Fishery Data Series No. 07-16

Norton Sound Winter Red King Crab Studies, 2006

by

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March 2007

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
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

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA SERIES NO. 07-16

NORTON SOUND WINTER RED KING CRAB STUDIES, 2006

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ABSTRACT

Biological data were collected for a winter red king crab *Paralithodes camtschaticus* pot survey project, begun in February of 1982 by the Alaska Department of Fish and Game, to monitor the near shore distribution, abundance, and life history parameters of the red king crab population in the Nome area. Red king crabs were caught with pots, measured, and tagged through established area stations in the sea ice offshore of Nome. Staff also monitored the winter subsistence and commercial fisheries to evaluate crab abundance available to local users. Project data, along with data from various other sources, were incorporated into a length based population model which was developed to predict population estimates for the red king crab biomass in Norton Sound. A total of 512 male and 25 female red king crabs were captured and sampled at 16 survey sites between January 26 and April 19, 2006. A total of 85 pot lifts were made for an overall CPUE of 6.0 male and 0.3 female red king crabs. Carapace length measurements and shell age were recorded from all male king crabs caught. Of the male king crabs, 62.5% were prerecruit, 15.6% were recruit, and 21.9% postrecruit. Analysis of the 2006 winter data indicated recruitment is less than last year but is expected to increase for the next two years.

Key words: Norton Sound, *Paralithodes camtschaticus,* red king crab, distribution, abundance, tagging, sea ice, subsistence, crab pots, population model, biomass.

INTRODUCTION

Red king crabs, *Paralithodes camtschaticus,* support both commercial and subsistence harvests in the Norton Sound area. For both fisheries, effort is concentrated within 100 miles of Nome. Commercial fisheries occur during the winter and summer months, with most of the catch occurring in the summer. Subsistence fisheries occur primarily in winter months and sporadically in summer months. The king crab population is concentrated near the shore from December through April, during which time shorefast ice allows subsistence fishers easy access. A winter red king crab pot survey project began in February of 1982 and sampling procedures were standardized in 1983. Except in 1988 (poor ice conditions), 1992 and 1994 (lack of funding), the survey has occurred every year up to the present.

The purpose of this study is to collect biological data during winter months (February to April) to monitor near-shore distribution, abundance, and size frequencies of the Norton Sound red king crab population. Collection is done by catching, measuring, and tagging red king crabs through established area stations in the sea ice offshore of Nome. Since shorefast and sea ice conditions around Nome constantly change during winter months and from year to year, placement of survey sites has also changed. From 1982 until 1987, survey sites were confined to a single transect of shorefast ice extending 0.5 to 2.0 miles directly offshore from the Nome Post Office (Lean 1987). In 1988, due to unstable ice and stormy weather, pots were lost and no study was conducted (Merkouris and Lean 1989). From 1989 until 1995, to reduce lost fishing time due to unstable ice at the original sites, the study area was expanded a few miles to the west of Nome where dredging activity occurred and a few miles east of Nome where little subsistence activity occurred (Brennan and LaFlamme 1995). In 1996, pots placed within 5 miles of Nome were lost due to moving ice so the study site was expanded further to the vicinity of Bluff, 50 miles east of Nome (Rob 1996). This was the only year that survey sites were located near Bluff. The following year, 1997, the active ice edge was closer to shore, and unstable ice prevented fishing with pots in the vicinity of Bluff. From 1997 to 2005, ice stations located from up to 12 miles west to 10 miles east of Nome were fished (Soong and Kohler 2005).

Winter project data, along with data from the summer commercial fishery and the triennial trawl survey, are incorporated into a length based population model that was developed to predict population estimates for the red king crab biomass in Norton Sound (Zheng et al. 1998). This model improves management of the red king crab fisheries by providing an annual estimate used to determine the guideline harvest level (GHL) for the summer commercial red king crab fishery. Before development of the length based model, the triennial Norton Sound king crab trawl survey was the only means of determining the crab biomass.

OBJECTIVES

Objectives for the 2006 winter field season:

1. Measure and record shell age, size, and number of sublegal and legal male red king crabs caught in order to evaluate recruitment into legal population before the summer fishery.
2. Tag all male new-shell red king crabs ≤ 100-mm carapace length (CL), as part of ongoing studies to estimate growth and movement of tagged crabs recaptured in summer and winter fisheries.
3. Monitor abundance of red king crab catch accessible to winter subsistence and commercial users in the Nome area.
4. Monitor intensity and distribution of winter fishing effort in the Nome area.
5. Measure and record size and number of female red king crabs captured and their egg clutch size.
6. Describe relative distribution of crabs within the winter 2006 study area using CPUE information.
7. Record other biological data such as incidence of disease, parasitism, and other species captured.

METHODS

Historically, survey stations were comprised of paired sites located 7 and 3 miles west of Nome, directly in front of Nome, and 2 and 5 miles east of Nome. Water depth ranged from 30 to 50 feet deep and the sites were located 1 to 2 miles offshore. In 2006, six survey stations comprised of 16 sampling sites were established in an area spanning from approximately 5.5 miles west to 5 miles east of Nome (Figure 1 and Table 1) beginning January 26. Each sampling site was located in water ranging from 30 to 54 feet deep and from approximately 0.5 mile to 1.5 mile offshore. Travel to and from stations was by snowmachines, with a sled to carry supplies and equipment.

The sampling sites were recorded with a handheld Global Positioning System (GPS) receiver (Garmin GPS 76[1]), and a chain saw was used to cut through the ice to determine its thickness. When ice was found between 1 and 3 feet thick, a square hole about 5 feet long on each side was

[1] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

cut in the ice. Water depth was checked using a weighted string. Other tools used included ice chisels or "tuks", shovels, and long poles. Conical, 4-foot diameter "Japanese style" king crab pots were baited with 2 one-quart bait containers filled with semi-frozen herring chopped into inch-long pieces. Each pot was deployed and attached to a line tethered to a stake at the ice surface. Each hole was covered with styrofoam and plywood to reduce refreezing of the hole and the stake marked per regulation (5AAC 34.925).

Once pots were deployed, each pot was checked and rebaited once or twice per week, depending on weather. When pots were checked, they were brought to the surface and suspended to keep all crabs in the pot immersed in water. Crabs were removed one at a time, determined to be legal (males ≥ 121-mm (4.75-in) carapace width including lateral spines) or sublegal, and measured biologically, from the posterior margin of the right eye orbit of the carapace to the center of the posterior carapace margin (carapace length (CL)). Based on CL, male crabs were considered to be postrecruit (legal, new-shell crabs > 115-mm CL and all legal old-shells), recruit (legal, new-shell crabs ≤ 115-mm CL), or prerecruit (sublegal crabs < 115 mm). Prerecruits were further broken down into ones (> 89-mm CL), twos (76-mm to 89-mm CL), and threes (< 76-mm CL). Other biological features recorded were shell age (determined as new or old shell by observing features such as scarring on the ventral surface, dullness on the dactyl tips and attached barnacle sizes), sex, and egg development and clutch size of female crabs. Spaghetti tags were attached with hog rings to male king crabs < 100-mm CL. Any prior injuries on crabs caught were noted and crabs were released into the same hole in which they were caught.

CPUE was calculated as the number of crabs caught per pot. Thus, comparison of CPUE between different survey sites gave an indication of relative abundance. CPUE for the entire season was calculated as the total number of crabs caught divided by the total number of pot lifts.

Additionally, conversation with commercial and subsistence fishers was solicited to get their impressions of the season, and how abundant the crabs appeared. The winter commercial fishery, which must occur through the ice, runs from November 15 to May 15 and commercial fishers must report and turn in fish tickets to the Nome ADF&G office weekly. Required permits that must be returned were given out to subsistence fishers for recording their catches. Although there is no closed season for subsistence crab fishing, the winter permit is valid only from November 15 to May 15, after which time the fishers must use a summer subsistence crab permit.

RESULTS

Due to high pressure ridges in many areas, only half of the stations in 2006 were near historical locations. On the west side, stations were situated at 2, 3.5, and 5.5 miles from Nome instead of the traditional 3 and 7 miles. In order to maximize fishing efficiency, up to three sampling sites were placed at some stations when space allowed. The first six pots (TLC 1-3, and D1-3), set out in late January and early February, were all lost when the ice went out in mid-February. The active ice edge then stabilized at approximately 1½ miles offshore for the rest of the season and no more pots were lost. Early in the season, high pressure ridges made travel difficult out on the pack ice, but in March, abundant snowfall filled in the ridges and allowed easier access. Trail conditions along the beach line were good all season.

A total of 512 males (of which 233 were tagged and 2 were recaptured) and 25 female red king crabs were captured and sampled between January 26 and April 19 (Table 2). The number of pot lifts totaled 85, which made for an overall CPUE of 6.0 male and 0.3 female red king crabs (Table 1). Station 3 (3.5 miles west of Nome) had the highest CPUE while station 5 (directly in front of Nome) had the lowest. Catch rates varied between 0.0 and 21.0 over the season depending on which pots were pulled and how long they soaked (Table 2). Of the 512 male crabs caught, recruit crabs made up less than 16% of the catch, postrecruit crabs less than 22%, and prerecruits made up the remainder, at over 60% (Table 3).

Number of male red king crabs caught and male CPUE were greater than the 2005 study but were only half of the averages from the winter surveys 1983-2005 (Table 4). Percentage of recruits was 61% of 2005, and postrecruits were 65% of 2005. Of the sublegal catch, percentage of pre-3 crabs was slightly less compared to 2005, while pre-2 crabs almost doubled, and pre-1 crabs increased by over one-third (Table 4). Since 2002, this is the first year that the prerecruit catch proportion has increased compared to prior year, while correspondingly, the legal crab catch proportion has decreased.

Of the 25 female crabs caught, one was a juvenile (< 72-mm CL, no eggs). Of the adults, 22 had an egg clutch above 60% full, while the remaining two were barren. All egg clutches were either purple or dark brown. A quarter of the crabs had eyed eggs while the rest had uneyed eggs.

Similar to past studies, other species caught included helmet crabs *Telmessus cheiragonus* (79), fiddler crabs *Hapalogaster grebnitzkii* (63), Arctic Lyre crabs *Hyas coarctatus* (24), flatbottom sea stars *Asterias* (46), sea urchins of the genus *Strongylocentrotus* (36), shrimp *Pandalus spp.* (14), saffron cod *Eleginus gracilis* (2), unidentified sculpins (28) and jellyfish (1). Also caught in 2006 were a Pacific cod *Gadus macrocephalus,* a Whitespotted greenling *Hexagrammos stelleri,* and a Ring seal**.** Compared to years prior to 2004, very few sea stars and shrimp were caught, and few sand fleas were observed (Paul Thompson, personal communication). No visible signs of disease were detected on the crabs caught in 2006.

Subsistence fishing effort was concentrated between 3 miles east to 2 miles west of Nome. The number of subsistence permits issued, 98, was 82% the average number of permits issued per year since 1984 (Table 5). Of the 97 fishers who returned their permit, 67 actually fished, harvesting 1,239 crabs, or 23% of the average harvest from 1984-2005. Almost all returned permits specified how many pots were used (and lost) and when fishing occurred. Out of 129 pots reported fishing, 50 were lost during the season due to the moving pack ice. Percentages of subsistence crabs caught each month are as follows: November 3%, December 1%, January 26%, February 15%, March 15%, April 33%, and May 7%. Most crabs were caught during January before the ice shifted and April after the pressure ridges had filled in with snow.

Commercial fishers also reported losing their pots during the 2006 winter season. Three fishers registered to fish, but only one made any deliveries. Since less than three fishers made deliveries, all commercial catch information is confidential.

No tags were turned in during the 2006 winter season by subsistence or commercial crab fishers. Generally, more tags are recovered during the summer commercial crab fishery.

DISCUSSION

Red king crab winter pot surveys have been conducted in the Nome area during 21 of the past 24 years since sampling procedures were standardized in 1983. The winter survey has provided opportunities to collect and interpret valuable information on the crab population available to residents of Nome during the winter subsistence and commercial fisheries.

Depending on ice conditions and number and placement of subsistence pots, survey sites have been placed at different distances offshore and at different locations along the coast. From 1982 to 1987, survey sites were confined to a single transect of shorefast ice extending 0.5 to 2.0 miles directly offshore from Nome. Starting in 1989, stations made up of paired sampling sites were located directly in front of Nome and within 7 miles east and west of town. In years when unstable ice prevented fishing in some of these locations, the survey sites were placed a few miles further east and west up to 12 miles. Due to differences in site placements and fishing competition from subsistence and commercial fishers, comparisons of CPUE between seasons may not be an accurate representation of crab abundance over the years. For the same year, CPUE might be more useful as an indicator of where crabs are located. In 2006, crabs appeared to be more concentrated in the areas 3.5 miles (station 3) and 5.5 miles (station 1) west of Nome, and least abundant directly in front of Nome (station 5). For the past year, the area half a mile south of Nome extending half a mile eastward has been dredged for a port improvement project. Disturbance of the substrate might possibly explain the lower catch rate in this area. The area around station 3 was full of high pressure ridges after the ice stabilized, and no subsistence activity was observed in the vicinity. A very limited area of thin pan of ice allowed placement of a single survey site at this station. Lack of competition from subsistence fishers in the same area possibly contributed to the higher catch rate, as well as an abundance of crab.

Winter catch of red king crab for ADF&G surveys, and subsistence and commercial fisheries have varied widely over the years 1983 to 2006, with lowest harvests in years 1988, 1993, 1997, 2001, and 2004 (Figure 3). Annual management reports for 1988 and 2001, and winter crab studies indicate prevalent bad ice conditions and lost pots during these years [Merkouris and Lean (1989), Brennan (1993), Rob and Fair (1997), Brennan et al. (2003), and Soong and Kohler (2004)]. These are also the years when fewer people fished for winter subsistence crab compared to other years (Figure 4). Fishers are less likely to put out pots when the pack ice is unstable for fear of losing their pots. Also, when potential fishers hear from early fishers that harvest is poor, as indicated by lower harvest averages in 1993, 2001, and 2004, they are less likely to put out their pots, resulting in lower harvest numbers. Unstable pack ice sometimes, but not always, results in high pressure ridges, making travel to favored fishing spots difficult. In 1984 and 1998, the pack ice was unstable and pots were lost, yet subsistence harvests were high. In those years, ice conditions were good later in the season (ADF&G 1984), or no large pressure ridges formed (Brennan 1998), which allowed easier access to fishing grounds.

Ice condition is not the only factor affecting catch. Results from Norton Sound trawl survey abundance estimates indicate that the legal population was high in the years 1985 and 1991 and highest in 1999 (Table 6 and Figure 3). Subsistence harvests in these years were also relatively high. Legal abundance estimate for 1996 was the lowest on record, while the pre-1 estimate for that year was the second lowest, indicating a low legal population for the following year, 1997. Correspondingly, winter catches for both years were among the lowest. Pre-2 estimates were

lowest for 1991 and 1999, indicating lower legal populations in 1993 and 2001, which had two of the lowest subsistence catch numbers.

In addition to ice conditions and changes in crab population and recruitment, variable distribution of crabs in nearshore waters also appear to impact catch performance. Legal abundance estimates and ice conditions for 2002 and 2006 were very similar, yet subsistence catch and average harvest were greater in 2002 than 2006 (Table 6, and Figures 3 and 4). Average CPUE in 2002 for the survey sites directly in front of Nome (sites N2 and N3) was 17.4, the highest CPUE for any survey sites that year, while in 2006, average CPUE for the same sites was 1.9, the lowest CPUE of any survey sites for the year (Brennan and Karpovich 2002). Since subsistence fishers concentrated their effort within 2-3 miles of Nome in 2006, lower distribution of crab in this area would have a great impact on winter fishing success. Therefore, factors affecting winter catch performance include ice conditions, fluctuations in crab population and recruitment, and changes in the nearshore distribution of crab during winter.

The 2006 winter survey data indicates recruitment has peaked and is less than 2005. Current size composition data show the portion of the crab population classified as recruits has decreased 9.8% since the 2005 survey and the postrecruit male crab population has decreased 11.6%. The high percentage of recruit and postrecruit crabs observed during the last two years has passed out of the system, replaced by the lower percentage of prerecruit crabs seen the previous year. The winter pot survey also points to an above average pre-1 and pre-2 populations and a very small pre-3 population. Pre-1 crabs require one molt to become part of the legal population next year, while pre-2 crabs require two molts. These findings indicate that the legal crab population is less compared to 2005, but is expected to increase over the next two years.

The triennial Norton Sound red king crab trawl survey was conducted in summer of 2006. Results from the survey suggest that the 2008 and 2009 legal king crab populations should increase from the current population (Soong and Banducci 2006). Legal and pre-1 male abundance estimates were similar to 2002 estimates, while pre-2 estimate was more than 80% above 2002 and is the highest on record (Table 6) (Brennan 2003). These findings indicate that there will be an increase in legal abundance in the near future, which correlate well with the winter survey results.

Winter project data are incorporated into a length based population model developed to predict biomass for the red king crab population in Norton Sound. Incorporating data from trawl surveys, winter and summer pot studies, and summer and winter fisheries from 1976 to present, this model improves upon the trawl estimate because it includes several different sources of data and uses historical abundance trends based on length. Additionally, the model can be used to project estimates in years when there is no trawl survey, allowing abundance based management of the Norton Sound red king crab summer fishery. The length frequency data from the 2006 winter crab project were added into the computer model to predict the Norton Sound summer crab biomass. The expected legal male crab abundance was 4.5 million pounds, with the legal population above 5-inch carapace width (market size) at 3.3 million pounds. This is a decline of approximately 6% from the revised population estimate of 4.8 million pounds for 2005. A 10% exploitation rate on the legal population, in accordance with the harvest strategy set by the Alaska Board of Fisheries, equates to a GHL of 454,000 pounds of crab. Therefore the 2006 summer commercial open-access king crab fishery allocation was 419,950 pounds, and the CDQ allocation was 34,050 pounds.

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TABLES AND FIGURES

Table 1.–Location, number of pot lifts, catch rate per sampling site, and CPUE per station during the winter red king crab pot survey, Norton Sound, 2006.

Station	Sampling Site[a]	Location (decimal degrees) Latitude	Longitude	Depth (ft)	Distance from Nome	Historical Location	Number of Pot Lifts	Male Red King Crab Number Caught	CPUE	Female Red King Crab Number Caught	CPUE	CPUE per Station
1	W 1	64.51268	165.6033	30	5.5 miles West	no	7	51	6.4	7	0.9	9.5
	W 2	64.51105	165.60318	32	5.5 miles West	no	8	82	10.3	3	0.4	
2	W 7a	64.50174	165.55518	54	4.5 miles West	no	11	21	1.9	0	0.0	5.6
	W 7b	64.49943	165.55577	49	4.5 miles West	no	9	81	9.0	2	0.2	
	W 7c	64.4977	165.55225	48	4.5 miles West	no	7	42	6.0	5	0.7	
3	W 3	64.48974	165.52388	48	3.5 miles West	yes	6	92	15.3	4	0.7	16.0
4	D 1	64.49157	165.47325	42	2 miles West	no	2	17	8.5	1	0.5	6.0
	D 2	64.48935	165.47342	45	2 miles West	no	1	0	0.0	0	0.0	
	D 3	64.48836	165.4774	51	2 miles West	no	0	0	0.0	0	0.0	
5	N 2	64.48701	165.40698	37	1/2 mile South	yes	8	31	3.9	0	0.0	1.9
	N 3	64.47967	165.38524	45	1 mile South	yes	6	1	0.2	0	0.0	
	TLC 1	64.48084	165.38974	46	1 mile South	yes	2	0	0.0	0	0.0	
	TLC 2	64.47869	165.38965	49	1 mile South	yes	2	3	1.5	0	0.0	
	TLC 3	64.47717	165.38889	50	1 mile South	yes	2	3	1.5	0	0.0	
6	E 1	64.46655	165.24739	30	5 miles East	yes	7	32	4.6	1	0.1	6.5
	E 2	64.46605	165.25168	35	5 miles East	yes	7	56	8.0	2	0.3	
Total							85	512	6.0	25	0.3	

[a] Pots D 1-3 and TLC 1-3 were lost in mid-February.

Table 2.–Daily catch of red king crabs for all sampling sites in the winter pot survey, Norton Sound, 2006.

Date Checked	Sampling Sites[a] (soak time in days)	Pot Lifts	Males	Females	Male CPUE	Female CPUE
30-Jan	TLC1+TLC2+TLC3 (4)	3	0	0	0.0	0.0
5-Feb	TLC1+TLC2+TLC3 (6)	3	6	0	2.0	0.0
6-Feb	D1 (7)	1	12	1	12.0	1.0
9-Feb	D1+D2 (3)	2	5	0	2.5	0.0
2-Mar	W7a (2)	1	2	0	2.0	0.0
6-Mar	W7a+W7b (4)	2	6	0	3.0	0.0
9-Mar	W1+W2+W7a+W7b (3)	4	11	0	2.8	0.0
13-Mar	N2+N3+E1+E2 (6)	4	49	3	12.3	0.8
14-Mar	W7a+W7b+W7c+W1+W2 (5)	5	36	0	7.2	0.0
20-Mar	N2+N3+E1+E2 (7)	4	27	1	6.8	0.3
21-Mar	W7a+W7b+W7c+W1+W2 (7)	5	39	5	7.8	1.0
22-Mar	N2 (2)	1	1	0	1.0	0.0
23-Mar	E1+E2+N3 (3)	3	6	0	2.0	0.0
24-Mar	W7a+W1+W2 (3)	3	5	0	1.7	0.0
28-Mar	W7b+W7c (6), W3 (7)	3	34	2	11.3	0.7
29-Mar	N2 (7), N3+E1+E2 (6)	4	8	0	2.0	0.0
31-Mar	W7a+W1+W2 (7)	3	18	0	6.0	0.0
3-Apr	W7b+W7c (6), W3 (5)	3	59	3	19.7	1.0
5-Apr	N2+N3+E1+E2 (7)	4	4	1	1.0	0.3
6-Apr	W1+W2+W7a (6), W3 (3)	4	24	0	6.0	0.0
10-Apr	W7a (4), W7b (7)	2	41	1	20.5	0.5
11-Apr	W7c (8), W3 (5), N2 (6)	3	4	0	1.3	0.0
12-Apr	W1+W2 (6), N3 (7)	3	26	3	8.7	1.0
13-Apr	E1+E2 (8)	2	15	0	7.5	0.0
14-Apr	W7a+W7b (4), W7c+W3 (3)	4	9	2.0	2.3	0.5
17-Apr	W1+W2 (5)	2	11	0.0	5.5	0
18-Apr	E2 (5)+N3 (6)+N2 (7)	3	10	0.0	3.3	0
19-Apr	W3+W7a+W7b+W7c (5)	4	44	3.0	11.0	0.8
	Total / Average	85	512	25	6.0	0.3

[a] Sampling sites grouped by "+" means the pots soaked for the same number of days.

Table 3.–Summary of male red king crab data from the winter pot survey, Norton Sound, 2006.

	Number	Percent	Average CL (mm)
Sublegal Male Crabs			90
New Shell	303	59.2%	
Old Shell	17	3.3%	
Legal Male Crabs			115
New Shell	113	22.1%	
Old Shell	79	15.4%	
Total	512	100.0%	
Prerecruit One Males[a]	169	33.0%	
Prerecruit Twos[b]	146	28.5%	
Prerecruit Threes[c]	5	1.0%	
Total	315	62.5%	
Prerecruit Males[d]	320	62.5%	
Recruit Males[e]	80	15.6%	
Postrecruit Males[f]	112	21.9%	
Total	512	100.0%	

Note: CL = carapace length.

[a] Prerecruit one crabs are sublegal crabs > 89mm-CL.

[b] Prerecruit twos are 76-mm to 89-mm CL.

[c] Prerecruit threes are < 76-mm CL.

[d] Prerecruits are sublegal crabs ≤ 115-mm CL.

[e] Recruits are new-shell, legal crabs with ≤ 115-mm CL.

[f] Postrecruits are new-shell, legal crabs with > 115-mm CL and all old-shell legal crabs.

Table 4.–Summary of red king crab data from the winter pot surveys, Norton Sound, 1983–2006.

		Females	Males							
					Prerecruits[a] / Sublegal			Legal		
Year[b,c]	Pot Lifts	Number Caught	Number Caught	CPUE	Threes[d,e]	Twos[d,f]	Ones[g]	Recruits[h]	Postrecruits[i]	CL (mm)
1983	107	236	2,586	24.2		26.2%	38.0%	26.1%	9.6%	[j]
1984	70	78	1,677	24.0		34.7%	31.0%	18.6%	15.8%	[j]
1985	31	14	760	24.5		24.7%	45.1%	20.4%	9.8%	[j]
1986	31	74	594	19.2		25.7%	35.0%	21.7%	17.7%	[j]
1987	26	6	151	5.8		12.5%	31.3%	10.4%	45.8%	[j]
1989	42	9	548	13.0		26.8%	15.4%	27.3%	30.5%	[j]
1990	99	18	2,076	21.0		15.9%	33.5%	24.7%	26.0%	115
1991	56	8	1,283	22.9	0.2%	4.8%	30.6%	33.5%	30.9%	114
1993	33	1	181	5.5	0.0%	3.3%	8.8%	17.1%	70.7%	118
1995[k]	126	10	776	6.2	2.1%	9.8%	11.4%	32.3%	44.4%	117
1996	159	26	1,582	9.9	9.2%	22.1%	33.1%	10.1%	25.5%	117
1997	140	60	399	2.9	11.0%	32.3%	20.8%	14.3%	21.6%	118
1998	84	38	882	10.9	0.8%	36.6%	44.3%	8.7%	9.5%	113
1999	122	15	1,308	10.7	0.7%	6.5%	42.4%	39.0%	11.3%	110
2000	93	22	575	6.2	3.1%	13.2%	20.3%	38.6%	24.9%	113
2001	14	1	44	3.1	4.5%	18.2%	15.9%	13.6%	47.7%	106
2002	64	46	832	13.0	10.7%	43.1%	25.5%	9.0%	11.8%	117
2003	86	22	826	9.6	4.2%	19.7%	41.6%	20.2%	14.2%	113
2004	77	9	286	3.7	0.0%	9.4%	40.2%	37.1%	13.3%	112
2005	93	20	406	4.4	1.5%	15.8%	23.9%	25.4%	33.5%	116
2006	85	25	512	6.0	1.0%	28.5%	33.0%	15.6%	21.9%	115
Avg. 1983-2005	78	36	889	12.0		22.7%	29.4%	22.4%	25.7%	114

[a] Prerecruits are sublegal crabs ≤ 115-mm CL.

[b] Unstable ice conditions in 1988 and 2001.

[c] The project was not funded in 1992 and 1994.

[d] Prior to 1991, carapace lengths (CL) were consolidated in pairs so that prerecruit threes and twos cannot be accurately separated.

[e] Prerecruit three crabs are < 76-mm CL.

[f] Prerecruit two crabs are 76-mm to 89-mm CL.

[g] Prerecruit ones are sublegal crabs > 89-mm CL.

[h] Recruits are new-shell, legal crabs ≤ 115-mm CL.

[i] Postrecruits are new-shell, legal crabs > 115-mm CL and all old-shell legal crabs.

[j] Prior to 1990, CL averages were not calculated.

[k] Includes catch from 12 sampling sites and from one commercial fisher's catch on April 5.

Table 5.–Winter commercial and subsistence red king crab harvests, Norton Sound, 1978–2006.

Commercial			Subsistence						
				Permits			Total Crabs		Average Harvested/
Year[a]	# Fishers	# Crabs Harvested	Winter[b]	Issued	Returned	Fished	Caught[c]	Harvested[d]	Permit Fished
1978	37	9,625	1977-78	290	206	149	[e]	12,506	84
1979	[f]	[f]	1978-79	48	43	38	[e]	224	6
1980	[f]	[f]	1979-80	22	14	9	[e]	213	24
1981	0	0	1980-81	51	39	23	[e]	360	16
1982	[f]	[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
1985-86	5	2,168	1985-86	136	133	107	10,751	7,052	66
1986-87	7	1,040	1986-87	138	134	98	7,406	5,772	59
1987-88	10	425	1987-88	71	58	40	3,573	2,724	68
1988-89	5	403	1988-89	139	115	94	7,945	6,126	65
1989-90	13	3,626	1989-90	136	118	107	16,635	12,152	114
1990-91	11	3,800	1990-91	119	104	79	9,295	7,366	93
1991-92	13	7,478	1991-92	158	105	105	15,051	11,736	112
1992-93	8	1,788	1992-93	88	79	37	1,193	1,097	30
1993-94	25	5,753	1993-94	118	95	71	4,894	4,113	58
1994-95	42	7,538	1994-95	166	131	97	7,777	5,426	56
1995-96	9	1,778	1995-96	84	44	35	2,936	1,679	48
1996-97	[f]	[f]	1996-97	38	22	13	1,617	745	57
1997-98	5	984	1997-98	94	73	64	20,327	8,622	135
1998-99	5	2,714	1998-99	95	80	71	10,651	7,533	106
1999-2000	10	3,045	1999-2000	98	64	52	9,816	5,723	110
2000-01	3	1,098	2000-01	50	27	12	366	256	21
2001-02	11	2,591	2001-02	114	61	45	5,119	2,177	48
2002-03	13	6,853	2002-03	107	70	61	9,052	4,140	68
2003-04[g]	2	522	2003-04	96	77	41	1,775	1,181	29
Average 1978-2005	9	2,356	Average 1983-2005	118	90	70	8,554	5,348	67

-continued-

Table 5.-Page 2 of 2.

Commercial			Subsistence						
				Permits			Total Crabs		Average Harvested/
Year[a]	# Fishers	# Crabs Harvested	Winter[b]	Issued	Returned	Fished	Caught[c]	Harvested[d]	Permit Fished
2004-05	4	2,091	2004-05[h]	170	102	60	6,496	3,973	66
2005-06	[f]	[f]	2005-06	98	97	67	2,083	1,239	18
Average 1978-2005	9	2,356	Average 1983-2005	120	93	71	8,170	5,415	70

[a] Prior to 1985 the winter commercial fishery occurred from January 1–April 30. As of March 1985, fishing may occur from November 15–May 15.

[b] The winter subsistence fishery can occur as early as December and continues through May.

[c] The number of crabs actually caught; some may have been released.

[d] The number of crabs harvested is the number of crabs caught and kept.

[e] Information not available.

[f] Data confidential under AS 16.05.815.

[g] Confidentiality was waived by the fishers.

[h] Prior to 2005, permits were only given out of the Nome ADF&G office. Starting with the 2004 season, permits were given out in Elim, Golovin, Shaktoolik, and White Mountain.

Table 6.–Standardized results from population assessment surveys for red king crab in Norton Sound, 1976-2006.

				Number of Red King Crabs Captured [a, b]				Population Abundance Estimates[c]			Standard Error		
Year	Dates	Research Agency	Gear	Pre-2 Males	Pre-1 Males	Legal Males [d]	Females	Pre-2 Males	Pre-1 Males	Legal Males	Pre-2 Males	Pre-1 Males	Legal Males
1976	9/2 - 9/5, 9/16 – 10/7	NMFS	Trawl	58(38)	110(213)	180(614)	101(35)	331,555	808,091	1,742,755	44,653	70,094	104,941
1979 [e]	7/26 - 8/5	NMFS	Trawl	N/A	N/A	90(86)	N/A			809,799			61,176
1980 [f]	7/4 – 7/14	ADF&G	Pots			3,290	158			1,900,000			
1981	6/28 - 7/14	ADF&G	Pots			3,415	1,933			1,285,195			
1982	7/6 - 7/20	ADF&G	Pots			2,001	424			353,273			
1982	9/5 - 9/11	NMFS	Trawl	42	107	97	256	356,724	832,581	877,722	50,116	76,454	79,907
1985	7/1 - 7/14	ADF&G	Pots			4,645	181			907,579			
1985	9/16 - 10/1	NMFS	Trawl	63	94	139	139	466,858	707,140	1,051,857	58,598	71,999	87,931
1988	8/16 - 8/30	NMFS	Trawl	82(0)	69(1)	135(3)	212(2)	565,255	493,030	978,748	62,339	58,224	82,083
1991	8/22 - 8/30	NMFS	Trawl	39	42	166	105	294,801	303,682	1,287,486	46,648	46,960	98,101
1996	8/7 - 8/18	ADF&G	Trawl	39(36)	32(17)	53(14)	98(70)	452,580	325,699	536,235	52,324	47,338	69,647
1999	7/28 – 8/7	ADF&G	Trawl	9(3)	64(38)	103(63)	64(18)	103,832	940,198	1,594,341	40,841	120,449	129,864
2002	7/27 – 8/6	ADF&G	Trawl	34(18)	42(23)	61(29)	116(35)	427,703	518,638	771,569	73,494	80,741	85,303
2006	7/25 – 8/8	ADF&G	Trawl	77(3)	37(16)	51(18)	66(1)	775,076	569,833	726,251	91,812	82,883	92,590

[a] Number of crabs captured on ADF&G pot surveys represent data standardized for a 24-hour soak.

[b] The 1976, 1979, 1988 and all ADF&G trawl catches include resampled stations (in parenthesis). The 1979, 1996, and 2006 population estimates incorporated resampled stations by combining catches and tow distances for each station resampled.

[c] Population estimates are valid for the date of the survey (i.e., either before or after the summer commercial fishery).

[d] Legal male red king crabs were defined as ≥ 121-mm (4.75-in) carapace width for the pot surveys and all ADF&G trawl surveys, and ≥ 104-mm CL for all of the NMFS trawl surveys except the 1979 survey which defined legal males as ≥ 100-mm CL.

[e] Pre-1 and pre-2 male, and female data is not available for the 1979 NMFS trawl survey and the legal male abundance estimate is fully standardized.

[f] The 1980 pot survey estimate has been revised from the original estimate of 13.4 million pounds which was thought inaccurate due to an under-reporting of recovered tagged crabs.

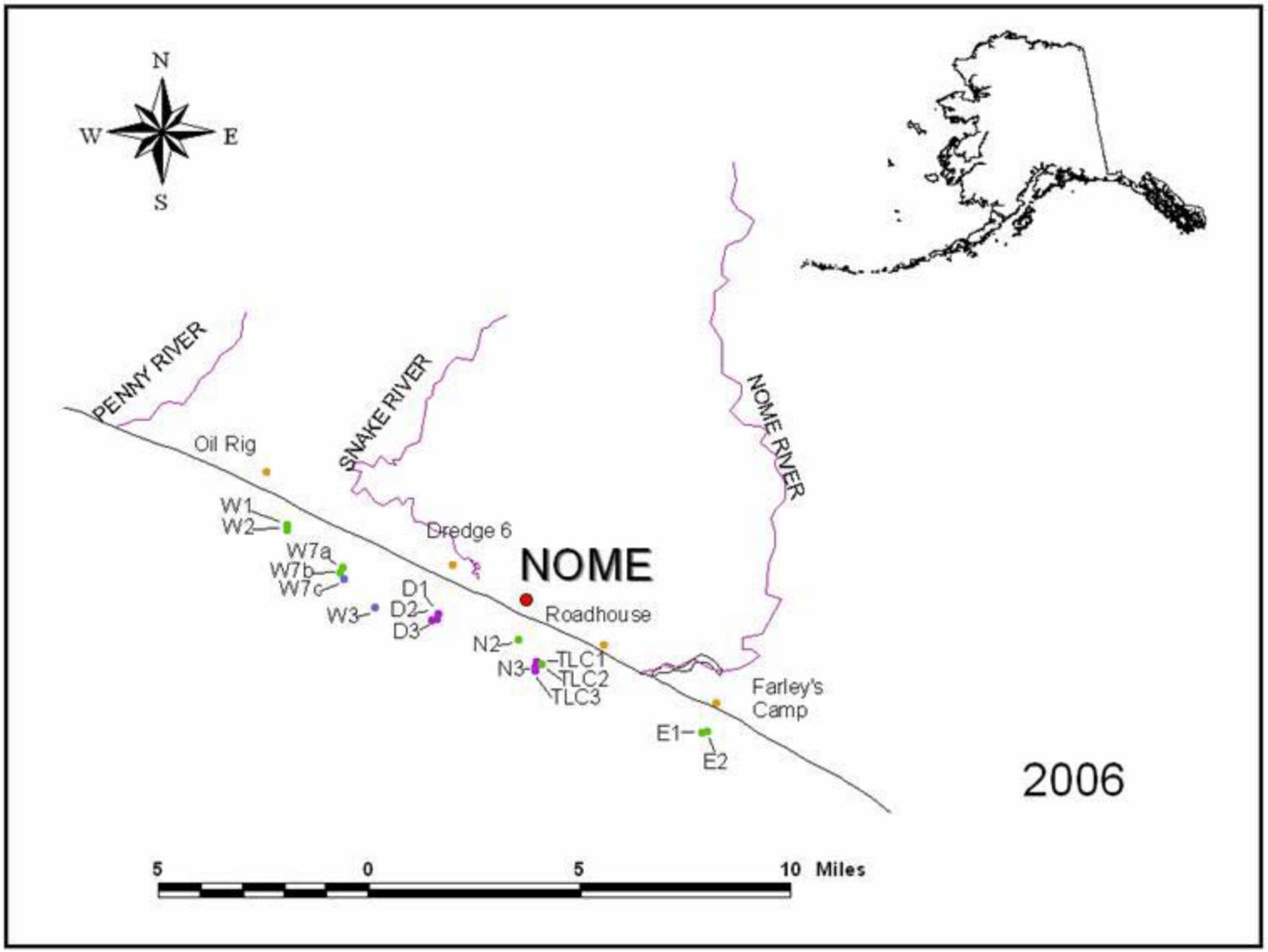


Figure 1.–Location of sampling sites for the winter red king crab pot survey, Norton Sound, 2006.

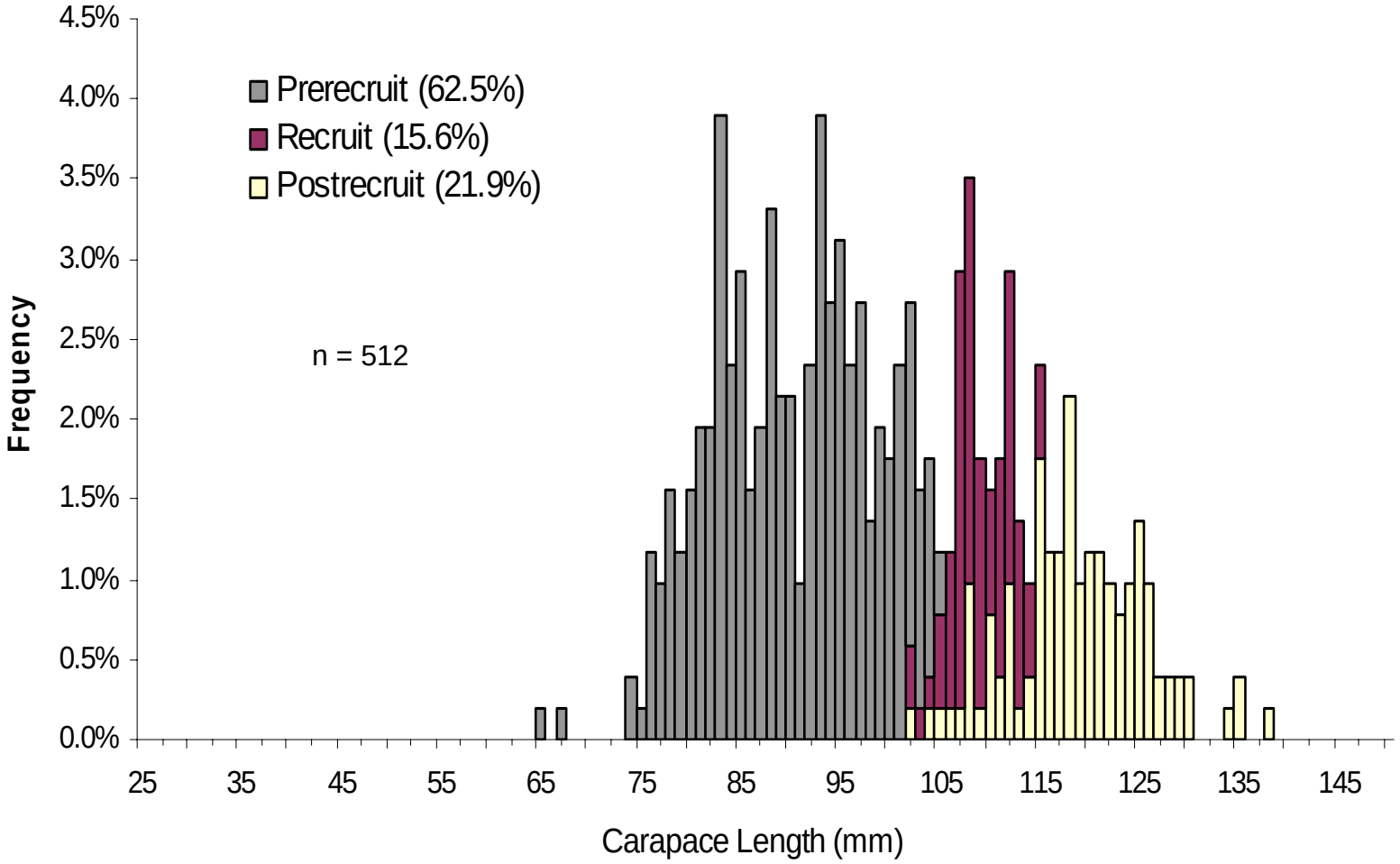
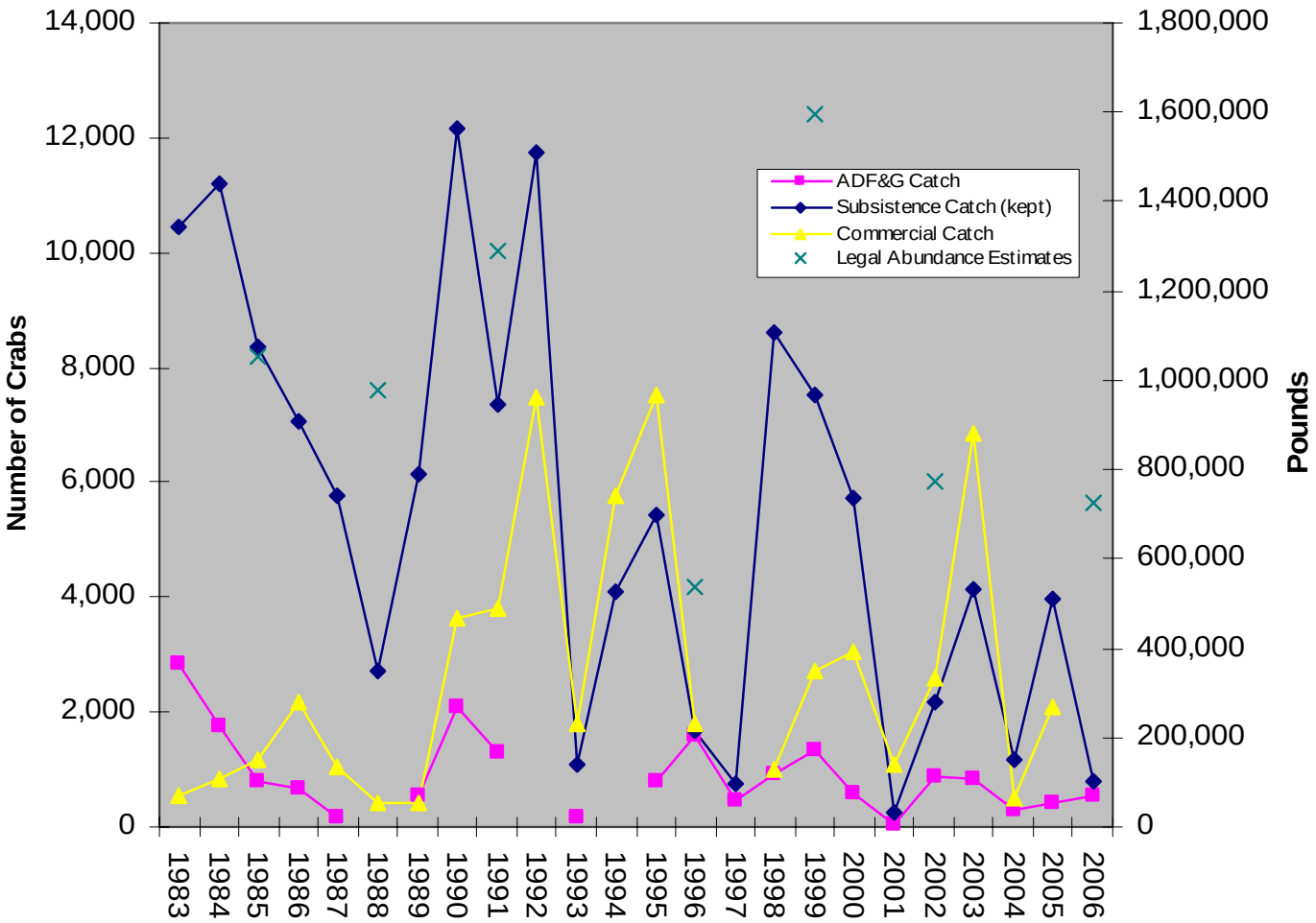


Figure 2.–Length frequency distribution of male red king crabs captured during the winter pot survey, Norton Sound, 2006.



Note: Only data from 1983 to 2006 is compared because information from commercial fishers is limited prior to these years.

Catches are plotted on the primary axis, and biomass estimates are plotted on the secondary axis. Blanks for ADF&G catch are because no studies were conducted in these years, while blanks for commercial catch are because catch information is confidential for these years.

Figure 3.–Comparison of winter red king crab catches between ADF&G surveys and commercial and subsistence fishers, and legal abundance estimates from trawl surveys, Norton Sound, 1983-2006.

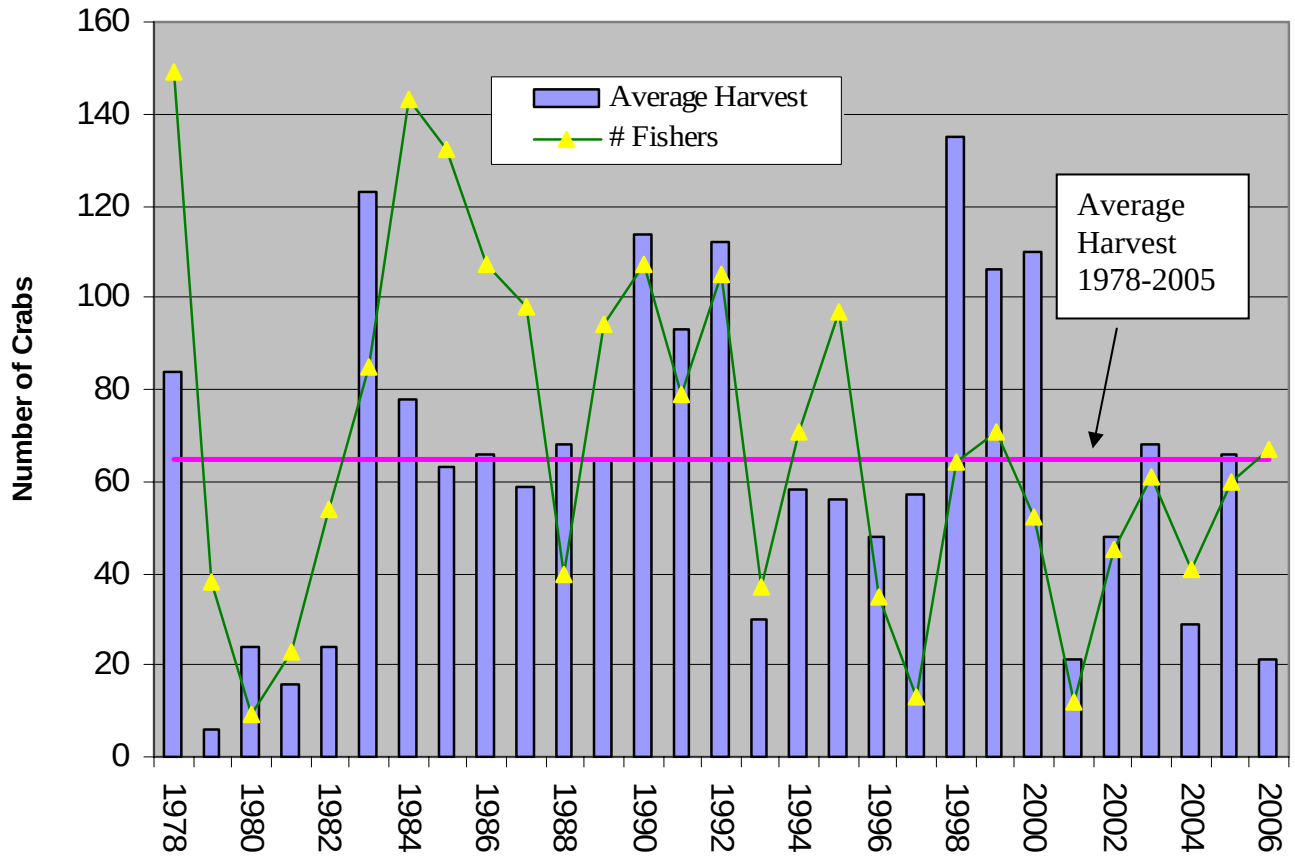


Figure 4.–Number of winter subsistence red king crab fishers and average harvest per fisher, Norton Sound, 1978-2006.