBRKC abundance." That prompt stemmed from a discussion that was included in the June 2023 EA/RIR (NPFMC 2023a) as a result of Council interest in public testimony it had received during its review of the series of discussion papers presented in 2022; that discussion was incorporated in the previous initial review draft as "Appendix 1: Establishment of Dynamic Closure Areas: Challenges and Potential Trade-Offs". Framework approaches to dynamic area-based management was only one part of the previous "Appendix 1". That appendix, itself, was a compilation of information that had been presented to the Council in the April and October 2022 BBRKC discussion papers (NPFMC 2022a and 2022b). For brevity, not all of that information is repeated here. In those documents incorporated by reference, readers may find discussion on the following topics:

- Discussion of scientific information needed to create dynamic closed areas;
- Public process requirements that limit the extent to which area closures can be dynamic within a calendar year, and a description of NMFS's inseason management authorities (and limitations);
- Examples of "incentive-based approaches" in the North Pacific region, including rolling hotspots for salmon avoidance and inter-annual PSC limit "buffer systems"; and
- Examples of different approaches to "time/area" closures.

This appendix expands on the final part of the previous version – "Proposal: Framework Approach to Area-Based Pot Cod Fishing Access" – with additional feedback provided to the authors by participants in BS groundfish fisheries. This was directly requested by the Council and, the authors note, is in line with a 2023 report by the Council Coordination Committee promoting that the Councils' "highly engaging and regionalized process" allows for adaptability of boundaries "to meet emerging conservation challenges" (CCC 2023, p.27).

Proposal for Framework Approach to Area-Based Pot Cod Fishing Access

The Council might consider an action that has similar goals as Alternative 3 but is less broadly restrictive as well as more flexible to new information and crab bycatch minimization techniques that might develop over time. Alternative 3 would close Area 512 to pot cod fishing on a year-round basis to remove a source of fishing mortality on BBRKC. The proposal envisions a system where the ability to fish for Pacific cod with pot gear east of a certain longitude would be contingent on the vessel operator (or LLP license holder) having signed onto an agreement concerning bycatch minimization measures that must be taken in that area. Examples given of measures include the use of sock tunnels or other gear modifications to prevent crab retention in pots, increased observer coverage, real-time hot spot reporting, active use of AIS, or other tools that might not be available at the time of implementation but could be adopted more swiftly if not tied to the Federal rulemaking process. In other words, the proposer envisioned allowing pot cod and crab fishery participants – across which there is a notable degree of overlap – to lead in the definition of the appropriate gear for areas that are important to both sectors. Pot cod vessel operators/participants that are not signed onto such an agreement would still be able to fish for BS Pacific cod with pot gear, but not east of an established boundary. As a starting point for discussion, the proposer identified the 163° W longitude line, which is roughly in line with Amak Island and the western extent of Area 516. It was stated that Pacific cod can be found west of the 163-degree line during the A season, but the pot cod fishery tends to occur farther east into Bristol Bay in the fall (B Season). Upon further consultation with pot cod participants (after June 2023), the analysts heard interest in the 162-degree line as a demarcation. The analysts also received feedback that the fall (B Season) is the period with the greatest need for self-restraint in pot cod effort if RKC bycatch minimization is the objective.

A "framework" approach means that arrangements are set in place prior to a season and have NMFS's approval. The arrangement, in this case, would be that enforceable crab bycatch minimization measures are in place.[55] The proposer consulted with NMFS, NPFMC, and NOAA OLE staff to scope potential benefits and challenges associated with the idea. The following paragraphs are a summary of those issues:

The pot cod fishery is a limited open access fishery with no universal cooperative organizational structure and relatively limited observer coverage. In addition to lower observer coverage rates in general, deliveries to tender vessels have increased in recent years and created additional logistical challenges to observer deployment. Voluntary steps to take additional monitoring might aid in fishery management, catch/bycatch accounting, and could eventually result in improved estimation of crab discard mortality from pot cod gear. Vessel operators might need dispensation to contract for additional observer coverage above and beyond how the Observer Program is currently administered through ODDS, and that this would represent a direct cost to vessels and would increase demand on observer providers that have a limited supply of observers who are qualified to monitor fishing with pot gear.

The contents of an agreement that would have to be signed annually in order to fish east of a certain longitude would need to be overseen by a third-party organization that is trusted by NMFS and fishery participants. That party could act as a clearinghouse to ensure the agreement requires participants to be following the most up-to-date best practices for crab bycatch minimization and can act nimbly to respond to new information about which measures are/are not working as intended. Any reporting requirements between that party and the Council – in order to inform the public – would need to be defined. To the analysts' knowledge, no organization comprehensively represents both pot cod and crab stakeholders. In any event, an existing organization that takes on new responsibilities would incur costs and require monetary or in-kind support from a broad group of fishery participants in order to take on new duties.

In real-time, enforcement officers would likely only be able to determine which vessels are party to the agreement (thus permitted in certain areas), where fishing is occurring, and what type of gear is being used. NMFS does not delegate enforcement of fishery regulations to external partners, so annual measures would need to be enforceable by existing authorities.

Deployment of fishery observers on pot vessels delivering to tenders in the eastern Bristol Bay region is logistically challenging, so a voluntary program that is reliant on higher observer coverage would require prioritization and coordination at several levels of management and stakeholder involvement. If any changes in observer requirements are to be mandated, those would have to occur through the Annual Deployment Plan (ADP) process and/or in regulations. At present, prioritization of limited partial coverage observer deployment resources is partly based on salmon and halibut bycatch, so increasing the importance of putting observers on pot cod vessels to monitor crab bycatch could have cascading effects as resources are spread or redistributed. It is possible that vessels could be allowed to contract directly with full observer coverage providers but – as the Council has dealt with in the past – any changes to who is subject to the partial coverage observer fee (percent of ex-vessel value) requires Council analysis and rulemaking.

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[55] The proposer referred to regulations that allow exemptions from regional delivery requirements within the BS crab rationalization program as a model (see 50 CFR 680.4(p)). Those regulations allow one or more crab IFQ holders, IPQ holders, and community representatives to apply for NMFS approval to be exempt from rules about where CR crab must be delivered for processing (under 680.7(a)). Uses of that exemption have occurred for AI golden king crab when there were no active processors in the western portion of the Aleutians. Another potential use that was discussed when the regulation was put in place was for snow crab quota that were caught in northern areas at times when sea ice blocked deliveries to processors in northern ports. The term "framework agreement" – presumably the origin of the proposer's use of the term – appears in regulation at 680.4(p)(4)(ii)(B): "Each applicant must certify, through an affidavit, that the applicant has entered into a framework agreement that [… goes on to specify circumstances that would trigger the exemption and actions that the various parties would need to take]".

Stakeholder Feedback on Framework Approaches for Trawl Sectors

Any framework approach would need to be paired with modification of existing regulations governing which gears can be used in areas that are currently closed to certain participants. Without the opportunity to attempt groundfish fishing with a greater degree of cautious experimentation, this approach would effectively increase restrictions and regulatory burden through additional commitments without offering new flexibilities to take advantage of “clean fishing” opportunities. That is the approach that the Council took when allowing IPAs for salmon bycatch avoidance and minimization. Stakeholders indicated that they are currently balancing multiple objectives (e.g., groundfish CPUE and quality, salmon avoidance, crab avoidance) and it is possible – if not likely – that optimal fishing time/location combinations to achieve those objectives are restricted by legacy static boundaries.

The trawl sectors have strong cooperative structures that could take advantage of information about where crab are located at a given time. The ability to respond to the presence of crab requires knowing their location, or having a strong scientifically-derived estimation. Knowledge of crab location could be viewed as either (1) a direct response to crab bycatch in trawl gear, or (2) a periodic, dynamic estimate of likely crab location based on multi-seasonal survey data (summer, winter) that are input into a model accounting for other variable factors (e.g., warm years, cold years). The direct observation approach is likely more actionable for non-pelagic trawl gear, which is more likely to see crab when they are present in the trawled area by nature of how the gear operates on the seafloor and its retentiveness of crab relative to pelagic trawl gear. Both approaches would benefit from ongoing winter surveys of crab distribution, but that expanded survey effort and cost – in terms of both fielding and analysis – would be more essential if dynamic closed areas were envisioned as “boxes” that are drawn annually or periodically. Any additional knowledge about crab location and sex, maturity, and recruitment potential by location would allow trawl cooperatives to work with crab stakeholders and the agency to protect the highest densities of the crab that are most important to stock health.

The fact that pelagic trawl gear retains few crab – by design – requires alternative approaches to a framework based on real-time presence responses. Pelagic trawl participants noted that the stakes of modifying area closures – even through a dynamic approach – are high for a fleet that balances multiple objectives and has been managed to focus on salmon avoidance primarily. A successful framework approach should be based on “actual data” to the greatest extent possible. Though to some this is a “second-best” solution, a framework that includes pelagic trawl vessels could be partially based on proxy information from crab encounters by non-pelagic trawl vessels (e.g., A80 CPs or TLAS yellowfin sole CVs). The ability of non-pelagic trawl data to inform pelagic trawl hotspot closures might require changes to where non-pelagic gear is allowed to be used relative to the status quo. Proxy information could be utilized in a format of: “if more than a certain number of crab or rate of crab are encountered then a given area (radius, etc.) is closed for a determined amount of time. An approach built on data sharing between the various trawl sectors (non-pelagic, pelagic) would require data-sharing agreements and infrastructure between their respective cooperatives. The potential value of data sharing also presupposes some temporal and spatial overlap or similarity between the two gear groups. In current practice, this is not always the case because subsets of the pelagic trawl sector (e.g., AFA pollock CPs) can have such low RKC sideboards that they rarely fish in Bycatch Limitation Zone 1 or in the vicinity of the RKCSA. Noting the issues mentioned above with the need for spatial/temporal overlap and inter-sectoral data sharing arrangements, crab bycatch by pot cod vessels could also be an option for proxy data by which to establish dynamic area closures. A specific hurdle for that approach would be the need to increase observer coverage on pot cod vessels and the rapidity of reporting, analyzing, and disseminating that observer data.

The best approach would also be informed by scientific conclusions about whether the BBRKC stock benefits more from avoidance of direct gear interaction with certain productive parts of the crab population (e.g., mature females) or from avoidance of key habitat areas.

Stakeholders highlighted the importance of selecting the best possible time to conduct winter pot surveys to understand where RKC are likely to be when trawl gear is present in the Bristol Bay management area (Area T) – roughly mid-February through March. If survey variability is observed to be low from year to year, it is possible that surveys would be needed less frequently over the medium- to long-term.

Trawl vessels that are part of a framework agreement that includes dynamic area restrictions (or other measures) could have "test protocols" to gain real-time crab presence/absence information that is shared throughout the cooperative fleet(s).

An overarching theme of stakeholder feedback was that minimizing and optimizing crab PSC use may sometimes be at odds with fixed-area closures. For example, fishing for target groundfish outside of an area historically closed for crab protection might result in low target CPUE and higher accumulated bycatch encounter without the opportunity to look for "clean fishing" in the closed areas. That view is predicated on the fact that the habitat effects of fishing are similar inside and adjacent to the closed area. Nevertheless, the expressed views of the trawl stakeholders on framework approaches were aligned on the notion that the potential gains from a dynamic approach would not be realized if all existing area restrictions remain in place.

Finally, it was noted that the objective of avoiding "more discrete areas of relatively higher female BBRKC abundance" could be more fully met if the directed crab fishery was also to develop a similar framework, as the directed fishery accounts for a high proportion of female and sublegal male bycatch and discards.