

TECHNICAL FISHERY REPORT 88-01



Alaska Department of Fish and Game
Division of Commercial Fisheries
PO Box 3-2000
Juneau, Alaska 99802

April 1988

**Population Assessment Trawl Survey for the Tanner Crab,
Chionoecetes bairdi, Around Kodiak Island, 1986**

by

William E. Donaldson

State of Alaska

Steve Cowper, Governor

The Technical Fishery Report Series was established in 1987, replacing the Technical Data Report Series. The scope of this new series has been broadened to include reports that may contain data analysis, although data oriented reports lacking substantial analysis will continue to be included. The new series maintains an emphasis on timely reporting of recently gathered information, and this may sometimes require use of data subject to minor future adjustments. Reports published in this series are generally interim, annual, or iterative rather than final reports summarizing a completed study or project. They are technically oriented and intended for use primarily by fishery professionals and technically oriented fishing industry representatives. Publications in this series have received several editorial reviews and at least one *blind* peer review refereed by the division's editor and have been determined to be consistent with the division's publication policies and standards.

Population Assessment Trawl Survey for the Tanner Crab,
Chionoecetes bairdi, Around Kodiak Island, 1986

By

William E. Donaldson

Technical Fishery Report No. 88-01

Alaska Department of Fish and Game
Division of Commercial Fisheries
Juneau, Alaska 99801

April 1988

(Page intentionally left blank)

TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	iv
LIST OF FIGURES	v
LIST OF APPENDICES	vi
ABSTRACT	vii
INTRODUCTION	1
METHODS	1
Explanation of Terms and Acronyms	1
Trawl Description and Procedures	2
Station Description	2
Sampling	3
Station Data	5
RESULTS AND DISCUSSION	5
North Mainland Survey Area	5
Tanner Crab	5
Westside Survey Area	6
Tanner Crab	6
Eastside-Barnabas Survey Area	6
Tanner Crab	6
Tanner Crab Population Estimates	7
Female Tanner Crab Shell Age and Ovigerity	7
Red King Crab	7
LITERATURE CITED	8
TABLES AND FIGURES	9
APPENDICES	26

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Number and percent of male Tanner crab, <i>Chionoecetes bairdi</i> , measured by cohort group and exoskeletal age in the North Mainland Area, 1986 trawl survey, Kodiak, Alaska	10
2. Number and percent of male Tanner crab, <i>Chionoecetes bairdi</i> , measured by cohort group and exoskeletal age in the Westside Area, 1986 trawl survey, Kodiak, Alaska	11
3. Number and percent of male Tanner crab, <i>Chionoecetes bairdi</i> , measured by cohort group and exoskeletal age in the Eastside-Barnabas Area, 1986 trawl survey, Kodiak, Alaska	12
4. Population estimates and standard error for Tanner crab, <i>Chionoecetes bairdi</i> , from the 1986 trawl survey, Kodiak, Alaska	13
5. Male red king crab, <i>Paralithodes camtschatica</i> , captured during the 1986 Kodiak trawl survey	14
6. Female king crab, <i>Paralithodes camtschatica</i> , captured during the 1986 Kodiak trawl survey	15

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. North Mainland and Westside station grid, Kodiak trawl survey, 1986	16
2. Eastside-Barnabas station grid, Kodiak trawl survey, 1986 . .	17
3. Carapace width frequency of all male and female Tanner crab, <i>Chionoecetes bairdi</i> , captured during the Kodiak trawl survey, 1986	18
4. Catch of sublegal (top) and legal male Tanner crab, <i>Chionoecetes bairdi</i> , per 1.85 km towed from the North Mainland (NM) and Westside (W) areas, Kodiak trawl survey, 1986 .	19
5. Catch of juvenile (top) and adult female Tanner crab, <i>Chionoecetes bairdi</i> , per 1.85 km towed from the North Mainland (NM) and Westside (W) areas, Kodiak trawl survey, 1986 .	20
6. Carapace width frequency of male Tanner crab, <i>Chionoecetes bairdi</i> , Kodiak trawl survey, 1986	21
7. Carapace width frequency of juvenile (□) and adult female Tanner crab, <i>Chionoecetes bairdi</i> , Kodiak trawl survey, 1986 .	22
8. Catch of sublegal (top) and legal male Tanner crab, <i>Chionoecetes bairdi</i> , per 1.85 km towed from the Eastside-Barnabas Areas, Kodiak trawl survey, 1986	23
9. Catch of juvenile (top) and adult female Tanner crab, <i>Chionoecetes bairdi</i> , per 1.85 km towed from the Eastside-Barnabas Area, Kodiak trawl survey, 1986	24
10. Carapace width frequency by shell age (A) and percent ovigerity by shell age (B) of adult female Tanner crab, <i>Chionoecetes bairdi</i> , Kodiak trawl survey, 1986	25

LIST OF APPENDICES

	<u>Page</u>
APPENDIX A: Collection and catch data per 1.85 km towed for Tanner crab, <i>Chionoecetes bairdi</i> , from the Kodiak trawl survey, 1986	27
APPENDIX B: Trawling record for the Kodiak trawl survey, 1986 . . .	32

ABSTRACT

During September and October 1986 an otter trawl survey for Tanner crab, *Chionoecetes bairdi*, was conducted in the North Mainland, Westside, and Eastside-Barnabas areas of the Kodiak Archipelago. This report presents the catch data for Tanner and red king crab (*Paralithodes camtschatica*).

A total of 14,241 Tanner crab and 20 king crab were captured. The total population of Tanner crab in the survey areas was estimated to be 40.6 million animals. Most adult female Tanner crab were carrying full or nearly full egg clutches.

KEY WORDS: Trawl survey; North Mainland; Westside; Eastside-Barnabas; Tanner crab; king crab

INTRODUCTION

The purpose of this document is to present the methodology and crab data collected from a trawl survey conducted by the Alaska Department of Fish and Game (ADF&G) aboard the research vessel RESOLUTION, from 14 October through 7 November 1986. Areas surveyed were the North Mainland and Westside portions of Shelikof Strait and the Eastside-Barnabas Sections of Kodiak Island (Figures 1 and 2), as described in ADF&G (1987).

The primary objective of the survey was to sample Tanner crab (*Chionoecetes bairdi*) populations to obtain: (1) estimates of abundance of legal (≥ 140 mm) and sublegal (< 140 mm) males, and (2) estimates of abundance and reproductive success for adult females. A secondary objective was to estimate the abundance of red king crab, *Paralithodes camtschatica*, and commercially important species of groundfish. Data obtained through annual trawl surveys are used to regulate the commercial crab fisheries around the Kodiak Archipelago. This report documents the catch of Tanner and red king crab.

METHODS

Explanation of Terms and Acronyms

The following definitions were developed for characterizing Tanner crab examined in this investigation.

- New shells (NS) - Hard exoskeletal animals; the dorsal side of the carapace brownish-red; no apparent scratching on ventral side; epifauna absent or limited; and dactyli, pterygostomial and branchial spines sharp.
- Old shells (OS) - An apparent skip molt; carapace hard and brownish; thoracic sternum and ventral sides of legs with numerous scratches and abrasions; dactyli, pterygostomial and branchial spines worn; epifauna may be present.
- Very Old shells (VOS) - An obvious skipmolt; carapace hard, dark brown to blackish; thoracic sternum and ventral side of legs with multiple scratches and abrasions; underside of legs usually dark yellow-brown; dactyli, pterygostomial and branchial spines heavily worn; epifauna usually present: e.g., large barnacles.
- Molting - All physiological events leading up to ecdysis and including ecdysis.
- Skip molt - A crab which has retained its exoskeleton (not molted) for more than 12 months.
- Crab Measurements - All crab measurements, e.g., \leq mm, refer to carapace width (CW) unless otherwise noted.

- Prerecruit IV's - Male Tanner crab ≤ 69 mm in carapace width and four or more molts from attaining legal size. Note that this group includes prerecruit IV, V, VI and younger crabs, but are referred to as prerecruit IV's herein.
- Prerecruit III's - Male Tanner crab 70-91 mm in carapace width and three molts from attaining legal size.
- Prerecruit II's - Male Tanner crab 92-114 mm in carapace width and two molts from attaining legal size.
- Prerecruit I's - Male Tanner crab 115-139 mm in carapace width and one molt from attaining legal size.
- Recruit Legals - New-shell male Tanner crab 140-164 mm in carapace width, recruited to legal size in year of capture.
- Postrecruit Legals - Male crab that have been legal size at least one year: defined as old shells and very old shells 140-164 mm and all males >164 mm in carapace width.
- Total Legals - All male Tanner crab >139 mm in carapace width.
- Females - Identified as adult or immature by visual observation of abdominal flap.

Trawl Description and Procedures

The R/V RESOLUTION towed a 400-mesh eastern otter trawl net. The net had a 21 m headrope with 18 floats, each being 20 cm in diameter. The footrope was 29 m without roller gear or ticklers. The two dandy lines were each 46 m and consisted of an 18-m x 16-mm cable and a pair of 27-m by 13-mm cables, one attached to the top and the other to the bottom of each net wing. The doors were Astoria "V" type, weighing 340 kg each and measuring 1.5 m x 2.1 m. The net was constructed with 102-mm stretch mesh at the mouth, 89-mm stretch mesh in the body, and the cod end had a 32-mm stretch mesh liner. The net was designed to sweep a 12 m path.

At each station the net was operated on the bottom for approximately 30 minutes and covered 1.85 km. Variations occurred in the performance of the trawls in the North Mainland and Westside Sections that caused unequal coverage of bottom area per unit time. Catches were adjusted to 1.85 km towed to account for this inaccuracy.

Station Description

Station grids remained essentially unchanged from the 1985 survey and are depicted on Figures 1 and 2. One additional station was fished in the Eastside-Barnabas section.

The North Mainland Survey Area consisted of 1150 km² and is depicted in Figure 1. The area was stratified by depth into three strata, two which were surveyed. Stratum I was the undefined, unfished nearshore area. Stratum II was the area from 36 m through 146 m on the west side of the North Mainland Section. Stratum III was the area from 146 m to the approximate mid-line of northern Shelikof Strait.

The Westside Survey Area consisted of 966 km² and is depicted in Figure 1. This area was stratified by depth into three strata, two of which were surveyed. Stratum IV was the area from the approximate mid-line of Shelikof Strait easterly to the 200-m contour. Stratum V includes those waters 100-200 m deep. Stratum I (>100 m) was not surveyed.

The Eastside-Barnabas Survey Area consisted of 2672 sq. km and is depicted in Figure 2. The survey area was stratified as follows: 100-200 m for Stratum I; <100 m for Stratum II; Kiliuda - Sitkalidak Bays for Stratum III; and Ugak Bay for Stratum IV.

Sampling

Total catch weight was determined by weighing the cod end of the trawl using an electronic crane scale accurate to the nearest 4.5 kg before and after the catch was removed. All large fish, which were difficult to subsample, and all fish of special interest were sorted from the catch; this included all halibut (*Hippoglossus stenolepis*), skates, and sharks (*Chondrichthyes*), cod (*Gadus macrocephalus*), sablefish (*Anoplopoma fimbria*), rockfish (*Sebastes*), salmon (*Oncorhynchus*), king crab, Tanner crab, Dungeness crab (*Cancer magister*), and weathervane scallops (*Precten caurinus*). Crabs were separated by sex and exoskeletal age. Carapace measurements were taken on king crab and Tanner crab using Vernier calipers (Colgate and Hicks, 1982). The relative volume of eggs carried by adult females and egg condition were examined and recorded. All Tanner crab infested with *Trichomaris invadens*, commonly known as Black Mat syndrome, were noted.

Halibut fork lengths were measured and skate weights were estimated and then the animals were returned to the sea. The remaining species were sampled by estimating their percent volume composition of the remaining catch.

Population estimates for Tanner crab were calculated using the standard area swept technique discussed in Colgate and Hicks (1982). For stratified data from a surveyed area, the population estimate is:

$$PE = \frac{6076 \cdot C_T \cdot A_T}{W}$$

where PE = population estimate in numbers of crabs

6076 = number of feet in one nautical mile

C_T = mean catch per mile

A_T = total area surveyed in miles squared

W = effective net width in feet

For stratified data, this formula remains the same although the method of obtaining mean catch is altered somewhat. The mean catch, C_T , is "weighted" to reflect the criteria of each of the particular strata selected in the following manner:

$$C_T = \frac{\sum_{i=1}^h C_i \cdot A_i}{A_T}$$

where C_T = mean catch

C_i = mean catch from the i^{th} stratum

A_i = area of the i^{th} stratum

A_T = total area

h = number of strata

The standard error of the mean catch, SE_T , is derived from stratified data as follows:

$$SE_T = \sqrt{\sum_{i=1}^h \left[\left(\frac{A_i}{A_T} \right)^2 \cdot \frac{SD_i^2}{n_i} \right]}$$

where SE_T = standard error of the mean catch

SD_i = standard deviation of the i^{th} stratum

A_i = area of the i^{th} degree

A_T = total area

n_i = number of tows in the i^{th} stratum

h = number of strata

The standard error of the mean catch was then used to calculate the percent error.

$$\text{Percent Error} = \frac{SE_T \times 100}{C_T}$$

Where SE_T = standard error of the mean catch

C_T = mean catch

King crab are reported in numbers per station.

Station Data

The captain recorded information on trawl location (starting and ending locations in both latitude-longitude and loran), depth (maximum, minimum, and average), time haul started, time haul ended, elapsed time, scope (length of trawl cable out during trawling), performance, trawling speed, trawling direction, date, distance towed, cloud cover, sea state, swell height, and comments. The haul was considered to start when the brake was set on the net, and it ended when the winches were started for retrieval.

RESULTS AND DISCUSSION

The 1986 survey consisted of 28 tows in the North Mainland, 24 tows on the Westside, and 27 tows in the Eastside-Barnabas Section for a total of 79 successful tows in 20 fishing days. A total of 14,241 Tanner crab were captured ranging from 6 to 184 mm carapace width (Figure 3). Only 20 red king crab were captured on the entire survey. Collection and catch data for Tanner crab and trawling records are presented in Appendix A and B, respectively.

Since only one tow was made at each station, analysis of within-station variations in catch per unit effort were not possible. However, catches at individual stations were lumped within strata before calculating population estimates to reduce variability, and the calculated abundance should reflect the actual abundance.

North Mainland Survey Area

Tanner Crab

A total of 5,078 Tanner crab were captured in the North Mainland Survey Area, of which 2,129 (42%) were female. All 28 tows captured Tanner crab,

and tow-catches ranged from 1 to 1,038 crab. Figures 4 and 5 depict the catch of sublegal and legal males and the catch of juvenile and adult females, respectively. The highest catches of legal and sublegal males were 42 (Station 9) and 891 (Station 21), respectively. The highest catches of adult and juvenile females were 356 (Station 3) and 128 (Station 21), respectively.

The most abundant size groups of males were prerecruit II's and III's (Table 1). Figure 6 and 7 depict the size frequency of captured males and females.

Prerecruit males were five times more abundant than legal males. Eighty-two percent of all males captured were new shell, 12% were old shell, 0.04% were very old shell, and 0.02% were recently molted.

Of the legals captured 63% were postrecruit crab. This suggests that the fishable population of the North Mainland Stock is composed of several year classes.

Westside Survey Area

Tanner Crab

A total of 3,130 Tanner crab were captured in the Westside Survey Area, of which 969 (31%) were females. All 24 tows captured Tanner crab and tow catches ranged from 5 to 621 crab. Figures 4 and 5 depict the catch of sublegal and legal males and the catch of juvenile and adult females, respectively. The highest catch of both legal (52) and sublegal (504) males occurred at Station 55. The largest catch of adult (56) and juvenile females (98) were at Stations 54 and 40, respectively.

Prerecruit IV's were the most abundant male size cohort group comprising 37% of the catch (Table 2). Nearly 91% of all males captured were new shell, 3.9% were old shell, 3.6% were soft shell, and 2.1% were very old shell. Figures 6 and 7 depict the size frequency of captured males and females. The legal population was comprised of 32% postrecruits and 68% recruits.

Eastside-Barnabas Survey Area

Tanner Crab

A total of 6,033 Tanner crab were captured in 27 tows in the Eastside-Barnabas Survey Area. Forty-eight percent of the catch was female crab and, of these, 56% were juvenile. Twenty-six of 27 tows captured Tanner crab with a high catch of 2,586 crab. Figures 8 and 9 depict the catch of sublegal and legal males and the catch of juvenile and adult females, respectively. The largest catch of legal crab (146) occurred at Station 18. The largest catch of sublegal male crab was 1,446 in Sitkalidak Bay and the majority of these animals (56%) were prerecruit III's. This same tow captured 39% (1,140) of all females.

Seventy-six percent of all males captured were sublegal and, of these, prerecruit III's were the most abundant cohort (42%). Recruit legals composed 47% of the total legal catch.

New-shell males comprised 81.5% of the male catch followed by old shells (16.2%), soft shell (2.0%), and very old-shell crab (0.3%). Figures 6 and 7 depict the size frequency of captured males and females.

Table 3 presents the number and percent of male Tanner crab measured by cohort group and exoskeletal age.

Tanner Crab Population Estimates

Population estimates by cohort groups are presented by survey area on Table 4.

The estimated population of Tanner crab in the North Mainland Survey Area was 18.7 million crab of which 10.9 million were males and 7.8 million were females.

The Westside Survey Area population estimate was 9.2 million crab, 6.2 million of which were males. Prerecruit IV's were the most abundant male group (2 million), while juvenile females were more abundant than all other adult groups by a factor of 3 to 1.

The Eastside-Barnabas Survey Area produced an estimate of 12.8 million crab. Females (7.0 million) were more abundant than males (5.8 million), and prerecruit III's were the most abundant group of male crab.

In terms of number of animals per km², the North Mainland Survey Area produced 16,266, the Westside 9,420 followed by the Eastside-Barnabas with 4,790.

Female Tanner Crab Shell Age and Ovigerity

Very old-shell crabs were the most numerous among adult females, followed by old-shell and then new-shell crabs (Figure 10A). Reproductive success appeared high as most adult females were carrying egg clutches estimated at either 75 or 100% capacity (10B).

Red King Crab

A total of 10 female and 10 male red king crab were captured on the entire survey. The females were comprised of 3 juveniles and 7 adults. Eight of the males were legal size (Tables 5 and 6).

LITERATURE CITED

- ADF&G (Alaska Department of Fish and Game). In press. Commercial shellfish regulations 1987 edition. Alaska Department of Fish and Game, Division of Commercial Fisheries, Juneau.
- Colgate, W. and D.M. Hicks. 1982. Investigations and life history and fishery for Tanner crab (*Chionoecetes bairdi*) in Alaska. Alaska Department of Fish and Game Report, Division of Commercial Fisheries, Project No. 5-47-R, Kodiak.

TABLES AND FIGURES

Table 1. Number and percent of male Tanner crab, *Chionoecetes bairdi*, measured by cohort group and exoskeletal age in the North Mainland Area, 1986 trawl survey, Kodiak, Alaska.

Group	Soft-shell		New-shell		Old-shell		Very old-shell		Total
	No.	%	No.	%	No.	%	No.	%	
Prerecruit IV's	12	3.0	354	95.0	8	2.0	0	0	374
Prerecruit III's	17	3.5	442	92.0	22	4.5	0	0	481
Prerecruit II's	16	2.9	471	85.5	46	8.3	18	3.3	551
Prerecruit I's	0	0	214	54.0	121	30.0	64	16.0	399
Recruit Legals	0	0	126	100.0	N.A.		N.A.		126
Postrecruit Legals	0	0	152	71.0	55	26.0	6	3.0	213
Total Legals	0	0	278	82.0	55	16.0	6	2.0	339
Total Males	45	2.0	1,759	82.0	252	12.0	88	4.0	2,144

N.A. = Not applicable

Table 2. Number and percent of male Tanner crab, *Chionoecetes bairdi*, measured by cohort group and exoskeletal age in the Westside Area, 1986 trawl survey, Kodiak, Alaska.

Group	Soft-shell		New-shell		Old-shell		Very old-shell		Total
	No.	%	No.	%	No.	%	No.	%	
Prerecruit IV's	20	3.4	565	95.4	7	1.2	0	0	592
Prerecruit III's	24	7.6	290	9.2	2	0.6	0	0	316
Prerecruit II's	11	2.7	373	91.9	11	2.7	11	2.7	406
Prerecruit I's	2	0.9	173	79.7	22	10.1	20	9.2	217
Recruit Legals	0	0	50	100.0	N.A.		N.A.		50
Postrecruit Legals	0	0	0	0	20	87.0	3	13.0	23
Total Legals	0	0	50	68.5	20	27.4	3	4.1	73
Total Males	57	3.6	1,451	90.5	62	3.9	34	2.1	1,604

N.A. = Not applicable

Table 3. Number and percent of male Tanner crab, *Chionoecetes bairdi*, measured by cohort group and exoskeletal age in the Eastside-Barnabas Area, 1986 trawl survey, Kodiak, Alaska.

Group	<u>Soft-shell</u>		<u>New-shell</u>		<u>Old-shell</u>		<u>Very old-shell</u>		Total
	No.	%	No.	%	No.	%	No.	%	
Prerecruit IV's	11	2.7	393	97.3	0	0	0	0	404
Prerecruit III's	13	2.7	474	96.7	3	0.6	0	0	490
Prerecruit II's	10	4.3	206	88.0	17	7.3	1	0.4	234
Prerecruit I's	1	0.7	42	27.5	106	69.3	4	2.6	153
Recruit Legals	0	0	202	100.0	N.A.		N.A.		202
Postrecruit Legals	0	0	80	34.5	151	65.1	1	0.4	232
Total Legals	0	0	282	65.0	151	34.8	1	0.2	434
Total Males	35	2.0	1,397	81.5	277	16.2	6	0.3	1,715

N.A. = Not applicable

Table 4. Population estimates and standard error for Tanner crab, *Chionoecetes bairdi*, from the 1986 trawl survey, Kodiak, Alaska.

Group	Numbers of Crabs ($\times 10^6$) + SE (%)		
	North Mainland	Westside	Eastside-Barnabas
Juvenile Females	2.7 ± 28.1	2.2 ± 18.2	2.5 ± 17.4
Adult Females	5.1 ± 28.2	0.7 ± 34.3	4.5 ± 71.9
Total Females	7.8 ± 21.2	3.0 ± 17.1	7.0 ± 46.8
Prerecruit IV's	1.5 ± 24.3	2.0 ± 20.5	1.4 ± 28.2
Prerecruit III's	3.1 ± 54.7	1.2 ± 31.8	1.6 ± 11.0
Prerecruit II's	3.8 ± 45.6	1.7 ± 46.3	0.9 ± 11.1
Prerecruit I's	1.7 ± 24.3	0.9 ± 53.0	0.5 ± 44.6
Recruit Legals	0.5 ± 22.7	0.2 ± 62.6	0.5 ± 42.5
Postrecruit Legals < 165	0.2 ± 24.2	0.08 ± 40.3	0.5 ± 54.0
> 164	0.1 ± 47.6	0.006 ± 68.3	0.3 ± 43.7
Total Legals	0.8 ± 20.4	0.4 ± 48.2	1.4 ± 44.3
Total Males	10.9 ± 33.0	6.2 ± 27.4	5.8 ± 13.8
Total Crabs	18.7 ± 24.5	9.1 ± 22.1	12.8 ± 28.9

Table 5. Male red king crab, *Paralithodes camtschatica*, captured during the 1986 Kodiak trawl survey.

Station	Tow #	Carapace Length (mm)	Carapace Condition	Comments
5	56	188	3	Legal
5	56	202	3	Legal
5	56	202	3	Legal
Ugak		160	1	Legal
9	47	165	1	Legal
9	47	130	1	Sublegal
9	47	154	1	Legal
9	47	156	1	Legal
9	47	127	1	Sublegal
9	47	150	2	Legal

Table 6. Female king crab, *Paralithodes camtschatica*, captured during the 1986 Kodiak trawl survey.

Station #	Tow #	Carapace Length (mm)	Carapace Condition	Percent Clutch	Egg Devel.	Clutch Condition	Comments
9	47	164	1	75	1	1	
9	47	127	1	100	1	1	
9	47	113	1	100	1	1	
9	47	96	1	-	-	-	Juvenile
9	47	50	1	-	-	-	Juvenile
9	47	145	1	100	1	1	
9	47	103	1	-	-	-	Juvenile
9	47	147	1	100	1	1	
5	56	154	1	15	1	1	
5	56	162	1	0	-	5	

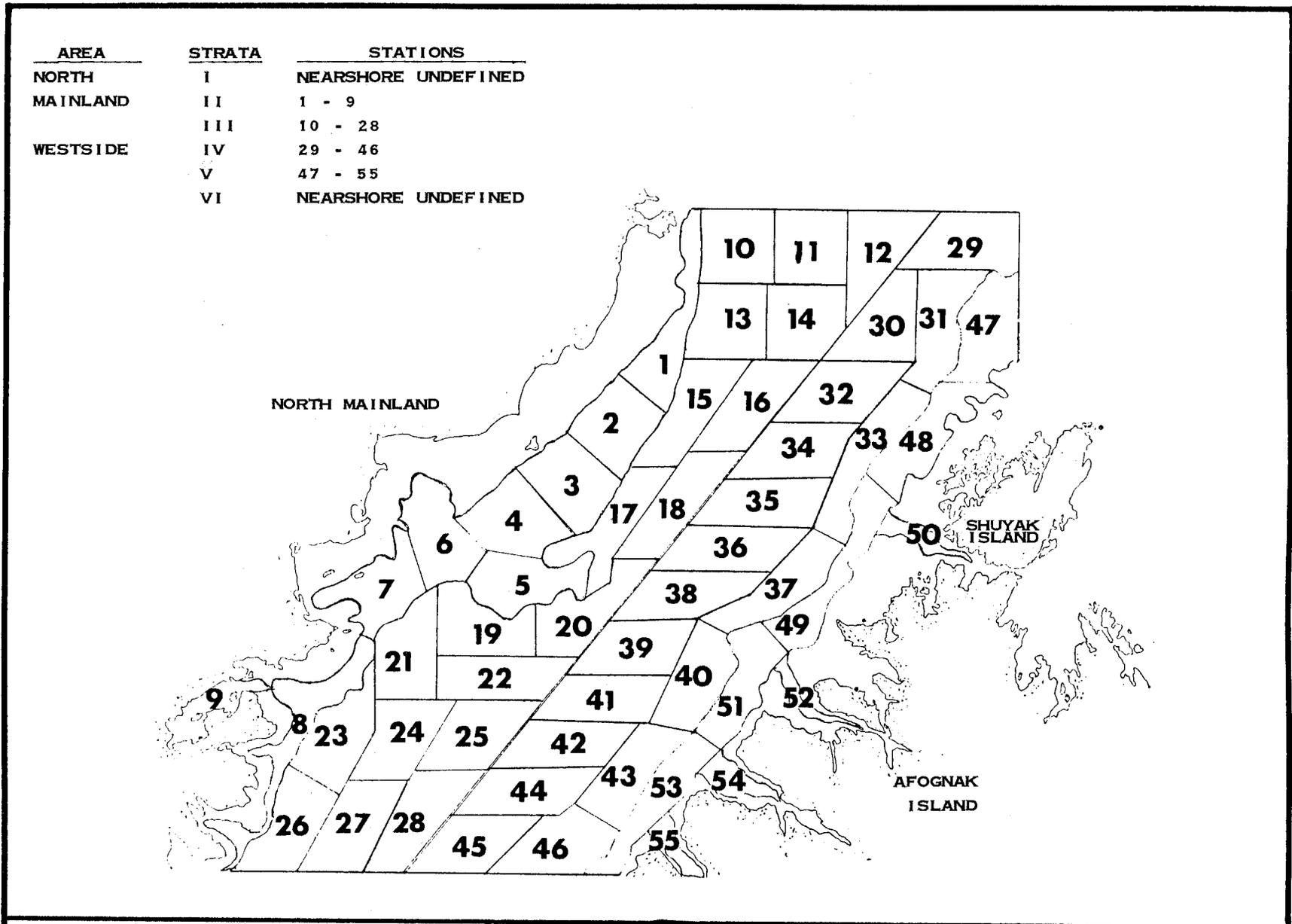


Figure 1. North Mainland and Westside station grid, Kodiak trawl survey, 1986.

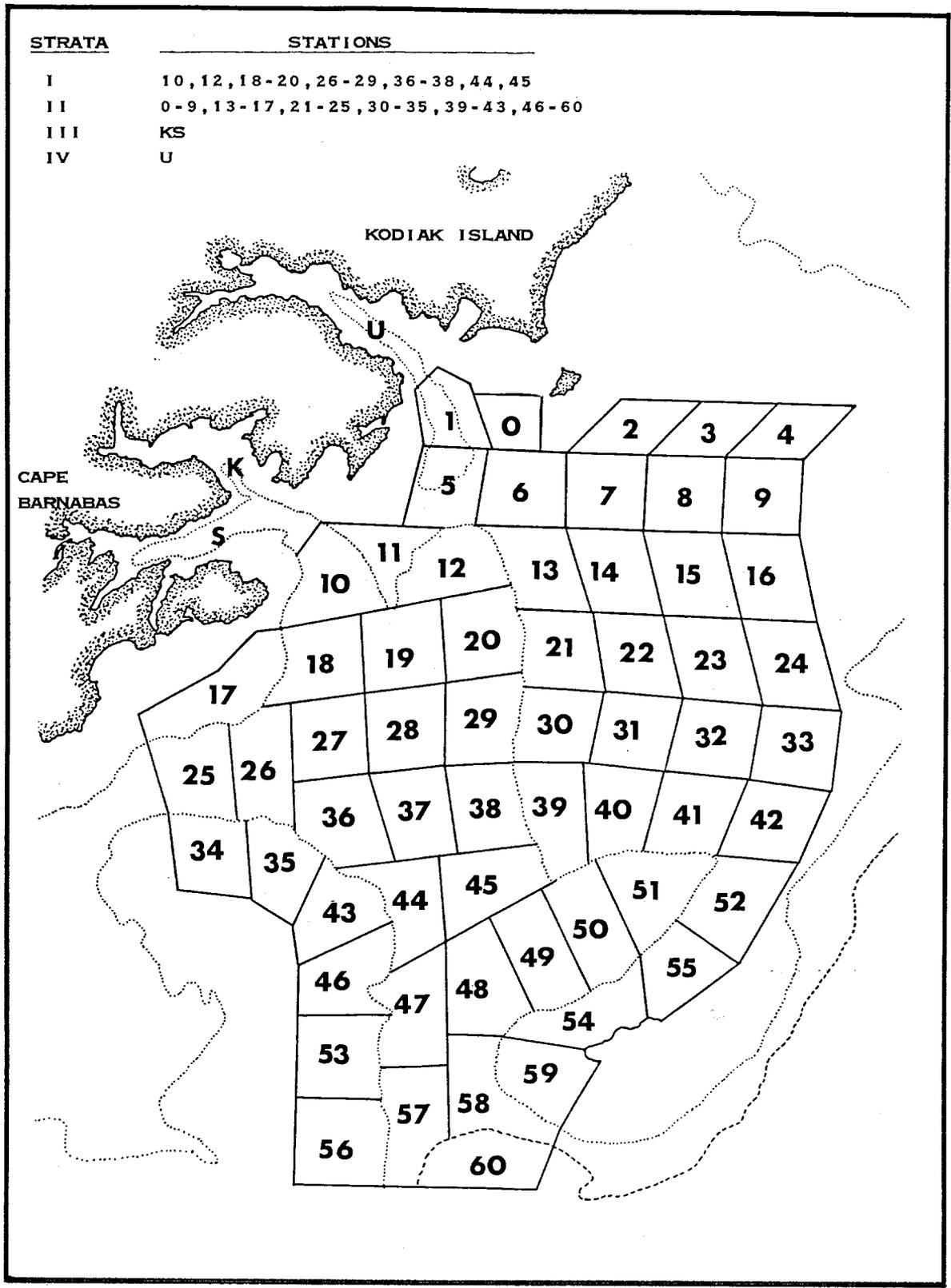


Figure 2. Eastside-Barnabas station grid, Kodiak trawl survey, 1986.

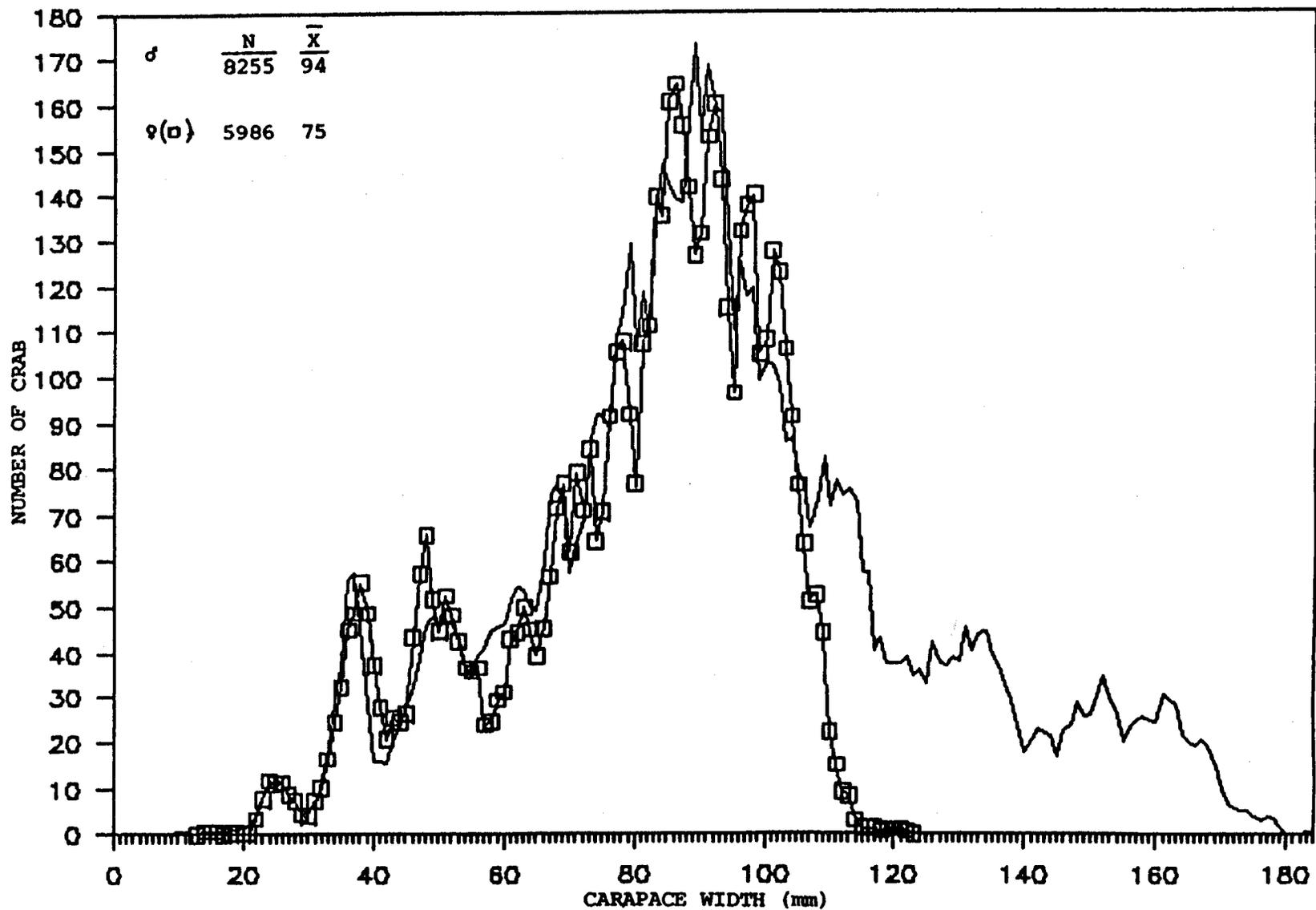


Figure 3. Carapace width frequency of all male and female Tanner crab, *Chionoecetes bairdi*, captured during the Kodiak trawl survey, 1986.

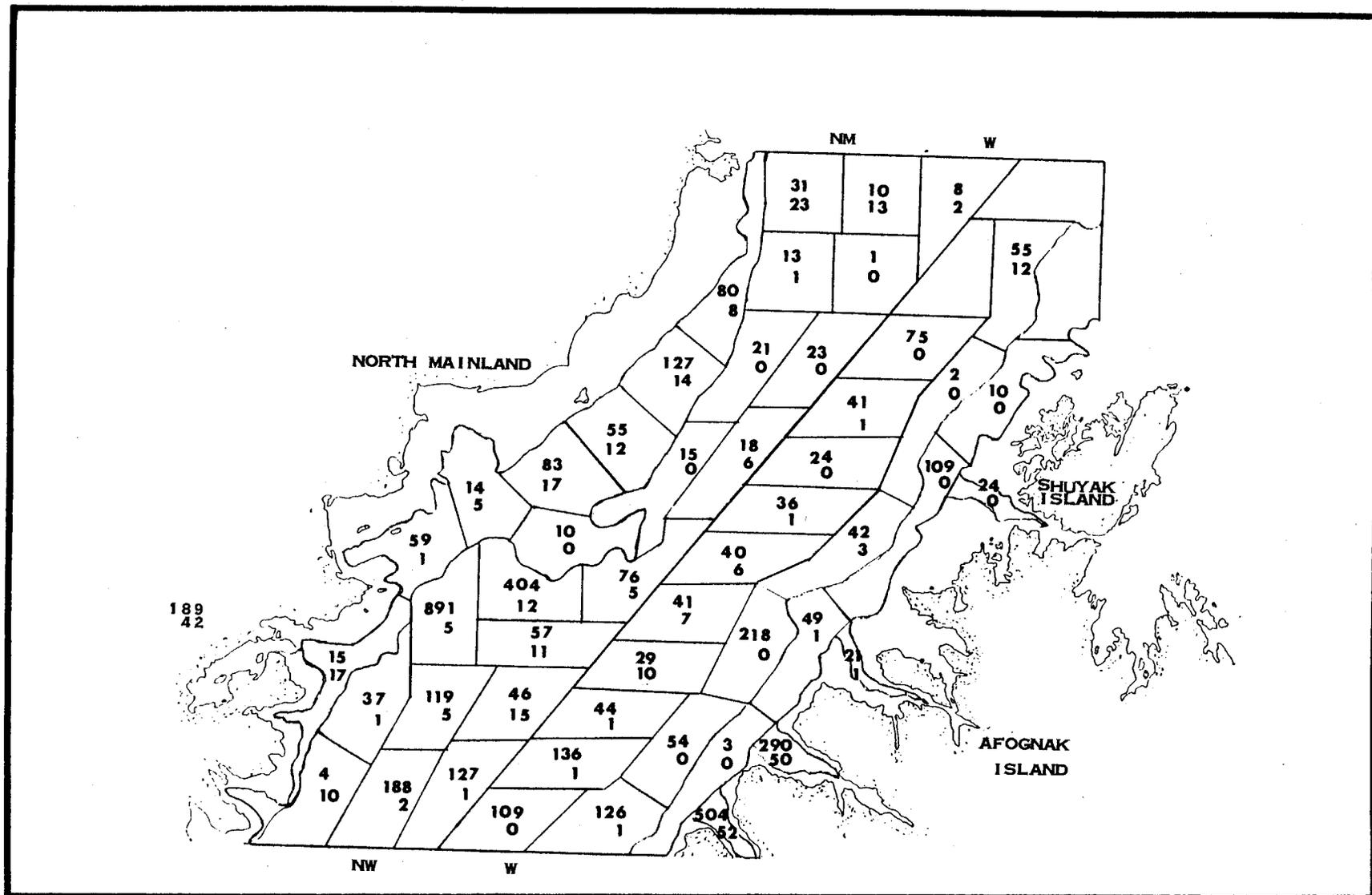
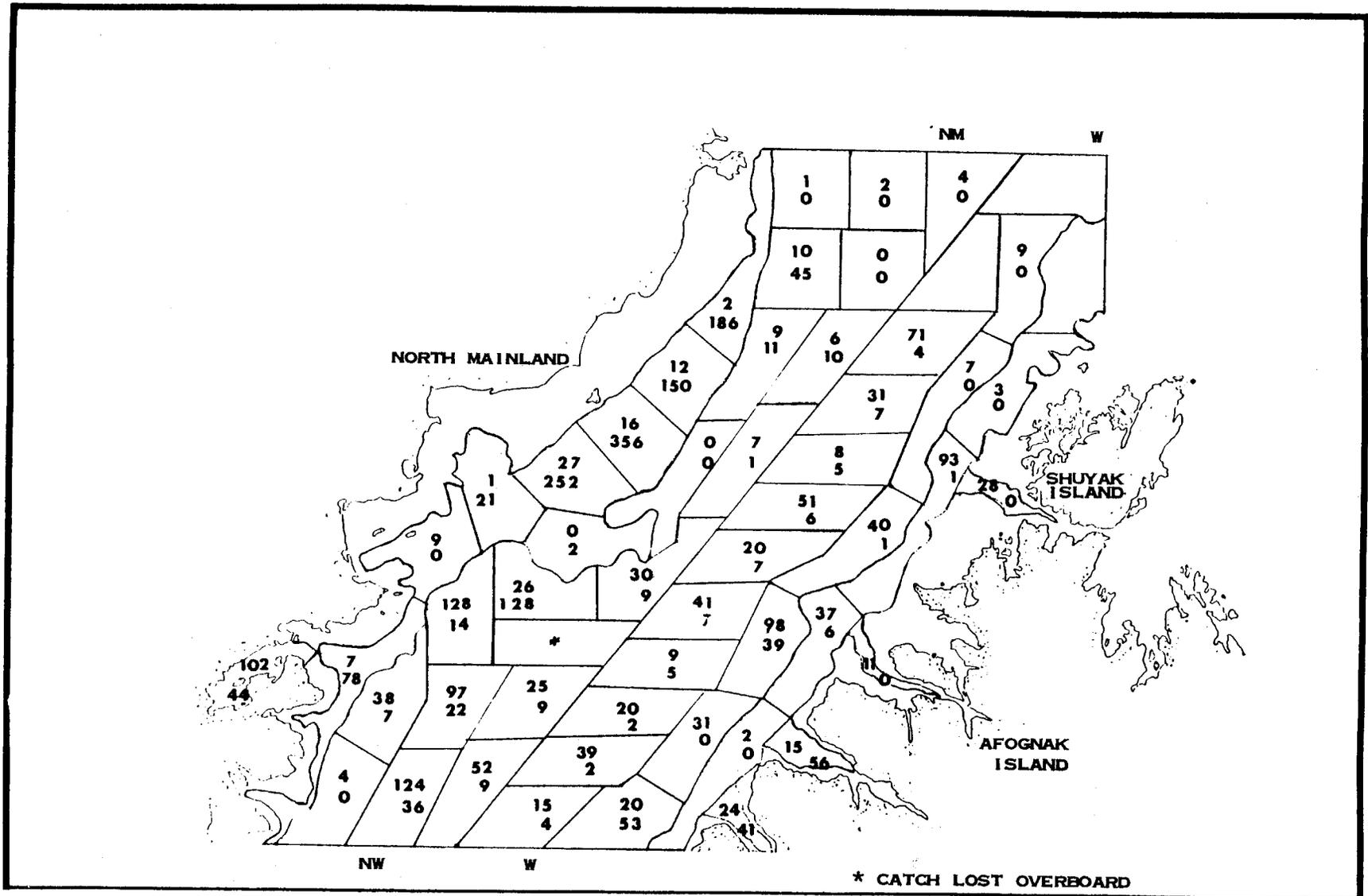


Figure 4. Catch of sublegal (top) and legal male Tanner crab, *Chionoecetes bairdi*, per 1.85 km towed from the North Mainland (NM) and Westside (W) areas, Kodiak trawl survey, 1986.



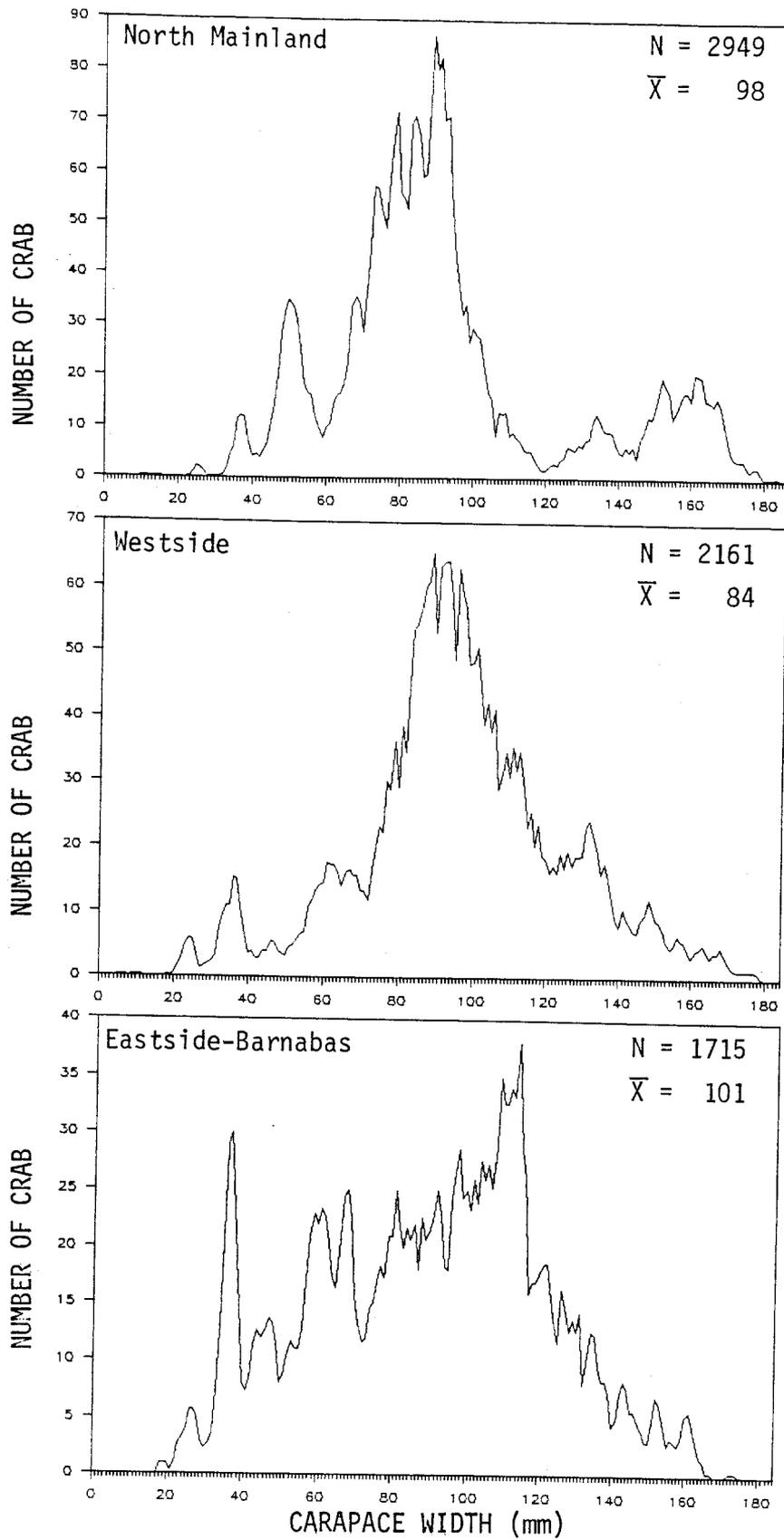


Figure 6. Carapace width frequency of male Tanner crab, *Chionoecetes bairdi*, Kodiak trawl survey, 1986.

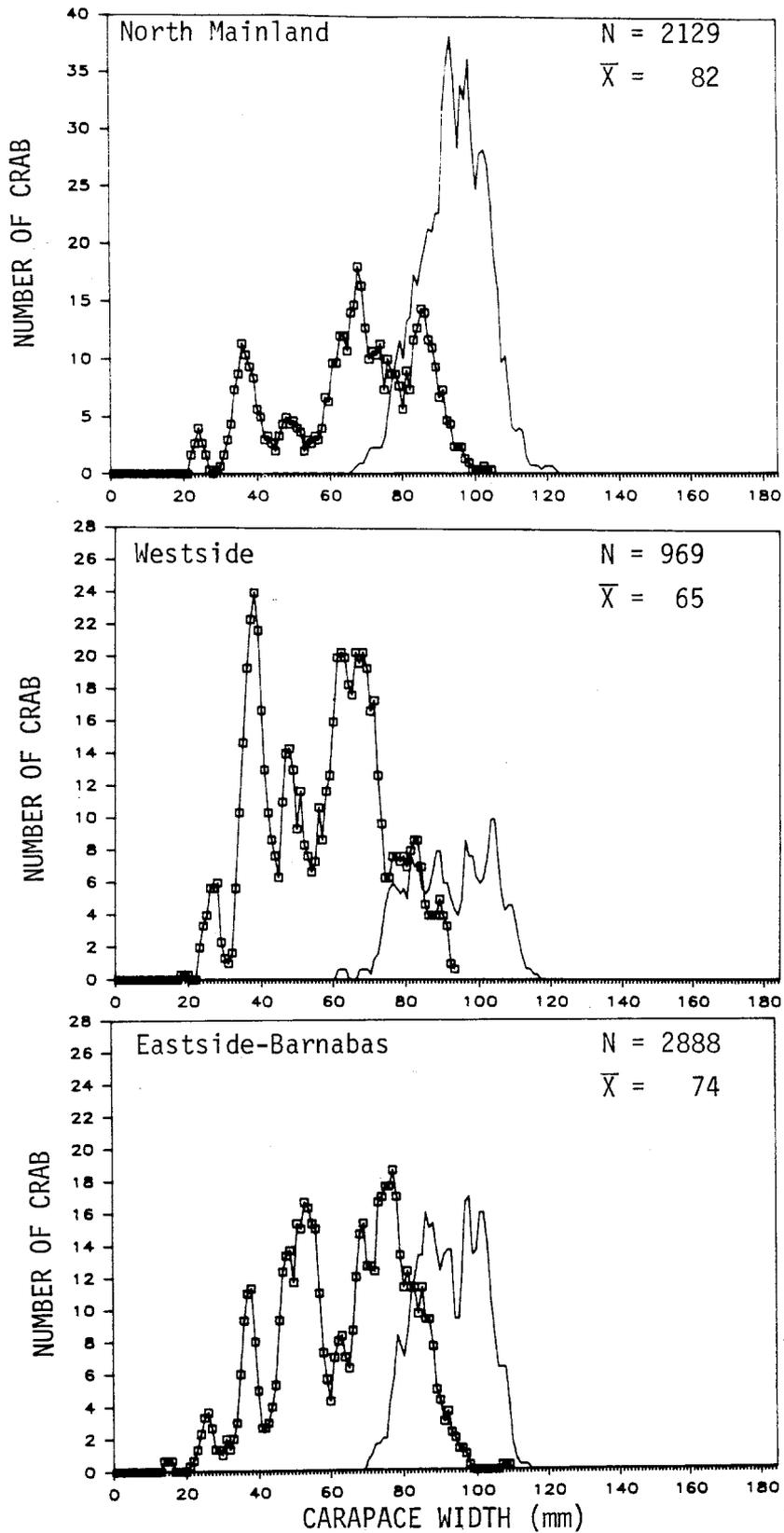


Figure 7. Carapace width frequency of juvenile (\square) and adult female Tanner crab, *Chionoecetes bairdi*, Kodiak trawl survey, 1986.

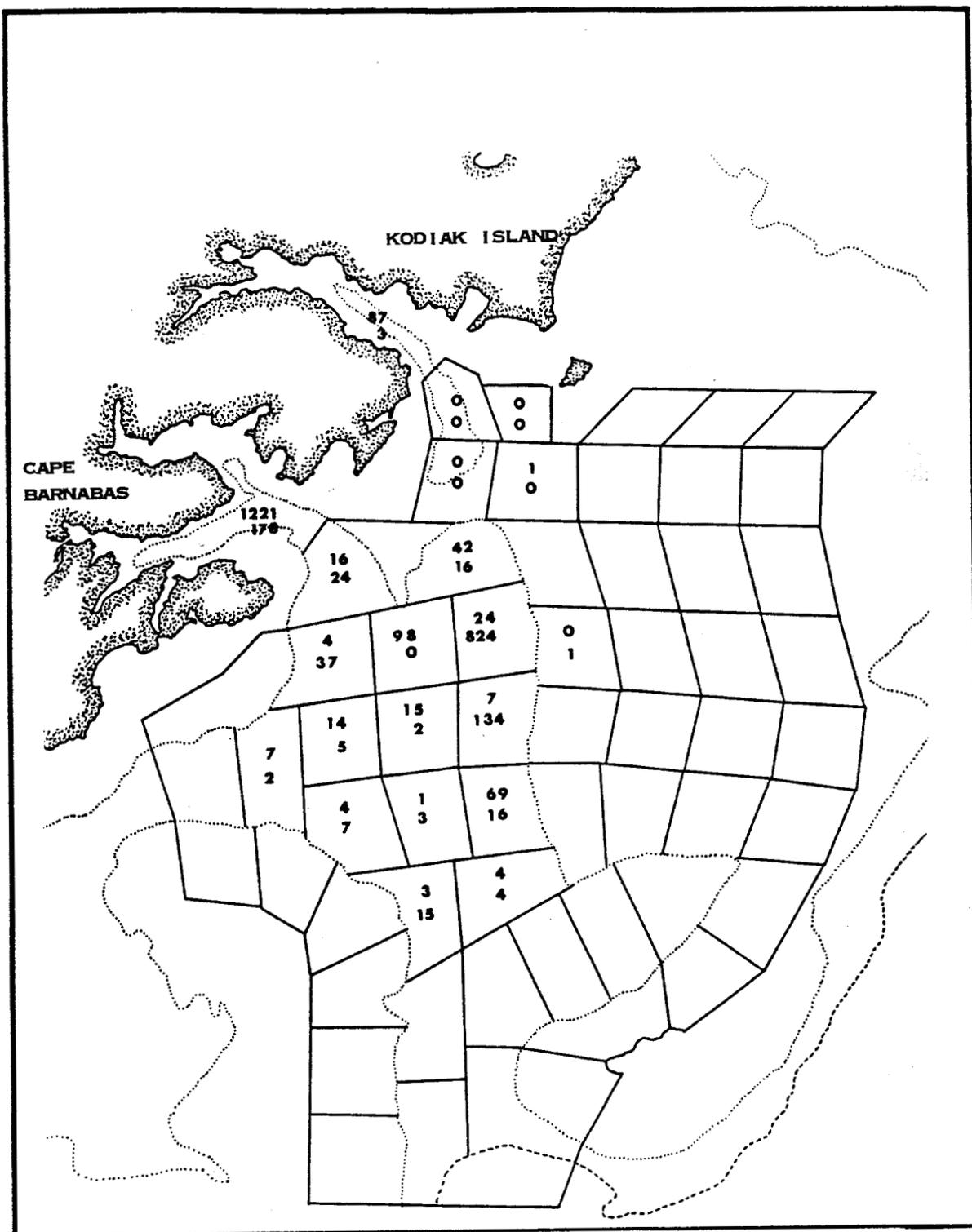


Figure 9. Catch of juvenile (top) and adult female Tanner crab, *Chionoecetes bairdi*, per 1.85 km towed from the Eastside-Barnabas Area, Kodiak trawl survey, 1986.

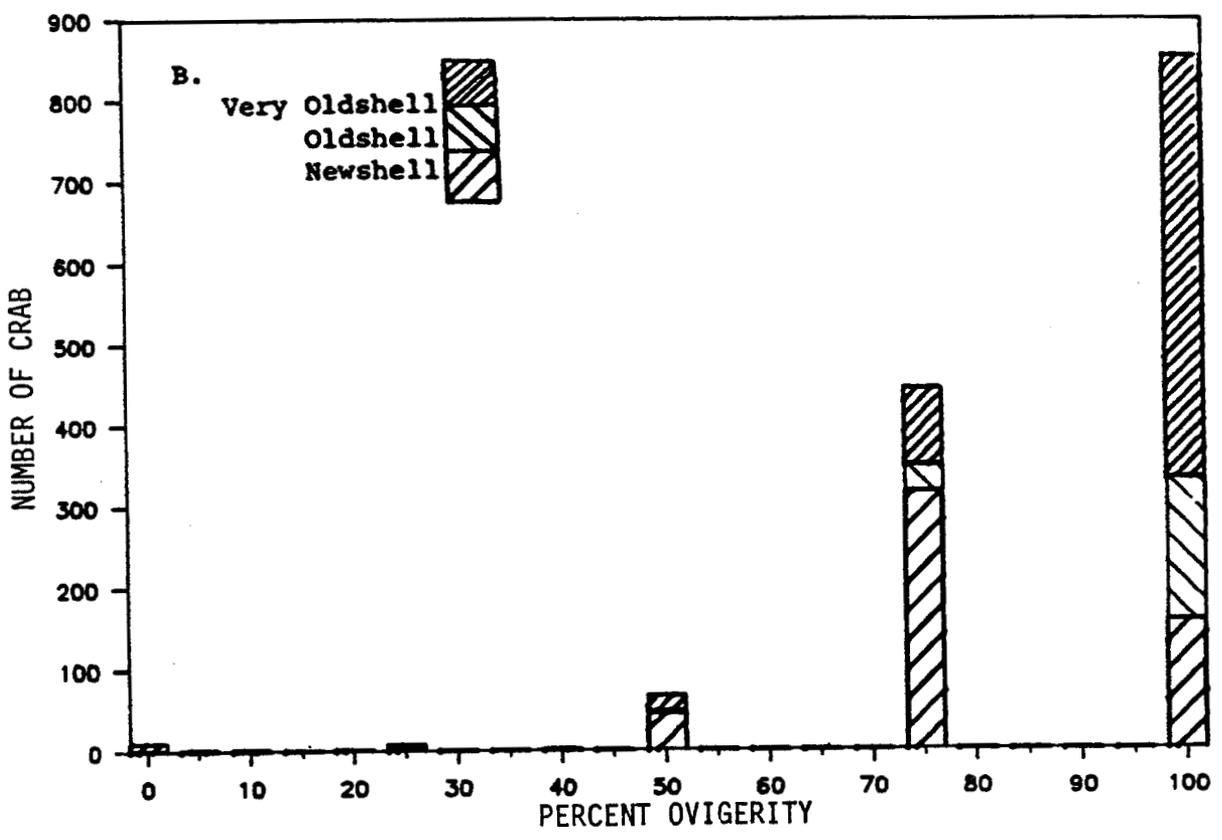
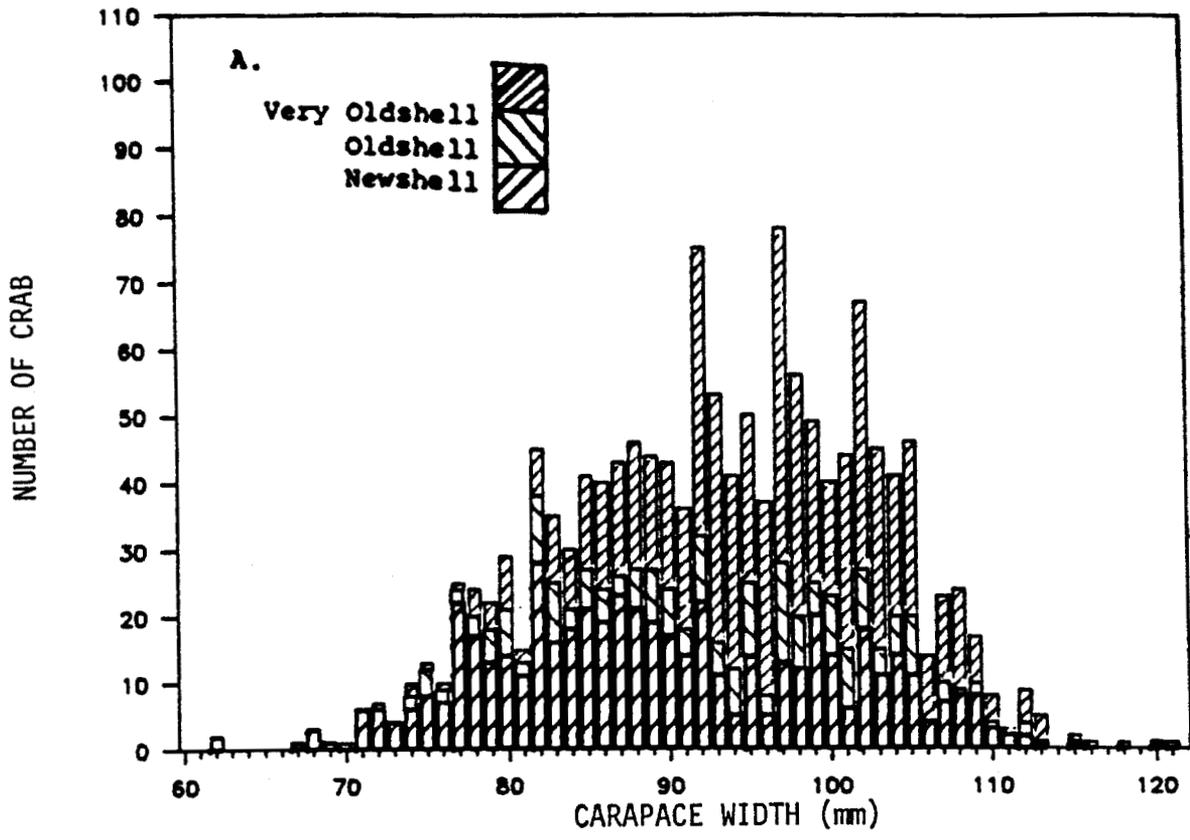


Figure 10. Carapace width frequency by shell age (A) and percent ovigerity by shell age (B) of adult female Tanner crab, *Chionoecetes bairdi*, Kodiak trawl survey, 1986.

APPENDICES

Appendix A. Collection and catch data per 1.85 km towed for Tanner crab, Chionoecetes bairdi, from the Kodiak trawl survey, 1986.

Sta tion	Tow #	Stra tum	-----Females-----			-----Sublegal Males-----				Recruit	-Postrecruit-		Total Legal	Total Male	Total Crab
			Juv	Adult	Total	(70	70-91	92-114	>114		(165	>164			
North Mainland															
5	28	2	0	2	2	1	1	3	5	0	0	0	0	10	12
3	31	2	16	356	372	9	2	9	35	9	4	0	12	67	439
2	32	2	12	150	162	9	41	46	31	7	7	0	14	141	303
1	33	2	2	186	188	4	2	26	48	4	4	0	8	88	276
4	40	2	27	252	279	16	4	20	43	11	4	2	17	100	379
6	41	2	1	21	22	1	0	1	12	4	1	0	5	19	41
7	42	2	9	0	9	1	27	24	7	1	0	0	1	60	69
9	47	2	102	44	146	8	66	75	40	25	1	16	42	231	377
8	48	2	7	78	85	3	1	3	8	14	0	3	17	32	117
#/Tow mi			19.6	125.7	145.3	5.8	16.0	23.6	26.4	8.3	2.4	2.3	13.0	84.8	230.1
Std dev			32.0	128.9	130.7	5.1	23.7	24.6	20.0	7.7	2.6	5.2	12.6	70.7	170.4
16	25	3	6	10	16	2	15	5	1	0	0	0	0	23	39
15	26	3	9	11	20	4	12	5	0	0	0	0	0	21	41
17	27	3	0	0	0	5	9	1	0	0	0	0	0	15	15
20	29	3	30	9	39	50	20	6	0	0	4	1	5	81	120
18	30	3	7	1	8	12	1	1	4	5	0	1	6	24	32
13	34	3	10	45	55	10	0	2	1	0	1	0	1	14	69
14	36	3	0	0	0	1	0	0	0	0	0	0	0	1	1
12	37	3	4	0	4	8	0	0	0	0	2	0	2	10	14
11	38	3	2	0	2	1	1	1	7	4	9	0	13	23	25
10	39	3	1	0	1	3	0	6	22	15	8	0	23	54	55

-continued-

Appendix A. (page 2 of 5)

Sta tion	Tow #	Stra tum	-----Females-----			-----Sublegal Males-----				Recruit	-Postrecruit-		Total Legal	Total Male	Total Crab
			Juv	Adult	Total	(70	70-91	92-114)114		(165)164			
21	43	3	128	14	142	36	444	385	26	0	3	2	5	896	1038
19	44	3	26	128	154	9	21	285	89	11	0	1	12	416	570
22	45	3	0	0	0	12	1	15	29	4	6	1	11	68	68
25	46	3	25	9	34	9	10	16	11	11	3	1	15	61	95
23	49	3	38	7	45	21	12	3	1	0	1	0	1	38	83
26	50	3	4	0	4	1	0	1	2	8	0	2	10	14	18
27	51	3	124	36	160	78	46	37	27	0	1	1	2	190	350
24	52	3	97	22	119	49	37	31	2	4	0	1	5	124	243
28	53	3	52	9	61	44	55	22	6	0	0	1	1	128	189
#/Tow mi			29.3	16.1	45.4	18.2	35.5	43.0	11.7	3.1	1.9	0.6	5.6	114.1	159.5
Std dev			41.7	30.7	56.6	21.8	100.3	104.8	21.1	4.5	2.6	0.7	6.1	212.9	256.2
Mean			26.4	49.4	75.8	14.5	29.6	37.1	16.2	4.7	2.0	1.1	7.9	105.2	181.0
Std Err			7.4	13.9	16.0	3.5	16.2	16.9	3.9	1.1	0.5	0.5	1.6	34.7	44.4
% Err			28.1	28.2	21.2	24.3	54.7	45.6	24.3	22.7	24.2	47.6	20.4	33.0	24.5
Pop Est			2,724,955	5,108,736	7,833,690	1,495,385	3,057,764	3,836,570	1,671,087	484,600	210,019	117,709	812,336	10,873,000	18,707,000
Westside															
46	1	4	20	53	73	16	23	70	17	1	0	0	1	127	200
45	2	4	15	4	19	9	60	30	10	0	0	0	0	109	128
44	3	4	39	2	41	22	66	46	2	1	0	0	1	137	178
42	4	4	20	2	22	12	21	10	1	0	1	0	1	45	67
43	5	4	31	0	31	31	15	8	0	0	0	0	0	54	85

-continued-

Appendix A. (page 3 of 5)

Sta tion	Tow #	Stra tum	-----Females-----			-----Sublegal Males-----				Recruit	-Postrecruit-		Total Legal	Total Male	Total Crab
			Juv	Adult	Total	(70	70-91	92-114	>114		(165	>164			
40	8	4	98	39	137	88	72	54	4	0	0	0	0	218	355
41	10	4	9	5	14	21	0	5	3	0	9	1	10	39	53
39	11	4	41	7	48	32	1	2	6	2	5	0	7	48	96
38	12	4	20	7	27	32	0	2	6	0	5	1	6	46	73
36	13	4	51	6	57	28	1	3	4	0	1	0	1	37	94
37	14	4	40	1	41	31	4	0	7	0	3	0	3	45	86
35	18	4	8	5	13	16	4	0	0	0	0	0	0	20	33
34	19	4	31	7	38	33	4	4	0	0	1	0	1	42	80
32	20	4	71	4	75	68	5	2	0	0	0	0	0	75	150
31	21	4	9	0	9	3	0	0	0	0	0	0	0	3	12
33	24	4	7	0	7	2	0	0	0	0	0	0	0	2	9
#/Tow mi			28.7	7.5	36.2	24.9	14.0	12.1	3.1	0.2	1.3	0.1	1.6	55.7	91.9
Std dev			23.4	12.4	29.3	21.3	20.1	18.5	3.8	0.5	2.2	0.3	2.5	46.4	72.0
55	6	5	24	41	65	2	84	270	148	52	0	0	52	556	621
53	7	5	2	0	2	0	1	2	0	0	0	0	0	3	5
54	9	5	15	56	71	4	32	108	146	50	0	0	50	340	411
51	15	5	37	6	43	34	9	5	1	1	0	0	1	50	93
52	16	5	11	0	11	16	4	1	0	0	1	0	1	22	33
49	17	5	93	1	94	106	3	0	0	0	0	0	0	109	203
50	22	5	28	0	28	24	0	0	0	0	0	0	0	24	52
48	23	5	3	0	3	9	1	0	0	0	0	0	0	10	13
#/Tow mi			29.1	14.3	43.4	26.2	19.4	56.7	41.5	14.5	0.1	0.0	14.6	158.5	201.9
Std dev			32.7	24.4	38.6	38.9	36.1	119.4	77.2	26.8	0.4	0.0	26.8	243.8	269.8

-continued-

Appendix A. (page 4 of 5)

Sta tion	Tow #	Stra tum	-----Females-----			-----Sublegal Males-----				Recruit	-Postrecruit-		Total Legal	Total Male	Total Crab
			Juv	Adult	Total	<70	70-91	92-114	>114		(165)164			
Mean			28.8	9.1	37.8	25.2	15.3	22.3	11.9	3.5	1.0	0.1	4.6	79.3	117.1
Std Err			5.2	3.1	6.5	5.2	4.9	10.3	6.3	2.2	0.4	0.1	2.2	21.7	25.9
% Err			18.2	34.3	17.1	20.5	31.8	46.3	53.0	62.6	40.3	68.3	48.2	27.4	22.1
Pop Est			2,245,067	706,476	2,951,545	1,966,001	1,190,746	1,739,876	928,038	271,290	81,803	6,266	359,358	6,184,021	9,135,570
East Side															
10	67	1	16	24	40	10	0	1	7	3	0	0	19	37	77
18	68	1	4	37	41	6	2	7	18	38	72	36	146	179	220
27	69	1	14	5	19	19	2	5	1	0	0	0	0	27	46
26	70	1	7	2	9	6	5	2	3	0	2	0	2	18	27
36	71	1	4	7	11	2	5	1	1	0	3	2	5	14	25
44	72	1	3	15	18	5	9	20	3	0	1	1	2	39	57
45	73	1	4	4	8	3	1	2	0	0	0	0	0	6	14
38	74	1	69	16	85	49	45	16	2	0	2	2	4	116	201
19	75	1	98	0	98	94	19	4	0	0	0	0	0	117	215
28	76	1	15	2	17	25	15	18	0	0	0	0	0	58	75
37	77	1	1	3	4	3	1	1	4	2	20	3	25	34	38
12	79	1	42	16	58	24	12	10	3	2	2	6	10	59	117
20	80	1	24	824	848	0	0	12	56	38	16	8	62	130	978
29	81	1	7	134	141	5	6	5	14	0	3	0	3	33	174
#/Tow mi			22.0	77.8	99.8	17.9	8.7	7.4	8.0	5.9	9.2	4.7	19.9	61.9	161.7
Std dev			28.8	217.5	219.1	25.6	12.0	6.7	14.8	13.6	19.1	9.5	40.0	52.4	246.4

-continued-

Appendix A. (page 5 of 5)

Sta tion	Tow #	Stra tum	-----Females-----			-----Sublegal Males-----				Recruit	-Postrecruit-		Total Legal	Total Male	Total Crab
			Juv	Adult	Total	(70	70-91	92-114	>114		(165	>164			
0	54	2	0	0	0	0	0	0	0	0	0	0	0	0	0
6	55	2	1	0	1	0	0	0	0	0	0	0	0	0	1
5	56	2	0	0	0	0	0	0	16	7	5	5	17	33	33
1	57	2	0	0	0	1	1	0	2	24	0	16	40	44	44
21	78	2	0	1	1	2	0	0	0	0	0	0	0	2	3
#/Tow mi			0.2	0.2	0.4	0.6	0.2	0.0	3.6	6.2	1.0	4.2	11.4	15.8	16.2
Std dev			0.4	0.4	0.5	0.9	0.4	0.0	7.0	10.4	2.2	6.9	17.6	21.1	20.8
62	62	3	10	0	10	3	0	1	0	0	0	0	0	4	14
62	63	3	77	6	83	22	28	17	4	3	0	1	4	75	158
62	64	3	164	2	166	82	320	44	4	0	0	0	0	450	616
62	65	3	970	170	1140	210	810	426	0	0	0	0	0	1,446	2586
#/Tow mi			305.3	44.5	349.8	79.3	289.5	122.0	2.0	0.8	0.0	0.3	1.0	493.8	843.5
61	58	4	37	0	37	20	12	3	1	78	0	17	95	131	168
61	59	4	6	0	6	2	0	0	0	3	1	0	4	6	12
61	60	4	7	0	7	10	0	0	0	0	0	0	0	10	17
61	61	4	37	3	40	17	32	16	4	7	0	1	8	77	117
#/Tow mi			21.8	0.8	22.5	12.3	11.0	4.8	1.3	22.0	0.3	4.5	26.8	56.0	78.5
Mean			32.1	58.8	90.9	17.6	21.2	11.6	6.6	6.5	6.9	4.4	17.8	74.8	165.8
Std Err			5.6	42.2	42.6	5.0	2.3	1.3	2.9	2.8	3.7	1.9	7.9	10.3	47.9
% Err			17.4	71.9	46.8	28.2	11.0	11.1	44.6	42.5	54.0	43.7	44.3	13.8	28.9
Pop Est			2,477,334	4,533,562	7,010,895	1,360,253	1,632,182	897,623	509,153	502,150	530,780	338,804	1,371,735	5,770,946	12,782,000

Appendix B. Trawling record for the Kodiak trawl survey, 1986.

Tow #	Station #	---Date---			Starting Position		Compass Heading	--Tow---		Fathoms	
		---	---	---	Loran C			Min	Km	Min	Max
1	46	10	14	86	32255.2	43575.9	65	30	2.2	115	115
2	45	10	14	86	32258.7	43625.3	200	33	2.8	105	105
3	44	10	14	86	32249.5	43628.7	25	30	2.2	100	101
4	42	10	14	86	32231.2	43625.9	15	30	2.0	95	96
5	43	10	14	86	32222.0	43568.2	10	30	2.2	104	104
6	55	10	15	86	32233.3	43487.0	308	30	1.5	54	61
7	53	10	15	86	32212.6	43535.2	10	30	1.7	81	87
8	40	10	15	86	32190.4	43543.5	10	32	2.2	120	124
9	54	10	15	86	32197.2	43478.8	255	30	1.9	63	69
10	41	10	16	86	32196.2	43607.6	10	30	2.2	89	90
11	39	10	16	86	32177.9	43601.0	5	30	2.4	92	92
12	38	10	16	86	32158.6	43601.9	360	30	2.2	94	95
13	36	10	16	86	32138.1	43601.9	5	30	2.0	94	95
14	37	10	16	86	32125.4	43548.0	180	31	1.9	97	102
15	51	10	16	86	32139.1	43529.9	195	30	1.9	102	105
16	52	10	17	86	32158.6	43450.7	260	30	1.9	47	50
17	49	10	17	86	32138.4	43524.0	15	30	1.7	99	105
18	35	10	17	86	32114.3	43571.6	15	30	1.9	87	88
19	34	10	17	86	32094.5	43578.1	15	30	2.2	85	85
20	32	10	17	86	32068.4	43579.6	15	30	1.7	86	86
21	31	10	17	86	32036.0	43560.3	15	30	1.3	102	102
22	50	10	18	86	32084.2	43468.1	295	30	1.7	79	97
23	48	10	19	86	32077.0	43540.4	5	30	1.9	110	113
24	33	10	19	86	32075.2	43547.9	185	30	2.0	113	115
25	16	10	20	86	32082.9	43630.3	355	30	2.0	92	94
26	15	10	21	86	32086.0	43660.4	190	30	3.0	88	90
27	17	10	21	86	32111.2	43667.2	200	30	2.2	80	83
28	5	10	21	86	32158.4	43698.6	250	30	2.8	76	78
29	20	10	21	86	32170.5	43657.1	110	30	2.0	102	110
30	18	10	21	86	32137.4	43631.4	15	30	2.0	83	84
31	3	10	22	86	32132.5	43727.9	75	30	1.9	51	55
32	2	10	22	86	32111.0	43709.2	30	30	1.9	52	53
33	1	10	22	86	32080.9	43691.2	25	30	1.5	59	62
34	13	10	22	86	32064.8	43681.1	355	30	1.5	81	83
36	14	10	23	86	32022.3	43637.9	360	25	1.3	88	89
37	12	10	23	86	31999.5	43628.5	10	30	2.4	88	89
38	11	10	23	86	32002.2	43654.5	255	30	2.0	82	83
39	10	10	23	86	32011.1	43688.8	260	30	2.0	88	89
40	4	10	24	86	32142.2	43731.6	190	30	1.9	57	60
41	6	10	24	86	32164.0	43746.2	215	30	2.2	60	63
42	7	10	24	86	32201.6	43822.8	35	28	1.9	50	56
43	21	10	24	86	32200.0	43750.8	195	30	1.9	104	112

-continued-

Appendix B. (page 2 of 2)

Tow #	Station #	---Date---			Starting Position Loran C		Compass Heading	--Tow---		Fathoms	
							Min	Km	Min	Max	
44	19	10	24	86	32207.0	43729.2	10	32	1.9	100	108
45	22	10	24	86	32212.9	43723.3	180	25	2.0	103	107
46	25	10	24	86	32229.8	43702.5	190	25	1.9	101	103
47	9	10	25	86	32267.2	43883.7	53	25	1.9	57	63
48	8	10	25	86	32251.1	43800.6	170	25	1.9	66	69
49	23	10	25	86	32264.3	43794.9	190	26	1.9	105	108
50	26	10	25	86	32285.5	43800.3	190	24	1.9	100	117
51	27	10	25	86	32288.6	43743.1	350	32	1.9	111	112
52	24	10	25	86	32258.9	43739.3	358	32	1.9	111	112
53	28	10	25	86	32259.3	43700.4	180	28	1.9	105	105
54	0	10	30	86	32382.8	43038.0	130	28	1.9	29	30
55	6	10	30	86	32395.0	43050.9	150	27	1.9	39	40
56	5	10	30	86	32409.7	43083.3	190	27	1.9	51	54
57	1	10	30	86	32401.3	43081.9	340	26	1.9	55	57
58	61	10	31	86	32384.7	43200.8	90	28	1.9	43	45
59	61	10	31	86	32380.5	43150.1	90	28	1.9	49	50
60	61	10	31	86	32384.5	43128.3	120	27	1.9	50	54
61	61	10	31	86	32382.3	43088.7	280	30	1.9	54	56
62	62	11	1	86	32444.5	43242.9	280	32	1.9	45	47
63	62	11	2	86	32463.9	43244.0	85	29	1.9	68	73
64	62	11	2	86	32468.6	43255.5	225	31	1.9	68	71
65	62	11	2	86	32482.9	43299.4	230	31	1.9	68	69
67	10	11	4	86	32457.7	43185.9	110	30	1.9	76	78
68	18	11	4	86	32472.4	43195.8	165	33	1.9	83	86
69	27	11	4	86	32498.1	43218.3	180	25	1.9	81	82
70	26	11	5	86	32516.8	43269.6	160	34	1.9	69	74
71	36	11	5	86	32519.2	43248.4	110	32	1.9	75	78
72	44	11	5	86	32526.5	43241.3	170	34	1.9	75	78
73	45	11	5	86	32519.3	43220.2	80	32	1.9	88	91
74	38	11	5	86	32504.6	43195.2	335	30	1.9	89	95
75	19	11	6	86	32464.5	43176.8	158	37	1.9	87	93
76	28	11	6	86	32489.2	43192.4	115	28	1.9	84	86
77	37	11	6	86	32501.7	43203.4	155	30	1.9	89	90
78	21	11	6	86	32435.5	43090.0	250	31	1.9	41	42
79	12	11	7	86	32434.1	43107.9	180	32	1.9	69	72
80	20	11	7	86	32443.6	43121.1	165	33	1.9	74	75
81	29	11	7	86	32468.0	43153.8	270	27	1.9	75	79

Because the Alaska Department of Fish and Game receives federal funding, all of its public programs and activities are operated free from discrimination on the basis of race, color, national origin, age, or handicap. Any person who believes he or she has been discriminated against should write to:

O.E.O.
U.S. Department of the Interior
Washington, D.C. 20240