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A Summary Of Data Collected By Scallop Observers From The 1994/1995 Commercial Scallop Fishery In Alaska's Westward Region

By

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INTRODUCTION

The Alaska scallop fishery began in 1967 and has evolved from a sporadic, low intensity fishery to one characterized by a highly specialized fleet by the early 1990's. An influx of larger, more efficient vessels from 1990 through 1993 increased harvests and altered the character of the fishery (Shirley and Kruse 1995).

Alaska Department of Fish and Game Commissioner Rosier declared the scallop fishery to be a high impact and emerging fishery on May 21, 1993 in order to address concerns about crab bycatch. As a result of this action, the department was required to implement an interim management plan including an observer program to monitor bycatch in the scallop fleet (Urban et al. 1994). Because the Alaskan scallop fishery was relatively minor until recently, it was passively managed and data collection was minimal (Shirley and Kruse 1995). The 1994/95 scallop fishing season marks the second year the mandatory scallop observer program has been in place. Scallop observer data collection was designed to assess scallop stocks as well as monitor incidental crab bycatch. As a result, the scallop observer program is providing baseline information relative to scallop biology and incidental bycatch.

An onboard observer is required when taking scallops in a fishery with a guideline harvest range established by regulation. Unless the department, in its discretion, determines that carrying an onboard observer will not serve the purposes of the onboard observer program (ADF&G 1994). Observer requirements have been waived in the Cook Inlet scallop fishery. Vessels participating in that fishery are limited to a single six foot dredge and are required to maintain logbooks. Periodic onboard observations are conducted by department personnel. In the Yakutat fishery vessels under 65 feet are generally not required to have an observer.

The scallop observer program began on July 1, 1993 and is ongoing. In addition to providing invaluable information pertaining to incidental bycatch, including crab and halibut, the observer program allows timely collection of scallop catch reports needed to manage the fishery. The program provides biological information about age, growth, size of scallops, and scallop bed locations, as well as incidental bycatch information and catch composition.

METHODS

Observer Training and Data Collection Procedures

Scallop observer training classes were conducted by the University of Alaska, Anchorage, North Pacific Fisheries Observer Training Center in January, June, and September, 1994. Course material included: history of the fishery, fishing operations and gear; program organization, objectives and rationale, overview of sampling duties, anatomy and physiology, scallop and crab measurements, prohibited species, scallop shell-aging, crab and finfish identification, and how to complete forms. A total of 16 observers successfully completed the program.

At-Sea Catch Sampling

Scallop observers were given detailed instructions to collect a variety of biological data on a daily basis. One dredge per haul per day was sampled for haul composition by weight. Observers were instructed to sample the hauls randomly; e.g., the decision to sample a particular haul was made prior to viewing its contents. All weights of biological species, rocks, wood, and man-made debris in the haul were determined, either by subsampling the catch or weighing biological species and other items directly. The first step of the subsample procedure was to estimate the weight of the entire catch and record it on the haul composition form (Appendix A.2.). Any objects not likely to be picked up in the basket sample were then weighed directly, summed, and recorded. Items normally weighed directly would include large rocks, chunks of wood, or large species such as skates, octopus, and large Pacific cod. Pacific halibut were measured to the nearest centimeter (cm) from the tip of the nose to the end of the central rays of the caudal fin. Weights were determined from a length/weight conversion table.

The remainder of the catch was subsampled to proportion its weight among the various species. The subsample consisted of two fish baskets filled with a random selection of the remaining catch. The subsample was sorted, weighed by species, and recorded.

To determine the total weight in the dredge of each of the subsample of species, subsample weights were extrapolated from the weight of the catch (adjusted for 100% sampling of large items) as shown in appendix A.2..

Six hauls were sampled daily for crab and halibut bycatch; one dredge per haul was examined. Observers identified, counted, and recorded the number of crab and halibut encountered in the bycatch sample dredges. Additionally, up to 100 crabs per sampled dredge were speciated, sexed, measured, shell aged, and checked for injuries and mortality. If a dredge contained more than 100 crabs observers were permitted to subsample the catch. For random subsampling, observers divided the crab catch into equal portions (halves, quarters, etc.) until each portion was estimated to contain between 50 to 100 crabs. All crabs in one portion were measured and the crabs in the remaining portions were counted only. All halibut were measured and checked for body injuries . One hundred scallops from the retained catch were measured each day. Measured scallops were randomly selected from at least three hauls. Shell height, sex, age, and gonad development information was collected from each scallop. Observers were instructed to collect 50 scallop shells per trip from the sample they aged. This allowed the department to evaluate the accuracy of each observer's shell aging. Twelve small (one to three year old) scallops were requested from each statistical area fished to confirm identification of the first and second annuli. Observers were instructed to document with photographs the fishing operation, gear, processing facilities, catch, and any evidence of potential regulatory violations.

Data Collection Forms

Scallop observer data collection forms used during the 1994/1995 scallop season were modified from those used in the 1993/1994 season and are shown in appendix A. The fishing log form (Appendix A.1.) is the only form completed by the vessel operator. It contains basic information on fishing location, dredge width, gear performance, depth, distance towed, time and speed of tows and catch information on a tow by tow basis. Dredge catch composition by weight of all

species caught including noncommercial species is recorded on the haul composition form (Appendix A.2.). It is also used to record man-made debris caught in the dredge such as plastics, fishing gear, cans, etc. The crab and halibut bycatch form (Appendix A.3.) is used to record the number of crab and halibut caught in sampled dredges; and is used in conjunction with the crab size and injury form (Appendix A.4.), and the halibut length and condition form (Appendix A.5.). Crab recorded on the bycatch form are identified, measured, sexed, shell-aged, and assessed for carapace and leg injury. All information is recorded on the crab size and injury form. Halibut measurements and body condition codes are recorded on the halibut length and condition form. Scallop shell height, age, sex, and gonad development is recorded on the scallop size frequency form (Appendix A.6.). A weekly summary form (Appendix A.7.) is used to summarize daily data collections including pounds of scallop meats, number of hauls and sampled dredges, and number of king and Tanner crab in sampled dredges by statistical area. The radio report form (Appendix A.8.) is used by observers to organize and encode observer data transmitted by radio reports to the ADF&G offices. Other forms used in the scallop observer program include a skipper evaluation form used by the vessel operator to evaluate the observer, a brief/debrief checklist, observer conflict of interest form, and an office radio log form.

Scallop Aging Techniques and Analysis

Scallop shells sampled by observers were aged by counting growth rings (annuli) on the exterior of the left (upper) valve. The left valve was chosen because the right valve rests on the bottom and is subject to excessive wear. The right valve also lacks the characteristic difference in shell color of summer versus winter growth, an important aspect of aging scallops. Aging weathervane scallops is difficult due to several factors: (1) the first and sometimes the second year annuli are not distinct. While this characteristic is a problem in scallops of any age, it is more prevalent in older scallops that exhibit wear in the umbo (lateral prominence just above the hinge) portion of the shell; (2) during the first two years of growth, there are a number of rings on the shell which might be considered annuli, that are in fact, false checks; and (3) shells that are broken due to environmental factors or damaged from dredges may "lose" an entire years growth effectively precluding accurate aging.

Shell-aging techniques were demonstrated to the department scallop biologist by Dr. Neil Bourne at the Pacific Biological Station in Nanaimo, British Columbia, Canada. Dr. Bourne has coordinated work on weathervane scallop shell-aging with Dr. Alla Silina from the Institute of Marine Biology in Vladivostok, Russia. Dr. Silina is considered the leading world expert on aging scallops. Her analysis of Dr. Bourne's shell aging combined with his instruction provided the basis for the shell-aging technique used in this report. Comparative results are pending from a sample of 58 aged weathervane scallop shells submitted to Dr. Silina for analysis in April 1995.

A sample of 887 scallop shells collected and aged by observers were also aged by the department scallop biologist. From these samples a paired t-test (Freund and Simon 1992) was performed on each set of shells from individual observers. The paired t-test was performed to test whether the observer age estimates were consistent with the scallop biologist's age estimates. If consistency was maintained, then the age and height measurements would be used in the height-at-age growth curve estimates. A logistic growth curve (Ratkowsky 1983) was fit using a least square estimate from the age versus shell height data.

Bycatch Estimation Procedures

Incidental bycatch of Dungeness (*Cancer magister*), king (*Paralithodes* spps), Tanner (*Chionoecetes bairdi*), snow (*C. opilio*), hybrid Tanner crabs, and halibut (*Hippoglossus stenolepis)* was estimated from data collected by onboard observers. The goal was to randomly sample six dredges for bycatch per day on each boat. Due to constraints such as weather conditions and sea sickness, the number of sampled dredges ranged from 1 to 6 per day per vessel. For analysis, bycatch data for *C. bairdi*, *C. opilio* and hybrid Tanner crabs were combined into a single category in the Bering Sea, (Area Q). The estimator used to calculate bycatch is described as : (total number of crab or halibut from sampled dredges / sampled dredge-hours) X (total dredge-hours X average number of dredges fished) summed over all fishing days for all vessels, given that a dredge-hour was 60 minutes of dredging. Bycatch estimates were then calculated by expanding crab or halibut per dredge-hour by the total dredge-hours in a day (maximum 20.8 hours) and then usually doubled, since most boats fished two dredges simultaneously. Confidence intervals for estimates greater than 1,000 crabs or halibut and standard errors for estimates between 100 and 1,000 crabs or halibut were calculated from a bootstrapping procedure (Effron and Tibshirani 1986). Standard errors for the Tanner crab bycatch estimate were not calculated for the Semidi District of the Kodiak Area or the Dutch Harbor Area due to the small sample size.

RESULTS

Twenty different observers were onboard 12 different vessels during the 1994/1995 scallop season. Vessel days totaled 1,027, given that vessel days include all days between observer briefing and debriefing, including weather and travel days. Scallop fishing occurred on 748 of the 1027 vessel days. A total of 717 days of fishing were observed (an observed day is a day with at least one sampled tow), from the 748 days on which fishing occurred. Vessel operators recorded 14,110 hauls on their logs, of which approximately 30 % were sampled by observers. Over 57,000 scallop shells and 48,000 Tanner crabs were measured. A total of 96 separate briefings and debriefings, not including 13 mid-trip debriefs, were conducted in the Westward Region and included 24 for the Bering Sea (Area Q), 10 for Dutch Harbor (Area O), 24 for the Alaska Peninsula (Area M), and 38 for Kodiak (Area K). The 38 briefings and debriefings for the Kodiak Area included 6 for the Northeast District and 32 for the Shelikof and Semidi Districts combined.

The highly mobile scallop fleet fished 77 different statistical areas in the Westward Region, extending from the Bering Sea to the Gulf of Alaska. Figure 1 shows major fishing areas in the westward Region during the 1994/1995 scallop fishery.

Target Scallop Fishery

Catch and Effort

Total scallop dredging effort by the observed fleet was 23,623 tow-hours per dredge, where a tow-hour per dredge is expressed as one dredge towed for 60 minutes (Figure 2). Most effort occurred in the Bering Sea with 11,281 tow- hours, while the least amount of effort occurred in Dutch Harbor with 81 tow-hours. The second highest effort level occurred in the Kodiak Area with 10,765 tow-hours. Kodiak Area totals reflect the sum of the Northeast District with 1,772 tow hours and the remainder of the Kodiak Area with 8,991 tow-hours. The Shelikof and Semidi Districts of Kodiak were combined to protect the confidentiality of individual vessels fishing the Semidi District. Dredging effort in the Alaska Peninsula was 1,496 tow- hours.

Total round weight of retained scallops as reported in vessel fishing logs from the Westward Region was 10,497,694 pounds (Figure 3). The largest catch occurred in the Bering Sea with 5,942,912 pounds reported. The second highest catch total occurred in Kodiak with 3,911,719 pounds reported. Kodiak totals reflect the sum of 389,202 pounds from the Northeast District and 3,552,517 pounds from the remainder of Kodiak, largely the Shelikof District. The Alaska Peninsula and Dutch Harbor catches totaled 619,473 and 23,590 pounds respectively.

Shucked meat weights as reported on fish tickets totaled 928,280 pounds from the Westward Region. The Kodiak Area harvest of 355,628 pounds included the Northeast District (35,517 pounds) and an additional 320,111 pounds from the remainder of Kodiak, largely the Shelikof District. Harvest totals for the remainder of the Westward Region included 65,282 pounds from the Alaska Peninsula, 1,931 pounds from Dutch Harbor, and 505,439 pounds from the Bering Sea Area.

Scallop catch-per-unit-effort (CPUE), expressed as the whole weight of retained scallops per tow-hour per dredge, averaged 444 pounds in the Westward Region (Figure 4). The highest CPUE occurred in the Bering Sea at 527 pounds/tow-hour/dredge. Catch-per-unit-effort from the Alaska Peninsula ranked second at 414 pounds/tow-hour/dredge. The Kodiak Area ranked third with 363 pounds/tow-hour/dredge. Catch-per-unit-effort in the Dutch Harbor Area was 291 pounds/tow-hour/dredge.

Shell Aging Analysis

Scallop shell size (height) from the retained catch varied by area in the Westward Region. The largest shell height (SH) occurred in the Dutch Harbor Area, with an average of 157.7 mm and a range of 129 mm to 178 mm (Figure 5). The smallest scallops occurred in the Alaska Peninsula (Area M) with an average shell height of 126.7 mm and a range of 30 mm to 189 mm (Figure 6). Scallops in the Semidi District of the Kodiak Area averaged 152.7 mm in SH with a range of 30 mm to 191 mm (Figure 7). In the Northeast District of the Kodiak Area, scallop shell height averaged 150.9 mm and ranged from 92 mm to 220 mm (Figure 8). Bering Sea scallops averaged 146.9 mm in SH and ranged in size from 36 mm to 223 mm (Figure 9). The Shelikof District of the Kodiak Area yielded scallops with an average SH of 131.4 mm and ranged from 33 mm to 226 mm (Figure 10). Small scallops in the 30 mm range found in retained catch samples

may have inadvertently been picked up with larger scallops when the retained catch was sorted by the crew.

From the paired t-tests, there was a significant difference ($p < .1$) between each observer's estimated ages and the scallop biologist's estimated ages for the same shells. Due to this difference, only the scallop ages estimated by the scallop biologist were used in estimating the logistic growth curves.

Logistic curves were fit to the subsample of measured scallop shells from the Shelikof and Northeast Districts of Kodiak and the Bering Sea with the three logistic curves looking similar (Figure 11). No test for significance was performed due to few small scallops and assumed different stocks. The Dutch Harbor Area and the Semidi District of Kodiak had too few scallops measured to estimate a logistic curve. Alaska Peninsula Area scallops could not be fit to a logistic curve due to the presence of two distinct shell types; one group exhibited "normal" growth and the other exhibited very slow growth, e.g. they grew a few millimeters over each of three identical years.

Scallop Fishery Bycatch

A wide range of species and debris (rocks, kelp, weathervane scallop shells, etc.) are caught incidentally in scallop dredges. However, weathervane scallops predominate catches (Table 1). In the Bering Sea, weathervane scallops comprised the largest percentage of the catch by weight at 77.2 % in contrast to the Northeast District of the Kodiak Area where weathervane scallops were lowest at 43.5 %. Catches of weathervane scallops in the Alaska Peninsula Area were similar to Bering Sea catches at 72.5 % of the catch. Lesser densities of scallop catches were also noted: 64.1 % in the Shelikof District of the Kodiak Area, 55.2 % in the Dutch Harbor Area, and 49.3 % in the Semidi District of the Kodiak Area.

Other species and debris (rocks, weathervane scallop shells, etc.) caught incidentally in scallop dredges varied by area (Table 1). Following weathervane scallops, the three most frequently caught species or items in scallop dredges by management area were: starfish (28 %), kelp, rocks, etc. (9 %), and skates (5 %), in the Northeast District of the Kodiak Management Area; weathervane scallop shells (10.1 %), kelp, rocks, etc. (9.1 %), and starfish (4.2 %), in the Shelikof District of the Kodiak Management Area; starfish (23.7 %), kelp, rocks, etc. (13.8 %) and weathervane scallop shells (4.6 %), in the Semidi District of the Kodiak Management Area; basket star (5.5 %), weathervane scallop shells (5.2%), and starfish (5.1 %); in the Alaska Peninsula Management Area; skates (17.5 %), rock sole (8.6 %),and miscellaneous invertebrates (7.7 %), in the Dutch Harbor Management Area; weathervane scallop shells (7.1 %), Tanner crab (2.8 %), and skates (2.8 %). in the Bering Sea Management Area. A ranking of the twenty most frequently caught species for each management area is contained in Appendix B.

Crab Bycatch Estimates

The highest bycatch of Tanner crabs occurred in the Bering Sea Area with total estimated bycatch of 245,001 crabs (Table 2). The estimate ranged from 221,331 to 270,133 crabs at the 95% confidence interval (C.I.). Tanner crabs were frequently caught in the Shelikof District of Kodiak,

with a total estimated bycatch of 64,444 crabs, and ranged from 54,137 to 75,330 crabs at the 95% C.I.. Tanner crab bycatch from the Alaska Peninsula was estimated to be 25,287 crabs, and ranged from 17,953 to 33,088 crabs at the 95% C.I.. Estimated bycatch of Tanner crabs in the Northeast District of Kodiak was 2,054 crabs, and ranged from 1,215 to 3,123 crabs at the 95% C.I.. Tanner crab bycatches in the Semidi District of the Kodiak Area and in the Dutch Harbor Area were estimated to be 984 and 757 Tanner crabs, respectively.

King crab bycatches were overall very low, and ranged from a high of 190 crabs in the Northeast District of Kodiak to zero in the Alaska Peninsula Area (Table 2).

Incidental Dungeness crab bycatch was highest in the Shelikof District of the Kodiak Area with an estimated 2,156 crabs taken as bycatch (Table 2). The estimate ranged from 1,450 to 2,861 crabs at the 95% C.I.. Estimated bycatch of Dungeness crab in the Alaska Peninsula Area was 143 crabs with a standard error of 78 crabs. Dungeness crab bycatch in the Semidi District of the Kodiak Area was estimated to be 129 crabs with a standard error of 66 crabs. The Dungeness bycatch estimate for the Bering Sea Area was minimal (15 crabs); no Dungeness crabs were caught in either the Dutch Harbor Area or Northeast District of the Kodiak Area.

Tanner Crab Bycatch Relative to the Commercial Scallop Fishery. The number of Tanner crabs caught per pound of retained scallop meats was calculated for all areas. The estimated catch of Tanner crabs per pound of retained scallop meats was highest in the Bering Sea Area at approximately 0.5 crabs per pound (Figure12). The Dutch Harbor and Alaska Peninsula Areas ranked second, each with approximately 0.4 crabs per pound of retained scallop meats. The Tanner bycatch rate in Kodiak was approximately 0.2 crabs per pound; however, this average rate does not reflect the very low bycatch of Tanner crab in the Northeast District (<0.1) but rather the higher rate of rate of bycatch data for all other districts in Kodiak (~0.2).

Size Distribution of Tanner Crab Bycatch. Tanner crab bycatch in the Northeast District of Kodiak was an estimated 2,054 crabs of which 300 were measured and sexed (Figure 13). Bycatch was dominated by small male and female Tanner crabs which measured less than 50 mm carapace width (CW) and comprised 68% of the total number of crabs measured. The average size of the 223 males measured was 45 mm CW, with a range of 8 mm to 153 mm CW. Males between 20 and 35 mm comprised 41 percent of the sampled males. Notably, only five males were 140 mm CW or greater; 140 mm CW is equivalent to the legal commercial size. The average size of the 77 measured females was 49 mm CW, and ranged from 10 mm to 89 mm CW. Thirty-three percent were between 30 mm and 50 mm CW.

Tanner crab bycatch in the Shelikof District was estimated to be 64,444 crabs of which 9,076 were measured and sexed (Figure 14). Forty-eight percent of the sampled bycatch were females between 80 mm and 100 mm CW. Of the 2,519 males measured, the average size was 91 mm CW, with a range of 7 mm to 183 mm CW. Male Tanner crabs exhibited a bimodal size distribution, with a mode between 17 mm and 37 mm CW and another mode between 120 mm and 139 mm CW. Legal males 140 mm CW or greater represented 16% of those measured. The average size of the 6,557 measured females was 83 mm CW and ranged from 9 mm to 121 mm CW. Sixty-seven percent of the females sampled were 80 mm to 100 mm CW.

Estimated Tanner crab bycatch in the Semidi District was 984 crabs, of which 160 were measured and sexed (Figure 15). Forty-nine percent of all crabs sampled were in the 70 mm to 105 mm CW range. Of the 125 males measured, the average size was 66 mm CW, with a range of 12 mm to 132 mm CW. Females comprised 35 individuals in the sample, with an average size of 75 mm CW and a ranged from 20 mm to 99 mm CW.

Estimated Tanner crab bycatch from the Alaska Peninsula was 25,287 crabs of which 4,394 were measured and sexed (Figure 16). The sample was dominated by crabs in the 8 mm to 25 mm CW range at 71 percent of the total sample. Of the 2,522 males measured, the average size was 23 mm CW, and ranged from 7 mm to 155 mm CW. Sixty-five percent of the males were between 8 mm and 21 mm CW. Only five legal males ($\geq$ 40 mm CW) were noted in the sample. The average size of the 1,872 measured females was 27 mm CW with a range of 7 mm to 122 mm CW. Fifty-eight percent of the females were in the 7 mm to 21 mm CW range.

Tanner crab bycatch in the Dutch Harbor Area was estimated to be 758 crabs, of which 142 were measured and sexed (Figure 17). The sample was dominated by crabs in the 60 mm to 90 mm CW range which comprised 74 percent of the total. Of the 58 males measured, the average size was 75 mm CW, and ranged in size from 20 mm to 134 mm CW. Of the 84 females measured, the average size was 57 mm CW, with a range of 13 mm to 107 mm CW.

Estimated Tanner crab bycatch in the Bering Sea Area was 245,001 crabs of which 29,472 were measured and sexed (Figure 18). The average size of 12,636 measured males was 108 mm CW, with a range of 8 mm to 176 mm CW. Fifty-four percent of males were in the 110 mm to 139 mm CW range while legal males $\geq$140 mm CW represented 9% of the male sample. The average size of the 16,836 measured females was 85 mm CW with a range of 10 mm to 124 mm. Eighty-six percent of the females were in the 70 mm to 110 mm CW range.

Tanner Crab Bycatch Mortality. Observed Tanner crab mortality in the scallop fishery varied between fishing areas. The highest proportion of dead Tanner crabs were observed in the Dutch Harbor fishery at 54%, while the lowest numbers were recorded in the Shelikof District of Kodiak at 14% (Table 3). Tanner crab bycatch mortality rates in the Northeast and Semidi Districts of Kodiak, the Alaska Peninsula and the Bering Sea Area were somewhat similar at 34%, 23%, 29%, and 23% respectively. Overall, Tanner crab bycatch mortality in the Westward Region is estimated to be 22.5%

Observations of mortality in Tanner crabs were similar to those observed in the 1993/1994 scallop fishery (Urban et al. 1994). Mortality varied with size of crabs in a roughly "U-Shaped" trend, with the highest observed mortality rates occurring in small and large crabs with the lowest rates occurring in the intermediate sized crabs. Data presented in figures 19 to 24 reflects actual values with a moving average smoothing line. In the Northeast District of the Kodiak Area, based on the smoothing line, observed mortality rates for Tanner crabs <75 mm carapace width (CW) peaked near 40% at 40 mm CW, steadily declining to approximately 16% at 75 mm CW (Figure 19). Between 75 mm and 100 mm CW, mortality increased to approximately 27% then decreased to zero at 125 mm CW. Between 125 mm and 157 mm CW, mortality increased sharply to near 59%.

Observed mortality rates for Tanner crabs in the Shelikof District of Kodiak indicate a peak mortality of approximately 34% at 37 mm CW, declining steadily to near 9% mortality at 100 mm CW (Figure 20). Between 101 mm and 163 mm CW mortality rose to near 19%, followed by a decline to 13% at 175 mm CW.

Tanner crab mortality in the Alaska Peninsula peaked near 32% at 25 mm CW (Figure 21). Between 26 mm and 80 mm CW Tanner mortality declined to 0.8%, then rose to 20% at 145 mm CW.

In the Bering Sea Area Tanner mortality peaked near 50% at 29 mm CW, steadily declining to 19% at 100 mm CW (Figure 22). Mortality rose from 19% at 100 mm CW to 28% at 135 mm CW, followed by a slight decline to 20% at 175 mm CW.

The general trend for mortality rates in Tanner crab is one of relatively high mortality (>25%) for Tanner crabs less than 60 mm CW, followed by decreased mortality in Tanner crabs between 61mm to 100 mm CW then rising again (>20%) for crabs >101 mm CW. Small sample sizes from the Semidi District of the Kodiak Area and the Dutch Harbor Area precluded useful analysis for establishing mortality curves (Figures 23 and 24).

The number of new injuries observed in Tanner crab bycatch samples were similar to those observed in 1993/1994 (Urban et al. 1994). Approximately 40% to 68% of the Tanner crab observed in the bycatch samples exhibited no new injuries, 16% to 22% of the Tanner crabs had one new injury, 7% to 13% of the Tanner crabs displayed two new injuries. Tanner crabs with three or more injuries were observed in <10% of the sample. Very few (<.1%) of Tanner crabs had more than 6 new injuries.

In the Northeast District of Kodiak approximately 40% of the Tanner crabs observed in bycatch samples had no new injuries while approximately 16% exhibited one new injury, 12% had two new injuries, 8% displayed three new injuries, and 10% exhibited four new injuries (Figure 25). Tanner crabs with 5 to 9 new injuries were observed in <5% of the sample.

In the Shelikof District of Kodiak approximately 68% of the Tanner crab observed in the bycatch had no new injuries, while approximately 17% exhibited one new injury, and 7% displayed two new injuries (Figure 26). Tanner crabs with 3 to 11 new injuries new injuries were observed in <5% of the sample.

Approximately 45% of the Tanner crabs observed in bycatch samples from the Semidi District of Kodiak exhibited no new injuries, while 17% had one new injury, 14% displayed two new injuries, 11% showed three new injuries, and 6% had four new injuries (Figure 27). Crabs with 5 to 10 new injuries were observed in <5% of the sample.

In the Alaska Peninsula Area approximately 56% of the Tanner Crabs observed in the bycatch had no new injuries, while 21% exhibited one new injury, and 8% displayed two new injuries (Figure 28). Tanner crabs with 3 to 10 new injuries were observed in <5% of the sample.

In the Dutch Harbor Area approximately 48% of the Tanner crabs observed in the bycatch samples had no new injuries, while 22% had one new injury, 11% displayed two injuries, and 10%

exhibited three injuries (Figure 29). Crabs with 4 to 9 new injuries were observed in <5% of the sample.

In the Bering Sea Area approximately 64% of the Tanner crabs observed in bycatch samples had no new injuries, while approximately 18% exhibited one new injury, and 9% displayed two new injuries (Figure 30). Tanner crabs with 3 to 11 new injuries were observed in <5% of the sample.

Mortality as a function of new injuries was similar to that observed in the 1993/1994 scallop fishery (Urban et al 1994). Mortality increased as the number of new injuries increased. Mortality ranged from approximately 3% to 27% for Tanner crabs with no new injuries, increasing sharply to near 100% for crabs with six or seven new injuries. The exception being the Dutch harbor Area where mortality reached 100% for crabs with three or more new injuries.

In the Northeast District of Kodiak mortality for Tanner crabs with no new injuries was approximately 10%. Mortality rates steadily increased to 100% for Tanners with seven new injuries, then decreased to approximately 62% for Tanners with eight new injuries and increased again to 100% for crabs with nine new injuries (Figure 25).

Tanner crab mortality in the Shelikof District of Kodiak was approximately 3% for crabs with no new injuries (Figure 26). Mortality rates increased to nearly 100% for Tanners with seven or more new injuries.

In the Semidi District of Kodiak, mortality of Tanner crabs with no new injuries was approximately 9% (Figure 27). Mortality rates increased to near 30% for Tanners with one, two or three new injuries. Tanners with four or five new injuries exhibited approximately 75% mortality. Crabs with six or more new injuries had a mortality rate of 100%.

In the Alaska Peninsula Area, mortality of Tanner crabs with no new injuries was approximately 15% (Figure 28). Tanners with one new injury exhibited nearly 38% mortality, declining to 28% with two new injuries. Tanners with four or five new injuries had approximately 80% mortality, while crabs having six or seven new injuries exhibited mortality near 90%. Crabs with eight or more new injuries had 100% mortality.

In the Dutch Harbor Area, Tanner crabs with no new injuries exhibited approximately 27% mortality (Figure 29). Mortality increased rapidly to 100% for Tanners with three or more new injuries.

In the Bering Sea Area, mortality of Tanner crabs with no new injuries was approximately 12%, increasing rapidly to near 100% for crabs with five or more new injuries (Figure 30).

Halibut Bycatch Estimates and Release Conditions

Pacific halibut bycatch was highest in the Bering Sea Area, with an estimated 3,464 halibut caught as incidental bycatch (Table 2). The estimate ranged from 1,363 to 6,125 halibut at the 95% C.I.. The Shelikof District of Kodiak had an estimated bycatch of 851 halibut with a standard error (SE) of 92 halibut. Halibut bycatch estimates for the Northeast and Semidi Districts of Kodiak,

the Alaska Peninsula Area and Dutch Harbor Area were 577, 21, 157 and zero halibut, respectively.

The number of halibut observed in sampled hauls totaled 291, ranging from 106 documented in the Shelikof District of Kodiak to zero in the Dutch Harbor Area (Table 4). Halibut released in excellent condition numbered 115, (39%) of the total. Fifty-nine halibut (20%) were released in good condition. Halibut released in fair condition numbered 40, (14%) of the total. Thirty one halibut (11%) were released in poor condition and thirty (10%) were released dead. Fifteen previously dead halibut were observed in the Northeast District of Kodiak and 1 in the Shelikof District of Kodiak. The combined total of 16 previously dead halibut comprise 5.5% of the total halibut observed in sampled dredges from all areas fished in the Westward Region (Table 4).

Summary

A summary of the 1994/1995 scallop fishing season data is presented in Table 5. Seven-hundred-seventeen days of fishing were observed. The reported scallop harvest was 10,527,694 pounds (round weight) or 928,280 pounds of shucked meats, from a total of 23,621 tow hours per dredge in the Westward Region. The catch per unit effort (CPUE) ranged from a low of 220 pounds in the Northeast District of Kodiak to a high of 527 pounds in the Bering Sea. Scallop dredges capture Tanner crabs ranging in size from $\leq$10 mm CW to legal size ($\geq$ 140 mm CW). Incidental bycatch of Tanner crabs in the Westward Region totaled 388,527. Incidental halibut bycatch in the Westward Region totaled 5,070 and ranged from a low of zero halibut in the Dutch Harbor Area to a high of 3,464 halibut in the Bering Sea Area.

Table 1. Summary of the most frequently caught species, by percent weight in sampled dredges, as recorded by scallop observers during the 1994/95 scallop fishery in the Westward Region.

SPECIES CATEGORY	MANAGEMENT AREA / DISTRICT					
	Kodiak			Alaska	Dutch	Bering
	Northeast	Shelikof	Semidi	Peninsula	Harbor	Sea
Weathervane scallops	43.5	64.1	49.3	72.5	55.5	77.2
PROHIBITED SPECIES BYCATCH						
Tanner crab	0.2	1.1	0.6	0.3	0	2.8
snow crab, opilio	0	0	0	0	0	0.5
king crab	<.1	<.1	<.1	<.1	0	<.1
Dungeness crab	<.1	0.1	0.2	<.1	0	<.1
Pacific halibut	1.6	0.4	<.1	0.1	0	<.1
OTHER COMMERCIAL SPECIES						
skates	5	3.5	0.8	0.4	17.5	2.8
arrowtooth flounder	2.2	1.5	0.5	2.1	0	1.2
rock sole	1.1	0.3	0.1	1	8.6	0.3
Dover sole	0.9	0.5	<.1	<.1	0	<.1
yellowfin sole	0.4	<.1	0.6	0.4	0	<.1
rex sole	0.4	<.1	<.1	<.1	0	<.1
flathead sole	1	0.4	0.7	0.4	0	1
butter sole	0.1	<.1	<.1	<.1	0	<.1
Pacific cod	0.4	0.2	<.1	<.1	0	0.5
starry flounder	0.2	<.1	1.3	<.1	0	<.1
walleye pollock	0.1	<.1	<.1	<.1	0	<.1
bay scallops	<.1	<.1	<.1	0.9	0	<.1
sea urchin	<.1	<.1	<.1	0.6	2.2	<.1
octopus	<.1	0.2	<.1	0.2	0	0.2
Alaska plaice	<.1	0.6	0.1	<.1	0	<.1
MISCELLANEOUS						
starfish	28	4.2	23.7	5.1	2.2	1.8
basket star	<.1	<.1	<.1	5.5	0	0.2
weathervane shells	3	10.1	4.6	5.2	5.5	7.1
kelp, rocks, etc.	9	9.1	13.8	2.4	1.3	0.5
fishing gear	0.2	0.5	<.1	<.1	0	0.6
Misc. invertebrates	1.5	1.5	2	1.7	7.7	2
Misc. fish	0.4	<.1	0.8	0.1	0	0

Table 2. Estimated bycatch and confidence intervals for Tanner, Dungeness, and king crab and halibut from the 1994/1995 scallop fishery.

MANAGEMENT AREA		BYCATCH ESTIMATES BY SPECIES[a]						
	n[b]	Tanner crab		Dungeness Crab		King Crab	Halibut	
		Bycatch	95% CI	Bycatch	95% CI	Bycatch	Bycatch	95%CI
Kodiak-Area K, Northeast District	66	2,054	1,215 - 3,123	0	NA	190 (165)[d]	577 (106)[d]	NA
Kodiak-Area K, Shelikof District	256	64,444	54,137 - 75,330	2,156	1,450 - 2,861	29	851 (92)[d]	NA
Kodiak-Area K, Semidi District	10	984	NA	129 (66)[d]	NA	22	21	NA
Alaska Peninsula, Area M	70	25,287	17,953 - 33,088	143 (78)[d]	NA	0	157 (39)[d]	NA
Dutch Harbor, Area O	6	757	NA	0	NA	7	0	NA
Bering Sea, Area Q	307	245,001[c]	221,331 - 270,133	15	NA	20	3,464	1,363 - 6,125

[a]Estimates were calculated as bycatch per hour sampled per boat per day x total hours dredged x number of dredges fished.

[b]n = number of vessel days.

[c]Chionoecetes bairdi, C. opilio, and hybrid Tanner crabs combined.

[d]Numbers in parentheses are standard errors of the estimate.

Table 3. Tanner crab bycatch mortality as recorded by scallop observers during the 1994/1995 fishing season.

MANAGEMENT AREA	NUMBER OF TANNER CRAB OBSERVED		
	Dead	Alive	Percent Dead
Kodiak, Northeast District	101	198	34
Kodiak, Shelikof District	1,284	7,779	14
Kodiak, Semidi District	45	114	28
Alaska Peninsula	1,094	2,701	29
Dutch Harbor	77	65	54
Bering Sea	7,923	25,481	24
Total all Areas	10,524	36,338	22.5

Table 4. Condition of halibut as recorded by scallop observers during the 1994/1995 fishing season.

MANAGEMENT AREA	CONDITION[a] Of HALIBUT (Number of Halibut)						
	Excellent	Good	Fair	Poor	Dead	Previously dead	Total
Kodiak, Northeast District	36	17	11	9	9	15	97
Kodiak, Shelikof District	52	20	11	13	9	1	106
Kodiak, Semidi District	2	1	1	1	0	0	5
Alaska Peninsula	8	9	5	2	9	0	33
Dutch Harbor	0	0	0	0	0	0	0
Bering Sea	17	12	12	6	3	0	50
Total all Areas	**115**	**59**	**40**	**31**	**30**	**16**	**291**

[a]Condition Codes

Excellent: Vigorous body movement before and after release; could close operculum tightly; minor external injuries, if any.
Good: Feeble body movements; could close operculum tightly; minor external injuries, if any.
Fair: No body movement; could close operculum tightly; minor external injuries, if any.
Poor: No body movement; could move operculum but not tightly; severe injuries (eg. bleeding).
Dead: No body or opercular movement; probably killed in sampled haul.
Previously dead: Obviously not killed in the current haul (incidentally caught).

Table 5. Summary of commercial fishery statistics and scallop observer data from the 1994/1995 scallop fishery.

Management Area	Season Dates	Number of Vessels	Number of Days Fishing Observed[a]	Pounds of Retained Scallops (Round Weight)	Pounds of Retained Scallops (Shucked Meats)	Tow Hours per Dredge	CPUE[b]	BYCATCH		% Scallops (by weight) in Catch	Number of Tanner Crab per Pound of Retained Scallop Meats
								Tanner Crab	Halibut		
Northeast District Kodiak	7/1/94 to 2/15/95	9	68	389,202	35,517	1,772	220	2,054	577	43.5	0.058
Shelikof District, Kodiak	7/1/94 to 10/1/95	11	256	3,522,517	320,111	8,991	392	64,444	851	64.1	0.204
Semidi District, Kodiak	7/1/94 to 2/15/95	Confidental	8	Confidental[d]	Confidental[d]	Confidental[d]	Confidental[d]	984	21	49.3	Confidental[d]
Total Kodiak Area	7/1/94 to 2/15/95	11	332	3,911,719	355,628	10,763	363	67,482	1,449	60.2	0.189
Alaska Peninsula	7/1/94 to 9/22/94	7	70	619,473	65,282	1,496	414	25,287	157	72.5	0.387
Dutch Harbor	7/1/94 to 2/15/95	3	6	23,590	1,931	81	291	757	0	55.2	0.392
Bering Sea	7/1/94 to 9/7/94[c]	8	309	5,942,912	505,439	11,281	527	245,001	3,464	77.2	0.485

[a]An observed day is a day with at least one sampled tow.

[b]Pounds (round weight) of retained scallops per tow-hour per dredge.

[c]East of 165^0 2' W. long closed 8/14/94.

[d]Combined with Shelikof District to protect confidentiality of individual vessels fishing the Semidi District.

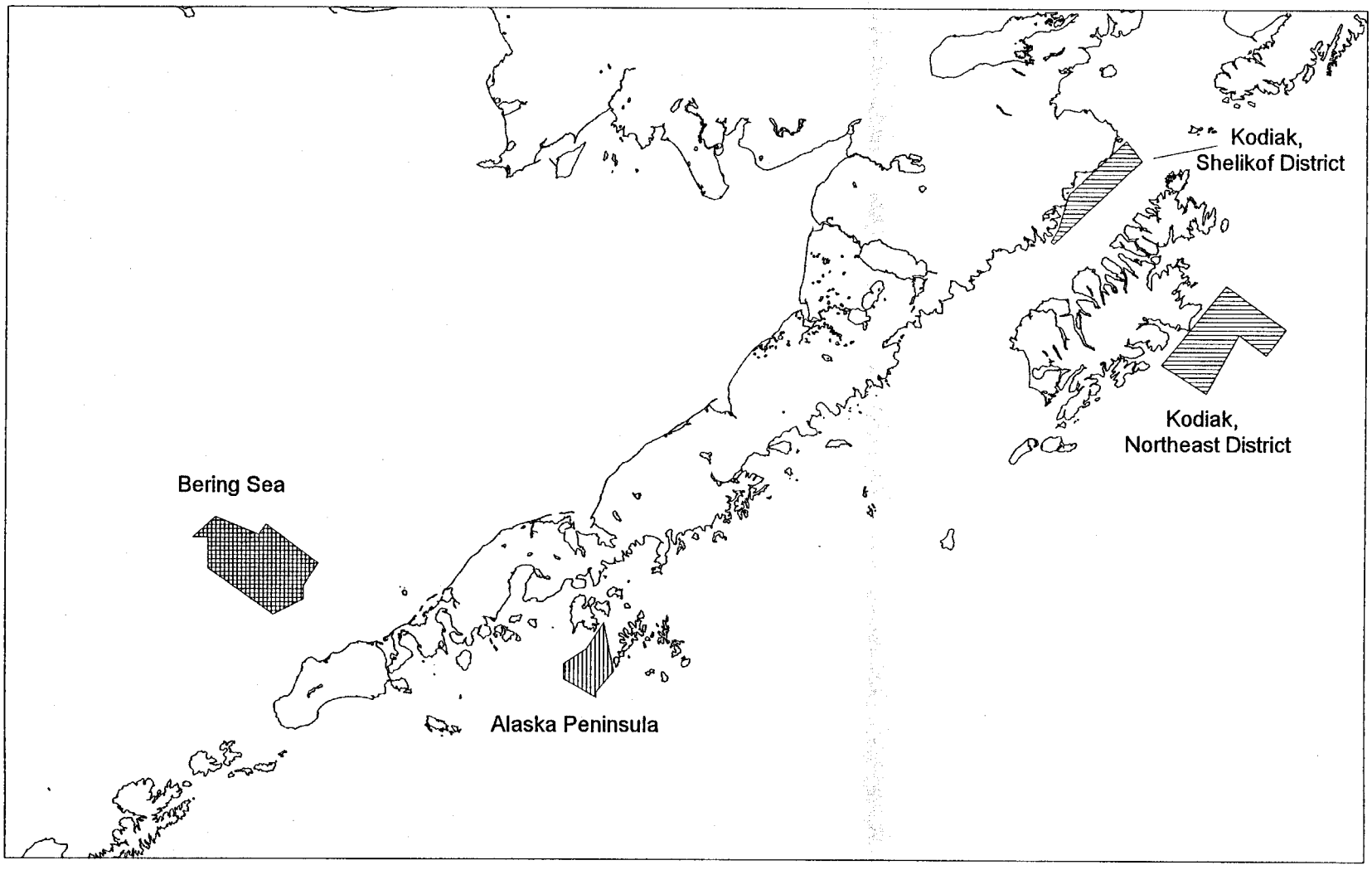

Figure 1. Major fishing areas in the Westward Region during the 1994/1995 scallop fishery. Fishing areas in the Semidi District of the Kodiak Area and in the Dutch Harbor were not shown due to confidentiality requirements.

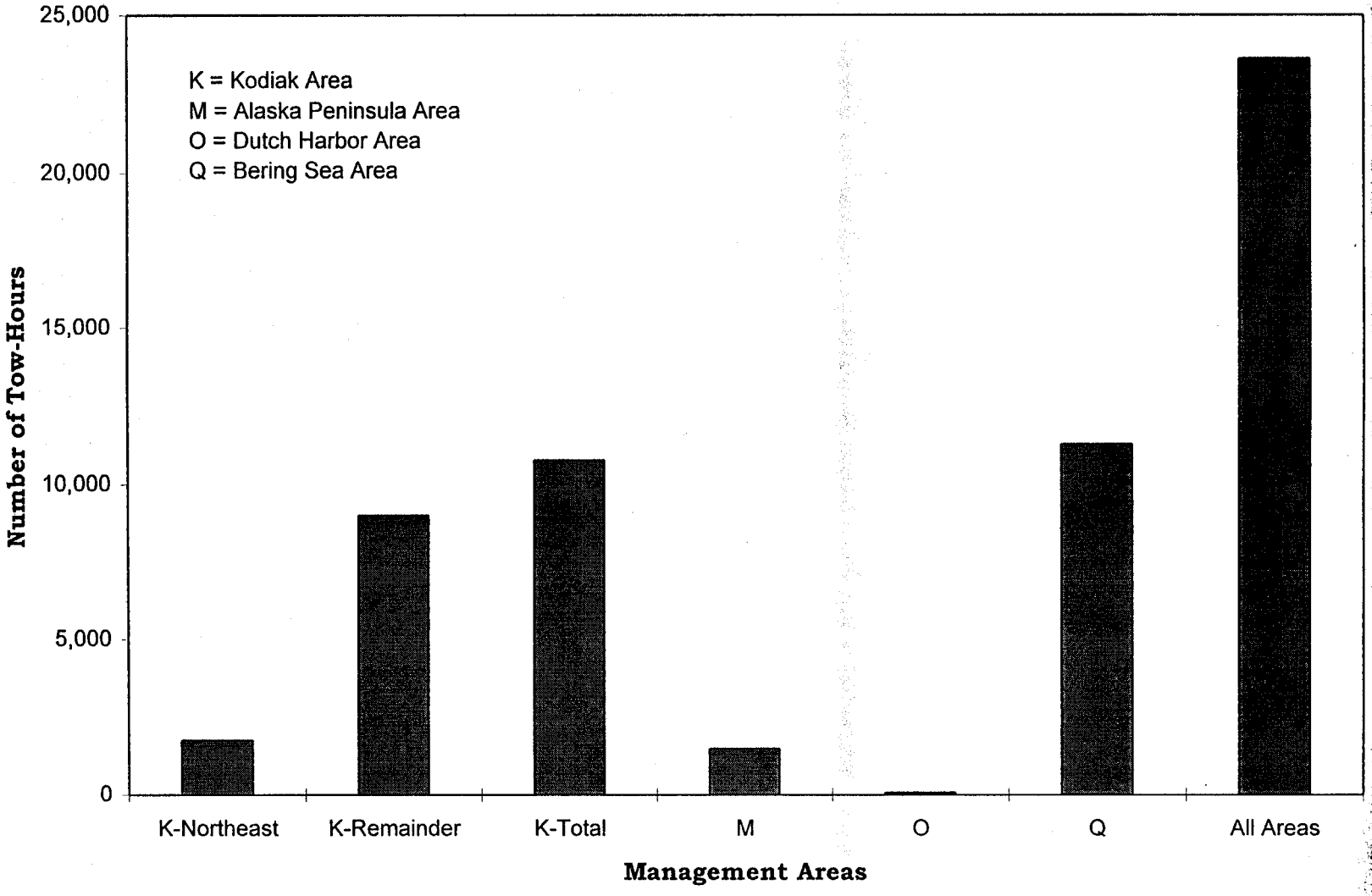

Figure 2. Fishing effort in tow-hours by management area in the 1994/1995 scallop fishery.

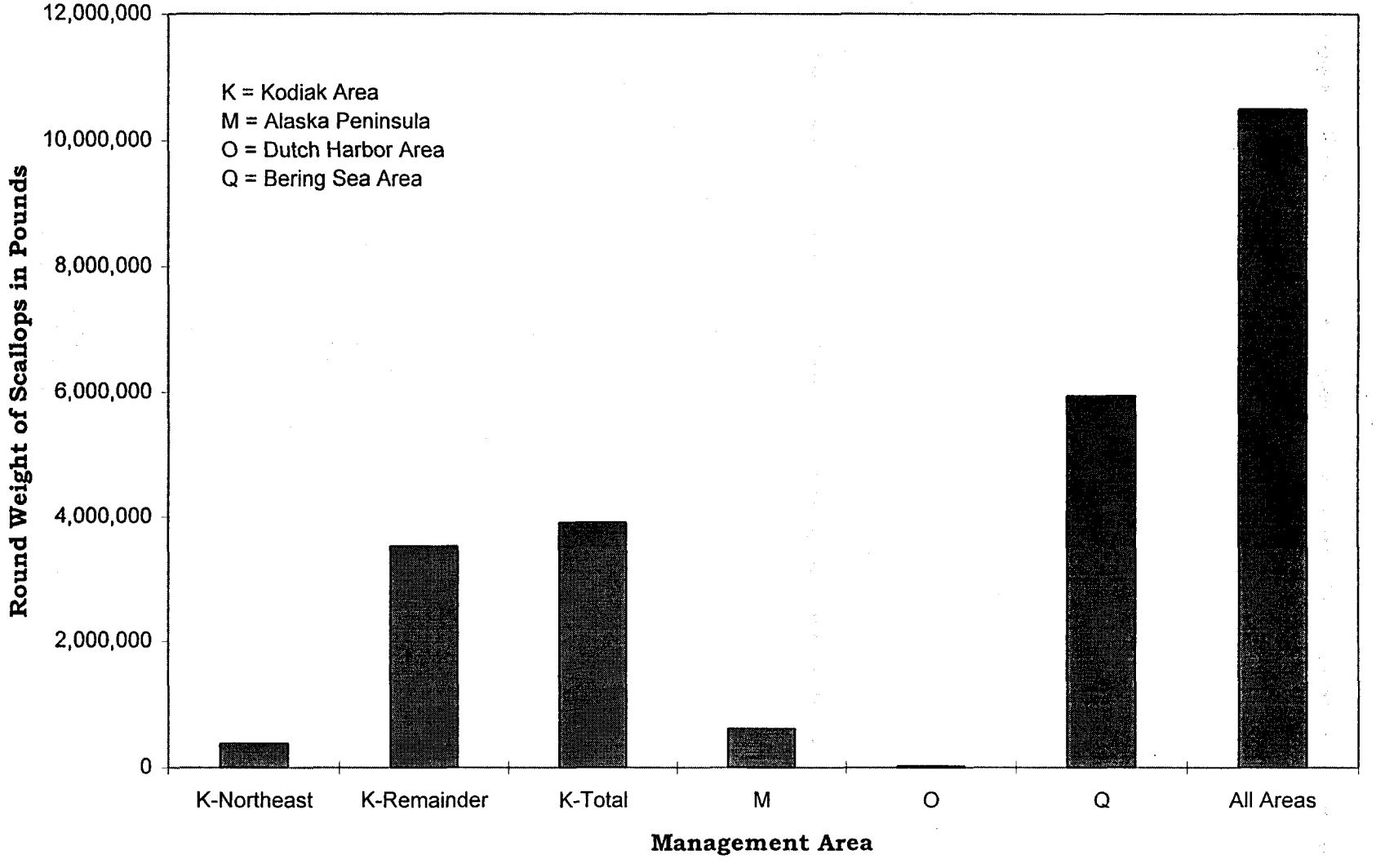

Figure 3. Round weight in pounds of retained scallops by management area in the 1994/1995 scallop fishery.

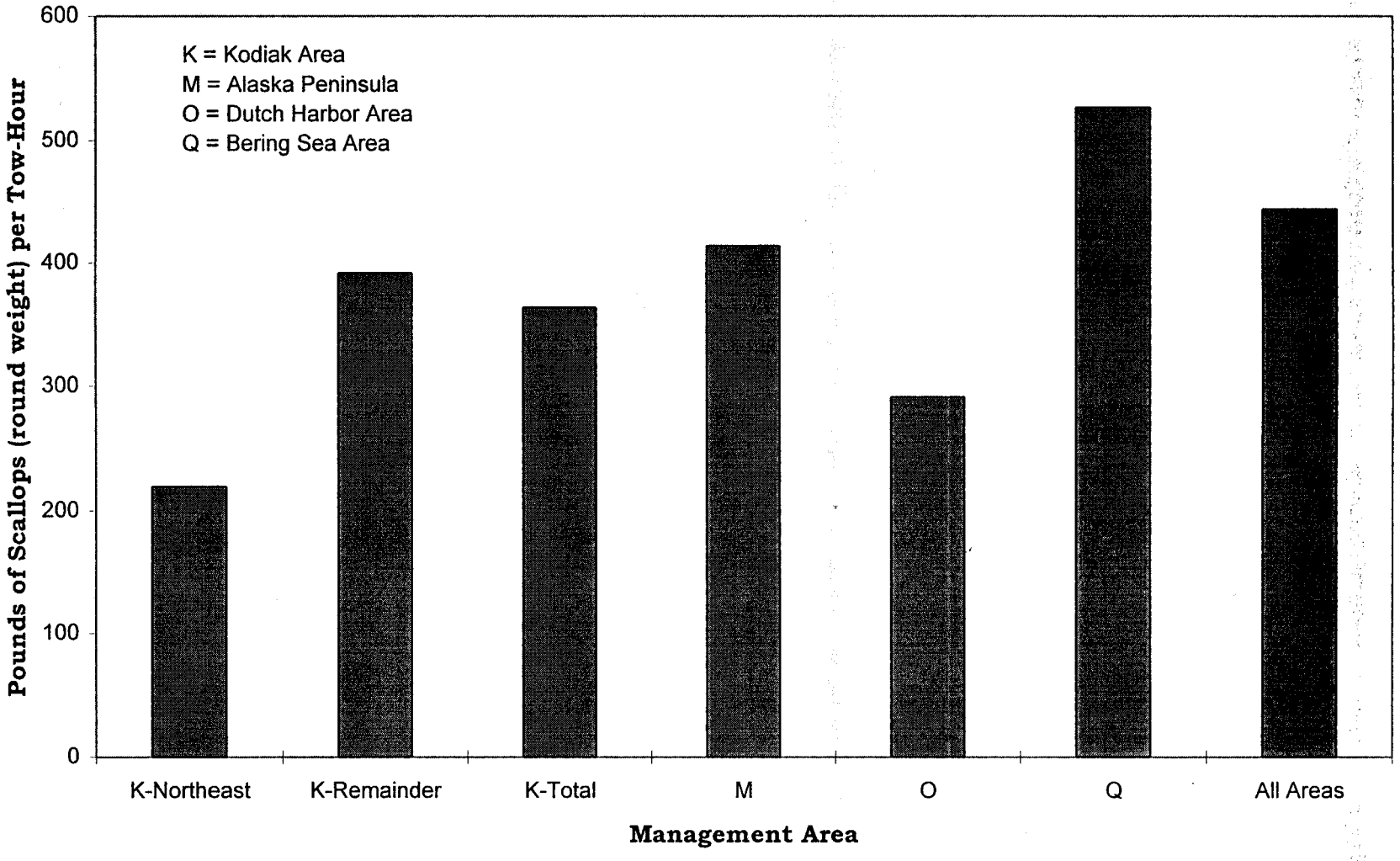

Figure 4. Scallop CPUE (round weight in pounds of retained scallops per tow-hour per dredge) by management area in the 1994/1995 scallop fishery.

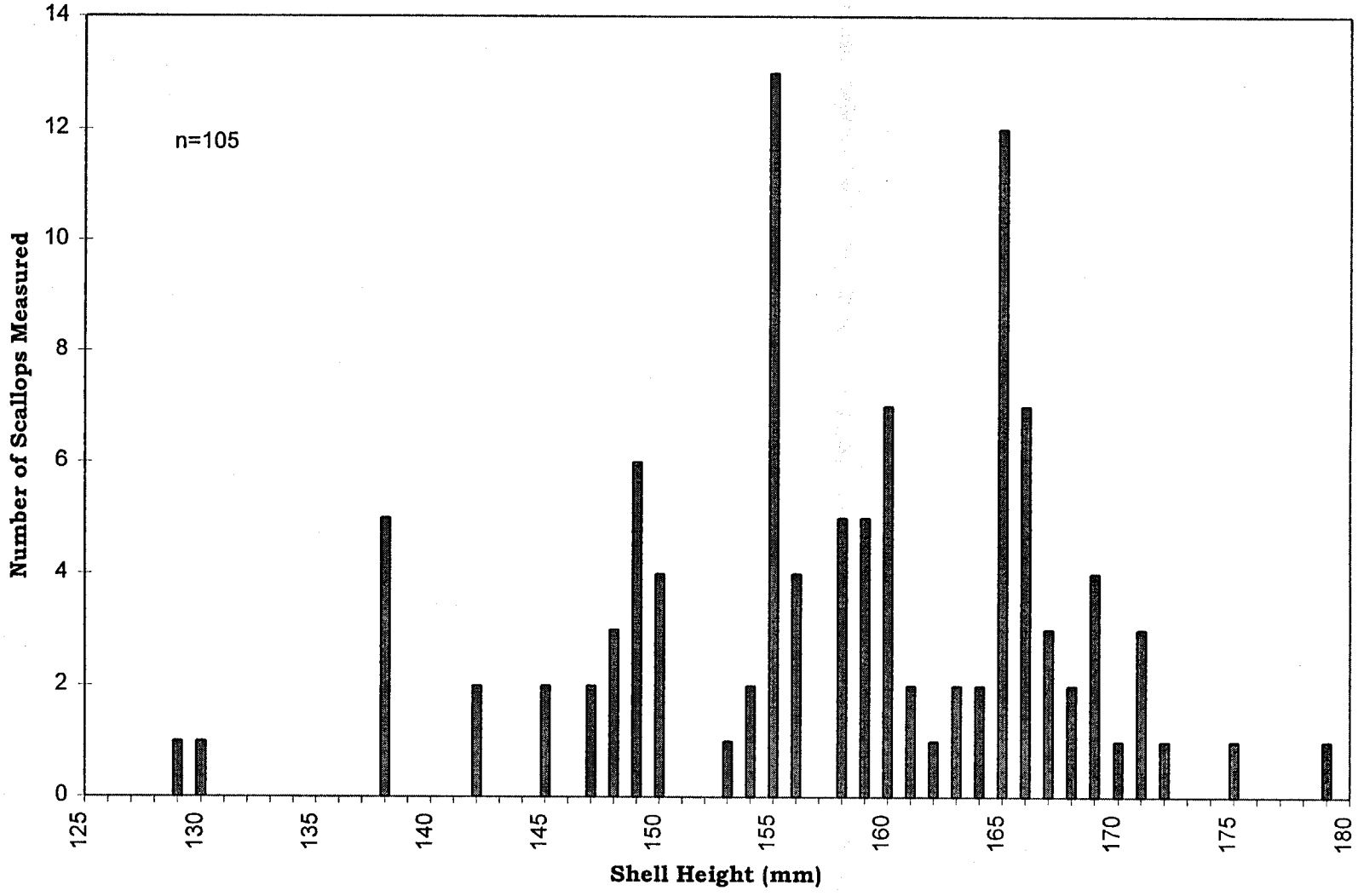

Figure 5. Shell height frequency of observer sampled scallops from the 1994/1995 scallop fishery in Dutch Harbor (Area O).

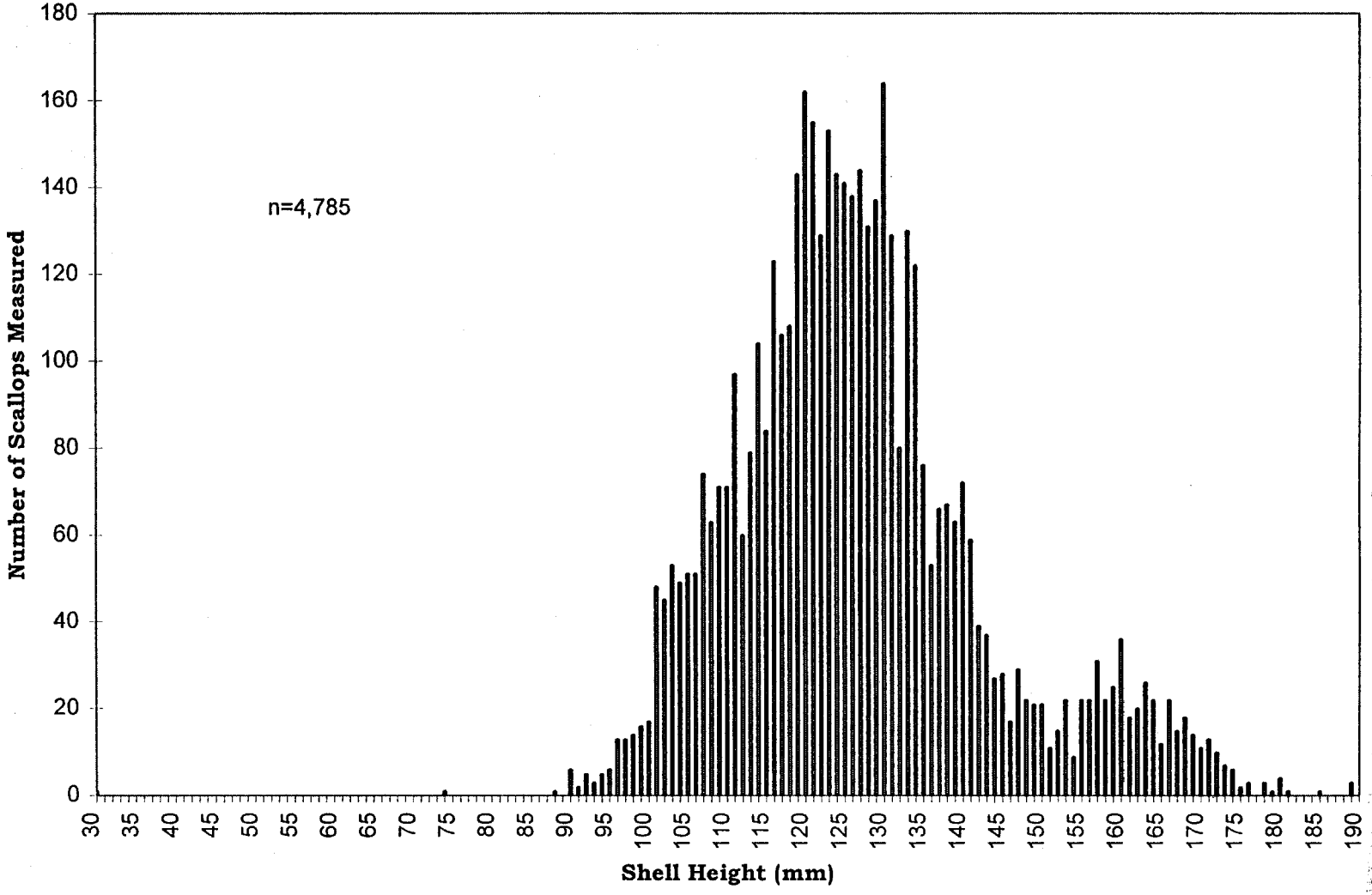

Figure 6. Shell height frequency of observer sampled scallops from the 1994/1995 scallop fishery in the Alaska Peninsula (Area M).

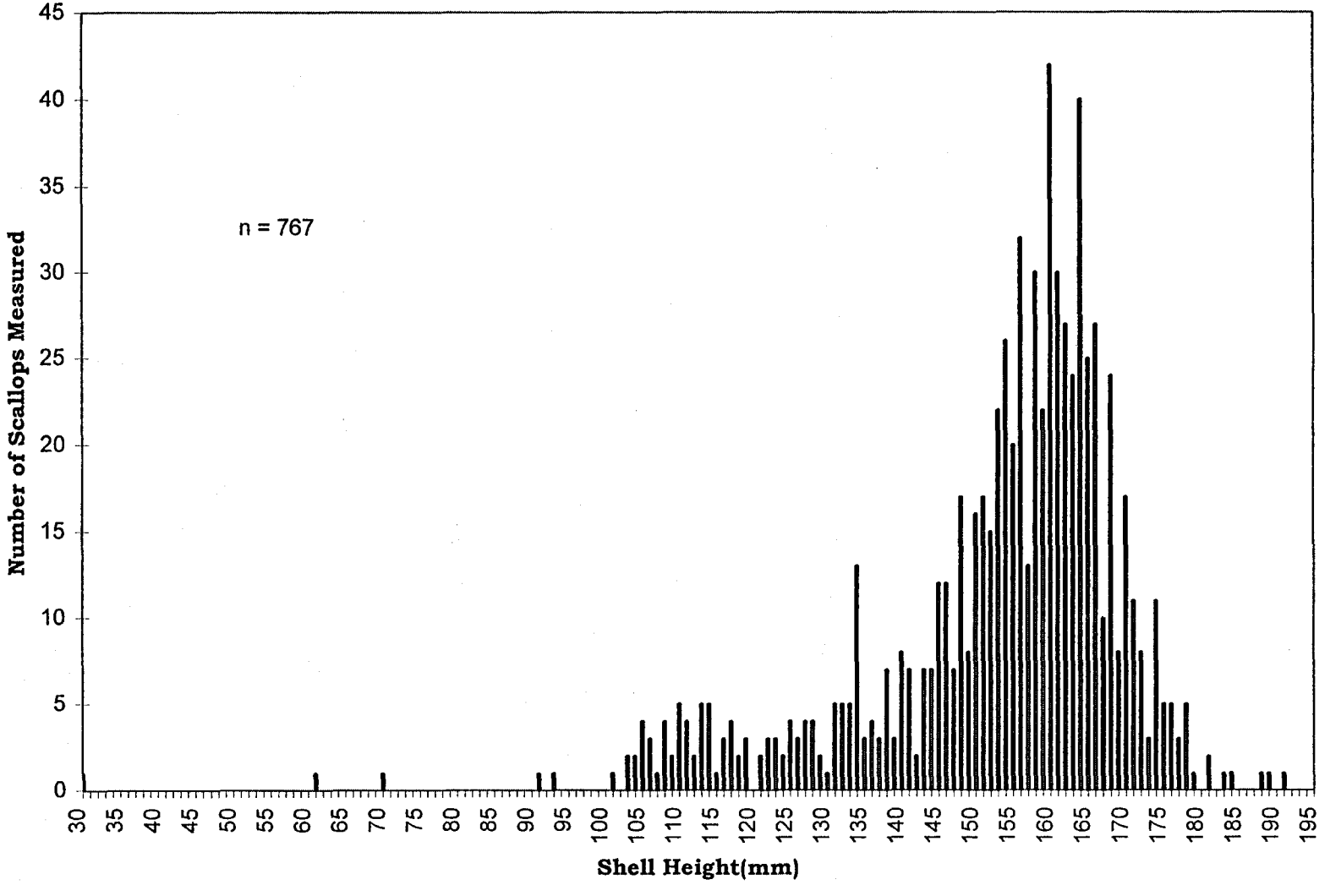

Figure 7. Shell height frequency of observer sampled scallops from the 1994/1995 scallop fishery in the Semidi District of Area K (Kodiak).

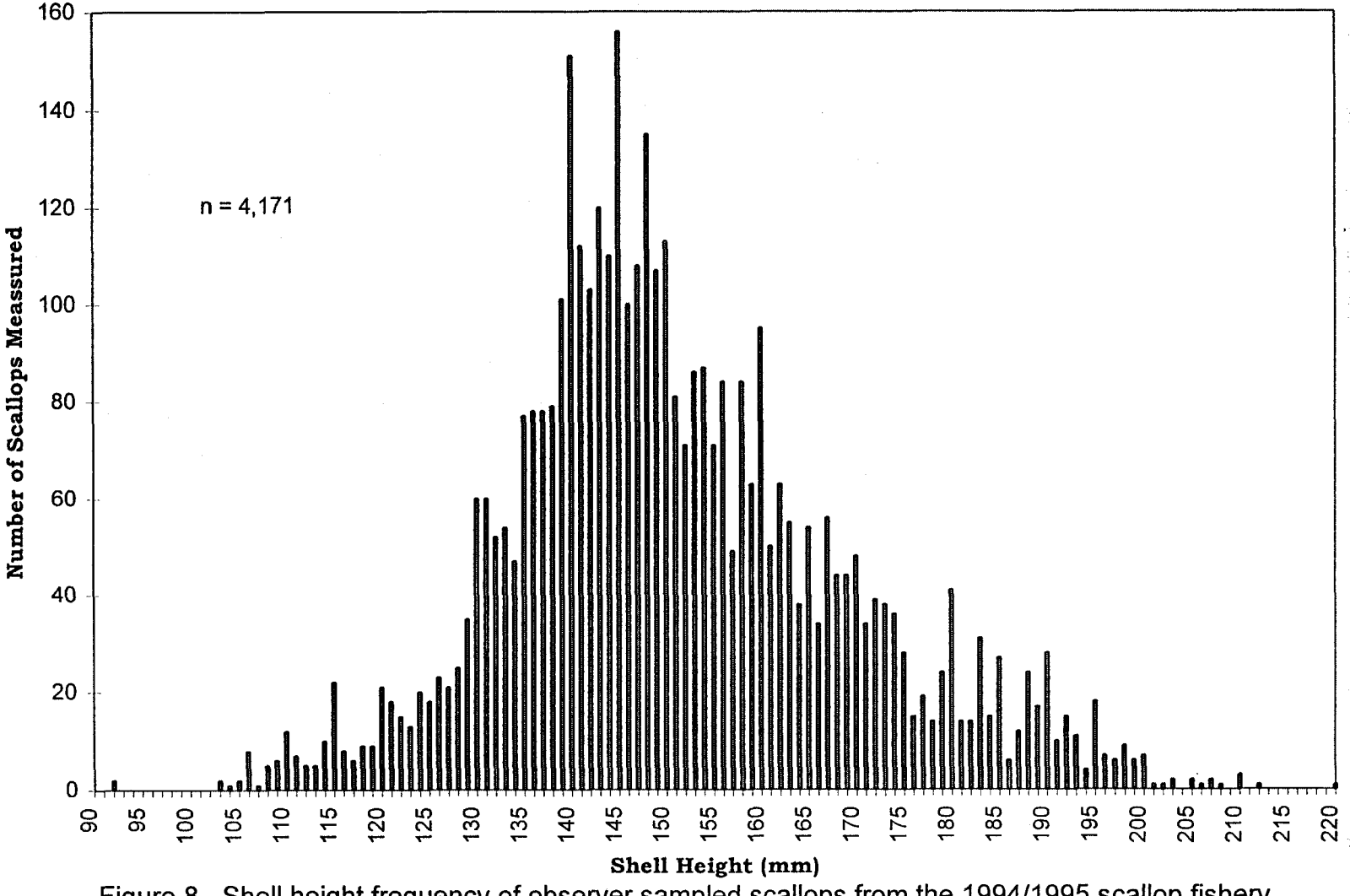

Figure 8. Shell height frequency of observer sampled scallops from the 1994/1995 scallop fishery in the Northeast District of Area K (Kodiak).

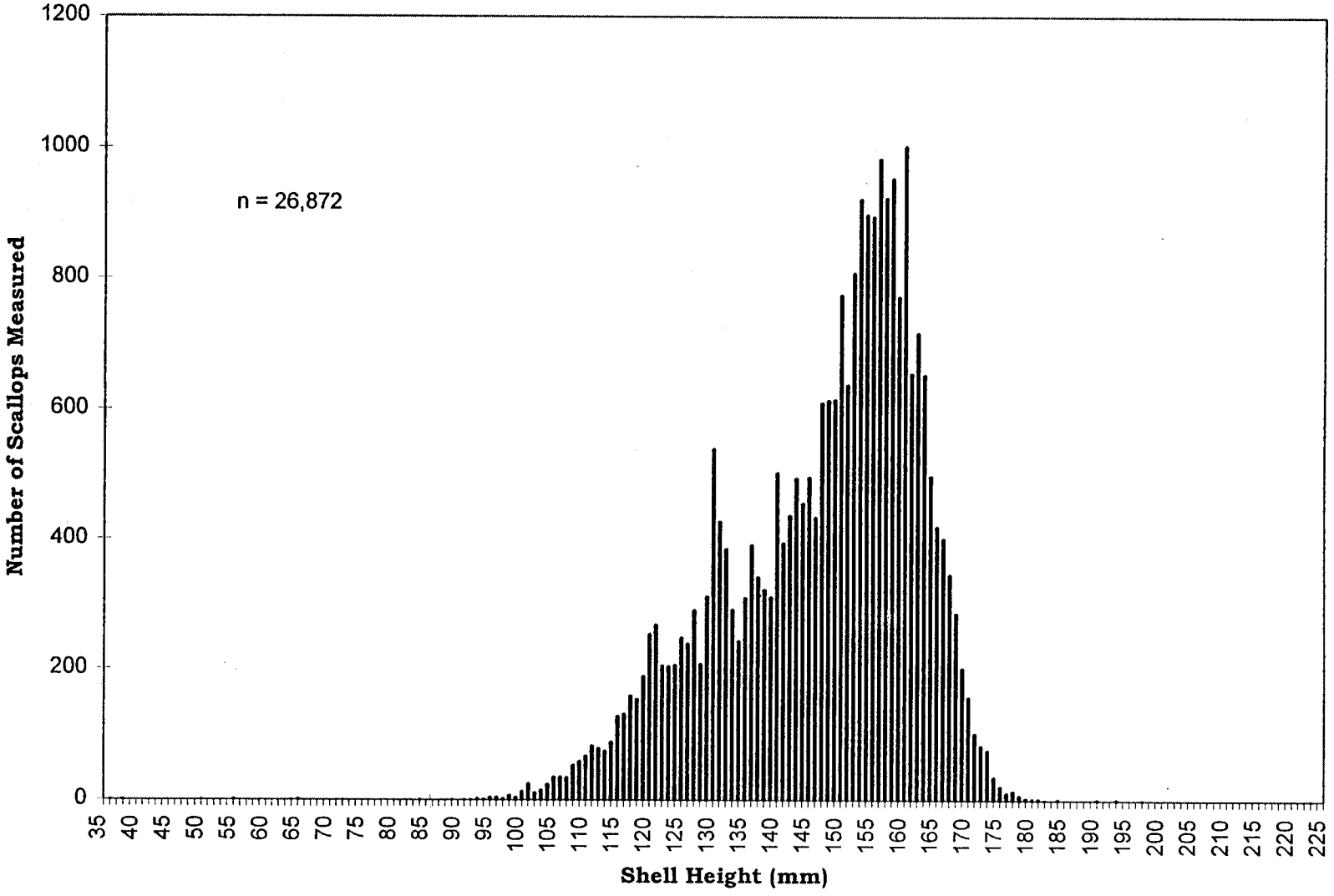

Figure 9. Shell height frequency of observer sampled scallops from the 1994/1995 scallop fishery in the Bering Sea (Area Q).

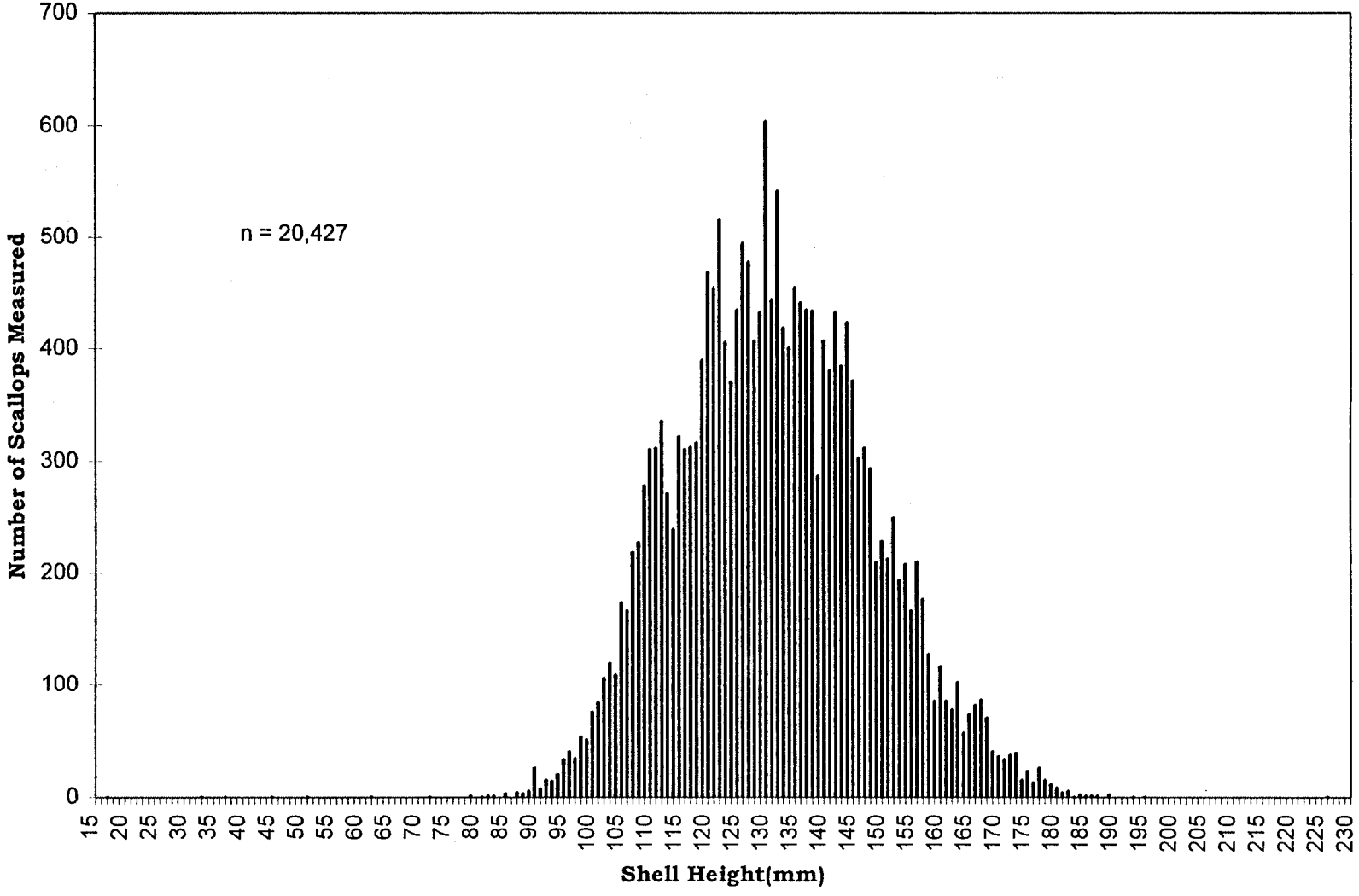

Figure 10. Shell height frequency of observer sampled scallops from the 1994/1995 scallop fishery in the Shelikof District of Area K (Kodiak).

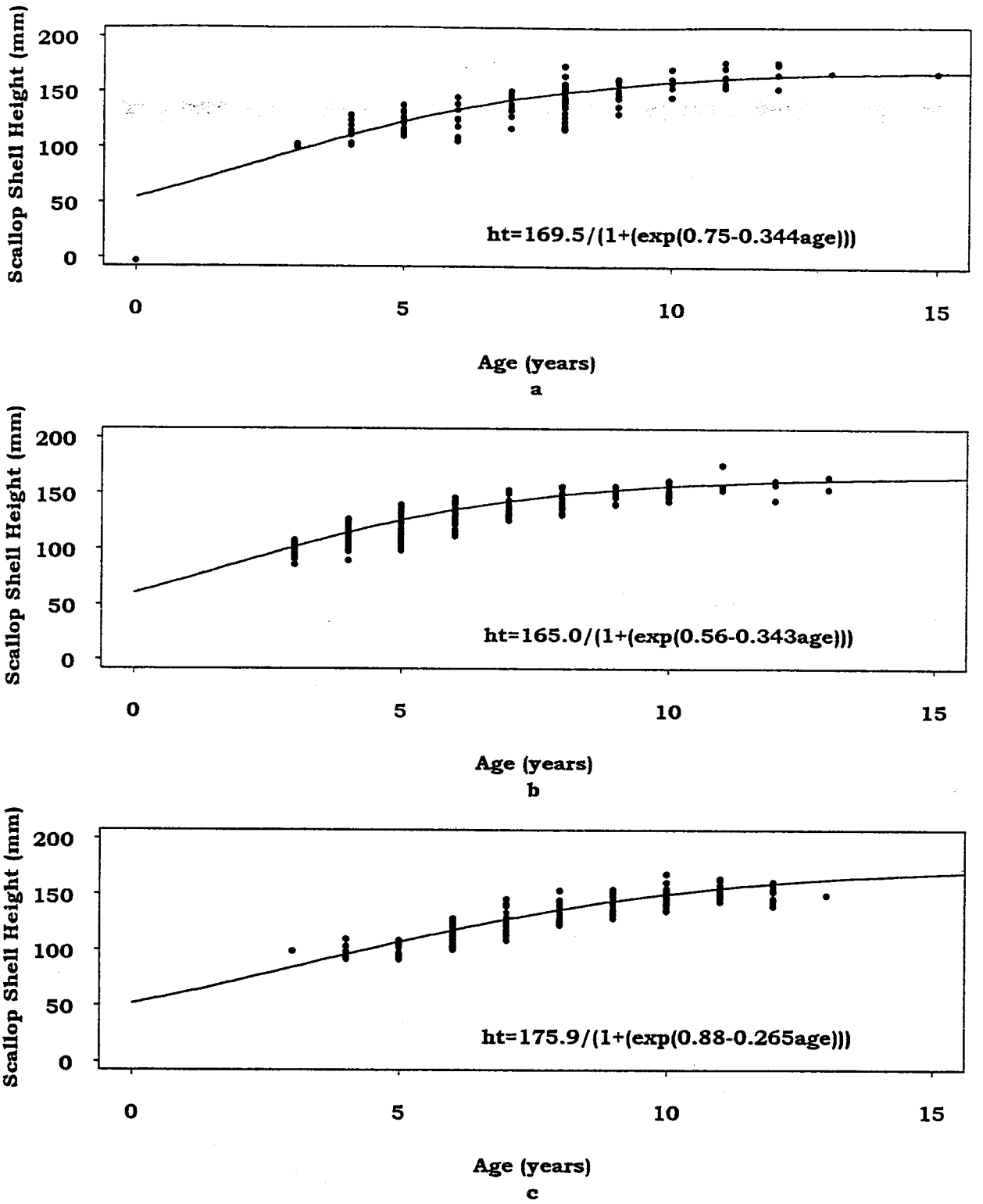

Figure 11. Scatter plot of scallop age versus shell height, with a logistic curve fit for Kodiak, Northeast District (a); Kodiak, Shelikof District (b); and Bering Sea (c).

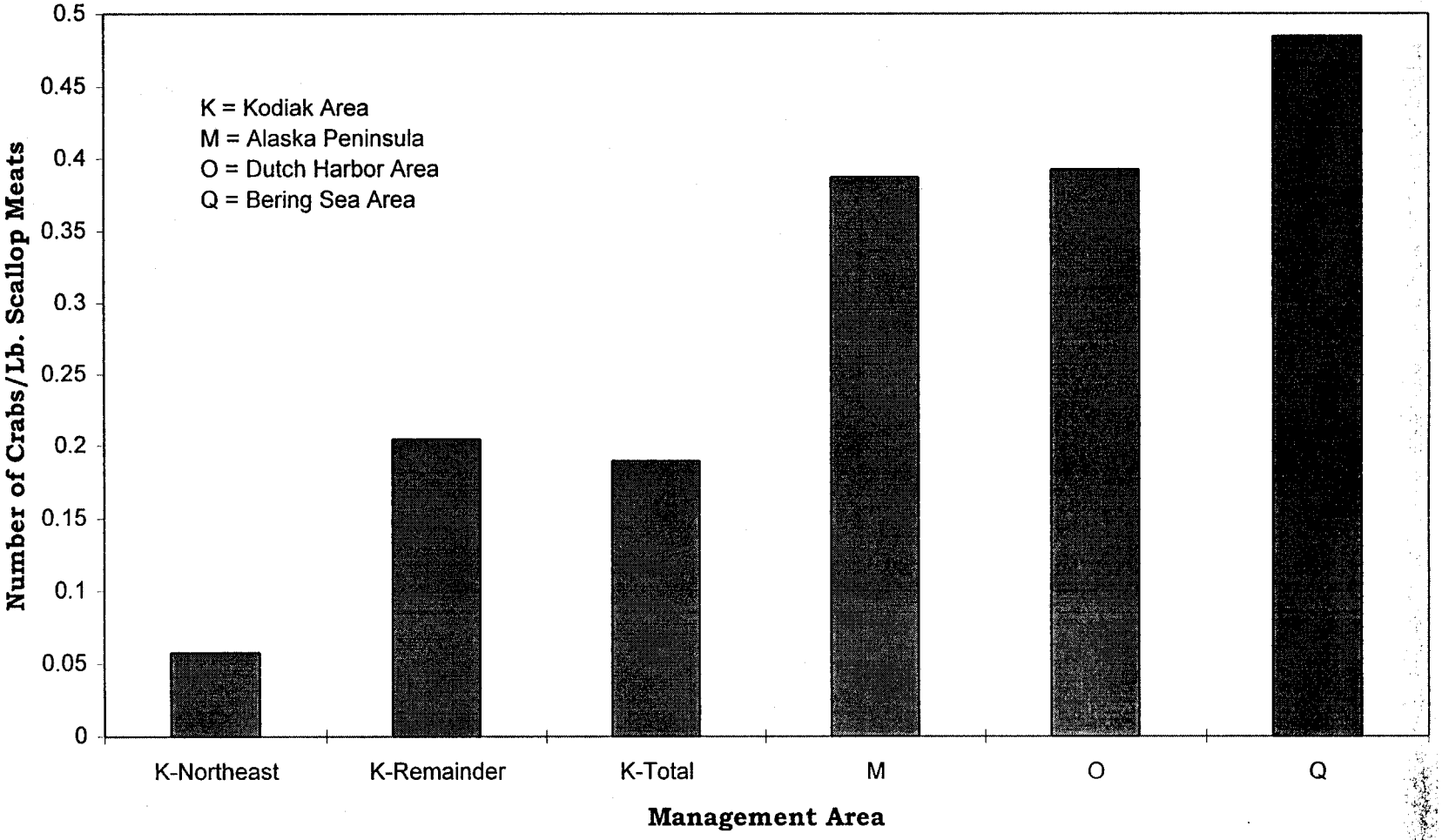

Figure 12. Catch of Tanner crabs per pound of retained scallops by management area in the 1994/ 1995 scallop fishery. Semidi and Shelikof Districts are combined (K- Remainder) due to confidentiality of the Semidi District data.

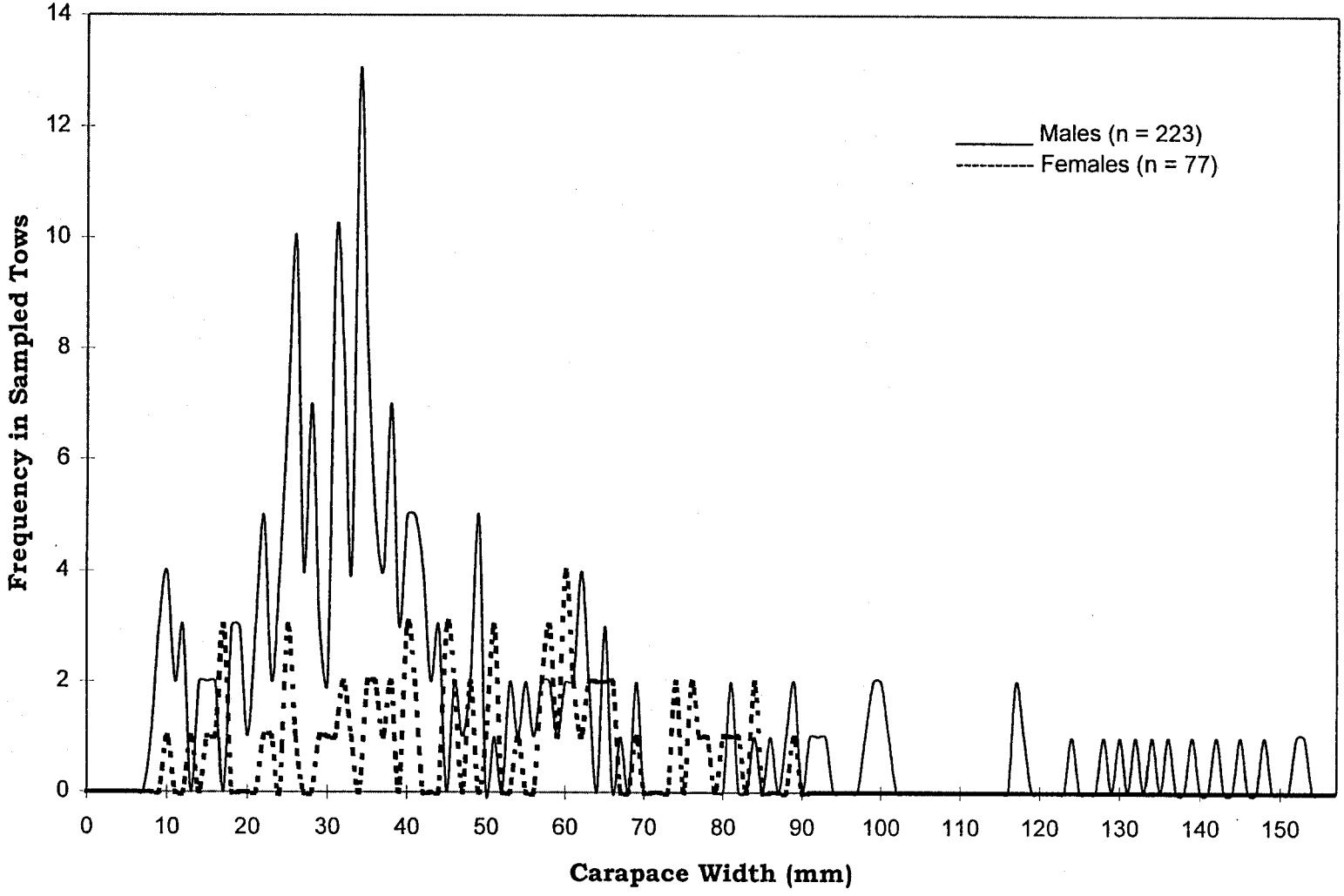

Figure 13. Tanner crab width frequency as determined from bycatch samples in the 1994/1995 scallop fishery in the Northeast District of Kodiak.

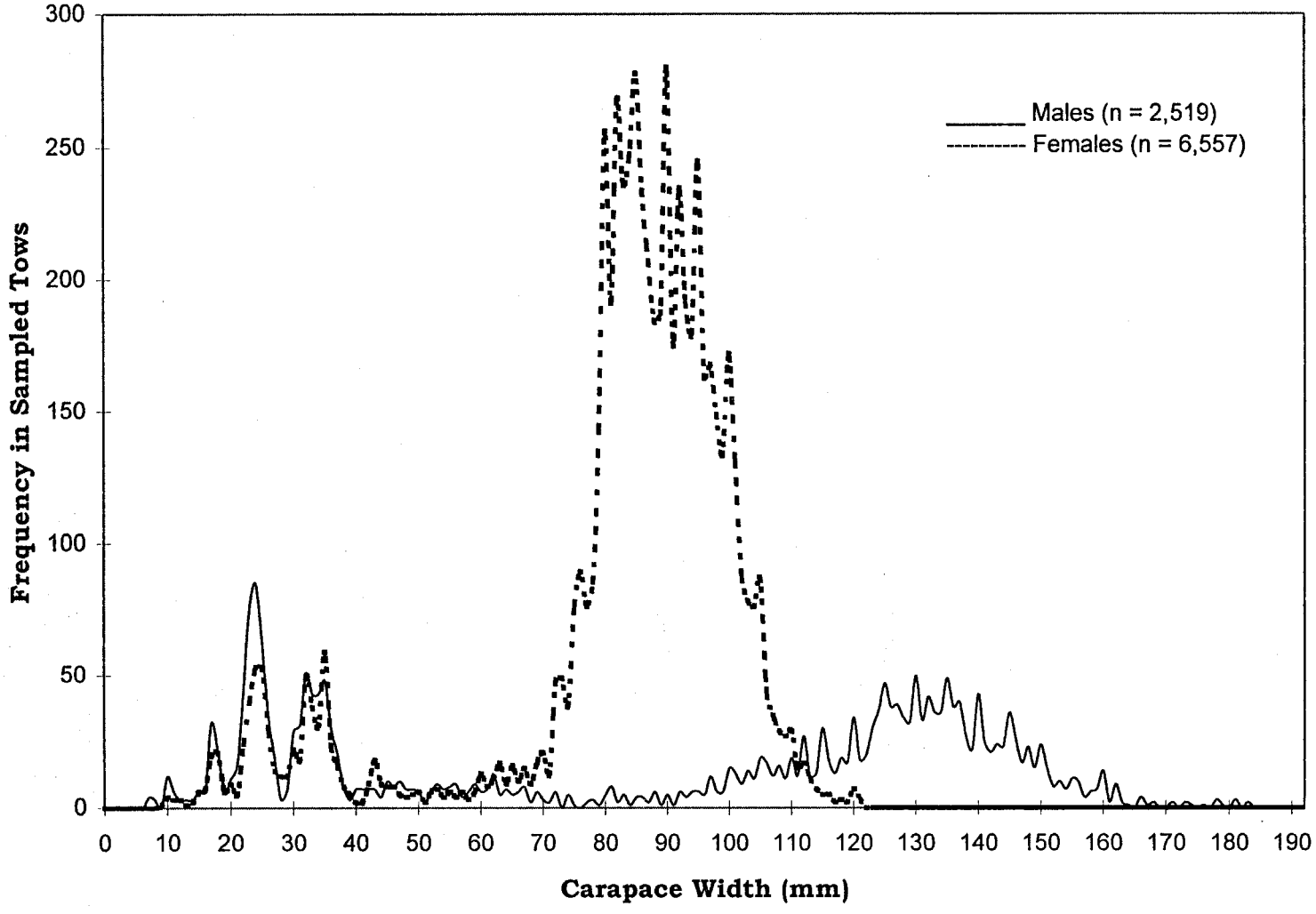

Figure 14. Tanner crab width frequency as determined from bycatch samples in the 1994/1995 scallop fishery in the Shelikof District of Kodiak.

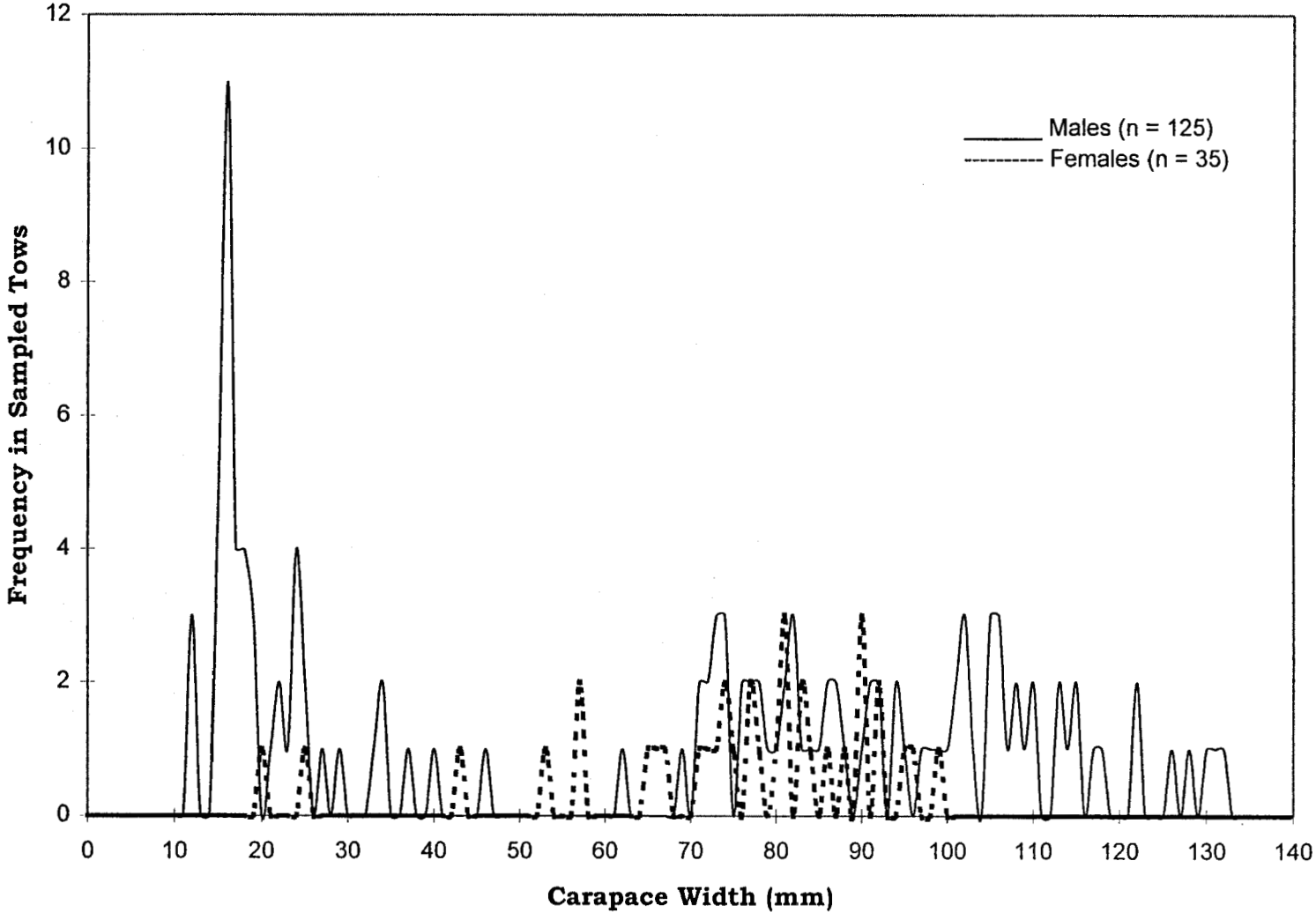

Figure 15. Tanner crab width frequency as determined from bycatch samples in the 1994/1995 scallop fishery in the Semidi District of Kodiak.

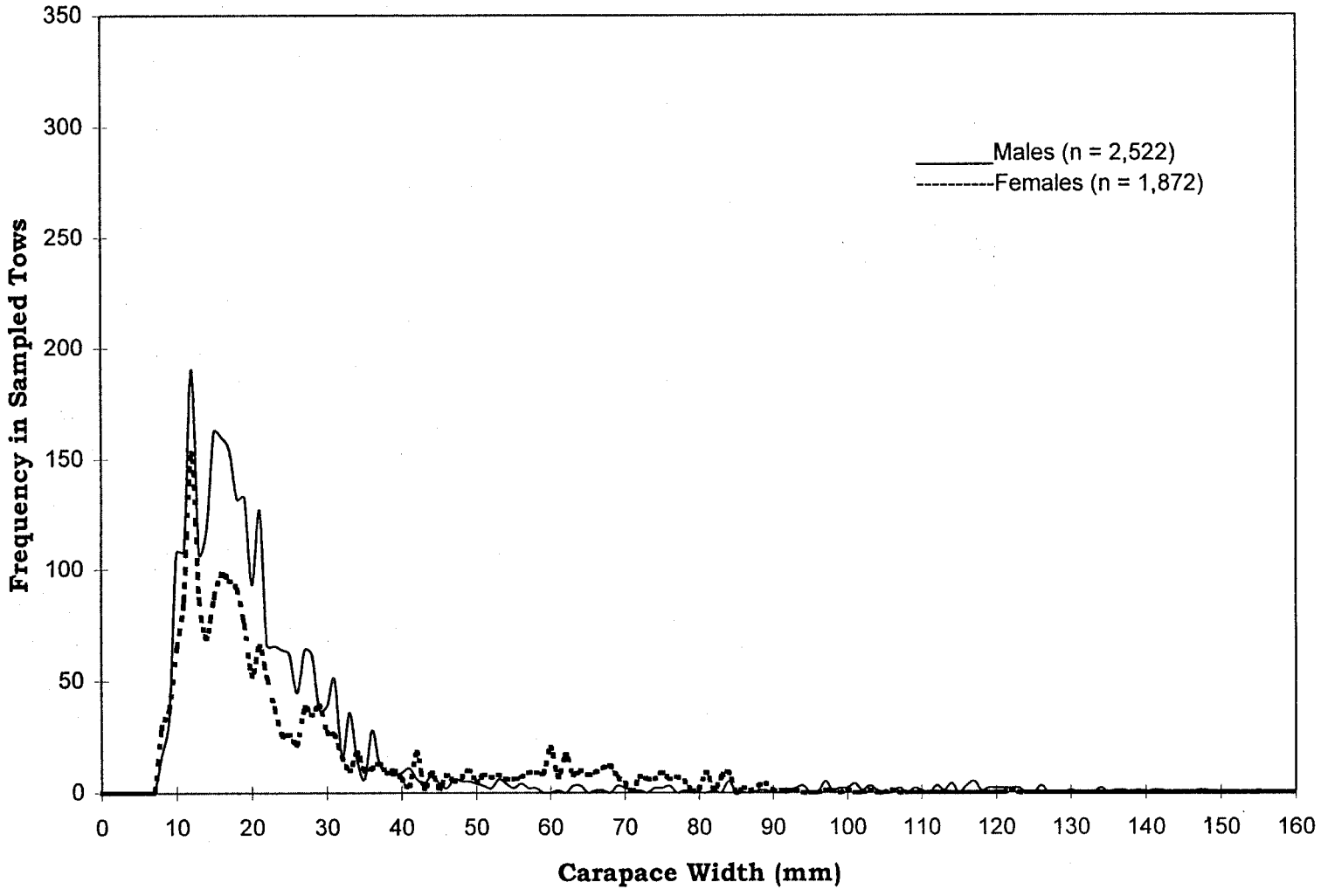

Figure 16. Tanner crab width frequency as determined from bycatch samples in the 1994/1995 scallop fishery in the Alaska Peninsula.

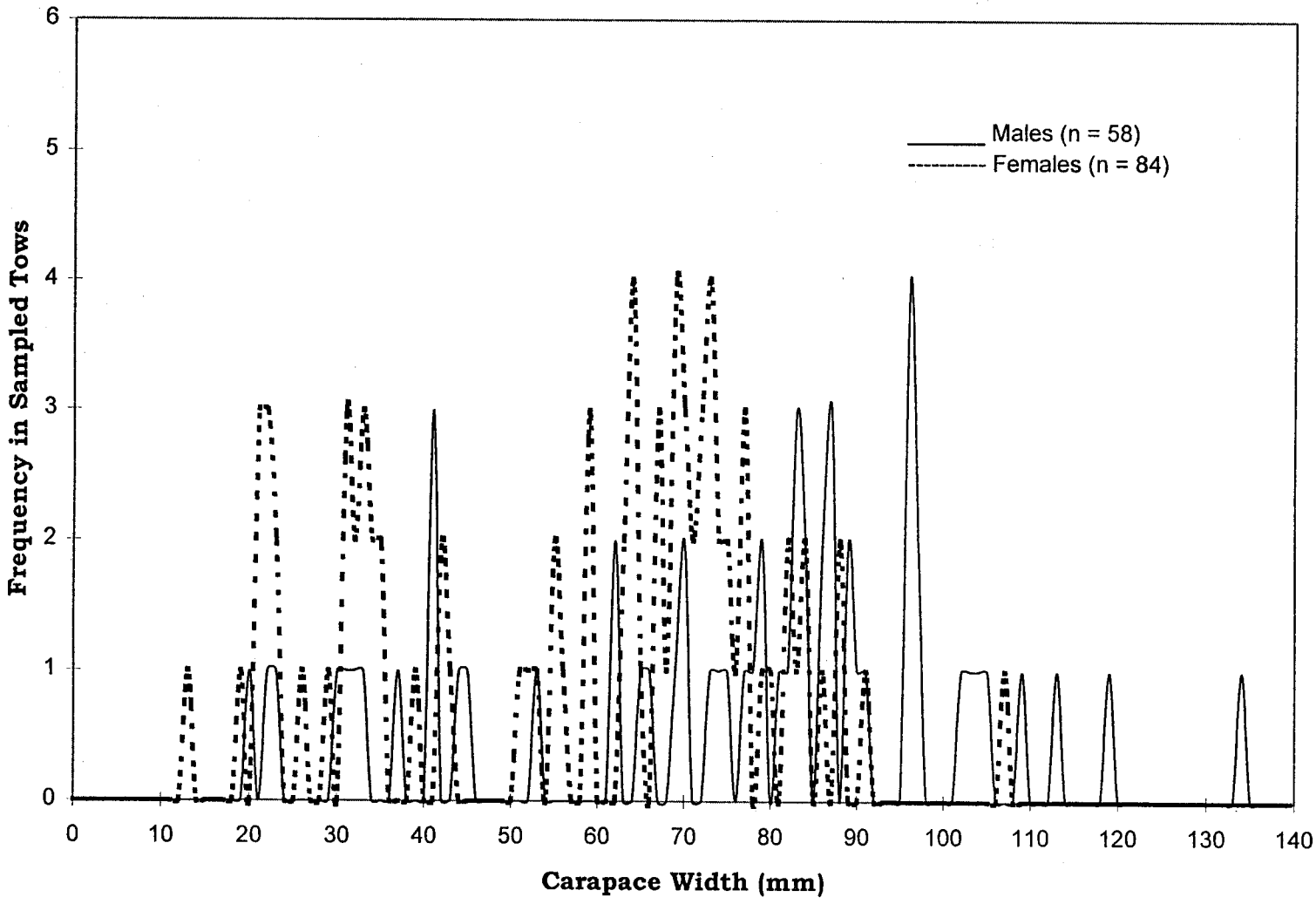

Figure 17. Tanner crab width frequency as determined from bycatch samples in the 1994/1995 scallop fishery in Dutch Harbor.

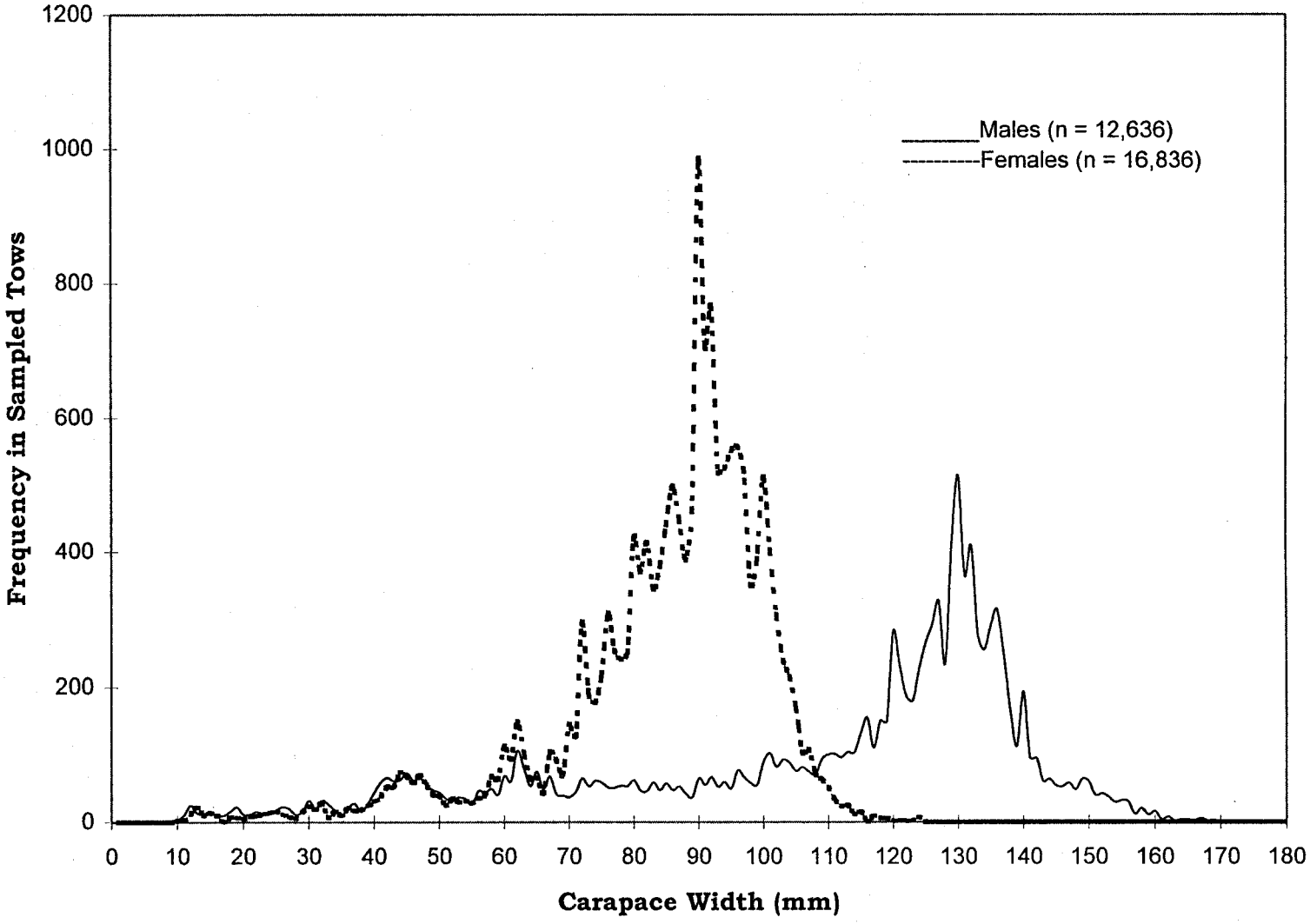

Figure 18. Tanner crab width frequency as determined from bycatch samples in the 1994/1995 scallop fishery in the Bering Sea.

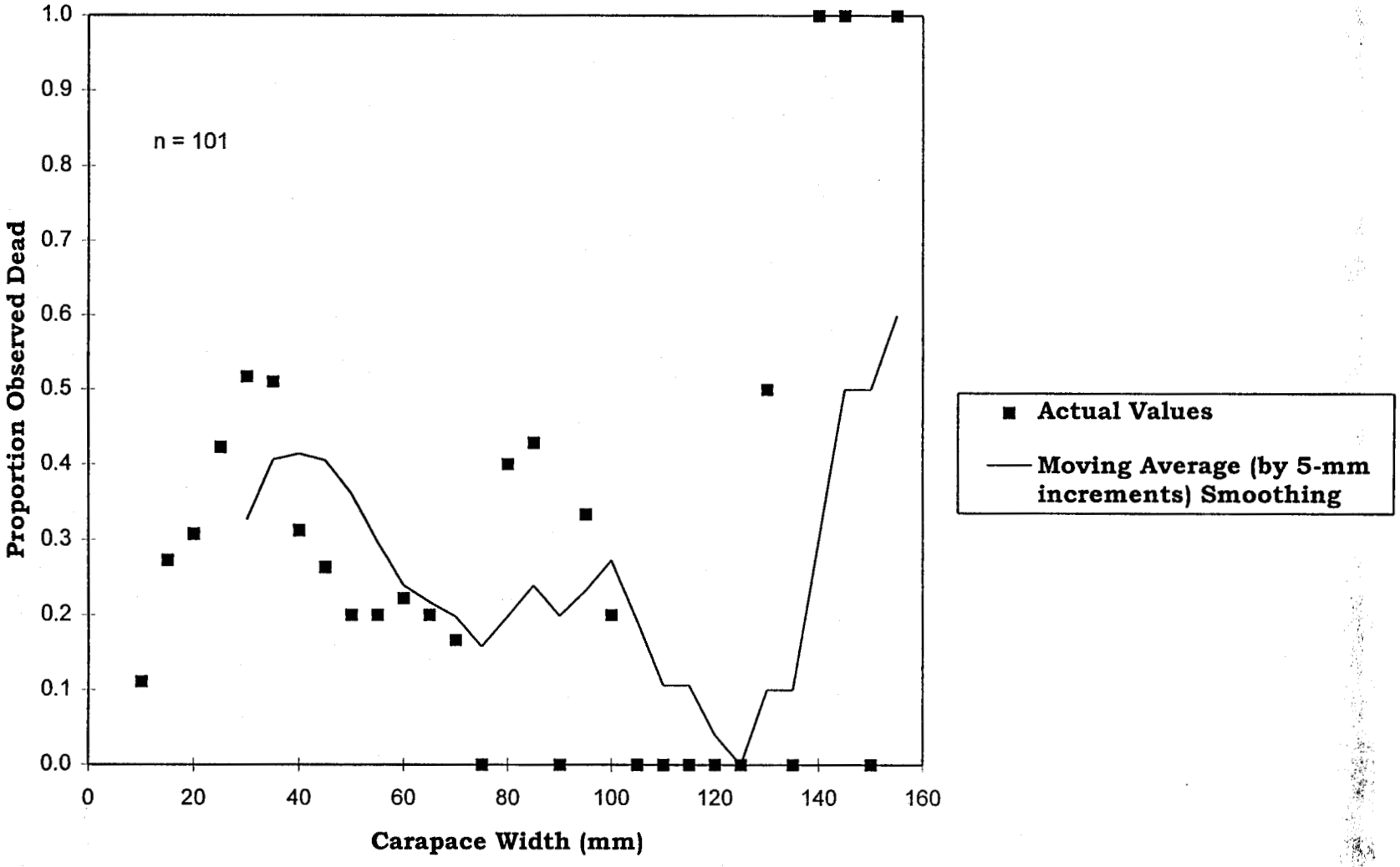

Figure 19. Observed mortality rate versus size in Tanner crab bycatch samples from the 1994/1995 scallop fishery in the Notheast District of Kodiak.

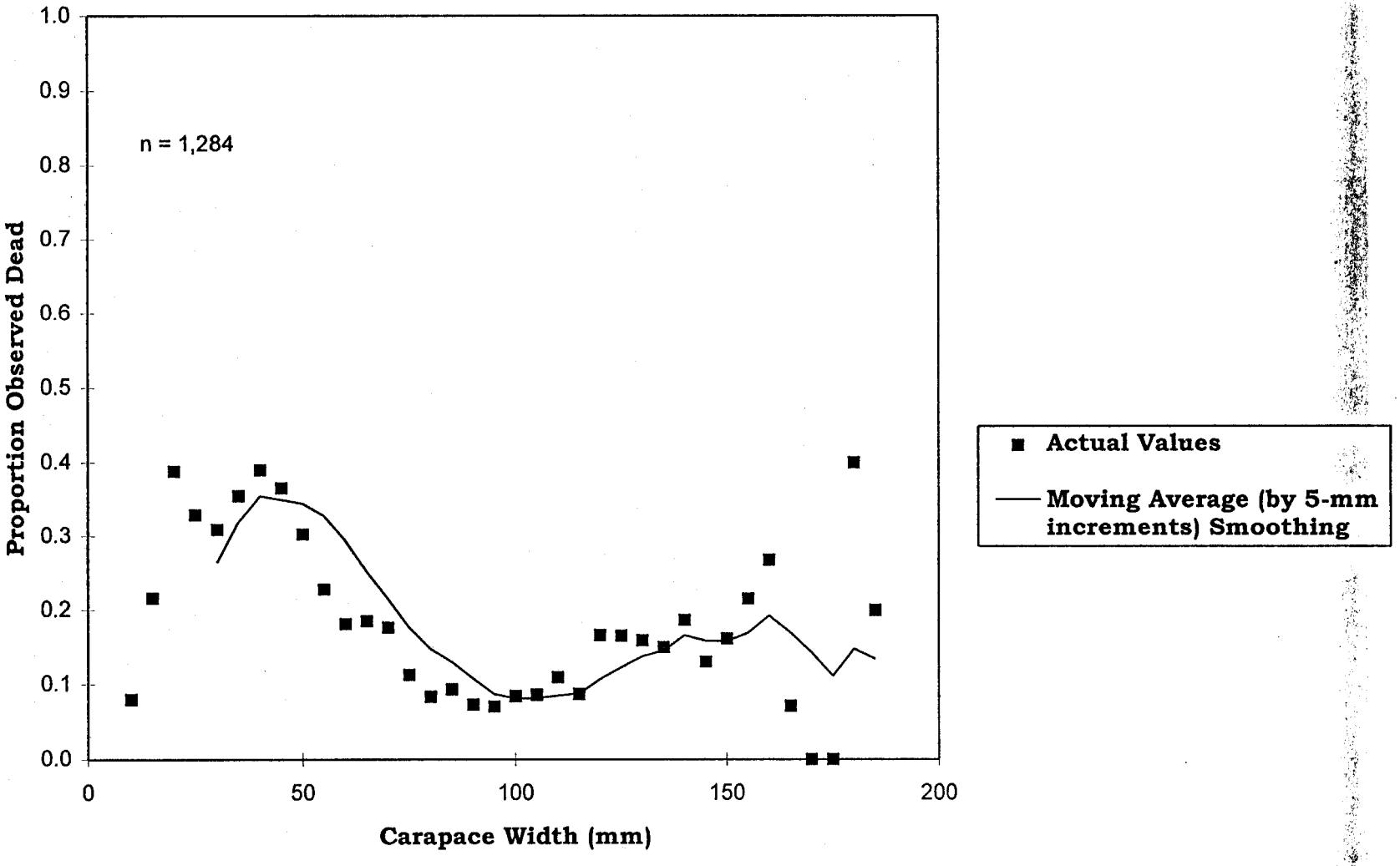

Figure 20. Observed mortality rate versus size in Tanner crab bycatch samples from the1994/1995 scallop fishery in the Shelikof District of Kodiak.

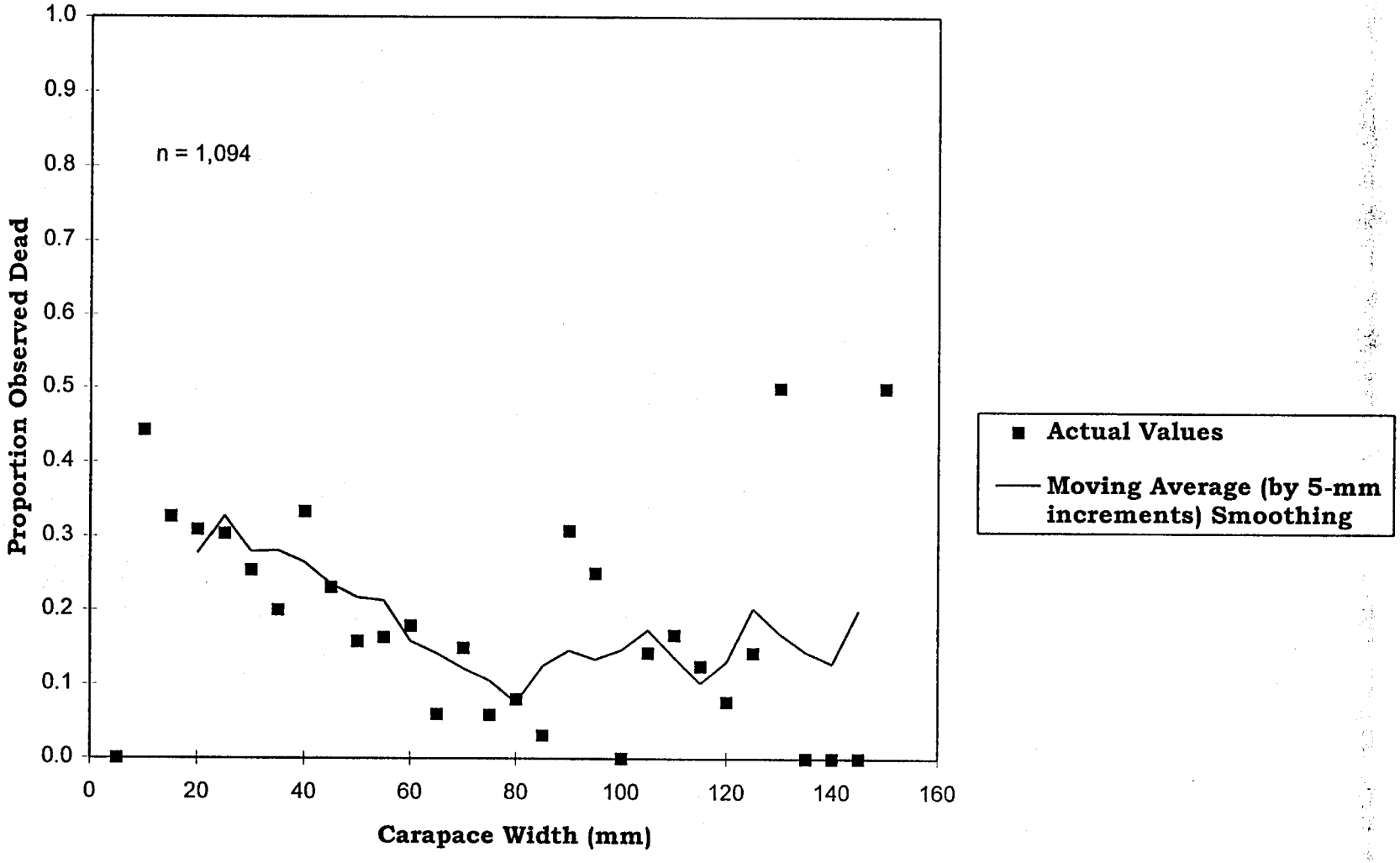

Figure 21. Observed mortality rate versus size in Tanner crab bycatch samples from the 1994/1995 scallop fishery in the Alaska Peninsula Area.

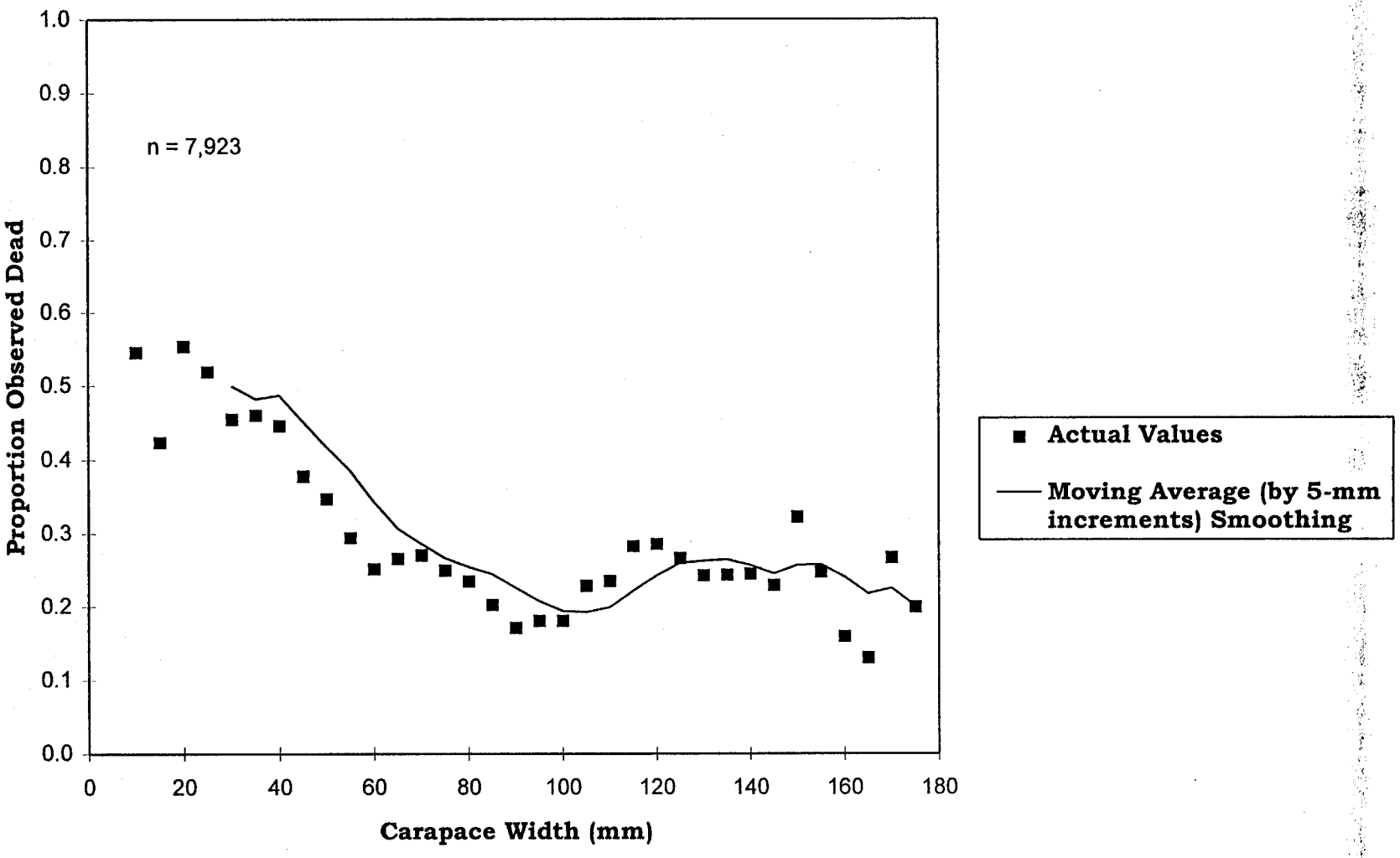

Figure 22. Observed mortality rate versus size in Tanner crab bycatch samples from the 1994/1995 scallop fishery in the Bering Sea.

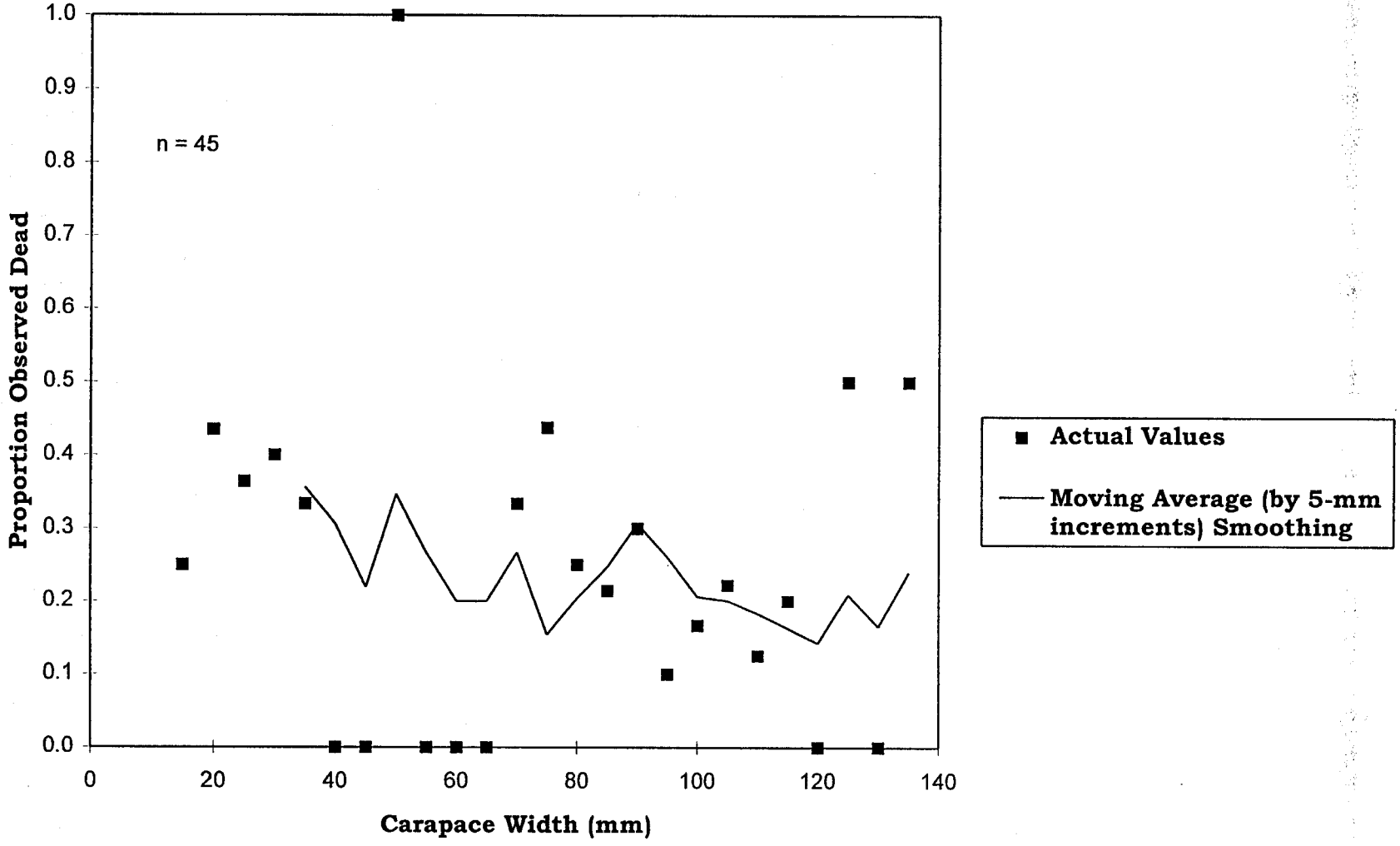

Figure 23. Observed mortality rate versus size in Tanner crab bycatch samples from the 1994/1995 scallop fishery in the Semidi District of Kodiak.

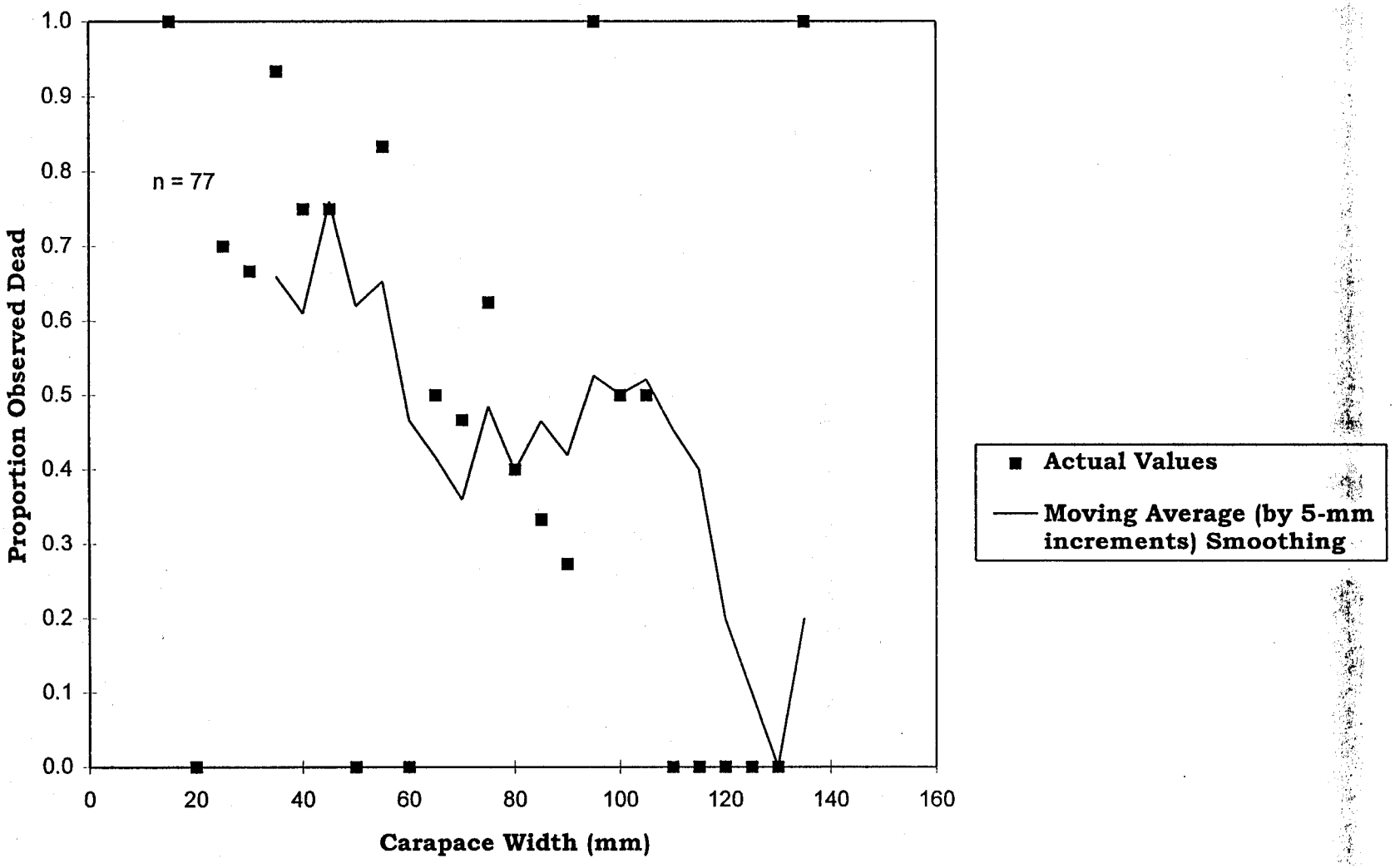

Figure 24. Observed mortality rate versus size in Tanner crab bycatch samples from the 1994/1995 scallop fishery in Dutch Harbor.

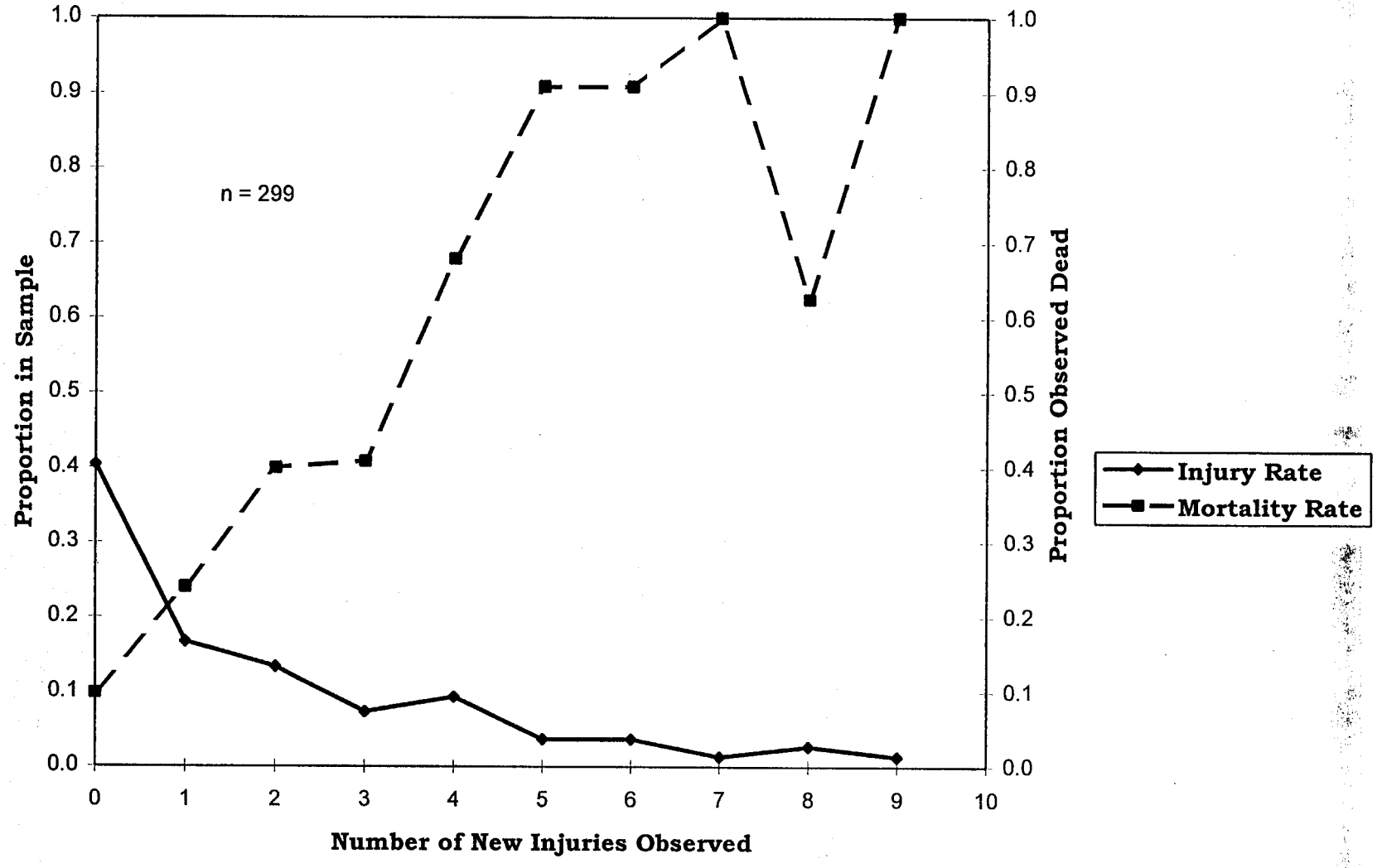

Figure 25. Number of new injuries and corresponding mortality rates recorded in Tanner crab bycatch samples from the 1994/1995 scallop fishery in the Northeast District of Kodiak.

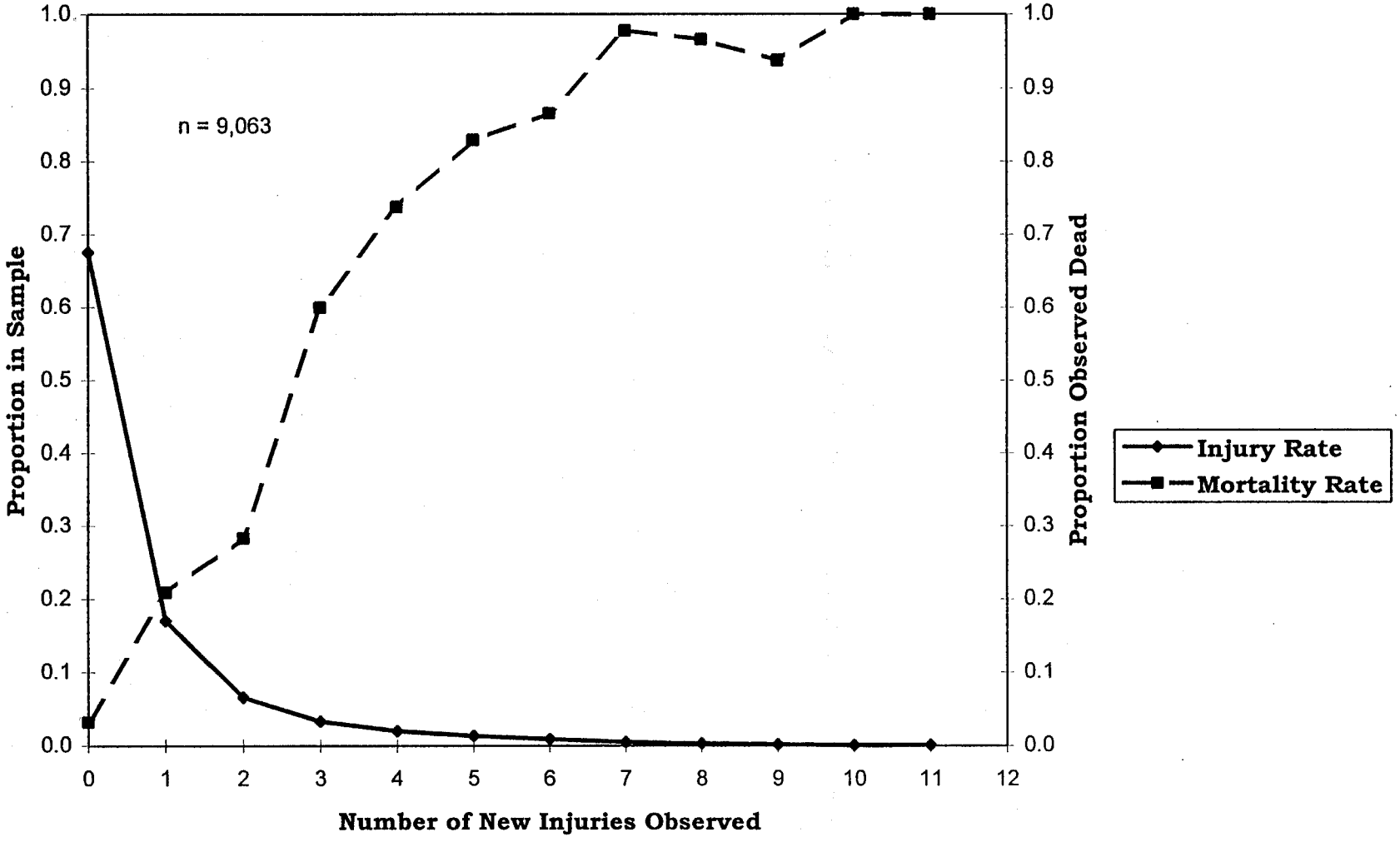

Figure 26. Number of new injuries and corresponding mortality rates recorded in Tanner crab bycatch samples from the 1994/1995 scallop fishery in the Shelikof District of Kodiak.

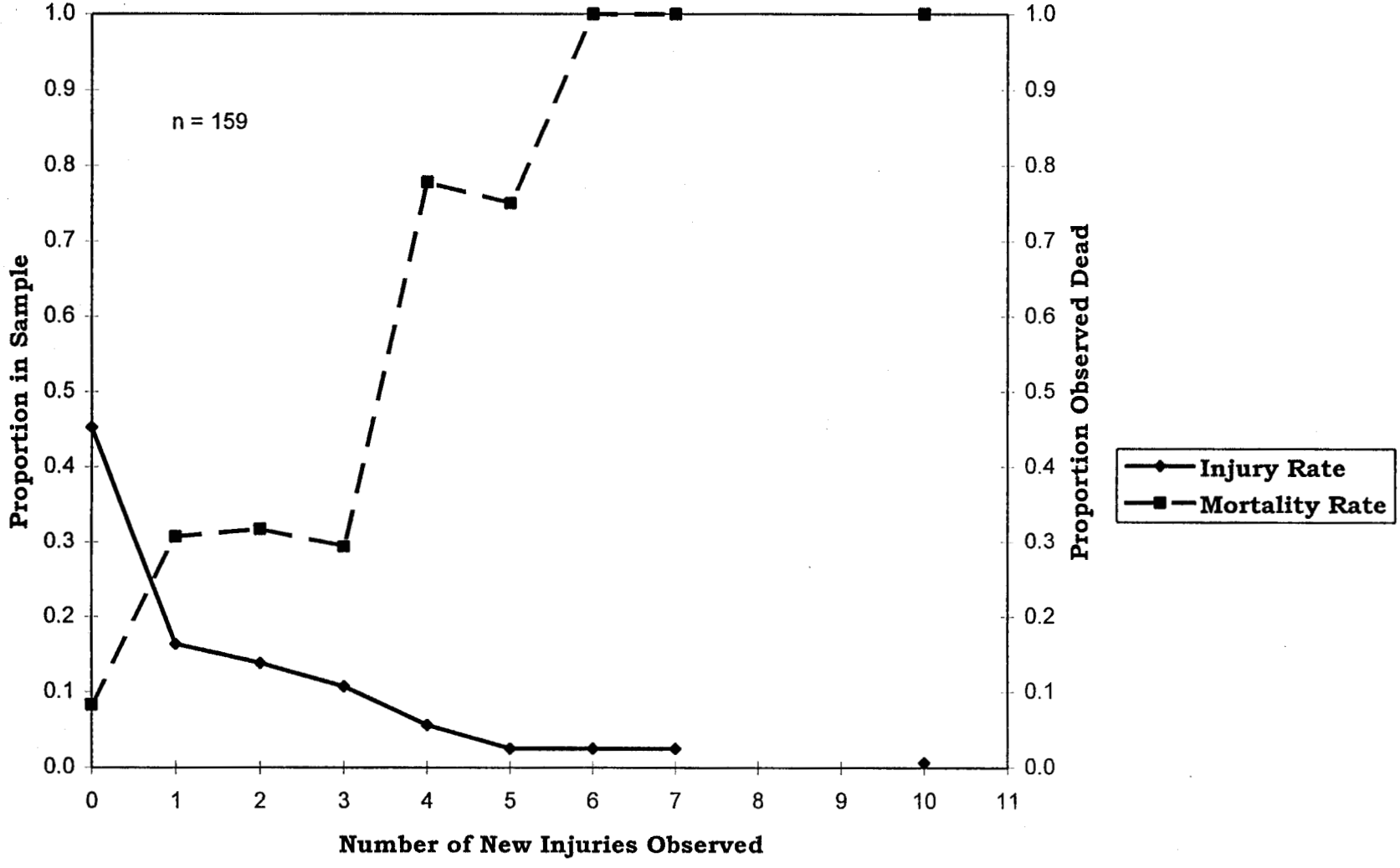

Figure 27. Number of new injuries and corresponding mortality rates recorded in Tanner crab bycatch samples from the 1994/1995 scallop fishery in the Semidi District of Kodiak.

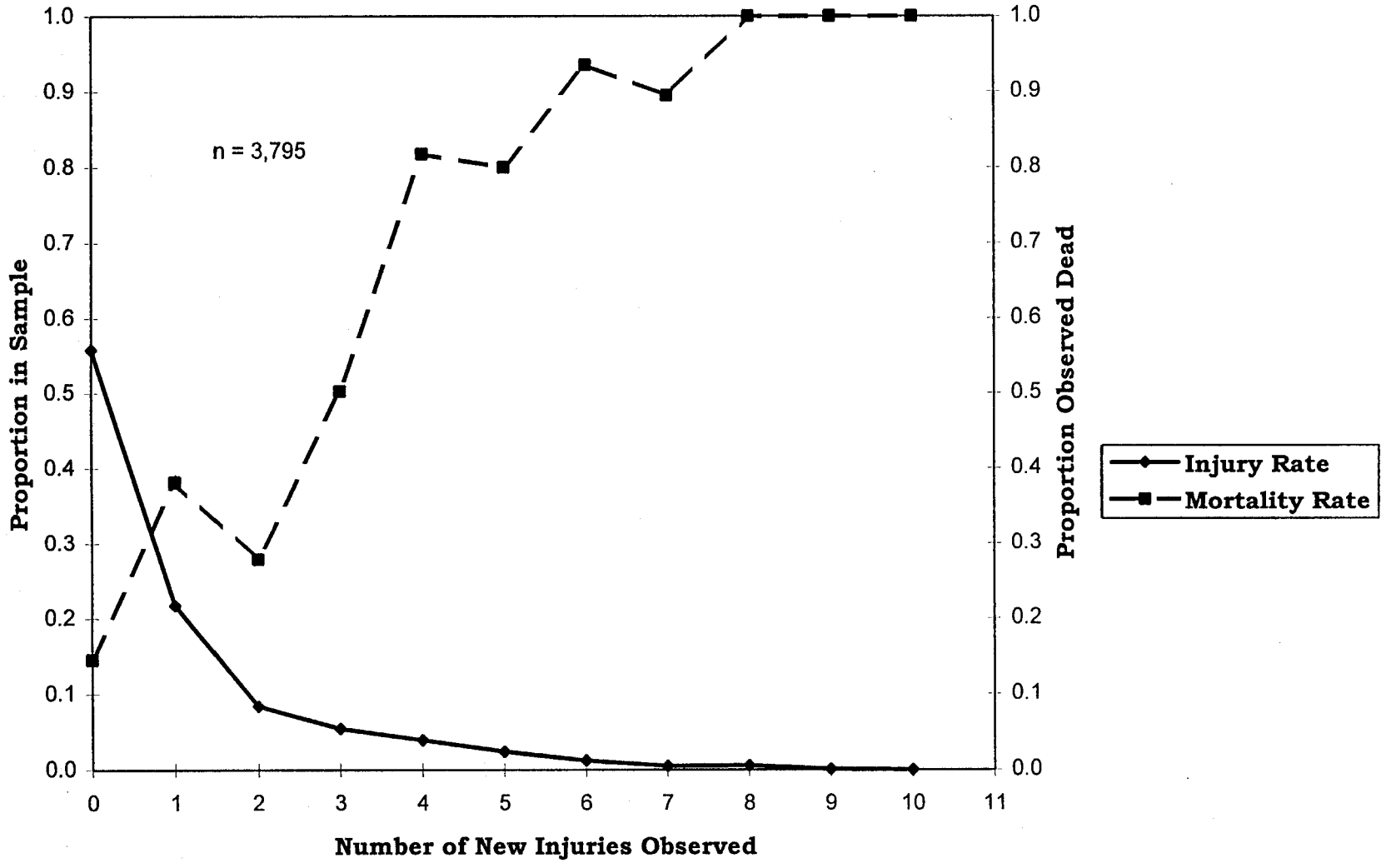

Figure 28. Number of new injuries and corresponding mortality rates recorded in Tanner crab bycatch samples from the 1994/1995 scallop fishery in the Alaska Peninsula.

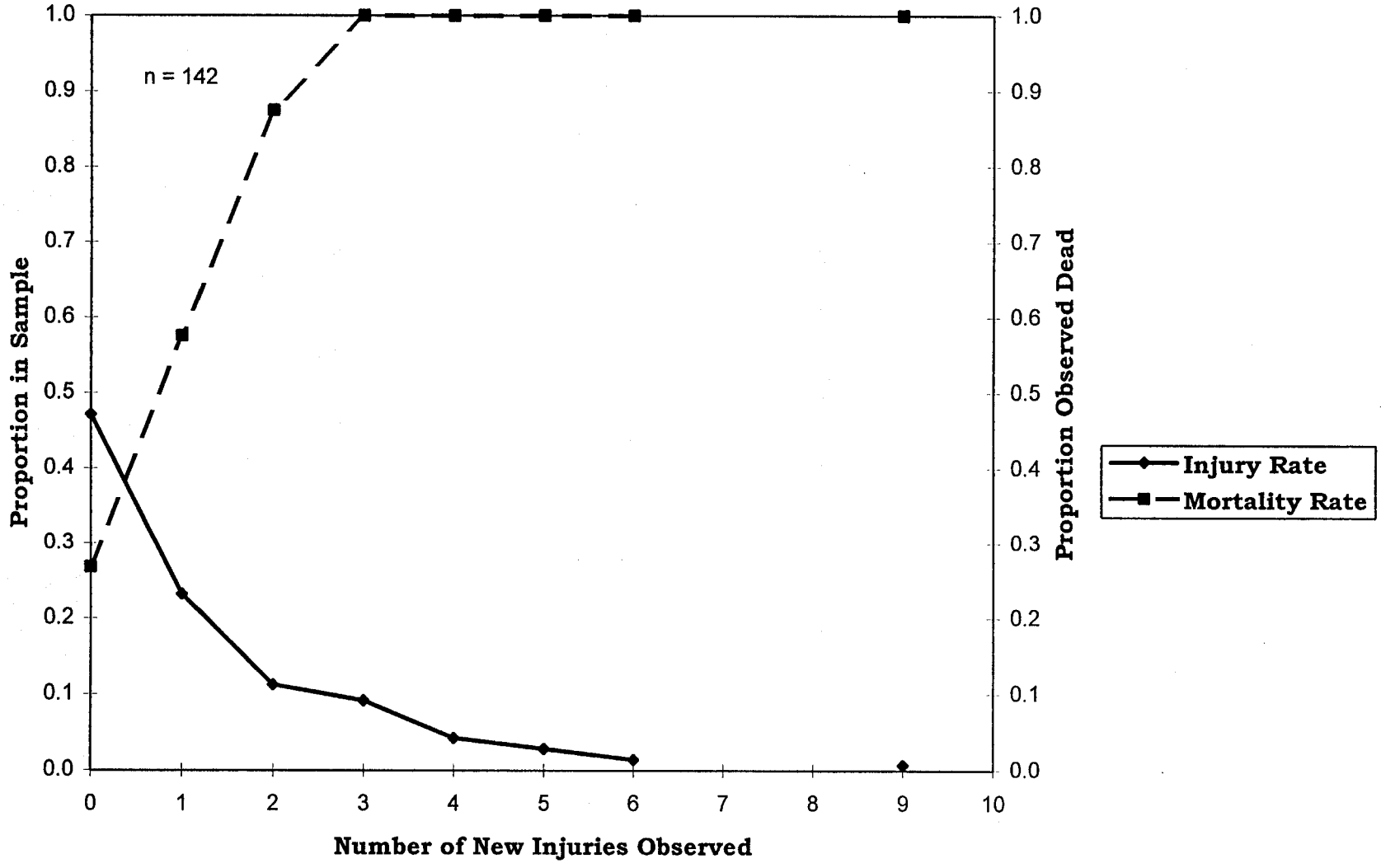

Figure 29. Number of new injuries and corresponding mortality rates recorded in Tanner crab bycatch samples from the 1994/1995 scallop fishery in Dutch Harbor.

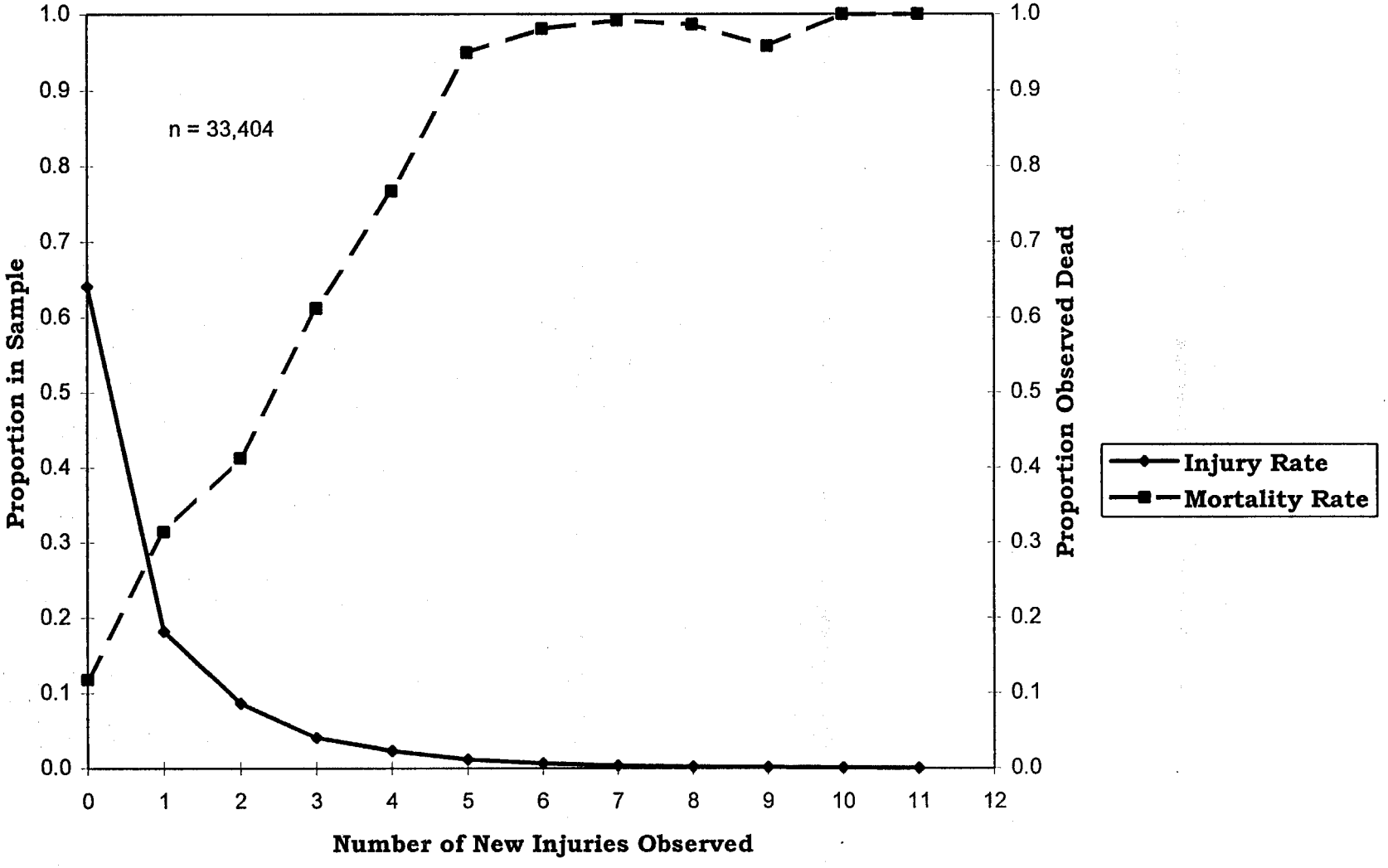

Figure 30. Number of new injuries and corresponding mortality rates recorded in Tanner crab bycatch samples from the 1994/1995 scallop fishery in the Bering Sea.

APPENDIX

Appendix A. Scallop observer data collection forms, 1994/1995.

Appendix A.1. Fishing log filled out by vessel captain to record haul location and catch information from each haul.

ALASKA DEPARTMENT OF FISH AND GAME
FISHING LOG FOR ALASKA SCALLOPS

Trip number	ADF&G #	Year

Captain's name ______________

Observer name ______________

Vessel Name ______________

Haul sampled	Total dredge width	Gear performance	Date Mon.	Date Day	Haul No.	Latitude (N)	E W	Longitude	Fishing times in ALT: Dredge on bottom	Fishing times in ALT: Dredge off bottom	Fishing duration (minutes)	Average bottom depth (fms)	Average Speed in knots	Catch: round weight in pounds	Discarded catch round weight in pounds	ADF&G statistical area
													.			
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													.			
													.			
													.			
													.			

Haul sampled
1- yes
2-no

gear performance
1-satisfactory (both dredges)
2-unsatisfactory (both dredges)
3-partially satisfactory (one dredge satisfactory and one dredge unsatisfactory)

Appendix A.2. Haul composition form used by onboard scallop observers to record catch composition by weight from a scallop dredge.

ALASKA DEPARTMENT OF FISH AND GAME PAGE ____ OF ____
HAUL COMPOSITION FORM

Observer _____
Vessel _____
Date _____
Sample time _____

Trip #	ADF&G #	Fish. Code	Haul #

Number of dredges fished ☐

SPECIES	SPECIES CODE	weight in subsample (column 6)	weight in sampled dredge (column 7)
Weathervane scallops	7 4 1 2 0		
scallop & other bivalve shells	9 9 9 9 3		
Chlamys scallops	7 4 1 0 4		
Octopus	7 8 0 1 0		
Starfish	8 0 0 0 0		
Rock Sole	1 0 2 6 0		
Flathead Sole	1 0 1 3 0		
Arrowtooth Flounder	1 0 1 1 0		
Tanner Crab *C. bairdi*	6 8 5 6 0		
Snow Crab *C. opilio*	6 8 5 8 0		
Dungeness crab	6 8 0 2 0		
DEBRIS: kelp, wood, rocks, et	9 9 9 9 9		
MAN MADE DEBRIS:			
plastics	9 9 9 9 5		
fishing gear (including rope)	9 9 9 9 6		
cans	9 9 9 9 7		
other man-made debris	9 9 9 9 8		

HALIBUT WORKSHEET	
LENGTH (CM)	WEIGHT (LBS)
TOTAL:	

(Column 8)
Number of man made debris items in sampled dredge

Subsample calculations (Weights in Pounds)

(A) Estimated weight of sampled dredge (lbs.) _____

(B) Fish, Rocks, wood, etc. weighed directly from sampled dredge _____

(C) Wt. from which basket subsample is taken (A minus B) _____

(D) Total basket subsample weight (sum of column 6) _____

(E) Raising Factor (C divided by D) used to expand individual subsample weights (Column 6) to the total weights found in the sampled dredge (column 7) _____

Notes:

1. **Sample one dredge only for haul composition weights (including crab and halibut).**
2. **Items weighed directly (B) are recorded in column 7. See manual for further directions.**
3. **Sum of weights in column 7 should nearly equal estimated weight of the sampled dredge (A).**
4. **Enter all halibut lengths on worksheet, use manual Appendix 11 to convert lengths to weights, enter the sum of the weights in column 7.**
5. **MAN MADE DEBRIS: Sample the whole dredge for debris, record weight in column 7, number of items in column 8.**

Appendix A.3. Crab and halibut bycatch form used by onboard scallop observers to record the number of crab and halibut observed in sampled hauls.

ALASKA DEPARTMENT OF FISH AND GAME
CRAB AND HALIBUT BYCATCH FORM

Page ____ of ____

Observer ______________

Vessel ______________

Year ______________

Trip #	ADF&G #	Fishery Code

date		haul	pt=1	Tanner Crab			Dungeness crab	king crab	H'but	Comments
mo.	day	Number	s'bd=2	*C.bairdi*	*C.opilio*	hybrid				

NOTES

1. Put only one dredge sample on a line.
2. In comments, note if the randomly selected, sampled dredge is noticeably different than the non-sampled dredge.
3. In comments, note if the king crab bycatch is other than red king crab, *Paralithodes camtschaticus*
4. Indicate sampled dredge: pt equals port dredge, s'bd equals starboard dredge

Appendix A.4. Crab size and injury form used by onboard scallop observers to record crab size and injuries from crab in sampled hauls.

ALASKA DEPARTMENT OF FISH AND GAME
CRAB SIZE AND INJURY FORM

Page __ of __

Observer _____
Vessel _____
Date _____

Trip #	ADF&G #	Fish. Code	Haul #

	Spp. Code	size (mm)	sex	Shell Cond	injury check ?	Damage c'pace	legs & claw old	legs & claw new	mort?
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
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20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									

	Spp. Code	size (mm)	sex	Shell Cond.	injury check ?	Damage c'pace	legs & claw old	legs & claw new	mort?
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
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64									
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66									
67									
68									
69									
70									

Species Codes
1=Brown King Crab
2= Red King Crab
3= Blue King Crab
6= C. Bairdi
7= C.opilio
8=Tanner hybrid
9= Dungeness crab

Sex
1-male
2-female

Shell Condition
0- Soft
1- New
2- Old
3-Very Old

Injury Check
1 = yes
2 = no

Damage (leave blank if no injury)
CARAPACE
1-Old injury
2- New injury
3-Old and new injuries
LEGS: enter actual number of old & new injuries to legs & claws.

Mortality
1- Dead or moribund
2-alive

Note: 1. Measure the length of king crab, the width of other crab species.
2. Add the number of crab measured to any crab counted and not measured and record on bycatch form.

Appendix A.5. Halibut length and condition form used by onboard scallop observers to record length and condition of halibut in sampled hauls.

ALASKA DEPARTMENT OF FISH AND GAME Page ___ of ___
HALIBUT LENGTH AND CONDITION FORM

Observer _____
Vessel _____
Year _____

Trip #	ADF&G #	Fishery Code

Date MO.	Date Day	Haul Number	Fish Length (cm)	Checked for injury Y=1, N=2	Condition Code	Comments

Condition Codes

1. Excellent-- vigorous body movement before and after release; could close operculum tightly; minor external injuries, if any.
2. Good--feeble body movements; could close operculum tightly; minor external injuries, if any.
3. Fair-- no body movement; could close operculum tightly; minor external injuries, if any.
4. Poor-- no body movement; could move operculum but not tightly; severe injuries (eg. bleeding).
5. Dead-- no body or opercular movement, probably killed in sampled haul.
6. Previously dead--Obviously not killed in the current haul, incidentally picked up.

Appendix A.6. Scallop size frequency form used by onboard scallop observers to record shell height, age and gonad development from sampled scallops.

ALASKA DEPARTMENT OF FISH AND GAME Page ____ of _____
SCALLOP SIZE FREQUENCY FORM

Observer _____
Vessel _____
Date _____

Trip #	ADF&G #	Haul #	Fish. Code

Sample type ☐

	Shell height (mm)	Age	Sex	Gonad Develop	mm to annuli 1		Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
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21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							

Sex
1-Male
2-Female
3-can not be determined

Gonad Development
1-Immature or juvenile
2-Full or ripe
3-Empty or spawned out
4-Initial recovery
5-Filling

Sample type
1-Unsorted catch
2-Retained catch
3-Discarded catch

Appendix A.7. Weekly summary form used by onboard scallop observers to summarize their daily data collections.

ALASKA DEPARTMENT OF FISH AND GAME Page ____ of ____
WEEKLY SUMMARY: SCALLOP CATCHER PROCESSOR

Beginning Monday _____ through Sunday _____

Observer _____
Vessel _____

Trip Number	ADF&G #	Fishery Code

				A	B	C	D
Date fished mon.	day	Statistical Area	Pounds of meat	Number of hauls	sampled dredges	# king crab in sampled dredges	# Tanner crab in sampled dredges

	Statistical Area	Pounds of shucked meat	Number hauls	# of sampled dredges	estimated # king crab	estimated # of Tanner crab
Weekly Trip Summary						
TOTALS						

Notes:

1. **sampled dredges includes bycatch sampling only and does not include species comp. samples.**
2. **estimated number of king crab = (ave. number per sampled dredge x 2) x number of hauls.** (C/B x 2) x A
3. **estimated number of Tanner crab = (ave. number per sampled dredge x 2) x number of hauls.** (D/B x 2) x A

Appendix A.8. Radio report form used by onboard scallop observers to record encoded numbers needed to make radio reports to ADF&G offices.

SCALLOP OBSERVER RADIO REPORT FORM

AREA: _____

VESSEL: _____

OBSERVER: _____

		MONDAY	TUESDAY	MON/TUES TOTALS	WEDNESDAY	THURSDAY	WED/THURS TOTALS	FRIDAY	SATURDAY	SUNDAY	FRI/SAT/SUN TOTALS	WEEKLY TOTAL
DATE												
ITEM 1. Stat-Area	actual											
	code											
ITEM 2. Total number	actual											
of hauls.	code											
ITEM 3. Number of	actual											
sampled dredges.	code											
ITEM 4. Number of king	actual											
crab in sampled dredges	code											
ITEM 5.	actual											
Sampling Condition	code											
ITEM 6. Number Tanner	actual											
crab in sampled dredges	code											
ITEM 7. Pounds of	actual											
scallops retained.	code											
ITEM 8.	actual											
	code											
ITEM 9.	actual											
	code											

Appendix B. Ranked catch composition of observed catches from 1994/1995 scallop fishery in the Westward Region.

Appendix B.1. Twenty most frequently caught species by weight as recorded by scallop observers during the 1994/95 Kodiak Area, Northeast District scallop season. Nontarget commercial species[a] accounted for 13.7% of the total catch by weight.

Rank	Species	Scientific Name	% of Total Catch
1	weathervane scallops	*Patinopecten caurinus*	43.5%
2	starfish	Class Stelleroidea	28.0%
3	kelp, rocks, etc		9.0%
4	skates	Family Rajidae	5.0%
5	weathervane shells	*P. caurinus*	3.0%
6	arrowtooth flounder	*Atheresthes stomias*	2.2%
7	Pacific halibut	*Hippoglossus stenolepis*	1.6%
8	sand dollar	*Echinarachnius parma*	1.5%
9	rock sole	*Lepidopsetta bilineata*	1.1%
10	flathead sole	*Hippoglossoides elassodon*	1.0%
11	Dover sole	*Microstomus pacificus*	0.9%
12	yellowfin sole	*Limanda aspera*	0.4%
13	rex sole	*Glyptocephalus zachirus*	0.4%
14	Pacific cod	*Gadus macrocephalus*	0.4%
15	Sculpin	Family Cottidae	0.4%
16	starry flounder	*Platichtys stellatus*	0.2%
17	fishing gear		0.2%
18	Tanner crab	*Chionoecetes bairdi*	0.2%
19	walleye pollock	*Theragra chalcogramma*	0.1%
20	butter sole	Isopsetta isolepis	0.1%

[a] Commercial species caught in declining order of poundage: *Chionoecetes bairdi*, skates, arrowtooth flounder, flathead sole, *C. opilio*, Pacific cod, rock sole, octopus, halibut, rex sole, pollock, yellowfin sole.

Appendix B.2. Twenty most frequently caught species by weight as recorded by scallop observers during the 1994/95 Kodiak Area, Shelikof District scallop season. Nontarget commercial species[a] accounted for 9.5% of the total catch by weight.

Rank	Species	Scientific Name	% of Total Catch
1	weathervane scallops	*Patinopecten caurinus*	64.1%
2	weathervane shells	*P. caurinus*	10.1%
3	kelp, rocks, etc.		9.1%
4	starfish	Class Stelleroidea	4.2%
5	skates	Family Rajidae	3.5%
6	arrowtooth flounder	*Atheresthes stomias*	1.5%
7	Tanner crab	*Chionoecetes bairdi*	1.1%
8	sea anemone	Order Actinaria	0.6%
9	Alaska plaice	*Pleuronectes quadrituberculatus*	0.6%
10	fishing gear		0.5%
11	Dover sole	*Microstomus pacificus*	0.5%
12	flathead sole	*Hippoglossoides elassodon*	0.4%
13	snails	Class Gastropoda	0.4%
14	hermit crab	Family Paguridae	0.4%
15	Pacific halibut	*Hippoglossus stenolepis*	0.4%
16	rock sole	*Lepidopsetta bilineata*	0.3%
17	Pacific cod	*Gadus macrocephalus*	0.2%
18	octopus	Family Octopodoteuthidae	0.2%
19	sea pen	Order Pennatulacea	0.1%
20	Dungeness Crab	*Cancer magister*	0.1%

[a] Commercial species caught in declining order of poundage: skates, arrowtooth flounder, *Chionecetes bairdi*, Alaska plaice, Dover sole, halibut, rock sole, Pacific cod, octopus, Dungeness crab, turbot, bay scallops, and sea urchin.

Appendix B.3. Twenty most frequently caught species by weight as recorded by scallop observers during the 1994/95 Kodiak Area, Semidi District scallop season. Nontarget commercial species[a] accounted for 5.4% of the total catch by weight.

Rank	Species	Scientific Name	% of Total Catch
1	weathervane scallops	*Patinopecten caurinus*	49.3%
2	starfish	*Class Stelleroidea*	23.7%
3	kelp,rock, etc.		13.8%
4	weathervane shells	*P. caurinus*	4.6%
5	starry flounder	*Platichtys stellatus*	1.3%
6	tunicate	*Subphylum Urochordata*	1.1%
7	skates	*Family Rajidae*	0.8%
8	flathead sole	*Hippoglossaides elassodon*	0.7%
9	giant wrymouth	*Delolepis gigantea*	0.6%
10	Tanner crab	*Chionoecetes bairdi*	0.6%
11	yellowfin sole	*Limanda aspera*	0.6%
12	arrowtooth flounder	*Atheresthes stomias*	0.5%
13	lyre crab	*Hyas lyratus*	0.4%
14	sea anemone	Order Actinaria	0.2%
15	sea pen	Order Pennatulacea	0.2%
16	Dungeness crab	*Cancer magister*	0.2%
17	flatfish unidentified		0.2%
18	hermit crab	Family Paguridae	0.1%
19	Alaska plaice	*Pleuronectes quadrituberculatus*	0.1%
20	rock sole	*Lepidopsetta bilineata*	0.1%

[a] Commercial species caught in declining order of poundage: skates, flathead sole, *Chionecetes bairdi*, yellowfin sole, arrowtooth flounder, Dungeness crab, Alaska plaice, rock sole, english sole, sea urchin, and Dover sole.

Appendix B.4. Twenty most frequently caught species by weight as recorded by scallop observers during the 1994/95 Alaska Peninsula Area scallop season. Non target commercial species[a] accounted for 6.7% of the total catch by weight.

Rank	Species	Scientific Name	% of Total Catch
1	weathervane scallops	*Patinopecten caurinus*	72.5%
2	basket star	*Gorgonocephalus caryi*	5.5%
3	weathervane shells	*P. caurinus*	5.2%
4	starfish	Class Stelleroidea	5.1%
5	kelp, rocks, etc.		2.4%
6	arrowtooth flounder	*Atheresthes stomias*	2.1%
7	rock sole	*Lepidopsetta bilineata*	1.0%
8	bay scallops	Chlamys spp.	0.9%
9	snails	Class Gastropoda	0.9%
10	sea urchin	Family Strongyocentrotidae	0.6%
11	flathead sole	*Hippoglossoides elassodon*	0.4%
12	yellowfin sole	*Limanda aspera*	0.4%
13	skates	Family Rajidae	0.4%
14	hermit crab	Family Paguridae	0.3%
15	sand dollar	*Echinarachnius parma*	0.3%
16	Tanner crab	*Chionoecetes bairdi*	0.3%
17	octopus	Family Octopodoteuthidae	0.2%
18	sea pen	Order Pennatulacea	0.2%
19	Sculpin	Family Cottidae	0.1%
20	Pacific halibut	*Hippoglossus stenolepis*	0.1%
21	sea anemone	Order Actinaria	0.1%

[a] Commercial species caught in declining order of poundage: arrowtooth flounder, rock sole, bay scallops, sea urchin, flathead sole, yellowfin sole, skates, *Chionoecetes bairdi*, octopus, halibut, pollock, Pacific cod, and Dover sole.

Appendix B.5. Catch composition by weight as recorded by scallop observers during the 1994/95 Dutch Harbor Area scallop season. Nontarget commercial species[a] accounted for 28.3% of the total catch by weight.

Rank	Species	Scientific Name	% of Total Catch
1	weathervane scallops	*Patinopecten caurinus*	55.2%
2	skates	Family Rajidae	17.5%
3	rock sole	*Lepidopsetta bilineata*	8.6%
4	weathervane shells	*P. caurinus*	5.5%
5	sponge	Phylum Porifera	4.4%
6	snails	Class Gastropoda	2.2%
7	starfish	Class Stelleroidea	2.2%
8	sea urchin	Family Strongyocentrotidae	2.2%
9	kelp, rocks, etc		1.3%
10	sand dollar	*Echinarachnius parma*	1.1%

[a] Commercial species caught in declining order of poundage: skates, rock sole, sea urchin.

Appendix B.6. Twenty most frequently caught species by weight as recorded by scallop observers during the 1994/95 Bering Sea Area scallop season. Nontarget commercial species[a] accounted for 9.7% of the total catch by weight.

Rank	Species	Scientific Name	% of Total Catch
1	weathervane scallops	*Patinopecten caurinus*	77.2%
2	weathervane shells	*P. caurinus*	7.1%
3	Tanner crab	*Chionoecetes bairdi*	2.8%
4	skates	Family Rajidae	2.8%
5	starfish	Class Stelleroidea	1.8%
6	arrowtooth flounder	*Atheresthes stomias*	1.2%
7	flathead sole	*Hippoglossoides elassodon*	1.0%
8	fishing gear		0.6%
9	sea anemone	Order Actinaria	0.6%
10	kelp, rocks, etc		0.5%
11	snow crab	*Chionoecetes opilio*	0.5%
12	Pacific cod	*Gadus macrocephalus*	0.5%
13	hermit crab	Family Paguridae	0.5%
14	snails	Class Gastropoda	0.4%
15	rock sole	*Lepidopsetta bilineata*	0.3%
16	basket star	*Gorgonocephalus caryi*	0.2%
17	octopus	Family Octopodoteuthidae	0.2%
18	Jellyfish	Class Scyphozoa	0.2%
19	tunicate	Subphylum Urochordata	0.2%
20	empty snail shells	Class Gastropoda	0.1%

[a] Commercial species caught in declining order of poundage: *Chionoecetes bairdi*, skates, arrowtooth flounder, flathead sole, *C. opilio*, Pacific cod, rock sole, octopus, halibut, rex sole, pollock, yellowfin sole.