

**ANALYSIS OF RED KING CRAB DATA FROM THE 1999
ADF&G TRAWL SURVEY OF NORTON SOUND**

By

Lowell F. Fair

and

Elisabeth L. Brennan

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AUTHORS

Lowell Fair is a Fishery Biologist for the Alaska Department of Fish and Game, Commercial Fisheries Division, Anchorage, AK.

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

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ABSTRACT

In July and August of 1999, the Alaska Department of Fish and Game conducted a trawl survey of Norton Sound to provide information on the distribution and abundance of demersal fishes and invertebrates. This project focuses on red king crab *Paralithodes camtschatica* data, in particular, population size, structure, and distribution; and shell age in relation to prerecruits, recruits, and postrecruit portions of the population. Population estimates were generated using an area-swept method as conducted in previous trawl surveys of Norton Sound. Legal male abundance was estimated at approximately 1.6 million crabs, equivalent to a biomass estimate of 4.8 million pounds. The 1999 trawl survey biomass estimate is nearly three times greater than the 1996 estimate and nearly one and a half times larger than the long-term average since 1976. Sublegal male abundance was estimated at approximately 1.0 million crabs, roughly one and a third larger than the 1996 estimate and only slightly larger than the long-term average since 1976.

INTRODUCTION

Several investigations provided preliminary information on the distribution and abundance of demersal biota (Andriyashev 1937 and Ellison et al. 1950) before the Atomic Energy Commission assessment survey of demersal fishes and invertebrates of the southeast Chukchi Sea/Norton Sound region in 1959 (Wilimovsky 1966). From 1976 through 1991, the National Marine Fisheries Service (NMFS) carried out a comprehensive program by conducting triennial stock assessment trawl surveys of Norton Sound designed to provide information on the distribution and abundance of demersal fishes and invertebrates (Wolotira et al. 1977, Sample and Wolotira 1985, NMFS 1982, Stevens and MacIntosh 1986, Stevens 1989, and Stevens 1992). Additionally, in 1980, 1981, 1982, and 1985, the Alaska Department of Fish and Game (ADF&G) conducted Norton Sound red king crab *Paralithodes camtschatica* pot surveys designed to provide: (1) annual distribution, abundance, and size class information; and (2) pre-season information to fishery managers regarding stock size and structure (Powell et al. 1983, ADF&G 1982a, ADF&G 1982b, Schwarz 1984, and Brannian 1987).

The NMFS eliminated Norton Sound from the 1994 triennial trawl survey schedule because of budget constraints. The 1996 ADF&G trawl assessment was the first survey since the 1991 NMFS survey, and the first Department trawl survey of Norton Sound (Blau et al. 1996 and Fair 1997). The purpose of the 1996 and 1999 trawl surveys was to provide abundance estimates of the Norton Sound red king crab population, crab size data and related biological characteristics; and to document benthic species composition in Norton Sound. The 1999 survey adds to the historical survey record and provides continuity in stock assessment methods. Ultimately, the information assessed by this project is used to determine the legal component of the red king crab population to better manage the commercial fisheries in the region. This report includes data on the abundance and size structure, biomass and distribution of the Norton Sound red king crab population from the 1999 survey.

The prioritized objectives for the 1999 Norton Sound red king crab trawl survey are listed below.

- Estimate the abundance and describe the size structure of the Norton Sound red king crab population.
- Describe the spatial distribution of the Norton Sound red king crab population and associated marine life. Compare the abundance, size structure and distribution of the present Norton Sound red king crab population with the historical trawl survey record.
- Collect the lengths, weights and additional biological data from other commercial or potentially commercial species captured; specifically, blue king crabs *Paralithodes platypus* and Pacific halibut *Hippoglossus stenolepis*.

The regulatory description of the Norton Sound section, located in the Northern District of Area Q, includes all waters east of 168° W longitude between the latitudes of Cape Romanzof and Cape Prince of Wales. The commercial fishing seasons for red king crabs in Norton Sound occur in two periods: (1) from July 1 through September 3 (summer season); and (2) through the

ice only, from November 15 to May 15 (winter season). Although the commercial fishery commenced in 1977, subsistence users who primarily fish through the ice during the winter have long harvested red king crabs.

Summer commercial fishery harvests have averaged 0.6 million pounds annually, ranging from a high of 2.9 million pounds in 1979 to a low of 0.02 million pounds in 1999. The winter commercial fishery is nominal, averaging about 2,700 crabs annually since 1978.

Population abundance estimates from the trawl survey are evaluated separately and incorporated into a model developed by Zheng et al. (1998). This model provides estimates of the legal and sublegal population size. A legal male red king crab is defined as having a carapace width \geq 121.8 mm (4.75 inches) or approximately 104 mm carapace length (CL). The model provides population size estimates for the two male sublegal crab categories, pre-2 crab requiring two or more molts to reach legal size and having a CL from 76 to 89 mm, and pre-1 crab requiring one molt to reach legal size and having a CL from 90 to 103 mm. Trawl survey and model population estimates are limited to abundances, because reliable paired weight-length information is not available to estimate biomass. The only available paired weight-length data comes from trawl surveys, collected onboard moving ships, which are susceptible to large errors in weight estimation. For management purposes, we simply multiply abundances by 3.0 pounds, the average weight of legal male crabs from the summer commercial fishery. Since 1976, red king crab trawl survey population estimates for legal males have ranged from a low of 0.6 million crabs in 1996 to a high of 1.7 million crabs in 1976, with an average of 1.1 million crabs.

METHODS

Trawl Survey

The 1999 ADF&G assessment survey was conducted aboard the chartered FV *Peggy Jo* from July 28 through August 8. For the 1999 Norton Sound assessment, we adopted the nonrandom, systematic station location design used by the NMFS in their six trawl surveys of Norton Sound and by the ADF&G in 1996. This approach provided us with a comparable survey pattern for the documentation of marine life in this area. We utilized the existing 10 x 10 nmi grid pattern, previously established for Norton Sound, with each grid identified by a station number (Figure 1). The centers of each survey station, denoted by latitude and longitude coordinates, indicate where each trawl began within a station (Table 1).

We towed a 400 eastern otter trawl, spread by two 1.5 x 2.1 m Astoria "V" doors for approximately one-half hour at a speed of approximately two knots/hour to cover a distance of 1.85 km (1-nmi). The global positioning system (GPS) calculated the location and distance towed. We recorded bottom temperatures of each tow with a computerized submersible probe, recorded at one-minute intervals. The probe's data was downloaded to a laptop computer each evening with the completion of all stations.

The highest priority was to trawl the target 55 stations, and conduct additional tows as time allowed. If additional charter days were available after surveying the original 55 target stations, selected stations with high catches of red king crabs were resurveyed. Surveying areas in duplicate allowed us to estimate variance between tows for each grid.

King Crab Population Estimation

Only catches from standardized stations were included in the population assessment procedures, as described in Fair (1998). Population estimates for red king crab were generated using the area-swept method, for direct comparison to previous analyses (Alverson and Pereyra 1969). Variances were estimated assuming that catch is binomially distributed (Seber 1982; page 22). Using the area-swept method, the total catch in numbers, n , and the total area trawled, a , were computed for each section trawled. Abundance for the j th section was estimated as:

$$\hat{N}_j = n_j * \frac{A_j}{a_j} , \quad (1)$$

where A is the total area of the section (Alverson and Pereyra 1969). The total abundance is estimated as:

$$\hat{N} = \sum_j \hat{N}_j . \quad (2)$$

The variance of \hat{N} is estimated as:

$$\hat{V}(\hat{N}) = \sum_j \hat{N}_j \left(1 - \frac{a_j}{A_j} \right) \frac{A_j}{a_j} \quad (3)$$

(Seber 1982; page 22).

The area-swept method assumes that catch is proportional to the area physically trawled and the density of crab (Ricker 1940, Gulland 1964). This assumption is likely satisfied. The method also assumes that density in the area physically trawled is representative of the grid section in which a trawl is located. The variance estimator assumes the probability that an animal is located within the trawl area is equal to the relative size of the trawl area, a uniformity assumption. The validity of these assumptions is difficult to assess. However, the distribution of animals within an area is likely dependent on various factors, such as bottom topography and patterns of seasonal migration. Given the relatively large size of the sampling grid, these assumptions may be violated. The degree to which potential violations of these assumptions may bias the estimator is unknown.

The variation of legal male abundance for comparison between years and between original and resurveys was estimated using two approaches. Both approaches incorporate the use of a coefficient of variation (CV), calculated as the standard error divided by the estimate. The first approach determines CV by using the legal male abundance estimate and its associated standard error. The second approach uses data collected only at those stations surveyed multiple times. Specifically, the standard error of the sum of the original and resurveyed abundance estimates are divided by the sum of the average abundance estimates from the original and resurveys.

King Crab Distribution, Shell Age, and Size Structure

We sampled all red and blue king crabs from each trawl, examining them for sex, size, legality, shell age and egg development, if applicable. We recorded the number and weight of each individual crab by species captured. Carapace lengths (CL) were measured to the nearest millimeter from the posterior margin of the right eye socket to the midpoint of the rear margin of the carapace.

We aged all king crab shells based on the shell condition. The shell condition method defines shell-age classes in the following way using the ventral side of the coxa of the walking legs (pereopods).

Soft-shell: Crab has molted within recent weeks. Exoskeleton is still soft and pliable from recent molt.

New-shell-pliable: The coxa and ventral surface of the exoskeleton are white. The legs are easily compressed when pinched (legs contain little muscle at this time). The exoskeleton is fragile and subject to breakage or puncture. With carapace removed, the gills appear translucent-cream in color. Crabs with this type of shell have had their present exoskeletons for approximately 1-3 months.

New-shell-hard: Coxa and ventral surface of exoskeleton white. The legs are mostly full of muscle, meri not easily compressed by pinching. If carapace is removed, the gills will be a light cream color. Crabs with this type of shell have had their present exoskeletons for 4-12 months.

Old-shell. The distal portion of the ventral coxa is partially or totally rimed with brown scratches or dots. Note: some crabs classified as old-shell are probably less than one year old but share the coxa characteristic of old-shell crabs. The legs are full of muscle and the meri is difficult to compress when pinched. If carapace is removed, gills are tan in color from fouling microorganisms. Crabs with this type of shell have had their present exoskeletons for 13-24 months.

Very old-shell: The distal portion of the ventral coxa is continuously rimed with black scratches or dots. The legs are full of muscle and the meri is difficult to compress when pinched. The tips of the dactyls are worn round and black. If the carapace is removed, gills appear dark gray or dark gray-brown in color from fouling microorganisms. Crabs with this type of shell have had their present exoskeletons more than 24 months.

Catch Sampling and Other Species

As the net was retrieved, fishes and crabs were shaken from the intermediate portion of the net down to the codend. Once onboard, we placed a lifting strap around the codend and weighed it

using a crane scale. We recorded and downloaded all pertinent information on data forms and in a computer database. The contents of the trawl were emptied on deck, and the tare weight of the net section originally weighed was reweighed and recorded.

All Pacific halibut and large Pacific cod *Gadus macrocephalus* were retrieved from each haul prior to subsampling. The total number of each species captured was recorded. Halibut were measured for total length (snout tip to end of tail) in cm. Halibut were not weighed, but their length was converted to a whole weight using a conversion table.

After the removal of all king crab, Pacific halibut, Pacific cod, large fish, and large debris from the catch, we subsampled the remaining catch. We used a shovel to fill one or two baskets from the remaining haul. The sampling fraction for estimating haul totals is calculated as the weight of the sample, divided by the weight of the total haul, minus the weight of the aforementioned items.

The fishes and invertebrates of each sampling basket were separated to the lowest taxon, and from debris (sticks, algae, garbage, tundra, etc.). We weighed and counted each taxon, assigned a NMFS species code and recorded the data. Total length measurements of non-target fishes were taken when possible.

Each day we checked the data for accuracy and entered it in a database on a notebook PC. Additionally, we maintained a daily radio schedule with the ADF&G office in Nome at 1600 hours to transmit catch information and trawl completion. We used a 35 mm camera to document portions of the survey (e.g. crew, trawling process and captured marine life), files of which are located in the Nome field office.

RESULTS

Trawl Survey

We had 59 successful tows from 64 attempts in daylight hours between July 28 and August 7 (Table 2). Two tows (stations 153 and 183; Figure 1) were unsuccessful and redone because of fishing gear malfunctions. An unsuccessful tow at station 162 destroyed the trawl net on a rocky sea bottom. Similar to the 1996 survey, stations 188, 207 and 223 were not towed because of adverse sea bottom conditions. Large amounts of mud in the net forced us to skip station 78 after two unsuccessful attempts. Of the 59 successfully trawled stations, eight were successfully resurveyed on the same day as the original survey. Resurveys were towed at the same depth, in close proximity to the initial tow track, and for similar lengths at each respective station.

The target tow distance was 1.85 km (1.0 nm); the average tow distance was 1.92 km (Table 1). We shortened a few of the trawls when questionable bottom terrain suddenly appeared on the hydroacoustic equipment or when nets filled with mud. The average trawl depth was 9.5 fathoms, ranging from 4 fathoms at station 77 to 17 fathoms at station 183.

The average bottom temperature for all tows ranged between 1.3 and 11.0 degrees C. The coldest temperatures occurred at stations 133 and 134 with readings of 1.3 and 1.9 degrees C, respectively (Table 1; Figure 2). The warmest temperatures occurred at stations 202 and 203 with readings of 11.0 and 10.4 degrees C (Table 1).

King Crab Population Estimation

Legal and pre-1 male catches were considerably larger in 1999 compared to the previous survey in 1996. We captured 184 legal males (Figure 3), of which 166 were located in the standardized area (Table 3). There were 109 pre-1 males captured in the survey (Figure 4), including 102 in the standardized area. Pre-2 male catches were the lowest of any previous survey with 13 crabs including 12 in the standardized area (Figure 5). Most male crabs were found in the immediate stations south-southeast of Nome and in those southern stations closest to Golovin Bay; whereas female crabs were most abundant in the area between the two male concentrations (Figure 6).

Similar to the 1996 trawl survey, the 1999 survey provided resurvey catch information that could be used for replicate abundance estimation with a corresponding variance between surveys for each retowed station (Appendix A). Of the eight stations surveyed twice, seven captured legal males in both tows (Figure 7).

The estimated abundance of legal male red king crabs was approximately 1.6 million with a corresponding biomass of approximately 4.8 million pounds (Table 3, Appendix B). The 1999 legal male abundance estimate of 1.6 million crabs is the second highest trawl survey estimate since the 1976 trawl survey estimate of 1.7 million (Table 3, Figure 8). Estimated abundances for pre-1 and pre-2 males were 0.9 million and 0.1 million crabs, respectively (Figure 8). The 1999 pre-1 male abundance estimate of 0.9 million crabs is the highest of all previous trawl surveys. Conversely, the pre-2 male abundance estimate of 0.1 million crabs is the lowest of all prior trawl surveys. A female abundance estimate was not generated because of the sporadic female distribution observed, but their catches were the lowest of all previous trawl surveys.

Stations with original and resurveys had similar abundance estimates for legal male crabs (Table 4). The resulting coefficient of variation for the original and resurveyed abundance estimates was 1%, far less than the 36% observed from the 1996 trawl survey.

Only one blue king crab was captured in the survey, not enough to estimate population abundance or biomass with any confidence.

King Crab Distribution, Shell Age, and Size Structure

The length frequency for all male crabs (N=316) caught during the 1999 Norton Sound trawl survey is shown in Figure 9. The distribution is made up of 42% prerecruits, 38% recruits, and

20% postrecruit male crabs, ranging in size from 23 to 138 mm CL with a mean of 97 mm CL. In the legal category (N=184), sizes range from 96 to 138 mm CL (Figure 10) with average sizes for new and old shell crabs of 110 and 114 mm CL, respectively. Figure 11 shows the length frequency for legal males from the 1999 winter pot study (N=658), summer commercial fishery (N=378), and trawl survey (N=184). From this comparison, we see visually similar distributions for the winter pot study and the trawl survey. On the other hand, the commercially harvested legal crabs have a flatter distribution and a greater mean length of 121 mm CL. The 1999 trawl survey length frequency distribution for legal males is shifted farther to the right than the 1996 survey, and has distinct similarities to the 1976 and 1979 distributions (Figure 12). For sublegal males (N=132, Figure 13), the average sizes for new and old shell crabs are 76 and 97 mm CL, respectively.

For female crabs, the 1999 length frequency distribution is flatter than most of the previous trawl surveys, but the sample size is small (Figure 14). Female length frequencies related to adult percent ovigerity shows that the majority of the adult females had high (60-89%) egg clutches (Table 5). Approximately one-half of the female crabs captured were adults.

One female blue king crab was captured at station 161, weighing 0.9 kg. No length measurements or sexual characteristics were noted.

Catch Sampling and Other Species

There were 139 taxa identified for a combined weight of 11,702 kg. The top three ranking taxa composed 68% of the total weight of all marine life, consisting of the purple-orange sea star, starry flounder, and red king crab (Table 6). Of the top 30 ranking taxa by weight, invertebrate species accounted for 77% of the catch.

All halibut (N=6) and Pacific cod (N=2) were measured for length. An opportunistic sampling of other fish species included: Alaska plaice *Pleuronectes quadrituberculatus* (N=8), Bering wolffish *Anarhichas orientalis* (N=1), plain sculpin *Myoxocephalus jaok* (N=4), polar eelpout *Lycodes turneri* (N=2), starry flounder *Platichthys stellatus* (N=23), and walleye pollock *Theragra chalcogramma* (N=5, Table 7).

DISCUSSION

The 1996 and 1999 ADF&G Norton Sound trawl surveys were similar; however, they differed from previous NMFS surveys in design and trawl gear. The total area surveyed in Norton Sound in 1976, 1979 and 1982 was slightly larger than the area surveyed from 1985 to the present. The trawl used on all six NMFS surveys in Norton Sound from 1976 to 1991 was an 83-112 trawl, whereas ADF&G used a 400 eastern. The 83-112 trawl has a similar footrope configuration to the 400 eastern and tows similarly over rough bottom. It is unlikely that catch selectivity differences exist between the 83-112 trawl used by NMFS and the 400 eastern used by ADF&G (Robert Otto, NMFS, personal communication).

The 1999 legal male abundance estimate is the highest since the initial Norton Sound trawl survey in 1976. Following the lowest point in 1996, large recruitment events pushed the population to the current high levels. The all-time high pre-1 male abundance estimate for 1999 indicates that the legal component will continue to expand at least one more year. However, the exceptionally weak 1999 pre-2 abundance estimate suggests at least one year of weak recruitment in the wake of this legal abundance boom.

The area-swept method for abundance estimation assumes that catch is proportional to the area physically trawled and crab density (Ricker 1940, Gulland 1964). This assumption is likely satisfied. The method also assumes that crab density in the area physically trawled is representative of the grid section in which a trawl is located. The variance estimator assumes the probability of a crab located within the trawl area is equal to the relative size of the trawl area, a uniformity assumption. The validity of these assumptions is difficult to assess. However, the distribution of crabs within an area is likely dependent on a variety of factors, such as bottom topography and patterns of seasonal migration. Given the relatively large size of the sampling grid, these assumptions may be violated. The degree to which potential violations of these assumptions may bias the estimator is unknown.

Some of the trawls during the survey were done in areas outside of the standardized zone defined in Fair (1998). There were seven nonstandard stations sampled during the 1999 survey, which were excluded from the population estimates. For legal males, five nonstandard stations accounted for 18 crabs, which is equivalent to an abundance estimate of 155,607. Pre-1 male catches outside of the standard area included 12 crabs or an abundance estimate of 79,442. Only one pre-2 male crab was captured at a nonstandard station with an abundance estimate of 6,332.

For legal male abundance estimates, coefficients of variation (CV) were determined using two methods. First, using the standard approach, the CV for 1999 legal male abundance is 8.1%, similar to the 1996 CV of 12.9%. In the second approach however, a large discrepancy arises between the CV's based on a comparison of original survey and resurvey abundance estimates for the 1996 and 1999 surveys. The 1996 CV was 35.9%, but only 1.0% for 1999 (Table 4). The difference may be attributed to the varying days between original and resurveys. In the 1996 trawl survey, the time between the original and resurveys ranged from 4 to 11 days, but in 1999 all resurveys were done on the same day as the original survey. Thus, in 1999, potential crab movement between surveys was minimized. Conversely, crab movement between surveys in 1996 may have artificially inflated the CV. If the resurveys can be considered to provide true replication, the second estimate of the CV is an essentially nonparametric estimate, and probably the most accurate.

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Table 1. Station data and the number of red king crab by sex and size captured during the ADF&G Norton Sound trawl survey, July 28 - August 7, 1999 (resurveyed stations are shown in bold).

| | | Station Location | | | | | | | | | | Female Red King Crab | | | | | | Male Red King Crab | | | |
|--------|-------------|------------------|-----------|-----------|-------------|------------|-------------|---------------------------|----------------------|-----------------|------------------|----------------------|----------|-----------------|--------------------|---------------|-----------|--------------------|--|--|--|
| | | W. | | | | | | | | | | Female Red King Crab | | | | Sublegal | | Legal | | | |
| | | N. Latitude | | | | Longitude | | | | | | Female Red King Crab | | | | Sublegal | | Legal | | | |
| Haul # | Station No. | Month | Day | Deg. | Min. | Deg. | Min. | Compass heading (degrees) | Distance towed (nmi) | Ave. Depth (fm) | Bottom temp (°C) | Juveniles | Adults | Threes (<76 mm) | Twos (76 to 89 mm) | Ones (>89 mm) | Recruit | Postrecruit | | | |
| 1 | 134 | 7 | 28 | 64 | 0011 | 166 | 3001 | 90 | 1.0 | 15 | 1.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2 | 133 | 7 | 28 | 64 | 0007 | 166 | 0463 | 95 | 1.0 | 11 | 1.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 3 | 132 | 7 | 28 | 64 | 0014 | 165 | 0040 | 95 | 1.0 | 9 | 5.3 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | | | |
| 4 | 131 | 7 | 29 | 64 | 0058 | 165 | 0015 | 20 | 1.5 | 8 | 5.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 5 | 130 | 7 | 29 | 64 | 0016 | 164 | 0056 | 130 | 1.3 | 9 | 4.3 | 0 | 0 | 0 | 1 | 1 | 3 | 0 | | | |
| 6 | 129 | 7 | 29 | 64 | 0000 | 164 | 3557 | 160 | 1.0 | 9 | 3.7 | 0 | 0 | 0 | 1 | 1 | 4 | 4 | | | |
| 7 | 129 | 7 | 29 | 67 | 0017 | 164 | 3501 | 160 | 1.0 | 9 | 3.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 8 | 128 | 7 | 29 | 64 | 0015 | 164 | 1284 | 160 | 1.0 | 8 | 3.4 | 1 | 0 | 0 | 0 | 0 | 2 | 1 | | | |
| 9 | 127 | 7 | 29 | 64 | 0054 | 163 | 5063 | 160 | 1.0 | 9 | 2.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 10 | 126 | 7 | 29 | 64 | 0014 | 163 | 2680 | 90 | 1.0 | 10 | 3.5 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | | | |
| 11 | 125 | 7 | 29 | 64 | 0025 | 163 | 0345 | 160 | 1.0 | 9 | 2.8 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | | | |
| 12 | 124 | 7 | 30 | 64 | 0032 | 162 | 4171 | 180 | 1.0 | 9 | 2.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 13 | 123 | 7 | 30 | 64 | 0044 | 162 | 1958 | 180 | 1.0 | 8 | 3.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 14 | 150 | 7 | 30 | 64 | 1024 | 162 | 1873 | 180 | 1.1 | 8 | 6.0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | | | |
| 15 | 176 | 7 | 30 | 64 | 2020 | 162 | 1707 | 180 | 1.4 | 8 | 9.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 16 | 201 | 7 | 30 | 64 | 2993 | 162 | 1588 | 180 | 1.3 | 5 | ° | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 17 | 204 | 7 | 31 | 64 | 3023 | 165 | 4482 | 160 | 0.9 | 8 | 8.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 18 | 186 | 7 | 31 | 64 | 2009 | 166 | 0639 | 160 | 0.8 | 11 | 5.0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | | | |
| 19 | 187 | 8 | 1 | 64 | 2005 | 166 | 3080 | 220 | 1.3 | 13 | ° | 0 | 0 | 0 | 0 | 0 | 1 | 0 | | | |
| 20 | 161 | 8 | 1 | 64 | 1023 | 166 | 2971 | 165 | 0.9 | 13 | ° | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 21 | 160 | 8 | 1 | 64 | 1012 | 166 | 0684 | 170 | 1.0 | 10 | ° | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 22 | 159 | 8 | 1 | 64 | 1000 | 165 | 4373 | 170 | 1.1 | 9 | 5.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 23 | 185 | 8 | 1 | 64 | 2028 | 165 | 4494 | 170 | 1.0 | 10 | 6.3 | 1 | 0 | 3 | 0 | 1 | 2 | 1 | | | |
| 24 | 184 | 8 | 2 | 64 | 2033 | 465 | 2107 | 160 | 1.2 | 11 | 5.6 | 0 | 0 | 0 | 0 | 2 | 5 | 0 | | | |
| 25 | 184 | 8 | 2 | 64 | 2028 | 165 | 1937 | 160 | 1.2 | 12 | 5.6 | 0 | 0 | 4 | 0 | 1 | 3 | 2 | | | |
| 26 | 158 | 8 | 2 | 64 | 1006 | 165 | 2062 | 160 | 1.0 | 6 | 4.3 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | | | |
| 27 | 157 | 8 | 2 | 64 | 1985 | 164 | 5796 | 160 | 1.2 | 7 | 6.1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | | | |
| 28 | 183 | 8 | 2 | 64 | 2008 | 164 | 5832 | 90 | 0.9 | 16 | 6.3 | 2 | 1 | 1 | 3 | 9 | 8 | 4 | | | |
| 29 | 183 | 8 | 2 | 64 | 2047 | 164 | 5851 | 90 | 0.7 | 17 | | | | | | | | | | | |
| 30 | 183 | 8 | 2 | 64 | 1979 | 164 | 5855 | 90 | 0.8 | 15 | 6.0 | 2 | 2 | 3 | 3 | 10 | 11 | 7 | | | |
| 31 | 182 | 8 | 2 | 64 | 2023 | 164 | 3488 | 45 | 1.0 | 7 | 8.4 | 0 | 6 | 0 | 1 | 3 | 6 | 0 | | | |
| 32 | 182 | 8 | 2 | 64 | 2048 | 164 | 3609 | 45 | 1.2 | 8 | 8.2 | 2 | 3 | 2 | 0 | 6 | 7 | 3 | | | |
| 33 | 156 | 8 | 3 | 64 | 1066 | 164 | 3405 | 90 | 1.0 | 7 | 6.8 | 0 | 3 | 0 | 0 | 3 | 1 | 1 | | | |
| 34 | 155 | 8 | 3 | 64 | 1044 | 164 | 1142 | 70 | 1.2 | 8 | 4.5 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | | | |
| 35 | 181 | 8 | 3 | 64 | 2008 | 164 | 1181 | 90 | 1.0 | 6 | 8.7 | 1 | 3 | 1 | 0 | 0 | 0 | 0 | | | |
| 36 | 203 | 8 | 3 | 64 | 3012 | 164 | 1199 | 90 | 1.2 | 8 | 10.4 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | | | |

Table 1. (Page 2 of 2)

| Haul # | Station No. | Station Location | | | | | | | Female Red King Crab | | Male Red King Crab | | | | | | |
|--------|------------------|------------------|-----|------|------|------|------|---------------------------|----------------------|-----------------|--------------------|-----------|--------|-----------------|--------------------|---------------|---------|
| | | Month | Day | Deg. | Min. | Deg. | Min. | Compass heading (degrees) | Distance towed (nmi) | Ave. Depth (fm) | Bottom temp (°C) | Juveniles | Adults | Threes (<76 mm) | Twos (76 to 89 mm) | Ones (>89 mm) | Recruit |
| 37 | 202 | 8 | 3 | 64 | 3010 | 163 | 4848 | 90 | 1.1 | 7 | 11.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 180 ^b | 8 | 3 | 64 | 2018 | 163 | 4933 | 90 | 1.1 | 8 | 7.7 | 23 | 1 | 21 | 0 | 0 | 2 |
| 39 | 154 | 8 | 3 | 64 | 1020 | 163 | 4957 | 90 | 1.0 | 8 | 5.4 | 0 | 0 | 0 | 1 | 2 | |
| 40 | 179 | 8 | 4 | 64 | 2002 | 163 | 2658 | 140 | 0.9 | 9 | 8.4 | 0 | 2 | 0 | 0 | 0 | |
| 41 | 153 | 8 | 4 | 64 | 1006 | 163 | 2581 | 90 | 1.1 | 10 | 7.5 | 1 | 4 | 0 | 9 | 9 | |
| 42 | 153 ^a | 8 | 4 | 64 | 1073 | 163 | 2535 | 90 | 1.0 | 9 | | | | | | | |
| 43 | 153 | 8 | 4 | 64 | 0968 | 163 | 2525 | 90 | 1.1 | 10 | 7.6 | 2 | 2 | 1 | 0 | 7 | |
| 44 | 152 | 8 | 4 | 64 | 1040 | 163 | 0458 | 110 | 0.9 | 12 | 3.4 | 0 | 0 | 3 | 3 | 2 | |
| 45 | 152 | 8 | 4 | 64 | 0989 | 163 | 1494 | 110 | 1.0 | 12 | 3.6 | 0 | 0 | 2 | 0 | 0 | |
| 46 | 151 | 8 | 4 | 64 | 1029 | 162 | 4228 | 110 | 0.8 | 10 | 3.1 | 2 | 0 | 0 | 0 | 2 | |
| 47 | 151 | 8 | 4 | 64 | 0984 | 162 | 4182 | 120 | 0.9 | 10 | 3.3 | 0 | 0 | 0 | 0 | 4 | |
| 48 | 098 | 8 | 5 | 63 | 5004 | 163 | 0465 | 140 | 1.2 | 8 | 4.6 | 0 | 2 | 1 | 1 | 0 | |
| 49 | 098 | 8 | 5 | 63 | 4956 | 163 | 0552 | 140 | 1.2 | 8 | 4.7 | 0 | 5 | 0 | 0 | 1 | |
| 50 | 097 | 8 | 5 | 63 | 4987 | 162 | 4248 | 120 | 1.1 | 8 | 4.3 | 0 | 0 | 0 | 0 | 0 | |
| 51 | 099 | 8 | 5 | 63 | 5023 | 163 | 2730 | 90 | 1.3 | 8 | 5.4 | 0 | 0 | 0 | 0 | 0 | |
| 52 | 100 | 8 | 5 | 63 | 5018 | 163 | 5023 | 270 | 1.1 | 8 | 9.2 | 0 | 1 | 0 | 0 | 3 | |
| 53 | 101 | 8 | 5 | 63 | 4989 | 164 | 1244 | 285 | 1.3 | 8 | 8.6 | 0 | 0 | 0 | 0 | 0 | |
| 54 | 102 | 8 | 5 | 63 | 5037 | 164 | 3264 | 285 | 1.2 | 8 | 8.0 | 0 | 1 | 0 | 0 | 2 | |
| 55 | 103 | 8 | 6 | 63 | 5016 | 164 | 5859 | 275 | 1.3 | 8 | 7.9 | 0 | 6 | 0 | 0 | 3 | |
| 56 | 104 | 8 | 6 | 63 | 5038 | 165 | 2083 | 90 | 1.0 | 8 | 7.8 | 0 | 0 | 0 | 0 | 3 | |
| 57 | 105 | 8 | 6 | 63 | 5014 | 165 | 4346 | 120 | 0.9 | 10 | 7.7 | 0 | 0 | 0 | 0 | 0 | |
| 58 | 106 | 8 | 6 | 63 | 5016 | 166 | 0638 | 140 | 0.8 | 13 | 6.2 | 0 | 0 | 0 | 0 | 0 | |
| 59 | 107 | 8 | 6 | 63 | 5075 | 166 | 2778 | 160 | 0.8 | 15 | 5.1 | 0 | 0 | 0 | 0 | 0 | |
| 60 | 135 | 8 | 6 | 64 | 0024 | 166 | 5212 | 160 | 0.9 | 16 | 3.2 | 0 | 0 | 0 | 0 | 0 | |
| 61 | 162 ^c | 8 | 7 | 64 | 1023 | 166 | 5193 | 160 | 0.9 | 15 | | | | | | | |
| 62 | 078 ^d | 8 | 7 | 63 | 4039 | 164 | 5757 | 60 | 0.5 | 7 | | | | | | | |
| 63 | 078 ^d | 8 | 7 | 63 | 4137 | 164 | 5741 | 90 | 0.6 | 7 | | | | | | | |
| 64 | 077 | 8 | 7 | 63 | 4034 | 164 | 3584 | 270 | 1.2 | 4 | 9.8 | 0 | 0 | 0 | 0 | 0 | |

^a Tows were redone due to problem with gear.

^b 4 sublegal male crab had damage to their carapace and could not be measured. 1 female crab had a damaged carapace and could not be measured.

^c Unsuccessful tow due to loss of net.

^d Tows unsuccessful due to large amount of mud.

^e No temperature data due to problem with temperature probe.

Notes: Adult female red king crab include all female crab with a carapace length ≥ 72 mm and all ovigerous females.

Prerecruit ones include all sublegal male crab with a carapace length > 89 mm.

Legal male red king crab are those crab with a carapace width ≥ 4.75 inches across.

Recruits are all legal newshell male crab with a carapace length ≤ 115 mm.

Table 2. Norton Sound trawl survey dates, gear type, total number of successful tows, number of resampled stations, and the sampling time schedule.

| Year | Dates | Gear Type | Total Number of Successful Tows | Number of Resampled Stations | Sampling Time |
|------|------------------------|----------------------------|---------------------------------|------------------------------|----------------|
| 1976 | 9/2 - 9/5, 9/16 - 10/6 | 83-112 Eastern Otter Trawl | 192 | 17 | 24-Hour Basis |
| 1979 | 7/26 - 8/5 | 83-112 Eastern Otter Trawl | 115 | 16 | 24-Hour Basis |
| 1982 | 9/5 - 9/11 | 83-112 Eastern Otter Trawl | 53 | 0 | 24-Hour Basis |
| 1985 | 9/16 - 10/1 | 83-112 Eastern Otter Trawl | 78 | 0 | Daylight Hours |
| 1988 | 8/16 - 8/30 | 83-112 Eastern Otter Trawl | 82 | 4 | 24-Hour Basis |
| 1991 | 8/22 - 8/30 | 83-112 Eastern Otter Trawl | 53 | 0 | Daylight Hours |
| 1996 | 8/7 - 8/18 | 400 Eastern Otter Trawl | 69 | 21 | Daylight Hours |
| 1999 | 7/28 - 8/7 | 400 Eastern Otter Trawl | 59 | 9 | Daylight Hours |

Table 3. Standardized results from population assessment surveys for red king crabs in Norton Sound since 1976.

| Year | Date | Research Agency | Gear | Number of Red King Crabs Captured ^{a,e} | | | | Population Abundance Estimates ^c | | | Standard Errors | | |
|-------------------|---------------------------|-----------------|-------|--|-------------|--------------------------|---------|---|-------------|-------------|-----------------|-------------|-------------|
| | | | | Pre-2 Males | Pre-1 Males | Legal Males ^b | Females | Pre-2 Males | Pre-1 Males | Legal Males | Pre-2 Males | Pre-1 Males | Legal Males |
| 1976 ^e | 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 ^f | 7/26 - 8/5 | NMFS | Trawl | N/A | N/A | 90(86) | N/A | | | 809,799 | | | 61,176 |
| 1980 ^d | 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 ^e | 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 ^e | 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 |

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

^b Legal male red king crabs were defined as ≥ 121.8 mm (4.75 in) in carapace width for the pot surveys and the 1996 ADF&G trawl survey, and ≥ 104 mm for all of the NMFS trawl surveys except the 1979 survey which defined legal males as ≥ 100 mm.

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

^d 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.

^e The 1976, 1979, 1996, and 1999 catches include resampled stations (in parenthesis). The 1979 and 1996 population estimates incorporated resampled stations by combining catches and tow distances for each station resampled.

^f 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.

Table 4. Abundance estimates and standard errors for legal male red king crab for those stations sampled twice during the 1999 Norton Sound ADF&G trawl survey.

| Station Number | <u>Abundance</u> | | | | |
|----------------|------------------|-----------|-----------|----------------|--------------------------|
| | Original Survey | Resurvey | Average | Standard Error | Coefficient of Variation |
| 98 | 63,323 | 88,652 | 75,988 | 17,910 | 23.6% |
| 129 | 121,581 | 0 | 60,791 | 85,971 | 141.4% |
| 151 | 113,982 | 168,862 | 141,422 | 38,806 | 27.4% |
| 152 | 219,520 | 45,593 | 132,557 | 122,985 | 92.8% |
| 153 | 179,608 | 234,872 | 207,240 | 39,078 | 18.9% |
| 182 | 91,185 | 126,646 | 108,916 | 25,075 | 23.0% |
| 183 | 202,634 | 341,945 | 272,290 | 98,508 | 36.2% |
| 184 | 63,323 | 63,323 | 63,323 | 0 | 0.0% |
| Sum | 1,055,156 | 1,069,893 | 1,062,525 | 10,421 | 1.0% |

Table 5. Length frequencies and percent ovigerity of all female red king crab captured during the 1999 Norton Sound trawl survey.

| Carapace Length (mm) | Adult Percent Ovigerity | | | | | Juvenile (<72 mm) | Total |
|----------------------|-------------------------|---------------|-----------------|-------------|---------|-------------------|-------|
| | Full 90 - 100% | High 60 - 89% | Medium 30 - 59% | Low 1 - 29% | None 0% | | |
| 15-20 | | | | | | 2 | 2 |
| 21-25 | | | | | | | 0 |
| 26-30 | | | | | | 3 | 3 |
| 31-35 | | | | | | 10 | 10 |
| 36-40 | | | | | | 7 | 7 |
| 41-45 | | | | | | 3 | 3 |
| 46-50 | | | | | | 2 | 2 |
| 51-55 | | | | | | 4 | 4 |
| 56-60 | | | | | | 4 | 4 |
| 61-65 | | | | | | 1 | 1 |
| 66-70 | | 1 | | | | 2 | 3 |
| 71-75 | | 2 | | | 1 | | 3 |
| 76-80 | 1 | 7 | | 1 | | | 9 |
| 81-85 | | 4 | | | | | 4 |
| 86-90 | 4 | 8 | | | | | 12 |
| 91-95 | 1 | 5 | | | 1 | | 7 |
| 96-100 | 1 | 3 | | | | | 4 |
| 101-105 | 1 | 1 | | | | | 2 |
| 106-110 | 1 | | | | | | 1 |
| Total: | 9 | 31 | 0 | 1 | 2 | 38 | 81 |
| Percent | 11% | 38% | 0% | 1% | 2% | 47% | |

Total number of adult females(≥ 72 mm) = 43
 Total number of juvenile females (<72mm) = 38
 Average length of juvenile females (<72mm) = 41.7 mm
 Average length of adult females (≥ 72 mm) = 87.2 mm
 Average length of all females = 65.6 mm

Note: one female crab was not measurable.

Table 6. The top 30 ranking by total weight of each taxon identified during the Norton Sound red king crab trawl survey conducted by the ADF&G, 1999.

| Rank | Common Name | Weight (kg) | Scientific Name or Taxon |
|------|------------------------------|-------------|--|
| 1 | Purple-orange sea star | 5,933 | <i>Asterias amurensis</i> |
| 2 | Starry flounder | 1,094 | <i>Platichthys stellatus</i> |
| 3 | Red king crab | 940 | <i>Paralithodes camtschaticus</i> |
| 4 | Saffron cod | 494 | <i>Eleginus gracilis</i> |
| 5 | Sea star unidentified | 348 | Evasterias sp. |
| 6 | Plain sculpin | 335 | <i>Myoxocephalus jaok</i> |
| 7 | Yellowfin Sole | 327 | <i>Pleuronectes asper</i> |
| 8 | Giant sea star | 319 | <i>Evasterias echinosoma</i> |
| 9 | Black-spined starfish | 256 | <i>Lethasterias nanimensis</i> |
| 10 | Alaska plaice | 180 | <i>Pleuronectes quadrituberculatus</i> |
| 11 | Helmet crab | 142 | <i>Telemessus cheiragonus</i> |
| 12 | Snow crab | 136 | <i>Chionoecetes opilio</i> |
| 13 | Anemone | 103 | Tealia Sp. |
| 14 | Ascidian unidentified | 91 | Urochordata |
| 15 | Jellyfish unidentified | 69 | Scyphozoa |
| 16 | Sea potato | 63 | <i>Styela rustica</i> |
| 17 | Basket starfish unidentified | 48 | Gorgonocephalidae |
| 18 | Green sea urchin | 43 | <i>Strongylocentrotus droebachiensis</i> |
| 19 | Northern neptune | 42 | <i>Neptunea heros</i> |
| 20 | Basket starfish | 40 | <i>Gorgonocephalus caryi</i> |
| 21 | Northern argid | 40 | <i>Argis lar</i> |
| 22 | Rock sole | 34 | <i>Pleuronectes bilineatus</i> |
| 23 | Polar eelpout | 29 | <i>Lycodes turneri</i> |
| 24 | Knobby six-rayed sea star | 25 | <i>Leptasterias polaris</i> |
| 25 | Walleye pollock | 25 | <i>Theragra chalcogramma</i> |
| 26 | Rainbow smelt | 24 | <i>Osmerus mordax</i> |
| 27 | Leister sculpin | 24 | <i>Enophrys lucasi</i> |
| 28 | Arctic sculpin | 20 | <i>Myoxocephalus scorpiodes</i> |
| 29 | Comb jelly unidentified | 19 | Ctenophora |
| 30 | Circumboreal toad crab | 18 | <i>Hyas coarctatus</i> |

Table 7. Fish length information collected from the 1999 Norton Sound trawl survey.

| Species | Number of Fish Measured | Number of Hauls Sampled | Minimum Size (cm) | Maximum Size (mm) | Median (cm) |
|-----------------|-------------------------|-------------------------|-------------------|-------------------|-------------|
| Alaska Plaice | 8 | 2 | 41 | 48 | 45 |
| Bering Wolffish | 1 | 1 | 41 | 41 | 41 |
| Pacific Cod | 2 | 2 | 69 | 76 | 73 |
| Pacific Halibut | 6 | 2 | 26 | 42 | 41 |
| Plain Sculpin | 4 | 2 | 51 | 59 | 57 |
| Polar Eelpout | 2 | 2 | 53 | 66 | 60 |
| Starry Flounder | 23 | 4 | 30 | 53 | 46 |
| Walleye Pollock | 5 | 5 | 69 | 79 | 72 |

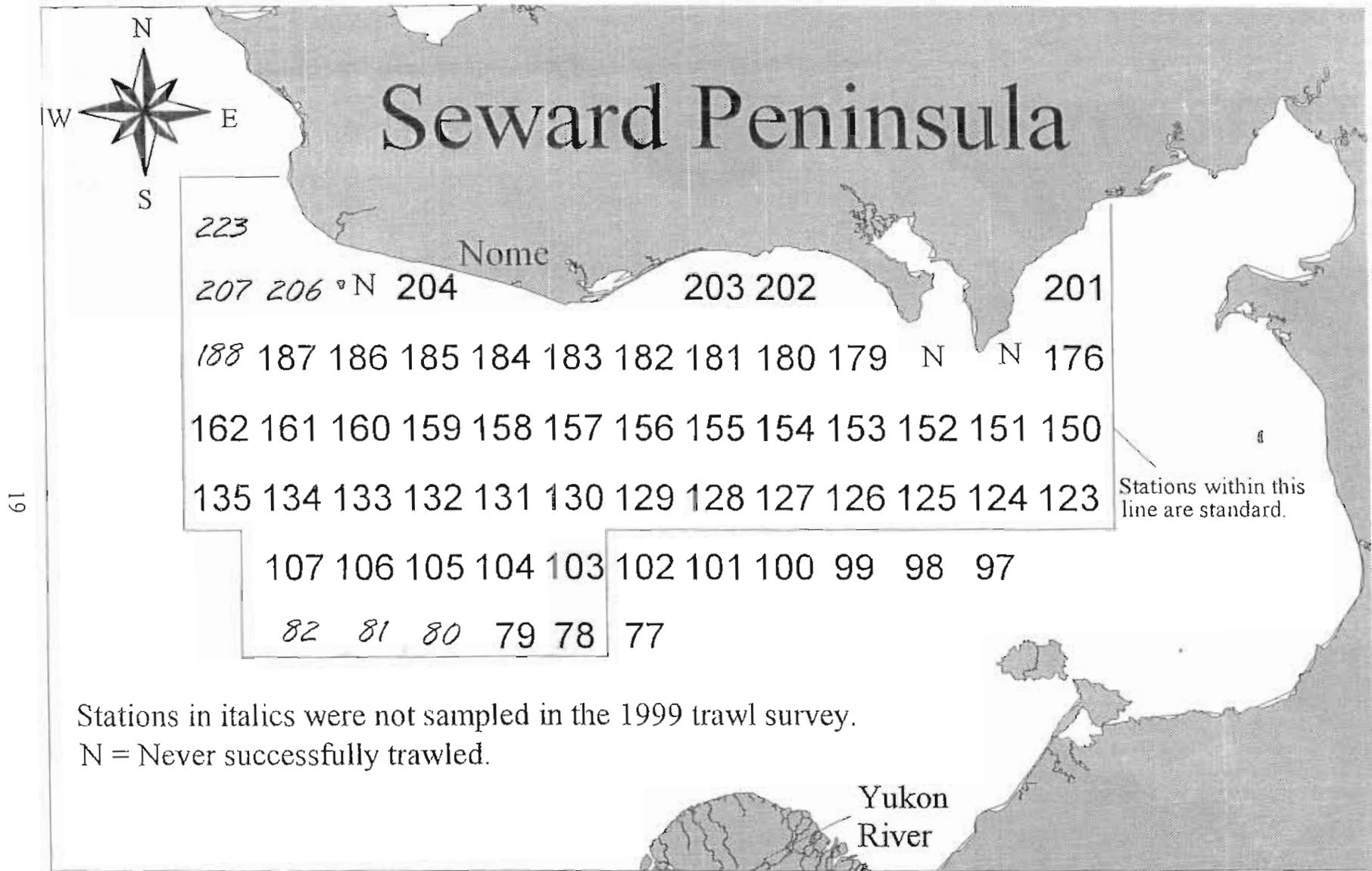


Figure 1. Station identification numbers for the 1999 ADF&G Norton Sound trawl survey.

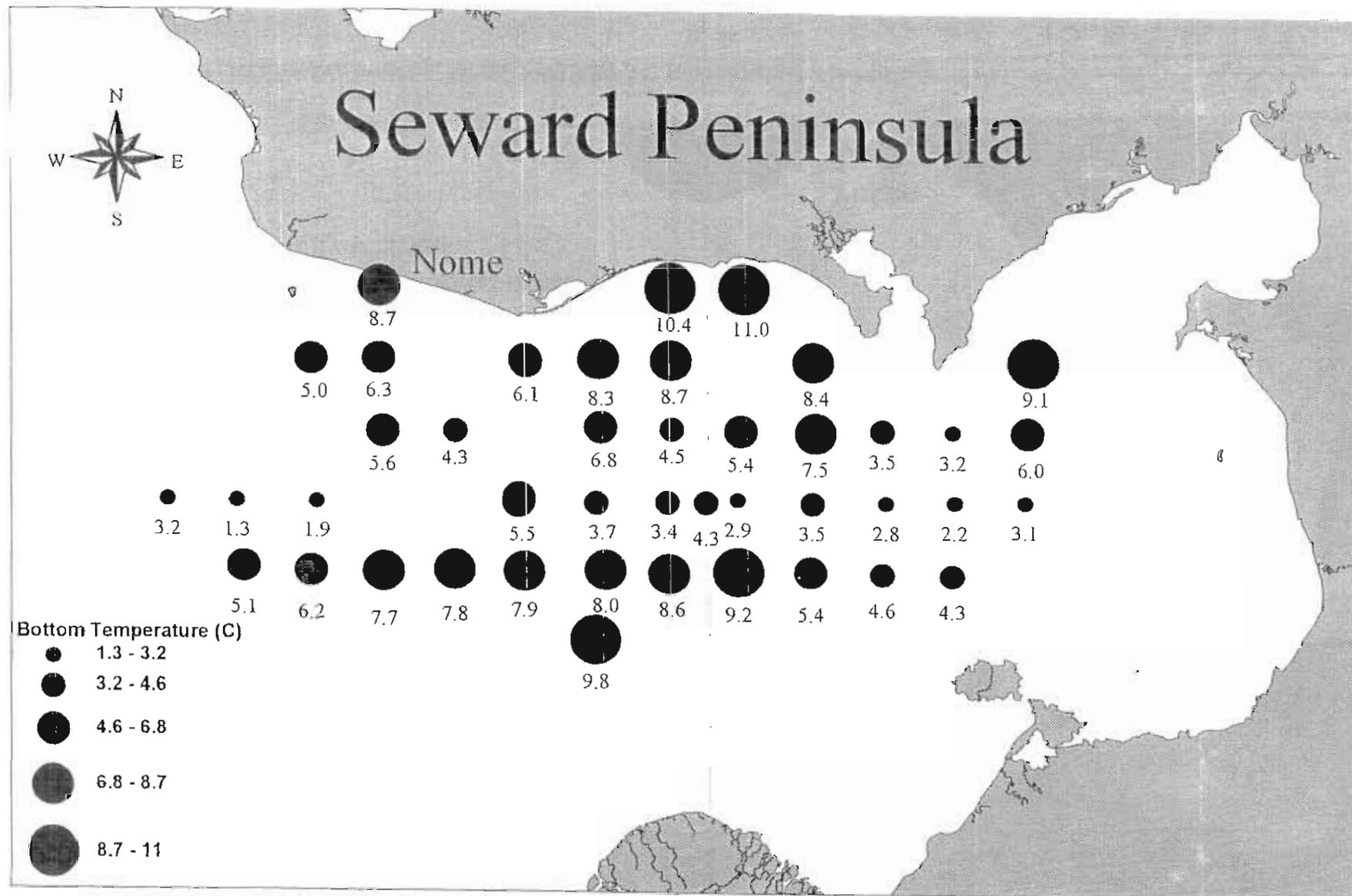


Figure 2. Bottom temperatures from the 1999 ADF&G Norton Sound trawl survey.

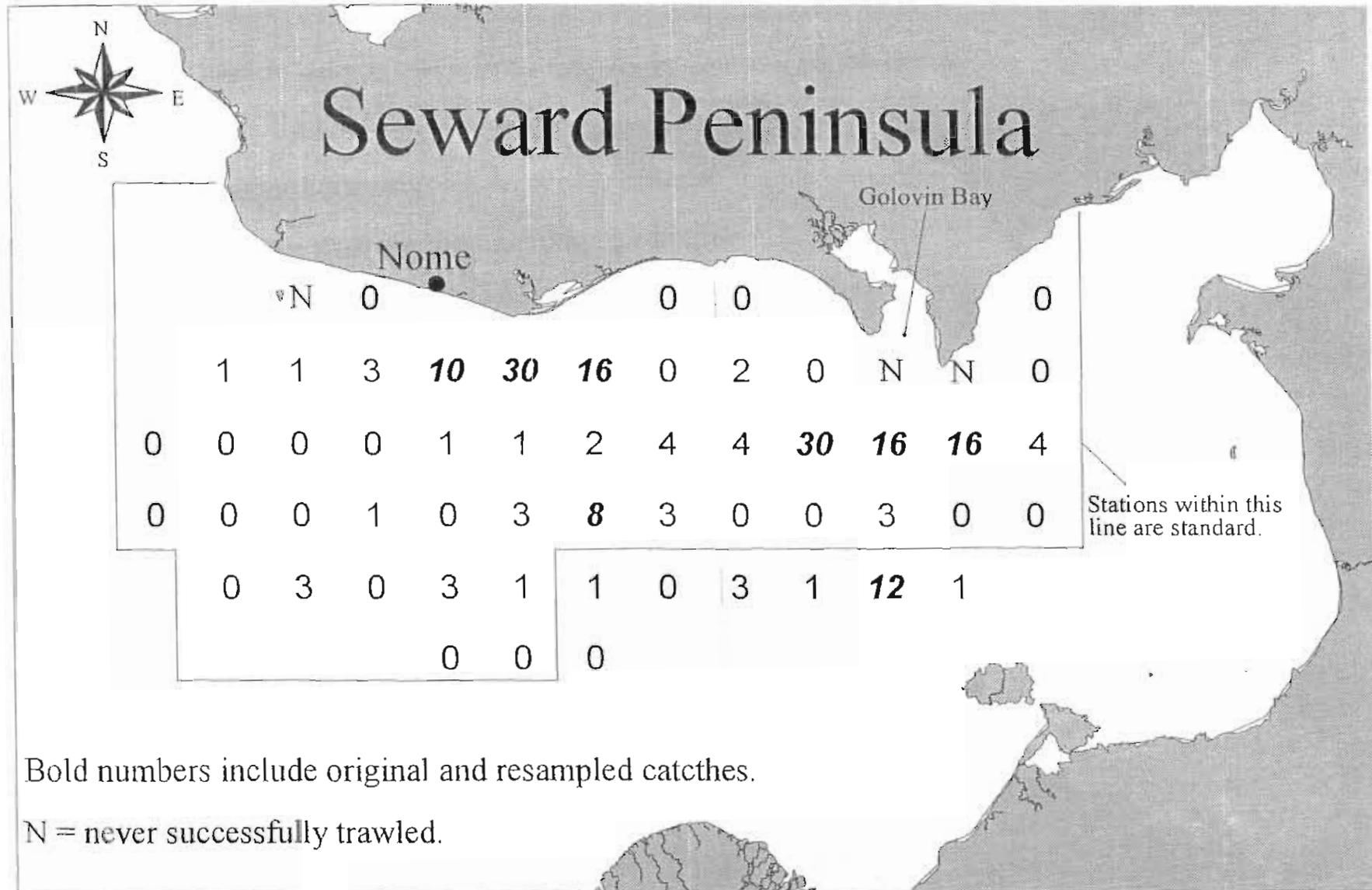


Figure 3. Legal male red king crab catches for the 1999 ADF&G Norton Sound trawl survey.

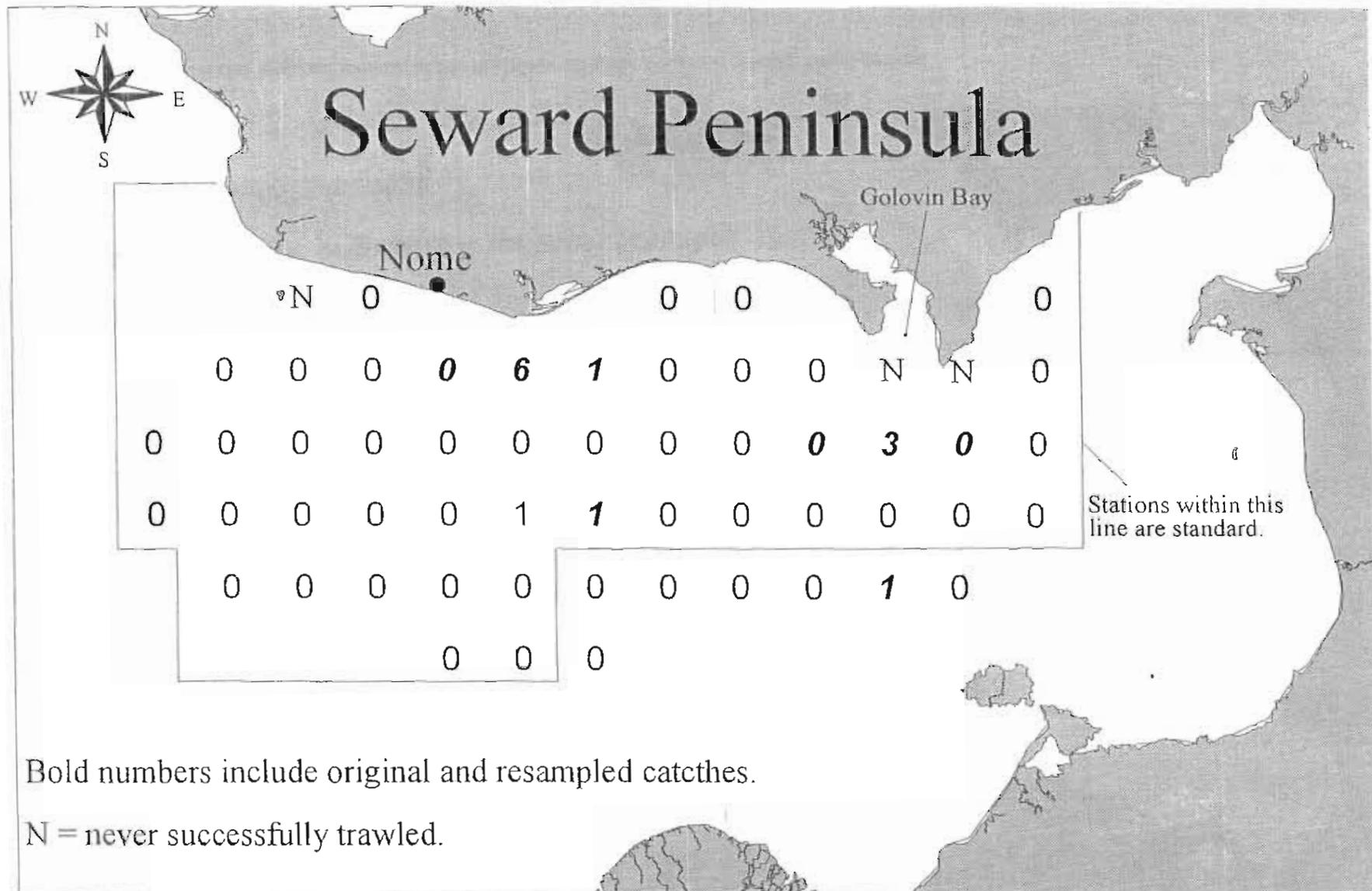


Figure 5. Pre-2 male red king crab catches for the 1999 ADF&G Norton Sound trawl survey.

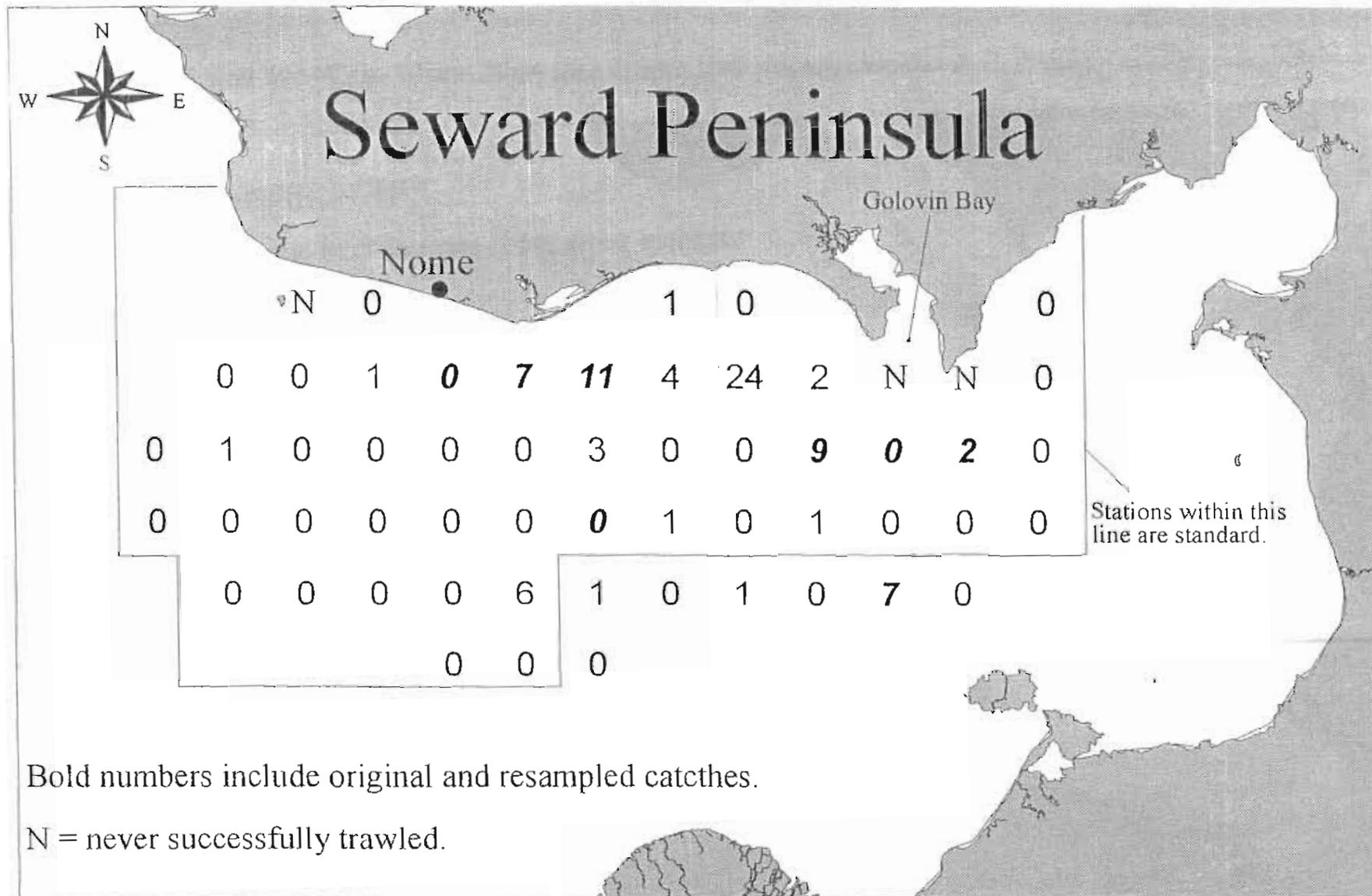


Figure 6. Female red king crab catches for the 1999 ADF&G Norton Sound trawl survey.

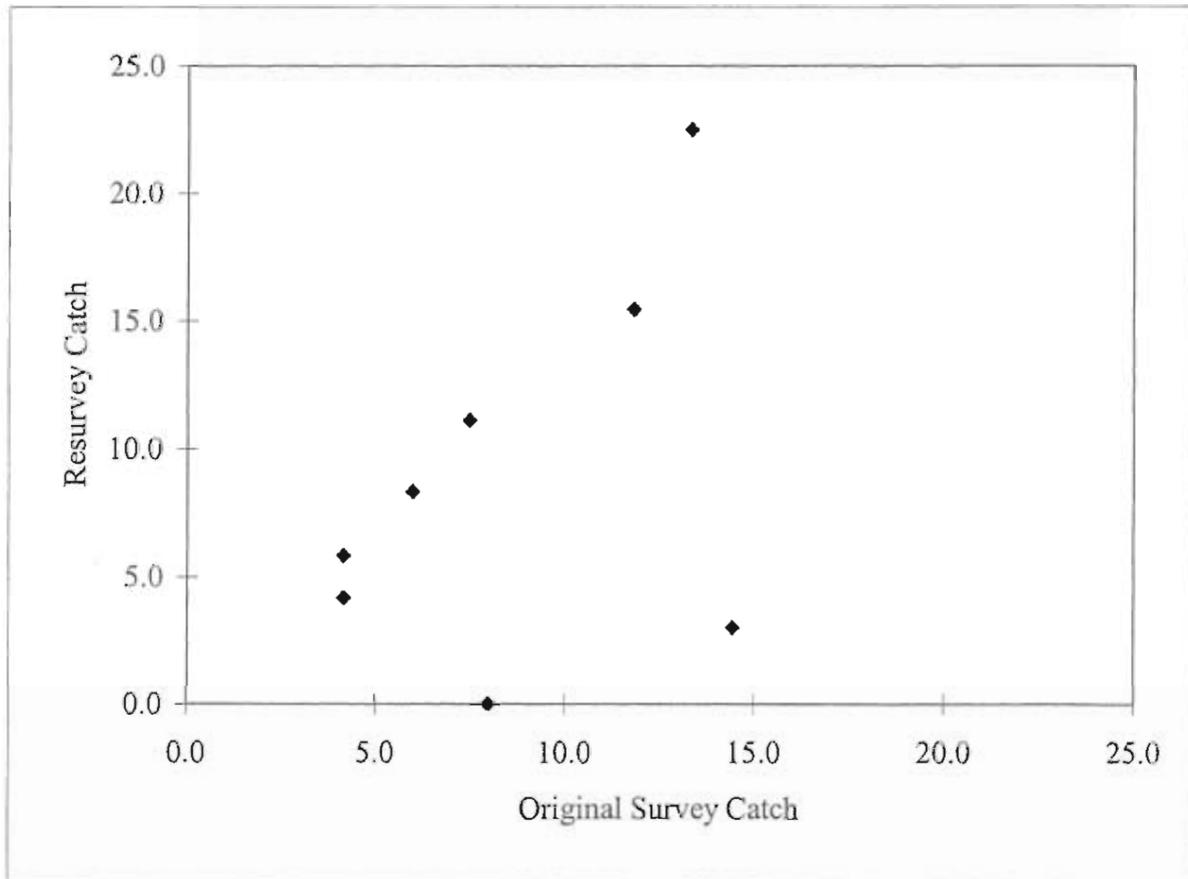


Figure 7. Legal male red king crab catches standardized by tow distance for stations trawled during the original survey and the resurvey conducted by the ADF&G in Norton Sound, 1999.

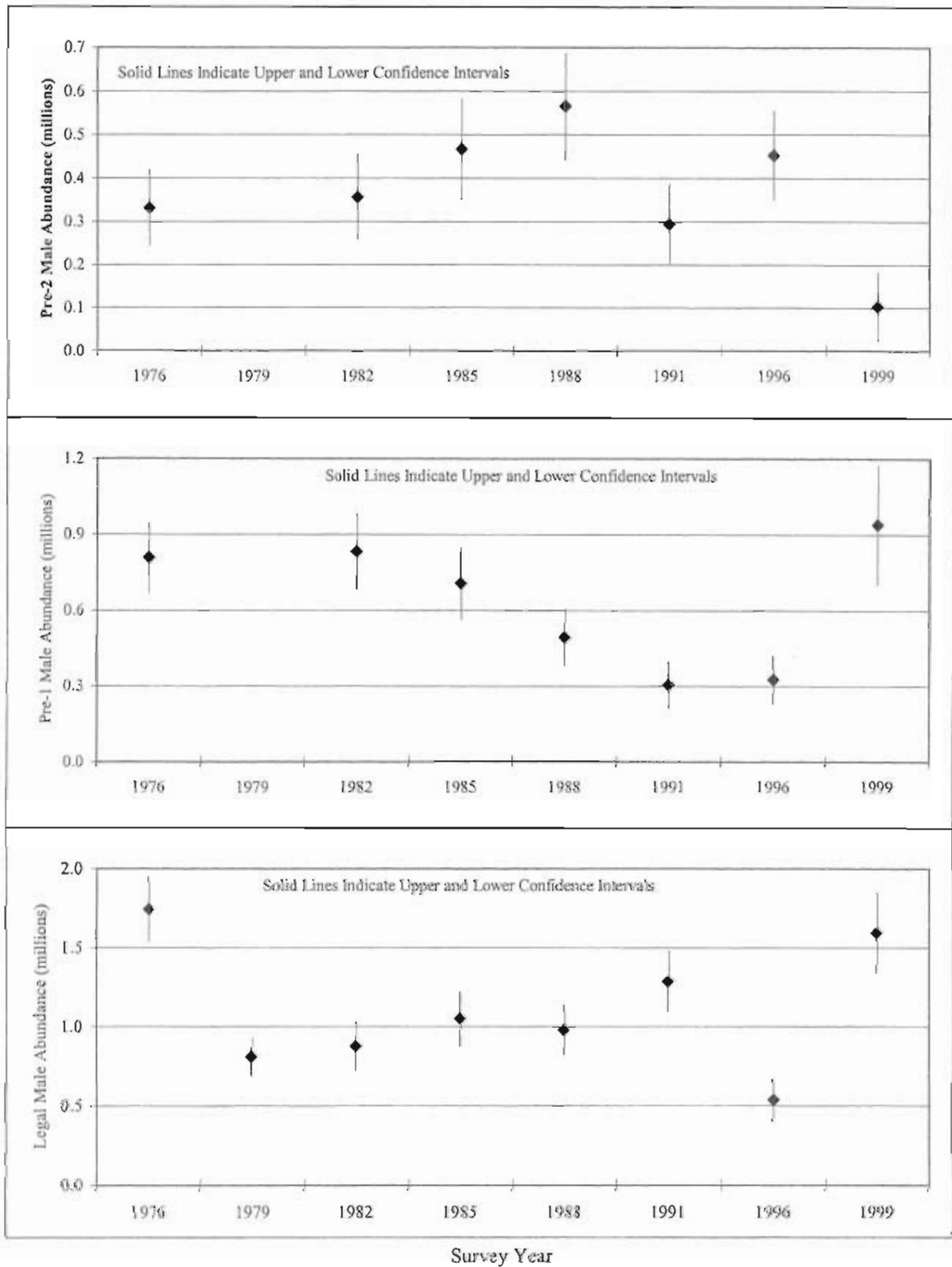


Figure 8. Standardized pre-2, pre-1, and legal male red king crab abundance estimates with 95% confidence intervals for the 1976-1999 Norton Sound trawl surveys.

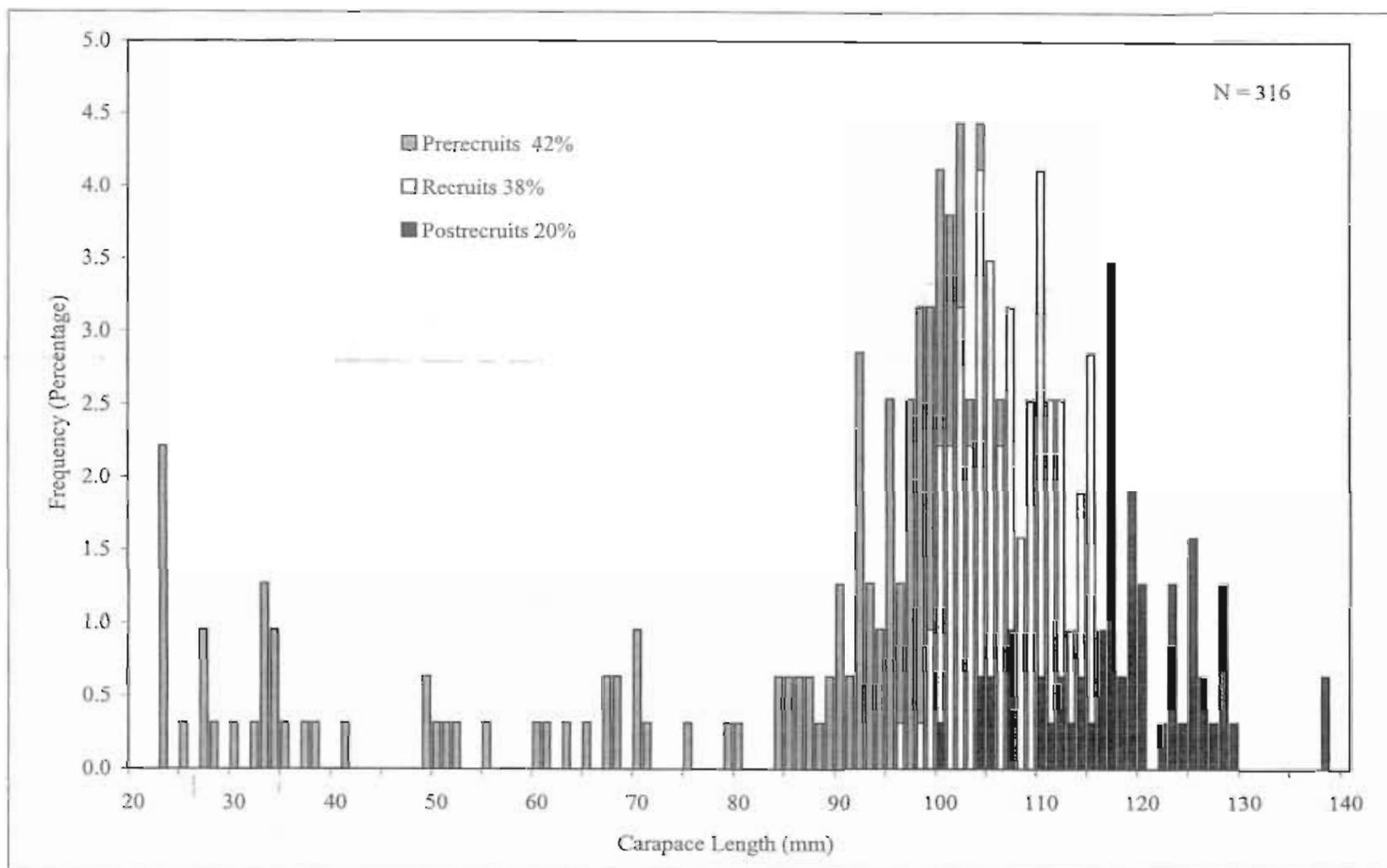


Figure 9. Length frequency distribution of all male red king crab measured during the Norton Sound trawl survey, 1999.

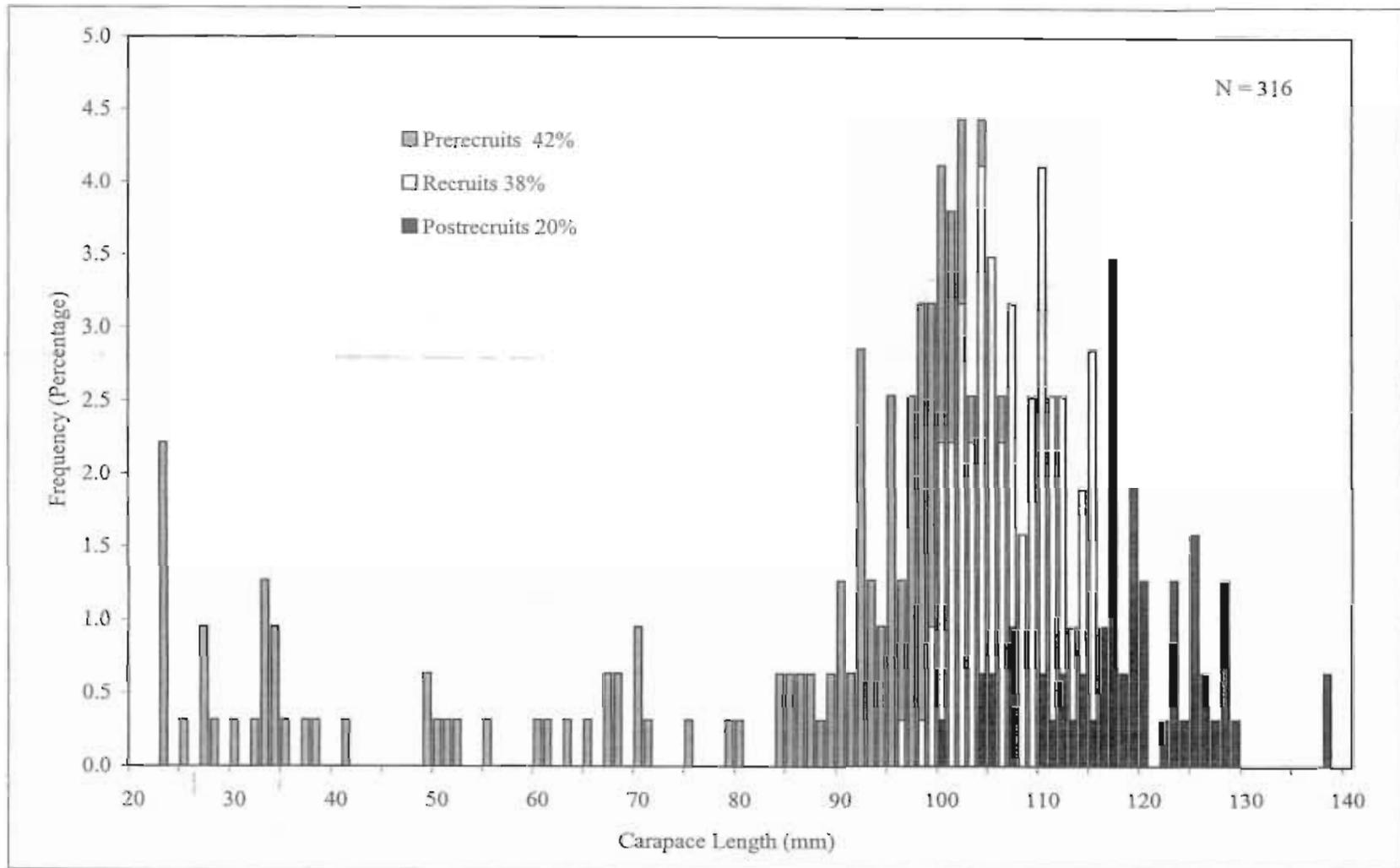


Figure 9. Length frequency distribution of all male red king crab measured during the Norton Sound trawl survey, 1999.

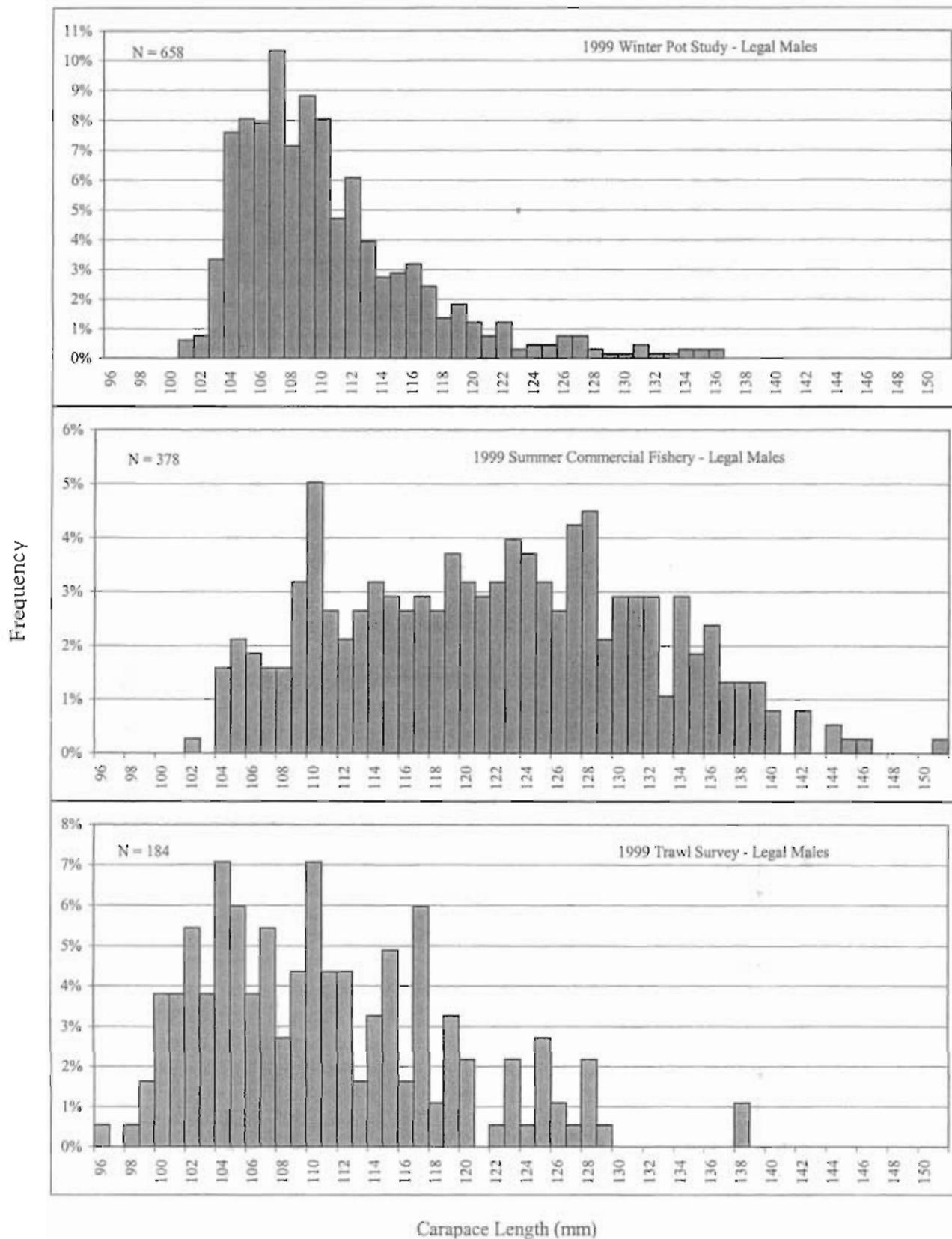


Figure 11. Norton Sound legal male red king crab length frequencies from the 1999 winter pot study (top), 1999 summer commercial fishery (middle), and 1999 trawl survey (bottom).

Frequency (Percentage)

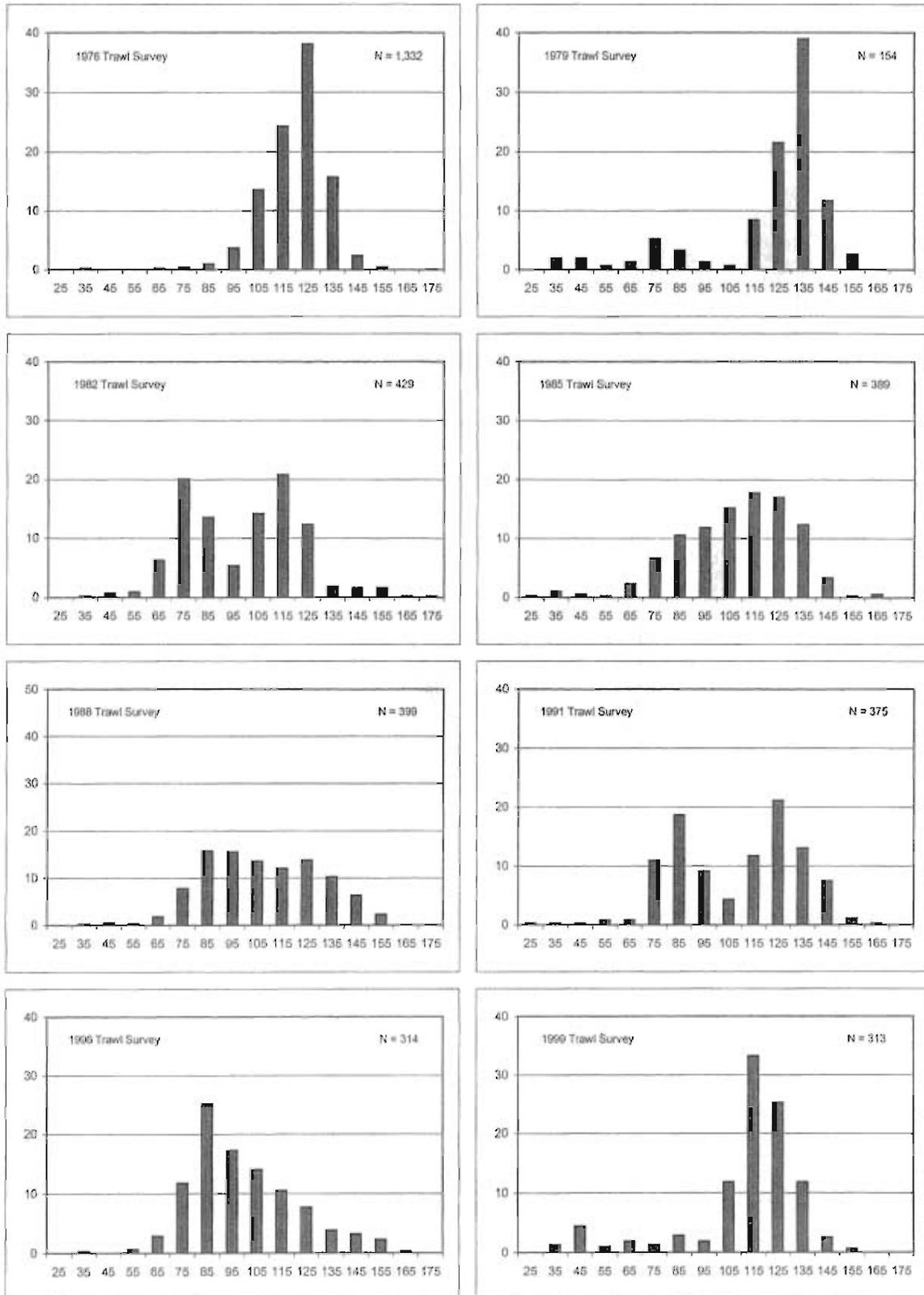
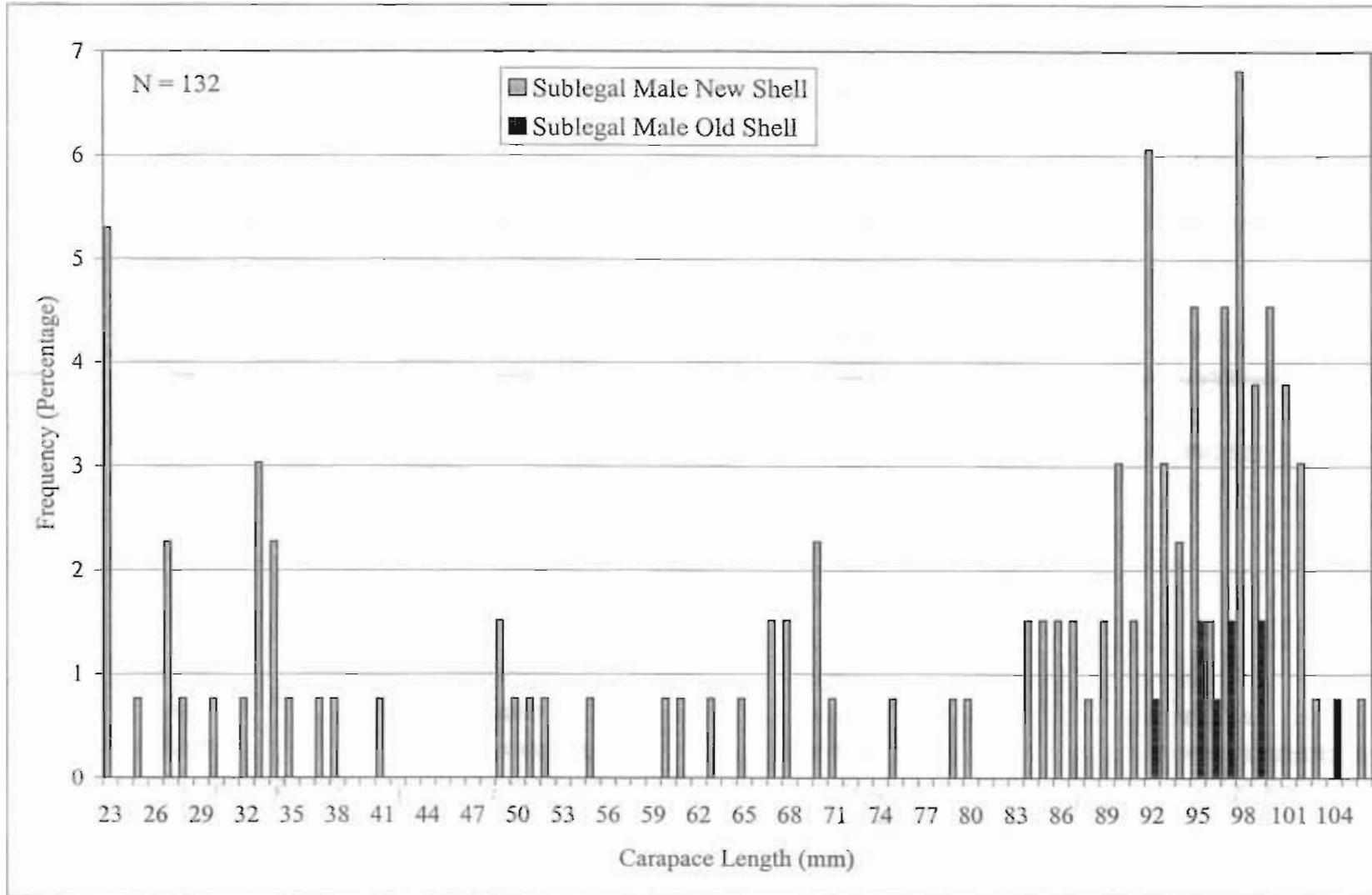


Figure 12. Norton Sound length frequencies for all male red king crab captured (standard and nonstandard stations) in the trawl surveys, 1976-1999.



Frequency (Percentage)

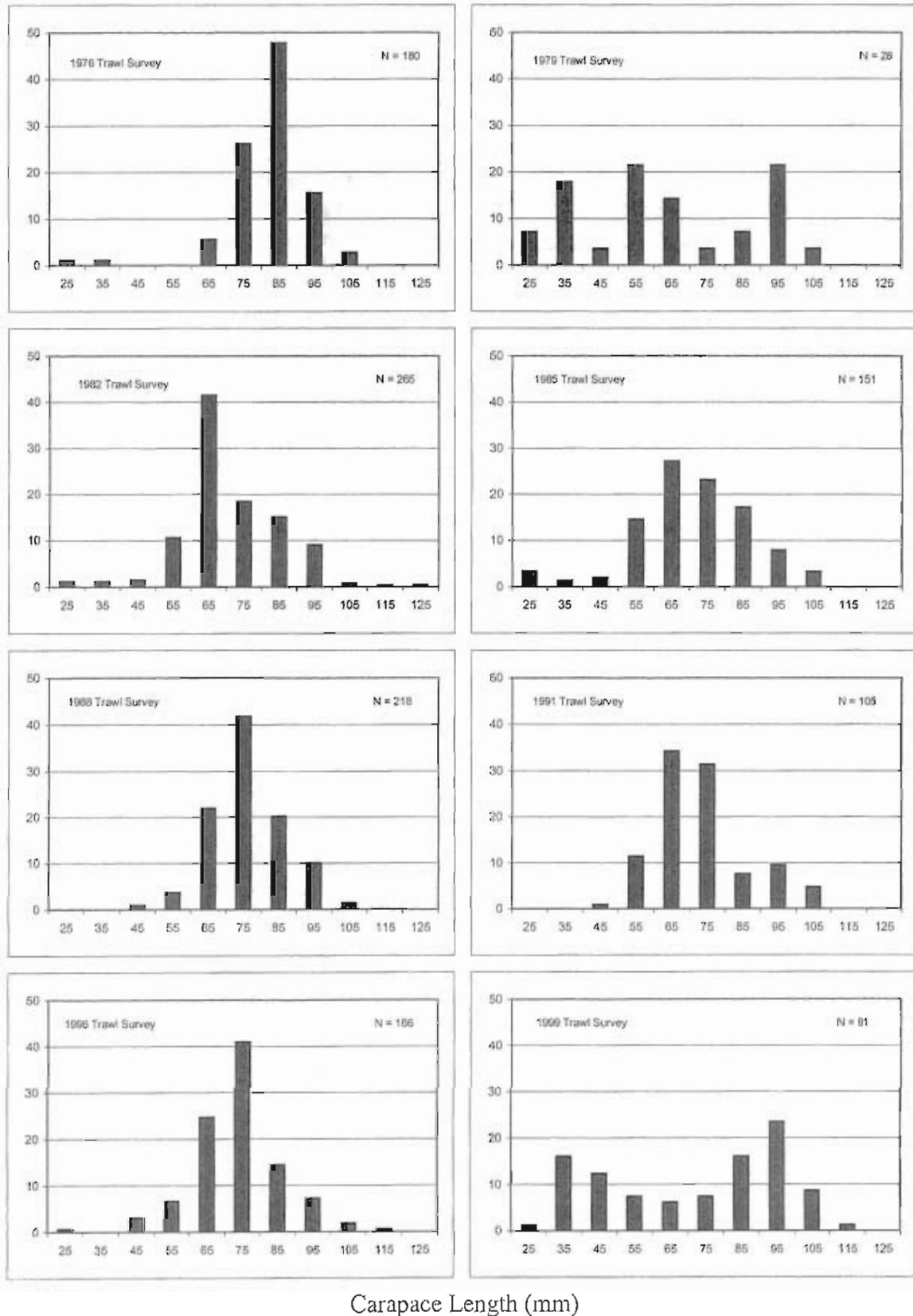


Figure 14. Norton Sound length frequencies for all female red king crab captured in the trawl surveys, 1976-1999.

Appendix A. 1999 Norton Sound ADF&G trawl survey data for legal male red king crab at each station sampled during the original survey and the resurvey. Information for each station includes: catch, area trawled, total area of the grid containing the given station, and the estimated abundance.

| Original Survey | | | | | Resurvey | | | | |
|-----------------|-----------|--------------------------|------------------------|-----------|----------------|-----------|--------------------------|------------------------|-----------|
| Station Number | Catch (#) | Area Trawled (sq. miles) | Total Area (sq. miles) | Abundance | Station Number | Catch (#) | Area Trawled (sq. miles) | Total Area (sq. miles) | Abundance |
| 77 | 0 | 0.0079 | 100 | 0 | | | | | |
| 97 | 1 | 0.0072 | 100 | 13,816 | | | | | |
| 98 | 5 | 0.0079 | 100 | 63,323 | 98 | 7 | 0.0079 | 100 | 88,652 |
| 99 | 1 | 0.0086 | 100 | 11,690 | | | | | |
| 100 | 3 | 0.0072 | 100 | 41,448 | | | | | |
| 101 | 0 | 0.0086 | 100 | 0 | | | | | |
| 102 | 1 | 0.0079 | 100 | 12,665 | | | | | |
| 103 | 1 | 0.0086 | 100 | 11,690 | | | | | |
| 104 | 3 | 0.0066 | 100 | 45,593 | | | | | |
| 105 | 0 | 0.0059 | 100 | 0 | | | | | |
| 106 | 3 | 0.0053 | 100 | 56,991 | | | | | |
| 107 | 0 | 0.0053 | 100 | 0 | | | | | |
| 123 | 0 | 0.0066 | 100 | 0 | | | | | |
| 124 | 0 | 0.0066 | 100 | 0 | | | | | |
| 125 | 3 | 0.0066 | 100 | 45,593 | | | | | |
| 126 | 0 | 0.0066 | 100 | 0 | | | | | |
| 127 | 0 | 0.0066 | 100 | 0 | | | | | |
| 128 | 3 | 0.0066 | 100 | 45,593 | | | | | |
| 129 | 8 | 0.0066 | 100 | 121,581 | 129 | 0 | 0.0066 | 100 | 0 |
| 130 | 3 | 0.0086 | 100 | 35,071 | | | | | |
| 131 | 0 | 0.0099 | 100 | 0 | | | | | |
| 132 | 1 | 0.0066 | 100 | 15,198 | | | | | |
| 133 | 0 | 0.0066 | 100 | | | | | | |
| 134 | 0 | 0.0066 | 100 | | | | | | |
| 135 | 0 | 0.0059 | 100 | | | | | | |
| 150 | 4 | 0.0072 | 100 | 55,264 | | | | | |
| 151 | 6 | 0.0053 | 100 | 113,982 | 151 | 10 | 0.0059 | 100 | 168,862 |
| 152 | 13 | 0.0059 | 100 | 219,520 | 152 | 3 | 0.0066 | 100 | 45,593 |
| 153 | 13 | 0.0072 | 100 | 179,608 | 153 | 17 | 0.0072 | 100 | 234,872 |
| 154 | 4 | 0.0066 | 100 | 60,790 | | | | | |
| 155 | 4 | 0.0079 | 100 | 50,659 | | | | | |
| 156 | 2 | 0.0066 | 100 | 30,395 | | | | | |
| 157 | 1 | 0.0079 | 100 | 12,665 | | | | | |
| 158 | 1 | 0.0066 | 100 | 15,198 | | | | | |
| 159 | 0 | 0.0072 | 100 | | | | | | |
| 160 | 0 | 0.0066 | 100 | | | | | | |
| 161 | 0 | 0.0059 | 100 | | | | | | |
| 176 | 0 | 0.0092 | 100 | | | | | | |
| 179 | 0 | 0.0059 | 100 | | | | | | |
| 180 | 2 | 0.0072 | 100 | 27,632 | | | | | |
| 181 | 0 | 0.0066 | 100 | | | | | | |
| 182 | 6 | 0.0066 | 100 | 91,185 | 182 | 10 | 0.0079 | 100 | 126,646 |
| 183 | 12 | 0.0059 | 100 | 202,634 | 183 | 18 | 0.0053 | 100 | 341,945 |
| 184 | 5 | 0.0079 | 100 | 63,323 | 184 | 5 | 0.0079 | 100 | 63,323 |
| 185 | 3 | 0.0066 | 100 | 45,593 | | | | | |
| 186 | 1 | 0.0053 | 100 | 18,997 | | | | | |
| 187 | 1 | 0.0086 | 100 | 11,690 | | | | | |
| 201 | 0 | 0.0086 | 91 | | | | | | |
| 202 | 0 | 0.0072 | 86 | | | | | | |
| 203 | 0 | 0.0079 | 83 | | | | | | |
| 204 | 0 | 0.0059 | 61 | | | | | | |
| Sum | 114 | 0.3577 | 5,021 | 1,719,387 | | 70 | 0.0553 | 800 | 1,069,893 |

Appendix B. 1999 Norton Sound ADF&G trawl survey data of legal male red king crab for each station sampled, combining the original survey and the resurvey. Information for each station includes: catch, area trawled, total area of the grid containing the given station, and the estimated abundance.

| Station Number | Catch (numbers) | Area Trawled (square miles) | Total Area (square miles) | Abundance |
|----------------|-----------------|-----------------------------|---------------------------|------------------------|
| 77 | 0 | 0.0079 | 100 | 0 |
| 97 | 1 | 0.0072 | 100 | 13,816 |
| 98 | 12 | 0.0158 | 100 | 75,988 |
| 99 | 1 | 0.0086 | 100 | 11,690 |
| 100 | 3 | 0.0072 | 100 | 41,448 |
| 101 | 0 | 0.0086 | 100 | 0 |
| 102 | 1 | 0.0079 | 100 | 12,665 |
| 103 | 1 | 0.0086 | 100 | 11,690 |
| 104 | 3 | 0.0066 | 100 | 45,593 |
| 105 | 0 | 0.0059 | 100 | 0 |
| 106 | 3 | 0.0053 | 100 | 56,991 |
| 107 | 0 | 0.0053 | 100 | 0 |
| 123 | 0 | 0.0066 | 100 | 0 |
| 124 | 0 | 0.0066 | 100 | 0 |
| 125 | 3 | 0.0066 | 100 | 45,593 |
| 126 | 0 | 0.0066 | 100 | 0 |
| 127 | 0 | 0.0066 | 100 | 0 |
| 128 | 3 | 0.0066 | 100 | 45,593 |
| 129 | 8 | 0.0132 | 100 | 60,790 |
| 130 | 3 | 0.0086 | 100 | 35,071 |
| 131 | 0 | 0.0099 | 100 | 0 |
| 132 | 1 | 0.0066 | 100 | 15,198 |
| 133 | 0 | 0.0066 | 100 | 0 |
| 134 | 0 | 0.0066 | 100 | 0 |
| 135 | 0 | 0.0059 | 100 | 0 |
| 150 | 4 | 0.0072 | 100 | 55,264 |
| 151 | 16 | 0.0112 | 100 | 143,036 |
| 152 | 16 | 0.0125 | 100 | 127,980 |
| 153 | 30 | 0.0144 | 100 | 207,240 |
| 154 | 4 | 0.0066 | 100 | 60,790 |
| 155 | 4 | 0.0079 | 100 | 50,659 |
| 156 | 2 | 0.0066 | 100 | 30,395 |
| 157 | 1 | 0.0079 | 100 | 12,665 |
| 158 | 1 | 0.0066 | 100 | 15,198 |
| 159 | 0 | 0.0072 | 100 | 0 |
| 160 | 0 | 0.0066 | 100 | 0 |
| 161 | 0 | 0.0059 | 100 | 0 |
| 162 | 0 | 0.0059 | 100 | 0 |
| 176 | 0 | 0.0092 | 100 | 0 |
| 179 | 0 | 0.0059 | 100 | 0 |
| 180 | 2 | 0.0072 | 100 | 27,632 |
| 181 | 0 | 0.0066 | 100 | 0 |
| 182 | 16 | 0.0145 | 100 | 110,528 |
| 183 | 30 | 0.0112 | 100 | 268,192 |
| 184 | 10 | 0.0158 | 100 | 63,323 |
| 185 | 3 | 0.0066 | 100 | 45,593 |
| 186 | 1 | 0.0053 | 100 | 18,997 |
| 187 | 1 | 0.0086 | 100 | 11,690 |
| 201 | 0 | 0.0086 | 91 | 0 |
| 202 | 0 | 0.0072 | 86 | 0 |
| 203 | 0 | 0.0079 | 83 | 0 |
| 204 | 0 | 0.0059 | 61 | 0 |
| Sum | 184 | 0.4130 | 5,021 | 1,594,341 ^a |

^a This number does not include the abundances of the non-standard stations (numbers 97-102), but does include abundance estimates for standard stations that were not surveyed as described in the methods section.