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FINDINGS FROM THE 1991 GOLDEN KING CRAB SURVEY IN THE  
DUTCH HARBOR AND ADAK MANAGEMENT AREAS  
INCLUDING ANALYSIS OF RECOVERED TAGGED CRABS

By

S. Forrest Blau

and

Douglas Pengilly

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## AUTHORS

S. Forrest Blau is a fishery biologist specializing in king crab research and Douglas Pengilly is a Westward regional biometrician. Both authors work for the Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, 211 Mission Road, Kodiak, Alaska 99615.

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## INTRODUCTION

The Aleutian Islands contains two management areas for king crabs, Dutch Harbor, Statistical Area O, and Adak, Statistical Area R (ADF&G 1993). They share a common boundary line at 171° W longitude. The developed phase of the Aleutian Islands golden or brown king crab *Lithodes aequispinus* fishery began in the 1981/82 season. In the ensuing 11 seasons 40,767 mt (90 million lb) of crabs with an exvessel value of \$280 million have been landed (Griffin and Ward 1994). Over the past 11 seasons, 84% of the catch weight and value came from the Adak Area and 16% from the Dutch Harbor Area.

Golden king crabs are generally called brown king crabs by commercial fishermen in Alaska. Golden king crab will be used in this report to prevent confusion with *Paralithodes brevipes* which was the first species to be called brown king, it occurs in the western Pacific (Blau 1990a).

The golden king crab fishery in the Aleutian Islands is the fourth largest shellfish fishery in Alaska; since 1980 only the red king crab *Paralithodes camtschaticus*, Tanner crab *Chionoecetes bairdi* and snow crab *C. opilio* fisheries in the Bering Sea are greater in value and tonnage landed (ADF&G 1994). The federal Fishery Management Plan for the Aleutian golden king crab fishery requires that recruitment overfishing not occur and that fishing mortality not exceed 0.3 (a 25% exploitation rate) annually. However, prior to 1991, no systematic survey of golden king crabs had been conducted in Alaska. The Bering Sea, Alaska Peninsula, Kodiak, and Cook Inlet Management Areas are surveyed annually for king and Tanner crabs whereas Norton Sound and southeastern Alaska are surveyed less frequently. Ironically five of these areas currently produce lower catches and value of crabs compared to the golden king crab fishery in the Aleutian Islands.

Observers from both the Alaska Department of Fish and Game (ADF&G) and the National Marine Fisheries Service (NMFS) have collected biological data on golden king crabs aboard foreign trawlers and domestic crabbing vessels in the Aleutians. Their findings have been summarized in the following reports: Molyneaux (1985), Urban (1986), Blau (1987), McBride et al. (1982), Ronholt et al. (1982), Otto et al. (1983), Otto (1983), Otto and Cummiskey (1985), Somerton and Otto (1986), Beers (1991 and 1992) and Tracy (1994). None of the aforementioned trips surveyed the population of golden king crabs in a systematic manner throughout the crabs' depth distribution. Data gathered was primarily at depths where legal male crabs were commercially fished. These crabs are known to segregate to various extents by size, sex and depth in Canadian fjords (Sloan 1985).

The golden king crab fishery around the Aleutian Islands occurs between the Islands of Four Mountains and the U.S. - Russia Convention Line of 1867, a spanning approximately 1,334 km (720 nmi) in length and covering an area of 98,700 km<sup>2</sup> (28,800 nmi<sup>2</sup>). This area was too large to survey due to funding limitations. Survey efforts were therefore restricted to the major commercial fishing grounds within both the Dutch Harbor and Adak Management Areas.

## *Survey Goals and Objectives*

The goal of this research project was to systematically survey golden king crabs throughout their depth distribution within the major fishing areas shared by both the Dutch Harbor and Adak Management Areas. Specific research objectives were to:

1. Estimate size at 50% maturity (SM50) for female golden king crabs in each portion of the Dutch Harbor and Adak Management Areas surveyed.
2. Test the hypothesis that the female SM50 is within 3 mm (0.1 in) carapace length, for both management areas.
3. Determine the size, sex, relative abundance, ovigerity and symbionts of golden king crabs within the survey area. Calculate catch per unit of effort or catch per pot (CPUE) of crabs by sex, size and depth groups for each area.
4. Estimate the percentage of male golden king crabs at each millimeter carapace length that have legal carapace widths.
5. Estimate the size of the merus from the second walking leg below which all male golden crabs have sublegal widths.
6. Estimate size at 50% maturity (SM50) for male golden king crabs in each portion of the Dutch Harbor and Adak Management Areas surveyed.
7. Test the hypothesis that the male SM50 is the same for both management areas.
8. Tag and release male and female golden king crabs. From tag recoveries of legal-sized males estimate the minimum exploitation rate for the 1991/92 season in both management areas. Determine growth and migratory movements of male and female crabs, and mature female brooding and molting cycles.

## **METHODS**

### *Study Site and Sampling Design*

To identify the golden king crab area to survey, commercial catches were compiled from Dutch Harbor and Adak Management Areas. Survey boundaries were from 169° W longitude to 173°20' W longitude and from 51°50' N latitude to 53°20' N latitude. This region included five of the seven statistical areas with the highest golden king crab production in the Aleutians at the time of survey planning in 1991 (Appendix A).

Stations were laid out on National Oceanic and Atmospheric Administration charts 16480 and 16500 using a 9.3 km (5 nmi) systematic spatial sampling design or grid pattern. Stations within the study site were selected when they occurred entirely within the depth range of 137-913 m

(75-500 fm); that depth range covered the majority of depths that golden king crabs inhabit (Blau 1990a). Each station encompassed an area of approximately 25 nmi<sup>2</sup>. Stations fished were located around Yunaska, Chagulak and Amutka Islands (Figure 1 and Appendix B).

## Collection Methods

The 31 m (101 ft) FV *Western Viking* was chartered at the rate of \$5,940/day to conduct the survey for the 30 day period from August 21 - September 19, 1991. The charter began and ended in Dutch Harbor. Mr. Jan Jastad skippered the vessel during the survey and had a crew of two deckhands and a cook. ADF&G's crew was composed of a fishery biologist (senior author) and three ADF&G technicians.

A goal of retrieving five stations per day each with 15 pots per station was initially planned (Blau 1992); but generally three stations composed of 10 pots were pulled each day. Conical crab pots covered with tarred nylon web with a stretch mesh of 9-11 cm (3.5-4 in) were fished in a longline fashion and weighed 50 kg (110 lbs) each (Figures 2 and 3). At each station pots were spaced 183 m (100 fm) apart linked together by C-clamps and longline made of 20 mm (3/4 in) diameter manline or grayline. A king crab pot 200 x 200 x 84 cm (6.6 x 6.6 x 2.6 ft) weighing 295 kg (650 lb) was set at each end of the string 183 m (100 fm) from the last conical pot in the string to anchor the string (Figure 3). A string of 10 conical pots stretched 1.6 km (900 fm) across the bottom; the total distance between the two anchor pots on a string was 2 km (1,100 fm). Each anchor pot was linked to the surface at each end by 366 to 1,098 m (200 to 600 fm) of 20 mm (3/4 in) polypropylene line to which three 40 cm (16 in) plastic trawl and two polypropylene buoys were attached (Figure 3). At the end of the buoys, nearest the surface, a radio beacon (model RF700C, NovaTech Designs Ltd., Canada<sup>1</sup>) was placed on most strings of gear. When not pulled underwater by current, the radio beacon sent out signals which could be picked up by a receiver (model TD-L1620, Simrad Taiyo<sup>1</sup>) located in the wheelhouse.

The goal was to fish the pots in each string for a soak time of two days. Each pot was baited with 3.8 L (1 gal) of chopped frozen Pacific herring *Clupea harengus pallasii* in two perforated bait jars, and one Pacific cod *Gadus macrocephalus* or an equivalent amount of bottomfish was used as hanging bait. Pots were set and retrieved with the assistance of a hydraulic crab block. Depths that pots were set in were read from a fathometer.

At each station for each conical pot fished, the skipper recorded on the Pilot House Log the set date, time, depth, bottom type, sequential pot number, latitude, and longitude (Appendix C.1.). When pots were retrieved the date and time of lift was recorded in sequence for each pot lifted. Pots lost were also noted on that form.

After the pots were retrieved, ADF&G personnel identified, measured, and recorded the entire catch from each pot on the Crab Research Data Form (Appendix C.2.) using the same sequential pot number that the skipper used. This form was made of water resistant paper. A unique number was given to each species captured to aid in data sorting and summarization. There was no subsampling of any pot's marine life. The sex and exoskeletal age of all crabs captured were

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<sup>1</sup>Reference to trade name does not imply endorsement by ADF&G.

recorded. Exoskeletal age followed the classification of Weber and Miyahara (1962) and crabs were categorized as either new soft-shell, new-shell, old-shell or very old-shell based on the amount of scratches on the ventral side of the coxa and/or presence of visible epibionts on the exoskeleton. Leatherback crabs are aneuviviant (old and very old-shell) male golden king crabs with soft or leathery carapaces while the rest of the exoskeleton is hard. All crabs with this condition were noted under the comments section on the Crab Data Form beginning with station 25. Prior to station 25 leatherback crabs were not noted on the Crab Data Form. Crab condition was recorded as dead or alive when it arrived on deck. Presence of externally visible diseases and the parasitic barnacle *Briarosaccus callosus* on golden king crabs were recorded. Female crabs were examined for presence or absence of embryos, embryo color, development stage, dead embryos and clutch size.

Most measurements on crabs were taken with Vernier calipers to the nearest millimeter (0.04 in) or to the nearest 0.1 mm (0.004 in) when measuring the right chela. Carapace length (CL) on golden and scarlet *Lithodes couesi* king crabs were taken from the right eye orbit to the midpoint of the posterior margin of the carapace (Figure 4A). On male golden king crabs the minimum legal size in the Dutch Harbor and Adak Management Areas was 152.4 mm (6.0 in) carapace width (CW) at the time of the survey and in the ensuing two seasons. Carapace width measurement was taken from the greatest straight line distance across the carapace at a right angle to a line midway between the eyes to the midpoint of the posterior portion of the carapace, including the spines (Figure 4A). On some males the merus length of the left, second walking leg and/or the right chela was also measured (Figure 4B and 4C). No measurements were taken of either the merus or chela if these parts were regenerated, or if they appeared smaller than normal for any given sized crab. Fork lengths on fish were measured to the nearest cm (0.4 in) and their condition when brought aboard, i.e., dead or alive, was recorded.

Male golden king crabs  $\geq 100$  mm (3.9 in) CL and one of every four females  $\geq 90$  mm (3.5 in) were tagged with a 45 cm (17.7 in) long, orange vinyl Floy<sup>2</sup> spaghetti tags. Each tag had "ADF&G ADAK C" and a sequential number printed on it in black ink. A 6 cm (2.4 in) length of 18-20 gauge wire sharpened at each end was used to apply the tag to the crab. One end of the wire was pushed into the hollow tag, the other end was drawn through the crab's isthmus muscle to equal lengths (Figure 5) (Alaska Dept. Fisheries 1954). Most tags were fastened with an overhand knot near the posterior margin of the carapace. About 100 tags had each end of the tag's tubing drawn through the grooves of a 7 mm (0.3 in) Nicopress swedge, which was slid near the crabs' isthmus muscle then crimped closed with end nipper pliers. All tagged crabs were released on the same station caught.

To examine the effects of tagging on crabs, 10 new-shell male and 10 new-shell female golden king crabs were selected from station 54 (average depth 435 m or 265 fm). Crabs were out of the water approximately one and one-half hours, in foggy mist, before being placed in a king crab pot with the entrances sewn shut. Five crabs of each sex were tagged, the remainder were untagged (control group). Carapace lengths of tagged males were 109, 120, 123, 143, and 152 mm (4.3, 4.7, 4.8, 5.6, 6.0 in); untagged males were 106, 134, 139, 153, and 171 mm (4.2, 5.3, 5.5, 6.0, 6.7 in). Carapace lengths of tagged females were: 102, 112, 132, 136, and 138 mm (4.0, 4.4, 5.2, 5.4, 5.4 in); untagged females were 104, 125, 133, 138, 143 mm (4.1, 4.9, 5.2, 5.4, 5.6

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<sup>2</sup>Reference to trade name does not imply endorsement by ADF&G.

in). The pot went overboard with the rest of the string at station 59 where it soaked for 1.1 days at a depth of 508 m (278 fm). After the pots were retrieved the condition of each crab was examined.

Tag recoveries were made by ADF&G dockside samplers in Dutch Harbor and from observers on catcher-processors. All tag recoveries were recorded on the Tag Recovery Form (Appendix C.3.). Tag recoveries reported here are from the two complete commercial golden king crab seasons following the completion of the 1991 survey. For Dutch Harbor, Area O, these seasons were: 1991 (O91 = 9/1-11/15/91) and 1992 (O92 = 9/1-11/15/92). For Adak, Area R, these seasons were: 1991 (R91 = 11/1/91 - 8/15/92) and for 1992 (R92 = 11/1/92 -8/15/93). Tag recovery rates for legal males were calculated for each management area after the completion of the 1991/92 season. Growth and net movement of recovered male crabs were calculated.

### **Electronic Data Entry and Editing**

All data collected on marine species were recorded on deck using the crab data form. On deck data were entered into a database called Adak91. The pilot house and tag recovery data were entered at the Kodiak, ADF&G office. All post-entry editing of the data was done in Kodiak.

### *Data Analyses*

#### **Female Size at Maturity**

Female golden king crab size at 50% maturity (SM50) for each management area was estimated using a logistic model (Cox and Snell 1989) to fit the proportion of females mature at given carapace lengths. All females examined for clutch fullness were included in the analysis. Mature females were defined as those females having either embryos or empty egg cases and funiculi on their pleopodal setae.

The model states:

$$p_m(L) = \frac{e^{\beta_0 + \beta_1 L}}{1 + e^{\beta_0 + \beta_1 L}}$$

where  $p_m(L)$  is the predicted proportion of females with carapace length  $L$  that are mature. The maximum likelihood estimates (MLE's) of  $\beta_0$  and  $\beta_1$  were obtained using the nonlinear estimation routine (NONLIN) of SYSTAT (Wilkinson 1990). Size at 50 percent maturity (SM50) was estimated by

$$SM50 = -\frac{\hat{\beta}_0}{\hat{\beta}_1}$$

where  $\hat{\beta}_0$  and  $\hat{\beta}_1$  are the MLE's of  $\beta_0$  and  $\beta_1$ , respectively. To obtain a confidence interval on the estimated SM50, the variance of the estimator was estimated by applying the variance and

covariance estimates for the MLE's of  $\beta_0$  and  $\beta_1$  to the Taylor series approximation of the variance of a ratio of two random variables (e.g., Mood et al. 1974).

### **Crab and Depth Categories**

For summarization and analysis purposes golden king crabs were categorized as follows. Juvenile females were defined as females without embryos or funiculi (egg stalks) on their pleopodal setae which were  $<SM50$ . Adult females had either embryos or empty egg cases and funiculi on their pleopodal setae, or are barren females  $\geq SM50$ . Sublegal males have carapace widths  $<152.4$  mm ( $<6.0$  in) measured outside the spines and were split into two groups. Prerecruit ones were males estimated to be one molt away from legal size. Based on growth per molt information their carapace lengths were estimated to be 121-137 mm (4.8-5.4 in) but less than legal minimum width (Koeneman and Buchanan 1985, R.S. Otto, National Marine Fisheries Service, Kodiak, personal communication). All other sublegal males  $\leq 120$  mm ( $\leq 4.7$  in) CL were grouped together as prerecruits 2-5, and estimated to be two to five years away from the recruit class. Legal males have carapace widths  $\geq 154.2$  mm ( $\geq 6.0$  in) measured outside the spines and were divided into two groups. Recruits were defined as new-shell males  $\leq 153$  mm (6.0 in) CL that have reached legal width. Postrecruits were males  $\geq 154$  mm ( $\geq 6.0$  in) CL including all legal-sized aneuvivants (old and very old-shell crabs). Catch per pot (CPUE) statistics for most of the preceding groups were calculated for each station fished and for 92 m (50 fm) depth categories. Box plots of data for crab groups by depth categories were constructed following the definitions found in Hoaglin et al. (1983).

### **Sublegal and Legal Male Size Overlap**

Carapace length and carapace width (outside the spines) of male golden king crabs were measured over the size range collected. Estimation of carapace width from carapace length was performed by linear regression and the percentage of males at each millimeter carapace length that have the size overlap of sublegal and legal sizes were calculated.

### **Male Merus Length vs. Legal Size**

The merus length of the second walking leg (after Somerton 1986) and the carapace width, outside the spines, was measured to the nearest millimeter on male golden king crabs over the size range collected. Data on proportion of male golden king crabs that were legal at merus lengths were fit to a logistic curve using the methods described for analyzing female size at maturity. The model is:

$$p_1(M) = \frac{e^{\beta_0 + \beta_1 M}}{1 + e^{\beta_0 + \beta_1 M}}$$

where  $p_1(M)$  is the predicted proportion of males with merus length  $M$  that are legal. The merus length at which 5% of males are legal (MSL05) was estimated by

where  $\hat{\beta}_0$  and  $\hat{\beta}_1$  are the MLE's of  $\beta_0$  and  $\beta_1$ , respectively. To obtain a confidence interval on the estimated MSL05, the variance of the estimator was estimated by using the Taylor series

$$MS\hat{L}05 = \frac{\ln(.05/.95) - \beta_0}{\beta_1},$$

approximation. The merus length at which 1% of males are legal (MSL01) was estimated by

$$MS\hat{L}01 = \frac{\ln(.01/.99) - \beta_0}{\beta_1}.$$

A confidence interval on the estimated MSL01 was, again, obtained by using the Taylor series approximation for the variance of the estimator.

## RESULTS

The area surveyed was located between 52° 18' and 52° 57' N latitude and 170° 17' and 171° 50' W longitude encompassing approximately 2,748 km<sup>2</sup> (800 nmi<sup>2</sup>). Sixty stations were fished (Figure 6 and Appendix B). The first station was set on August 23 and the last was retrieved on September 17 (Table 1). Thirty-three stations had a radio beacon attached to one end of the string. Each station was on "hard" bottom as recorded by the skipper from his fathometer. Approximately 200 km (108 nmi) of buoylines and longlines were set and retrieved; similarly, 597 conical pots were set and only three were lost and not retrieved. Conical pots retrieved per station ranged from seven to 10 with 56 stations having 10 pots (Table 1). The mean soak time of pots per station was 3.2 days with a range of 1.1 to 7.7 days (Table 1 and Figure 7). Half of the pots retrieved had soak times from 2.5 to 3.1 days (Figure 7). Depths fished ranged from 137 m (75 fm) to 852 m (466 fm).

There were 12,545 golden king crabs captured during the survey of which 6,479 (51.6%) were females and 6,066 (48.4%) were males (Table 1). Golden king crabs occurred in 54 (90%) of the 60 stations fished; none were captured at stations 1, 2, 7, 12, 18, and 60. Of the 594 pots retrieved 489 (82.3%) contained one or more golden king crabs.

The overall catch per pot (CPUE) of golden king crabs was 21.1. The overall CPUE and percentage of total crabs caught by sex and size groups was as follows: sublegal males 8.1 CPUE (36.2%), legal males 2.1 CPUE (10.1%), juvenile females 5.6 CPUE (26.3%) and adult females 5.3 CPUE (25.3%) (Table 1). Mean depth per station was 404 m (221 fm) ranging from 143 m (78 fm) to 849 m (464 fm) (Table 1 and Figure 8). The spatial distribution of golden king crabs by station and CPUE are depicted by sex and size groups on Figures 9-13. The highest CPUE at any one station of each crab group was as follows: total crabs, 102.7 (station 5); sublegal males, 50.3 (station 5); legal males, 8.4 (station 8); juvenile females, 52.4 (station 5); and adult females, 26.4 (station 57) (Table 1 and Figures 9-13).

### *Carapace Length and Carapace Width Relationships*

Carapace lengths were taken on 6,063 male and 6,475 female golden king crabs (Figure 14). Only three males were not measured for carapace length. The size range of carapace lengths was 37 to 197 mm (1.5 to 7.6 in) for males and 35 to 161 mm (1.4 to 6.3 in) for females. The sample mode was 132 mm (5.4 in) for males (n=92) and 110 mm (4.3 in) for females (n=139) (Figure 14). Male crabs were the predominate sex captured beginning at 128 mm (5.0 in) CL. Mean carapace length for sublegal males was 99 mm (3.9 in) and 146 mm (5.7 in) for legal males. Juvenile females average 83 mm (3.3 in) CL and adult females 124 mm (4.9 in) CL. Mean carapace lengths for these groups by station are listed in Table 1.

The relationship between carapace width and carapace length in the 3,206 measured male golden king crabs is shown in Figure 15. The smallest and largest paired carapace length and width measurements were 41 mm CL and 45 mm CW (1.6 and 1.8 in) and 197 mm CL and 223 mm CW (7.6 and 8.8 in). Although carapace width has a high linear correlation with carapace length ( $r=0.987$ ) and the length-width relationship is close to linear (Figure 15), the carapace length-width scatter plot also indicates that the variance of carapace width increases with carapace length. Hence, linear regression of carapace width on carapace length is not appropriate without first performing a variance stabilizing transformation of the data. Log transforming of both carapace width and carapace length resolved the problem of variance heterogeneity while retaining the linear relationship, indicating that the "transform both sides" regression technique of Carroll and Ruppert (1988) was appropriate. Accordingly, linear regression was performed on the transformed variables,

$$w^* = \ln(\text{carapace width}), \text{ and}$$

$$l^* = \ln(\text{carapace length}).$$

Estimates of the regression parameters,  $\beta_0$  and  $\beta_1$ , for the regression model,

$$w^* = \beta_0 + \beta_1 l^*,$$

are

$$\beta_0 = 0.007,$$

and

$$\beta_1 = 1.020.$$

Standard errors of the estimates of the regression parameters,  $\beta_0$  and  $\beta_1$ , were estimated as 0.0119 and 0.0025, respectively. The  $r^2$  value for the regression is high (0.982), with the variance of  $w^*$  about the regression line estimated as 0.00081. Ninety-five percent confidence intervals for  $\beta_0$  and  $\beta_1$  were estimated as -0.017 to 0.031 and 1.015 to 1.024, respectively.

Back-transforming the regression equation into the original scale gives the equation for predicting carapace width from carapace length,

$$\text{carapace width} = 1.007 (\text{carapace length})^{1.020}.$$

### ***Sublegal - Legal Size Overlap***

There were 2,330 male golden king crabs which shared carapace lengths from 119 to 152 mm (4.7 to 6.0 in) which overlapped both sublegal and legal carapace widths (Table 2). All males  $\leq 118$  mm (4.6 in) CL had sublegal widths and all males  $\geq 153$  mm (6.1 in) CL had legal widths. Near the 137 mm (5.4 in) CL was where 50% of the males could be either sublegal or legal.

### ***Legal Size at Merus Length***

Merus length was paired with carapace width and sublegal-legal determinations on 1,921 male golden king crabs (790 from the Dutch Harbor and 1,131 from the Adak portions of the survey area). Logistic curves were fit individually to each of the Dutch Harbor Area and Adak Area samples. The 95% confidence intervals for the logistic curve parameters indicate that no real difference exists between males from the two areas in the relationship between proportion legal and merus length (Table 4). Accordingly, all males from the two areas were combined for analysis (Figure 16). The merus length at which only 5% of males are legal (MSL05) was estimated to be approximately 99 mm from the combined sample, while the merus length at which only 1% of males are legal (MSL01) was estimated to be approximately 93 mm (Table 4). In the combined samples of males from the Adak and Dutch Harbor Areas ( $n = 1,921$ ) the largest merus length for a sublegal crab was 95 mm; the remaining 751 males with merus lengths  $\leq 95$  mm were sublegal in carapace width size.

### ***Shell Aging***

Exoskeleton ages were classified on 12,543 golden king crabs. Ninety-eight percent of the crabs (12,289) were new-shell, 1.7% (219) were old-shell, and 0.3% (35) very old-shell crabs (Table 3). There were no new soft-shell crabs captured on the survey. Exoskeleton classification was nearly identical for the Dutch Harbor and Adak Areas and was consistent by size and sex. Old and very old-shell crabs were  $<1\%$  of the total number of juvenile and adult females captured, while 2.0% of the sublegal and 11.7% of the legals were in these shell age categories.

### ***Effort and Catch of Golden King Crabs by Management Area and Depth***

Of the total pots retrieved, 255 (42.9%) were fished in the Dutch Harbor Area and 339 (57.1%) were fished in the Adak Area (Table 5 and Figure 17). Seventy-five percent of the pot lifts for both areas combined were fished in the 183-547 m (100-299 fm) depth range. Although the mean depth for pots fished in each area were similar [366 m (200 fm) for Dutch Harbor and 434 m (237 fm) for Adak] the distribution of depths fished was skewed on the shallow side for the

Dutch Harbor portion of the survey and deeper in the Adak Area. In the 137-364 m (75-199 fm) depth range 65% of the pot lifts were pulled in the Dutch Harbor portion of the survey area compared to 22% of the Adak pot lifts. Conversely, in the 458-730 m (250-399 fm) depth range, 11% of the pot lifts occurred in the Dutch Harbor side of the survey area compared to 50% of the pot lifts from Adak. Pot lift effort was 16% for both areas in the 366-456 m (200-249 fm) depth range. Only 4% of the survey pot lifts occurred in the deepest 731-913 m (400-499 fm) depth range fished.

The greatest number of golden king crabs captured for the entire survey coincided with the largest number of pot lifts in the 274-547 m (150-299 fm) depth range (Table 5 and Figure 18). In six of the nine depth categories more than 1,000 golden king crabs were captured in the Dutch Harbor and Adak samples combined (Table 5). CPUE for total crabs caught was 14.9 on the Dutch Harbor side of the survey, 25.8 on the Adak side and 21.1 for the entire survey. Adak had higher CPUE in the shallowest seven depth groups, 137-730 m (75-399 fm) and the Dutch Harbor side of the survey area had higher CPUE in the deepest two depth groups, 731-913 m (400-499 fm) (Table 5). Total CPUE at any depth grouping ranged from 7.9 to 102.7 for both sides of the survey area combined (Table 5).

Catch per pot for each crab group for the entire survey is as follows: juvenile females, 5.6; adult females, 5.3; prerecruit males  $\leq 120$  mm ( $\leq 4.7$  in) CL, 6.1; prerecruit ones, 2.0; recruits, 1.6; and postrecruits, 0.5 (Table 5 and Figure 19). Overall CPUE was greater in the Adak Area for both female and sublegal male groups; conversely CPUE was slightly higher in the two legal-sized crab groups on the Dutch Harbor side of the survey (Table 5). Prerecruit males  $\leq 120$  mm ( $\leq 4.7$  in) CL had the highest CPUE in both the 137-182 and 457-547 m (75-99 and 250-299 fm) depth groups. Adult female CPUE was the highest in three consecutive depth groups, from 183-456 m (100-249 fm). Juvenile females had the highest CPUE in the deepest four depth groups from 548-913 m (300-499 fm).

A more detailed view of golden king crab distribution by depth is gained by examining various crab groups by station CPUE and proportion grouped by depth ranges fished using box plots. Box plots reveal the median, quartiles and range of values at each of the nine depth groups that the various crab groups occur in. Data analysis is focused on the first seven depth ranges since the two deepest depth groups only had one station each. For total crabs captured, the median of station CPUE ranged from 12-18 in the shallowest seven depth groups, yet CPUE varied widely among stations within the same depth range (Figure 20). Median station CPUE values for sublegal males ranged from 4-10 in the first seven depth range groups but rose sharply at the deepest station fished to 50 (Figure 21). Median station CPUE for legal-sized crabs was highest at 2-3 in the 274-639 m (150-349 fm) depths and none were captured in the 731-913 m (400-499 fm) range (Figure 22). The catch per pot by station of legal-sized crabs was generally lower than any other crab category, and never exceeded 10 (Table 1 and Figure 23). Highest legal CPUE for stations was 6-8, occurring in only 3 of the stations fished, while 31 stations had legal CPUE of  $< 2$  per pot. Median station CPUE values of juvenile females generally increased by depth, peaking at 52 in the one station fished in the 823-913 m (450-499 fm) depth group (Figure 24). In contrast, no adult females were captured in the two deepest depth zones (Figure 25). CPUE of adult females was generally highest in the 274-364 (150-199 fm) depth zones where the median was 10.

Sex ratios in the 137-273 m (75-99 fm) and 457-639 m (250-349 fm) depth zones tended to be dominated by males; in the remaining depth zones the sex ratios were closer to 1:1 (Figure 26). Amongst males, sublegals predominated at all depth zones except in the 274-364 m (150-199 fm) depth zones (Figures 27). Legal crabs represented <20% of the total golden king crabs in all depth zones (Figure 29). Adult females predominated over the juvenile females in depth zones <457 m (250 fm) while juvenile females predominated in depth zones  $\geq 548$  m (300 fm) (Figure 29).

### *Size at Maturity*

#### **Females**

A plot of the proportions of females mature at given carapace lengths for each of the Adak and Dutch Harbor Area samples against a preliminary logistic curve fit for the combined samples (Figure 30) indicated that combining the two samples was not appropriate. The logistic curve estimated from the combined sample had a poor fit to the data from the individual Adak and Dutch Harbor Area samples. Accordingly, the proportions mature at carapace lengths were analyzed separately for each management area.

The logistic curve fit to the Adak Area sample was adequate and the SM50 from the Adak Area sample data was estimated as approximately 107 mm (4.2 in) (Table 6 and Figure 31). In contrast, a logistic curve could not be fit adequately to the full Dutch Harbor sample due to large variation in the proportion of matures observed in carapace lengths >122 mm (>4.8 in). The logistic curve fit to the full Dutch Harbor sample overestimates the proportion mature at lengths between approximately 80 mm (3.1 in) and 110 mm (4.3 in) and underestimates the proportion mature at lengths between approximately 110 mm (4.3 in) and 150 mm (5.9 in) (Figure 32). Removal of three outlier females at 152, 154, and 160 mm (6.0, 6.1, 6.3 in) CL that were barren (i.e. having only clean pleopodal setae) and refitting the curve to the reduced data set had no effect on improving the fit to the data. An adequate fit for the Dutch Harbor data was obtained only after removing all females with carapace lengths  $\geq 123$  mm ( $\geq 4.8$  in) (Figure 32). Estimated SM50 from the sample of Dutch Harbor females with carapace lengths  $\leq 122$  mm ( $\leq 4.8$  in) was approximately 109 mm (4.3 in), as compared to the estimate of approximately 110 mm that was obtained from the full data set. Though the difference between the estimated SM50 for the Adak Area and either of the estimated SM50 estimates for the Dutch Harbor Area was slight, 95% confidence intervals for the Adak and Dutch Harbor SM50 estimates did not overlap (Table 6).

#### **Males**

Chela height and carapace length measurements were taken on 2,457 male golden king crabs. The chela height-carapace length relationship in those data (Figure 33) is curvilinear and does not indicate the relationship assumed by applying the method used by Jewett et al. (1985) for estimating size at maturity.

## *Tagging and Tag Returns*

### **Effects of Tagging**

All 10 untagged crabs and seven of the tagged crabs from the tagging experiment survived both retrievals, or "elevator rides" from stations 54 and 59. One tagged male and two tagged females were dead when retrieved, 15% of the total crabs or 30% of the tagged crabs. Both female exoskeletons were empty, except for a few amphipods (sand fleas).

### **Number of Crabs Tagged**

There were 4,802 golden king crabs tagged and released on the survey composed of 2,350 sublegal and 1,262 legal-sized males and 290 juvenile and 898 adult females (Tables 1 and 7). Approximately twice as many crabs were released from the Adak portion of the survey area compared to the Dutch Harbor side (Table 7).

### **Tags Recovered**

There were 193 tags recovered from the Dutch Harbor and Adak Management Areas in the two commercial golden king crab seasons following the 1991 survey; 190 of the tags were from males and three were from females (Appendix D). Seventy-eight tags were recovered in the Dutch Harbor 1991 (O91) season, 55 tags from the Adak 1991/92 (R91) season, 34 tags from the Dutch Harbor 1992 (O92) season, and 24 tags from the Adak 1992/93 (R92) season. Two tags recovered had no area or season recorded. Of the 193 recaptured crabs, the number of crabs that had both the release and recovery information in the following categories were: 105 carapace lengths, 188 dates, 104 shell ages, 90 latitude and longitude readings, and 92 depth readings (Appendix D). Tags were recovered from 16 to 685 days after release.

For the combined 1991/92 and 1992/93 commercial golden king crab seasons in the Dutch Harbor and Adak Management Areas there were 69 crabs recovered of the initial 2,350 (2.9%) crabs released as sublegals (2.9%) and 121 of the 1,262 (9.6%) legal-sized crabs recovered (Table 8). For both management areas the percentage of crabs recovered was greater in the 1991/92 season than in the 1992/93 season for crabs released as sublegals and legals. The percentage of crabs recovered in both categories and seasons were also greater in the Dutch Harbor Area. Of the 69 crabs released as sublegals, 10 were rereleased, presumably because they were still sublegal in size. Of the 59 sublegal crabs retained, some probably were still sublegal in size while others molted and grew. A minimum estimate of the legal harvest rate based on the raw recovery rates of crabs released as legals was calculated at 10.3% in Dutch Harbor and 4.4% in the Adak Area for the 1991/92 season (Table 8).

### **Growth**

There were 105 tagged male golden king crabs that had both release and recovery carapace length measurements (Table 9 and Appendix D). Of those, 15 had negative change in length measurements; 25 had no change in length, and 65 crabs had lengths increasing between 1 and 34 mm (Table 9). Since exoskeletons are rigid and do not shrink, the measurement error between release and recovery length can be detected for those differences with a minus sign. It is possible that some recovery lengths that were several millimeters (0.1 in) greater than rel

length are also attributable to measurement error. Hence, where "true growth" begins can not be discerned from this data. For the sake of summarizing the growth data, only crabs having lengths  $\geq 8$  mm (0.3 in) in recovery minus release are included. There were 21 crabs in this category growing between 10 to 34 mm (0.4 to 1.3 in) CL (Table 9 and Figure 34). In this range there were seven crabs that grew and were recovered during the 1991/92 Dutch (n=3) and Adak (n=4) commercial golden king crab seasons, while 14 grew prior to recovery during the 1992/93 Dutch (n=9) and Adak (n=5) seasons (Figure 34). All of the crabs that grew had lengths of <140 mm (<5.5 in) when released (Figure 34).

There was no indication of growth in recoveries that occurred less than 41 days after release (Figure 35). One crab that was recovered 41 days after release increased 26 mm (1.0 in) in CL. The crab with the greatest growth (34 mm or 1.3 in, CL) was recovered 423 days after release. That crab probably molted twice before being recovered. Of the crabs for which length at recovery was recorded, the crab that was free for the longest period (685 days) before recapture grew 27 mm (1.1 in) CL. The proportion of crabs growing  $\geq 8$  mm (0.3 in) CL increased with the increasing number of days after release (Figure 35). Fourteen of the 21 (67%) of the crabs growing  $\geq 8$  mm (0.3 in) CL occurred after one year from release (Appendix D).

### **Net Movement**

The straight line net movement of 90 male golden king crabs which had both release and recovery data were calculated for both management areas for the 1991/92 and 1992/93 commercial seasons (Table 10 and Appendix D). Twenty-seven of these crabs were sublegal and 53 were legal-sized when released; 71 of these crabs were recovered in the 1991/92 season and 19 were recovered in the 1992/93 season (Table 10). Seventy-one of the crabs recovered were from the Dutch Harbor Area and 19 from the Adak Area.

Seventeen crabs that were released as sublegals and 54 crabs that were released as legals were recovered during the 1991/92 seasons of both management areas (Table 10 and Figures 36 and 37). The average distance moved by sublegals and legals was similar within each management area; about 11.1 km (6 nmi) in Dutch Harbor and 19.8 km (10.7 nmi) in Adak.

Recovery location was recorded for only 19 of the crabs that were recovered during the 1992/93 seasons, compared with 71 recoveries in the previous season. For the crabs released as sublegals seven were recovered from the Dutch Harbor Area, averaging a net movement of 24.1 km (13.0 nmi), while three crabs recovered from the Adak Area averaged a net movement of 20.2 km (10.9 nmi) (Table 10 and Figure 38). Nine crabs released as legals were recaptured in the Dutch Harbor Area, with movements averaging 20.2 km (14.4 nmi) (Figure 39). No legals were recaptured from the Adak Area with recovery location data. Crabs from the Dutch Harbor Area averaged twice the distance moved in the 1992 vs 1991 seasons, while those recovered in the Adak Area in 1992 averaged about the same distance (Table 10).

The combined net movements of all crabs recovered from the 1991 and 1992 seasons averaged 15.4 km (8.3 nmi), with a minimum of 1.3 km (0.7 nmi) to a maximum net movement of 61.2 km (33.1 nmi) (Table 10). The combined net movement plots of all 90 crabs is shown in Figure 40. The 171° W longitude line is the shared boundary line between the Dutch Harbor and Adak Management Areas. Of those crabs with recovery location recorded, four were released in one management area and recovered in the other (Figures 37, 38, and 40). The net movements did

not increase in proportion to the number of days after release, with 80 of the 90 crabs (89%) having net movements of 27.8 km (15 nmi) or less (Figure 41 and Appendix D).

### **Shell Ages of Tagged Crabs**

Of the 193 recovered crabs 104 (64%) had documented shell ages while 89 crabs (46%) had no shell ages recorded (Table 11, part A). Over 90% of the recovered crabs with shell ages recorded were judged as having new-shell exoskeletons. Shell ages of nine (9%) crabs probably misclassified at recovery since they did not grow and seven crabs were classified with younger exoskeletal ages and two crabs supposedly had older shells in too short a time period (Table 11, part C). Eight male crabs were judged to have new-shells both when tagged and recovered but did not grow (<8 mm (0.3 in) CL) although they were not recovered until 337 to 423 days after being tagged (Appendix D).

### ***Adult Female Reproductive Condition***

There were 3,174 adult female golden king crabs captured on the survey that had one or more of the following conditions recorded: egg color, egg development, presence of dead eggs or percent clutch size (Table 12). Sixty-nine percent of the females had orange eggs while 21% had tan eggs. Orange eggs were less developed than tan eggs. Tan colored eggs were 99% eyed while orange eggs were 28% eyed. Approximately equal numbers of adult females had either uneyed eggs, eyed eggs, or were barren. Dead eggs in the clutch can be indicators of unfertilized eggs, egg predators, other symbionts or presence of diseases. Few females had any dead eggs visible while 96% of the females with eggs had no dead eggs apparent (Table 12).

Sixty-five percent of the adult females had clutches of eggs while 35% were barren (Table 12). Of those females with external eggs 70% were in the full clutch category. About one third of the way through the survey (beginning with pot #170) females with clutches 1-29% full, having tan eyed eggs and numerous empty egg cases were noted in the comments column on the Crab Research form as "hatching," denoting that most of the eggs had already hatched and the remaining would imminently follow. Of the 176 females that had clutches in the 1-29% full range, 106 (60%) were noted as being in the hatching category. The mean length and depth of the females with hatching clutches was 125 mm (4.9 in) CL and 377 m (206 fm). Females with hatching clutches were found in depths from 212 to 578 m (116 to 316 fm). Their mean length and depth distribution were similar to other females that carried clutches. Barren females that had all their eggs hatched but still had egg cases or egg stalks attached to their pleopods constituted 26% of all adult females examined. Barren females with clean pleopods (without egg cases or egg stalks) made up 9% of the adult females and their mean size was smaller than any other clutch size or egg condition category (Table 12). The mean sizes and depths that the adult females lived in were generally in a narrow range regardless of the egg condition and clutch size categories (Table 12). The minimum and maximum depths that adult females were captured from ranged from 148 m (81 fm) to 725 m (396 fm) (Table 12).

### *Leatherbacks*

Thirty-eight leatherback crabs were captured at 14 stations at a mean depth of 426 m (233 fm) and ranged from 350 m (191 fm) to 562 m (307 fm) (Table 13). Mean size of leatherback crabs was 148.9 mm (5.9 in) CL; size ranged from 131 to 184 mm (5.2 to 7.2 in) CL. Eleven of these crab were sublegal; five had old-shells and six had very old-shells. Seventy-seven were legal-sized; 16 had old-shells and 11 had very old-shells.

### *Parasitic Barnacle and Rust Disease*

Sixty-seven golden king crabs had one or more externae of the parasitic barnacle *Briarosaccus callosus* observed on the soft portion or dorsal side of their abdomens (Table 14 and Figure 42). These barnacles are known to cause castration and reduce body growth in king crabs (Boschma and Haynes 1969; McMullen and Yoshihara 1970; Hawkes et al. 1985, and 1987). These barnacles were found in juvenile and adult females and sublegals but not legal sized crabs in depths ranging from 152 to 851 m (83 to 465 fm). Rust disease was observed on seven crabs (Table 14).

### *Miscellaneous Crab Species*

There were eight scarlet king crabs *Lithodes couesi* captured in five different pots in depths ranging from 545 to 853 m (298 to 466 fm) (Table 15). Three grooved Tanner crabs *Chionoecetes tanneri* were captured in three different pots; two pots also had *L. couesi* in them (Table 15).

### *Miscellaneous Fish and Invertebrates*

Nine species of fish (n = 208) and nine species of invertebrates (n = 43) excluding crab species came up in the pots (Table 16). Miscellaneous species occurred in 132 (22%) of the 594 pots retrieved. Greenland turbot *Reinhardtius hippoglossoides* and Pacific halibut *Hippoglossus stenolepis* were the most common of the five commercial fish species captured in the pots. Seventy-seven percent of the turbot and 41% of the halibut were dead when the pots arrived on deck.

### *Ocean Temperatures*

Eleven water temperatures were taken with thermometers attached to pots. Temperatures ranged from 3.7° to 5.6 °C (38.6° to 42.0 °F) in depths ranging from 174 m (95 fm) to 554 m (303 fm) (Table 17).

## DISCUSSION

Golden king crabs were nearly ubiquitous within the area surveyed. They occurred at 90% of the stations, in 82% of the pots retrieved and at depths from 137 to 853 m (75 to 466 fm). The area surveyed was selected due to its high production record of legal males (Blau 1992). In the Aleutian Islands golden king crabs have been noted to prefer the deeper waters of large passes with strong currents (Dunaway 1982). Amutka Pass is one of three passes in the Aleutian Islands that permit significant flow of water from the Alaskan Stream into the Bering Sea (Favorite 1967). Strong currents of 3.7-7.4 km/hr (2-4 knots) have been noted in the survey area (US Dept. Commerce 1981). The CPUE of golden king crabs was greater at every depth interval for the Adak side of the survey compared to the Dutch Harbor side (except at depths >731 m (400 fm) where little effort was spent). Perhaps this was due directly or indirectly to the movement of Alaska Stream waters through the deeper Amutka Pass on the Adak side of the survey area.

It is important to remember that comparisons of CPUE within this report and between most other reports are not standardized based on the various soak times or pots used in the capture of crabs. In this report soak times varied as much as six and one-half days. It is generally known by commercial fishermen and crab biologists alike that the number of crabs captured and the length of soak times is not a direct relationship. This relationship has been studied in red king crabs and Tanner crabs (Rothschild et al. 1970; Johnson 1985). Designing and carrying out soak time studies on golden king crabs could be beneficial to both fishermen and to crab biologists and their agencies. Additionally, survey CPUE may not be comparable to commercial fishery CPUE as most fishermen who longline for golden king crabs in the Dutch Harbor and Adak Areas use larger king crab pots or conical pots of different sizes and average soak times are generally six to seven days (Beers 1991 and D. Tracy, Alaska Department of Fish and Game, Dutch Harbor, personal communication).

The vertical distribution of golden king crabs in the survey area reveals a general pattern of increasing CPUE with increasing depth. This is particularly true of juvenile females and small males. This pattern contrasts sharply with findings in Portland Inlet in British Columbia where the greatest proportion of juvenile females were in "shallow" waters <150 m (<82 fm) deep (Sloan 1985). Similarly, the greatest proportion of adult females in Portland Canal were also found in shallower depths, 151-250 m (83-137 fm), versus the 1991 survey distribution of adult females which had their greatest concentrations in greater depths, 274-364 m (150-249 fm).

For the complete survey, legal-sized crabs constituted 2% to 18% of the total number of golden king crabs at any given depth zone (Table 5). Legal-sized crab retentions of 9% to 14% in the 1990-92 Dutch Harbor commercial seasons and 27% in the 1992 Adak golden king crab season (Tracy 1994) indicates that  $\geq 73\%$  of the golden king crabs caught are discarded in these fisheries. Recruit-sized crabs composed  $\geq 64\%$  of the legal crabs at any depth zone surveyed during the 1991 survey (Table 5).

The SM50 calculated for female golden king crabs in the Dutch Harbor and Adak areas of the 1991 survey did not overlap at the  $\pm 95\%$  confidence interval level, but they were within the 3 mm range stated in the methods for data analysis section as a benchmark as to whether they would be considered the same. Somerton and Otto (1986) observed an increase in female golden king crab SM50 with decreasing latitude in the Bering Sea, where females from an area 55°-58°

N had an SM50 of 100 mm (3.9 in) CL and those from an area between 52°-54° N (which included the 1991 survey area) had an SM50 of 111 mm (4.4 in) CL. In British Columbia from 54°30'-56°00' latitude the SM50 was 106 mm CL. Regardless of the area from which the SM50 is calculated, SM50 could increase or decrease depending on the size structure of each population sampled over time and space (Hsu 1987; Blau 1990b). Female golden king crabs continue to carry their empty egg cases and egg stalks for long periods before molting and mating again and some may appear as if they no longer have these appendages on their pleopods. So some females can be incorrectly classified as eggless or immature, possibly skewing a SM50 calculation.

Although most of the survey goals and objectives of the 1991 golden king crab survey were met, several objectives were not completed. The objective to estimate male size at maturity from the chela height-carapace length relationship for Adak and Dutch Harbor Area male golden king crabs using methods found in Jewett et al. (1985) was not done. An examination of the chela height-carapace length relationship in red king crabs by Johnson (1991) indicates that the application of this technique to king crabs may rest on false assumptions concerning the chela height-carapace length relationship. The data collected on the 1991 golden king crab survey appears curvilinear as opposed to two separate lines denoting immature and mature golden king crabs as assumed by Jewett et al. (1985). There were 2,453 paired chela height-carapace length data sets taken on the 1991 survey, a larger sample than used in the male golden king crab size at maturity analyses done by Jewett et al. (1985) or Somerton and Otto (1986). The 1991 data may prove useful once a thorough analysis is made to find out if the chela height-carapace length relationship is possible for delineating male king crab size of maturity. An assessment of female golden king crab growth, movements, brooding and molting cycle could not be achieved because of the low number of tagged females recovered and the accompanying lack of data with those recoveries. In addition, although reproductive data was gathered on adult females, analysis of reproductive condition as a function of depth was not done.

Defining the size range at which male golden king crabs can be sublegal or legal at given carapace lengths and defining the probability of smallest merus lengths at a given size that can equal the minimum legal width can help ADF&G shellfish managers and Alaska Department of Public Safety, Fish and Wildlife enforcement personnel in dealing with minimum size questions and enforcement of the commercial minimum size regulations 5AAC 34.620 and 34.720 (ADF&G 1993).

Data from recovered tagged crabs can provide information on growth, movements, molting frequency, reproductive condition, measurement and shell aging biases, and fishing, natural, and tag mortality rates. There were only 193 tags recovered out of 4,802 (4%) released in two commercial seasons in the Dutch Harbor and Adak Management Areas. The information from the three females retrieved was negligible. Three facts are notable concerning the tag recovery information: 1) a crab recovered after 41 days grew 26 mm CL, while no other crabs grew that much unless they were recovered  $\geq 28$  months later, 2) only crabs with carapace length at release  $< 140$  mm CL grew, and 3) there were male crabs that were judged to have new shells at recovery, and did not grow although they were recovered more than a year after release. The range of growth for similar periods of freedom for male golden king crabs in this study appears to be similar to those in southeast Alaska (Koeneman and Buchanan 1985) and earlier research in the Aleutian Islands (R.S. Otto, National Marine Fisheries Service, Kodiak, personal communication). Detailed tag release and recovery information collected from the 1991 survey

(Appendix D) will enhance existing and future information necessary for continued research on golden king crabs.

The experiment on crab mortality from tagging revealed that additional research must be done to properly evaluate the use of the isthmus tag on golden king crabs in estimating population size or fishing mortality. Larger sample sizes, including comparison of crabs of similar lengths, males and females, and varying soak times would provide a better estimate of tag mortality than the limited experiment conducted on the 1991 survey. Three crabs that died out of 20 crabs used in the 1991 experiment were from the 10 tagged crabs. Using  $3/10 = 30\%$  as an estimate of tagging mortality rate would increase the minimum estimates of legal-sized fishing mortalities for the 1991/92 seasons in Dutch Harbor from 10.3% to 14.7% and in Adak from 4.4% to 6.3%. Any of these fishing mortality figures are less than the 0.3 annual fishing mortality maximum (equals a 25% exploitation rate) allowed under the federal Fishery Management Plan. The 30% estimated mortality used in the above example, should be viewed cautiously due to the small sample size, possible differences between size and sex of crabs tagged and only one soak time used in the tag mortality experiment. In addition unreported tags also lead to lower fishing mortality estimates than actually occurred.

Two tagged crabs retrieved from the tag mortality experiment had only empty exoskeletons containing a few amphipods (sand fleas). When a crab is tagged through the isthmus muscle blood is lost, likely attracting amphipods when it is returned to the seafloor. Once on the seafloor amphipods can gather in great numbers and consume the crab's soft parts in a short time. The use of passive integrated transponder (PIT) tags which have been injected into red king crabs and equipment made to automatically detect them (Donaldson et al. 1992; Pengilly and Watson 1994) may prove to be a better tag to use with golden king crabs since less blood is lost at the point of injection (fifth pereopod) compared to Floy tags in the isthmus muscle. Mortality between red king crabs injected with PIT tags and a control group monitored in live tanks for six months was similar (L.J. Watson, ADF&G, personal communication).

Net movements of 39 male golden king crabs released on a tagging charter in 1984 on the FV *Starlite* near Seguam Is. (Otto and Cumminskey 1985) (west of the 1991 survey area) and recovered two years later averaged 10.7 km (5.8 nmi) and ranged from 4.3 to 28.9 km (2.3 to 15.6 nmi) (Urban 1986). The second year recoveries of the 1984 tagged crabs recovered by Urban were about half the average net movement of second year recoveries of the 1991 ADF&G tagged crabs. Additional tag recoveries from 1984 releases would be interesting to compare with the recoveries from the 1991 survey but to-date, that data is unpublished. The net movements of red king crabs *Paralithodes camtschaticus* and Tanner crabs *Chionoecetes bairdi* can be greater than golden king crabs (Hayes and Montgomery 1962; Simpson and Shippen 1968; and Donaldson 1983).

The boundary line at 171° W longitude which divides the Dutch Harbor from Adak Management Area has been in place since 1984 (ADF&G 1984). Of the 90 recovered tagged crabs that had both release and recovery locations, only four crabs were recovered that "crossed over" the boundary line to the adjacent management area. Three of these crabs were released close to the boundary line. All moved from west to east, from the Adak to the Dutch Harbor Management Area. Two crabs were recovered during both the 1991 and 1992 Dutch Harbor commercial golden king crab seasons (Figures 37, 38, 40). Using all tag recovery data there were 16 crabs

that crossed over the boundary line, five that were tagged in the Dutch Harbor Area side were recovered in the Adak Area and 11 different crabs did the reverse (Table 8).

Mandatory shellfish observers on catcher-processors provided the majority of the tag returns and tag information from the golden king crabs released on the 1991 survey. Most of their information and measurements were recorded in an accurate manner. Review of all of the tag recovery data shows that additional training of the observers may improve the accuracy of shell aging and carapace length measurements. Additional training may also increase the amount of recovery data filled in on the crab tag recovery form (Appendix C.3.) and the number of tagged females recovered. The observers also sampled the golden king crab commercial catches that provide data which can be compared with survey results like sex ratios, female reproductive condition, CPUE, depths fished, soak times and incidental species captured (Beers 1991 and 1992; Tracy 1994). The 1991 survey provides information on golden king crabs that spanned most of their depth distribution and surveyed an area in a systematic manner, neither of which is normally done by commercial fishermen.

The golden king crab fishery in the Dutch Harbor and Adak Management Areas is worth millions of dollars annually to fishermen and currently is Alaska's fourth most valuable shellfish fishery. Additional ADF&G surveys on golden king crabs in the Aleutian Islands are necessary and should be implemented. The habitat of golden king crabs has been estimated at 137,200-274,400 km<sup>2</sup> (40,000-80,000 nmi<sup>2</sup>) throughout the Aleutian Islands (Blau 1987). The area covered by the 1991 survey was only 2-10% of their estimated habitat. The federal Fishery Management Plan mandates that annual fishing mortality of 0.3 and recruitment overfishing does not occur. Estimates of exploitation rates and population sizes are feasible through intensive tagging surveys and subsequent recoveries in the commercial seasons or by resurveying the area. Stratified sampling by depth zones instead of systematic sampling may allow a better understanding of the vertical distribution of golden king crabs. Future surveys should encompass depth zones shallower and deeper than those set on the 1991 survey so that the vertical distribution of golden king crabs is fully evaluated. Any future golden king crab surveys occurring in the Aleutian Islands should consider incorporating radio beacons and a receiver. This technology made the retrieval of gear more timely and decreased the average soak time of the pots. Also, king crab pots should be the required pot type since this is the most common pot style used in the Aleutian Islands' golden king crab fishery.

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Table 1. Station locations and number of golden king crabs *Lithodes aequispina* caught on the 1991 Alaska Department of Fish and Game survey conducted in the Dutch Harbor and Adak Management Areas, Alaska.

Sta- tion	Station Retrieved 1991	No. Pots Pulled	Mean Soak Days	Location Mid-String		Depth Range m <sup>a</sup>	Mean Depth m fm	No. & Mean ( $\bar{x}$ ) Carapace Length (mm) of Golden King Crabs/Station										Total Crabs
				N Lat. Deg. Min.	W Long. Deg. Min.			Males					Females					
								Legal	$\bar{x}$	Sublegal	$\bar{x}$	Tagged	Adult	$\bar{x}$	Juv.	$\bar{x}$	Tagged	
1	8/25	10	2.2	52 34.92	170 54.30	139 to 196	163 89	0	0	0	0	0	0	0	0	0	0	0
2	8/25	7	2.2	52 39.96	170 54.19	192 to 230	208 114	0	0	0	0	0	0	0	0	0	0	0
3	8/25	10	2.5	52 44.97	170 54.56	523 to 554	536 293	82	145	84	116	147	28	131	21	94	10	215
4	8/26	10	3.1	52 49.96	170 54.24	766 to 821	794 434	0	0	46	68	2	0	0	73	68	1	119
5	8/26	10	3.1	52 55.02	170 45.37	847 to 852	849 464	0	0	503	67	2	0	0	524	63	1	1,027
6	8/27	10	3.9	52 45.01	170 45.21	287 to 322	305 167	29	152	72	111	83	35	129	21	101	19	157
7	8/27	10	3.5	52 45.30	170 36.80	137 to 146	143 78	0	0	0	0	0	0	0	0	0	0	0
8 <sup>b</sup>	8/26	9	2.6	52 50.00	170 45.19	496 to 516	510 278	76	148	83	120	157	34	126	6	101	11	199
9	8/26	10	2.4	52 49.92	170 37.16	360 to 377	371 203	16	148	78	94	31	118	132	55	89	38	267
10	8/29	10	4.2	52 44.99	170 29.23	278 to 379	329 180	2	187	0	0	2	0	0	0	0	0	2
11	8/28	10	3.1	52 50.04	170 29.49	208 to 238	221 121	14	147	31	122	44	8	131	5	102	4	58
12	8/28	10	2.5	52 50.05	170 22.98	237 to 278	256 140	0	0	0	0	0	0	0	0	0	0	0
13	8/27	10	1.2	52 55.03	170 29.74	258 to 340	296 162	22	146	50	116	69	218	129	14	101	62	304
14	8/28	10	1.8	52 54.99	170 22.08	230 to 240	234 128	35	146	189	116	221	2	128	2	107	1	228
15	8/29	10	2.5	52 45.02	170 22.04	326 to 360	346 189	6	146	2	128	8	0	0	0	0	0	8
16	8/29	10	2.7	52 40.01	170 22.12	230 to 249	388 212	10	161	4	116	14	28	145	2	97	10	44
17	8/30	10	2.4	52 35.02	170 22.28	355 to 358	357 195	12	151	2	123	14	1	147	0	0	1	15
18	8/31	10	4.2	52 35.00	170 35.00	265 to 274	271 148	0	0	0	0	0	0	0	0	0	0	0
19	8/30	10	2.4	52 29.95	170 22.72	263 to 283	274 150	52	149	39	113	77	150	133	40	96	49	281
20	8/30	10	1.8	52 25.01	170 22.38	263 to 287	276 151	23	153	6	131	29	108	131	1	102	26	138
21	8/30	10	1.8	52 25.01	170 28.61	527 to 549	536 293	14	150	1	94	14	1	137	0	0	1	16
22 <sup>b</sup>	8/31	9	2.5	52 30.01	170 29.38	331 to 340	333 182	39	146	16	124	52	4	140	0	0	2	59
23	9/01	10	2.8	52 25.00	170 55.52	420 to 435	428 234	26	149	54	100	48	0	0	34	80	1	114
24	9/01	10	2.5	52 25.01	170 46.03	291 to 304	296 162	36	146	38	125	73	169	126	10	101	48	253
25	9/01	10	2.5	52 25.00	170 37.56	333 to 353	342 187	63	148	27	122	85	102	130	4	95	33	196
26 <sup>b</sup>	9/02	10	3.0	52 30.03	170 55.80	408 to 422	415 227	34	144	44	127	77	11	127	0	0	4	89
27 <sup>b</sup>	9/02	9	2.9	52 30.10	171 03.30	459 to 470	466 255	13	150	12	125	25	0	0	0	0	0	25
28	9/02	10	2.6	52 25.02	171 03.45	448 to 459	457 250	5	149	6	122	10	0	0	1	70	0	12
29	9/03	10	2.9	52 35.05	171 02.65	490 to 507	525 287	14	147	12	125	26	5	127	1	99	2	32
30 <sup>c</sup>	9/08	10	7.2	52 40.02	171 02.42	532 to 561	549 300	40	145	59	116	81	8	114	23	95	8	130
31 <sup>c</sup>	9/07	10	6.4	52 40.02	171 11.09	527 to 561	541 296	23	145	128	99	58	2	111	67	90	10	220
32 <sup>c</sup>	9/08	10	6.3	52 44.98	171 02.35	717 to 726	724 396	2	135	96	80	11	2	120	93	77	4	193
33 <sup>c</sup>	9/08	10	6.8	52 44.97	171 10.96	435 to 503	474 259	20	143	227	91	68	3	110	145	89	20	395
34	9/04	10	2.4	52 44.99	171 21.05	174 to 183	179 98	4	145	70	117	69	51	117	4	106	16	129
35	9/04	10	1.9	52 50.02	171 10.56	181 to 216	198 105	11	143	133	114	129	10	115	14	100	6	168
36	9/04	10	1.6	52 50.03	171 20.85	172 to 176	174 95	8	143	129	113	121	66	118	22	101	23	225
37	9/06	10	3.6	52 54.99	171 21.05	291 to 311	300 164	8	141	87	98	40	60	110	119	94	38	274
38	9/06	10	2.1	52 50.02	171 30.18	212 to 216	214 117	12	143	61	109	51	224	114	71	99	74	368
39	9/07	10	2.8	52 45.01	171 30.59	148 to 157	152 83	30	140	97	125	126	19	123	2	104	7	148
40	9/07	10	3.0	52 40.01	171 20.45	401 to 444	422 231	20	146	226	107	165	25	113	144	96	41	415

-Continued-

Table 1. (page 2 of 2)

Sta- tion	Station Retrieved 1991	No. Pots Pulled	Mean Soak Days	Location Mid-String		Depth Range m <sup>a</sup>	Mean Depth		No. & Mean ( $\bar{x}$ ) Carapace Length (mm) of Golden King Crabs/Station										Total Crabs
				N Lat. Deg. Min.	W Long. Deg. Min.		m	fm	Males					Females					
									Legal	$\bar{x}$	Sublegal	$\bar{x}$	Tagged	Adult	$\bar{x}$	Juv.	$\bar{x}$	Tagged	
41	9/06	10	1.5	52 55.05	171 10.97	287 to 298	294	161	13	144	185	105	130	106	112	163	98	66	467
42	9/9,10	10	3.0	52 50.03	171 39.94	358 to 510	446	244	21	144	176	99	79	260	114	131	90	90	588
43	9/09	10	2.5	52 45.02	171 40.83	293 to 311	304	167	14	142	208	95	56	172	115	231	91	81	625
44	9/09	10	3.6	52 40.02	171 30.68	492 to 543	516	282	26	143	184	106	125	16	119	142	87	18	368
45	9/10	10	2.8	52 34.96	171 20.68	282 to 388	305	167	33	146	60	125	91	73	116	14	100	23	180
46	9/11	10	3.8	52 34.99	171 30.30	444 to 457	450	246	24	143	76	119	91	49	113	33	94	22	182
47	9/11	10	3.6	52 35.00	171 40.87	594 to 600	598	327	24	141	138	93	77	19	110	155	79	11	336
48	9/10	10	1.5	52 40.00	171 40.06	550 to 593	571	312	12	142	353	83	77	86	113	387	79	38	838
49	9/11	10	2.2	52 35.00	171 50.25	697 to 710	704	385	19	141	339	76	62	25	109	377	73	18	760
50 <sup>d</sup>	9/14	10	5.3	52 30.03	171 50.57	558 to 587	574	314	28	146	71	110	81	21	110	44	92	13	164
51 <sup>d</sup>	9/15	10	5.6	52 30.01	171 40.79	582 to 589	585	320	36	144	104	120	127	16	116	31	94	9	187
52 <sup>d</sup>	9/17	10	7.7	52 30.05	171 30.89	536 to 543	539	295	36	147	49	119	75	39	119	61	90	17	185
53 <sup>d</sup>	9/16	10	5.9	52 24.99	171 51.08	280 to 287	283	155	5	146	1	140	60	111	136	0		28	117
54 <sup>d</sup>	9/16	10	5.5	52 25.03	171 40.97	422 to 441	435	238	14	146	12	126	21	100	127	2	104	26	128
55 <sup>d</sup>	9/16	10	5.3	52 25.01	171 31.03	459 to 479	470	257	49	147	29	125	78	105	120	5	102	29	188
56 <sup>d</sup>	9/14	10	3.1	52 19.99	171 30.43	443 to 466	459	251	39	147	35	124	72	120	135	7	97	32	201
57 <sup>d</sup>	9/14	10	3.0	52 19.99	171 40.62	380 to 391	386	211	26	155	13	130	39	264	132	0		67	303
58 <sup>d</sup>	9/14	10	2.8	52 20.02	171 51.11	177 to 304	221	121	46	147	41	129	87	98	139	0		27	185
59	9/17	10	1.1	52 19.98	171 21.16	508 to 510	508	278	2	142	10	122	11	5	123	1	96	2	18
60	9/17	10	1.2	52.19.97	171 11.08	691 to 759	726	397	0		0		0	0		0		0	0
<b>Totals</b>		<b>594</b>	<b>3.2</b>			<b>137 to 852</b>	<b>404</b>	<b>221</b>	<b>1,268</b>	<b>4,796</b>	<b>3,614</b>	<b>3,177</b>	<b>3,302</b>	<b>1,188</b>	<b>12,543<sup>e</sup></b>				
<b>Percent of Catch</b>									<b>10.1</b>	<b>36.2</b>		<b>25.3</b>	<b>26.3</b>						
<b>Overall Mean Catch Per Pot</b>									<b>2.1</b>	<b>8.1</b>		<b>6.1</b>	<b>5.3</b>						

- a To convert meters (m) to fathoms, divide the number of meters by 1.83.
- b Ten pots set at this station but one pot was lost and therefore not retrieved.
- c Strong currents prevented retrieval within the 2 day soak time.
- d Storm force winds occurred on September 12 and 13, 1991 which delayed the retrieval of these stations.
- e Total includes two males which were tagged but not measured from station 39 and 40.

Table 2. Size overlap of sublegal and legal male golden king crabs from the 1991 survey conducted in the Adak and Dutch Harbor Management Areas by the Alaska Department of Fish and Game.

Carapace Length		Number of Crabs		Percent Total	Legal
mm	in	Sublegals	Legals		
119 <sup>a</sup>	4.69	60	1	61	1.6
120	4.72	71	0	71	0
121	4.76	49	0	49	0
122	4.80	71	0	71	0
123	4.84	62	0	62	0
124	4.88	69	0	69	0
125	4.92	59	1	60	1.7
126	4.96	63	0	63	0
127	5.00	69	0	69	0
128	5.04	68	1	69	1.5
129	5.08	73	0	73	0
130	5.12	78	2	80	2.5
131	5.16	72	2	74	2.7
132	5.20	77	5	82	6.1
133	5.24	77	10	87	11.5
134	5.28	49	17	66	25.8
135	5.31	58	27	85	31.8
136	5.35	47	40	87	46.0
137	5.39	38	39	77	50.6
138	5.43	31	61	92	66.3
139	5.47	27	61	88	69.3
140	5.51	22	69	91	75.8
141	5.55	7	62	69	89.9
142	5.59	9	70	79	88.6
143	5.63	4	60	64	93.8
144	5.67	1	75	76	98.9
145	5.71	0	51	51	100.0
146	5.75	2	57	59	96.6
147	5.79	0	68	68	100.0
148	5.83	2	60	62	96.8
149	5.87	0	51	51	100.0
150	5.91	0	52	52	100.0
151	5.94	0	42	42	100.0
152 <sup>b</sup>	5.98	1	30	31	96.8
Totals		1,316	1,014	2,330	43.5

<sup>a</sup> All male golden king crabs  $\leq$  118 mm carapace length had sublegal widths.

<sup>b</sup> All male golden king crabs  $\geq$  153 mm carapace length had legal widths.

Table 3. Classification of golden king crab exoskeletons found in the Dutch Harbor Management Area (stations 1-26) and the Adak Management Area (stations 27-60) during the 1991 golden king crab survey conducted by the Alaska Department of Fish and Game.

Area & Crab Group	Exoskeleton Classification (Number of Crabs)				Total
	New Soft	New Shell	Old Shell	Very Old Shell	
<b>Dutch Harbor Area<sup>a</sup></b>					
Sublegal Males	0	1,360	8	1	1,369
Legal Males	0	520	58	13	591
Juvenile Females	0	812	0	0	812
Adult Females	0	1,011	6	0	1,017
<b>Totals</b>	<b>0</b>	<b>3,711</b>	<b>64</b>	<b>14</b>	<b>3,789</b>
<b>Percents</b>	<b>0</b>	<b>97.9</b>	<b>1.7</b>	<b>0.4</b>	<b>100</b>
<b>Adak Area</b>					
Sublegal Males	0	3,340	78	9	3,427
Legal Males	0	592	73	12	677
Juvenile Females	0	2,488	2	0	2,490
Adult Females	0	2,158	2	0	2,160
<b>Totals</b>	<b>0</b>	<b>8,578</b>	<b>155</b>	<b>21</b>	<b>8,754<sup>b</sup></b>
<b>Percents</b>	<b>0</b>	<b>98.0</b>	<b>1.8</b>	<b>0.2</b>	<b>100</b>
<b>Dutch &amp; Adak Combined</b>					
Sublegal Males	0	4,700	86	10	4,796
Legal Males	0	1,120	123	25	1,268
Juvenile Females	0	3,300	2	0	3,302
Adult Females	0	3,169	8	0	3,177
<b>Grand Totals</b>	<b>0</b>	<b>12,289</b>	<b>219</b>	<b>35</b>	<b>12,543<sup>c</sup></b>
<b>Percents</b>	<b>0</b>	<b>98.0</b>	<b>1.7</b>	<b>0.3</b>	<b>100</b>

<sup>a</sup> Number of pots retrieved from the Dutch Harbor Area fished was 255.

<sup>b</sup> Number of pots retrieved from the Adak Area fished was 339.

<sup>c</sup> Two male golden king crabs were tagged but their sizes and shell ages were not recorded before they were released.

Table 4. Parameter estimates for logistic regression of legal status on merus length for golden king crabs and estimates of merus length for which these crabs have 5% and 1% probabilities of being legal. Data from the 1991 survey of a portion of the Dutch Harbor and Adak Management Areas conducted by the Alaska Department of Fish and Game.

Survey Area & Sample Size	Parameters	Estimates	95% Confidence Intervals	
			Lower	Upper
<b>Dutch Harbor</b> Stations 1-26 n = 790	$\beta_0$	-29.146	-34.355	-23.838
	$\beta_1$	0.271	0.222	0.320
	MSL05 <sup>a</sup>	96.8 mm (3.8 in)	94.5 mm (3.7 in)	99.1 mm (3.9 in)
	MSL01 <sup>b</sup>	90.7 mm (3.6 in)	87.3 mm (3.4 in)	94.0 mm (3.7 in)
<b>Adak</b> Stations 27-60 n = 1,131	$\beta_0$	-30.314	-34.401	-26.227
	$\beta_1$	0.272	0.235	0.309
	MSL05	100.5 mm (4.0 in)	98.8 mm (3.9 in)	102.2 mm (4.0 in)
	MSL01	94.5 mm (3.7 in)	92.0 mm (3.6 in)	96.9 mm (3.8 in)

<sup>a</sup> Merus length at which a male golden king crab has the probability of being legal is 5%.

<sup>b</sup> Merus length at which a male golden king crab has the probability of being legal is 1%.

Table 5. Catches of golden king crabs by depth ranges in the Dutch Harbor Management Area (stations 1-26) and the Adak Management Area (stations 27-60) during the 1991 golden king crab survey conducted by the Alaska Department of Fish and Game.<sup>a</sup>

Depths Fished		No.	No. Females				No. Prerecruit Males				No. Legal Males				Total Crabs	
Meters	Fathoms	Pots	Juv. <sup>b</sup>	CPUE <sup>c</sup>	Adults <sup>d</sup>	CPUE	≤120 mm CL	CPUE	≥ 121 mm CL <sup>e</sup>	CPUE	Recruits <sup>f</sup>	CPUE	Postrecruits <sup>g</sup>	CPUE	No.	CPUE
<b>Dutch Harbor Area</b>																
137-182	75- 99	18	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
183-273	100-149	60	27	0.5	179	3.0	164	2.7	87	1.5	60	1.0	21	0.4	538	9.0
274-364	150-199	88	70	0.8	643	7.3	118	1.3	103	1.2	177	2.0	74	0.8	1,185	13.5
365-456	200-249	40	91	2.3	132	3.3	115	2.9	64	1.6	61	1.5	26	0.7	489	12.2
457-547	250-299	27	20	0.7	62	2.3	71	2.6	82	3.0	122	4.5	48	1.8	405	15.0
548-639	300-349	2	7	3.5	1	0.5	12	6.0	3	1.5	1	0.5	1	0.5	25	12.5
640-730	350-399	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
731-822	400-449	10	73	7.3	0	0.0	45	4.5	1	0.1	0	0.0	0	0.0	119	11.9
823-913	450-499	10	524	52.4	0	0.0	501	50.1	2	0.2	0	0.0	0	0.0	1,027	102.7
<b>Totals</b>		<b>255</b>	<b>812</b>	<b>3.2</b>	<b>1,017</b>	<b>4.0</b>	<b>1,026</b>	<b>4.0</b>	<b>342</b>	<b>1.3</b>	<b>421</b>	<b>1.7</b>	<b>170</b>	<b>0.7</b>	<b>3,788</b>	<b>14.9</b>
<b>Adak Area</b>																
137-182	75- 99	31	28	0.9	152	4.9	166	5.4	143	4.6	50	1.6	5	0.2	544	17.5
183-273	100-149	27	85	3.1	291	10.8	138	5.1	81	3.0	46	1.7	4	0.1	645	23.9
274-364	150-199	52	529	10.2	573	11.0	440	8.5	96	1.8	61	1.2	19	0.4	1,718	33.0
365-456	200-249	55	230	4.2	722	13.1	275	5.0	140	2.5	67	1.2	45	0.8	1,479	26.9
457-547	250-299	96	511	5.3	249	2.6	595	6.2	194	2.0	160	1.7	62	0.6	1,771	18.4
548-639	300-349	48	637	13.3	146	3.0	554	11.5	170	3.5	120	2.5	17	0.4	1,644	34.3
640-730	350-399	25	470	18.8	27	1.1	416	16.6	19	0.8	20	0.8	1	0.0	953	38.1
731-822	400-449	5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
823-913	450-499	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<b>Totals</b>		<b>339</b>	<b>2,490</b>	<b>7.3</b>	<b>2,160</b>	<b>6.4</b>	<b>2,584</b>	<b>7.6</b>	<b>843</b>	<b>2.5</b>	<b>524</b>	<b>1.5</b>	<b>153</b>	<b>0.5</b>	<b>8,754</b>	<b>25.8</b>
<b>Dutch &amp; Adak</b>																
137-182	75- 99	49	28	0.6	152	3.1	166	3.4	143	2.9	50	1.0	5	0.1	544	11.1
183-273	100-149	87	112	1.3	470	5.4	302	3.5	168	1.9	106	1.2	25	0.3	1,183	13.6
274-364	150-199	140	599	4.3	1,216	8.7	558	4.0	199	1.4	238	1.7	93	0.7	2,903	20.7
365-456	200-249	95	321	3.4	854	9.0	390	4.1	204	2.1	128	1.3	71	0.7	1,968	20.7
457-547	250-299	123	531	4.3	311	2.5	666	5.4	276	2.2	282	2.3	110	0.9	2,176	17.7
548-639	300-349	50	644	12.9	147	2.9	566	11.3	173	3.5	121	2.4	18	0.4	1,669	33.4
640-730	350-399	25	470	18.8	27	1.1	416	16.6	19	0.8	20	0.8	1	0.0	953	38.1
731-822	400-449	15	73	4.9	0	0.0	45	3.0	1	0.1	0	0.0	0	0.0	119	7.9
823-913	450-499	10	524	52.4	0	0.0	501	50.1	2	0.2	0	0.0	0	0.0	1,027	102.7
<b>Grand Totals</b>		<b>594</b>	<b>3,302</b>	<b>5.6</b>	<b>3,177</b>	<b>5.3</b>	<b>3,610</b>	<b>6.1</b>	<b>1,185</b>	<b>2.0</b>	<b>945</b>	<b>1.6</b>	<b>323</b>	<b>0.5</b>	<b>12,542</b>	<b>21.1</b>

- Footnotes Continued on Next Page -

Table 5. (page 2 of 2)

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- a No adjustments to the numbers of golden king crabs caught were made based on the varying soak times of the pots.
- b Juvenile females include all barren females  $<108$  mm (4.3 in) CL with silky pleopodal setae.
- c CPUE: catch per unit of effort or catch per pot.
- d Adult females include all crabs carrying embryos, all females  $\geq 108$  mm ( $\geq 4.3$  in) CL and all barren females whose pleopodal setae have empty egg cases or funiculi attached to them.
- e Prerecruit ones are male crabs 121-137 mm (4.8-5.4 in) CL, but less than the minimum legal width of 152.4 mm, within one molt of legal size.
- f Recruits are newshell males  $\leq 153$  mm ( $\leq 6.0$  in) CL, that have obtained legal width.
- g Postrecruit males are all males  $\geq 154$  mm ( $\geq 6.1$  in) CL and all legal sized aneuvivants (old and very old shell crabs).

Table 6. Parameter estimates for logistic regression of female golden king crabs maturity on size and estimates of size at 50% mature (SM50). Data from the 1991 survey of a portion of the Dutch Harbor and Adak Management Areas conducted by the Alaska Department of Fish and Game.

Survey Area & Sample Size	Parameters	Estimates	95% Confidence Intervals	
			Lower	Upper
<b>Dutch Harbor</b>				
Stations 1-26				
Total Females	$\beta_0$	-15.558	-19.123	-11.992
n = 1,829	$\beta_1$	0.142	0.111	0.173
Carapace Length:	SM50	109.6 mm (4.3 in)	106.7 mm (4.2 in)	112.6 mm (4.4 in)
Females <123 mm CL (4.8 in)	$\beta_0$	-28.273	-33.327	-23.219
n = 1,092	$\beta_1$	0.260	0.214	0.306
Carapace Length:	SM50	108.8 mm (4.3 in)	107.8 mm (4.2 in)	109.9mm (4.3 in)
<b>Adak</b>				
Stations 27-60				
n = 4,602	$\beta_0$	-28.244	-30.181	-26.308
	$\beta_1$	0.264	0.246	0.282
Carapace Length:	SM50	107.0 mm (4.2 in)	106.6 mm (4.2 in)	107.5 mm (4.2 in)

Table 7. Number of golden king crabs tagged on the 1991 survey by the Alaska Department of Fish and Game in portions of the Dutch Harbor and Adak Mangagement Areas.<sup>a</sup>

Crab Sex-Size No. Crabs Tagged	Dutch Harbor Area Stations (1-26)	Adak Area (Stations 27-60)	Total
<b>Males</b>			
Sublegals	659	1,691	2,350
Legals	590	672	1,262
Males not measured	0	2	2
<b>Females</b>			
Juveniles	37	253	290
Adults	285	613	898
<b>Totals</b>	<b>1,571</b>	<b>3,231</b>	<b>4,802</b>

<sup>a</sup> Crabs were tagged with Floy spaghetti tags through the isthmus muscle, below the back margin of the carapace.

Table 8. Recoveries of tagged male golden king crabs in the Dutch Harbor (O) and Adak (R) Management Areas during the 1991 and 1992 commercial seasons grouped by their size and area that were released on the 1991 golden king crab survey in the Aleutian Islands by the Alaska Department of Fish and Game.

Release Area	No. Released	No. Tags Recovered by Fishery & Combined Seasons & Ratio (%) Recaptures to Total No. Released by Area						
		O91 <sup>a</sup>	R91 <sup>a</sup>	Total 91	O92 <sup>a</sup>	R92 <sup>a</sup>	Total 92	Totals 91 & 92
<b>Sublegals<sup>b</sup></b>								
O	659	14 2.1%	2 0.3%	16 2.4%	12 1.8%	1 0.2%	13 2.0%	29 4.4%
R	1,691	0 0.0%	24 1.4%	24 1.4%	3 0.2%	12 0.3%	15 0.9%	40 <sup>c</sup> 2.4%
Subl. Totals	2,350	14 0.6%	26 1.1%	40 1.7%	15 0.6%	13 0.6%	28 1.2%	69 <sup>c</sup> 2.9%
<b>Legals<sup>d</sup></b>								
O	590	59 10.0%	2 0.3%	61 10.3%	16 2.7%	0 0.0%	16 2.7%	77 13.1%
R	672	5 0.7%	25 3.7%	30 4.4%	3 0.4%	10 1.5%	13 1.9%	44 <sup>c</sup> 6.5%
Legal Totals	1,262	64 5.1%	27 2.1%	91 7.2%	19 1.5%	10 0.8%	29 2.3%	121 <sup>c</sup> 9.6%

<sup>a</sup> Commercial fishing seasons for golden king crabs are designated with an **O** for the Dutch Harbor and **R** for the Adak Management Areas and **91** and **92** for the 1991 and 1992 seasons which occurred with the following dates: **O91** = 9/1-11/15/91, **R91** = 11/1/91-8/15/92, **O92** = 9/1-11/15/92, and **R92** = 11/1/92-8/15/93.

<sup>b</sup> Sublegals are male golden king crabs whose carapace width outside the spines were <152.4 mm (<6.0 in) and whose carapace length was ≥100 mm (3.9 in) on the date of their tagging. Note they may have grown to legal size by the time they were recovered during the fishery.

<sup>c</sup> Includes a sublegal and legal-sized crab that were tagged and released in the Adak Area and recaptured in a subsequent fishery having no recorded fishing season or management area assigned.

<sup>d</sup> Legals are male golden king crabs whose carapace width outside the spines were ≥152.4 mm (≥6.0 in) on the date of their tagging.

Table 9. Frequency of carapace length at recovery minus length at release for 105 male golden king crabs having both measurements. These crabs were released in the Aleutian Islands on the 1991 golden king crab survey by the Alaska Department of Fish and Game and recovered from the 1991 and 1992 Dutch Harbor and Adak commercial golden king crab fisheries.

Recovery Minus Release Length (mm)	Number	Recovery Minus Release Length (mm)	Number
-7	1	14	1
-6	1	15	0
-5	0	16	1
-4	2	17	1
-3	0	18	5
-2	15	19	1
-1	21	20	2
0	25	21	0
1	11	22	1
2	3	23	0
3	2	24	0
4	1	25	0
5	1	26	1
6	0	27	1
7	1	28	0
8	0	29	0
9	0	30	0
10	1	31	0
11	1	32	0
12	3	33	0
13	1	34	1

Table 10. Distance traveled by male golden king crabs tagged on the 1991 golden king crab survey in the Aleutian Islands by the Alaska Department of Fish and Game and subsequently recovered during the 1991 and 1992 commercial seasons in the Dutch Harbor (O) and Adak (R) Management Areas.<sup>a</sup>

		Commercial Golden King Crab Seasons				
		091 <sup>b</sup>	R91 <sup>b</sup>	092 <sup>b</sup>	R92 <sup>b</sup>	<u>Both</u> Seasons
<b>Sublegals<sup>c</sup></b>						
No. Crabs		12	5	7	3	27
<b>Distances: km &amp; (nmi):</b>						
Average	13.1 (7.1)	19.4 (10.5)	24.1 (13.0)	20.2 (10.9)		
Minimum	3.9 (2.1)	4.8 (2.6)	1.9 (1.0)	13.9 (7.5)		
Maximum	24.6 (13.3)	37.2 (20.1)	61.2 (33.1)	32.7 (17.7)		
Stand. Dev.	5.7 (3.1)	13.0 (7.0)	22.0 (11.9)	10.7 (5.8)		
<b>Legals<sup>d</sup></b>						
No. Crabs		43	11	9	0	63
<b>Distances km &amp; (nmi):</b>						
Average	10.4 (5.6)	20.0 (10.8)	26.4 (14.4)	-		
Minimum	1.3 (0.7)	5.9 (3.2)	7.4 (4.0)	-		
Maximum	35.7 (19.3)	37.6 (20.3)	59.4 (32.1)	-		
Stand. Dev.	7.3 (3.8)	10.0 (5.4)	18.5 (10.0)	-		
<b>All Crabs</b>						
No. Crabs		55	16	16	3	90
<b>Distances km &amp; (nmi):</b>						
Average	10.9 (5.9)	19.8 (10.7)	25.5 (13.8)	20.2 (10.9)	15.4 (8.3)	
Minimum	1.3 (0.7)	4.8 (2.6)	1.9 (1.0)	13.9 (7.5)	1.3 (0.7)	
Maximum	35.7 (19.3)	37.6 (20.3)	61.2 (33.1)	32.7 (17.7)	61.2 (33.1)	
Stand. Dev.	6.8 (3.7)	10.5 (5.7)	20.0 (10.8)	10.7 (5.8)	12.4 (6.7)	

<sup>a</sup> Only tagged male golden king that had exact release and recovery locations were used to calculate the **straight-line** distance between these two locations. The total distance traveled while released is not possible to calculate.

<sup>b</sup> Commercial fishing seasons for golden king crabs are designated with an **O** for the Dutch Harbor and **R** for the Adak Management Areas and **91** and **92** for the 1991 and 1992 seasons which occurred with the following dates: **O91** = 9/1-11/15/91, **R91** = 11/1/91-8/15/92, **O92** = 9/1-11/15/92, and **R92** = 11/1/92-8/15/93.

<sup>c</sup> Sublegals are male golden king crabs whose carapace width outside the spines were are <152.4 mm (<6.0 in) on the date of their tagging. Note they may have grown to legal size by the time they were recovered during the fishery.

<sup>d</sup> Legals are male golden king crabs whose carapace width outside the spines were ≥152.4mm (≥6.0 in) on the date of their tagging.

Table 11. Comparison of exoskeletal classification on tagged golden king crabs on the 1991 survey by the Alaska Department of Fish and Game in portions of the Dutch Harbor and Adak Management Areas and the recovery of those crabs in the 1991/92 and 1992/93 commercial fisheries.

A.			
<u>Shell Age</u>	<u>No. Released</u>	<u>No. Recovered</u>	
New Shell	178	98	
Old Shell	13	5	
Very Old Shell	2	1	
Not Recorded	<u>0</u>	<u>89</u>	
Total	193	193	

B.				
Shell Age at Release:	<u>Shell Age at Recovery</u>			
	<u>New Shell</u>	<u>Old Shell</u>	<u>Very Old Shell</u>	<u>Total</u>
New Shell	90	4	1	95
Old Shell	7	0	0	7
Very Old Shell	1	1	0	2
Totals	98	5	1	104

C.			
<u>Probable Errors in Shell Aging Crabs that Grew &lt;8 mm (0.3 in) CL</u>			
<u>Shell Age At:</u>		<u>No. Days</u>	<u>What Shell Age at Recovery</u>
<u>Release</u>	<u>Recovery</u>	<u>Free</u>	<u>Probably Should Have Been</u>
New	Old	34	New (1 crab)
New	Very Old	285	Old (1 crab)
Old	New	34 to 111	New (5 crabs)
Very Old	Old	33	Very Old (1 crab)
Very Old	New	37	Very Old (1 crab)

Table 12. Reproductive condition of 3,174 adult female golden king crabs found on the 1991 survey in a portion of the Dutch Harbor and Adak Management Areas by the Alaska Department of Fish and Game.

Condition	No. Females <sup>a</sup>	Mean Carapace Length (mm)	Depth					
			Mean		Minimum		Maximum	
			m	fm	m	fm	m	fm
<b>Egg Color</b>								
Tan	634	124	348	190	174	95	597	326
Orange	1,426	123	348	190	148	81	725	396
Barren Females	1,114	123	353	193	148	81	725	396
<b>Egg Development</b>								
Uneyed	1,022	124	350	191	148	81	725	396
Eyed	1,037	124	348	190	154	84	710	388
Barren	1,115	123	353	193	148	81	725	396
<b>Dead Eggs</b>								
Not Apparent	1,972	124	348	190	148	81	725	396
<20% in Clutch	85	127	340	186	212	116	564	308
>20% in Clutch	2	121	388	212	360	197	417	228
Barren	1,115	123	353	193	148	81	725	396
<b>% Clutch Size</b>								
0%-Clean Pleopods	292	115	355	194	148	81	706	386
0%-Empty Egg Cases	823	125	351	192	148	81	725	396
1-29% Full	194	125	370	202	148	81	598	327
30-59% Full	81	125	382	209	172	94	725	396
60-89% Full	347	125	344	188	174	95	710	388
90-100% Full	1,437	123	344	188	148	81	706	386

<sup>a</sup> Three adult females that had no reproductive data recorded for them.

Table 13. Depth, size, and exoskeleton ages of "leatherback" male golden king crabs from stations 25-60 on the 1991 golden king crab survey conducted in a portion of the Dutch Harbor and Adak Management Areas by the Alaska Department of Fish and Game.

Station	Depth		Carapace Length (mm)	Carapace Width	
	Meters	Fathoms		Sublegal=1 Legal=2 <sup>a</sup>	Shell Age Old=2 Very Old=3
25	350	191	154	2	3
30	562	307	158	2	2
31	544	297	138	2	2
33	490	268	152	2	2
33	478	261	145	2	3
33	459	251	144	2	3
40	437	239	148	1	2
40	415	227	139	1	3
40	412	225	134	1	3
41	298	163	133	1	3
42	511	279	163	2	2
42	447	244	167	2	3
42	421	230	133	1	3
42	359	196	130	1	2
42	359	196	138	1	2
52	542	296	150	2	3
52	542	296	138	1	3
52	538	294	155	2	3
53	280	153	143	2	2
53	285	156	152	2	3
54	434	237	153	2	2
55	479	262	157	2	3
55	478	261	135	1	3
55	478	261	166	2	3
55	461	252	146	2	3
56	447	244	146	1	2
56	452	247	131	1	2
56	452	247	147	2	2
56	452	247	144	2	2
56	470	257	162	2	2
56	467	255	153	2	2
57	381	208	155	2	2
57	382	209	153	2	2
57	282	209	138	2	2
57	384	210	184	2	2
57	388	212	158	2	3
58	178	97	149	2	2
58	304	166	169	2	2
Means :	426	233	148.9		

<sup>a</sup> Legal-sized male crabs are those whose width measures  $\geq 152.4$  mm ( $\geq 6.0$  in) outside their spines.

Table 14. Infestation of the parasitic barnacle *Briarosaccus callosus* and the incidence of rust disease<sup>a</sup> on golden king crabs found on the 1991 golden king crab survey in the Aleutian Islands by the Alaska Department of Fish and Game.

	Males		Females		Total
	Sublegal	Legal	Juvenile	Adult	
<b>Barnacle</b>					
No. Crabs	33	0	29	5	67
<b>Crab Size:<sup>b</sup></b>					
Mean	92	-	85	117	91
Minimum	60	-	59	108	59
Maximum	132	-	106	143	143
<b>Depth:</b>					
Mean	576m 315fm	-	567m 310fm	538m 294fm	569m 311fm
Minimum	152m 83fm	-	216m 118fm	483m 264fm	152m 83fm
Maximum	851m 465fm	-	851m 465fm	587m 321fm	851m 465fm
<b>Rust Disease</b>					
No. Crabs	4	2	0	1	7
<b>Crab Size:</b>					
Mean	126	149	-	115	131
Minimum	114	142	-	115	114
Maximum	131	155	-	115	155
<b>Depth:</b>					
Mean	306m 167fm	318m 174fm	-	329m 180fm	313m 171fm
Minimum	232m 127fm	302m 165fm	-	329m 180fm	232m 127fm
Maximum	426m 233fm	333m 182fm	-	329m 180fm	426m 233fm

<sup>a</sup> "Rust disease" is a term used for species of chitinoclastic bacteria which can occur on the crab exoskeletons.

<sup>b</sup> Crab size is carapace length (CL) in millimeters.

Table 15. Catch and biological data of deep sea crabs *Lithodes couesi* and *Chionoecetes tanneri* caught on the 1991 golden king crab survey conducted by the Alaska Department of Fish and Game in portions of the Adak and Dutch Harbor Management Areas. Crab exoskeletons were all new-shell.

Station	Pot No.	Depth		Carapace Size (mm)			Embryos				Rt. Chela Height (mm)	Merus Length (mm)
		(m)	(fm)	Length	Width <sup>a</sup>	Sex	Color	Develop	Condition	% Clutch		
<b><i>Lithodes couesi</i></b>												
5	39	851	465	101		F	Tan	Uneyed	No Dead Eggs	90-100%		
5	46	853	466	111		F	Orange	Uneyed	No Dead Eggs	90-100%		
5	46	853	466	110		F	Tan	Eyed	No Dead Eggs	30-59%		
5	47	853	466	105		F	Orange	Uneyed	No Dead Eggs	90-100%		
21	188	549	300	131	141	M					33.1	115
21	188	549	300	130	145	M					32.2	99
21	189	545	298	141	166	M					36.6	118
21	189	545	298	124	159	M					29.0	96
<b><i>Chionoecetes tanneri</i></b>												
5	39	851	465		126	-						
5	46	853	466		105	F	Orange	Eyed	No Dead Eggs	90-100%		
49	476	699	382		148	M						

<sup>a</sup> Carapace width on *Lithodes couesi* was taken outside the longest pair of lateral carapace spines. On *Chionoecetes tanneri* the carapace width was measured from the greatest straight-line distance across the carapace at a right angle to a line midway between the eyes to the midpoint of the posterior portion of the carapace inside the spines.

Table 16. Miscellaneous species captured during the 1991 golden king crab survey conducted in portions of the Dutch Harbor and Adak Management Areas by the Alaska Department of Fish and Game.

Common Name	Scientific Name/Group	No. Pots	Number of Animals		Size Range <sup>a</sup> (cm)			Condition When Landed			Depth Range (m) <sup>b</sup>		
			Measured	Not Measured	Min.	Max.	Avg.	Dead	Alive	Not Recorded	Min.	Max.	Avg.
<b>FISH</b>													
Greenland turbot	<i>Reinhardtius hippoglossoides</i>	60	96	4	53	98	81	67	20	13	137	853	598
Pacific halibut	<i>Hippoglossus stenolepis</i>	46	58	4	62	138	90	21	30	11	137	395	234
Pacific cod	<i>Gadus macrocephalus</i>	9	8	2	76	83	80	6	4	-	139	366	205
Sablefish	<i>Anoplopoma fimbria</i>	6	9	1	60	76	65	-	8	2	463	759	551
Rockfish-unident.	Scorpaenidae	1	1	0	20	20	20	1	-	-	467	467	467
Skate-unident.	Rajiformes	2	1	1	4	4	4	-	1	1	534	600	567
Yellow Irish lord	<i>Hemilepidotus jordani</i>	14	1	16	38	38	38	1	9	7	137	370	209
Sculpin-unident.	Cottidae	2	0	5	-	-	-	-	-	3	357	357	357
Rattail-unident.	Macrouridae	1	1	0	92	92	92	-	-	1	767	767	767
<b>INVERTEBRATES</b>													
Pacific octopus	<i>Octopus dolfeini</i>	1	0	1	-	-	-	-	1	-	333	333	333
Sea urchin	<i>Strongylocentrotus</i> sp.	1	0	1	-	-	-	-	-	1	143	143	143
Basket star	<i>Gorgonocephalus caryi</i>	10	0	27	-	-	-	-	-	27	141	205	152
Sunflower star	<i>Pycnopodia helianthoides</i>	1	0	1	-	-	-	-	-	1	221	221	221
Starfish-unident.	Asteroidea	1	0	1	-	-	-	-	-	1	172	172	172
Sponge-unident.	Porifera	2	0	2	-	-	-	-	-	2	192	231	210
Snail-unident.	Gastropoda	5	0	8	-	-	-	-	-	8	141	227	174
Red tree coral	<i>Primnoa willeyi</i>	1	0	1	-	-	-	-	-	1	214	214	214
Coral-unident.	Cnidaria	1	0	1	-	-	-	-	-	1	192	192	192

<sup>a</sup> Fish were measured to the nearest centimeter from the tip of the mouth to the midpoint of the caudal fin (i.e. fork-length).

<sup>b</sup> To convert meters (m) to fathoms, divide the number of meters by 1.83.

Table 17. Bottom ocean temperatures collected at 12 stations on the 1991 golden king crab survey by the Alaska Department of Fish and Game in portions of the Dutch Harbor and Adak Management Areas.

Station	Depth		Temperature	
	Meters	Fathoms	°C	°F
2	231	126	4.3	39.8
3	554	303	3.8	38.8
10	238	130	4.2	39.5
12	278	152	4.6	40.2
14	231	126	4.3	39.8
34	174	95	5.0	41.0
35	181	99	3.8	38.8
38	212	116	5.6	42.0
40	445	243	3.7	38.6
42	359	196	5.0	41.0
45	282	154	4.7	40.5

<sup>a</sup> Temperatures may be slightly higher than actual bottom temperatures, since it took from 5-30 minutes for the thermometers to reach the surface from the pots they were attached in. Also temperatures rose quickly once thermometer was removed from its water filled case.

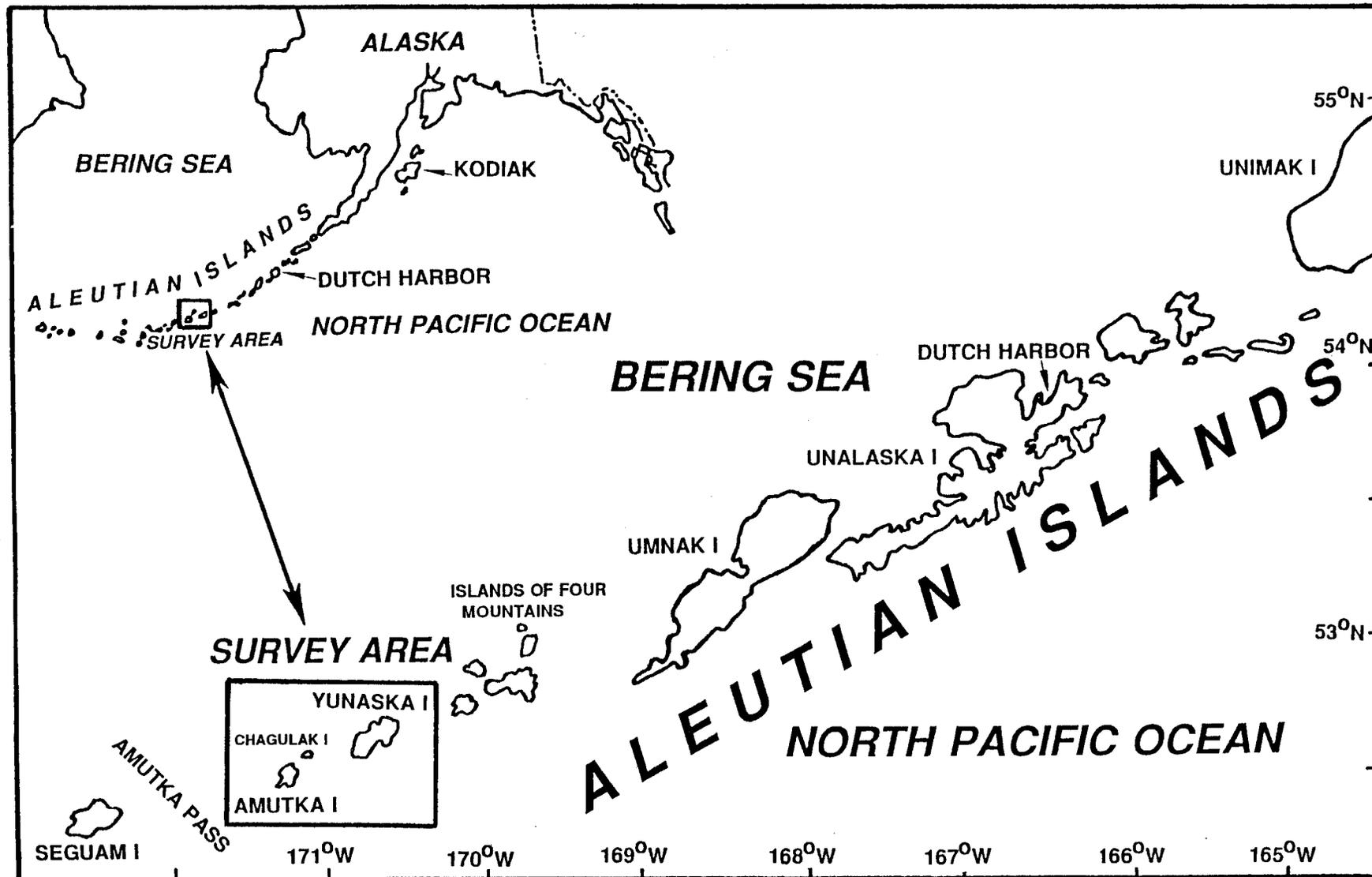


Figure 1. Location of the area surveyed around Yunaska, Chagulak and Amutka islands for golden king crabs. The survey was conducted in August and September of 1991 by the Alaska Department of Fish and Game aboard the chartered FV Western Viking.

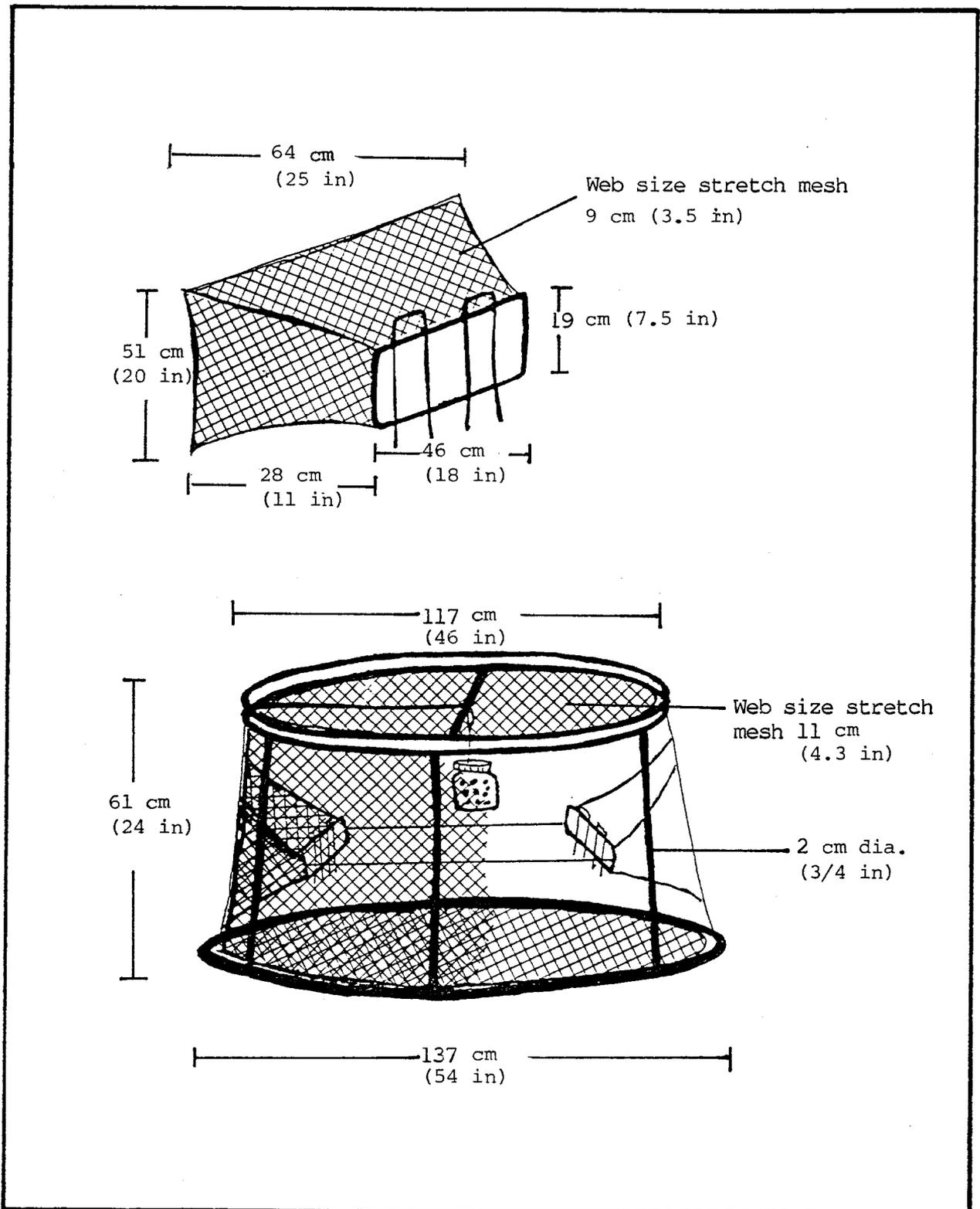


Figure 2. Diagram of a typical conical pot used on the FV Western Viking on the 1991 golden king crab survey conducted by the Alaska Department of Fish and Game around Yunaska, Chaçulak and Amutka Islands in the Aleutian Islands.

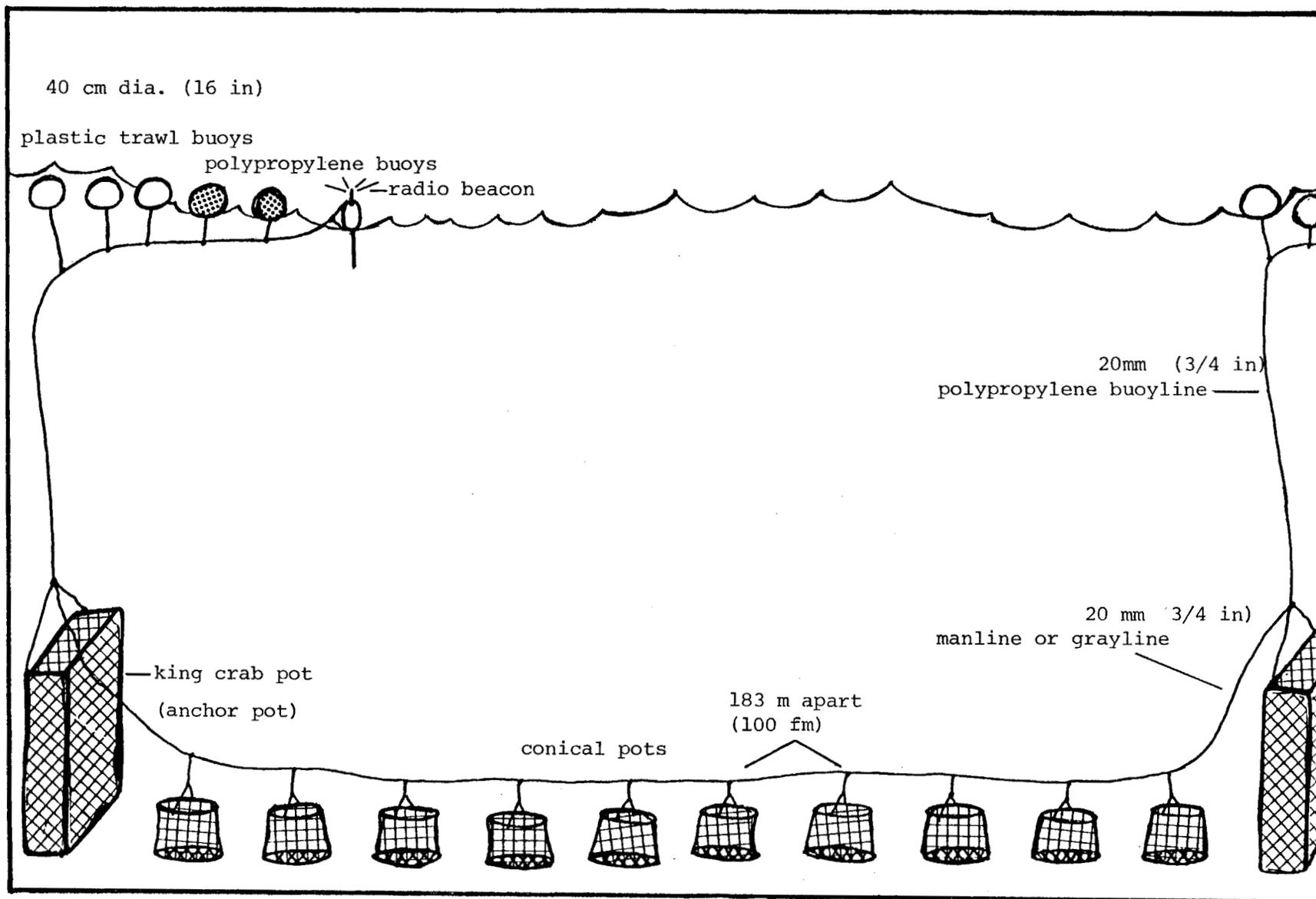


Figure 3. Diagram of a longline string of gear used on the 1991 golden king crab survey around Yunaska, Chagulak, and Amutka islands conducted by the Alaska Department of Fish and Game. The distance between pots was 183 m (100 fm) and 2 km (1,100 fm) between the two anchor (king crab) pots. The king crab pots do not land on end as depicted; rather they were drawn that way only as a means to fit them in the diagram.

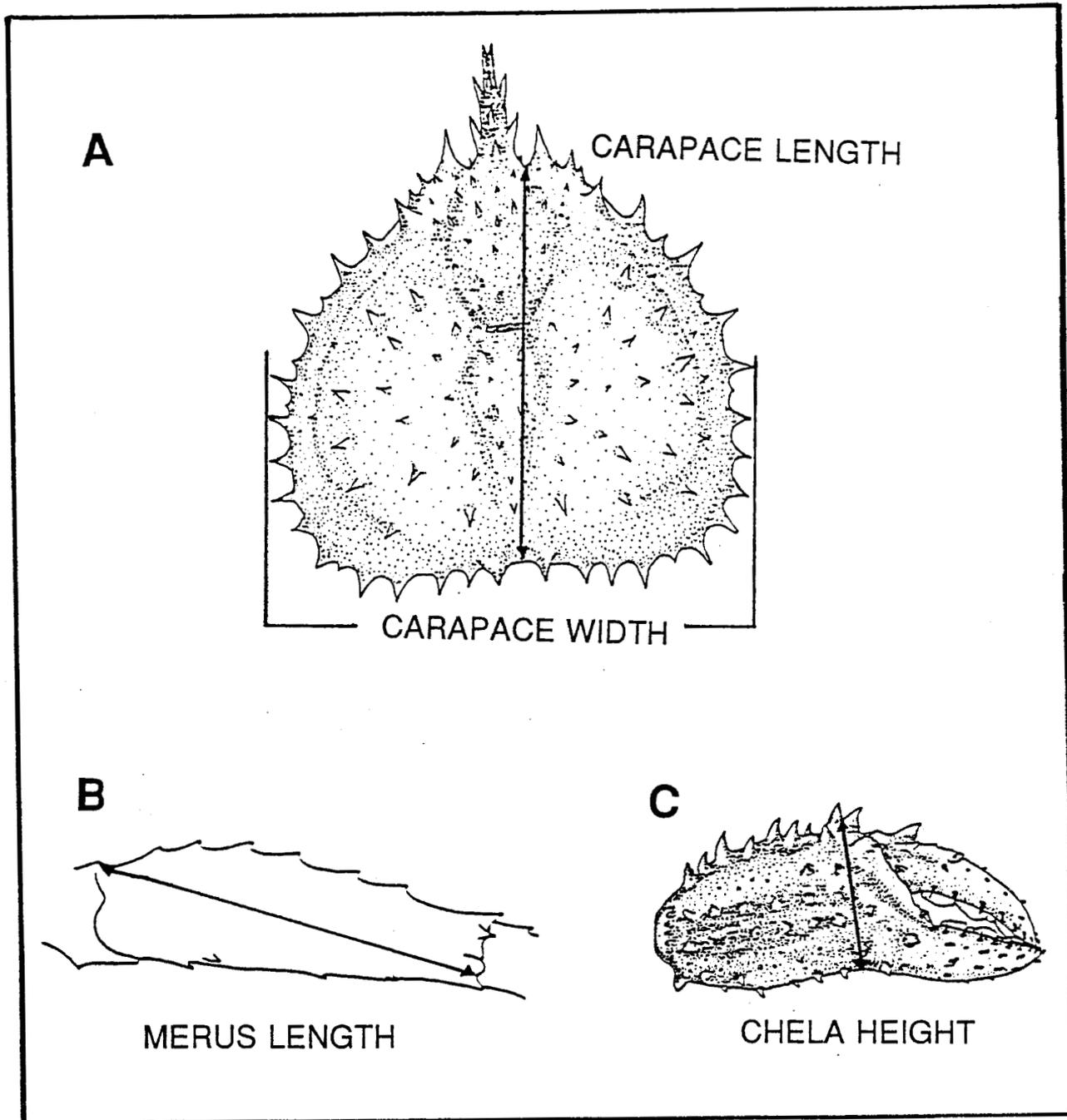


Figure 4. Locations where various measurements were taken on golden king crabs *Lithodes aeguespina* on the 1991 golden king crab survey in the Aleutian Islands by the Alaska Department of Fish and Game. A). Carapace length was measured between the right eye orbit and the midpoint of the carapace. Carapace width was measured outside the two widest parallel spines. B). Merus length was measured from on the ventral surface of the left second walking leg. C). Chela height was measured on male crab's right chela as shown. Source for drawings A and C from Sloan 1984 with permission of Canadian Department of Fisheries, Pacific Biological Station; B was adapted from Somerton 1986 with permission of the author.

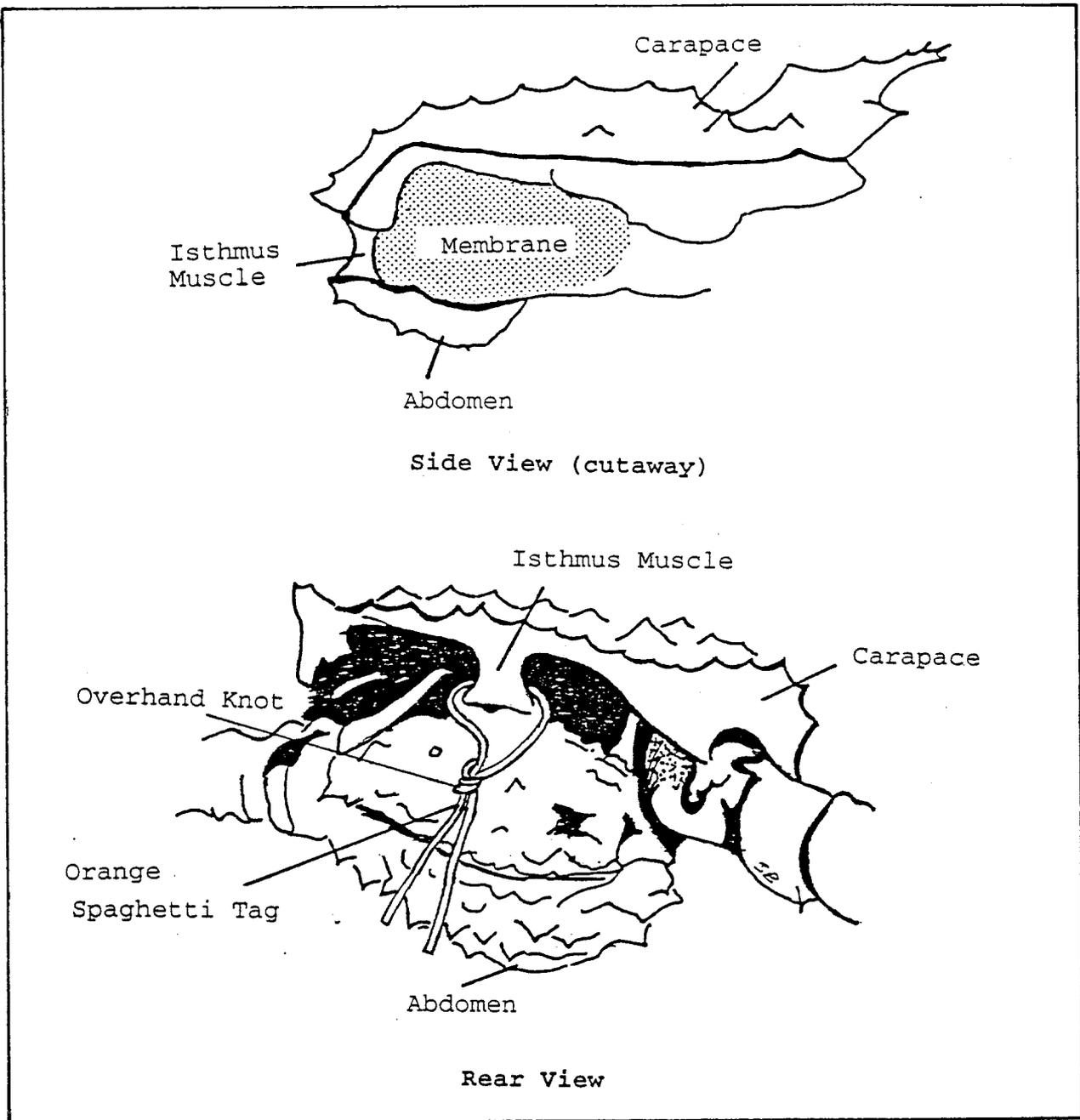
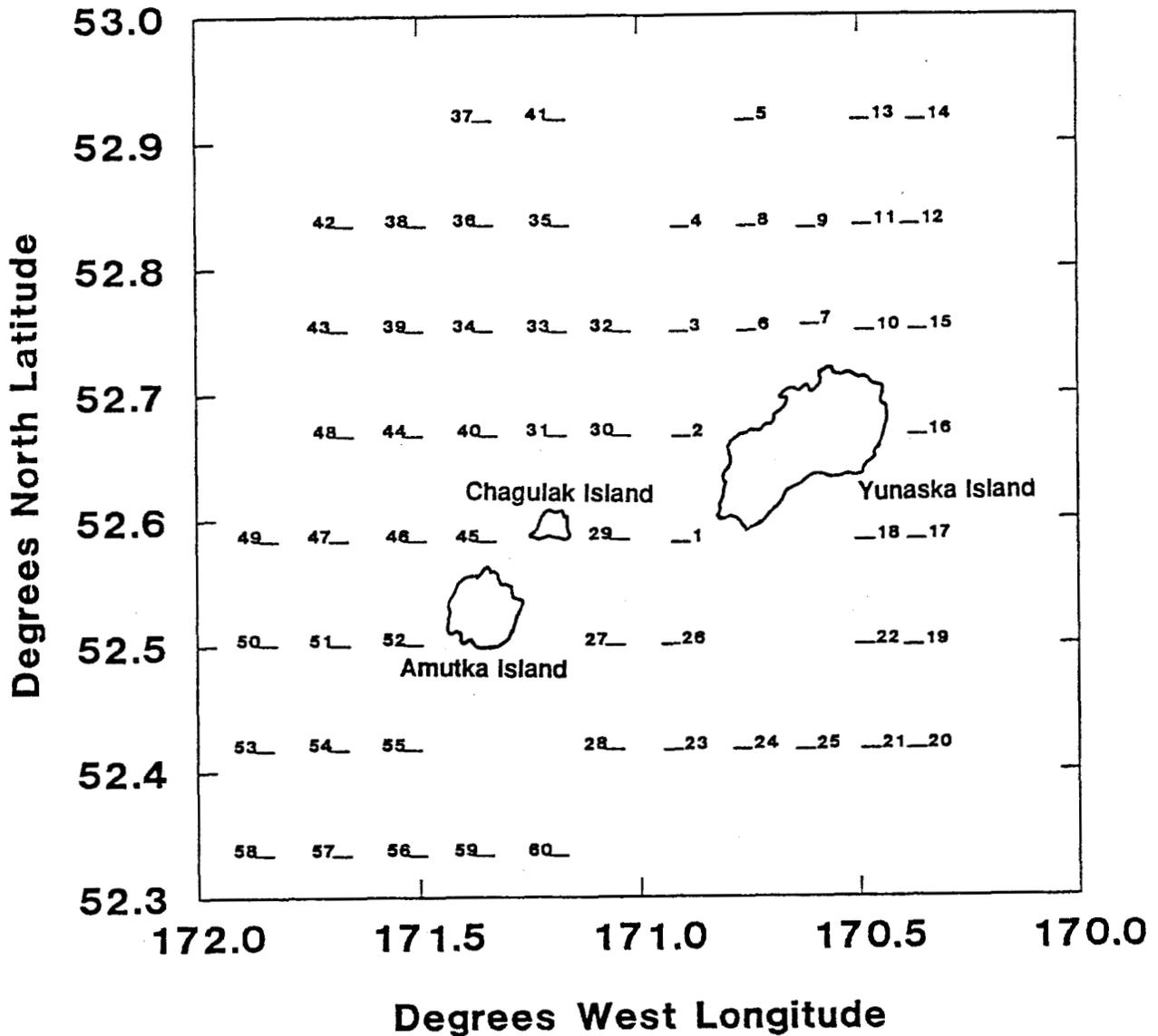


Figure 5. The isthmus muscle connects the carapace to the abdomen. Location of numbered vinyl spaghetti tags placed through the isthmus muscle.



### STATION NUMBERS AND LOCATIONS

Figure 6. Locations of the 60 research stations fished for golden king crabs around Yunaska, Chagulak, and Amutka islands in the Aleutian Islands in 1991 by the Alaska Department of Fish and Game on the FV Western Viking. Size and locations of the islands are approximate.

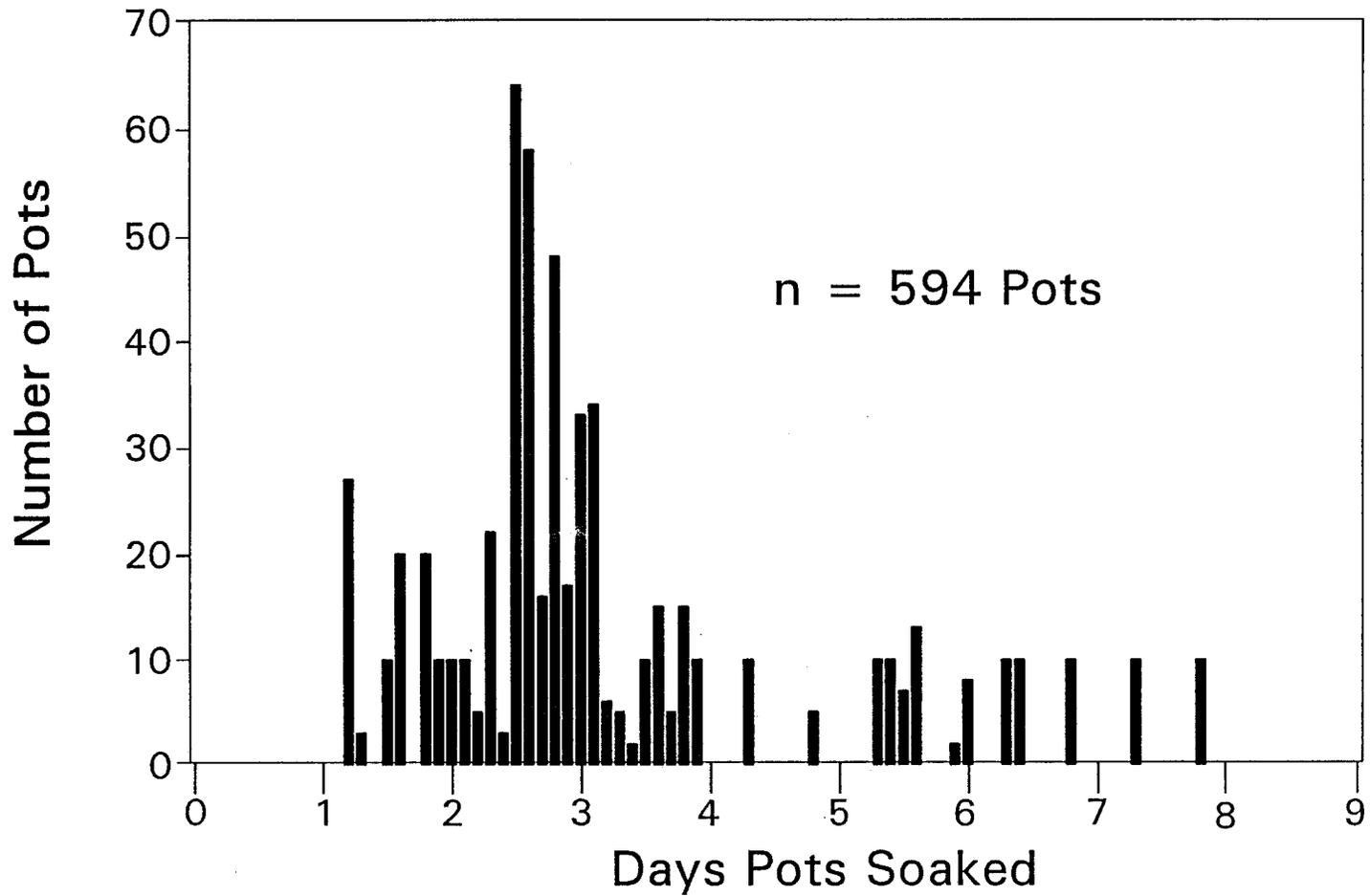


Figure 7. Frequency distribution of the soak time for conical pots fished on the 1991 golden king crab survey in the Aleutian Islands by the Alaska Department of Fish and Game.

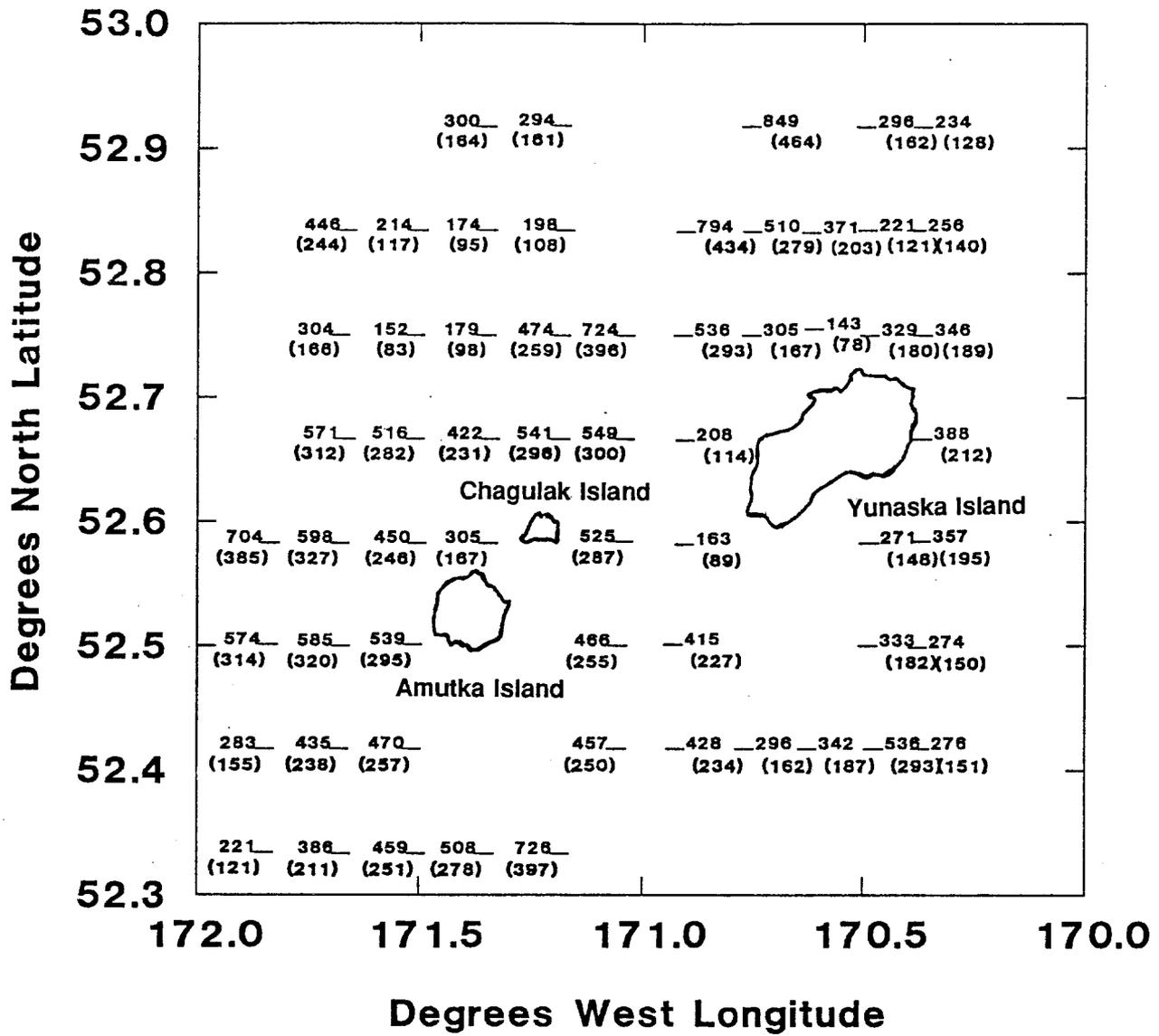


Figure 8. Mean station depth at each of the 60 stations fished during the 1991 golden king crab survey around Yunaska, Chagulak and Amutka islands by the Alaska Department of Fish and Game.

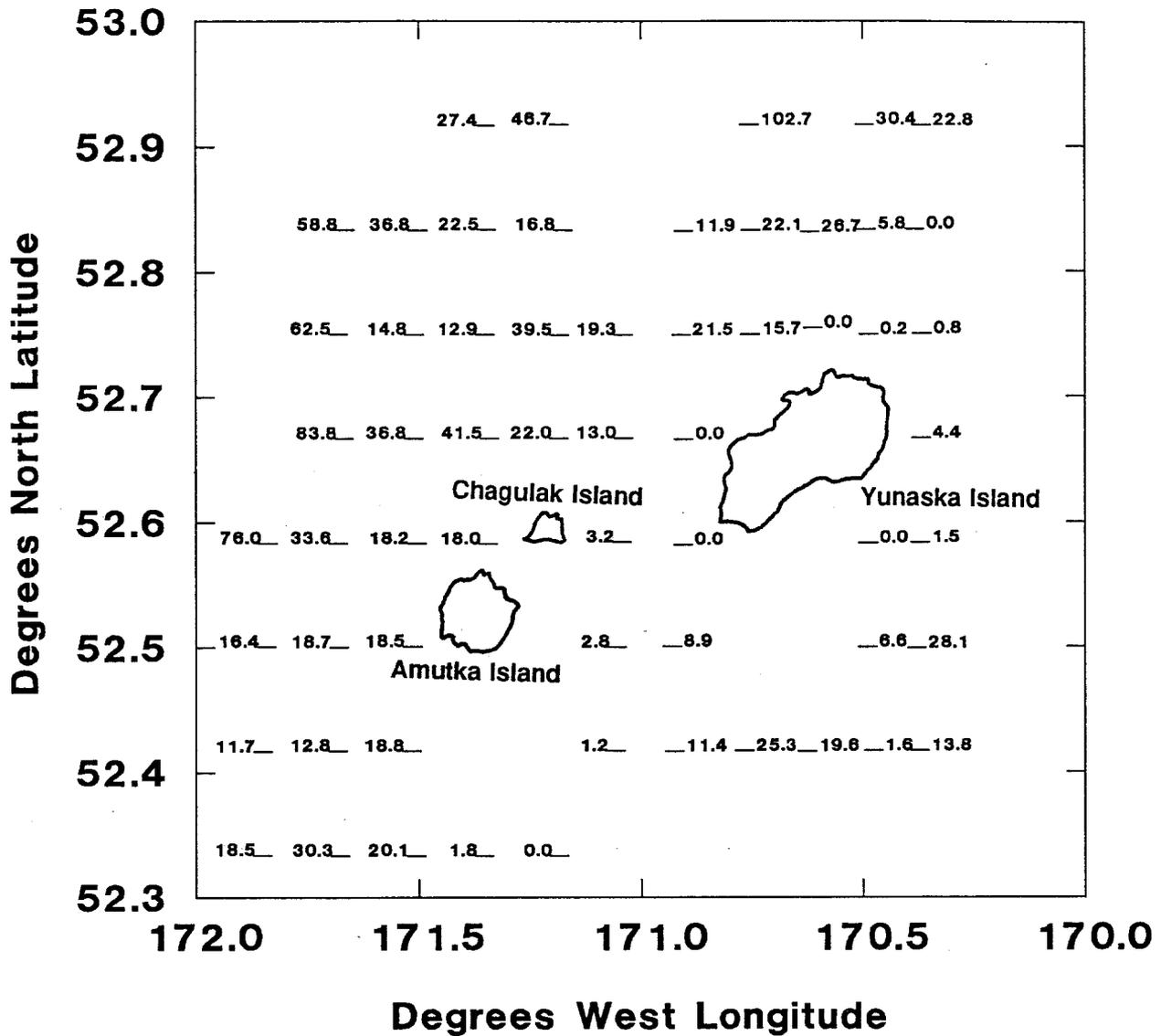


Figure 9. Mean catch per pot of all golden king crabs captured on the 1991 survey around Yunaska, Chagulak and Amutka islands by the Alaska Department of Fish and Game.

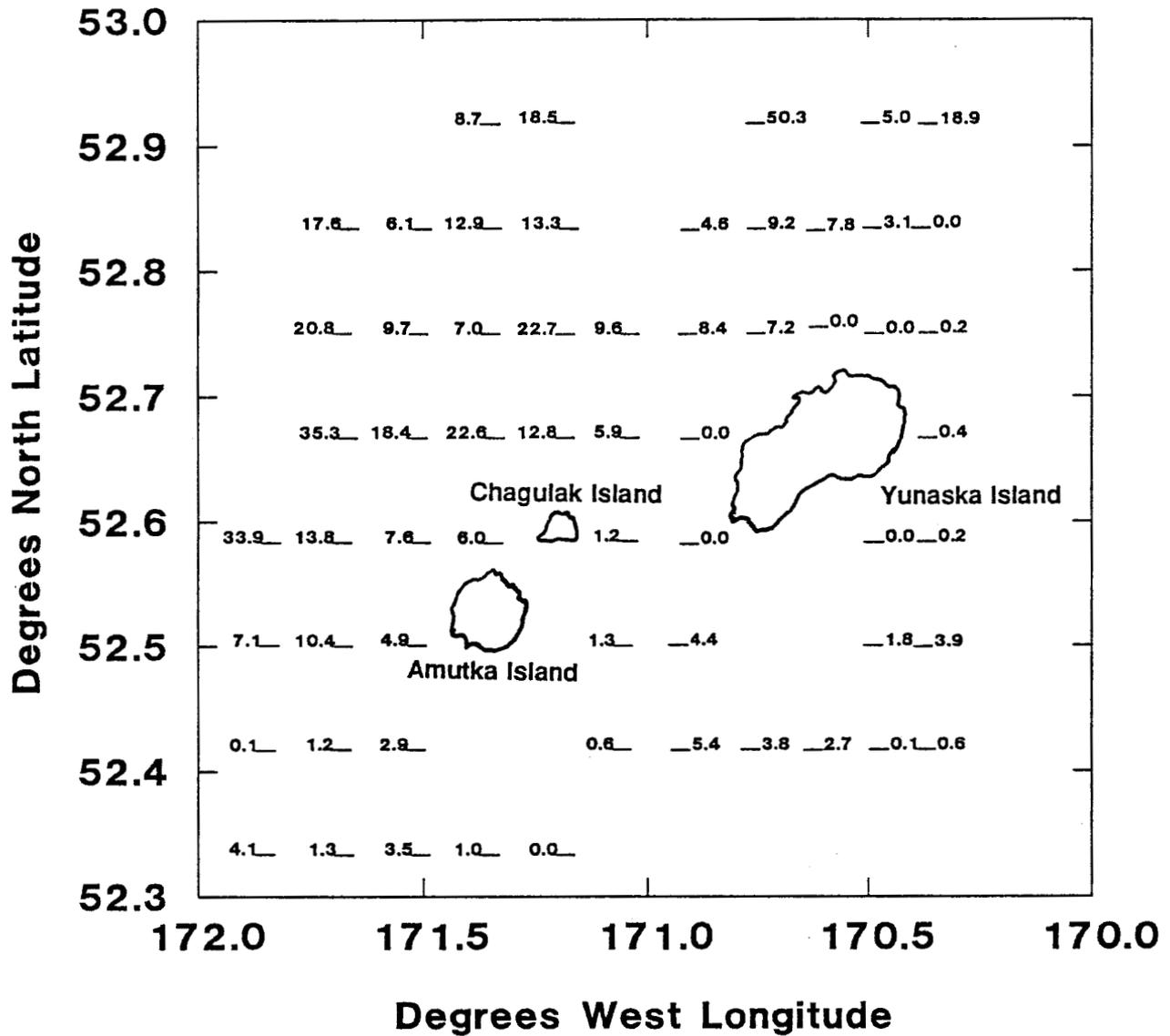


Figure 10. Mean catch per pot of sublegal male golden king crabs captured on the 1991 survey around Yunaska, Chagulak and Amutka islands by the Alaska Department of Fish and Game.

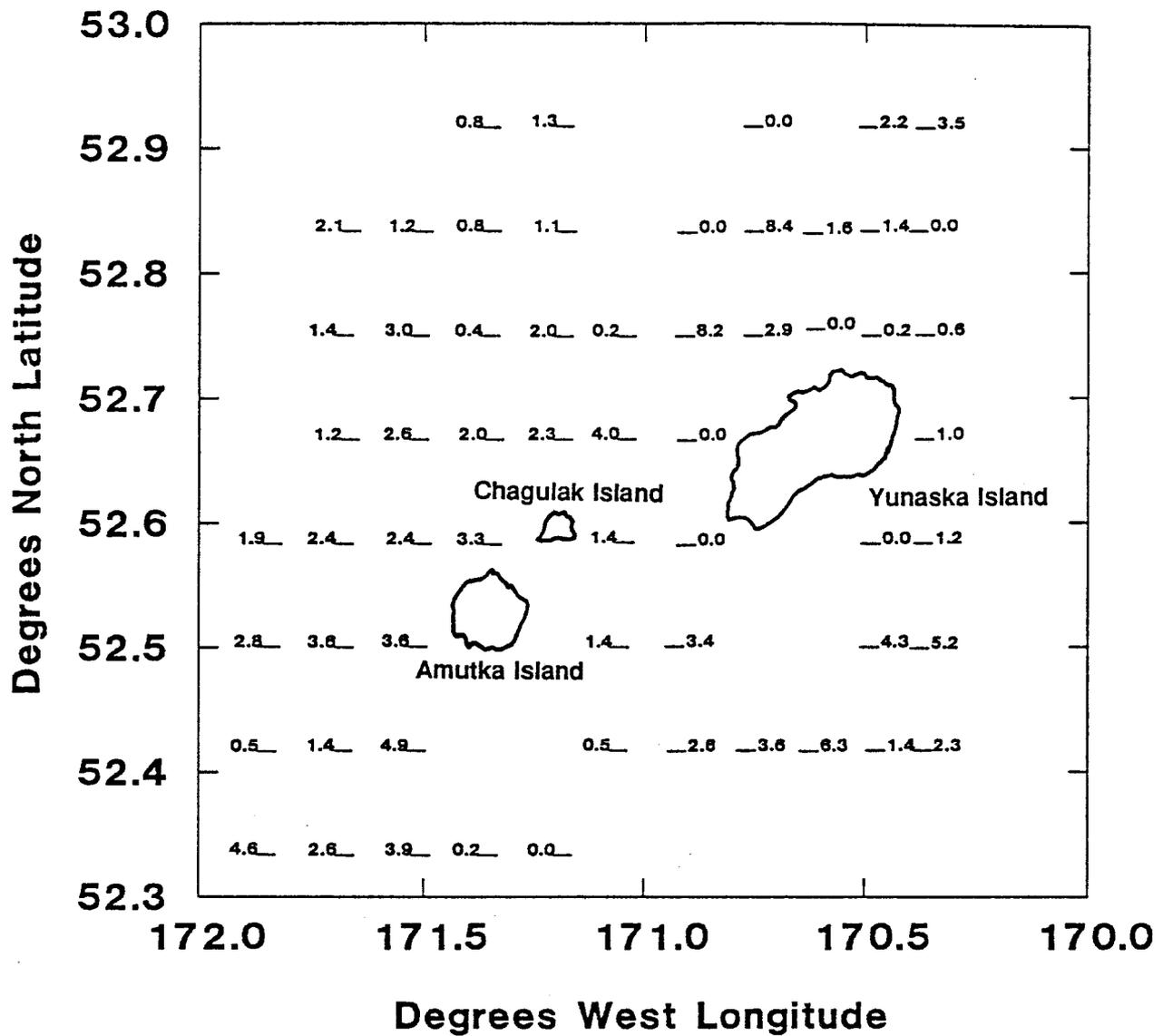


Figure 11. Mean catch per pot of legal male golden king crabs captured on the 1991 survey around Yunaska, Chagulak and Amutka islands by the Alaska Department of Fish and Game.

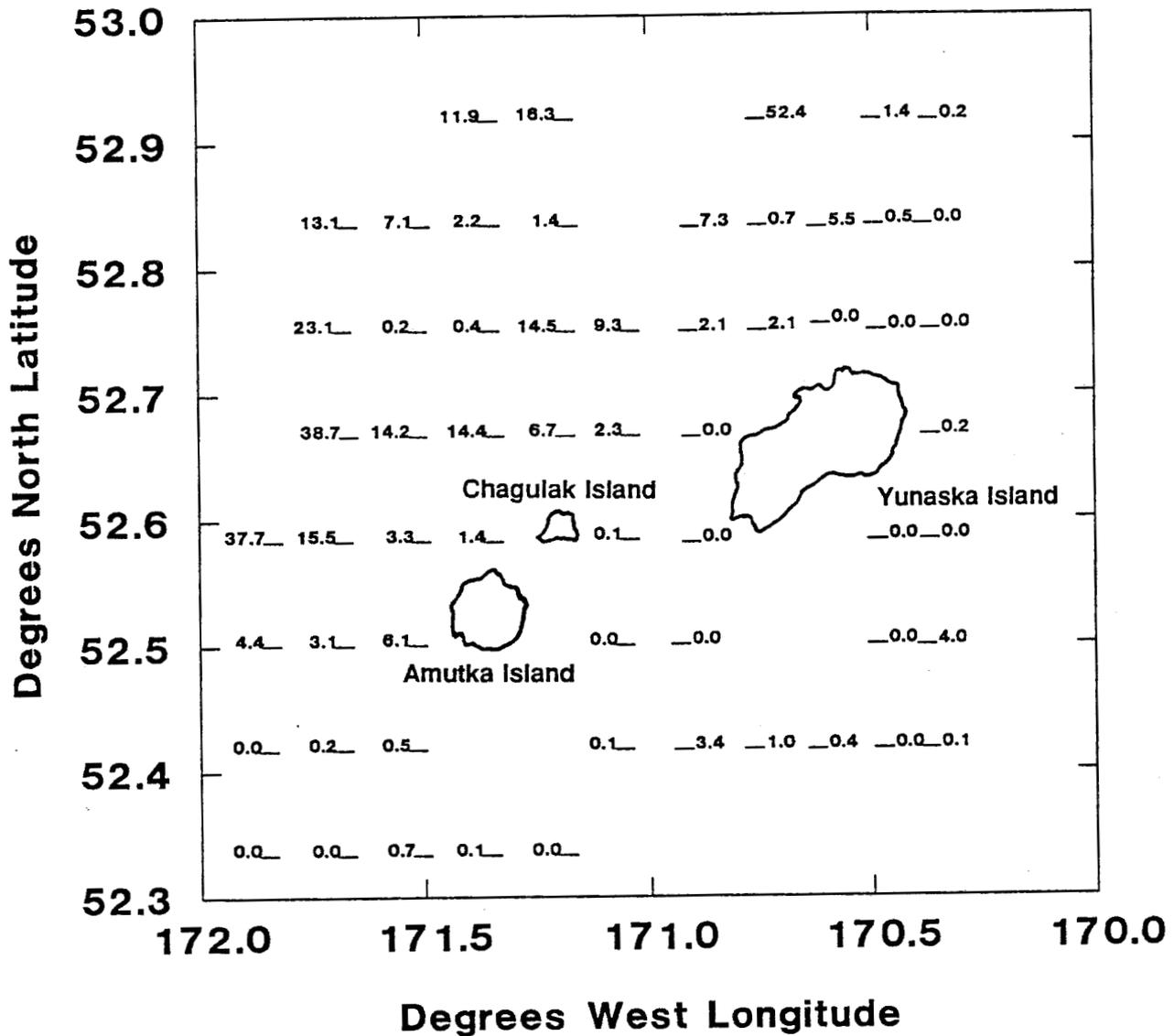


Figure 12. Mean catch per pot of juvenile female golden king crabs captured on the 1991 survey around Yunaska, Chagulak and Amutka islands by the Alaska Department of Fish and Game.

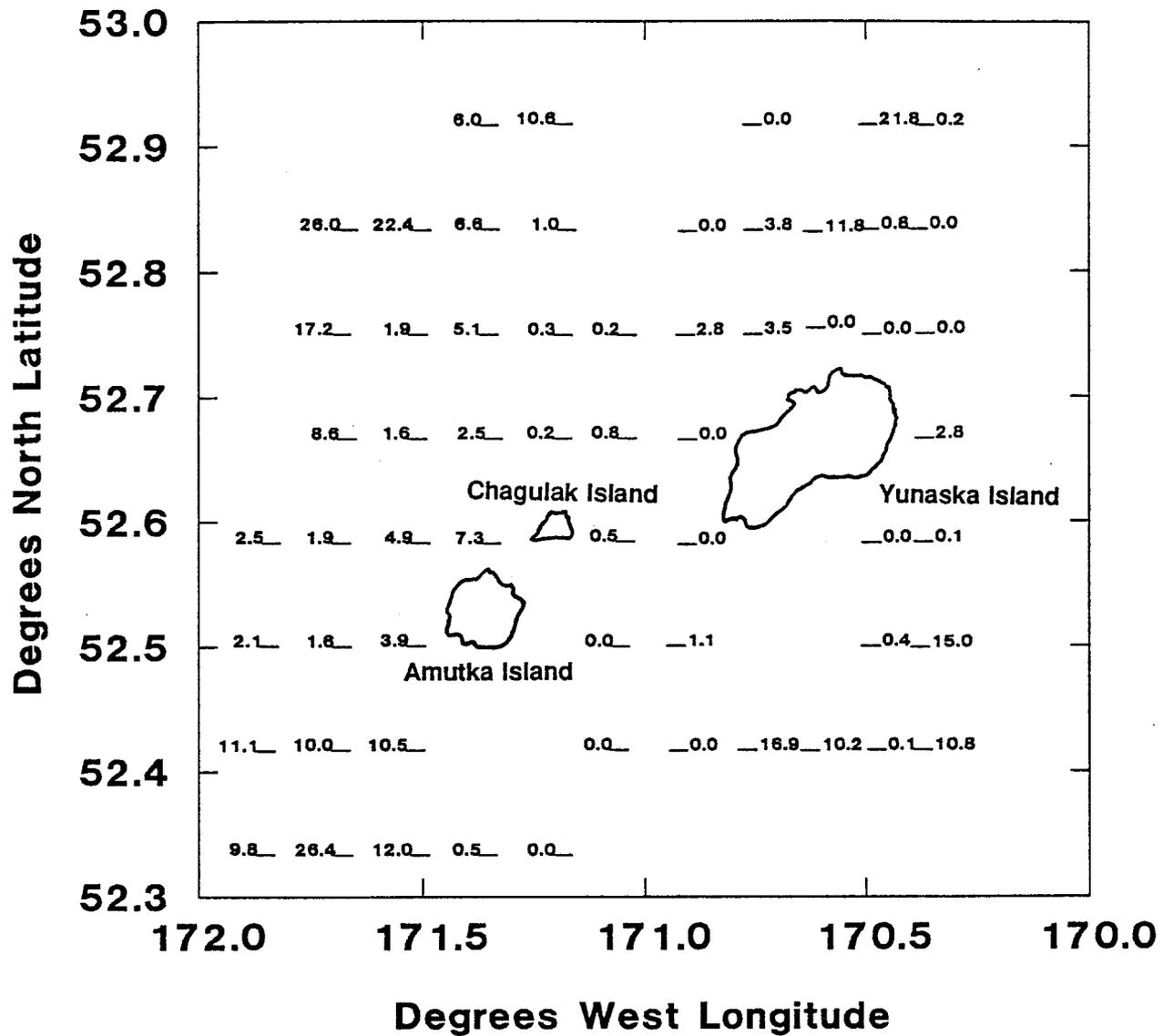


Figure 13. Mean catch per pot of adult female golden king crabs captured on the 1991 survey around Yunaska, Chagulak and Amutka islands by the Alaska Department of Fish and Game.

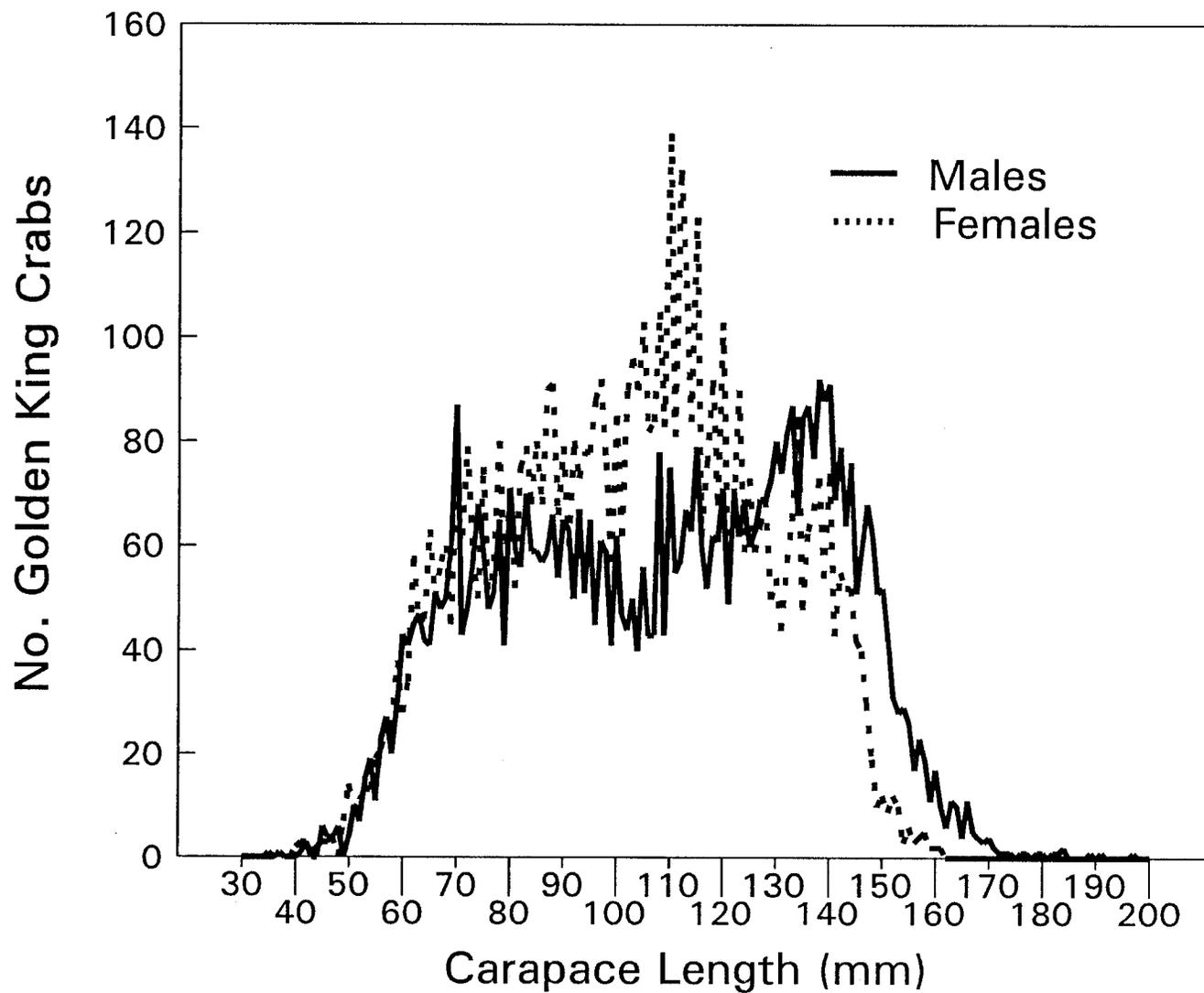


Figure 14. Carapace length frequency distribution of male and female golden king crabs from the 1991 survey around Yunaska, Chagulak and Amutka islands, in the Aleutian Islands, by the Alaska Department of Fish and Game.

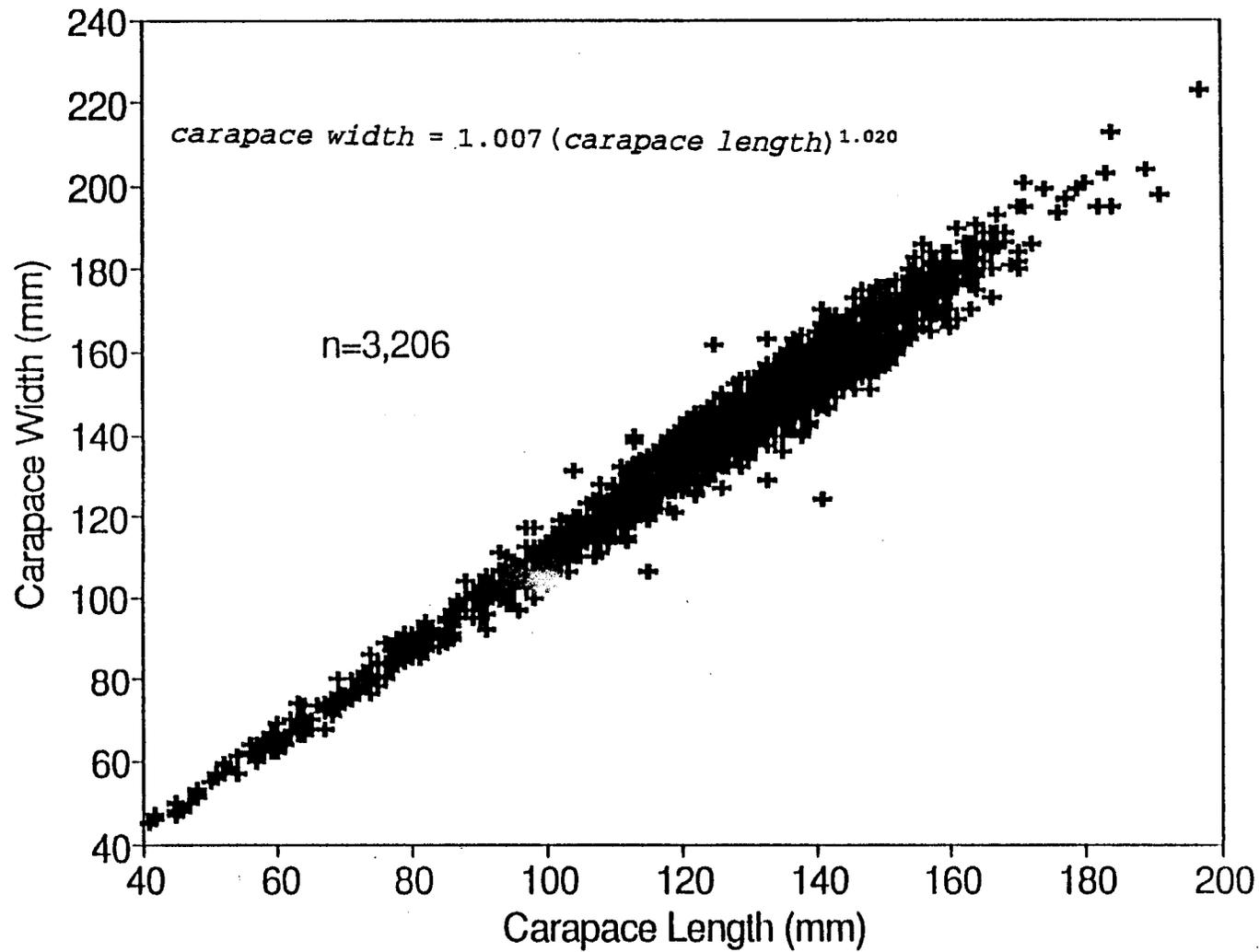


Figure 15. Relationship between the paired carapace width and length measurements for 3,206 male golden king crabs measured during the 1991 survey around Yunaska, Chagulak and Amutka islands by the Alaska Department of Fish and Game.

# MALE GOLDEN KING CRAB LEGAL SIZE AS FUNCTION OF MERUS LENGTH

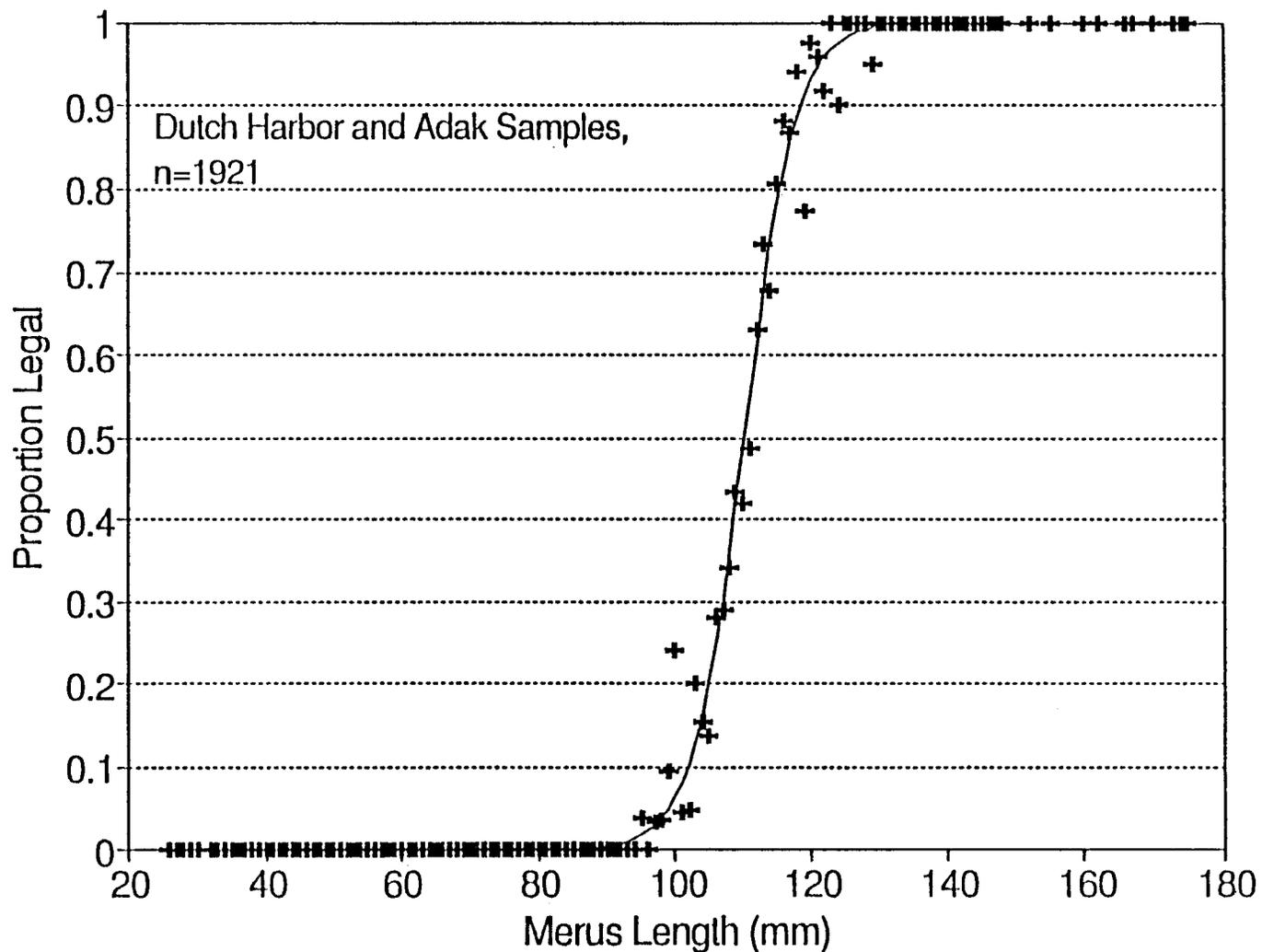


Figure 16. Logistic curve of the proportion of male golden king crabs that have legal carapace widths that correspond to merus length of the right second walking leg. Data from the 1991 golden king crab survey by Alaska Department of Fish and Game around Yunaska, Chagulak and Amutka islands.

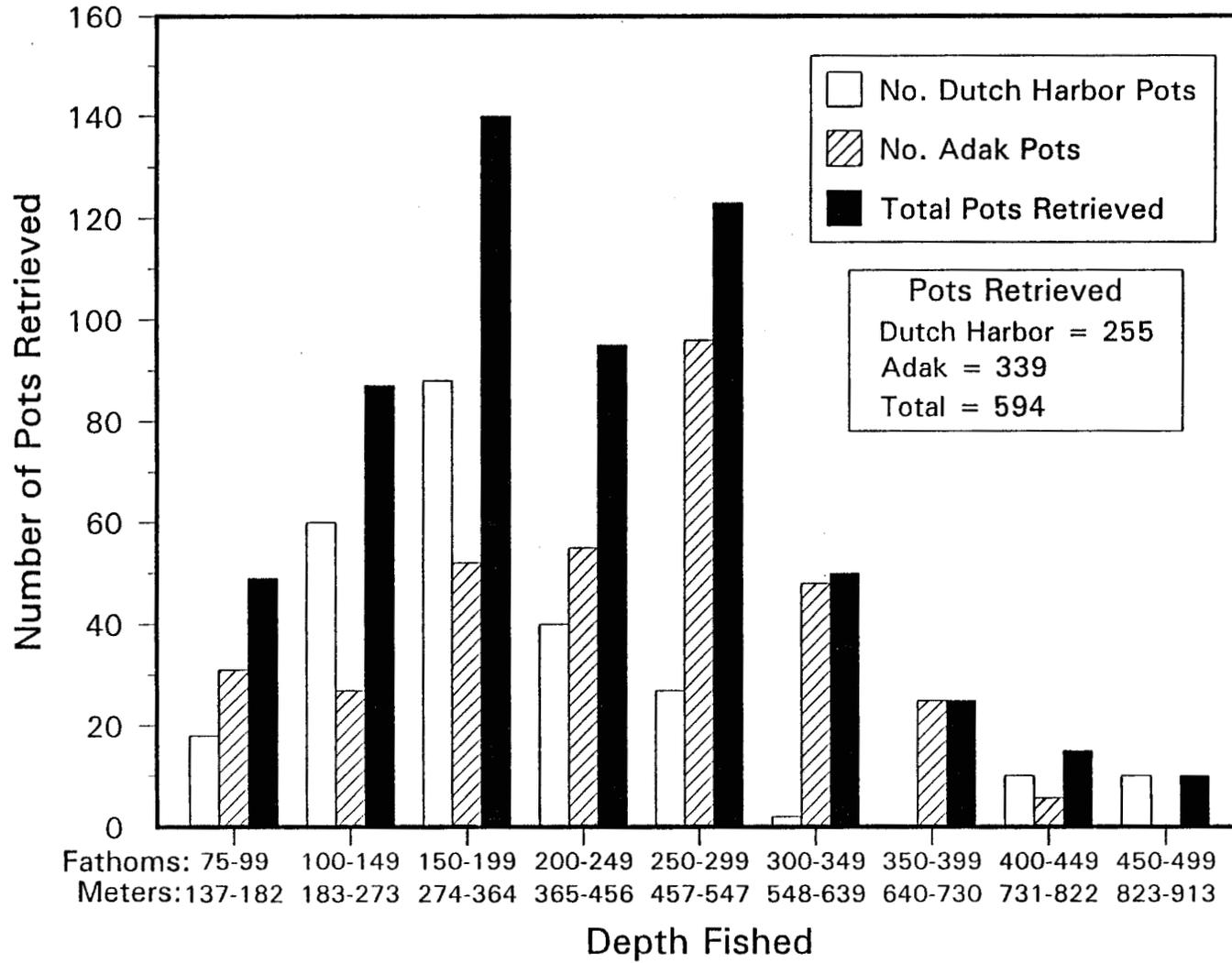


Figure 17. Number of conical pots retrieved from various depth groupings from the 1991 golden king crab survey in portions of both the Dutch Harbor and Adak Management Areas.

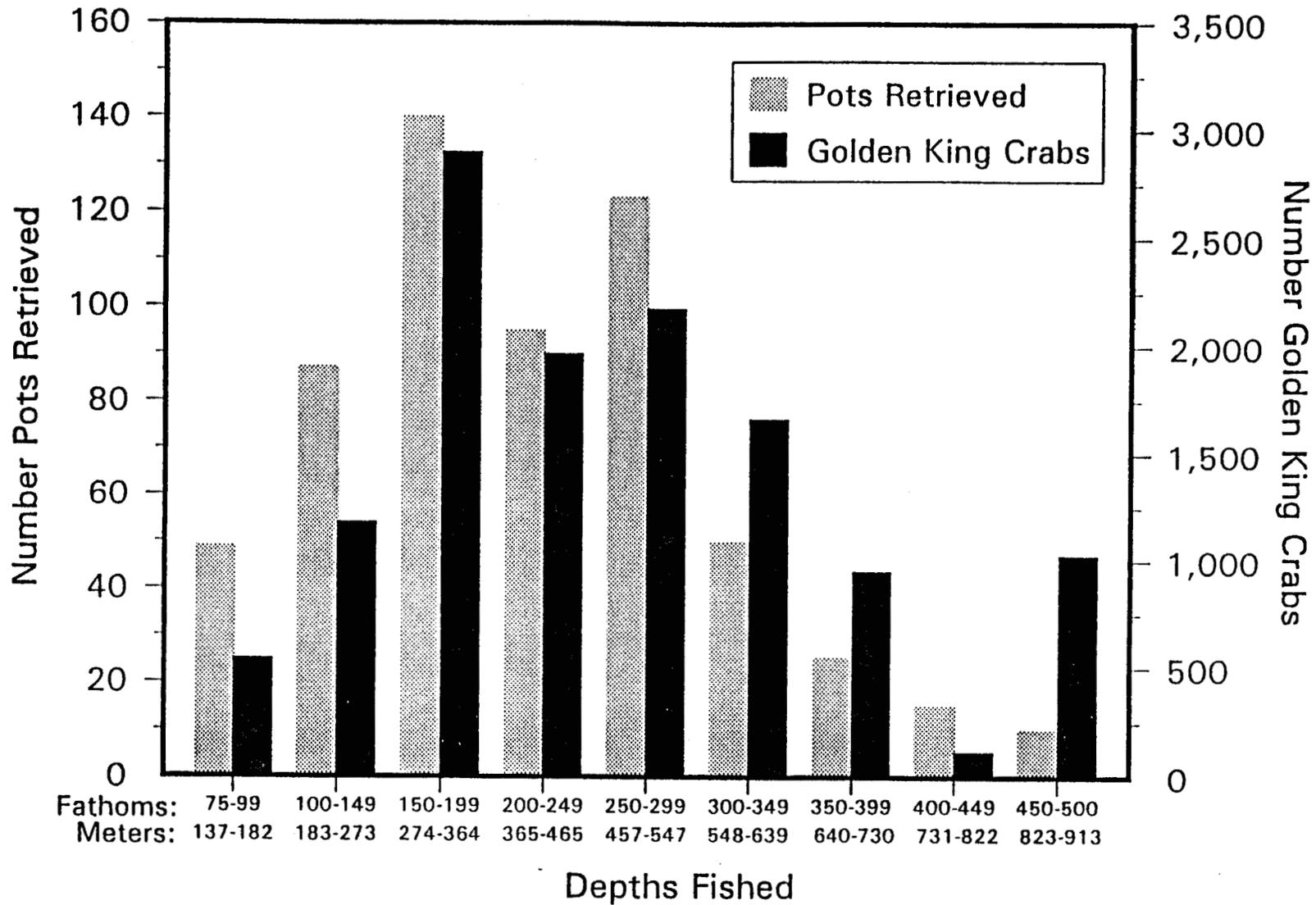


Figure 18. Number of conical pots retrieved compared to the number of golden king crabs captured by depth groups on the 1991 golden king crab survey around Yunaska, Chagulak and Amutka islands by the Alaska Department of Fish and Game.

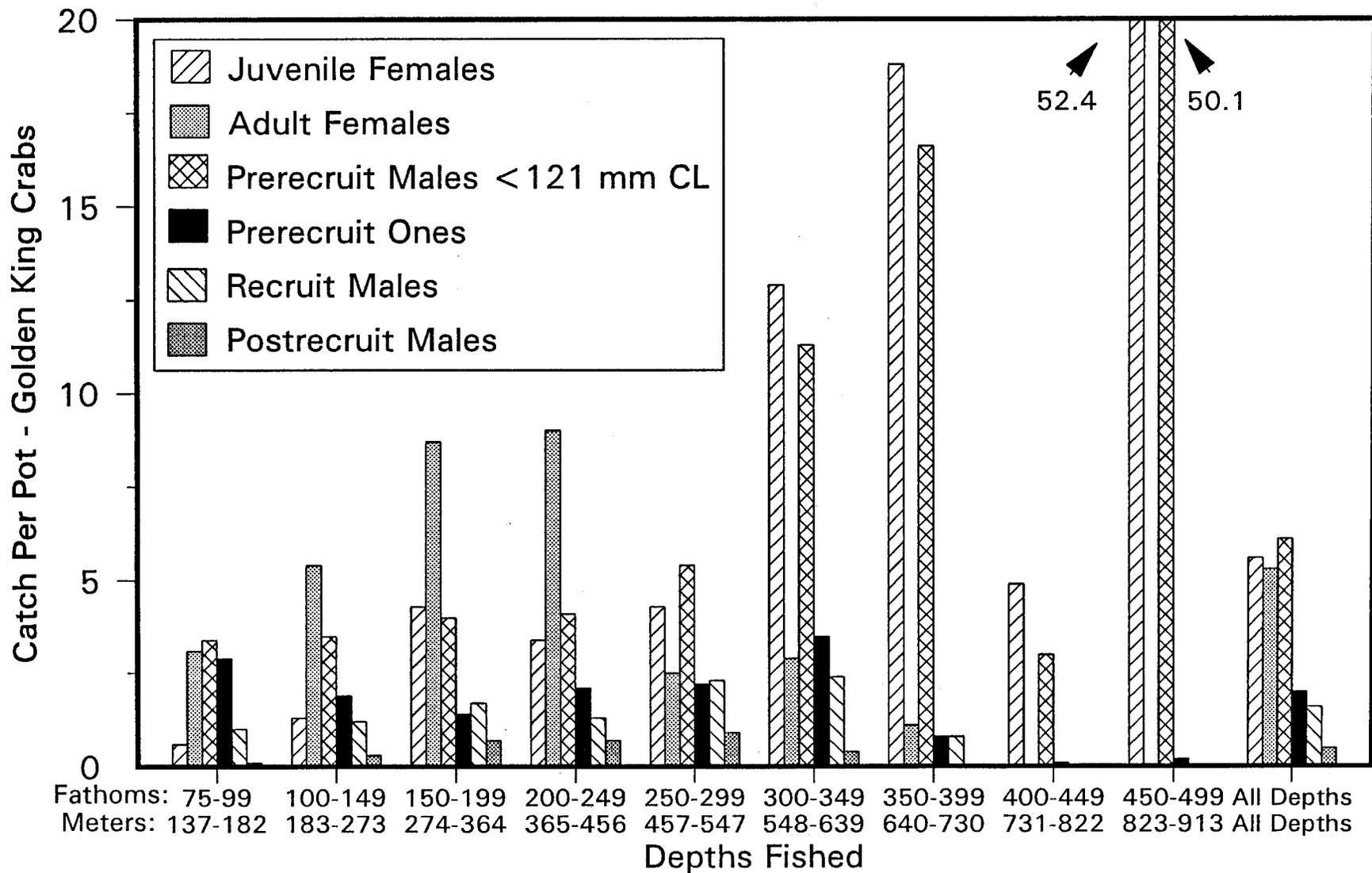
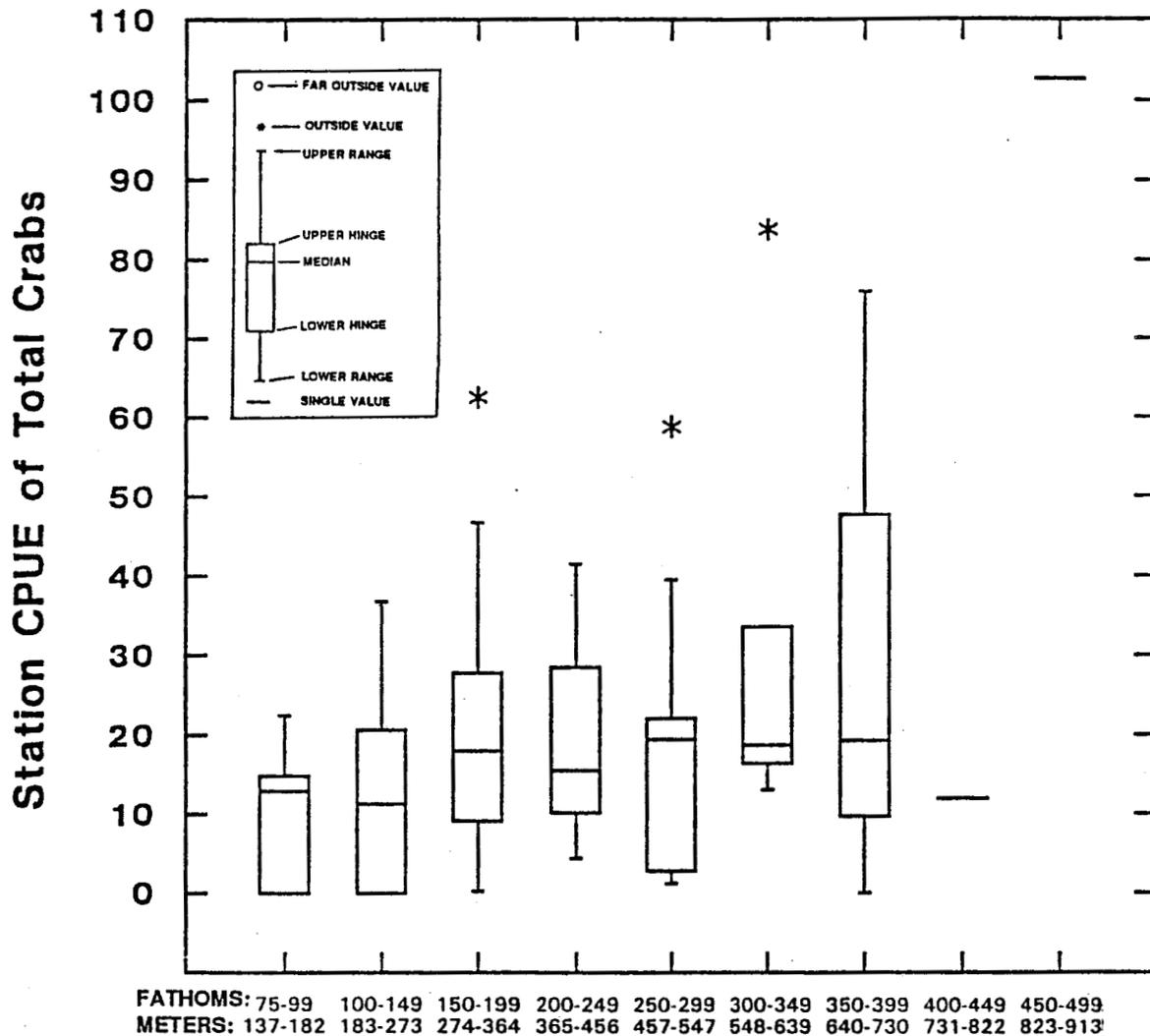


Figure 19. Catch per pot of various size and sex categories of golden king crabs compared to depth groups. Data from the 1991 survey around Yunaska, Chagulak and Amutka islands by the Alaska Department of Fish and Game.



### DEPTH ZONES

Figure 20. Box plots of the station catch per unit of effort (CPUE) of golden king crabs by depth groups from the 1991 survey around Yunaska, Chagulak and Amutka islands, by the Alaska Department of Fish and Game. Median is the midpoint of all data values; upper hinge is the midpoint between median and minimum value; lower hinge is the midpoint between median and minimum value; and a single bar indicates only a single station was fished at that depth zone.

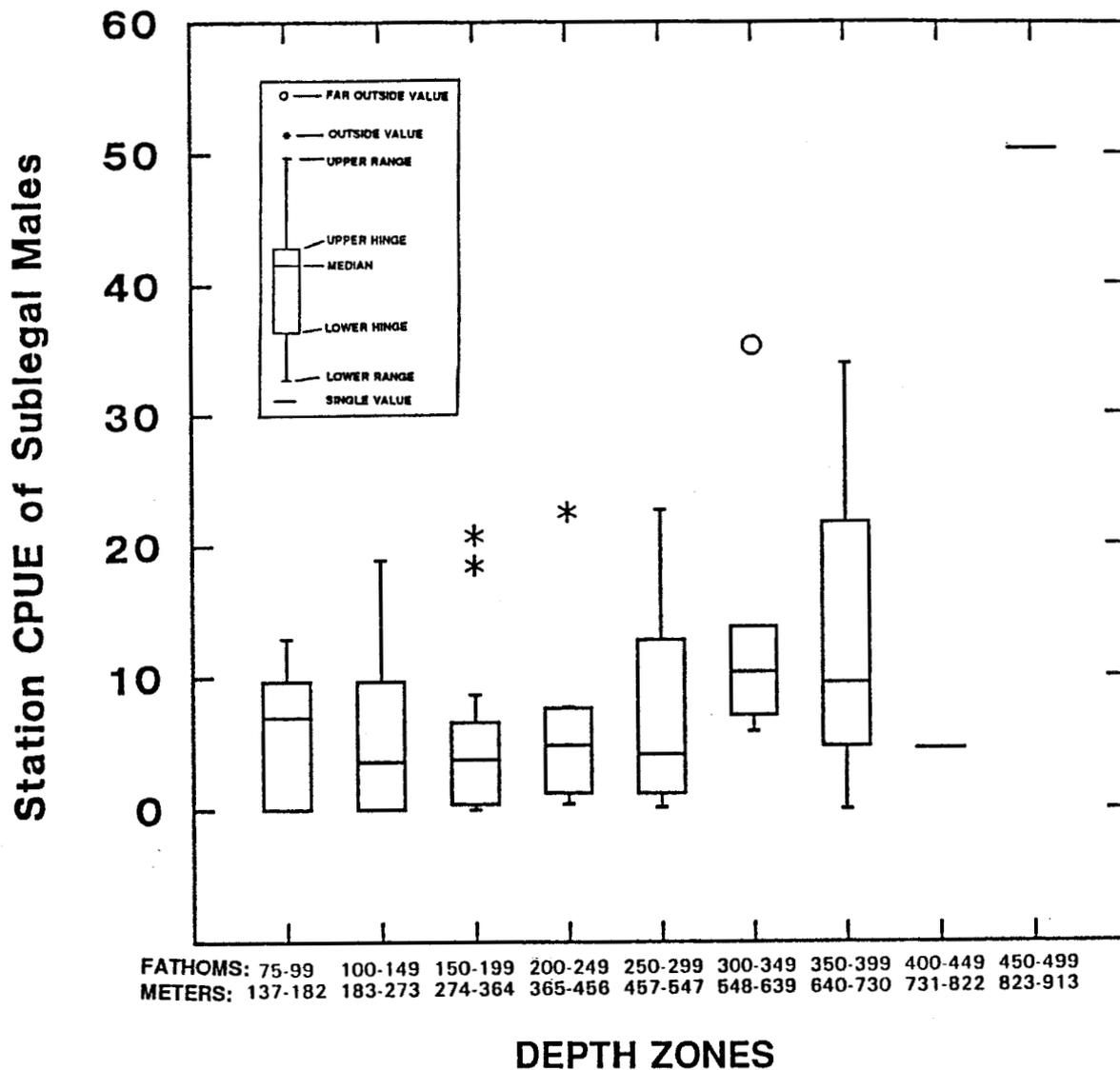
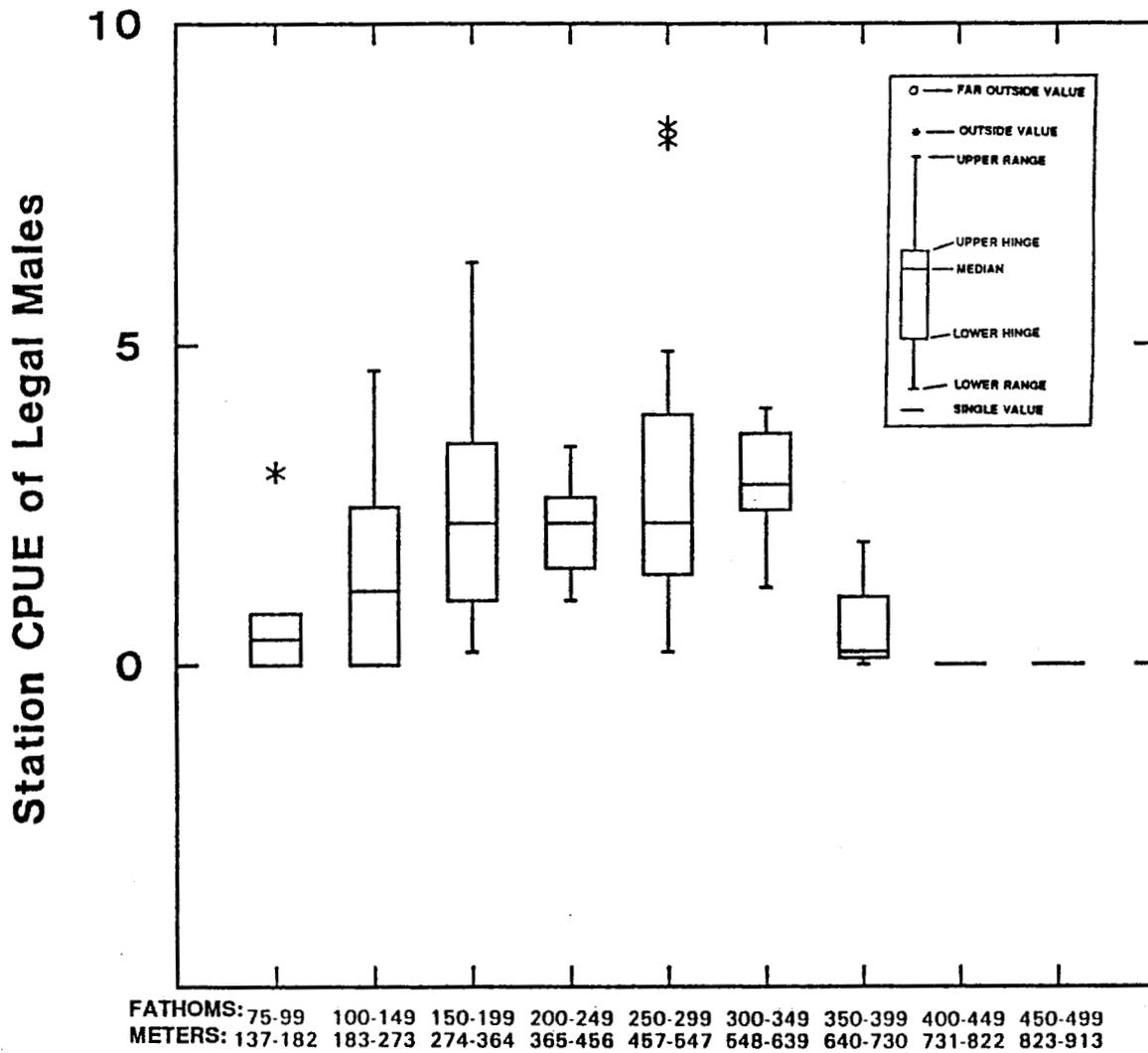


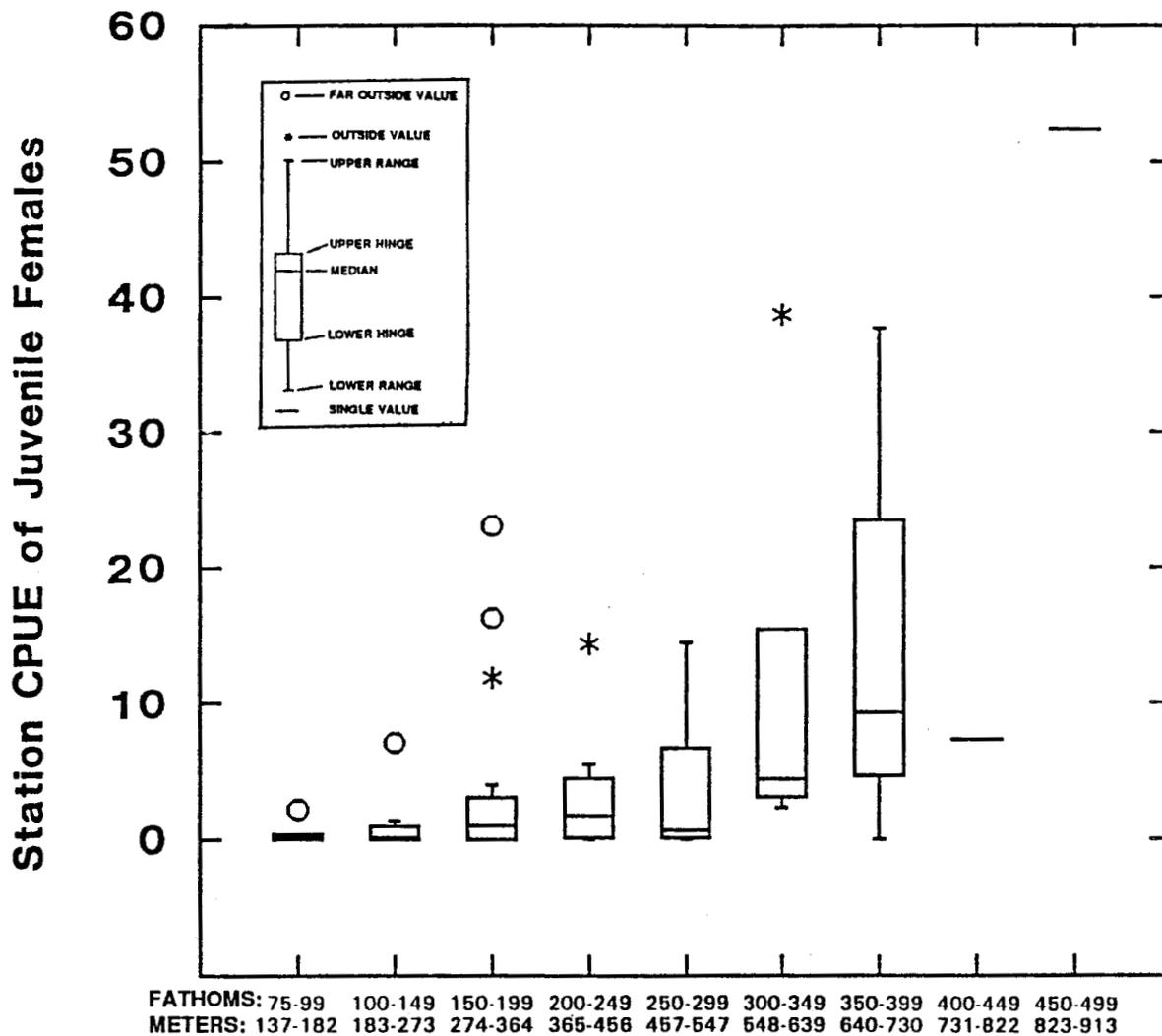
Figure 21. Box plots of the station catch per unit of effort (CPUE) of sublegal male golden king crabs by depth groups from the 1991 survey around Yunaska, Chagulak and Amutka islands, by the Alaska Department of Fish and Game. Median is the midpoint of all data values; upper hinge is the midpoint between median and minimum value; lower hinge is the midpoint between median and minimum value; and a single bar indicates only a single station was fished at that depth zone.



### DEPTH ZONES

Figure 22. Box plots of the station catch per unit of effort (CPUE) of legal male golden king crabs by depth groups from the 1991 survey around Yunaska, Chagulak and Amutka islands, by the Alaska Department of Fish and Game. Median is the midpoint of all data values; upper hinge is the midpoint between median and minimum value; lower hinge is the midpoint between median and minimum value; and a single bar indicates only a single station was fished at that depth zone.





### DEPTH ZONES

Figure 24. Box plots of the station catch per unit of effort (CPUE) of juvenile female golden king crabs by depth groups from the 1991 survey around Yunaska, Chagulak and Amutka islands, by the Alaska Department of Fish and Game. Median is the midpoint of all data values; upper hinge is the midpoint between median and minimum value; lower hinge is the midpoint between median and minimum value; and a single bar indicates only a single station was fished at that depth zone.

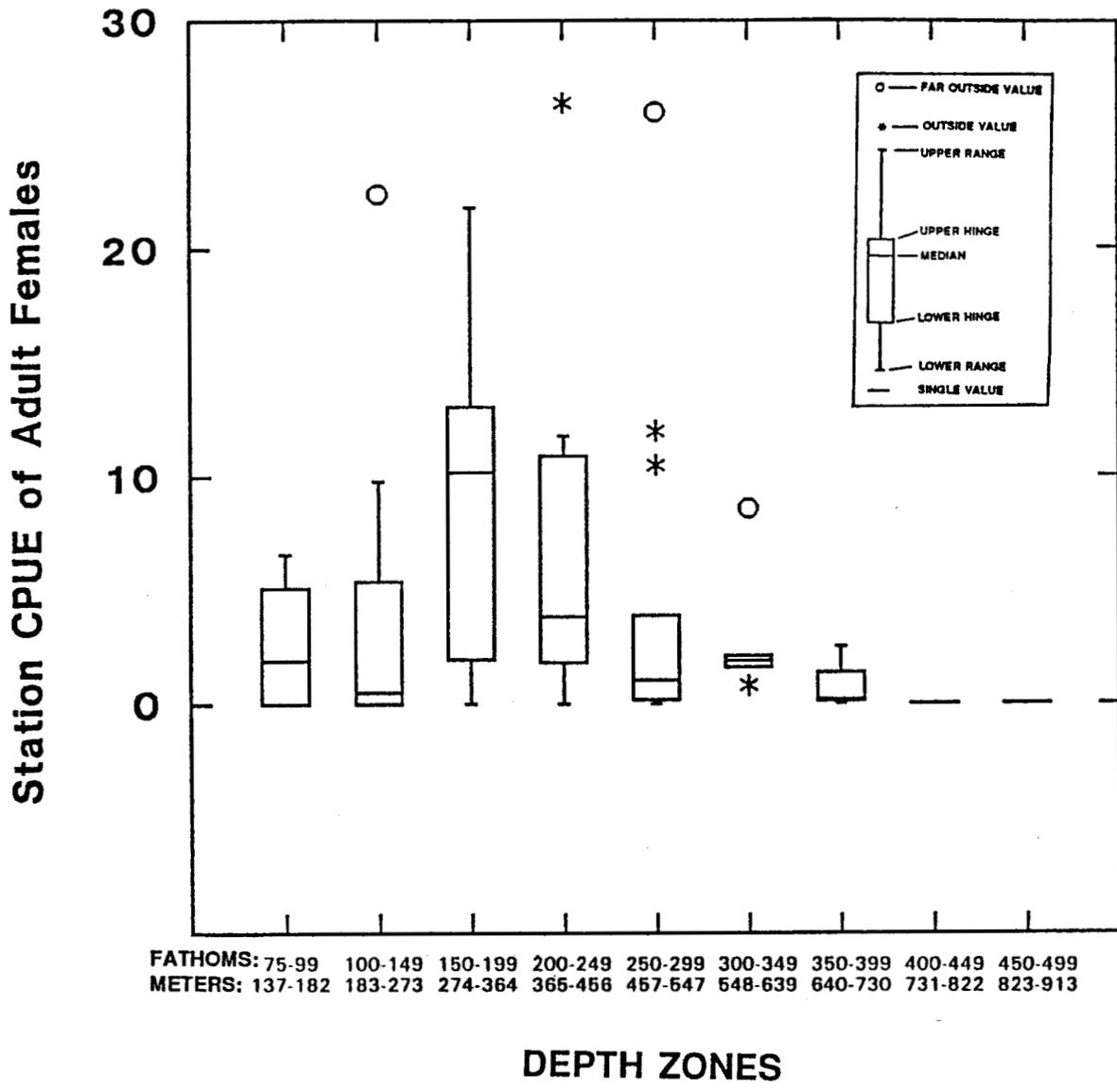
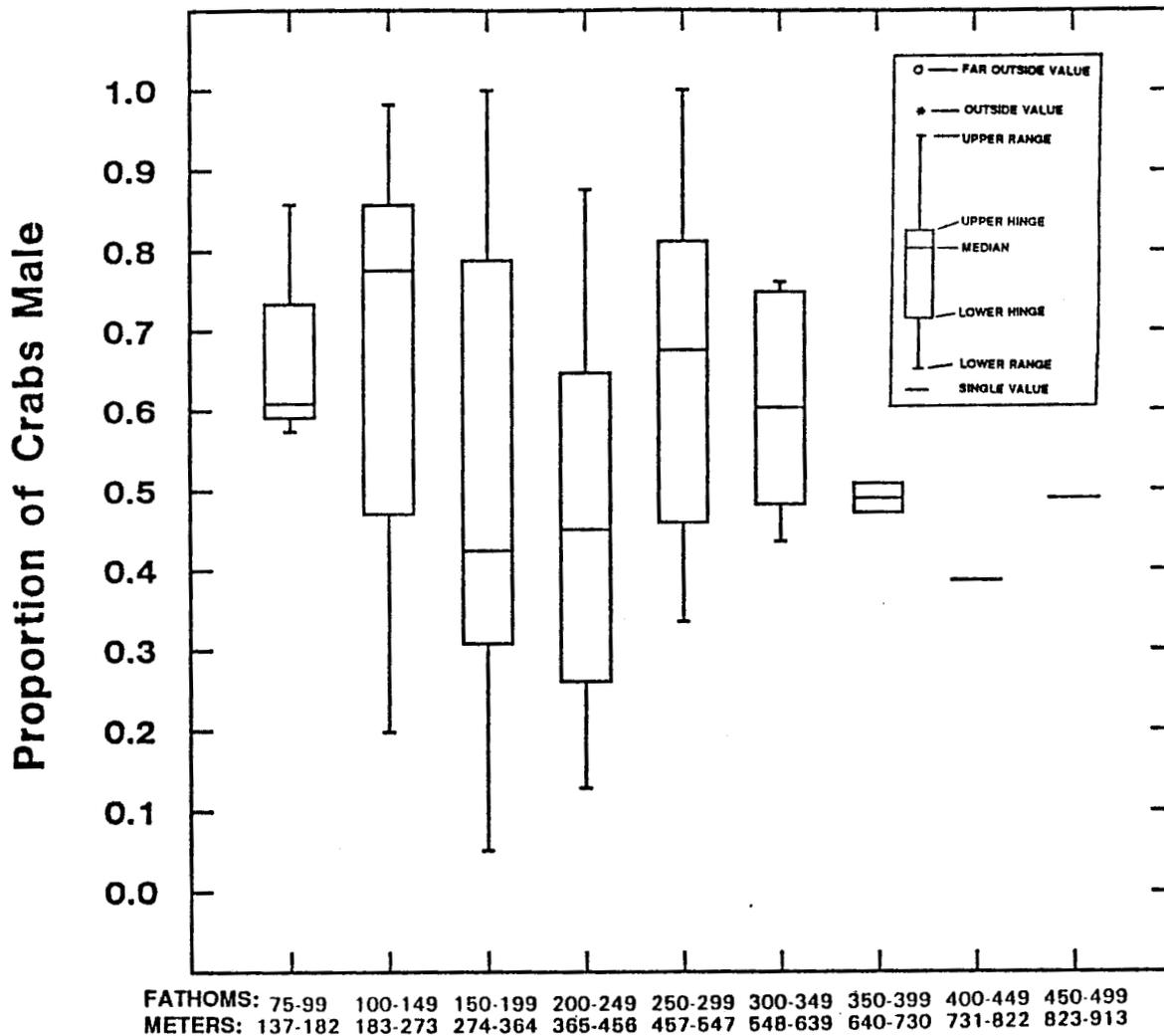


Figure 25. Box plots of the station catch per unit of effort (CPUE) of adult female golden king crabs by depth groups from the 1991 survey around Yunaska, Chagulak and Amutka islands, by the Alaska Department of Fish and Game. Median is the midpoint of all data values; upper hinge is the midpoint between median and minimum value; lower hinge is the midpoint between median and minimum value; and a single bar indicates only a single station was fished at that depth zone.



### DEPTH ZONES

Figure 26. Box plots of the proportion of male golden king crabs by depth groups from the 1991 survey around Yunaska, Chagulak and Amutka islands, by the Alaska Department of Fish and Game. Median is the midpoint of all data values; upper hinge is the midpoint between median and minimum value; lower hinge is the midpoint between median and minimum value; and a single bar indicates only a single station was fished at that depth zone.

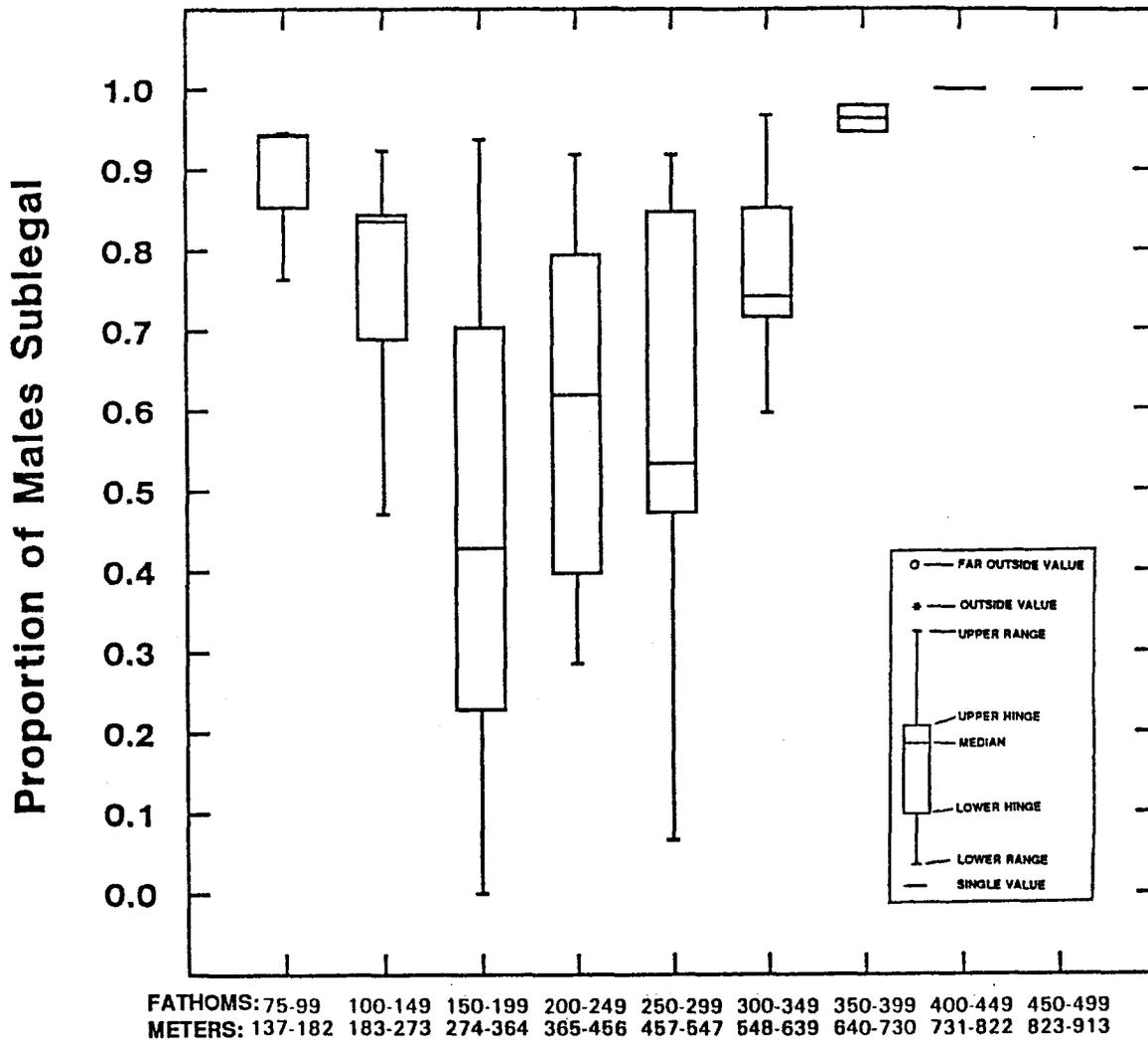
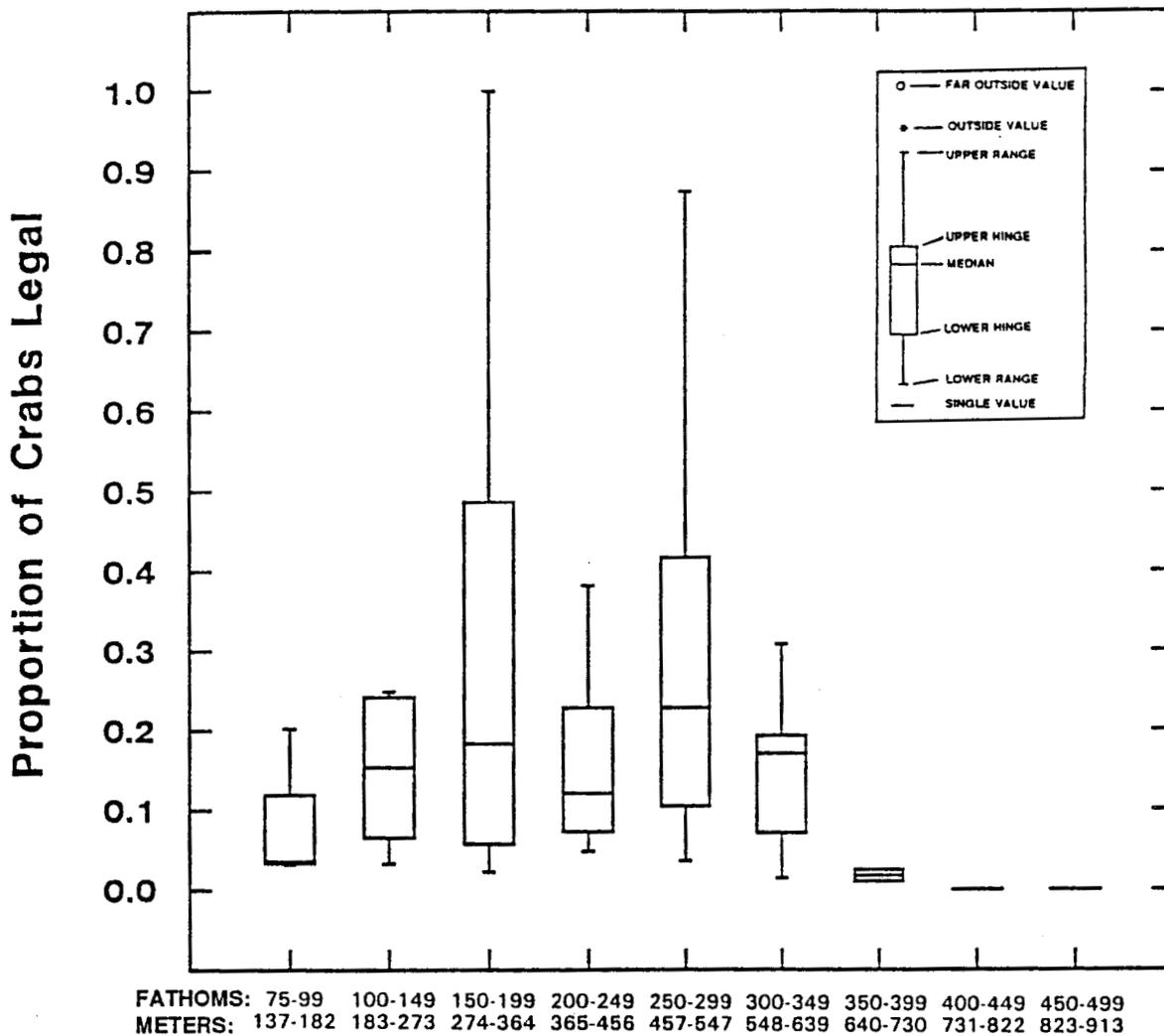


Figure 27. Box plots of the proportion of sublegal male golden king crabs by depth groups from the 1991 survey around Yunaska, Chagulak and Amutka islands, by the Alaska Department of Fish and Game. Median is the midpoint of all data values; upper hinge is the midpoint between median and minimum value; lower hinge is the midpoint between median and minimum value; and a single bar indicates only a single station was fished at that depth zone.



### DEPTH ZONES

Figure 28. Box plots of the proportion of legal male golden king crabs by depth groups from the 1991 survey around Yunaska, Chagulak and Amutka islands, by the Alaska Department of Fish and Game. Median is the midpoint of all data values; upper hinge is the midpoint between median and minimum value; lower hinge is the midpoint between median and minimum value; and a single bar indicates only a single station was fished at that depth zone.

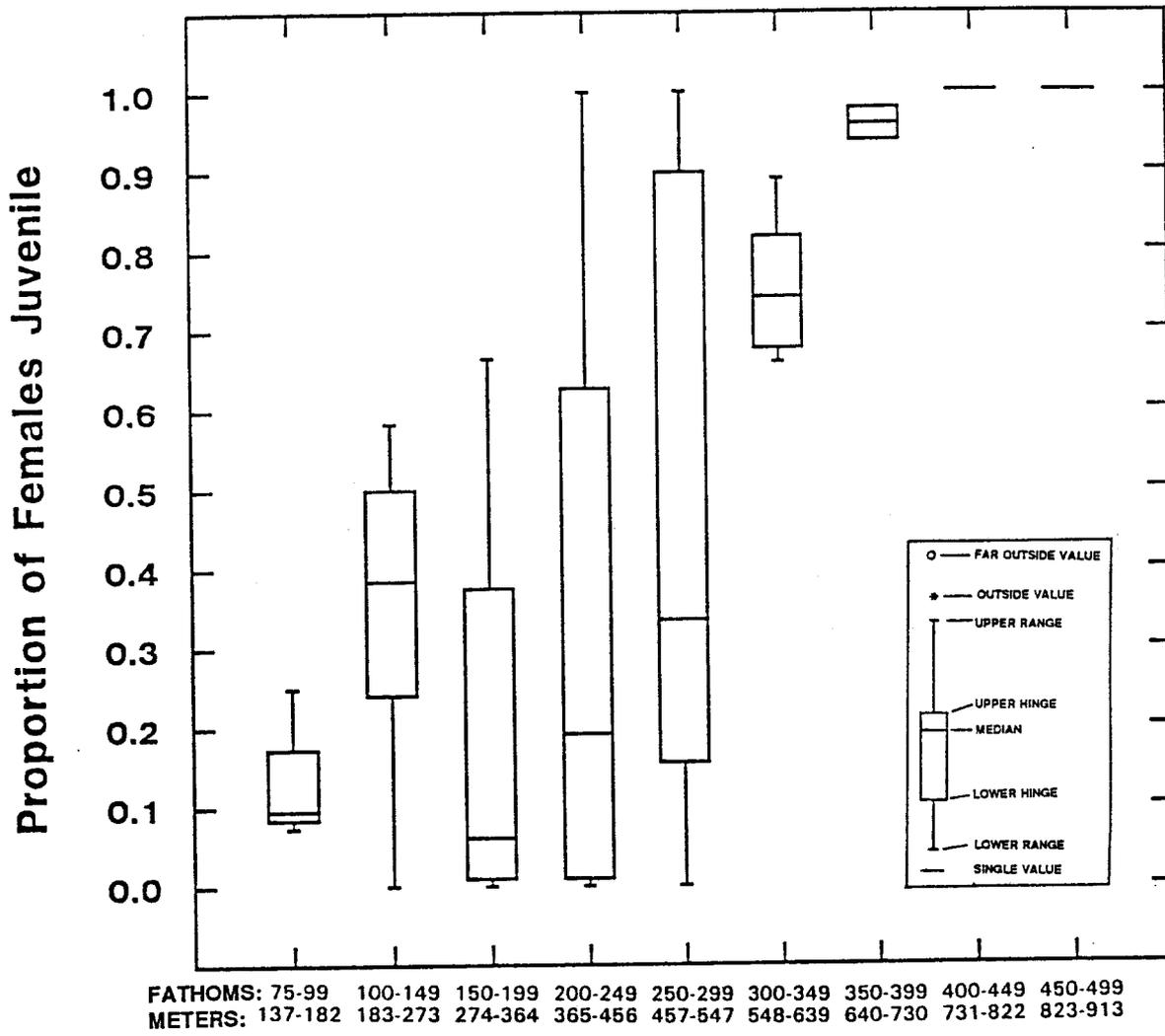


Figure 29. Box plots of the proportion of juvenile female golden king crabs by depth groups from the 1991 survey around Yunaska, Chagulak and Amutka islands, by the Alaska Department of Fish and Game. Median is the midpoint of all data values; upper hinge is the midpoint between median and minimum value; lower hinge is the midpoint between median and minimum value; and a single bar indicates only a single station was fished at that depth zone.

# FEMALE GOLDEN KING CRAB SIZE AT MATURITY

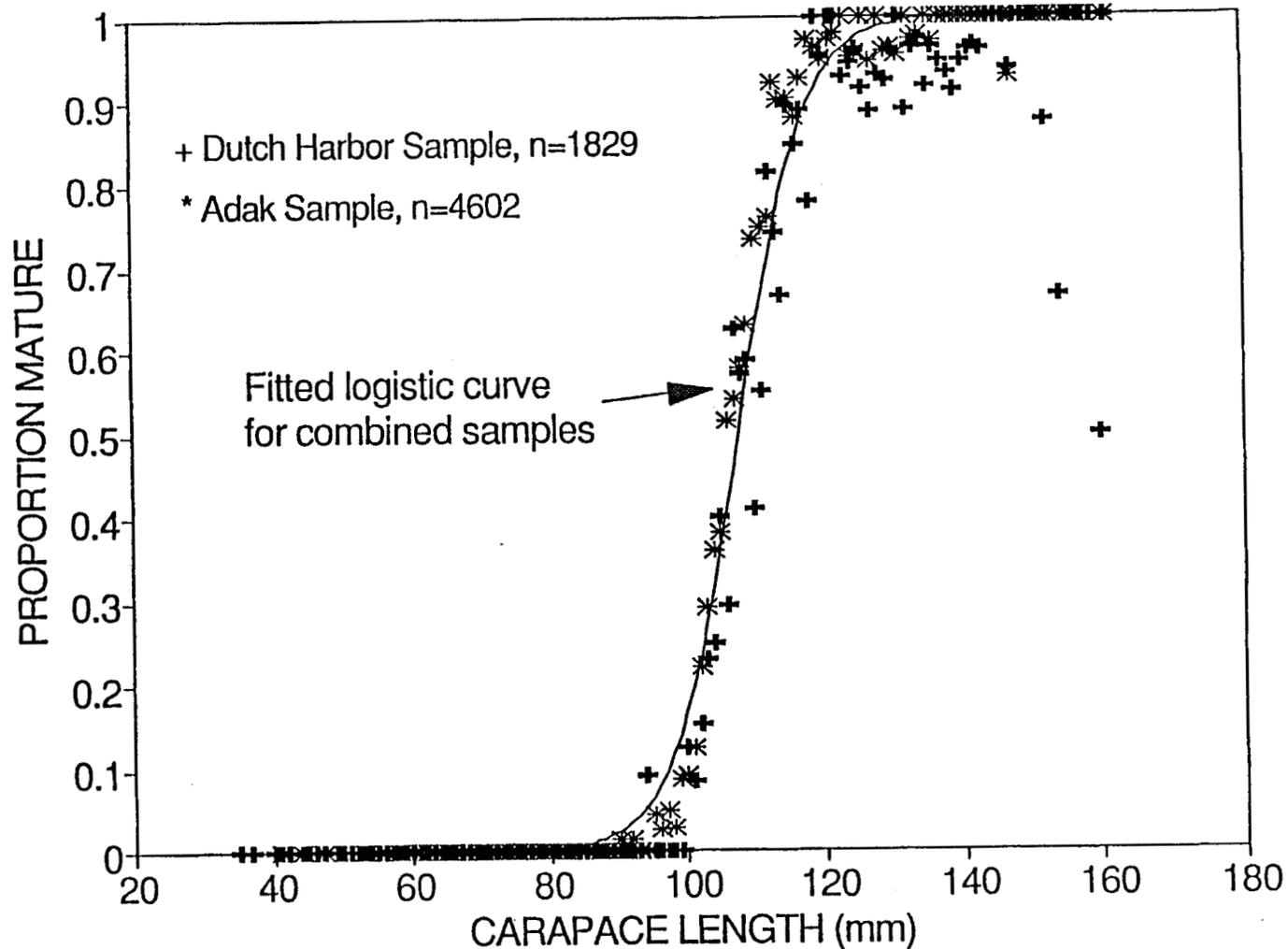


Figure 30. Preliminary logistic curve fitting the combined Dutch Harbor and Adak female golden king crab samples together from the 1991 golden king crab survey around Yunaska, Chagulak and Amutka islands by the Alaska Department of Fish and Game. The logistic curve estimated from the combined sample was a poor fit from the two data sets so they were analyzed separately.

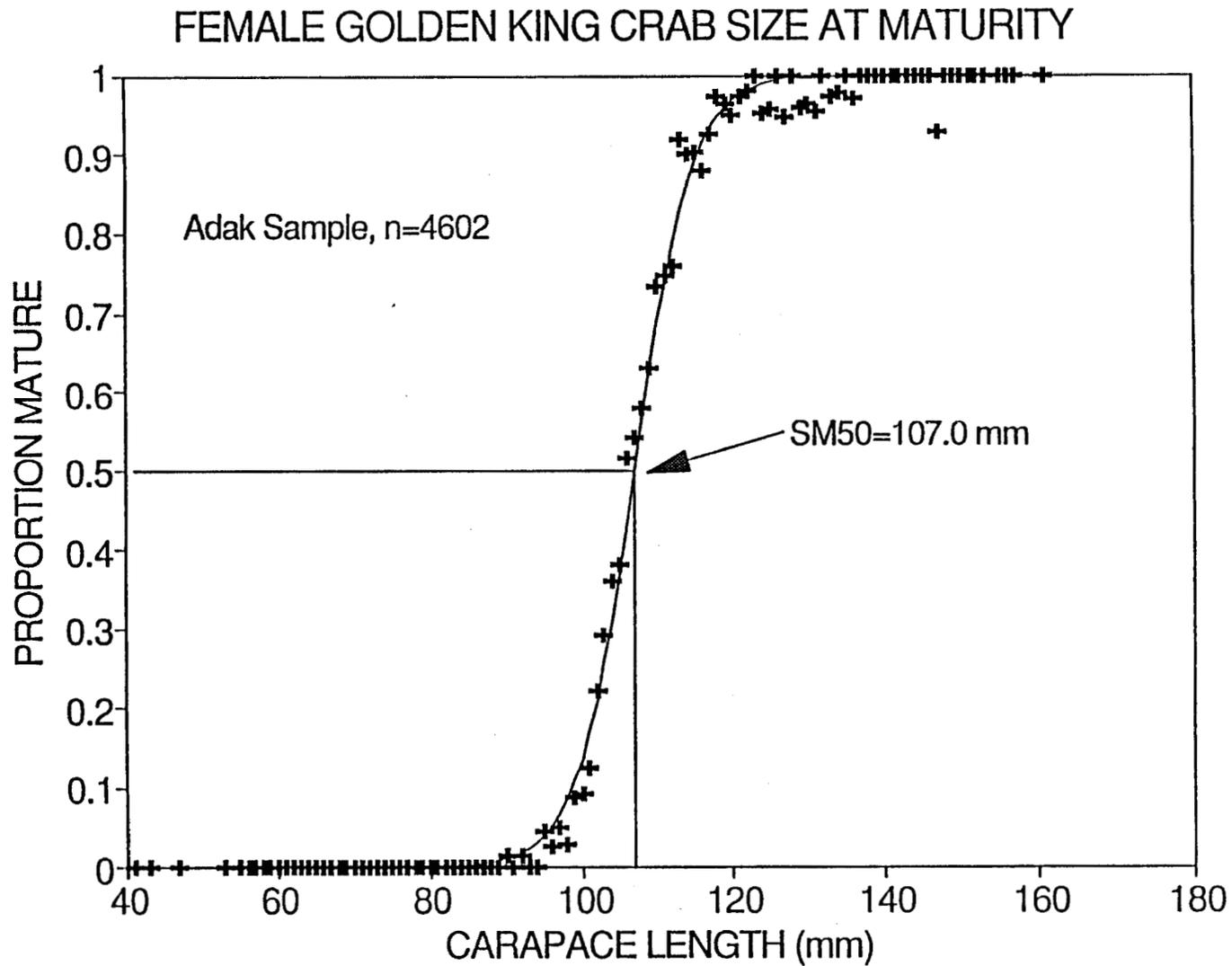


Figure 31. Logistic curve fit to the sample of golden king crab females captured on the Adak portion of the 1991 survey around Yunaska, Chagulak and Amutka islands by the Department of Fish and Game. The size at maturity at 50% was 107.0 mm (4.2 in) in carapace length.

## FEMALE GOLDEN KING CRAB SIZE AT MATURITY

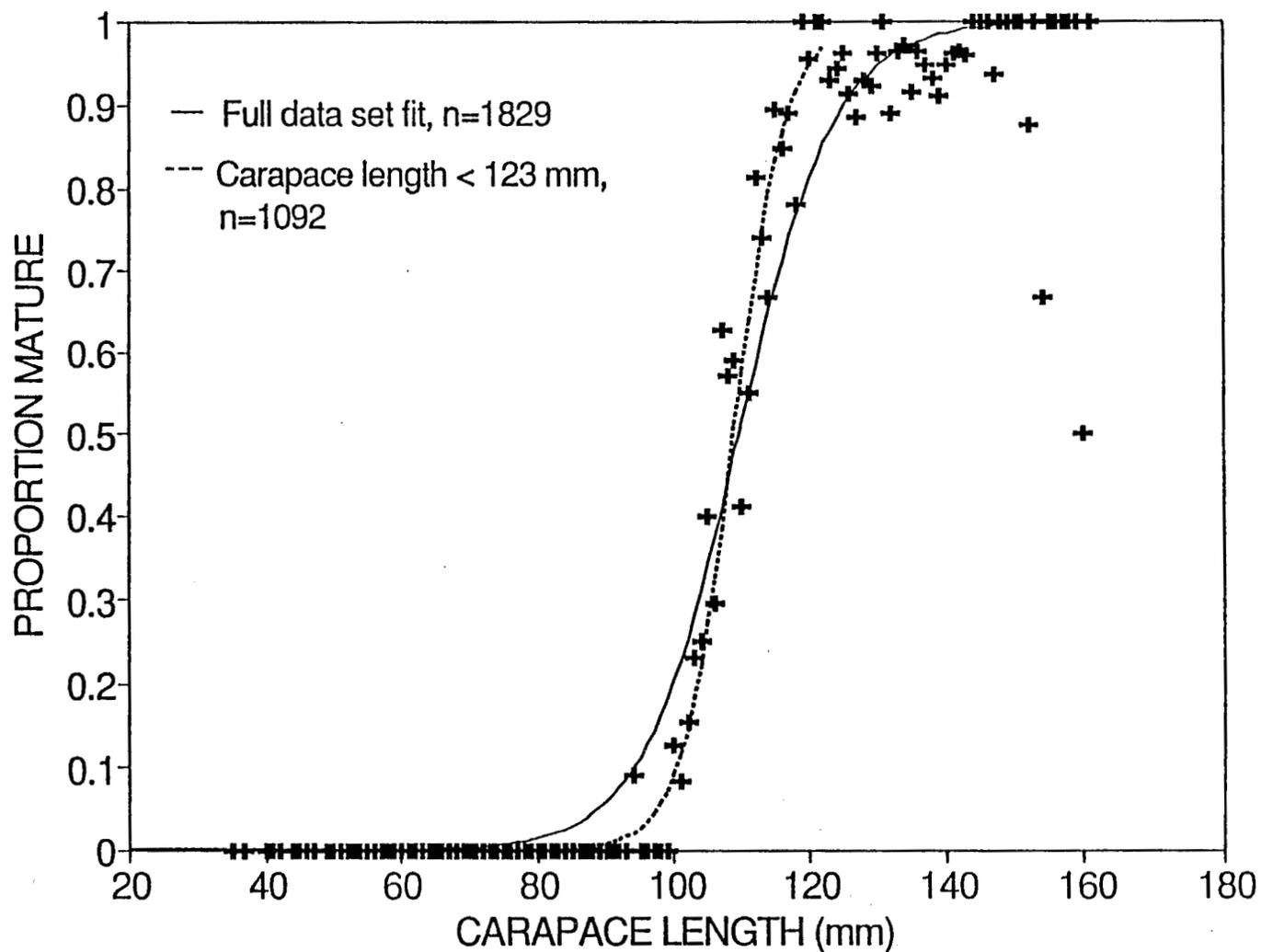


Figure 32. Logistic curve fit to the sample of golden king crab females captured on the Dutch Harbor portion of the 1991 survey around Yunaska, Chagulak and Amutka islands by the Alaska Department of Fish and Game. The size at maturity at 50% was 108.8 mm (4.2 in) in carapace length for females less than 123 mm (less than 4.8 in) in carapace length.

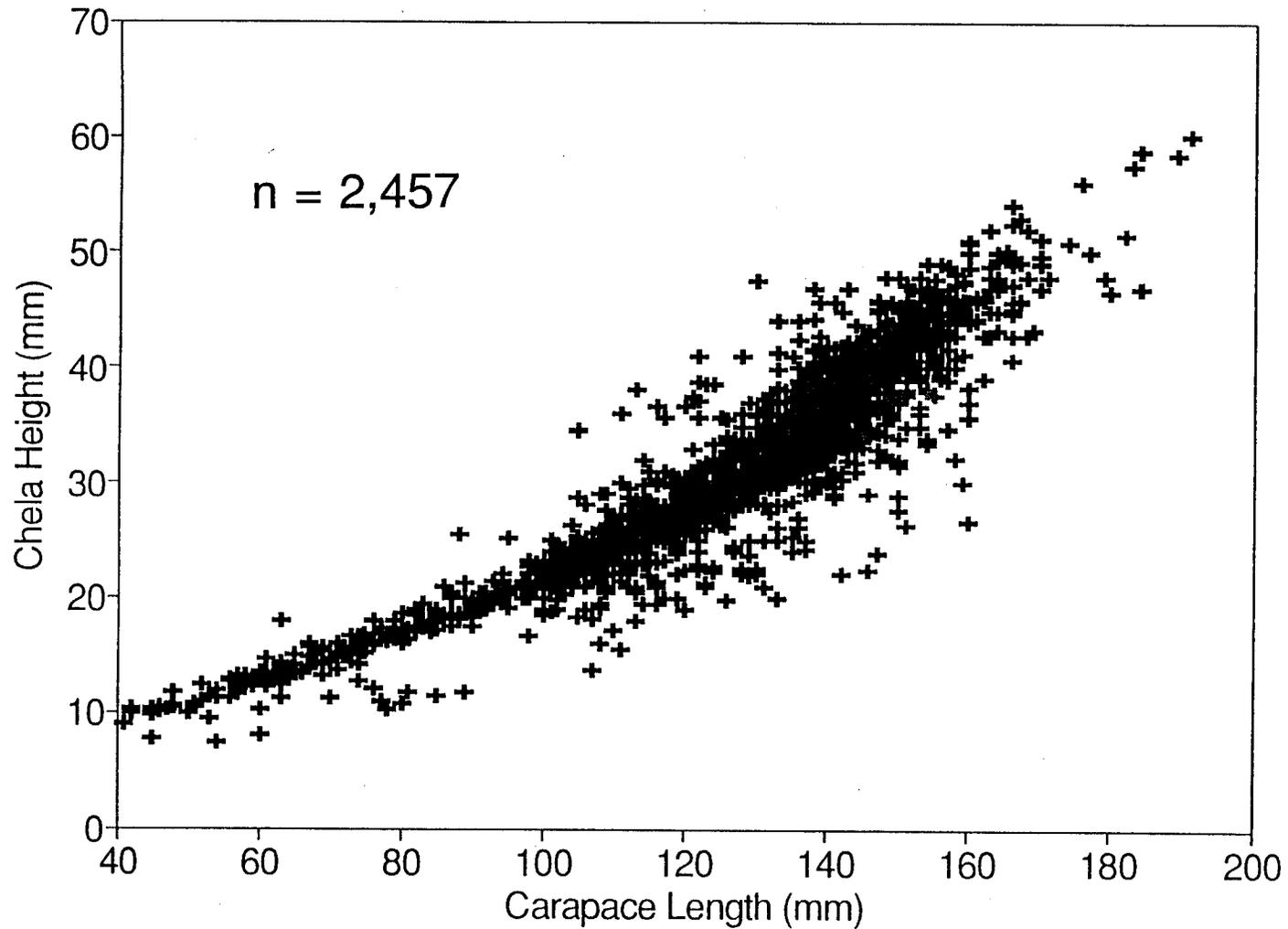


Figure 33. Paired measurements of chela height and carapace length from 2,453 male golden king crabs captured on the 1991 survey around Yunaska, Chagulak and Amutka islands by the Alaska Department of Fish and Game.



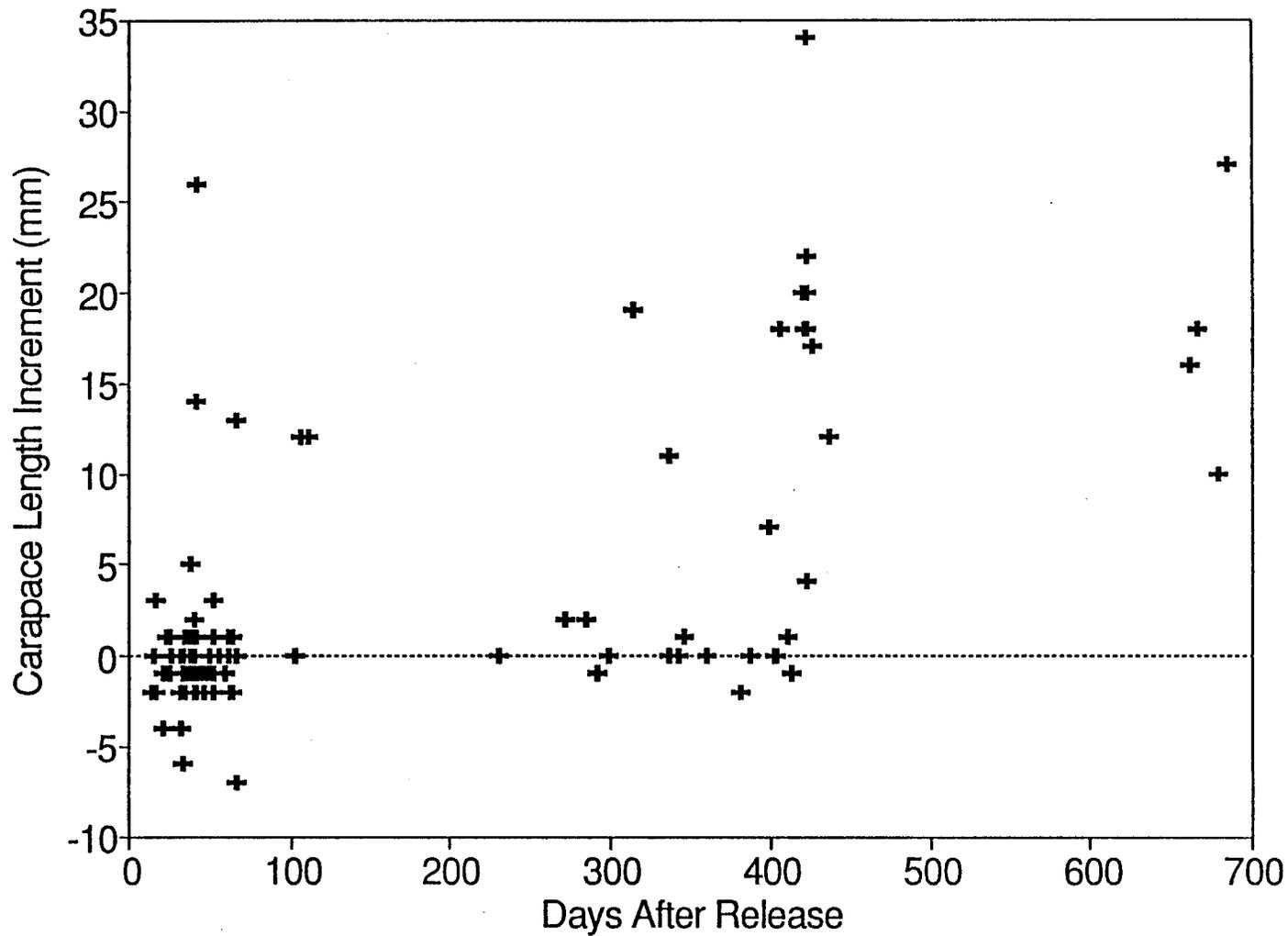


Figure 35. Carapace length increment of tagged male golden king crabs at recovery minus their length at release versus the number of days of freedom before recapture. Crabs tagged on the 1991 survey around Yunaska, Chagulak, or Amutka islands by the Alaska Department of Fish and Game. Crabs were recovered during the 1991/92 and 1992/93 commercial golden king crab fishing seasons in the Dutch Harbor and Adak Management Areas.

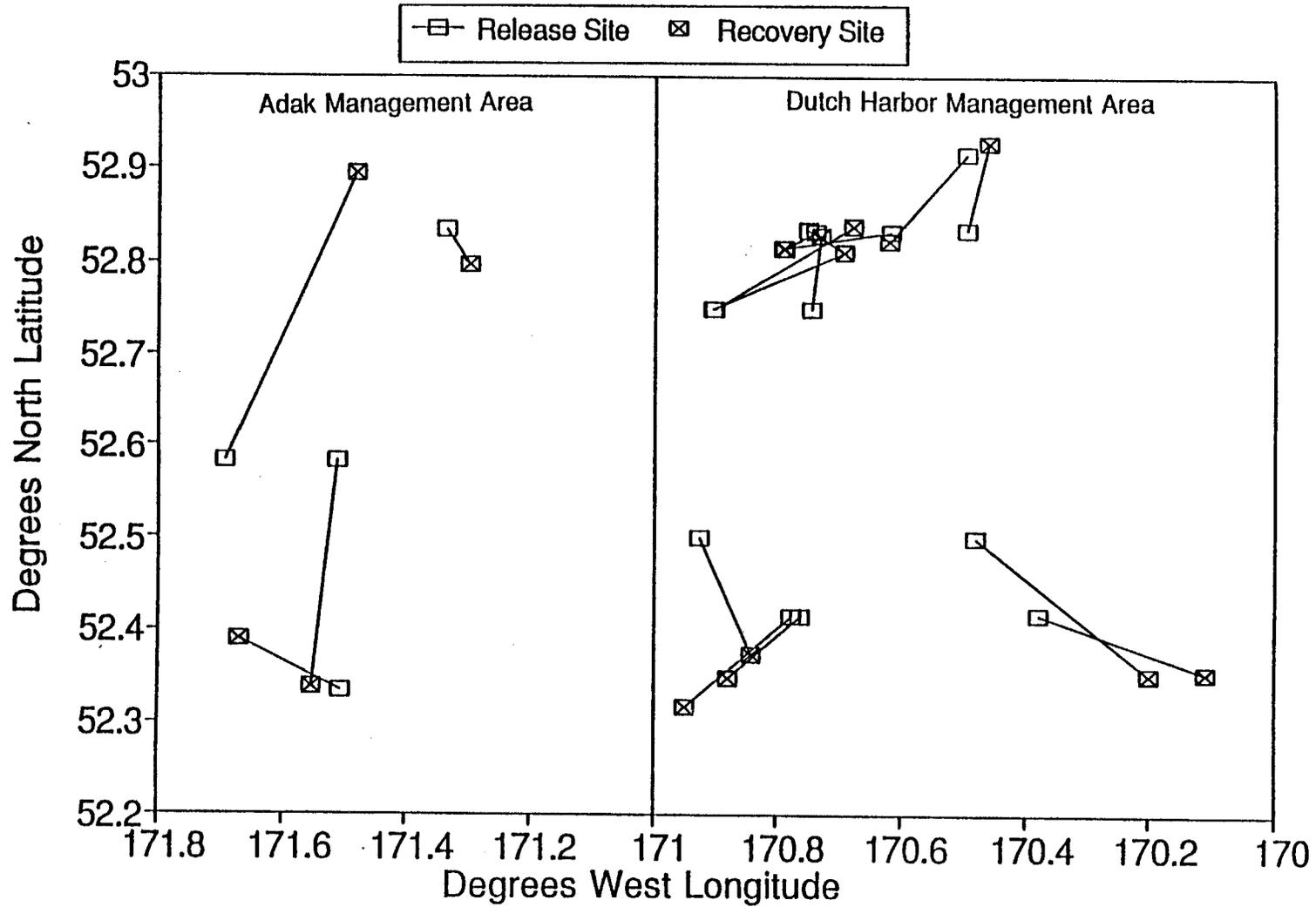


Figure 36. The straight line net movements of male golden king crabs that were sublegal size when released on the 1991 survey around Yunaska, Chagulak and Amutka islands. These crabs were recovered during the 1991/92 commercial golden king crab fisheries in the Dutch Harbor and Adak Management Areas.

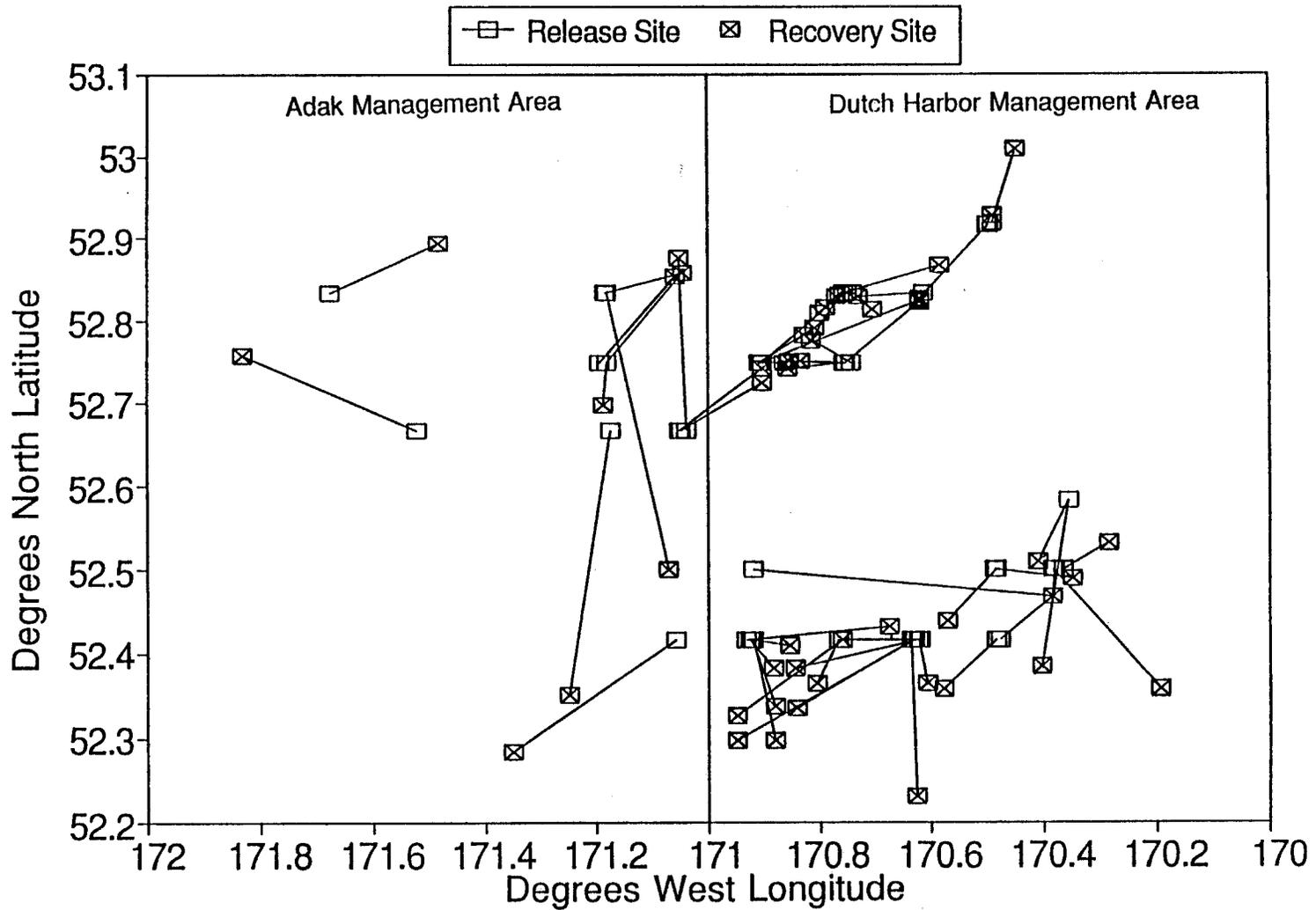


Figure 37. The straight line net movements of male golden king crabs that were legal size when released on the 1991 survey around Yunaska, Chagulak and Amutka islands. These crabs were recovered during the 1991/92 commercial golden king crab fisheries in the Dutch Harbor and Adak Management Areas.



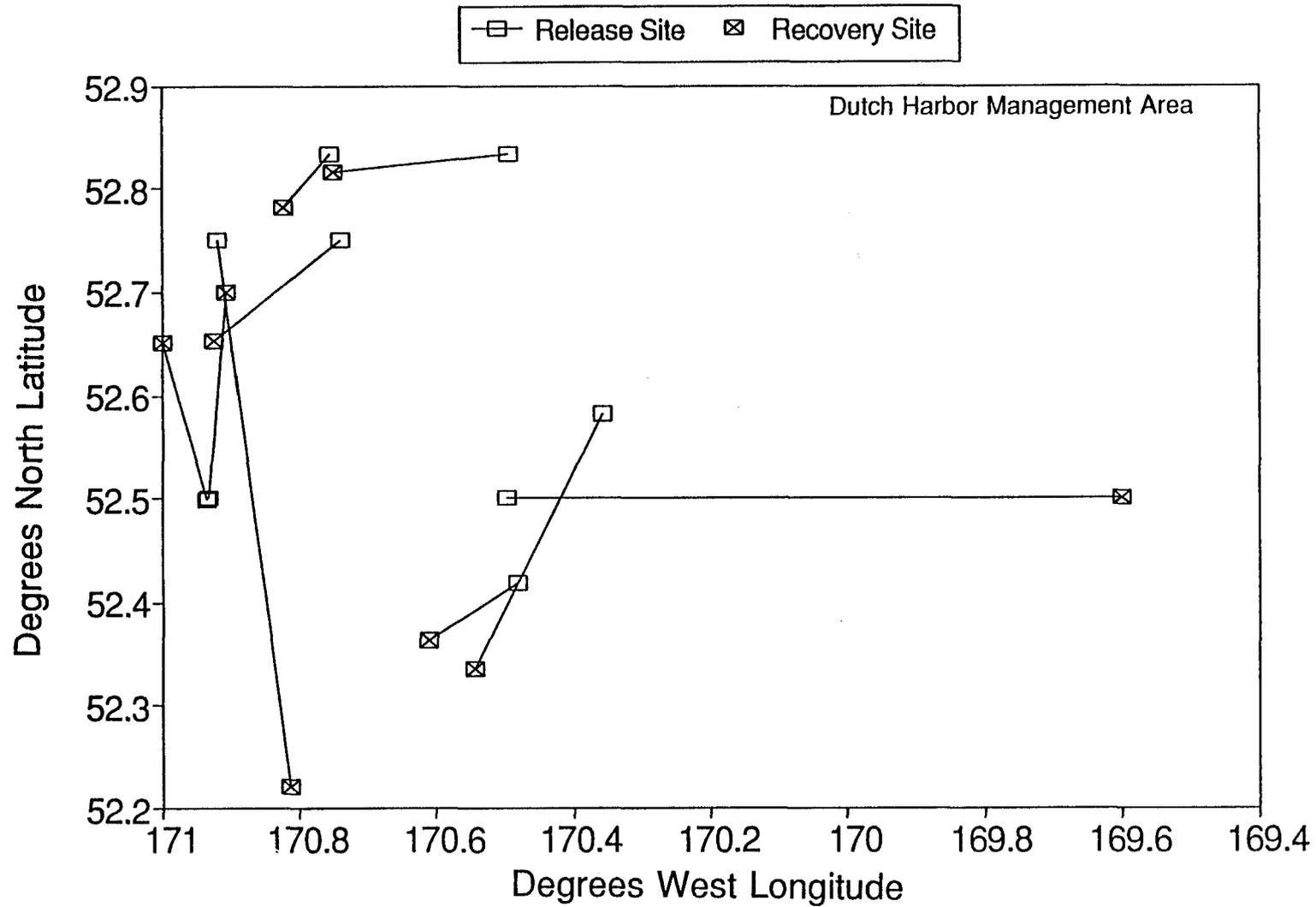


Figure 39. The straight line net movements of male golden king crabs that were legal size when released on the 1991 survey around Yunaska, Chagulak and Amutka islands. These crabs were recovered during the 1992/93 commercial golden king crab fisheries in the Dutch Harbor Management Area.

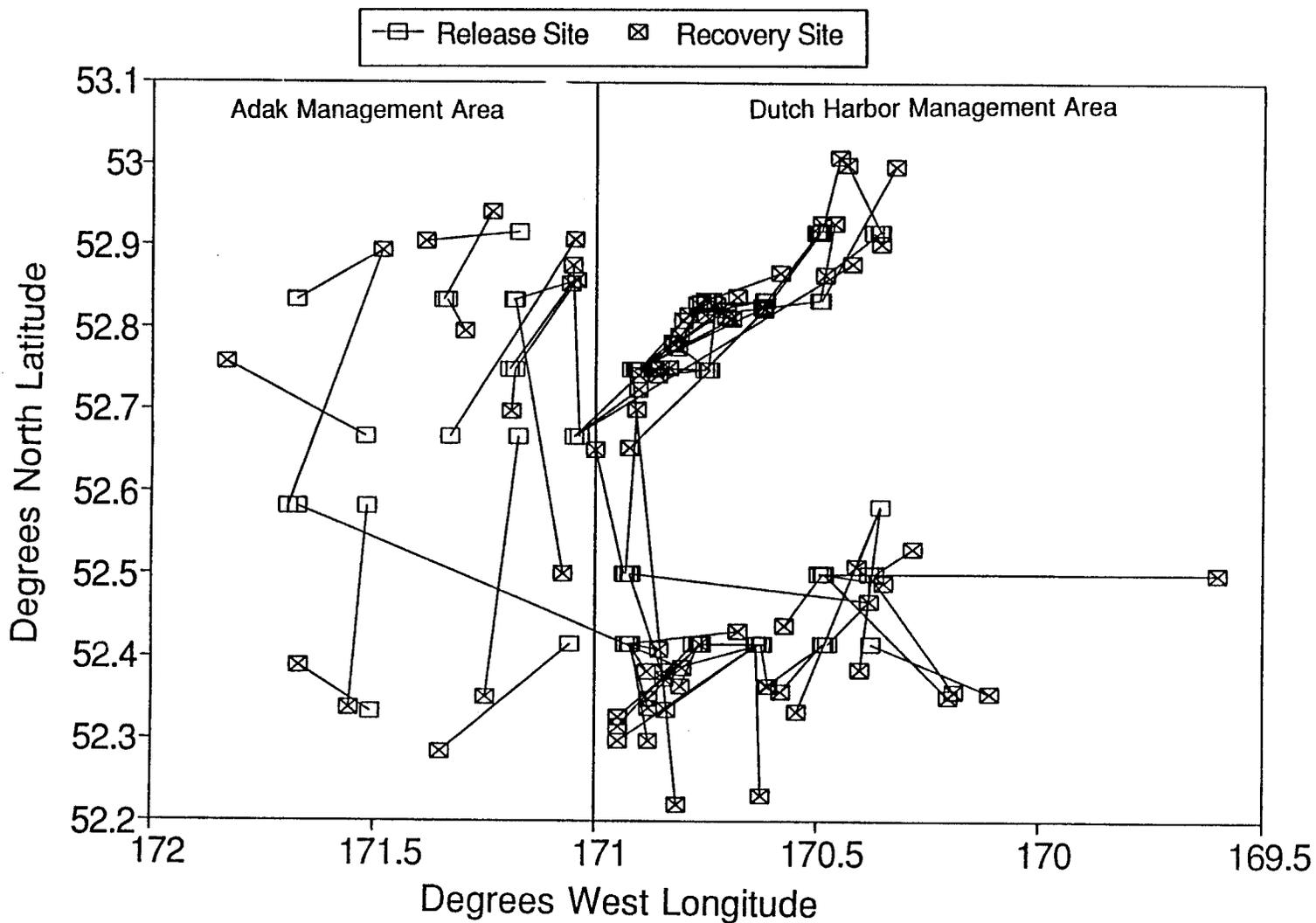


Figure 40. The straight line net movements of all male golden king crabs that were sublegal and legal-sized when released on the 1991 survey around Yunaska, Chagulak and Amutka islands. These crabs were recovered during the 1991/92 and 1992/93 commercial golden king crab fisheries in the Dutch Harbor and Adak Management Areas.

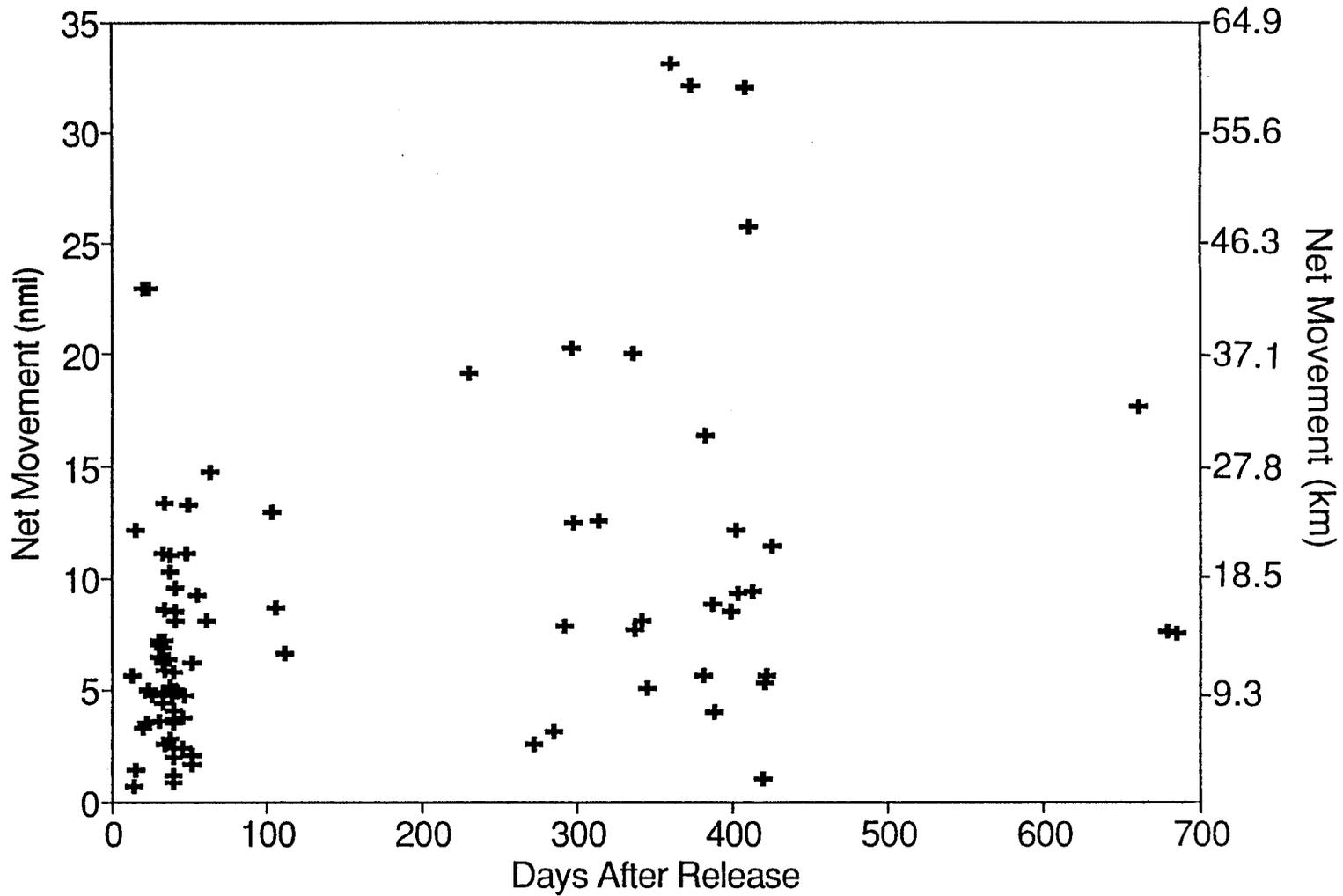


Figure 41. The straight line net movements all sublegal and legal-sized male king crabs that were tagged on the 1991 survey around Yunaska, Chagulak and Amutka islands versus the number of days free before their recapture in the 1991/92 or 1992/93 commercial golden king crab fisheries in the Dutch Harbor and Adak Management Areas.



Figure 42. The externae of the parasitic barnacle Briarosaccus callous attached to the abdomens of female golden king crabs. This barnacle species is known to castrate both male and female crabs that it infects and reduces the crabs' growth. The externae are the brooding chamber for the barnacles' eggs from which live larvae are released. There is one externae in the top photo, note the four pleopods, fingerlike structures that embryos ("eggs") normally attach to. There are three externae on the crab in the bottom photo. Photos by Terry Butler, Canadian Department of Fisheries and Oceans. Permission to use these photos given by Pacific Biological Station, Nanaimo, British Columbia.

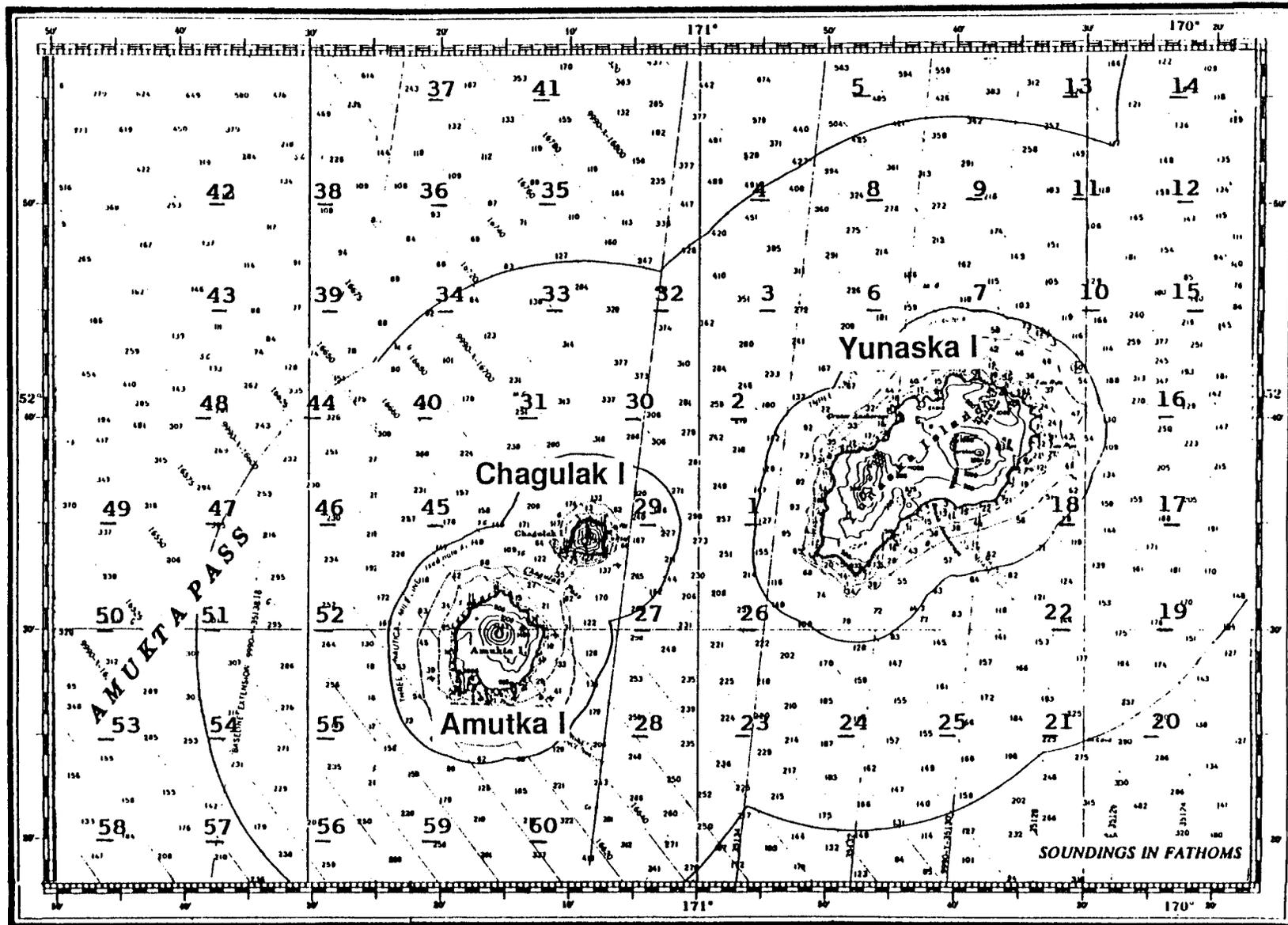
**APPENDIX**

Appendix A.1. Mean numbers of legal-sized golden king crabs landed from Dutch Harbor and Adak Management Areas during the 1986/87 to 1989/90 seasons. Only statistical areas having >45,000 crabs landed in them during one or more of these seasons are included.

Statistical Areas	Mean No. Crabs	Four Year Ranking
<b>Dutch Harbor</b>		
695301	61,486	12
705200	117,923	7
705232	118,788	6
705300	44,964	16
<b>Adak</b>		
715202	295,266	1
715231	149,743	2
715232	44,010	17
725201	119,824	5
725230	40,279	18
765132	19,889	28
775131	37,976	20
785131	55,965	13
795132	62,993	11
805101	22,693	26
805103	51,158	14
805132	132,165	3
805201	72,291	10
815131	21,978	27
825201	41,997	18
825203	15,054	29
835130	22,544	25
835200	121,184	4
845130	37,282	21
845201	28,701	23
845202	113,457	8
855200	75,960	9
865203	29,642	22
875232	46,600	15
885300	27,689	24

Four-Season Mean: 2,029,500<sup>a</sup>

<sup>a</sup> This mean equaled 75% of the total mean number of legal-sized golden king crabs landed (2,701,116) in the entire Dutch Harbor and Adak Management Areas during the four commercial seasons of 1986/87 to 1989/90.



Appendix B.1. Approximate locations of the 60 stations fished on the Alaska Department of Fish and Game's 1991 golden king crab survey around Yunaska, Chagulak and Amutka islands in a portion of the Dutch Harbor and Adak Management Areas. Stations were drawn on portions of charts 16480 and 16500 of the National Oceanic and Atmospheric Administration.



**ADF&G CRAB RESEARCH DATA FORM**  
**Adak/Dutch Harbor L. sequeispina Research Survey**

SPECIES \_\_\_\_\_ STATION NUMBER 

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 MEASURER \_\_\_\_\_

SEX \_\_\_\_\_ BUOY NUMBER 

--	--	--	--

 RECORDER \_\_\_\_\_

VESSEL **WESTERN VIKING** TRAWL HAUL NUMBER 

--	--	--	--

 PAGE \_\_\_\_\_

DATE 

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 SAMPLING FACTOR 

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 OF \_\_\_\_\_

SEQUENTIAL POT NUMBER	SPECIES	SEX	SIZE CRABS (MM) FISH (CM)	LEGAL	SHELLAGE	EGGS				OTHER	CARAPACE WIDTH (mm) (OUTSIDE THE SPINES)	BT. CHELA HEIGHT (mm)	MERIDIAN LENGTH (mm)	TAG NUMBER	COMMENTS
						COLOR	DEVELOP	COMBINATION	% CLUTCH						
1															
2															
3															
4															
5															
6															
7															
8															
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<p><b>Crab Species</b></p> <p>1 - <i>L. sequeispina</i></p> <p>2 - <i>P. camtschaticus</i></p> <p>3 - <i>P. platypus</i></p> <p>4 - <i>Erimacrus</i></p> <p>5 - <i>C. bairdi x opilio</i></p> <p>6 - <i>C. bairdi</i></p> <p>7 - <i>C. opilio</i></p> <p>8 - <i>C. angulatus</i></p> <p>9 - <i>Cancer magister</i></p> <p>A - <i>L. couesi</i></p> <p>D - <i>C. tanneri</i></p>	<p><b>Fish &amp; Invert. Species</b></p> <p>See coded species list</p> <p><b>Sex</b></p> <p>1 - Male</p> <p>2 - Female</p> <p><b>Legal</b></p> <p>1 - Sublegal</p> <p>2 - Legal</p> <p><b>Shell Age</b></p> <p>0 - Soft</p> <p>1 - New</p> <p>2 - Old</p> <p>3 - Very Old</p>	<p><b>Live Egg Color</b></p> <p>1 - Tan</p> <p>2 - Purple</p> <p>3 - Brown</p> <p>4 - Orange</p> <p>5 - Purple-brown</p> <p>6 - Pink</p> <p>7 - Reddish</p> <p>8 -</p> <p>9 -</p> <p>0 - Other, describe in comments</p>	<p><b>Egg Devel</b></p> <p>1 - Uneyed</p> <p>2 - Eyed</p> <p><b>Clutch Condition</b></p> <p>1 - Dead eggs not apparent</p> <p>2 - Dead eggs &lt;20%</p> <p>3 - Dead eggs &gt;20%</p>	<p><b>Percent Clutch</b></p> <p>1 - Barren, clean pleopods</p> <p>2 - Barren, with empty eggs cases and/or stalks</p> <p>3 - Clutch 1-29% full</p> <p>4 - Clutch 30-59% full</p> <p>5 - Clutch 60-89% full</p> <p>6 - Clutch 90-100% full</p>	<p><b>Others</b></p> <p>1 - Dead</p> <p>2 - Alive</p> <p>3 - Nematodes in clutch</p> <p>4 - Turbellarians in clutch</p> <p>5 - Black mat</p> <p>6 - Bitter crab disease</p> <p>7 - "cottage cheese" disease</p> <p>8 - Shell rust</p> <p>9 - B. callosus</p>
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Appendix C.2. Crab Research Data Form was used on deck of the FV Western Viking by ADF&G technicians to record various measurements and conditions of crabs captured by individual pots on the Alaska Department of Fish and Game's 1991 golden king crab survey around Yunaska, Chagulak and Amutka islands in a portion of the Dutch Harbor and Adak Management Areas. Form shown here is reduced to 77% of original size.

ADF&G WESTWARD REGION CRAB TAG RECOVERY FORM

SPECIES \_\_\_\_\_ SEX a/ \_\_\_\_\_ REGISTRATION AREA \_\_\_\_\_ RECORDER \_\_\_\_\_

	External Tag Series & Number	Size (mm) King - CL Tanner - CW	Shell Age b/	Fate c/	CAPTURE							DEPTH (fm)	STATISTICAL AREA	ADF&G VESSEL NO.
					Mo.	Day	Yr.	LATITUDE - N			LONGITUDE - E OR W			
1														
2														
3														
4														
5														
6														
7														

a/ If female crab record additional data on back. b/ Shell Age: 0 = Soft; 1 = New; 2 = Old; 3 = Very Old. c/ Fate: 1 = Dead; 2 = Rereleased.

	Received Tag or Tagged Crab From:			Recovery Location Data From:			Vessel Name	Codes d/	PIT TAGS								
	Who?	When?	Where?	Who?	When?	Where?			ID Numbers & Letters								
1																	
2																	
3																	
4																	
5																	
6																	
7																	

d/ Pit Codes: 1 = Detected; 2 = Not detected (no Pit tag found upon dissection); 3 = Not checked (tail section unavailable); 4 = Not checked (tail section collected, must have floy tag attached).

Revised 7/91

Appendix C.3. The Tagged Crab Recovery Form was used by Mandatory Shellfish Observers on vessels commercially fishing golden king crabs *Lithodes aequispina* and by ADF&G dockside samplers during the 1991/92 and 1992/93 golden king crab seasons in the Dutch Harbor and Adak Management Areas. Crab tag number, size and condition, date, depth and location information were recorded when possible. Tagged crab were recovered from those released off of the FV Western Viking in 1991 during the golden king crab survey around Yunaska, Chagulak and Amutka islands. Form shown here is reduced to 77% of original size.

**ADF&G WESTWARD REGION CRAB TAG RECOVERY FORM  
(REVERSE SIDE)**

**FEMALE CRAB ONLY!!!!**

*	EGGS				OTHER **	COMMENTS
	COLOR	DEVELOP	CONDITION	% CLUTCH		
1						
2						
3						
4						
5						
6						
7						

- |                                    |                               |  |                              |
|------------------------------------|-------------------------------|--|------------------------------|
| <u>Live Egg Color</u>              | <u>Egg Devel</u>              | <u>Percent Clutch</u>                                | <u>Others</u>                |
| 1 - Tan                            | 1 - Uneyed                    | 1 - Barren, clean pleopods                           | 3 - Nemertean in clutch      |
| 2 - Purple                         | 2 - Eyed                      | 2 - Barren, with empty<br>egg cases and/or<br>stalks | 4 - Turbellarians in clutch  |
| 3 - Brown                          | <u>Clutch Condition</u>       | 3 - Clutch 1-29% full                                | 5 - Black mat                |
| 4 - Orange                         | 1 - Dead eggs not<br>apparent | 4 - Clutch 30-59% full                               | 6 - Bitter crab disease      |
| 5 - Purple-brown                   | 2 - Dead eggs <20%            | 5 - Clutch 60-89% full                               | 7 - "cottage cheese" disease |
| 6 - Pink                           | 3 - Dead eggs >20%            | 6 - Clutch 90-100% full                              | 8 - Shell rust               |
| 7 - Reddish                        |                               |  | 9 - B. callosus              |
| 8 -                                |                               |  |                              |
| 9 -                                |                               |  |                              |
| 0 - Other, describe in<br>comments |                               |  |                              |

\* FILL IN DATA FOR FEMALES USING SAME SEQUENCE NUMBER WHICH IS ON THE FRONT SIDE.

\*\* NOTE: CAN HAVE TWO NUMBERS IN SAME ROW IN THIS COLUMN.

Revised 7/91

Appendix C.3. The reverse side of the Tagged Crab Recovery Form used for recording additional clutch size and condition information on female golden king crabs recovered from the 1991 survey by the Alaska Department of Fish and Game around Yunaska, Chagulak and Amutka islands. Form shown here is reduced to 77% of original size.

Appendix D.1. Tag recovery data for male golden king crabs recovered from the 1991 and 1992 golden king crab seasons in the Dutch Harbor (O) and Adak (R) Management Areas. The crabs were released on the Alaska Department of Fish and Game's 1991 golden king crab survey around Yunaska, Chagulak and Amutka islands in the Aleutian Is.

Tag No.	Date of Crab's		Days Free	Days <sub>+<sup>b</sup></sub>	Carapace Length-mm			Shell Age <sup>a</sup>		Release Location		Recovery Location		Net Movement nmi	Depth			Fishery <sup>f</sup>					
	Release	Recovery			Rel. <sup>c</sup>	Rec. <sup>d</sup>	Diff. <sup>e</sup>	Rel. <sup>c</sup>	Rec. <sup>d</sup>	N Lat.	W Long.	N Lat.	W Long.		Rel. <sup>c</sup>	Rec. <sup>d</sup>	Rel. <sup>c</sup>		Rec. <sup>d</sup>	Fathoms	meters		
119	08/25/91	09/10/91	16		148	151	3	1	1	52	45.00	170	54.27	52	44.95	170	51.95	1.4	289	260	529	476	O91
595	08/27/91	09/10/91	14		144	142	-2	1	1	52	55.06	170	29.46	53	0.46	170	27.13	5.6	154	205	282	375	O91
518	08/27/91	09/11/91	15		149	149	0	1	1	52	55.00	170	30.12	52	55.54	170	29.45	0.7	180	185	329	339	O91
958	08/30/91	09/15/91	16		144	142	-2	1	1	52	35.00	170	21.45	52	23.00	170	24.26	12.1	195	174	357	318	O91
1394	09/01/91	09/22/91	21		151	147	-4	1	1	52	25.03	170	37.43	52	21.79	170	36.49	3.3	188	209	344	382	O91
1619	09/02/91	09/23/91	21	5	150	149	-1	1	1	52	29.96	170	55.29	52	28.00	170	23.00	19.3	223	-0- <sup>g</sup>	408	-0-	O91
1039 <sup>h</sup>	8/30/91	09/23/91	24	5	138	139	1	1	1	52	29.96	170	22.88	52	28.00	170	23.00	2.0	149	-0-	273	-0-	O91
1214	08/31/91	09/23/91	23	5	154	155	1	1	1	52	25.01	170	28.61	52	28.00	170	23.00	4.5	294	-0-	538	-0-	O91
1285	09/01/91	09/24/91	23		164	163	-1	1	1	52	25.01	170	46.02	52	21.78	170	48.36	3.5	162	160	296	293	O91
956	08/30/91	09/25/91	26		147	147	0	1	1	52	35.00	170	21.45	52	30.54	170	24.62	4.8	195	180	357	329	O91
1383	09/01/91	09/26/91	25		142	141	-1	1	1	52	25.04	170	37.29	52	25.04	170	45.68	5.0	189	159	346	291	O91
575	08/27/91	09/27/91	31		131	131	0	1	1	52	55.02	170	29.73	52	49.43	170	37.27	7.2	165	220	302	403	O91
92	08/25/91	09/27/91	33		142	140	-2	1	1	52	44.97	170	54.56	52	47.50	170	48.61	4.4	292	260	534	476	O91
488	08/27/91	09/27/91	31		154	150	-4	1	1	52	44.99	170	45.40	52	44.61	170	51.45	3.6	172	260	315	476	O91
550	08/27/91	09/27/91	31		150	150	0	1	1	52	55.02	170	30.01	52	49.59	170	37.36	7.0	176	200	322	366	O91
107	08/25/91	09/27/91	33		142	142	0	1	1	52	44.99	170	54.43	52	49.50	170	37.33	11.1	290	200	531	366	O91
469	08/27/91	09/27/91	31		142	140	-2	1	1	52	45.00	170	45.34	52	49.43	170	37.27	6.5	170	220	311	403	O91
324	08/26/91	10/01/91	36	30	139	-0-	-0-	1	-0-	52	50.00	170	45.18	-0-	-0-	-0-	-0-	-0-	281	-0-	514	-0-	O91
622	08/27/91	10/01/91	35	30	146	-0-	-0-	2	-0-	52	55.02	170	29.18	-0-	-0-	-0-	-0-	-0-	145	-0-	265	-0-	O91
1154	08/31/91	10/01/91	31	30	129	-0-	-0-	1	-0-	52	30.04	170	29.89	-0-	-0-	-0-	-0-	-0-	181	-0-	331	-0-	O91
346	08/26/91	10/02/91	37		168	167	-1	3	1	52	50.02	170	45.36	52	52.02	170	35.13	6.4	281	260	514	476	O91
127	08/25/91	10/02/91	38		140	141	1	1	1	52	45.00	170	54.27	52	48.65	170	48.00	5.2	289	266	529	487	O91
65	08/25/91	10/02/91	38		134	134	0	1	1	52	45.00	170	54.72	52	45.15	170	49.99	2.8	293	260	536	476	O91
1219	08/31/91	10/03/91	33		146	140	-6	3	2	52	25.04	170	29.04	52	21.51	170	34.72	4.9	290	245	531	448	O91
1488	09/01/91	10/05/91	34		144	145	1	1	2	52	25.00	170	55.52	52	22.94	170	52.90	2.6	234	211	428	386	O91
296	08/26/91	10/05/91	40		161	159	-2	1	1	52	50.00	170	45.04	52	49.83	170	46.33	0.8	282	260	516	476	O91
212	08/26/91	10/05/91	40		167	167	0	2	1	52	50.00	170	36.88	52	49.77	170	43.75	4.1	205	270	375	494	O91
1334	09/01/91	10/05/91	34		127	126	-1	1	1	52	24.96	170	46.59	52	18.93	170	56.99	8.6	166	230	304	421	O91
426	08/27/91	10/05/91	39		126	126	0	1	1	52	45.00	170	44.77	52	49.79	170	43.79	4.8	161	270	295	494	O91
1467	09/01/91	10/05/91	34		147	146	-1	1	1	52	24.96	170	55.13	52	17.90	170	52.70	7.2	232	230	425	421	O91
237	08/26/91	10/05/91	40		141	143	2	1	1	52	49.97	170	44.34	52	49.83	170	46.33	1.2	280	260	512	476	O91
1423	09/01/91	10/05/91	34		160	158	-2	1	1	52	25.01	170	37.90	52	17.80	170	56.95	13.4	184	230	337	421	O91
1264	09/01/91	10/05/91	34		130	129	-1	2	1	52	25.00	170	45.75	52	20.89	170	52.79	5.9	160	230	293	421	O91
1248	09/01/91	10/05/91	34		156	155	-1	1	1	52	24.95	170	45.61	52	19.67	170	56.91	8.6	159	250	291	458	O91
134	08/25/91	10/06/91	42		139	137	-2	1	1	52	44.97	170	54.09	52	50.34	170	40.77	9.6	289	270	529	494	O91
302	08/26/91	10/06/91	41		161	160	-1	1	1	52	50.00	170	45.04	52	48.79	170	42.34	2.0	282	260	516	476	O91
418	08/27/91	10/06/91	40		160	160	0	2	1	52	45.02	170	44.65	52	46.90	170	49.70	3.5	159	260	291	476	O91
304	08/26/91	10/06/91	41		137	136	-1	1	1	52	50.00	170	45.04	52	48.75	170	41.59	2.4	282	255	516	467	O91
102	08/25/91	10/06/91	42		130	144	14	1	1	52	44.99	170	54.43	52	48.70	170	41.50	8.5	290	265	531	485	O91
465	08/27/91	10/06/91	40		155	155	0	1	1	52	45.00	170	45.20	52	45.15	170	51.38	3.7	169	253	309	463	O91
1068	08/30/91	10/07/91	38		139	139	0	1	1	52	30.00	170	23.00	52	21.37	170	11.68	11.0	150	160	275	293	O91
1130	08/30/91	10/07/91	38		133	138	5	1	1	52	25.03	170	22.69	52	21.29	170	6.63	10.3	152	170	278	311	O91

-Continued-

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Tag No.	Date of Crab's		Days Free	Days $\pm^b$	Carapace Length-mm			Shell Age <sup>a</sup>		Release Location		Recovery Location		Net Movement nmi	Depth				Fishery <sup>f</sup>	
	Release	Recovery			Rel. <sup>c</sup>	Rec. <sup>d</sup>	Diff. <sup>e</sup>	Rel. <sup>c</sup>	Rec. <sup>d</sup>	N Lat.	W Long.	N Lat.	W Long.		Rel <sup>c</sup>	Rec <sup>d</sup>	Rel <sup>c</sup>	Rec <sup>d</sup>		
908	08/28/91	10/08/91	41		131	157	26	1	1	52 50.00	170 29.71	52 55.68	170 27.60	5.8	116	129	212	236	O91	
981	08/30/91	10/10/91	41		141	142	1	1	1	52 29.96	170 22.06	52 31.89	170 17.06	3.5	145	147	265	269	O91	
397	08/26/91	10/11/91	46		152	150	-2	2	1	52 49.93	170 45.81	52 46.65	170 48.93	3.8	271	260	496	476	O91	
2866	09/08/91	10/11/91	33		156	154	-2	1	1	52 40.02	171 2.86	52 43.50	170 54.25	6.2	305	260	558	476	O91	
2851	09/08/91	10/11/91	33		146	145	-1	1	1	52 40.00	171 2.99	52 44.50	170 54.25	6.9	306	260	560	476	O91	
1390	09/01/91	10/13/91	42		144	142	-2	1	1	52 25.03	170 37.43	52 22.87	170 50.56	8.1	188	180	344	329	O91	
1482	09/01/91	10/13/91	42		142	141	-1	1	1	52 25.00	170 55.40	52 20.27	170 52.79	5.0	234	180	428	329	O91	
1184	08/31/91	10/13/91	43		149	148	-1	1	1	52 30.00	170 29.20	52 29.42	170 21.04	4.9	181	149	331	273	O91	
198	08/26/91	10/17/91	52		126	125	-1	1	1	52 49.97	170 37.15	52 48.90	170 47.45	6.2	207	260	379	476	O91	
239	08/26/91	10/17/91	52		123	122	-1	1	1	52 49.97	170 44.34	52 48.88	170 47.38	2.1	280	260	512	476	O91	
305	08/26/91	10/17/91	52		141	139	-2	1	1	52 50.00	170 45.04	52 48.95	170 47.25	1.7	282	260	516	476	O91	
1475	09/01/91	10/17/91	46		154	153	-1	1	1	52 24.97	170 55.25	52 24.47	170 51.25	2.4	233	190	426	348	O91	
1190	08/31/91	10/18/91	48		147	146	-1	1	1	52 29.96	170 29.04	52 26.30	170 34.29	4.8	182	200	333	366	O91	
1193	08/31/91	10/20/91	50		137	137	0	1	1	52 29.98	170 28.85	52 21.15	170 12.15	13.3	184	175	337	320	O91	
1456	09/01/91	10/20/91	49		144	143	-1	1	1	52 24.95	170 38.16	52 13.85	170 37.61	11.1	182	350	333	641	O91	
1506	09/01/91	10/27/91	56		164	164	0	2	1	52 25.00	170 55.95	52 25.94	170 40.63	9.2	237	155	434	284	O91	
1176	08/31/91	10/30/91	60	7	140	-0-	-0-	1	-0-	52 30.01	170 29.37	-0-	-0-	-0-	-0-	181	-0-	331	-0-	O91
235	08/26/91	10/30/91	65	7	152	145	-7	1	1	52 49.97	170 44.34	-0-	-0-	-0-	-0-	280	-0-	512	-0-	O91
1194	08/31/91	10/30/91	60	7	146	-0-	-0-	1	-0-	52 29.98	170 28.85	-0-	-0-	-0-	-0-	184	-0-	337	-0-	O91
30	08/25/91	10/30/91	66	7	139	139	0	1	1	52 44.97	170 55.02	-0-	-0-	-0-	-0-	295	-0-	540	-0-	O91
363	08/26/91	10/30/91	65	7	144	144	0	2	-0-	52 49.97	170 45.54	-0-	-0-	-0-	-0-	279	-0-	511	-0-	O91
560	08/27/91	10/30/91	64	7	155	156	1	1	1	52 55.02	170 29.85	-0-	-0-	-0-	-0-	170	-0-	311	-0-	O91
1086	08/30/91	10/30/91	61	7	141	141	0	1	1	52 30.00	170 23.11	-0-	-0-	-0-	-0-	153	-0-	280	-0-	O91
2846	09/08/91	10/30/91	52	7	155	158	3	1	1	52 39.99	171 3.10	-0-	-0-	-0-	-0-	307	-0-	562	-0-	O91
909	08/28/91	10/30/91	63	7	141	142	1	1	1	52 50.00	170 29.71	-0-	-0-	-0-	-0-	116	-0-	212	-0-	O91
2836	09/08/91	10/30/91	52	7	153	-0-	-0-	1	-0-	52 39.99	171 3.10	-0-	-0-	-0-	-0-	307	-0-	562	-0-	O91
2847	09/08/91	10/30/91	52	7	158	159	1	1	1	52 39.99	171 3.10	-0-	-0-	-0-	-0-	307	-0-	562	-0-	O91
125	08/25/91	10/30/91	66	7	133	146	13	1	1	52 45.00	170 54.27	-0-	-0-	-0-	-0-	289	-0-	529	-0-	O91
818	08/28/91	10/30/91	63	7	131	-0-	-0-	1	-0-	52 55.00	170 21.70	-0-	-0-	-0-	-0-	127	-0-	232	-0-	O91
1504	09/01/91	10/30/91	59	7	148	-0-	-0-	1	-0-	52 25.00	170 55.95	-0-	-0-	-0-	-0-	237	-0-	434	-0-	O91
445	08/27/91	10/30/91	64	7	164	-0-	-0-	3	-0-	52 45.02	170 45.06	-0-	-0-	-0-	-0-	167	-0-	306	-0-	O91
1087	08/30/91	10/30/91	61	7	153	-0-	-0-	1	-0-	52 30.00	170 23.11	-0-	-0-	-0-	-0-	153	-0-	280	-0-	O91
318	08/26/91	10/30/91	65	7	149	-0-	-0-	1	-0-	52 50.00	170 45.18	-0-	-0-	-0-	-0-	281	-0-	514	-0-	O91
1564	09/02/91	10/30/91	58	7	142	141	-1	1	1	52 29.97	170 56.02	-0-	-0-	-0-	-0-	230	-0-	421	-0-	O91
1134	08/30/91	10/30/91	61	7	138	139	1	1	1	52 25.04	170 22.80	-0-	-0-	-0-	-0-	153	-0-	280	-0-	O91
1605	09/02/91	11/03/91	62		152	150	-2	1	1	52 29.98	170 55.54	52 22.40	170 50.52	8.1	225	210	412	384	R91	
3895	09/11/91	11/14/91	64		134	132	-2	1	1	52 34.97	171 30.80	52 20.27	171 33.15	14.8	250	240	458	439	R91	
1512	09/02/91	12/14/91	103		151	151	0	1	1	52 25.02	171 3.45	52 17.00	171 21.00	12.9	254	240	465	-0-	R91	
1430	09/01/91	12/16/91	106		134	146	12	1	1	52 24.97	170 38.04	52 20.14	170 50.50	8.7	183	170	335	-0-	R91	
4373	09/14/91	01/03/92	111		131	143	12	2	1	52 19.98	171 30.43	52 23.39	171 40.14	6.6	247	200	452	-0-	R91	
3698	09/10/91	02/15/92	158	10	130	-0-	-0-	1	-0-	52 34.97	171 21.25	-0-	-0-	-0-	-0-	168	-0-	307	-0-	R91
3557	09/10/91	02/15/92	158	10	139	-0-	-0-	1	-0-	52 40.00	171 40.33	-0-	-0-	-0-	-0-	316	-0-	578	-0-	R91
2521	09/07/91	02/15/92	161	10	116	-0-	-0-	1	-0-	52 45.00	171 30.84	-0-	-0-	-0-	-0-	81	-0-	148	-0-	R91
3493 <sup>h</sup>	9/10/91	02/15/92	158	10	110	-0-	-0-	1	-0-	52 40.02	171 39.59	-0-	-0-	-0-	-0-	301	-0-	551	-0-	R91
2489	09/07/91	02/15/92	161	10	142	-0-	-0-	1	-0-	52 39.99	171 11.71	-0-	-0-	-0-	-0-	288	-0-	527	-0-	R91

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Appendix D.1. (page 3 of 5)

Tag No.	Date of Crab's		Days Free	Days $\pm^b$	Carapace Length-mm			Shell Age <sup>a</sup>		Release Location		Recovery Location		Net Movement nmi	Depth			Fishery <sup>f</sup>			
	Release	Recovery			Rel. <sup>c</sup>	Rec. <sup>d</sup>	Diff. <sup>e</sup>	Rel. <sup>c</sup>	Rec. <sup>d</sup>	N Lat.	W Long.	N Lat.	W Long.		Rel. <sup>c</sup>	Rec. <sup>d</sup>	Rel. <sup>c</sup>		Rec. <sup>d</sup>		
3661	09/10/91	02/15/92	158	10	159	-0-	-0-	1	-0-	52 34.99	171 20.88	-0-	-0-	-0-	-0-	168	-0-	307	-0-	R91	
1001	08/30/91	02/15/92	169	10	143	-0-	-0-	1	-0-	52 29.96	170 22.38	-0-	-0-	-0-	-0-	150	-0-	275	-0-	R91	
3922	09/11/91	02/15/92	157	10	149	-0-	-0-	1	-0-	52 34.95	171 30.54	-0-	-0-	-0-	-0-	250	-0-	458	-0-	R91	
1582	09/02/91	02/15/92	166	10	138	-0-	-0-	1	-0-	52 30.03	170 55.79	-0-	-0-	-0-	-0-	228	-0-	417	-0-	R91	
3868	09/11/91	02/15/92	157	10	110	-0-	-0-	1	-0-	52 35.02	171 41.22	-0-	-0-	-0-	-0-	328	-0-	600	-0-	R91	
3105	09/09/91	02/15/92	159	10	142	-0-	-0-	1	-0-	52 44.97	171 40.22	-0-	-0-	-0-	-0-	162	-0-	296	-0-	R91	
3238	09/09/91	02/15/92	159	10	142	-0-	-0-	1	-0-	52 40.00	171 31.15	-0-	-0-	-0-	-0-	271	-0-	496	-0-	R91	
3825	09/11/91	02/15/92	157	10	106	-0-	-0-	1	-0-	52 35.04	171 40.43	-0-	-0-	-0-	-0-	326	-0-	597	-0-	R91	
3941	09/11/91	02/15/92	157	10	134	-0-	-0-	1	-0-	52 34.99	171 30.29	-0-	-0-	-0-	-0-	246	-0-	450	-0-	R91	
2449	09/07/91	02/15/92	161	10	154	-0-	-0-	2	-0-	52 40.00	171 10.52	-0-	-0-	-0-	-0-	307	-0-	562	-0-	R91	
1655	09/04/91	02/15/92	164	10	140	-0-	-0-	1	-0-	52 45.02	171 21.76	-0-	-0-	-0-	-0-	95	-0-	174	-0-	R91	
4461	09/15/91	02/15/92	153	10	132	-0-	-0-	1	-0-	52 29.98	171 41.02	-0-	-0-	-0-	-0-	321	-0-	587	-0-	R91	
1741	09/04/91	02/15/92	164	10	128	-0-	-0-	1	-0-	52 50.00	171 20.27	-0-	-0-	-0-	-0-	94	-0-	172	-0-	R91	
4015	09/14/91	02/15/92	154	10	147	-0-	-0-	1	-0-	52 29.95	171 51.06	-0-	-0-	-0-	-0-	307	-0-	562	-0-	R91	
3486	09/10/91	02/15/92	158	10	130	-0-	-0-	1	-0-	52 40.02	171 39.59	-0-	-0-	-0-	-0-	301	-0-	551	-0-	R91	
4565 <sup>h</sup>	9/16/91	02/15/92	152	10	103	-0-	-0-	1	-0-	52 24.97	171 31.62	-0-	-0-	-0-	-0-	262	-0-	479	-0-	R91	
3259	09/09/91	02/15/92	159	10	124	-0-	-0-	1	-0-	52 39.99	171 30.95	-0-	-0-	-0-	-0-	273	-0-	500	-0-	R91	
2544	09/07/91	02/15/92	161	10	134	-0-	-0-	1	-0-	52 45.02	171 30.59	-0-	-0-	-0-	-0-	83	-0-	152	-0-	R91	
4449	09/15/91	02/15/92	153	10	122	-0-	-0-	1	-0-	52 29.97	171 41.15	-0-	-0-	-0-	-0-	322	-0-	589	-0-	R91	
3331	09/09/91	02/15/92	159	10	143	-0-	-0-	1	-0-	52 39.97	171 30.00	-0-	-0-	-0-	-0-	295	-0-	540	-0-	R91	
3242	09/09/91	02/15/92	159	10	137	-0-	-0-	1	-0-	52 40.00	171 31.15	-0-	-0-	-0-	-0-	271	-0-	496	-0-	R91	
3797	09/11/91	02/15/92	157	10	130	-0-	-0-	1	-0-	52 35.00	171 40.13	-0-	-0-	-0-	-0-	325	-0-	595	-0-	R91	
1979	09/04/91	02/15/92	164	10	137	-0-	-0-	1	-0-	52 50.00	171 10.93	-0-	-0-	-0-	-0-	102	-0-	187	-0-	R91	
3256	09/09/91	02/15/92	159	10	132	-0-	-0-	1	-0-	52 39.99	171 30.95	-0-	-0-	-0-	-0-	273	-0-	500	-0-	R91	
3826	09/11/91	02/15/92	157	10	130	-0-	-0-	1	-0-	52 35.04	171 40.43	-0-	-0-	-0-	-0-	326	-0-	597	-0-	R91	
3235	09/09/91	02/15/92	159	10	137	-0-	-0-	1	-0-	52 40.00	171 31.15	-0-	-0-	-0-	-0-	271	-0-	496	-0-	R91	
2022	09/04/91	02/15/92	164	10	140	-0-	-0-	1	-0-	52 49.99	171 11.23	-0-	-0-	-0-	-0-	99	-0-	181	-0-	R91	
3255	09/09/91	02/15/92	159	10	138	-0-	-0-	1	-0-	52 39.99	171 30.95	-0-	-0-	-0-	-0-	273	-0-	500	-0-	R91	
4530	09/15/91	02/15/92	153	10	129	-0-	-0-	1	-0-	52 30.01	171 40.52	-0-	-0-	-0-	-0-	318	-0-	582	-0-	R91	
3861	09/11/91	02/15/92	157	10	133	-0-	-0-	1	-0-	52 35.00	171 41.00	-0-	-0-	-0-	-0-	328	-0-	600	-0-	R91	
2513	09/07/91	02/15/92	161	10	140	-0-	-0-	1	-0-	52 45.00	171 31.03	-0-	-0-	-0-	-0-	81	-0-	148	-0-	R91	
3499	09/10/91	02/15/92	158	10	133	-0-	-0-	1	-0-	52 40.00	171 39.68	-0-	-0-	-0-	-0-	303	-0-	554	-0-	R91	
2441	09/07/91	04/24/92	230		137	137	0	1	2	52 40.00	171 10.52	52	21.00	171	15.00	19.2	307	240	562	439	R91
1742	09/04/91	06/02/92	272		123	125	2	1	1	52 50.00	171 20.27	52	47.84	171	17.92	2.6	94	69	172	126	R91
2977	09/08/91	06/19/92	285		143	145	2	1	3	52 44.97	171 10.96	52	41.82	171	11.27	3.2	261	290	436	531	R91
2003	09/04/91	06/26/92	296		140	-0-	-0-	1	-0-	52 50.00	171 10.93	52	30.12	171	04.27	20.3	102	275	187	503	R91
3015	09/08/91	06/26/92	292		143	142	-1	1	1	52 45.04	171 11.68	52	51.26	171	03.49	7.8	244	196	446	359	R91
3237	09/09/91	07/03/92	298		146	146	0	1	1	52 40.00	171 31.15	52	45.50	171	49.93	12.5	271	300	496	549	R91
2894	09/08/91	07/18/92	314		138	157	19	1	1	52 40.02	171 2.29	52	52.57	171	03.19	12.6	297	300	544	549	R91
4369	09/14/91	08/01/92	322	10	147	-0-	-0-	2	-0-	52 19.98	171 30.43	-0-	-0-	-0-	-0-	247	-0-	452	-0-	R91	
2533	09/07/91	08/01/92	329	10	127	-0-	-0-	1	-0-	52 45.00	171 30.71	-0-	-0-	-0-	-0-	82	-0-	150	-0-	R91	
3389	09/10/91	08/12/92	337		154	154	0	1	1	52 49.99	171 40.59	52	53.69	171	28.93	7.7	271	300	496	549	R91
3882	09/11/91	08/12/92	336		134	145	11	1	1	52 34.99	171 41.50	52	53.69	171	28.93	20.1	328	300	600	549	R91
2006	09/04/91	08/15/92	346		148	149	1	1	1	52 50.00	171 11.09	52	51.46	171	02.74	5.1	101	268	185	490	R91
2978	09/08/91	08/15/92	342		140	140	0	1	1	52 44.97	171 10.96	52	51.46	171	02.74	8.0	261	268	478	490	R91

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Appendix D.1. (page 4 of 5)

Tag No.	Date of Crab's		Days Free	Days $\pm^b$	Carapace Length-mm			Shell Age <sup>a</sup>		Release Location		Recovery Location		Net Movement nmi	Depth				Fishery <sup>f</sup>				
	Release	Recovery			Rel. <sup>c</sup>	Rec. <sup>d</sup>	Diff. <sup>e</sup>	Rel. <sup>c</sup>	Rec. <sup>d</sup>	N Lat.	W Long.	N Lat.	W Long.		Rel <sup>c</sup> Rec <sup>d</sup>	Rel <sup>c</sup> Rec <sup>d</sup>	fathoms	meters					
3819	09/11/91	09/05/92	360		128	128	0	1	1	52	35.00	171	40.24	52	23.15	170	48.29	33.1	326	250	597	458	O92
643	08/28/91	09/06/92	375	5	143	-0-	-0-	1	-0-	52	55.00	170	22.52	-0-	-0-	-0-	-0-	-0-	131	-0-	240	-0-	O92
1341	09/01/91	09/07/92	372		136	-0-	-0-	1	-0-	52	24.96	170	46.59	-0-	-0-	-0-	-0-	-0-	166	-0-	304	-0-	O92
3663	09/10/91	09/07/92	363	7	144	-0-	-0-	1	-0-	52	34.99	171	20.88	-0-	-0-	-0-	-0-	-0-	168	-0-	307	-0-	O92
1274	09/01/91	09/07/92	372	7	130	-0-	-0-	1	-0-	52	25.01	170	45.90	-0-	-0-	-0-	-0-	-0-	161	-0-	295	-0-	O92
360	08/26/91	09/07/92	378	7	147	-0-	-0-	1	-0-	52	49.97	170	45.54	-0-	-0-	-0-	-0-	-0-	279	-0-	511	-0-	O92
2954	09/08/91	09/07/92	365	7	164	-0-	-0-	1	-0-	52	45.00	171	10.78	-0-	-0-	-0-	-0-	-0-	264	-0-	483	-0-	O92
1165	08/31/91	09/07/92	373		163	-0-	-0-	1	-0-	52	30.02	170	29.80	52	30.00	169	36.00	32.1	181	200	331	366	O92
1076	08/30/91	09/07/92	374	7	163	-0-	-0-	1	-0-	52	30.00	170	23.11	-0-	-0-	-0-	-0-	-0-	153	-0-	280	-0-	O92
1212	08/31/91	09/15/92	381		156	154	-2	1	1	52	25.03	170	28.88	52	21.80	170	36.72	5.7	294	210	538	384	O92
954	08/30/91	09/15/92	382		151	149	-2	1	1	52	35.00	170	21.45	52	20.05	170	32.68	16.4	195	180	357	329	O92
407	08/27/91	09/17/92	387		165	-0-	-0-	1	-0-	52	45.00	170	44.49	52	39.20	170	55.50	8.8	157	140	287	256	O92
332	08/26/91	09/17/92	388		144	144	0	1	2	52	50.02	170	45.36	52	46.81	170	49.38	4.0	281	255	514	467	O92
77	08/25/91	09/27/92	399		137	144	7	1	1	52	44.97	170	54.56	52	49.38	170	42.33	8.5	292	258	534	472	O92
1346	09/01/91	10/03/92	398		126	-0-	-0-	1	-0-	52	25.00	170	36.88	-0-	-0-	-0-	-0-	-0-	193	-0-	353	-0-	O92
906	08/28/91	10/05/92	404		147	147	0	1	1	52	50.00	170	29.71	52	48.90	170	45.20	9.3	116	246	212	450	O92
614	08/27/91	10/06/92	406	3	110	128	18	1	1	52	55.04	170	29.34	-0-	-0-	-0-	-0-	-0-	148	-0-	271	-0-	O92
14	08/25/91	10/06/92	408		139	-0-	-0-	1	-0-	52	44.97	170	55.16	52	13.22	170	48.84	32.0	296	220	542	403	O92
1567	09/02/91	10/09/92	403		146	146	0	1	2	52	29.95	170	56.02	52	42.06	170	54.36	12.1	230	255	421	467	O92
1336	09/01/91	10/09/92	404		141	-0-	-0-	1	-0-	52	24.96	170	46.59	-0-	-0-	-0-	-0-	-0-	166	-0-	304	-0-	O92
1170	08/31/91	10/11/92	407		138	-0-	-0-	1	-0-	52	30.01	170	29.48	-0-	-0-	-0-	-0-	-0-	181	-0-	331	-0-	O92
1554	09/02/91	10/19/92	413		146	145	-1	1	1	52	29.95	170	56.15	52	39.11	170	59.99	9.4	230	287	421	525	O92
3623	09/10/91	10/20/92	406	6	133	-0-	-0-	1	-0-	52	34.97	171	20.30	-0-	-0-	-0-	-0-	-0-	159	-0-	291	-0-	O92
4097	09/14/91	10/20/92	402	6	128	-0-	-0-	1	-0-	52	20.00	171	50.25	-0-	-0-	-0-	-0-	-0-	100	-0-	183	-0-	O92
667	08/28/91	10/21/92	420	3	122	142	20	1	1	52	55.00	170	22.52	52	54.20	170	21.54	1.0	131	130	240	238	O92
820	08/28/91	10/22/92	421		121	139	18	1	1	52	55.00	170	21.70	52	51.93	170	28.87	5.3	127	130	232	238	O92
2858	09/08/91	10/23/92	411		133	134	1	1	1	52	40.00	171	2.99	52	52.70	170	25.27	25.8	306	134	560	425	O92
827	08/28/91	10/23/92	422		126	144	18	1	1	52	55.00	170	21.53	53	-0-	170	26.00	5.7	126	186	231	340	O92
840	08/28/91	10/24/92	423	3	120	154	34	1	1	52	55.00	170	21.53	52	53.00	-0-	-0-	-0-	126	120	231	220	O92
715	08/28/91	10/24/92	423	3	136	154	18	1	1	52	55.00	170	22.23	52	53.00	-0-	-0-	-0-	129	120	236	220	O92
839	08/28/91	10/24/92	423	3	118	140	22	1	1	52	55.00	170	21.53	52	53.00	-0-	-0-	-0-	126	120	231	220	O92
697	08/28/91	10/24/92	423	3	126	146	20	1	1	52	55.00	170	22.28	52	53.00	-0-	-0-	-0-	129	120	236	220	O92
792	08/28/91	10/24/92	423	3	135	139	4	1	1	52	54.99	170	21.82	52	53.00	-0-	-0-	-0-	127	120	232	220	O92
870	08/28/91	10/27/92	426		135	152	17	1	1	52	50.02	170	29.42	52	59.75	170	19.59	11.4	121	103	221	188	O92
72	08/25/91	11/06/92	439	7	132	-0-	-0-	1	-0-	52	44.97	170	54.56	-0-	-0-	-0-	-0-	-0-	292	-0-	534	-0-	R92
2459	09/07/91	11/06/92	426	7	135	-0-	-0-	1	-0-	52	40.02	171	11.09	-0-	-0-	-0-	-0-	-0-	295	-0-	540	-0-	R92
4439	09/15/91	11/06/92	418	7	143	-0-	-0-	1	-0-	52	29.97	171	41.15	-0-	-0-	-0-	-0-	-0-	322	-0-	589	-0-	R92
4594	09/16/91	11/06/92	417	7	141	-0-	-0-	1	-0-	52	25.01	171	31.03	-0-	-0-	-0-	-0-	-0-	258	-0-	472	-0-	R92
1520	09/02/91	11/07/92	432	7	158	-0-	-0-	1	-0-	52	30.01	171	3.99	-0-	-0-	-0-	-0-	-0-	260	190	476	348	R92
1093	08/30/91	11/07/92	435	7	159	-0-	-0-	1	-0-	52	30.00	170	23.11	-0-	-0-	-0-	-0-	-0-	153	190	280	348	R92
3666	09/10/91	11/07/92	424	7	133	-0-	-0-	1	-0-	52	34.99	171	20.88	-0-	-0-	-0-	-0-	-0-	168	190	307	348	R92
4197	09/14/91	11/07/92	420	7	145	-0-	-0-	1	-0-	52	20.00	171	51.43	-0-	-0-	-0-	-0-	-0-	162	-0-	296	-0-	R92
1898	09/04/91	11/07/92	430	7	139	-0-	-0-	1	-0-	52	50.02	171	10.17	-0-	-0-	-0-	-0-	-0-	116	-0-	212	-0-	R92
4520	09/15/91	11/25/92	437	23	139	151	12	1	1	52	29.98	171	40.63	-0-	-0-	-0-	-0-	-0-	318	160	582	293	R92
4460	09/15/91	03/14/93	546	9	128	-0-	-0-	1	-0-	52	29.98	171	41.02	-0-	-0-	-0-	-0-	-0-	321	-0-	587	-0-	R92

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Appendix D.1. (page 5 of 5)

Tag No.	Date of Crab's		Days Free	Days $\pm^b$	Carapace Length-mm			Shell Age <sup>a</sup>		Release Location		Recovery Location		Net Movement nmi	Depth		Fishery <sup>f</sup>						
	Release	Recovery			Rel. <sup>c</sup>	Rec. <sup>d</sup>	Diff. <sup>e</sup>	Rel. <sup>c</sup>	Rec. <sup>d</sup>	N Lat.	W Long.	N Lat.	W Long.		Rel <sup>c</sup> Rec <sup>d</sup> fathoms	Rel <sup>c</sup> Rec <sup>d</sup> meters							
4621	09/16/91	03/14/93	545	9	139	-0-	-0-	1	-0-	52	25.02	171	30.63	-0-	-0-	-0-	-0-	255	-0-	467	-0-	R92	
3261	09/09/91	03/14/93	552	9	132	-0-	-0-	1	-0-	52	39.99	171	30.95	-0-	-0-	-0-	-0-	273	-0-	500	-0-	R92	
4188	09/14/91	05/14/93	608	14	144	-0-	-0-	1	-0-	52	20.00	171	51.29	-0-	-0-	-0-	-0-	149	-0-	273	-0-	R92	
4559	09/16/91	05/14/93	606	14	149	-0-	-0-	1	-0-	52	24.97	171	31.62	-0-	-0-	-0-	-0-	262	-0-	479	-0-	R92	
2777	09/07/91	06/29/93	661		135	151	16	1	1	52	40.00	171	19.70	52	54.52	171	2.82	17.7	225	273	412	500	R92
4556	09/16/91	07/13/93	666	1	129	147	18	1	1	52	24.97	171	31.62	-0-	-0-	-0-	-0-	262	-0-	479	-0-	R92	
4780	09/17/91	07/15/93	667	14	139	-0-	-0-	1	-0-	52	30.02	171	30.75	-0-	-0-	-0-	-0-	296	-0-	542	-0-	R92	
4103	09/14/91	07/15/93	670	14	135	-0-	-0-	1	-0-	52	20.00	171	50.25	-0-	-0-	-0-	-0-	100	-0-	183	-0-	R92	
3717	09/11/91	07/15/93	673	14	126	-0-	-0-	1	-0-	52	34.99	171	51.04	-0-	-0-	-0-	-0-	386	-0-	706	-0-	R92	
2073	09/06/91	07/16/93	679		120	130	10	2	1	52	55.00	171	10.42	52	54.29	171	23.15	7.6	160	243	293	445	R92
1797	09/04/91	07/20/93	685		109	136	27	1	1	52	49.99	171	20.68	52	56.34	171	14.03	7.5	96	-0-	176	-0-	R92
404	08/27/91	-0-	-0-		152	-0-	-0-	2	-0-	52	45.00	170	44.49	-0-	-0-	-0-	-0-	157	-0-	287	-0-	O91	
2927	09/08/91	-0-	-0-		120	-0-	-0-	1	-0-	52	44.97	171	2.48	-0-	-0-	-0-	-0-	396	-0-	168	-0-	R92	
2918	09/08/91	-0-	-0-		141	-0-	-0-	1	-0-	52	40.02	171	1.85	-0-	-0-	-0-	-0-	292	-0-	168	-0-	R92	
3321	09/09/91	-0-	-0-		135	-0-	-0-	2	-0-	52	39.97	171	30.15	-0-	-0-	-0-	-0-	291	-0-	-0-	-0-	-0-	
4831	09/17/91	-0-	-0-		156	-0-	-0-	1	-0-	52	30.04	171	31.38	-0-	-0-	-0-	-0-	297	-0-	-0-	-0-	-0-	

- a The exoskeleton or shell age of crabs were classified as either new shell = 1, old shell = 2, or very shell = 3.
- b The number given is the estimate of plus or minus the number of days of a crab's freedom derived from a delivery date by the vessel known or believed to have delivered the tagged crab.
- c Release data.
- d Recovery data.
- e The numbers given in this column are calculated as the difference from the recovery minus the release length.
- f Commercial fishing seasons for golden king crabs in the two management areas are designated O91 = 9/1-11/15/91 and O92 = 9/1-11/15/92 for Dutch Harbor and R91 = 11/1/91-8/15/92 and R92 = 11/1/92-8/15/93.
- g No data = -0-
- h Female golden king crabs.

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