Central Gulf of Alaska Crab Protection Measures

Discussion Paper

June 2017[1]

1. Introduction

At its December 2016 meeting, the Council passed a number of motions to address trawl bycatch issues in the Gulf of Alaska. Among those was direction for staff to prepare a discussion paper summarizing the Council's actions to protect Tanner crab (*Chionoecetes bairdi*) habitat in the Central Gulf of Alaska

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(CGOA) including information on the abundance and distribution of Tanner crab. The rationale for the motion was the question of trawl fishery impacts on Tanner crab, specifically the concern about Federally managed CGOA trawl groundfish fishery as a factor in the recovery of the CGOA Tanner crab stock and return of a viable state-managed Tanner crab fishery. Tanner crab bycatch was not a major discussion point during the development of the GOA TBM analysis.

This discussion paper does not evaluate the adequacy of the protection measures that are in place for Tanner crab, but does address some tools that might be available for that line of inquiry, including the limitations of those tools. Although the December 2016 motion referred to "crab," all of the surrounding discussion was related to Tanner crab, and so the information provided in this discussion paper focuses primarily on Tanner crab. There is no Federally-permitted fishery for king or Tanner crab in the GOA. These species are prohibited species catch (PSC) in the GOA groundfish FMP, and if caught by groundfishing operations must be immediately returned to the sea with a minimum of injury.

A variety of protective measures are in place in the CGOA to reduce impacts of groundfish gear (). Restrictions in place to reduce impacts to king crab and Steller sea lion or other ecosystem components identified as in need of protection may potentially reduce impacts to Tanner crab as well, depending on the nature of the protective measure.

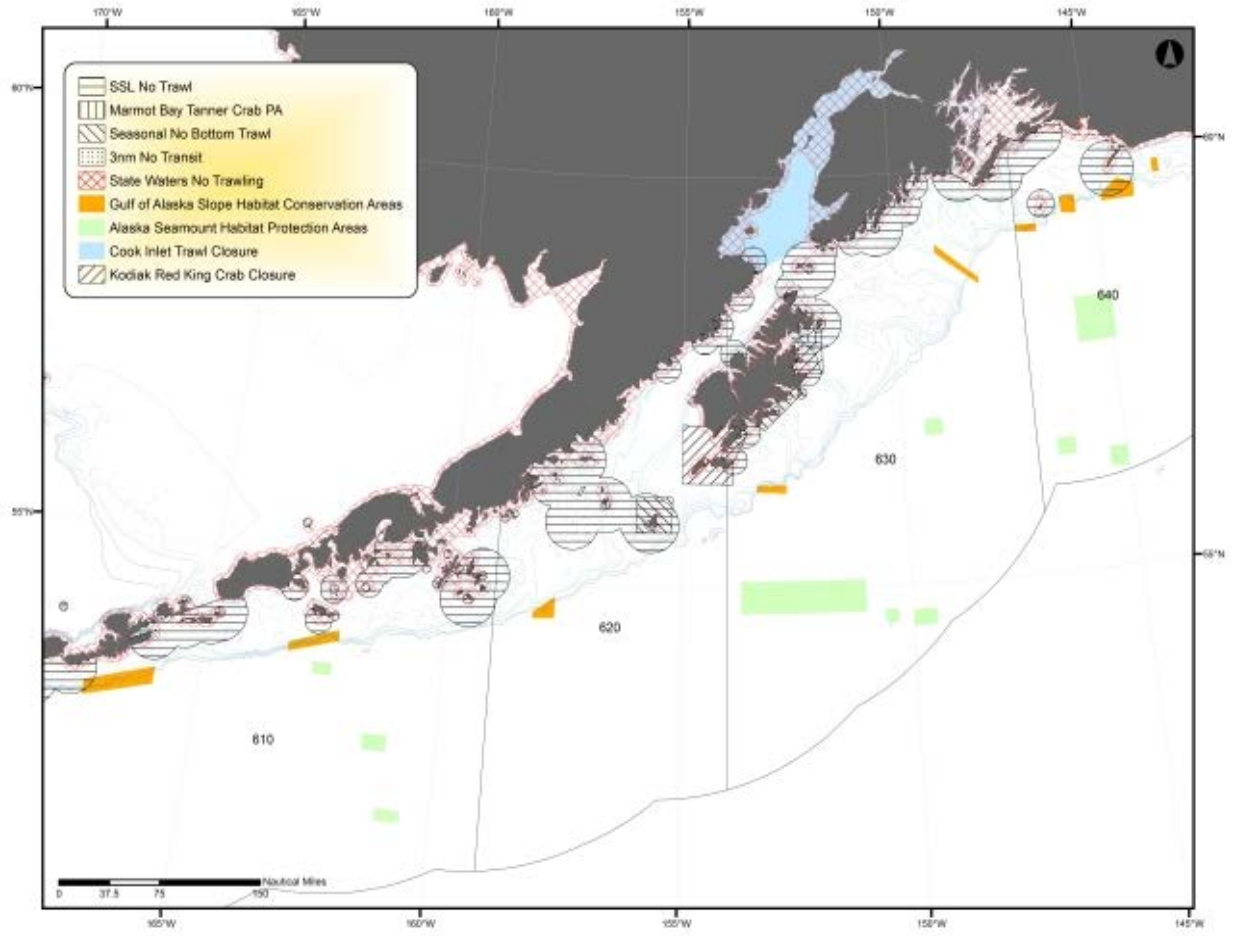

Figure 1. Areas closed to trawl fishing in the Central Gulf of Alaska.

1.1. Indirect Tanner Crab Protections in the CGOA

1.1.1. Federal Red King Crab Protections

Areas around Kodiak Island have been established to protect red king crab (*Paralithodes camtschaticus*) stocks. These areas are designated as Type I, II, or III areas (Table 1). Type I (year-round) and Type II (seasonal) closures protect adult crab in established areas irrespective of king crab population conditions. For purposes of implementing a Type III area, a "recruitment event" must occur (see Table 1), which is defined as a substantial increase in numbers of female crab according to threshold criteria. Recruitment is monitored by the Kodiak crab survey conducted by the Alaska Department of Fish and Game (ADF&G). Type III area closures continue until either 1) a commercial crab fishery opens for that district, or 2) the number of crab drops below the threshold level established for that district. Implementation of the Type III area closures are accomplished by regulatory amendment.

Table 1. Names and definitions of Type I, II and III King and Tanner crab closure areas around Kodiak Island (Source: GOA Groundfish FMP)

Area Type	Name	Definition
I	• Alitak Flats and Towers Areas • Marmot Flats Area	Type I areas are those king crab stock rebuilding areas where a high level of protection will be provided to the king crab by closing the area year-round to bottom trawling. Fishing with other gear would be allowed.
II	• Chirikof Island Area • Barnabas Area	Type II areas are those areas that are sensitive for king crab populations and in which bottom trawling will be prohibited during the soft-shell season (February 15 - June 15). Fishing with other gear would be allowed and fishing with bottom trawl gear would be allowed from January 1 - February 14 and June 16 - December 31.
III	• Outer Marmot Bay • Barnabas • Horse's Head • Chirikof	Type III areas are those geographic areas adjacent to a Type I or Type II areas that have been identified as important juvenile king crab rearing or migratory areas. These areas only become operational following a determination that the "recruitment event criteria" have occurred. The NMFS Regional Administrator will classify the expanded area as either Type I or II depending on the information available.
Tanner Crab Trawl Closure	Marmot Bay Tanner Crab Protection Area	A Tanner crab area of high abundance and high incidence of bycatch in the groundfish trawl fisheries, where a high level of protection will be provided to Tanner crab by closing the area year-round to trawling, except for pelagic trawling for pollock. Fishing with other gear would be allowed.

1.2. Stellar Sea Lion Closures

Regulations intended to protect marine mammals include those that would limit fishing effort, both temporally and spatially, around areas important to marine mammals. Objective 23 of the Council's Groundfish Management Policy specifically addresses the need to protect Steller sea lion (SSL) as a function of groundfish fishery management: "Maintain or adjust current protection measures as appropriate to avoid jeopardy of extinction or adverse modification of critical habitat for ESA-listed Steller sea lions." Closures to protect critical habitat for the Western DPS of SSL have been established in several areas in the CGOA (Figure 1). SSL protections in place in the CGOA can be grouped into two categories:

1. Fishing and transit restrictions near shorelines used by SSL as breeding grounds.
2. Fishing restrictions on SSL forage species

Either type of protection measure could potentially protect Tanner crab by reducing the amount of trawling, particularly non-pelagic trawling, below that which could occur if the area restrictions were not

in place. It is likely, however, that only reduction of gear contact with bottom habitat that indirectly comes from these restrictions provides protection to Tanner crab.

Table 2. Sites in the Central Gulf of Alaska where SSL protections may reduce Tanner crab bycatch by prohibiting use of trawl gear. (Source: GOA Groundfish FMP)

Site Name	Area or Subarea	Boundaries from		Boundaries to[1]		No transit[2]
		Latitude	Longitude	Latitude	Longitude	3 nm
Chirikof I.	Gulf of Alaska	55° 46.50 N	155° 39.50 W	55° 46.44 N	155° 43.46 W	Y
Sugarloaf I.	Gulf of Alaska	58° 53.25 N	152° 02.40 W			Y
Marmot I.	Gulf of Alaska	58° 13.65 N	151° 47.75 W	58° 09.90 N	151° 52.06 W	Y
Outer (Pye) I.	Gulf of Alaska	59° 20.50 N	150° 23.00 W	59° 21.00 N	150° 24.50 W	Y
Chernabura I.	Gulf of Alaska	54° 45.18 N	159° 32.99 W	54° 45.87 N	159° 35.74 W	Y
Atkins I.	Gulf of Alaska	55° 03.20 N	159° 17.40 W			Y
Chowiet I.	Gulf of Alaska	56° 00.54 N	156° 41.42 W	56° 00.30 N	156° 41.60 W	Y

1.3. Other Closed Areas

In February 2005, bottom trawling for all groundfish species was prohibited in 10 designated areas along the continental shelf of the Gulf of Alaska. The GOA Slope Habitat Conservation Areas, which are thought to contain high relief bottom and coral communities (Figure 1).

The Alaska Seamount Habitat Protection Area encompasses all 16 seamounts in Federal waters off Alaska that are named on NOAA charts, fifteen of which are in the Gulf of Alaska. Bottom-contact fishing is prohibited in all of these HAPCs (Figure 1).

While these areas offer potential protection for Tanner crab from trawl impacts, they are, for the most part, quite far from areas where Tanner crab bycatch in groundfish fisheries occurs in the GOA. Through the analyses conducted for the EFH Omnibus Amendment (NPFMC 2012) Tanner crab show limited association with slope, pinnacle, and seamount bottom features.

1.4. Direct Federal Tanner Crab Protections

Tanner crab are categorized as prohibited species catch (PSC) in the Gulf of Alaska Groundfish FMP, meaning they must be avoided while fishing groundfish and must be immediately returned to the sea with a minimum of injury when caught and brought aboard. This prohibition recognizes the potential for bycatch of Tanner crab by the groundfish trawl fleet and reduces impacts to Tanner crab by not allowing for development of incentives for retention. Unlike some other PSC species in the GOA FMP (e.g., halibut, chinook salmon), there is no PSC limit for Tanner crab that could close groundfish fishing.

In recognition of the need to further protect Tanner crab and Tanner crab habitat, the Council, in 2009, initiated Amendment 89 (NPFMC 2010) to the GOA Groundfish FMP. The amendment was not effective until February 2014, following supplementary analyses on a gear modification provision. The Council listed several reasons for the protection measures put into place through Amendment 89:

- Tanner crab is identified in the FMP as a prohibited species which is incidentally caught in the Central GOA groundfish trawl, pot, and longline fisheries. Tanner crab is incidentally caught in relatively high proportion by vessels using non-pelagic trawl gear in the Central GOA.
- Directed fisheries for Tanner crab in the Central GOA are fully allocated under the current limited entry system managed by the State of Alaska.

- No specific conservation measures exist in the Central GOA to address adverse interactions with Tanner crab by vessels using trawl gear to directed fish for groundfish.

- Tanner crab is a bottom-dwelling species, and limits on the use of non-pelagic trawl gear may reduce Tanner crab PSC and adverse effects on Tanner crab habitat.

The regulatory changes that resulted from Amendment 89 included:

1. Establishing a habitat protection area in Marmot Bay near Kodiak, AK, and closing the area to most trawl fishing to reduce Tanner crab PSC in the Central GOA groundfish fisheries and potential adverse effects on bottom habitat; and

2. Requiring the use of modified pelagic trawl gear when directed fishing for flatfish in the Central GOA.

Importantly, the purpose of Amendment 89 was not to improve Tanner crab stock abundance, but to further protect Tanner crab stocks from adverse effects of GOA groundfish fisheries. Because Tanner crab bycatch amounts in the GOA groundfish fisheries can be small relative to the overall Tanner crab population, bycatch can also be concentrated in certain areas or at certain times. Thus, time and area closures were seen as more effective than establishing Tanner crab PSC limits in reducing the potential impacts of non-pelagic trawl (NPT) gear. Additionally, the Amendment 89 requirement that non-pelagic trawl gear used in the directed flatfish fisheries in the CGOA be modified with elevated sweeps was intended to reduce the adverse effects of trawl gear by reducing the unobserved mortality and injury.

Enhanced observer coverage requirements were initially included as options leading up to Amendment 89. Specifically, the Council recommended that 100% NPT observer coverage and 30% pot coverage in areas near Kodiak, AK (Statistical Areas 525702 and 525630 and Chiniak Gully [Figure 2]). The intent was to improve estimates of Tanner crab bycatch data in the GOA groundfish fisheries. At the same October 2010 meeting, however, the Council also recommended BSAI/GOA Amendments 86/76 to comprehensively restructure the funding and deployment of observers (i.e., Restructured Observer Program). Accordingly, the Council included as part of the Amendment 89 effort to improve estimates of Tanner crab bycatch, an observer deployment strategy that ensured adequate coverage to establish "statistically robust observations'' in the three areas near Kodiak.

Figure 3 illustrates the closure area (Marmot Bay TCPA) established through Amendment 89. Also shown are permanent and seasonal closure areas intended to protect king crab.

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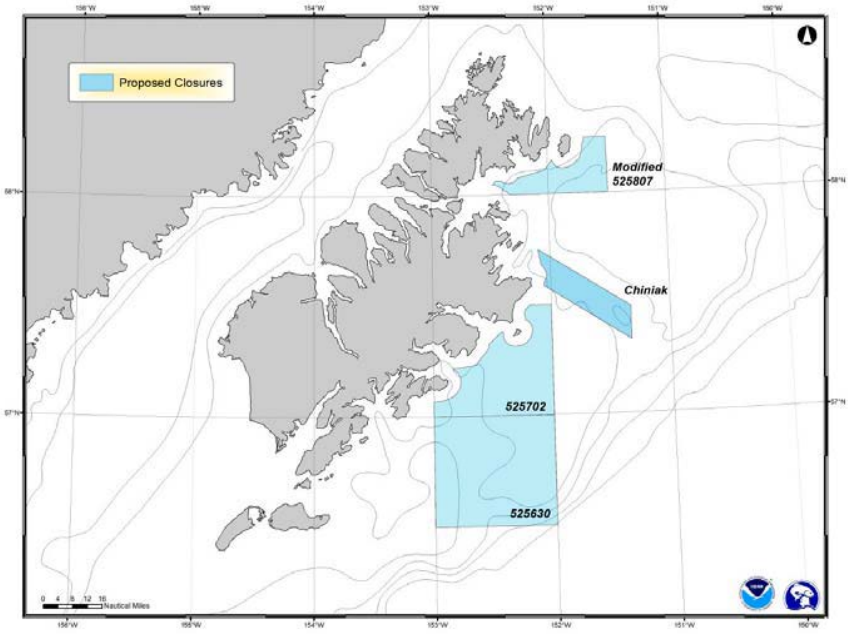

Figure 2. Areas around Kodiak that were considered for closure to groundfish trawl fisheries and restricted access for groundfish pot fisheries in the development of Amendment 89.

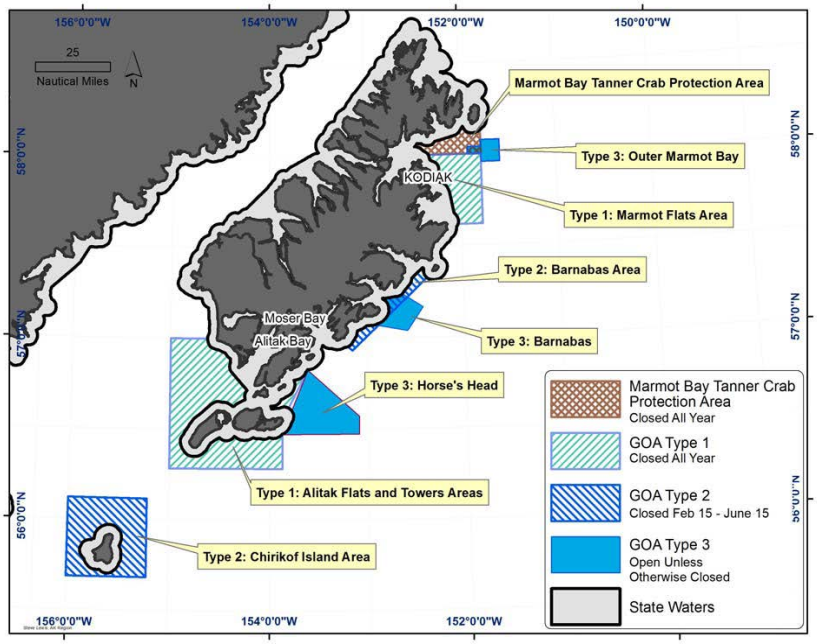

Figure 3. The Marmot Bay Tanner Crab Protection Area as well as other closures in place prior to Amendment 89 to protect king crab around Kodiak island.

1.5. State of Alaska Protections of Tanner Crab in CGOA

1.5.1. State Waters Trawl Ban

Fishery surveys conducted by the ADF&G in Cook Inlet throughout the early and mid-1990s indicated that both Tanner and red king crab stocks were at historically low levels of abundance. The Alaska Board of Fisheries (BOF) prohibited the use of non-pelagic trawl gear in State waters encompassing primary crab habitat in 1990. In 1996, the Board extended that prohibition to all of the State waters of Cook Inlet and in many other areas of the Gulf of Alaska. In 1999, based on continuing concerns about the impacts of trawl gear on crab bycatch and habitat, the Board further extended State water closures to non-pelagic trawl gear in additional areas of the GOA, particularly in State waters in the Kodiak region (Figure 1).

1.5.2. State Tanner Crab Management

Fishery surveys conducted by the ADF&G in Cook Inlet throughout the early and mid-1990s indicated that both Tanner and red king crab stocks were at historically low levels of abundance. The Alaska Board of Fisheries (BOF) prohibited the use of non-pelagic trawl gear in State waters encompassing primary crab habitat in 1990. In 1996, the Board extended that prohibition to all of the State waters of Cook Inlet and in many other areas of the Gulf of Alaska. In 1999, based on continuing concerns about the impacts of trawl gear on crab bycatch and habitat, the Board further extended State water closures to non-pelagic trawl gear in additional areas of the GOA, particularly in State waters in the Kodiak region (Figure 1).

The Tanner crab fisheries in the GOA are managed entirely by the State of Alaska and, like other Alaska shellfish fisheries, are regulated using management areas, districts, and sections. Direct protections or conservation of the Tanner crab stock by the State of Alaska are realized through the evidence-based standards for opening areas for crab harvest. Additional protections include restrictions on the harvestable components of the crab stock, specifically limited to male crab with a minimum carapace width of 5.5 inches which conserves female crab and allows for reproduction by males before harvest.

The Federally-defined Central Gulf groundfish reporting area does not align precisely with State Registration Area J, but within Area J, the Kodiak District covers the protections provided by the 2010 Council action. As such, for the purposes of this discussion paper, we focus primarily on Tanner crab in the Kodiak District. The Kodiak District for Tanner crab includes Pacific Ocean waters south of the latitude of Cape Douglas, west of the longitude of Cape Fairfield, and east of the longitude of Cape Kumlik. The district is subdivided into eight sections: Northeast, Eastside, Southeast, Southwest, Semidi Island Overlap, Westside, North Mainland, and South Mainland (Figure 4).

In the Kodiak District, commercial regulatory harvest strategies specify mature male Tanner crab abundance and fishery management thresholds that must be achieved before any commercial fishing may occur (Urban et al. 1999). Guideline harvest levels (GHL) are determined annually using stock abundance information collected during the ADF&G trawl survey. The Tanner crab seasons in the Kodiak District (as well as the Chignik and South Peninsula Districts) opens by regulation on January 15 unless management thresholds are not met. If the commercial Tanner crab fishery is opened and the level of mature male abundance is estimated to be equal to or less than the long-term average, then no more than 10% of the molting mature male abundance and 30% of the legal male abundance may be harvested. If the commercial fishery is not opened, the fishery will open in the following season only if the population is estimated to be sufficient to provide twice or more of the GHL and only half of the GHL may be harvested.

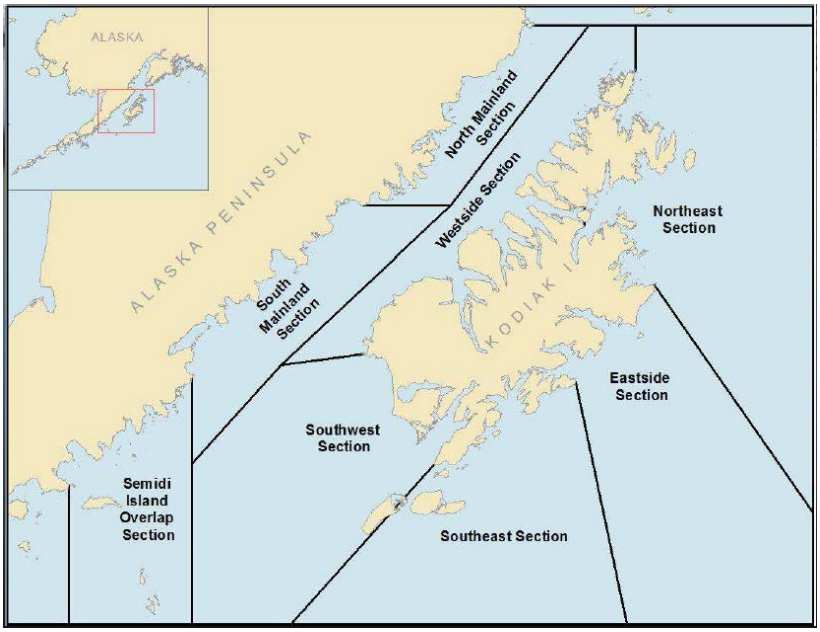

Figure 4. ADF&G fishery management sections within the Kodiak District.

2. Update on Tanner Crab Habitat, Abundance, and Distribution

2.1. Tanner crab Habitat

Tanner crab habitat is not well defined for the GOA. In the Bering Sea, post-settlement juveniles and adults are associated with soft bottom substrates, primarily mud (NPFMC 2011). Muddy bottom habitat is easily modified by bottom contacting fishing gear, but also tends to recover very quickly. The long term effects of fishing gear on muddy habitat is generally described as much less than for hard bottoms with established epibiota. In State reports on Tanner crab, habitat and distribution are generally treated as one in the same. For the purposes of this discussion paper, spatially defined measures to protect Tanner crab are considered to be equivalent to protections for Tanner crab habitat.

2.2. Abundance and Distribution

While the intent of the existing Federal Tanner crab protections in the GOA was not to rebuild the Tanner crab stock, as explicitly stated above, a measure of the current condition of that stock may be useful when considering the stock's continued need for protection. The most recent estimates of Tanner crab abundance are available in the 2016 ADF&G report on the results of the State's large mesh trawl survey (Spalinger 2016; attached), which includes data through 2015 (Table 3).

The 2015 estimate of total Tanner crab abundance in the Kodiak District is slightly greater than 40 million. The largest abundance estimate in the entire time series (>200 million) occurred in 2013. These abundance estimates are not smoothed or otherwise corrected, but instead reflect simple expansions of catches based on the survey trawl footprint, also referred to as swept-area abundance estimates. The variability between years is explained by the inclusion of all size categories in the abundance estimate. The abundance estimates of Tanner crab less than 70 mm can vary by a factor of 20 between years (see Spalinger 2016) and these small crab can comprise more than 90% of the population (in numbers) in a given year. This suggests that mortality from the transition of juveniles to adults is very high.

The 2015 estimated abundance of legal-sized male Tanner crab in the Kodiak District was 0.9 million crab, less than the 2014 estimate of 2.0 million, and the second lowest legal-size male abundance estimate in trawl survey history (Table 4). The low abundance of legal male Tanner crab continues a downward trend that began in 2011 for this segment of the population (Figure 5).

Based on the Tanner crab harvest strategy, the Southeast Section of the Kodiak District was above the mature male abundance threshold but did not satisfy the minimum GHL criteria, while the Northeast, Eastside, Southwest, Westside, and North Mainland sections were below the thresholds required to consider opening a commercial Tanner crab fishery. As such, the Kodiak District did not open to commercial Tanner crab fishing in 2016.

The cumulative catches (2006-2016) of Tanner crab in the Kodiak district are shown in Figure 6. Also shown are area closures to protect Tanner and red king crab. Statistical areas 525702 and 525630, which were identified in the analysis leading to Amendment 89 as areas needing increased observer coverage do not fall within any closures. These areas are protected by the trawl sweep requirement and the PSC designation in the Groundfish FMP.

Table 3a. Kodiak District Tanner crab abundance estimates (all sizes) from 2003-2015. Source ADF&G Fishery Management Report 16-20 (Spalinger 2016).

Year	Northeast	Eastside	Southeast	Southwest	Westside	North Mainland	Kodiak District
2003	13,443,591	36,166,904	6,058,690	3,141,350	4,593,172	7,013,798	70,417,505
2004	16,321,335	26,352,608	12,333,843	3,575,099	1,804,194	10,356,807	70,743,886
2005	17,403,505	19,113,246	10,974,042	3,011,422	3,947,639	13,226,334	67,676,188
2006	21,906,413	68,461,704	33,083,614	15,342,283	9,334,219	16,914,410	165,042,643
2007	18,653,830	98,433,348	35,342,446	25,861,206	4,582,398	3,382,721	186,255,949
2008	21,179,965	50,858,092	10,731,234	23,520,341	8,397,115	4,825,933	119,512,680
2009	16,992,570	39,006,970	7,768,620	9,716,347	5,623,343	5,283,555	84,391,405
2010	14,636,198	28,316,042	13,703,955	10,695,866	3,448,153	5,527,360	76,327,574
2011	5,087,405	20,520,713	8,040,692	2,980,159	2,829,698	15,908,038	55,366,705
2012	9,824,797	13,065,652	8,661,956	3,305,464	4,212,731	5,489,937	44,560,537
2013	51,293,257	64,895,112	30,097,334	39,793,007	5,769,911	8,428,755	200,277,376
2014	18,785,815	47,163,678	23,264,259	16,249,309	4,023,535	3,821,351	113,307,947
2015	4,163,174	13,098,266	4,668,205	7,064,760	2,418,935	8,695,374	40,108,714

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Table 3b. Kodiak District Tanner crab abundance estimates (legal-size males; ≥ 5.5in CW) from 2003-2015. Source ADF&G Fishery Management Report 16-20 (Spalinger 2016).

Year	Northeast	Eastside	Southeast	Southwest	Westside	North Mainland	Kodiak District
2003	507,088	747,989	154,368	213,865	239,486	79,684	1,942,480
2004	1,012,868	1,465,666	316,387	1,382,233	187,762	86,221	4,451,137
2005	1,046,453	3,735,106	318,135	827,508	179,753	89,723	6,196,678
2006	244,424	2,758,751	308,990	729,563	329,622	186,380	4,557,730
2007	342,396	1,689,456	306,590	1,216,944	271,233	136,314	3,962,933
2008	340,185	1,129,318	164,157	385,400	263,184	148,294	2,430,538
2009	687,402	2,787,271	737,020	387,610	393,196	182,846	5,175,345
2010	806,513	4,714,871	1,607,073	1,238,613	293,211	88,756	8,752,994
2011	282,944	2,434,967	1,836,691	766,008	164,607	90,561	5,575,778
2012	217,523	2,834,799	940,131	579,235	138,422	292,225	5,002,335
2013	109,389	654,455	483,354	314,928	87,740	162,128	1,811,994
2014	153,376	293,185	1,272,952	129,958	105,649	75,259	2,030,379
2015	55,923	158,439	83,254	157,933	60,195	347,703	863,447

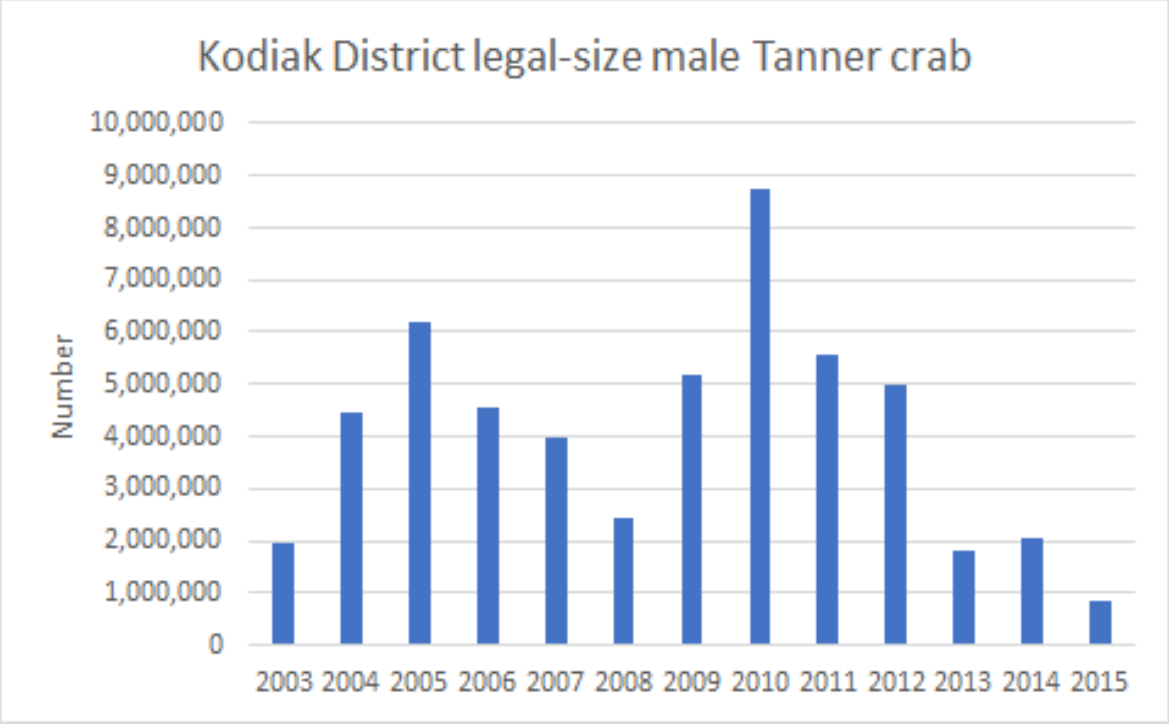

Figure 5. Tanner crab (legal males) abundance estimates from 2003-2015.

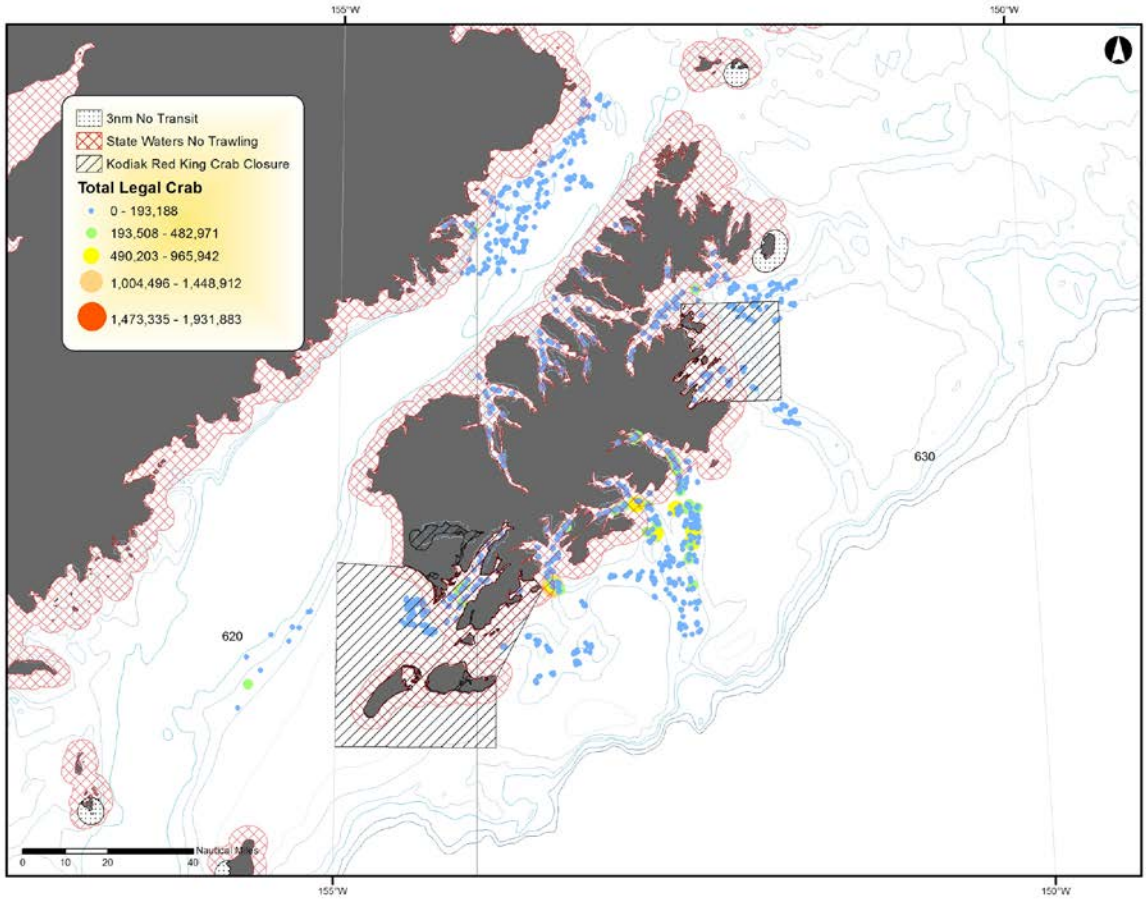

Figure 6. Tanner crab (all sizes) abundance and distribution around Kodiak Island including existing trawl closure areas (2006 - 2016 combined).

3. Central GOA Tanner Crab Fishery History

The State of Alaska shellfish management districts that overlap the CGOA groundfish FMP area include Kodiak, Chignik, and South Peninsula. While the rest of this discussion paper focuses on Kodiak, information on Chignik and South Peninsula are included for completeness, until further Council guidance defines the scope of any future action that might be considered. This section provides a brief overview of management history and tanner crab fishing outcomes in those districts. Describing historical harvest, value, and participation in the directed GOA Tanner crab fishery allows the reader to understand the scale of potential benefits that could accrue if abundance and management thresholds are met in the future and the fishery is reopened.

3.1. Kodiak District

Since 2003, the Kodiak district has been managed as a limited entry permit fishery with 180 available permits. Table 4 reports the number of permits issued in each year that the district was open, showing that the full limit of 180 permits was not utilized. Kodiak is “super-exclusive” for Tanner crab, meaning that Kodiak district permit holders may not fish in any other Tanner crab fishery during the same calendar

year. Vessels are subject to pot limits that slide on a scale from 20 to 60. The pot limit is increased during the season, once a certain percentage of the annual GHL has been taken. Increasing the pot limit improves the likelihood that the fleet can achieve the GHL as the season winds down, thus providing a greater economic benefit from the resource. The Kodiak district is divided into six sections, as shown in Figure 4. For the district's fishery to be opened, the combined GHL for all six sections must meet or exceed 400,000 lbs. A section will not be opened if its specific GHL is not at least 100,000 lbs.

The Tanner crab fishery in the Kodiak District began in 1967 when 110,961 pounds were landed. The fishery expanded and over 34 million pounds were harvested from 1968 through the 1972 season. In response to increased demand and larger harvests, ADF&G initiated a pot survey in 1973 to estimate relative abundance, predict recruitment trends, and develop annual harvest levels. The fishery continued to grow with annual harvests increasing to a peak of 33 million pounds in the late-1970s. ADF&G implemented an April 30 season closure date in 1975 to protect crab at the onset of the mating and molting season. The minimum carapace width of 5.5 inches was established in 1976. In the early 1980s, Tanner crab stocks and commercial harvests in the district began to decline, and by the early 1990s annual harvests averaged less than two million pounds. The fishery was closed from 1995 through 2001. During the six-year closure, ADF&G developed the harvest strategy of biological and management thresholds described earlier in this document.

Under limited entry, from 2003 through 2013, harvest ranged from 360,000 to 2.1 million lbs. During that period, the number of active vessels ranged from 31 to 80, which was a marked reduction from the average of 165 vessels that participated in the 10 years prior to limited entry.

Table 4. Kodiak District commercial Tanner crab guideline harvest level (GHL), effort, harvest, and value, 1967-2013/14 [Excerpted]. Source ADF&G Fishery Management Report 16-16, Table 2, p.24 (Stichert 2016).

		Number					Avg. pounds	Avg.	Avg.	Avg. price	Exvessel
Season	GHL	Vessels	Landings	Crab[a]	Pounds[a]	Pots lifted	per landing	CPUE	weight	per pound	value
1994/95–1999/00					No Commercial Fishery						
2000/01	500,000	145	192	193,138	510,407	7,233	2,658	27	2.6	$2.29	$1,168,832
2001/02	500,000	181	279	146,672	361,086	10,446	1,294	14	2.5	$2.04	$736,615
2002/03	510,000	72	276	215,924	511,324	11,108	1,853	19	2.4	$2.32	$1,186,272
2003/04	795,000	66	252	254,960	566,218	15,550	2,247	16	2.2	$2.34	$1,324,950
2004/05	1,750,000	76	291	779,041	1,806,416	21,429	6,338	36	2.3	$1.73	$3,065,256
2005/06	2,100,000	68	249	890,925	2,123,931	21,962	8,530	41	2.4	$1.53	$3,231,946
2006/07	800,000	50	96	318,815	765,092	7,834	7,970	41	2.4	$1.77	$1,354,213
2007/08	500,000	33	64	172,230	425,353	5,490	6,646	31	2.5	$2.00	$850,706
2008/09	400,000	31	48	148,882	359,056	5,835	7,480	26	2.4	$1.80	$646,301
2009/10	700,000	52	84	294,569	650,315	8,417	7,742	35	2.2	$1.34	$871,422
2010/11	1,490,000	80	131	638,959	1,537,384	11,213	11,736	57	2.4	$2.70	$4,150,937
2011/12	950,000	64	93	436,133	1,078,106	10,460	11,593	42	2.5	$1.88	$2,026,839
2012/13	660,000	59	115	263,213	658,194	13,084	5,723	20	2.5	$1.49	$980,709
2013/14					No Commercial Fishery						

Notes: CPUE = legal crab per pot lift; a = Includes deadloss and personal use.

Table 5. Permits issued for Kodiak district, by year and vessel size category (source: CFEC data provided by AKFIN)

Year	Kodiak U60'	Kodiak 60'+	Kodiak U120 (Ltd.)	Kodiak U60 (Ltd.)
1991	117	49		
1992	114	50		
1993	104	56		
1994	90	48		
2001	116	31		
2002	151	41		
2003			8	79
2004			8	62
2005			9	81
2006			15	61
2007			6	48
2008			7	29
2009			5	26
2010			11	42
2011			14	69
2012			14	53
2013			9	57

3.2. Chignik District

The Chignik district is an open access fishery, but also requires superexclusive registration for Tanner crab. The district is managed as a single section (as opposed to the six in Kodiak and two in South Peninsula), and the minimum GHL required to open a commercial fishery is 200,000 lbs. The district has a 58-foot maximum vessel size limit, and per-vessel pot limits that range from 30 to 50 depending on the size of the GHL.

The Chignik district fishery began in 1968, peaking in 1976 with 11 million lbs. harvested by 35 vessels. In that era, most fishing in the district has occurred in late March after the Kodiak and South Peninsula districts close on their harvest limits. The district was closed due to low recruitment from 1990 through 2004. Since then, the district has only been open in 2005, 2006, 2011, and 2012. During those years, annual harvest ranged from 143,000 to 698,000 lbs. and the fleet size ranged from four to 28 vessels.

Table 6. Chignik District commercial Tanner crab guideline harvest level (GHL), effort, harvest, and value, 1968-2013/14 [Excerpted]. Source ADF&G Fishery Management Report 16-16, Table 4, p.26 (Stichert 2016).

		Number					Avg. pounds	Avg.	Avg.	Avg. price	Exvessel
Season	GHL	Vessels	Landings	Crab[a]	Pounds[a]	Pots lifted	per landing	CPUE	weight	per pound	value
1989/90–2003/04					No Commercial Fishery						
2004/05	400,000	22	59	184,706	410,741	7,456	6,962	25	2.2	$1.66	$675,349
2005/06	200,000	4	7	57,547	143,164	2,037	20,452	28	2.5	$1.20	$170,769
2006/07–2009/10					No Commercial Fishery						
2010/11	600,000	13	35	276,691	646,531	5,516	18,472	50	2.3	$2.58	$1,666,330
2011/12	700,000	28	43	296,310	698,043	8,141	16,234	36	2.4	$2.21	$1,532,089

Notes: No commercial fishery in 2012/13 and 2013/14; CPUE = legal crab per pot lift; a = Includes deadloss and personal use.

3.3. South Peninsula District

The South Peninsula district is also an open access fishery, but does not require super-exclusive registration for Tanner crab. Similar to Chignik, South Peninsula has a 58-foot vessel size limit and pot limits that fluctuate between 30 and 50 pots per vessel depending on the GHL. Tanner crab fishing in the district began in 1967, and harvest limits were established in 1974 due to increasing harvest levels. Harvest peaked in the mid-to late-1970s around 7 million lbs. per year, then declined over the course of the 1980s. The district was closed from 1990 to 2000 due to low abundance of legal-sized Tanner crab. During that closure, the State of Alaska developed mature male abundance thresholds and management thresholds (minimum GHLs required to open the fishery). The fishery opened for four days in 2001, and 56 vessels landed 261,000 lbs. of a 375,000 lbs. GHL. The district was again opened from 2005 through 2013. In 2005 the state divided the district into two sections so that part of the fishery could remain open while the other area is closed to rebuild from low abundance. Since 2005, annual harvest ranged from 166,000 to 2.9 million lbs., and the fleet size ranged from six to 56 vessels.

Table 7. South Peninsula District commercial Tanner crab guideline harvest level (GHL), effort, harvest, and value, 1968-2013/14 [Excerpted]. Source ADF&G Fishery Management Report 16-16, Table 5, p.28 (Stichert 2016).

		Number					Avg. pounds	Avg.	Avg.	Avg. price	Exvessel
Season	GHL	Vessels	Landings	Crab[a]	Pounds[a]	Pots lifted	per landing	CPUE	weight	per pound	value
1989/90–1999/00						No Commercial Fishery					
2000/01	375,000	56	69	108,613	260,982	4,510		24	2.4	$1.24	$320,122
2001/02–2003/04						No Commercial Fishery					
2004/05	300,000	42	68	134,019	295,741	5,655		24	2.2	$1.67	$492,176
2005/06	290,000	15	47	127,061	287,749	3,703		34	2.3	$1.21	$348,092
2006/07	200,000	6	15	74,187	165,811	1,959		38	2.2	$0.79	$130,330
2007/08	250,000	9	42	102,290	236,241	3,368		30	2.3	$1.01	$237,330
2008/09	275,000	12	66	122,441	265,560	5,311		23	2.2	$1.31	$346,455
2009/10	500,000	41	72	261,170	583,202	5,779		45	2.2	$1.42	$827,527
2010/11	2,300,000	51	134	1,135,050	2,866,041	15,816		72	2.5	$2.31	$6,622,701
2011/12	1,620,000	56	117	723,578	1,875,277	10,524		68	2.6	$2.05	$3,844,652
2012/13	230,000	24	44	141,912	343,293	3,596		39	2.4	$2.20	$751,588
2013/14						No Commercial Fishery					

Notes: CPUE = legal crab per pot lift; a = Includes deadloss and personal use.

3.4. CGOA-Wide Data Summary

This section provides data on harvest, value, and fleet size, and processing activity aggregated across all CFEC Fish Tickets that recorded Tanner crab catch in areas that overlap the Central GOA FMP area. These records date back to 1991; Central GOA Tanner crab harvests were recorded from 1991 through 1994, and from 2001 through 2013.

Table 8 summarizes fleet size, landed weight, and ex-vessel value. During the studied period, 603 different vessels harvested Tanner crab in the Central GOA. Landings totaled roughly 20.9 million lbs., and the median annual figure of 760,000 lbs. reflects that the period from 2001 through 2013 includes years of lower harvest relative to the early 1990s. The total ex-vessel value of landings was roughly $44.4 million, with a nominal average annual value of $2.6 million for years when a commercial fishery occurred. The table also includes a price adjustment to 2016 dollars, using the Bureau of Labor Statistics producer price index for seafood product preparation and packaging (Series ID PCU3117), which is only available beginning in 2003.[2]

[2] Within the BLS producer price index, the sub-index that aligns most closely with the consumer price index for "All Items" is the Personal Consumption series. The producer price index for personal consumption tracks changes in manufacturer selling prices for consumer foods, as well as energy goods, durable goods, and nondurable goods.

The State of Alaska does not report ex-vessel value per pound on a district-level. Referring to Table XX, one can calculate that the annual average price per pound (nominal value) for Central GOA tanner crab ranged from $1.52 in 2006 to $2.97 in 2011. The state does report nominal ex-vessel price per pound of Tanner crab on a state-wide basis. Figure 7 tracks this measure from 1985 through 2016. The highest state-wide value was $3.41 in 1994. Looking at more recent years, prices jumped from the $1.50 to $1.80 range (2005 - 2010) to the $2.50 to $3.10 range (2011 - 2016).

Of the 20.9 million lbs. that were harvested, all but 162,000 lbs. were processed at shore-based facilities. Table 9 shows the number of active facilities, by community, as well as the total weight processed onshore in each year. Kodiak received landings in each year. Kenai, Seldovia, Seward, and Naknek only received landings during the 1991 through 1994 period, while Sand Point only began processing Central GOA Tanner crab in 2005.

Nearly half of the 162,000 lbs. processed on a vessel occurred on a single vessel in a single year. Typically, a vessel that processed Tanner crab at sea produced on the order of 10,000 to 30,000 lbs. (whole weight). Table 10 provides a count of vessels that processed Central GOA Tanner crab by year; those vessels were identified in CFEC Fish Tickets as a mix of floating catcher processors, floating catcher sellers, and floating catcher exporters.

Because most other communities had only one active processing facility that received Tanner crab, confidentiality rules dictate that landings by community can only be described by Kodiak and all other communities in aggregate. Since 2001, Kodiak received 94% (11.5 million lbs.) of all Central GOA tanner crab (both shore-based and at-sea processed). In 2005, when deliveries were also made to Sand Point, Homer, and Dutch Harbor, Kodiak received 91% of landings. During the three years that only Kodiak and Sand Point processed Tanner crab, 85% of the delivered weight was processed in Kodiak.

Table 8. Tanner crab harvest and value in management districts overlapping the Central GOA FMP area, 1991 through 2013 (source: CFEC Fish Tickets).

Year	Vessel Count	Weight Landed (lbs.)	Ex-Vessel Value (nominal $)	Ex-Vessel Value (2016 $)
1991	202	2,441,865	3,979,569	
1992	261	2,803,920	6,378,498	
1993	273	1,850,476	3,676,517	
1994	239	1,570,829	3,748,245	
2001	144	500,883	1,155,036	
2002	179	360,747	792,922	
2003	71	498,052	1,154,983	1,626,216
2004	66	564,089	1,382,582	1,901,051
2005	91	1,954,881	3,380,022	4,481,234
2006	71	2,145,436	3,269,507	4,302,304
2007	50	759,998	1,396,116	1,742,670
2008	33	423,589	838,283	954,937
2009	31	357,855	644,139	726,721
2010	52	641,525	1,016,176	1,103,142
2011	84	1,872,972	5,557,917	5,585,687
2012	77	1,487,132	4,277,653	4,308,252
2013	59	644,694	1,740,029	1,754,986
Total	603	20,878,943	44,388,194	
Average	117	1,228,173	2,611,070	
Median	77	759,998	1,740,029	

Table 9. Count of facilities processing Tanner crab harvested in management districts overlapping the Central GOA FMP area, 1991 through 2013 (source: CFEC Fish Tickets).

Year	Kodiak	Homer	Anchorage	Sand Point	Kenai	Ninilchik	Dutch Harbor	Seldovia	Seward	Naknek	Total Lbs.
1991	10	1						1			2,432,009
1992	10	1	1			1			1		2,790,393
1993	10	1	1		1						1,847,322
1994	7	2	1		1					1	1,487,280
2001	8										500,883
2002	7										360,747
2003	5										498,052
2004	5										563,751
2005	6	1	1	1		1	1				1,941,589
2006	5			1							2,140,828
2007	5										759,998
2008	5										423,589
2009	4										357,855
2010	6										637,301
2011	5			1							1,872,372
2012	5			1							1,457,841
2013	5										644,694

Table 10. Count of vessels processing Central GOA Tanner crab at sea, 1991 through 2012 (source: CFEC Fish Tickets).

Year	# Vessels
1991	1
1992	2
1993	1
1994	4
2004	1
2005	4
2006	1
2010	1
2011	1
2012	3

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Figure 7. ***Alaska state-wide Tanner crab nominal ex-vessel price per lb., 1985 through 2016 (source: http://www.adfg.alaska.gov/index.cfm?adfg=CommercialByFisheryshellfish.shellfishcatch_exvessel_crab).***

4. Updated Information on Tanner Crab Bycatch in the CGOA Groundfish Fisheries

Added protections to Tanner crab envisioned by Amendment 89 included a localized trawl closure area, CGOA-wide trawl gear modifications, and an expectation of improved observer coverage in select areas. Because the effective date of Amendment 89 was 2014, impacts from that action that could, at least indirectly, improve population conditions for CGOA Tanner crab through reduced mortality may not be fully manifested (female Tanner crab are reproductively mature at age 5 and males at age 6). Additionally, evaluating the magnitude of any contribution of changes in the activities of the CGOA trawl fleet to changes in Tanner crab population size or year class strength presents analytical challenges that are beyond the scope of this discussion paper.

PSC estimates from 2003 – 2016 for different gear types and target species are provided in Tables 11-13 below. Consistent with the analysis supporting Amendment 89, among gear types, bycatch of Tanner is dominated by non-pelagic trawl (NPT) and pot gear (Table 11). Within the NPT gear type most of the Tanner crab bycatch occurs in flatfish fisheries (Table 12). Pacific cod is the only target species associated with Tanner PSC in the data (Table 13).

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Table 11. PSC estimates for different commercial gear types in the CGOA from 2003 – 2016. (Source AKRO Blend and Catch Reporting).

Year	HAL	NPT	POT	PTR	Total
2003	19	135,381	9,191	108	144,699
2004	1	53,017	10,064	650	63,731
2005	1,251	91,906	89,087	136	182,380
2006	503	223,783	78,241	390	302,917
2007	123	196,382	167,300	1,298	365,103
2008	1,523	127,221	138,188	37	266,968
2009	430	227,148	20,495	4	248,078
2010	1,065	88,317	101,597	19	190,997
2011	5,441	96,756	11,906	1	114,104
2012	2,615	82,478	111,922	371	197,385
2013	884	239,742	320,411	1,349	562,386
2014	152	63,490	35,462	0	99,105
2015	167	75,664	63,804	124	139,759
2016	220	91,336	31,460	0	123,016
Total	**14,393**	**1,792,621**	**1,189,128**	**4,487**	**3,000,629**

Table 12. PSC estimates for different targets within the NPT gear group in the CGOA from 2003 – 2016. (Source AKRO Blend and Catch Reporting).

Year	ATF	SWF	Rex	Flathd	Poll-NPT	Pcod	Rockfish	Sablefish	Other	Poll-Mid	Total
2003	28,189	58,618	29,467	17,383	0	1,532	171	0	20	1	**135,381**
2004	33,265	8,583	5,888	2,315	555	894	1,517		0	0	**53,017**
2005	66,944	5,946	4,398	12,540		270	1,620		189	0	**91,906**
2006	87,179	33,120	70,913	23,473	7,744	532	822	0			**223,783**
2007	41,865	78,474	44,797	24	19,346	11,629	71	169	7	0	**196,382**
2008	34,553	23,100	47,993	6,515	233	14,529	62	176	59	0	**127,221**
2009	39,866	30,020	141,324	7,647	6,558	1,456	205	71	2		**227,148**
2010	46,414	21,515	14,235	5,067	87	860	83	55		0	**88,317**
2011	70,620	5,311	5,902	4,704	10,193	1	25	0		0	**96,756**
2012	72,575	3,783	0	2,996	357	2,699	68	0	0	0	**82,478**
2013	99,202	118,603	750	11,235	6,625	3,287	40	0		0	**239,742**
2014	39,225	10,488	233	0	2,041	11,331	173	0		0	**63,490**
2015	6,643	62,251	81	3,225	2,216	1,223	0	25		0	**75,664**
2016	77,209	10,398	0	299	3,412	18	0	0	0	0	**91,336**
Total	**743,749**	**470,209**	**365,980**	**97,422**	**59,367**	**50,262**	**4,857**	**496**	**278**	**1**	**1,792,621**

Table 13. PSC estimates for species target within the POT gear group in the CGOA from 2003 – 2016. (Source AKRO Blend and Catch Reporting).

Year	Pacific Cod
2003	9,191
2004	10,064
2005	89,087
2006	78,241
2007	167,300
2008	138,188
2009	20,495
2010	101,597
2011	11,906
2012	111,922
2013	320,411
2014	35,462
2015	63,804
2016	31,460
Total	1,189,128

4.1. Marmot Bay Tanner Crab Protection Area

The overlap of the Marmot Bay TCPA, historic bottom contact by fishing gear, and presence of Tanner crab in the ADF&G trawl survey (Figure 8) is consistent with the information examined in Amendment 89 which led to the establishment of this closure area. An estimate of the protective power of this closure area is not attempted here, but further spatial analysis may help with that question. The maps provide a picture of cumulative fishing gear contact with bottom habitat. It is assumed that contact with trawl gear and bottom habitat in the Marmot Bay TCPA is nil since its implementation.

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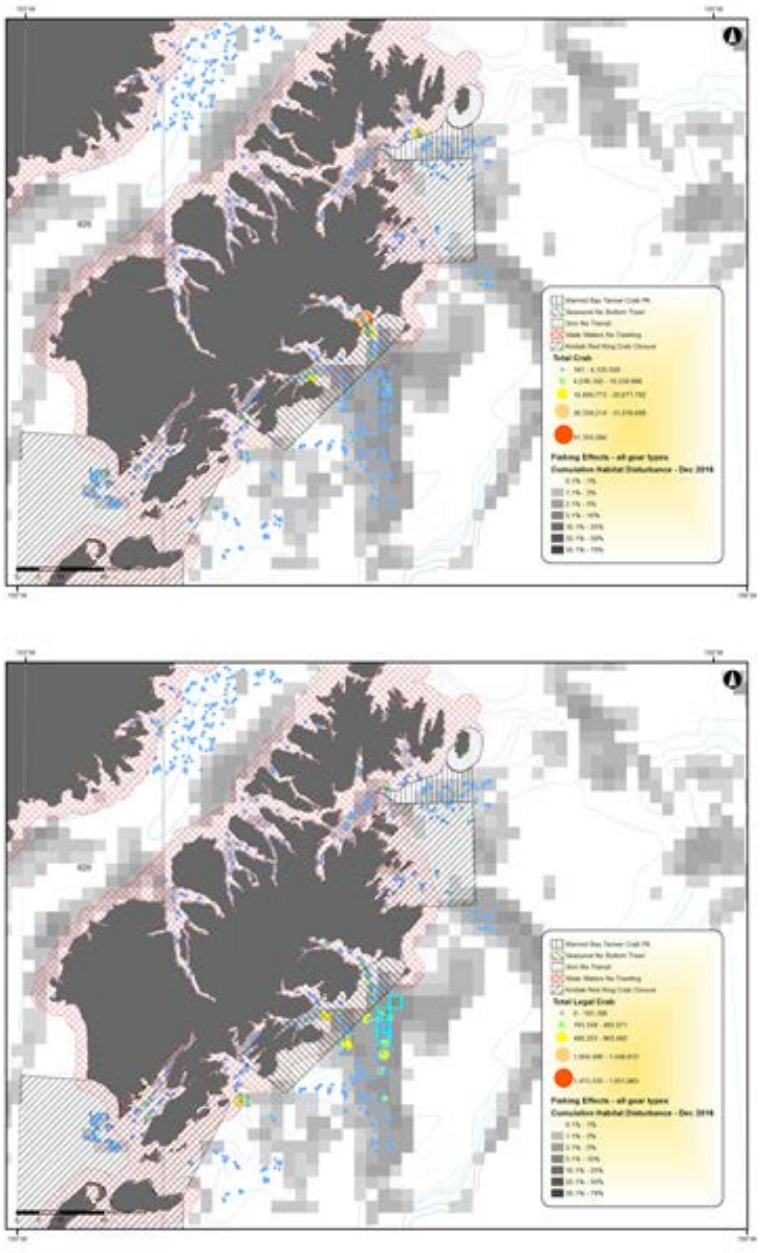

Figure 8. Distribution of Tanner crab from the ADF&G survey, crab protection closure areas, and the footprint of bottom-contacting fishing gear around Kodiak Island.

4.2. Non-Pelagic Trawl Gear Modifications

Amendment 89 required vessels using non-pelagic trawl gear when fishing for flatfish in the CGOA to comply with the same performance standard and gear construction requirements for vessels in the Bering Sea flatfish fisheries. Central GOA flatfish fisheries include directed fisheries for shallow-water flatfish, deep-water flatfish, arrowtooth flounder, rex sole, and flathead sole. The Council considered but rejected alternatives that would have required the use of modified NPT gear in other GOA NPT fisheries (e.g., Pacific cod), and the use of NPT gear in the Eastern and Western GOA flatfish fisheries. Flatfish fisheries

in the Central GOA contributed the greatest proportion of Tanner crab PSC in the analysis supporting Amendment 89, while other NPT gear fisheries in the GOA accounted for only a modest proportion of Tanner crab PSC.

Figure 9 provides a time series of Tanner crab PSC by the CGOA NPT flatfish fisheries (arrowtooth, SW, DW, rex, flathead). A conservative comparison shows that the three-year period (2014-2016) since the gear modification requirement is associated with a 17% reduction in Tanner PSC relative to the 2010-2012 period. This comparison is conservative because it ignores the very large PSC estimate for 2013. Before initiating the gear modification for the CGOA flatfish fisheries, the Council reviewed supplementary analyses in 2012 of potential impacts its required use in the Central GOA flatfish fisheries. The Council recommendation requiring that vessels directed fishing for flatfish in the Central GOA use modified NPT gear was supported by those analyses.

As stated in the Amendment 89 EA, "while requiring this modification for vessels fishing in the Central GOA flatfish fisheries could certainly provide benefit to crab stocks, by reducing unobserved mortality, it would not be likely to change reported PSC totals from trawl fishing, which account only for PSC that comes up in the trawl net."

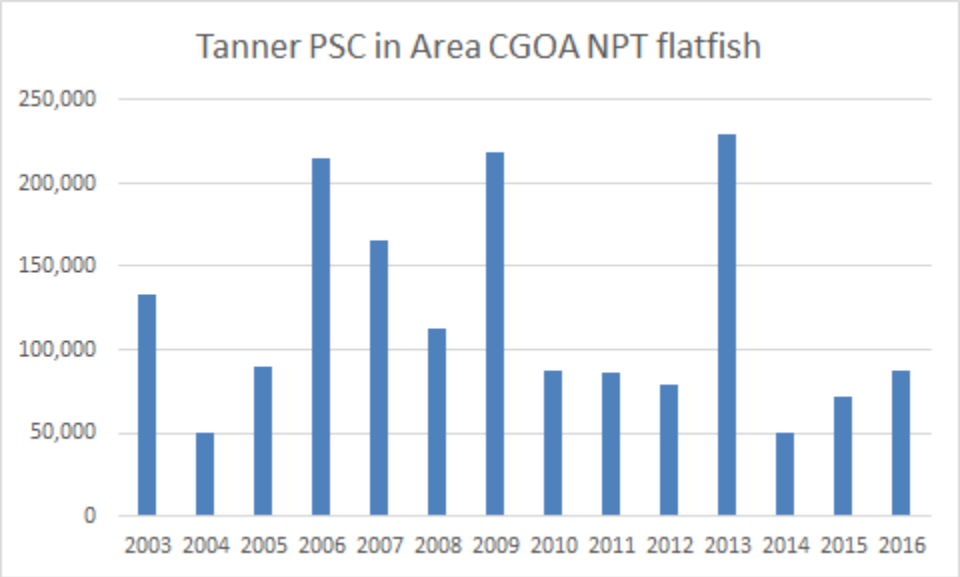

Figure 9. Updated time-series of Tanner crab bycatch in the CGOA NPT flatfish fisheries affected by the gear modification requirement.

4.3. Observer Coverage

As stated above, "Aware of its decision on [restructuring the Observer Program], the Council included as part of its recommendation for improved estimates of Tanner crab bycatch [through Amendment 89] that NMFS ''incorporate, to the extent possible, an observer deployment strategy that ensures adequate coverage to establish statistically robust observations'' in the three specific areas near Kodiak."

A simple evaluation of the level of observer coverage in the stat areas since restructuring was attempted. Observer coverage was defined in terms of observed vessel days, so that, from the observer database, an observed vessel day was the unique combination of a vessel identifier and date. The data query was

restricted to the two primary statistical areas of interest and observer days were summed annually to compare before and after restructuring. Only CVs and non-rockfish trips using NPT gear were included.

The number of observer days in Stat Areas 525702 and 525630 since 2013 appear to reflect a decrease compared to earlier years (Figure 10). Further examination of observer days GOA-wide, however, shows that the decrease is consistent with a decrease in GOA coverage overall. One of the major accomplishments of the restructured observer program was to expand coverage into previously under-sampled components of the fleet. Additionally, because of the complicated nature of the assigning of observers to the partial coverage fleet, it is likely that the utility of the information from this exercise is limited and further analysis should be done before drawing any conclusions about observer coverage in these areas.

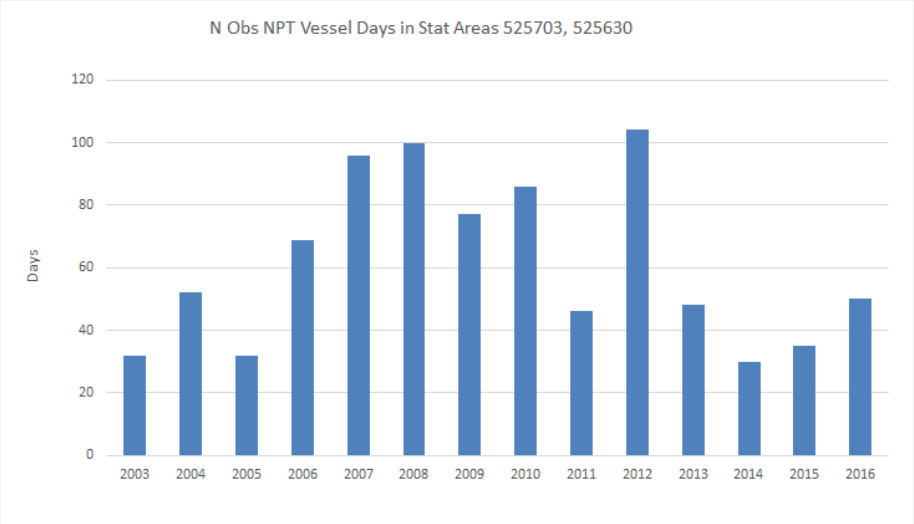

Figure 10. Number of observed vessel days in the CGOA groundfish fisheries.

5. Summary

A brief review of the direct and indirect protections for Tanner crab in the CGOA has been provided, along with information on the status of the Tanner crab stock and Tanner crab fishery management by the State of Alaska.

The factors constraining crab stock recovery in the GOA are likely complicated. Through the accumulation of indirect protections, and finally through the direct protections put in place by the Council, Tanner crab in the CGOA are less affected by the activity of the groundfish trawl fleet than they would be in the absence of those measures. Nevertheless, it is not well understood how important trawl bycatch is relative to other factors in the environment that may be limiting recovery of the stock and resumption of a stable and profitable Tanner crab fishery. Areas south of Kodiak, specifically statistical areas 525702 and 525630 show concentrations of Tanner crab from the ADF&G survey, as well as a relatively high degree of groundfish gear use (Figure 8). Since 2014, however, trawl gear modifications should be associated with reduced impacts to crab and crab habitat throughout the Central Gulf.

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