THE 1997 ALEUTIAN ISLANDS GOLDEN KING CRAB SURVEY

By

S. Forrest Blau,
Leslie J. Watson and Ivan Vining

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AUTHORS

S. Forrest Blau and Leslie Watson are Alaska Department of Fish and Game (ADF&G) shellfish research biologists. Ivan Vining is the regional biometrician for the Westward region ADF&G office. All are employed at the Commercial Fisheries Management and Development Divison office at 211 Mission Road, Kodiak.

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Stephen Hall, captain and owner of the FV *Spirit of the North*, and his crew did an admirable job in performing the 1997 Aleutian Islands golden king crab survey. In addition to setting and retrieving the longlined gear, the vessel crew did an excellent job sorting the catch and assisting the biologists in tagging and measuring crabs. Crew members of the *Spirit of the North* included Faron McHohne, engineer; Jack Sternhagen, deck boss; and deck hands Ricky Cruz, Ray Kerbs, and Sean Piko, who also served as the cook.

ADF&G staff onboard the vessel consisted of Forrest Blau, crew leader; Rance Morrison, assistant crew leader; and Fish and Wildlife technicians Mary Schwenzfeier and Elizabeth Wilson. The ADF&G vessel staff did a fine job of sorting, measuring, tagging, and recording data on crabs and other species caught. They prepared tagging needles, edited and kept paperwork in order, tallied preliminary survey results, did data entry, dissected crabs and collected ovaries, took photographs and collected crabs for the state's Mandatory Shellfish Observer program, and assisted with vessel duties.

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FOREWORD

This project was funded primarily under the State of Alaska Bering Sea Crab Test Fishery Program (BSTF) and the State of Alaska Capital Improvement Project for king crab assessment in the Aleutian Islands. Initiated in 1990, the primary focus of the BSTF program has centered on Bristol Bay red king crab research. The first ADF&G survey on golden king crabs occurred during the summer of 1991 in the Aleutian Islands and was funded by the BSTF. Beginning in 1995, ADF&G began triennial king crab surveys on a rotating basis for St. Matthew Is. blue king crabs, Norton Sound red king crabs (1996), and Aleutian Islands golden king crabs (1997). BSTF project operational plans have been documented (Blau 1992; Blau et al. 1996b; Tracy and Pengilly 1996 and 1997; Watson and Blau 1997; Watson and Pengilly 1992, 1993a, 1993b, 1994, and 1996; and Watson et al. 1995a and 1995b).

INTRODUCTION

The economic importance of the Aleutian Islands fishery for golden (or "brown") king crabs *Lithodes aequispinus* is substantial, with 121.5 million pounds worth and estimated exvessel value of $338 million landed from 1980 to 1995 (ADF&G 1997). Despite the value of the fishery, little is known regarding the abundance and basic life history parameters of golden king crab populations. Historically, there has been no program for performing systematic surveys of Aleutian golden king crabs on a regular basis. The impact of management measures and fishing practices has been difficult to assess without the baseline survey data needed to monitor the population.

In the absence of regular surveys, ADF&G and National Marine Fisheries Service (NMFS) biologists have collected biological data on golden king crabs from trawlers and crab vessels fishing in the Aleutian Islands (Molyneaux 1985; Urban 1986: Blau 1987; McBride et al. 1982, Ronholt et al. 1982; Otto 1983; Otto et al. 1983; Otto and Cummiskey 1985; Somerton and Otto 1986; Beers 1991 and 1992; Tracy 1994, 1995a, and 1995b; Boyle et al. 1996). In 1991, the Alaska Department of Fish and Game conducted its first systematic survey of golden king crabs in portions of the former Dutch Harbor and Adak king crab management areas, which provided information on the distribution of golden king crabs by depth, size frequency, morphometric relationships, female size at maturity, and tagged crab recovery information (Blau and Pengilly 1994, Blau et al. 1996a). Approximately 1,250 legal male golden king crabs were tagged during the 1991 survey, and recoveries were monitored through at-sea observers and ADF&G dockside samplers in the subsequent commercial fisheries.

Inseason management and biological information on golden king crabs in the Aleutians has been obtained since 1988 through at-sea data collections onboard catcher-processors and floating processors under the state's Mandatory Observer Program. However, as the number of catcher-processors participating in the commercial fishery declined through the mid-1990s, collection of data declined due to lack of observer coverage (Boyle et al. 1996). In response to the lack of current fishery information, the Alaska Board of Fisheries (BOF) implemented regulations in March 1995 that expanded observer coverage to include all vessels fishing in the subsequent 1995/96 Adak and Dutch Harbor commercial seasons (ADF&G 1996a).

The Adak golden king crab fishery has historically been managed on the basis of size, sex, and season, and monitored through inseason catch reporting (ADF&G 1996b). While a formal guideline harvest level was never set for the Dutch Harbor area, it has been managed based on an average harvest goal of approximately 1.5 million pounds. From 1975 to 1995, golden king crabs were harvested disproportionately east and west of 171°W longitude, the boundary between the Dutch Harbor and Adak Management areas.

In March 1996, the BOF passed regulations that combined the Dutch Harbor and Adak king crab management areas into the new Aleutian Islands Registration Area O (ADF&G 1996a). ADF&G established a guideline harvest level of 5.9 million pounds for this new combined management area (Morrison and Gish 1997). A 3.2 million pound quota per season was set for the area east of

174°W longitude, and a 2.7 million pound quota for the remaining part of the management area west of 174°W longitude.

METHODS

Vessel and Personnel

The 150 foot commercial crabber, FV *Spirit of the North*, was chartered at the rate of $3,900 per day for 35 days, from July 25-August 28, 1997 to conduct the golden king crab survey in the Aleutian Islands (ADF&G 1996a). The charter began and ended in Dutch Harbor. Four ADF&G personnel and six vessel crewman were onboard during the survey.

Research Area and Station Grid

The triennial Aleutian Islands golden king crab research survey, which lies between 52° - 53° N latitude and 169° - 173° W longitude, was selected from the eastern portion of the Aleutian Islands Registration area because it has supported a significant portion of the golden king crab harvest. This determination was made from historic Aleutian Islands golden king crab fishery fish ticket data, distribution and density of golden king crabs from the 1991 ADF&G Aleutian Islands survey, and location of observer pot samples from the 1996 fishery east of 174° W longitude (Blau and Pengilly 1994, Watson and Blau 1997). A grid of points 5 nautical miles (nmi) apart, both north-to-south and east-to-west, was laid out and 183 stations were established within the 75 to 500 fathom depth contours (Watson and Blau 1997). Actual locations of set gear, the time and date that each pot was set and retrieved, and gear depth were recorded by the captain on the Pilot House Log (Appendix A).

1997 Survey and Contingency Stations and Soak Time Goals

The 1997 survey goal consisted of fishing 89 of the 183 stations described (Figure 1). Each station consisted of 10 king crab pots spaced 0.079 nmi (80 fm) apart on a longline, and arrayed east-to-west. Stations were prioritized for fishing, and contingency stations, those with the lowest priority to fish, were all located at the western flank of the 1997 survey grid. Target soak time for each pot fished was 48 to 72 hours, and a goal of setting and retrieving three stations per day was established.

Setting and Retrieving Gear

Important navigational equipment in the wheel house used to find survey stations, and to set and retrieve gear included: a gyro compass (MK 37), Wagner[1] Mark IV auto pilot, Furuno[1] radar

[1] Reference to trade names does not imply endorsement by ADF&G.

(model 48), Furuno Dopler current indicator (set to determine current velocity and direction at 10, 100, and 150 fathoms simultaneously), Furuno fathometer/color video plotter (model GD-180, and Simrad[1] Taigo directional finder for Nova Tech[1] radio beacons.

Seventy-five king crab pots were used for all crab fishing. Pots had welded steel frames (7' x 7' x 34" OD), weighed approximately 700 pounds each, and were webbed with tarred and untarred (tunnels only) #92 nylon twine. Stretch mesh was 2 3/4" on all webbing. Two opposing tunnel eyes were made of 5/8" round-stock steel and measured 8" x 36" ID. A cod trigger (7" x 34" ID) with 15 plastic fingers on each side, was sewn onto each tunnel eye to reduce escapement of captured marine life. Each pot was baited with one gallon of chopped frozen herring.

Each king crab pot had a bridle tied to it with a C-link (made of 5/8" round-stock steel at its apex), which was connected to another C-link on the longline, or groundline, at given intervals until a string of 10 pots was made. The groundlines and buoy lines were made of 1 1/4" diameter American Rope[1], Manline[1], or Norwegian[1] lines. A buoy line was tied to each end of the groundline, with five hard floats (18" diameter, made of aluminum and plastic coated) connected near the surface end. At the surface end of each buoy line a Nova Tech[1] radio beacon was attached using electrical tape and hose clamps to a 5' length of PVC pipe inserted through a sea lion buoy. Pots were pulled aboard using a hydraulic block, placed in a pot launcher by a picking boom, and pushed from the deck in front of the launcher to a spot mid-deck by deckhands, where a hydraulic pot mover (called a "bull" by vessel crewmen) moved pots aft prior to setting the next station. A hydraulic crane located at the forward part of the line bin also moved pots on deck when needed. The groundline from each string was pulled in a continuous fashion, stopping momentarily to unhook it at each pot, to the line bin where a hydraulic coiler deposited it.

Catch Sorting and Sampling

Once onboard the catch from each pot was moved from the starboard to the port side of the vessel. The contents of each pot were then dumped into the vessel's 7' x 9'1" x 1' aluminum sorting table that stood 2 1/2' above the deck. Marine life from each pot was placed in plastic baskets or 32 gallon plastic garbage cans according to species, or sex and/or size group (Figure 2). The abdominal flap of each crab was examined for the presence of the externae or scars of the parasitic barnacle *Briarosaccus callosus*. The sorting table was then moved hydraulically so that it was parallel to the 4' x 8' x 1' ADF&G aluminum table, and the baskets or garbage cans were placed into it or adjacent to it. Two aluminum measuring/tagging tables 24" x 48" x 5/16" were attached to the aft and forward port side corners of the ADF&G sorting table. Generally, female crabs were handled on the forward table and males on the aft table. An ADF&G biologist and technician (who served primarily as a data recorder) worked at each measuring/tagging table while the vessel crew assisted in sorting and sampling the catch. A chute was constructed between these tables from which all crabs were released directly into the ocean. The vertical distance from the bottom of the chute to the ocean surface was 42" in calm seas. All crabs were tagged and released on station.

[1] Referency to trade names does not imply endorsement by ADF&G.

The carapace length (CL) of all golden king crabs and scarlet king crabs *Lithodes couesi* and the carapace width (CW) of grooved Tanner crab *Chionoecetes tanneri* were measured with Vernier calipers to the nearest millimeter. Carapace lengths of king crabs were measured from the posterior margin of the right eye socket to the midpoint of the rear margin of the carapace (Wallace et al. 1949). The carapace width of *C. tanneri* was the straight-line distance across the lower lateral margin of the carapace at a right angle to a line midway between the eyes to the midpoint of the posterior portion of the carapace, not including spines.

Male golden king crabs near the minimum legal size of 6" carapace width (ADF&G 1996a) were checked with 6-inch "go-no-go sticks" to determine legal status.

Subsampling of adult females and male golden king crabs <121 mm CL was conducted when necessary. A denominator for each subsampled pot was noted to allow accurate summaries of all crabs captured with their respective conditions.

Shell-Aging

The shell age categories below were tailored to golden king crabs and also applied to *L. couesi* and *C. tanneri*:

Soft-shell: Crab has molted within weeks. Exoskeleton soft and pliable.

New-shell-pliable: Exoskeleton approximately one to three months old. Coxa and ventral surface of exoskeleton shiny, not scratched or pitted. Legs easily compressed when pinched since legs contain little meat shortly after molting. Exoskeleton fragile and subject to breakage when crab handled or dropped onto the sorting table. If carapace removed, gills are translucent to light cream in color.

New-shell-hard: Coxa and ventral surface of exoskeleton dull. Legs mostly full of meat, meri not easily compressed when pinched. If carapace removed, gills are light cream in color. This category includes mostly ovigerous females and all females with matted setae.

Old-shell: Distal portion of ventral coxa is partially or totally covered with brown or black scratches or dots. Legs full of meat, meri not easily compressed when pinched. If carapace removed, gills are tan in color due to fouling by microorganisms. These crabs often have barnacles and other fouling marine organisms on their carapaces and/or elsewhere.

Very old-shell: Distal portion of ventral coxa densely covered with brown or black scratches or dots. Legs full of meat, meri not easily compressed when pinched. Tips of dactyls are worn, rounded, and black. If carapace removed, gills are dark gray or gray-black in color due to fouling by microorganisms. They are frequently covered with barnacles and other fouling marine organisms.

Male golden king crabs with hardened exoskeletons but unique in having soft, leather-like carapaces were termed "leatherbacks" and were noted as such in the "Other" column on the Crab Data Form (Appendix B).

Female Reproductive Conditions

Each female crab measured was also examined for clutch condition, embryo color and development, and percent clutch fullness; these conditions were noted on the Crab Data Form. "Hatching" was defined as a small clutch (1-29% full) of well developed, eyed embryos with "matted setae" from hatched larvae also present.

Miscellaneous Species

Miscellaneous fish and invertebrates were identified in all pot catches and code in the "Species" column on the Crab Data Form using a three digit species code (Blau and Watson 1997). The fork length of commercial fish species was measured to the nearest 0.4" (1 cm) and recorded. Presence of clutch symbionts, parasites or diseases found on crabs were recorded in the "Other" column in the Crab Data Form.

Tagging Protocols and Materials

Only golden king crabs ≥90 mm CL were tagged. Tagging was conducted by two teams; one for male crabs and one for female crabs. Tagging of male golden king crabs ≥121 mm CL (prerecruit ones and legal-sized) was done first so that the amount of time these crabs were on deck was kept to a minimum prior to release. Smaller, sublegal males 90-120 mm CL were then tagged. Tagging of female crabs began simultaneously by the other tagging team. Crabs infected with parasitic barnacles or had cracked carapaces, torn leg segments, or any other new injuries were not tagged; however, crabs with old injuries (regenerated legs, black leg caps, etc.) were tagged.

Tagging goals for male and female golden king crabs are shown below. If the number of sublegal male or female crabs captured significantly slowed sampling, they were tagged in lesser proportions (e.g., 1 of 4 or 1 of 5 crabs).

Priority	Sex-Size Group	Tagging Goals	Average CPUE from 1991 ADF&G GKC Survey	Estimated Number of Tagged Crabs[1]
1	Prerecruit Ones and Legal Males (≥121 mm CL)	100%	4.1	3,198
2	Females ≥90 mm CL	1 of 2	7.3	2,847
3	Sublegal Males (90-120 mm CL)	1 of 2	3.1	2,418
			Estimated total number of tagged crabs:	8,463

[1] Projected numbers of crabs to be tagged were generated using average catch per pot of sex-size groups from the 1991 ADF&G survey combined with the tagging goals for each sex-size group.

Tags were made by the Floy Tag and Manufacturing Company[1] and were constructed of 20" long by 1/16" diameter florescent green polyvinyl tubing. The series letter `B` followed by the tag number (1 to 10,000) was printed in black twice on each tag, once midway on the tubing and once on one side of a 3/4" x 1/4" white oval plastic disc through which the tubing was strung. The reverse side of the disc was printed with "LEAVE TAG ON CRAB NOTIFY ADF&G". Tagging needles were fabricated onboard the charter vessel using 16 or 18 gauge galvanized wire and were U-shaped, sharpened at each end, and when straightened, measured 3 1/4" to 3 3/4" long. Prior to tagging, one end of the needle was inserted into a hollow end of the polyvinyl tag. One person exposed and stretched the isthmus muscle of each crab to be tagged by pushing on the lateral margins of the carapace while holding the animal against their chest. The needle and about half of the tubing was drawn through the midpoint of the isthmus muscle and the free ends of the tag were tied using an overhand knot (Alaska Department of Fisheries 1954). Each tagged crab was released via the chute into the ocean.

Tagged crabs were recovered during the commercial fishery by shellfish observers deployed on all fishing vessels during the 1997/98 Aleutian Islands golden king crab fishing season. All tag recoveries were documented on the Tag Recovery Form (Appendix C).

Ancillary Data Collections

Several small-scale studies were conducted during the survey on a time-available basis after the pot sampling and tagging data were collected (Watson and Blau 1997).

Crab Weights

Wet weight of female and new-shell and old-shell male golden king crabs were to be taken over the length ranges of those captured and recorded on the Crab Data Form. A minimum sampling goal of 50 crabs at 10-mm CL size intervals was established.

Ovarian Weights

In order to determine the relationship between ovarian weight, carapace length and reproductive condition, the entire ovarian tracts were collected from a sample of female golden king crabs. The goal was to remove and weigh 490 ovaries from females that ranged in size from 80 to 149 mm CL. Sampled crabs were divided into 5-mm groups and subdivided into the following clutch/embryo condition categories (Appendix D): 1) clean setae; 2) uneyed embryos with full clutches only; 3) eyed embryos (but well developed, late stage, prehatch), full clutches only; 4) eyed embryos (hatching), clutches 1-19% full, and 5) barren clutch with only matted setae. Ovaries were removed, wrapped in cellophane, frozen, and identified with a label containing the sequential pot number, carapace length, and unique identifying number of the specimen. At the completion of the charter, the samples were taken to the Dutch Harbor ADF&G office where each ovarian sample was weighed to the nearest 2-g weight on an Ohaus[1] LS5000 scale and data recorded on the Crab Data Form.

[1] Reference to trade names does not imply endorsement by ADF&G.

Bottom Temperatures

Bottom temperatures (°C) were obtained by attaching a Brancker[1] Model TR-1000 submersible temperature recorder in pots deployed at a number of different stations. Temperatures were recorded every hour from two separate temperature recorders. Data from one recorder was downloaded onto a personal computer and the average bottom temperature at each pot location was calculated. The other recorder was irretrievable from the lost pot to which it was attached.

Minnow Traps to Capture Small Golden King Crabs

The purpose of this experiment was to: 1) determine if minnow traps can capture small (≤ 25mm CL) golden king crabs, 2) document the depths that small golden king crabs are found, 3) determine what baits will attract small golden king crabs, and 4) to find out if small golden king crabs prefer unbaited traps as habitat. The sampling goal was to clip one minnow trap to the bottom web in each survey pot fished. Carapace lengths of any golden king crabs captured in minnow traps and what type of bait was used, if any, was recorded. Minnow traps were either unbaited, or baited with approximately one cup of chopped herring or crumbled sponge "baits". Sponges were collected from previously-fished king crab pots and saved for baiting ensuing stations. Until enough sponges were collected, five consecutive unbaited minnow traps and five consecutive herring-baited traps were set at the same station (10 traps per station). When enough sponges were collected, nine minnow traps were set per station using serial sets of three traps per bait type; three with sponges, three with herring, and three unbaited. The sequence of either the two or three bait-type minnow traps was rotated from station to station for subsequent statistical analysis of the catch results.

Dissection of Crabs with Parasitic Barnacles

A sample goal of 20 golden king crab dissections (17 tissues per crab) infected with parasitic barnacles *Briarosaccus callosus* was established. Samples were provided to Dr. Frank Morado, NMFS pathologist for analysis. Instructions, forms, tissue cassettes, and preservation materials (10% buffered formalin) were provide by NMFS.

Crab Specimens and Photos

Specific crab specimens and photos were requested by Dutch Harbor ADF&G Mandatory Observer Program personnel for use in training observers.

Leech Collection

Leeches and leech cocoons from several commercial crab species were collected at the request of the National Museum of Natural History as part of a leech taxonomy study.

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Crab and Depth Categories

For summarization and analysis purposes, golden king crabs were categorized as follows. "Juvenile females" were barren with only clean pleopodal setae and were smaller than the size at maturity 50% (SM50) for all females as estimated from this survey. "Adult females" had either embryos, or were barren and matted with empty egg cases and funiculi on the pleopodal setae, or were barren with clean setae and were ≥ SM50. "Sublegal males" were males with carapace widths <154.2 mm (<6.0 in) measured outside the spines and were split into two groups. The first group, "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 mm (4.8 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 ≤120 mm (≤4.7 in) CL were grouped together. "Legal males" had carapace widths ≥154.2 mm (≥6.0 in), measured outside the spines, and were divided into two groups. "Recruits" were defined as new-shell males ≤153 mm (6.0 in) CL that had reached legal width; "postrecruits" included all new-shell males ≥154.2 mm (≥6.0 in) CL and included all legal-sized anexuviants (old and very old-shell crabs). Catch per pot (CPUE) statistics for most of the preceding groups were calculated at each station fished and at 50 fathom (fm) depth categories, but not standardized for varying soak times. Box plots of data for crab groups by depth zone were constructed following the definitions in Hoaglin et al. (1983).

Electronic Data Entry, Editing, and Database

Data recorded on the Crab Data and Pilot House Log forms were entered in Rbase[1] software programs and archived as the Aleut97 database. All Pilot House Log data and a portion of the Crab Data Form data were electronically entered at sea during the survey by ADF&G staff. The majority of Crab Data Form data was completed by ADF&G data entry clerks at the Dutch Harbor office. Data editing was conducted by ADF&G staff at the Kodiak and Dutch Harbor offices.

Data Analyses

Female Size at Maturity

Female golden king crab size at 50% maturity (SM50) 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 having either embryos or empty egg cases and funiculi on the pleopodal setae. No old-shell females were included in the study.

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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 (MLEs) of β_0 and β_1 were obtained using a generalized linear model estimation, with binomial error and linked to a logit function S-Plus[1] (Venables and Ripley 1994). Size at 50 percent maturity was estimated by

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

where $\hat{\beta}_0$ and $\hat{\beta}_1$ are the MLEs of β_0 and β_1, respectively. To obtain a confidence interval on the SM50, the variance of the estimator was estimated by applying the variance and covariance estimates for the MLEs of β_0 and β_1 to the Taylor series approximation of the variance of a ratio of two random variables (e.g., Mood et al. 1974).

RESULTS

Survey Overview and Fishing Statistics

The area surveyed was located between 52°15' and 53°00' N latitude and 169°48 and 171°34' W longitude, encompassing approximately 1,775 nmi^2. Seventy-one stations were fished, the first was set on July 25 and the last was retrieved on August 27, 1997 (Table 1 and Figure 1). There were 703 king crab pots which yielded useable data. An additional five pots were lost, and a sixth pot had a bent door, rendering the data from it unusable. The captain recorded bottom types based on fathometer observations and sea floor material on, or in pots. A total of 667 pots rested on rock substrates, 30 pots on sand, two on silt, and four on gravel. Pot soak times ranged from 1.8 to 8.4 days with 3.5 days being the average (Figure 3). Thirty-four of the pots soaked within the target soak time range of 2-3 days, while 97% of the pots soaked from 1.8 to 3.8 days. Fishing depths ranged from 79 to 529 fm and averaged 358 fm (Table 1).

Golden King Crab Data Summaries

Number Captured

There were 73,042 golden king crabs captured during the survey of which 49% were males and 51% were females (Table 1). Golden king crabs occurred in 69 (97%) of the 71 stations fished; none were captured at stations 44 or 73 (Figure 1). Golden king crabs were present in 92% of the pots.

[1] Reference to trade names does not imply endorsement by ADF&G.

The overall average catch per pot (CPUE) of golden king crabs was 104. CPUE values were not standardized to soak time. Overall average CPUE for golden king crabs by sex and size group was as follows: legal males 4, sublegal males 47, adult females 20, and juvenile females 32 (Table 1). The highest average CPUE at any one station of each sex and size group was as follows: 492 crabs of both sexes (station 25); 29 legal males (station 72); 247 sublegal males (station 25), 143 adult females (station 21), and 242 juvenile females (station 25). The highest number of golden king crabs captured in any one pot was 1,044 (pot 462 at station 25).

Spatial Distribution

Consistently higher numbers of male and female golden king crabs were captured north of Amukta, Chagulak, and Yunaska islands (in the Bering Sea) compared to catches on the Pacific Ocean side of these islands (Table 1 and Figure 4). Catches of juvenile and adult females were segregated by station, i.e., catches at one station tended to be mostly juvenile or mostly adult (Figure 5).

Distribution of Effort and Catch by Depth Zone

The greatest number of pots retrieved (29%) within any 50-fathom depth group occurred in the 100-149 fm depth zone (Table 2 and Figure 6).

The combined average catch of golden king crabs at the three shallowest depth zones (50-149 fm) was 62 crabs per pot. CPUE of crabs generally increased as depth increased, from 142 crabs per pot at the 200-249 fm zone to a peak of 292 crabs per pot in the 400-449 fm zone (Table 2). CPUE decreased in the deepest zones (450 to 549 fm) to catch per pot values of 116 to 177 crabs.

There were two major catch trends seen in crab groups related to the capture depth zones. One was an increasing CPUE of juvenile females and prerecruit males <121 mm CL) as depths increased; with peak catches for each group occurring at the 400-449 fm zone (Table 2 and Figure 7). Conversely, larger crabs generally occurred at depths less than 350 fm, and the CPUE of adult females always exceeded the CPUE of males ≥121 mm CL. Adult female CPUE was greatest in the four shallowest zones (50-249 fm) while males ≥121 mm CL reached highest CPUE in the 200 to 349 fm zone. In the 50-349 fm depth range, the CPUE for prerecruit one males was double that of recruit males, and CPUE for recruit crabs was triple that of postrecruits.

A more detailed view of golden king crab depth distribution is gained by examining sex-size groups using box plots (Figures 8-13). Most crabs were caught between 100 and 450 fm (Figure 7); however, the highest CPUE of crabs occurred in the somewhat narrower depth range of 200 to 450 fm (Figure 9). Box plots of legal male and adult female catches by depth zone are quite similar, with most crabs occurring in depth zones of 50 to 350 fm (Figures 10 and 11). The distribution of sublegal males and juvenile females is generally highest at greater depths, from 200 to 550 fm (Figures 12 and 13). The distribution of all sex-size groups of crabs overlapped at depth zones from 50 to 499 fm.

Size Distribution

Carapace length measurements were taken on 35,762 male and 37,280 female golden king crabs, resulting in a wide range in size distribution for both sexes (Figure 14). Males ranged in size from 23 to 190 mm CL with prominent modes around 70 mm and 110 mm CL. Legal male crabs comprised the smallest portion of the length distribution, while sublegal males dominated the distribution. The two largest female size modes were identical to males (70 mm and 110 mm CL); females ranged in size from 22 mm to 165 mm CL.

Crabs Tagged and Preliminary Tag Returns

A total of 9,762 golden king crabs were tagged and released on the survey. Most of the tagged crabs were sublegals (4,678), followed by legals (2,943), adult females (1,611), and juvenile females (530)(Table 1). Distribution of tagging effort by sex-size class for each station where tagging occurred is shown in Table 1 and Figure 15. Tagging goals for prerecruit ones and legal-sized males were generally maintained; 69 legal-sized crabs were not tagged due to their poor condition. At some stations sampled during August 15-25 prerecruit ones were tagged at ratios of 1:2 or 1:4. Females ≥90 mm CL and males 90-120 mm CL were primarily tagged at ratios of 1:3; however, these groups were tagged at a set number of crabs per station (i.e., 30, 10, 5, or none) in the last 22 stations surveyed. The remaining tags were saved to insure that all legal males captured could be tagged. During that same time period, prerecruit ones were also tagged at reduced ratios.

A total of 884 (9.1%) of the golden king crabs tagged in the 1997 survey were recovered in the commercial fishery east of 174° W longitude from September 1-November 24, 1997 (Table 3). Legal-sized crabs were recovered at a rate of 20.4% and recruits, which accounted for most of the legals tagged, were recovered at 19.2% rate. Sublegal crabs were recovered at 5.1%, with juvenile and adult female recovery rates at 1.3% and 2.4%., respectively (Table 3). Growth, changes in female reproductive conditions, and movement data will be reported following the 1998/99 Aleutian Islands commercial brown (golden) king crab fishery.

Shell Age Composition

Exoskelton ages were classified on 72,926 golden king crabs. Ninety-nine percent of the crabs were classified as having new-shell exoskeletons, with the new-hard category dominant in all sex-size groups (Table 4). Old and very old-shells accounted for the remaining 1% of the exoskeletons classified. No soft-shell crabs were captured on the survey. Legal males were the only group that had a significant amount (7.8%) of skip molt crabs.

Female Reproductive Condition

A logistic model was fit to the proportion of mature golden king crab females at a given carapace length from the sample of 37,130 females (Figure 16). The two parameters of the logistic curve were estimated to be $\beta_0 = -27.1962$ with a standard error of 0.3378 and $\beta_1 = 0.2548$ mm^{-1}, with a standard error of 0.0032 mm^{-1}. This produced a SM50 estimation of 106.7 mm, with a standard

error of 0.07866 mm. A 95% confidence interval for the estimated SM50 carapace length was 106.6 mm to 106.9 mm.

Nearly all of the females captured were examined for clutch fullness. Most (65%) females had only clean setae (Table 5). This group was composed predominantly of juveniles, had the lowest mean carapace length (83 mm), and were found at deeper depths than any other clutch size group. Females with hatched embryos (i.e., with only matted setae) had the largest mean size and composed about a third of all females with clutches. Females with hatching embryos comprised 58% of all females in the 1-29% clutch group. Of the females carrying embryos, the full clutch group was dominant.

Average carapace length of mature females and the depths they were captured in were similar regardless of the embryo or percentage clutch size categories (Table 5). Embryo colors were mostly orange (76% of the clutches); the remainder were tan. Embryo developments in most clutches were uneyed (60%), with lesser numbers eyed (37%) or hatching (3%). Clutches that had orange embryos were predominantly uneyed (78%), indicating early stages of embryo development. Conversely, tan colored clutches were more developed and had eyed embryos in 85% of the samples. Clutches that were batching only had tan colored, eyed embryos. Dead embryos were apparent in only 7% of the clutches; however, 6% of the clutches had <20% dead embryos, while clutches having >20% dead embryos were rare (1%).

Ovarian weights and carapace lengths were taken from a total of 338 female golden king crabs. Carapace lengths ranged from 80 to 151 mm and ovarian weights ranged from 0 to 86 g. Pearson's linear correlation coefficient, r, for carapace length versus ovarian weight was 0.5823 (Figure 17). Removing the ovary weights of 0 g from the analysis (as in Devore and Peck 1993) lowered the correlation value to $r = 0.4857$. Pearson's correlation was estimated for five clutch fullness categories and ovarian weights and was not highly correlated; crabs with hatching clutches had the highest correlation at $r = 0.6689$.

The correlation between carapace length, ovarian weight, and clutch fullness by four, 50 fathom depth zones ranging from 100 to 299 fm was also examined. Results were similar to those when using clutch categories instead of depths. Overall, there was little or no improvement in correlation when substituting depth zones for clutch fullness categories and only a few correlation estimates were greater than 0.60. The highest correlation was $r = 0.8394$ for barren females with only empty embryo cases (n=8) in the 250-299 fm depth zone.

Sublegal-Legal Size Overlap

Males with legal or sublegal carapace widths had carapace lengths that overlapped in the 117 mm to 159 mm CL range (Table 6). However, 90% of the overlap fell in a 10 mm range between 130 mm and 140 mm CL. Fifty-one percent of the 135-136 mm CL males were legal-sized. All males $\leq$ 116 mm CL were sublegal-sized and all males $\geq$ 159 mm CL were legal-sized.

Leatherbacks

One hundred and four leatherback male crabs were captured at 21 stations at depths ranging from 84 to 317 fm (Table 7). Most (82%) were encountered at depths greater than 200 fm. Legal-sized leatherback males totaled 101 crabs (82%) of those sampled. Shell-ages of leatherbacks were dominated by old-shell animals (75%), followed by new-shell-hard (14%) and very old-shells (11%). No females were observed with the leatherback condition.

Diseases and Symbionts

There were 482 golden king crabs (0.7% of those captured) that were infected with the parasitic barnacle *Briarosaccus callosus* as evidenced by the presence of externae or holes on the abdomen left by the externae. Male and female crabs were infected equally, and at similar sizes and depth zones (Table 8). Shell "rust" disease was recorded on 52 golden king crabs and occurred equally between sexes. One female (106 mm CL) was collected at station 116 due to the appearance of what looked like nemerteans (embryo predators) in the clutch; examination of the preserved clutch in the laboratory revealed at least one nemertean.

Ten male and ten female golden king crabs were dissected onboard the vessel either due to infestation of parasitic barnacles or because they had shell rust. Up to 17 tissues from each crab with parasitic barnacles and pieces of exoskeleton from one crab with shell rust were collected and preserved in 10% buffered formalin. The samples were sent to Dr. Frank Morado (NMFS pathologist, Seattle WA) for analysis; his findings (personal communication, March 4, 1998) were as follows:

> "Eighteen crabs were parasitized to varying degrees by the parasitic barnacle. In advanced cases, the barnacle's interna (invasive rootlike system within crab tissues) were located in the connective tissue of all organs and tissues, but interna were never found in the gills. Under these advanced circumstances, the interna could be found as far anterior as the brain and eye stalks and also in the heart. In less advanced cases, the internae were located around the thoracic ganglion, midgut, hindgut, hepatopancreas, bladder, and antennal gland. The ovaries of females were markedly changed; many ova appeared arrested in development and their cytoplasm was typically vacuolated. Male gonads were not collected.
>
> Under normal circumstances, a host response is not directed at the presence of interna. However, in three of the 18 cases, the interna showed signs of deterioration. Some of the interna were encapsulated and in one advanced instance, some of the interna were melanized by the host crab. A host response was not directed at all of the interna suggesting that the host may have been parasitized by more than one parasite or that there is differential deterioration of interna of senescent parasites.
>
> Shell disease (not shell rust) is the preferred label for a number of organisms that can attack crustacean exoskeletons. A piece of carapace from one golden king crab was collected and had a classical case of shell disease. The surface of the

lesion was marked by an intense and melanized hemocytic response. The lesion was limited to the surface, that is, the shallow hypodermis was primarily affected. The causative agent could not be identified, but historically, the cause is a mixture of bacterial and/or fungal organisms. Beneath the host response, a new epidermis was being formed."

Minnow Traps for Small Golden King Crabs

Golden king crabs were not captured in any of the minnow traps deployed at the 40 stations fished during 7/28-8/11. As a result, the experiment was discontinued half way through the survey. Amphipods were prevalent in the traps baited with herring and frequently ate holes through the muslin bait bags. One eelpout, one skate, and a few shrimp were also noted inside the minnow traps.

Miscellaneous Marine Life Captured

The number and estimated biomass of 40 taxa of miscellaneous species captured in the pots was relatively small compared to that of golden king crabs. The most common commercial fishes captured were Pacific cod *Gadus macrocephalus*, sablefish *Anoplopoma fimbria*, Greenland turbot *Reinhardtius hippoglossoides*, and Pacific halibut *Hippoglossus stenolepis* (Table 9). Other commercially important fish species included Atka mackeral *Pleurogrammus monopterygius*, walleye pollock *Theragra chalcogramma*, and several rockfish species. Lengths of all commercially important fish species were taken to the nearest centimeter. Noncommercial fish species included yellow Irish Lords *Hemilepidotus jordani*, rattails (Macrouridae), prowfish *Zaprora silenus*, skates (Rajiformes), and snailfish (Liparidae).

In addition to golden king crabs, other commercially valuable invertebrate species caught included scarlet king crabs *Lithodes couesi*, *Chionoecetes tanneri*, *Paralomis multispina* and Pacific octopus *Octopus dofleini*. Scarlet king crabs were the most numerous invertebrate captured incidental to golden king crabs (Table 9). They occurred at 13 stations and consisted of 320 (53%) females and 273 (47%) male; most of these crabs (74%) were captured at stations 146 and 147 located at the southeastern edge of the survey grid (Figure 1). Scarlet king crabs were encountered at depths ranging from 160 to 529 fm, though most (96%) were captured at depths ranging from 250 to 450 fm. Size and clutch data were recorded for females observed, but were not summarized for this report. Five female and three male scarlet king crabs were infested with *B. callosus* at an overall infection rate of 1%, similar to that found for golden king crabs on the survey.

Although macroscopic algae do not occur at any of the depths fished, the following dislodged drift algae came up in survey pots: brown algae (winged kelp *Alaria* sp., bull kelp *Nereocystis luetkeana*, *Desmarestia* sp.) and red algae (*Neoptilota* sp., *Constantinea simplex*, and *Odonthalia* sp.).

Ancillary Data Collections

A total of 19 crab were collected including golden and scarlet king crabs, *C. tanneri*, and *P. multispina*, for use as teaching aids in the Mandatory Observer Program. Crabs were selected based on sex, shell condition and presence of various symbionts. Several rolls of film were taken of various crabs, also for use in teaching.

Ten leeches were taken from golden king crabs and were sent to the U.S. National Museum, Washington, D.C. as part of a larger 1997 study on leech identification and distribution of various crabs in the Aleutian Islands and Bering Sea.

Live weights of golden king crabs could not be taken onboard even in calm weather as vessel movement affected proper weighing due to the sensitivity of the scale used (2 g interval). Durometer readings of golden king crab shell hardness were not made due to the unanticipated large volume of golden king crabs captured during the survey.

Bottom Temperatures

Hourly bottom temperature readings were retrieved from a single submersible temperature recorder deployed at 12 stations during the survey. Bottom temperatures ranged from a minimum of 2.9°C to a maximum of 6.4°C, with station averages ranging from 3.2°C to 5.2 (Table 10). Generally, as depth increased, temperature decreased.

Video

A two hour 16 mm video tape documenting the fishing methods, sorting the catch, tagging crabs, life onboard, and scenery was made during the survey and is on file at the Westward Regional ADF&G Kodiak office of the BSTF program.

DISCUSSION

The 1997 Aleutian Island golden king crab survey sampled only a small fraction of the habitat of that species throughout the Aleutians. Stations were sampled both east and west of 171°W longitude, the boundary line between the former Adak and Dutch Harbor King Crab Management Areas. The population of golden king crabs surveyed in the summer of 1997 appeared quite healthy and occurred over a broad (450 fm) depth range. Recruitment of crabs was strong over a wide size range for both sexes; occurring in most pots and stations fished. The capture rates of small golden king crabs were greater than those normally encountered on trawl or pot surveys for red or blue king crabs. Small crabs (juvenile females and prerecruit males $\leq$121 mm CL) occur at all depths whereas larger crabs become scarcer at depths > 250 fm. The high abundance of small crabs north of the Aleutian Islands may indicate that crab larvae tend to be swept north by net movements of waters from the Pacific Ocean to the Bering Sea through Amukta Pass and nearby Chagulak Pass (Favorite 1967).

Parasitic barnacles cause castration and reduce body growth in crabs (Hawkes et al. 1987). Their incidence on golden king crabs observed during the 1997 was quite low (<1%) and was similar to findings in 1991 from this area (Blau and Pengilly 1994). Other populations of golden king crab in Alaska and Canada have had incidence rates ≥30% (Sloan 1984; Hawkes et al. 1986).

There are several interesting comparisons among the 1991 and 1997 ADF&G surveys. The 1997 survey covered much of the same area although the exact station locations were different. The 1997 survey had five more charter days and two more vessel crewmen, larger pots (3.6 times the volume of 1991 pots) with smaller mesh, fished at deeper average depths, and tagged twice the number of crabs compared to the 1991 survey. Average soak times were similar between the two surveys. Overall CPUE was 104 crabs per pot in 1997 versus 21 in 1991. While CPUE of golden king crabs captured at nearly every size-sex category and at nearly every 50 fm depth zone was greater on the 1997 survey (due to the larger size of pots used), length frequencies of male and female crabs were strikingly similar in the two surveys. This may indicate that recruitment of golden king crabs over time is relatively stable, unlike red king crabs where recruitment can be irregular (Blau 1986).

The 1997 Aleutian Islands golden king crab tagging survey, combined with 100% mandatory observer coverage aboard commercial vessels during the ensuing 1997/98 fishery, provided a unique opportunity to maximize recoveries of tagged crabs. Tag recovery rates during the two commercial seasons following the 1991 tagging survey were less than half for female, sublegal, and legal crabs (Blau and Pengilly 1994) than 1997 tag recovery rates for those same groups. Low recovery rates during the 1991/92 and 1992/93 seasons are probably attributable to the lack of required observers on catcher vessels; at that time, observers were only required on catcher and floating processors in that fishery.

The federal Fishery Management Plan for the Aleutian Islands golden king crab fishery mandates that the annual fishing mortality on mature males must not exceed 0.3 (or a 25% exploitation rate) (McKean 1991). Mature males are defined as those males ≥ 121 mm CL (Otto and Cummiskey 1985). Using the tag recovery rate from the 1997 fishery as a direct estimate for the legal harvest rate, the estimated exploitation rate for mature males east of 174° W longitude during the 1997 fishery was 7.9%. That estimate was calculated by multiplying the tag recovery rate of legal male crabs estimated from tagged crab recoveries during the 1997 fishery (20.4%) by the percentage of mature males that were legal-sized in survey catches (3,012 legals/7,790 mature males or 38.7%). Harvest rate estimates of legal males should be considered a minimum estimate as some captured tagged crabs were not recovered by observers while at sea. Mortality caused by tagging is an additional, unquantified factor that can make tag recovery rates an underestimate of the true harvest rate of crabs (Blau and Pengilly 1994). Application of the tag recovery rate as a harvest rate estimate is also difficult due to the relatively small size of the survey area compared to the range of the fishery and wide distribution of the golden king crab population throughout the Aleutian Islands (Area 'O').

This was the first of a continuing series of triennial golden king crab surveys to be carried out in this area and will serve as a baseline with which to compare future survey findings and ongoing commercial catch and observer data collected from this fishery. The next ADF&G survey in this area will be in the year 2000. Ideally, surveys on commercially exploited king crab stocks should

be annual. Triennial golden king crab surveys are a first step in that direction, even though the area surveyed is estimated to be only 4%-8% of the golden king crab habitat in the Aleutians (Blau 1987; Blau and Pengilly 1994). The 1991 and 1997 surveys have added to knowledge regarding the distribution of golden king crabs by size, sex and depth zone. Moreover, the surveys have provided preliminary estimates of golden king crab exploitation rates, female size at maturity, recruitment to legal size, growth, and crab movements over time. Future triennial surveys, in addition to analyses of tagged golden king recoveries will provide an index to gauge population fluctuations and recruitment changes occurring across various sex/size groups. The combined cooperative efforts of ADF&G biologists, commercial fishermen, and observers will continue to lead towards a better understanding of golden king crabs and man's utilization of them.

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Table 1. Fishing locations, effort and catch, and tag summaries from the 1997 Aleutian Islands golden king crab *Lithodes aequispinus* survey conducted by the Alaska Department of Fish and Game.

Station	Date Retrieved	No. Pots	Mean Soak (Days)	N-Latitude Deg.	N-Latitude Min.	W-Longitude Deg.	W-Longitude Min.	Depth Min.	Depth Max.	Depth Avg.	Males Legals No.	Males Legals Tagged	Males Sublegals No.	Males Sublegals Tagged	Females Adults No.	Females Adults Tagged	Females Juveniles No.	Females Juveniles Tagged	Totals Tagged	Totals Crabs
1	8/12,13	9	2.2	53	.00	171	8.45	442	529	480	0	0	1,058	5	0	0	1,326	9	14	2,384
2	8/10	10	2.0	53	.00	170	28.23	230	271	249	64	55	2,152	114	498	24	1,332	0	193	4,046
9	8/15	9	2.0	52	55.00	171	23.13	225	316	266	92	90	1,150	327	431	0	251	0	417	1,924
10	8/15	10	2.0	52	55.00	171	16.58	146	150	147	34	33	372	107	394	8	187	2	150	987
11	8/13	10	3.0	52	55.00	171	9.04	147	163	155	32	32	527	108	362	5	408	5	150	1,329
12	8/13	10	3.0	52	55.00	171	1.28	370	398	380	1	1	1,538	9	1	1	1,518	14	25	3,058
13	8/10	10	2.0	52	55.00	170	43.59	478	484	482	0	0	886	5	1	0	633	0	5	1,520
14	8/9,10	10	2.3	52	55.00	170	36.28	344	365	354	3	3	1,752	7	2	1	1,851	0	11	3,608
15	8/10	10	2.0	52	55.00	170	28.15	134	157	143	19	19	262	65	120	17	134	9	110	535
16	8/9	10	2.0	52	55.00	170	20.01	120	122	120	27	27	290	71	23	4	76	5	107	416
21	8/22	10	4.0	52	50.00	171	32.73	128	133	131	50	49	476	61	1,428	0	384	0	110	2,338
22	8/15	10	2.0	52	50.00	171	24.81	102	105	103	34	34	391	80	650	7	358	3	124	1,433
23	8/17	10	2.0	52	50.05	171	17.12	89	91	90	39	38	698	55	403	5	249	0	98	1,389
24	8/14	10	2.0	52	50.00	171	8.92	109	135	120	30	28	664	131	72	5	194	5	169	960
25	8/13	10	2.0	52	50.01	171	.66	384	440	413	8	5	2,471	40	14	2	2,422	8	56	4,916
26	8/12	10	2.0	52	50.00	170	52.40	396	423	409	1	1	1,107	11	1	0	1,114	1	13	2,223
27	8/12	10	2.0	52	50.02	170	44.58	282	298	291	82	80	278	114	20	7	52	3	204	432
28	8/10	10	2.0	52	50.00	170	36.20	209	217	214	71	70	709	168	642	91	445	30	359	1,867
29	8/8	10	2.0	52	50.00	170	28.63	116	124	119	15	15	104	50	76	6	13	0	71	208
30	8/9	10	2.0	52	50.00	170	19.93	132	147	139	44	44	434	220	7	1	0	0	265	485
37	8/22	9	4.0	52	45.00	171	33.04	84	101	91	31	29	346	56	716	0	126	0	85	1,219
38	8/17	9	2.0	52	45.01	171	22.45	86	90	88	15	15	273	22	541	5	159	0	42	988
39	8/17	10	2.0	52	45.01	171	17.06	88	94	90	10	10	513	25	328	4	211	1	40	1,062
40	8/14	10	2.0	52	45.02	171	8.77	290	310	300	23	22	2,131	50	17	3	1,702	7	82	3,873
41	8/13	10	2.0	52	45.00	171	.29	385	399	390	2	2	51	9	1	1	68	1	13	122

-Continued-

Table 1. (page 2 of 3)

Station	Date Retrieved	No. Pots	Mean Soak (Days)	N-Latitude		W-Longitude		Depth			Males				Females				Totals	
											Legals		Sublegals		Adults		Juveniles			
				Deg.	Min.	Deg.	Min.	Min.	Max.	Avg.	No.	Tagged	No.	Tagged	No.	Tagged	No.	Tagged	Tagged	Crabs
42	8/11	10	2.0	52	45.00	170	52.35	275	288	281	90	90	114	64	20	3	19	1	158	243
43	8/11	9	2.0	52	45.00	170	44.81	168	185	178	11	11	112	33	155	19	57	6	69	335
44	8/8	10	2.0	52	45.00	170	36.10	90	92	90	0	0	0	0	0	0	0	0	0	0
45	8/7	10	2.0	52	45.00	170	28.04	180	211	198	12	12	27	16	4	2	1	0	30	44
46	8/7	10	2.0	52	45.00	170	19.82	96	128	114	1	1	0	0	0	0	0	0	1	1
55	8/24	10	2.0	52	40.00	171	25.51	304	312	309	70	70	805	56	231	0	89	0	126	1,195
56	8/22	10	8.0	52	40.00	171	16.54	215	217	215	101	99	2,758	83	388	0	1,560	0	182	4,807
57	8/19	10	5.0	52	40.00	171	8.21	314	317	315	38	38	1,278	22	51	0	1,452	0	60	2,819
58	8/16	10	2.0	52	40.00	171	.91	281	289	284	56	56	643	113	22	1	619	9	179	1,340
59	8/16	10	2.0	52	40.02	170	52.43	100	128	114	37	37	23	23	37	9	1	1	70	98
60	8/7	10	2.0	52	40.00	170	27.89	106	149	130	58	57	51	48	0	0	0	0	105	109
61	8/7	10	2.0	52	40.00	170	20.48	153	198	176	59	59	22	18	11	2	2	0	79	94
70	8/25	10	3.0	52	35.00	171	25.50	229	240	232	46	46	364	32	334	0	160	0	78	904
72	8/23	10	7.0	52	35.00	171	0.49	290	303	298	291	291	584	57	103	0	226	0	348	1,204
73	8/18	10	2.0	52	35.04	170	52.60	81	100	92	0	0	0	0	0	0	0	0	0	0
74	8/7	10	2.0	52	35.00	170	28.96	132	151	141	63	61	100	81	4	1	0	0	143	167
75	8/4	10	2.0	52	35.00	170	20.61	168	204	197	34	34	22	10	16	3	0	0	47	72
92	8/4	10	2.0	52	30.00	171	25.14	177	214	192	33	32	103	14	212	0	39	0	46	387
94	8/25	10	2.0	52	30.00	171	0.40	226	229	227	46	46	104	13	12	0	15	0	59	177
95	8/27	10	2.0	52	30.00	170	53.10	170	197	183	91	89	157	95	907	25	52	5	214	1,207
96	8/6	10	2.0	52	30.00	170	45.07	79	81	80	23	23	10	10	0	0	0	0	33	33
97	8/6	10	2.0	52	30.00	170	36.91	138	139	138	42	42	57	45	1	1	0	0	88	100
98	8/4	10	2.0	52	30.00	170	28.81	161	169	165	34	32	85	45	185	20	16	0	97	320
99	7/30	10	2.0	52	30.00	170	19.77	134	166	142	52	45	48	28	365	115	6	3	191	471
115	8/26	9	2.0	52	25.04	171	24.87	156	189	174	35	35	157	74	436	22	174	8	139	802
116	8/25	10	2.0	52	25.01	171	8.78	153	193	174	71	71	170	102	709	25	44	5	203	994
117	8/25	10	2.0	52	25.00	171	0.76	237	241	238	34	34	81	5	7	0	44	0	39	166

-Continued-

Table 1. (page 3 of 3)

Station	Date Retrieved	No. Pots	Mean Soak (Days)	N-Latitude Deg.	N-Latitude Min.	W-Longitude Deg.	W-Longitude Min.	Depth Min.	Depth Max.	Depth Avg.	Males Legals No.	Males Legals Tagged	Males Sublegals No.	Males Sublegals Tagged	Females Adults No.	Females Adults Tagged	Females Juveniles No.	Females Juveniles Tagged	Totals Tagged	Totals Crabs
118	8/5	10	2.0	52	25.00	170	52.30	210	219	214	11	11	49	13	3	0	21	2	26	84
119	8/3,4	10	3.5	52	25.00	170	44.40	159	161	159	21	21	544	106	125	40	673	110	277	1,363
120	8/1	10	2.0	52	25.00	170	36.24	180	188	183	23	23	170	87	233	88	40	10	208	466
121	7/31	10	2.0	52	24.96	170	28.39	263	269	266	75	74	283	173	88	39	69	9	295	515
122	7/30	10	2.0	52	24.99	170	20.00	133	140	136	21	20	21	8	536	166	7	2	196	585
123	7/28	10	2.0	52	25.06	170	11.92	114	119	115	52	51	78	60	95	33	0	0	144	225
124	7/28	10	2.0	52	24.99	170	3.69	137	141	139	29	28	24	19	210	79	0	0	126	263
125	7/27	10	2.0	52	25.03	169	55.87	113	115	114	43	43	12	9	1	1	0	0	53	56
126	7/28	10	3.0	52	24.98	169	48.14	171	270	218	12	12	19	19	0	0	0	0	31	31
141	8/5	10	2.0	52	20.00	170	52.50	143	191	173	56	55	252	121	91	12	46	5	195	447
142	8/3	10	3.0	52	19.99	170	44.79	101	111	105	34	34	211	115	455	161	80	14	324	780
143	8/1,2	10	2.2	52	19.99	170	35.25	119	189	139	55	53	248	148	602	96	18	1	298	923
144	7/31	10	2.0	52	20.04	170	28.98	315	350	338	22	22	45	22	0	0	5	1	45	73
145	7/30	9	2.0	52	19.97	170	20.34	185	296	245	151	143	122	75	100	39	62	15	272	435
146	7/29	10	3.0	52	20.02	170	12.55	344	487	402	7	7	1	1	0	0	0	0	8	8
147	7/28	10	2.0	52	19.99	170	4.46	271	438	330	28	26	23	15	12	3	0	0	44	63
159	8/2,3	10	2.5	52	15.00	170	48.65	219	229	221	157	149	1,612	421	282	53	1,183	142	766	3,235
160	8/2	10	3.0	52	13.49	170	44.40	130	153	137	36	35	385	203	534	210	348	70	518	1,303
161	7/31	10	2.0	52	14.99	170	36.42	136	186	163	24	23	138	66	560	146	54	8	243	776
Totals:																				
71		703	2.2					79	529	358	3,012	2,943	32,745	4,678	14,885	1,611	22,395	530	9,766	73,042
Percent of Catch:											4.1		44.8		20.4		30.7			100
Overall Mean Catch Per Pot:											4.3		46.6		20.4		31.9			103.9

[a] Overall catch per pot figures are not standardized for different soak times used.

Table 2. Distribution of golden king crabs by 50 fathom depth groups from the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

Depths Fished (fm)	No. of Pots	Females				Prerecruit Males				Legal Males				Total Crabs	
		Juveniles		Adults		≤120 mm CL		Ones ≥121 mm CL		Recruits		Postrecruits			
		No.	CPUE[a]	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
50-99	67	697	10.4	1,687	25.2	1,357	20.3	403	6.0	106	1.6	7	0.1	4,257	63.5
100-149	207	1,771	8.6	5,714	27.6	2,845	13.7	1,296	6.3	649	3.1	134	0.6	12,409	59.9
150-199	135	1,664	12.3	3,973	29.4	1,948	14.4	672	5.0	452	3.3	133	1.0	8,842	65.5
200-249	96	3,992	41.6	2,202	22.9	5,607	58.4	1,124	11.7	512	5.3	164	1.7	13,601	141.7
250-299	69	2,670	38.7	822	11.9	3,840	55.7	710	10.3	447	6.5	173	2.5	8,662	125.5
300-349	49	3,237	66.1	371	7.6	4,070	83.1	535	10.9	275	5.6	92	1.9	8,580	175.1
350-399	41	3,886	94.8	6	0.1	3,858	94.1	21	0.5	19	0.5	2	<.1	7,792	190.0
400-449	20	2,944	147.2	12	0.6	2,860	143.0	18	0.9	6	0.3	1	0.1	5,841	292.1
450-499	15	1,301	87.6	0	0.0	1,350	90.0	0	0.0	0	0.0	1	0.1	2,652	176.8
500-549	4	233	58.3	0	0.0	229	57.3	0	0.0	0	0.0	0	0.0	462	115.5
Totals:	703	22,395	31.9	14,787	21.0	27,964	39.8	4,779	6.8	2,466	3.5	707	1.0	73,098	104.0

[a] CPUE means catch per unit effort. CPUE figures are not standardized to a specific soak time.

Table 3. Number of golden king crabs tagged on the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game and recoveries from the 1997/98 commercial fishery as of January 11, 1998.

Sex-Size Class	No. Tagged	Crabs Recovered	
		No.	Percent
	Males		
Sublegals	4,678	237	5.1
Legals			
Recruits	2,249	432	19.2
Postrecruits	694	57	8.2
Legals without shell age or lengths on recovery	N/A[b]	112	N/A
Total Legals:	2,943	601	20.4
Total Males:	7,621	838	11.0
	Females		
Juveniles	530	7	1.3
Adults	1,611	39	2.4
Total Females:	2,141	46	2.1
Total Crabs:	9,762	884	9.1

[a] N/A means not applicable.

Table 4. Classification of golden king crab exoskeletons from the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

Crab Sex/ Size Groups[a]	Exoskeleton Classification											
			New-Shell									
	Soft		Pliable		Hard		Old-Shell		Very Old-Shell		Totals	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Females												
Juveniles:	0	0.0	59	0.3	22,308	99.7	0	0.0	0	0.0	22,367	100.0
Adults:	0	0.0	35	0.2	14,771	99.8	2	<0.1	0	0.0	14,808	100.0
Males												
Sublegals:	0	0.0	74	0.2	32,513	99.3	147	0.4	6	0.1	32,740	100.0
Legals:	0	0.0	6	0.2	2,769	92.0	223	7.4	13	0.4	3,011	100.0
Grand Totals:	0	0.0	174	0.2	72,361	99.2	372	0.5	19	0.1	72,926	100.0

[a] There were 49 golden king crabs that did not have their shell ages recorded (28 juvenile and 15 adult females, five sublegal males, and one legal male).

Table 5. Embryo condition and percent clutch size of female golden king crabs from the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

Condition	No. of Females	Mean Carapace Length (mm)	Depth (fm) Mean	Minimum	Maximum
Embryo Color					
Orange	6,910	116	159	84	386
Tan	2,174	115	171	84	365
Embryo Development					
Uneyed	5,390	117	158	84	386
Eyed	3,403	115	166	84	385
Hatching	289	116	184	88	316
Dead Embryos					
Not Apparent	8,493	116	161	84	478
< 20 %	547	115	173	87	365
> 20%	60	113	187	121	307
Percent Clutch Size					
0% - Clean Setae	24,180	83	288	84	529
0% - Matted Setae	3,913	119	155	84	419
1 - 29% Full	499	115	176	85	317
30 - 59% Full	422	114	151	84	316
60 - 89 % Full	1,255	115	159	84	317
90 - 100 % Full	6,910	116	162	84	386

	Embryo Development		
Embryo Color	Uneyed	Eyed	Hatching
Orange	4,623	1,318	0
Tan	17	1,512	260

Table 6. Size overlap of sublegal and legal male golden king crabs from the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

Carapace Length (CL)[a]		Number of Crabs			Percent
(mm)	(in)	Sublegal	Legal	Total	Legal
117	4.68	412	1	413	0.2
118	4.72	390	2	392	0.5
119	4.76	309	2	311	0.6
120	4.80	407	0	407	0.0
121	4.84	325	1	326	0.3
122	4.88	400	2	402	0.5
123	4.92	379	1	380	0.3
124	4.96	360	2	362	0.6
125	5.00	376	2	378	0.5
126	5.04	263	3	266	1.1
127	5.08	362	4	366	1.1
128	5.12	281	2	283	0.7
129	5.16	290	5	295	1.7
130	5.20	296	14	310	4.5
131	5.24	222	16	238	6.7
132	5.28	254	30	284	10.6
133	5.32	232	50	282	17.7
134	5.36	196	84	280	30.0
135	5.40	140	108	248	43.5
136	5.44	85	122	207	58.9
137	5.48	91	181	272	66.5
138	5.52	42	159	201	79.1
139	5.56	27	155	182	85.2
140	5.60	15	173	188	92.0
141	5.64	6	131	137	95.6
142	5.68	6	142	148	95.9
143	5.72	6	156	162	96.3
144	5.76	6	109	115	94.8
145	5.80	3	136	139	97.8
146	5.84	0	94	94	100.0
147	5.88	3	121	124	97.6
148	5.92	1	105	106	99.1
149	5.96	2	72	74	97.3
150	6.00	2	82	84	97.6
151	6.04	0	63	63	100.0
152	6.08	4	61	65	93.8
153	6.12	0	64	64	100.0
154	6.16	1	59	60	98.3
155	6.20	2	52	54	96.3
156	6.24	2	35	37	94.6
157	6.28	1	39	40	97.5
158	6.32	1	58	59	98.3
159	6.36	1	34	35	97.1
Total		6,201	2,732	8,933	

[a] All male golden king crabs ≤ 116 mm CL had sublegal widths; all male golden king crabs ≥ 159 CL had legal widths.

Table 7. Size and shell age distribution of leatherback golden king crabs from the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

Carapace	Shell Age			
Length (mm)	New-Hard	Old	Very Old	Total
103	0	1	0	1
123	0	1	0	1
124	0	1	0	1
125	1	0	0	1
131	0	1	0	1
132	0	1	0	1
133	0	2	1	3
134	0	1	0	1
135	0	2	0	2
136	0	1	0	1
137	0	1	0	1
138	0	1	0	1
139	0	3	1	4
140	1	2	0	3
141	0	1	1	2
142	1	4	0	5
143	0	4	0	4
144	1	3	0	4
145	3	1	0	4
146	1	2	0	3
147	0	4	0	4
148	0	7	0	7
149	0	5	0	5
150	0	5	0	5
151	1	4	0	5
152	0	3	0	3
153	1	3	1	5
154	1	1	0	2
155	0	2	2	4
156	0	1	0	1
157	1	2	0	3
158	1	1	1	3
159	0	1	0	1
161	0	0	2	2
162	0	2	0	2
163	1	0	1	2
164	0	1	1	2
166	0	1	0	1
167	0	1	0	1
172	1	0	0	1
184	0	1	0	1
Totals:	15	78	11	104

Table 8. Number of golden king crabs infected by the parasitic barnacle *Briarosaccus callosus* from the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

Host Sex	No. Parasitized	Carapace Length (mm)			Depth (fm)		
		Average	Minimum	Maximum	Average	Minimum	Maximum
Male	273	84	60	143	293	87	518
Female	209	89	56	129	283	90	500
Combined:	482	86	56	143	289	87	518

Table 9. Miscellaneous species captured during the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

Common Name	Taxa	Total Catch
Scarlet king crab	*Lithodes couesi*	604
Grooved Tanner crab	*Chionoecetes tanneri*	16
Paralomis crab	*Paralomis multispina*	1
Hermit crabs unident.	Paguridae	1
Arctic lyre crab	*Hyas coarctatus*	1
Lyre crab unident.	*Hyas* sp.	1
Tank shrimp	*Sclerocrangon boreas*	1
Shrimp spp.		NC[a]
Hard and soft corals (5-10 unident. species)	Anthozoa	NC
Golden coral	*Callogorgia* sp.	NC
Red tree coral	*Primnoa willeyi*	NC
Kamchatka coral	*Paragorgia arborea*	NC
Coral bryozoan	*Cellepora ventricosa*	NC
Sea whip	Coelenterates	NC
Hydroids (5-10 unident. species)	Hydrozoa	NC
Moss animals (5-10 unid. species)	Bryozoans	NC
Sea squirts (5-10 unid. species)	Tunicates	NC
Sea blob unident.	*Synoicum* sp.	NC
Sponge unident. (5-10 unid. species)	Porifera	NC
Basket star	*Gorgonocephalus caryi*	NC
Basket star	*Gorgonocephalus eucnemis*	NC
Black spined sea star	*Lethasterias nanimensis*	NC
Sea star	*Henricia* sp.	2
Starfish unident.	Asteroidea	4
Brittle star unident.	Ophiuroidea	1
Sea urchins (2 unident. species)	Echinoidea	5
Bay scallop unident.	*Chlamys* sp.	NC
Hairy triton	*Fusitriton oregonensis*	NC
Stearn's volute	*Arctomelon stearnsii*	NC
Neptune snail	*Neptunea insularis*	14
Pacific octopus	*Octopus dolfeini*	7

-Continued-

Table 9. (page 2 of 2)

Common Name	Taxa	Total Catch
Walleye pollock	*Theragra chalcogramma*	5
Sablefish (blackcod)	*Anoplopoma fimbria*	491
Pacific cod	*Gadus macrocephalus*	1,394
Rockfish unident.	Scorpaenidae	28
Longspine thornyhead	*Sebastolobus altivelis*	2
Flatfish unident.		1
Pacific halibut	*Hippoglossus stenolepis*	150
Turbot, Greenland halibut	*Reinhardtius hippoglossoides*	180
Arrowtooth flounder	*Atheresthes stomias*	4
Rattails unident.	Macrouridae	30
Atka mackerel	*Pleurogrammus monopterygius*	8
Prowfish	*Zaprora silenus*	6
Snailfish unident.	Liparidae	7
Sculpins unident.	Cottidae	49
Yellow Irish lord	*Hemilepidotus jordani*	10
Skate, ray unident.	Rajiformes	7
Unidentified fish		5

[a] NC = not counted.

Table 10. Bottom temperatures at various stations fished during the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

Station	Sequential Pot No.	Date Set	Time Set	Date Up	Time Up	No. Hourly Readings	Depth (fm)	Temperature (°C) Avg.	Min.	Max.
124	25	7-26	00:11	7/28	00:43	48	140	4.7	4.3	5.1
145	85	7-28	07:57	7/30	17:49	57	250	3.7	3.6	3.9
143	139	7-30	21:46	8/1	22:24	49	120	4.4	4.0	5.0
75	198	8-2	03:40	8/4	23:03	67	199	4.2	3.5	4.7
46	256	8-5	01:06	8/7	01:51	48	125	4.7	4.4	5.0
16	325	8-7	03:39	8/9	03:27	48	120	4.5	4.5	4.6
43	396	8-9	07:48	8/11	13:04	53	177	3.2	2.9	3.6
25	465	8-11	16:02	8/13	22:26	53	411	3.2	2.9	3.6
58	537	8-14	01:41	8/16	02:35	49	287	3.2	2.7	3.6
73	596	8-16	05:51	8/18	18:00	60	99	5.2	4.4	6.4
92	636	8-22	10:28	8/24	08:23	46	183	4.5	4.1	4.9
115	696	8-24	09:53	8/26	18:27	57	180	4.4	3.9	5.6

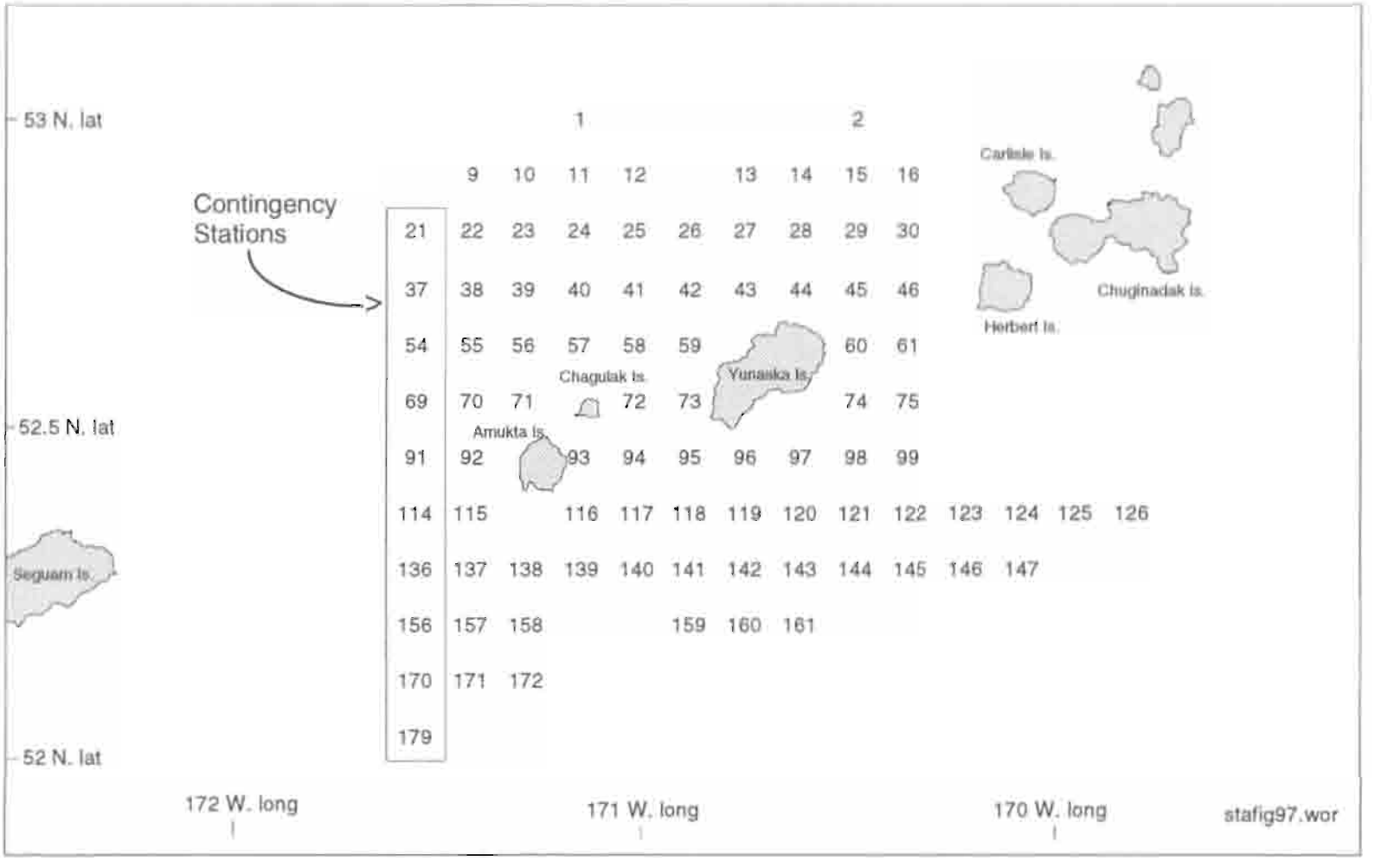

Figure 1. Layout of the 89 stations fished on the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

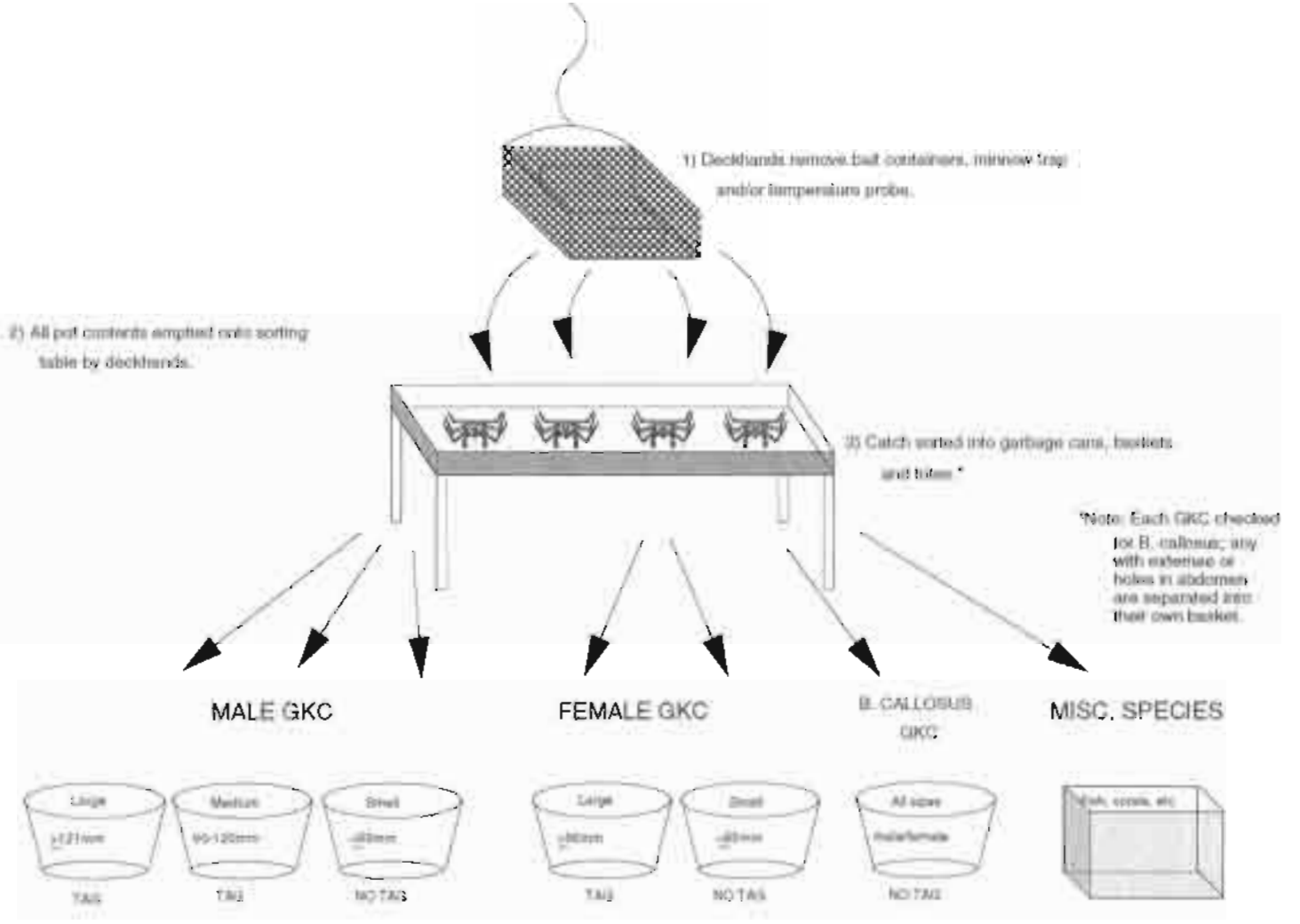

Figure 2. Catch sorting on the 1997 Aleutian Islands golden king crab (GKC) survey conducted by the Alaska Department of Fish and Game.

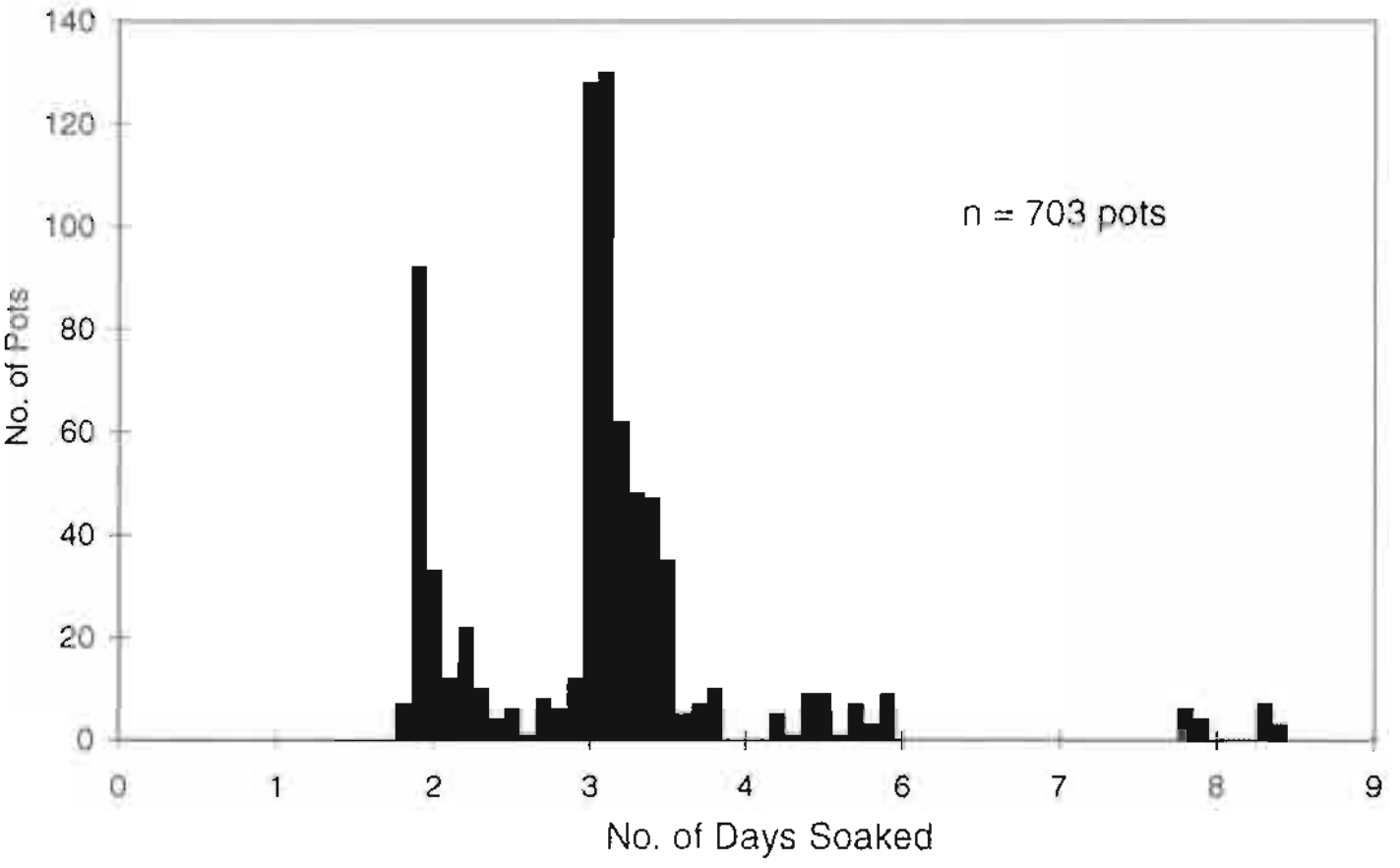

Figure 3. Frequency distribution of the soak time for king crab pots fished on the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

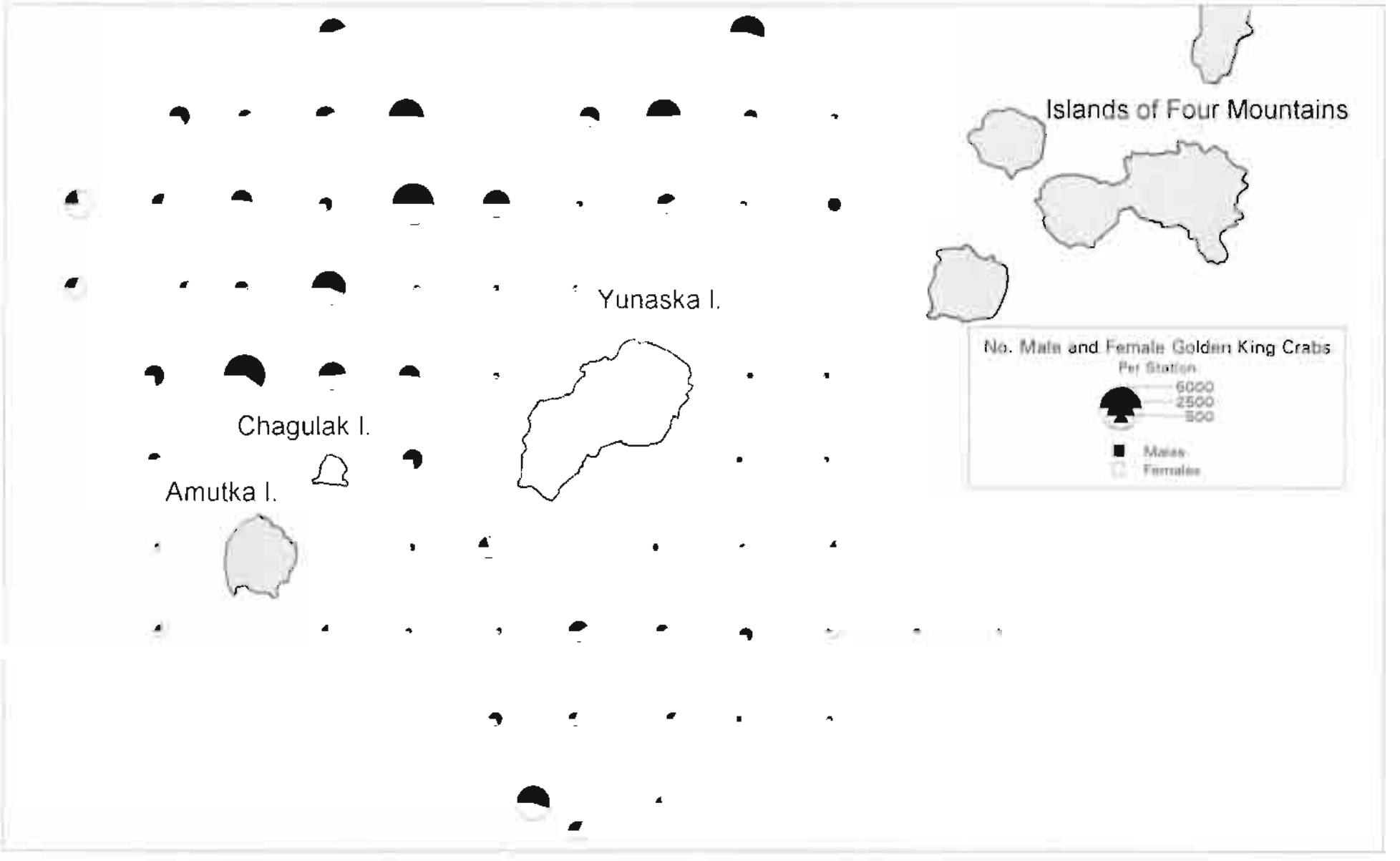

Figure 4. Male and female golden king crabs per station on the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

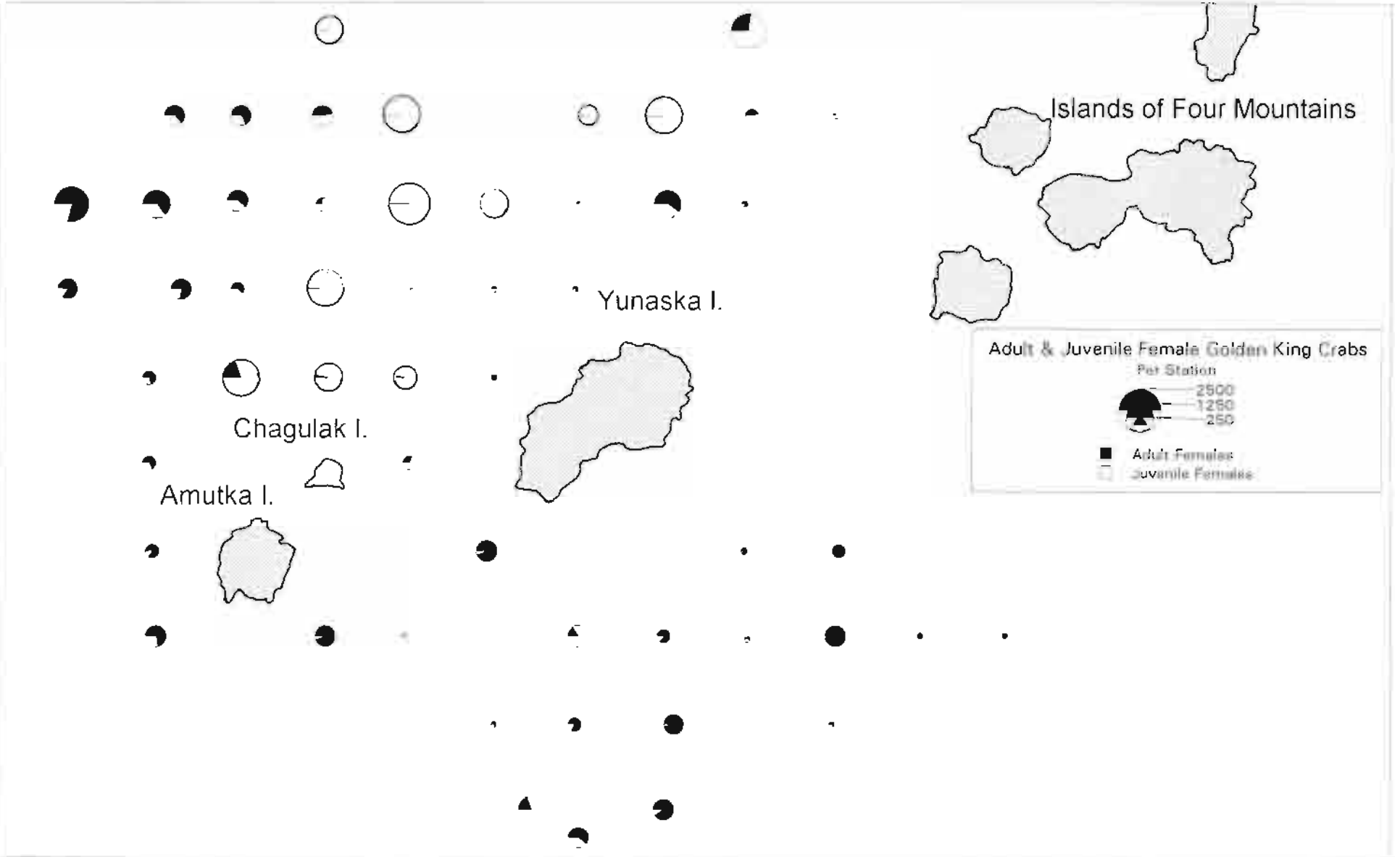

Figure 5 Adult and juvenile female golden king crabs per station on the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

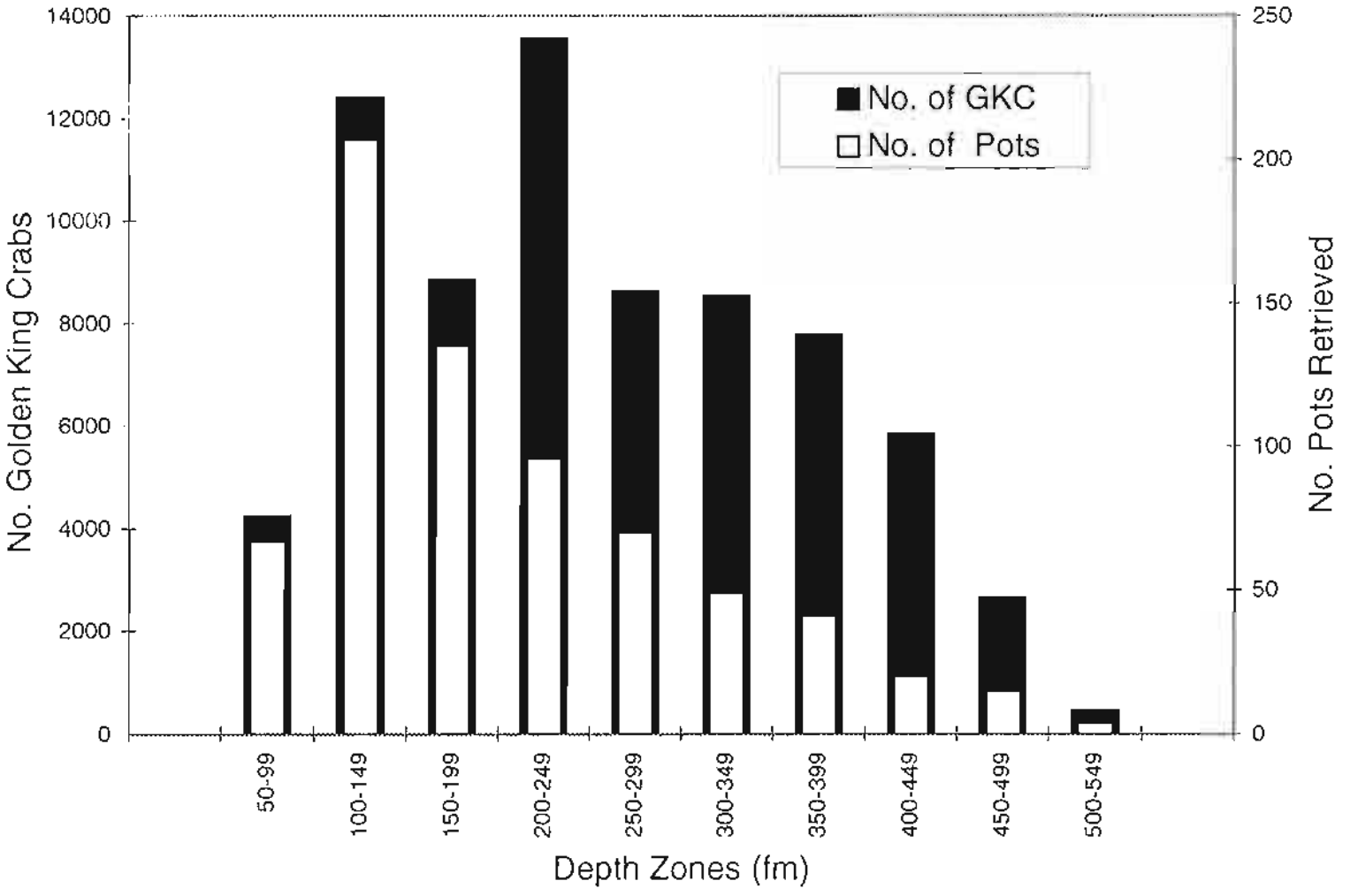

Figure 6. Number of golden king crabs captured compared to the number of pots retrieved by depth zones from the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game. Minimum and maximum depths fished were 79 and 529 fathoms, respectively.

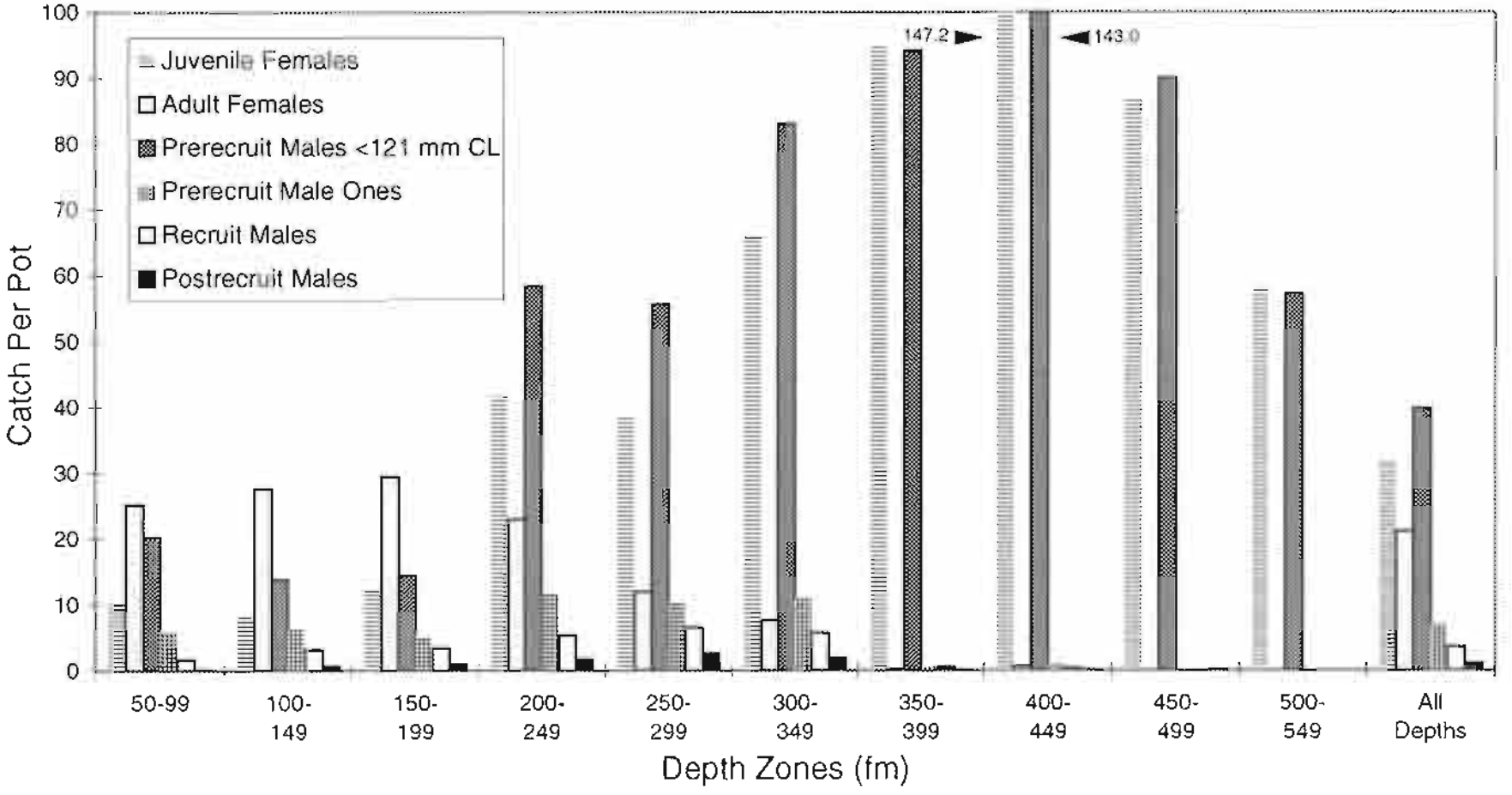

Figure 7. Catch per pot of various size and sex categories of golden king crabs by 50 fathom depth zones from the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

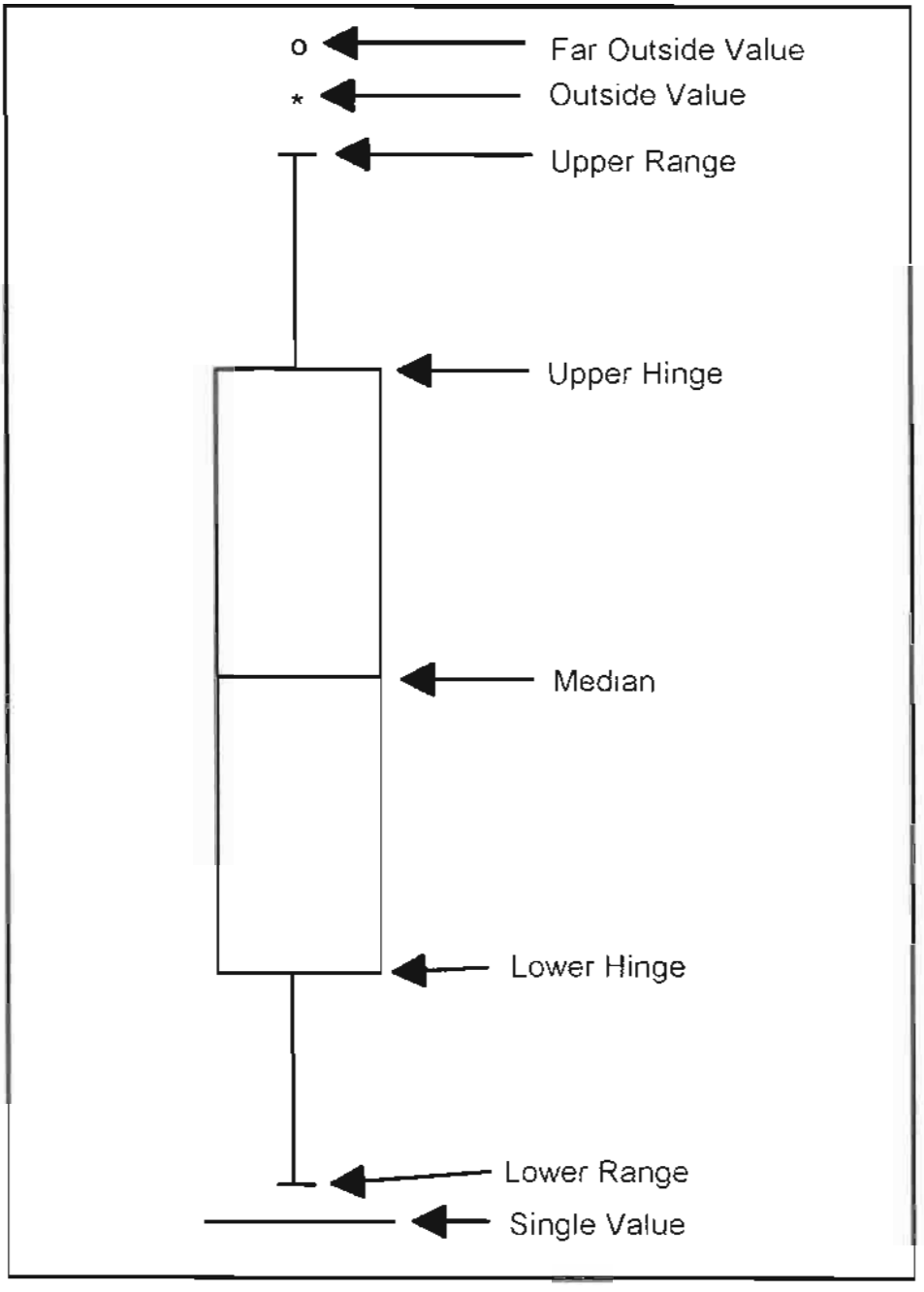

Figure 8. Characteristics of box plots: *median* is the midpoint of all data values; *upper hinge* is the midpoint between the median and maximum value; *lower hinge* is the midpoint between the median and the minimum value. Outside and far outside values denote outlying values atypically far from the median.

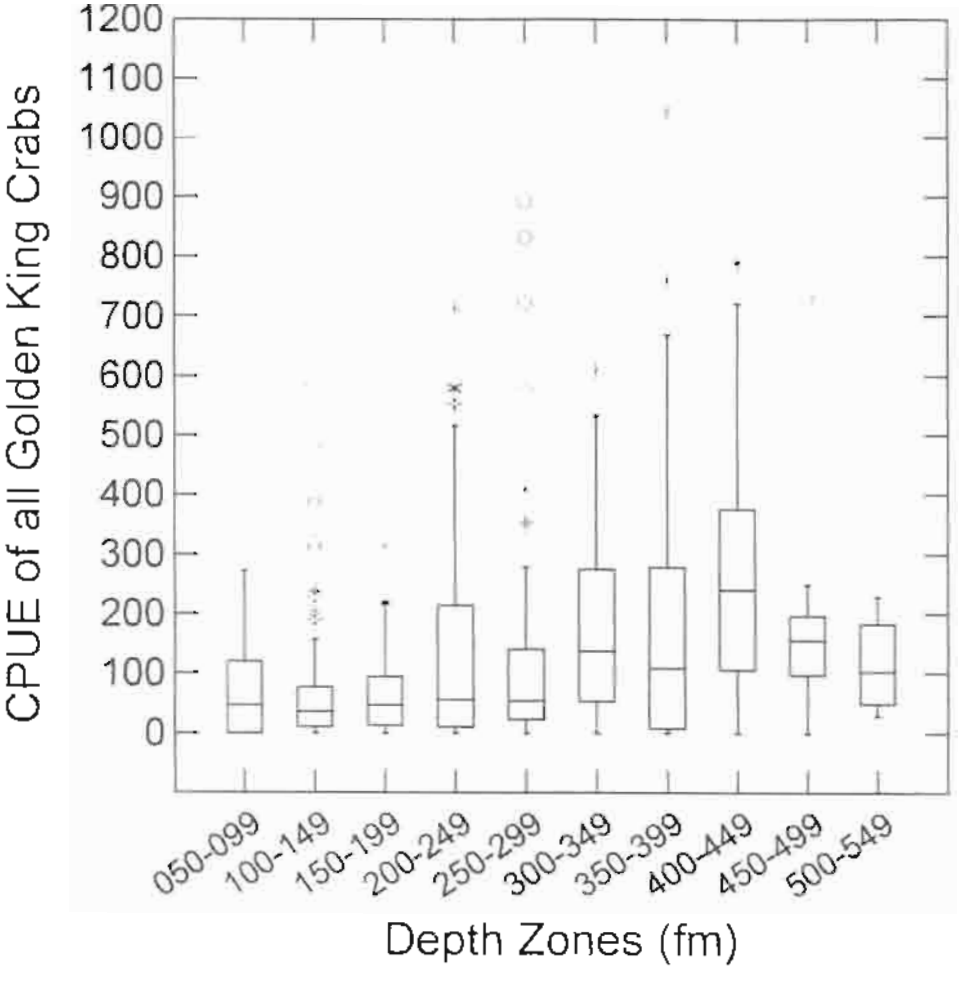

Figure 9. Box plots of the CPUE of all golden king crabs by depth zones from the 1997 Aleutian Islands survey conducted by the Alaska Department of Fish and Game.

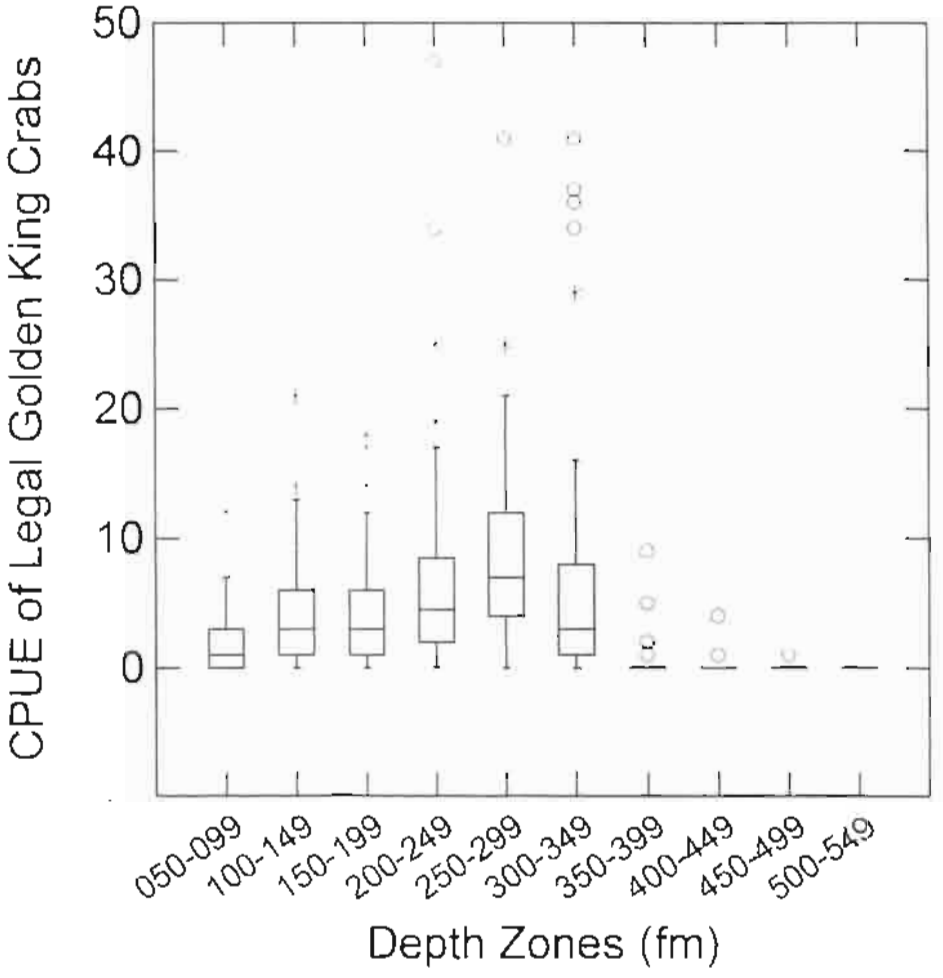

Figure 10 Box plots of the CPUE of legal male golden king crabs by depth zones from the 1997 Aleutian Islands survey conducted by the Alaska Department of Fish and Game. A single bar indicates that all pots in a depth zone caught the same number of crabs.

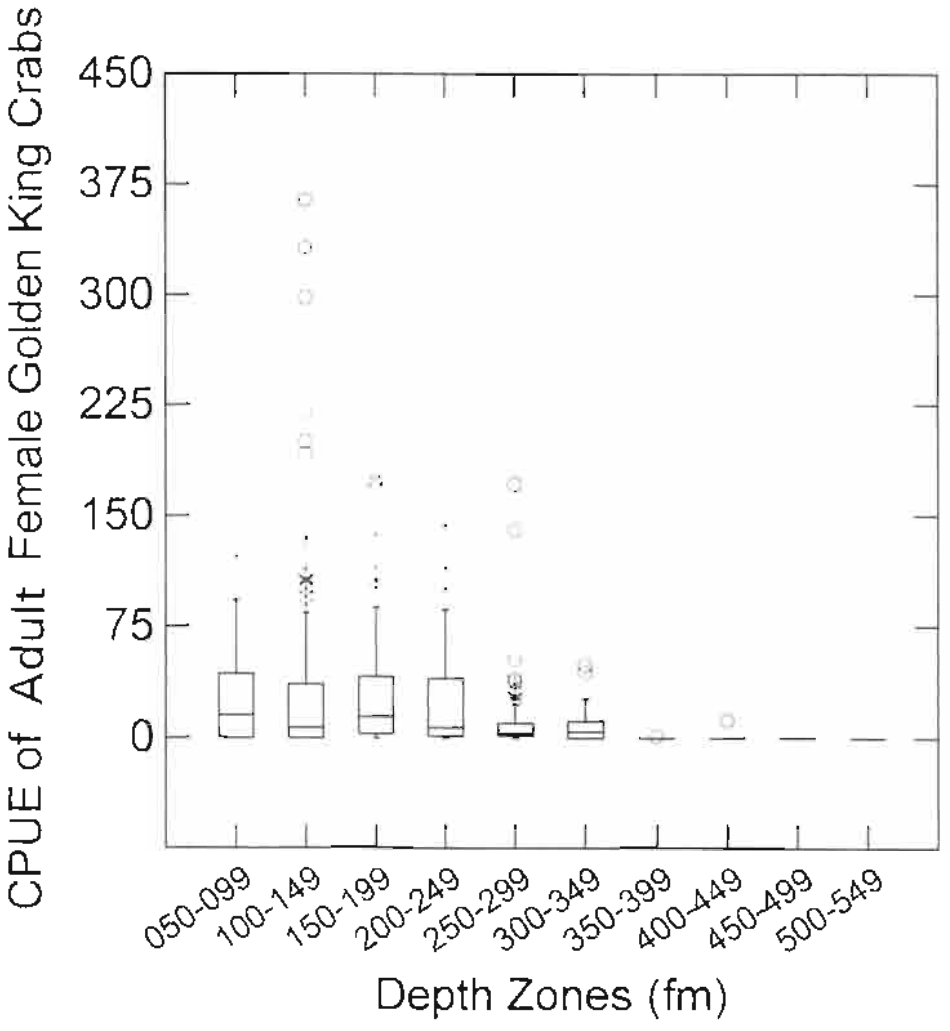

Figure 11. Box plots of the CPUE of adult female golden king crabs by depth zones from the 1997 Aleutian Islands survey conducted by the Alaska Department of Fish and Game. A single bar indicates that all pots in a depth zone caught the same number of crabs.

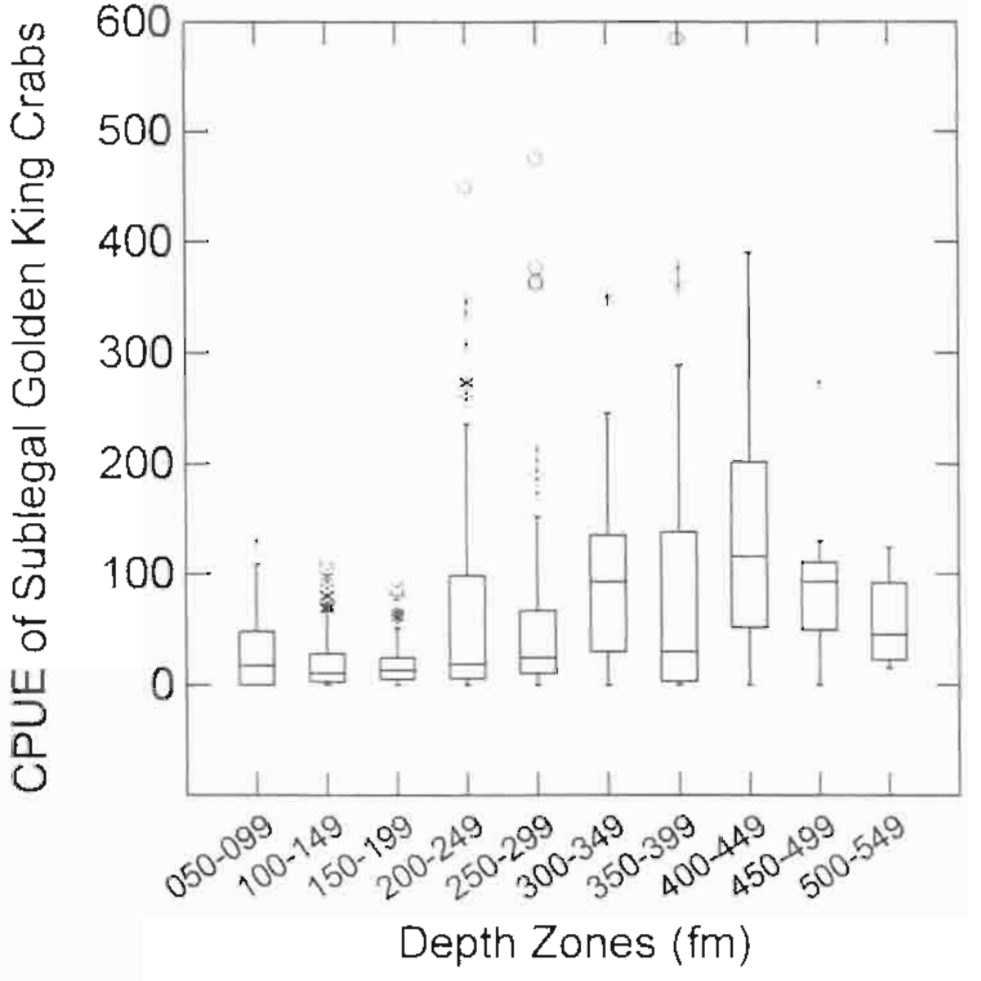

Figure 12. Box plots of the CPUE of sublegal male golden king crabs by depth zones from the 1997 Aleutian Islands survey conducted by the Alaska Department of Fish and Game.

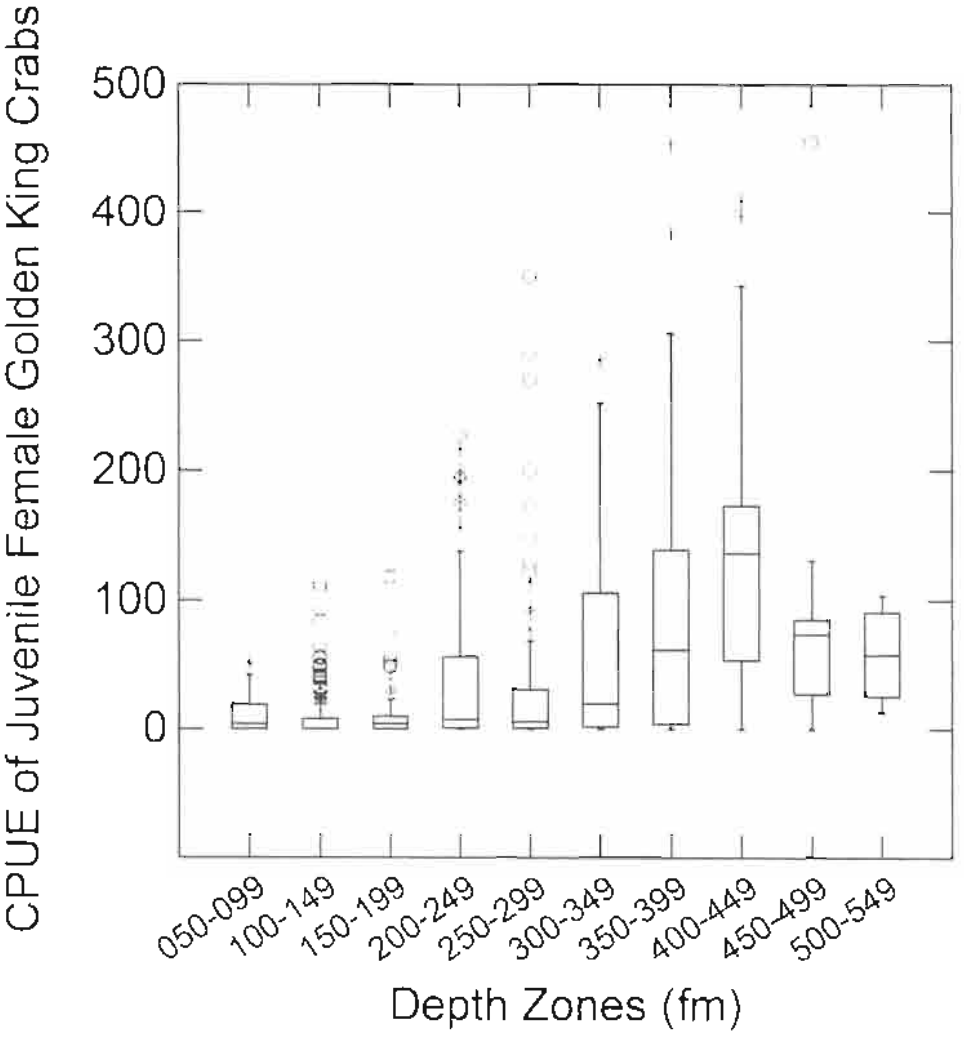

Figure 13. Box plots of the CPUE of juvenile female golden king crabs by depth zones from the 1997 Aleutian Islands survey conducted by the Alaska Department of Fish and Game.

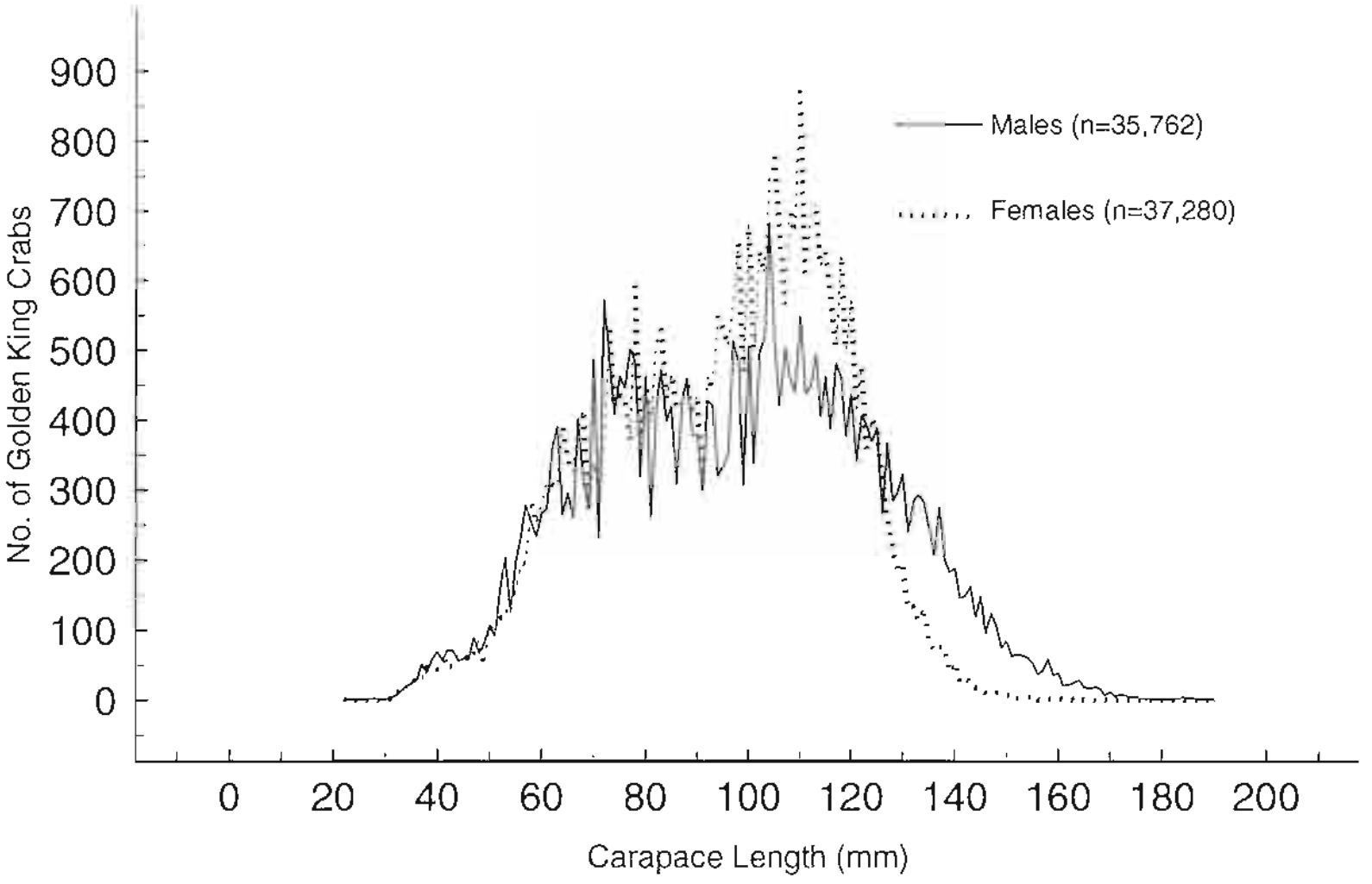

Figure 14. Carapace length frequency distribution of male and female golden king crabs from the 1997 Aleutian Islands survey conducted by the Alaska Department of Fish and Game.

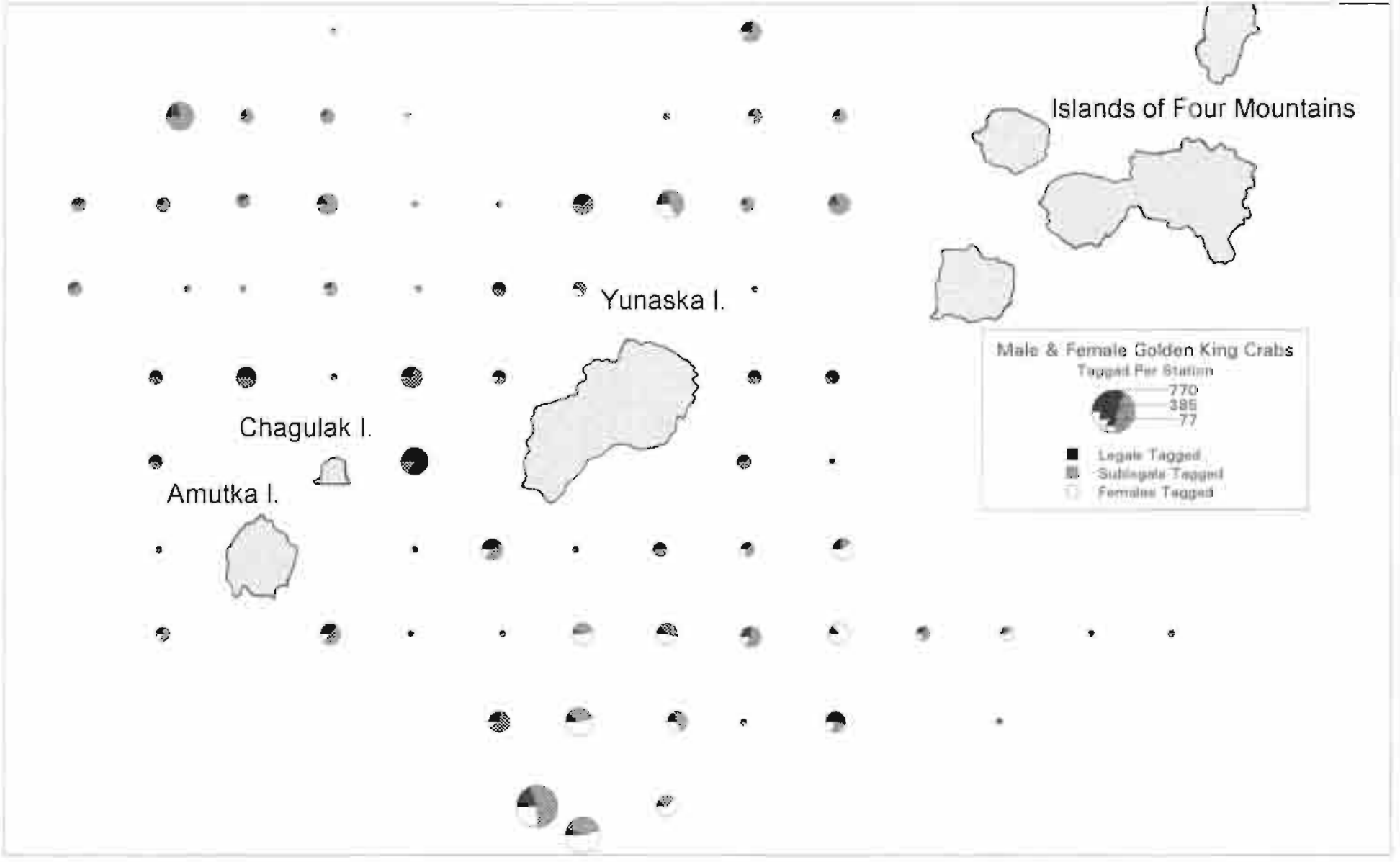

Figure 15. Legal, sublegal and female golden king crabs tagged per station on the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Depatment of Fish and Game

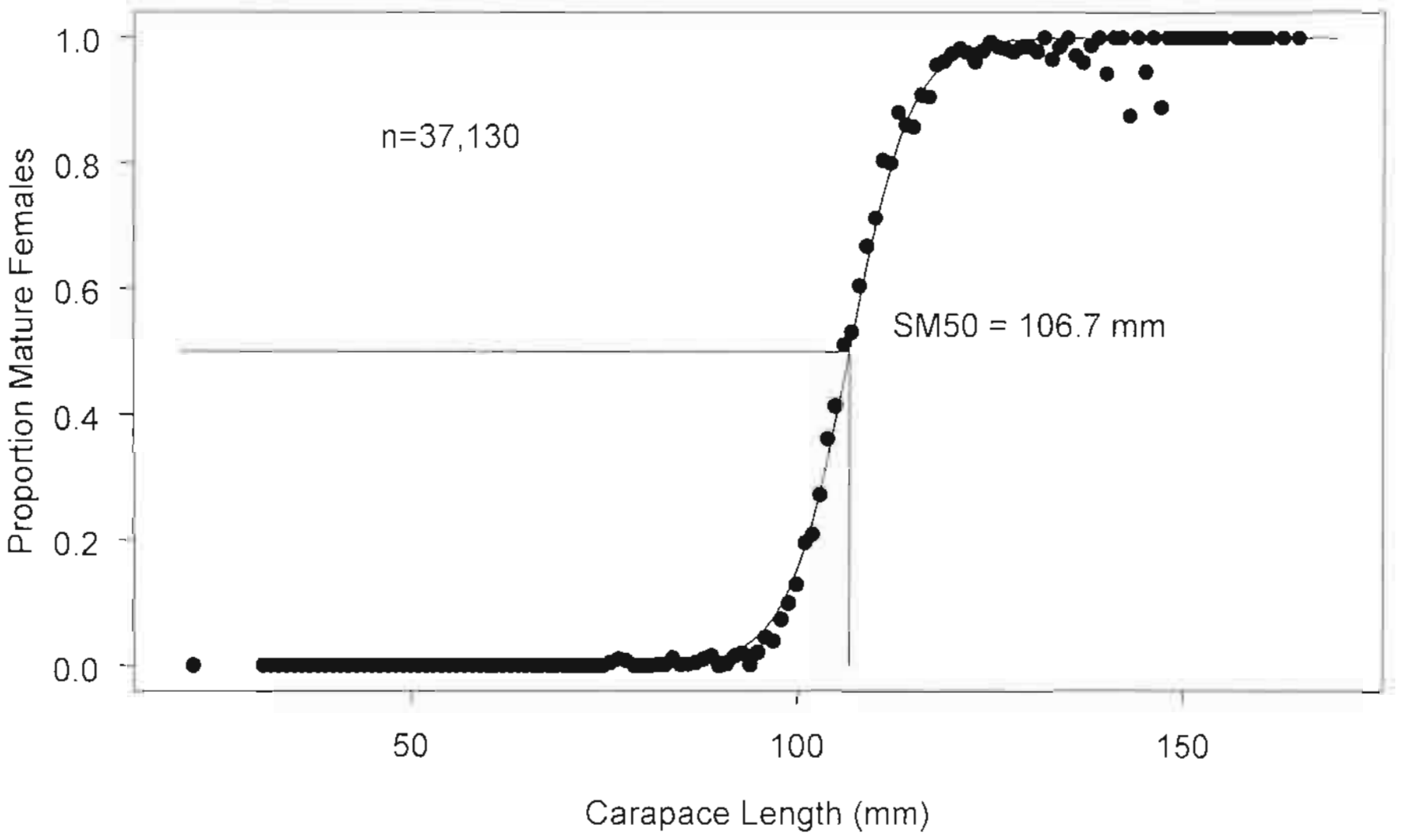

Figure 16. Logistic curve and size at 50% maturity (106.7 mm CL) for female golden king crabs captured during the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

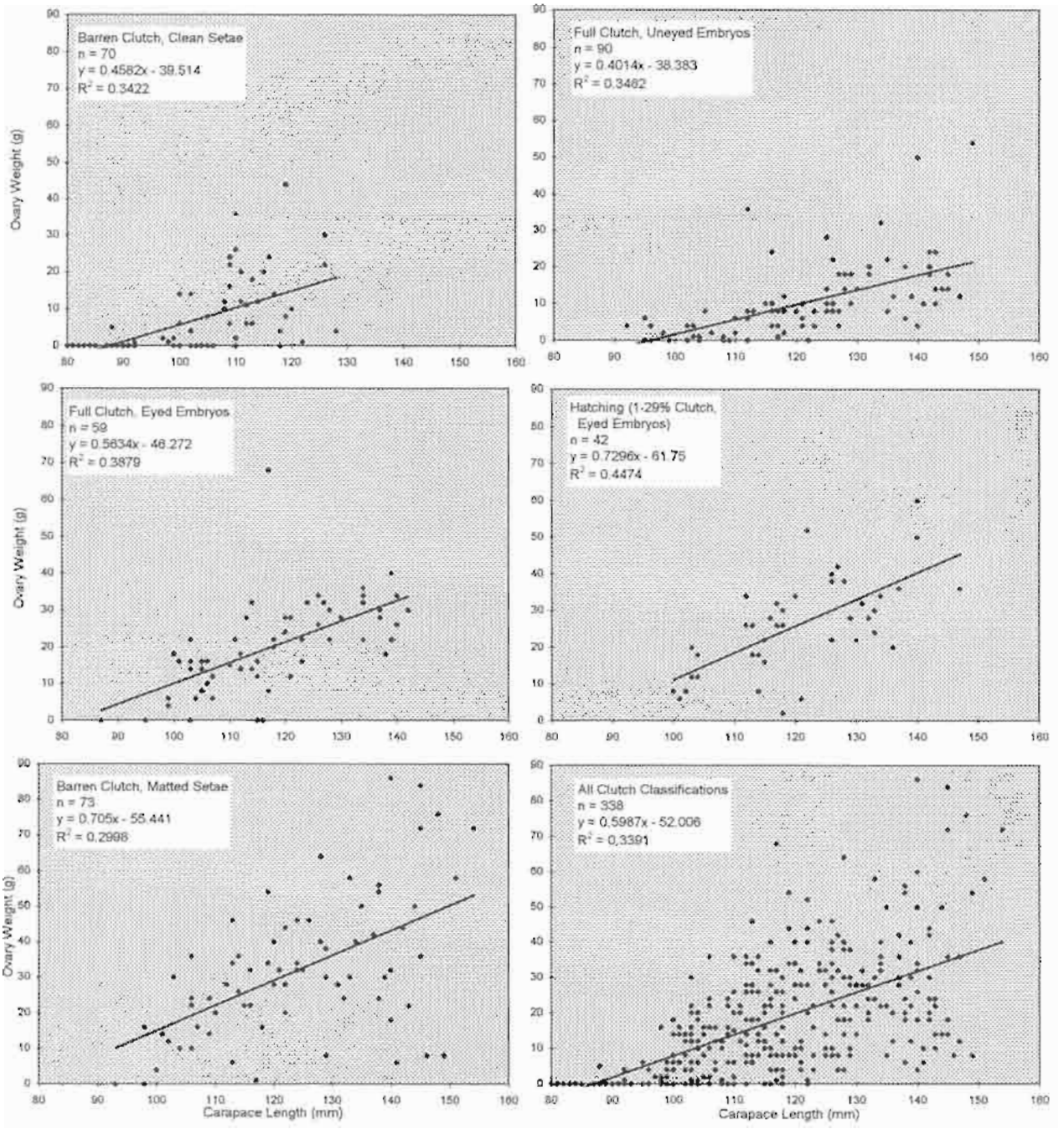

Figure 17. Female golden king crab ovarian weights versus carapace length and clutch condition from the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game.

APPENDIX

Appendix A. **PILOT HOUSE LOG - ALEUTIAN ISLANDS TRIENNIAL GOLDEN KING CRAB SURVEY**

DISTANCE BETWEEN POTS: 100 FM

RECORDER: Steve Hall

VESSEL: Spirit of the North

YEAR: 1997

STATION* | | |

RADIO BEACON ID: _____ kHZ

SET GEAR								DEPTH			BOT	SEQUENTIAL				BUOY	LIFT GEAR*								LATITUDE-N						LONGITUDE-W					
MONTH		DAY		MILITARY TIME				(FM)			TYPE**	POT NUMBER*				NO.	MONTH		DAY		MILITARY TIME				DEG.		MIN.		SEC.		DEG.			MIN.		SEC.	

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*Skipper **must** tell ADF&G crew what station is being pulled and the sequential pot number of each pot when landed on deck.
"Lost pot" must be written across the appropriate Lift Gear boxes, but keep its sequential pot number.
Notify the ADF&G deck crew whenever a pot is lost and what it's sequential pot number is so that the proper notation can be made on the on-deck sampling forms.

**Bottom type codes: 1-Rock; 2-Sand; 3-Silt; and 4-Mud.

Appendix B. **ADF&G ALEUTIAN ISLANDS TRIENNIAL GOLDEN KING CRAB SURVEY DATA FORM**

FV *SPIRIT OF THE NORTH* STATION NUMBER MEASURER

BUOY NOS; WEST END RECORDER

DATE 0 9 7 EAST END PAGE OF

	SEQUENTIAL	POT NUMBER	SPECIES	SEX	SIZE CRABS (MM)	SIZE FISH (CM)	LEGAL	SHELL AGE	EMBRYOS COLOR	EMBRYOS DEVELOPMENT	EMBRYOS CONDITION	EMBRYOS % CLUTCH	OTHER	WEIGHT (GRAMS)	OVARIAN WEIGHT (GRAMS)	TAG NUMBER	COMMENTS
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	
21																	
22																	
23																	
24																	
25																	

Crab Species
1-*L. aequispinus*
2-*P. camtschaticus*
4-*Erimacrus*
5-*C. angulatus*
6- *C.bairdi*
10-*L. couesi*
11-*C. tanneri*
12- *Par. multispina*

Fish & Invert. Species
See coded species list

Sex
1- Male
2- Female

Legal
1- Sublegal
2- Legal

Shell Age
0- Soft
1- New-Pliable
2- New-Hard
3- Old
4- Very Old

Live Embryo Color
1- Tan
2- Purple
3- Brown
4- Orange
5- Purple-brown
6- Pink
7- Reddish
0- Other, describe In Comments

Embryo Devel.
1- Uneyed
2-Eyed
3- Hatching

Clutch Condition
1- Dead embryos not apparent
2 - Dead embryos <20%
3- Dead embryos >20%

Percent Clutch
1- Barren, clean pleopods
2-Barren with empty emt embryo cases & or
3- Clutch 1-29% full
4- Clutch 30-59% full
5- Clutch 60-89% full
6- Clutch 90-100% full

Others
1- Dead
2-Alive
3-Nemerteans in clutch
4-Turbellarians in clutch
5-Black mat
6-Bitter crab disease
7-"Cottage cheese" disease
8-Shell rust
9-*B. callosus*
0- Leatherback, male golden king crab with soft carapace & is old or very-old shell

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Appendix C. **ADF&G WESTWARD REGION TAGGED CRAB RECOVERY FORM**

SPECIES _____ **FISHERY CODE** _____ **OBSERVER/ DOCKSIDE SAMPLER** _____

	SEQ. POT NO.	FLOY TAG SERIES & NUMBER	SIZE (mm) KING - CL TANNER - CW	LEGAL (a)	SEX (b)	SHELL (c)	FATE (d)	CAPTURE DATE MO.	DAY	YEAR	CAPTURE LOCATION (Note: "E." longitude if applicable) N. LATITUDE	W. LONGITUDE	DEPTH (FM)	STATISTICAL AREA	ADF&G VESSEL NO.
1															
2															
3															
4															
5															

(a) **LEGAL**: 1=Sublegal; 2=Legal. (b) **SEX**: 1=Male; 2=Female. (c) **SHELL AGE**: 0=Soft; 1=New; 2=Old; 3= Very Old.

(d) **FATE**: 1=Retained for sale; 2=Released alive; 3=Dead (not retained for sale; found in deadloss pile or frozen whole for ADF&G/Observer sampling).

NOTE: If a tagged female crab, record additional information on the back of this form. Record comments for males and females on the back of this form.

	Received Tag or Tagged Crab From: Name, Address & Phone	Received Recovery Location Data From: Name, Address & Phone	Vessel Name	Processor Name	Sampling Date Mo.	Day	Year
1	Needs hat ☐ Issued hat ☐						
2	Needs hat ☐ Issued hat ☐						
3	Needs hat ☐ Issued hat ☐						
4	Needs hat ☐ Issued hat ☐						
5	Needs hat ☐ Issued hat ☐						

Edited by: Date: Entered by: Date: c:leslie\adak97\tagrec97.xls 7/97

Appendix C. (page 2 of 2).

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

*	SEQ. POT NO.	EMBRYOS				OTHER	COMMENTS
		COLOR	DEVELOPMENT	CONDITION	% CLUTCH		
1							
2							
3							
4							
5							

LIVE EMBRYO COLOR
1-Tan
2-Purple
3-Brown
4-Orange
5-Purple-brown
6-Pink
7-Reddish
0-Other; describe in Comments.

EMBRYO DEVELOPMENT
1-Uneyed
2-Eyed

CLUTCH CONDITION
1-Dead embryos not apparent
2-Dead embryos <20 %
3-Dead embryos >20%

PERCENT CLUTCH
1-Barren, clean pleopods
2-Barren, with empty embryo cases and/or stalks
3-Clutch 1-29% full
4-Clutch 30-59% full
5-Clutch 60-89% full
6-Clutch 90-100% full

OTHER
3-Nemerteans in clutch
4-Turbellarians in clutch
5-Black mat syndrome
6-Bitter crab syndrome
7-"Cottage cheese" disease
8-Shell rust
9-*Briarosaccus callosus* (sac-like parasitic barnacle on king crab abdomens)
0-Leatherback: male brown king crab w/soft carapace & is old or very old shell

SPECIES	CHANGES IN EMBRYO COLOR		COMMENTS
	UNEYED	EYED-WELL DEVELOPED	
Red King	Purple	Reddish	Occasionlly brown or gray intermediate.
Blue King	Purple	Pinkish-reddish	
Golden (brown) king	Orange	Tan	
Tanner (*C. bairdi)*	Orange	Brown or purple brown	
Snow (*C. opilio)*	Orange	Brown or purple brown	

Note: If other species are tagged, update this form before use.

Appendix D. On deck tally sheet for ovarian weights taken from female golden king crabs by external clutch and size categories on the 1997 Aleutian Islands golden king crab survey conducted by the Alaska Department of Fish and Game. Goal was to collect seven samples per 5-mm size category.

Carapace Length (mm)	Clean Setae	Uneyed Embryos*	Eyed Embryos*	Eyed Embryos Hatching	Matted Setae
80-84					
85-89					
90-94					
95-99					
100-104					
105-109					
110-114					
115-119					
120-124					
125-129					
130-134					
135-139					
140-144					
145-149					

***Use full clutch females if at all possible**