ALASKA DEPARTMENT OF FISH AND GAME
SUMMARY OF THE 1996 MANDATORY SHELLFISH OBSERVER PROGRAM DATABASE

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INTRODUCTION

During the spring of 1988, the Alaska Board of Fisheries (BOF) mandated at-sea observer coverage for all vessels commercially processing king and *Chionoecetes bairdi* (Tanner) crab in Alaskan waters. Since then, the BOF has amended state shellfish regulations to include observer coverage in the Bering Sea *C. opilio* fishery. Regulations requiring observers on all vessels fishing king crab in the Aleutian Islands were passed in the spring of 1995. In addition, board members granted authority to the Alaska Department of Fish & Game (ADF&G) to place observers on commercial vessels participating in other Alaskan shellfish fisheries when such action would facilitate the only means to collect biological and fishery management data. In recent years that has included all vessels participating in the Bering Sea/Aleutian Islands Korean hair crab fishery and all vessels targeting *C. tanneri*, *C. angulatus* and *L. couesi*. Also all vessels participating in the Aleutian Islands brown king crab fishery.

Although observers devote a considerable amount of effort toward monitoring and documenting commercial vessel fishing activities for regulatory compliance, they also collect a significant amount of biological data. These data have been useful for many applications, such as developing models for estimating relative stock abundance, defining male and female crab size/age distributions on an annual basis, chronicling species' reproductive cycles, and quantifying levels of incidental bycatch. Ultimately, the shellfish observer biological database provides a source of information to aid shellfish managers and the BOF in comprehensive management of Alaska's shellfish resources.

The databases of biological and regulatory compliance information collected by observers is maintained by Westward Region ADF&G staff members. Archived information includes a variety of commercial fishing and shellfish biology statistics ranging from pot locations, gear types and soak duration, to species composition of catches, biological and legal crab carapace size distributions, and the reproductive status of female crabs.

In this report, compiled data were collected during fisheries primarily occurring within the 1996 calendar year. Due to the substantial volume of available statistics, the scope of data presented has been narrowed to include only size composition and molt stages of commercially retained crabs, the documented incidence of illegally retained crabs, and the general results of random pot sampling. Beginning in 1995, estimates of catch per pot and estimated total catch for selected species and fisheries using harvest data has been included in the report. Also a summary of all species encountered in bycatch pot sampling is included for each fishery.

The number of pots sampled within a fishery may differ between tables. Through 1996, observers' random pot sampling protocols included data from pots fished for both the target species of crab and pots that had been set to capture cod for bait. The tables showing Catch Per Unit Effort estimate only include pots targeting crab. Figures illustrating Catch Per Pot show all sampled pots.

Topical statistics from the 1993, 1994, 1995, and 1996 seasons are occasionally included for comparative purposes. Any inconsistencies between findings presented in this document and previously published reports regarding the shellfish observer database are the result of updated summaries and interpretation of historical data.

Size distributions of retained crabs often include those collected in a number of fisheries by ADF&G personnel at shoreside processing locations. Additional information, including Bering Sea/Aleutian Islands fishery catch statistics, has been provided by ADF&G Westward Region staff, 1997.

METHODS

Comprehensive shellfish observer sampling methodologies are outlined in the most recent publishing of the ADF&G Shellfish Observer Field Manual (ADF&G 1993).

For purposes of this report, terms related to the discussion of sampled crabs are as follows:

Carapace Length (CL) - the straight line distance across the carapace from the posterior margin of the right eye orbit to the medial-posterior margin of the carapace; the biological size measurement of hair crabs, all species of *Paralomis* crabs, and all king crab species.

Carapace Width (CW) - the straight line distance across the carapace at a right angle to a line midway between the eyes to the medial-posterior margin of the carapace, not including the spines; the biological size measurement of *C. bairdi, C. opilio, C. tanneri,* and *C. angulatus.*

Legal Size - the straight line distance across the carapace of male crabs at a right angle to a line midway between the eyes to the medial-posterior margin, including the spines.

Mature - male and female crabs that have at least attained a biological size at which 50 percent or more of a random sample of individuals are physiologically capable of mating.

Immature - male and female crabs that have not attained a biological size at which 50 percent or more of a random sample of individuals are physiologically capable of mating.

Soft shell - crabs that have molted within the previous two months.

New shell - crabs that have molted between the preceding two to twelve months.

Old shell - crabs that have molted between the preceding twelve to twenty-four months.

Very old shell - crabs that have not molted within the preceding twenty-four months.

Eyed Eggs - embryoid eggs.

Uneyed Eggs - non-embryoid eggs.

Mated/Barren - female crabs not carrying eggs but showing signs of previously mating (based on evidence of egg clutch extrusion).

Non-mated/Barren - female crabs not carrying eggs and not exhibiting signs of prior mating activity (including immature crabs).

Recruit - male crabs at an age/size within one growth cycle beyond the minimum legal size established for the species.

Post-recruit - male crabs at an age/size greater than one growth cycle beyond the minimum legal size established for the species, which also includes old shelled crabs at or above the legal size.

During the 1996 Bering Sea/Aleutian Islands shellfisheries, observers were deployed on catcher-processor, floater-processor, and catcher vessels. Observers on board floater-processors have access only to pre-sorted and retained catches, while those placed on catcher-processor and catcher vessels are able to examine total pot contents prior to catch sorting.

Floater-Processors

Catch deliveries to floater-processors are monitored by observers for commercial fishing regulations compliance with regard to retention of legal crab species, sex, and size. Sampling procedures consist of surveying 600 crab taken from individual vessel catches to ascertain a percentage, if any, of illegally retained animals. This sample type is referred to as a 'Legal Tally'.

Biological data collected by observers on board floater-processors includes the measurement of 100 randomly selected crabs from each catch delivery to determine carapace size distribution and shell age condition. The mean weight of harvested crabs is also calculated from a vessel's catch.

Normally, observers on floater-processors are directed to monitor all catch deliveries to their vessel. On limited occasions, this convention necessitates a work schedule in excess of 24-hour intervals.

Catcher-Processors

In addition to collecting the carapace size, Legal Tally, and average catch weight samples from retained crabs, observers deployed on catcher-processors routinely examine randomly selected pots for species composition. This exercise is referred to as 'Bycatch Sampling'. Methodology includes enumerating all species in a pot, recording the carapace size frequency and shell age composition of all commercially important crab species observed, and evaluating the reproductive condition of female crabs.

There are occasions when other vessels will deliver crab to a catcher-processor. When this occurs the observer on the catcher-processor will sample the crab delivered as they would if on a floating-processor.

Catcher Vessels

Routine data collection objectives for observers on board catcher vessels are similar to those assigned to personnel deployed on catcher-processors, except that pot contents assessment is usually the primary at-sea sampling activity. Retained catches are formally inspected for regulations compliance (consisting of a Legal Tally sample) only on occasions when the vessel delivers to a processing facility. When a vessel transfers harvested crabs to an at-sea processor, Legal Tally and biological carapace measurements are collected concurrently by observers deployed on each vessel.

Daily observer sampling goals on catcher-processors and catcher vessels (regarding quantity of fished pots examined, crabs measured, etc.) are dependent on a number of variables, such as whether an individual has been assigned any special data collection projects, the anticipated duration of the fishery in which the observer is deployed, and the data collection priorities established by ADF&G. Fishery-specific sampling goals are discussed in subsequent sections where appropriate.

Several special shellfish research assignments were carried out by observers on board catcher-processors and catcher vessels during 1996. These included: recording length, width and height data from the hair crab fishery, St. Matthew blue king crabs, and *C. tanneri* crabs for use in escape ring studies. Observers also collected Pribilof Island blue and red king crabs for Genetic Stock Inventory (GSI) sampling; collected morphometric measurements from male and female *C. tanneri*, and male *C. opilio* crabs for size-at-maturity estimation; investigated the prevalence of snailfish egg masses within brown king crab carapaces; and tagged red and brown king crab in the Aleutian Islands. Investigation of these data have not been included in this report.

Estimation of Catch Per Unit Effort (CPUE) and Total Fishery Catch

Estimates for CPUE and their standard errors were generated using weighted variance formulas for stratified sampling (Cochran 1977; Appendix A-1). With this technique each vessel-day is considered a separate stratum. The weights reflect the relative importance of a vessel's daily sampling compared to all the days on which sampling occurred -- the more pots sampled on a given day, the greater the weight for that day. Variances were calculated for each vessel-day and then summed over all vessels and all days for the entire fishery. Weighted estimates are presented in figures displaying CPUE estimates for 1996 fisheries.

As can be seen in the tables displaying the standard error estimates, there are several ways to calculate CPUE. Multiple estimates are included not to confuse the reader, but rather to provide a range of information and a basis for comparison. The 'sample' CPUE is generated from observer data, and is based solely on the sampled bycatch pots. This is the estimate which has been reported in past observer reports (Tracy 1994, 1995a, 1995b). It is calculated as total catch from sampled pots divided by total pots sampled. The 'weighted' CPUE uses the Cochran stratified technique as described above and in Appendix A-1. Weighted estimates and standard errors were calculated with Cochran's method for those crab species with a 'sample' CPUE greater than one. The 'actual total fishery' CPUE is based on fish ticket information as reported in the Regional Information Reports for commercial crab fisheries in the Bering Sea and Aleutian Island Management Areas (ADF&G Westward Region staff 1997). The 'AOF CPUE' is generated from confidential interviews with the vessel's captain, which are performed by onboard observers or dockside samplers. The 'actual total fishery' and 'actual observed fleet' CPUE's are generated for retained legal crabs only. Both provide information on total catch of retained crab, total pots pulled and fishing locations. Information from confidential interviews is recorded on a daily basis (fish tickets reflect an entire trip between deliveries) and is generally considered more accurate than information obtained from fish tickets.

Estimated catch totals are derived by multiplying the CPUE estimates by the total number of pots pulled in the fishery. For those fisheries with 100 percent observer coverage the total pots pulled information is taken from confidential interviews. Otherwise the total pots pulled data is taken from fish ticket summaries.

When viewing CPUE and total catch estimates for both the directed catch and bycatch, the reader should note the precision and accuracy of the estimates as indicated by the standard errors and by the comparability of the estimates for legal retained crabs obtained from observer data with those obtained from confidential interviews and fish tickets. The reader should also take note of whether the CPUE and total catch estimates provided here were based on data gathered by observers deployed on all participating fishing vessels or by observers deployed on catcher-processor vessels. Application of CPUE estimates obtained from catcher-processor vessels to the entire fishing fleet assumes that catch rates for that distinct portion of the fleet are comparable to the remaining, catcher vessel component of the fleet.

RESULTS AND DISCUSSION

Bering Sea Chionoecetes opilio

The record historic harvests of this stock have occurred since at-sea observer coverage was authorized in 1991. The immense harvests and extended seasons in previous years have generated some of the larger data sets amassed by observers since the program's inception. Over 6 million male and female *C. opilio* have been examined by observers for biological or legal descriptive characteristics since 1991.

In the 1996 fishery observers were deployed on a total of 15 catcher-processor and 11 floater-processor vessels. The bycatch pot sampling goal for observers on catcher-processor vessels was four pots per day fished. Pot contents were sorted by species, sex, and legal size and counted for all sampled pots. However, measurements were collected from animals in only one of the four sampled pots due to the large number of crabs per pot routinely taken in this fishery. Also, this method may reduce crab mortality while observers are sampling during the extreme weather that occurs during this fishery. The contents of 1,394 pots were sampled.

Observers also collected right chela height and carapace width data from male *C. opilio* as part of a joint ADF&G and National Marine Fisheries Service (NMFS) size-at-maturity project. Investigations of these data are not included in this report.

Samples of retained crabs taken from catcher-processors, floater-processors, and shoreside locations revealed a mean carapace width (CW) of 107.5 millimeters (mm) (Table 1). Nearly 97,000 retained crabs were examined throughout the course of the season; the majority of measurements were collected by observers on board catcher-processors. The overall size distribution of retained *C. opilio* has varied slightly over the past seasons; nearly 40 percent of all crabs examined since 1993 have ranged between 106 mm and 115 mm CW (Table 2). The mean carapace width of retained crabs has varied during the same period. Traditionally male *C. opilio* 4 inch CW and larger are desired by processors. However, in 1996 more male crabs of 3.75 inches CW and larger were purchased by processors than in previous years (ADF&G Westward Region staff 1997).

The carapace width distribution of all male *C. opilio* measured by observers showed an apparent increase in the proportion of recruit-sized crabs in comparison to the 1995 data (Figure 1). The mean size of all observed *C. opilio* males was similar to that in 1995 but 6 mm less than the 1994 data. Juvenile crabs below 65 mm CW are not commonly documented in fished pots, which may account in part for the somewhat static annual nature of these data.

Observations of female *C. opilio* were especially rare in pots sampled during the 1996 fishery. From a total of 1,394 pots examined for contents, only 563 females were enumerated and 136 were measured. Histograms depicting the size distribution of *C. opilio* females measured over

four seasons show an increase in new shelled animals sampled in 1996 (Figure 2). Since the 1993 fishery, the mean CW of captured females has not fallen below 66 mm. The occurrence of females observed in sampled pots during the 1996 season was comparable to data summarized in 1995, although, in terms of mean catch per pot, the abundance of female *C. opilio* has decreased by nearly 80 percent over the past four years (Figure 3).

Retention of illegal crabs was insubstantial during the 1996 season. Random tallies of 600 crabs harvested daily by catcher-processors, combined with legal measurements collected from catches delivered to floating-processors, produced a total sample of nearly 460,000 retained animals examined for legal size, sex, and species (Table 3). Approximately 0.5 percent of the sample was comprised of unlawfully retained catch, most of which were pre-recruit sized *C. bairdi* males.

Legal *C. opilio* males dominated the catches in sampled pots at a mean of 189 individuals (Figure 3). Catches of incidental species were minor compared to the abundance of legal crabs. Sub-legal sized *C. bairdi* constituted the largest portion of incidentally caught crab. A comparison of pot sampling conducted since 1993 reflects a decrease in the CPUE of legal retained males associated with the decrease in the overall harvest during that period. Estimated CPUE, standard error and the total fishery catch for selected crab species during the fishery are also presented (Table 4). Other commercially valuable species observed included small numbers of blue king crab, Pacific cod, and halibut (Appendix C-1).

Shell age classifications of sampled male *C. opilio* (legal and sublegal crabs) differed with findings from prior seasons (Table 5). Seventy-one percent of all males examined were classified as new shell, the balance consisting almost exclusively of old-shelled crabs. Very old shelled crabs (those failing to molt for two or more consecutive growth cycles) comprised over 4 percent of the samples, at least a fourfold increase from the previous three seasons.

Comparison of female *C. opilio* shell condition assessment to data collected in previous seasons seems to represent an increase in the numbers of new-shelled crabs (Table 5). During the 1996 season the numbers of new-shelled females constituted 36 percent of the total sample. However, the female sample size was much smaller than previous years.

At the time of the 1996 fishery, 60 percent of the *C. opilio* females inspected for signs of mating activity possessed clutches of eyed eggs (Table 6). A small number (3.7 percent) carried uneyed eggs. All other females were devoid of eggs, with 21 percent described as non-mated. Summarized results of *C. opilio* reproductive condition assessments during the last several seasons are also given in Table 6.

The location of bycatch pots sampled in the 1996 Bering Sea *C. opilio* fishery are depicted in Appendix B-1. A summary of all animals encountered in observer sampled pots is presented in Appendix C-1.

Bering Sea Chionoecetes bairdi (Tanner Crab)

Shellfish regulations adopted in 1993 resulted in the *C. bairdi* fishery opening on November 1, concurrent with the Bristol Bay red king crab season. Ten days following the Bristol Bay red king crab fishery closure the *C. bairdi* directed fishery reopens west of 163 degrees W longitude. Catch composition information for the 1993 and 1996 *C. bairdi* fishery includes data collected only after the closure of the red king crab fishery, since no directed Tanner crab effort was documented by observers on board catcher-processors during either period when both species were legally retained.

The Bristol Bay red king crab fishery remained closed in 1994 and 1995 due to a low estimated abundance of female red king crabs. However, the *C. bairdi* fishery opened as scheduled by regulation on November 1 during those years, and all observer data collected during those seasons has been included in the historic tables and graphs.

In 1996, the directed *C. bairdi* fishery opened on November 1. The bycatch pot sampling goal for observers on catcher-processor vessels during the 1996 season was four pots per day fished. The animals in the sampled pots were sorted by species, sex, and legal size and enumerated. Measurements were collected from animals in two of the four sampled pots. Two catcher-processors and one floater-processor participated in the 1996 season. Catch data from the catcher-processors are confidential. Pot content data was collected from 134 sampled pots.

More than 4,400 retained *C. bairdi* measurements were obtained from a combination of observer sampling effort on catcher-processors, the floater-processor, and ADF&G personnel stationed at shoreside locations. Included in this data set are retained *C. bairdi* measurements obtained during the Bristol Bay red king crab fishery. Combined measurements from all sample locations produced a mean width of 152 mm (Table 8). In the 1993 through 1996 seasons approximately 55 to 65 percent of measured crabs ranged between 141 mm and 155 mm CW (Table 8).

In 1996, shellfish observers collected only 352 carapace measurements from *C. bairdi* males, in comparison to a sample size of nearly 40,000 in 1993. The decrease in the number of crabs sampled is the result of decreases in season lengths, CPUE and the number of catcher-processors participating in the fishery.

The sample size of *C. bairdi* females observed in sampled pots was much smaller than data summarized from the 1993, 1994, and 1995 seasons. Histograms from each respective year are provided in Figure 5.

A total of only 134 pot samples were collected during the 1996 season. The number of pots sampled was the lowest in four years and was primarily due to the shortened seasons and the decrease in the number of catcher-processor vessels currently participating in the fishery.

Results of pot sampling during the 1996 season appear to reflect the decline in the overall abundance of legal male *C. bairdi* in the areas commercially fished.

St. Matthew District Blue King Crab

Shellfish observers were deployed on three catcher-processors during the 1996 season. Also, three floater-processors were in the area to take deliveries from both the St. Matthew and Pribilof district fisheries. The bycatch pot sampling goal for observers on catcher-processor vessels during the 1996 season was four pots per day fished. Crabs were sorted by species, sex, and legal size and counted for all sampled pots. Measurements were collected from animals in two of the four sampled pots. There were 96 pots sampled during the short season.

A sample of 5,130 retained male blue king crab (measured at all processing locations) revealed a mean carapace length of 135 mm (Table 13). The majority of sampled crabs (59 percent) ranged between 126 mm and 140 mm CL (Table 14). The size distribution of harvested males has remained virtually constant since 1993. Accordingly, the mean size of sampled crabs during this period has fluctuated by only 2 mm CL.

A histogram representing 555 legal and sub-legal male blue king crab measurements derived from sampled pots is depicted in Figure 7. Mean carapace length of all measured crabs was identical to data collected in the 1995 season.

Histograms of blue king crab female size and shell age composition from the 1993, 1994, 1995, and 1996 seasons are provided in Figure 8 for comparative purposes. The mean carapace length of the 233 female measured in sampled pots was 91 mm. The size of captured females ranged between 59 mm and 127 mm CL.

Prior to the 1996 fishery, summaries of pot samples indicated that female blue king crabs constituted the largest portion of the animals caught in the St. Matthew fishery followed by undersized male blue king crabs (Figure 9). However, the mean catch of all blue king crab observed during the 1996 season was dramatically different than the three prior seasons. For the first time, the mean catches of both legal and sublegal male blue king crab exceeded that of females. Since 1993 the mean catch per pot of female blue king crabs has fluctuated between a high of 37 crabs in 1994 to a low of 5 crabs in 1996 (Figure 9). Pot soak times in the St. Matthew fishery rarely exceed 24 hours. Estimated CPUE, standard error and total fishery catch for selected crab species are presented in Table 15. A summary of all animals encountered in observer sampled pots is presented in Appendix C-3.

The shell age composition of male and female blue king crabs during the commercial harvest period have been well-documented in observer data sets over the past four years (Table 16). Prior to 1996, over 90 percent of all males examined have been categorized as new shells, the remainder almost exclusively being described as single year skip molts (old shell). Data from the 1996 fishery indicated that only 55 percent of the males were new shell with 43 percent described as old shell. Shell age classification of blue king females has varied over the same interval; numbers of those recorded as new shelled have comprised approximately 25 to 84 percent of the total sample (Table 16).

Summarized pot sample data from the past several years consistently indicate that ovigerous female blue king crabs are nearly absent from the geographic area targeted in the St. Matthew fishery (Table 17). No gravid females were observed among the 233 females sampled during the 1996 season. Prior mating activity was evident in 71 percent of the total female crabs sampled.

Approximately 13 percent of the 1996 blue king crab harvest was monitored for illegally retained catch (Table 18). Undersized males and females comprised the majority of prohibited crabs from Legal Tally sampling. Illegal crabs comprised less than one percent of the aggregate for the entire fishery. Extrapolation of this percentage to the entire catch in 1996 indicates that a total of approximately 4,000 undersized male and female crabs were harvested (Table 18).

Location of bycatch pots sampled in the 1996 St. Matthew fishery are shown in Appendix B-3.

Pribilof District Red and Blue King Crab

In 1996 the Pribilof district was open concurrently for both red and blue king crab. The blue king crab fishery had been closed in the Pribilof district since 1987, while the red king crab fishery had opened in 1993 (ADF&G Westward Region staff 1997). No observers were deployed in the 1996 fishery, precluding any discussion of fishing and biological statistics in this report. Published historical summaries of shellfish observer data collected in this fishery are available from the ADF&G.

Bristol Bay Area Red King Crab

The Bristol Bay fishery reopened in 1996 after being closed following the 1993 season due to a critically low estimated abundance of female red king crabs. Only data from the 1996 fishery is included in this report. Published historical summaries of shellfish observer data collected in this fishery are available from the ADF&G

Observers were deployed on four catcher-processor vessels and one on a floater-processor during the fishery. The bycatch pot sampling goal for observers on catcher-processor vessels during the 1996 season was four pots per day fished. Crabs were sorted by species, sex, and legal size and counted for all sampled pots. Measurements were collected from animals in two of the four sampled pots. A total of 84 pots were sampled.

Length frequency data collected from 8,896 retained red king crab by at-sea observers and ADF&G personnel revealed a mean carapace length of 153 mm (Table 19). New shell crab were predominate among the retained males at 76 percent. The majority of the sampled crabs (62 percent) ranged between 146 mm and 165 mm (Table 20).

The mean carapace width of all male red king crab (legal and sublegal crabs) measured in sampled pots was 139 mm (Figure 10). Only 11 females were observed and measured from the sampled pots (Figure 10).

Bycatch pot samples were dominated by legal male red king crab which averaged nearly 14 per pot (Figure 11). Sub-legal males and females were evident at a rate of 7.5 and 0.1 per pot, respectively. Combined sizes and sexes of *C. bairdi* averaged 3.5 per pot. Estimates of CPUE, standard errors and the total catch for selected species are presented in Table 21. Other species present in the sampled pots are shown in Appendix C-4.

Shell age conditions of sampled crabs indicated that 84 percent of the males and all 11 females were new shell. The remainder of the males were categorized as old or very old (Table 22). None of the females were gravid and none exhibited signs of prior mating.

Illegally retained crab encountered during the random tallies of retained animals comprised less than one percent of the samples (Table 23). Over 26,000 crab were checked for legal status from both the catcher-processors and deliveries to the floater-processor. Sub-legal red king crab males comprised the majority of the illegal crab retained.

Location of bycatch pots sampled in the 1996 Bristol Bay red king crab fishery are shown in Appendix B-4.

Adak Area Brown King Crab

Shellfish observers on board catcher-processors in the Adak fishery have traditionally been the primary means for ADF&G to collect descriptive biological information on king crab stocks inhabiting the Western Aleutians. New regulations adopted by the Alaska BOF during the spring of 1995 required observer coverage on all vessels participating in Aleutian Islands king crab fisheries.

Data compiled in this report encompasses a nine and a half month regulatory period in which the fishery occurred, beginning November 1, 1995 and concluding on August 15, 1996. Fishing activity occurred during every month of the season. The pot sampling goals given observers varied depending upon the type of pots fished. A minimum of eight pots were sampled each day if the vessel was fishing rectangular pots and a minimum of 12 pots per day were sampled if smaller, conical pots were fished. At the conclusion of the 1995-96 season, one catcher-processor and 24 catcher vessels had participated in the fishery. Data was collected from the contents of 13,321 sampled pots. Catch data from the catcher-processor are confidential.

The combination of data gathered by ADF&G personnel at shoreside facilities, measurements collected by observers on at-sea processors, and from observers assigned to catcher vessels, produced an aggregate sample of 17,850 retained males with a mean CL of 147 mm (Table 25). Over the last several seasons, the mean length of retained crab and the size distribution of harvested crabs has remained virtually unchanged (Table 25).

The mean carapace length of 128 mm for all males (legal and sub-legal crabs) in the sampled pots was very similar to the average calculated from observer data collected in the 1993, 1994, and 1995 seasons (Figure 12). Juvenile male crabs less than 50 mm CL occurred as bycatch in

sampled pots; mature male crabs exceeding 190 mm CL were also documented. The mean size of female brown king crabs measured during the same four-year period has fluctuated between 118 mm and 122 mm (Figure 13).

For the first time, data was collected over the entire geographic area where fishing effort occurs and from every month during the long season. The number of pot samples collected by observers also increased substantially. The species composition of pots sampled annually in the Adak fishery includes a wide variety of invertebrate and fish species. However, brown king crab females and sub-legal males constitute the predominant incidental catch. In 1995-96, the mean catch of 5 legal males per pot was less than the previous three seasons (Figure 14). Catches of female and undersized male brown king crabs each averaged 10 animals per pot in 1995-96. A summary of all animals encountered in observer sampled pots is presented in Appendix C-5.

Classification of male and female brown king crab shell condition varied slightly from the prior three years' observer data. This might be attributable to the larger area sampled and to the collection of data from the entire length of the season. During the 1995-96 season, about 95 percent of male crabs and over 90 percent of the females examined were characterized as new shelled (Table 28). Observers have annually reported the periodic occurrence of very old, large brown king males described as having discolored, highly abraded shells with a soft, "leathery" texture. These crabs comprise a negligible portion of shell age samples.

Ovigerous crabs accounted for 50 percent of the 134,718 brown king females assessed for signs of reproductive activity (Table 29). Approximately one of every three females was observed as barren with no evidence of prior mating.

Location of bycatch pots sampled in the 1995-96 Adak brown king crab fishery are shown in Appendix B-5.

Adak Area Red King Crab

The Adak red king crab fishery was closed to fishing during 1996 because of poor fishery performance in 1995. Published summaries of shellfish observer data collected in the fishery prior to 1996 are available from the Alaska Department of Fish and Game.

Adak Area Lithodes couesi King Crab

A single catcher vessel targeted *Lithodes couesi* (common name "scarlet king crab") in the Adak registration area. Fishing activity occurred during April and again during June and July. Bycatch pot sampling goals for observers were 10 pots per day fished, with a total of 184 pots sampled from the directed fishery. The legal size for *L. couesi* is 5.5 inches CL. Catch data from the vessel are confidential.

Dutch Harbor Area Brown King Crab

New regulations adopted by the Alaska Board of Fisheries during the spring of 1996 combined the separate Dutch Harbor and Adak areas into a single area. Fishery data from the new Aleutian Island Area will be presented in the 1997 report. Published summaries of shellfish observer data collected in the Dutch Harbor brown king crab fishery prior to 1996 are available from the Alaska Department of Fish and Game.

Bering Sea Korean Hair Crab

Prior to the onset of the 1992 Bering Sea fishery, a general lack of established life history and other biological knowledge of hair crab, and concerns over possible excessive red king crab and *C. bairdi* bycatch, prompted ADF&G to include observer coverage as a permit requirement for all participants. Legislation enacted by the Alaska legislature in 1996 placed a four year moratorium on the entry of additional vessels into this fishery which occurs outside of five miles from shore.

Observers were deployed on 18 catcher vessels in 1996; no catcher-processor or floater-processor vessels participated in the fishery. Vessels targeting hair crabs typically deploy large numbers of pots on a daily basis. In order to obtain representative catch composition statistics from the 1996 fishery, individual observers were directed to examine a total of 30 pots per day of fishing activity. Size and other biological data was collected from the animals in 10 of the sampled pots; the remaining 20 pots were sampled for species composition, sex, and legal status. The resulting archive contained nearly 9,200 bycatch pot samples.

Per instructions from ADF&G, all observers assisted with the collection of red and blue king crab specimens for genetic stock identification (GSI). Additionally, one observer was assigned to collect length, width, and height measurements from male and female hair crabs. This data was compiled to address any future discussions on escape ring regulations. Data from these special projects are not included in this report.

A combined total of 5,600 carapace length measurements from retained male hair crabs indicated that the mean size was 93 mm (Table 36). Crabs landed in the 1993, 1994, and 1995 seasons were somewhat smaller than those observed in 1996; mean sizes ranged from 88 mm to 91 mm CL between the respective seasons (Table 37).

The lengths of more than 7,000 measured male hair crabs (legal and sub-legal crabs) observed in pot samples showed little variation from the size distribution of the retained catch. The average size of all sampled male crab was 92 mm CL. (Figure 17). The catch of male crabs larger than 110 mm CL has been rare in all years.

There were 573 female hair crabs measured during the 1996 fishery. Carapace length distribution ranged from 41 mm to 103 mm, although size frequencies predominantly ranged within a 58 mm

to 76 mm interval (Figure 18). Females averaged 67 mm CL in 1996, virtually identical to the mean-sized crab observed in 1995 and 1994.

Summary of the data indicated that legal hair crabs were landed more frequently than all other crab species (Figure 19). Sublegal *C. bairdi* were the next largest component of the catch in sampled pots. Mean pot catches of male hair crab for the 1993, 1994 and 1995 seasons are nearly static. The 1996 catch rate was less than half of that of the prior three seasons. Estimated CPUE, standard error and total fishery catch of hair crab is presented in Table 38. A summary of all animals encountered in observer sampled pots is presented in Appendix C-7.

Classification of male hair crab shell condition was dissimilar to the sampled catch in the three previous years (Table 39). Approximately 64 percent of male hair crab sampled were characterized as having molted in the preceding year. This figure has ranged from 78 - 87 percent in previous years. The majority of the females (90 percent) were also described as new shell (Table 39). The incidence of a large proportion of hair crab with extensive barnacle growth was evident for the first time in 1996. While this phenomenon not quantified, observers, industry and ADF&G staff had not previously seen the density of barnacle growth on hair crabs nor the number of crabs affected. Environmental conditions may have contributed to a barnacle "bloom" not previously evident during this fishery.

Of the 576 female hair crab examined, 126 (22 percent) were ovigerous at the time of the fishery; of these, 122 carried clutches of eyed eggs (Table 40). Females described as non-mated comprised the remaining 78 percent of the sample.

Results of observer Legal Tally sampling on catcher vessels indicated that a relatively small number of under-sized male hair crabs were harvested. Just over 43,000 crabs were inspected, which amounted to 8.9 percent of the total retained catch in 1996 (Table 41). Prohibited crabs comprised less than one percent of the crabs sampled, the majority of which were sub-legal male hair crabs.

Location of bycatch pots sampled in the 1996 Bering Sea Korean Hair crab fishery are shown in Appendix B-7.

Adak Area Korean Hair Crab

Limited exploratory fishing for Korean hair crab was undertaken by a single catcher vessel in December. Catch data from this vessel are confidential. The observer onboard this vessel sampled 136 pots during the four days the vessel fished. Catch data from the vessel are confidential.

Bering Sea Chionoecetes tanneri

Over the last three years, significant commercial interest in marketing *C. tanneri* (commonly referred to as "grooved Tanner crab" or "deep sea Tanner crab") has resulted in directed fishing effort in the Bering Sea, Aleutian Islands, and South Peninsula registration areas. Little is known of the life history and population dynamics of these previously unexploited stocks. In order to establish a baseline archive of biological descriptive characteristics and initiate research activities aimed at enhancing fisheries management, ADF&G mandated observer coverage on all vessels targeting *C. tanneri* in Alaskan waters prior to the 1994 fisheries. All *C. tanneri* fisheries have been conducted as permit fisheries with a year-round season.

The legal size established for *C. tanneri* in all registration areas is 5.0 inches CW. The legal size of other crab species commonly encountered by observers during sampling in this fishery are: *C. angulatus* = 4.5 inches CW and *Lithodes couesi* = 5.5 inches CW.

Observers in all areas were assigned to collect morphometric measurements from various size ranges of male and female *C. tanneri* and *C. angulatus* for the purpose of determining size at sexual maturity. Length, width and height measurement data were also collected for determination of escape ring size.

The commercial harvest of *C. tanneri* in the Bering Sea occurred from March through May, and also during December, 1996. Shellfish observers were deployed on three catcher vessels during this period. Observers were instructed to collect biological data from all animals from a minimum of 12 pots sampled each day fished. Observers sampled 822 pots during the fishery.

The carapace widths of 391 retained males measured by observers averaged 146 mm CW (Table 42). The sample was comprised of crabs ranging between approximately 121 mm and 170 mm CW (Table 43). The size distribution of all 3,596 male *C. tanneri* (legal and sub-legal) observed in sampled pots ranged between 82 mm and 182 mm CW (Figure 20). Female *C. tanneri* carapace widths ranged between 80 mm and 126 mm (Figure 21). Mean size of the 567 females measured during the Bering Sea fishery was 102 mm CW.

Shell age assessments of *C. tanneri* proved difficult for observers, mostly due to little evidence of integument abrasion and decay that is commonly observed in other crab species. Almost all sampled males (95 percent) were judged to have completed a molt cycle within the preceding 12 months (Table 44). Eighty-nine percent of the 567 female crabs inspected were characterized as new shell.

A small number of unlawfully retained crabs were documented in observer Legal Tally sampling. Nine percent of the fishery harvest was monitored, from which only seven under-sized male *C. tanneri* were observed (Table 45).

In addition to *C. tanneri*, several other species of commercially important crabs appeared in sampled pots. These included *C. angulatus*, *L. couesi*, and brown king crabs (Figure 22). Legal size *C. tanneri* constituted the majority of the retained catch, averaging nearly 4 crabs per pot.

The mean catch of legal male *C. tanneri* was over 10 per pot in 1994 and over 8 per pot in 1995. Estimates of CPUE, standard error and total fishery catch generated for *C. tanneri* and other crab species are presented in Table 46. Appendix C-8 presents a summary of the species enumerated from all sampled pots in 1996.

Over 83 percent of the female *C. tanneri* caught in sampled pots were gravid, with almost equal proportions of eyed and uneyed egg clutches (Table 47). Of the 95 barren females sampled, 65 exhibited no evidence of prior reproduction.

Location of bycatch pots sampled in the 1996 Bering Sea *C. tanneri* fishery are shown in Appendix B-8.

Eastern Aleutian Area Chionoecetes tanneri

In the 1996 Eastern Aleutian registration area, fishing effort targeted on *C. tanneri* at varying levels from March through June. During that period observers were deployed on three catcher vessels. Minimum bycatch pot sampling goals for observers were 12 pots per day. The contents of 460 pots were examined.

Analysis of 568 retained crab measurements collected by observers during deliveries to shoreside processors revealed a mean size of 136 mm CW (Table 48). This is somewhat lower than the mean widths observed in the previous two seasons (Table 49).

The combined size frequency distribution of retained and discarded *C. tanneri* males ranged between 85 mm and 171 mm CW. Histograms of the sampled crabs are provided in Figure 23. The overall mean size calculated from these data was 127 mm CW.

Female *C. tanneri* sizes in 1996 ranged between 74 mm and 121 mm CW. This size distribution was similar to the size distribution of female crabs collected in the 1995 fishery (Figure 24). Mean sizes of females from the previous two years is also nearly identical.

Summarized Legal Tally data indicated that illegal crabs comprised 1.2 percent of the 1996 harvest (Table 50). The majority of illegal crabs detected among the 3,868 crab sampled by observers during deliveries of their assigned vessels were under-sized male *C. tanneri.* Seven percent of the total harvest was sampled for legal status.

A total of 460 pots were sampled for contents. Female *C. tanneri* dominated catches, averaging over 3.5 per pot (Figure 25). Legal and sublegal male *C. tanneri* were the next most prevalent animals caught averaging about 2 crabs per pot each. A comparison of mean pot sample catches from the 1994, 1995, and 1996 fisheries reveal that the catch of legal male *C. tanneri* declined by 64 percent over that period, and over the same period the mean catch of female *C. tanneri* declined by 39 percent. Table 51 presents the estimated CPUE, standard error and total catch of commercially significant crab species encountered during the 1996 fishery. A summary of all animals encountered in observer sampled pots is presented in Appendix C-9.

Shell age assessments of all male *C. tanneri* indicated that 69 percent of sampled crabs were new shell (Table 52). Female *C. tanneri* examined in the Eastern Aleutian area were characterized as 36 percent old shell and 47 percent very old shell. This differs substantially from age distributions in the two prior years of the fishery (Table 52) and may be attributed to the difficulty in assessing shell ages of this species, as was discussed previously. No soft shelled crab were observed during the season.

Over 88 percent of inspected female *C. tanneri* carried eggs; 57 percent were uneyed (Table 53). Of the 186 females identified as barren, 138 displayed evidence of prior mating.

Locations of bycatch pots sampled in the 1996 Eastern Aleutian *C. tanneri* fishery are shown in Appendix B-9.

Western Aleutian Area Chionoecetes tanneri

Directed effort from one vessel for *C. tanneri* crab in the Western Aleutian registration area during 1996 occurred from April through June. The bycatch sampling goal of observers in this fishery was a minimum of 12 pots per day. Biological data was collected from the animals in all 503 pots sampled. Catch data from the vessel are confidential.

South Peninsula Area Chionoecetes tanneri

Six catcher vessels participated during the 1996 fishery. Fishing activity occurred in March through May, and from August through December. New regulations enacted by the BOF allowing long-line fishing of crab pots in the South Peninsula registration area became effective on August 14, 1996. Pot limits were also implemented at that time and allowed up to 300 small pots or 150 large pots per vessel. A small pot was defined as being no more than 20 feet in perimeter and no more than 42 inches high.

Bycatch sampling goals for this fishery were a minimum of 10 pots per day. Observers sampled 1,586 pots during the season. A total of 1,648 retained *C. tanneri* CW measurements were obtained by observers, and a summary of these data produced a mean width of 134 mm (Table 60). Historic width frequency data of retained male *C. tanneri* are presented in Table 61.

Male *C. tanneri* from sampled pots averaged 126 mm CW (Figure 28). The average size of males from this fishery was smaller than the mean size of males from the 1996 Bering Sea, Eastern Aleutian, and Western Aleutian *C. tanneri* fisheries. Comparative illustrations of these data are provided in Figures 20, 23, and 26, respectively.

The size distribution of female *C. tanneri* ranged between 75 mm and 125 mm CW, and averaged 97 mm (Figure 29). Females landed in the South Peninsula fishery were also smaller than females observed in the Bering Sea, Eastern Aleutian, and Western Aleutian areas (Figures 21, 24 and 26, respectively).

Approximately three percent of harvested *C. tanneri* were inspected during Legal Tally sampling. Retention rates of prohibited animals exceeded one percent of crabs landed; under-sized male *C. tanneri* accounted for nearly all illegal crabs detected (Table 62).

The composition of pot catches was dominated by *C. tanneri* males. An average of 19 legal crabs were landed in the 1,586 sampled pots; sample CPUE for females and sub-legal males averaged 10 and 11 per pot, respectively (Figure 30). Other commercially important species observed included *L. couesi*, brown king crabs, and sablefish, although none were recorded in large quantities. Catch rates for all categories of *C. tanneri* have decreased substantially from the 1995 fishery (Figure 30). The estimated CPUE, standard error and total fishery catch for selected crab species during the 1996 season are presented in Table 63. A summary of all species observed in sampled pots is shown in Appendix C-11.

Approximately 72 percent of all male *C. tanneri* inspected during the season were categorized as new shelled while only 81 percent of females were categorized as old shell (Table 64). Only five male crabs were identified as soft shell from the 47,493 males sampled.

Over 97 percent of all female *C. tanneri* assessed for reproductive condition during the fishery were ovigerous with 68 percent carrying uneyed eggs (Table 65). Less than one percent of females examined were identified as non-mated.

Location of bycatch pots sampled in the 1996 South Peninsula *C. tanneri* fishery are shown in Appendix B-11.

Eastern Aleutian Area Chionoecetes angulatus

Two catcher vessels targeted *C. angulatus* (common name "triangle Tanner crab") in the Eastern Aleutian area during 1996. While all vessels targeting *C. tanneri* also retained some *C. angulatus,* these catches were incidental to the overall harvest. The legal size for male *C. angulatus* was 4.5 inches CW. Fishing activity took place from mid-May until early August. Observers were assigned a bycatch sampling goal of 10 pots per day, and data from 1,049 pot samples were collected. Catch data from these vessels are confidential.

Bering Sea Chionoecetes angulatus

One catcher vessel targeted *C. angulatus* in the Bering Sea registration area during 1996. Fishing activity took place from late April to mid-May. Observers were assigned a bycatch sampling goal of 10 pots per day with data from 179 pots samples collected from the fishery. Catch data from this vessel are confidential.

Accuracy and Precision of CPUE Estimates

In using CPUE estimates based on observer data it is important to have some assessment of their reliability in estimating the catch rates for observed vessels and, especially, for all vessels participating in a fishery. Although the observer data is the only source of information on bycatch rates in the fisheries presented in this report, confidential interviews with the operators of observed vessels and fish tickets provide data for independent estimates of the CPUE of retained legal crabs. We can gain some understanding of the reliability of the CPUE estimates computed from observer data by comparing the retained legal CPUE estimates computed from observer data with those computed from confidential interview and fish ticket data.

The confidential interview data provides estimates of retained legal CPUE for the observed vessels participating in a fishery. Accordingly, in this discussion we will refer to the retained legal CPUE estimated from confidential interview data as the "Actual Observed Fleet CPUE" (AOF CPUE). Note that in those fisheries for which 100% observer coverage was required (i.e., the Bering Sea Korean hair crab fishery, all *C. tanneri* fisheries, all *C. angulatus* fisheries, the Adak Area brown king crab fishery, and the Adak Area *L. couesi* fishery), the Observed Fleet CPUE also provides an independent retained legal CPUE estimate for the entire fishery. Fish ticket data from all landings of all vessels participating in a fishery provide an independent estimate of the total fishery CPUE of retained legal crabs for a fishery in which observers were required only on catcher-processor vessels. We will refer to the CPUE of retained legal crabs estimated from the fish ticket data for all fishery landings as the "Actual Total Fishery CPUE" (ATF CPUE).

CPUE estimates computed from observer data for retained legal crabs are within 6% or less of the AOF CPUE for the Bering Sea *C. opilio*, St. Matthew District blue king crab, Bristol Bay red king crab, Adak Area brown king crab, Western Aleutian Area *C. tanneri*, South Peninsula Area *C. tanneri*, and the Eastern Aleutian Area *C. angulatus* fisheries (Table 76). The close agreement between the observer-based and AOF CPUE estimates for retained legal crab in each of those seven fisheries indicates that observer data provides highly reliable estimates of CPUE for the observed portion of the fleet in each of those fisheries. The close agreement between those two CPUE estimates also indicates that observer data provides reliable CPUE estimates for the entire fishery in the Adak Area brown king crab, Western Aleutian Area *C. tanneri*, South Peninsula Area *C. tanneri*, and the Eastern Aleutian Area *C. angulatus* fisheries, because observer coverage was 100% in each of those fisheries.

CPUE estimates computed from observer data for retained legal crabs in each of the Bering Sea *C. bairdi*, the Adak Area *L. couesi*, the Eastern Aleutians Area *C. tanneri* and the Bering Sea *C. angulatus* fisheries differed from the AOF CPUE by 20% or more, indicating lower reliability of observer data in providing catch rate estimates for the observed fleets in those fisheries (Table 76). Those four fisheries are characterized by having both low numbers of pots sampled and low number of vessels on which observers were deployed. Since the observer data for the Adak Area *L. couesi*, the Eastern Aleutian Area *C. tanneri*, and the Bering Sea *C. angulatus* fisheries were

based on 100% observer coverage, those comparisons also reflects on the ability of the observer coverage in those fisheries to provide reliable estimates for the entire fishery. It should be noted, however, that some large relative difference between the CPUE estimates may be associated with only small absolute differences between the estimates; for example, although the CPUE estimate based on observer data for retained legal crabs in the Bering Sea *C. bairdi* fishery is 53.5% greater than the estimate based on confidential interviews, in absolute numbers the two estimates differ by less than one legal crab per pot (1.75 vs 1.14 crabs per pot, Table 35). Similarly, the relative difference of 31.8% for the Adak Area *L. couesi* fishery is based on an absolute difference of 0.40 crabs per pot (Table 32).

The estimated CPUE for legal retained males from the Bering Sea *C. angulatus* fishery is problematic. The relative difference between the estimated CPUE and the AOF CPUE of 26% is based on an absolute difference of 5 crabs per pot (25.3 vs 20.1, Table 73). One possible explanation for the lack of agreement between the estimates is that the 179 pots sampled by observers were not enough to capture the variability of the overall catch from the single catcher vessel which participated in this fishery. Alternatively, there may have been an error in recording the pots pulled data on the Confidential Interview. A vessel will often fish for several species of deep-water crabs on the same trip. *C. angulatus* caught as bycatch in a string targeting another species will be added to the total catch for the *C. angulatus* fishery although the effort (pots pulled) may not. In such a scenario the CPUE is mistakenly inflated.

Comparison of CPUE estimates based on observer data for retained legal crabs with the ATF CPUE in fisheries with partial observer coverage (Table 76) indicates that partial observer coverage provided adequate data for estimation of CPUE for the entire fishery in the St. Matthew District blue king crab fishery. It is noteworthy that observers deployed only on the three catcher-processors in that fishery and sampling only 95 pots provided adequate data to accurately (within 6%) estimate the retained legal CPUE for the entire fishery.

The most accurate CPUE estimates were for the Adak Area brown king crab fishery, in which the observer-based CPUE estimate differed from the AOF CPUE by less than 1%. CPUE estimates for the 1994-95 Adak brown king crab fishery differed from ATF CPUE estimates by more than 37% in a fishery with partial observer coverage (Boyle et al., 1996). That fishery had observers deployed on only 12% of the vessels participating. Observer coverage was increased to 100% coverage for the 1995-96 fishery, resulting in more accurate and precise estimates, as the estimated standard error dropped from 0.23 crabs per pot to 0.06 crabs per pot (Table 27).

The "stratified" CPUE estimator used in this report is different from the "sample" CPUE estimate used in past Mandatory Shellfish Observer Database Summaries (e.g., Tracy 1994, 1995a,b). Although the "stratified" estimation method can provide more accurate and precise estimates, the "stratified" and "sample" CPUE estimates are generally very close to each other. Therefore the "stratified" estimates presented here are comparable to those CPUE estimates included in previous observer data summaries. The value of using the "stratified" CPUE estimates is that the estimation method allows for computation of the standard errors of the estimates.

The standard errors of estimates provided in this report give a measure of the precision or repeatability of the CPUE estimates. Generally, the stratified CPUE estimates appear to be precise, as reflected in the relatively small standard errors. We did not compute confidence intervals for the CPUE estimates as the sample size within each stratum (vessel-day) was not large enough to assume an asymptotic normal distribution. However, bootstrap simulation of observer data collected in the 1995 Bering Sea and Aleutian Islands crab fisheries suggests that the stratified CPUE estimates plus or minus two standard errors was adequate to characterize the true CPUE of the targeted species (Byrne and Pengilly 1997).

It is worth noting that the CPUE estimates based on observer data for retained legal crabs in the Bering Sea *C. bairdi*, Bering Sea Korean hair crab, Bering Sea *C. tanneri*, Eastern Aleutian Area *C. tanneri,* and Bering Sea *C. angulatus* fisheries differ from the AOF CPUE by more than three standard errors. That situation may indicate that slight biases exist in the estimates of CPUE provided by either or both of the observer data or the confidential interviews.

LITERATURE CITED

Alaska Department of Fish and Game. 1993. ADF&G Observer Manual for Alaskan Crab Processors. Third Edition.

Boyle, L., Byrne, L.C., Moore, H., and Pengilly, D. 1996. Alaska Department of Fish and Game Summary of the 1995 Mandatory Shellfish Observer Program Database. Regional Information Report 4K96-47. Kodiak. 140 pp.

Byrne, L. C. and D. Pengilly. 1997. Estimates of CPUE for the 1995 crab fisheries of the Bering Sea and Aleutian Islands based on observer data. Proceedings of the 15th Lowell Wakefield Fisheries Symposium. Fishery Stock Assessment Models for the 21st Century. University of Alaska Sea Grant College Program. (In Press).

Cochran, W.G. 1977. Sampling Techniques. John Wiley and Sons. New York. 428 pp.

Alaska Department of Fish and Game, Westward Region staff. 1997. Annual management report of the 1996 Westward Region shellfish fisheries. Regional Information Report No. 4K97-41. ADF&G, Kodiak. 264 pp.

Tracy, D. A. 1994. Alaska Department of Fish and Game Summary of the 1992 Mandatory Shellfish Observer Program Database. Regional Information Report 4K94-10. ADF&G, Kodiak. 116 pp.

Tracy, D. A. 1995a. Alaska Department of Fish and Game Summary of the 1993 Mandatory Shellfish Observer Program Database. Regional Information Report 4K95-14. ADF&G, Kodiak. 128 pp.

Tracy, D. A. 1995b. Alaska Department of Fish and Game Summary of the 1994 Mandatory Shellfish Observer Program Database. Regional Information Report 4K95-32. ADF&G, Kodiak. 96 pp.

Table 1. Retained *Chionoecetes opilio* mean carapace width and shell age statistics by processor type from the 1996 Bering Sea *C. opilio* fishery.

Sample Type	Sample Size	Mean Width	Shell Age (%)			
			Soft	New	Old	Very Old
Catcher Processor	47,188	106.5 mm	<0.1	67.0	28.5	4.5
Floating Processor	31,459	108.8 mm	-	82.7	16.3	1.0
Shoreside Processor	18,349	108.0 mm	-	86.4	13.2	0.4
Totals	96,996	107.5 mm	<0.1	75.8	21.6	2.6

Table 2. Retained *Chionoecetes opilio* carapace width frequencies from the Bering Sea *C. opilio* fisheries, 1993-1996.

Width (mm)	1993		1994		1995		1996	
	Num. Crab	Percent	Num. Crab	Percent	Num. Crab	Percent	Num. Crab	Percent
86-90	752	0.3	1,590	0.9	1,655	1.6	1,991	2.0
91-95	1,194	0.8	4,333	2.5	4,713	4.5	5,058	5.2
96-100	5,196	2.1	13,435	7.8	11,784	11.1	12,073	12.4
101-105	14,474	5.8	29,095	16.8	20,050	19.0	19,803	20.4
106-110	33,958	13.6	37,902	21.9	21,442	20.3	20,572	21.2
111-115	51,358	20.5	37,157	21.4	18,824	17.8	17,018	17.5
116-120	59,911	23.9	27,721	16.0	13,817	13.0	11,317	11.7
121-125	47,999	19.2	14,512	8.4	8,006	7.6	5,620	5.8
126-130	24,657	9.8	5,127	3.0	3,062	2.9	1,822	1.9
131-135	7,952	3.2	1,080	0.6	756	0.7	400	0.4
Totals	247,451	99.2	171,952	99.3	104,109	98.5	95,674	98.5
	Mean width = 111.6 mm		Mean width = 110.4 mm		Mean width = 110.0 mm		Mean width = 107.5 mm	

Table 3. Summary of illegally retained crabs observed during the 1996 Bering Sea *Chionoecetes opilio* fishery.

Sample Location	Sample Size	Male		Female		Other Crabs[a]	Total Percent Illegal	Number Crabs Harvested[b]	Estimated Number Illegal Crabs[c]	Percent Harvest Sampled
		Number	Percent	Number	Percent					
Catcher Processor	275,251	785	0.3	16	<0.1	723	0.6	7,622,835	41,926	3.6
Floating Processor	184,727	242	0.1	36	<0.1	595	0.5	25,367,766	119,229	0.7
Totals	459,978	1,027	0.2	52	<0.1	1,318	0.5	32,990,601	171,551	1.4

[a] Other illegal crabs primarily male *C. bairdi*.

[b] ADF&G, Westward Region staff 1997

[c] Estimates derived from percentages of illegal crabs from sample locations multiplied by number of crabs harvested in the fishery.

Table 4. Estimated catch per pot (CPUE) of selected crab species from potlifts sampled by observers deployed on catcher-processors during the 1996 Bering Sea *Chionoecetes opilio* fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from 1,348 potlifts sampled from all 15 catcher-processors that participated in the fishery.

Species / Sex Class	Total Pot Sample Catch	Estimated CPUE For Sampled Fleet	Estimated Total Fishery Catch [a]
C. opilio			
retained males	165,219	117.90 (2.44) [b]	61,385,000 [c]
legal males	263,204	193.25 (3.40)	100,616,000
sublegal males	14,838	11.06 (0.55)	5,758,000
females	563	0.42 [d]	219,000
C. bairdi			
legal males	1,137	0.84 [d]	439,000
sublegal males	5,329	3.84 (0.27)	2,000,000
females	1,947	1.47 (0.32)	765,000
opilio x bairdi hybrid			
legal males	10,943	7.61 (0.39)	3,962,000
sublegal males	1,130	0.84 [d]	437,000
females	44	0.03 [d]	17,000

[a] Estimated CPUE multiplied by 520,651 total pot lifts (ADF&G, Westward Region staff 1997) during fishery.

[b] Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 120.46 for observed vessels; actual total fishery CPUE of retained legal crabs was 102 for all vessels (ADF&G, Westward Region staff 1997).

[c] Actual catch of retained legal crabs for the fishery was 52,912,823 (ADF&G, Westward Region staff 1997).

[d] CPUE computed as total pot sample catch divided by 1,348 pots sampled; standard errors of estimates were not computed.

Table 5. Shell age statistics for all *Chionoecetes opilio* males and females observed in the Bering Sea *C. opilio* fisheries, 1993-1996.

Fishery Year	Sample Size[a]	Shell Age Classes					
		New	% Total	Old	% Total	Very Old	% Total
1993							
Males	135,989	121,809	89.6	13,227	9.7	953	0.7
Females	1,919	199	10.4	1,123	58.5	597	31.1
1994							
Males	167,443	156,555	93.5	9,942	5.9	946	0.6
Females	1,273	62	4.9	929	73.0	282	22.2
1995							
Males	54,165	47,021	86.8	6,597	12.2	547	1.0
Females	539	74	13.7	328	60.8	137	25.4
1996							
Males	76,028	54,249	71.4	18,163	23.9	3,570	4.7
Females	136	49	36.0	46	33.8	41	30.1

[a] Crab measured from random pots sampled by observers, including soft shelled crabs.

Table 6. Summary of the reproductive status of female *Chionoecetes opilio* observed in the Bering Sea *C. opilio* fisheries, 1993-1996.

Year	Eyed Eggs	Percent Total	Uneyed Eggs	Percent Total	Barren, Mated	Percent Total	Barren, Non-mated	Percent Total
1993	979	51.0	172	9.0	455	23.7	312	16.3
1994	800	64.0	60	4.8	116	9.3	273	21.9
1995	340	80.4	53	12.5	26	6.2	4	1.0
1996	81	59.6	5	3.7	22	16.2	28	20.6
Totals	2,200	59.0	290	7.8	619	16.7	617	16.6

Table 7. Retained *Chionoecetes bairdi* mean carapace width and shell age statistics by processor type from the 1996 Bering Sea *C. bairdi* fishery.

Sample Type	Sample Size	Mean Width	Shell Age (%)			
			Soft	New	Old	Very Old
Catcher Processor		CONFIDENTIAL				
Floating Processor	787	155.6 mm	0.0	13.0	87.0	0.0
Shoreside Processor	2,541	151.5 mm	0.0	63.7	36.0	0.3
Totals		CONFIDENTIAL				

Table 8. Retained *Chionoecetes bairdi* carapace width frequencies from the Bering Sea *C. bairdi* fisheries, 1993-1996.

Width (mm)	1993		1994		1995		1996	
	Num. Crab	Percent	Num. Crab	Percent	Num. Crab	Percent	Num. Crab	Percent
131-135	306	0.4	115	0.4	64	0.3	30	0.7
136-140	7,270	10.2	3,073	11.1	2,601	13.5	358	8.1
141-145	15,047	21.0	6,173	22.3	4,531	23.5	788	17.8
146-150	15,507	21.6	6,202	22.4	4,279	22.2	843	19.0
151-155	13,838	19.3	5,284	19.1	3,555	18.4	864	19.5
156-160	10,156	14.2	3,678	13.3	2,349	12.2	740	16.7
161-165	5,717	8.0	2,125	7.7	1,259	6.5	448	10.1
166-170	2,467	3.4	761	2.7	454	2.4	241	5.4
171-175	1,010	1.4	185	0.7	134	0.7	85	1.9
176-180	196	0.3	30	0.1	28	0.2	20	0.4
Totals	71,514	99.8	27,626	99.8	19,254	99.9	4,417	99.6
	Mean width = 150.7 mm		Mean width = 150.0 mm		Mean width = 149.3 mm		Mean width = 152.1 mm	

Table 9. Summary of illegally retained crabs observed during the 1996 Bering Sea *Chionoecetes bairdi* fishery.

Sample Location	Sample Size	Male		Female		Other Crabs	Total Percent Illegal	Number Crabs Harvested[a]	Estimated Number Illegal Crabs[b]	Percent Harvest Sampled
		Number	Percent	Number	Percent					
Catcher Processor	CONFIDENTIAL									
Floating Processor	2,071	2	0.1	0	-	0	0.6	3,350[c]	3	62.9
Totals	CONFIDENTIAL									

[a] ADF&G, Westward Region staff 1997

[b] Estimates derived from percentages of illegal crabs from sample locations multiplied by number of crabs harvested in the fishery.

[c] Preliminary numbers

Table 11. Shell age statistics for all *Chionoecetes bairdi* males and females observed in the Bering Sea *C. bairdi* fisheries, 1993-1996

Fishery Year	Sample Size[a]	Shell Age Classes					
		New	% Total	Old	% Total	Very Old	% Total
1993							
Males	40,385	34,019	84.2	5,837	14.4	529	1.3
Females	10,471	1,248	11.9	7,054	67.4	2,169	20.7
1994							
Males	5,791	4,948	85.4	777	13.4	66	1.1
Females	2,132	218	10.2	1,720	80.7	194	9.1
1995							
Males	5,590	1,752	31.3	3,432	61.4	406	7.3
Females	3,208	464	14.5	1,089	33.9	1,655	51.6
1996							
Males		CONFIDENTIAL					
Females							

[a] Crab measured from random pots sampled by observers, including soft shelled crabs.

Table 12. Summary of the reproductive status of female *Chionoecetes bairdi* observed in the Bering Sea *C. bairdi* fisheries, 1993-1996.

Year	Eyed Eggs	Percent Total	Uneyed Eggs	Percent Total	Barren, Mated	Percent Total	Barren, Non-mated	Percent Total
1993	7,596	72.5	2,395	22.9	197	1.9	286	2.7
1994	423	20.0	1,602	75.8	51	2.4	38	1.8
1995	176	5.5	2,796	87.2	117	3.7	117	3.6
1996				CONFIDENTIAL				
Totals				CONFIDENTIAL				

Table 13. Retained blue king crab mean carapace length and shell age statistics by processor type from the 1996 St. Matthew District blue king crab fishery.

Sample Type	Sample Size	Mean Length	Shell Age (%)			
			Soft	New	Old	Very Old
Catcher Processor	443	135.1 mm	0.0	22.8	69.3	7.9
Floating Processor	1,829	137.6 mm	0.0	80.2	18.2	1.6
Shoreside Processor	2,858	132.6 mm	0.0	99.7	0.3	0.0
Totals	5,130	134.6 mm	0.0	85.7	12.9	1.3

Table 14. Retained blue king crab carapace length frequencies from the St. Matthew District blue king crab fisheries, 1993-1996.

Length (mm)	1993		1994		1995		1996	
	Num. Crab	Percent	Num. Crab	Percent	Num. Crab	Percent	Num. Crab	Percent
111-115	13	0.1	15	0.1			2	<0.1
116-120	201	1.7	315	2.8			163	3.2
121-125	1,193	9.9	1,445	12.9			653	12.3
126-130	2,168	18.1	2,505	22.4			886	17.3
131-135	2,666	22.3	2,735	24.4	CONFIDENTIAL		1,120	21.8
136-140	2,478	20.7	2,209	19.7			1,019	19.9
141-145	1,842	15.4	1,228	10.9			717	13.9
146-150	976	8.2	533	4.8			394	7.7
151-155	333	2.8	147	1.3			128	2.5
156-160	74	0.6	48	0.4			36	0.7
Totals	11,944	99.8	11,180	99.7			5,118	99.3
	Mean length = 135.4 mm		Mean length = 133.3 mm				Mean lenght = 134.6 mm	

Table 15. Estimated catch per pot (CPUE) of selected crab species from potlifts sampled by observers during the 1996 St. Matthew Island District blue king crab *Paralithodes platypus* fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from 95 potlifts sampled from the 3 catcher-processor vessels that participated in the fishery.

Species / Sex Class	Total Pot Sample Catch	Estimated CPUE For Sampled Fleet	Estimated Total Fishery Catch [a]
P. platypus			
legal males	617	6.61 (0.48) [b]	603,000 [c]
sublegal males	640	6.87 (0.63)	627,000
females	509	4.88 (0.75)	445,000
C. opilio			
legal males	1,308	11.04 (2.14)	1,007,000
sublegal males	2,702	29.76 (6.14)	2,714,000
females	10	0.05 [d]	4,600

[a] Estimated CPUE multiplied by 91,205 total pot lifts (ADF&G, Westward Region staff 1997) during fishery.

[b] Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 6.26 for observed vessels; actual total fishery CPUE of retained legal crabs was 7 for all vessels (ADF&G, Westward Region staff 1997).

[c] Actual catch of retained legal crabs for the fishery was 661,115 (ADF&G, Westward Region staff 1997).

[d] CPUE computed as total pot sample catch divided by 95 pots sampled; standard errors of estimates were not computed.

Table 16. Shell age statistics for all blue king crab males and females observed in the St. Matthew District blue king crab fisheries, 1993-1996.

Fishery Year	Sample Size[a]	Shell Age Classes					
		New	% Total	Old	% Total	Very Old	% Total
1993							
Males	2,797	2,555	91.4	239	8.5	3	<0.1
Females	2,721	1,734	63.7	968	35.6	19	0.7
1994							
Males	6,054	5,960	98.4	90	1.5	0	-
Females	5,107	4,285	83.9	818	16.0	4	<0.1
1995							
Males		CONFIDENTIAL					
Females							
1996							
Males	555	305	54.9	238	42.9	12	2.2
Females	233	58	24.9	163	69.9	12	5.2

[a] Crab measured from random pots sampled by observers, including soft shelled crabs.

Table 17. Summary of the reproductive status of female blue king crab observed in the St. Matthew District blue king crab fisheries, 1993-1996.

Year	Eyed Eggs	Percent Total	Uneyed Eggs	Percent Total	Barren, Mated	Percent Total	Barren, Non-mated	Percent Total
1993	0	-	0	-	1,957	71.9	763	28.0
1994	0	-	2	<0.1	3,443	67.4	1,661	32.5
1995	CONFIDENTIAL							
1996	0	-	0	-	165	70.8	68	29.2
Totals	CONFIDENDTIAL							

Table 18. Summary of illegally retained crabs observed during the 1996 St. Matthew District blue king crab fishery.

Sample Location	Sample Size	Male		Female		Other Crabs	Total Percent Illegal	Number Crabs Harvested[a]	Estimated Number Illegal Crabs[b]	Percent Harvest Sampled
		Number	Percent	Number	Percent					
Catcher Processor	9,081	39	0.4	5	0.06	4	0.5	37,682	200	24.1
Floating Processor	39,667	323	0.8	78	0.20	71	1.2	332,405	3,956	11.9
Totals	48,748	362	0.7	83	0.2	75	1.1	370,087	3,960	13.2

[a] ADF&G, Westward Region staff 1997

[b] Estimates derived from percentages of illegal crabs from sample locations multiplied by number of crabs harvested in the fishery.

Table 19. Retained red king crab mean carapace length and shell age statistics by processor type from the 1996 Bristol Bay red king crab fishery.

Sample Type	Sample Size	Mean Length	Shell Age (%)			
			Soft	New	Old	Very Old
Catcher Processor	1,374	152.6mm	0.0	74.3	22.7	2.9
Floating Processor	1,740	152.3mm	0.0	61.2	36.8	2.0
Shoreside Processor	5,782	152.8mm	0.0	80.5	18.2	1.3
Totals	8,896	152.6mm	0.0	75.8	22.5	1.7

Table 20. Retained red king crab carapace length frequencies from the 1996 Bristol Bay red king crab fishery.

Length (mm)	1996	
	Num. Crab	Percent
131-135	201	2.3
136-140	842	9.5
141-145	1,302	14.6
146-150	1,511	16.9
151-155	1,572	17.7
156-160	1,427	16.0
161-165	1,049	11.8
166-170	591	6.6
171-175	266	2.9
176-180	90	1.0
Totals	8,851	99.30
	Mean length = 152.6 mm	

Table 21. Estimated catch per pot (CPUE) of selected crab species from potlifts sampled by observers during the 1996 Bristol Bay red king crab *Paralithodes camtschaticus* fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from 175 potlifts sampled from the 4 catcher-processor vessels that participated in the fishery.

Species / Sex Class	Total Pot Sample Catch	Estimated CPUE For Sampled Fleet	Estimated Total Fishery Catch [a]
P. camtschaticus			
legal males	1,152	13.31 (0.87) [b]	1,017,000 [c]
sublegal males	626	7.78 (1.08)	595,000
females	11	0.13 [d]	10,000
C. bairdi			
legal males	240	2.74 (0.41)	210,000
sublegal males	42	0.50 [d]	38,000
females	10	0.14 [d]	10,700

[a] Estimated CPUE multiplied by 76,433 total pot lifts (ADF&G, Westward Region staff 1997) during fishery.

[b] Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 12.58 for observed vessels; actual total fishery CPUE of retained legal crabs was 16 for all vessels (ADF&G, Westward Region staff 1997).

[c] Actual catch of retained legal crabs for the fishery was 1,266,048 (ADF&G, Westward Region staff 1997).

[d] CPUE computed as total pot sample catch divided by 84 pots sampled; standard errors of estimates were not computed.

Table 22. Shell age statistics for all red king crab males and females observed in the 1996 Bristol Bay red king crab fishery.

Fishery Year	Sample Size[a]	Shell Age Classes					
		New	% Total	Old	% Total	Very Old	% Total
Males	642	539	83.9	97	15.1	6	0.9
Females	11	11	100.0	-	-	-	-

[a] Crab measured from random pots sampled by observers, including soft shelled crabs.

Table 23. Summary of illegally retained crabs observed during the 1996 Bristol Bay red king crab fishery.

Sample Location	Sample Size	Male		Female		Other Crabs	Total Percent Illegal	Number Crabs Harvested[a]	Estimated Number Illegal Crabs[b]	Percent Harvest Sampled
		Number	Percent	Number	Percent					
Catcher Processor	10,764	53	0.5	3	<0.1	8	0.6	61,286	362	17.6
Floating Processor	15,433	56	0.4	8	<0.1	0	0.4	196,431	805	7.9
Totals	26,197	109	0.4	11	<0.1	8	0.5	257,717	1,263	10.2

[a] ADF&G, Westward Region staff 1997

[b] Estimates derived from percentages of illegal crabs from sample locations multiplied by number of crabs harvested in the fishery.

Table 24. Retained brown king crab mean carapace length and shell age statistics by processor type from the Adak Area brown king crab fishery, 1995-96.

Sample Type	Sample Size	Mean Length	Shell Age (%)			
			Soft	New	Old	Very Old
Catcher Processor		CONFIDENTIAL				
Catcher Vessel	9,847	147.8 mm	0.0	91.9	7.6	0.4
Shoreside Processor	1,241	147.8 mm	0.0	95.1	4.9	0.0
Totals		CONFIDENTIAL				

Table 25. Retained brown king crab carapace length frequencies from the Adak Area brown king crab fisheries, 1993-1996.

Length (mm)	1993		1994		1995		1996	
	Num. Crab	Percent	Num. Crab	Percent	Num. Crab	Percent	Num. Crab	Percent
126-130			35	0.2	74	0.2	73	0.4
131-135			793	3.9	1,513	4.4	1,006	5.6
136-140			3,456	16.9	6,276	18.4	3,307	18.5
141-145			5,006	24.5	7,895	23.2	4,497	25.2
146-150	CONFIDENTIAL		4,471	21.9	6,967	20.5	3,518	19.7
151-155			3,048	14.9	4,679	13.7	2,210	12.4
156-160			1,691	8.3	3,001	8.8	1,392	7.8
161-165			1,038	5.1	1,829	5.4	930	5.2
166-170			539	2.6	1,004	2.9	491	2.8
171-175			224	1.1	533	1.6	238	1.3
Totals			20,301	99.4	33,771	99.1	17,662	98.9
			Mean length = 147.8 mm		Mean length = 147.8 mm		Mean length = 147.3 mm	

Table 26. Summary of illegally retained crabs observed during the Adak Area brown king crab fishery, 1995-96.

Sample Location	Sample Size	Male		Female		Other Crabs	Total Percent Illegal	Number Crabs Harvested[a]	Estimated Number Illegal Crabs[b]	Percent Harvest Sampled
		Number	Percent	Number	Percent					
Catcher Processor			CONFIDENTIAL							
Catcher Vessel	61,020	588	1.0	52	0.1	1	1.1	1,040,093	10,920	5.9
Totals			CONFIDENTIAL							

[a] ADF&G, Westward Region staff 1997

[b] Estimates derived from percentages of illegal crabs from sample locations multiplied by number of crabs harvested in the fishery.

Table 28. Shell age statistics for all brown king crab males and females observed in the Adak Area brown king crab fisheries, 1993-1996.

Fishery Year	Sample Size[a]	Shell Age Classes					
		New	% Total	Old	% Total	Very Old	% Total
1993							
Males				CONFIDENTIAL			
Females							
1994							
Males	5,578	5,424	97.2	154	2.7	0	-
Females	3,462	3,429	99.0	32	0.9	1	<0.1
1995							
Males	26,193	25,314	96.6	853	3.3	26	0.1
Females	12,294	11,656	94.8	626	5.1	12	0.1
1996							
Males	188,858	178,790	94.7	9,365	4.9	616	0.3
Females	134,800	121,932	90.5	12,574	9.3	240	0.2

[a] Crab measured from random pots sampled by observers, including soft shelled crabs.

Table 29. Summary of the reproductive status of female brown king crab observed in the Adak Area brown king crab fisheries, 1993-1996.

Year	Eyed Eggs	Percent Total	Uneyed Eggs	Percent Total	Barren, Mated	Percent Total	Barren, Non-mated	Percent Total
1993				CONFIDENTIAL				
1994	507	14.6	1,075	31.1	757	21.9	1,122	32.4
1995	3,779	30.6	2,923	23.7	1,661	13.5	3,969	32.2
1996	32,332	24.0	35,148	26.1	26,415	19.6	40,823	30.3
Totals				CONFIDENTIAL				

Table 36. Retained Korean hair crab mean carapace length and shell age statistics by processor type from the 1996 Bering Sea Korean hair crab fishery.

Sample Type	Sample Size	Mean Length	Shell Age (%)			
			Soft	New	Old	Very Old
Catcher Vessel	5,604	92.9 mm	0.2	82.7	16.1	1.1

Table 37. Retained Korean hair crab carapace length frequencies from the Bering Sea Korean hair crab fisheries, 1993-1996.

Length (mm)	1993		1994		1995		1996	
	Num. Crab	Percent	Num. Crab	Percent	Num. Crab	Percent	Num. Crab	Percent
61-65	0	-	0	-	1	<0.1	0	-
66-70	8	0.1	0	-	0	-	0	-
71-75	126	0.9	19	0.3	40	0.5	17	0.3
76-80	1.,337	9.2	321	5.0	450	6.0	185	3.3
81-85	3,263	22.5	945	14.7	968	12.9	570	10.2
86-90	4,760	32.9	1,603	25.0	1,721	23.0	1,132	20.2
91-95	3,563	24.6	1,913	29.8	2,166	28.9	1,629	29.2
96-100	1,237	8.6	1,191	18.6	1,515	20.3	1,412	25.2
101-105	161	1.1	392	6.1	530	7.1	567	10.1
106-110	12	0.1	31	0.5	86	1.2	85	1.5
Totals	13,468	100.0	6,415	100.0	7,477	99.9	5,597	100.0
	Mean length = 88.0 mm		Mean length = 91.0 mm		Mean length = 91.3 mm		Mean length = 92.9 mm	

Table 38. Estimated catch per pot (CPUE) of selected crab species from potlifts sampled by observers during the 1996 Bering Sea Korean hair crab *Erimacrus isenbeckii* fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from 9,192 potlifts sampled from all 18 catcher vessels that participated in the fishery.

Species / Sex Class	Total Pot Sample Catch	Estimated CPUE For Sampled Fleet	Estimated Total Fishery Catch [a]
E. isenbeckii			
legal males	14,001	1.55 (0.02) [b]	620,000 [c]
sublegal males	826	0.09 [d]	36,000
females	1,090	0.12 [d]	48,000

[a] Estimated CPUE multiplied by 398,136 total pot lifts during fishery as reported on confidential interview forms.

[b] Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 1.33; actual total fishery CPUE of retained legal crabs was 1.3 (ADF&G, Westward Region staff 1997).

[c] Actual catch of retained legal crabs for the fishery as reported on confidential interview forms was 505,748.

[d] CPUE computed as total pot sample catch divided by 9,192 pots sampled; standard errors of estimates were not computed.

Table 39. Shell age statistics for all Korean hair crab males and females observed in the Bering Sea Korean hair crab fisheries, 1993-1996.

Fishery Year	Sample Size[a]	Shell Age Classes					
		Soft	% Total	New	% Total	Old	% Total
1993							
Males	55,552	2,659	4.8	43,394	78.1	9,499	17.1
Females	4,418	21	0.5	4,089	92.6	308	6.9
1994							
Males	4,088	1	<0.1	3,437	84.1	650	15.9
Females	91	0	-	86	94.5	5	5.5
1995							
Males	13,587	2	<0.1	11,755	86.5	1,830	13.5
Females	706	0	-	644	91.2	62	8.8
1996							
Males	7,063	6	<0.1	4,499	63.7	2,558	36.2
Females	573	11	1.9	516	90.1	46	8.0

[a] Crab measured from random pots sampled by observers, including soft shelled crabs.

Table 40. Summary of the reproductive status of female Korean hair crab observed in the Bering Sea Korean hair crab fisheries, 1993-1996.

Year	Eyed Eggs	Percent Total	Uneyed Eggs	Percent Total	Barren, Mated	Percent Total	Barren, Non-mated	Percent Total
1993	117	2.7	24	0.6	842	19.2	3,414	77.6
1994	2	2.3	14	16.3	1	1.2	69	80.2
1995	94	13.6	18	2.6	148	21.4	432	62.4
1996	122	21.2	4	0.7	138	23.9	312	54.2
Totals	335	5.83	60	1.04	1,129	19.6	4,227	73.5

Table 41. Summary of illegally retained crabs observed during the 1996 Bering Sea Korean hair crab fishery.

Sample Location	Sample Size	Male		Female		Other Crabs	Total Percent Illegal	Number Crabs Harvested[a]	Estimated Number Illegal Crabs[b]	Percent Harvest Sampled
		Number	Percent	Number	Percent					
Catcher Vessel	43,098	133	0.3	18	<0.1	39	0.4	485,722	2,138	8.9

[a] ADF&G, Westward Region staff 1997

[b] Estimates derived from percentages of illegal crabs from sample locations multiplied by number of crabs harvested in the fishery.

Table 42. Retained *Chionoecetes tanneri* mean carapace width and shell age statistics by vessel type from the 1996 Bering Sea *C. tanneri* fishery.

Sample Type	Sample Size	Mean Width	Shell Age (%)			
			Soft	New	Old	Very Old
Catcher Vessel	391	145.6 mm	-	98.2	1.8	-

Table 43. Retained *Chionoecetes tanneri* carapace width frequencies from the Bering Sea *C. tanneri* fisheries, 1994-1996.

Width (mm)	1994		1995		1996	
	Num. Crab	Percent	Num. Crab	Percent	Num. Crab	Percent
121-125	61	4.5	200	4.0	11	2.8
126-130	161	11.8	457	9.1	60	15.4
131-135	213	15.6	652	13.1	48	12.3
136-140	241	17.7	681	13.6	46	11.8
141-145	188	13.8	653	13.1	33	8.4
146-150	137	10.1	598	12.0	28	7.2
151-155	131	9.6	573	11.5	48	12.3
156-160	101	7.4	537	10.8	40	10.2
161-165	70	5.1	380	7.6	47	12.0
166-170	44	3.2	189	3.8	22	5.6
Totals	1,347	98.8	4,920	98.6	383	98.0
	Mean width = 142.6 mm		Mean width = 144.8 mm		Mean width = 145.6 mm	

Table 44. Shell age statistics for all *Chionoecetes tanneri* males and females observed in the Bering Sea *C. tanneri* fisheries, 1994-1996.

Fishery Year	Sample Size[a]	Shell Age Classes					
		New	% Total	Old	% Total	Very Old	% Total
1994							
Males	5,747	5,112	88.9	430	7.5	83	1.4
Females	3,899	632	16.2	1,943	49.8	1,319	33.8
1995							
Males	39,335	34,653	87.9	4,442	11.3	240	0.6
Females	8,801	5,552	63.1	2,738	31.0	511	5.8
1996							
Males	3,569	3,403	94.6	191	5.4	0	-
Females	567	504	88.9	59	10.4	4	0.7

[a] Crab measured from random pots sampled by observers, including soft shelled crabs.

Table 45. Summary of illegally retained crabs observed during the 1996 Bering Sea *Chionoecetes tanneri* fishery.

Sample Location	Sample Size	Male		Female		Other Crabs	Total Percent Illegal	Number Crabs Harvested[a]	Estimated Number Illegal Crabs[b]	Percent Harvest Sampled
		Number	Percent	Number	Percent					
Catcher Vessel	4,594	7	0.2	0	-	0	0.2	49,849	75	9.2

[a] ADF&G, Westward Region staff 1997

[b] Estimates derived from percentages of illegal crabs from sample locations multiplied by number of crabs harvested in the fishery.

Table 46. Estimated catch per pot (CPUE) of selected crab species from potlifts sampled by observers during the 1996 Bering Sea *Chionoecetes tanneri* fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from 792 potlifts sampled from the 3 catcher vessels that participated in the fishery.

Species / Sex Class	Total Pot Sample Catch	Estimated CPUE For Sampled Fleet	Estimated Total Fishery Catch [a]
C. tanneri			
legal males	3,141	4.28 (0.17) [b]	62,000 [c]
sublegal males	459	0.58 [d]	8,400
females	570	0.72 [d]	10,400
C. angulatus			
legal males	1,138	1.31 (0.11)	19,000
sublegal males	778	0.98 [d]	14,200
females	21	0.03 [d]	400
L. couesi			
legal males	644	0.81 [d]	11,800
sublegal males	777	0.98 [d]	14,200
females	788	0.99 [d]	14,400

[a] Estimated CPUE multiplied by 14,504 total pot lifts during fishery as reported on confidential interview forms.

[b] Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 3.57; actual total fishery CPUE of retained legal crabs was 3 (ADF&G, Westward Region staff 1997).

[c] Actual catch of retained legal crabs for the fishery as reported on confidential interview forms was 53,906.

[d] CPUE computed as total pot sample catch divided by 792 pots sampled; standard errors of estimates were not computed.

Table 47. Summary of the reproductive status of female *Chionoecetes tanneri* observed in the Bering Sea *C. tanneri* fisheries, 1994-1996.

Year	Eyed Eggs	Percent Total	Uneyed Eggs	Percent Total	Barren, Mated	Percent Total	Barren, Non-mated	Percent Total
1994	343	8.8	3,303	84.7	63	1.6	188	4.8
1995	270	3.1	7,854	89.2	125	1.4	551	6.3
1996	246	43.3	228	40.1	30	5.3	65	11.4
Totals	859	6.5	11,385	85.8	218	1.6	804	6.1

Table 48. Retained *Chionoecetes tanneri* mean carapace width and shell age statistics by processor type from the1996 Eastern Aleutian Area *C. tanneri* fishery.

Sample Type	Sample Size	Mean Width	Shell Age (%)			
			Soft	New	Old	Very Old
Catcher Vessel	568	136.0 mm	-	69.7	28.2	2.1

Table 49. Retained *Chionoecetes tanneri* carapace width frequencies from the Eastern Aleutian Area *C. tanneri* fisheries, 1994-1996.

Width (mm)	1994		1995		1996	
	Num. Crab	Percent	Num. Crab	Percent	Num. Crab	Percent
121-125	373	6.8	495	9.6	78	13.7
126-130	525	9.6	614	11.9	91	16.0
131-135	776	14.2	874	17.0	132	23.2
136-140	1,219	22.3	992	17.9	98	17.3
141-145	1,232	22.6	733	14.3	71	12.5
146-150	803	14.7	532	10.4	33	5.8
151-155	295	5.4	370	7.2	30	5.3
156-160	131	2.4	245	4.8	12	2.1
161-165	42	0.8	135	2.6	10	1.8
166-170	15	0.3	65	1.3	2	0.3
Totals	5,411	99.1	5,055	97.0	557	98.0
	Mean width = 139.3 mm		Mean width = 139.1 mm		Mean width = 136.0 mm	

Table 50. Summary of illegally retained crabs observed during the 1996 Eastern Aleutian Area *Chionoecetes tanneri* fishery.

Sample Location	Sample Size	Male		Female		Other Crabs	Total Percent Illegal	Number Crabs Harvested[a]	Estimated Number Illegal Crabs[b]	Percent Harvest Sampled
		Number	Percent	Number	Percent					
Catcher Vessel	3,868	34	0.9	0	-	13	1.2	55,593	678	7.0

[a] ADF&G, Westward Region staff 1997

[b] Estimates derived from percentages of illegal crabs from sample locations multiplied by number of crabs harvested in the fishery.

Table 51. Estimated catch per pot (CPUE) of selected crab species from potlifts sampled by observers during the 1996 Eastern Aleutian Area *Chionoecetes tanneri* fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from 460 potlifts sampled from the 3 catcher vessels that participated in the fishery.

Species / Sex Class	Total Pot Sample Catch	Estimated CPUE For Sampled Fleet	Estimated Total Fishery Catch [a]
C. tanneri			
legal males	1,107	3.39 (0.39) [b]	51,200 [c]
sublegal males	843	3.14 (0.58)	47,400
females	1,622	5.44 (1.93)	82,100
L. couesi			
legal males	693	1.23 (0.09)	18,600
sublegal males	519	0.91 (0.09)	13,700
females	1,106	2.06 (0.21)	31,000

[a] Estimated CPUE multiplied by 15,091 total pot lifts during fishery as reported on confidential interview forms.

[b] Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 4.83.

[c] Actual catch of retained legal crabs for the fishery as reported on confidential interview forms was 53,906.

Table 52. Shell age statistics for all *Chionoecetes tanneri* males and females observed in the Eastern Aleutian Area *C. tanneri* fisheries, 1994-1996.

Fishery Year	Sample Size[a]	Shell Age Classes					
		New	% Total	Old	% Total	Very Old	% Total
1994							
Males	16,012	15,004	93.7	992	6.2	16	<0.1
Females	5,044	3,465	68.7	1,564	31.0	15	0.3
1995							
Males	41,339	30,446	73.6	10,584	25.6	299	0.7
Females	15,923	5,159	32.4	10,133	63.5	651	4.1
1996							
Males	1,942	1,339	68.9	569	29.3	34	1.8
Females	1,621	266	16.4	589	36.3	766	47.3

[a] Crab measured from random pots sampled by observers, including soft shelled crabs.

Table 53. Summary of the reproductive status of female *Chionoecetes tanneri* observed in the Eastern Aleutian Area *C. tanneri* fisheries, 1994-1996.

Year	Eyed Eggs	Percent Total	Uneyed Eggs	Percent Total	Barren, Mated	Percent Total	Barren, Non-mated	Percent Total
1994	219	4.3	4,798	95.1	9	0.2	17	0.3
1995	790	5.0	14,868	93.4	154	1.0	100	0.6
1996	503	31.1	927	57.4	138	8.5	48	3.0
Totals	1,512	6.7	20,593	91.2	301	1.3	165	0.7

Table 55. Retained *Chionoecetes tanneri* carapace width frequencies from the Western Aleutian Area *C. tanneri* fisheries, 1995-1996.

Width (mm)	1995		1996	
	Num. Crab	Percent	Num. Crab	Percent
121-125	44	3.31		
126-130	173	13.06		
131-135	286	21.57		
136-140	296	22.34		
141-145	247	18.63	CONFIDENTIAL	
146-150	150	11.31		
151-155	75	5.65		
156-160	30	2.25		
161-165	14	1.05		
166-170	2	0.15		
Totals	1,317	99.3		
	Mean width = 138.6 mm			

Table 58. Shell age statistics for all *Chionoecetes tanneri* males and females observed in the Western Aleutian Area *C. tanneri* fisheries, 1995-1996.

Fishery Year	Sample Size[a]	Shell Age Classes					
		New	% Total	Old	% Total	Very Old	% Total
1995							
Males	8,665	7,544	87.0	1,084	12.5	29	0.3
Females	5,922	4,730	79.9	1,188	20.0	4	<0.1
1996							
Males		CONFIDENTIAL					
Females							

[a] Crab measured from random pots sampled by observers, including soft shelled crabs.

Table 59. Summary of the reproductive status of female *Chionoecetes tanneri* observed in the Western Aleutian Area *C. tanneri* fisheries, 1995-1996.

Fishery Year	Eyed Eggs	Percent Total	Uneyed Eggs	Percent Total	Barren, Mated	Percent Total	Barren, Non-mated	Percent Total
1995	221	3.7	5,389	91.0	239	4.0	79	1.3
1996	CONFIDENTIAL							
Totals	CONFIDENTIAL							

Table 60. Retained *Chionoecetes tanneri* mean carapace width and shell age statistics by processor type from the1996 South Peninsula Area *C. tanneri* fishery.

Sample Type	Sample Size	Mean Width	Shell Age (%)			
			Soft	New	Old	Very Old
Catcher Vessel	1,648	134.0 mm	0.0	81.1	16.3	2.5

Table 61. Retained *Chionoecetes tanneri* carapace width frequencies from the South Peninsula Area *C. tanneri* fisheries, 1994-1996.

Width (mm)	1994		1995		1996	
	Num. Crab	Percent	Num. Crab	Percent	Num. Crab	Percent
121-125			1,990	26.9	245	14.9
126-130			1,704	23.0	266	16.1
131-135			1,172	15.8	341	20.7
136-140			1,149	15.5	322	19.5
141-145	CONFIDENTIAL		799	10.8	234	14.2
146-150			318	4.3	115	6.9
151-155			71	1.0	27	1.6
156-160			18	0.2	12	0.7
161-165			0	-	4	0.2
166-170			0	-	0	-
Totals			7,221	97.5	1,566	94.8
			Mean width = 131.6 mm		Mean width = 134.0 mm	

Table 62. Summary of illegally retained crabs observed during the 1996 South Peninsula Area *Chionoecetes tanneri* crab fishery.

Sample Location	Sample Size	Male		Female		Other Crabs	Total Percent Illegal	Number Crabs Harvested[a]	Estimated Number Illegal Crabs[b]	Percent Harvest Sampled
		Number	Percent	Number	Percent					
Catcher Vessel	10,017	114	1.1	1	<0.1	0	1.2	335,234	3,855	3.0

[a] ADF&G, Westward Region staff 1997

[b] Estimates derived from percentages of illegal crabs from sample locations multiplied by number of crabs harvested in the fishery.

Table 63. Estimated catch per pot (CPUE) of selected crab species from potlifts sampled by observers during the 1996 South Peninsula Area *Chionoecetes tanneri* fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from 1,567 potlifts sampled from the 6 catcher vessels that participated in the fishery.

Species / Sex Class	Total Pot Sample Catch	Estimated CPUE for Fishery	Estimated Fishery Catch [a]
C. tanneri			
legal males	30,036	16.91 (0.24) [b]	332,000
sublegal males	17,594	9.28 (0.18)	182,000
females	15,659	8.11 (0.77)	159,000

[a] Estimated CPUE multiplied by 19,642 total pot lifts during fishery as reported on confidential interview forms.

[b] Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 16.66.

[c] Actual catch of retained legal crabs for the fishery as reported on confidential interview forms was 327,325.

Table 64. Shell age statistics for all *Chionoecetes tanneri* males and females observed in the South Peninsula Area *C. tanneri* fisheries, 1994-1996.

Fishery Year	Sample Size[a]	Shell Age Classes					
		New	% Total	Old	% Total	Very Old	% Total
1994							
Males				CONFIDENTIAL			
Females							
1995							
Males	66,714	49,747	74.6	14,411	21.6	2,521	3.8
Females	14,374	10,142	70.6	3,962	27.5	270	1.9
1996							
Males	47,493	34,005	71.6	11,914	25.1	1,574	3.3
Females	15,628	2,631	16.8	12,712	81.3	285	1.8

[a] Crab measured from random pots sampled by observers, including soft shelled crabs.

Table 65. Summary of the reproductive status of female *Chionoecetes tanneri* observed in the South Peninsula Area *C. tanneri* fisheries, 1994-1996.

Year	Eyed Eggs	Percent Total	Uneyed Eggs	Percent Total	Barren, Mated	Percent Total	Barren, Non-mated	Percent Total
1994				CONFIDENTIAL				
1995	1,052	7.4	13,038	91.2	110	0.8	94	0.6
1996	4,528	29.2	10,539	67.9	364	2.3	96	0.6
Totals				CONFIDENTIAL				

Table 66. Retained *Chionoecetes angulatus* mean carapace width and shell age statistics by processor type from the 1996 Eastern Aleutian Area *C. angulatus* fishery.

Sample Type	Sample Size	Mean Width	Shell Age (%)			
			Soft	New	Old	Very Old
Catcher Vessel			CONFIDENTIAL			
Shoreside Processor	127	117.5 mm	0.0	100.0	0.0	0.0
Totals			CONFIDENTIAL			

Table 76. Observer coverage, pot sampling effort by observers, and relative difference of observer-based CPUE estimates for retained legal crabs from the Actual Observed Fleet CPUE and from the Actual Total Fishery CPUE. Data is from crab fisheries with mandatory observers and seasons ending in 1996.

Fishery (Table in report referenced)	Vessels		Pot lifts		Percent difference of observer-based CPUE estimate from:	
	Observed	Total Fishery	Sampled	Total Fishery	Actual Observed Fleet CPUE[a]	Actual Total Fishery CPUE[b]
Bering Sea *Chionoecetes opilio* (Table 4)	15	234[c]	1,358	520,651	-2.1%	15.6%
Bering Sea *C. bairdi* (Table 10)	2	196[c]	134	149,289	53.5%	-65.0%
St. Matthew District blue king crab (Table 15)	3	122[c]	95	91,205	5.6%	-5.6%
Bristol Bay red king crab (Table 21)	4	196[c]	84	76,433	5.8%	-16.8%
Adak Area brown king crab (Table 27)	25	25[c]	12,987	226,463	-0.6%	-[d]
Adak Area *Lithodes couesi* king crab(Table 32)	1	5		19,170	31.8%	-[d]
Bering Sea Korean hair crab (Table 38)	18	20	9,192	398,136	16.5%	-[d]
Bering Sea *C. tanneri* (Table 46)	21	21	10,117	447,555	19.9%	-[d]
Eastern Aleutians Area *C. tanneri* (Table 51)	3	3	460	15,091	-29.8%	-[d]
Western Aleutians Area *C. tanneri* (Table 57)	1	1	CONFIDENTIAL			-[d]
South Peninsula Area *C. tanneri* (Table 63)	6	7	1,579	19,642	1.5%	-[d]
Eastern Aleutians Area *C. angulatus* (Table 68)	2	2	CONFIDENTIAL			-[d]
Bering Sea *C. angulatus* (Table 73)	1	1	CONFIDENTIAL			-[d]

[a] Actual Observed Fleet CPUE is based on confidential interviews with the operators of observed vessels. Percent difference is computed as: {[(Observer-based CPUE)-(Confidential Interview CPUE)]/(Confidential Interview CPUE)} X 100%.

[b] Actual Total Fishery CPUE is based on fish ticket data on all landings in the fishery. Percent difference is computed as: {[(Observer-based CPUE)-(Fish Ticket CPUE)]/(Fish Ticket CPUE)} X 100%. Computed only for fisheries with partial observer coverage.

[c] ADF&G, Westward Region Staff, 1997.

[d] Fishery with 100% observer coverage. Comparison with observed fleet CPUE provides comparison with total fishery CPUE.

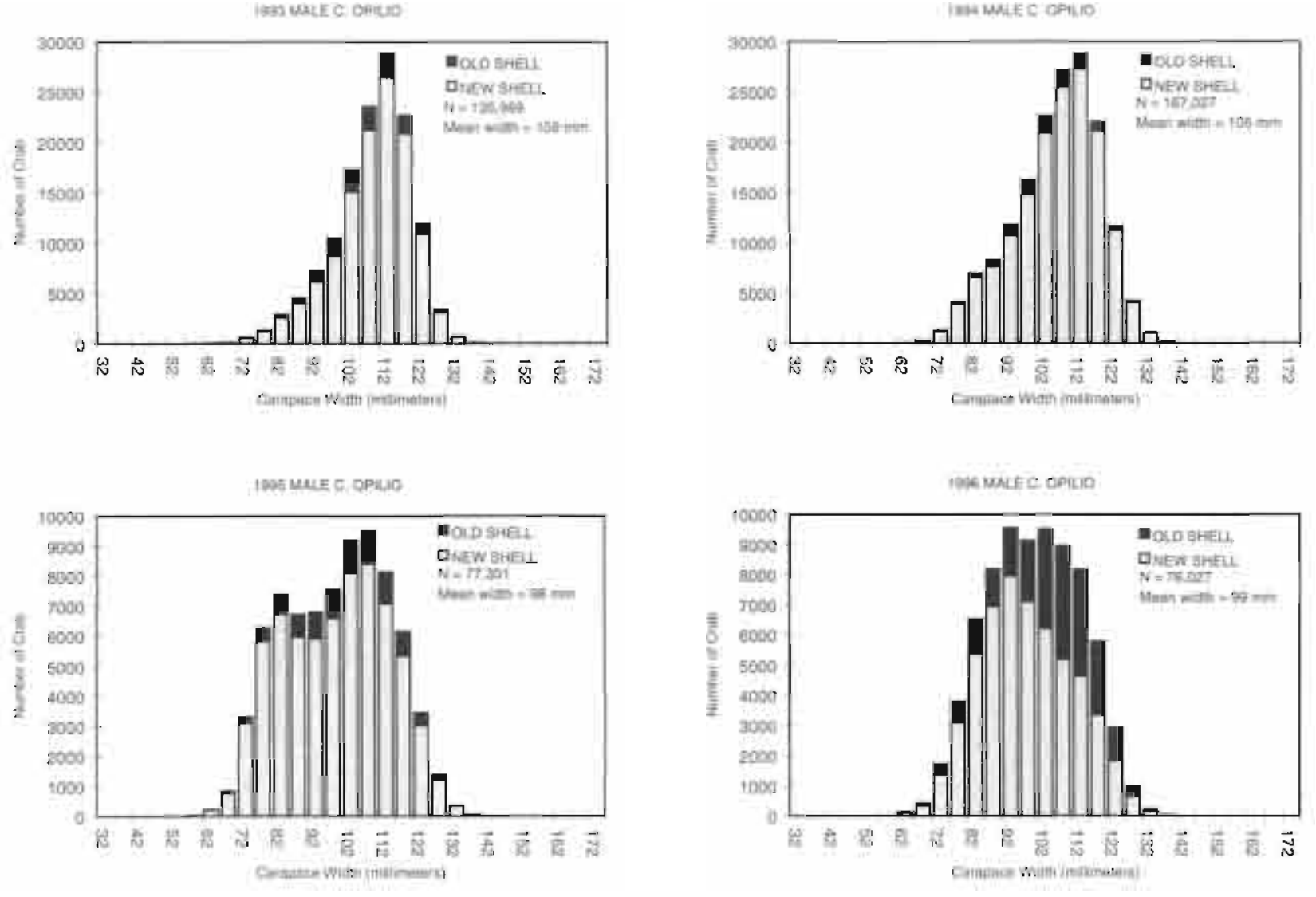


Figure 1. Carapace width distribution histograms of all *C. opilio* males observed in the Bering Sea fishery, 1993-1996.

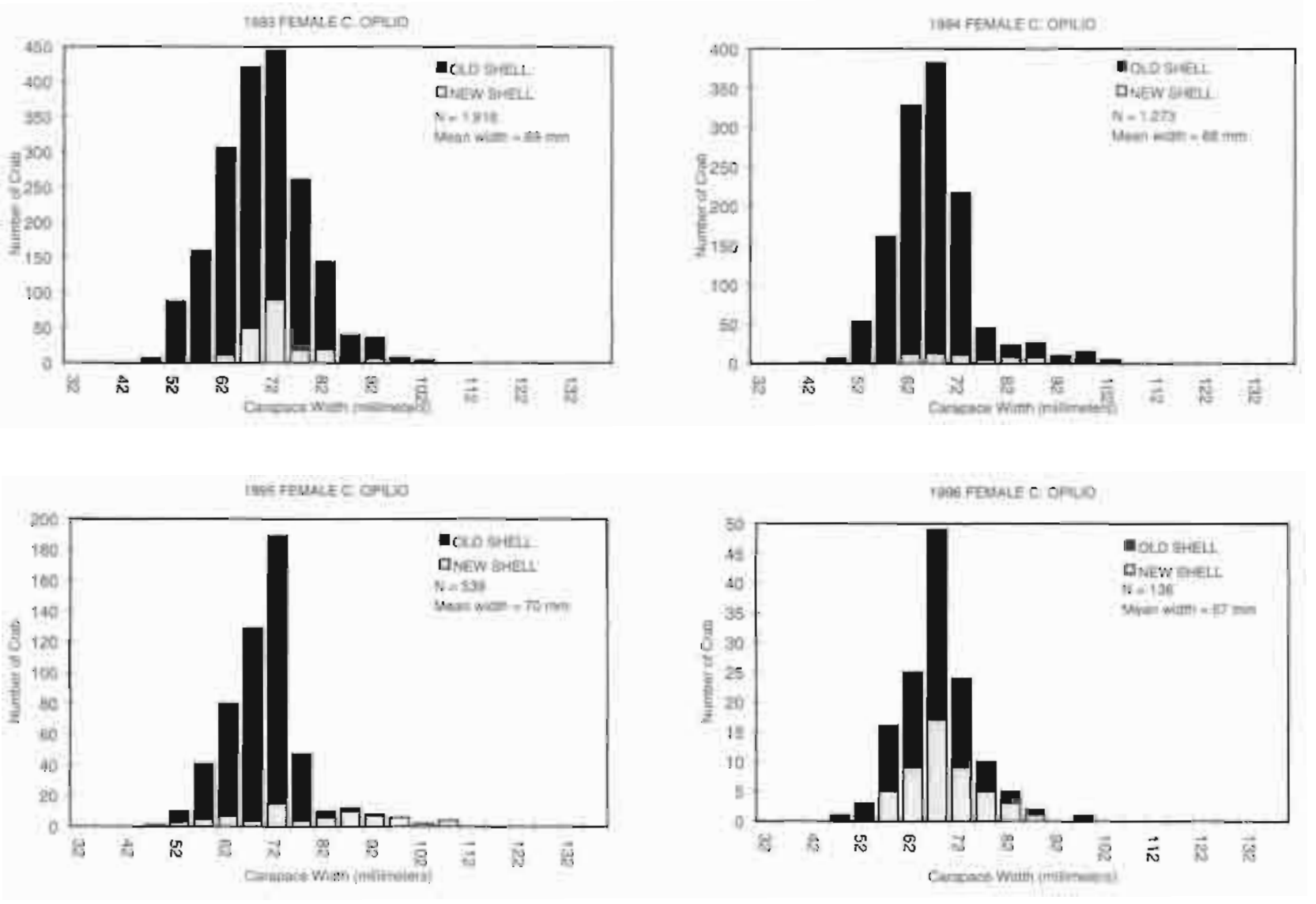


Figure 2. Carapace width distribution histograms of all *C. opilio* females observed in the Bering Sea fishery, 1993-1996.

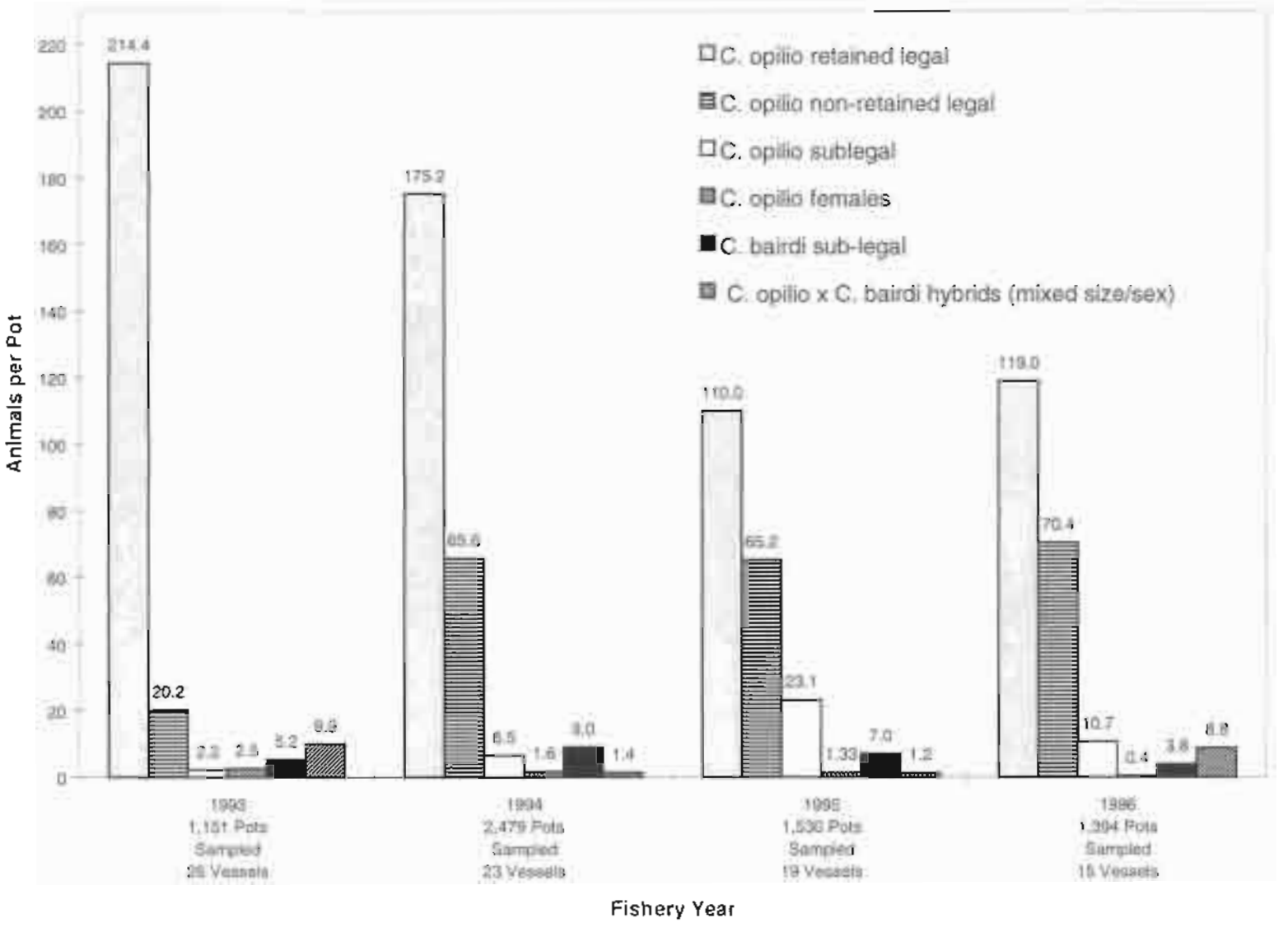


Figure 3. Catch per pot of selected species from the Bering Sea *C. opilio* fishery, 1993-1996.

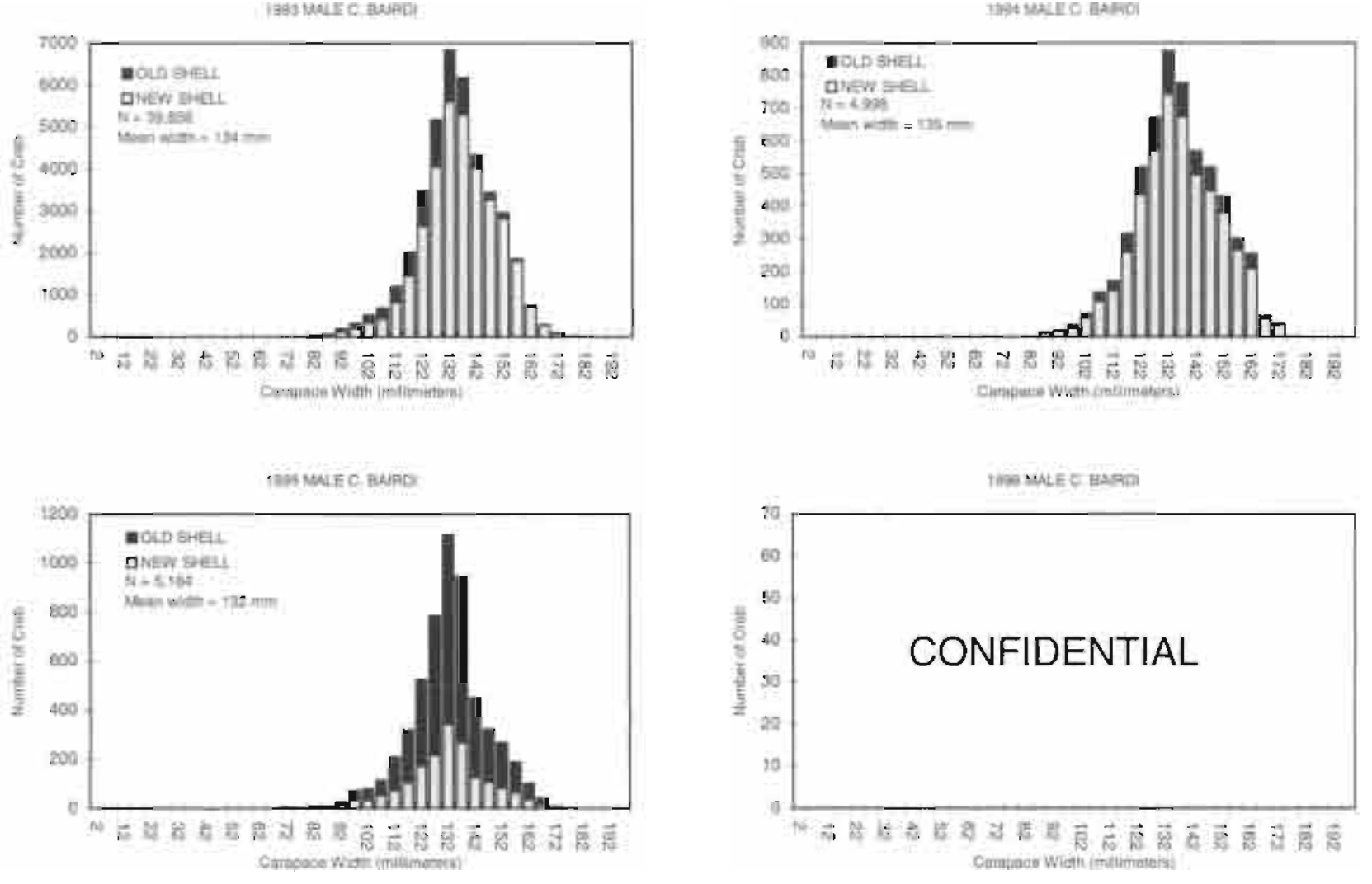


Figure 4. Carapace width distribution histograms of all *C. bairdi* males observed in the Bering Sea fishery, 1993-1996.

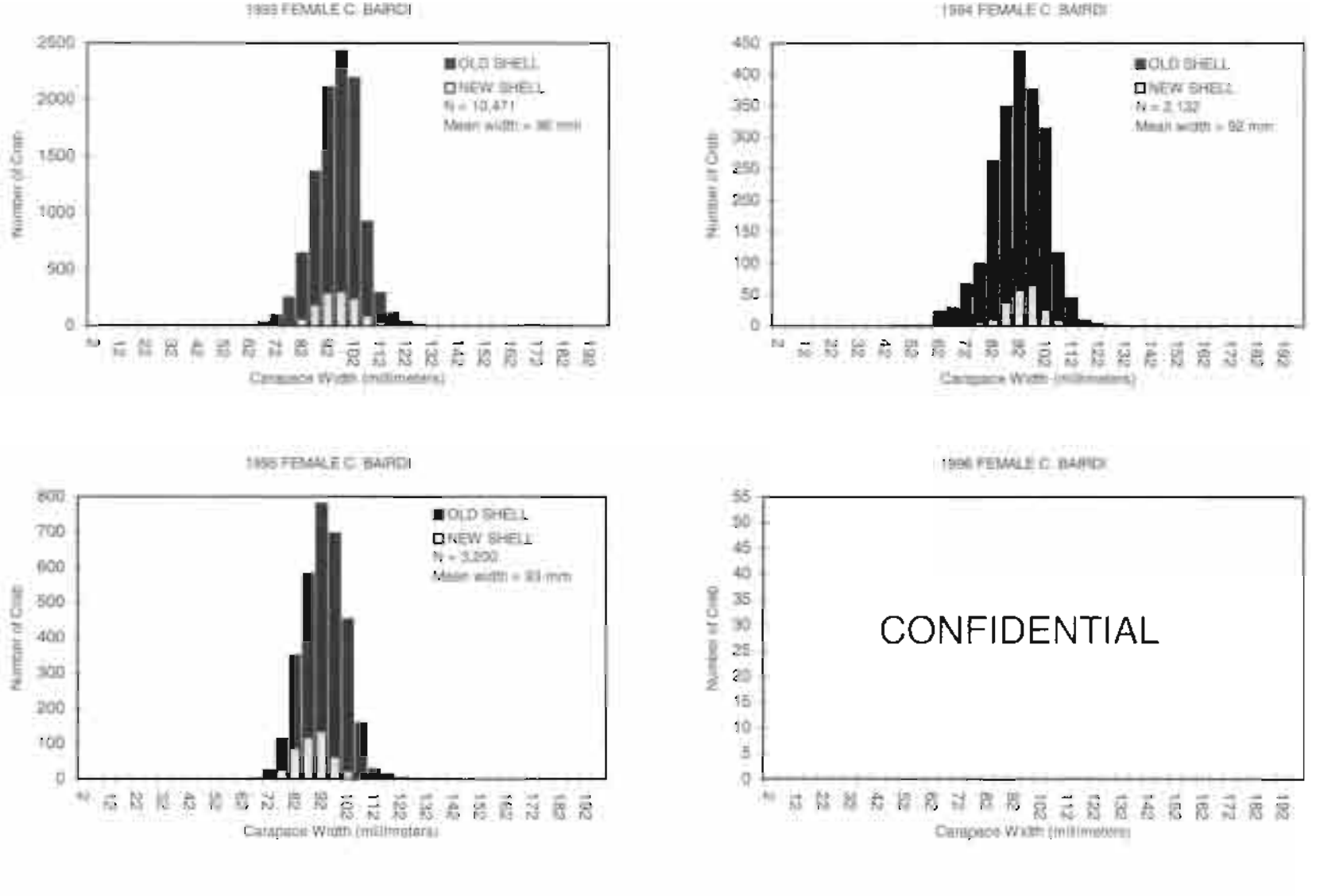


Figure 5. Carapace width distribution histograms of all *C. bairdi* females observed in the Bering Sea fishery, 1993-1996.

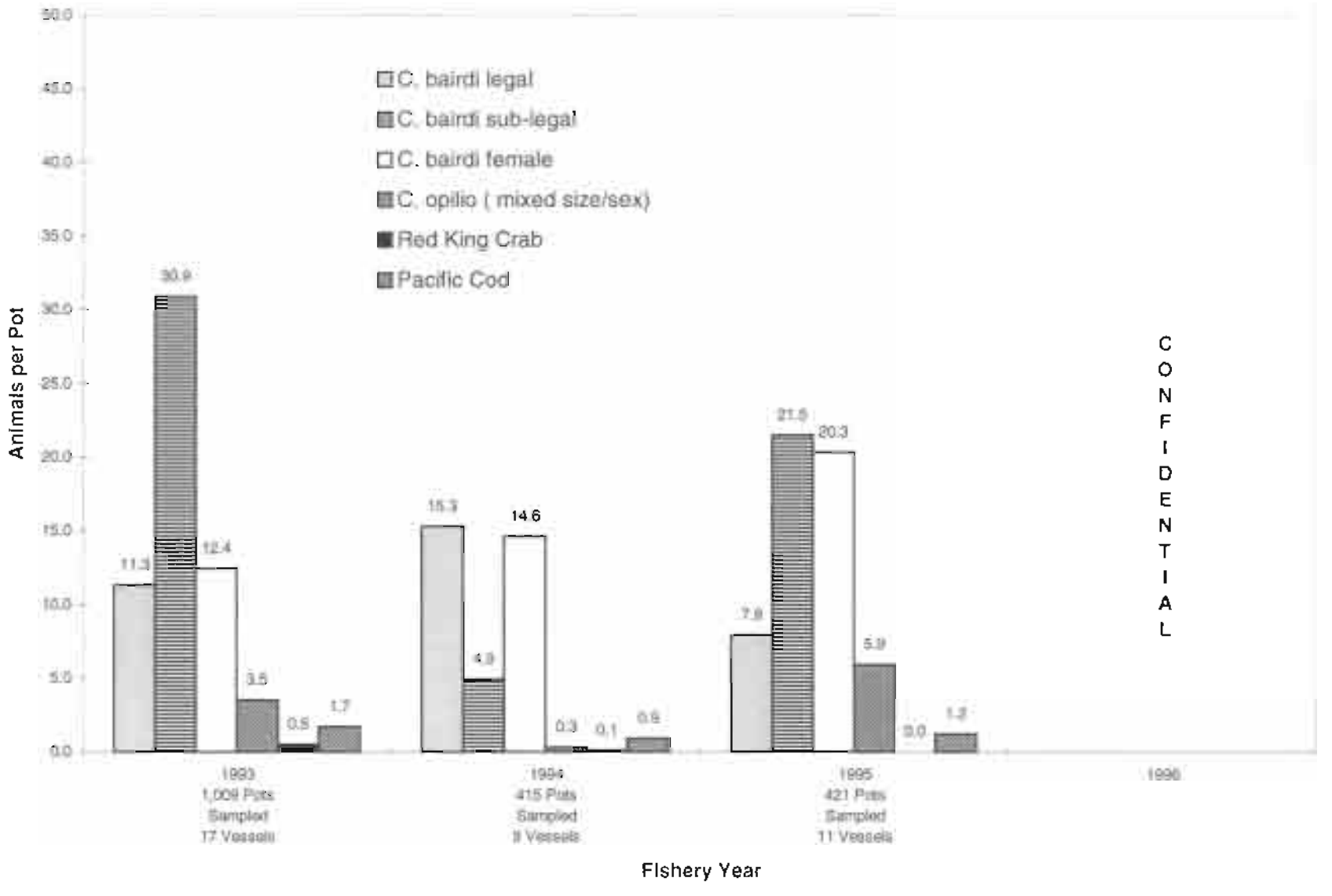


Figure 6. Catch per pot of selected species from the Bering Sea *C. bairdi* fishery, 1993-1996.

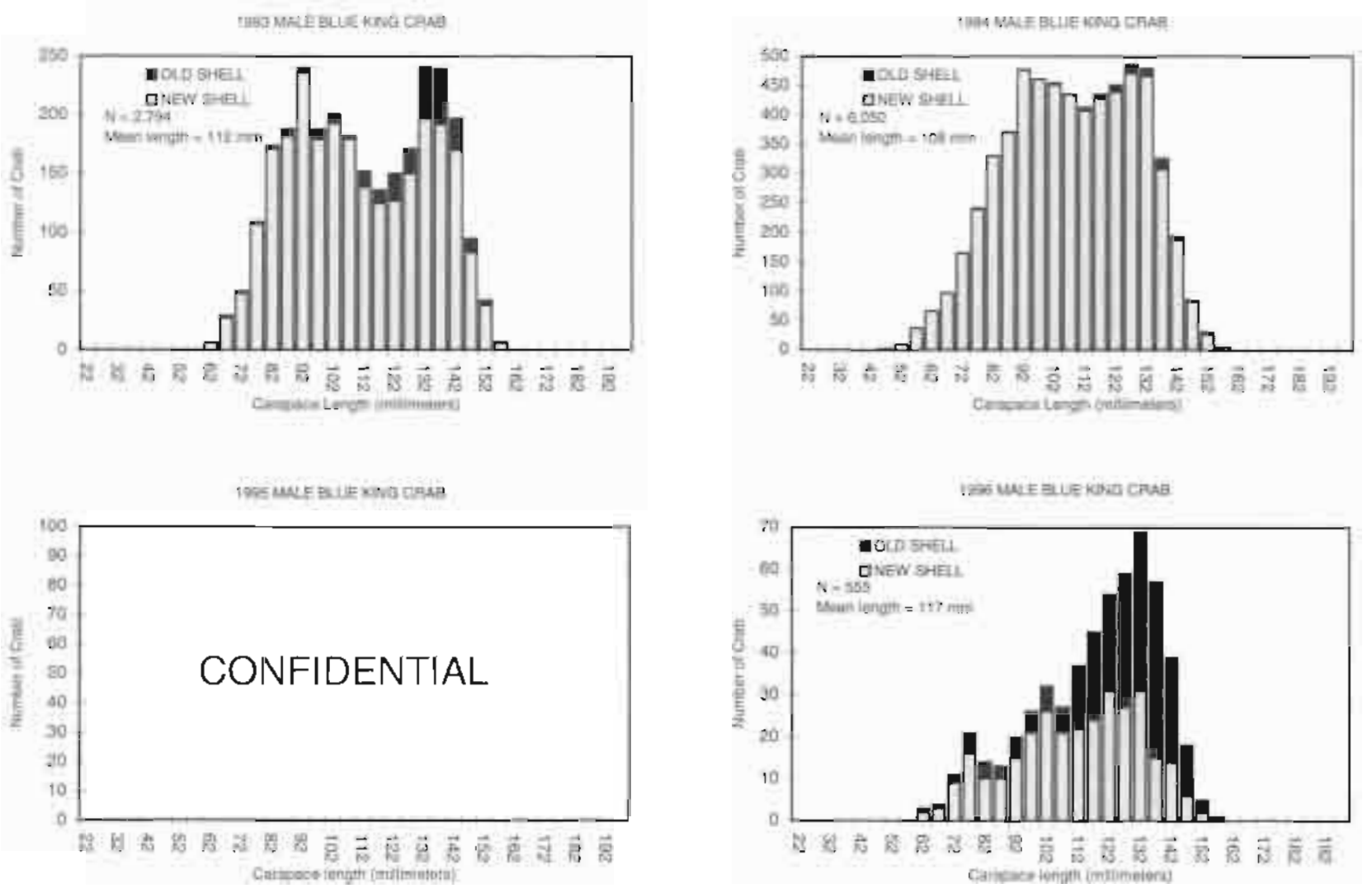


Figure 7. Carapace length distribution histograms of all blue king crab males observed in the St. Matthew District fishery, 1993-1996.

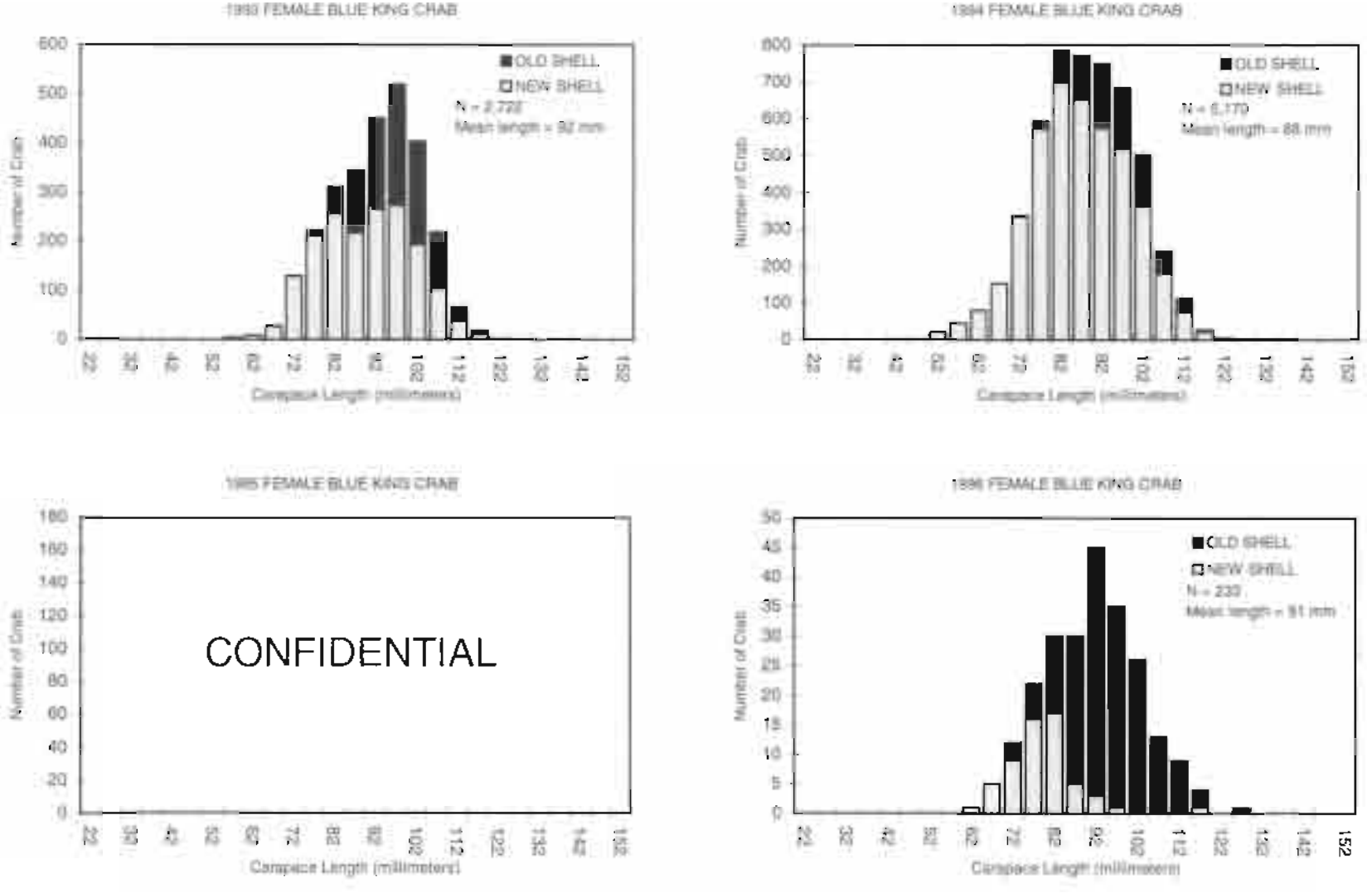


Figure 8. Carapace length distribution histograms of all blue king crab females observed in the St. Matthew District fishery, 1993-1996.

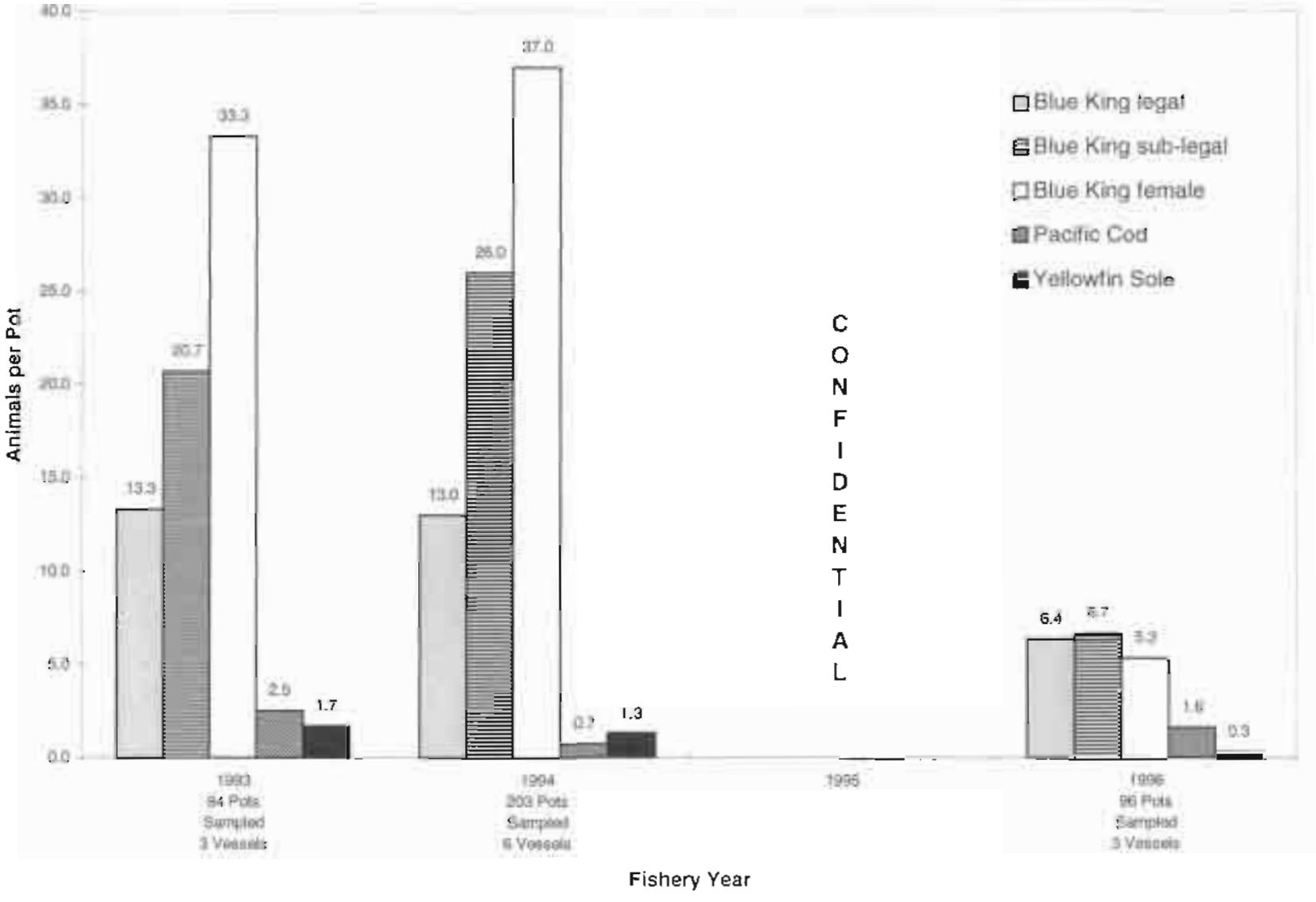


Figure 9. Catch per pot of selected species from the St. Matthew District blue king crab fishery, 1993-1996.

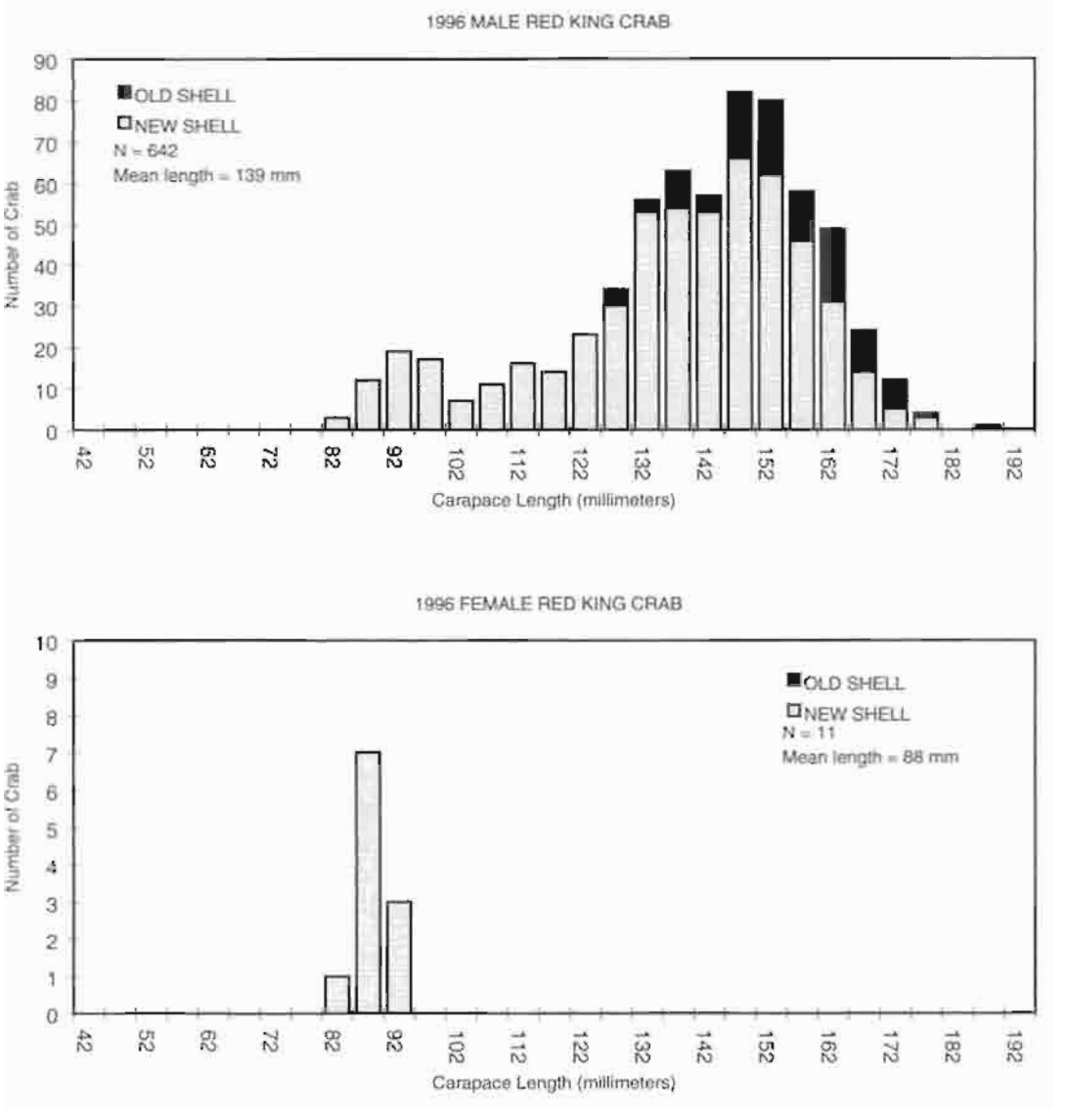


Figure 10. Carapace length distribution histograms of all red king crab males and females observed in the Bristol Bay area fishery, 1996.

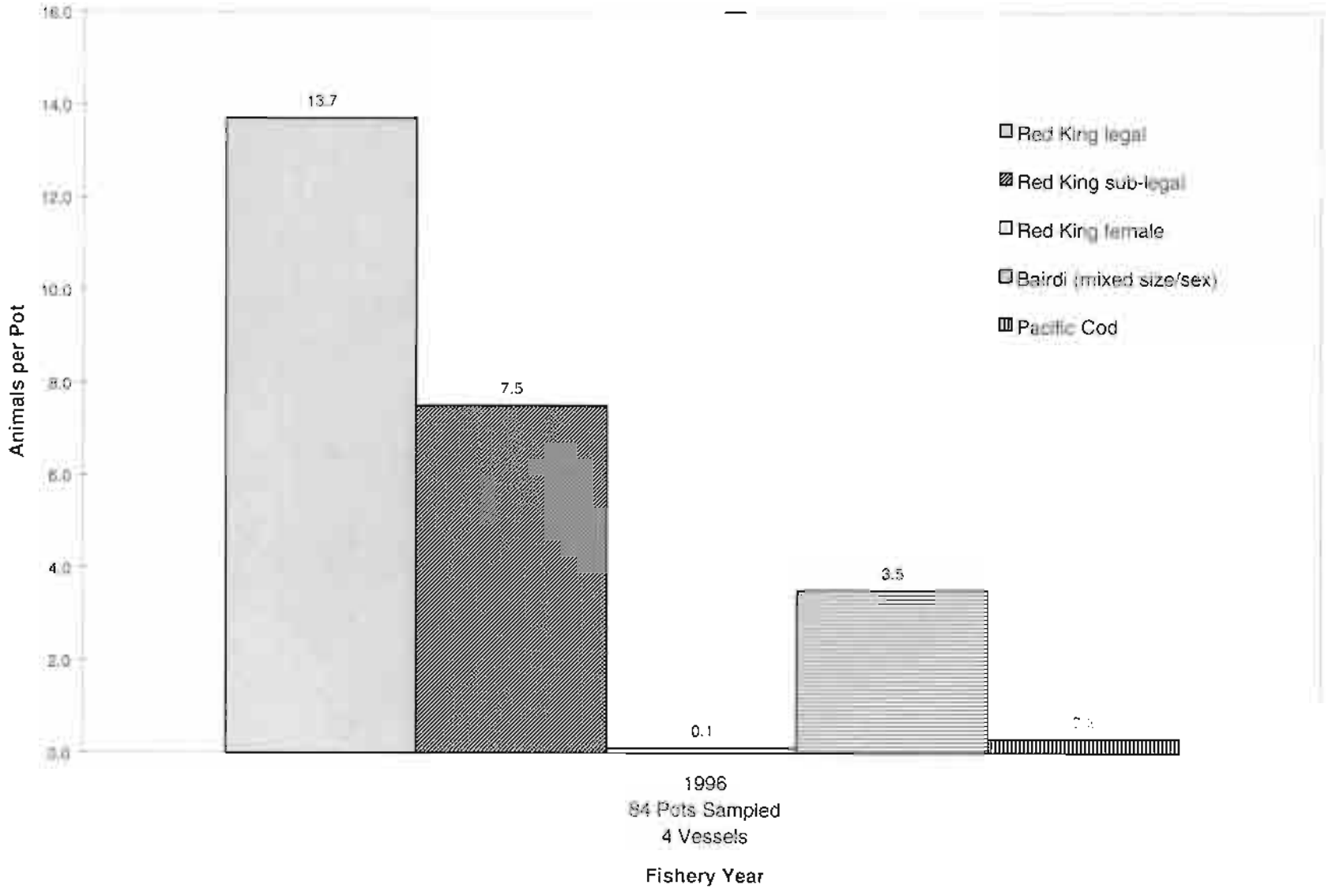


Figure 11. Catch per pot of selected species from the Bristol Bay area red king crab fishery, 1996.

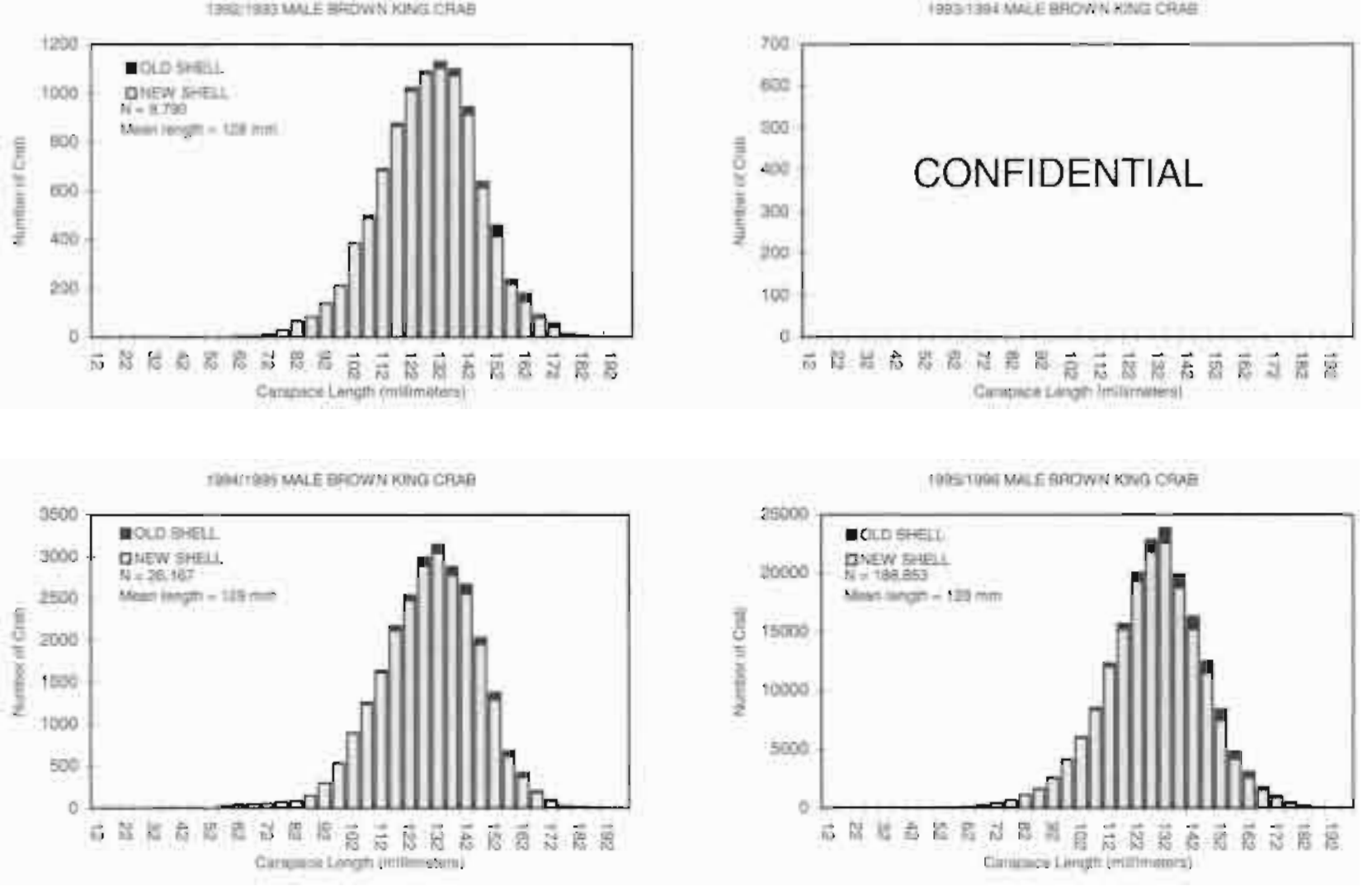


Figure 12. Carapace length distribution histograms of all brown king crab males observed in the Adak Area fishery, 1993-1996.

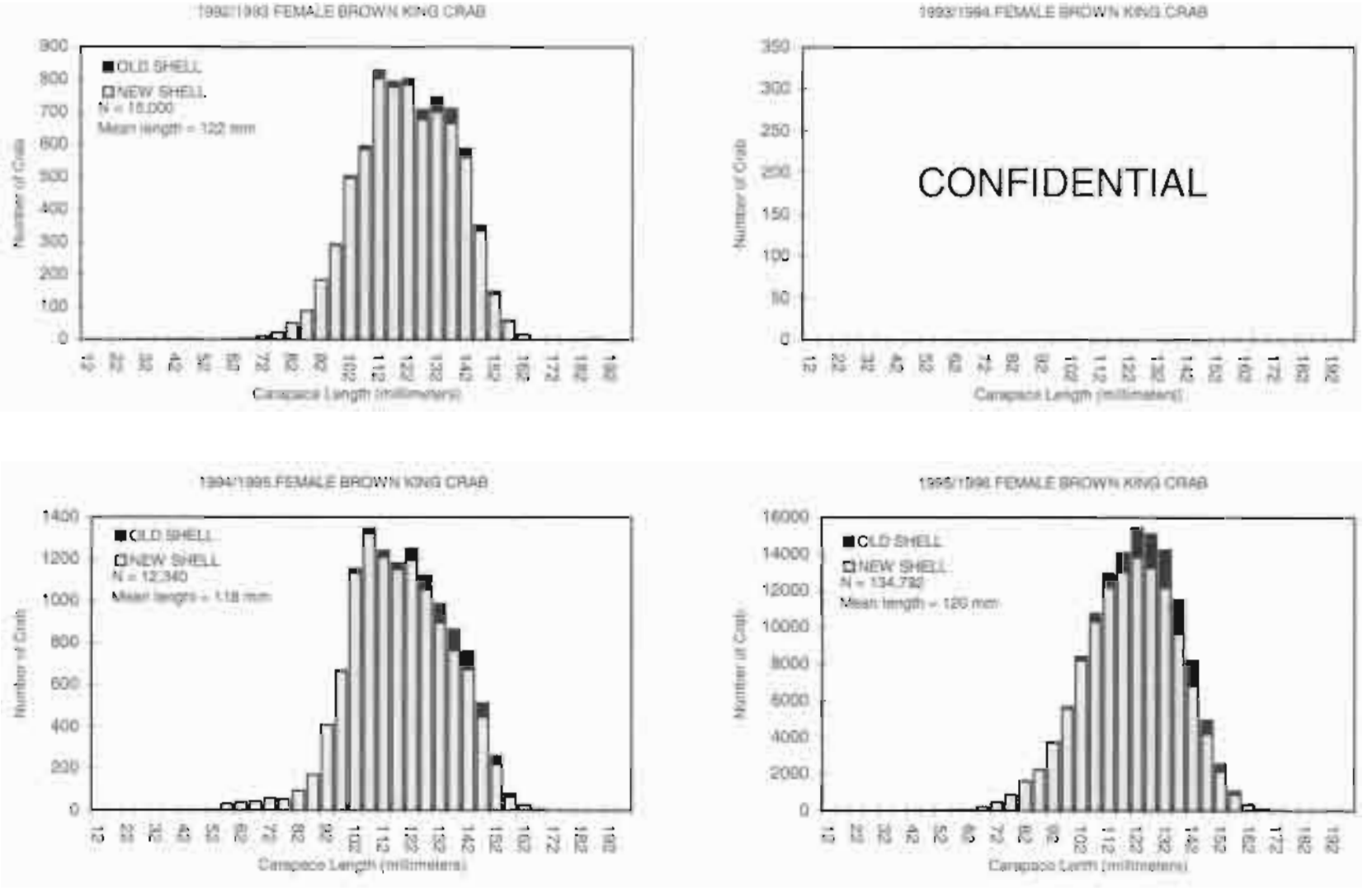


Figure 13. Carapace length distribution histograms of all brown king crab females observed in the Adak Area fishery, 1993-1996.

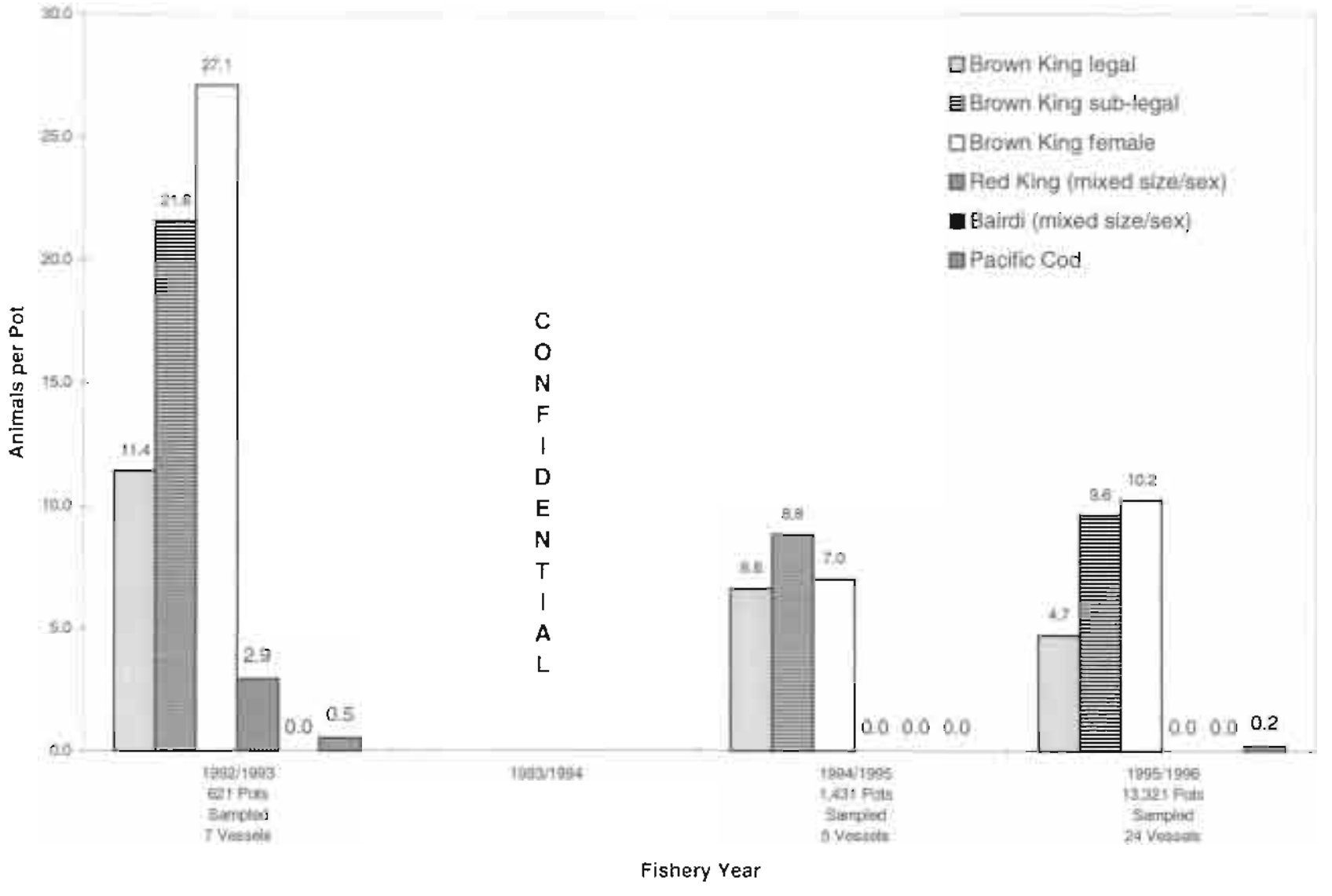


Figure 14. Catch per pot of selected species from the Adak Area red king crab fishery, 1993-1996.

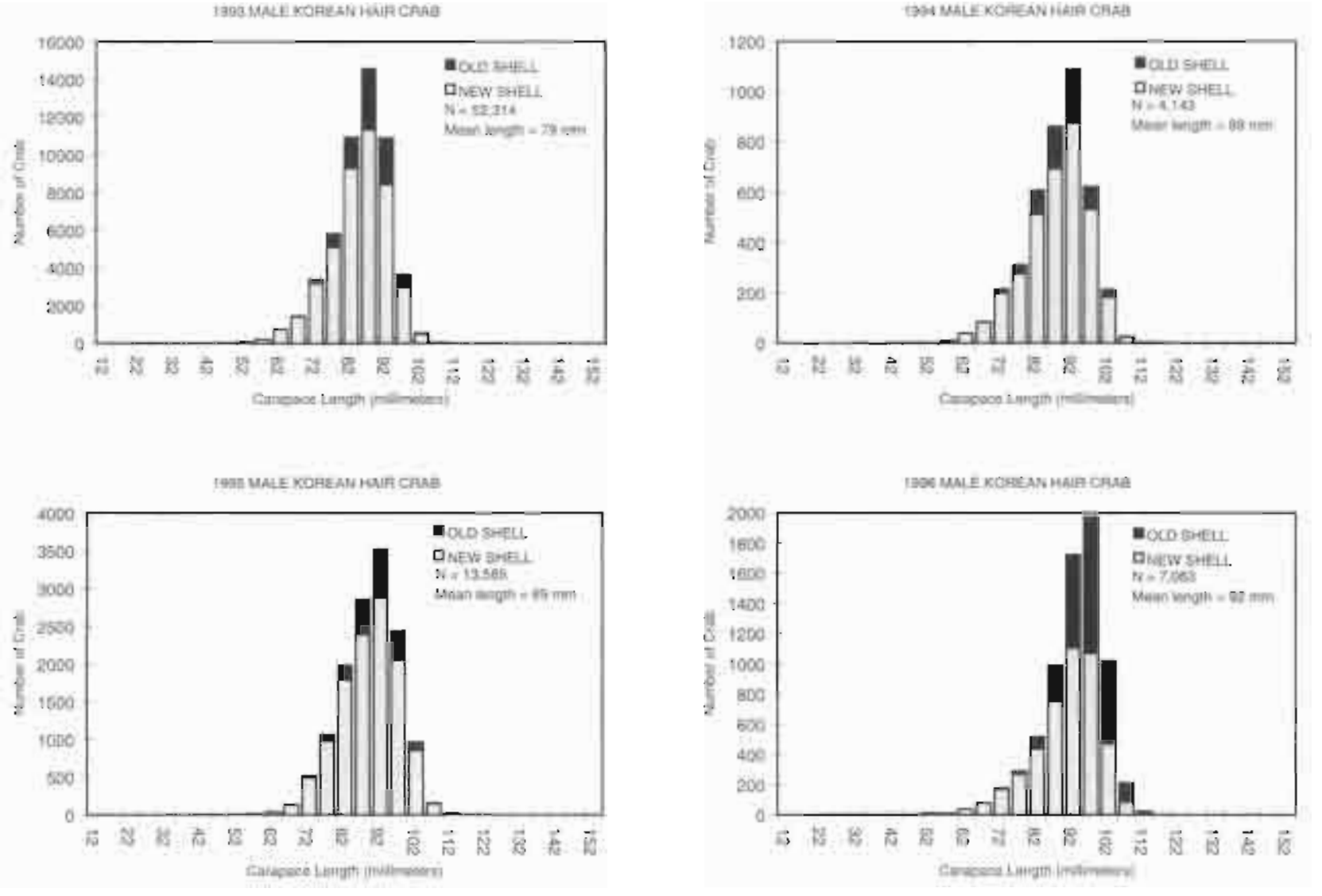


Figure 17. Carapace length distribution histograms of all Korean hair crab males observed in the Bering Sea fishery, 1993-1996.

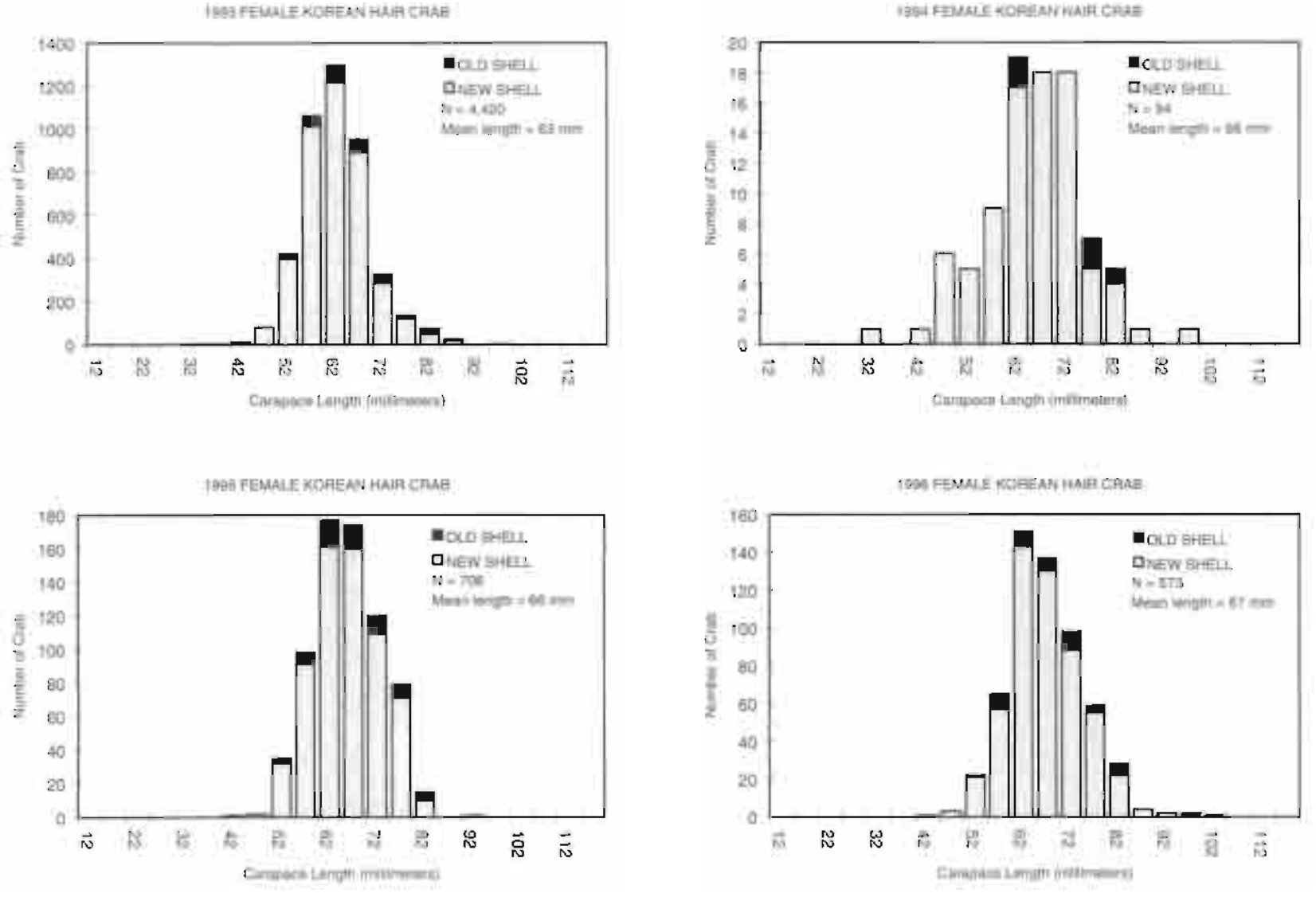


Figure 18. Carapace length distribution histograms of all Korean hair crab females observed in the Bering Sea fishery, 1993-1996.

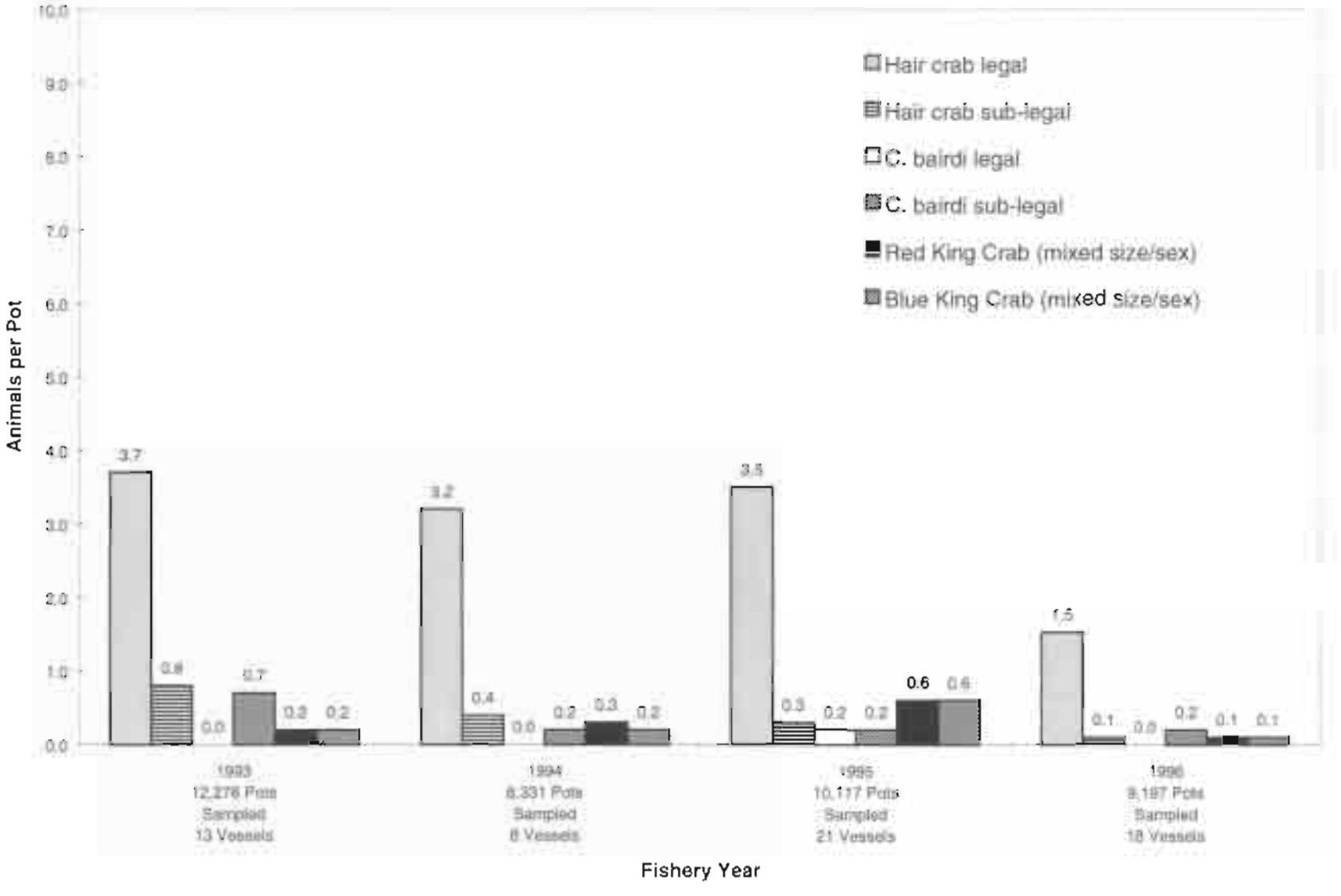


Figure 19. Catch per pot of selected species from the Bering Sea Korean hair crab fishery, 1993-1996

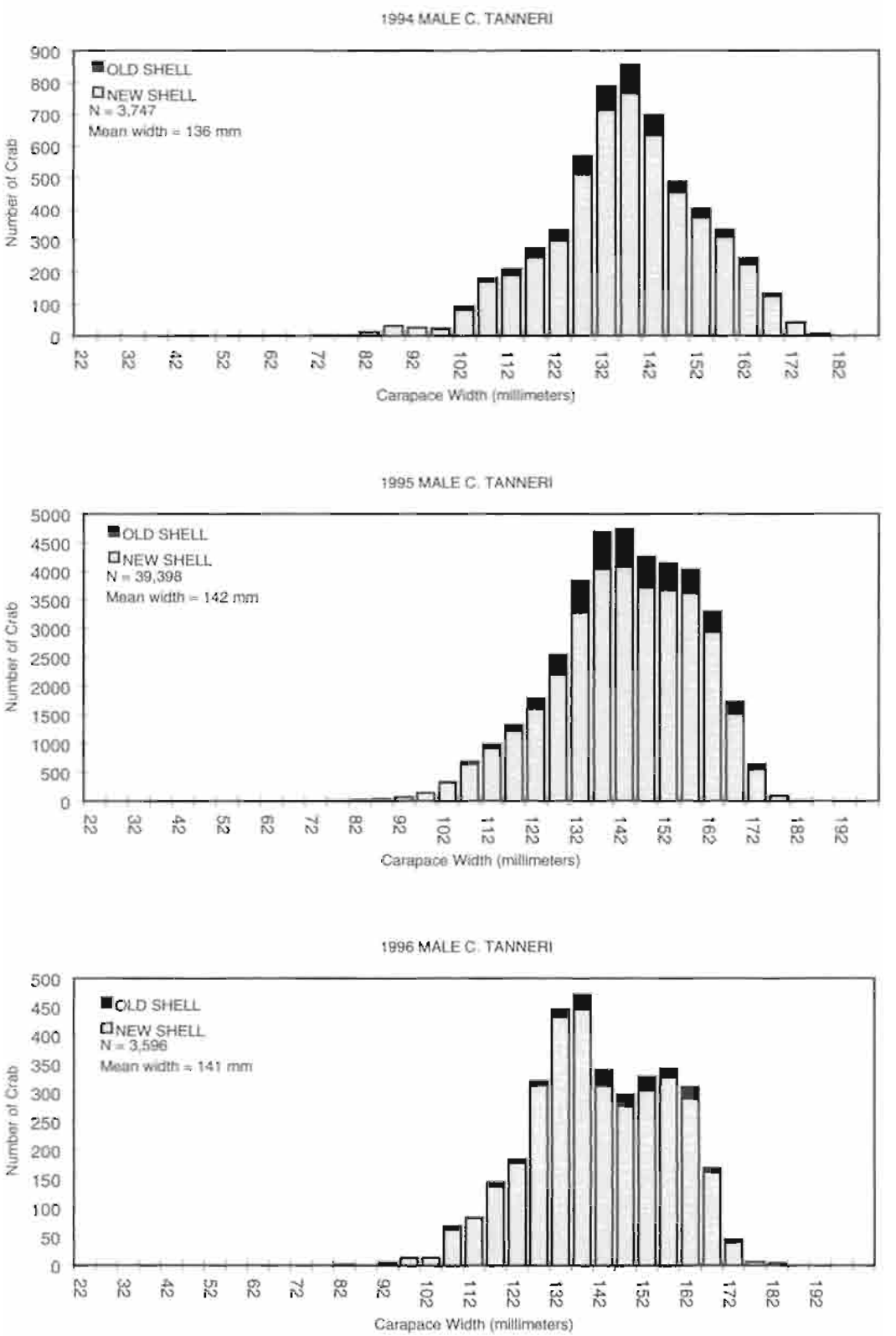


Figure 20. Carapace width distribution histograms of all *C. tanneri* males observed in the Bering Sea fishery, 1994-1996.

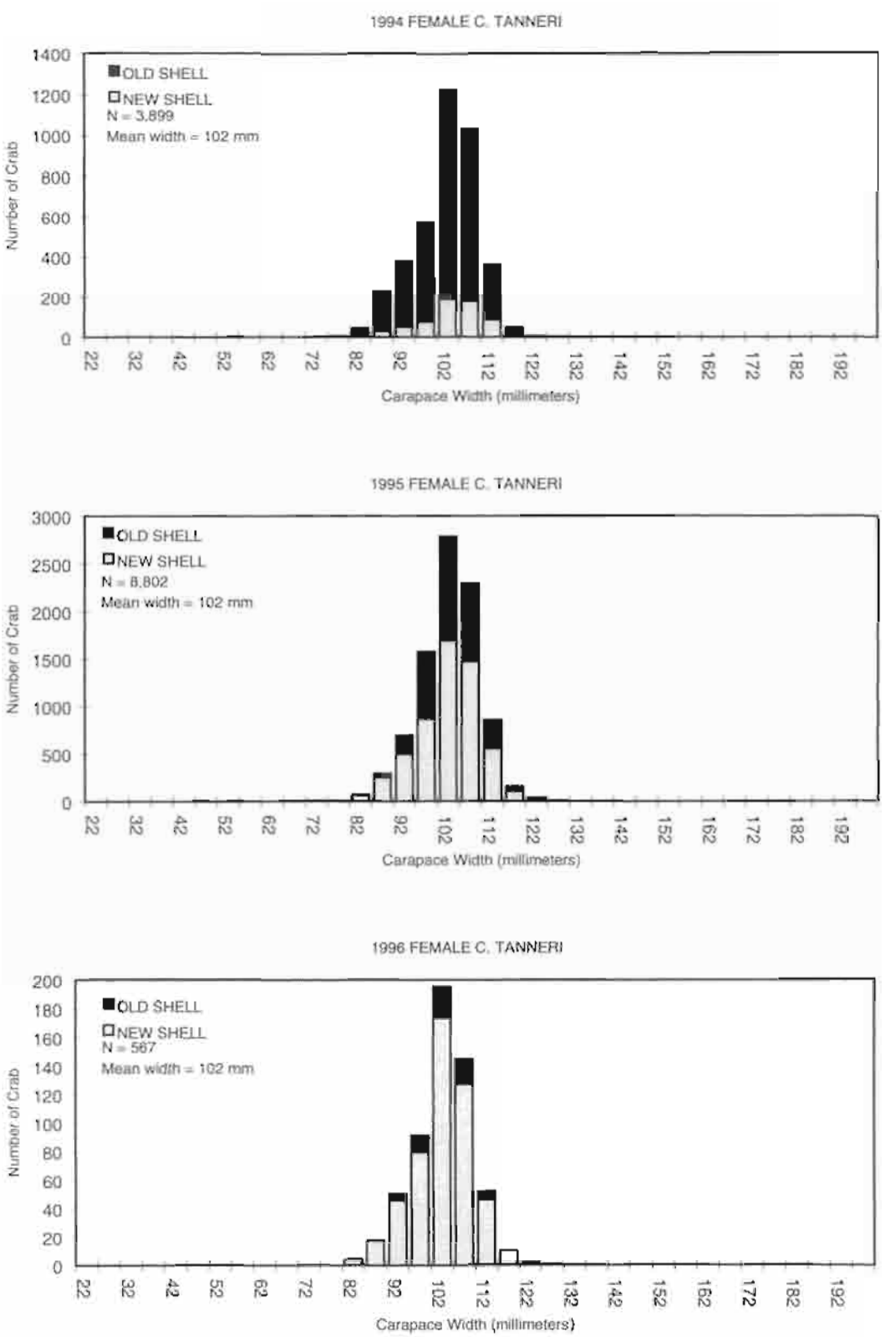


Figure 21. Carapace width distribution histograms of all *C. tanneri* females observed in the Bering Sea fishery, 1994-1996.

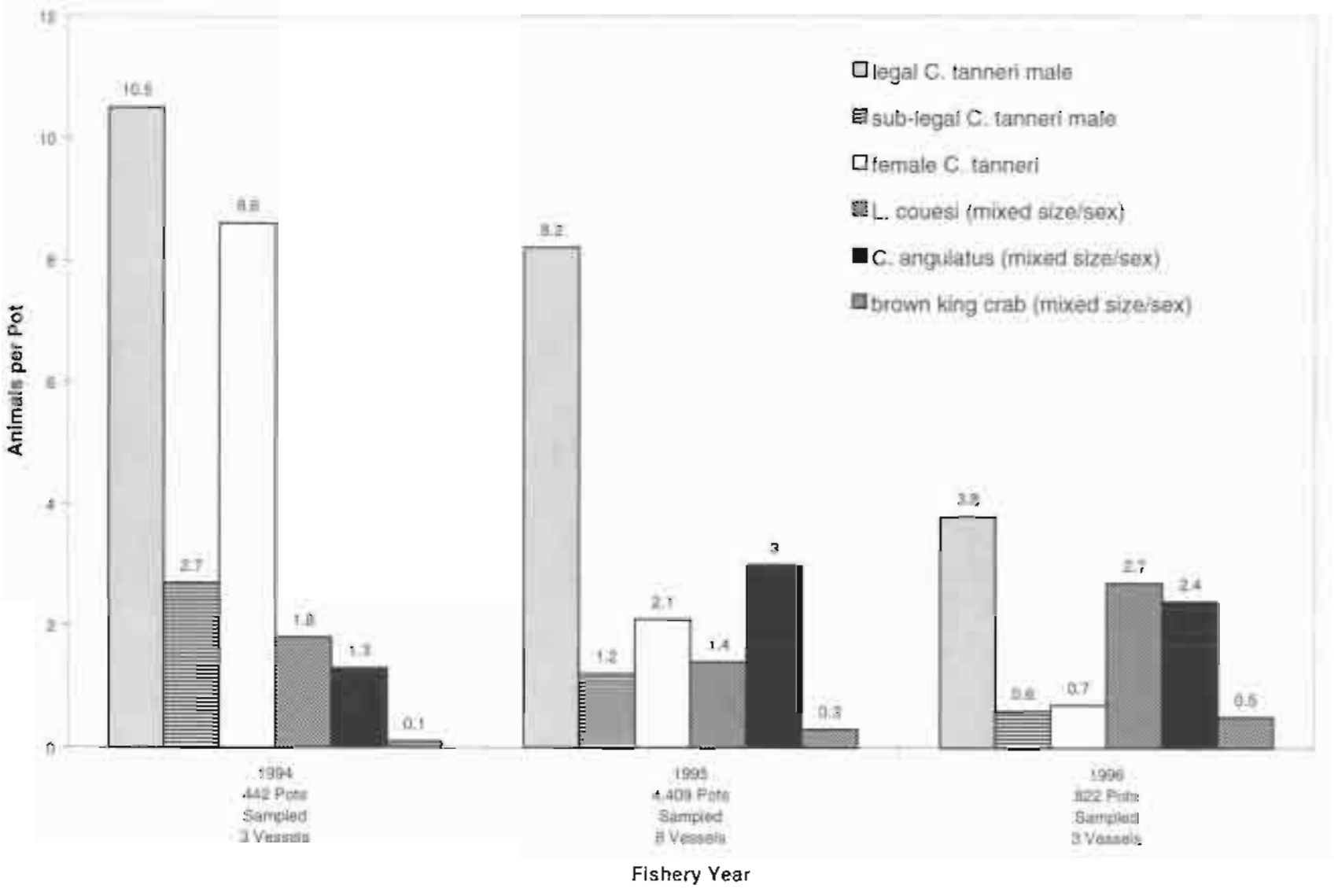


Figure 22. Catch per pot of selected species from the Bering Sea *C. tanneri* fishery, 1994-1996.

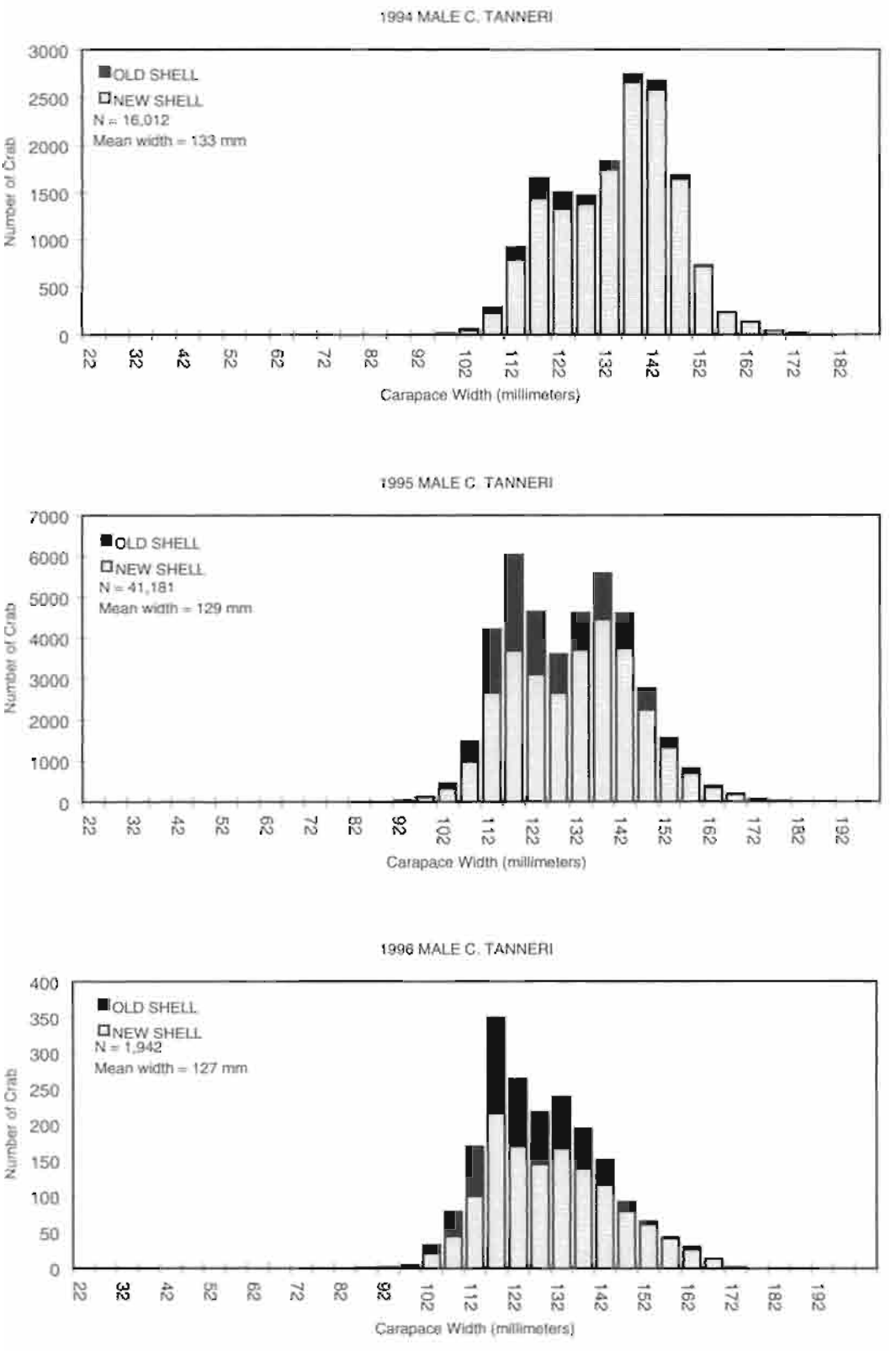


Figure 23. Carapace width distribution histograms of all *C. tanneri* males observed in the Eastern Aleutian Area fishery, 1994-1996.

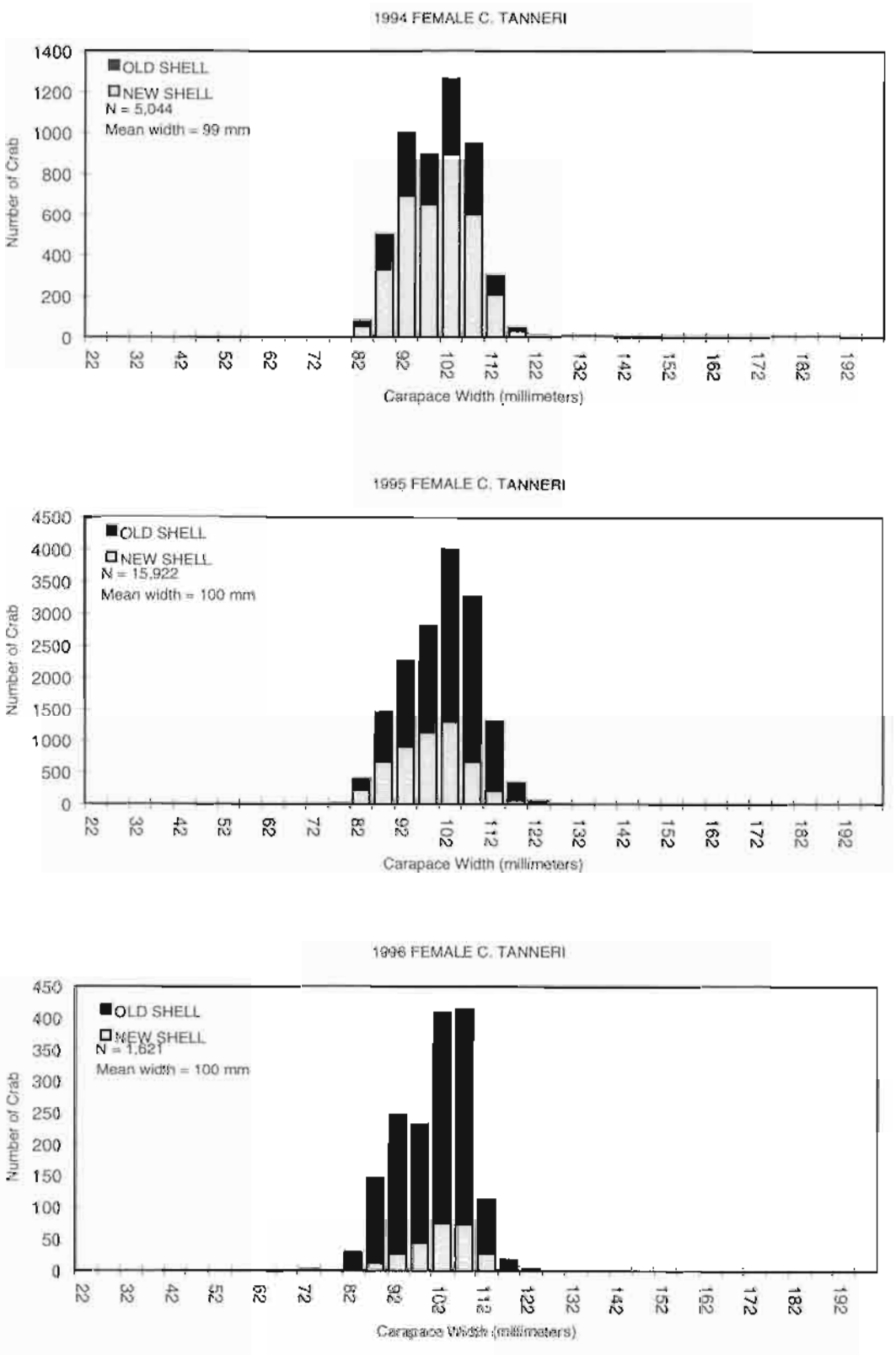


Figure 24. Carapace width distribution histograms of all *C. tanneri* females observed in the Eastern Aleutian Area fishery, 1994-1996.

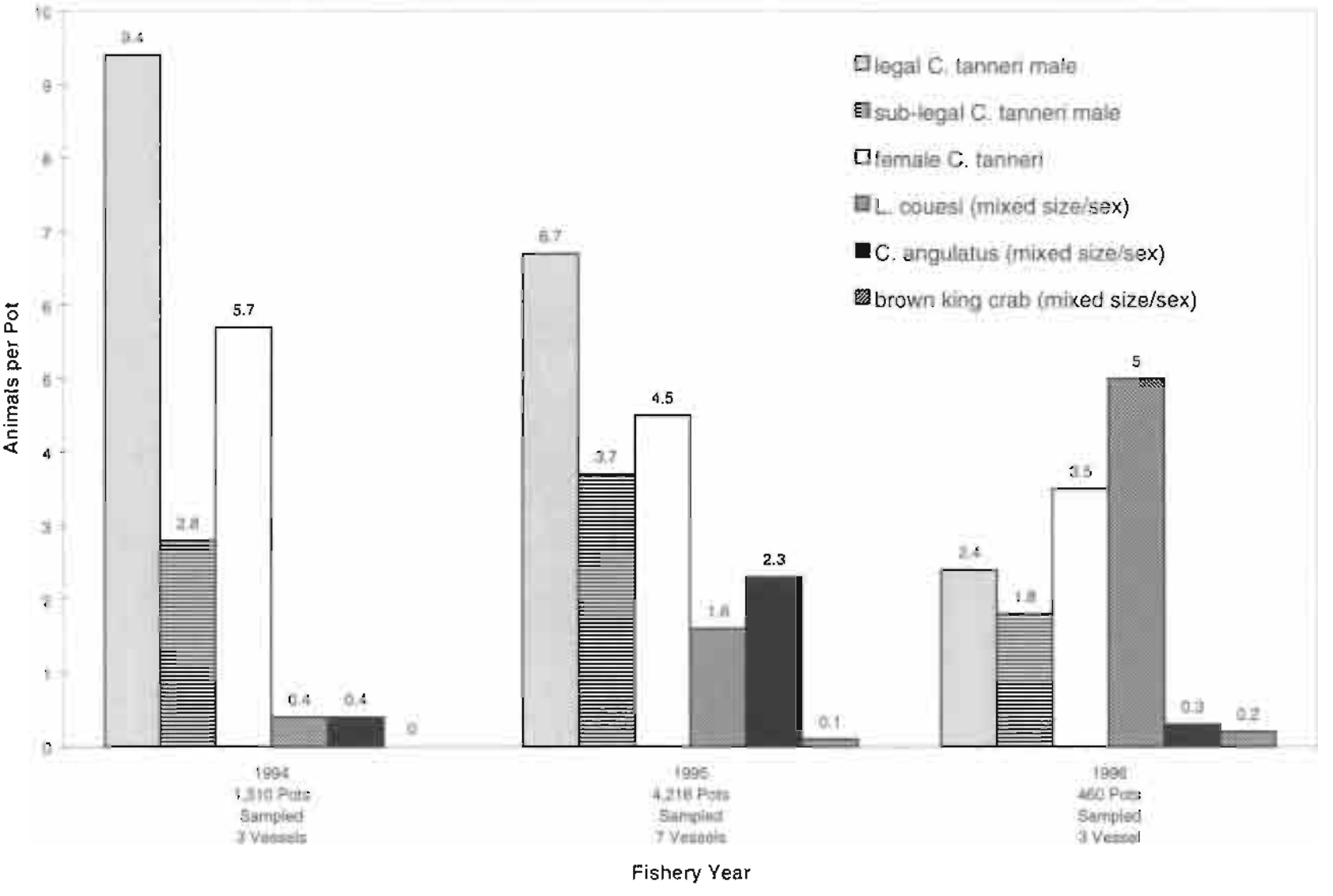


Figure 25. Catch per pot of selected species from the Eastern Aleutian Area *C. tanneri* fishery, 1994-1996.

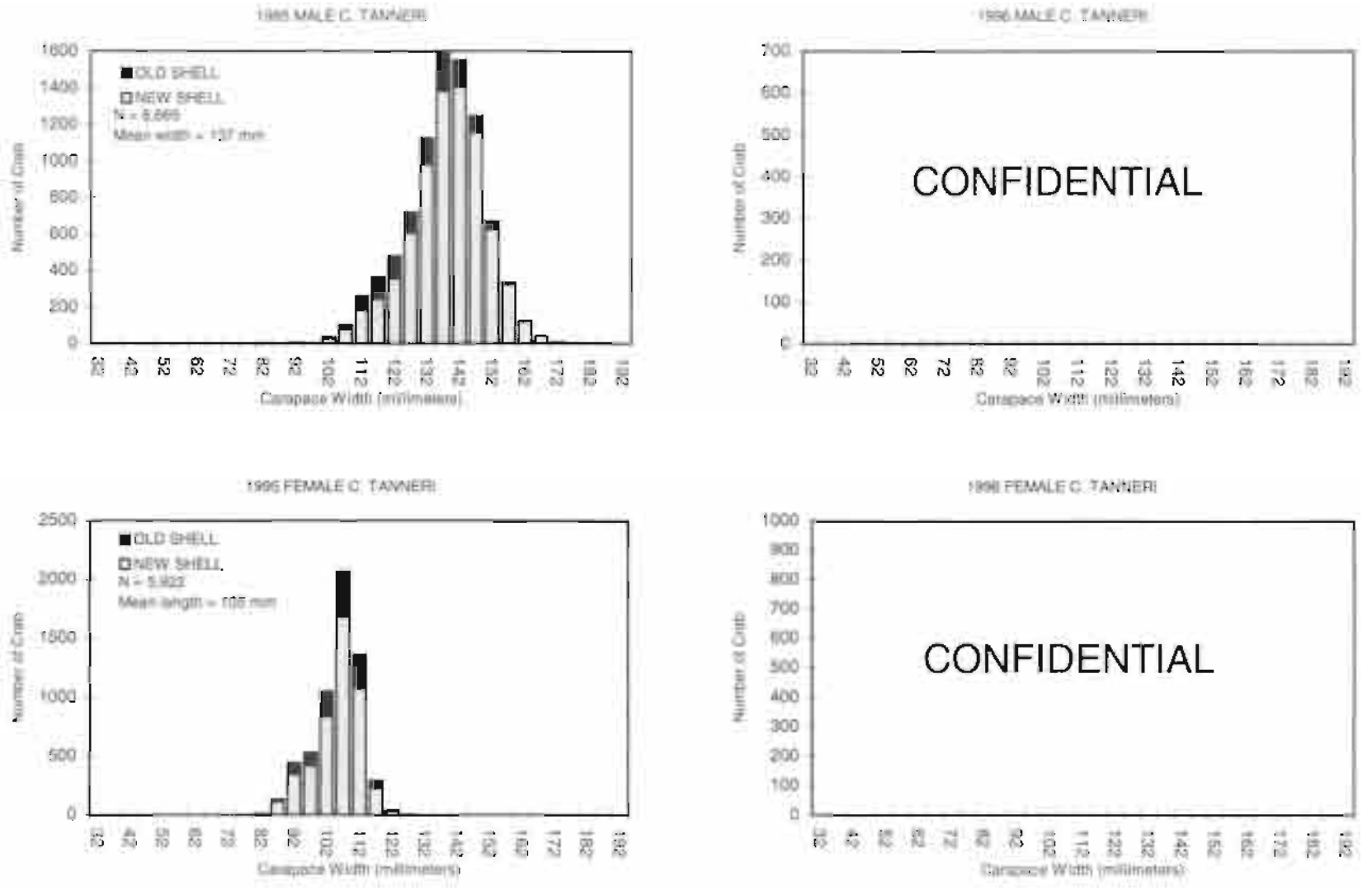


Figure 26. Carapace width distribution histograms of all *C. tanneri* males and females observed in the Western Aleutian Area fishery, 1995-1996.

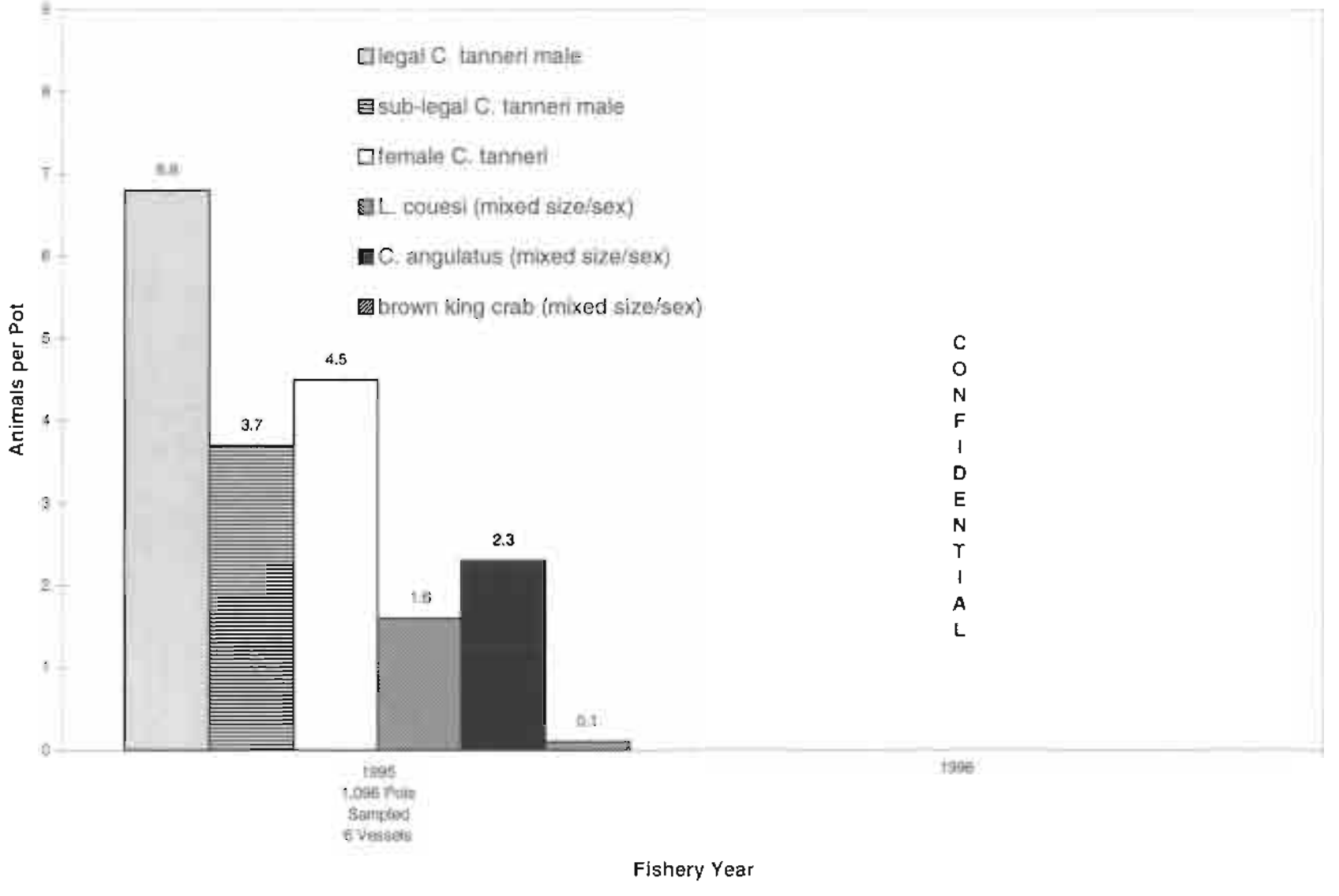


Figure 27. Catch per pot of selected species from the Western Aleutian Area *C. tanneri* fishery, 1995-1996.

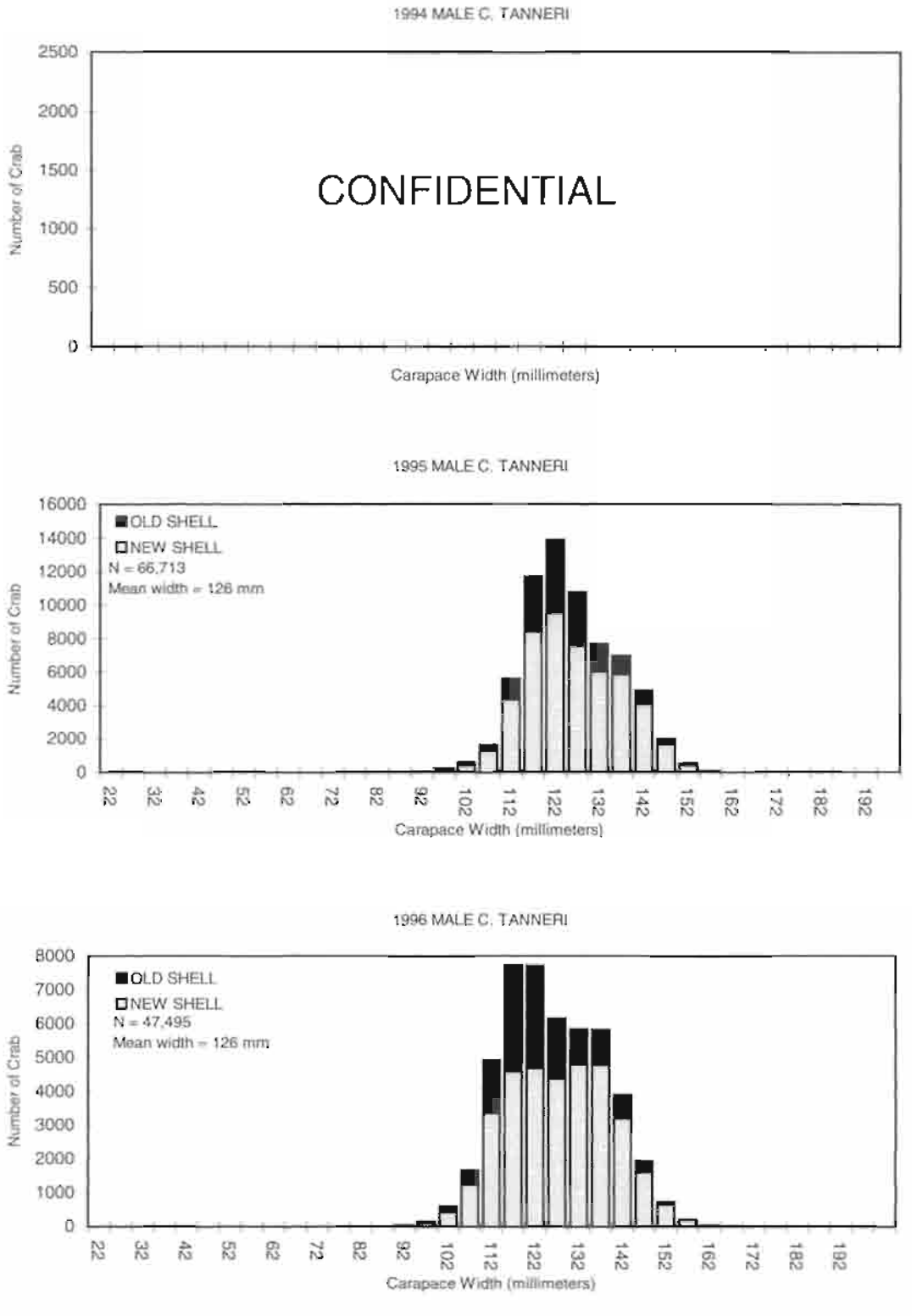


Figure 28. Carapace width distribution histograms of all *C. tanneri* males observed in the South Peninsula fishery, 1994-1996.

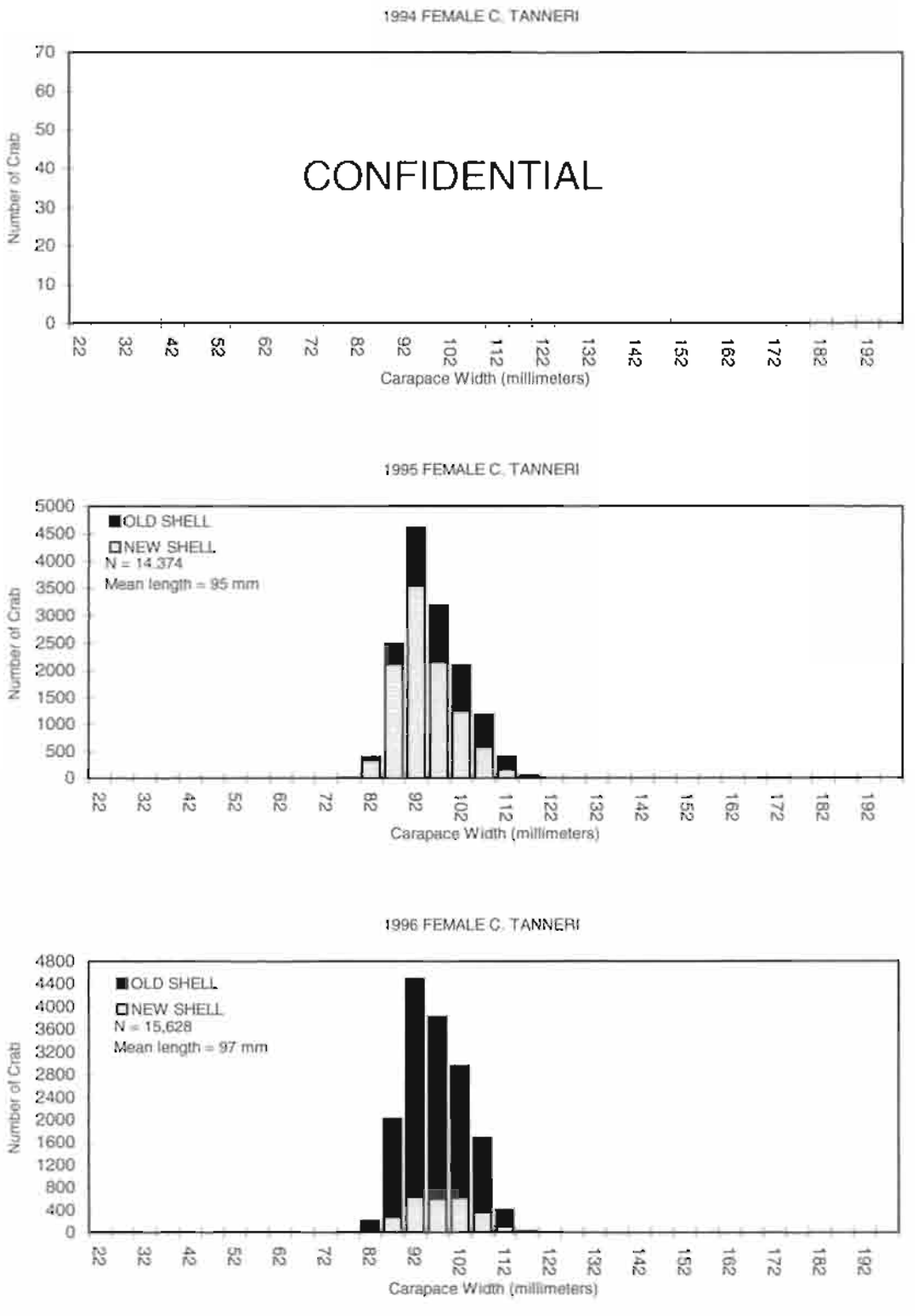


Figure 29. Carapace width distribution histograms of all *C. tanneri* females observed in the South Peninsula fishery, 1994-1996.

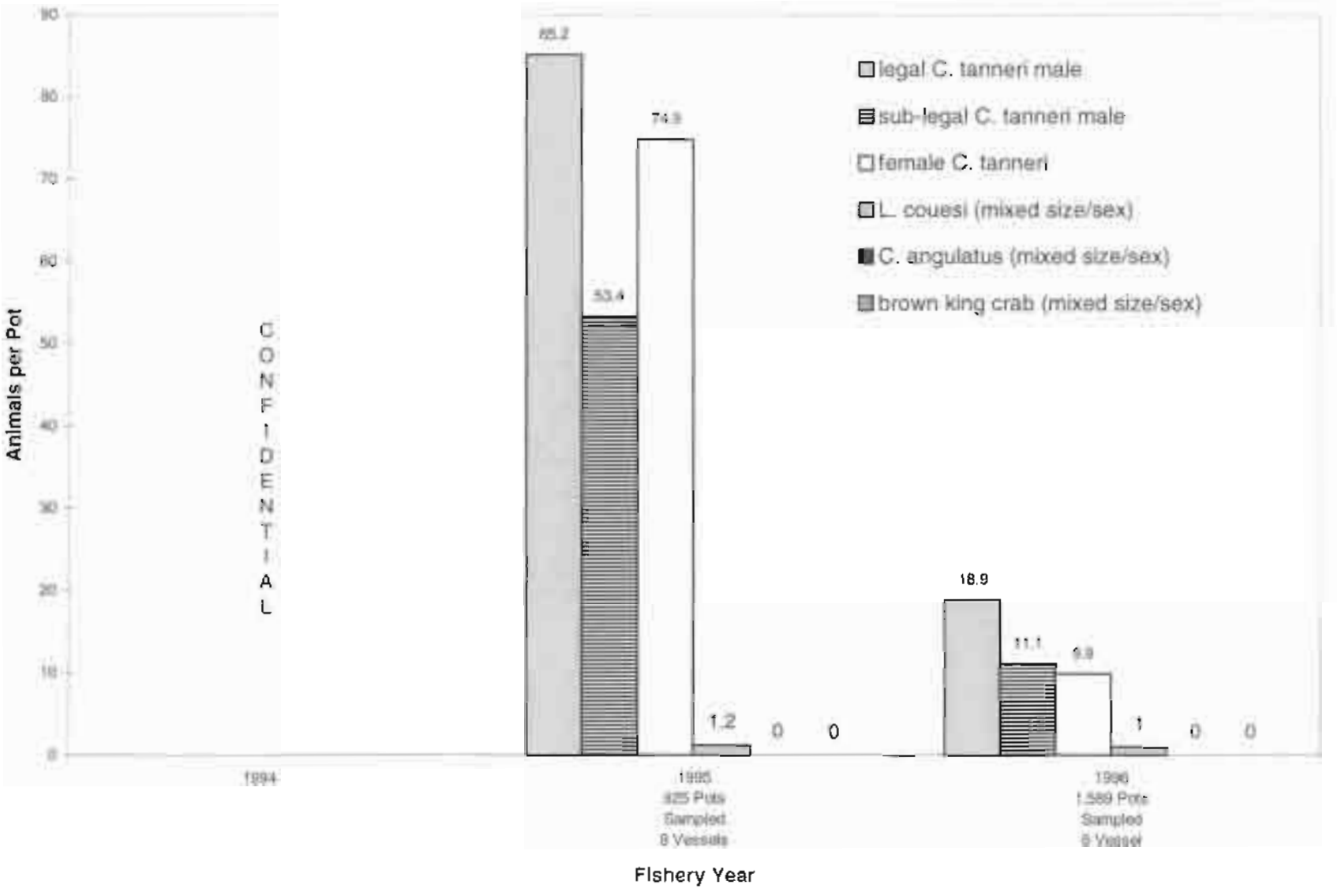


Figure 30. Catch per pot of selected species from the South Peninsula Area *C. tanneri* fishery, 1994-1996.

APPENDIX

Appendix A-1. Formulas used to calculate weighted mean and variance estimates for CPUE.

For a given fishery, observers are instructed to randomly sample n potlifts per day. In practice this number will vary by day, vessel and observer. Observers actually sample n_{ij} pots per day from a total of N_{ij} pots pulled by vessel i on day j. Formulas follow Cochran (1977).

The mean CPUE for vessel i on day j is

$$\bar{x}_{ij\cdot} = 1/ n_{ij} \Sigma_k x_{ijk}$$

and the variance for this estimator is

$$\hat{\text{var}}\ (\bar{x}_{ij\cdot}) = (\Sigma_k (x_{ijk} - \bar{x}_{ij\cdot})^2 / (n_{ij} - 1)) / n_{ij}$$

where x = number of crab in pot sample
i = vessel
j = day
k = pot sampled
n = number of pots sampled.

It follows that

$$(\bar{x}_{ij\cdot})\ (N_{ij}) = \text{estimated total catch by vessel } i \text{ on day } j$$

$$\Sigma_j\ (\bar{x}_{ij\cdot}\ N_{ij}) = \text{estimated total catch by vessel } i \text{ over the fishery}$$

$$(1/N_{i\cdot})\ \Sigma_j\ (\bar{x}_{ij\cdot}\ N_{ij}) = \text{estimated weighted mean catch per pot lift by vessel } i \text{ over the fishery}$$
$$= \Sigma_j\ (\bar{x}_{ij\cdot})\ (w_{ij})$$
$$= (\bar{x}_{i\cdot\cdot})$$

and

$$\hat{\text{var}}\ (\bar{x}_{i\cdot\cdot}) = \Sigma_j\ \hat{\text{var}}\ (\bar{x}_{ij\cdot})\ w_{ij}^2$$

where $w_{ij} = N_{ij} / N_{i\cdot}$. The weights reflect the importance of a day's sampling based on the number of pots lifted on day j by vessel i relative to the total number of pots lifted by vessel i over the course of the fishery.

-Continued-

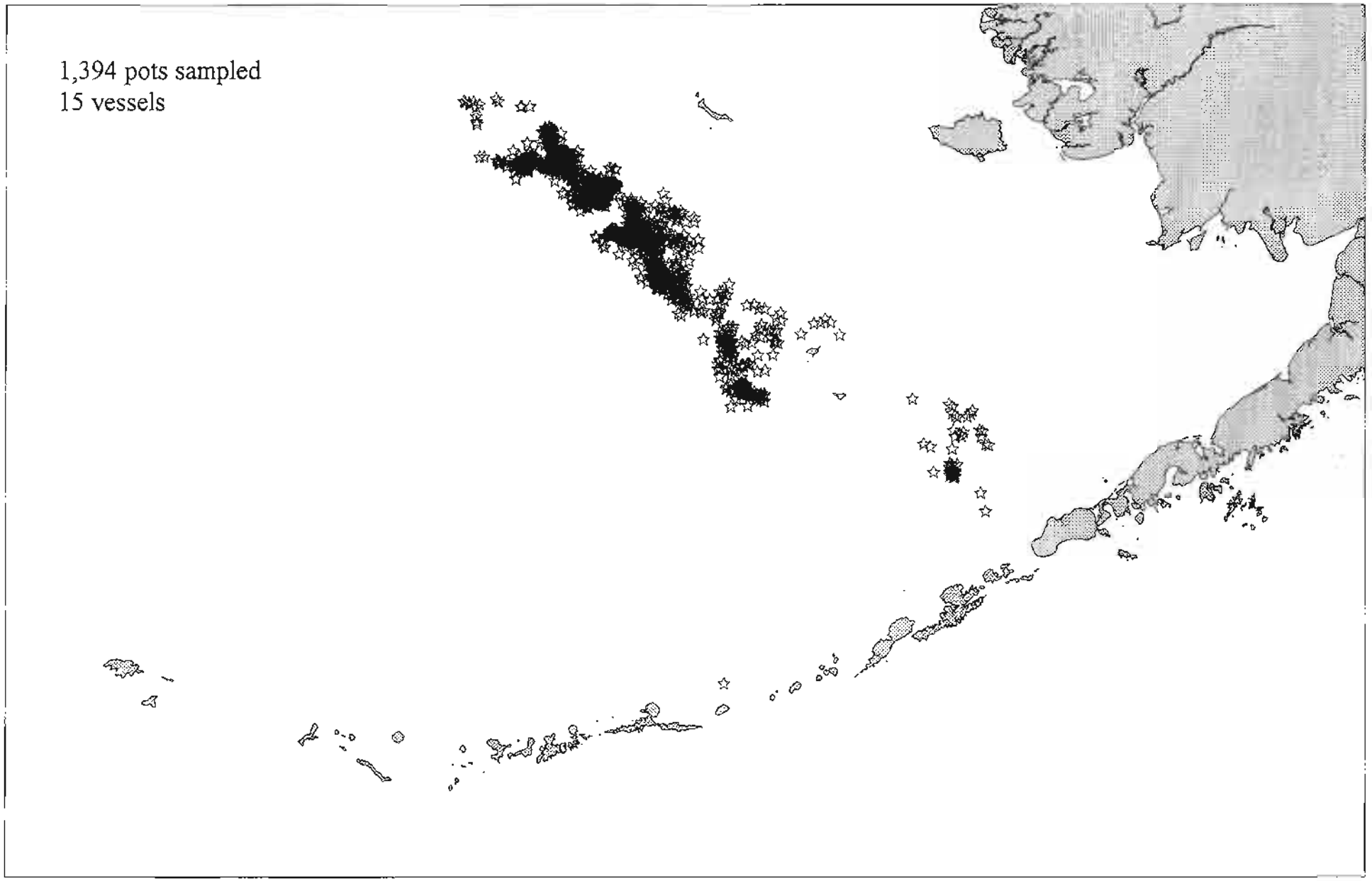
The estimated mean catch per pot lift for all vessels over the fishery is

$$\begin{aligned}\bar{x}\ldots &= (1/N..)\,\Sigma_i\,(\bar{x}_{i..})\,N_{i.}\\ &= \Sigma_i\,(\bar{x}_{i..})\,w_i\\ &= (1/N..)\,\Sigma_i\,\Sigma_j\,(\bar{x}_{ij.}\,N_{ij})\end{aligned}$$

and the variance of this estimator is

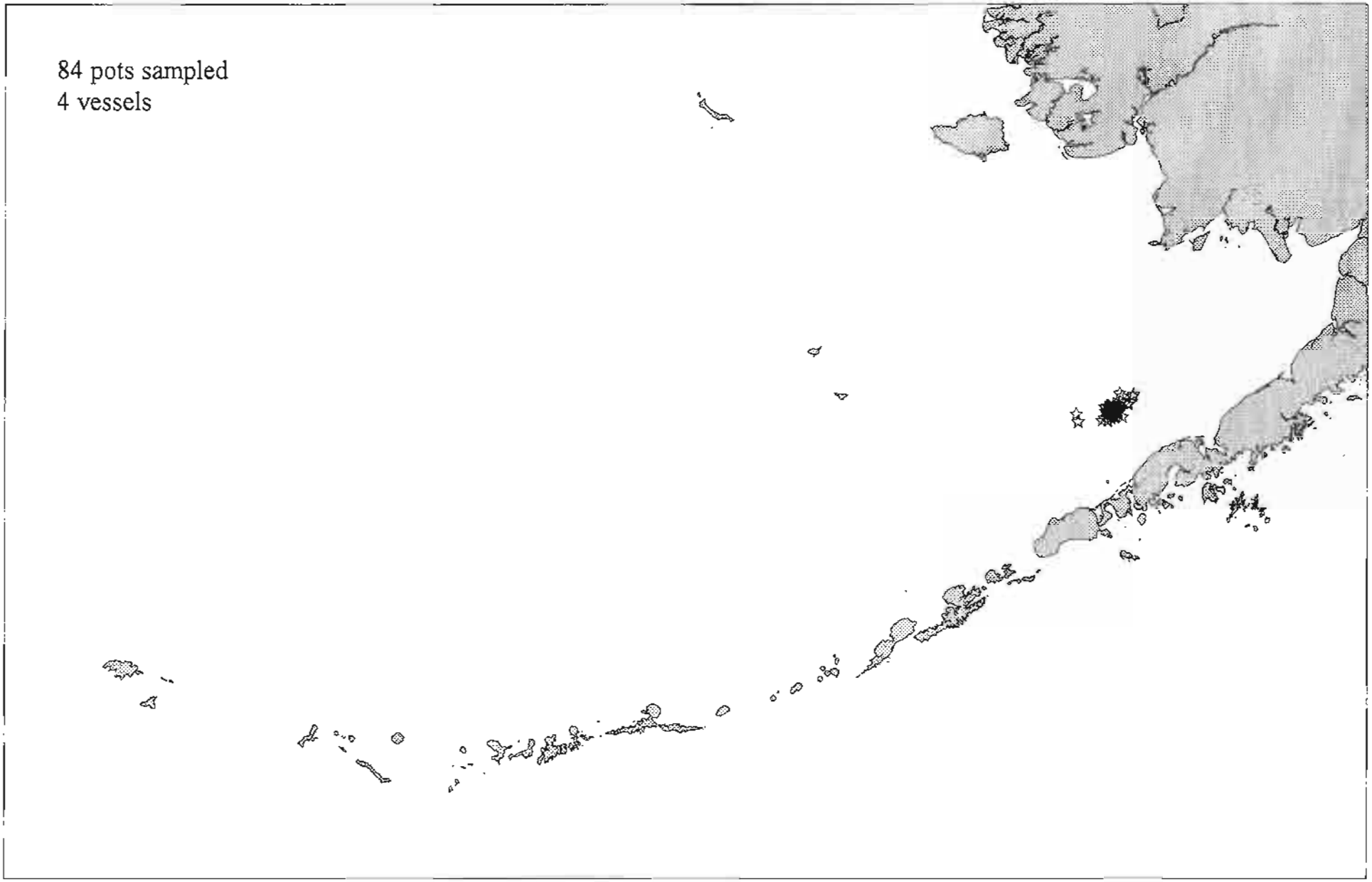
$$\begin{aligned}\hat{\mathrm{var}}\,(\bar{x}\ldots) &= \Sigma_i\ \hat{\mathrm{var}}\,(\bar{x}_{i..})\,w_{i.}^{2}\\ &= \Sigma_i\,\Sigma_j\ \hat{\mathrm{var}}\,(\bar{x}_{ij.})(\,w_{ij}^{2}\ w_{i.}^{2}\,)\\ &= \Sigma_i\,\Sigma_j\ \hat{\mathrm{var}}\,(\bar{x}_{ij.})(\,N_{ij}/N_i)(N_i/N_{..})\\ &= \Sigma_i\,\Sigma_j\ \hat{\mathrm{var}}\,(\bar{x}_{ij.})(N_{ij}/N..)^{2}\\ &= (1/N..)^{2}\,\Sigma_i\,\Sigma_j\ \hat{\mathrm{var}}\,(\bar{x}_{ij.})(N_{ij}^{2})\end{aligned}$$

where $w_{i.} = N_{i.} / N..$

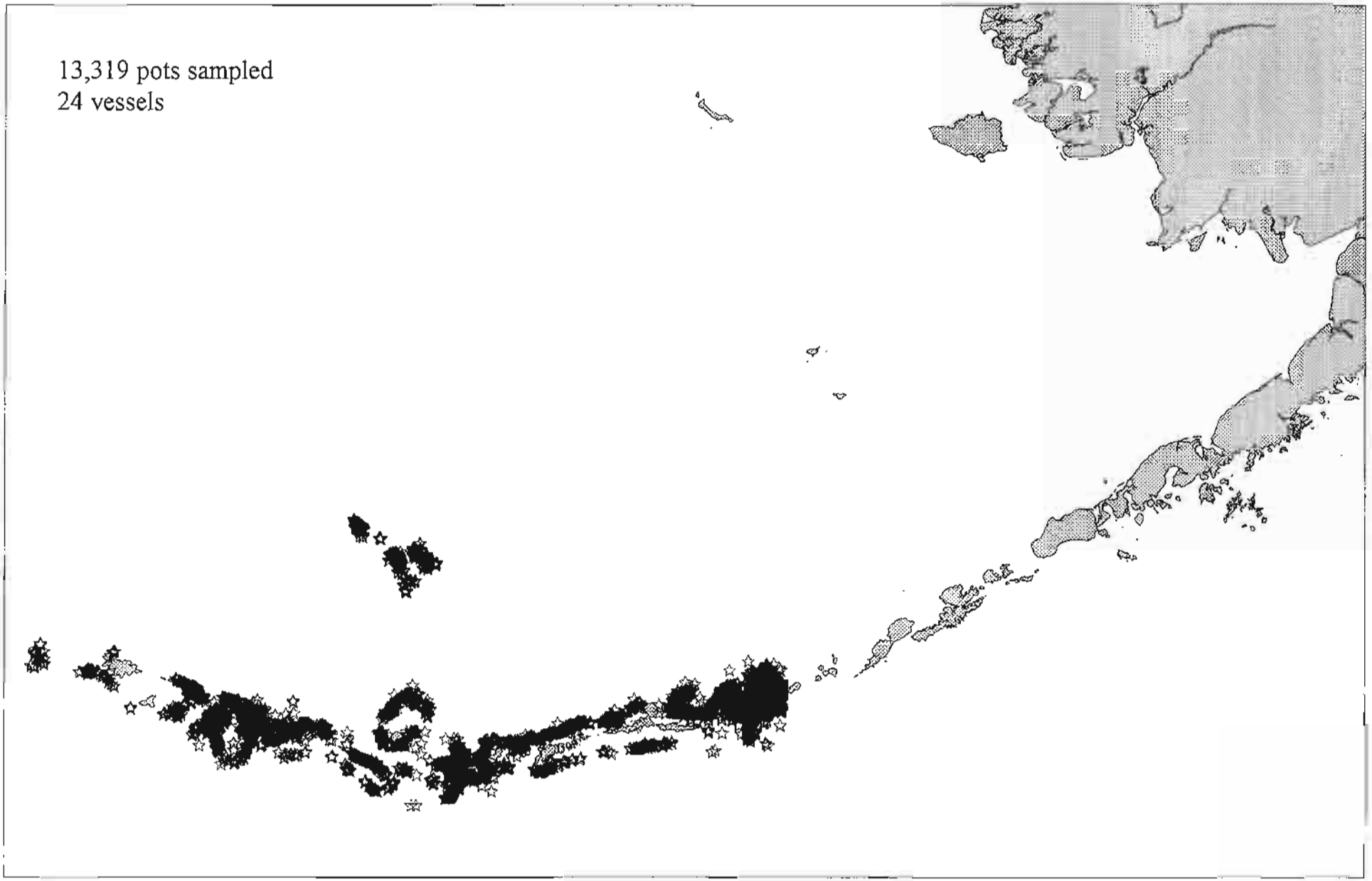


Appendix B-1. Location of pots sampled by observers in the 1996 Bering Sea C. opilio fishery.

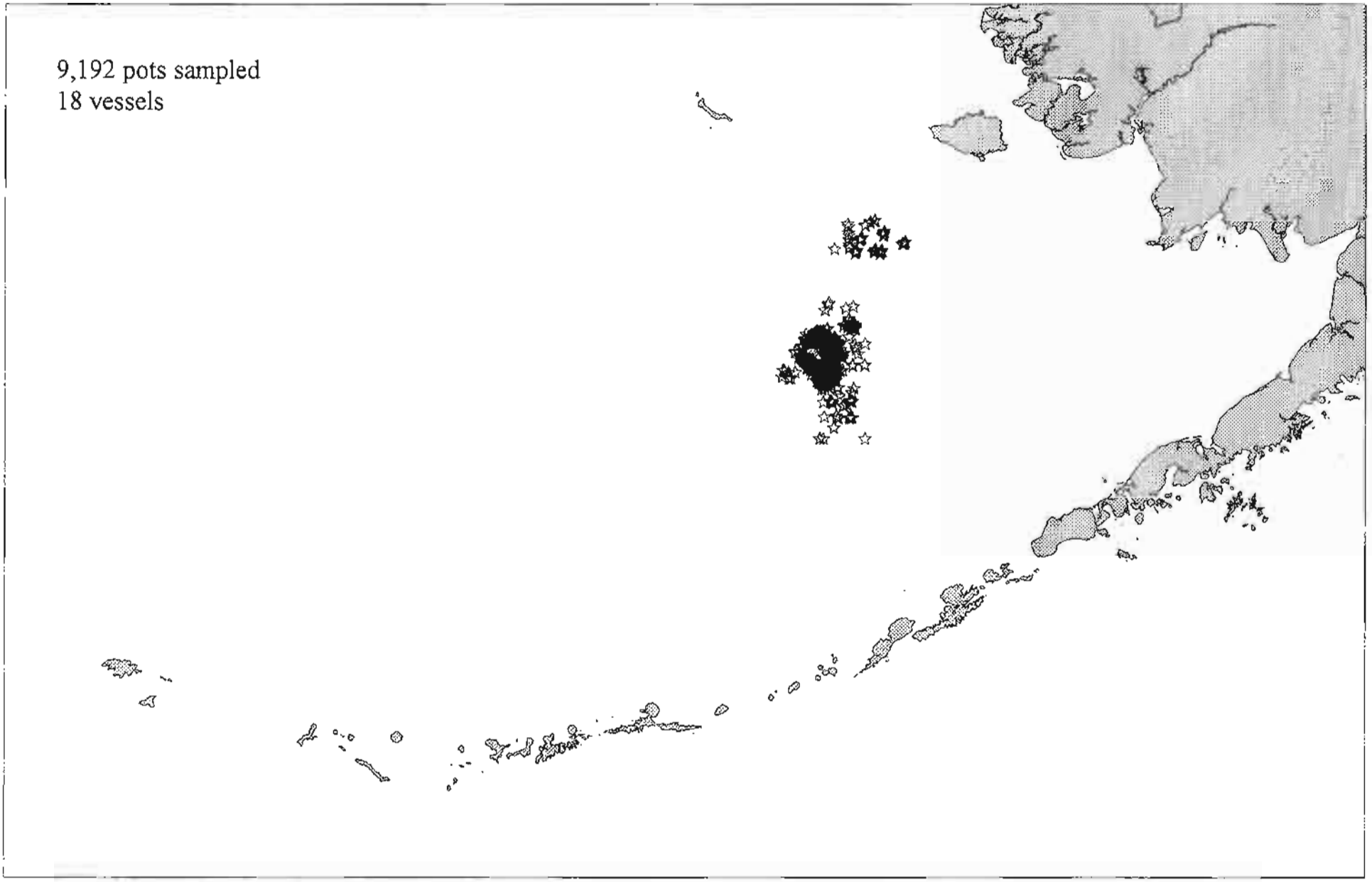
Appendix B-3. Location of pots sampled by observers in the 1996 St. Matthew District blue king crab fishery.



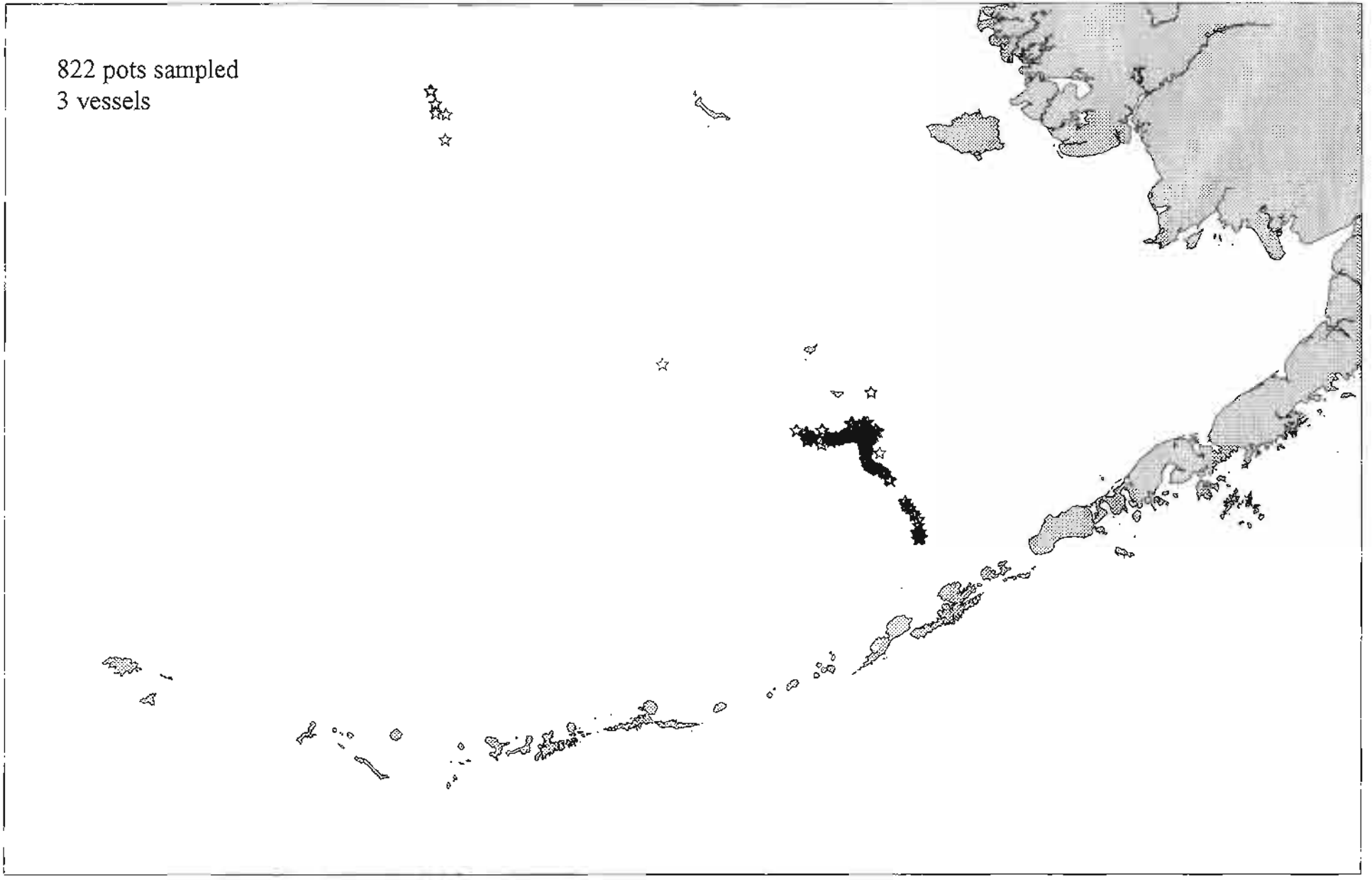
Appendix B-4. Location of pots sampled by observers in the 1996 Bristol Bay red king crab fishery.



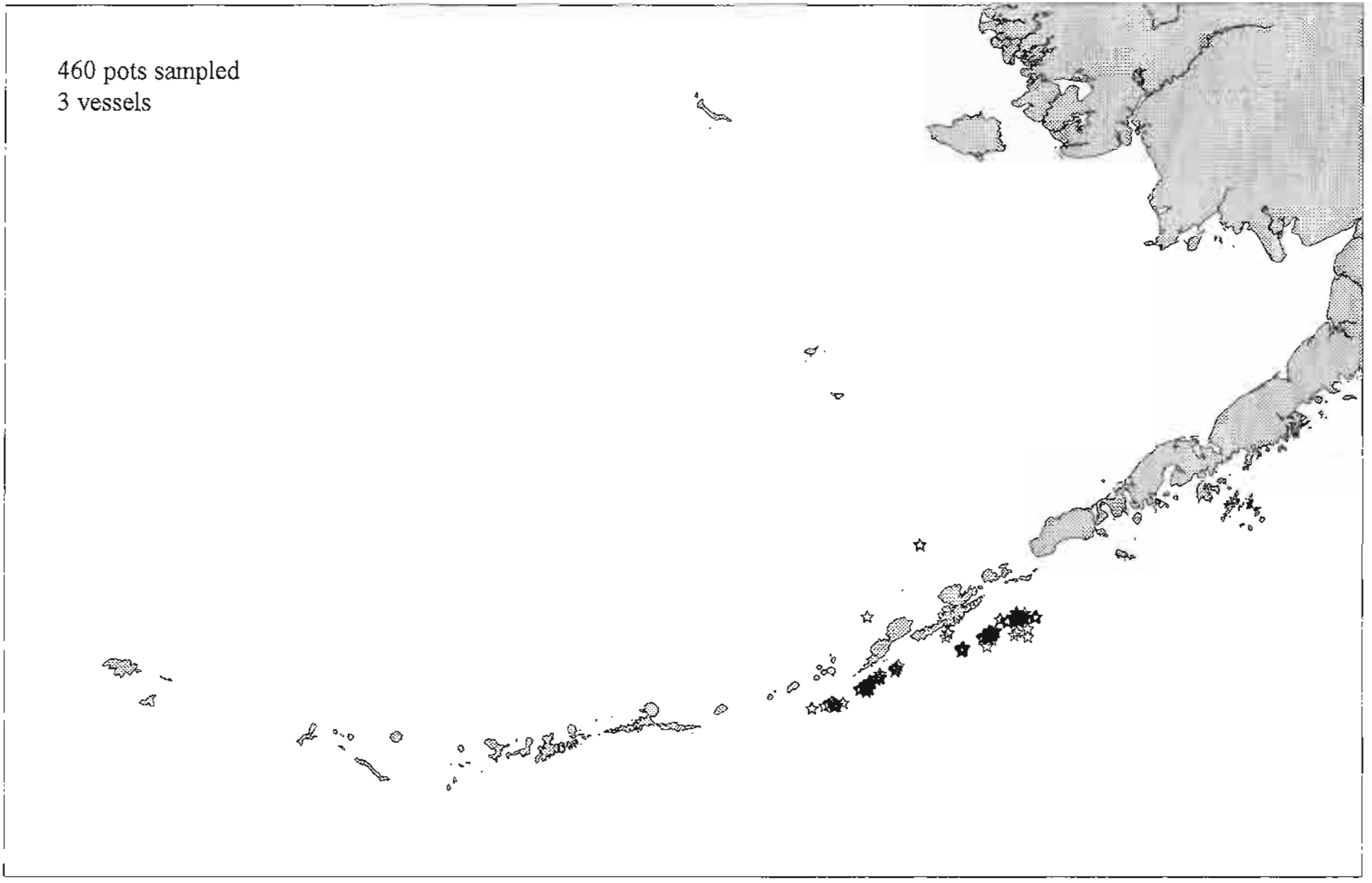
Appendix B-5. Location of pots sampled by observers in the 1995-96 Adak brown king crab fishery.



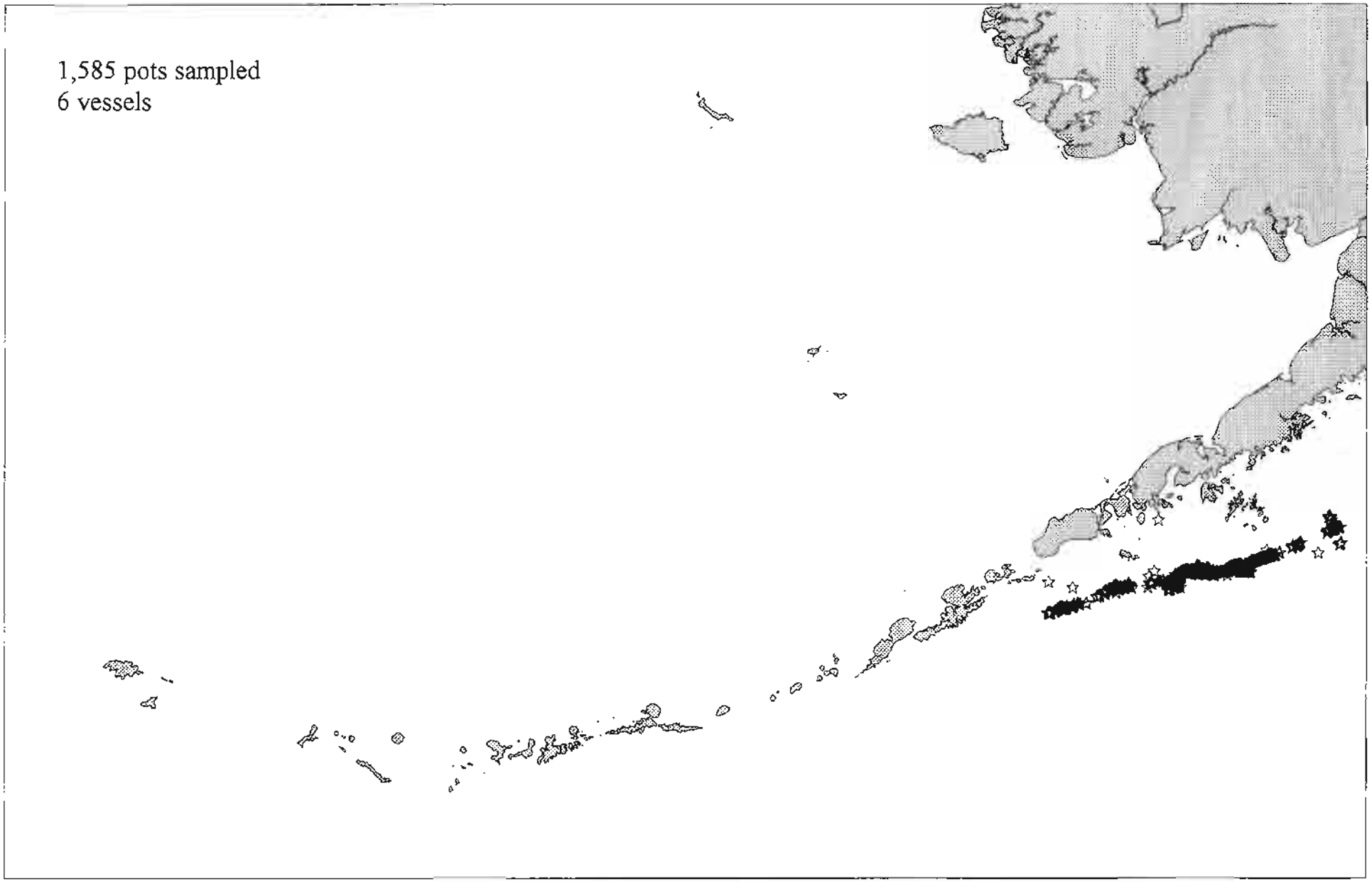
Appendix B-7. Location of pots sampled by observers in the 1996 Bering Sea Korean Hair Crab fishery.



Appendix B-8. Location of pots sampled by observers in the 1996 Bering Sea C. tanneri fishery.



Appendix B-9. Location of pots sampled by observers in the 1996 Eastern Aleutian Area C. tanneri fishery.



Appendix B-11. Location of pots sampled by observers in the 1996 South Peninsula Area C. tanneri fishery.

Appendix C-1. Total pot contents from 1,349 randomly sampled pots during the Bering Sea *C. opilio* fishery, 1996.

Species		Total number observed
Hermit crab unident.		201
Chionoecetes tanneri	Legal Male	0
	Sublegal	0
	Female	1
Starfish unident.		219
Tanner crab, hybird	Legal Male	10,943
	Sublegal	1,130
	Female	158
Halibut		57
Greenland turbot		5
Flathead sole		1
Rock sole		1
Alaska plaice		1
Yellowfin sole		21
Arrowtooth flounder		7
Walleye pollock		27
Pacific cod		947
Sablefish		2
Shortfin eelpout		1
Pacific ocean perch		3
Sculpin unident.		27
Great sculpin		1
Yellow irish lord		72
Snailfish unident.		3
Scallop unident.		1
Snail unident.		5,709
Fusitriton oregonensis		11
Lyre crab		84
Sea urchin unident.		1
Squid unident.		2
Sea anemone		16
Octopus		1
Plicifusu kroeyeri		1
Red King Crab	Legal Male	1
	Sublegal	0
	Female	0
Blue King Crab	Legal Male	45
	Sublegal	18
	Female	0
Brown King Crab	Legal Male	0
	Sublegal	1
	Female	0
Tanner Crab, *C. bairdi*	Legal Male	1,137
	Sublegal	5,349
	Female	1,947
Tanner Crab, *C. opilio*	Legal Male	264,015
	Sublegal	14,873
	Female	563
Korean Hair Crab	Legal Male	3
	Sublegal	0
	Female	0

Appendix C-3. Total pot contents from 96 randomly sampled pots during the St. Matthew Blue King crab fishery, 1996.

Species		Total number observed
Hermit crab unident.		8
Tanner Crab, hybrid	Legal male	176
	Sublegal	1021
	Female	2
Skate unident.		1
Greenland turbot		2
English sole		1
Yellowfin sole		26
Walleye pollock		5
Pacific cod		152
Sculpin unident.		10
Great sculpin		12
Snailfish unident.		5
Snail unident.		1
Lyre Crab		175
Blue King Crab	Legal Male	617
	Sublegal	640
	Female	509
Tanner Crab, *C. opilio*	Legal Male	1308
	Sublegal	2702
	Female	10

Appendix C-4. Total pot contents from 84 randomly sampled pots during the Bristol Bay Red King crab fishery, 1996.

Species		Total number observed
Hermit crab unident.		2
Starfish unident.		7
Tanner Crab, hybrid	Legal male	0
	Sublegal	1
	Female	0
Halibut		3
Yellowfin sole		28
Pacific cod		27
Sculpin unident.		2
Bigmouth sculpin		2
Yellow irish lord		1
Snail unident.		2
Red King Crab	Legal Male	1152
	Sublegal	626
	Female	11
Tanner Crab, *C. bairdi*	Legal Male	240
	Sublegal	42
	Female	10
Tanner Crab, *C. opilio*	Legal Male	0
	Sublegal	1
	Female	0
Korean Hair Crab	Legal Male	1
	Sublegal	0
	Female	0

Appendix C-5. Total pot contents from 13,321 randomly sampled pots during the Adak brown king crab fishery, 1995/96.

Species		Total number observed
Placetron wosnessenskii		8
Hermit crab unident.		5
Lithodes couesi	Legal Male	592
	Sublegal	86
	Female	113
Paralomis multispina	Legal Male	0
	Sublegal	1
	Female	1
Chionoecetes tanneri	Legal Male	102
	Sublegal	42
	Female	23
Chionoecetes angulatus	Legal Male	2
	Sublegal	8
	Female	1
Starfish unident.		922
Skate unident.		252
Flatfish unident.		13
Halibut		556
Greenland turbot		110
Rock sole		11
Dover sole		10
Yellowfin sole		1
Arrowtooth flounder		72
Turbot unident.		1
Walleye pollock		20
Pacific cod		3,017
Sablefish		289
Atka mackerel		145
Prowfish		16
Eelpout unident.		1
Shortfin eelpout		2
Grenadiers, rattails		21
Rockfish unident.		60
Pacific ocean perch		101
Northern rockfish		29
Rougheye rockfish		270
Redbanded rockfish		3
Yelloweye rockfish		4
Dusky rockfish		3
Shortspine thornyhead		49
Greenling		1
White spotted greenling		2
Sculpin unident.		1,256
Bigmouth sculpin		9
Great sculpin		7
Yellow irish lord		235
Snailfish unident.		36
Basket starfish unident.		617
Brittle star		79
Mussel unident.		5

-Continued-

Appendix C-5. (page 2 of 2)

Species		Total number observed
Scallop unident.		1
Weathervane scallop		6
Chlamys sp.		1
Snail unident.		1,317
Lyre crab		72
Jellyfish unident.		3
Sea urchin unident.		738
Sea cucumber unident.		26
Tunicate unident.		5
Barnacle unident.		5
Sea anemone		39
Sea pen		5
Octopus		119
Hairy triton		32
Neptunea pribilofensis		24
Buccinum scaliforme		1
Sponge unident.		535
Red King Crab	Legal Male	16
	Sublegal	24
	Female	12
Brown King Crab	Legal Male	62,608
	Sublegal	128,094
	Female	135,682
Tanner Crab, *C. bairdi*	Legal Male	3
	Sublegal	26
	Female	16
Tanner Crab, *C. opilio*	Legal Male	0
	Sublegal	0
	Female	1
Korean Hair Crab	Legal Male	57
	Sublegal	85
	Female	27

Appendix C-7. Total pot contents from 9,197 randomly sampled pots during the Bering Sea korean hair crab fishery, 1996.

Species		Total number observed
Hermit crab unident.		694
Decorator crab	Legal Male	0
	Sublegal	0
	Female	28
Tanner crab, hybrid	Legal Male	176
	Sublegal	74
	Female	65
Starfish unident.		65,051
Rock sole		12
Alaska plaice		1
Yellowfin sole		61
Starry flounder		1
Walleye pollock		1
Pacific cod		989
Sculpin unident.		1,567
Yellow irish lord		827
Sturgeon poacher		1
Snailfish unident.		2
Mussel unident.		7
Snail unident.		1,076
Lyre crab		590
Jellyfish unident.		14
Sea urchin unident.		55
Sea cucumber unident.		10
Sea anemone		6
Octopus		50
Red King Crab	Legal Male	13
	Sublegal	203
	Female	879
Blue King Crab	Legal Male	46
	Sublegal	315
	Female	551
Brown King Crab	Legal Male	15
	Sublegal	2
	Female	13
Tanner Crab, *C. bairdi*	Legal Male	119
	Sublegal	2,085
	Female	2,888
Tanner Crab, *C. opilio*	Legal Male	8,261
	Sublegal	1,679
	Female	45
Korean Hair Crab	Legal Male	14,001
	Sublegal	826
	Female	1,090

Appendix C-8. Total pot contents from 822 randomly sampled pots during the Bering Sea *C. tanneri* crab fishery, 1996.

Species		Total number observed
Paralomis verilli		138
Lithodes couesi	Legal Male	644
	Sublegal	777
	Female	788
Paralomis multispina	Legal Male	124
	Sublegal	79
	Female	229
Chionoecetes tanneri	Legal Male	3,141
	Sublegal	459
	Female	570
Chionoecetes angulatus	Legal Male	1,138
	Sublegal	778
	Female	21
Starfish unident.		35
Skate unident.		2
Halibut		5
Greenland turbot		19
Pacific cod		51
Sablefish		3
Grenadiers, rattails		2
Shortspine thornyhead		1
Sculpin unident.		5
Snail unident.		325
Octopus		1
Brown King Crab	Legal Male.	143
	Sublegal	185
	Female	54
Tanner Crab, *C. bairdi*	Legal Male	0
	Sublegal	4
	Female	0
Tanner Crab, *C. opilio*	Legal Male	3
	Sublegal	1
	Female	0
Korean Hair Crab	Legal Male	0
	Sublegal	1
	Female	0

Appendix C-9. Total pot contents from 460 randomly sampled pots during the Eastern Aleutian *C. tanneri* fishery, 1996.

Species		Total number observed
Paralomis verilli		1
Lithodes couesi	Legal Male	693
	Sublegal	519
	Female	1,106
Paralomis multispina	Legal Male	21
	Sublegal	8
	Female	19
Chionoecetes tanneri	Legal Male	1,107
	Sublegal	843
	Female	1,622
Chionoecetes angulatus	Legal Male	93
	Sublegal	39
	Female	3
Starfish unident.		8
Arrowtooth flounder		1
Pacific cod		13
Sablefish		25
Pacific ocean perch		1
Snail unident.		12
Jellyfish unident.		1
Sea urchin unident.		1
Sea cucumber unident.		1
Octopus		3
Brown King Crab	Legal Male	2
	Sublegal	41
	Female	28

Appendix C-11. Total pot contents from 1,586 randomly sampled pots during the South Peninsula *C. tanneri* fishery, 1996.

Species		Total number observed
Paralomis verilli		1
Lithodes couesi	Legal Male	447
	Sublegal	312
	Female	895
Paralomis multispina	Legal Male	4
	Sublegal	3
	Female	16
Chionoecetes tanneri	Legal Male	30,036
	Sublegal	17,594
	Female	15,659
Chionoecetes angulatus	Legal Male	13
	Sublegal	3
	Female	0
Starfish unident.		14
Flatfish unident.		2
Halibut		18
Arrowtooth flounder		7
Pacific cod		150
Sablefish		154
Grenadiers, rattails		16
Rockfish unident.		3
Shortspine thornyhead		20
Snail unident.		82
Sea urchin unident.		7
Sea cucumber unident.		3
Sea anemone		1
Octopus		20
Sponge unident.		2
Brown King Crab	Legal Male	2
	Sublegal	3
	Female	4