

NORTON SOUND WINTER RED KING CRAB STUDIES, 2002

By

Elisabeth L. Brennan

and

Shawna Karpovich

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AUTHOR

Elisabeth Brennan is a Fishery Biologist for the Alaska Department of Fish and Game, Division of Commercial Fisheries, Pouch 1148, Nome, AK 99762

Shawna Karpovich is a Fishery Biologist for the Alaska Department of Fish and Game, Division of Commercial Fisheries, Pouch 1148, Nome, AK 99762

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ABSTRACT

A winter king crab test-fishing project began in February of 1982 in the Nome area. Sampling procedures were standardized in 1983. We collected biological data during the winter months to monitor the nearshore distribution, abundance, and life history of the red king crab population. This is done by catching, measuring, and tagging king crab through established 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 is incorporated into a length-based population model developed to predict population estimates for the red king crab biomass in Norton Sound. A total of 832 male and 46 female red king crab were captured and sampled at 8 stations between February 13 and April 18, 2002. A total of 64 pot lifts were made for an overall CPUE of 13.0 male and 0.7 female red king crab. Carapace length measurements and shell age were taken from 832 male crab. Of the total male crab caught, 659 or 79.2% were prerecruit, 75 or 9.0% were recruit, and 98 or 11.8% postrecruit. The composition of the male catch of red king crab in the 2002 pot survey changed dramatically from the 2000 and 2001 surveys. Analysis of the 2002 winter data indicated a trend of decreased legal crab abundance and healthier recruitment in the near future.

Key Words: red king crab, Norton Sound, Nome, carapace

INTRODUCTION

Red king crab *Paralithodes camtschatica* support both commercial and subsistence harvests in the Norton Sound area. The greatest area of effort for both fisheries is concentrated in the vicinity of Nome. Commercial fisheries occur during the winter and summer months, most of the commercial catch occurs in the summer. Subsistence fisheries occur primarily in winter months and sporadically in summer months. The king crab population is concentrated near to shore from December through April, when shorefast ice allows subsistence fishers easy access. A winter king crab test-fishing project began in February of 1982. Sampling procedures were standardized in 1983. Results of prior studies were reported by Schwarz and Lean (1982, 1983, 1984), Lean and Brannian (1987), Lean (1987), Bue and Lean (1990), Knuepfer and Gebhard (1990), Brennan and Anderson (1993), Brennan (1993, 1998, 1999, 2000), Brennan and LaFlamme (1995), Rob (1996), and Rob and Fair (1997).

Shorefast and sea ice conditions constantly change during the winter months. From 1982 until 1987, test fishing stations were restricted to a single transect of shorefast ice extending $\frac{1}{2}$ to 2 miles directly offshore from the Nome Post Office. Poor ice conditions precluded any test fishing in 1988. During the 1989 and 1990 seasons, the study area was expanded 6 miles to the west of Nome, in the vicinity of gold dredging activity, and 6 miles to the east of Nome, where less subsistence activity occurs. Test fishing effort was reduced in 1991 and 1993 because poor ice condition and budget constraints. In 1992 and 1994, test fishing was not funded. Test fishing was expanded in 1996 to the vicinity of Bluff, 50 miles east of Nome. In 1997 the active ice edge was closer to shore, and sea ice conditions were quite rough because of pressure ridges. Pots were established in more shallow water than in the past, and unstable ice prevented fishing with pots in the vicinity of Bluff. In 1998, 1999, and 2000 traditional ice stations were fished. In 2001 sea ice around Nome was extremely unstable. Pots deployed in traditional areas were lost when shore ice broke off at the beginning of the project. Three pots were deployed from the ice that remained close to shore but few crab were captured in these pots.

The purpose of this study is to collect biological data during the winter months for monitoring the nearshore distribution, abundance, and life history of the red king crab population. This collection is done by catching, measuring, and tagging king crab through established stations in the sea ice offshore of Nome. The winter subsistence and commercial fisheries are monitored to evaluate the abundance available to local users. The winter project data is incorporated into a length-based population model (Zheng et al. 1998) developed to predict population estimates for the red king crab biomass in Norton Sound. The model improves the management of the red king crab fisheries by providing an annual estimate that is used to determine the guideline harvest level (GHL). Prior to the development of the length-based model, the triennial Norton Sound king crab survey was the only means of determining the crab biomass.

Objectives for the 2002 winter field season were:

1. Enumerate the catch of sublegal and legal male red king crab; determine the shell age of each age class to evaluate recruitment into legal population before the summer fishery.

2. Enumerate and describe the subsistence and commercial king crab catch accessible to winter users in the Nome area.
3. Monitor the intensity and distribution of the winter fishing effort in the Nome area.
4. Tag all male new shell red king crab with carapace length ≤ 100 mm, as part of ongoing studies to estimate the growth and movement of tagged crab recaptured in summer and winter fisheries.
5. Measure and record the size and number of female red king crab captured and estimate egg development and clutch size.
6. Monitor other life history and biological data such as disease, parasitism, and the incidence of competing species.
7. Describe the relative distribution of crab within the winter 2002 study area using catch per unit effort information.

METHODS

Eight test fishing stations were established in an area spanning from approximately 7 miles west of Nome to 5 miles east of Nome (Table 1, Figure 1) beginning February 7, 2002. All but three stations were located as close as possible to historical sites. Stations East 2, 3, and 4 were located in deeper water than usual because of ice conditions. Each station was located in water ranging from 36 feet to 70 feet deep and from approximately $\frac{1}{2}$ mile to 3 miles offshore. Travel to and from stations was by snowmachines towing sleds to carry supplies and equipment.

Station locations were established by locating the approximate historical site with a Garmin GPS (Global Positioning System) 45². A test hole was drilled using a gasoline-powered auger and water depth was checked using a weighted string. When the appropriate water depth was found, a square hole about five feet long on each side was cut in the ice using ice augers. Other tools used include ice chisels or “tuks”, axes, shovels, ice picks and long poles. Conical, four foot diameter “Japanese style” king crab pots were baited with chopped herring in two one-quart bait containers and one string of 10 whole saffron cod. Each pot was deployed and attached to a line tethered at the surface of the ice. Each hole was covered with Styrofoam and plywood to reduce refreezing of the hole. All holes were marked per regulation (5AAC 34.925). The GPS was used to record all station locations.

Once pots were deployed, each pot was checked and rebaited twice per week, (weather permitting). When pots were checked, they were brought to the surface and suspended so that all crab in the pot remained immersed in water. Crab were removed one at a time and legal and biological measurements were made to the nearest millimeter. A legal red king crab is a

² Use of vendor name does not imply endorsement.

male crab with a shell width greater than or equal to 4¾ inches, approximately 121 mm, across (legal measurement). Biological measurement is the measurement taken from the posterior margin of the right eye orbit of the carapace to the center of the posterior carapace margin. The relationship between legal measurements and biological measurements is good and suggests that minimally legal crab, as defined by the legal measurement, would theoretically have a biological measurement of 104mm in carapace length. Shell age was 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. Egg development and clutch size of female crab was noted. New shell and old shell male crab with a carapace length of 100mm or less were tagged with hog rings with spaghetti tags to estimate growth rates of these mainly sub-legal crab. Any prior injuries on all tagged crab caught were noted. Also noted were general observations on the condition of the crab. All crab were released into the same hole in which the pot was suspended in.

Casual conversation with commercial and subsistence fishers was solicited to get their impressions of the season, any general observations they had as to where the crab were, and how abundant they appeared. Subsistence permits were given out to fishers for recording their catches. Commercial fishers must report and turn in fish tickets to the Nome ADF&G office weekly. In this way the commercial harvest were tracked inseason.

Catch per unit effort (CPUE) was calculated as the catch of crab per pot lift. The relative distribution of crab within the study area was plotted on a map, using catch per unit effort statistics. CPUE is used to compare the relative abundance between seasons and areas that are fished.

Stations were deployed beginning on February 7, 2002. Ice conditions in the Nome area were fair in regard to traveling offshore. Pot locations, distances from Nome, and distance offshore were computed and recorded using the GPS (Table 1).

RESULTS

A total of 832 male and 46 female red king crab were captured and sampled at 8 stations between February 13 and April 18, 2002. A total of 64 pot lifts were made for an overall CPUE of 13.0 male and 0.7 female red king crab (Table 2). The CPUE for all crab captured at each station is presented in Table 2 and Figure 2. Daily catch information is presented in Table 3. A total of 607 male crab were tagged. Other species captured include Arctic Lyre crab *Hyas coarctatus*, Soft crab *Hapalogaster grebnitzkii*, flatbottom sea star *Asterias*, sea urchins of the genus *Strongylocentrotus*, shrimp *Pandalus* (sp.), Saffron Cod *Eleginus gracilis*, unidentified sculpins and jellyfish.

Stations West 3 and West 4 were set in traditional sites on February 7. These stations were lost on February 12 when shore ice broke and moved offshore. These stations were not checked before being lost. Stations Nome 2 and Nome 3 and East 1 were lost when sea ice broke off on February 27.

Carapace length measurements and shell age were taken from 832 male crab. Of the total male crab caught, 659 or 79.2% were prerecruit, 75 or 9.0% were recruit, and 98 or 11.8% postrecruit (Table 4). Prerecruit threes (sublegal crab with carapace length <76mm) comprised 10.7 % of the total male crab catch. Prerecruit twos (sublegal crab with carapace length 76 to 89 mm) accounted for 43.1% of the total male crab catch. Prerecruit ones (sublegal crab with carapace length >89 mm) comprised 25.5% of the total male crab catch (Table 5). The average length of all male king crab captured was 92 mm (Table 5). The length distribution of all male crab captured during the winter pot study ranged from 52 mm to 147 mm (Table 5, Figure 3).

Legal male crab accounted for 18.3% of the total male crab catch (Table 4). The average carapace length of the legal crab caught was 117 mm (Table 6). Legal new shell male crab had an average carapace length of 116 mm. Legal old shell male crab had an average carapace length of 119 mm. Recruit crab (legal, new shell male crab with carapace length \leq 115 mm) made up 43.4% of the legal male catch and postrecruit crab (legal new shell male crab with carapace length \geq 116 mm and all legal old shell males) made up 56.6 % (Table 6). Sublegal new shell male crab made up 96.7% of the sublegal crab catch at 79.2% (Table 4, Table 7). The average carapace length of all sublegal male crab caught was 85 mm.

A total of 46 female crab were caught, 2 juveniles (carapace length < 72mm, no eggs) and 44 adults. The average carapace length was 67 mm for juvenile female crab, and 79 mm for adult female crab (Table 8). Sixteen adult female crab had egg clutches 90-100% full, 23 adults had egg clutches 90 - 100% full, one adult female had egg clutch 30-59% full, and 4 adult female crab had no egg clutches. All egg clutches had purple or dark brown eggs. This indicates eggs had been extruded and fertilized within the last 4 months.

Subsistence fishing effort was concentrated in front of Nome within five miles east and west. The subsistence effort of 114 permits was just below the average number of permits issued since 1977 (118), but greater than the previous six winter seasons (Table 9). This increase was primarily because of the good sea ice condition. A regulation was put into place in 1999 to ensure winter subsistence crab fishers had use of the prime fishing area. Commercial winter crab fishers are now excluded from a section of sea ice lying between the mouth of the Nome River and Dredge #6 west of Nome, and extending due south. Only subsistence and personal use fishers are allowed to operate in this area, but not confined to the area. Subsistence crab permits indicate 3,287 crab were harvested. Although permits were due into the Nome ADF&G office by May 31. Ninety-nine of the 114 permits were returned by July 15, 2002.

Commercial fishing effort extended about 20 miles west of town and east toward Cape Nome. Eleven fishers participated in the 2002 winter commercial fishery. This is the largest group of commercial winter fishers since 1995 (Table 9). Ice conditions were somewhat stable throughout the season. Fish ticket results show commercial fishers harvested 2,591 crab. The harvest was slightly above the average harvested since 1977.

Appendix A lists individual stations and catches by date. Stations Nome 3 and Nome 2 had the highest crab catches of all stations (17.8 and 17.0 crab per pot lift), but were lost on February 27 when the ice broke off in front of Nome. Station West 5 had the poorest CPUE

of all stations (6.3 crab per pot lift). No incidence of parasitism or disease was observed in the crab captured during the study.

DISCUSSION

The red king crab winter pot survey has been conducted in the Nome area during 17 of the past 20 years since sampling procedures were standardized in 1983. The winter survey has provided opportunities to collect and interpret valuable information on the crab population immediately available to the residents of Nome during the winter subsistence and commercial fisheries. Winter project data are incorporated into a length-based population model developed to predict biomass for the red king crab population in Norton Sound. The model is especially useful in years no summer trawl survey estimate is done. It improves upon the trawl estimate because it incorporates all sources of data taking into account historical abundance trends based on length.

The sea ice was somewhat stable in the historical study area throughout the 2002 season. Sea ice broke off near the beginning of the project and five stations were lost. Some stations were deployed in areas outside of the traditional study area where sea ice was more stable. Weather conditions were only severe enough to prevent travel a few times throughout the season. There were no large pressure ridges that have made travel difficult in some years. Travel conditions along the beach line were good all season.

The 2002 winter pot survey had a catch of 832 male king crab compared to an average of 964 male crab in the winter surveys 1983 through 2001 (Table 10). Male CPUE (13 crab/pot) was the highest CPUE for the winter surveys since 1991 (Table 10, Figure 3). The total number of female crab caught, 46, was above the average of 39 female crab. Female CPUE was the highest (0.7) since 1986. Subsistence and commercial fishers indicated a good abundance of crab throughout the winter fishing season.

The composition of the male catch of red king crab in the 2002 pot survey changed dramatically from the 2000 and 2001 surveys (Table 11). The 2002 sublegal catch proportion was 79.2% of the total male catch, and was well above the average of 50.1% (Table 11). Prerecruit threes and twos combined made up 53.8%. This is well above the average of 21.6% prerecruit threes and twos since 1983. These juvenile crab are two and three years away from molting into the legal population. Prerecruit ones made up 25.5% of all male crab sampled. This was slightly below the 1983-2001 average of 28.6%. Prerecruit one crab will molt into the legal biomass in fall of 2002. The prerecruit segment of the crab captured during the winter study indicates at least 3 years of good recruitment beginning in 2003.

The legal crab catch proportion of 20.8% is the second lowest since 1983 (Table 11). This compares to the average of 49.9% for the years 1983 to 1999. Recruit crab made up only 9.0% of all male crab captured. This is the second lowest recruitment seen in the pot survey since it was begun in 1983. Postrecruit crab made up 11.8% of all male crab captured. Subsistence and commercial fishers in the Nome area also reported this trend of high numbers of prerecruit crab and lower numbers of recruit and postrecruit age crab. Legal crab captured

during the 2002 winter survey had the highest average length (117 mm) since the 1997 study (Table 12).

Eight tags were turned in by winter subsistence and commercial crab fishers (Table 13). All but one of the tags returned were initially deployed during the 2002 project. Tag NZ04253 was deployed on March 27, 2001, and was recovered March 7, 2002. The crab had molted in the fall of 2001 and grown 13 mm.

The Norton Sound red king crab length based population model developed by Zheng, et al. (1998) incorporates trawl surveys, winter and summer pot studies, and summer and winter fisheries data from 1976 to present. In this way, 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 fisheries. The length frequency data from the winter crab project were incorporated into the computer model to predict the Norton Sound 2002 summer crab biomass. The expected legal male crab abundance is 3.1 million pounds, therefore the 2002 summer commercial crab fishery will be managed for a guideline harvest goal of 240,000 pounds. This equates to an 8% exploitation rate in accordance with the harvest strategy set by the Board of Fisheries.

The 2002 winter data indicates a trend of decreased legal crab abundance for the 2002 summer season and healthier recruitment in the near future. The 2002 king crab trawl survey scheduled for late July will give the department a better snapshot of the overall structure of the population.

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Table 1. Location of test fishing stations for the winter red king crab pot survey, Norton Sound, 2002.

Station	Longitude (degrees)	Latitude (degrees)	Depth (ft)	Historical Station
Nome 2	64 29 04	165 25 37	45	yes
Nome 3	64 28 50	165 25 51	55	yes
West 5	64 31 20	165 46 10	36	yes
West 6	64 31 38	165 52 42	38	yes
East 1	64 28 30	165 21 14	40	no
East 2	64 26 05	165 15 37	72	no
East 3	64 25 13	165 10 43	70	no
East 4	64 24 44	165 10 10	73	no
East 5	64 27 46	165 14 37	41	yes

Table 2. Number of pot lifts and catch, by station, for all stations in the winter red king crab pot survey, Norton Sound, 2002.

Station	Number of Pot Lifts	Number of Male Red King Crab Caught	CPUE for Male Red King Crab	Number of Female Red King Crab Caught	CPUE for Female Red King Crab
Nome 2	5	85	17.0	2	0.4
Nome 3	4	71	17.8	4	1.0
East 1	3	36	12.0	1	0.3
East 2	14	165	11.8	13	0.9
East 3	12	197	16.4	13	1.1
East 4	9	76	8.4	9	1.0
East 5	8	134	16.8	3	0.4
West 5	6	38	6.3	0	0.0
West 6	3	30	10.0	1	0.3
Total	64	832	13.0	46	0.7

Table 3. Daily catch of red king crab for all stations in the winter pot survey, Norton Sound, 2002.

Date Checked	Stations	Number of			Male CPUE	Female CPUE
		Pots Lifted	Males	Females		
13-Feb	N2, N3	2	50	2	25.0	1.0
15-Feb	N2, N3	2	28	0	14.0	0.0
19-Feb	N2, E1	2	42	2	21.0	1.0
21-Feb	N2, N3, E1	3	18	2	6.0	0.7
25-Feb	E1	1	16	0	16.0	0.0
26-Feb	N2, N3, E2	3	65	3	21.7	1.0
28-Feb	E2	1	4	0	4.0	0.0
4-Mar	E2, E3	2	22	3	11.0	1.5
6-Mar	E2, E3, E4	3	23	2	7.7	0.7
11-Mar	E2, E3, E4	3	15	0	5.0	0.0
13-Mar	E2, E3, E4	3	3	0	1.0	0.0
18-Mar	E2, E5	2	43	1	21.5	0.5
19-Mar	E3, E4	2	106	11	53.0	5.5
22-Mar	E2, E3, E4, E5	4	27	1	6.8	0.3
26-Mar	E2, E3, E5, W5	4	65	4	16.3	1.0
29-Mar	E2, E3, E5, W5	4	62	6	15.5	1.5
3-Apr	E2, E3, E4, E5, W5	5	109	5	21.8	1.0
5-Apr	E2, E3, E4, E5, W5	5	12	0	2.4	0.0
8-Apr	E2, E3, E4, E5, W5, W6	6	45	1	7.5	0.2
11-Apr	E2, E3, E5, W5, W6	5	69	3	13.8	0.6
18-Apr	W5, W6	2	8	0	4.0	0.0
		64	832	46	13.0	0.7

Table 4. Summary of male red king crab data from the winter pot survey, Norton Sound, 2002.

	Number	Percent	Mean Length (mm)
Sublegal Male Crab			85
New Shell	637	76.6%	
Old Shell	22	2.6%	
Legal Male Crab			117
New Shell	152	18.3%	
Old Shell	21	2.5%	
Totals	832	100%	
Prerecruit Males	659	79.2%	
Recruit Males	75	9.0%	
Postrecruit Males	98	11.8%	
Total	832	100.0%	

Prerecruits are sublegale crab with a carapace length ≤ 115 mm.

Recruit crab are new shell, legal crab with a carapace length ≤ 115 mm.

Postrecruit crab are legal crab with a carapace length ≥ 116 mm.

Table 5. Length frequency distribution of all male red king crab captured during the winter pot survey, Norton Sound, 2002.

Carapace Length (mm)	Prerecruits		Recruits		Postrecruits		Totals		%	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
52	1	0.1%					1	0.1%		
58	0	0.0%					0	0.0%		
59	1	0.1%					1	0.1%		
60	1	0.1%					1	0.1%		
61	1	0.1%					1	0.1%		
62	1	0.1%					1	0.1%		
63	0	0.0%					0	0.0%		
64	1	0.1%					1	0.1%		
65	5	0.6%					5	0.6%		
66	4	0.5%					4	0.5%		
67	1	0.1%					1	0.1%		
68	1	0.1%					1	0.1%		
69	5	0.6%					5	0.6%		
70	7	0.8%					7	0.8%		
71	6	0.7%					6	0.7%		
72	10	1.2%					10	1.2%		
73	10	1.2%					10	1.2%		
74	15	1.8%					15	1.8%		
75	19	2.3%					19	2.3%		
76	18	2.2%					18	2.2%		
77	33	4.0%					33	4.0%		
78	23	2.8%					23	2.8%		
79	23	2.8%					23	2.8%		
80	29	3.5%					29	3.5%		
81	24	2.9%					24	2.9%		
82	36	4.3%					36	4.3%		
83	27	3.2%					27	3.2%		
84	24	2.9%					24	2.9%		
85	34	4.1%					34	4.1%		
86	23	2.8%					23	2.8%		
87	17	2.0%					17	2.0%		
88	22	2.6%					22	2.6%		
89	25	3.0%					25	3.0%		
90	23	2.8%					23	2.8%		
91	17	2.0%					17	2.0%		
92	20	2.4%					20	2.4%		
93	17	2.0%					17	2.0%		
94	16	1.9%					16	1.9%		
95	20	2.4%					20	2.4%		
96	15	1.8%					15	1.8%		
97	14	1.7%					14	1.7%		
98	18	2.2%					18	2.2%		
99	16	1.9%					16	1.9%		
100	7	0.8%	0	0.0%			7	0.8%		
101	11	1.3%	1	0.1%			12	1.4%		
102	9	1.1%	5	0.6%	0	0.0%	14	1.7%		
103	6	0.7%	5	0.6%	0	0.0%	11	1.3%		
104	3	0.4%	7	0.8%	0	0.0%	10	1.2%		
105	0	0.0%	7	0.8%	1	0.1%	8	1.0%		
106	0	0.0%	4	0.5%	0	0.0%	4	0.5%		
107	0	0.0%	7	0.8%	0	0.0%	7	0.8%		
108	0	0.0%	4	0.5%	0	0.0%	4	0.5%		
109	0	0.0%	3	0.4%	0	0.0%	3	0.4%		
110	0	0.0%	4	0.5%	1	0.1%	5	0.6%		
111			4	0.5%	0	0.0%	4	0.5%		
112			5	0.6%	2	0.2%	7	0.8%		
113			5	0.6%	0	0.0%	5	0.6%		
114			4	0.5%	1	0.1%	5	0.6%		
115			10	1.2%	1	0.1%	11	1.3%		
116					5	0.6%	5	0.6%		
117					4	0.5%	4	0.5%		
118					7	0.8%	7	0.8%		
119					5	0.6%	5	0.6%		
120					7	0.8%	7	0.8%		
Totals	659	79.2%	75	9.0%	(continued)					

Postrecruits (continued)				
Length (mm)	Number	Percent	Totals	%
121	9	1.1%	9	1.1%
122	6	0.7%	6	0.7%
123	5	0.6%	5	0.6%
124	6	0.7%	6	0.7%
125	5	0.6%	5	0.6%
126	5	0.6%	5	0.6%
127	8	1.0%	8	1.0%
128	6	0.7%	6	0.7%
129	1	0.1%	1	0.1%
130	1	0.1%	1	0.1%
131	1	0.1%	1	0.1%
132	3	0.4%	3	0.4%
133	0	0.0%	0	0.0%
134	2	0.2%	2	0.2%
135	2	0.2%	2	0.2%
136	3	0.4%	3	0.4%
137	0	0.0%	0	0.0%
138	0	0.0%	0	0.0%
139	0	0.0%	0	0.0%
140	0	0.0%	0	0.0%
141	0	0.0%	0	0.0%
142	0	0.0%	0	0.0%
143	0	0.0%	0	0.0%
144	0	0.0%	0	0.0%
145	0	0.0%	0	0.0%
146	0	0.0%	0	0.0%
147	1	0.1%	1	0.1%
148	0	0.0%	0	0.0%
149	0	0.0%	0	0.0%
150	0	0.0%	0	0.0%
151	0	0.0%	0	0.0%
152	0	0.0%	0	0.0%
153	0	0.0%	0	0.0%
154	0	0.0%	0	0.0%
155	0	0.0%	0	0.0%
156	0	0.0%	0	0.0%
157	0	0.0%	0	0.0%
158	0	0.0%	0	0.0%
159	0	0.0%	0	0.0%
160	0	0.0%	0	0.0%
Totals	98	11.8%	832	100.0%

Number of Prerecruit threes (< 76mm)	89	10.7%
Number of Prerecruit twos (76 to 89 mm)	358	43.0%
Number of prerecruit ones (> 89mm)	212	25.5%
		79.2%
Average Length of all male crab captured =		92 mm

Table 6. Length frequencies by shell age of all legal male red king crab captured in the winter pot survey, Norton Sound, 2002

Carapace Length (mm)	Legal New Shell Males		Legal Old Shell Males		Total Legal Males	
	Number	Percent	Number	Percent	Number	Percent
100	0	0.0%	0	0.0%	0	0.0%
101	1	0.6%	0	0.0%	1	0.6%
102	5	2.9%	0	0.0%	5	2.9%
103	5	2.9%	0	0.0%	5	2.9%
104	7	4.0%	0	0.0%	7	4.0%
105	7	4.0%	1	0.6%	8	4.6%
106	4	2.3%	0	0.0%	4	2.3%
107	7	4.0%	0	0.0%	7	4.0%
108	4	2.3%	0	0.0%	4	2.3%
109	3	1.7%	0	0.0%	3	1.7%
110	4	2.3%	1	0.6%	5	2.9%
111	4	2.3%	0	0.0%	4	2.3%
112	5	2.9%	2	1.2%	7	4.0%
113	5	2.9%	0	0.0%	5	2.9%
114	4	2.3%	1	0.6%	5	2.9%
115	10	5.8%	1	0.6%	11	6.4%
116	3	1.7%	2	1.2%	5	2.9%
117	3	1.7%	1	0.6%	4	2.3%
118	7	4.0%	0	0.0%	7	4.0%
119	3	1.7%	2	1.2%	5	2.9%
120	6	3.5%	1	0.6%	7	4.0%
121	6	3.5%	3	1.7%	9	5.2%
122	5	2.9%	1	0.6%	6	3.5%
123	5	2.9%	0	0.0%	5	2.9%
124	6	3.5%	0	0.0%	6	3.5%
125	4	2.3%	1	0.6%	5	2.9%
126	3	1.7%	2	1.2%	5	2.9%
127	8	4.6%	0	0.0%	8	4.6%
128	6	3.5%	0	0.0%	6	3.5%
129	1	0.6%	0	0.0%	1	0.6%
130	1	0.6%	0	0.0%	1	0.6%
131	0	0.0%	1	0.6%	1	0.6%
132	3	1.7%	0	0.0%	3	1.7%
133	0	0.0%	0	0.0%	0	0.0%
134	2	1.2%	0	0.0%	2	1.2%
135	2	1.2%	0	0.0%	2	1.2%
136	2	1.2%	1	0.6%	3	1.7%
137	0	0.0%	0	0.0%	0	0.0%
138	0	0.0%	0	0.0%	0	0.0%
139	0	0.0%	0	0.0%	0	0.0%
140	0	0.0%	0	0.0%	0	0.0%
141	0	0.0%	0	0.0%	0	0.0%
142	0	0.0%	0	0.0%	0	0.0%
143	0	0.0%	0	0.0%	0	0.0%
144	0	0.0%	0	0.0%	0	0.0%
145	0	0.0%	0	0.0%	0	0.0%
146	0	0.0%	0	0.0%	0	0.0%
147	1	0.6%	0	0.0%	1	0.6%
148	0	0.0%	0	0.0%	0	0.0%
149	0	0.0%	0	0.0%	0	0.0%
150	0	0.0%	0	0.0%	0	0.0%
151	0	0.0%	0	0.0%	0	0.0%
152	0	0.0%	0	0.0%	0	0.0%
153	0	0.0%	0	0.0%	0	0.0%
154	0	0.0%	0	0.0%	0	0.0%
155	0	0.0%	0	0.0%	0	0.0%
156	0	0.0%	0	0.0%	0	0.0%
157	0	0.0%	0	0.0%	0	0.0%
158	0	0.0%	0	0.0%	0	0.0%
159	0	0.0%	0	0.0%	0	0.0%
160	0	0.0%	0	0.0%	0	0.0%
Totals	152	87.9%	21	12.1%	173	100.0%
Average Lengths	116		119		117	
Total Recruits=			75	43.4%		
Total Postrecruits=			98	56.6%		

Table 7. Length frequencies by shell age of all sublegal male red king crab captured in the winter pot survey, Norton Sound, 2002.

Carapace Length (mm)	Sublegal New Shell Males				Sublegal Old Shell Males				Total Sublegal Males	
	Threes (<76 mm)	Twos (76 to 89 mm)	Ones (>89 mm)	%	Threes (<76 mm)	Twos (76 to 89 mm)	Ones (>89 mm)	%		%
52	1			0.2%	0			0.0%	1	0.2%
53	0			0.0%	0			0.0%	0	0.0%
54	0			0.0%	0			0.0%	0	0.0%
55	0			0.0%	0			0.0%	0	0.0%
56	0			0.0%	0			0.0%	0	0.0%
57	0			0.0%	0			0.0%	0	0.0%
58	0			0.0%	0			0.0%	0	0.0%
59	1			0.2%	0			0.0%	1	0.2%
60	1			0.2%	0			0.0%	1	0.2%
61	1			0.2%	0			0.0%	1	0.2%
62	1			0.2%	0			0.0%	1	0.2%
63	0			0.0%	0			0.0%	0	0.0%
64	1			0.2%	0			0.0%	1	0.2%
65	5			0.8%	0			0.0%	5	0.8%
66	4			0.6%	0			0.0%	4	0.6%
67	1			0.2%	0			0.0%	1	0.2%
68	1			0.2%	0			0.0%	1	0.2%
69	3			0.5%	2			0.3%	5	0.8%
70	5			0.8%	2			0.3%	7	1.1%
71	6			0.9%	0			0.0%	6	0.9%
72	9			1.4%	1			0.2%	10	1.5%
73	10			1.5%	0			0.0%	10	1.5%
74	15			2.3%	0			0.0%	15	2.3%
75	20			3.0%	0			0.0%	20	3.0%
76		17		2.6%		1		0.2%	18	2.7%
77		32		4.8%		1		0.2%	33	5.0%
78		23		3.5%		0		0.0%	23	3.5%
79		23		3.5%		0		0.0%	23	3.5%
80		29		4.4%		0		0.0%	29	4.4%
81		23		3.5%		1		0.2%	24	3.6%
82		35		5.3%		1		0.2%	36	5.5%
83		27		4.1%		0		0.0%	27	4.1%
84		23		3.5%		1		0.2%	24	3.6%
85		33		5.0%		1		0.2%	34	5.2%
86		22		3.3%		1		0.2%	23	3.5%
87		17		2.6%		0		0.0%	17	2.6%
88		22		3.3%		0		0.0%	22	3.3%
89		25		3.8%		0		0.0%	25	3.8%
90			23	3.5%			0	0.0%	23	3.5%
91			17	2.6%			0	0.0%	17	2.6%
92			20	3.0%			0	0.0%	20	3.0%
93			13	2.0%			4	0.6%	17	2.6%
94			16	2.4%			0	0.0%	16	2.4%
95			17	2.6%			3	0.5%	20	3.0%
96			15	2.3%			0	0.0%	15	2.3%
97			14	2.1%			0	0.0%	14	2.1%
98			18	2.7%			0	0.0%	18	2.7%
99			15	2.3%			1	0.2%	16	2.4%
100			5	0.8%			2	0.3%	7	1.1%
101			11	1.7%			0	0.0%	11	1.7%
102			9	1.4%			0	0.0%	9	1.4%
103			6	0.9%			0	0.0%	6	0.9%
104			3	0.5%			0	0.0%	3	0.5%
105			0	0.0%			0	0.0%	0	0.0%
106			0	0.0%			0	0.0%	0	0.0%
107			0	0.0%			0	0.0%	0	0.0%
108			0	0.0%			0	0.0%	0	0.0%
109			0	0.0%			0	0.0%	0	0.0%
110			0	0.0%			0	0.0%	0	0.0%
Totals	85	351	202	96.7%	5	7	10	3.3%	660	100.0%

Average Length
(mm) 85

Average Length of all sublegal new shell males = 85 mm

Average Length of all sublegal old shell males = 85

Table 8. Length frequencies and percent ovigerity of all female red king crab captured in the winter pot survey, Norton Sound, 2002.

Carapace Length (mm)	Percent Ovigerity					Juvenile	Total
	Adult						
	Full 90 - 100%	High 60 - 89%	Medium 30 - 59%	Low 1 - 29%	None 0%		
30	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0
62	0	0	0	0	0	1	1
63	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0
70	0	1	0	0	0	0	1
71	0	1	0	0	0	1	2
72	0	3	0	0	0	0	3
73	2	0	1	0	1	0	4
74	0	1	0	0	0	0	1
75	2	4	0	0	1	0	7
76	1	0	0	0	0	0	1
77	2	4	0	0	1	0	7
78	1	4	0	0	0	0	5
79	3	1	0	0	1	0	5
80	3	1	0	0	0	0	4
81	1	1	0	0	0	0	2
82	0	0	0	0	0	0	0
83	0	1	0	0	0	0	1
84	0	0	0	0	0	0	0
85	0	0	0	0	0	0	0
86	0	1	0	0	0	0	1
87	0	0	0	0	0	0	0
88	1	0	0	0	0	0	1
89	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0
	16	23	1	0	4	2	46

Total number of juvenile females (<72mm) = 2
 Average length of juvenile females (<72mm) = 67 mm
 Average length of adult females (≥72mm) = 79 mm

Table9. Winter commercial and subsistence red king crab harvests, Norton Sound, Eastern Bering Sea, 1978 - 2001.

Year ^a	Commercial		Subsistence						
	Fishers	# Crab Harvested	Winter ^b	Permits Issued	Permits Returned	Permits Fished	Total Crab Caught ^c	Total Crab Harvested ^d	Average/ permit fished
1978	37	9,625	1977-78	290	206	149	^e	12,506	84
1979	1	221	1978-79	48	43	38	^e	224	6
1980	1	22	1979-80	22	14	9	^e	213	24
1981	0	0	1980-81	51	39	23	^e	360	16
1982	1	17	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	167	71	57	5,918	4,059	71
1996	9	1,778	1995-96	84	44	35	2,936	1,679	48
1997	2	83	1996-97	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	1999-2000	98	64	52	9,816	5,723	107
2001	3	1,098	2000-2001	50	26	12	366	256	21
2002	11	2,591	2001-2002	114	61	45	5,119	2,177	48
Avg 1978	10	2,395	Avg 1984-2000	118	90	70		5,474	68

^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 occurs during months of two calendar years (as early as December, through May).

^c The Number of crab actually caught; some may have been returned.

^d The number of crab harvested is the number of crab caught and kept.

Table 10. Total catch of red king crab during the winter pot surveys, Norton Sound, 1983 - 2002.

Year	# of Pot Lifts	# of Males Captured	Male CPUE	# of Females Captured	Female CPUE
1983	107	2,586	24.2	236	2.2
1984	70	1,677	24.0	78	1.1
1985	31	760	24.5	14	0.5
1986	31	594	19.2	74	2.4
1987	26	151	5.8	6	0.2
1988 ^a					
1989	42	548	13.0	9	0.2
1990	99	2,076	21.0	18	0.2
1991	56	1,283	22.9	8	0.1
1992 ^b					
1993	33	181	5.5	1	0.0
1994 ^b					
1995	126	776	6.2	10	0.1
1996	159	1,582	9.9	26	0.2
1997	140	399	2.9	60	0.4
1998	84	882	10.9	38	0.5
1999	122	1,308	10.7	15	0.1
2000	93	575	6.2	22	0.2
2001 ^c	14	44	3.1	1	0.1
2002	64	832	13.0	46	0.7
Average 1983-2001	77	964	13.1	39	0.5

^a No data collected in 1988 because of unstable ice conditions.

^b The project was not funded.

^c Unstable ice conditions.

Table 11. Percent prerecruits, recruits, and postrecruits in the catch of red king crab during the winter pot surveys, 1983 - 2002, Norton Sound.

Year	Sublegal Prerecruits			Subtotal	Legal			Total
	Threes ^{ab}	Twos ^{bc}	Ones ^d		Recruits	Postrecruits	Subtotal	
1983		26.2%	38.0%	64.2%	26.1%	9.6%	35.7%	100%
1984		34.7%	31.0%	65.6%	18.6%	15.8%	34.4%	100%
1985		24.7%	45.1%	69.8%	20.4%	9.8%	30.2%	100%
1986		25.7%	35.0%	60.7%	21.7%	17.7%	39.3%	100%
1987		12.5%	31.3%	43.8%	10.4%	45.8%	56.3%	100%
1988 ^e								
1989		26.8%	15.4%	42.2%	27.3%	30.5%	57.8%	100%
1990		15.9%	33.5%	49.4%	24.7%	26.0%	50.6%	100%
1991	0.2%	4.8%	30.6%	35.6%	33.5%	30.9%	64.4%	100%
1992 ^f								
1993	0.0%	3.3%	8.8%	12.2%	17.1%	70.7%	87.9%	100%
1994 ^f								
1995 ^g	2.1%	9.8%	11.4%	23.3%	32.3%	44.4%	76.7%	100%
1996	9.2%	22.1%	33.1%	64.3%	10.1%	25.5%	35.7%	100%
1997	11.0%	32.3%	20.8%	64.2%	14.3%	21.6%	35.8%	100%
1998	0.8%	36.6%	44.3%	81.7%	8.7%	9.5%	18.3%	100%
1999	0.7%	6.5%	42.4%	49.6%	39.0%	11.3%	50.3%	100%
2000	3.1%	13.2%	20.3%	36.5%	38.6%	24.9%	63.5%	100%
2001	4.5%	18.2%	15.9%	38.6%	13.6%	47.7%	61.3%	100%
2002	10.7%	43.1%	25.5%	79.3%	9.0%	11.8%	20.8%	100%
Averages 1983 2001	Average of threes and twos combined =	21.6%	28.6%	50.1%	22.3%	27.6%	49.9%	

^a Prerecruit threes are all sublegal males with carapace length < 76 mm.

^b Prior to 1991 carapace lengths were consolidated in pairs so that prerecruit threes and twos cannot be accurately separated.

^c Prerecruit twos are all sublegal males with carapace length from 76 through 89 mm.

^d Prerecruit ones are all sublegal males with carapace length > 89 mm.

^e No data collected due to unstable ice conditions during the winter of 1988.

^f No data collected due to lack of funds.

^g Includes catch from 12 testfishing stations and from one commercial fisherman catch on 5 April.

Table 12. Average length frequencies of legal male and female red king crab captured during the winter pot surveys, Norton Sound, 1983 - 2002.

Year	Average Carapace Length (mm)	
	Legal Male	Female
1983	c	c
1984	c	c
1985	c	79
1986	c	70
1987	c	71
1988	a	
1989	c	79
1990	115	83
1991	114	75
1992	b	
1993	118	93 ^d
1994	b	
1995	117	77
1996	117	71
1997	118	74
1998	113	76
1999	110	72
2000	113	72
2001	106	75 ^d
2002	92	77

^a No data collected in 1988 due to unstable ice conditions.

^b No data collected in 1992 and 1994 due to a lack of funds.

^c Information not available.

^d Only one female crab captured during 1993 and 2001.

Table 13. Red king crab tag information recovered during the 2002 Norton Sound winter commercial and subsistence crab fisheries.

Tag Number	Capture Date	Stat. Area of Capture	Carapace Length (mm)	Shell Age	Tagging Date	Tagging Location ^b	Carapace Length (mm)	Growth (mm) ^c	No. of Molts ^a	Skip Molts	Average Growth per Molt (mm)
NZ 04253	7-Mar-02	656402	106	new	27-Mar-01	W4	93	13	1	0	13.0
NZ 00031	3-Apr-02	656402	88	new	26-Mar-02	E5	88	0	0	0	
NZ 00192	12-Apr-02	656403	90	new	3-Apr-02	W5	90	0	0	0	
NZ 00026	29-Apr-02	656403	84	new	26-Mar-02	E3	84	0	0	0	
NZ 00103	13-May-02	656403	x	new	3-Apr-02	E3	99	x	x	x	
NZ 00060	10-May-02	656403	96	new	29-Mar-02	W5	98	-2	0	0	
NZ 00094	19-May-02	656430	98	new	29-Mar-02	W5	98	0	0	0	
NZ 04255	24-May-02	656403	94	new	13-Feb-02	N2	93	1	0	0	

Average Growth 13.0

x = missing data

^a Crab growth of 12 mm (+/- 5mm) per year is thought to be the average growth in one molting period.

^b E3 = 7.9 miles east of Nome.

^b E5 = 5 miles east of Nome.

^b N2 = 0.85 miles south of Nome.

^b N3 = 1.34 miles south of Nome.

^b W2 = 6.78 miles west of Nome

^b W3 = 2.8 miles west of Nome

^b W4 = 2.8 miles west of Nome.

^b W5 = 4 miles west of Nome.

^c Growth of + or - 5 mm are considered errors in measurement.

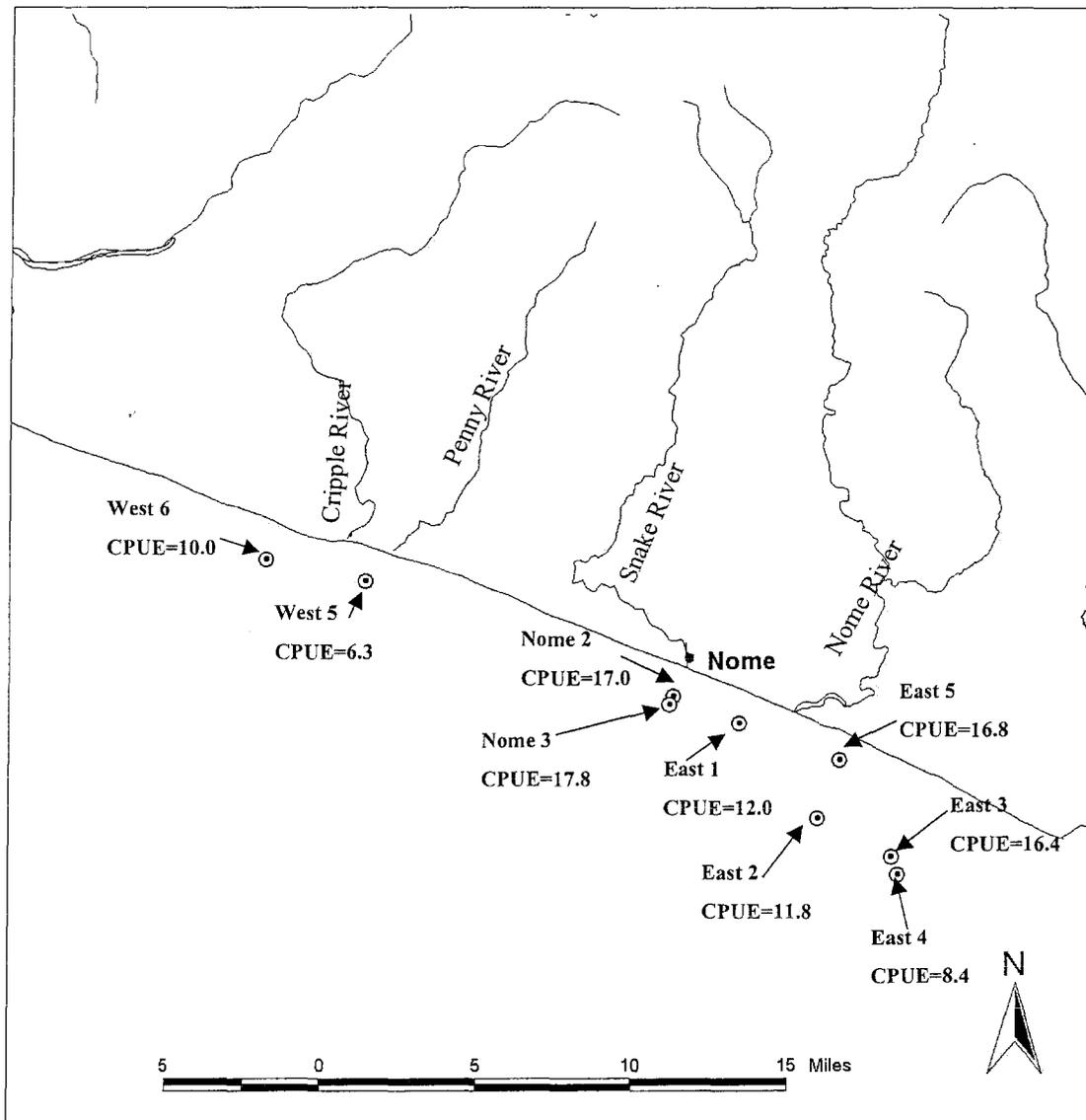


Figure 1. Area location map and CPUE for the red king crab winter pot survey, Norton Sound, 2002.

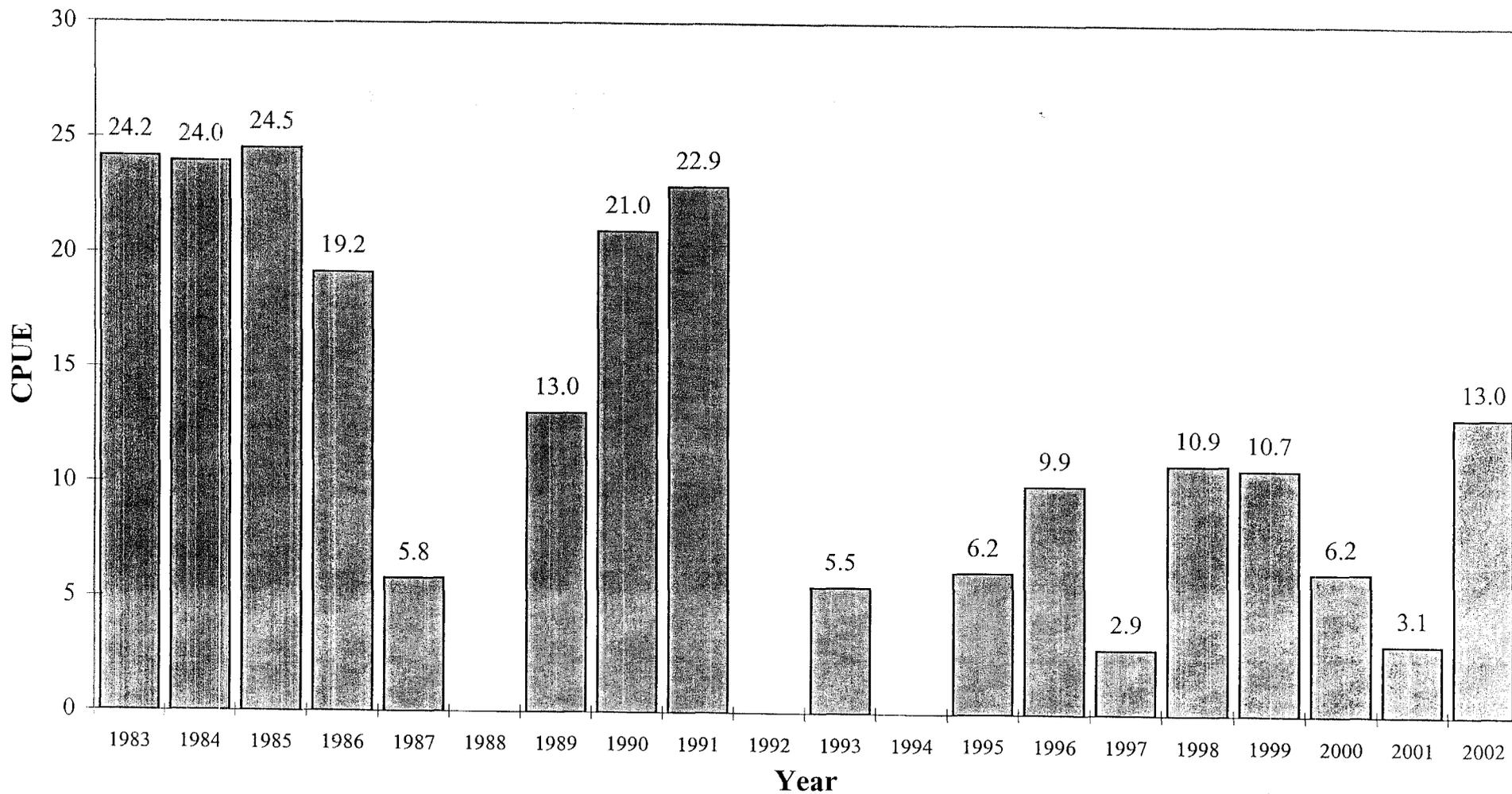


Figure 2. Annual catch per unit effort (CPUE) for male red king crab in the winter pot survey, Norton Sound, 1983 - 2001. There were no winter pot surveys in 1988, 1992 and 1994.

Norton Sound Male King Crab Winter 2002

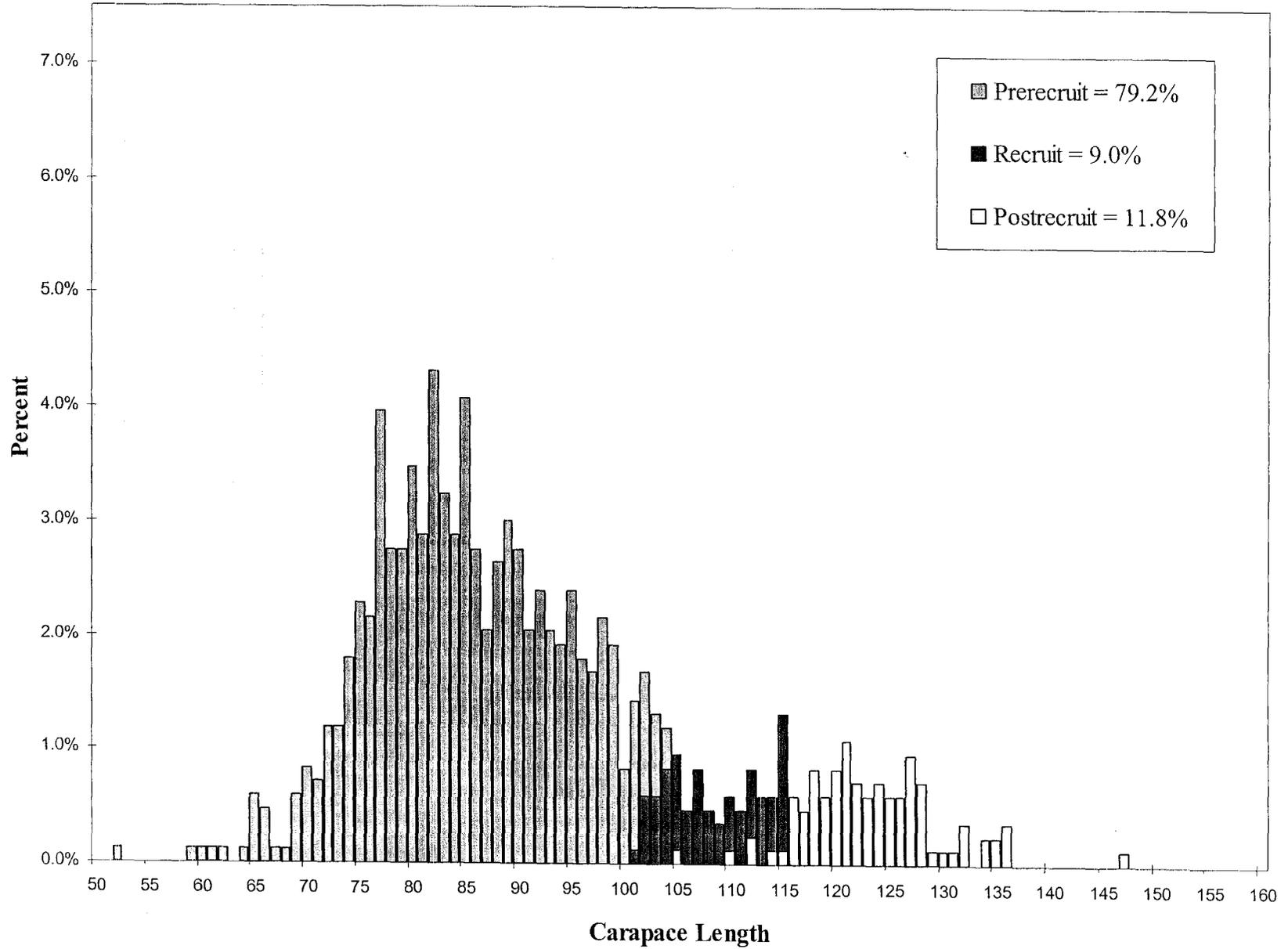


Figure3. Length frequency distribution of all male red king crab captured during the winter pot survey, Norton Sound, 2002.

Appendix A. Catch by station for the 2002 winter crab project. (page 1 of 3)

Station E1

2002 Date	Soak time (days)	Daily count of males captured	Cumulative count of males captured	Daily count of females captured	Cumulative count of females captured
19-Feb	5	20	20	1	1
21-Feb	2	0	20	0	1
25-Feb	4	16	36	0	1

Avg. male catch per pot lift = 12.0

Station E2

2002 Date	Soak time (days)	Daily count of males captured	Cumulative count of males captured	Daily count of females captured	Cumulative count of females captured
26-Feb	6	27	27	2	2
28-Feb	2	4	31	0	2
4-Mar	4	22	53	3	5
6-Mar	2	0	53	0	5
11-Mar	5	10	63	0	5
13-Mar	2	1	64	0	5
18-Mar	5	21	85	0	5
22-Mar	4	4	89	0	5
26-Mar	4	0	89	0	5
28-Mar	2	9	98	3	8
3-Apr	6	29	127	2	10
5-Apr	2	2	129	0	10
8-Apr	3	12	141	0	10
11-Apr	3	24	165	3	13

Avg. male catch per pot lift = 11.8

Station E3

2002 Date	Soak time (days)	Daily count of males captured	Cumulative count of males captured	Daily count of females captured	Cumulative count of females captured
4-Mar	3	0	0	0	0
6-Mar	2	10	10	1	1
11-Mar	5	5	15	0	1
13-Mar	2	1	16	0	1
19-Mar	6	47	63	3	4
22-Mar	3	20	83	1	5
26-Mar	4	39	122	4	9
28-Mar	2	25	147	2	11
3-Apr	6	25	172	2	13
5-Apr	2	2	174	0	13
8-Apr	3	7	181	0	13
11-Apr	3	16	197	0	13

Avg. male catch per pot lift = 16.4

Station E4

2002 Date	Soak time (days)	Daily count of males captured	Cumulative count of males captured	Daily count of females captured	Cumulative count of females captured
6-Mar	2	13	13	1	1
11-Mar	5	0	13	0	1
13-Mar	2	1	14	0	1
19-Mar	6	59	73	8	9
22-Mar	3	0	73	0	9
26-Mar	4	0	73	0	9
3-Apr	8	3	76	0	9
5-Apr	2	0	76	0	9
8-Apr	3	0	76	0	9

Avg. male catch per pot lift = 8.4

Station E5

2002 Date	Soak time (days)	Daily count of males captured	Cumulative count of males captured	Daily count of females captured	Cumulative count of females captured
18-Mar	4	22	22	1	1
22-Mar	4	3	25	0	1
26-Mar	4	26	51	0	1
28-Mar	2	18	69	1	2
3-Apr	6	38	107	1	3
5-Apr	2	6	113	0	3
8-Apr	3	3	116	0	3
11-Apr	3	18	134	0	3

Avg. male catch per pot lift = 16.8

Station N2

2002 Date	Soak time (days)	Daily count of males captured	Cumulative count of males captured	Daily count of females captured	Cumulative count of females captured
13-Feb	5	38	38	1	1
15-Feb	2	12	50	0	1
19-Feb	4	22	72	1	2
21-Feb	2	1	73	0	2
26-Feb	5	12	85	0	2

Avg. male catch per pot lift = 17.0

Station N3

2002 Date	Soak time (days)	Daily count of males captured	Cumulative count of males captured	Daily count of females captured	Cumulative count of females captured
13-Feb	5	12	12	1	1
15-Feb	2	16	28	0	1
21-Feb	6	17	45	2	3
26-Feb	5	26	71	1	4

Avg. male catch per pot lift = 17.8

Station W5

2002 Date	Soak time (days)	Daily count of males captured	Cumulative count of males captured	Daily count of females captured	Cumulative count of females captured
28-Mar	2	10	10	0	0
3-Apr	6	14	24	0	0
5-Apr	2	2	26	0	0
8-Apr	3	0	26	0	0
11-Apr	3	8	34	0	0
18-Apr	7	4	38	0	0

Avg. male catch per pot lift = 6.3

Station W6

2002 Date	Soak time (days)	Daily count of males captured	Cumulative count of males captured	Daily count of females captured	Cumulative count of females captured
8-Apr	3	23	23	1	1
11-Apr	3	3	26	0	1
18-Apr	7	4	30	0	1

Avg. male catch per pot lift = 10.0