Crab PSC in the Bering Sea/Aleutian Islands Fisheries

Discussion paper[1]
January 2014

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1. Introduction

The Council requested that staff prepare a discussion paper on crab PSC in groundfish fisheries and existing closure areas and management measures for 4 specific stocks: Bristol Bay red king crab (BBRKC), Bering Sea snow crab, Bering Sea Tanner crab and Saint Matthew blue king crab(SMBKC). Specifically the Council requested information on recent stock distribution, and the distribution and amount of PSC in the trawl and fixed gear groundfish fisheries. Specific elements to include were the proportion of PSC by trawl and fixed gear fisheries inside of existing closure area boundaries and a detailed history of the closures to help identify the fraction of historical fisheries that occurred in these areas as well as their crab PSC. This paper briefly described the stock distribution for the 4 stocks, existing closures and their rationale historically as well as current trends by gear type in PSC in groundfish fisheries. This information is intended to assist the Council in deciding what, if any, action to take to initiate modifications to the existing management measures for these 4 stocks.

2. Summary of existing management measures

The BSAI groundfish FMP specifies crab bycatch management measures for protection of Bristol Bay red king crab, EBS Tanner crab, EBS snow crab, Pribilof blue king crab and St. Matthew blue king crab stocks (Table 1). These measures consist of triggered or fixed time and area closures for trawl fisheries. Additional details on the individual measures and trends in PSC catch for the 4 requested stocks are included in the stock specific overview sections. No measures are currently in place for any fixed gear fisheries (pending the Pribilof Islands pot closure), nor are overall limits placed on bycatch of any crab species. Bycatch management measures are not linked to new BSAI crab FMP requirements to account for total removals from all fisheries under new ACL requirements.

1 Prepared by Diana Stram, Council staff with input from Mike Fey AKFIN and Steve Lewis NMFS AKR

Table 1. Summary of groundfish management measures to address crab bycatch in the trawl fisheries.

Stock	Area	Gear type	Timing	For trigger closures		
				Allocation by sector or target fishery in 2013	How catch accrues	2013 PSC limit
Bristol Bay red king crab	Red King Crab Savings Area	nonpelagic trawl	closed year-round, except subarea	Up to 25% of Zone 1 PSC limit		
	Nearshore Bristol Bay Trawl Closure	nonpelagic trawl	closed year-round, except Togiak subarea open 4/15-6/15			
	Zone 1	all trawl	when limit is reached, area closes to target fishery	Amd. 80 sector yellowfin sole Pacific cod pollock/mackerel/ other species	RKC bycatch in Zone 1, by fishery	97,000 allocated among target fisheries
EBS Tanner crab	Zone 1	all trawl	when limit is reached, area closes to target fishery	Amd. 80 sector yellowfin sole rockfish Pacific cod pollock/mackerel/ other species	Tanner crab bycatch in Zone 1, by fishery	980,000 allocated among target fisheries
	Zone 2	all trawl	when limit is reached, area closes to target fishery	Amd. 80 sector yellowfin sole rockfish Pacific cod pollock/mackerel/ other species	Tanner crab bycatch in Zone 2, by fishery	2,970,000 allocated among target fisheries
Pribilof Islands blue king crab	Pribilof Islands Habitat Conservation Area	all trawl	year-round			
EBS snow crab	*C. opilio* Bycatch Limitation Zone (COBLZ)	all trawl	when limit is reached, area closes to target fishery	Amd. 80 sector yellowfin sole rockfish Pacific cod pollock/mackerel/ other species	Snow crab bycatch in the COBLZ, by fishery	10,501,333 allocated among target fisheries
	Northern Bering Sea Research Area	nonpelagic trawl	currently year-round; fishing may resume in future under a research plan			
St Matthew blue king crab	St Matthew Island Habitat Conservation Area	nonpelagic trawl	year-round			

Bycatch in groundfish fisheries is currently accounted for in numbers (See previous discussion papers for an overview of the methodology by which these calculations are made). The link for the two previous papers are:http://www.npfmc.org/wp-content/PDFdocuments/bycatch/CrabBycatchBSAI213.pdf and http://www.npfmc.org/wp-content/PDFdocuments/bycatch/CrabBycatchPSC510.pdf. The Council has already indicated an interest in moving to weight-based crab PSC management and a procedure has been developed for calculating PSC using weights (and extrapolation by weight to unobserved catch). These data are currently used by crab stock assessment authors for estimating annual total mortality from groundfish fisheries. For purposes of this paper, catch data are reported in numbers of crab as existing PSC limits for crab are currently in numbers. PSC catch data for all stocks and areas are from AKFIN

(data extracted 1/19/2014) and are calculated for the crab fishing year with the exception of the observed PSC for SMBKC which was taken from the Catch-in-Areas database and is not extrapolated for total catch (observations within the HCA only are reported). No mortality rates have been applied to these data. For purposes of calculating the mortality which accrues towards crab ACLs annually, handling mortality rates of 80% for trawl gear and 50% for fixed gear are applied. The basis for those estimates are described in the previous paper and not repeated here. Stock assessment authors apply those rates in their assessments annually for calculating relative mortality by gear type. Mortality rates are not currently employed for PSC accruing toward PSC limits in groundfish fisheries.

3. Crab stock registration areas

Registration areas are defined by stock and are a Category 2 measure under the Crab FMP. PSC estimates are now available by State statistical area thus more precise area-specific estimates (for stocks such as BBRKC and SMBKC) of total PSC are now available for use in estimating bycatch mortality in crab assessments. Actual survey distribution for each stock is contained in the stock specific sections below. Figure 1 shows the registration areas for the Bristol Bay District (for BBRKC), the Saint Matthew Island Section (for SMBKC), while snow and Tanner crab areas are Bering Sea-wide.

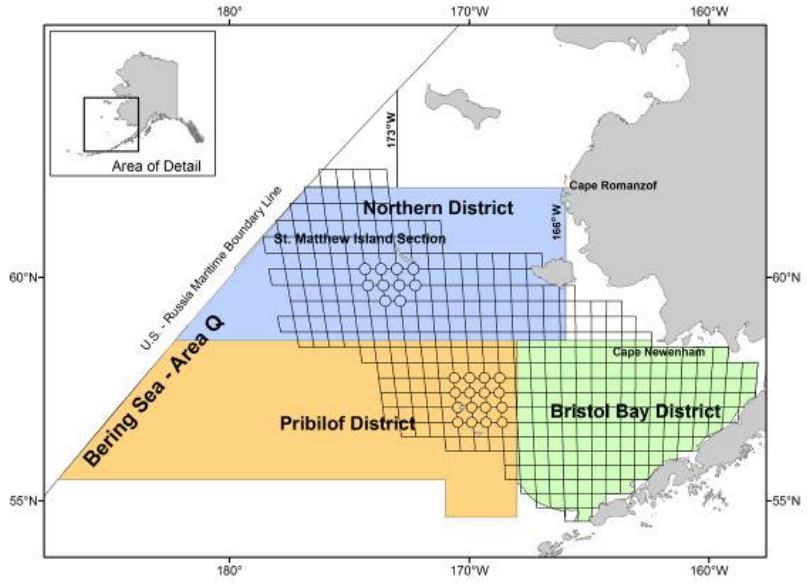


Figure 1 Registration areas for crab stocks under the Crab FMP.

4. Bristol Bay red king crab (BBRKC)

The largest red king crab stock in the Bering Sea is found in the Bristol Bay area, which includes all waters north of the latitude of Cape Sarichef (54o36' N lat.), east of 168o00' W long., and south of the latitude of Cape Newenham (58o39' N lat.). The spatial distribution from the 2013 summer trawl survey (mature males) is shown in Figure 2 (Zheng, 2013).

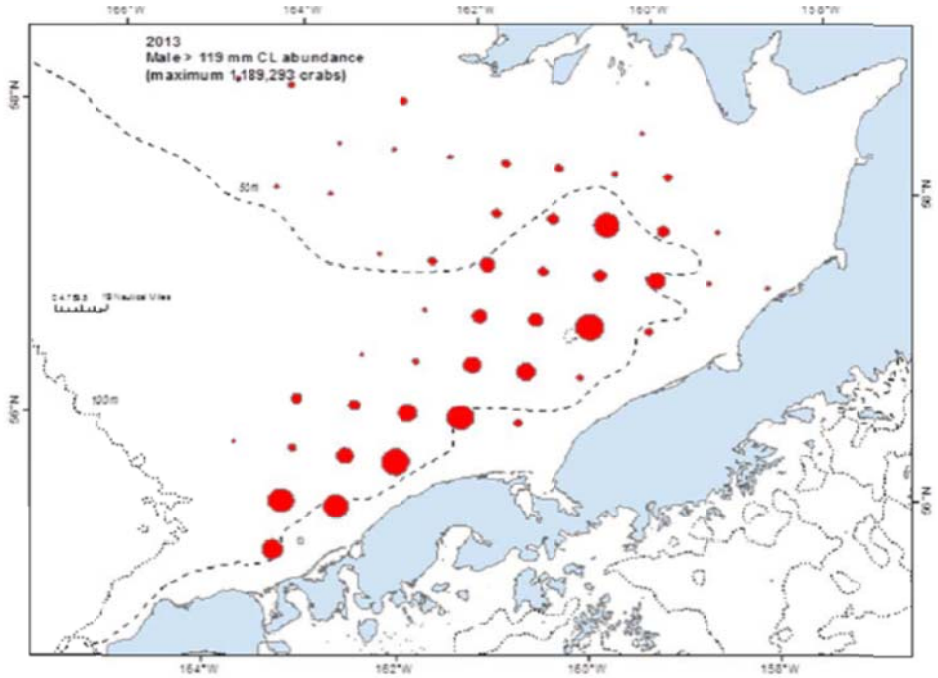


Figure 2 Distribution of mature male red king crab abundance from the NMFS trawl survey 2013

There are several management measures under the FMP to protect Bristol Bay red king crab stocks and habitat. These are fixed closures and a triggered time/area closure to trawl gear. No additional bycatch management measures are currently in place for fixed gear or bycatch outside of the designated areas. A description of the current measures are included below.

Figure 3 illustrates existing fishing closures for the protection of red king crab in the Bering Sea. The closures are described, by reporting area, in Table 1. There are two permanent closure areas in place: for all trawl in the Nearshore Bristol Bay Trawl Closure (NBBTC), and for non-pelagic trawl in the Red King Crab Savings Area (RKCSA). Zone 1 is a triggered closure that closes to select target trawl fisheries when applicable red king crab PSC limits are reached by those fisheries. A seasonal closure in reporting area 516, remnant of the Crab and Halibut Protection Zone that predated the NBBTC, also closes the area to all trawl gear from March 15 to June 15, annually.

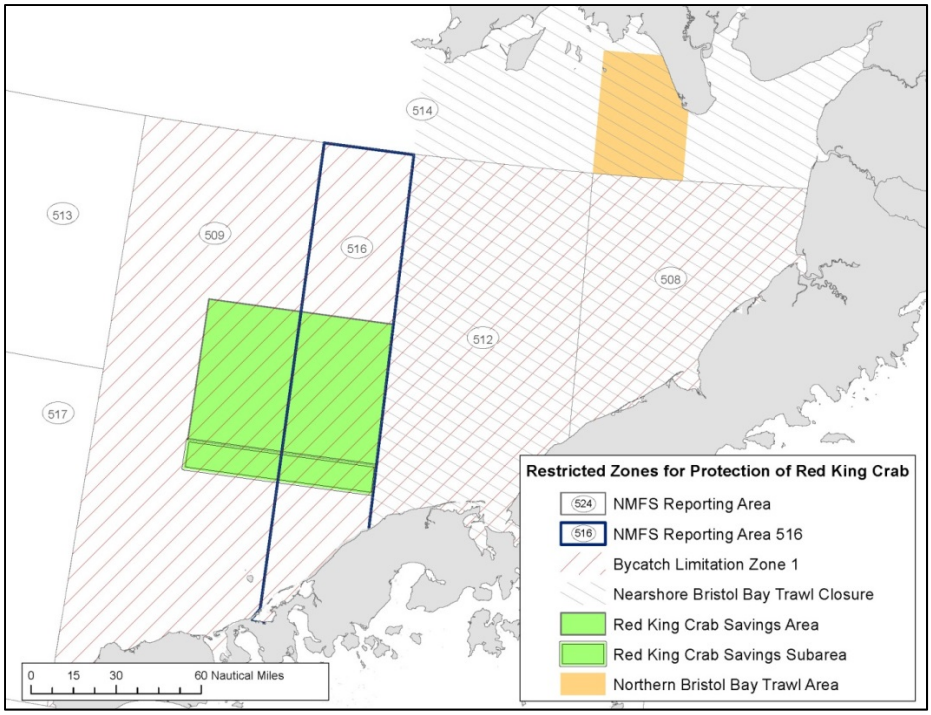


Figure 3 Restricted trawling areas for protection of red king crab in the eastern Bering Sea.

Table 2 Red king crab trawl closures, by NMFS reporting area

Area	Effective date	Closure
508	1997	• Closed to all trawl as part of Nearshore Bristol Bay Trawl Closure • Longline and pot vessels required to carry 100% observer coverage
509	--	• Open to trawling, except RKCSA (see below) • Closes, as part of Zone 1, to select target trawl fisheries when applicable red king crab PSC limits are reached by those fisheries
512	March 1987	• Closed to all trawl, first as the Crab and Halibut Protection Zone, and subsequently as part of Nearshore Bristol Bay Trawl Closure • Domestic Pacific cod trawl fishery allowed out to 25 fathoms, with 100% observer coverage, from 1987 to 1997
Eastern part of 514 *(east of 162º W)*	1997	• Closed to all trawl as part of Nearshore Bristol Bay Trawl Closure • Seasonal exemption for the Northern Bristol Bay Trawl Area, which is open to trawling from April 1 to June 15, annually[1]
516	1989	• Closes to all trawl from March 15 to June 15, annually, originally as a seasonal extension of the Crab and Halibut Protection Zone • Closes, as part of Zone 1, to select target trawl fisheries when applicable red king crab PSC limits are reached by those fisheries
Red King Crab Savings Area (RKCSA) *(straddles 509 & 516)*	1995	• Closed by emergency rule from Jan 20-April 19, 1995, to non-pelagic trawl (note, 516 portion of RKCSA also closed March 15-June 15) • Closed by inseason action to all trawl from Jan 20-June 15, 1996 • Closed by amendment to non-pelagic trawl beginning 1997 • Exemption for trawling allowed in the Red King Crab Savings Subarea, when a commercial fishery for Bristol Bay red king crab was allowed the previous year • 100% observer coverage required for all pot and longline vessels fishing in the RKCSA, and all trawl vessels fishing in the subarea

[1] Under a voluntary agreement between industry and members of the Togiak community, in place since 2009, the trawl fleet has agreed to cease fishing in the exempted Northern Bristol Bay Trawl Area by June 1, to avoid potential interactions with halibut.

Zones 1 and 2 are closed to directed fishing when the crab PSC limits (red king crab and EBS Tanner crab) are attained in specified trawl fisheries (Figure 4). Zones 1 and 2 were established by Amendment 10 to the BSAI groundfish FMP, after being implemented by emergency rule by NMFS in 1986 (NPFMC 1986). These areas were initially based upon the trawl survey distribution of red king crab and Tanner crab stocks at that time. These areas have not been modified since however the PSC limits which are allocated by trawl fishery have been modified under subsequent amendments.

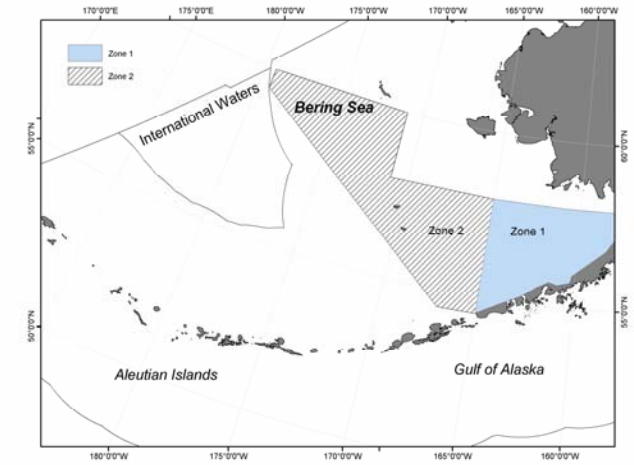


Figure 4. Zones 1 and 2 area for closures (Bristol Bay red king crab and EBS Tanner crab).

Table 3. PSC limits for red king crab.

PSC limits for Zone 1 red king crab (No Zone 2 RKC)	
Abundance	PSC Limit
Below threshold or 14.5 million lbs of effective spawning biomass (ESB)	33,000 crabs
Above threshold, but below 55 million lbs of ESB	97,000 crabs
Above 55 million lbs of ESB	197,000 crabs

The stair step procedure for determining PSC limits for red king crab taken in Zone 1 trawl fisheries is based on abundance of Bristol Bay red king crab (Table 3). Based on the 2013 estimate of effective spawning biomass of 49.3 million pounds, the PSC limit for 2014 is 97,000 red king crabs. Up to 25% of the red king crab PSC limit can be used in the 56º - 56º10'N strip of the Red King Crab Savings Area. The red king crab PSC limit has generally been allocated among the pollock/Atka mackerel/other species, Pacific cod, rock sole, and yellowfin sole fisheries.

Nearly all BBRKC PSC is taken within Zone 1 however only trawl crab PSC accrues toward the PSC limit. Trawl PSC has comprised between 11-96% of the total BBRKC PSC. The proportion of hook and line and pot gear proportion of PSC catch has ranged from 3-19% (hook and line) and 0-86% (pot gear) (Table 5).

Table 4 Comparison of total BBRKC PSC with the proportion of PSC taken in the area of Zone 1 (all gears)

Year	Total BBRKC PSC	BBRKC PSC in Zone 1	Proportion of total BBRKC PSC taken in Zone 1
2004-2005	111,693	111,617	100%
2005-2006	88,731	88,235	99%
2006-2007	77,138	76,845	100%
2007-2008	113,131	111,540	99%
2008-2009	90,395	90,119	100%
2009-2010	58,091	57,995	100%
2010-2011	54,138	53,816	99%
2011-2012	48,879	47,586	97%
2012-2013	33,801	32,403	96%
2013-2014	83,126	77,440	93%

Table 5 Number and proportion of BBRKC PSC taken by gear type within the Zone 1 closure compared to the total PSC by all gear types (groundfish trawl, groundfish hook and line and groundfish pot gear) of BBRKC by year (numbers of crab).

Year	Overall BBRKC PSC Zone 1	Zone 1 trawl PSC	Proportion Trawl of total PSC (Zone 1)	Zone 1 Hook and Line PSC	Proportion H and L of total PSC (Zone 1)	Zone 1 Pot PSC	Proportion pot of total PSC (Zone 1)
2004-05	111,617	97,191	87%	14,328	13%	98	0%
2005-06	88,235	71,362	81%	16,461	19%	411	0%
2006-07	76,845	65,756	86%	6,785	9%	4,304	6%
2007-08	111,540	85,588	77%	4,511	4%	21,441	19%
2008-09	90,119	75,116	83%	6,378	7%	8,624	10%
2009-10	57,995	50,517	87%	5,539	10%	1,939	3%
2010-11	53,816	51,621	96%	2,017	4%	178	0%
2011-12	47,586	32,272	68%	4,317	9%	10,997	23%
2012-13	32,403	18,408	57%	5,524	17%	8,471	26%
2013-14	77,440	8,392	11%	2,521	3%	66,527	86%

5. EBS Tanner crab stock

The Bering Sea District of Tanner crab Registration Area J includes all waters of the Bering Sea north of Cape Sarichef at 54° 36'N and east of the U.S.-Russia Maritime Boundary Line of 1991. This district is divided into the Eastern and Western Subdistricts at 173°W. The survey distribution of mature males from the 2013 summer trawl survey is shown in Figure 5 (Stockhausen et al, 2013).

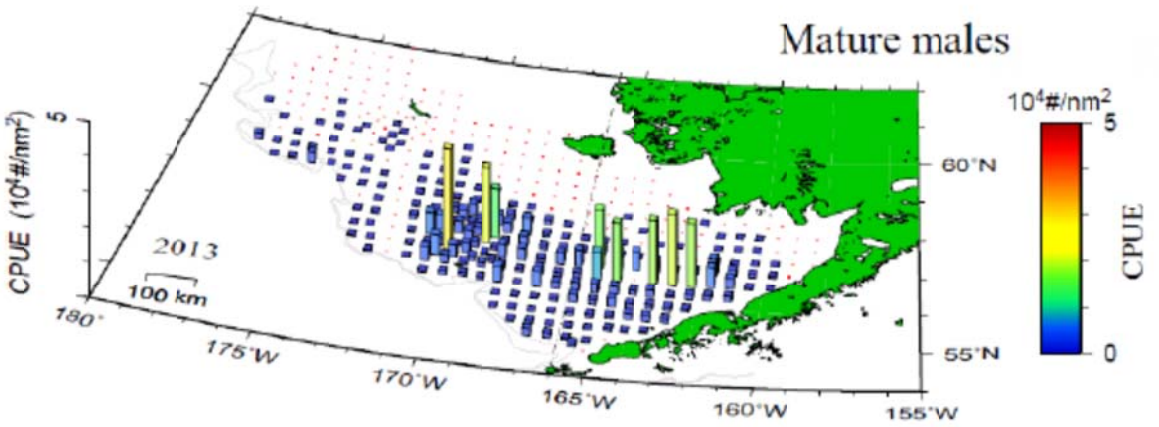


Figure 5 Distribution of mature males (number/sq. nm) in the summer trawl survey 2013

There are two triggered closures in the trawl fishery to address trawl bycatch of Tanner crab. These are triggered time/area closures to trawl gear as shown in Figure 4. Trawl PSC trigger limits for EBS Tanner crab in Zones 1 and 2 are based on a percentage of the total abundance minus an additional reduction implemented in 1999 of Tanner crab as indicated by the NMFS trawl survey (Table 6). Based on the 2013 model estimated total abundance (945,562,422 crabs), the PSC limit in 2014 for *C. bairdi* is unchanged from last year: 980,000 crabs in Zone 1 and 2,970,000 crabs in Zone 2.

Table 6. PSC limits for EBS Tanner crab.

PSC limits for bairdi Tanner crab: Zone 1 and 2		
Zone	Abundance	PSC Limit
Zone 1	0-150 million crabs	0.5% of abundance
	150-270 million crabs	750,000
	270-400 million crabs	850,000
	over 400 million crabs	1,000,000
Zone 2	0-175 million crabs	1.2% of abundance
	175-290 million crabs	2,100,000
	290-400 million crabs	2,550,000
	over 400 million crabs	3,000,000

There are no additional limits for trawl fisheries outside of the Zone 1 and Zone 2 trigger areas nor limits on any of the fixed gear fisheries.

Table 7 shows the total number of crab taken inside of Zones 1 and 2 by trawl fisheries as compared to the overall annual total number of Tanner crab taken as trawl bycatch and the proportion which accrues toward the existing PSC limit. Since 2004-05, 29-89% of the total PSC of EBS Tanner crab has been taken by trawl fisheries within the Zone 1 and Zone 2 trawl closure areas with the remaining bycatch primarily from fixed gear fisheries (Table 8). The majority of the bycatch on average occurs consistently in the Pacific cod pot fishery, followed by the non-pelagic trawl fisheries, specifically in the yellowfin sole, rock sole and flathead sole fisheries.

Table 7 Total Tanner crab PSC compared with PSC within the Zone 1 and Zone 2 areas and the trawl PSC which accrues under existing PSC limits

Year	Total Tanner PSC Bering Sea wide	Total Tanner in zones 1 and 2	Proportion of total in zones 1 and 2	Total trawl Tanner PSC under limit	
2004-2005	1,700,902	794,582	47%	695,366	41%
2005-2006	1,341,742	1,247,978	93%	1,033,096	77%
2006-2007	1,316,897	1,178,866	90%	692,568	53%
2007-2008	1,993,481	1,619,514	81%	573,487	29%
2008-2009	1,375,877	1,076,578	78%	622,375	45%
2009-2010	880,347	785,371	89%	435,213	49%
2010-2011	676,549	587,285	87%	388,296	57%
2011-2012	1,025,952	988,672	96%	914,544	89%
2012-2013	585,547	538,771	92%	455,069	78%
2013-2014	704,470	648,147	92%	448,397	64%

Table 8 Number and proportion of Tanner crab PSC taken by gear type within the Zone 1 and 2 closure areas compared to the total PSC by all gear types of Tanner crab by year (numbers of crab). H & L refers to hook and line gear.

Year	Total Tanner PSC Zones 1 and 2	Zone 1 and 2 Pot PSC	Proportion Pot (Zone 1 and 2) of total PSC	Zone 1 and 2 H&L PSC	Proportion H&L (Zone 1 and 2) of total PSC	Zone 1 and 2 Trawl PSC	Proportion Trawl (Zone 1 and 2) of total PSC
2004-05	794,582	87,259	11%	11,957	2%	695,366	88%
2005-06	1,247,978	200,405	16%	14,477	1%	1,033,096	83%
2006-07	1,178,866	470,603	40%	15,694	1%	692,568	59%
2007-08	1,619,514	1,029,608	64%	16,418	1%	573,487	35%
2008-09	1,076,578	418,532	39%	35,671	3%	622,375	58%
2009-10	785,371	315,750	40%	34,408	4%	435,213	55%
2010-11	587,285	178,069	30%	20,921	4%	388,296	66%
2011-12	988,672	54,082	5%	20,046	2%	914,544	93%
2012-13	538,771	71,411	13%	12,292	2%	455,069	84%
2013-14	648,147	188,848	29%	10,902	2%	448,397	69%

6. EBS Snow crab stock

Snow crab (*Chionoecetes opilio*) are distributed on the continental shelf of the Bering Sea, Chukchi Sea. In the Bering Sea, snow crab are common at depths less than about 200 meters. The eastern Bering Sea population within U.S. waters is managed as a single stock; however, the distribution of the population may extend into Russian waters to an unknown degree (Turnock and Rugolo, 2013). The 2013 mature male survey distribution is shown in Figure 6.

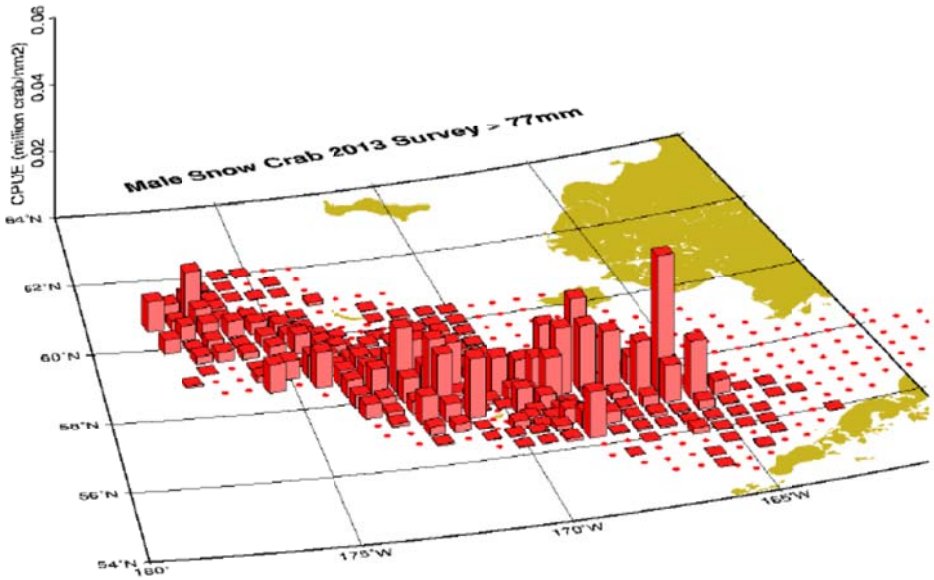


Figure 6 2013 Survey CPUE (million crab per nm2) of males >77mm by tow. Filled circles are tows with 0 CPUE.

The FMP contains a triggered time/area closure (described below) for trawl fisheries to protect snow crab stocks and their habitat. There are no additional management measures for fixed gear fisheries or trawl bycatch outside of the time/area closure.

A closure for EBS snow crab (*C. opilio*) is triggered if the limit is reached in specified fisheries. The limit accrues for bycatch taken within the *C. opilio* Bycatch Limitation Zone (COBLZ). That area then closes for the fishery that reaches its specified limit. (Figure 7). The COBLZ area was specified under amendment 40 the FMP and was established in 1997. At that time it was designed to encompass 'nearly the entire population of snow crab' according to the 1996 NMFS summer trawl survey (NPFMC 1997).

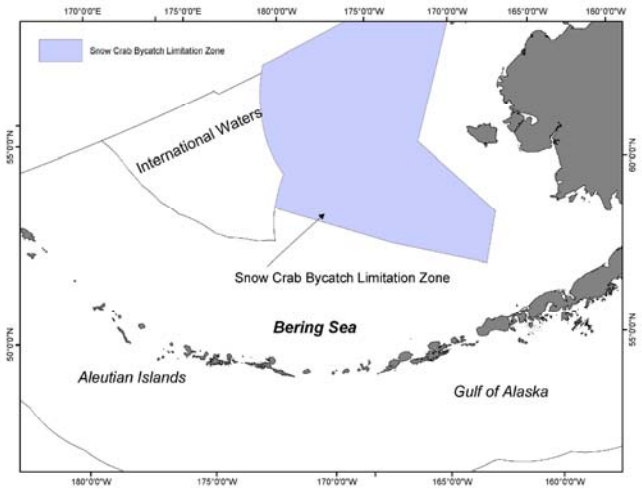


Figure 7. *C. opilio* Bycatch Limitation Zone (COBLZ)

EBS snow crab trawl PSC limits are based on total abundance of snow crab as indicated by the NMFS standard trawl survey. The cap is set at 0.1133% of snow crab abundance index, with a minimum of 4.5 million snow crabs and a maximum of 13 million snow crabs; the cap is further reduced by 150,000 crabs. The 2013 model estimate of 10,005,200,000 crabs result in a 2014 PSC limit of 11,185,892 crabs. Only snow crab taken within the COBLZ accrue toward the PSC limits established for individual trawl fisheries.

Table 9 and Table 11 show the total number of snow crab taken inside of COBLZ by trawl fisheries as compared to the overall annual total number of snow crab taken as bycatch. Since 2004, 62-94% of the total bycatch of snow crab has been taken within the COBLZ however only trawl PSC accrues toward the limit to close the area. There are no PSC limits for fixed gear nor for bycatch outside of the COBLZ by trawl gear. The majority of the bycatch occurs consistently in the non-pelagic trawl fisheries, specifically in the yellowfin sole, flathead sole and rock sole fisheries as well as the Pacific cod trawl fishery. Of the fixed gear fisheries, the highest amounts of bycatch on average are in the Pacific cod pot and hook and line fisheries.

Table 9 Total snow crab PSC taken within the COBLZ area, and the proportion by trawl gear (which accrues toward the COBLZ limit) as compared with trawl PSC for the whole Bering Sea area.

Year	COBLZ total PSC	total PSC	proportion total PSC (all gears) in COBLZ	Proportion of trawl PSC of total COBLZ	Proportion of total trawl PSC Bering Sea wide
2004-2005	3,237,561	3,426,667	94%	98%	93%
2005-2006	1,089,579	1,328,250	82%	96%	79%
2006-2007	1,426,916	2,013,533	71%	96%	68%
2007-2008	1,183,054	1,893,592	62%	81%	51%
2008-2009	723,380	1,113,976	65%	86%	56%
2009-2010	1,706,116	2,491,146	68%	97%	66%
2010-2011	556,321	824,215	67%	96%	65%
2011-2012	570,801	681,392	84%	100%	84%
2012-2013	792,006	859,358	92%	100%	92%
2013-2014	186,079	247,397	75%	100%	75%

Table 10 Proportion of total snow crab PSC taken by fixed gear

Year	Proportion of total PSC by hook and line	Proportion of total PSC by pot gear
2004-2005	2%	3%
2005-2006	4%	11%
2006-2007	3%	26%
2007-2008	4%	39%
2008-2009	8%	28%
2009-2010	3%	28%
2010-2011	7%	23%
2011-2012	7%	4%
2012-2013	3%	2%
2013-2014	5%	11%

7. St. Matthew blue king crab stock

The St. Matthew Island Section for blue king crab is within Area Q2 (Figure 1), which is the Northern District of the Bering Sea king crab registration area and includes the waters north of of Cape Newenham (58°39’ N. lat.) and south of Cape Romanzof (61°49’ N. lat.). The stock tends to be concentrated in the vicinity of St. Matthew Island. The distribution of the stock (mature males) from the 2013 summer trawl survey is shown in Figure 8 (Gaeumann, 2013).

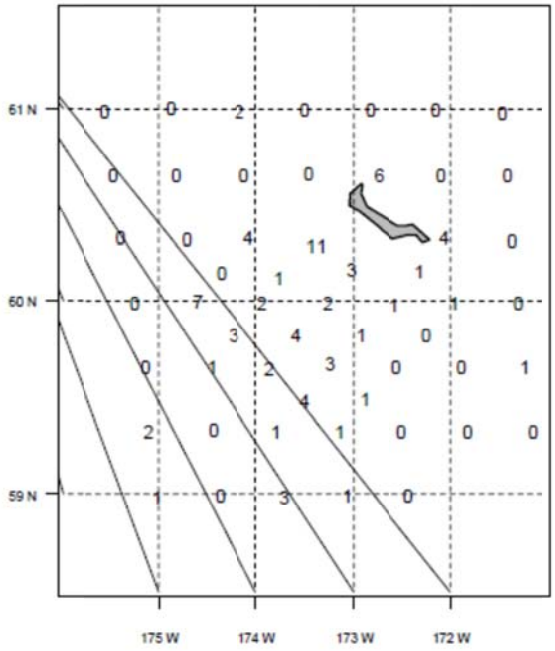


Figure 8 Catches of male blue king crab measuring at least 90 mm CL from the 2013 NMFS trawl-survey

There are no PSC limits for any gear type for SMBKC. Since 2007 non-pelagic trawl gear fishing is prohibited in St. Matthew Island Habitat Conservation Area in the vicinity of St. Matthew Island to protect blue king crab stocks and habitat (Figure 9).

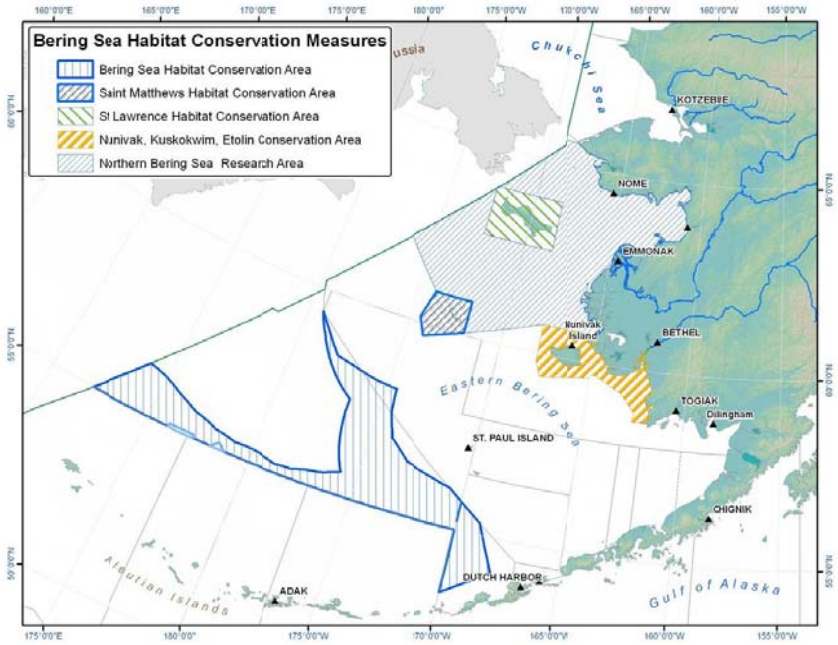


Figure 9. Bering Sea Habitat Conservation measures closure areas.

Bycatch of SMBKC by all groundfish fisheries for the Crab Fishing Year (July-June) from numbers of and average proportion by gear type are shown in Table 11. The majority of the bycatch occurs the Pacific cod pot and hook and line fisheries.

Table 11 Total PSC by all gear types of SMBKC in number of crab and proportion by gear type.

Year	total	Proportion by gear type			
		Non-pelagic trawl	Pelagic trawl	Hook and line	pot
2004-2005	2,322	66%		33%	1%
2005-2006	1,038	32%		68%	
2006-2007	3,703	44%		53%	3%
2007-2008	186,386	1%		0%	98%
2008-2009	8,841	3%	0%	97%	0%
2009-2010[2]	15,165	10%		80%	10%
2010-2011[1]	10,359	1%	0%	4%	95%
2011-2012	1,551	32%	1%	66%	
2012-2013	1,275	37%		63%	
2013-2014	559	33%	1%	66%	

Observed PSC (not extrapolated to total catch) for all gear types are shown for the area inside of the Habitat Conservation Area (HCA). This area has been closed to non-pelagic trawling since 2007. Extrapolated catch inside and outside of this area for comparison is not available at this time.

Table 12 Observed amount of blue king crab PSC inside of HCA (all gears)

Year	Blue king crab inside HCA
2001	4,595
2002	7,148
2003	2,243
2004	1,443
2005	527
2006	1,676
2007	27,152
2008	5,164
2009	7,098
2010[1]	25,942
2011	286
2012	161
2013	100

2 Note that data discrepancies for PSC estimates in 2010 are being examined by staff

8. References

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