

1990
NORTON SOUND AREA
SHELLFISH REPORT
to the
Alaska Board of Fisheries

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ABSTRACT

Summaries of the commercial and subsistence red king crab (Paralithodes camtschatica) fisheries are presented. The methods used are discussed within the section describing stock status and research in Norton Sound. Based on available information on stock status, the 1990 harvest is not expected to exceed 200,000 pounds.

INTRODUCTION

The Norton Sound section of the Northern district in Area Q is described in the shellfish regulations as all waters east of 168 degrees W. long., between the latitudes of Cape Romanzof and Cape Prince of Wales (Figure 1). The only shellfish fishery in Norton Sound is for red king crab (Paralithodes camtschatica). Blue king crab (P. platypus) and Tanner crab (Chionoecetes opilio) also occur within the section but are very seldom caught by commercial or subsistence fishermen. Red king crab have been utilized for subsistence purposes by local residents for many years, but the commercial fishery was not initiated until 14 years ago. In April 1977, the Alaska Board of Fisheries opened an "exploratory" commercial fishery in order to increase the knowledge and commercial utilization of Norton Sound king crab. Since 1976 there have been four National Marine Fisheries Service (NMFS) research trawl studies in Norton Sound as well as four Alaska Department of Fish and Game (ADF&G) research pot fishing studies. Data from population studies, from winter research studies, mining impact studies, and from 13 commercial fishing seasons have greatly increased the knowledge of the Norton Sound king crab. There are two seasons during which crab may be taken commercially: November 15 - May 15 and August 1 - September 3.

The St. Lawrence Island section lies immediately west and north of the Norton Sound Section. The St. Lawrence Island section has been managed by Westward Region's Dutch Harbor office since the Bering Sea crab fleet bases there. This section has been open to commercial fishing for the same amount of time as the Norton Sound section. The only reported commercial catches to date in the St. Lawrence Island section were made in 1983 when 52,557 pounds of blue king crab were delivered from 13 landings and this past season, 1989, when 3,603 pounds of red king crab and 984 pounds of blue king were delivered from 8 landings. In 1983 the commercial crab fleet concentrated near the southeast shore of St. Lawrence Island. The following year a regulation proposal to close the waters within 10 miles of all inhabited islands within the section was adopted in an attempt to protect stocks targeted by local fishermen during the winter. During the 1989 season relatively few blue king crab were taken near rocks and shoals still open to commercial fishing but red king crab were discovered in low densities near Point Hope, the northern boundary of the section. The villagers of Little Diomed Island have also traded and sold blue king crab with residents of Nome and other villages for years. The Department has not been able to obtain an accurate record of the magnitude of this trade. The remoteness of this village is also a factor contributing to the lack of catch records. A regulation was recently passed to legalize the commercial sale of crab from the St. Lawrence Island section during the winter. Local residents of St. Lawrence Island have decided not to export any of their winter catch for commercial sale. Department staff did travel to the village of Gambell to explain the new regulation and licensing requirements. The decision not to commercially fish was apparently decided in village meetings at Gambell and Savoonga.

COMMERCIAL FISHERY

Norton Sound Summer Commercial Fishery

The National Marine Fisheries Service provided the last red king crab population estimate of Norton Sound in 1988. The red king crab had maintained a relatively constant legal sized population since 1985. The legal sized biomass was estimated to be 3.0 million pounds in 1988, considerably below the 1978 all time high of 11.0 million pounds. A mandate to maintain adequate abundance for the local subsistence fishery and a concern that funding for population monitoring will decline has caused the staff to set the summer harvest goal at 200,000 pounds since 1988. Apparently catch plus natural mortality have equaled recruitment since 1985. In the 4 years prior to 1988, harvests had averaged 400,000 pounds. By reducing the harvest, handling mortality of females and juvenile crab should be reduced and a broader spectrum of mature male crab will be available for reproduction. The Norton Sound section commercial red king crab season opened by regulation at noon, August 1. Ten vessels were present on the scheduled tank inspection and registration day, July 31. The 1989 commercial crab fleet consisted of seven catcher-processors and three fishing vessels. The ten vessels brought a total of 2,555 pots to fish in Norton Sound.

The season was open for 3 days. The season was closed by emergency order at noon ADT, Friday August 4, when it was anticipated a harvest of 200,000 pounds of legal male king crab would be reached. The closure announcement was made immediately following the first catch report day (Thursday, August 3) at 11:00 a.m. ADT, which gave the fleet a 25 hour notice.

All fish tickets were not received prior to vessel departure. One fishing vessel tendered his crab for delivery to Dutch Harbor. Very rough seas the day of the closure, and the weekend following, complicated the season closure activities. Analysis of fish ticket data indicates a total of 246,487 pounds was harvested. No significant deadloss was reported. The average price advanced to the fishermen in season was \$3.00 per pound. Thus, the fishery was worth approximately \$739,460.00 to the fishermen.

Catches this season were reported for six statistical areas (636401, 646330, 656330, 656401, 666330, and 666401). The average catch per pot pull for the season was 15.4 crab per pot; a total of 79,116 crab were captured in 5,149 pot lifts. The average weight of legal male crab was 3.1 pounds, the same as in 1988.

Compliance with daily verbal catch reports was good. The Fish and Wildlife Protection officer stationed in Nome was available for answering regulatory questions and to assist with registration and tank inspections. Complaints were received during vessel registration regarding fishing prior to the season (by vessels which arrived during the weekend before the fishery). Without large vessel enforcement support, this problem could not be addressed.

Regulation 5 AAC 30.141 was in effect for the first time in Norton Sound during 1989. This regulation required onboard observers on all seven catcher-processors.

In addition, a Department observer was placed on a fishing vessel for the duration of the fishery. Orientation for all observers took place in the Nome office the morning of July 31, prior to tank inspections and registrations. Since this was the first implementation of the mandatory observer program for the Norton Sound fishery, and the program is currently under scrutiny, careful preparation was made prior to the orientation. Most observer materials (manuals, codes, forms, etc.), were provided by the Dutch Harbor staff member and program coordinator, Alan Quimby. The updated version of the observer manual was provided by HQ. The Dutch Harbor ADF&G staff and F&WP Officer Gallus provided invaluable assistance during and after the Norton Sound fishery. Most problems encountered were related to departure of vessels without checking out or without de-briefing of observers, as required by regulation. Additional documentation and substitute forms were provided to the observers by the Nome staff since we were requiring additional or different biological data to be collected. Also, Norton Sound length frequency forms were used since they provided the proper length categories for our stocks, where the minimum legal size male crab is approximately 104mm in length. Although good orientation of data to be collected was given, and a comprehensive addendum was included in the observer manual, there appeared to be a wide range of observer ability to collect and process data. Some inconsistencies occurred which included the following:

- 1) Inability to properly determine shell age.
- 2) Incorrect carapace measurements, i.e., legal (width) shell measurements instead of biological (length).
- 3) Lack of understanding of the concept of "recruit" crab, although it was specifically defined in the manual addendum.
- 4) Discrepancies in attention to in season catch data to be relayed, which was thoroughly discussed and documented during orientation and in the manual. Some observers gave cumulative rather than daily catch data, as requested. Others had to be repeatedly asked for catch and effort by stat area, rather than totaled for all stat areas fished.
- 5) Requests for wavier of observer de-briefing, which is required by regulation.

Additionally, there was a wide range of professionalism among observers; some collected the bare minimum, or less, of data, while others performed all tasks completely. Paperwork turned in ranged from very complete and comprehensive, to unusable. Following de-briefing of several observers, Nome staff opted to exclude some observer data from inclusion in the summary report.

A Department observer was on board a fishing vessel during the entire fishery and ended up traveling to Dutch Harbor with the vessel as rough sea conditions prevented off loading in Nome on the evening of August 4. He also summarized all observer data, which is presented in a separate report. A total of 273 pot lifts were observed by the Department observer during the fishery. A total of 4,327 legal male, 1,272 sublegal male, and 1,438 female crab were observed. A total of 293 legal male crab were measured for carapace length and condition; the mean carapace length was 118.4mm; the recruit to post recruit ratio was 23% to 77%.

St. Lawrence Island Summer Commercial Fishery

The St. Lawrence Island Section includes the American portion of the Bering and Chukchi Seas between Cape Romanzof and Point Hope except the Norton Sound Section. A natural division of the St. Lawrence Section occurs at the Bering Strait. In 1983 the commercial harvest was taken near St. Lawrence Island. Concern over the activity affecting sea mammal abundance near subsistence hunting sites caused the most productive areas to be closed. In 1984 several boats explored north of the Bering Strait but failed to find commercial quantities of crab. From 1984 until 1989 the St. Lawrence Section had virtually no commercial effort.

Immediately after the 1989 Norton Sound closure 5 catcher processors began reexploring the St. Lawrence Island Section. Five boats spent several days each in the Bering Sea. Their combined catch totaled 29 pounds of red and 940 pounds of blue king crab. The average harvest was roughly .2 crabs/pot lift. As expected the best catches came from shoals and rocks outside the closed areas.

Fishing success was only slightly better in the Chukchi Sea. Four boats spent several days each exploring that area. Catch rates approached one legal crab per pot lift along the coast in the northern portion of the section. A total of 3,574 pounds of red king crab and 44 pounds of blue king crab were harvested in the Chukchi Sea.

Five vessels landed 3,603 pounds of red king crab and 984 pounds of blue king crab during the 1989 season from the St Lawrence Island Section. The value of the harvest is estimated to be \$13,761 assuming price remained at \$3.00 per pound. Fishing began about August 7 and continued to about August 18. Observers were debriefed in Nome.

Norton Sound Winter Commercial Fishery

Regulation allows a commercial fishery in the Norton Sound Section from December 15 through May 15. During the winter season, crab are taken through the ice near Nome. During the winter of 1988-89, 59 landings were reported by 5 commercial fishermen ranging from January 14 through April 4. A total of 409 crab were sold commercially. Since the market for these crab were residents of Nome the crab were sold whole. The average crab brought \$5.40 putting value of the winter fishery at \$2210.

The winter crab fishermen generally use crab pots but some use hand lines to "prospect". Most fishermen consider commercial crabbing to be a sideline and most hold other jobs. During many years, two or three fishermen sell the bulk of the crab. A lack of market has never limited this fishery. Because of the low volume of crab involved, no local processor has found it profitable to operate. The crab sold locally are all sold fresh as are those shipped to Anchorage or other non local markets. During the mid-winter months fishermen find it difficult keeping the crab from freezing. Many Nome residents prefer to buy frozen crab since they are able to extract the meat prior to cooking. Fresh frozen crab are easily marketed in Nome but are not accepted in Anchorage.

SUBSISTENCE FISHERY

Red king crab are utilized by Norton Sound residents mainly during the winter. Fishing occurs through holes or cracks in the ice with the use of handlines and pots. In order to document trends in the subsistence harvest, the Board of Fisheries enacted a regulation in 1977 requiring subsistence fishermen in Norton Sound to obtain a permit prior to fishing and record daily effort and catches on these permits (Tables 1 and 3).

After the first commercial harvest of about 1/2 million pounds in the summer of 1977, a successful winter fishery was conducted in 1977-78 when the average subsistence catch was 84 crab and the average winter commercial catch was 260 legal sized crab. The winter fishery declined sharply the following year and remained at very depressed levels through the 1981-82 season. The lack of success in the winter crab fishery during some past years has been attributed to a declining crab population caused by removal of crab in the summer commercial fishery together with low recruitment, low effort due to poor ice conditions, and changes in the near shore winter distribution of crab. All of these factors probably had some effect on the success of the winter fishery in varying degrees. During the 1978-79 winter fishery, the king crab population was still relatively high. Despite this relatively large population, winter catches were the poorest on record indicating that the major factors limiting winter catches during 1978-79 were probably poor ice conditions and the distribution of crab. During the winter of 1981-82, poor winter catches could more reasonably be attributed to a declining crab population resulting from poor recruitment rather than the effects of commercial catch removals since the crab population was at its lowest documented level. Subsistence fishing success during the winters of 1982-83 through 1986-87 had improved due to a rebuilding of the population and increased use of more efficient gear (pots instead of handlines). Unstable ice conditions and record snowfalls adversely effected the past 2 years catch. In recent years the average harvest per fisherman has been approximately 65 crab (Table 1).

The winter crab fisheries are limited by the extent that stable shorefast ice extends over nearshore areas. Ice stability seems to have a greater effect in the winter catches than the population size does. Some of the highest winter catches occurred at relatively low population levels (Table 1). The winter of 1988-89 was no exception; record snowfalls caused the sea ice to sink and flood (overflow) making travel difficult and causing some fishermen to shorten their crabbing season.

Since the winter of 1983-84, the permits issued have been more detailed than past years, asking for the gear type used, the sex of the catch, the number of crab caught and the number of crab kept (Table 3). Permit information again showed that pots were by far the most commonly used gear type. Gear type information is not available from past permits; however, it has been observed that historically the major gear type was handlines. During the season of 1982-83, fishermen began to use pots more frequently.

STOCK STATUS / RESEARCH

In 1976 when monitoring of the Norton Sound king crab population first began, the population was mainly composed of prerecruit and recruit crab (Table 4, Figure 4). This first population assessment survey by the NMFS estimated the legal male king crab population at 8.1 million pounds (Table 4). The legal male crab population peaked in 1978 at an estimated 11 million pounds. During the 4 years following 1978, recruitment into the legal male crab population was very low. Subsequent NMFS surveys in 1979 and 1982 documented a population of predominantly postrecruit crab, and estimated a decline in the population to 2.6 million pounds by 1982 (Table 4). The Department of Fish and Game conducted their first population assessment survey in 1980, with subsequent surveys in 1981 and 1982 (Figure 5). These survey assessments documented a similar decline from 6.6 million pounds (1980) to 1.3 million pounds (1982). Beginning in 1981, sublegal crab abundance began to increase, and by 1983 recruitment into the legal male population also began to increase. No assessment work was conducted in 1983 or 1984. However, samples of the commercial catches indicated a significant increase of recruit crab into the legal male population; from a historic low of 10% in 1981 to 59% in 1984 (Table 5).

In 1985 both NMFS and ADF&G conducted population assessment surveys in Norton Sound (Table 4, Figure 6). The Department fished 65 stations throughout Norton Sound capturing 4,645 legal males, of which one-third was tagged. Subsequent recapture of tagged crab by the commercial fleet in August of 1985 provided tag to untagged ratios, and the population prior to the fishery was estimated at 2.4 million pounds (Table 4). After the commercial fishery in 1985 NMFS conducted a population assessment survey using trawl gear over a slightly larger area than that surveyed by the Department. Catches of male king crab by NMFS were in the process of or had just molted with the result being that their estimate of 3.4 million pounds of legal male king crab included some recruitment. Adjusting this estimate for molting, and including the summer commercial harvest, the estimate became 3 million pounds present prior to the 1985 August fishery. Both surveys documented relatively substantial numbers of recruit crab and a healthy percentage of prerecruit crab (Figure 6).

During September of 1988 NMFS conducted a fourth population assessment with trawl gear. They swept an area roughly the same as in 1985, but increased sampling frequency in the proposed mineral lease area near Nome. The timing of the study was almost a month earlier than similar surveys in the past, which occurred during the male molt. Nearly all the 1988 catch was in pre-molt condition. NMFS estimated 3.0 million pounds of legal male and 1.0 million pounds of prerecruit-one male red king crab; totaling 4.0 million pounds. Annual mortality is approximately 20% or in this case 0.8 million pounds. Ignoring growth and the winter harvests the population prior to the 1989 summer fishery would be 3.2 million pounds, very close to the 1985 trawl estimate of 3.4 million pounds.

FUTURE INVESTIGATIONS

The winter crab studies began as an index of near shore crab abundance during the season of heaviest local subsistence use. Today some of the controversy of mining impacts on crab distribution has taken the place of previous controversy over commercial versus subsistence use of the resource. From the perspective of the local management biologist this documentation of crab abundance is important because it is presently the most objective comparison of crab availability to local people. Controversy over this preferred subsistence personal use resource is likely to continue in the future especially if winter crab harvests decline even for a short time.

The catch per pot lift had been declining in the winter study until the 1990 season. At this time CPUE is well above the last several years, roughly twice the 1987 and 1989 levels. A consistent trend over the years has been the low proportion of pre-recruit crab observed in the near shore winter study as compared to proportions observed in the summer commercial fishery. The population now has an age class that is about to recruit and accounts for roughly half the winter crab catch this season. Without current research studies such as the ADF&G surveys conducted in 1980-82, and 1985, and the NMFS trawl surveys conducted in 1976, 1979, 1982 and 1985, it will be very difficult to determine whether the legal male crab population of Norton Sound is being exploited at a level which will allow the population to stabilize and rebuild. The department is currently relying on age data collected during the summer fishery and the winter study to track recruitment.

There has been recent work in the Kodiak area on one year old king crab (pre-recruit 6). The Nome staff is currently experimenting trying to apply the results of that study to Norton Sound. The hope is to index reproductive success 5 years in advance of recruitment and to document critical habitat that might be impacted by mining.

OUTLOOK 1990

There has been very little recruitment to the Norton Sound fishery for the past two years. The 1990 fishery will concentrate on relatively old crab however there are good numbers of prerecruit crab and commercial fisherman may find significant portions of their catch undersize.

The harvest goal will stand at 200,000 pounds for the summer fishery. Commercial fishermen should not expect closed areas to be relaxed during the 1990 or 1991 seasons. The staff will be concerned with undersize catch and handling mortality.

Table 1. Winter commercial and subsistence red king crab harvests, Norton Sound 1978-1989.

COMMERCIAL			SUBSISTENCE						
Year ¹	Fisher- men	#Crab Harvested	Winter ²	Permits Issued	Permits Returned	Permits Fished	Total Crab Caught ³	Total Crab Harvested ⁴	Average Harvest/fm
1978	37	9,625	1977-78	290	206	149	⁵	12,506	84
1979	1	221	1978-79	48	43	38	⁵	224	6
1980	1	22	1979-80	22	14	9	⁵	213	24
1981	0	0	1980-81	51	39	23	⁵	360	16
1982	1	17	1981-82	101	76	54	⁵	1,288	24
1983	5	549	1982-83	172	106	85	⁵	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	136	113	76	6,630	4,810	63

¹ Prior to 1985 the winter commercial fishery occurred from January 1 - April 30; as of March 1985, the winter commercial harvest may occur from November 15 - May 15.

² The winter subsistence fishery occurs during months of two calendar years (as early as December, through May).

³ The number of crab actually caught; some may have been returned.

⁴ The number of crab "harvested" is the number of crab caught and kept.

⁵ Data unavailable.

Table 2. Summer commercial red king crab harvest, Norton Sound, 1977-1989.

Year	Legal male Pop. est. ¹	Commercial harvest ²	Number of vessels	Crab per pot	Average weight	Exvessel price	Fishery value millions \$
1976 ^{3&4}	8.1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1977 ⁵	10.0	0.52	7	36	2.7	0.75	0.229
1978 ⁵	11.0	2.09	8	64	3.0	0.95	1.897
1979 ⁴	5.4	2.93	34	28	3.0	0.75	1.878
1980	6.6	1.19	9	29	3.6	0.75	0.890
1981	4.7	1.38	36	11	3.7	0.85	1.172
1982	1.3	0.23	11	6	3.6	2.00	0.405
1983	2.1	0.37	23	12	2.8	1.50	0.537
1984	2.7	0.39	8	14	2.8	1.02	0.395
1985	2.4	0.43	6	11	2.9	1.00	0.427
1986 ⁶	2.8	0.48	3	38	2.9	1.25	0.600
1987 ⁷	2.2	0.33	9	10	3.2	1.50	0.491
1988 ⁸	3.2	0.24	2	32	3.1	n.a.	n.a.
1989	3.2	0.25	10	15	3.1	3.00	0.739

¹ Population estimate prior to fishery in given year in millions of pounds.

² Millions of pounds.

³ No commercial fishery in 1976.

⁴ Population estimate derived by National Marine Fisheries Service.

⁵ Population estimate derived from catch per pot from commercial fishery.

⁶ Population estimate derived from 1985 ADF&G assessment survey.

⁷ Population estimate based on 1985 assessment survey data and recruitment of current assessment data; estimate probably low due to lack of recent data.

⁸ Population estimate based on NMFS post season trawl survey combined with summer fishery harvest.

Table 3. Winter subsistence red king crab catches and effort by gear type, Norton Sound, 1988-1989.

Gear Type	# Fisher- men	# Males Caught	# Males Kept	# Females Caught	# Females Kept	Total Crab Captured	Total Crab Kept	Average Harvest/fm ¹
Pots	26	2282	1525	157	26	2439	1551	60
Handlines	35	1920	1767	89	9	2009	1776	51
Both	22	3088	2620	194	42	3282	2662	121
Unknown	11	206	137	9	0	215	137	12
Totals	94	7496	6049	449	77	7945	6126	65

¹ Harvest refers to crab that are kept.

* Total permits issued 139, 115 permits returned (as of 3-8-90).

Table 4. Results of the population assessment surveys conducted for red king crab in Norton Sound since 1976.

Year	Date	Research Agency	Vessel	Gear Effort	Number of Red King Crab Captured ¹			Population Estimates of Legal Male Crab ³	
					Sublegal Males	Legal ² Males	Females	Numbers	Pounds
1976	9/02 - 9/05	NMFS	Miller-Freeman	Trawl	768	555	180	3,119,800	8,111,480
1979	9/16 -10/07	NMFS	Miller-Freeman	158 tows	46	194	40	837,241	2,511,723
1980	7/26 - 8/05	NMFS	Miller-Freeman	Trawl	46	194	40	837,241	2,511,723
1980	7/04 - 7/14	ADF&G	Altair	71 tows	443	3,290	158	1,900,000	6,600,000 ⁴
1981	6/28 - 7/14	ADF&G	Altair	Pots 397 lifts	4,097	3,415	1,933	1,285,195	4,755,221
1982	7/06 - 7/20	ADF&G	Aleutian #1	Pots 718 lifts	5,019	2,001	424	353,273	1,271,783
1982	9/05 - 9/11	NMFS	Miller-Freeman	Trawl	322	107	265	970,646	2,620,744
1985	7/01 - 7/14	ADF&G	Arctic Sea	50 tows	6,086	4,645	181	907,579	2,414,644
1985	9/16 -10/01	NMFS	Argosy	Pots 642 lifts	266	163	151	1,203,000	3,369,000
1988	8/16 - 8/30	NMFS	Miller-Freeman	Trawl 78 tows 82 tows	258	141	218	1,037,000	3,038,000

¹ Number of crab captured on ADF&G surveys represent data standardized for a 24 hour soak.

² Legal male red king crab were defined as at least 106mm in carapace length for the 1976 NMFS survey; 105mm for the 1979 and 1985 NMFS survey; and at least 121mm in carapace width for all ADF&G surveys.

³ Population est. are valid for the date of the survey, ie either before or after the summer commercial fishery.

⁴ The 1980 estimate has been revised from the original estimate of 13.4 million pounds. The original estimate was thought inaccurate due to under-reporting of recovered tagged crab.

Table 5. Percent recruit size crab for the Norton Sound male red king crab population from commercial catch samples.

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Recruits ¹	53	29	33	15	10	27	55	59	45	49	22	25	23
Postrecruits ²	47	71	67	85	90	73	45	41	55	51	78	75	77

¹ Percent Recruits = All new shell, legal size, male crab of carapace length <115mm.

² Percent Postrecruits = All other, legal size, male king crab.

Table 6. Percent of Norton Sound king crab from winter research pots, percent by size categories.¹

Year	SUBLEGAL			LEGAL		
	Prerecruit Twos	Prerecruit Ones	Totals	Recruits	Post Recruits	Totals
1983	26	38	64	26	10	36
1984	35	31	66	19	16	35
1985	25	45	70	20	10	30
1986	26	35	61	22	17	39
1987	13	31	44	11	45	56
1988 ²						
1989	27	15	42	27	31	58

¹ Sublegals = male king crab less than 4 3/4" carapace width.
 Pre-recruit Ones = Sublegals greater than 89mm in carapace length.
 Pre-recruit Twos = Sublegals smaller than 90mm in carapace length.

Legals = male king crab greater than 4 3/4" carapace width.
 Recruits = Legal new shell crab smaller than 116mm in carapace length.
 Post-recruits = all non-recruit legal males.

² No data collected in 1988 due to poor ice conditions.

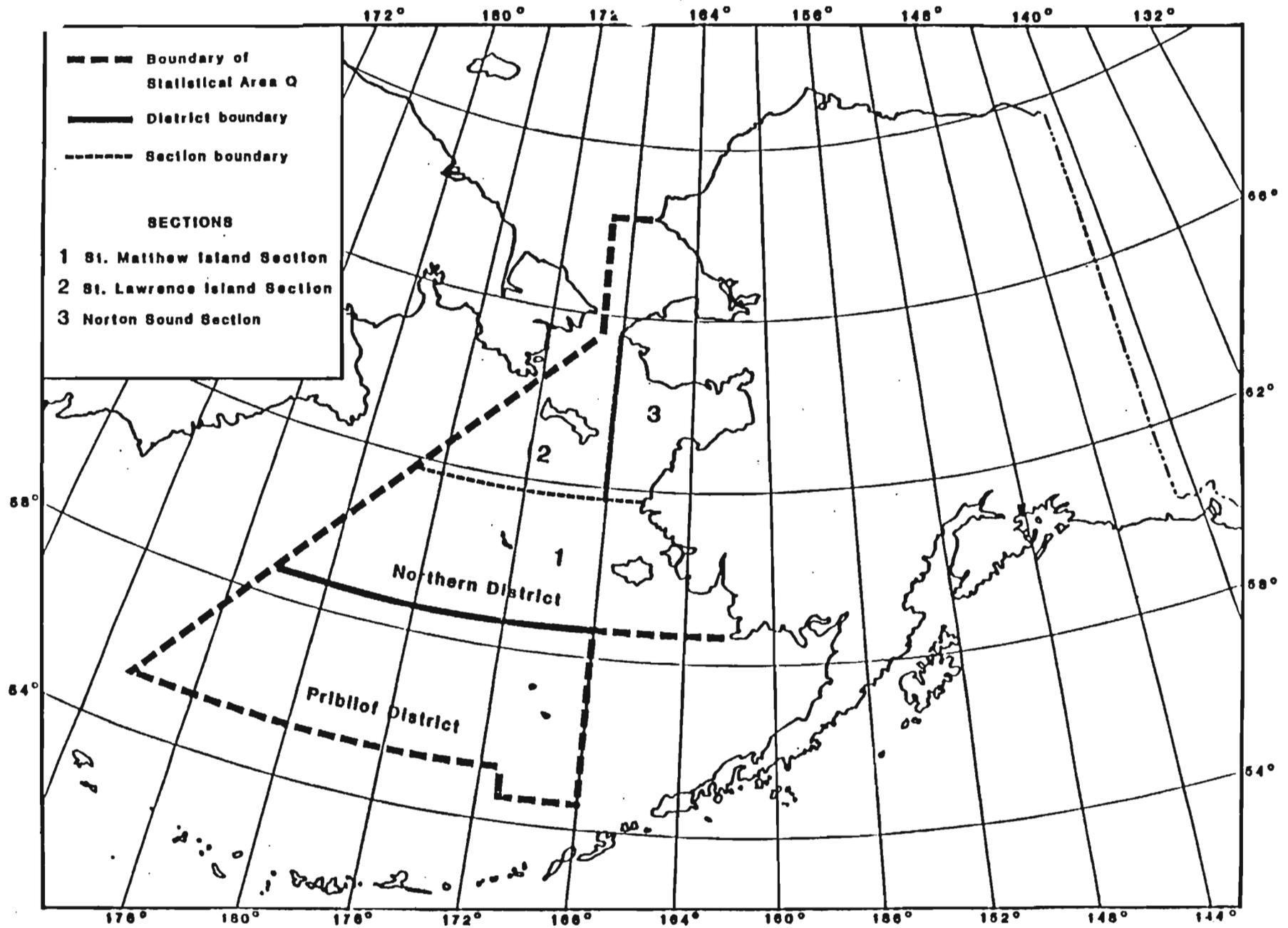
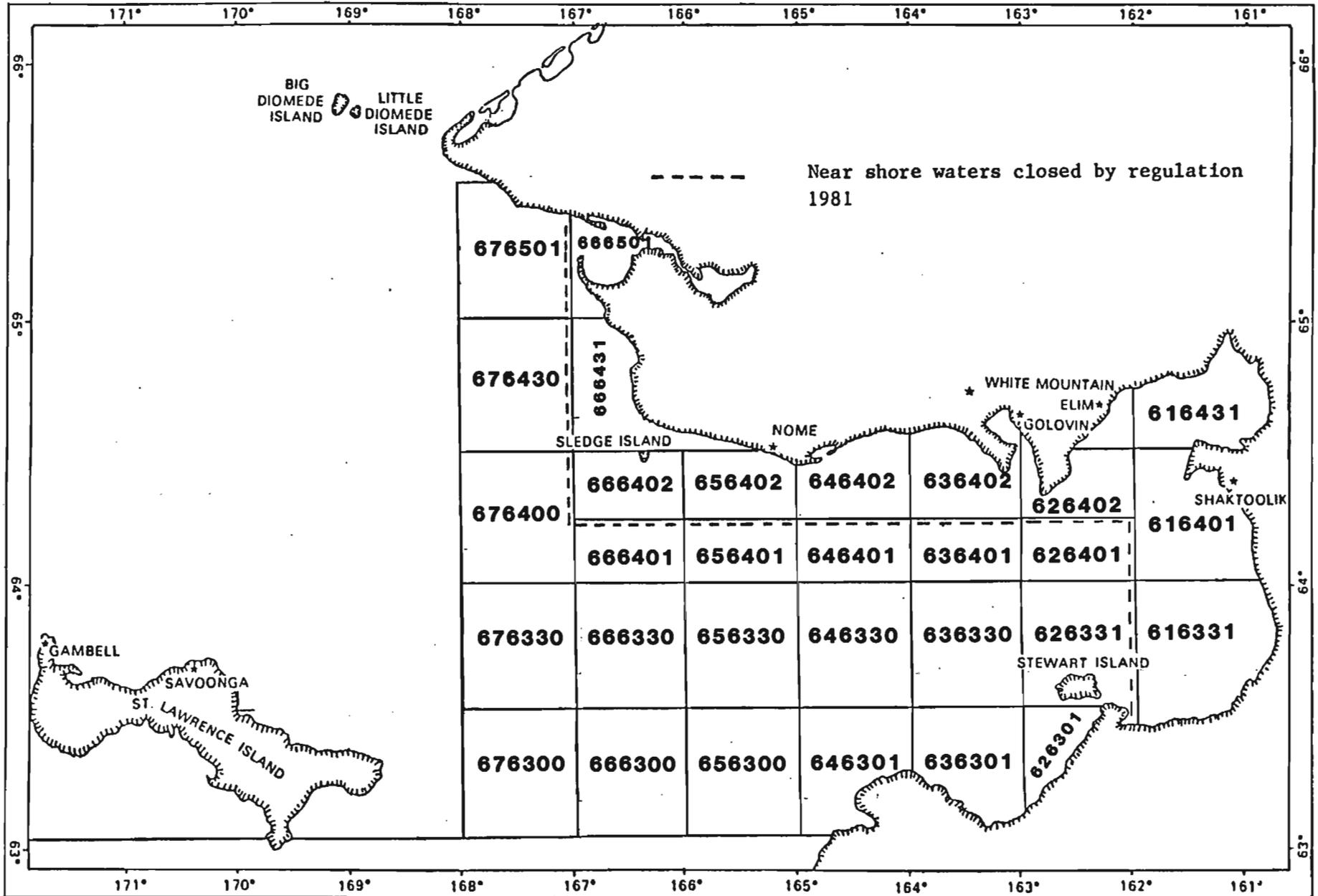


Figure 1. King crab fishing districts and sections of Statistical Area Q

Figure 2. Statistical areas for the Norton Sound Red King Crab Fishery.



PERCENTAGE OF TOTAL SAMPLE

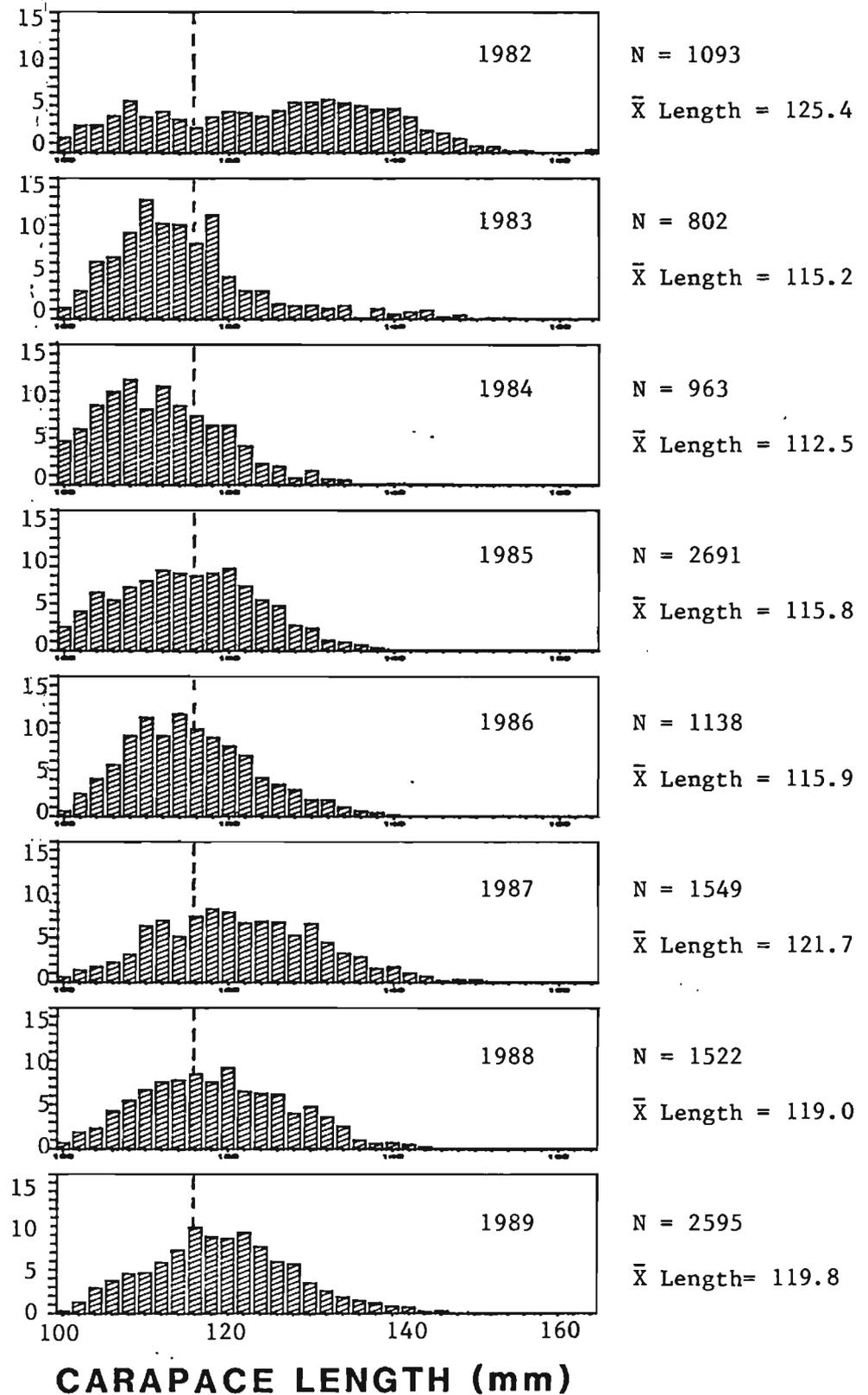


Figure 3. Red king crab commercial catch samples from the Norton Sound section summer fishery, 1982-1989. Crab to the left of dotted lines are recruits.

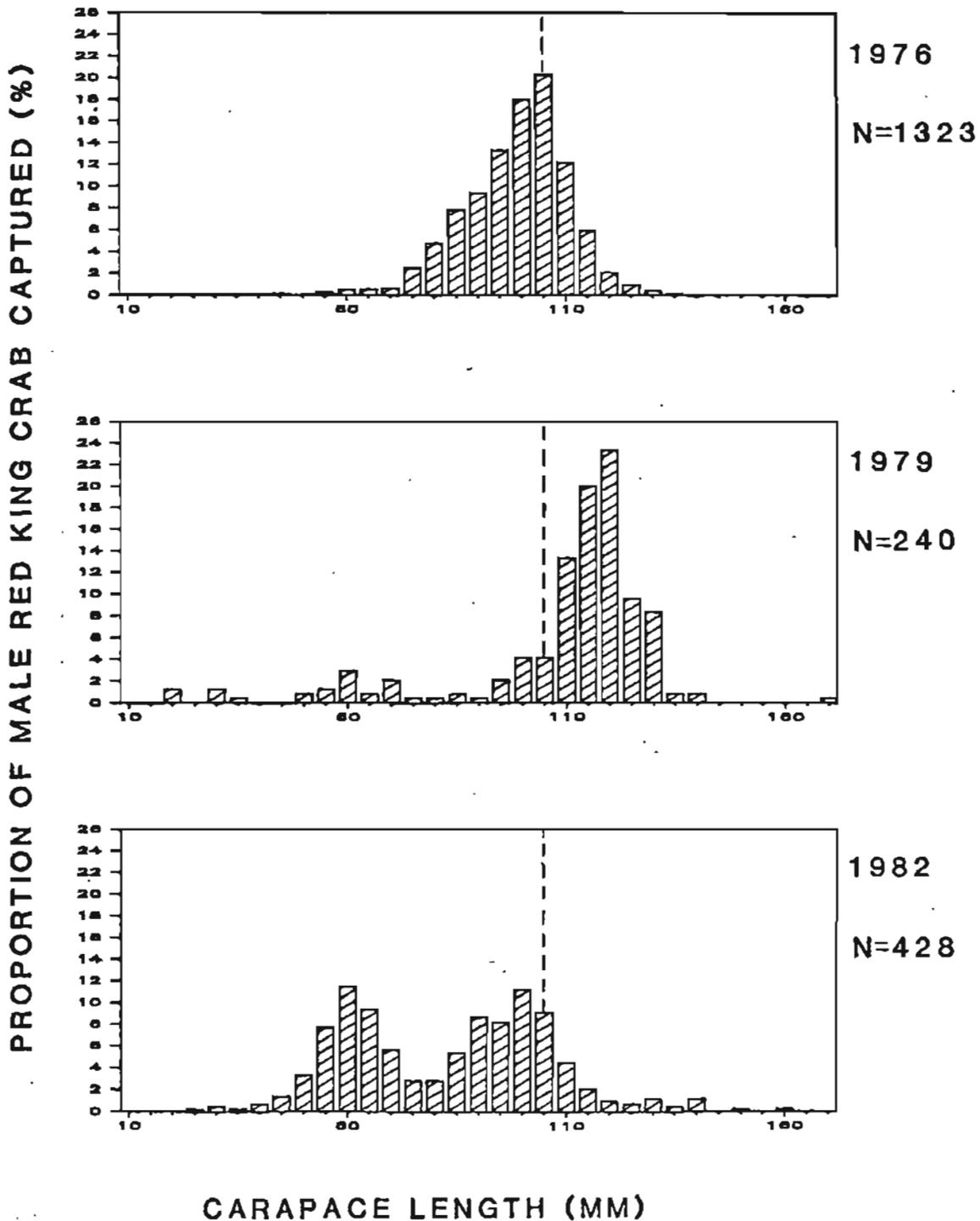


Figure 4 . Size structure of the male red king crab population, Norton Sound, Alaska as determined by research fishing, NMFS. Dotted line represents present minimum legal size.

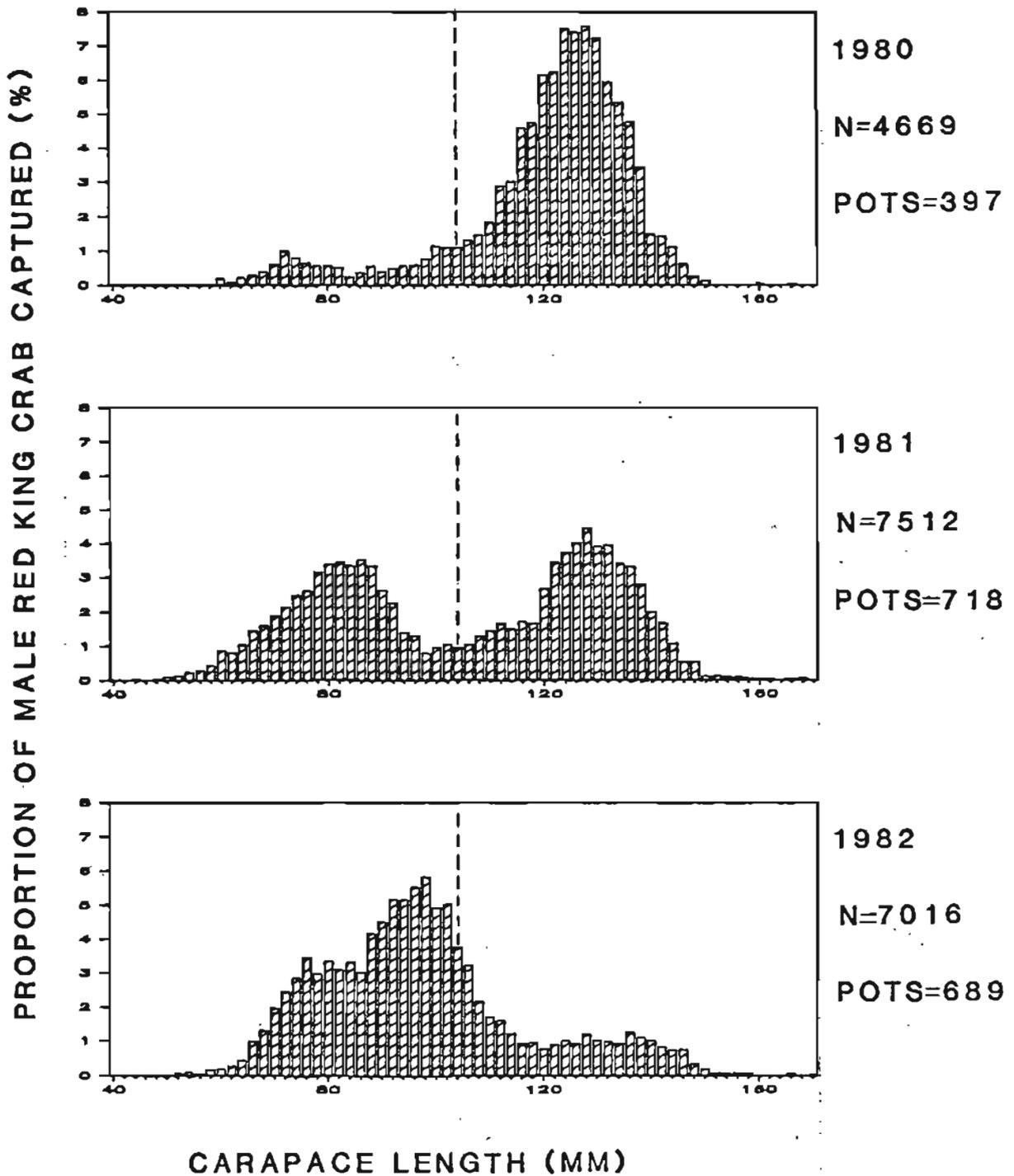


Figure 5. Size structure of the male red king crab population, Norton Sound, Alaska as determined by research fishing, ADF&G, 1980-1982. Dotted line represents present minimum legal size.

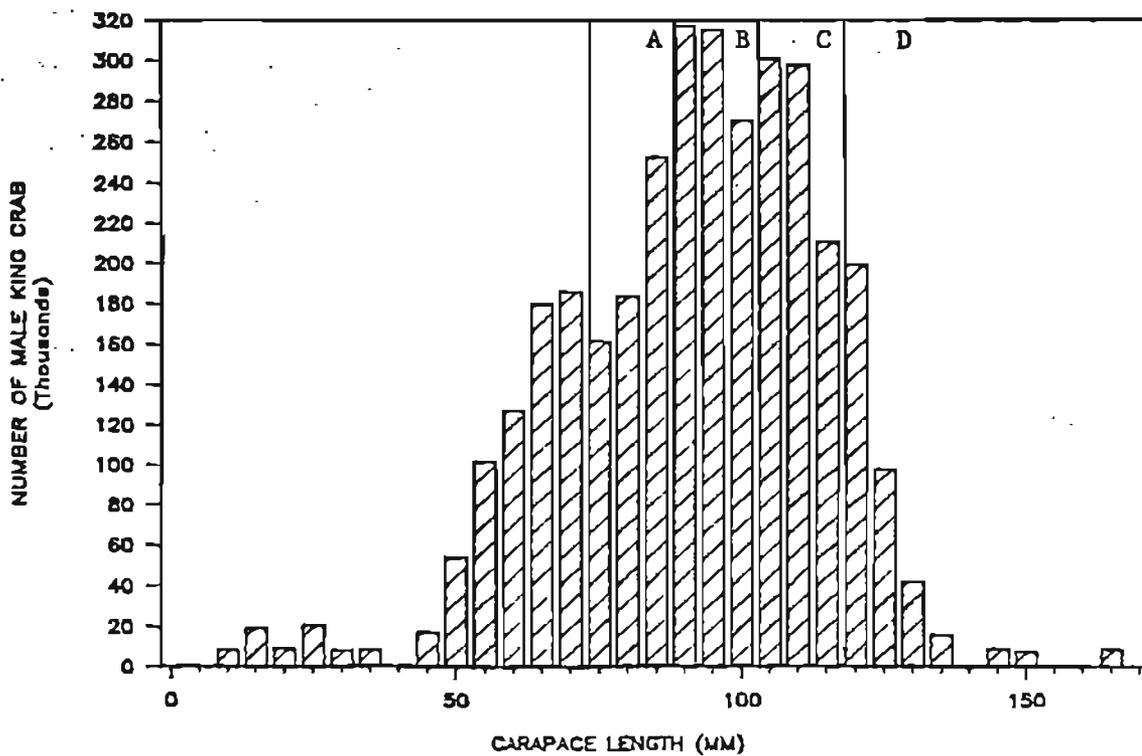
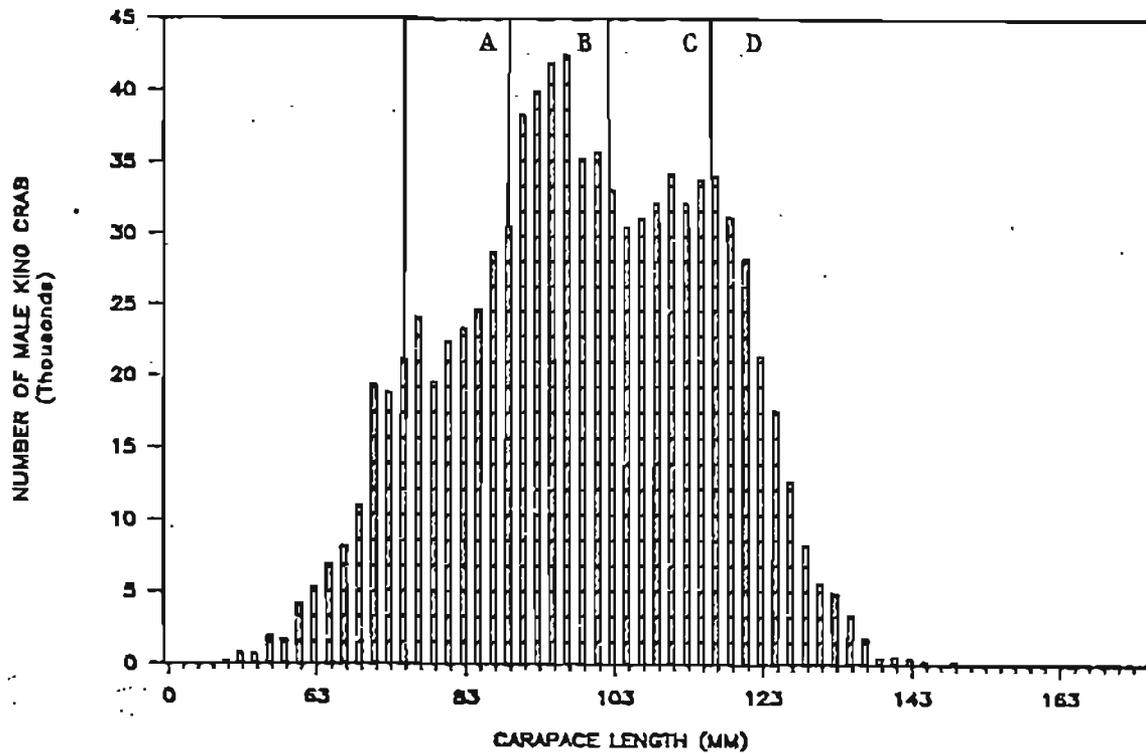


Figure 6 . Size distribution of the 1985 Norton Sound male red king crab population from assessment surveys conducted by ADF&G (Top) and NMFS (Bottom). Portions of the graph labeled A are prerecruit two crab (1987 recruitment); B are prerecruit one crab (1986 recruitment); C are recruit crab; D are postrecruit crab.

Figure 7. Size distribution of the 1988 NMFS population assessment survey.

N = 399

