

Fishery Management Report No. 14-09

**Norton Sound Section Shellfish, 2013;
A Report to the Alaska Board of Fisheries**

by

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and

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March 2014

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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Weights and measures (metric)		General		Mathematics, statistics	
centimeter	cm	Alaska Administrative Code	AAC	<i>all standard mathematical signs, symbols and abbreviations</i>	
deciliter	dL	all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	alternate hypothesis	H_A
gram	g	all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.	base of natural logarithm	e
hectare	ha	at	@	catch per unit effort	CPUE
kilogram	kg	compass directions:		coefficient of variation	CV
kilometer	km	east	E	common test statistics	(F, t, χ^2 , etc.)
liter	L	north	N	confidence interval	CI
meter	m	south	S	correlation coefficient	
milliliter	mL	west	W	(multiple)	R
millimeter	mm	copyright	©	correlation coefficient (simple)	r
		corporate suffixes:		covariance	cov
Weights and measures (English)		Company	Co.	degree (angular)	$^\circ$
cubic feet per second	ft ³ /s	Corporation	Corp.	degrees of freedom	df
foot	ft	Incorporated	Inc.	expected value	E
gallon	gal	Limited	Ltd.	greater than	>
inch	in	District of Columbia	D.C.	greater than or equal to	\geq
mile	mi	et alii (and others)	et al.	harvest per unit effort	HPUE
nautical mile	nmi	et cetera (and so forth)	etc.	less than	<
ounce	oz	exempli gratia	e.g.	less than or equal to	\leq
pound	lb	(for example)		logarithm (natural)	ln
quart	qt	Federal Information Code	FIC	logarithm (base 10)	log
yard	yd	id est (that is)	i.e.	logarithm (specify base)	log ₂ , etc.
		latitude or longitude	lat or long	minute (angular)	'
Time and temperature		monetary symbols (U.S.)	\$, ¢	not significant	NS
day	d	months (tables and figures): first three letters	Jan, ..., Dec	null hypothesis	H_0
degrees Celsius	$^\circ\text{C}$	registered trademark	®	percent	%
degrees Fahrenheit	$^\circ\text{F}$	trademark	™	probability	P
degrees kelvin	K	United States (adjective)	U.S.	probability of a type I error (rejection of the null hypothesis when true)	α
hour	h	United States of America (noun)	USA	probability of a type II error (acceptance of the null hypothesis when false)	β
minute	min	U.S.C.	United States Code	second (angular)	"
second	s	U.S. state	use two-letter abbreviations (e.g., AK, WA)	standard deviation	SD
Physics and chemistry				standard error	SE
all atomic symbols				variance	
alternating current	AC			population	Var
ampere	A			sample	var
calorie	cal				
direct current	DC				
hertz	Hz				
horsepower	hp				
hydrogen ion activity (negative log of)	pH				
parts per million	ppm				
parts per thousand	ppt, ‰				
volts	V				
watts	W				

FISHERY MANAGEMENT REPORT NO. 14-09

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A REPORT TO THE ALASKA BOARD OF FISHERIES**

by

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ABSTRACT

This report provides an overview of king crab resources available in the Norton Sound Section, a description of subsistence and commercial fisheries in the section, and a brief summary of research needs. Specific background is provided on those aspects of fishery management relevant to 2014 Alaska Board of Fisheries Norton Sound Section shellfish proposals. Of note is background related to (1) the documentation of a new king crab species, Hanasaki king crab (*Paralithodes brevipes*) in the Norton Sound Section, (2) the establishment and alteration of commercial season opening and closing dates, and (3) the establishment and modification of closed water boundaries for the summer commercial crab fishery. Management actions taken in 2013 regarding summer commercial season opening and closing dates, and closed water boundaries are provided for reference.

Key words *Paralithodes camtschaticus*, *Paralithodes platypus*, *Paralithodes brevipes*, red king crab, Hanasaki king crab, blue king crab, Norton Sound, hand lines, pots, CDQ, closed waters, molting.

KING CRAB FISHERIES OVERVIEW

NORTON SOUND SHELLFISH SECTION DISTRICT BOUNDARIES

The Norton Sound Section encompasses all waters in King Crab Registration Area Q north of the latitude of Cape Romanzof (61°49'N), east of the Maritime Boundary Agreement Line, and south of lat 66°N (Figure 1). In 2010, due to concern over lack of stock status information on arctic fish populations, the National Marine Fisheries Service (NMFS) closed the area above the latitude of Cape Prince of Wales to commercial fishing, and that area is now open to commercial fishing only in state waters.

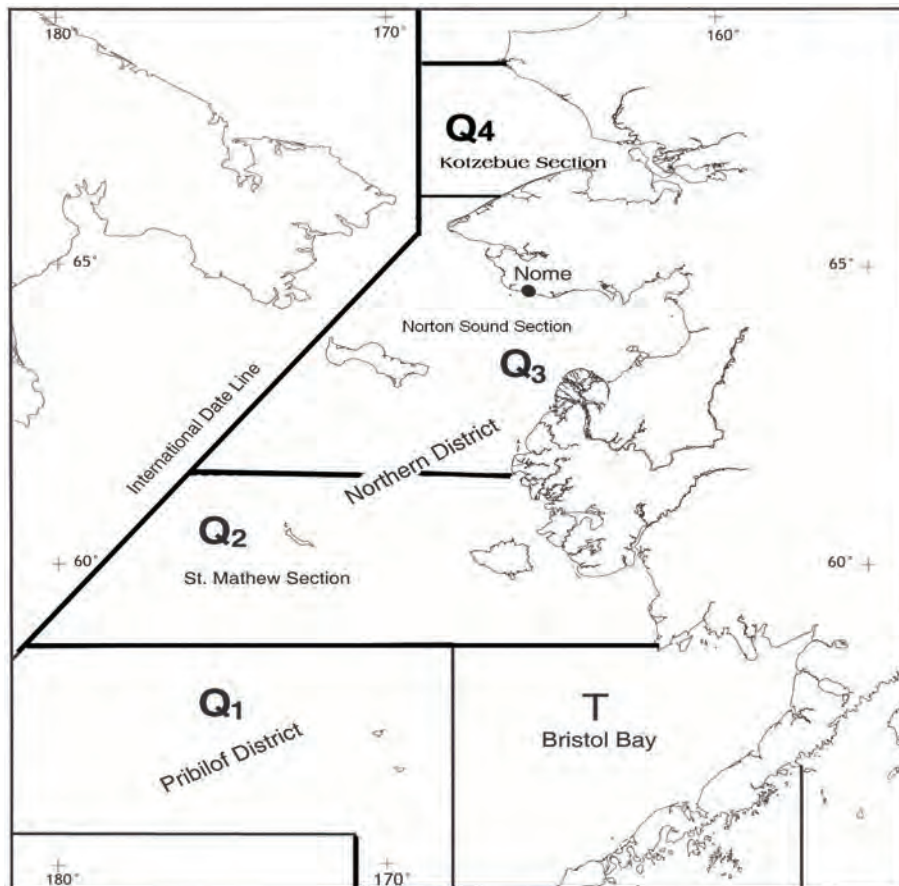


Figure 1.—King crab fishing districts and sections of Registration Area Q.

KING CRAB RESOURCES

King crab in the Norton Sound section include red (*Paralithodes camtschaticus*), blue (*Paralithodes platypus*), and the more recently documented Hanasaki king crab (“spiny king crab” *Paralithodes brevipes*). Red king crab is by far the most abundant crab species in the Norton Sound Section, and is the primary target of subsistence and commercial fisheries in Norton Sound. Norton Sound red king crab is one of the northernmost red king crab populations that can support a commercial fishery (Powell et al. 1983). Red king crab are found throughout the northern and eastern portion of Norton Sound where suitable habitat is available. The majority of research conducted on king crab in Norton Sound has targeted red king crab, because it is the dominant crab species in the region and within harvests.

Blue king crab are less abundant, although their distribution is concentrated in the western portion of the section in the Bering Strait and Saint Lawrence Island area; abundance information is extremely difficult to assess due to strong currents and bottom topography. Commercial and subsistence blue king crab harvests are allowed by regulation. There is no management plan for blue king crab because of a lack of data and limited harvests. Blue king crab may be sold incidentally in the red king crab commercial fishery harvest. Thomas (1981) and Magdanz (1982) report subsistence use of king crab in the Bering Strait from 1980–1981, documented by using household surveys and interviews with elders in the communities of Gambell, Savoonga, and Little Diomedede. Exploitation is likely very low due to the low number of residents in the region. Commercial catches in the former Saint Lawrence Island Section have only been reported for 4 years. In 1983, the commercial crab fleet near the southeast shore of Saint Lawrence Island harvested 52,557 pounds of blue king crab. In 1984, a regulation was adopted to close waters within 10 miles of all inhabited islands within the Saint Lawrence Island Section (Saint Lawrence Island, Little Diomedede, and King Island) to protect nearshore crab aggregations targeted by subsistence users in the Bering Strait. As a result of the nearshore closure, commercial catches in the former Saint Lawrence Island Section have been very low, with the exception of 7,913 pounds of blue king crab delivered in 1995 (Bue et al. 1997).

Populations of Hanasaki king crab are known to occur in the waters around the Hanasaki Peninsula near Hokkaido, Japan; and in the Okhotsk Sea along the Kamchatka Peninsula in Russia. In 2003, Hanasaki king crab were first documented in the Norton Sound Section when a single specimen was harvested by a subsistence user at Little Diomedede Island. Few reports of this species occurred between 2003 and 2010, but several dozen Hanasaki king crab have been harvested since 2011, including specimens harvested close to shore in the winter through-the-ice commercial fishery near Nome in 2012 and 2013. Additionally, small subsistence catches comprised entirely of Hanasaki king crab, including gravid females, were documented near Gambell on Saint Lawrence Island during the summer of 2013. A juvenile Hanasaki king crab was also observed and photographed by an observer during the 2013 Norton Sound summer commercial red king crab fishery.

RED KING CRAB FISHERIES

SUBSISTENCE FISHERIES

Historically, Norton Sound-Bering Strait residents have utilized king crab for subsistence purposes. Magdanz (1982) documented village elders recalling “sled loads” of king crab caught by single individuals using the traditional subsistence harvest method of hand lines (lines and ring nets) baited with fish dropped through holes, cracks or leads in the ice (Kuhlmann et al. 1979). Based on local and traditional knowledge, king crab catches were likely a significant component of historical subsistence-caught food in Norton Sound. The Alaska Board of Fisheries (board) has made a positive customary and traditional use finding for all shellfish in the Bering Sea Area (5 AAC 02.608).

Typically, subsistence crabbing occurs in waters 10 fathoms or less in depth. Beginning with the 1978/1979 winter season, hand line use began to diminish in favor of pot gear to more efficiently harvest king crab (Schwarz et al. 1984). The primary contributing factor to pot gear becoming more prevalent was the perceived decline in nearshore crab abundance (Schwarz et al. 1984). Schwarz et al. (1984) wrote “*during the winter of 1977–78 and earlier seasons, the high abundance of crab made handlining an efficient gear type. The relatively low abundance of crab in nearshore waters during recent winters has made hand lines inefficient. The most successful fishermen are currently using king crab pots or traps.*” Low subsistence harvests observed from 1978–1982 have been posited to be caused by several factors; (1) large-scale removal of red king crab biomass by the summer commercial fishery that began in 1977; (2) low recruitment; (3) unfavorable ice conditions; and (4) inter-annual variability in crab distribution (Schwarz et al. 1984).

Subsistence harvests of red king crab were monitored beginning in the mid-1970s using household interview survey methods, and beginning in 1977, using subsistence permits (Magdanz 1982). During the mid-1970s, harvests averaged 60–70 crab per household (Magdanz 1982) and the 1978 average harvest was 84 crab; the 1978 season also had a record number of permits fished (149) and record winter subsistence crab harvest (12,506 crab) (Figure 2; Appendix A1). However, subsistence harvests declined precipitously during the 1979–1982 period when harvests ranged from 213 crab by 9 permits fished in 1980, to 1,288 crab harvested by 54 permits fished in 1982 (Figure 2; Appendix A1). Subsistence crab harvests increased dramatically again during the 1982–83 and 1983–84 winter seasons when an estimated total of 21,652 crab were harvested for the two seasons combined (Appendix A1). The sudden increase in subsistence harvest was partially attributed to increased recruitment of legal male crab into the fishery (Schwarz et al. 1983). Increase in harvest was also attributed to widespread use of more efficient pot gear; 9,273 crab (89%) of the 10,432 crab harvested during the 1982–83 winter season were captured with pot gear (Schwarz et al. 1984).

From 1977–1998, the average subsistence harvest was 5,678 crab caught by an average of 75 active permit holders (Appendix A1). During the subsequent 10-year period (1999–2008), the average harvest was 4,789 crab by 66 permits fished; 16% and 13% reductions from the 1977–1998 averages, respectively (Appendix A1). The overall average subsistence crab harvest during the most recent 5-year period (2009–2013) was 6,694 crab; 18% above the 1977–1998 average (Appendix A1). Additionally, the 98 permits fished on average during the 2009–2013 period was 31% above the 1977–1998 period average number of permits fished (Appendix A1).

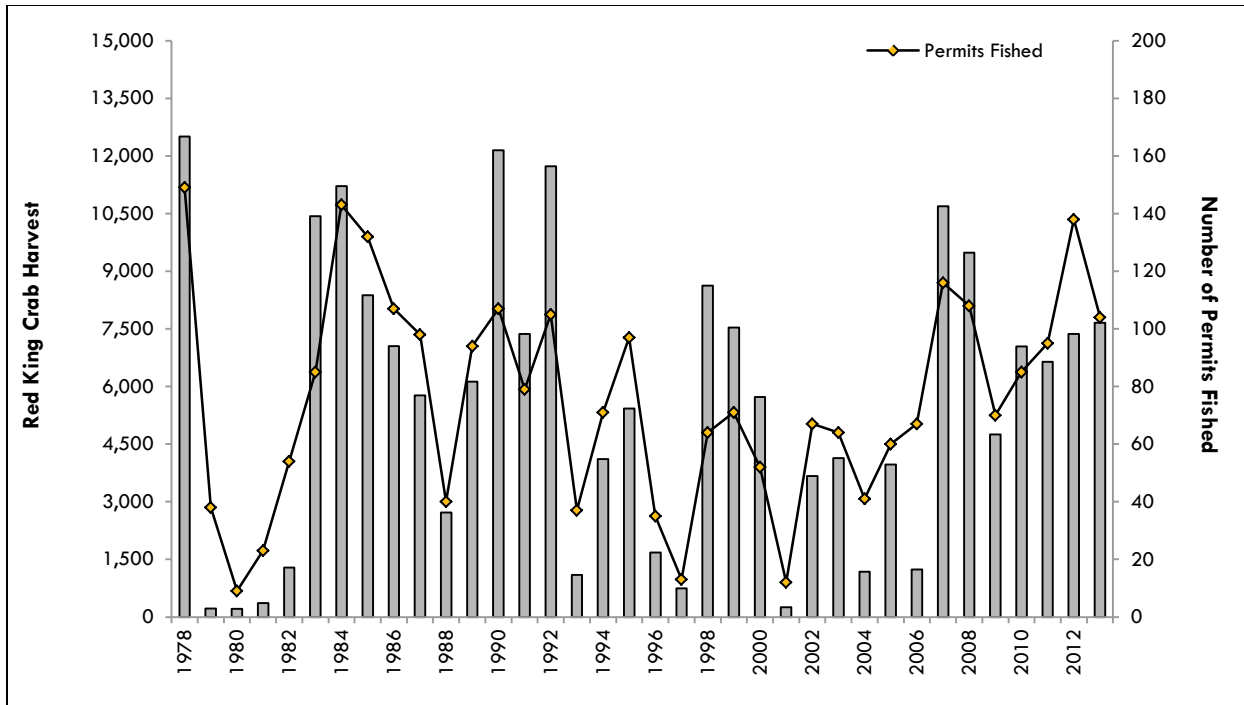


Figure 2.—Annual subsistence king crab harvest (numbers of crab) compared to number of permits fished in the winter through-the-ice subsistence fishery, 1978–2013, Norton Sound.

COMMERCIAL FISHERIES

Winter Commercial Fishery

A winter commercial fishery in Norton Sound Section occurs from November 15 through May 15 through the ice only. As with the subsistence fishery, stability of sea ice greatly affects the success of the winter fishery. Historically, the fishery has been largely based in the vicinity of Nome. However, recent surges in crab prices, and an initiative by Norton Sound Economic Development Corporation (NSEDC) to support crabbers in remote villages, have led to increases in commercial winter crabbing effort from the surrounding villages of Saint Michael, Unalakleet, Shaktoolik, Elim, and Golovin. With the exception of the 1977/1978, 1993/1994, and 1994/1995 seasons, a small number of permit holders have accounted for the majority of the winter commercial crab harvest in most years (Figure 3; Appendix A1). During the 2011/2012 and 2012/2013 winter seasons, near record levels of participation in the winter fishery were observed. In 2011/2012, deliveries were made by 35 of 41 registered permit holders, harvesting 9,157 crab, which at the time was second highest harvest on record (Figure 3; Appendix A1; Menard et al. 2013). During the following winter (2012/13), 26 permit holders harvested 22,639 crab (approximately 60,000 pounds), which was 135% above the previous record of 9,625 crab taken during the 1977/1978 winter (Figure 3; Appendix A1). The bulk of the effort during the record harvest year occurred in the vicinity of Nome; ice conditions were unstable in the surrounding villages during the winter of 2012/2013.

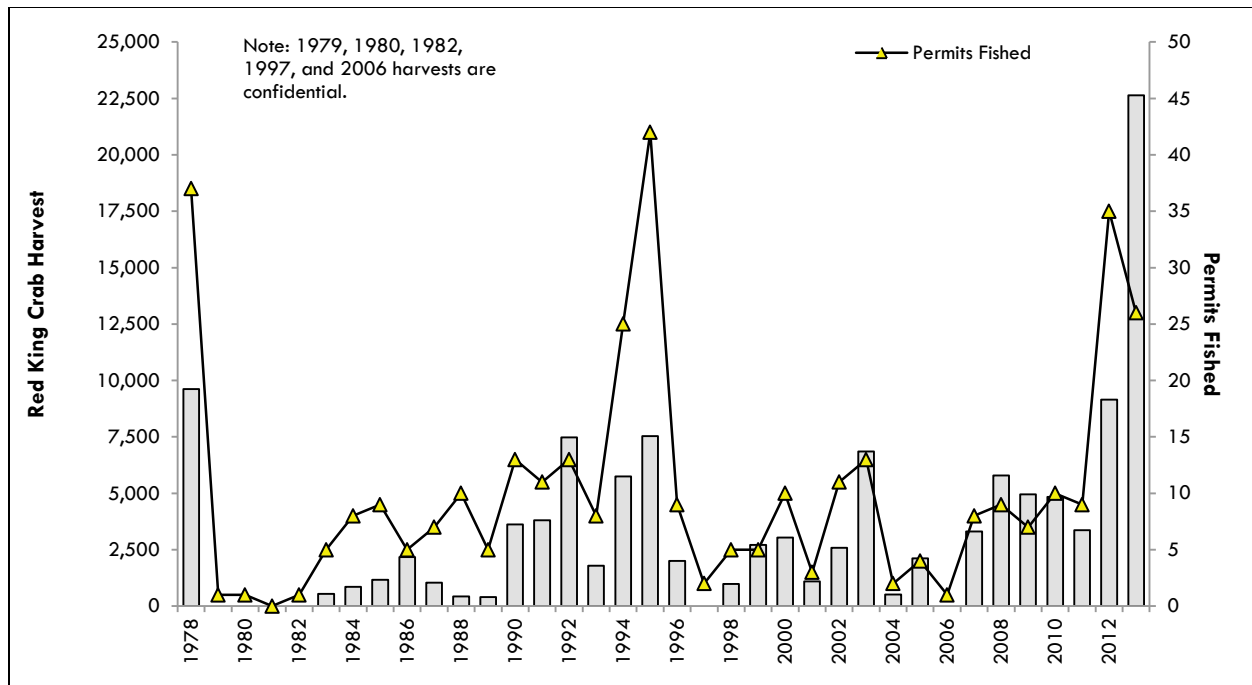


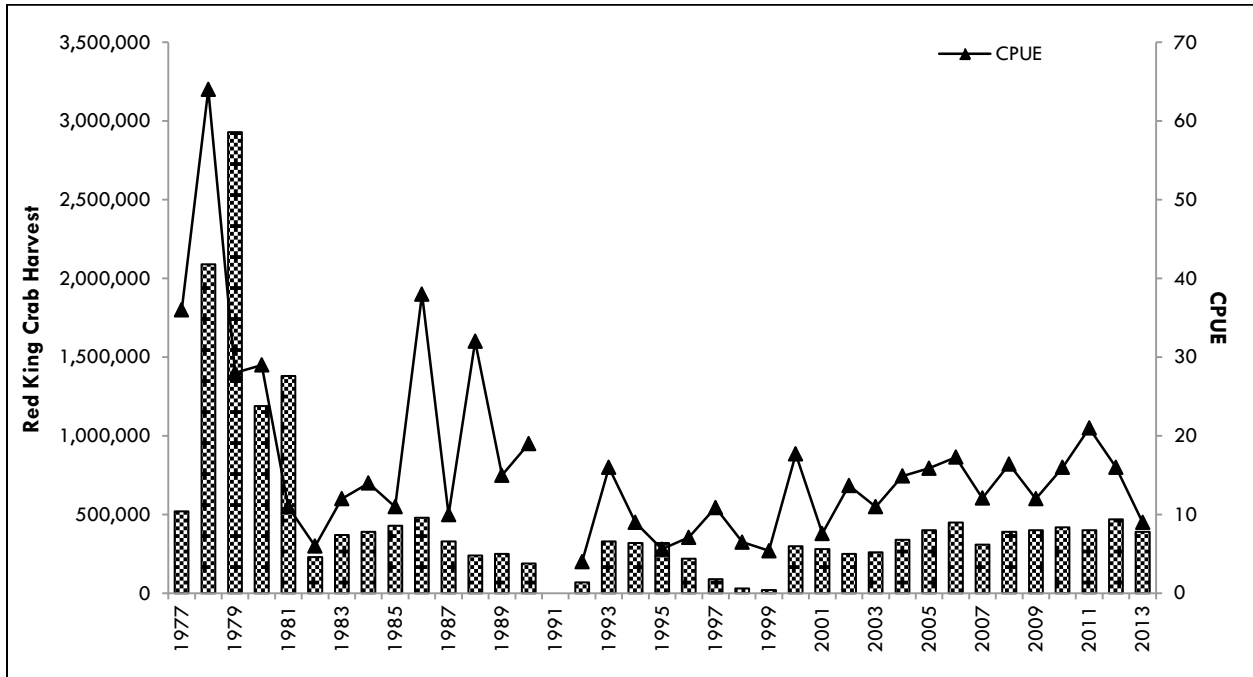
Figure 3.—Annual red king crab harvest (numbers of crab) compared to number of permits fished in the winter through-the-ice commercial fishery, 1978–2013, Norton Sound Section.

Summer Commercial Fishery

The Norton Sound summer commercial red king crab fishery was termed “exploratory” at its inception and was opened via regulations adopted by the board in 1977 (Kuhlman et al. 1979). The fishery was managed aggressively during its early years as commercial harvests averaged 1.9 million pounds from 1977–1981, including a record harvest of 2.93 million pounds in 1979 (Figure 4; Appendix A2). Estimated legal male exploitation rates were high and peaked at 41% in 1979 (Kulhmann et al. 1980). From 1982–1993, the board gradually reduced harvest rates and eventually adopted a more prescriptive harvest strategy in 1988, such that more conservative harvest rates were implemented at lower levels of estimated legal male abundance and higher harvest rates were allowed for higher abundance levels (Lean et al. 1995). Through 1993, the fleet was primarily made up of large Bering Sea fishing vessels. In 1994, the Norton Sound red king crab fishery received a superexclusive designation, which prohibited any vessel participating in the Norton Sound crab fishery from participating in any other king crab fishery in the state during that year (Howard and Hamazaki 2012). In 2000, the License Limitation Program (LLP) went into effect for the Norton Sound crab fishery which requires vessels greater than 32 feet in length to possess a valid crab license issued under LLP by NMFS (Menard et al. 2013). Consequently, these regulations resulted in smaller, locally-owned vessels participating in this fishery. Beginning in 1998, Community Development Quota (CDQ) groups were allocated a portion of the summer harvest, but no CDQ harvest occurred until the 2000 season and no harvest occurred in 2001.

Harvests and exploitation rates in the early years of the fishery were high, followed by more conservative and sustainable exploitation rates so that harvest levels reflected abundance trends. Periodic strong recruitment events contributed to harvests of 450,000, 420,000, and 470,000

pounds during the 2006, 2010, and 2012 seasons, respectively; these harvests were the largest since the mid-1980s (Figure 4; Appendix A2). Commercial harvests during the most recent 5-year period (2009–2013) averaged 420,000 pounds (open access and CDQ) for 29 active permits, which are 52% and 44% increases from the 1982–2008 average harvest and vessel participation levels, respectively (Appendix A2).



Note: No fishery occurred in 1991 and harvest was only 20,000 pounds in 1999.

Figure 4.—Annual summer commercial red king crab harvest (pounds) including CDQ harvest compared to catch per unit of effort (CPUE), Norton Sound Section, Eastern Bering Sea, 1977–2013.

Abundance Estimation and Harvest Strategy

The federal *Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs* (FMP) establishes a cooperative structure deferring management of Bering Sea/Aleutian Islands (BSAI) king and Tanner crab fisheries to the State of Alaska, with federal oversight. The Norton Sound red king crab summer commercial season is from June 15–September 3. The state sets guideline harvest levels (GHL) under state regulation and in accordance with established acceptable biological catch (ABC) limitations set by the North Pacific Fishery Management Council (NPFMC). Guideline harvest levels for Norton Sound red king crab summer commercial fishery are set in regulation as being contingent on predicted legal male biomass (5 AAC 34.915). Since 1998 a length-based population model has been used to predict legal male biomass for the red king crab population in Norton Sound (Zheng et al. 1998). Incorporating data from trawl surveys, historical winter and summer pot studies, and winter and summer fisheries, the model is used to project abundance estimates of legal male crab even in years when no trawl survey occurs. When new data are incorporated into the population model it estimates current abundance as well as revises prior years’ abundance estimates and refines uncertainty around those estimates.

In 2012, the board revised the management strategy regulation 5 AAC 34.915 such that the department may only allow a summer commercial fishery at a threshold level of at least 1.25 million pounds of legal male red king crab abundance. Harvest rates are established when abundance levels of mail red king crab exceed the threshold; (1) between 1.25–2 million pounds a harvest rate up to 7% can be implemented; (2) between 2–3 million pounds the harvest rate cannot exceed 13%, and (3) at above 3 million pounds, a harvest rate up to 15% can be set. A retrospective analysis for the 2000–2010 period estimated that the commercial red king crab fishery was removing 9–17% of the legal male biomass (Howard and Hamazaki 2012). The crab stock remained relatively stable and actually showed a net trend of increasing abundance during the 2000–2010 seasons, indicating that these harvest rates are sustainable.

There is no GHL set for the winter commercial red king crab fishery in Norton Sound, and currently the ABC set by NPFMC is only applied to the summer fishery harvest. There is some indication that NPFMC may take action to apply the ABC to both fisheries because both fisheries target the same population. If one ABC is applied to both fisheries, harvest allocation between summer and winter red king crab fishery harvests may become an issue.

2013 Summer Commercial Season Harvest Summary

For the 2013 season, a harvest rate of 12% of the legal male biomass was set, resulting in a GHL of 495,600 pounds. By regulation, the CDQ fishery was allocated 7.5% of the 2013 GHL, and consequently, the CDQ and open access harvest quotas were set at 37,170 pounds and 458,430 pounds, respectively. The 2013 summer open access commercial crab fishery was opened by emergency order on July 3 and closed on September 15. For the fourth time in the last 5 years, the CDQ fishery opened concurrently with the open access fishery. CDQ crab deliveries began on July 16 and the last delivery was made September 15. Two companies were registered to buy crab, and 5 fishermen registered to sell crab dockside as catcher-seller or catcher-processor.

Open access harvest from fish ticket reports was 373,278 pounds (81% of the open access quota) by 33 permit holders, and the CDQ harvest was 18,585 pounds (approx. 50% of the CDQ allocation) by 4 permit holders (Appendix A2). The 2013 season was the first time since 2008 in which the open access quota has not been attained or exceeded and the first time in 10 years that the majority of the CDQ allocation was not harvested. Catch per unit of effort (CPUE) for the 2013 season was 9 legal crab per pot lift, which was the lowest CPUE observed since 2001 (Figure 4; Appendix A2). Despite the poor catch rates, high dock prices for crab led to an estimated exvessel value of \$2.2 million for both open access and CDQ fisheries combined; the 2013 fishery value was second only to the \$2.6 million for the 2012 summer season (Appendix A2).

ESTABLISHMENT OF CLOSED WATERS

In 1981, the board adopted regulation 5 AAC 34.935 closing waters from approximately 0 to 15 miles offshore from the southern coast of the Seward Peninsula to the summer commercial red king crab fishery. This regulation was established in response to three consecutive seasons (1978/1979, 1979/1980, and 1980/1981 winters) of poor subsistence crab harvests compared to the large 1977/1978 winter subsistence harvest which occurred the year the commercial fishery began. The closed area served as a buffer to conserve nearshore aggregations of king crab utilized by subsistence users in through-the-ice fisheries (Schwarz et al. 1982; Figure 5). Schwarz et al. (1982) stated “*the newly established nearshore closure to summer commercial crabbing definitely lowered the exploitation rate on crab which were nearshore during the spring.*”

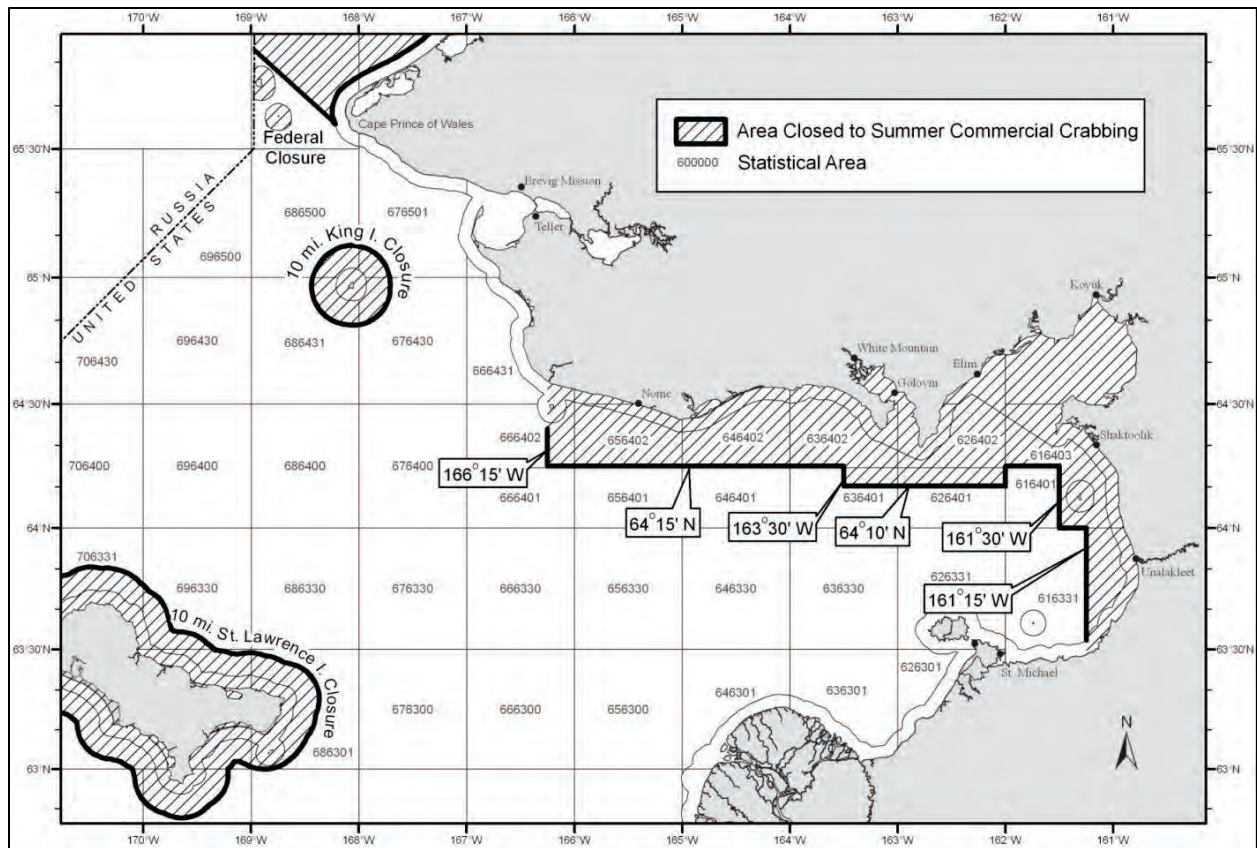


Figure 5.—Map showing Norton Sound statistical fishing areas and current regulatory nearshore closed waters boundary line for the summer commercial red king crab fishery.

Closed water areas have been modified by the board on several occasions since the original regulation was adopted in 1981. In 1984, the board further modified 5 AAC 34.935 and closed all waters within 10 miles of Saint Lawrence, Little Diomed, and King Islands to summer commercial crabbing (Lean et al. 1995; Figure 5). At the March 2002 board meeting, the boundary was extended farther offshore from just west of Rocky Point because subsistence users expressed concern that commercial fishing in nearshore waters causes depletions of local crab populations (Banducci et al. 2003). In addition, the eastern boundary was moved eastward because residents from the villages of Shaktoolik and Unalakleet expressed interest in commercial fishing closer to their communities (Banducci et al. 2003; Figure 5).

Closure Line Relaxation Background

Prior to the 1982 summer commercial crab season, the board adopted a new provision to regulation 5 AAC 34.935 giving the department inseason discretion to reduce, by small increments, closed waters up to 3 miles from shore to allow the commercial fleet to efficiently obtain the allowable harvest of king crab (Schwarz et al. 1983). The board adopted this provision largely due to findings from a 1981 tagging study which showed that inshore and offshore portions of the crab stock intermix (Fred Gaffney, unpublished memorandum summarizing the board's consideration of BSAI king crab proposals). During this study, 35 (16%) of the 216 red king crab tagged 2 ½ to 5 miles offshore of Nome were recaptured in the commercial fishery outside the closed waters area (Schwarz et al. 1982).

In 1982, poor catch rates were encountered throughout the fleet at the onset of the season with 11 large vessels harvesting only 10,000 pounds per day. In an attempt to achieve the GHL of 500,000 pounds and following the intent of the regulation, the closure line was reduced by 5 miles (Schwarz et al. 1983). However, despite relaxing the line northward in 1982, CPUE remained at record low levels and 64% of the GHL was not harvested (Schwarz et al. 1983; Table 1). Between 1983 and 2012, the closed waters area was reduced in four seasons (1985, 1993, 1994, and 1995) in order to more efficiently obtain the GHL (Table 1). Results of line relaxation were mixed in terms of improvements to CPUE. For example, in 1985 and 1993, CPUE increased inseason by nearly 100% and 300%, respectively (Table 1). The average CPUE was near the 1982–2008 historic average of 14 during the 1985 (21% below) and 1993 (14% above) seasons (Appendix A2). However, in 1994 and 1995, there was only a slight increase in CPUE following line relaxation (Table 1), and CPUE was 36% and 57% below the 1982–2008 historic average CPUE, respectively (Appendix A2). A more detailed summary of historical closed waters inseason actions and results of these actions are shown in Table 1.

There have also been a number of years in which line relaxation was considered to mitigate poor commercial catch rates, but the department ultimately elected to not reduce closed waters. For example, line relaxation was considered but not implemented in 1992 because of concerns with increased handling mortality of sublegal crab, near record levels of fishing power, and limited enforcement capabilities (Lean et al. 1993). Later in 1996, 1997, and 1998, closed waters were not reduced because of public outcry following line relaxation actions taken from 1993–1995; subsistence users perceived declining nearshore subsistence catches to be the result of opening up closed waters in prior years (Bue et al. 1997; Brennan et al. 1998, 1999). In 2009, the department also considered moving the line to counter low catch rates, but decided against it because of several factors; (1) the department's stance from 1996–1998; (2) uncertainty regarding crab distribution in 2009; (3) potential impacts to sublegal and female king crab; and (4) the board's original intent to conserve nearshore aggregations of king crab utilized by through-the-ice subsistence fisheries. The department alternatively elected to extend the season to September 20 in 2009 (Menard et al. 2011). Above average CPUE occurred during the 2010–2012 seasons and line relaxation and extensions to the season were not considered, because GHGs were met before the regulatory closure date (Appendix A2).

Table 1.–Summary of historical inseason closed waters reductions implemented by emergency order in the Norton Sound red king crab summer commercial fishery.

Year	Description of Actions Taken	Result
1982	Fishery opened August 9. Line relaxed by five miles on August 26. Fishery closed September 1.	CPUE remained low at 6 before and after line relaxation. Only 46% of the harvest quota obtained.
1985	Fishery opened August 1. Closed waters reduced five miles on August 7. Fishery closed August 23.	Average daily CPUE rose from 6 to 11. 95% of harvest quota reached.
1993	Fishery opened July 1. Closed waters reduced by five miles July 15. Fishery closed August 28.	CPUE improved from 4 to 16 and 99% of harvest quota reached. 58% (193,000 pounds) of commercial harvest taken inside statistical area 656402, waters normally closed by regulation.
1994	Fishery opened July 1, and closed waters boundary reduced by five miles on July 1. Eastern Norton Sound closure line moved eastward on July 8 to allow Shaktoolik and Unalakleet fishermen access closer to these villages. Fishery closed July 31.	CPUE remained low at 9, but 96% of harvest quota reached. 76% (250,000 pounds) of the commercial harvest taken in statistical areas 646402 and 656402, waters normally closed by regulation.
1995	Fishery opened July 1. Closed waters reduced by five miles on July 1 after June 26–28 pot survey suggested that outer edge of legal male biomass concentration 5–10 miles offshore. Fishery closed September 5 because of weather.	CPUE tied for third lowest on record at 6; but 95% of harvest quota reached. 35% (114,000 pounds) of harvest occurred in waters normally closed by regulation. Subsistence users voice concerns regarding declining nearshore subsistence catch rates beginning during the 1995–96 winter.
2000	Eastern Norton Sound line relaxed eastward at start of the season. Season closed on August 29.	CPUE was 18 and 95% of open access quota reached. However, only 1.5% of harvest originated from eastern Norton Sound.

2013 Closure Line Relaxation Measures

From the onset of the 2013 season, catch rates were poor for the bulk of the fleet. By the end of July it was apparent that the GHF would not be reached until late September based upon the catch rates. After careful consideration, a series of precise line relaxations were implemented in an effort to improve the harvest efficiency of the commercial fleet following the intent of 5 AAC 34.935. The first action taken was an emergency order issued August 1 moving the nearshore closure line northward 3 nautical miles to lat 64°18'N between long 166°15'W (Sledge Island) and long 163°30'W (near Square Rock; Figure 6). Later on August 7, an emergency order was issued moving the closure line between long 162°38'W (Carson Creek) and long 162°W (the eastern border of statistical area 626401) northward by 5 nautical miles to lat 64°15' N (Figure 6). The August 7 emergency order also moved the closure line between long 162°W and long 161°30'W (Cape Denbigh) northward by 3 nautical miles to lat 64°18'N (Figure 6).

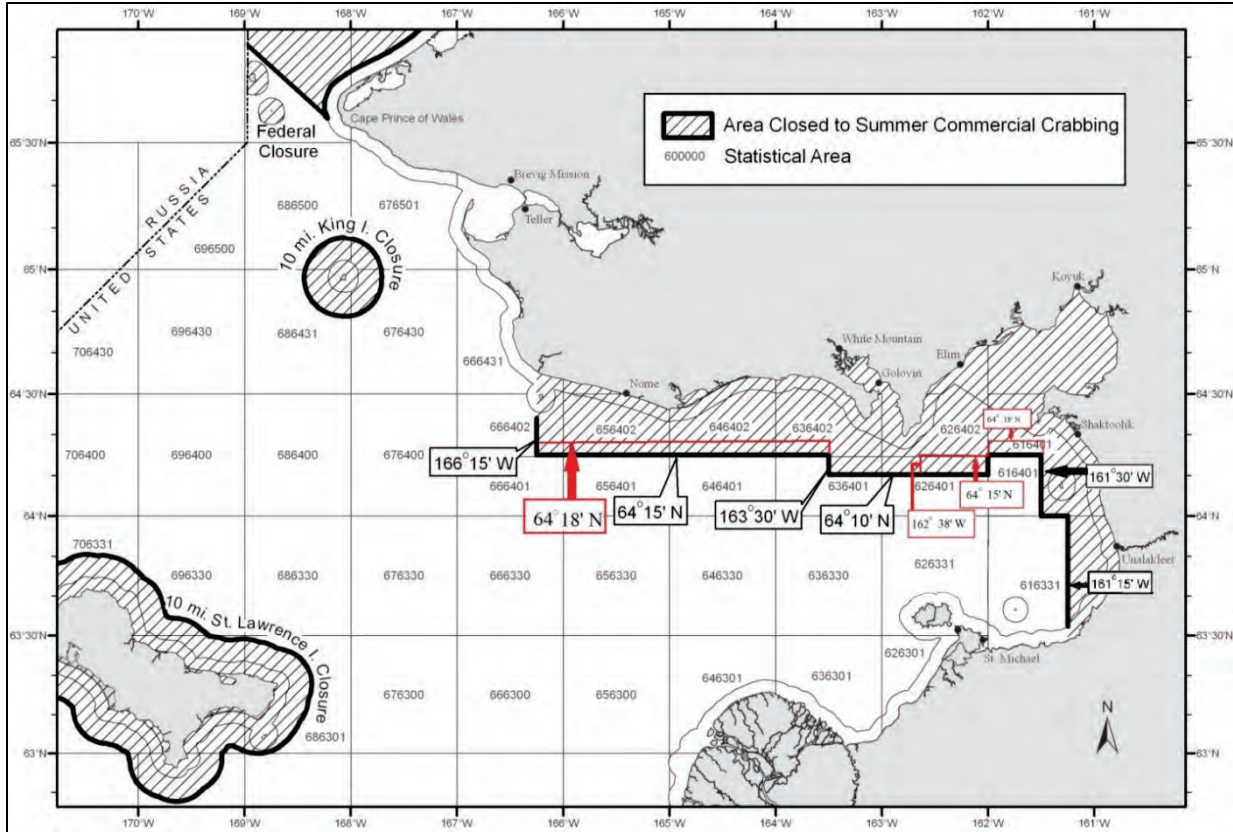


Figure 6.—Changes in closed water boundary lines in effect for the 2013 Norton Sound summer commercial crab fishery.

In the weeks following line relaxation, CPUE increased for some permit holders, but fleetwide average CPUE did not change and eventually decreased. From August 1–15, average daily CPUE was 8 legal crab per pot lift, which was similar to the average daily CPUE of 9 legal crab per pot lift observed from July 3–31 (Figure 7; Appendix A3). From August 16–31, daily CPUE decreased to 6 legal crab per pot lift. The portion of the fleet that fished in the western half of Norton Sound did notice a slight improvement in catch rates, but fishermen in eastern Norton Sound experienced very poor catch rates. Additional reductions in the closed water areas were not made because further action could not be justified: the line relaxation provision in 5 AAC 34.935 may be used to allow the commercial king crab fishery to efficiently obtain the allowable harvest, but 2013 catch rate data indicated that line relaxation actions taken had not increased harvest efficiency. It was not until late August that CPUE finally began to improve significantly, which coincided with the bulk of the fleet moving farther offshore (20–40 nautical miles) to statistical areas 666401, 656401, and 646401 (Figure 5). Average CPUE from September 1–15 was 14 legal crab per pot lift, a 133% increase from the August 16–31 average CPUE of 6 legal crab per pot lift (Appendix A3). Approximately 28% (~105,000 pounds) of the open access harvest was caught from August 28 to September 15 (Appendix A3).

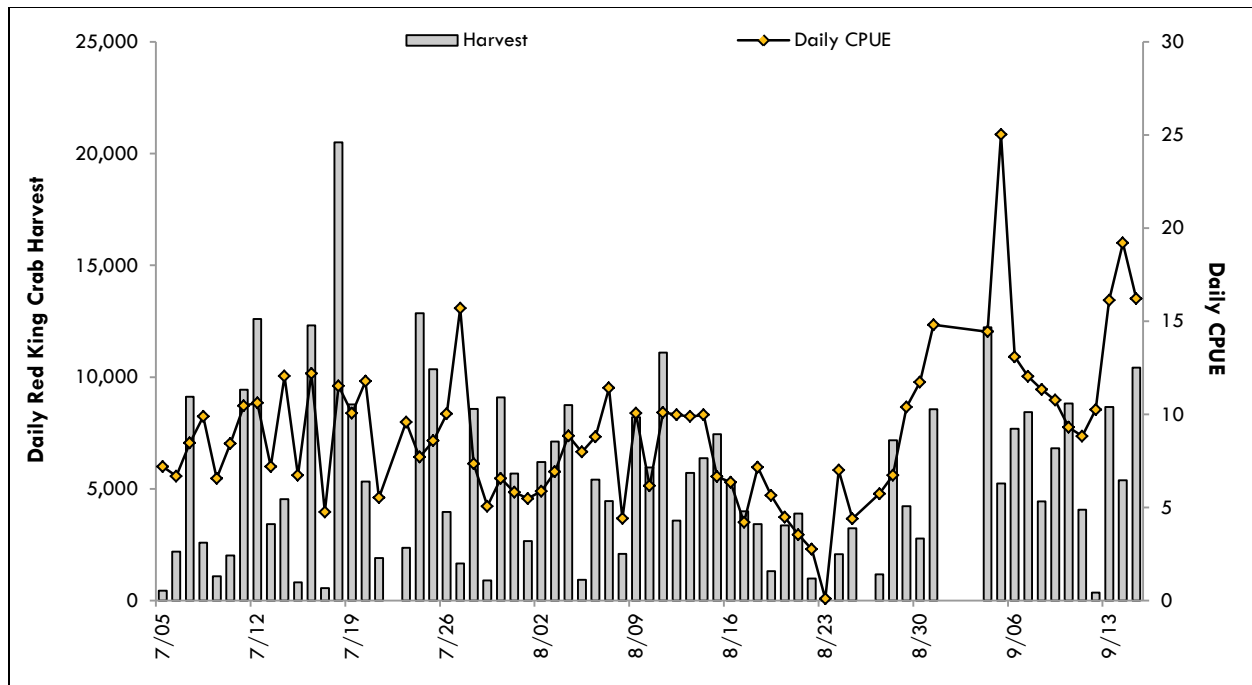


Figure 7.—Daily commercial harvest (in pounds) of red king crab compared to daily CPUE from July 5 to September 15, 2013, summer open access red king crab fishery, Norton Sound Section.

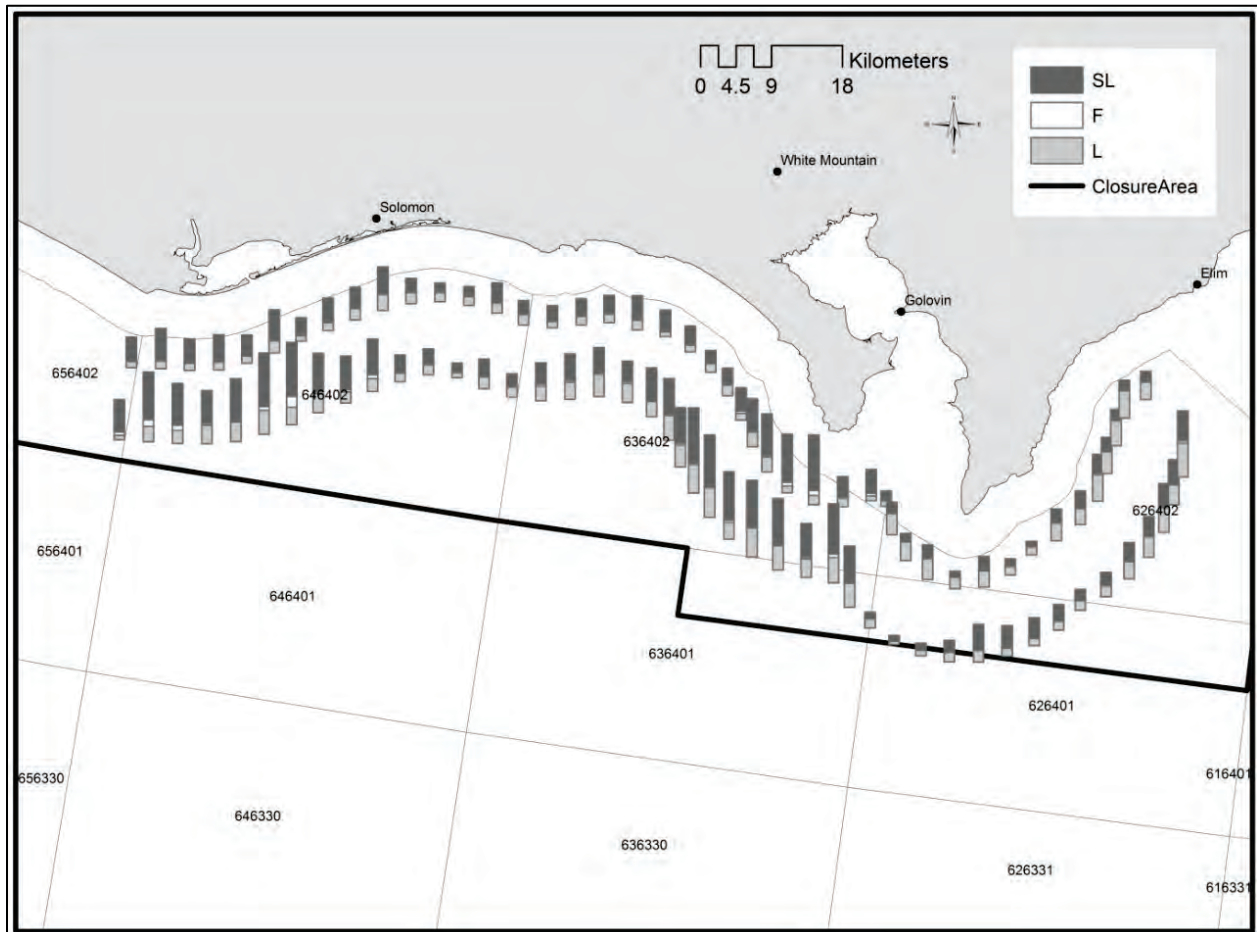
Considerations Regarding Line Relaxation

The 2013 red king crab summer commercial fishery highlighted the uncertainty surrounding the use of the closed waters line relaxation tool. While this line relaxation tool is predicated as a means of allowing for a more efficient harvest of the commercial GHL, there is uncertainty surrounding what metric should be used to evaluate harvest efficiency, and historical evidence shows considerable inconsistencies regarding whether this tool actually provides a means of providing for more efficient harvest. In some years (e.g., 1985 and 1993) line relaxation measures were clearly correlated with improved catch rates and the GHL was easily achieved (Lean et al. 1986, 1995). However, in 1982 (Schwarz et al. 1983) and 2013, closure line relaxation did not correlate with an increase in commercial harvest efficiency. In 1994 and 1995, the GHL was reached following line relaxation, but CPUE remained at near record low levels and the bulk of the effort was concentrated in nearshore statistical areas close to Nome (Table 1).

Potential impacts of closed waters reductions on through-the-ice subsistence fisheries are unknown. Findings from nearshore tagging studies show that inshore and offshore aggregations of the Norton Sound red king crab population intermingle (Brannian 1987; Powell et al. 1983; Schwarz et al. 1982). The line relaxation provision is predicated on the hypothesis that significant removal of crab biomass inshore does not affect nearshore abundance of crab due to this movement of crab between the areas. However, variability in local movement patterns and distribution of red king crab in Norton Sound are poorly understood. Ongoing crab movement research has shown that crab tagged closer to shore have relatively lower recapture rates in the offshore commercial fishery than those tagged further offshore (J. Bell and T. Hamazaki, ADF&G Division of Commercial Fisheries, unpublished data). Given this preliminary evidence, crab may be migrating smaller distances, or, more likely, there may be more variation in movement patterns than had previously been thought.

In 1993, 58% (~193,000 pounds) of the commercial harvest was taken in statistical area 656402, within waters normally closed by regulation (Appendix A4). In 1994, 76%, or 250,000 pounds, of the commercial harvest originated from statistical areas 646402 and 656402 combined (Appendix A4). In 1995, 35% or 114,000 pounds of the harvest occurred within closed waters following line relaxation. Subsequent to this 3-year period of line relaxations, subsistence users voiced concern over the impact of the commercial fishery on their nearshore winter subsistence harvest. Line relaxation has been a contentious issue since the regulation was first adopted in 1982, and has only been used a few times with mixed results.

Based on current regulatory language, the department views line relaxation as a management tool that may be implemented in an attempt to increase harvest rates in the commercial fishery, but must be used with caution because of uncertainty surrounding its potential impacts to subsistence harvests and non-targeted portions of the red king crab stock. An unintended benefit of the current closed waters is that important nursery and female brooding zones appear to lie within the current boundaries (Figure 8). By default, therefore, a large segment of brood stock and future king crab recruitment may not be subjected to intensive fishing effort, and may be protected from fishery-induced mortality due to increased handling of sublegal and female crab.



Note: Heights of bars are scaled to relative abundance.

Figure 8.—Map showing relative abundance of sublegal (SL), legal (L), and female (F) red king crab captured by pot location along 5- and 10-mile nearshore transects, ADF&G spring tagging study, 2013, Norton Sound Section.

In 2013, the department used information collected inseason to implement a balanced management approach, in an attempt to increase commercial harvest efficiency, while minimizing adverse fishery-induced impacts to non-targeted portions of the king crab stock. Because the effects of relaxing the closure line are not well known (such as the potential impact on subsistence users), the department will continue to be conservative with using this management tool.

RED KING CRAB MOLT TIMING

Available data to inform biologically-based opening and closure dates for Norton Sound red king crab is limited. In most areas of Alaska, molting of legal male red king crab occurs from March through April (Powell et al. 1983). Norton Sound area management biologists were the first to hypothesize that molt timing of red king crab may be more variable in Norton Sound than in other locales, based on newly molted male crab observed between March and September (Kuhlmann et al. 1979, 1980; Schwarz et al. 1981). In the early days of the commercial fishery, a comprehensive study of red king crab in Norton Sound was conducted by Powell et al. (1983) and included a limited investigation into molt timing. Powell et al. agreed with the variable molt timing hypothesis and further speculated it was the result of highly variable biophysical conditions inherent to Norton Sound, because of its lack of relatively deep water. In this study, Powell et al. (1983) interpreted the high percentage of new shelled crab observed in July surveys from 1977–1981 as indirect evidence molting had occurred prior to July, and very likely from April to June. Powell et al. also termed the occurrence of molting crab in August observed in 1979 as “unusual” and possibly the result of low recruitment. Powell et al. (1983) also suggested that sublegal males may molt at different times than legal males based on small males captured in mid-July 1981 that had either recently molted or were getting ready to molt.

Alternatively, Brannian (1987) posited that Norton Sound male red king crab molt between late August and late October. This alternative view was based on (1) the absence of molting crab in department winter pot survey catches (January to May) from 1982 and 1985; (2) verbal reports of molting crab from late August to September in the commercial fishery; (3) and the occurrence of molting crab in the NMFS triennial trawl surveys in August (Brannian 1987). However, a lack of molting crab in 3 years of winter pot surveys is not conclusive evidence of an absence of molting, as these surveys are extremely limited in scope and only include a few pots, and there might have been some behavioral changes in molting crab that would reduce the probability of entering a pot. Likewise, the NMFS trawl survey observations do not mention if the crab were legal or sublegal males, and molting crab are not identified in subsequent trawl surveys. Together, these observations are not inconsistent with the hypothesis that molt timing may be variable and there may be ontogenetic shifts in molt timing within the same population.

Unfortunately, the two important assessments by Powell et al. (1983) and Brannian (1987) do not provide a conclusive indication of ideal season opening and closure dates to protect crab at vulnerable stages and protect market quality, and more research is needed. Given this uncertainty and the need for management clarity regarding molt timing specific to the 2013 season, the department initiated an exploratory investigation of Norton Sound red king crab molt timing in fall of 2013. A fall pot survey was conducted with the primary objective to describe temporal and spatial variability of red king crab molting phases. Figure 9 illustrates the location of fall pot survey locations and transects. The three transects began 3 miles offshore and pots set every 2 nautical miles for a total of 13 pots per transect covering approximately 24 nautical miles.

Common physical parameters that may indicate onset of molting in red king crab were defined, which included pereopod joint color and shell hardness. Pots were checked twice from mid-September to early October. A total of 1,639 red king crab (872 legal males, 360 females, and 407 sublegal males) were captured. There were no significant relationships between shell hardness and pereopod joint color. The proportion of recently molted crab was significantly greater during the second time hauling the pots, in late September and October, indicating a slight progression in the molting phase. However, over the course of the survey, the overall number of recently molted crab was only 7.7% (126 crab) of the total catch (sublegal, female and legal crab): <1% (6 crab) of legal male crab had recently molted. Of the total crab that recently molted only 28 (or 1.7%) were soft shelled at the time of capture.

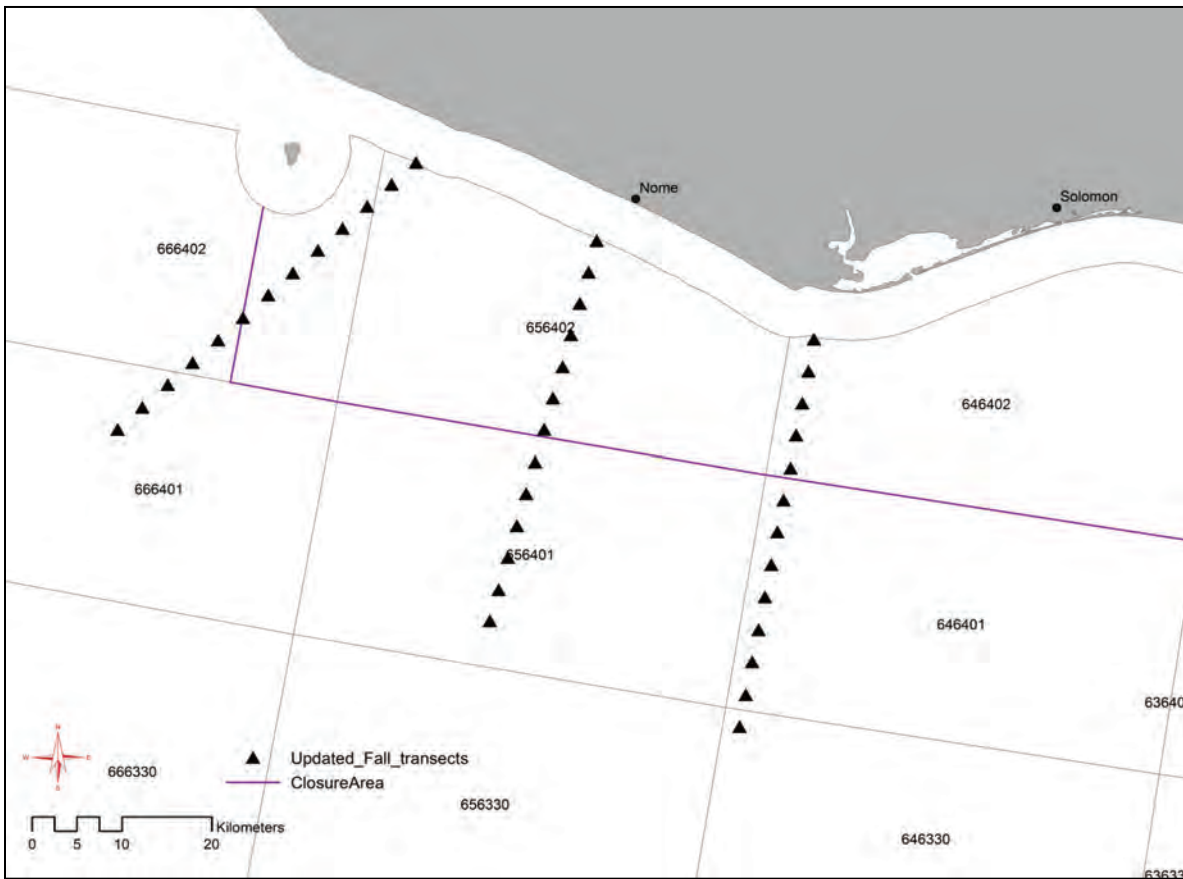


Figure 9.—Map delineating approximate pot locations along ADF&G fall pot survey transects from Cape Nome to Sledge Island, 2013, Norton Sound Section.

The very low occurrence (0.7 %) of legal male crabs that had recently molted suggests that it is possible that the majority of the legal male molting did not occur in September and early October in 2013. Alternatively, red king crab in the latter stages of the pre-molting stage may undergo behavioral changes as a function of reduced foraging rates (Zhou et al. 1998) and are therefore unlikely to enter pot gear. The higher occurrence of newly molted sublegal crab (29.7% of captured sublegal crab) is also consistent with Powell et al.'s (1983) suggestion that sublegal molting period may be temporally isolated from the legal male molting phase. This study, however, was simply an initial investigation and results should be interpreted cautiously. A considerably expanded study is warranted to assess molt timing in Norton Sound, and to help understand inter-annual and ontogenetic variability of this process.

Summer Fishing Season Regulatory Dates

As with seasons for other shellfish stocks, Norton Sound red king crab summer commercial fishing season dates were established in an attempt to maximize meat recovery and avoid biologically sensitive periods of crab life cycles (e.g. molting and mating). In 1980, the current regulatory closure date of September 3 was adopted; there is no documentation concerning why this date was selected (Schwarz et al. 1981). In 1982, the board moved the season opening date from July 15 to August 1. One of the justifications for re-establishing the August 1 opening date was “*a delayed season opening would likely improve crab recovery rates and decrease soft-shelled handling mortalities*”; (Fred Gaffney, ADF&G, unpublished 1982 memorandum summarizing the board’s consideration of BSAI king crab proposals). No mention is made of the September 3 closure in the context of a biological closure until 1993, when double-shelled and very new-shelled crab were detected during the last week of August by Lean et al. (1995). The authors wrote “*although the proportion of molting crab was very low, continuing the fishery beyond the regulatory closure date of September 3 does not seem appropriate in future years.*” Additionally, Lean et al. (1995) noted that recently molted king crab were caught in the 1985 NMFS triennial trawl survey in August. In the fall of 1993, the board moved the season opening date up by one month to July 1 (Bue et al. 1996a), presumably to provide increased opportunity for the new small boat fleet to obtain GHL. Most recently, the regulatory opening date was moved up again to June 15 by the board in 2008 (Menard et al. 2010) in response to eastern Norton Sound crab fishermen wanting access to red king crab at a time when crab aggregations are thought to be closer to the Shaktoolik and Unalakleet coastline (Kent and Soong 2007).

Historical Crab Fishing Season Extensions

Out of concern for increasing harvests of molting and/or double shelled crab, the summer red king crab season had not been extended beyond the regulatory closure date until 2000, except for brief extensions to allow safe gear retrieval due to inclement weather. However, since 2000, the department has granted extensions during 5 seasons, either to separate open-access and CDQ harvests, or to mitigate low CPUE in the summer fishery caused by environmental conditions or patchily distributed red king crab abundance. In 2000, a specific season was announced via emergency order from August 29–September 29 to facilitate the harvest of the CDQ allocation: there were no reports of molting and/or double shelled crab being observed in 2000 despite fishing well into September (Brennan et al. 2002). The department did not extend the season beyond September 9 in 2001 “*because of the continuing biological concern for molting crab*” (Brennan et al. 2003), as molting and double-shelled crab were documented as early as the third week of August (Table 2; Brennan et al. 2003). From 2002–2008, there were no extensions beyond the regulatory closure date. In 2009, a major crab buyer suspended buying operations for eight days in early July because of concerns that poor meat fill would negatively affect Norton Sound red king crab marketability (Menard et al. 2011). Poor catch rates persisted throughout the 2009 season until September 4 when the daily CPUE nearly doubled from an average CPUE of 9 to 17 legal crab per pot lift (Menard et al. 2011). Approximately 31% of the open-access harvest occurred from September 3–20 (Menard et al. 2011). After the season ended, NSEDC voiced concern that a significant amount (approx. 25,000 pounds) of crab landed in September 2009 included double-shelled crab (Wes Jones, fishery biologist, NSEDC, Unalakleet, personal communication 2009). However, a different buyer mentioned only a few double-shelled crab were observed in September deliveries, but no more than is usual. The season was again extended in 2012 until September 13 to achieve CDQ allocation, but molting crab were encountered in the live tanks and the fishery was closed by emergency order on September 13 (Table 2; Menard et al. 2013).

Table 2.–Summary of historical extensions to the Norton Sound summer commercial red king crab season and observations concerning molting of red king crab.

Year	Description of Actions Taken	Observations
2000	Open access season closed August 29. CDQ season extended until September 29 to allow the CDQ harvest quota to be achieved.	No available information concerning presence of molting crab in harvest. Only 59% of CDQ GHL harvested.
2001	Open access season closed September 1. CDQ season opened from September 2–9 to allow for CDQ allocation to be harvested.	Molting crab reported third week of August. 0% of CDQ GHL harvested because of weather. Season not extended further because of molting concerns.
2009	NSSP suspends buying from 6/29–7/6 because of poor meat fill. Open access season extended until September 20 to mitigate poor CPUE and achieve GHL.	CPUE nearly doubles in September. Open access harvest 7% above GHL. Presence of double shelled crab affecting ~25,000 pounds of harvest reported by NSEDC postseason.
2012	CDQ crab season extended until September 13 to achieve CDQ allocation.	CDQ GHL harvested but a few molting crab observed in early September.
2013	Start of season delayed until July 3 due to poor meat fill observed in test fishery samples. Open access and CDQ fisheries extended until September 15 to achieve GHL.	A handful of newly molted crab observed in harvests beginning in late August. CPUE increases 133% during month of September. 22% of open access harvest occurs from September 4–15. CDQ and open access harvests fall short of their GHLs.

2013 Season Extension

By mid-July, it was evident that the 2013 GHL would not be achieved by September 3. Persistent cold spring temperatures and ice cover may have resulted in delayed and/or prolonged timing of biological processes, including mating, movement patterns, and foraging rates. The first indication of this was that crab sampled in late June showed poor meat fill, which ultimately delayed the opening of the fishery until July 3. Later on July 18, post-recruit male crab clasping with females were caught south of Sledge Island (Adem Boeckmann, skipper, FV *Anchor Point*, Nome, personal communication 2013). This documented occurrence of breeding red king crab was 3 to 4 weeks later than what would be considered normal. “Light” crab, that is crab presumed to have low meat fill, were also observed throughout the season by catch monitoring personnel, which was also consistent with later timing of biological processes in 2013.

While inseason information indicated that biological processes, including molt timing, should be expected to occur later than normal, managers were concerned about extending the fishing season because of the presence of molting crab observed in some years. In an attempt to avoid adverse impacts to the marketability of Norton Sound red king crab and minimize handling of soft-shelled crab, the department initiated a proactive monitoring effort in the days leading up to the extension. Specifically, there were daily communications with buyers and daily sampling events in order to carefully monitor crab shell condition and look for other morphological signs of molting crab (e.g., numbers of double/thin-shelled crab and newly molted crab). This intensive shore-based monitoring effort coincided with similar efforts by on-board observers and skippers on the fishing grounds. Ultimately, the number of newly molted or double shelled crab remained at barely detectable levels until the season was closed on September 15. However, the

season was not extended further, based on concerns that some of the crab with more pliable shells could be in the final stages of pre-molt and consequently have a negative impact on valuable overseas live markets of Norton Sound red king crab. It is noteworthy that there have been no reports from buyers that the proportion of double, thin, or pliable-shelled crab negatively impacted market sales of Norton Sound red king crab in 2013.

KING CRAB RESEARCH PRIORITIES

Based on management needs, research priorities for Norton Sound red king crab are focused on four major topics: (1) molt timing and condition; (2) meat fill quality; (3) juvenile settling and rearing locations; and (4) movement of red king crab.

Molt timing in Norton Sound red king crab is a top research priority because it has implications for determining if the current summer season dates protect red king crab during biologically sensitive periods of their life cycle. Season dates based on more definitive molt timing information could benefit the fishery by providing the greatest potential to maximize meat fill and fishing success, while protecting soft shelled crab. Continued pot surveys conducted in the fall, subsequent to the commercial fishery, may provide indices of molt timing. However, evidence suggests crab don't feed during molting and slow feeding on either side of molting (Zhou et al. 1998) may make crab less likely to enter crab pots seeking food, thus limiting the utility of the survey results. A more thorough investigation into molt timing would include blood analysis to assess levels of ecdysteroids (molting hormones). This type of analysis could take place throughout the year, taking advantage of red king crab from all fisheries from different locales, and provide more precise estimates of temporal and spatial patterns in molt timing.

Another important information gap is lack of an effective protocol for determining quality of meat fill. At present, meat fill quality is used to establish the opening date of the summer commercial fishery and is evaluated opportunistically from a few red king crab captured in a separate study. There is limited understanding how meat fill varies across different locations in order to focus commercial fishing in areas where crab have acceptable meat fill. Further, it may be useful to establish a relationship between crab weight and meat fill to be able to assess meat fill in a non-destructive manner.

The third research priority is to identify essential settling and rearing habitat of juvenile and sublegal red king crab. Current closed areas may serve to shelter juvenile and brooding female crab from the impacts of commercial fishing.

The final research priority is movement. Currently there is a large scale project designed to determine movement patterns of red king crab in eastern Norton Sound. The project has been successful in increasing our understanding of crab movement patterns, but is not designed to elucidate the specific mechanisms (e.g., salinity, temperature, food base, storm activity, etc.) affecting movement and local and/or interannual variations in movement. Additionally the current study is only looking at a subsection of Norton Sound. Thus, expanding the scope of this study to include other locations would provide a more complete picture of crab movement in Norton Sound.

NORTON SOUND SECTION 2014 BOARD PROPOSALS

PROPOSAL 344 – Seeks to define “spiny”, or Hanasaki, king crab *Paralithodes brevipes* as a king crab species in the statewide definition regulation.

PROPOSAL 345 – Seeks to establish hand lines as legal commercial gear in the winter through-the-ice commercial king crab fishery in the Norton Sound Section.

PROPOSAL 346 – This proposal was submitted as a placeholder to potentially allow for changes to be made to the Norton Sound Section red king crab harvest strategy.

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APPENDIX A

Appendix A1.–Winter commercial and subsistence red king crab harvest statistics, Norton Sound, Eastern Bering Sea, 1978–2013.

Year ^a	Commercial		Subsistence						
	Number of Fishermen	Number of Crab Harvested	Winter ^b	Number of Permits Issued	Number of Permits Returned	Number of Permits Fished	Total Crab Caught ^c	Total Crab Harvested ^d	Average Number Kept/Permits Fished
1978	37	9,625	1977-78	290	206	149	^e	12,506	84
1979	1	^f	1978-79	48	43	38	^e	224	6
1980	1	^f	1979-80	22	14	9	^e	213	24
1981	0	0	1980-81	51	39	23	^e	360	16
1982	1	^f	1981-82	101	76	54	^e	1,288	24
1983	5	549	1982-83	172	106	85	^e	10,432	123
1984	8	856	1983-84	222	183	143	15,923	11,220	78
1985	9	1,168	1984-85	203	166	132	10,757	8,377	63
1986	5	2,168	1985-86	136	133	107	10,751	7,052	66
1987	7	1,040	1986-87	138	134	98	7,406	5,772	59
1988	10	425	1987-88	71	58	40	3,573	2,724	68
1989	5	403	1988-89	139	115	94	7,945	6,126	65
1990	13	3,626	1989-90	136	118	107	16,635	12,152	114
1991	11	3,800	1990-91	119	104	79	9,295	7,366	93
1992	13	7,478	1991-92	158	105	105	15,051	11,736	112
1993	8	1,788	1992-93	88	79	37	1,193	1,097	30
1994	25	5,753	1993-94	118	95	71	4,894	4,113	58
1995	42	7,538	1994-95	166	131	97	7,777	5,426	56
1996	9	1,999	1995-96	84	44	35	2,936	1,679	48
1997	2	^f	1996-97 ^g	38	22	13	1,617	745	57
1998	5	984	1997-98	94	73	64	20,327	8,622	135
1999	5	2,714	1998-99	95	80	71	10,651	7,533	106
2000	10	3,045	1999-00	98	64	52	9,816	5,723	107
2001	3	1,098	2000-01 ^g	50	27	12	366	256	21
2002	11	2,591	2001-02	114	101	67	8,805	3,669	55
2003	13	6,853	2002-03	107	73	64	9,052	4,140	65
2004 ^h	2	522	2003-04	96	77	41	1,775	1,181	29
2005	4	2,121	2004-05 ⁱ	170	102	60	6,496	3,973	66

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Year ^a	Commercial		Winter ^b	Subsistence					
	Number of Fishermen	Number of Crab Harvested		Number of Permits Issued	Number of Permits Returned	Number of Permits Fished	Total Crab Caught ^c	Total Crab Harvested ^d	Average Number Kept/Permits Fished
2006	1	^f	2005-06 ^g	98	97	67	2,083	1,239	18
2007	8	3,313	2006-07	129	127	116	21,444	10,690	92
2008	9	5,796	2007-08	139	137	108	18,621	9,485	88
2009	7	4,951	2008-09	105	105	70	6,971	4,752	68
2010	10	4,834	2009-10	125	123	85	9,004	7,044	83
2011	9	3,365	2010-11	148	148	95	9,183	6,640	70
2012	35	9,157	2011-12	204	204	138	11,341	7,371	53
2013	26	22,639	2012-13	149	148	104	21,752	7,662	74
1978-1998 Average	10	2,894	1977-1998 Average	124	97	75	9,072	5,678	66
1999-2008 Average	7	3,117	1999-2008 Average	110	89	66	8,911	4,789	65
2009-2013 Average	17	8,989	2009-2013 Average	146	146	98	11,650	6,694	70

^a Prior to 1985 the winter commercial fishery occurred from 1/1 - 4/30;

^b The winter subsistence fishery is open December through May.

^c The number of crab actually caught; some may have been released.

^d The number of crab harvested is the number of crab retained.

^e Information not available.

^f Confidential under AS 16.05.815.

^g Poor catches largely attributed to extremely poor nearshore ice conditions.

^h Confidentiality was waived by the fishermen.

ⁱ Permits were only given out of the Nome ADF&G office, except during the 2004-5 season, when permits were also given out in Elim, Golovin, Shaktoolik, and White Mountain.

Appendix A2.—Historical summer commercial red king crab fishery performance, Norton Sound Section, Eastern Bering Sea, 1977–2013.

Year	Dates	Guideline	Legal Male		Commercial			CPUE	Total		Total	Total		
		Harvest	Population Est.		Harvest (lbs) ^{a, b}				Exvessel	Fishery Value				
		Level	No. crab	lbs ^b	Open	Total Number of							Total Number of Pots	Price/lb
(lbs) ^b	(millions)		Access	CDQ	Vessels	Permits	Landings	Registered	Pulls					
1977	^c	^c	1.7	0.52		7	7	13	36	^c	5,457	0.75	0.23	
1978	6/07-8/15	3.00	1.7	2.09		8	8	54	64	^c	10,817	0.95	1.90	
1979	7/15-7/31	3.00	0.8	2.93		34	34	76	28	^c	34,773	0.75	1.88	
1980	7/15-7/31	1.00	1.9	1.19		9	9	50	29	^c	11,199	0.75	0.89	
1981	7/15-8/22	2.50	1.2	1.38		36	36	108	11	^c	33,745	0.85	1.17	
1982	8/09-9/01	0.50	0.9	0.23		11	11	33	6	^c	11,230	2.00	0.41	
1983	8/01-8/05	0.30	0.9	0.37		23	23	26	12		3,583	11,195	1.50	0.54
1984	8/01-8/15	0.40	0.9	0.39		8	8	21	14		1,245	9,706	1.02	0.40
1985	8/01-8/23	0.45	1.1	0.43		6	6	72	11		1,116	13,209	1.00	0.43
1986	8/01-8/25 ^d	0.42		0.48		3	3 ^c		38		578	4,284	1.25	0.60
1987	8/01-8/12	0.40		0.33		9	9 ^c		10		1,430	10,258	1.50	0.49
1988	8/01-8/11	0.20	1.0	0.24		2	2 ^c		32		360	2,350 ^c		^c
1989	8/01-8/04	0.20		0.25		10	10 ^c		15		2,555	5,149	3.00	0.74
1990	8/01-8/05	0.20		0.19		4	4 ^c		19		1,388	3,172 ^c		^c
1991		0.34	1.3	No Summer Fishery										
1992	8/01-8/03	0.34		0.07		27	27 ^c		4		2,635	5,746	1.75	0.13
1993	7/01-8/28 ^e	0.34		0.33		14	20	208	16		560	7,063	1.28	0.43
1994	7/01-7/31	0.34		0.32		34	52	407	9		1,360	11,729	2.02	0.65
1995	7/01-9/05	0.34		0.32		48	81	665	6		1,900	18,782	2.87	0.93
1996	7/01-9/03 ^f	0.34	0.5	0.22		41	50	264	7		1,640	10,453	2.29	0.52
1997	7/01-8/13 ^g	0.08		0.09		13	15	100	11		520	2,982	1.98	0.18
1998	7/01-9/03 ^h	0.08		0.03	0.00	8	11	50	7		360	1,639	1.47	0.04
1999	7/01-9/04 ⁱ	0.08	1.6	0.02	0.00	10	9	53	5		360	1,630	3.08	0.07
2000	7/01- 9/29 ^j	0.33	1.4	0.29	0.01	15	22	201	18		560	6,345	2.32	0.72
2001	7/01- 9/09 ^k	0.30	1.3	0.28	0.00	30	37	319	8		1,200	11,918	2.34	0.67
2002	6/15-9/03 ^l	0.24	1.0	0.24	0.01	32	49	201	14		1,120	6,491	2.81	0.73
2003	6/15-8/24 ^m	0.25	1.0	0.25	0.01	25	43	236	11		960	8,494	3.09	0.82

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Year	Dates	Guideline	Legal Male		Commercial		Total Number of			CPUE	Total		Total		
		Harvest	Population Est.		Harvest (lbs) ^{a, b}						Exvessel	Fishery Value			
		Level	No. crab	lbs ^b	Open	Access	CDQ	Vessels	Permits	Landings	Total Number of Pots	Registered	Pulls	Price/lb	(millions \$)
2004	6/15-8/08 ⁿ	0.35	1.6		0.31	0.03		26	39	227	15	1,120	8,066	3.12	1.06
2005	6/15-8/27 ^o	0.37	1.7		0.37	0.03		31	42	255	16	1,320	8,867	3.14	1.26
2006	6/15-8/22 ⁿ	0.45	1.6		0.42	0.03		28	40	249	17	1,120	8,867	2.26	1.02
2007	6/15-8/17 ⁿ	0.32	1.1		0.29	0.02		38	30	251	12	1,200	9,118	2.49	0.75
2008	6/23-9/03 ^p	0.41	1.5		0.36	0.03		23	30	248	16	920	8,721	3.20	1.23
2009	6/15-9/20 ^q	0.38	1.3		0.37	0.03		22	27	359	12	920	11,934	3.17	1.23
2010	6/28-8/24 ^r	0.40	1.7		0.39	0.03		23	32	286	16	1,040	9,698	3.73	1.53
2011	6/28-7/30 ^s	0.36	1.5		0.37	0.03		24	25	173	21	1,040	6,808	5.23	2.02
2012	6/29-9/08 ^t	0.47	1.4		0.44	0.03		40	29	312	16	1,200	10,041	5.41	2.56
2013	7/03-9/14 ^u	0.50	1.6		0.37	0.02		37	33	460	9	1,420	15,058	5.63	2.17
1977-1981 Average		2.38	1.40		1.90	NA		22	22	56	29	NA	22,634	0.83	1.46
1982-2008 Average		0.30	1.22		0.28	NA		20	26	213	14	1,244	7,849	2.21	0.63
2009-2013 Average		0.42	1.50		0.39	0.03		29	29	318	15	1,124	10,708	4.63	1.90

Note: Blank cells indicate that information is unavailable.

^a Deadloss included in total.

ⁱ The season was extended 24 hours due to bad weather.

^q CDQ opened 6/15-7/28. OA opened 6/15

^b Millions of pounds.

^j Open access (OA) closed 8/29. CDQ opened 9/1-9/29.

^r CDQ opened 6/28-7/16. OA opened 7/1

^c Information not available.

^k OA closed 9/1. CDQ opened from 9/1-9/9.

^s CDQ opened 6/28-7/8. OA opened 6/28

^d Fishing actually began 8/12.

^l OA opened 7/1-8/6. CDQ opened 6/15-6/28 and 8/9-9/3.

^t CDQ opened 6/29. OA opened 6/29-8/11.

^e Fishing actually began 7/8.

^m OA opened 7/1-8/13. CDQ opened 6/15-6/28 and 8/15-8/24

^u CDQ and OA opened and closed at same time

^f Fishing began 7/9 due to fishermen strike.

ⁿ CDQ opened 6/15-6/28. OA opened 7/1 to the end date.

^g First delivery was made 7/10.

^o OA opened 7/1-8/15. CDQ opened 6/15-6/28 and 8/17-8/27.

^h First delivery was made 7/16.

^p OA opened 6/23-8/18. CDQ opened 8/17-9/3.

Appendix A3.—Daily catch based on fish ticket data for the open-access summer commercial king crab harvest, Norton Sound Section, Eastern Bering Sea, July 3–September 14, 2013.

Date	Landings	Number of Crabs	Lbs of Crabs Harvested	Cumulative Lbs	Number of Pots Pulled	Average Weight (lbs)	Daily CPUE
7/05	1	144	453	453	20	3.1	7
7/06	4	755	2,187	2,640	113	2.9	7
7/07	9	3,036	9,124	11,764	359	3.0	8
7/08	3	880	2,591	14,355	89	2.9	10
7/09	3	374	1,097	15,452	57	2.9	7
7/10	2	666	2,016	17,468	79	3.0	8
7/11	9	3,189	9,438	26,906	305	3.0	10
7/12	11	4,151	12,604	39,510	391	3.0	11
7/13	5	1,144	3,417	42,927	159	3.0	7
7/14	3	1,446	4,537	47,464	120	3.1	12
7/15	1	269	823	48,287	40	3.1	7
7/16	10	3,999	12,319	60,606	328	3.1	12
7/17	2	195	562	61,168	41	2.9	5
7/18	17	6,871	20,496	81,664	596	3.0	12
7/19	11	2,976	8,777	90,441	296	2.9	10
7/20	4	1,884	5,329	95,770	160	2.8	12
7/21	3	651	1,912	97,682	118	2.9	6
7/23	3	776	2,360	100,042	81	3.0	10
7/24	15	4,314	12,853	112,895	560	3.0	8
7/25	12	3,423	10,356	123,251	399	3.0	9
7/26	4	1,313	3,971	127,222	131	3.0	10
7/27	3	502	1,657	128,879	32	3.3	16
7/28	12	2,896	8,578	137,457	394	3.0	7
7/29	2	304	903	138,360	60	3.0	5
7/30	15	3,071	9,096	147,456	468	3.0	7
7/31	9	1,905	5,690	153,146	327	3.0	6
8/01	6	876	2,661	155,807	160	3.0	5
8/02	8	2,091	6,199	162,006	356	3.0	6
8/03	12	2,427	7,117	169,123	351	2.9	7
8/04	11	2,971	8,748	177,871	336	2.9	9
8/05	1	311	929	178,800	39	3.0	8
8/06	6	1,846	5,411	184,211	210	2.9	9
8/07	5	1,529	4,452	188,663	134	2.9	11
8/08	4	696	2,096	190,759	158	3.0	4
8/09	7	2,815	8,209	198,968	280	2.9	10
8/10	9	1,969	5,955	204,923	320	3.0	6
8/11	10	3,727	11,093	216,016	369	3.0	10
8/12	4	1,168	3,581	219,597	117	3.1	10
8/13	6	1,917	5,714	225,311	194	3.0	10
8/14	8	2,153	6,368	231,679	216	3.0	10
8/15	10	2,468	7,439	239,118	371	3.0	7

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Date	Landings	Number of Crabs	Lbs of Crabs Harvested	Cumulative Lbs	Number of Pots Pulled	Average Weight (lbs)	Daily CPUE
8/16	9	1,811	5,326	244,444	285	2.9	6
8/17	11	1,369	4,002	248,446	326	2.9	4
8/18	3	1,146	3,422	251,868	160	3.0	7
8/19	3	451	1,317	253,185	80	2.9	6
8/20	7	1,130	3,365	256,550	252	3.0	4
8/21	11	1,317	3,896	260,446	372	3.0	4
8/22	3	331	997	261,443	120	3.0	3
8/23	1	4	13	261,456	40	3.3	0
8/24	3	616	2,076	263,532	88	3.4	7
8/25	9	1,069	3,244	266,776	243	3.0	4
8/27	3	396	1,170	267,946	69	3.0	6
8/28	10	2,359	7,181	275,127	351	3.0	7
8/29	5	1,403	4,223	279,350	135	3.0	10
8/30	2	915	2,784	282,134	78	3.0	12
8/31	5	2,798	8,568	290,702	189	3.1	15
9/04	8	3,899	12,228	302,930	270	3.1	14
9/05	3	1,777	5,237	308,167	71	2.9	25
9/06	6	2,617	7,694	315,861	200	2.9	13
9/07	8	2,851	8,430	324,291	237	3.0	12
9/08	4	1,485	4,440	328,731	131	3.0	11
9/09	6	2,195	6,817	335,548	204	3.1	11
9/10	12	2,920	8,826	344,374	314	3.0	9
9/11	5	1,368	4,065	348,439	155	3.0	9
9/12	1	123	367	348,806	12	3.0	10
9/13	6	2,854	8,660	357,466	177	3.0	16
9/14	3	1,747	5,386	362,852	91	3.1	19
9/15	8	3,436	10,426	373,278	212	3.0	16
Total	435	124,485	373,278	373,278	14,196	3.0	9

Note: The fishery closed by emergency order on 9/14/13 at 6:00 PM and the last delivery was made on 9/15/13.

Appendix A4.—Commercial summer harvest (pounds) of red king crab by statistical area, Norton Sound Section, Eastern Bering Sea, 1977–2013.

Statistical Area	Year									
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
616331	7,893									
616401										
626331	40,020					22				
626401	31,572			4,830	399					
626402	38,995									
636330										
636401				12,398	61,823	32,246	5,880	41	891	
636402										
646301										
646330					4,716					
646401			155,972		1,319	17,532				
646402	80,969					748				
656300			161,699		15,174					
656330			323,518	72,735	395,662	3,983	24,246	83,479	7,632	
656401			138,011	121,147	253,387	60,480	11,422	183,119	246,200	
656402	306,302	90,187	288,869	918	3,098	2,832			132,363	
666230		55,490			77					
666300		162,795	60,816	84,874	9,167	95		4,534		
666330		353,016	505,050	367,446	141,513	8,990	1,192		389	70,615
666401		179,212	486,947	205,400	381,510	79,580	325,045	116,254	5,341	408,848
666402	12,036	515,778	534,938	183,581		17,585			32,992	
666431			146,029							
676300		13,238		126,231						
676330		51,304	81,798	6,762	18,734					
676400		667,130	33,856	274	92,026	1,315	247		32	
676430		3,811	12,309		373	3,513			1,171	
676501					36					
686330			1,860							
686431										
Total	517,787	2,091,961	2,931,672	1,186,596	1,379,014	228,921	368,032	387,427	427,011	479,463

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Statistical Area	Year									
	1987	1988	1989	1990	1992	1993	1994	1995	1996 ^a	1997
616331							48			
616401								35		
626331									61	
626401								18,971	45,045	18,066
626402										
636330									4,560	3,838
636401			22,030		1,159	1,373	3,340	24,329	70,677	59,206
636402							1,754	3,466		
646301								4,628	13,888	
646330			5,212					1,493	2,894	314
646401						1,963	37,510	105,045	22,834	1,052
646402						730	139,661	66,821		
656300										
656330	79,006	36,129	1,757		4,814	265		19,745	15,446	4,661
656401	194,408	165,644	100,956	171	53,119	105,341	34,686	32,289	9,985	4,035
656402						193,079	110,289	44,000		
666230										
666300									25,519	
666330	2,963	13,020	1,275	27,185	4,305	31,758		730		
666401	50,744	21,895	115,257	162,263	10,632	746	396		3,001	1,816
666402						535	1,221			
666431								1,124		
676300									546	
676330										
676400				3,212					9,775	
676430										
676501										
686330										
686431										
Total	327,121	236,688	246,487	192,831	74,029	335,790	328,905	322,676	224,231	92,988

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Statistical Area	Year									
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
616331		633	4,557		3,506	646			2,357	
616401										231
626331					2,455				1,415	27,018
626401	8,065	508	4,689	61,620	53,722	15,899	23,113	94,130	118,202	61,704
626402						1,352				
636330	2,449			2,253				126	26,680	10,253
636401	10,771	14,201	130,463	91,343	50,906	83,949	166,489	227,204	224,531	123,092
636402										
646301										
646330		3,021		1,868	1,955		2,226	4,097	2,629	5,290
646401	3,194	221		4,287		3,952	1,964	149	1,660	
646402										
656300						14	932		284	1,909
656330	4,078	1,300	1,990	20,869	12,374	21,176	46,288	47,411	17,752	4,911
656401	1,127	2,739	95,979	55,158	63,038	40,566	21,579	9,405	28,434	70,065
656402						1,441		380	807	2,254
666230									1,721	
666300									18,245	
666330			5,839	7,030	1,332	1,296	12,359	142	5,041	511
666401		930	69,007	43,771	35,970	83,998	42,452	727	600	2,498
666402					30,070	12,873	23,344	16,025	1,050	2,959
666431					4,274	45				
676300										
676330										
676400										180
676430										
676501								1,008		
686330										
686431									340	
Total	29,684	23,553	312,524	288,199	259,602	267,207	340,746	400,804	451,748	312,875

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Statistical Area	Year						Total
	2008	2009	2010	2011	2012	2013	
616331	5,658	888					26,186
616401	416	6,170				7,729	14,581
626331	3,235	3,047		2,489		686	80,448
626401	96,327	103,043	52,054	85,271	115,524	36,802	1,049,556
626402							40,347
636330	2,350	5,026	2,584		1,454	12,035	73,608
636401	197,948	96,279	182,040	146,973	148,183	34,027	2,223,791
636402							5,220
646301							18,516
646330	1,505	933	1,205		1,204	4,195	44,757
646401	18,728	46,264	77,437	83,099	98,811	59,737	742,730
646402						5,271	294,200
656300							180,012
656330		10,617	17,660	1,546	8,168	8,515	1,297,733
656401	68,968	107,557	82,747	77,149	85,920	147,569	2,672,399
656402						37,743	1,214,562
666230							57,288
666300							366,045
666330		1,514		2,042	1,000		1,567,553
666401		10,021			15,726	33,469	2,894,056
666402		6,228	1,577	2,271		1,419	1,396,482
666431						2,669	154,141
676300							140,015
676330							158,598
676400							808,047
676430							21,177
676501							1,044
686330							1,860
686431							340
Total	395,135	397,587	417,304	400,840	475,990	391,863	17,545,291

Note: Blank cells indicate statistical areas in which there was no recorded harvest. No commercial fishery occurred in 1991.

^a Does not include approximately 2,490 lbs not reported on fish tickets.