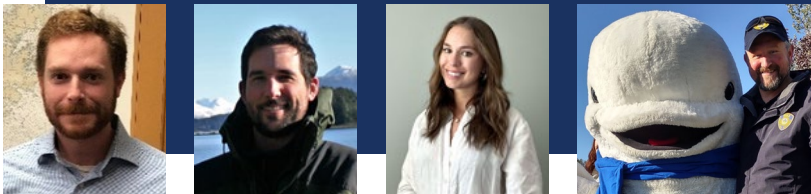


C2 BBRKC CLOSURE AREAS

SAM CUNNINGHAM, MASON SMITH, SARAH RHEINSMITH,
ALEX PERRY

FEBRUARY 2024



Presentation Outline

- History of action, purpose & need, alternatives, and management area (Sec. 1 & 2)
 - Existing groundfish time/area management regulations
 - Council questions RE: RKCSA/SS and area-swept biomass (Sec. 2.4)
- Analyses of fishing effort distribution and effects (Sec. 3.3)
 - PSC rates; CPUE; participant input
- BBRKC life history & movement research, groundfish predation, habitat, and gear-seafloor interaction (Sec. 5.3 & 5.5)
- “Framework approaches” (Appendix 4)
- Pelagic Trawl Performance Standard (Sec. 8)



[Note: PNCIAC report prior to public testimony]



Purpose & Need (Sec. 1.1)

- BBRKC stock and recruitment is at a low level
- Consecutive BBRKC fishery closures
- Caused by a “combination of factors related to continued warming and variability in ocean conditions”
- Consider 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
- Objective: “**may help increase**” stock abundance and promote optimum yield in the BBRKC fishery **while minimizing impacts** on GF fleet and other target/PSC species



Alternatives (Section 2)

Alt. 1: No Action

Alt. 2: Annual closure of RKCSA/SS to all commercial groundfish gears (i.e., PTR, NPT, POT, HAL)

Option 1: Closure in effect if ADF&G did not establish a TAC for the BBRKC directed fishery in the preceding year

Option 2: Closure in effect if total area-swept biomass for BBRKC is less than 50,000 mt (most recent EBS trawl survey)

Suboptions (apply to Alt. 2 regardless of Option selected):

Sub. 1: Exempt HAL gear (→ RKCSA closed to PTR, NPT, POT)

Sub. 2: Exempt POT gear (→ RKCSA closed to PTR, NPT, HAL)

Alt. 3: Annual closure of NMFS Area 512 to Pacific cod pot fishing

Must select either Option 1 or 2 as an annual trigger



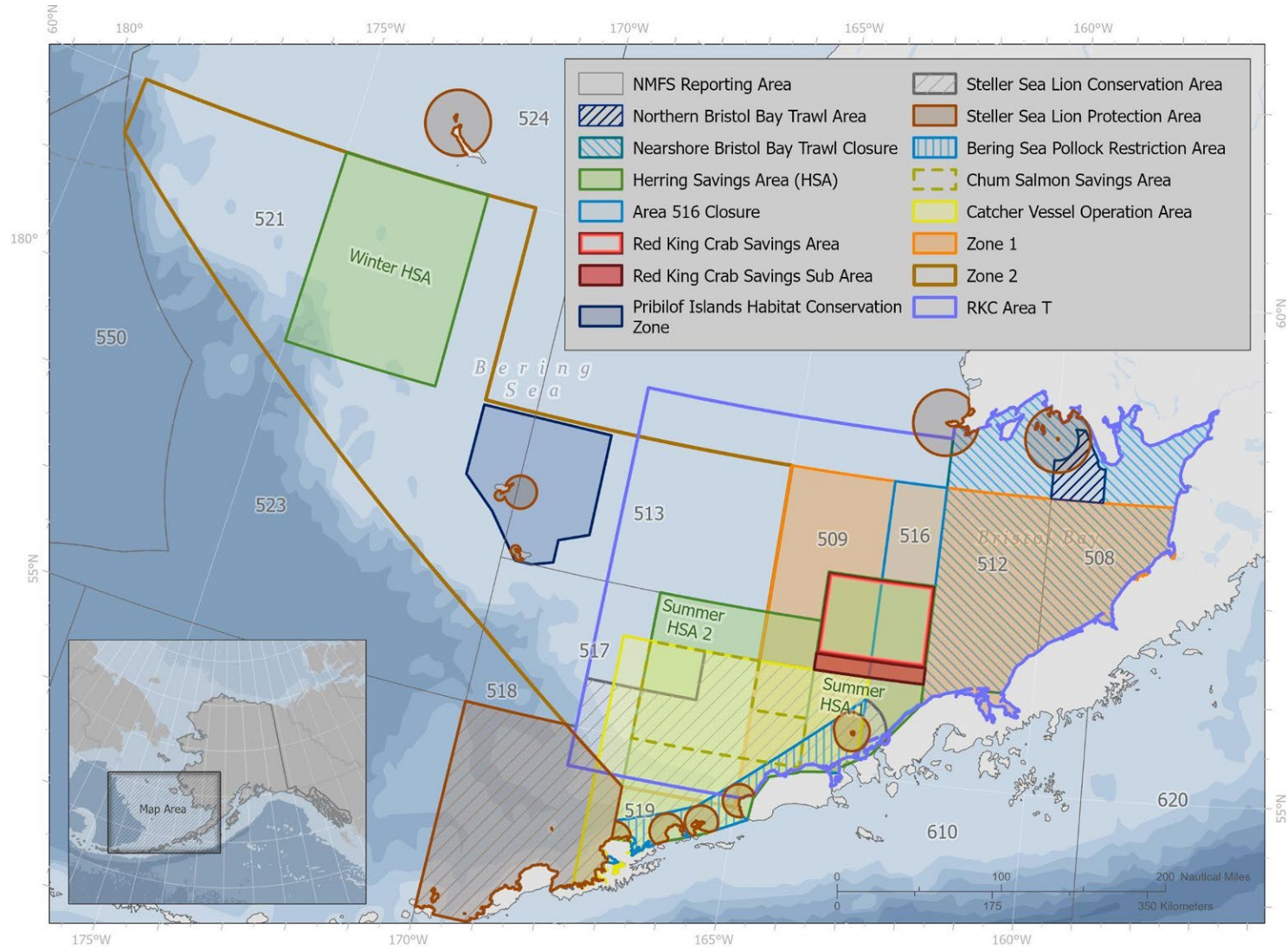


Figure 1-2 Management boundaries and RKC protection measures in the Bering Sea



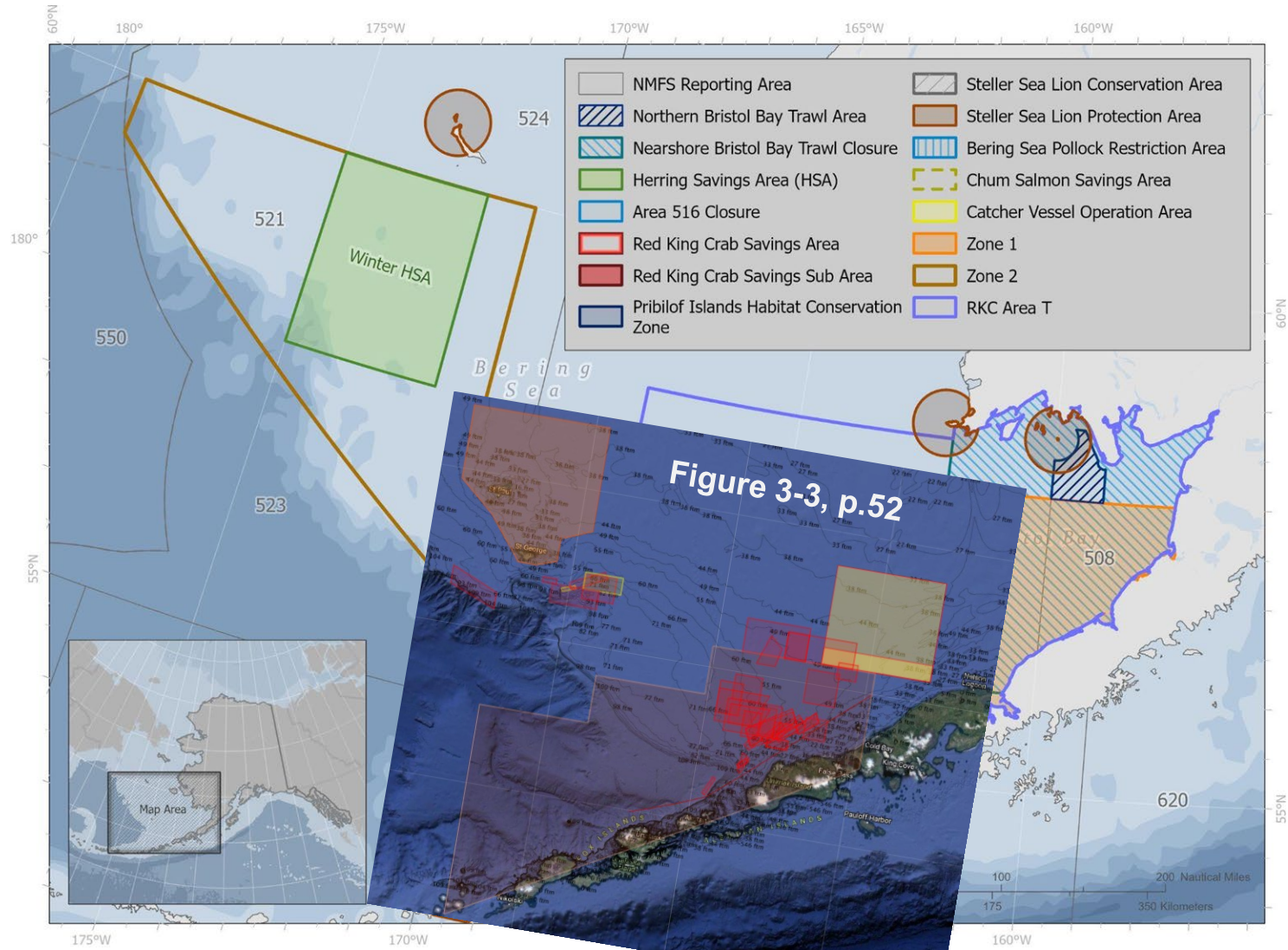


Figure 1-2 Management boundaries and RKC protection areas in the Bering Sea



Council Questions: RKCSA and Options (2.4)

- Stock-level impacts of different red king crab PSC levels in the RKCSA and NMFS 512 at current levels of BBRKC abundance
- Relative importance of RKCSA and NMFS 512 with respect to the BBRKC stock
- Likelihood that BBRKC area-swept biomass estimate is $> 50,000$ mt over the next 10-15 years, given projected ecosystem conditions; merits of “area-swept trigger” compared to “crab-closure trigger”



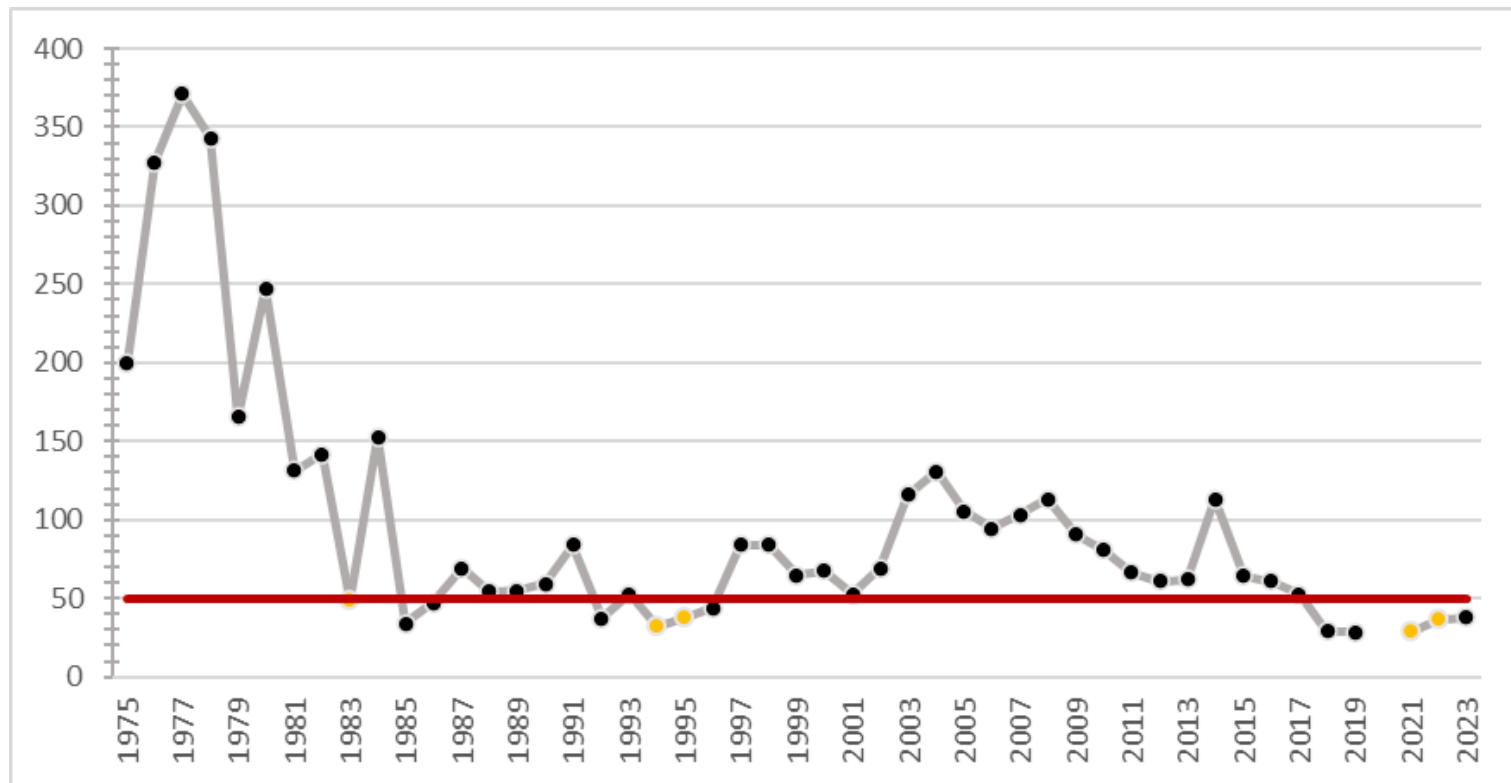


Figure 2-1 Total survey biomass “area-swept” estimate (mt), 1975-2023; survey years preceding a BBRKC directed fishery closure are highlighted in orange



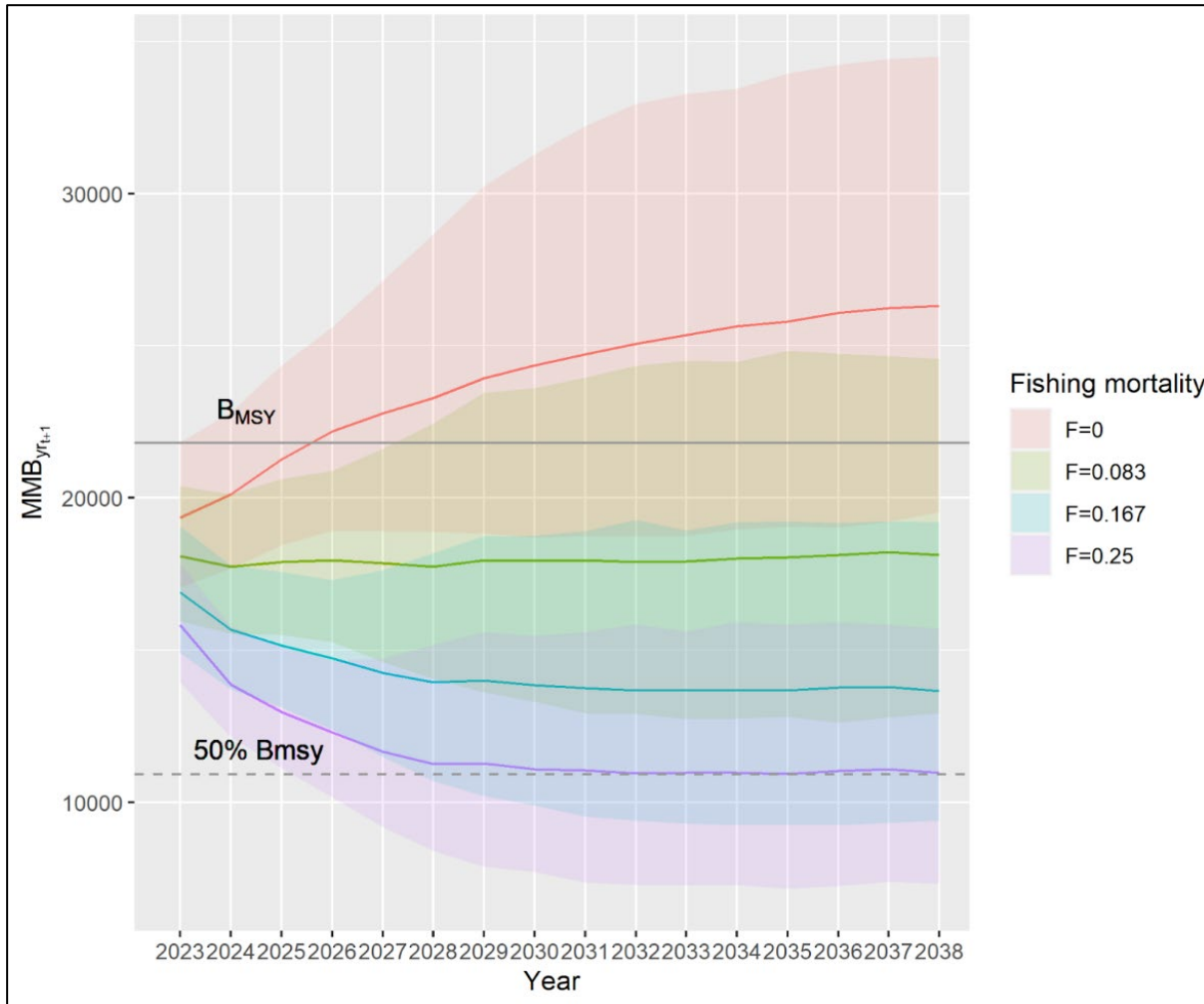


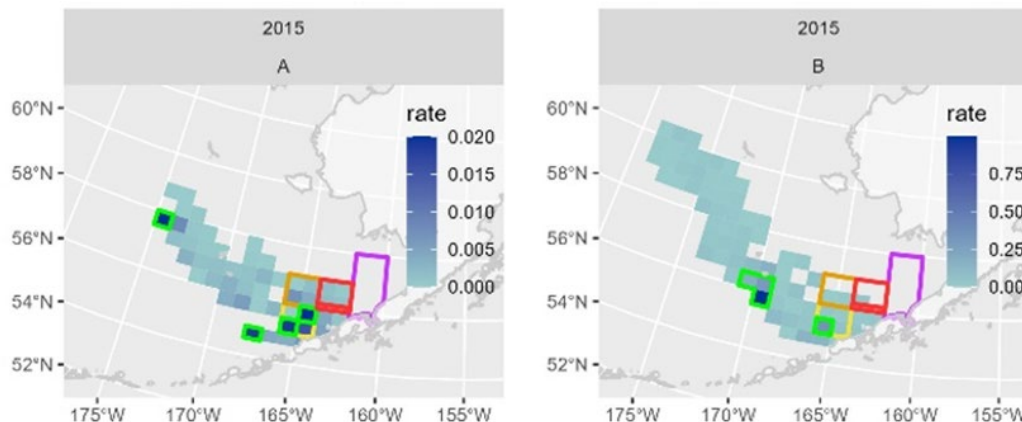
Figure 2-2 Mature male biomass (MMB) projections (15 years) for BBRKC under different levels of fishing pressure



PSC Rate-Based Approach

- June 2023, Council: “Incorporate the 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.”
- Estimated annual & seasonal PSC impacts under Alts. 2 and 3 from 2013-2022
- The areas **displaced to** represent a ‘maximum’ scenario’ where statistical areas with the highest average PSC rates were chosen as groupings of equivalent size to the areas **displaced from**

$$\Delta PSC = (GF Catch_{old\ area} \times [PSC/GF\ Catch]_{new\ area}) - PSC_{old\ area}$$



CPUE-Based Approach

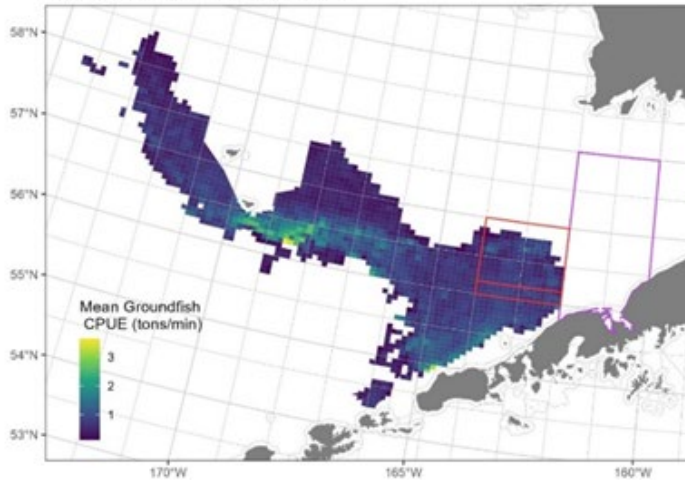
- June 2023: SSC recommended staff “*develop a richer and better integrated model of effort displacement across the fleets,*” and “*using the predicted spatial effort reallocation, estimate key outcome variables*”
 - Council requested staff “*Incorporate SSC recommendations as practicable for additional steps to more accurately portray the likely range and certainty of costs and benefits of the proposed alternatives.*”
- A catch per unit effort (CPUE) model was developed to assume location choice based on fleets choosing areas of highest catch rates
- Effort displaced to the new areas identified, PSC estimated as follows:

$$\Delta PSC = (\text{Displaced Effort}_{old\ area} \times PSC\ CPUE_{new\ area}) - PSC_{old\ area}$$

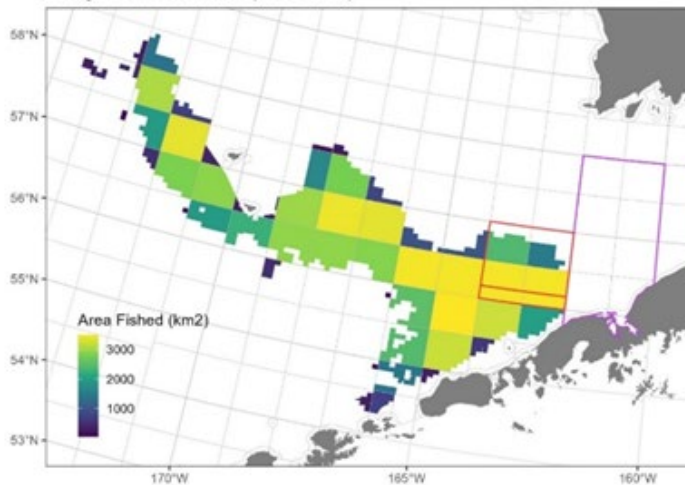


Selection of Displacement Locations

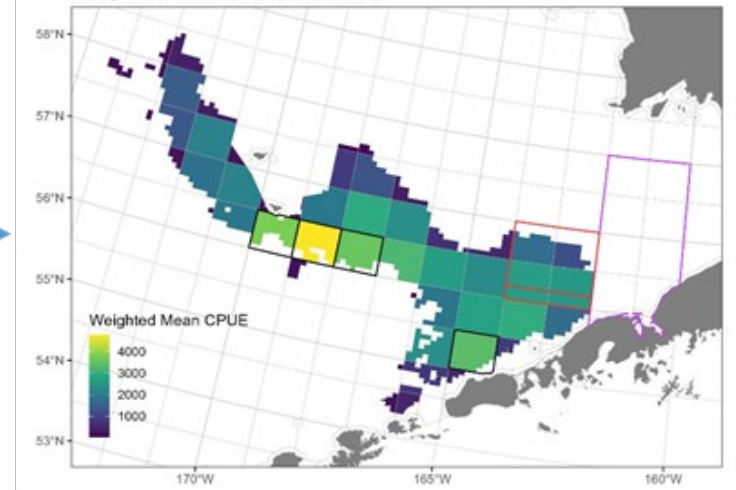
Pelagic Trawl A Season (2013-2022)



Pelagic Trawl A Season (2013-2022)

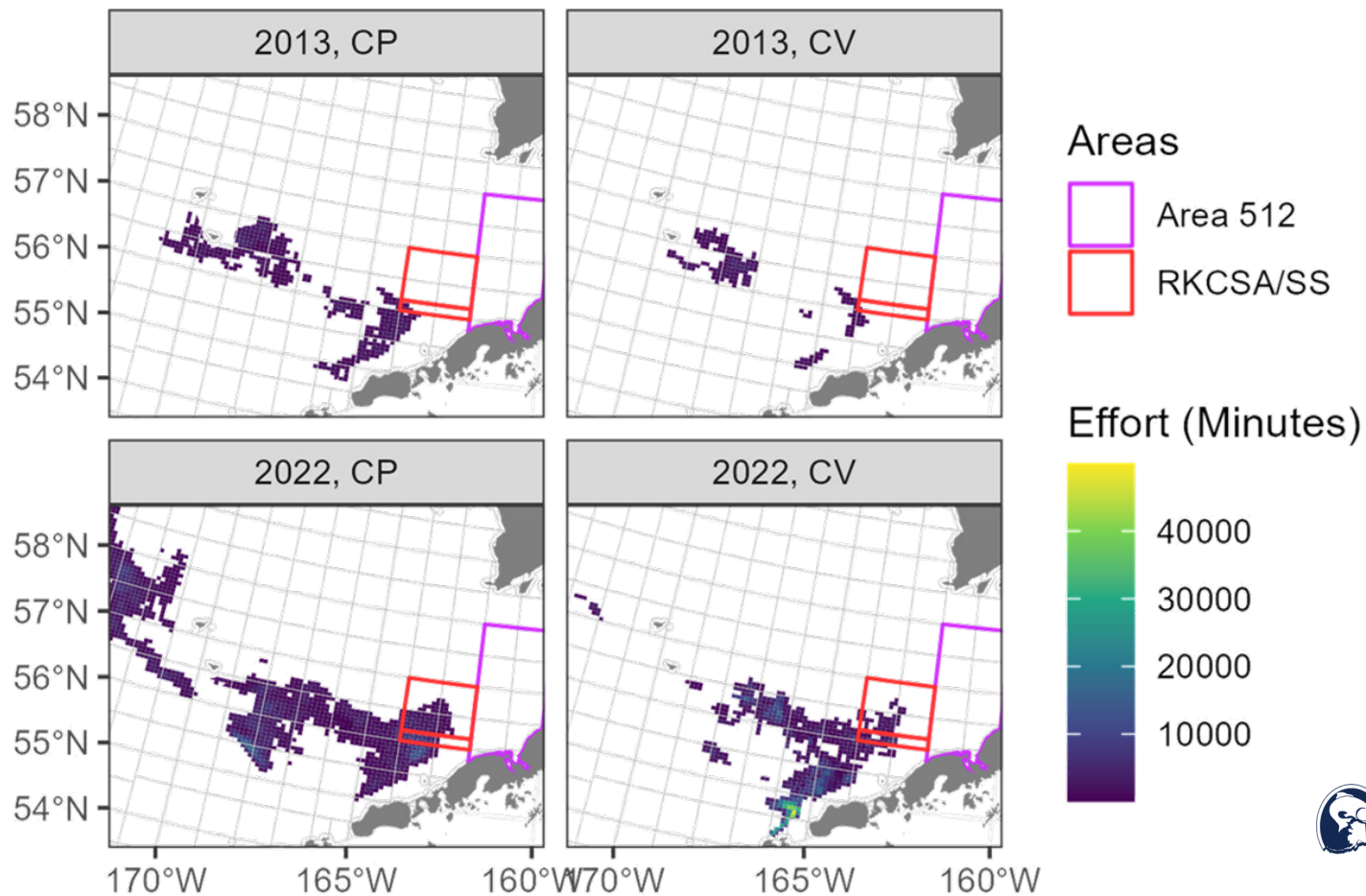


Pelagic Trawl A Season (2013-2022)



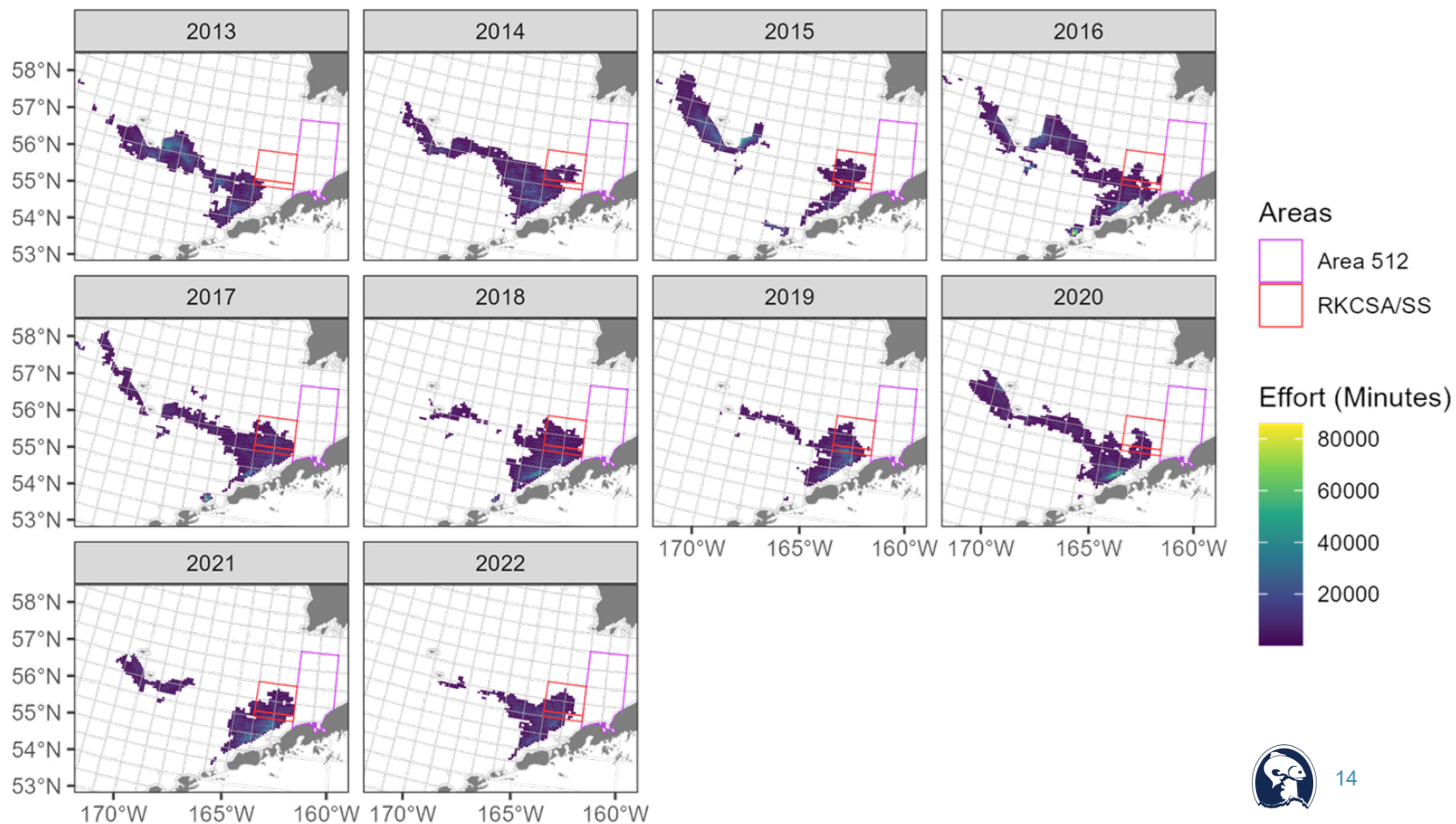
Effort Displaced [Example]

Pelagic Trawl Effort: A Season



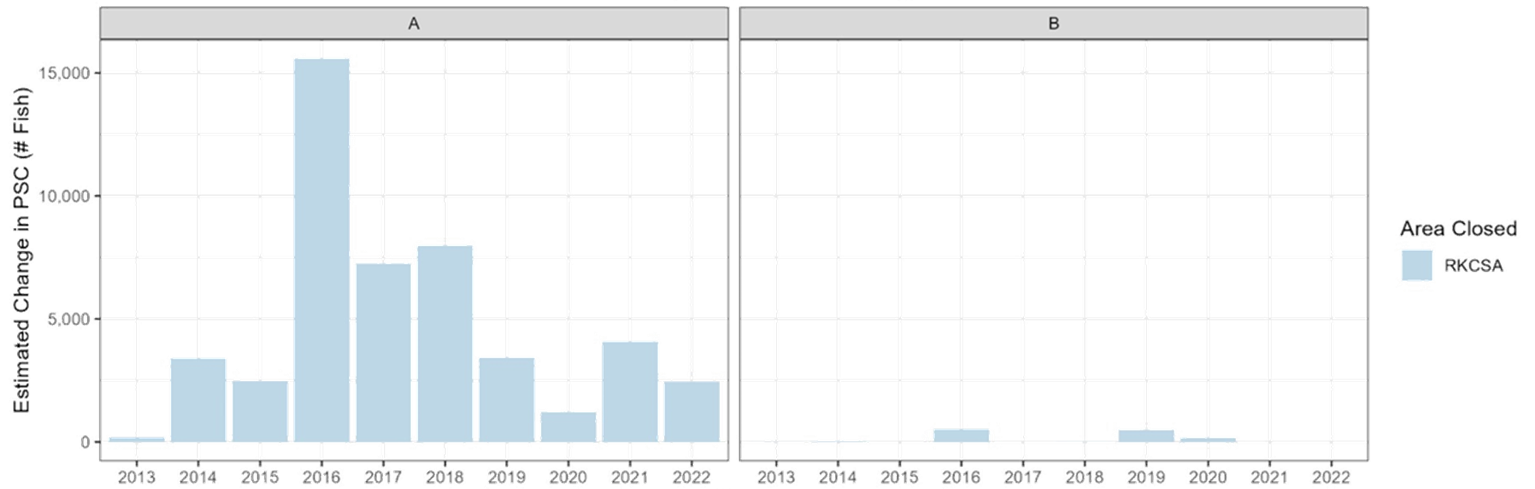
Effort Displaced [Pelagic Trawl]

Pelagic Trawl Effort: A Season

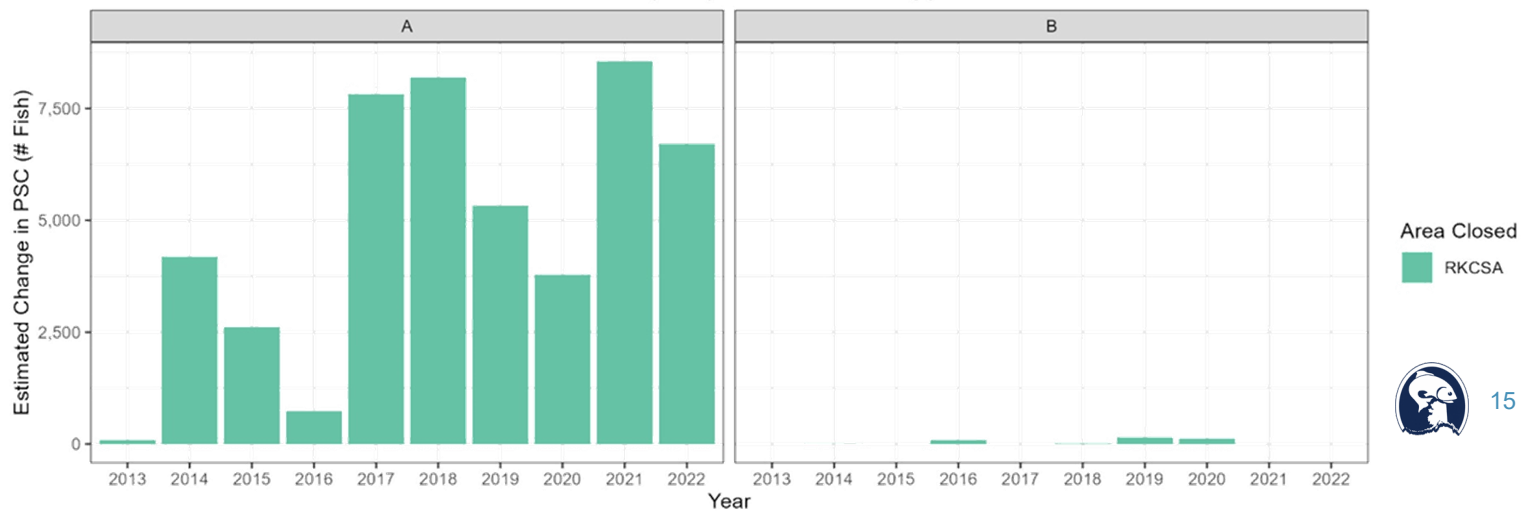


Estimated PSC Change: Chinook in PTR

Chinook Salmon (PTR) - PSC Rate Approach

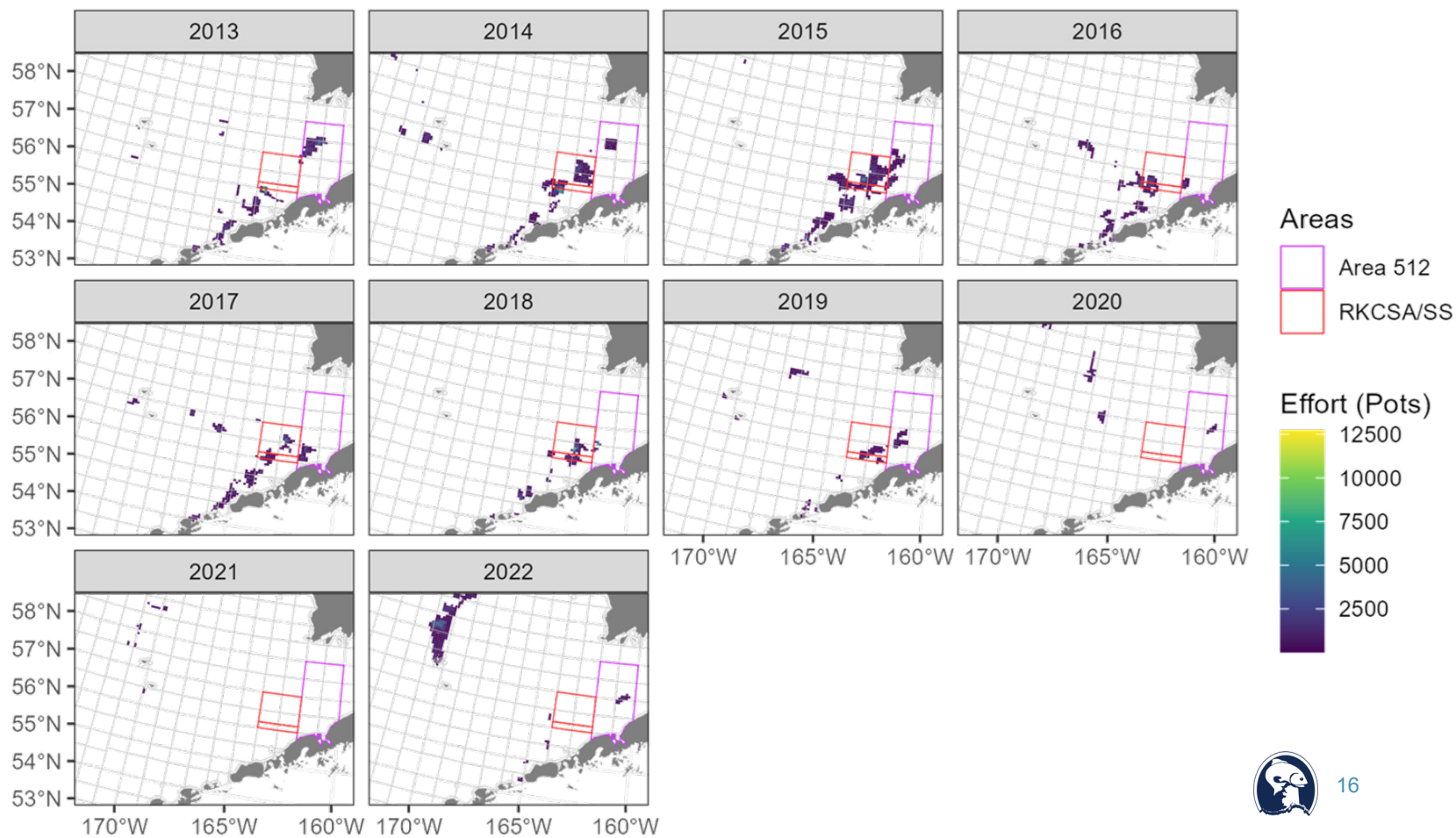


Chinook Salmon (PTR) - CPUE-Based Approach

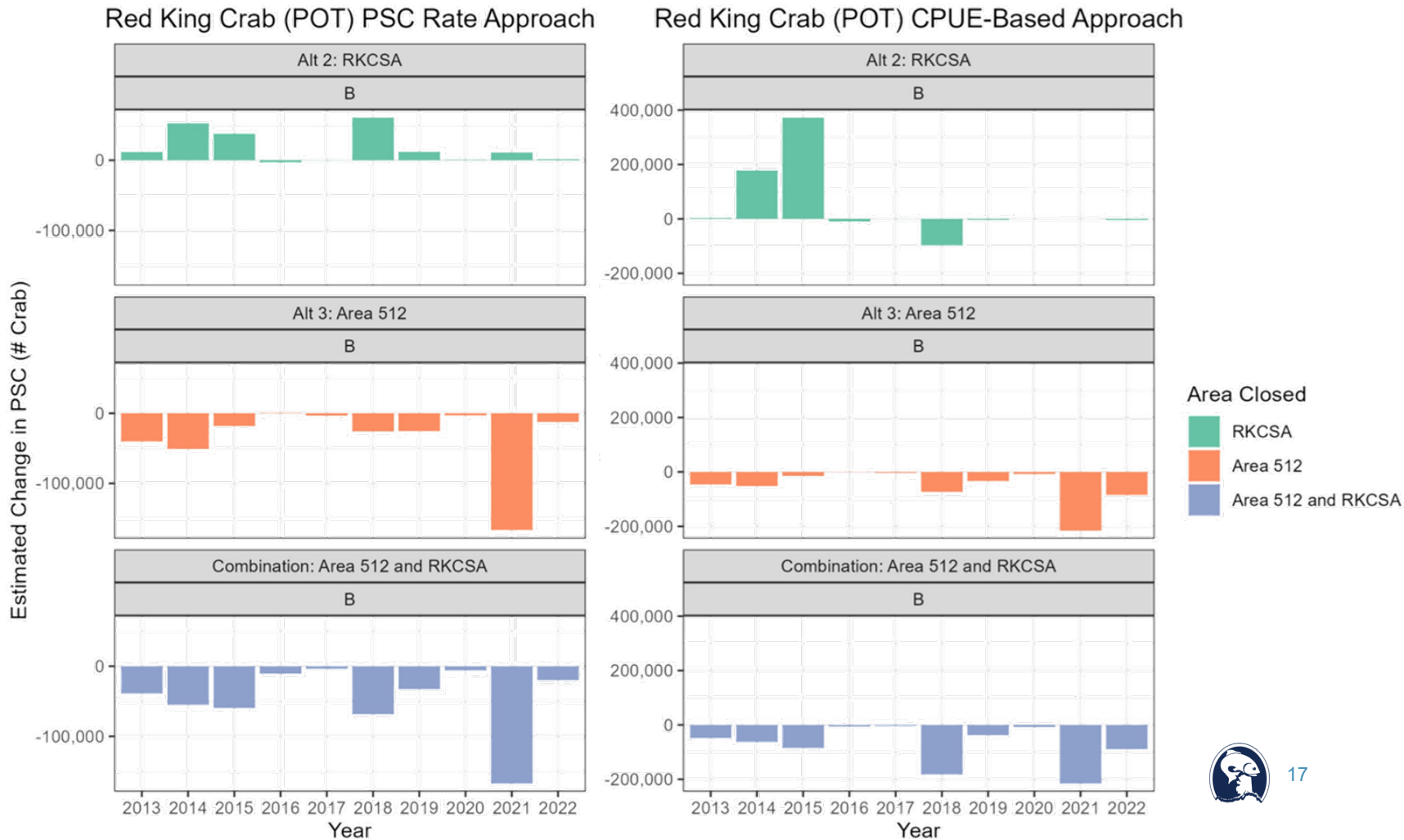


Effort Displaced [Pot]

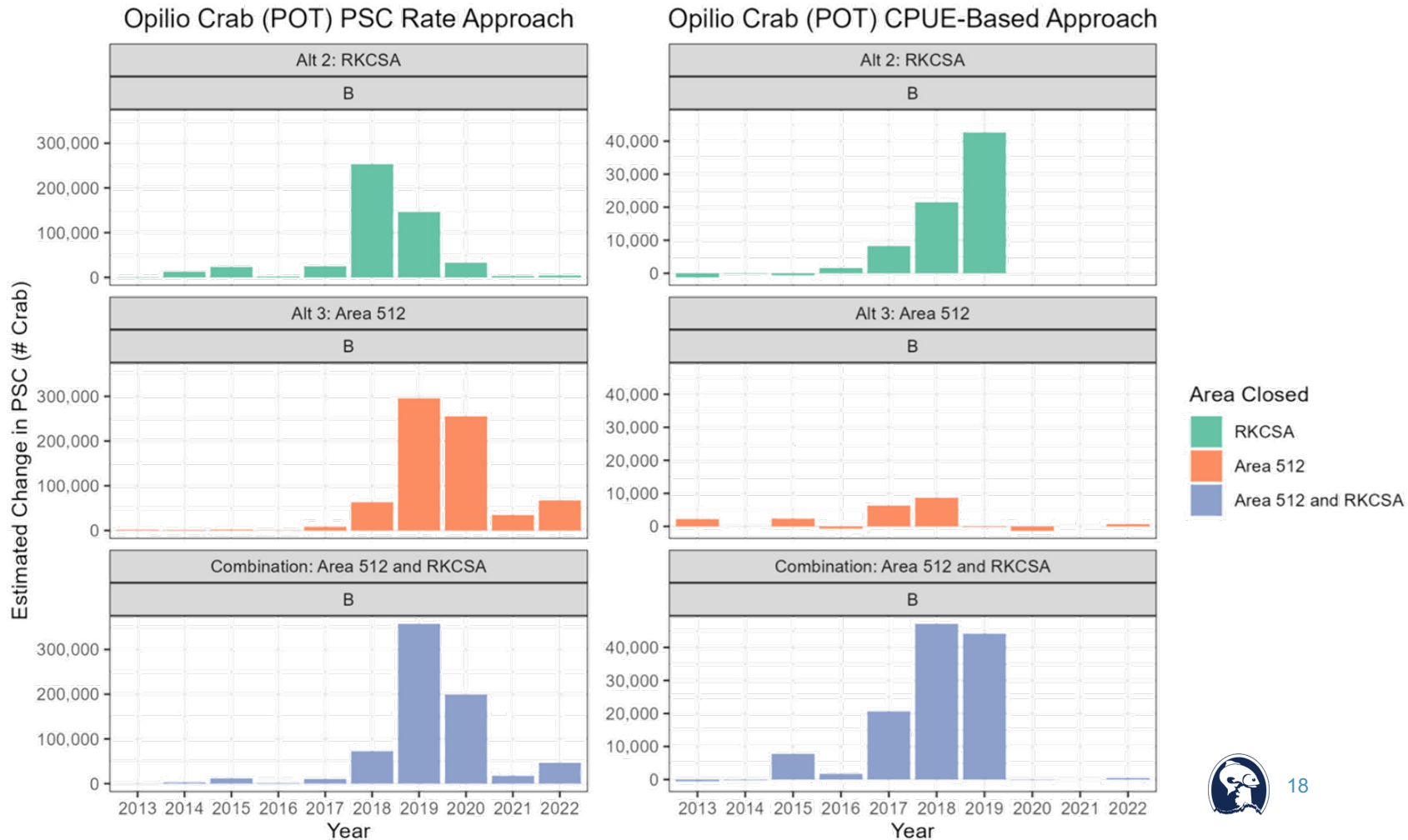
Pot Cod Effort: B Season



Estimated PSC Change: RKC in POT

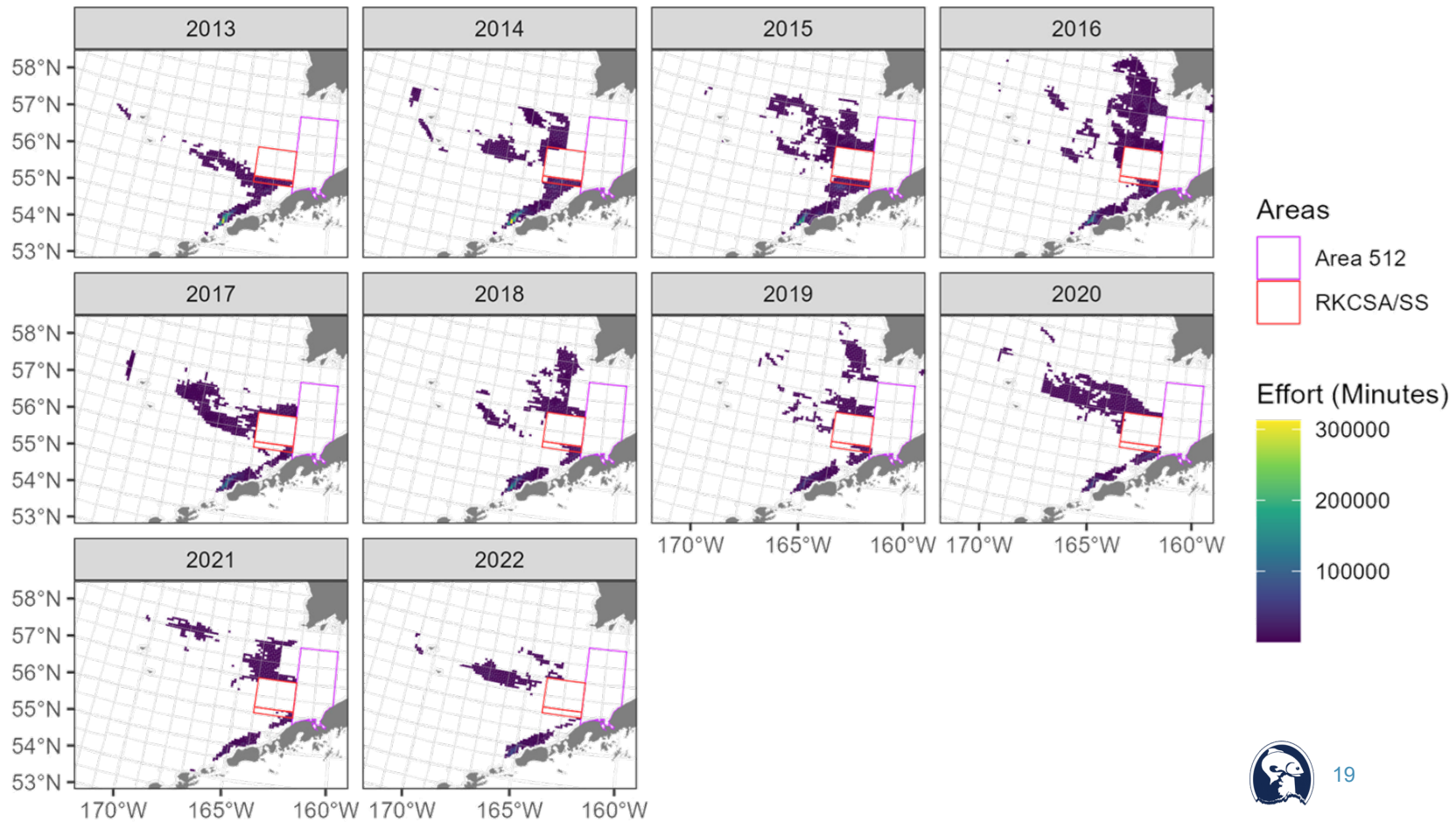


Estimated PSC Change: Opilio in POT



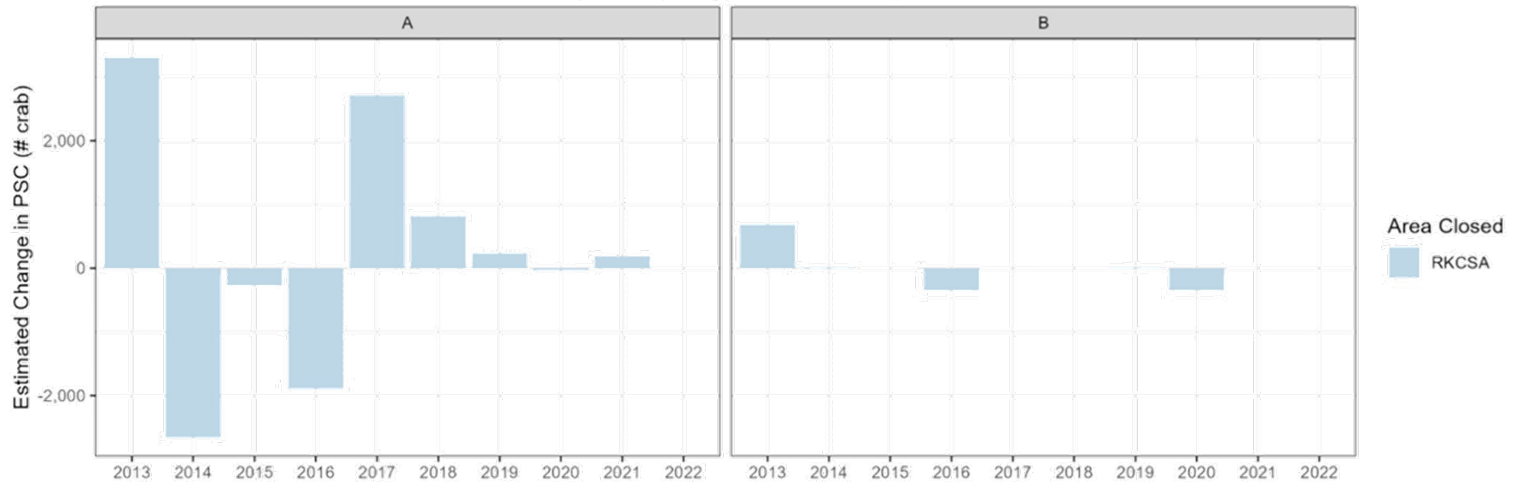
Effort Displaced [Non-Pelagic Trawl]

Non-pelagic Trawl Effort: Rock Sole & Pacific Cod, A Season

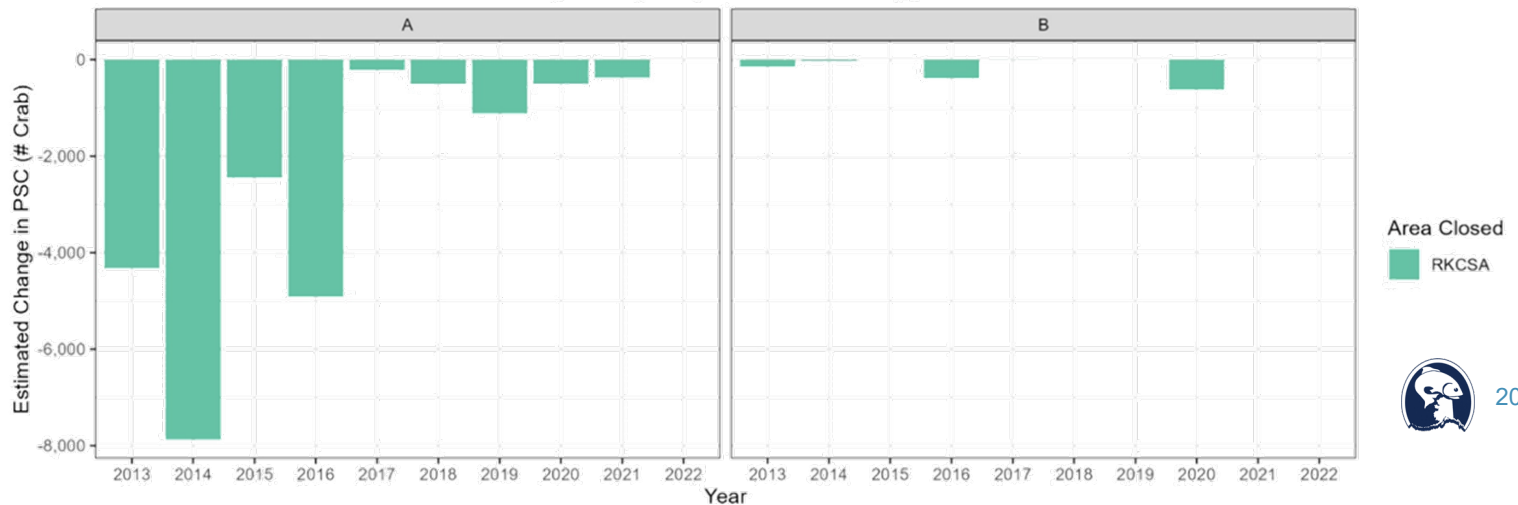


Estimated PSC Change: RKC in NPT

Red King Crab (NPT) - PSC Rate Approach

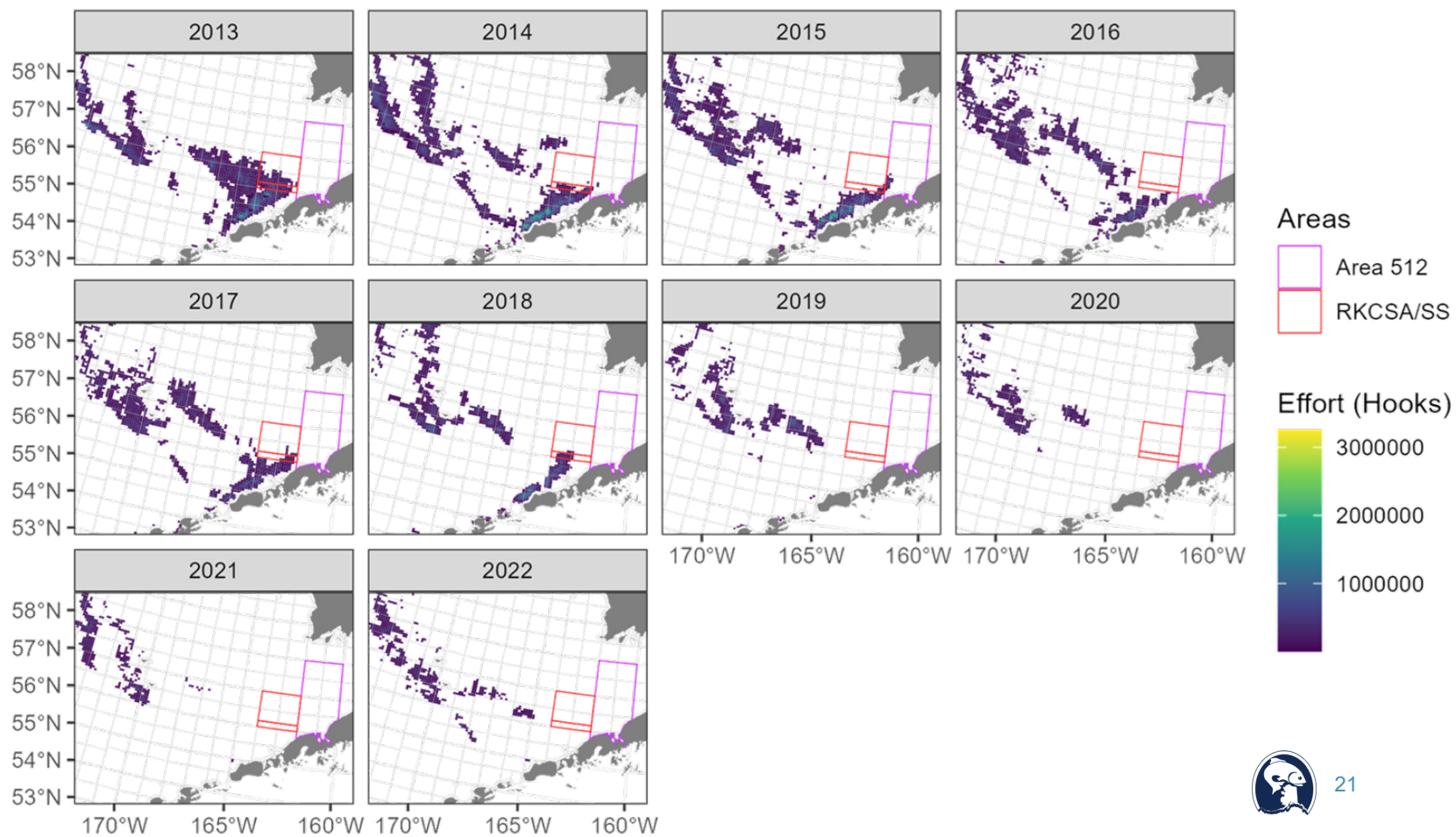


Red King Crab (NPT) - CPUE-Based Approach



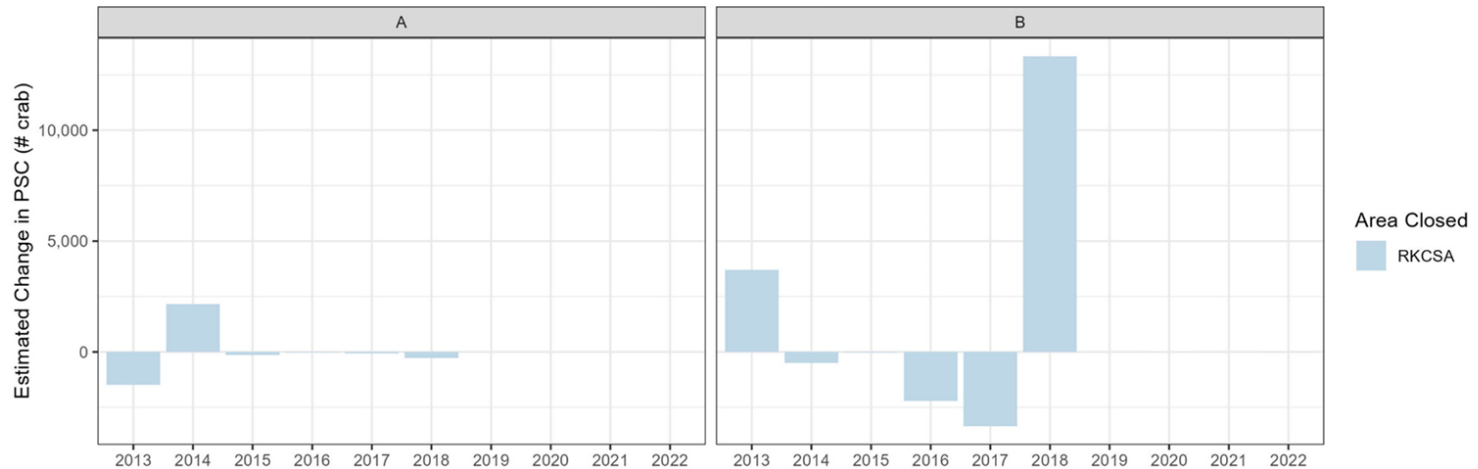
Effort Displaced [Hook-and-Line]

Hook-and-Line Effort: A Season

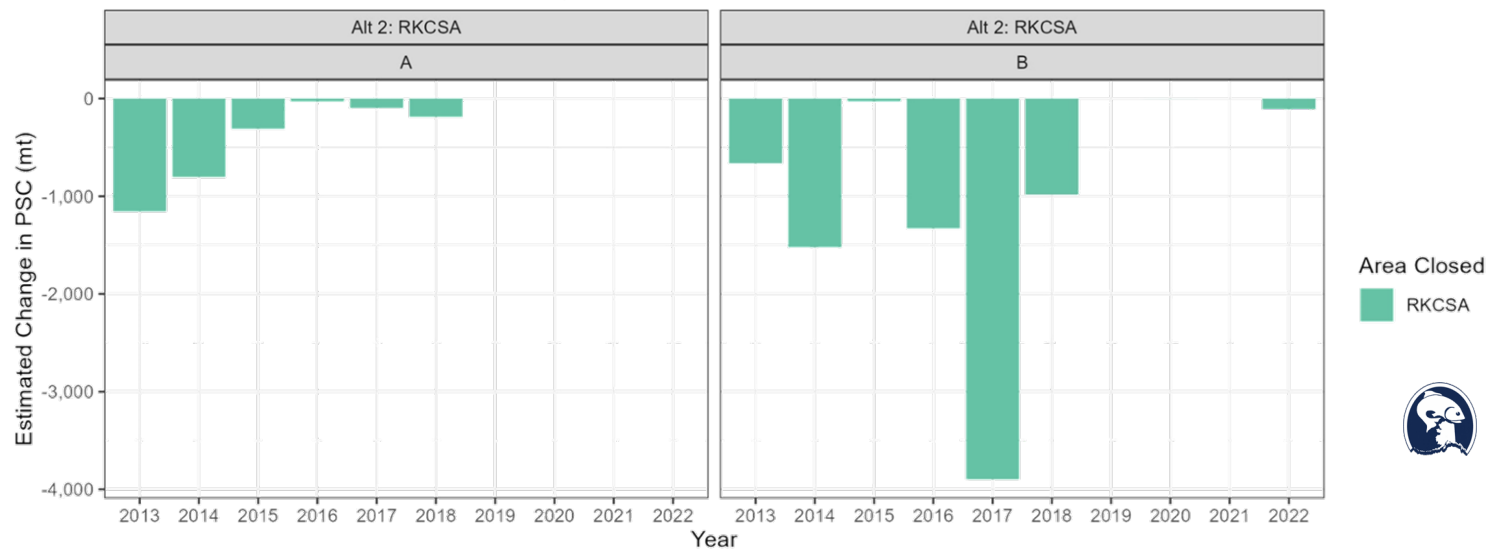


Estimated PSC Change: RKC in HAL

RKC (HAL) - PSC Rate Approach



RKC (HAL) - CPUE-Based Approach



Conclusions

- RKC PSC reduced in Alt. 2 (NPT and HAL) and Alt. 3 (POT), but increased in Alt. 2 (POT)
- Tradeoffs with increased PSC estimated for other species

PSC Species	Alt 2				Alt 3	Alt 2/3
	POT	NPT	PTR	HAL	POT	POT
Red king crab	↑	↓		↓	↓	↓
Opilio crab	↑	↑			↑	↑
Bairdi crab	NA	↑			NA	↓
Halibut		↑		↑		
Chinook salmon			↑			
Non-Chinook salmon			↑			
Herring			↑			

↓	Decrease
↑	Increase
↓	Uncertain
NA	NA



Environmental Assessment

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

- **Seabirds:** no effect on seabirds as a result of the proposed alternatives.
- **Target species:** Pollock, Pacific cod, Yellowfin sole, Northern rock sole- no stock is overfished or approaching overfishing
 - Effects of the alternatives on target species largely dependent on the reallocation of effort (Ch 3)
- **BBRKC:** updated for this review and may provide additional information for decision making
- **Habitat:** updated for this review and may provide insight into RKC habitat occupied by life-stage & season



BBRKC Status

- Molt/ Mate timing for BBRKC Jan-June
- Legal size male RKC decreased in 2023 (14,127 ± 5,125 t) from 2022
- Mature Female RKC increased 67% in 2023 (16,723 ± 13,381 t) from 2022
 - 37% were caught at 1 survey station N. of Port Moller
 - 23/24 BBRKC Season based on increased in female abundance meeting SHS threshold of 8.4 mil. females
- Female biomass low compared to historical values, and no strong signal of recruitment

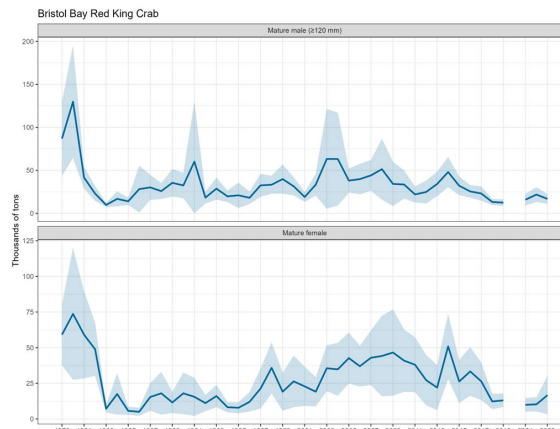


Figure 5-2

RKC Legal Male

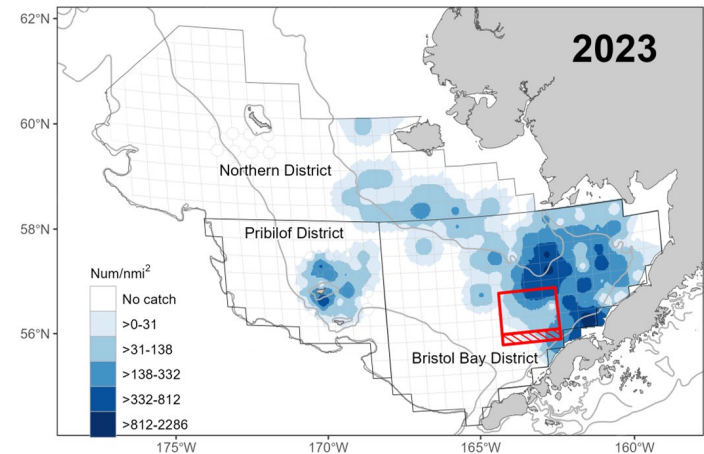


Figure 5-3

RKC Mature Female

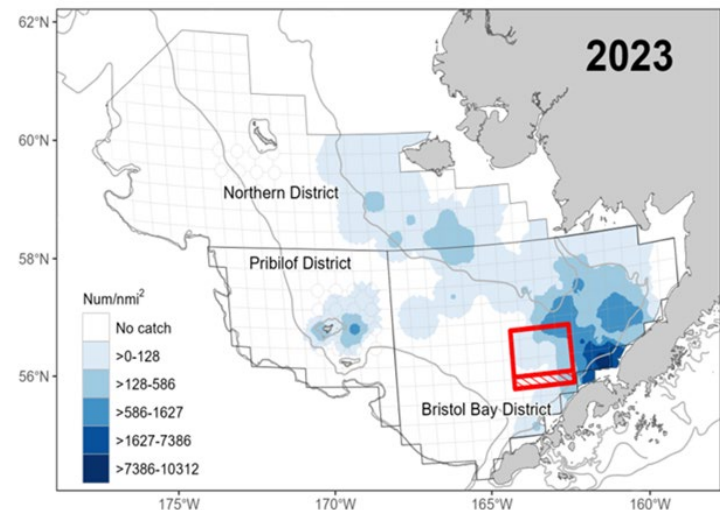


Figure 5-4

BBRKC in the RKCSA/SS

RKCSA/SS mean proportion:

- Immature M: 0.11 (0.03)
- Immature F: 0.07 (0.02)
- Mature M: 0.16 (0.03)
- Mature F: 0.11 (0.04)

Area 512 mean proportion:

- Immature M: 0.49
- Immature F: 0.55
- Mature M: 0.33
- Mature F: 0.58

Note: Mature Males highest proportion outside RKCSA/SS and Area 512 (0.40 in remainder of BB)

(Table 5-2)

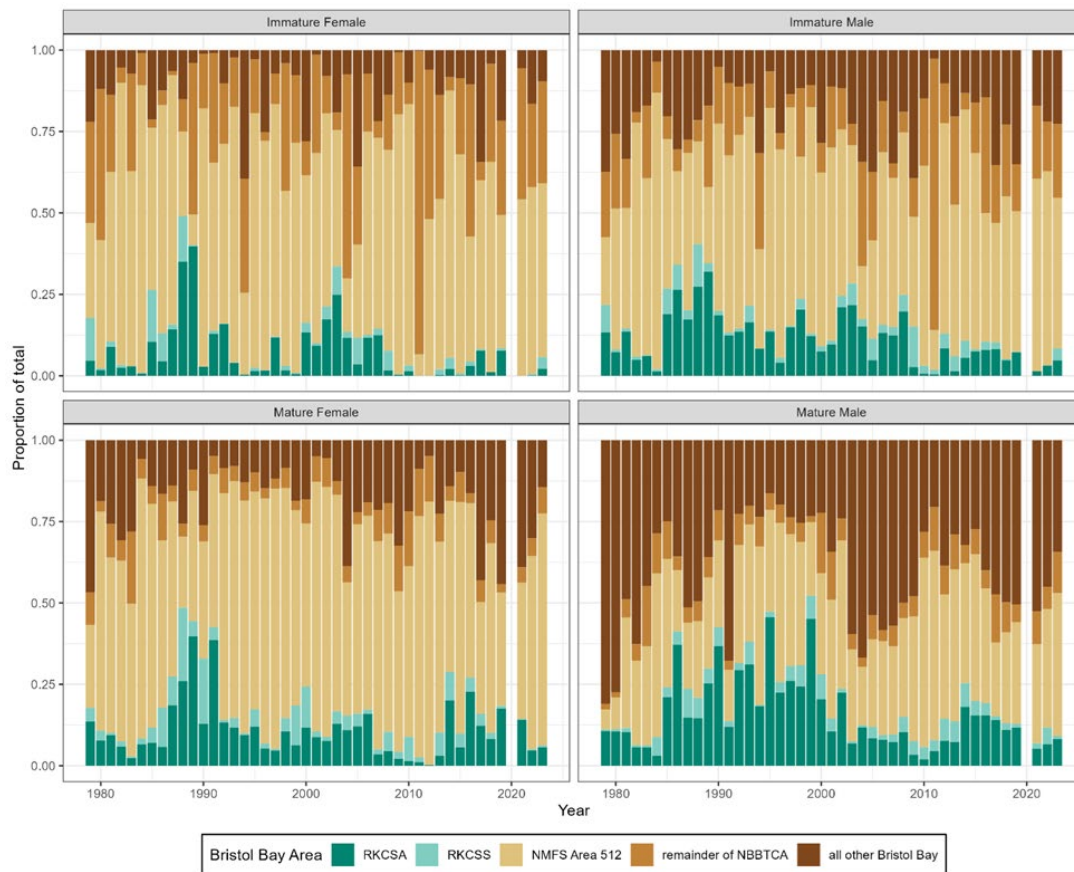


Figure 5-5

BBRKC Ongoing Research

■ Tagging Studies

■ Males:

- males tagged in the core Bristol Bay region (east of 164°W) tended to move towards the RKCSA
- Male crabs that were west of the 164°W tended to move southwest into deeper waters
- From Oct-June, there is consistent movement from RKCSA into shallower waters toward the north and east
 - Potentially temperature driven or for reproduction

■ Females:

- 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
- *Working hypothesis: females move in the spring to 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)



BBRKC Ongoing Research

- Spatial modeling effort to predict RKC distribution (Ch 5.5)
- CPS1 Survey Results and ongoing CPS2 planning (Spring 2024)
- Groundfish Predation Research
 - NMFS/FLC/ABSC collaborative research project to inform predator/prey dynamics between RKC and Pacific cod (2024 A season)
 - Sockeye Salmon runs could apply significant predation pressure to larvae and post-larval stage RKC
- UFMWG report- identified areas for ongoing research to best determine unobserved fishing mortality associate with gear

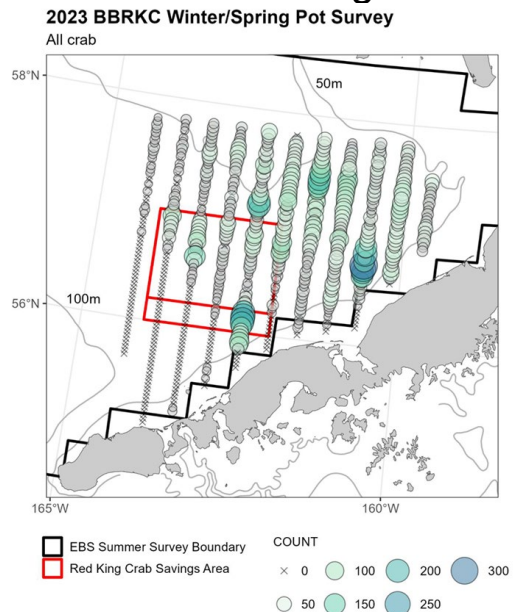


Figure 5-7

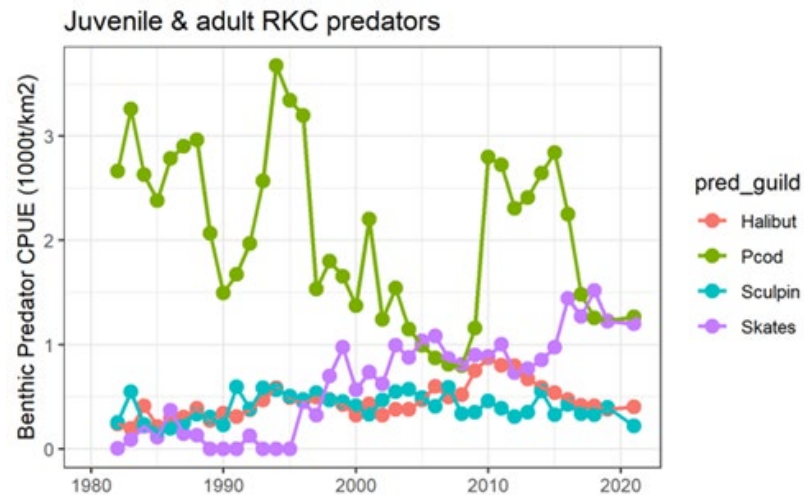


Figure 5-11



Effects of the Alternatives on BBRKC

- PSC shifts due to relocation. It is likely that a reduction in PSC would benefit the BBRKC stock
 - PSC is a factor to consider, but is likely not the sole driver behind low recruitment in the stock
 - Potential benefit from reduced unobserved mortality- more research is necessary to quantify the magnitude of UFM by gears
- Predator- Prey dynamics shift
 - potential for an increase in predation if fishing pressure is removed from the RKCSA/Area 512 with high concentrations of pacific cod
- 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.



BBRKC Habitat

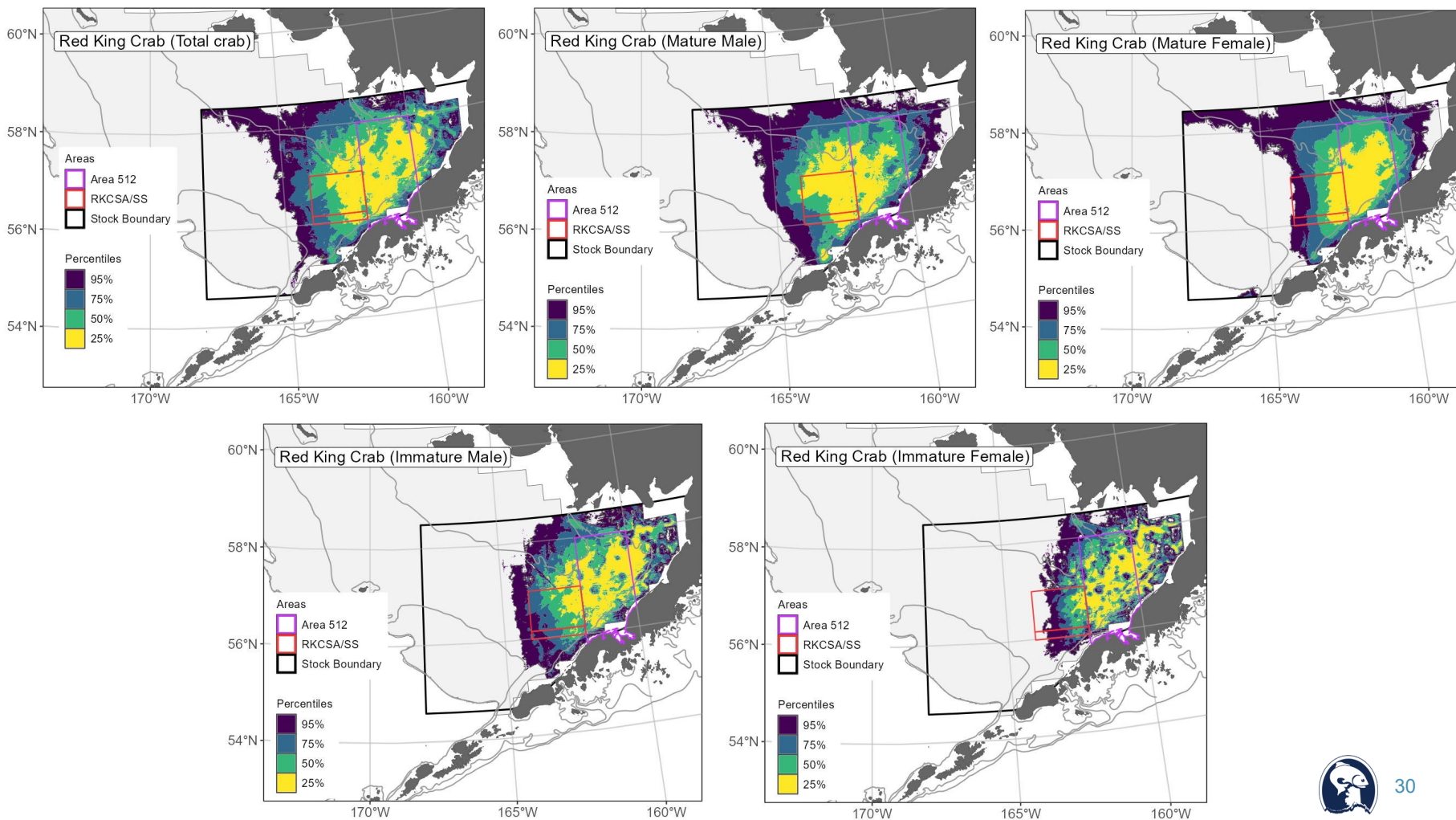


Figure 5-14
Appendix 3: SDM Methodology



BBRKC Habitat

- Across all life stages Area 512 and RKCSA are in the top 50% for habitat occupied
- Immature males and females occupy a higher % of habitat in Area 512 than RKCSA
- Mature Males occupy a higher % of habitat in RKCSA
- Main takeaway: Habitat in the RKCSA and Area 512 are important to BBRKC
 - Habitat is critical to RKC in providing refuge during juvenile life stages and during molt/mate timing

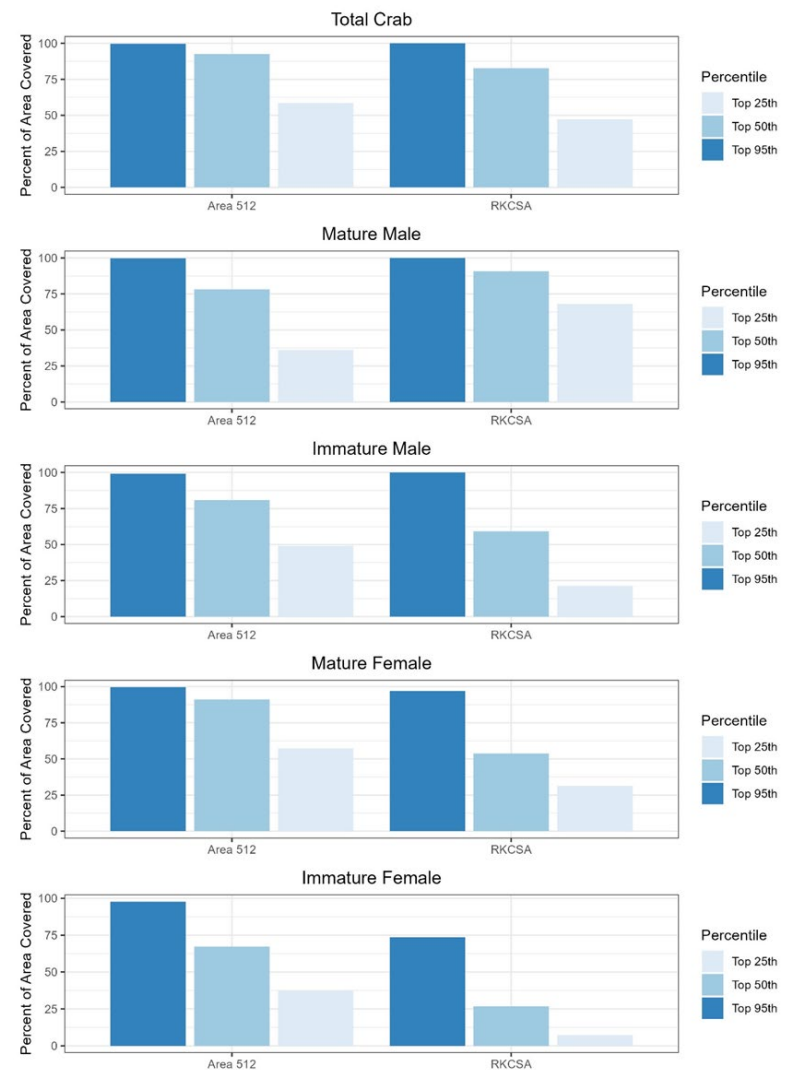


Figure 5-15

BBRKC Habitat

- Mature Male: >120mm CL
- Legal Male: >135mm CL

Fall Encounter rate Map RKC Legal Males

- Largely be absent from the southwest corner of the RKCSA and the Bristol Bay management area
 - Consistent with Summer habitat occupied map, CPS1 survey and bottom trawl survey
- Encounter probability is higher in the northwest corner of the Bristol Bay management area than in the southwest.
- Seasonal shifts in RKC habitat occupied from summer to fall
- A potential temperature- dependent shift in movement of legal males in and out of the RKCSA ([January 2024 CPT ppt](#)).

Fall RKC Legal Male Encounter Probability

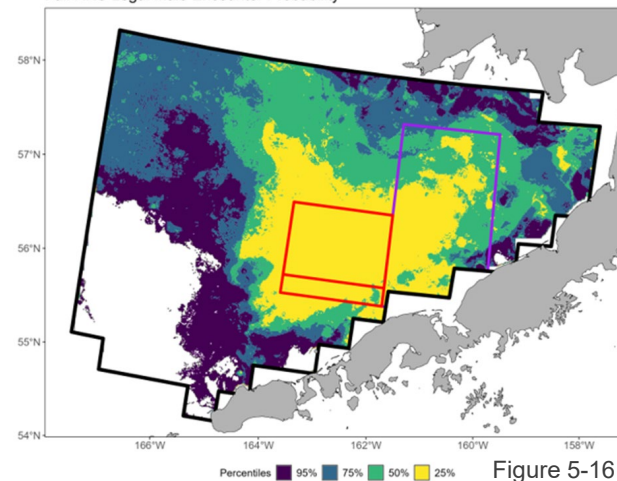


Figure 5-16

Fall Red King Crab Legal Male Sampling Distribution
N = 47,746

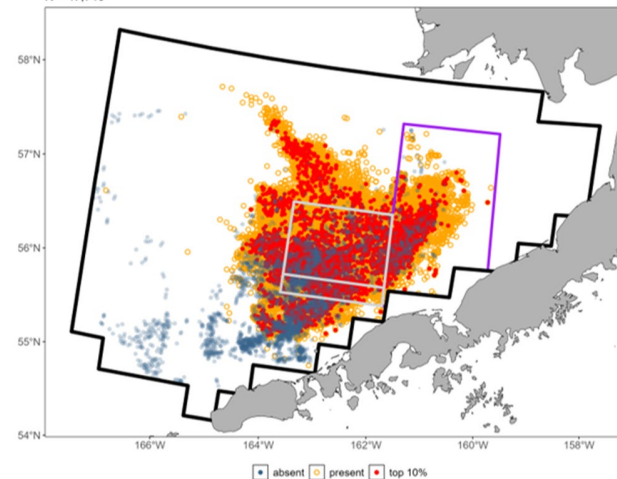


Figure 5-17



Bottom Contact

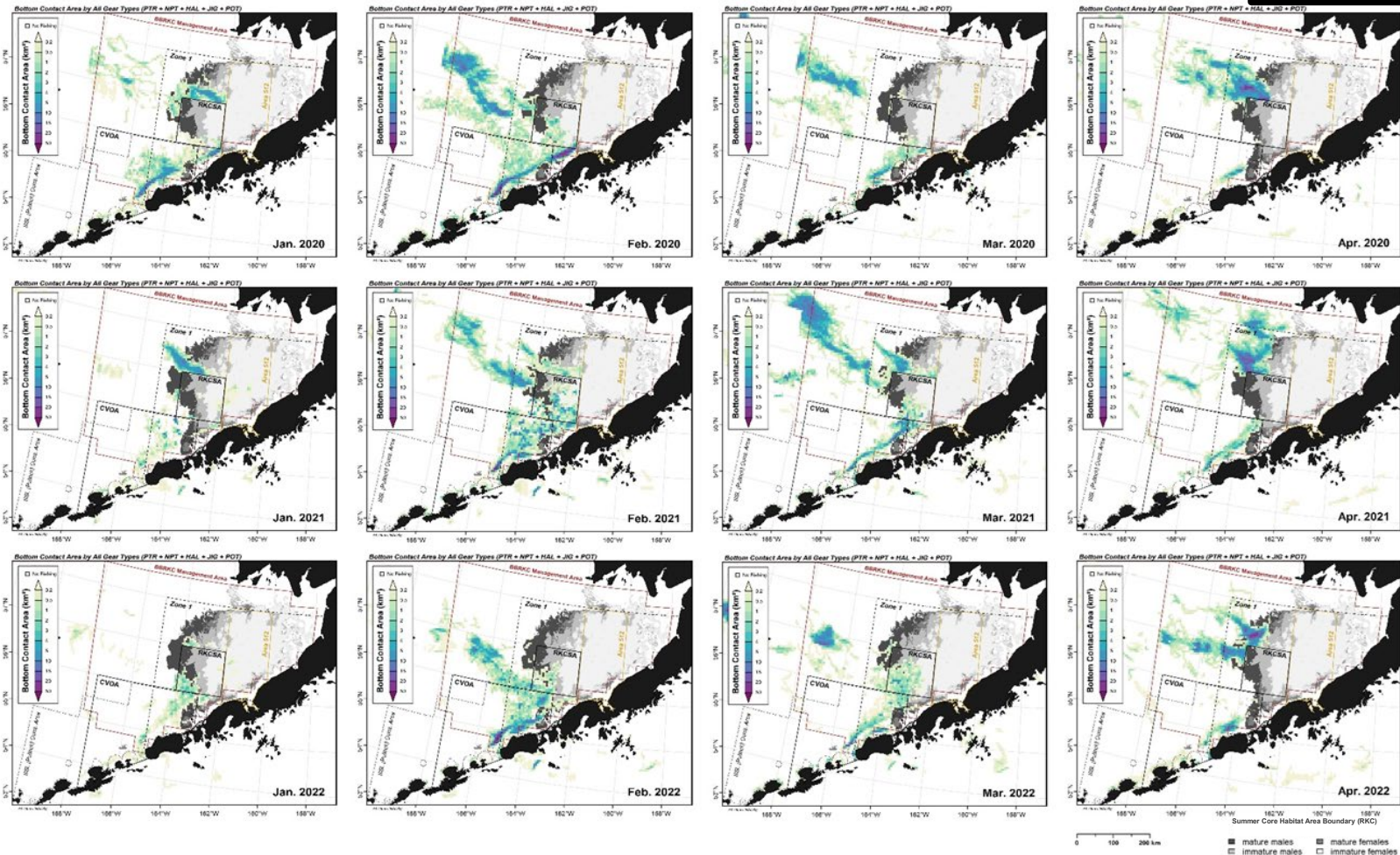
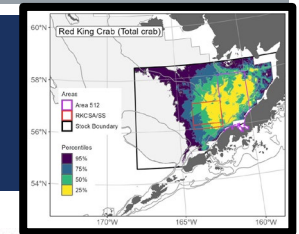


Figure 5-18

Bottom Contact

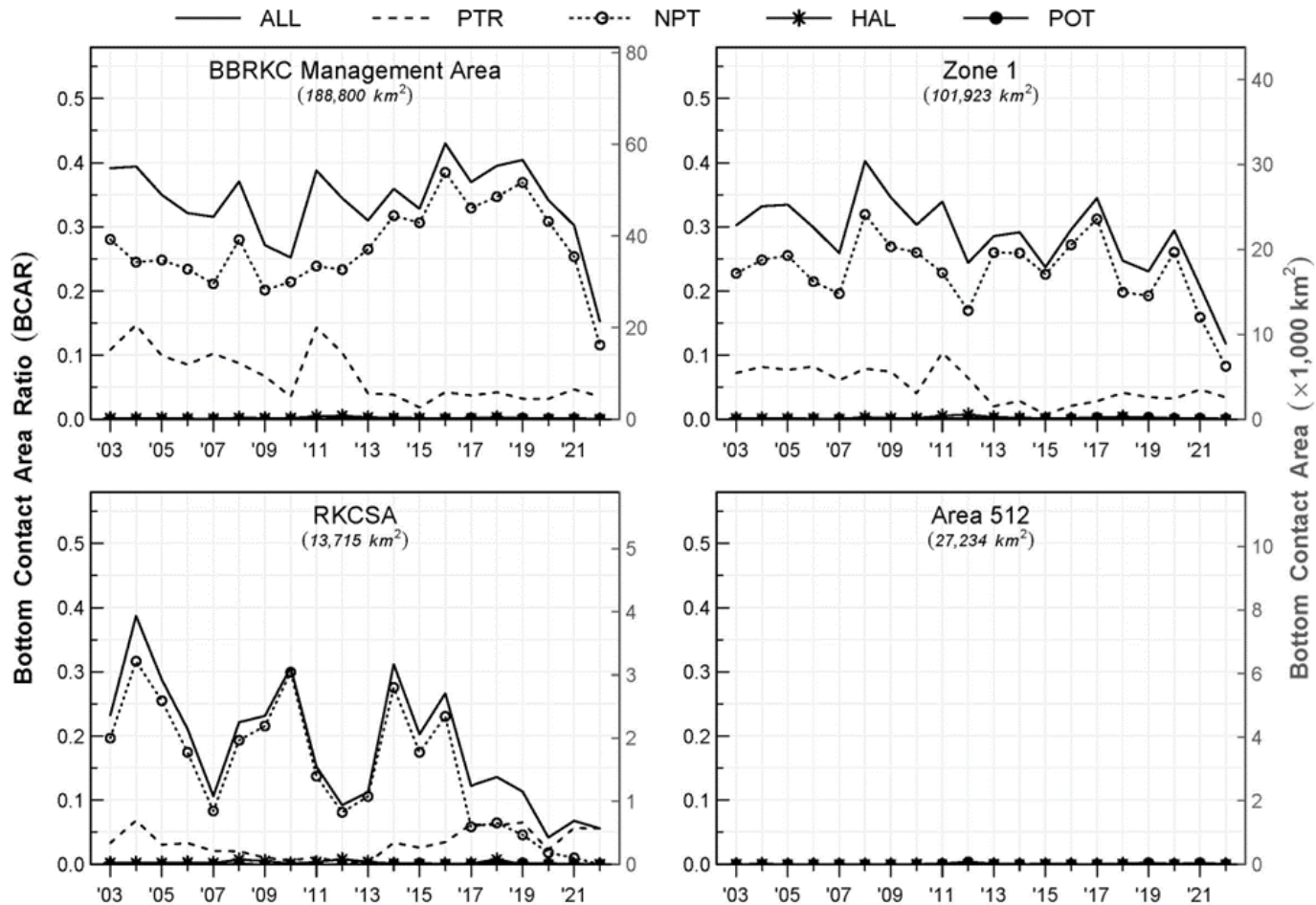


Figure 5-19



Effects of the Alternatives on BBRKC Habitat

- Potential redistribution of habitat disturbance as a result of fishing in areas outside of the RKCSA and/or Area 512 (CH 3)
- Both RKCSA and Area 512 are the top 25% of habitat occupied by RKC of all life stages
- Bottom contact in the A season may overlap with mate-molt timing in the core habitat occupied, specifically RKC in the RKCSA where fishing activity is higher that time of year.
- Area 512 may act as important habitat for females and immature males and females
 - Continued research on the unobserved mortality associated with pot gear in Area 512 to better quantify the effects of fishing on RKC
- Reduction in fishing effort, specifically trawl effort rather than displacement would likely result in net benefit to habitat critical for RKC in the RKCSA.



Framework Approaches (Appendix 4)

- *Similar goals to the alts (reduce BBRKC mortality in RKCSA/512) “but would be more dynamic and responsive to seasonal spatial distribution of BBRKC and focus on more discrete areas of relatively higher female BBRKC abundance”*
- Discussion stems from Council’s requested reports on
 - Time/area closures
 - Incentive-based approaches (e.g., rolling hotspots; PSC limit buffers)
 - Limitations on dynamic mgmt. (e.g., public process requirements; NMFS Inseason Mgmt. Authority)
 - Scientific information needed to create dynamic closed areas



Framework Approaches: Stakeholder Input

- Pacific cod pot (~Alt. 3)
 - Ability to fish east of a boundary contingent on an agreement RE: bycatch minimization measures
 - Examples: sock tunnels/gear mods; increased observer coverage; hot spot reporting; AIS; 'other' measures that could be implemented more rapidly outside of Fed regulatory process
 - Requirements of agreement could vary by season (bycatch levels, crab vulnerability)
 - Challenges: appropriate third-party required, lack of cooperative structure, ability to fairly and comprehensively deal with crab sector, availability of observers (esp. in the context of tendering), reporting requirements, enforceability



Framework Approaches: Stakeholder Input

- Trawl sectors
 - Allow flexibility to pursue times/locations of “clean fishing” – in terms of crab, other PSC species, CPUE, and quality
 - Should be paired with changes to static area closures
 - Existing cooperative structures and experience with real-time third-party information management and reporting requirements
 - Ability to adopt “test protocols” to determine crab presence and share information
 - Avoiding crab requires knowledge of crab location. In the form of:
 - Direct response to presence of crab? (trawl gear varies in retentiveness)
 - Dynamic estimation of likely crab location? (imperfect information)
 - Should define objective: Avoid interaction with specific RKC (e.g. mature female)? Avoid key habitat areas?
 - Modifying closure areas is high-stakes; should be based on hard data
 - Proxy data; inter-sector data sharing
 - Are data from one sector reflective of another sector? (time/location/observer coverage)



Sec. 8: Pelagic Trawl Performance Standard

Evaluation of the Pelagic Trawl Performance Standard

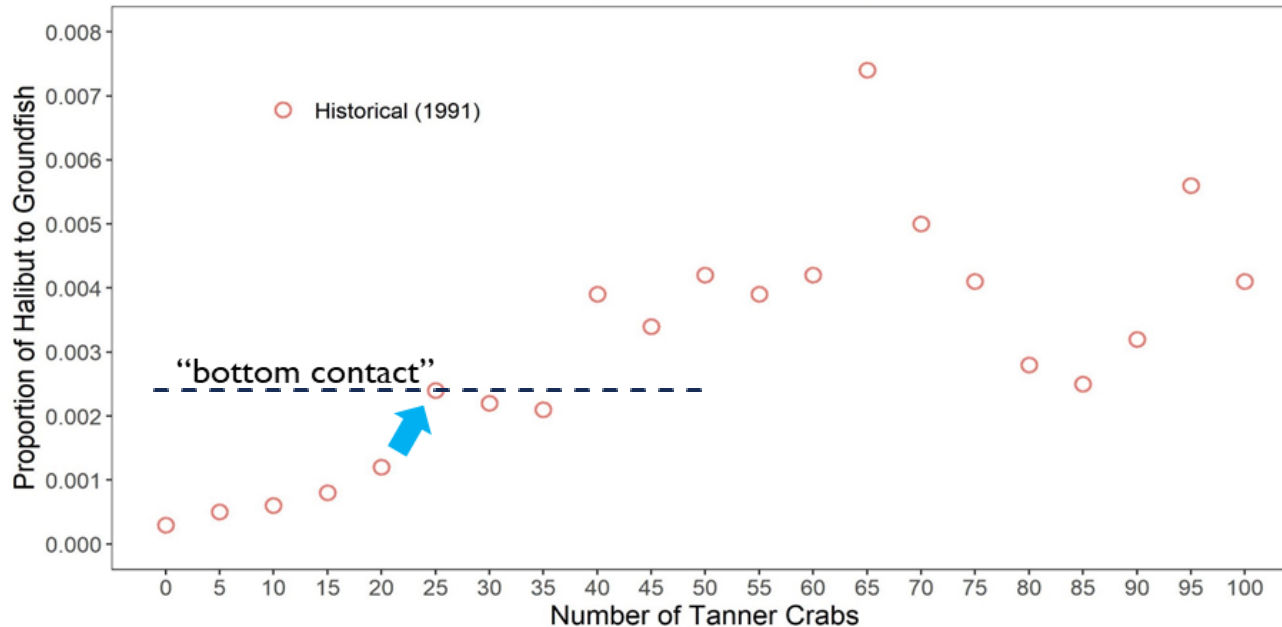
50 CFR 679.7 Prohibitions (a)(14)

(i) **BSAI.** Use a vessel to participate in a directed fishery for pollock using trawl gear and have on board the vessel, at any particular time, 20 or more crabs of any species that have a carapace width of more than 1.5 inches (38 mm) at the widest dimension.



Pelagic Trawl Performance Standard

- 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.*”
 - Implemented as the *means* to discourage or prevent trawl operations on sea bed
 - Modified in 2000 to apply at all times
- 1991 observer data: as halibut bycatch doubled when > 20 crab caught, the Council considered > 20 crab as likely the result of operating a trawl on the sea bed



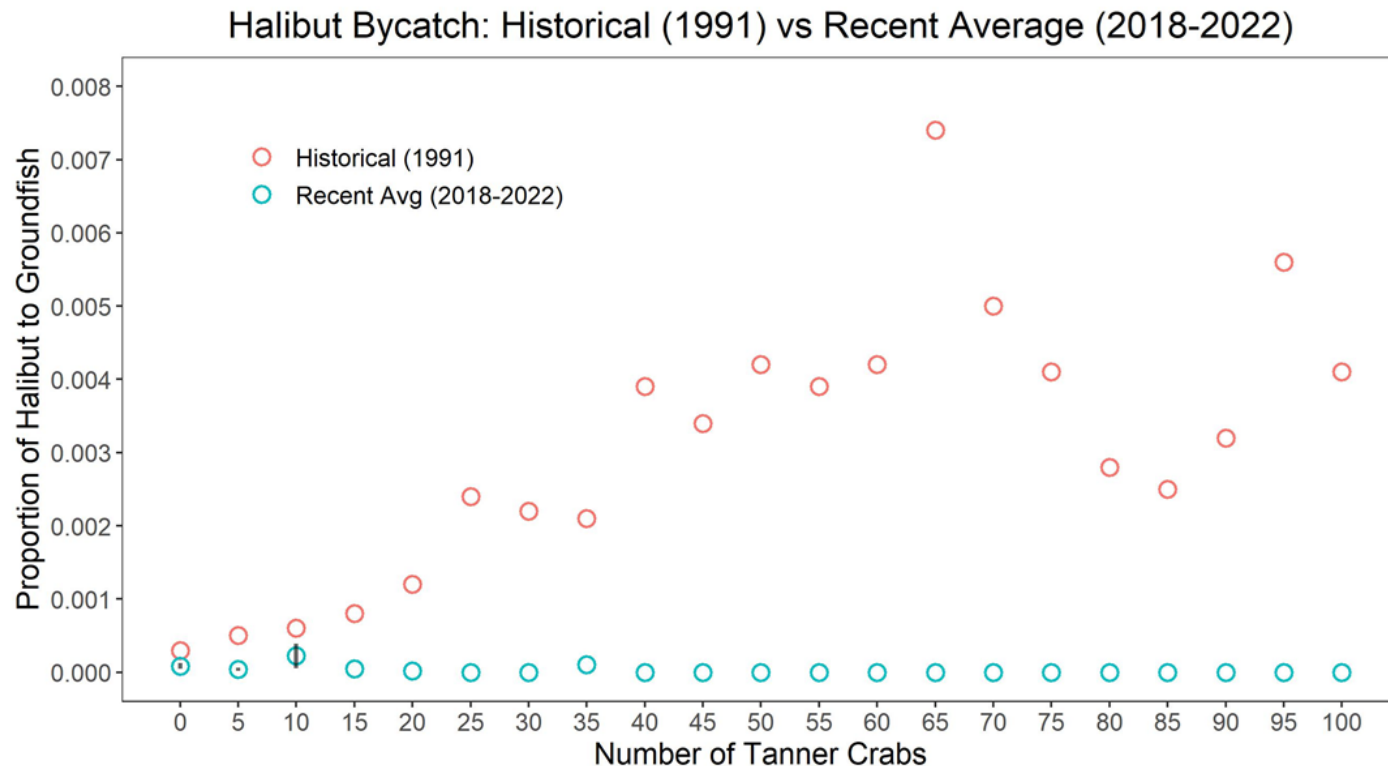
Pelagic Trawl Performance Standard

- **1993 PR:** “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.”
- **2000 EA/RIR/IRFA:** 1.2.2 “Alternative 2 (**preferred**): Prohibit the use of nonpelagic trawl gear in the BSAI pollock fishery. Only pelagic trawl gear as defined in regulations could be used by vessels when engaged in a directed pollock fishery. 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.”



Pelagic Trawl Performance Standard

- Evaluation: Same analysis for recent years (2018-2022)
 - Substantially lower halibut bycatch rates



CHALLENGES WITH REPORTING CRAB NUMBERS FOR TPS

- The only way OLE has historically learned about trawl performance standard violations has been from observers
- Extrapolated data from observer samples cannot be used by OLE as evidence to prove TPS infractions (only direct observations of “at any particular time, 20 or more crabs of any species that have a carapace width of more than 1.5 inches (38 mm) at the widest dimension”)
- Observer priorities emphasize random sampling; collection of crab from outside composition samples is not the norm;
- Observer data recording protocols are not designed to easily record crab sizes for animals collected non-randomly and outside samples;
- Observers have reported safety concerns about collecting (or requesting crew collect) crab from the footrope, intermediate mesh, or otherwise outside the codend;
- The wording in the TPS is difficult to interpret for observers because not all catch is visible, “at any particular time;”
 - A few crab observed while dumping the catch does not indicate what an observer may find in the rest of the catch while sampling



Pelagic Trawl Performance Standard

Crab Bycatch: Observer Statement Analysis

1999-2023: OLE received 38 observer statements recording 66 potential trawl performance standard violations in the BSAI.

- 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).

Actions:

- 0 monetary penalties
- 4 Compliance Assistance
- 3 Written Warnings



Pelagic Trawl Performance Standard

Crab Bycatch: Observer Statement Analysis

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)

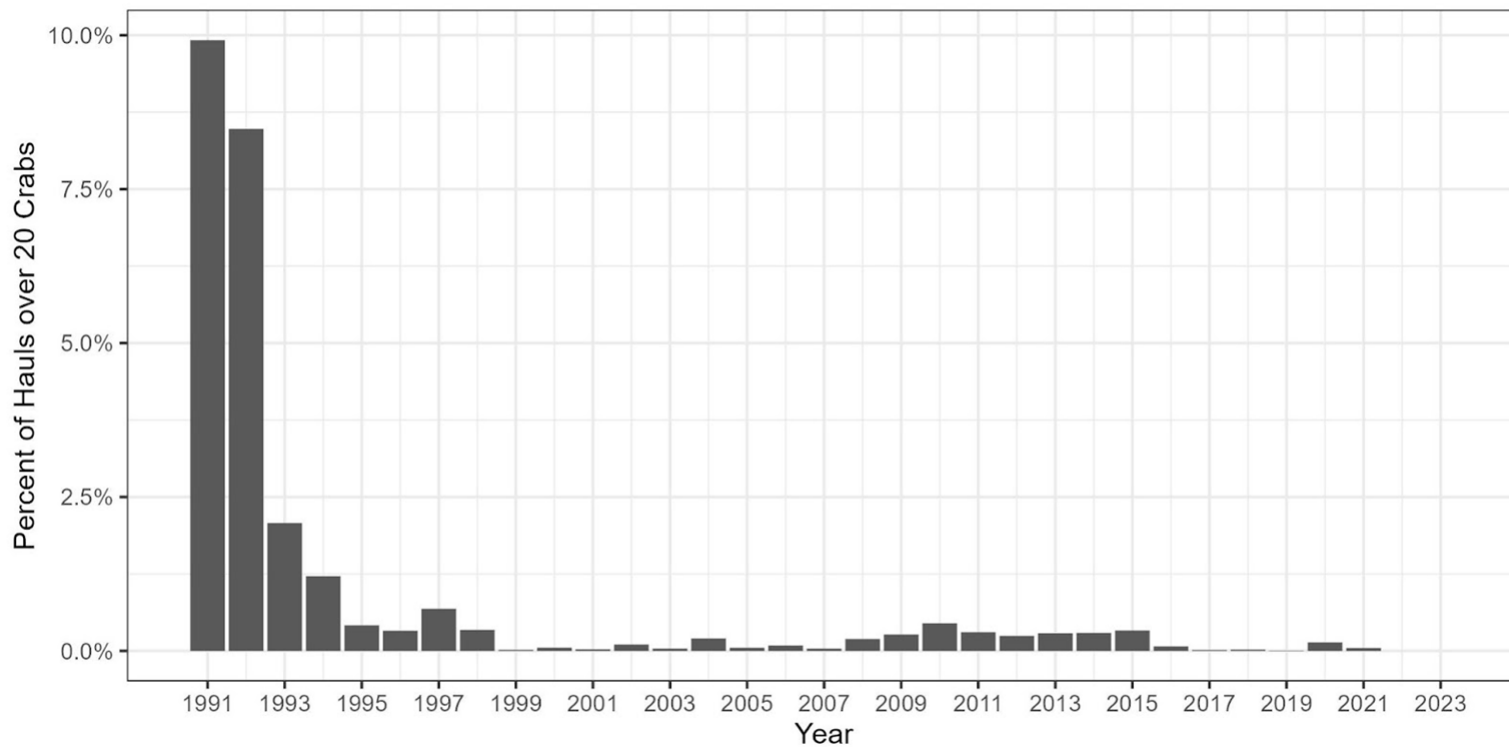
Year	# Hauls w >= 20 crab	# Statements/ Year	# Potential Violations/Year	Percent hauls reported to OLE	Compliance Assisatnce	Written Warning
1991	2675	NA	NA			
1992	1783	NA	NA			
1993	332	NA	NA			
1994	189	NA	NA			
1995	67	NA	NA			
1996	59	NA	NA			
1997	95	NA	NA			
1998	52	NA	NA			
1999	2	1	1	50.00%		
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



Pelagic Trawl Performance Standard

Crab Bycatch

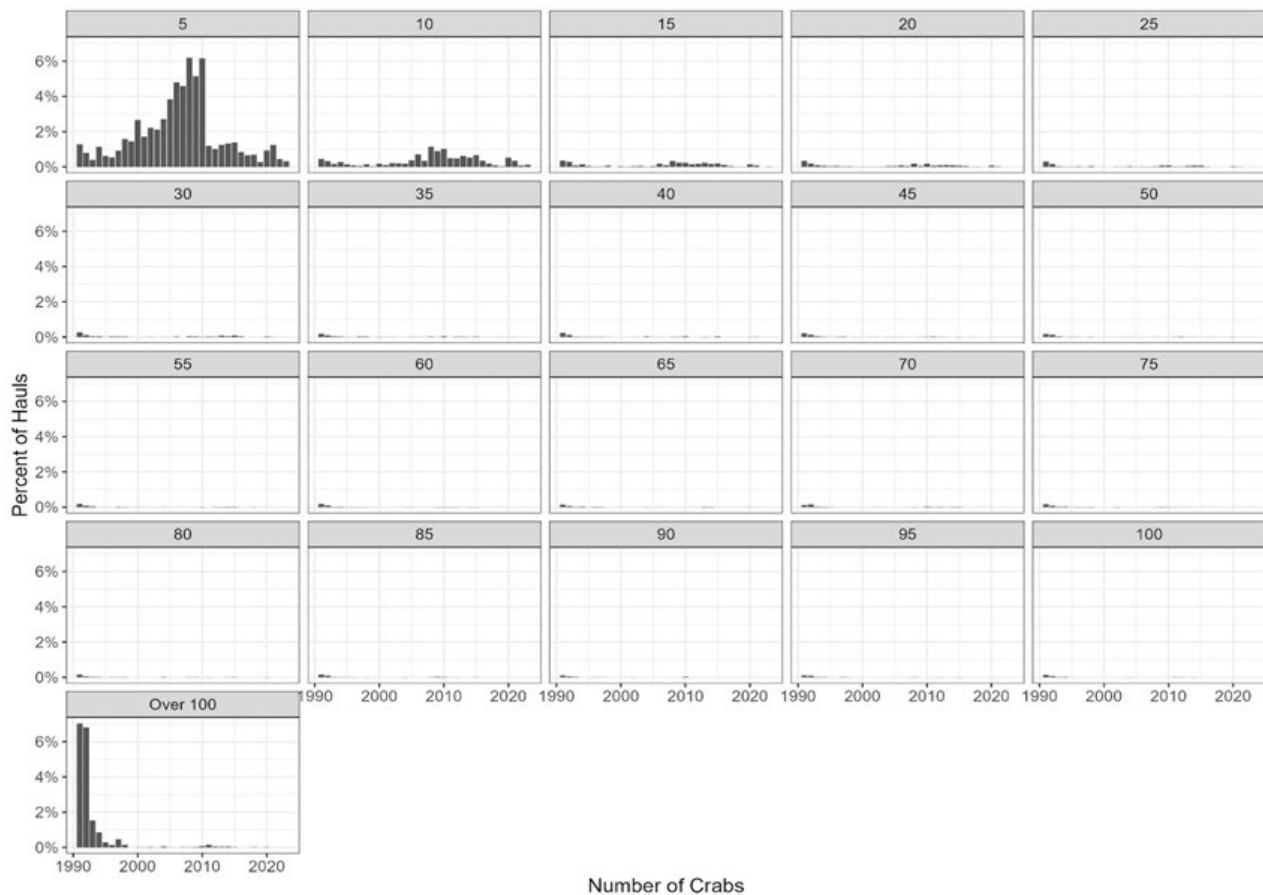
Figure 8-4 Percentage of hauls in observer species composition data catching over 20 crabs with pelagic trawl gear in the BSAI between 1993 and 2023



Pelagic Trawl Performance Standard

Crab Bycatch

Figure 8-5 Breakdown of the percentage of hauls catching over 0 crabs with pelagic trawl gear in the BSAI between 1993 and 2023



Pelagic Trawl Performance Standard

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” appears 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.
- This analysis shows that the pelagic trawl performance standard is not an effective tool to limit seafloor contact for pelagic trawl gear



Pelagic Trawl Performance Standard

COUNCIL DIRECTION:

- If 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.
 - Council May wish to define and clarify new objectives specific to seafloor contact.
- 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.



Sec. 8: Pelagic Trawl Performance Standard

COUNCIL DIRECTION:

- If Council wishes to retain the existing 20 crab standard, mandatory retention of crab could be considered
- Council could apply other observer program data collections
- Council could consider listing pelagic trawl as bottom contact and mobile bottom contact gear.
- Standard specific to BBRKC area/s, all of BSAI, all of AOR
- Consider TEM program
- Contact threshold through technology integration (novel EM)



Questions?

