



INVESTIGATIONS OF LIFE HISTORY AND FISHERY FOR TANNER CRAB  
(Chionoecetes bairdi) IN THE WESTWARD REGION, ALASKA, 1982

By:  
William A. Colgate  
and  
David M. Hicks

September 1983

## ADF&G TECHNICAL DATA REPORTS

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The primary purpose of these reports is presentation of data. Description of programs and data collection methods is included only to the extent required for interpretation of the data. Analysis is generally limited to that necessary for clarification of data collection methods and interpretation of the basic data. No attempt is made in these reports to present analysis of the data relative to its ultimate or intended use.

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## ABSTRACT

A pilot trawl survey program, initiated in 1980 to assess Tanner crab, *Chionoecetes bairdi*, populations continued during 1982. Surveys were completed in the North Mainland fishing section of the Kodiak Management District and in the Chignik Management District. Sampling effort was equal to or higher than on previous survey years. Many more crabs were captured in 1982 than on previous surveys. Much information was gained on small sized (< 115 mm carapace width) crabs which was one of the main objectives of the project. Reproductive potential of the female portion of the population seems to be in a healthy state.

Population indexing surveys using pots were conducted in the Kodiak and South Peninsula management districts in 1982. In Kodiak, all stocks of legal size crabs showed increases in relative abundance with a substantial district-wide percentage increase from the 1981 survey (+ 121%). The increase was a result of excellent recruitment. Kodiak female reproductive potential remained healthy in 1982. In the South Peninsula Management District, all categories of crabs showed declines in relative abundance in 1982 with a substantial decrease in the abundance of legal size crabs (- 52%). The female portion of the population seemed to be reproductively healthy in 1982.

Observations on the 1982 commercial fishery showed increases in the harvest (13% - 280%) in all management districts except Chignik which registered a slight decline (10%) from 1981. Effort, in terms of vessels fishing and numbers of pot lifts increased in all areas of the Westward Region in 1982.

Studies on Black Mat Syndrome (*Trichomarix invadens*) have shown a highly area-specific incidence of infection. The disease is uncommon in the bay areas while crabs from offshore areas may show an infection rate as high as 60%.

## EXPLANATION OF TERMS

- Newshe11 (NS)
- Hard exoskeletal animals. The dorsal side of the carapace is brownish-red. No apparent scratching on ventral side. Epifauna is absent or limited. Dactyli, pterygostomial and branchial spines sharp.
- Oldshell (OS)
- An apparent skipmolt. Carapace is hard and brownish. The thoracic sternum and ventral sides of the legs have obtained numerous scratches and abrasions. Dactyli, ptergostomial and branchial spines are worn. Epifauna may be present.
- Very oldshell (VOS)
- An obvious skipmolt. Carapace is hard, dark brown to blackish. Thoracic sternum and ventral side of legs with multiple scratches and abrasions. Under-side of legs may be dark yellow-brown. Dactyli, pterygostomial and branchial spines heavily worn. Epifauna most always present, e.g. large barnacles.
- Molting
- All physiological events leading up to ecdysis, including ecdysis.
- Skip molt
- A crab which has not molted in more than 12 months.
- Crab Measurements
- All crab measurements, e.g.  $\leq 69$  mm, refer to carapace width (C.W.) unless otherwise noted.
- Size and Age Groups:
- Pre-recruit Fours
- Male Tanner crabs  $\leq 69$  mm in carapace width and 4 or more molts from attaining legal size without skip molting. Note that this group includes pre-recruit four, five, six and younger crabs.
- Pre-recruit Threes
- Male Tanner crabs 70-91 mm in carapace width and 3 molts from attaining legal size.
- Pre-recruit Twos
- Male Tanner crabs 92-114 mm in carapace width and 2 molts from attaining legal size.
- Pre-recruit Ones
- Male Tanner crabs 115-139 mm in carapace width and 1 molt from attaining legal size.
- Recruit Legals
- Newshe11 male Tanner crabs 140-164 mm in carapace width, recruited to legal size in year of capture.
- Post-recruit Legals
- Oldshell and very oldshell male Tanner crabs 140-164 mm and all males  $> 164$  mm in carapace width. Have been legal size at least one year.
- Total Legals
- Male Tanner crabs  $> 139$  mm in carapace width.

## PILOT TRAWL SURVEY

### Introduction

One of the responsibilities of the Alaska Department of Fish and Game (ADF&G) is the assessment of king (*Paralithodes camtschatica*) and Tanner crab (*Chionoecetes bairdi*) stocks in the Western Gulf of Alaska. Data obtained from the assessment program are used to estimate the annual abundance of legal male crabs and predict recruitment trends 2 to 4 years in advance of crabs attaining commercial size. These estimates and predictions are utilized by the ADF&G to establish annual harvest levels and harvesting strategies in order to obtain optimum yield under management policies enacted by the Alaska Board of Fisheries and the North Pacific Fishery Management Council (NPFMC).

In 1973 an experimental crab stock assessment program was begun which used special crab pots to simultaneously collect king and Tanner crabs. The experimental design called for sampling the crab stocks through one life cycle of crabs, roughly 8 to 10 years, so that the method could be adequately tested and evaluated. The tenth year of the crab pot index program was completed in August 1982. Some problems associated with using pots as a sampling tool for the Tanner crab have been identified: (1) Catchability of crabs is variable and dependent on crab size, attraction to a given bait, and ability to escape from a pot they have entered; (2) Determining the fishing power of a pot(s) or fraction of the population captured per unit time and area is a complex and difficult task for which current methodologies have produced variable results; and (3) Tanner crab behavioral traits are such that crabs one or more years away from entering the fishery do not appear to be captured by successive surveys in a manner reflecting their subsequent predicted abundance as recruits.

Whereas pots have historically been used to assess crab stocks in the Gulf of Alaska, trawls have successfully been used by the National Marine Fisheries Service (NMFS) to assess crab stocks in the Bering Sea (Reeves 1979). The need for better assessment data, particularly for pre-recruit Tanner crab, has generated interest in the use of trawls as a management tool in the Western Gulf of Alaska. An experimental crab stock assessment program was devised whose overall objectives were as follows: (1) Test the feasibility of using trawls to assess the abundance of Tanner crab stocks in certain areas of the Western Gulf of Alaska where little or no stock assessment information is available; (2) Continue this feasibility study for at least 2 years to determine the reproducibility of results in terms of estimating legal male abundance and predicting recruitment trends; and (3) Evaluate the practicability and cost effectiveness of using trawls in place of current pot assessment surveys by simultaneously surveying certain key areas using both methods.

### Materials and Methods

The NMFS has had some success in assessing crab stocks in the Bering Sea using trawls. In the hope of minimizing sampling problems we utilized gear similar to that used on the NMFS survey (Otto et al. 1979). The net used was a 400 mesh eastern otter trawl. It was constructed of 36 thread 10.2 cm mesh in the wings, 60 thread 8.9 cm mesh in the intermediate, and a 96 thread 3.2 cm mesh codend liner. Headrope flotation was provided by eighteen 20.3 cm diameter floats. The

bridle consisted of 45.7 m dandy lines (18.3 m single, 27.4 m double). The doors measured 1.5 x 2.1 m, were of the Astoria "V" type and weighed 340 kg apiece. This trawl has an effective net width (path swept) of about 12 m. Budget restraints limited the initial phase of the study (in 1980) to one area, namely northern Shelikof Strait (Figure 1) which is located in the Kodiak Management District. Due to better funding of the experimental trawl program, the 1981 survey was expanded to include the Semidi Islands (Figure 2, no. 35), Chiniak Gully (Figure 2, no. 14), and northern Shelikof Strait (Figure 1) in the Kodiak Management District and the Chignik Management District (Figure 1). In 1982 we concentrated our survey effort in the North Mainland fishing section of the Kodiak Management District (Figure 2, no. 41) and the Chignik Management District (Figure 1). Supplementary sampling was done in Uyak and Uganik Bays (Figure 1) on the west side of Kodiak Island while waiting for better weather conditions in Shelikof Strait.

Each station consisted on one, 30-minute tow (Appendix Table 1). Upon retrieval of the net the catch was weighed to the nearest kilogram using an electronic crane scale. The contents of the net were emptied onto the deck (1980 and 1982 surveys) or sorting table (1981 survey) and all Tanner and king crabs were separated from the catch. The remainder of the catch was sampled by bottomfish research biologists. Among the numerous observations made on the catch, data was obtained on the number of species captured, their relative abundance, and relative weights. Tanner crabs were separated by sex, weighed, counted, aged, and in most cases carapace width (CW) was measured (Figure 3). It should be noted that the weights for Tanner crab were obtained by weighing all individuals captured while the weights of most other animal forms were obtained from randomly selected subsamples of the catch after removal of the Tanner crab. This process probably resulted in some distortion of the actual ranking by weight of Tanner crab in the population of larger animals living on or near the surface of the benthos in the survey area. Abdominal width (Figure 3) was also taken on juvenile females during the 1980 and 1981 trawl surveys. In 1982, male chela width (Figure 3) was measured on many of the crabs captured in the Chignik Management District. Other pertinent data were collected on egg clutch size (as percentage fullness of the brood chamber) and egg condition. The presence or absence of Black Mat Syndrome was noted. Tagging was accomplished using a carapace dart tag and conducted differently on each of the survey years. During the 1980 trawl survey in northern Shelikof Strait, 50% of the legal sized male Tanner crabs were tagged. Since no tag recoveries from newshell crabs were reported during the subsequent commercial fishery, we suspected that we might either be tagging too early or were inadvertently killing crabs. So, during the 1981 trawl survey, we tagged 100% of the legal sized oldshell crabs. Crabs which showed new injuries or were missing many legs were not tagged. Old injuries and missing legs were noted for tagged individuals. All tagged crabs were released while on station as soon as possible after capture. In 1982 tagging was not conducted on the trawl surveys.

The boats chartered for the trawl surveys were the 25 m dragger M/V COMMANDER (1980), the 30 m R/V ALASKA (1981), and the 27 m dragger M/V ROYAL BARON (1982).

Upon returning to Kodiak, the data was stratified, when feasible, and population estimates for various size and age groups of Tanner crab were generated using the standard area-swept technique (Colgate and Hicks 1982).

Using the resulting population estimates, predictions were made for the number of legal sized crabs that would be available for the subsequent commercial fishing

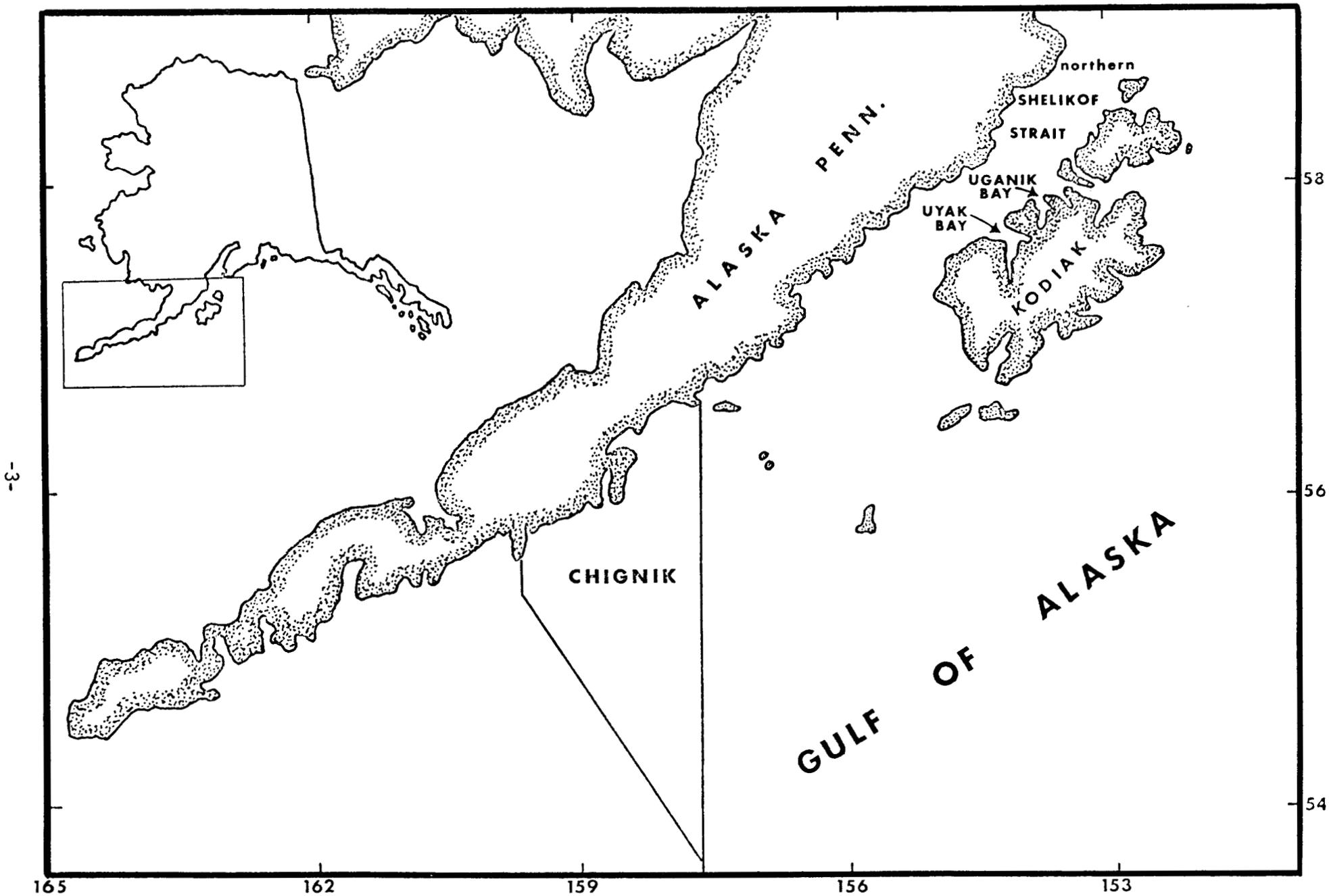


Figure 1. Areas of the western Gulf of Alaska in which trawl surveys were completed or attempted during the summer of 1982.

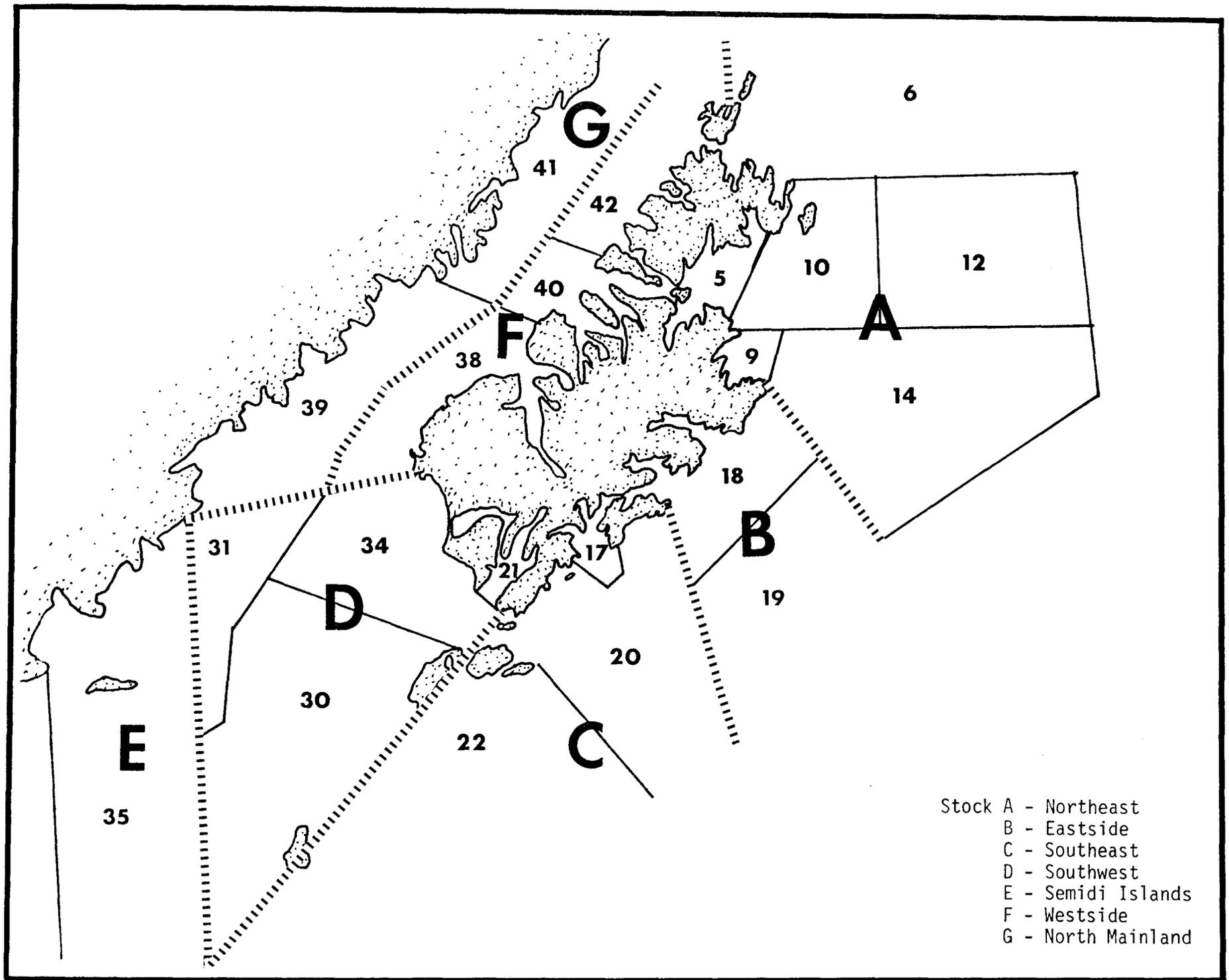


Figure 2. Tanner crab, *Chionoecetes bairdi*, stocks and schools, Kodiak Management District.

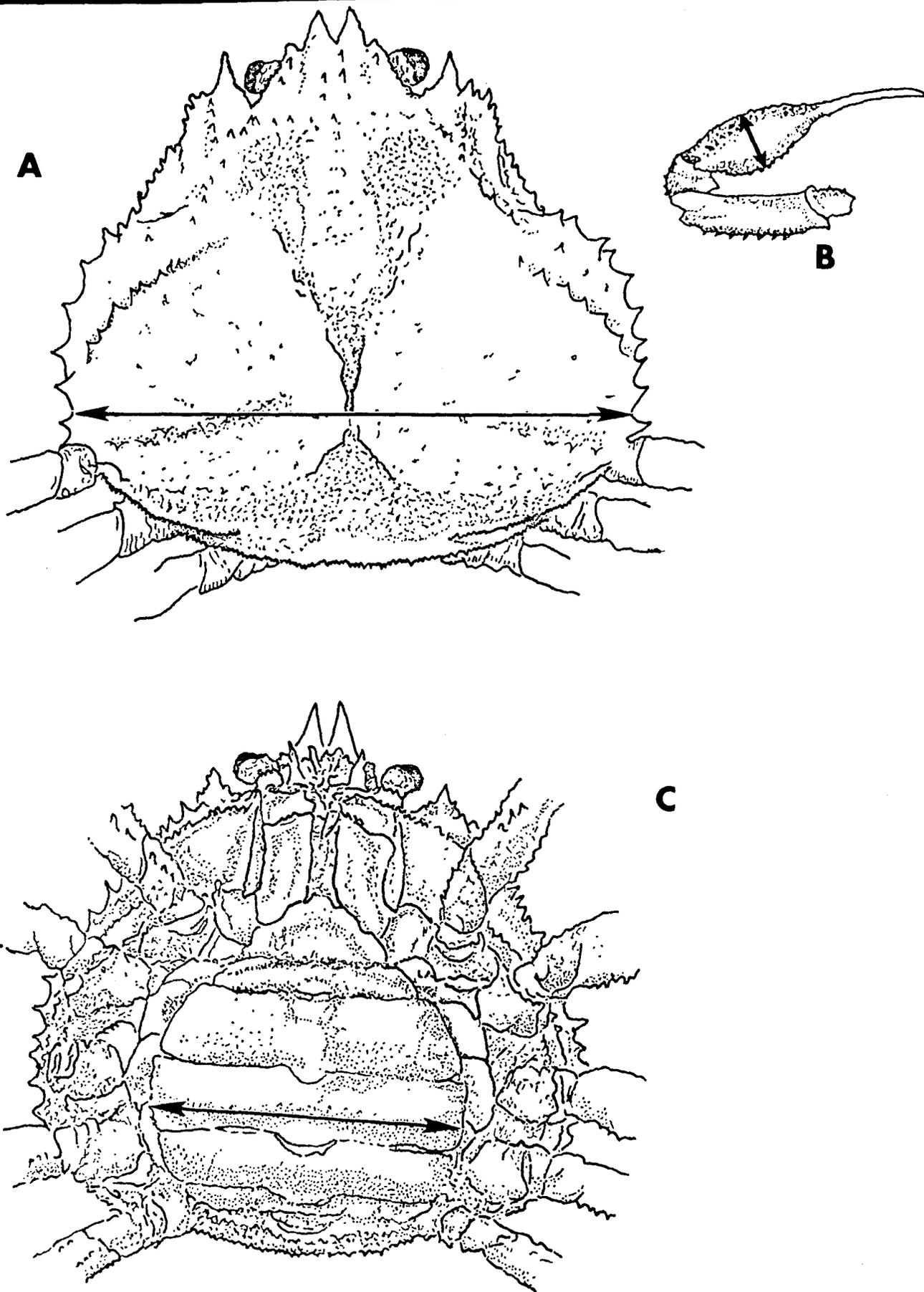


Figure 3. Tanner crab, *Chionoecetes bairdi*, measurement locations for carapace width (A), male right chela width (B, ventral view) and female abdomen width (C).

seasons. These predictions assumed an annual natural mortality rate of 20% and a resource exploitation rate of 40%. Because of the high incidence of skip molting in male Tanner crabs  $\geq 115$  CW (i.e., pre-recruit ones and older), predicting recruitment is neither accurate nor straightforward. In order to take the skip molting into account the following formula was used to predict recruitment into a future fishery.

$$\text{Recruitment Coefficient (RC)} = \frac{\text{Newshell } \sigma\text{'s } 140\text{-}164 \text{ mm}}{\text{Newshell } \sigma\text{'s } 140\text{-}164 \text{ mm} + \text{oldshell } \sigma\text{'s } 115\text{-}136 \text{ mm}}$$

$$\text{Recruitment Coefficient (RC)} \times A$$

where A = population estimate of 115-139 mm males times 0.72

(or 1-1/2 years survival with an annual mortality rate of 20%)

RC = recruitment coefficient (from above)

### Results and Discussion

The following are results from the 1980 trawl survey in the North Mainland fishing section of the Kodiak Management District and the 1981 and 1982 trawl surveys in the same area of the Kodiak District and in the Chignik Management District.

Kodiak Management District, 1980-1982:

Complete surveys were conducted in the North Mainland fishing section in 1980, 1981, and 1982 while preliminary sampling was done in Uyak and Uganik bays on the west side of Kodiak Island in 1982.

North Mainland. The North Mainland fishing section of the Kodiak Management District is comprised of all waters between  $58^{\circ} 00'$  and  $58^{\circ} 51'$  N. lat. west of a line from  $58^{\circ} 51'$  N. lat.,  $152^{\circ} 45'$  W. long. to  $58^{\circ}$  N. lat.,  $154^{\circ}$  W. long. The area has been stratified, by depth, into three strata, two of which are surveyed (Figures 4, 5, and 6). Stratum II is the area from 36.5 m through 146.1 m on the west side of the North Mainland fishing section. Stratum III is the area from 146.2 m to the boundary of the fishing section (approximately the midline of northern Shelikof Strait).

The number of tows taken to survey the North Mainland fishing section varied on the three trawl surveys. A high of 30 tows was completed in 1980 while the low of 17 was taken during the 1981 survey. Twenty-eight tows were taken in 1982. The low number of tows taken in 1981 was the result of applying optimal allocation of stratified sampling based on the standard deviations of the 1980 sampling scheme (Cochran 1977). Theoretically, this would have allowed us to obtain a 1981 survey comparable to the 1980 survey with fewer tows (at least in terms of the statistical error). Tow distribution varied between each of the three surveys (Figures 4, 5, and 6) despite the fact that attempts were made to be consistent. Most of the variation was due to weather and tidal conditions being different on each of the three surveys. Since natural conditions are frequently marginal for trawling in Shelikof Strait many of the tows were made whenever and wherever we could fish. Sampling intensity on the three surveys varied from one tow/36.6 km<sup>2</sup> in 1982 to one tow/64.5 km<sup>2</sup> in 1981. Intensity on the 1980 survey was similar to that in 1982 with one tow/39.2 km<sup>2</sup>.

All animal forms captured on the northern Shelikof Strait trawl surveys were ranked according to their relative weight in the catch in kg/hr. Results from

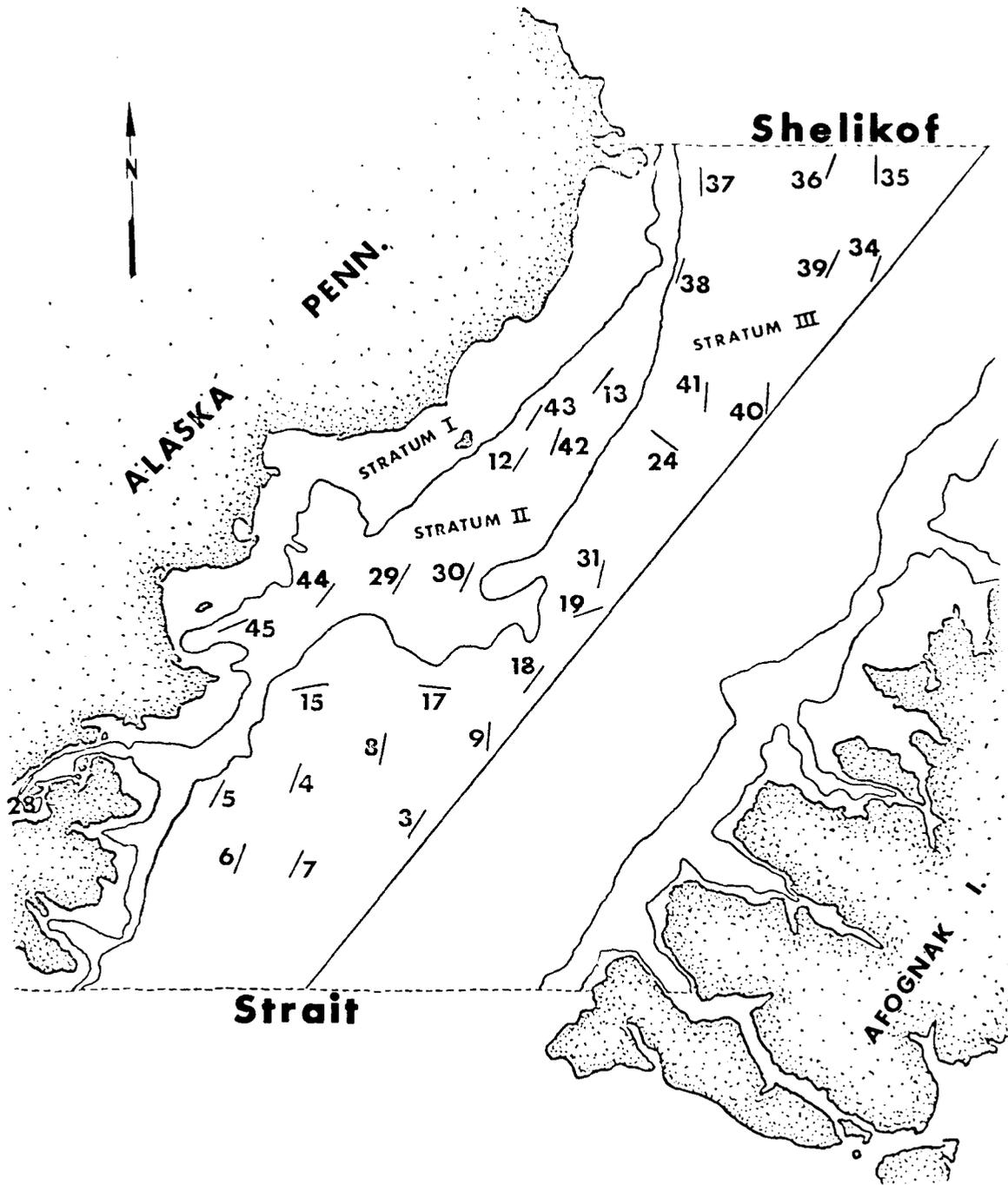


Figure 4. Tow locations in North Mainland fishing section, 1980 Kodiak Management District trawl survey.

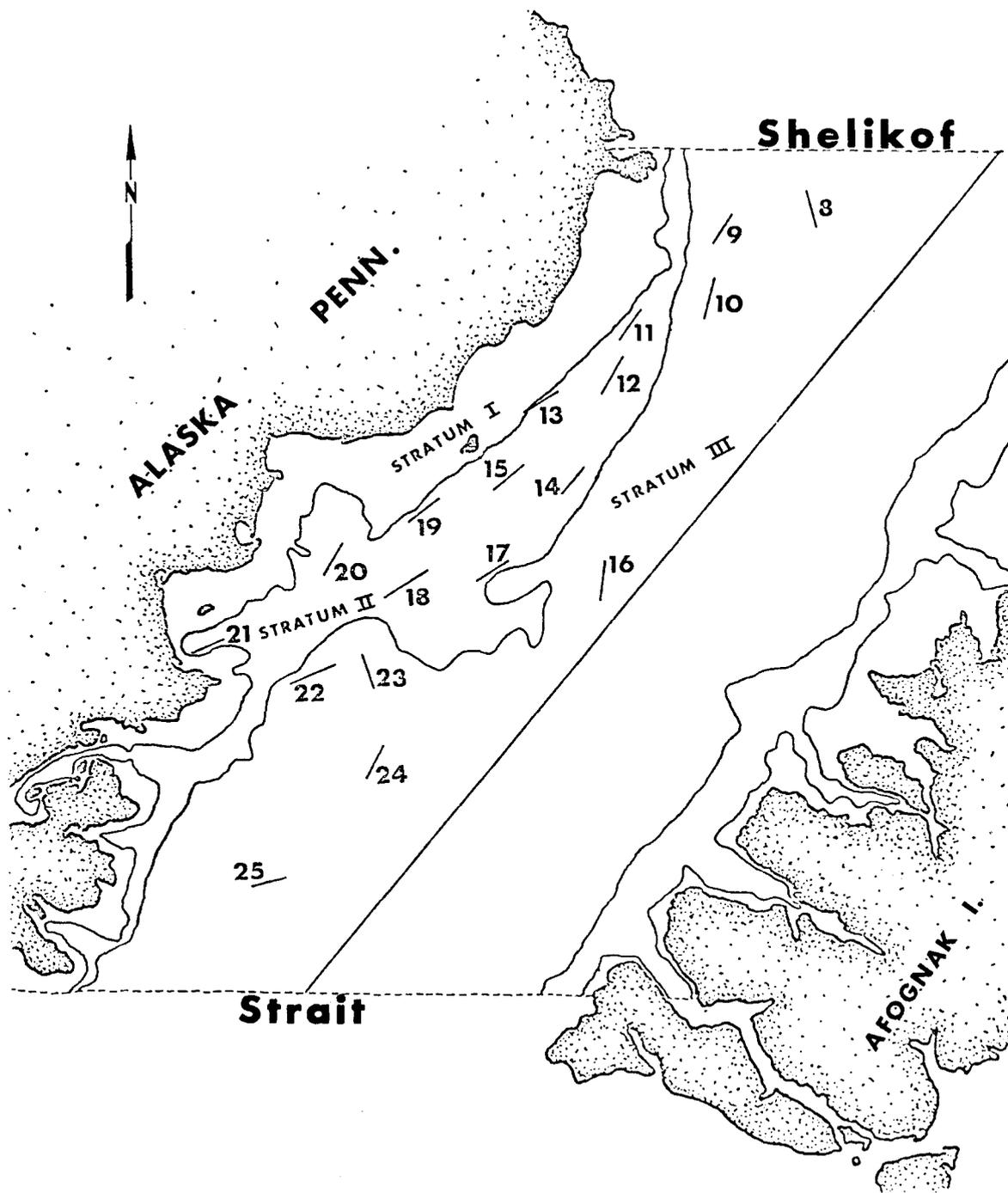


Figure 5. Tow locations in North Mainland fishing section, 1981 Kodiak Management District trawl survey.

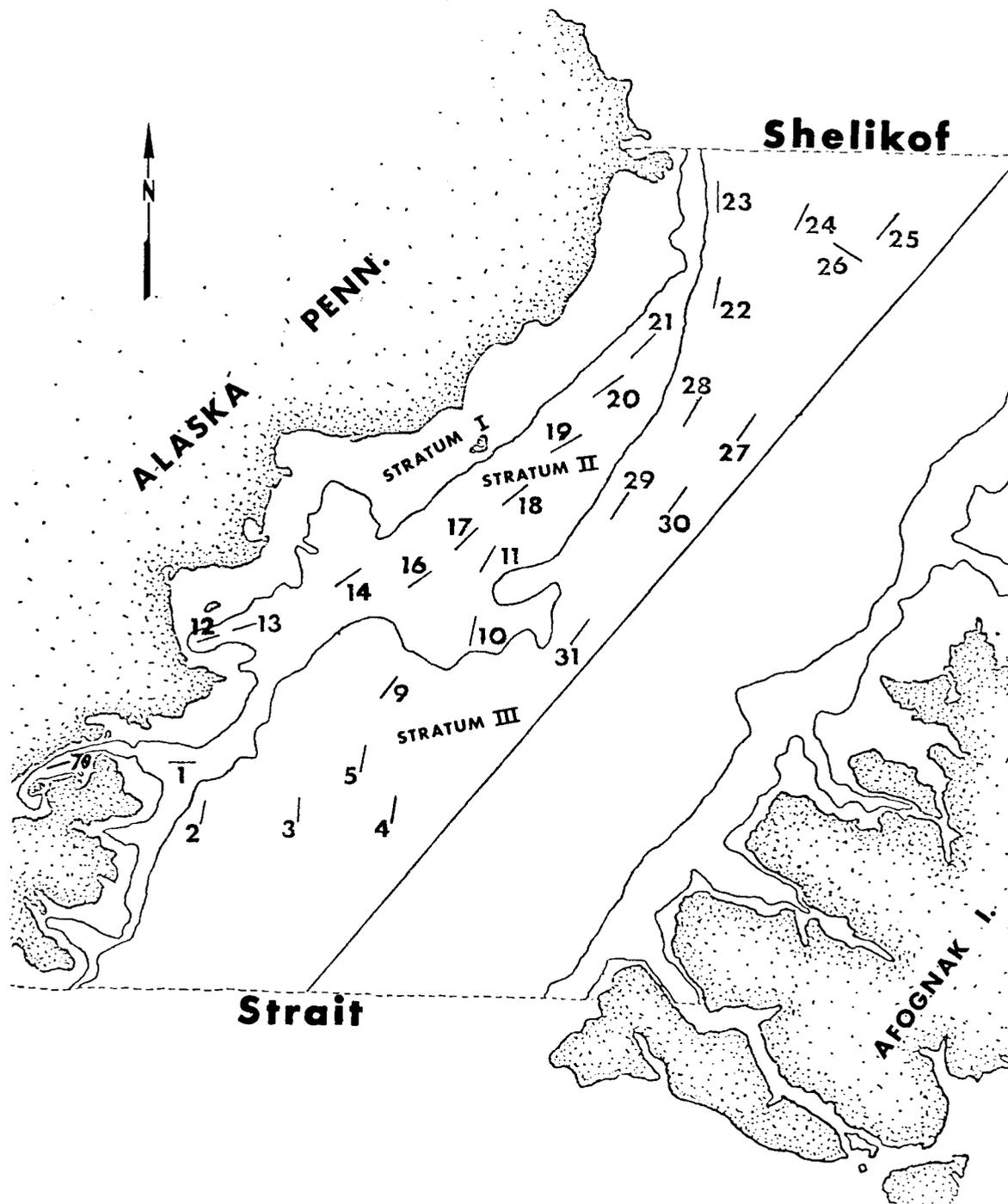


Figure 6. Tow locations in North Mainland fishing section, 1982 Kodiak Management District trawl survey.

the 1980 and 1981 surveys are reported elsewhere (Colgate and Hicks 1982). The results of the 1982 survey (Table 1) shows the top three positions in the species ranking occupied by three fishes, walleye pollock, flathead sole, and arrowtooth flounder. These species produced 631, 306, and 200 kg per hour of towing, respectively. Male Tanner crabs occupied fourth place with 179 kg/hr and Tanner crabs eighth place with 42 kg/hr. Combining males and females, Tanner crabs would occupy third place with 221 kg/hr.

The Tanner crab portion of the catch was standardized to 1.85 km (1 nm) tows. Crab catches in the North Mainland fishing section varied considerably on each of the trawl surveys (Tables 2, 3, and 4). With the exception of juvenile females and pre-recruit four (and younger) males, the 1982 catches were the highest of the three survey years in every size and age group, male and female. In 1980, 1,602 juvenile females were captured (compared to 1,071 in 1982) while 1,075 pre-recruit four and younger males were caught (compared to 830 in 1982). Overall 5,968, 2,934, and 9,048 crabs were captured on the 1980, 1981, and 1982 surveys, respectively. Catches of legal size crabs showed the same trend with 354, 240, and 873 crabs captured, respectively. In terms of the male and female components, males accounted for 52% and 51% of the total crab catch in 1980 and 1981, respectively. In 1982, the proportion changed with 67% of the total catch being male. While the change could probably be attributed to changes in tow distribution, this was not obvious from a comparison of the highest catches of males and females on a tow by tow basis (Tables 2, 3, and 4). Of the top five tow catches for male and female crabs three of the top five catches of each sex were from the same tows in 1980 and 1982, while four of the top five catches of each sex were from the same location in 1981. This data would suggest that male and female Tanner crabs were frequently found in greatest concentrations in the same areas of the North Mainland fishing section, at least in summer when the trawl surveys were conducted.

Looking at the male portion of the Tanner crab catch (Table 5), considerable variation was observed between size and age groups and between survey years within the size and age groups. The percent of the total male catch that was legal size was 11.4%, 16.2%, and 14.5% in 1980, 1981, and 1982, respectively. Within the legal size crab group, the recruit crab portion increased from 63.3% in 1980 to 80.7% in 1982, a 17.4% increase.

The shell age makeup of the male catches varied little between surveys in the smaller size and age groups (Table 6). In the pre-recruit one group the percent crabs that were oldshell in 1982 decreased markedly from previous observations. This group accounted for 10.7% of the total pre-recruit ones in 1982 while the same group was 26.1% and 29.1% of the total in 1980 and 1981, respectively. A decrease in the percent of post-recruits that were oldshell at the time of the surveys was observed over the three year period. In 1980 the observed percent oldshell post-recruits was 82.9%, subsequently decreasing to 59.8% in 1981 and 49.0% in 1982. This may not be an accurate reflection of the shell age makeup of the post-recruit legal population since very few individuals in this group were captured (16, 36, and 71 crabs - 1980-81). Overall, the shell age makeup of the total male population changed little over the three survey periods (Table 6). Newshell crabs accounted for approximately 90% of the catch each year while oldshell crabs made up 9% and very oldshell crabs about 1% of the total on each survey.

Table 1. Common and scientific name, rank, and catch per unit effort (CPUE) of taxa captured in the North Mainland fishing section, 1982, Kodiak Management District trawl survey.

Common Name	Scientific Name	Rank	CPUE kg/hr
Walleye pollock	<i>Theragra chalcogramma</i>	1	631
Flathead sole	<i>Hippoglossoides elassodon</i>	2	306
Arrowtooth flounder	<i>Atheresthes stomias</i>	3	200
Tanner crab male	<i>Chionoecetes bairdi</i>	4	179
Pacific cod	<i>Gadus macrocephalus</i>	5	161
Pacific halibut	<i>Hippoglossus stenolepis</i>	6	92
Big skate	<i>Raja binoculata</i>	7	49
Tanner crab female	<i>Chionoecetes bairdi</i>	8	42
Sablefish	<i>Anoplopoma fimbria</i>	9	34
Eelpout	Family Zoarcidae	10	29
Eulachon	<i>Thaleichthys pacificus</i>	11	26
Great sculpin	<i>Myoxocephalus</i> sp	12	24
Sponge	Phylum Porifera	13	15
Alaska plaice	<i>Pleuronectes quadrituberculatus</i>	14	14
King crab female	<i>Paralithodes camtschatica</i>	15	12
Shrimp	Order Decapoda (Suborder Natantia)	16	12
Dover sole	<i>Microstomus pacificus</i>	16	12
King crab male	<i>Paralithodes camtschatica</i>	18	8
Mud starfish	<i>Ctenodiscus crispatus</i>	19	7
Dungeness crab	<i>Cancer magister</i>	20	6
Longnose skate	<i>Raja rhina</i>	21	6
Oregon triton	<i>Fusitriton oregonense</i>	22	5
Northwest neptune	<i>Neptunea lyrata</i>	23	5
Sea Anemone	Order Actiniaria	24	5
Weathervane scallop	<i>Patinopecten caurinus</i>	25	4
Hermit crab	Family Paguridae	26	3
Skate	Family Rajidae	26	3
Sea Urchin	Class Echinoidea	28	3
Spinyhead sculpin	<i>Dasycottus setiger</i>	28	3
Rougheyeye rockfish	<i>Sebastes aleutianus</i>	30	3
Longsnout prickleback	<i>Lumpenella longirostris</i>	31	2
Rock sole	<i>Lepidopsetta bilineata</i>	32	2
Starfish	Class Asteroidea	33	2
Kennicott's buccinum	<i>Beringus kennicotti</i>	33	2
Pacific Ocean perch	<i>Sebastes alutes</i>	33	2
Octopus	<i>Octopus dofleini</i>	36	2
Bigmouth sculpin	<i>Hemitripterus bolini</i>	37	1
Basket starfish	<i>Gorgonocephalus caryi</i>	38	1
Yellow Irish lord	<i>Hemilepidotus jordani</i>	39	.7
Giant wrymouth	<i>Delolepis gigantea</i>	40	.6
Spiny dogfish shark	<i>Squalus scanthius</i>	41	.5
Sea pen	Order Pennatulacea	41	.5
Searcher	<i>Bathymaster signatus</i>	43	.4
Smooth lumpsucker	<i>Aptocyclus ventricosus</i>	43	.4
Lyre crab	<i>Hyas lyratus</i>	45	.1
Dusky rockfish	<i>Sebastes ciliatus</i>	45	.1
Sculpin	Family Cottidae	45	.1

-Continued-

Table 1. Common and scientific name, rank, and catch per unit effort (CPUE) of taxa captured in the North Mainland fishing section, 1982, Kodiak Management District trawl survey (continued).

Common Name	Scientific Name	Rank	CPUE kg/hr
No. spearnose poacher	<i>Agonopsis emmelane</i>	45	.1
Sturgeon poacher	<i>Agonus acipenserinus</i>	45	.1
Barnacles	Subclass Cirripedia	45	.1
Squid	Class Cephalopoda	45	.1
Sea potato	<i>Halocynthia</i> sp.	45	.1
Stern's volute	<i>Arctomelon stearnsi</i>	45	.1
Greenland halibut	<i>Reinhardtius hippoglossoides</i>	54	T
Rex sole	<i>Glyptocephalus zachirus</i>	54	T
Yellowfin sole	<i>Limanda aspera</i>	54	T
Scissortail sculpin	<i>Triglops forificata</i>	54	T
Poacher	Family Agonidae	54	T
Snailfish	Family Cyclopteridae	54	T
Clams	Class Pelecypoda	54	T
Snail	Class Gastropoda	54	T
Lamp shells	Phylum Brachiopoda	54	T
Polychaete	Class Polychaeta	54	T
Sea mouse	Family Aphroditidae	54	T
Nudibranchs	Order Nudibranchia	54	T
Sea cucumber	Class Holothuroidea	54	T
Number of tows			28
Total kg/hr			1,944

Table 2. Number of Tanner crabs, *Chionoecetes bairdi*, captured per 1.85 km in North Mainland fishing section, 1980, Kodiak Management District trawl survey.

Tow No.	Juv. ♀	Adult ♀	Total Female	Pre-recruit Fours ♂	Pre-recruit Threes ♂	Pre-recruit Twos ♂	Pre-recruit Ones ♂	Recruit Legals ♂	Post-recruit Legals ♂	Total Legals ♂	Total Male	Total Crabs
3	15	8	23	2	21	8	0	0	0	0	31	54
4	22	4	26	17	10	2	3	0	0	0	32	58
5	14	1	15	25	3	0	1	0	3	3	32	47
6	34	3	37	24	1	1	1	0	2	2	29	66
7	91	23	114	61	34	10	4	0	2	2	111	225
8	8	11	19	3	1	3	1	3	3	6	14	33
9	15	3	18	7	3	2	0	0	1	1	13	31
12	77	81	158	36	23	84	80	29	9	38	261	419
13	18	22	40	3	7	26	19	7	7	14	69	109
15	6	13	19	1	1	4	53	50	3	53	112	131
17	1	5	6	2	0	1	4	0	4	4	11	17
18	8	0	8	12	3	2	3	0	2	2	22	30
19	22	1	23	24	2	0	0	1	0	1	27	50
24	12	0	12	8	3	0	0	0	0	0	11	23
28	88	6	94	66	44	36	28	14	6	20	194	288
29	91	477	568	0	52	83	96	22	31	53	284	852
30	71	26	97	31	15	25	30	17	5	22	123	223
34	211	1	212	159	16	1	0	0	0	0	176	388
35	169	0	169	123	7	2	2	0	2	2	136	305
36	36	8	44	34	3	1	3	0	4	4	45	89
37	99	201	300	39	11	32	26	2	15	17	125	425
38	20	229	249	12	19	98	151	20	19	39	319	568
39	31	3	34	24	11	0	0	0	0	0	35	69
40	32	8	40	28	44	4	3	0	1	1	80	120
41	10	9	19	7	19	2	3	0	0	0	31	50
42	224	45	269	176	51	25	18	14	3	17	287	556
43	32	6	38	43	3	10	38	23	3	26	120	158
44	61	74	135	14	81	33	18	3	5	8	154	289
45	84	3	87	94	31	15	52	19	0	19	211	298
Total	1,602	1,271	2,873	1,075	519	510	637	224	130	354	3,095	5,968

Table 3. Number of Tanner crabs, *Chionoecetes bairdi*, captured per 1.85 km in North Mainland fishing section, 1981, Kodiak Management District trawl survey.

Tow No.	Juv. ♀	Adult ♀	Total Female	Pre-recruit Fours ♂	Pre-recruit Threes ♂	Pre-recruit Twos ♂	Pre-recruit Ones ♂	Recruit Legals ♂	Post-recruit Legals ♂	Total Legals ♂	Total Male	Total Crab
8	95	49	144	42	34	23	15	3	3	6	120	264
9	166	153	319	27	117	24	18	10	4	14	200	519
10	63	119	182	6	66	44	8	3	3	6	130	312
11	6	6	12	2	4	2	0	0	0	0	8	20
12	2	48	50	1	0	5	32	21	4	25	63	113
13	2	4	6	1	1	1	0	1	0	1	4	10
14	197	34	231	100	82	44	18	6	2	8	252	483
15	46	86	132	18	15	19	41	15	2	17	110	242
16	26	18	44	17	9	8	9	4	0	4	47	91
17	16	22	38	2	21	30	26	5	5	10	89	127
18	17	82	99	5	26	13	44	9	15	24	112	211
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	1	5	3	8	9	9
21	8	0	8	9	2	5	39	34	8	42	97	105
22	22	74	96	1	12	27	26	23	5	28	94	190
23	30	54	84	12	17	31	38	35	6	41	139	223
24	0	2	2	0	1	1	1	3	0	3	6	8
25	1	1	2	1	0	1	0	2	1	3	5	7
Total	697	752	1,449	244	407	278	316	179	61	240	1,485	2,934

Table 4. Number of Tanner crabs, *Chionoecetes bairdi*, captured per 1.85 km in North Mainland fishing section, 1982, Kodiak Management District trawl survey.

Tow No.	Juv. ♀	Adult ♀	Total Female	Pre-recruit Fours ♂	Pre-recruit Threes ♂	Pre-recruit Twos ♂	Pre-recruit Ones ♂	Recruit Legals ♂	Post-recruit Legals ♂	Total Legals ♂	Total Male	Total Crab
1	30	73	103	8	16	69	78	10	16	26	197	300
2	0	40	40	0	0	14	66	23	1	24	104	144
3	15	248	263	4	1	23	43	6	5	11	82	345
4	4	5	9	11	1	8	33	24	3	27	80	89
5	6	1	7	4	2	19	36	29	4	33	94	101
7	27	11	38	12	34	83	63	9	0	9	201	239
9	1	57	58	1	2	5	14	3	3	6	28	86
10	31	9	40	38	6	13	10	6	0	6	73	113
11	27	40	67	9	28	73	50	34	4	38	198	265
12	21	4	25	15	17	76	228	62	7	69	405	430
13	9	2	11	9	12	98	679	301	62	362	1,160	1,171
14	17	2	19	6	15	4	6	0	0	0	31	50
16	1	112	113	0	14	66	73	27	5	32	185	298
17	0	54	54	1	1	22	31	5	1	6	61	115
18	24	204	228	8	35	125	68	10	6	16	252	480
19	28	110	138	5	5	70	30	10	1	11	121	259
20	12	91	103	3	1	36	77	36	6	42	159	262
21	395	25	420	438	683	191	78	10	7	17	1,407	1,827
22	28	296	324	15	33	136	100	15	5	20	304	628
23	151	344	495	18	45	30	44	10	10	20	157	652
24	25	30	55	32	24	48	79	10	12	22	205	260
25	68	11	79	58	6	29	72	47	4	51	216	295
26	35	6	41	25	6	2	2	2	1	3	38	79
27	15	2	17	17	10	2	1	0	0	0	30	47
28	12	3	15	13	12	5	1	0	0	0	31	46
29	48	1	49	44	3	3	1	0	0	0	51	100
30	28	145	173	20	11	33	9	0	3	3	76	249
31	13	14	27	16	3	19	34	16	3	19	91	118
Total	1,071	1,940	3,011	830	1,026	1,302	2,006	705	169	873	6,037	9,048

Table 5. Number of male Tanner crabs, *Chionoecetes bairdi*, captured per 1.85 km by size and age group and percent total male catch in North Mainland fishing section, 1980, 1981, and 1982 Kodiak Management District trawl surveys.

Group <sup>1</sup>	1980		1981		1982		Percent of Legals		
	No.	%	No.	%	No.	%	1980	1981	1982
Pre-recruit Fours	1,075	34.7	244	16.4	830	13.7			
Pre-recruit Threes	519	16.8	407	27.4	1,026	17.0			
Pre-recruit Twos	510	16.5	278	18.7	1,302	21.6			
Pre-recruit Ones	637	20.6	316	21.3	2,006	33.2			
Recruit Legals	224	7.2	179	12.1	705	11.7	63.3	74.6	80.7
Post-recruit Legals	130	4.2	61	4.1	169	2.8	36.7	25.4	19.3
Total Legals	354	11.4	240	16.2	873	14.5			
Total Males	3,095	100.0	1,485	100.0	6,037	100.0			
No. Tows	30		17		28				

<sup>1</sup> See "Explanation of Terms" for Tanner crab size and age descriptions.

Table 6. Number and percent total male Tanner crabs, *Chionoecetes bairdi*, measured by size and age group and exoskeletal age in the North Mainland fishing section, 1980, 1981, and 1982 Kodiak Management District trawl surveys.

Group	1980						1981						1982					
	NS		OS		VOS		NS		OS		VOS		NS		OS		VOS	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Pre-recruit Fours	1,066	99.3	7	0.7	0	-	374	99.7	1	0.3	0	-	819	99.0	8	1.0	0	-
Pre-recruit Threes	463	98.5	7	1.5	0	-	650	99.7	2	0.3	0	-	992	97.1	24	2.3	6	0.6
Pre-recruit Twos	436	94.6	24	5.2	1	0.2	391	90.9	35	8.1	4	1.0	1,138	90.0	115	9.1	12	0.9
Pre-recruit Ones	419	71.9	152	26.1	12	2.0	338	68.8	143	29.1	10	2.1	1,612	87.5	197	10.7	34	1.8
Recruit Legals	191	100.0	NA	-	NA	-	269	100.0	NA	-	NA	-	634	100.0	NA	-	NA	-
Post-recruit Legals	16	12.4	107	82.9	6	4.7	36	39.1	55	59.8	1	1.1	71	45.8	76	49.0	8	5.2
Total Legals	207	64.7	107	33.4	6	1.9	305	84.5	55	15.2	1	0.3	705	89.4	76	9.6	8	1.0
Total Males	2,591	89.1	297	10.2	19	0.7	2,058	89.1	236	10.2	15	0.7	5,266	91.6	420	7.3	60	1.0

Female Tanner crabs captured on the North Mainland surveys accounted for 48.1%, 49.4%, and 33.3% of the total catch in 1980, 1981, and 1982, respectively. Among the females 44.2%, 51.8%, and 64.4% of those caught were adults in 1980, 1981, and 1982, respectively.

One way of examining reproductive potential is by observing the relative egg clutch size of females. In the North Mainland fishing section females with full egg clutches (90-100% full) accounted for 54.8%, 66.1%, and 63.4% of the total adult females on the 1980, 1981, and 1982 surveys, respectively (Table 7). However, if those females that carried partial egg clutches were included 94.4% of the 1980 survey females had egg clutches while 93.9% of the 1981 survey females and 96.7% of the 1982 survey females had egg clutches. The female reproductive potential showed little change over the 3 year period and it seems that it has remained in a healthy state throughout the period. Of the barren females on the 1982 survey 36.7% had ova in the ovaries while 63.3% had inactive ovaries and were those likely barren because of senescence.

One reason to develop a trawl survey for Tanner crab population assessment was the desire to obtain information on sublegal sized crabs which would aid the Department in predicting future recruitment trends. This is data we have not been able to obtain using our current population indexing program with pots since Tanner crab behavioral traits are such that crabs one or more molts away from entering the fishery do not appear to be captured by successive surveys in a manner reflecting their subsequent predicted abundance as recruits. The size frequency distribution of the male component of the catch showed interesting differences between the 1980, 1981, and 1982 trawl surveys (Figure 7). The size mode of crabs observed at 60 mm carapace width (CW) in 1980 was seen at 80 mm CW in 1981 and 110 mm CW on the 1982 North Mainland survey. These modes correspond to crab growth (through molting) from pre-recruit fours to pre-recruit threes between 1980 and 1981 and from pre-recruit threes to pre-recruit twos between 1981 and 1982. The magnitudes of the size modes are probably not quantitatively indicative of the year class strengths. In the example cited above the number of crabs observed at the height of the pre-recruit three group in 1981 was about 43 crabs, a decrease from the 55 crabs seen at the height of the pre-recruit four group in 1980. This was a 22% drop in the magnitude of this year class which could be explained by natural mortality between the surveys. We have consistently used 20% annual natural mortality to our recruitment forecasts and consider it to be a reasonable estimate from studies of other shellfish (Balsiger 1974). However, in 1982 when this year class appeared in the survey as pre-recruit twos with the size mode at about 110 mm CW the magnitude of the mode was approximately 30% greater than the magnitude of the 1981 pre-recruit three size mode. This would suggest that the 1981 survey in the North Mainland was not extensive enough to provide the quality of information necessary to compare the frequency distributions of the three surveys in a quantitative manner. Only 17 tows were made in the area in 1981 while 30 and 28 tows were completed on the 1980 and 1982 surveys, respectively. Differences in tow distribution of the surveys may explain our inability to quantitatively follow year class strength or decay through the 3 survey years. A possible example of this problem may be seen by examining the growth history of the year class of crabs which were observed as newshell pre-recruit ones with the size frequency mode at 130 mm CW in 1982 (Figure 7). In 1981 the size mode for these crabs was observed at 105 mm CW as pre-recruit twos while they appeared as pre-recruit three crabs with the size mode at 85 mm CW on the 1980 survey. The apparent great strength of the year class in 1982 would not have been expected

Table 7. Number of female Tanner crabs, *Chionoecetes bairdi*, measured by shell age and percent fullness of egg clutch in North Mainland fishing section, 1980-1982, Kodiak Management District trawl surveys.

Class	Juvenile			Percent fullness of clutch																	
				0			1 - 24			25 - 49			50 - 74			75 - 89			90 - 100		
Shellage	N	0	V0	N	0	V0	N	0	V0	N	0	V0	N	0	V0	N	0	V0	N	0	V0
Number	1407	3	0	0	4	42	2	1	17	8	1	22	69	8	26	76	25	71	85	221	146
% Total (adults)				0.5	5.1		0.2	0.1	2.1	1.0	0.1	2.7	8.4	1.0	3.2	9.2	3.0	8.6	10.3	28.8	17.7
% by class				5.6			2.4			3.8			12.6			20.8			54.8		

1981

Class	Juvenile			Percent fullness of clutch																	
				0			1 - 24			25 - 49			50 - 74			75 - 89			90 - 100		
Shellage	N	0	V0	N	0	V0	N	0	V0	N	0	V0	N	0	V0	N	0	V0	N	0	V0
Number	1078	9	0	1	3	67	1	4	19	2	0	22	31	7	21	172	24	24	262	474	44
% Total (adults)				0.1	0.3	5.7	0.1	0.3	1.6	0.2	-	1.9	2.6	0.6	1.8	14.6	2.0	2.0	22.2	40.2	3.7
% by class				6.1			2.0			2.1			5.0			18.6			66.1		

1982

Class	Juvenile			Percent fullness of clutch																	
				0			1 - 24			25 - 49			50 - 74			75 - 89			90 - 100		
Shellage	N	0	V0	N	0	V0	N	0	V0	N	0	V0	N	0	V0	N	0	V0	N	0	V0
Number	1053	0	18	2	7	54	0	4	17	1	2	16	81	12	14	452	18	23	118	1006	97
% Total (adults)				0.1	0.4	2.8	-	0.2	0.9	0.1	0.1	0.8	4.2	0.6	0.7	23.5	0.9	1.2	6.1	52.3	5.0
% by class				3.3			1.1			1.0			5.5			25.6			63.4		

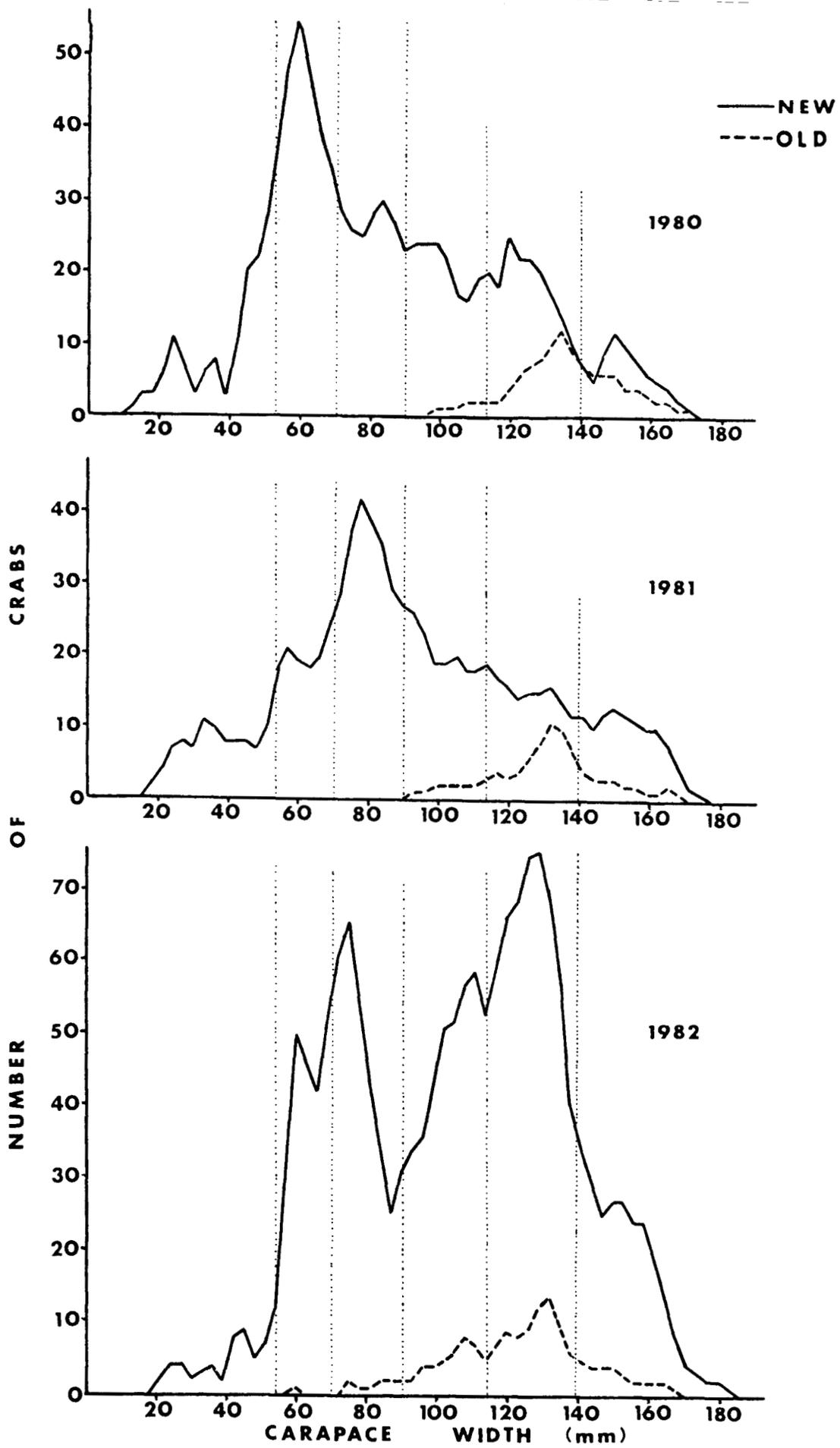


Figure 7. Carapace width frequencies of male Tanner crabs, *Chionoecetes bairdi*, measured on 1980-1982 North Mainland trawl surveys, Kodiak Management District. Dotted lines separate size groups (see Explanation of Terms).

from either of the two previous surveys. The sampling intensity of the 1980 survey should have been great enough to show the strength of the year class, but this did not prove to be the case. Tow distribution and possible clumping of the population may have been responsible for the erratic data, however, and examination of the tow and catch distribution did not indicate tow distribution to be a significant factor in the example given. Clumping of the Tanner crab population, particularly by size group, is not something we can comment on with the data we have at this time. We need to do more work on these potential sampling problems.

The female component of the size frequency distribution showed problems similar to the male component (Figure 8). While growth of various year classes can be seen without difficulty there seems to be inconsistencies in the magnitude (or observed year class strength) of the observations between survey years. The most outstanding problem seems to be the shell age of females on the 1982 survey as compared with the 1981 survey. The oldshell portion in 1982 made up a much larger fraction of the adult female population than would have been expected from the 1981 survey catch of newshell adult females (most females > 90 mm CW were adults) which would have been oldshell in 1982. This may have been a matter of differences in tow distribution or even of shell aging by survey personnel. The survey personnel have been consistent in their determination of shell age on all of the North Mainland trawl surveys. Some of the apparent discrepancies were most likely due to problems in accurately distinguishing between some oldshell and very oldshell individuals. There is a gray area where shell aging is quite subjective and mistakes can easily be made. It is interesting that the proportion of adults that were aged as very oldshell crabs did not change significantly from 1981 to 1982 despite the apparent abundance of oldshell adult females in 1981 which should have become very oldshell crabs in 1982. According to the 1982 survey this did not occur. If the oldshell adults observed in 1981 and the newshell adults observed the same year are combined, the magnitude of the resulting mode would approach that observed for the oldshell portion of the 1982 survey catch. It may be possible that the physical changes that take place as a crab shell ages take place at a slower rate than we have believed. If this is so, it could create overlap and some confusion in the shell age structure of the population given our present ability to age the crabs. Crabs which we label as oldshell may look like "oldshell" crabs for 2 years. The same might be said of newshell (though not recently molted) crabs.

Population estimates were calculated for Tanner crabs using the standard area swept technique (Table 8). The area was stratified (Figures 4-6) in order to lessen the variability between tow catches (Figures 4-6); the three strata comprising the North Mainland fishing section are: Stratum I, shore through 36.4 m in depth; Stratum II, 36.5 through 146.1 m in depth; and Stratum III, 146.2 m in depth to midline of strait.

As was seen when comparing the male size frequency distributions between the three survey catches (Figure 7), comparing the population estimates of certain size and age groups with the expected estimate calculated from the previous survey is problematic. For instance, the population estimate for pre-recruit three males in 1981 was 1.8 - 3.9 million crabs. With an assumed natural mortality rate of 20% the estimated population or pre-recruit two males (after the annual molt) in 1982 should have been 1.4 - 3.1 million crabs. The 1982 survey produced a popula-

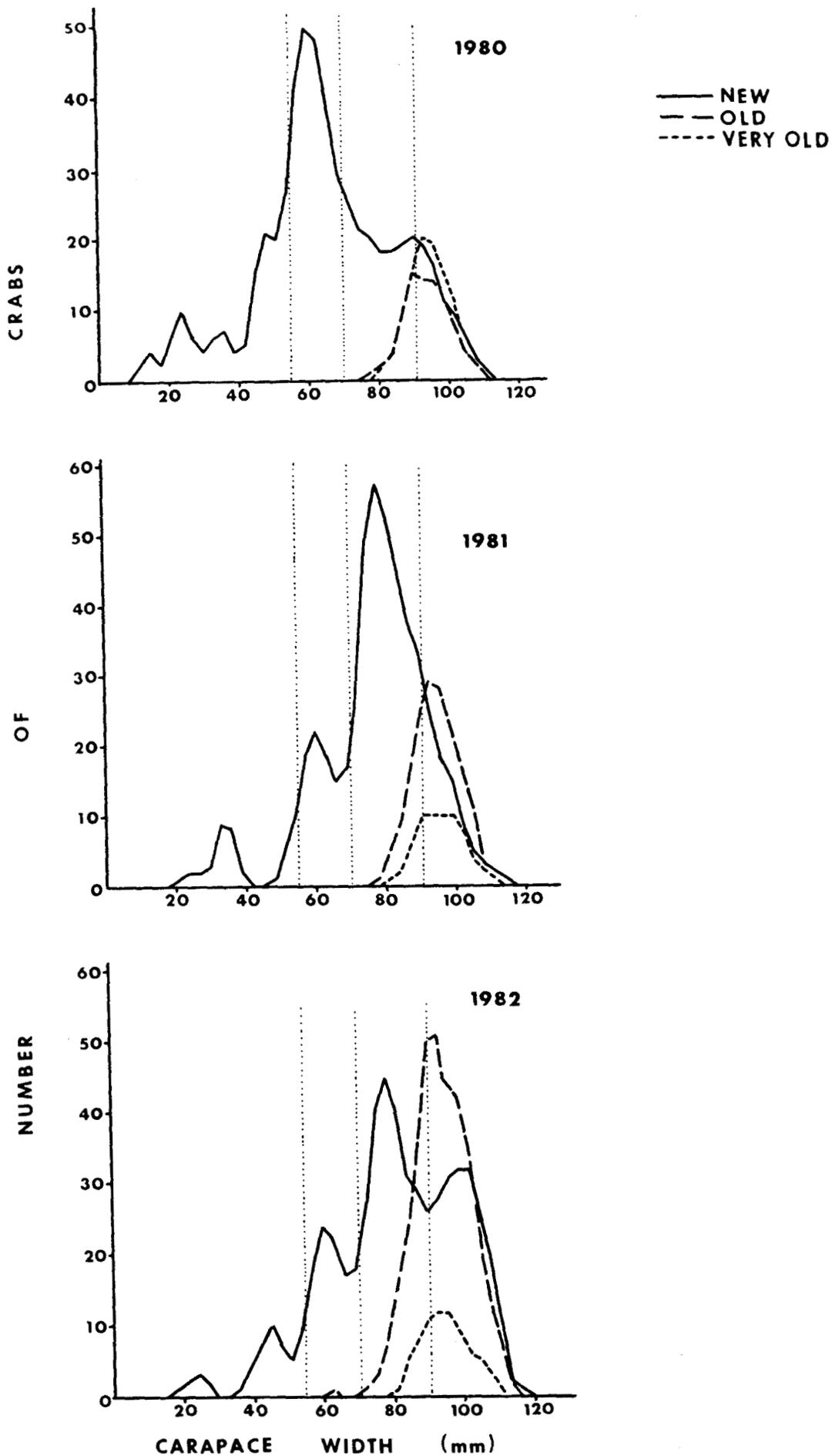


Figure 8. Carapace width frequencies of female Tanner crabs, *Chionoecetes bairdi*, measured on 1980-1982 North Mainland trawl surveys, Kodiak Management District. Dotted lines separate size groups (see Explanation of Terms).

Table 8. Population estimates for female and various size and age groups of male Tanner crabs, *Chionoecetes bairdi*, in the North Mainland fishing section, 1980, 1981, and 1982 Kodiak Management District trawl surveys.

Group	Population Estimate ± percent error		
	1980	1981	1982
Juvenile ♀	5,759,662 ± 18.5%	4,651,558 ± 34.0%	3,657,158 ± 31.6%
Adult ♀	4,408,643 ± 42.3%	5,211,812 ± 27.6%	7,552,062 ± 30.1%
Total ♀	10,168,305 ± 21.8%	9,862,336 ± 28.5%	11,208,187 ± 25.3%
Pre-recruit Fours	3,887,669 ± 22.1%	1,434,747 ± 35.4%	2,666,893 ± 40.5%
Pre-recruit Threes	1,812,040 ± 17.7%	2,829,181 ± 37.8%	2,858,124 ± 57.1%
Pre-recruit Twos	1,778,962 ± 25.0%	1,846,152 ± 22.8%	4,041,687 ± 18.8%
Pre-recruit Ones	2,210,007 ± 27.7%	1,736,582 ± 21.8%	6,121,450 ± 27.2%
Recruit Legals	777,327 ± 25.7%	1,082,262 ± 30.6%	2,126,279 ± 34.2%
Post-recruit Legals	449,651 ± 27.4%	333,878 ± 22.6%	537,513 ± 29.4%
Total Legals	1,226,978 ± 21.1%	1,415,107 ± 27.2%	2,658,624 ± 32.3%
Total Males	10,915,656 ± 13.1%	9,261,768 ± 20.8%	18,365,484 ± 22.0%
No. tows	30	17	28

tion estimate of 3.3 - 4.8 million crabs. Although the high end of the 1981 estimate is close to the low end of the 1982 estimate, the estimate in 1982 is higher than what would have been expected from the 1981 survey data. Comparisons of population estimates of pre-recruit one and legal sized crabs between surveys are difficult (maybe impossible at this time) because of the presence of significant numbers of skip molt crabs in the larger size groups which hampers our ability to make recruitment predictions.

In an attempt to account for skip molting in the pre-recruit one size group when making recruitment predictions we have used a Recruitment Coefficient which compares the number of recruit legal crabs with the number of oldshell pre-recruit one crabs from a survey. These two groups of crabs represent 1 year class, so the ratio between the two (the Recruitment Coefficient) should represent that proportion of pre-recruit one crabs that molted into legal size the previous molting season. The coefficient can then be applied to future recruitment predictions and will hopefully be an adequate estimate of the amount of skipmolting that will occur (Table 9). Recruitment coefficients calculated from the 1980 and 1981 surveys indicated that 57.3% of the 1980 pre-recruit one crabs would molt to legal size (recruits) in 1981 (Table 9a) and that 69.2% of the 1981 pre-recruit one crabs would molt to legal size in 1982 (Table 9b). The 1982 recruitment forecast (from the 1980 survey data) was 911,760 crabs when calculated from the 1980 survey population estimate of pre-recruit one crabs, and 974,036 crabs when calculated from the 1981 survey population estimate of recruit legals (Table 9a). These estimates were quite similar and would lead one to suspect that: (1) the 1980 and 1981 survey results are comparable for those size and age groups; and (2) the "Recruitment Coefficient" is an adequate method of accounting for skip molting in these recruitment predictions. Unfortunately, the same exercise using the subsequent survey and commercial seasons does not produce similar results (Table 9b). The 1983 recruitment forecast (from the 1981 survey data) was 865,235 crabs when calculated from the 1981 survey population estimate of pre-recruit one crabs and 1,913,651 crabs when calculated from the 1982 survey population estimate of recruit legals (Table 9b). Even when the range of 1,259,182 - 2,568,120 crabs is considered, the estimates aren't very close. It is not possible for us to determine which of the survey forecasts is most correct with the data we have. It is possible that the 1981 survey, with only 17 tows, undersampled the pre-recruit one group of male crabs. The 1982 survey, which was more intensive, would seem to indicate this. The answer to this question may become clear when we do the 1983 survey which will equal the 1982 survey in sampling intensity.

Another way of checking the results of the trawl survey is to calculate a population estimate of total legal crabs from the subsequent commercial fishery using the Leslie population estimation method (Leslie and Davis 1939). This was done for the 1981 and 1982 fisheries (Figure 9). Again, the results were mixed. The Leslie population estimate generated from the 1981 season was 1,536,182 crabs. This was considerably higher than the 1,104,280 crab population estimate generated by the 1980 survey. Some of the discrepancy may be explained by the low  $r^2$  value which was only 0.74. The Leslie population estimate generated from the 1982 commercial fishery information from the North Mainland fishing section was 1,268,000 crabs. This was very close to the 1,273,596 crab estimate produced by the 1981 trawl survey (adjusted for natural mortality to the start of the 1982 season). The  $r^2$  value on this Leslie estimate was a high 0.98. While it is encouraging that the two methods seem to verify each other, the close correlation is puzzling

Table 9. Legal male Tanner crab, *Chionoecetes bairdi*, recruitment forecasts from pre-recruit one crab population estimates to their respective commercial fisheries, 1980 (a) and 1981 (b) North Mainland trawl surveys, Kodiak Management District.

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(a) Recruitment forecast from 1980 survey

$$\text{Recruitment Coefficient (RC)} = 0.573$$

$$\begin{aligned} \text{Recruitment to 1982 fishery} &= A \times \text{RC, where } A = 2,210,007 \times .72^1 \\ & \times 0.573 = 1,591,205 \\ & = 911,760 \text{ crabs (recruit legals)} \end{aligned}$$

Population estimate of recruits at start of 1982 fishery from 1981 trawl survey data = 675,981 - 1,272,091 crabs, midpoint of 974,036 crabs.

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(b) Recruitment forecast from 1981 survey

$$\text{Recruitment Coefficient (RC)} = .692$$

$$\begin{aligned} \text{Recruitment to 1983 fishery} &= A \times \text{RC, where } A = 1,736,582 \times .72^1 \\ & = 1,250,339 \times .692 \\ & = 865,235 \text{ crabs (recruit legals)} \end{aligned}$$

Population estimation of recruits at start of 1983 fishery from 1982 trawl survey data = 1,259,182 - 2,568,120 crabs, midpoint of 1,913,651 crabs.

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<sup>1</sup>Survival after 1-1/2 years at 20% annual natural mortality.

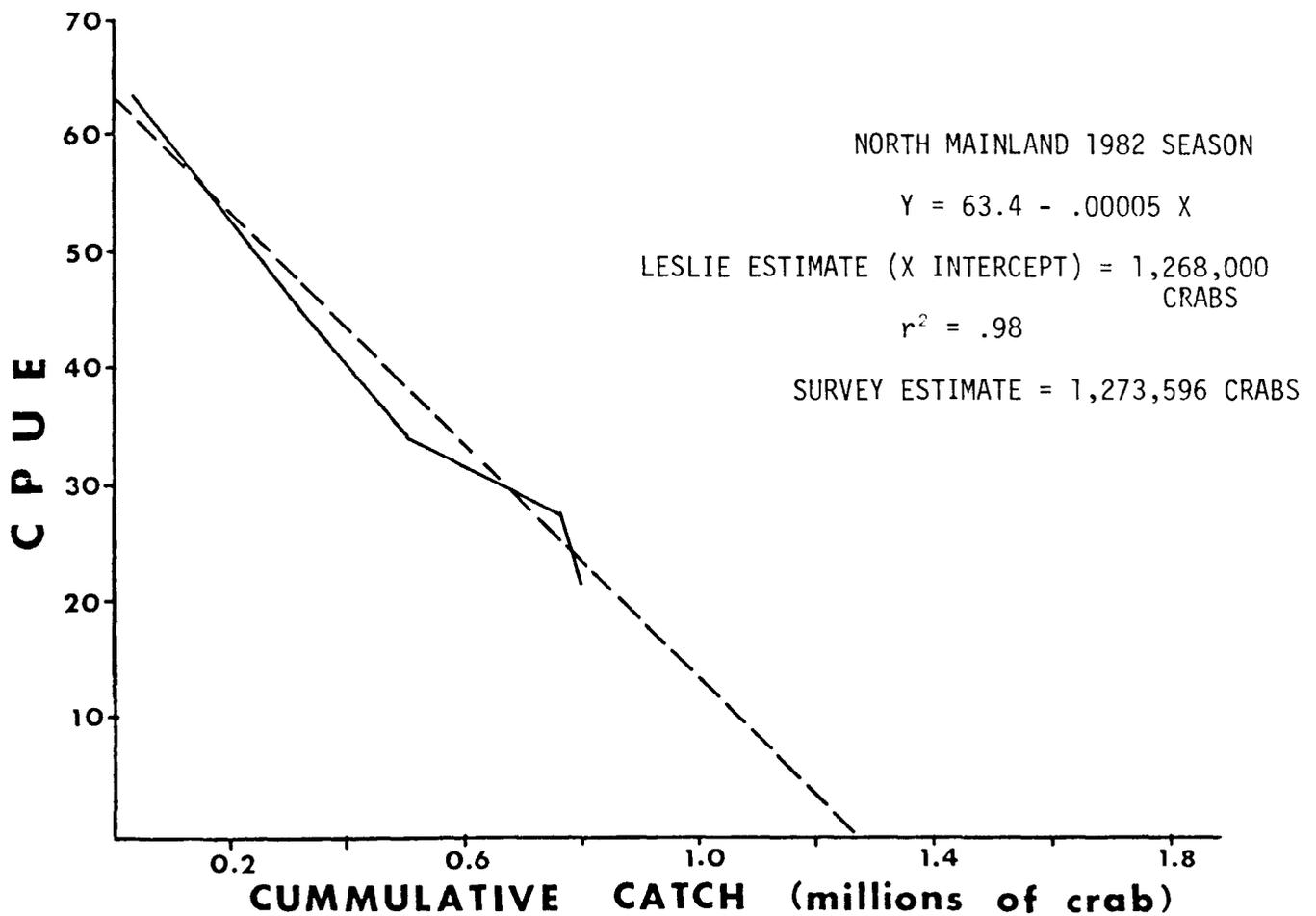
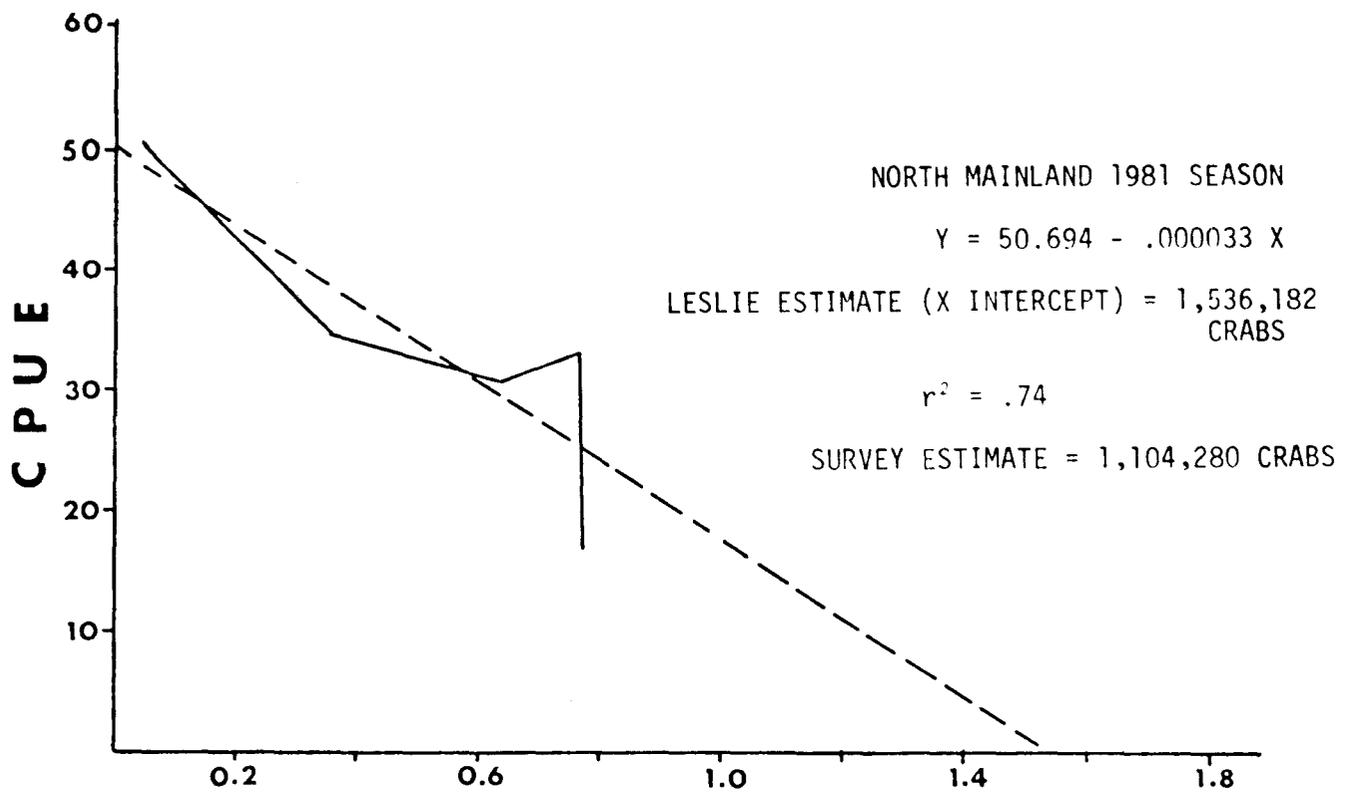


Figure 9. Leslie population estimates for legal size Tanner crabs, *Chionoecetes bairdi*, from 1981 and 1982 North Mainland commercial catch data, Kodiak Management District.

since we generally have not had as much confidence in the results of the 1981 survey compared to the 1980 and 1982 trawl surveys. It is probably because of the way the 1982 fishing season progressed; data from that fishery lent itself to the Leslie analysis better than the data procured from the 1981 fishery. Sampling intensity on the 1981 trawl survey was only half that of the 1980 or 1982 surveys. It will be interesting to see what kind of Leslie estimate we get from the 1983 commercial season when compared to the population estimate of legal sized crabs from the 1982 trawl survey. It must also be kept in mind that the commercial fishery information used to generate the Leslie population estimate is only as good as the information given to commercial processors by fishermen when landing their catches. This, plus the fact that for a number of reasons, the catch per pot can actually rise toward the end of the Tanner crab commercial season, suggests that the Leslie population estimation should only be used when the manager has confidence in the fishery data and CPUE follows a "normal" pattern of decline as the fishery progresses.

Hopefully, the 1983 and 1984 trawl surveys in the North Mainland fishing section of the Kodiak Management District will be able to answer some of the questions that have arisen from the previous three surveys. It would be particularly helpful if we could determine what effect tow distribution has on the accuracy of our population estimates.

Uyak and Uganik Bay. After completing work in the North Mainland fishing section of the Kodiak Management District the vessel headed for the Chignik Management District to begin the survey work scheduled. Unfortunately, the weather deteriorated to the point that we headed for cover in Uyak Bay on Kodiak Island (Figure 1). While waiting for better weather we utilized our time by attempting to survey Uyak and Uganik Bays (Figure 1). After completing our survey of the Chignik Management District we spent another day trawling in Uyak and Uganik Bays in the hope of completing an adequate survey. In both Uyak and Uganik Bays our trawling efforts were hampered by the presence of a large amount of Dungeness crab gear in some areas of the bays.

Eight tows were successfully made in Uyak Bay (Figure 10) while seven tows were made in Uganik Bay (Figure 11) in 1982.

The area considered surveyed was 115 km<sup>2</sup> in Uganik Bay with a sampling intensity of 1 tow per 19 km<sup>2</sup>. In Uyak Bay 100 km<sup>2</sup> were considered surveyed at 1 tow per 14 km<sup>2</sup>. Despite the high sampling intensity in the two bays, results of a partial analysis was disappointing. Population estimates for legal size crabs seemed quite low and the percent errors around the estimates too high (> 34%). This may have been a result of our inability to make more tows or successfully complete tows in the heads of the respective bays. As a result of our problems with the data a complete analysis was not conducted on the Uyak and Uganik surveys.

The Tanner crab catch per 1.85 km for various size and age groups is included for general interest (Table 10). In Uyak Bay (Table 10a) 993 crabs were captured with two-thirds of the total being males (625 individuals). Eighteen percent (111 individuals) of the male crabs were legal size. Of the 368 females captured, all of the adults (174 individuals) had egg clutches. In Uganik Bay (Table 10b), 851 Tanner crabs were captured with three-fourths of the total being males (637 individuals). Thirty-two percent of the male crabs were legal size. Of the 214

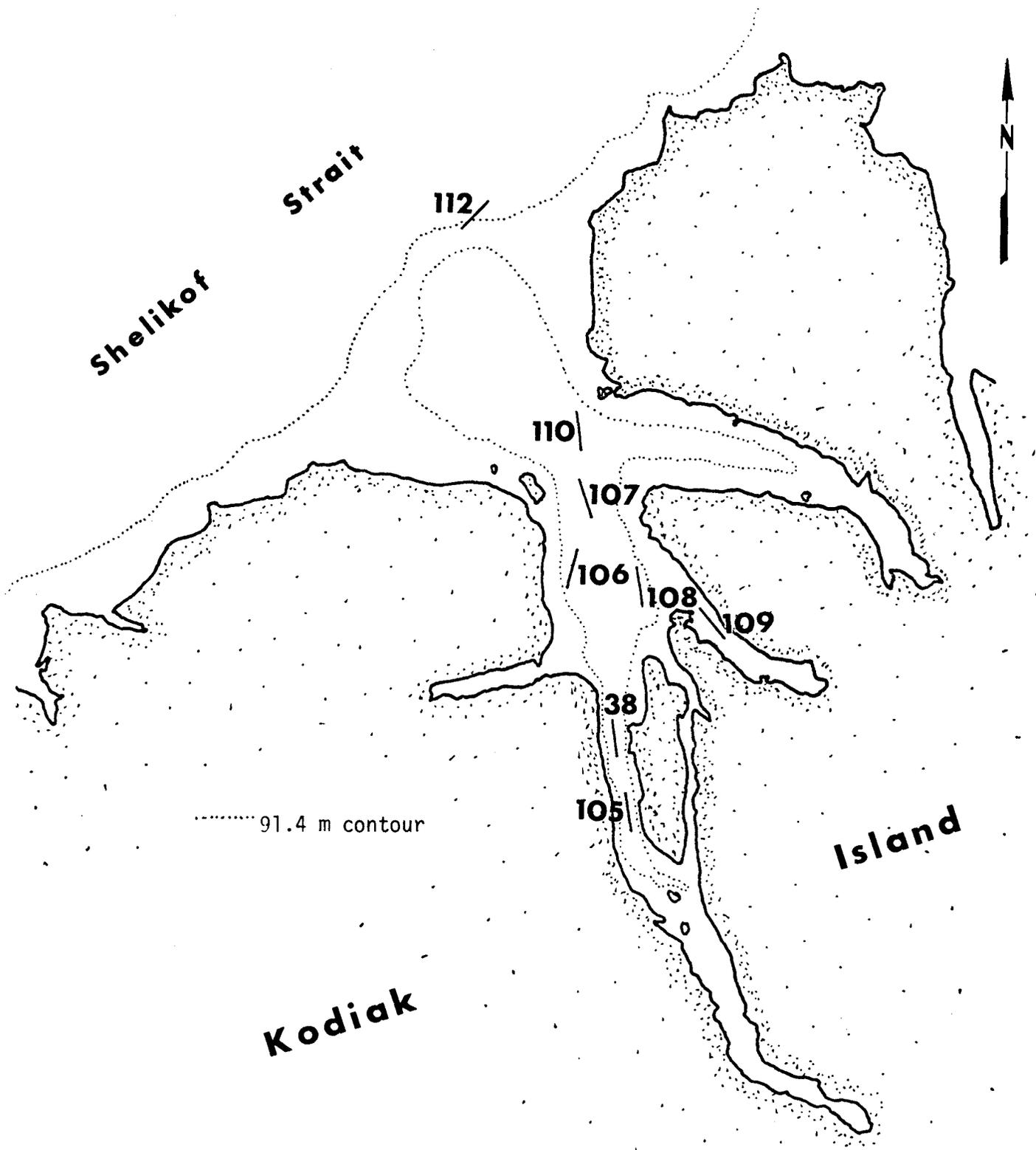


Figure 10. Uyak Bay area tow locations, 1982 Kodiak Management District trawl survey.

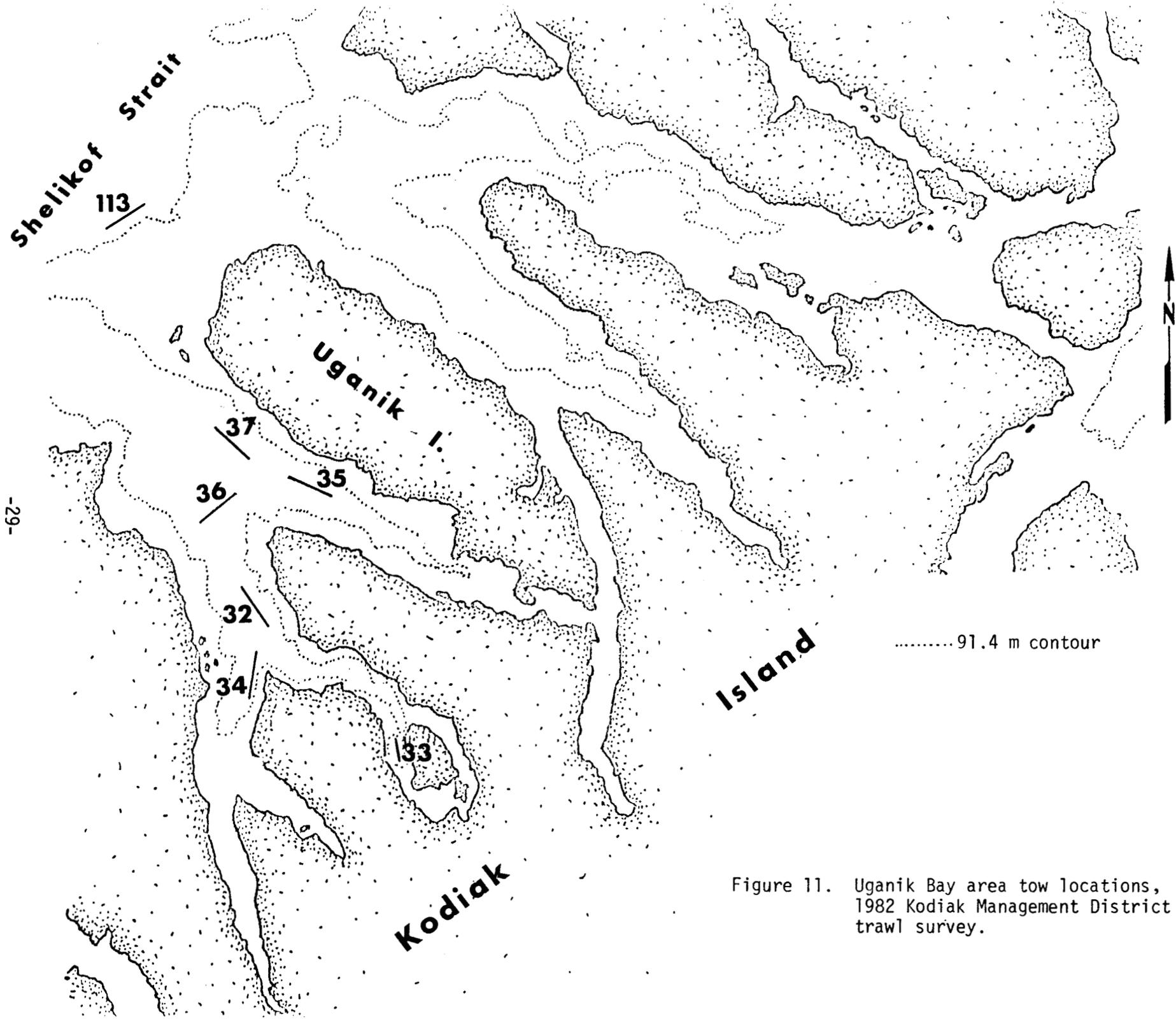


Figure 11. Uganik Bay area tow locations, 1982 Kodiak Management District trawl survey.

Table 10. Number of Tanner crabs, *Chionoecetes bairdi*, captured per 1.85 km in a) Uyak Bay and b) Uganik Bay, 1982 Kodiak Management District trawl survey.

a) Uyak Bay

Tow No.	Juv. ♀	Adult ♀	Total Female	Prerecruit Four ♂	Prerecruit Three ♂	Prerecruit Two ♂	Prerecruit One ♂	Recruit Legal ♂	Postrecruit Legal ♂	Total Legal ♂	Total Male	Total Crabs
38	5	1	6	1	3	11	23	35	8	43	81	87
105	96	5	101	34	74	90	47	12	5	17	262	363
106	13	37	50	2	3	3	9	6	1	7	24	74
107	8	35	43	6	11	2	13	2	1	3	35	78
108	38	24	62	20	27	30	16	8	5	13	106	168
109	3	48	51	1	1	1	9	14	10	24	36	87
110	9	23	32	11	15	8	19	1	2	3	56	88
112	22	1	23	22	0	0	2	0	1	1	25	48
Total	194	174	368	97	134	145	138	78	33	111	625	993

-30-

b) Uganik Bay

Tow No.	Juv. ♀	Adult ♀	Total Female	Prerecruit Four ♂	Prerecruit Three ♂	Prerecruit Two ♂	Prerecruit One ♂	Recruit Legal ♂	Postrecruit Legal ♂	Total Legal ♂	Total Male	Total Crabs
32	8	5	13	5	14	24	38	76	12	88	169	182
33	2	7	9	3	2	14	29	32	5	37	85	94
34	11	7	18	8	6	20	43	25	2	27	104	122
35	3	56	59	2	2	9	37	27	7	34	84	143
36	55	22	77	66	24	16	19	6	2	8	133	210
37	2	33	35	5	5	14	24	8	2	10	58	93
113	3	0	3	4	0	0	0	0	0	0	4	7
Total	84	130	214	93	53	97	190	174	30	204	637	851

females captured, all of the adults (130 individuals) had egg clutches.

We may decide to survey Uyak and Uganik Bays at a later date. If we do we will have to increase our sampling intensity considerably to see exactly how many tows we need to obtain sufficient data for an adequate survey. The survey will also have to be done at a time when conflicts with Dungeness crab gear can be avoided.

#### Chignik Management District, 1981-1982:

Before 1981, the ADF&G did not assess crab populations in the Chignik Management District of the Westward Region. In order to obtain needed information on Tanner crab stocks, a trawl survey was initiated in 1981. The 1982 survey provided the second year's information and we hope to continue surveying the District for a minimum of two more years.

The area sampled on the two Chignik trawl surveys varied somewhat between 1981 and 1982. In 1981, the area sampled was east of a line from the southernmost tip of Kupreanof Point to the easternmost point of Castle Rock and east of a line extending southeast ( $135^\circ$ ) from the easternmost point of Castle Rock and west of  $157^\circ 27' 00''$  West longitude out to the continental shelf break at 182.9 m (Figure 12). This represented an area of 11,287 km<sup>2</sup>. The area sampled was cut to 5,204 km<sup>2</sup> (Figure 12, shaded area) on the 1982 trawl survey in order to concentrate effort in the area traditionally fished during the commercial fishing season. In order to facilitate comparison of the two surveys, only the tows completed in the 1982 survey area will be reported here. (For a full discussion of the 1981 survey in the Chignik Management District see Colgate and Hicks 1982.)

Of the 55 successfully completed tows on the 1981 trawl survey 46 were made in an area comparable to that surveyed in 1982 when 60 tows were used in calculating Tanner crab population estimates (Figure 13 and 14). Each survey was stratified into inshore and offshore stations. In 1981 sampling intensity in the inshore areas was 1 tow per 72 km<sup>2</sup> while the offshore stratum was sampled at a tow density of 1 tow per 137 km<sup>2</sup>. In 1982 sampling intensity inshore was 1 tow/35 km<sup>2</sup> while each tow represented 159 km<sup>2</sup> in the offshore areas.

All animal forms captured on the Chignik trawl surveys were ranked according to their relative weight in catch in kg/hr. Results from the 1981 survey are presented elsewhere (Colgate and Hicks 1982). The results of the 1982 survey (Table 11) shows the top three positions in the species ranking occupied by three fishes: walleye pollock, flathead sole and arrowtooth flounder. These species produced 491, 420, and 265 kg/hr of tows, respectively. The same species held the top three positions on the 1981 survey. Male Tanner crabs were in sixth place in the species ranking with 63 kg/hr of tows while female Tanner crabs were in seventeenth place with only 5 kg/hr of tows. Combining the catch figures for both sexes does not affect the ranking; total Tanner crab would place sixth with 68 kg/hr of tows. In 1981 total Tanner crab ranked seventh with 43 kg/hr of tows being captured.

The Tanner crab portion of the catch was standardized to 1.85 km (1 nm) tows. In these terms, 2,065 crabs were captured on the 1981 survey while 4,204 crabs were captured on the 1982 Chignik trawl survey (Tables 12 and 13). The higher catches in 1982 were partly a result of the higher number of tows made in 1982;

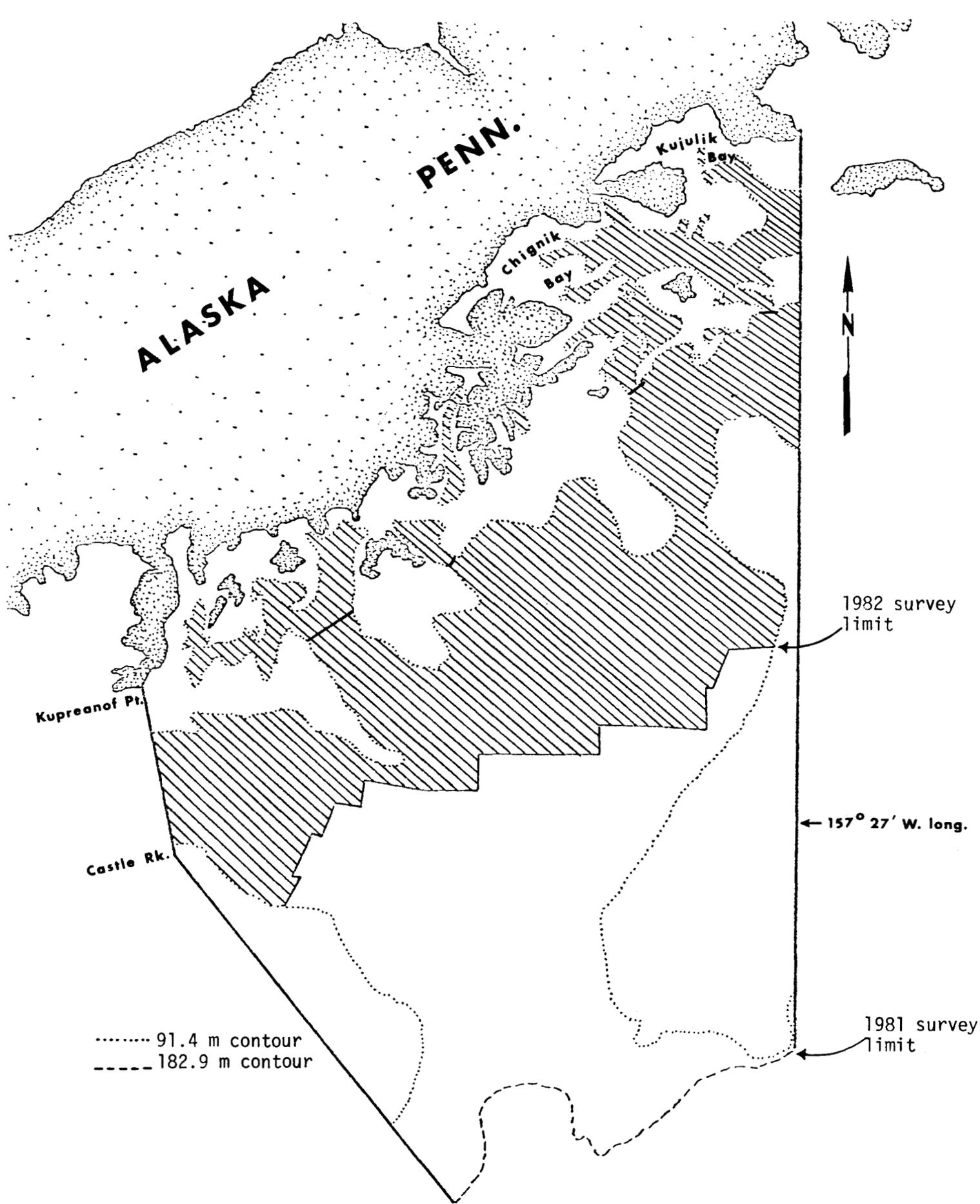


Figure 12. Areas surveyed on 1981 (shore to 182.9 m contour) and 1982 (shaded) trawl surveys in the Chignik Management District.

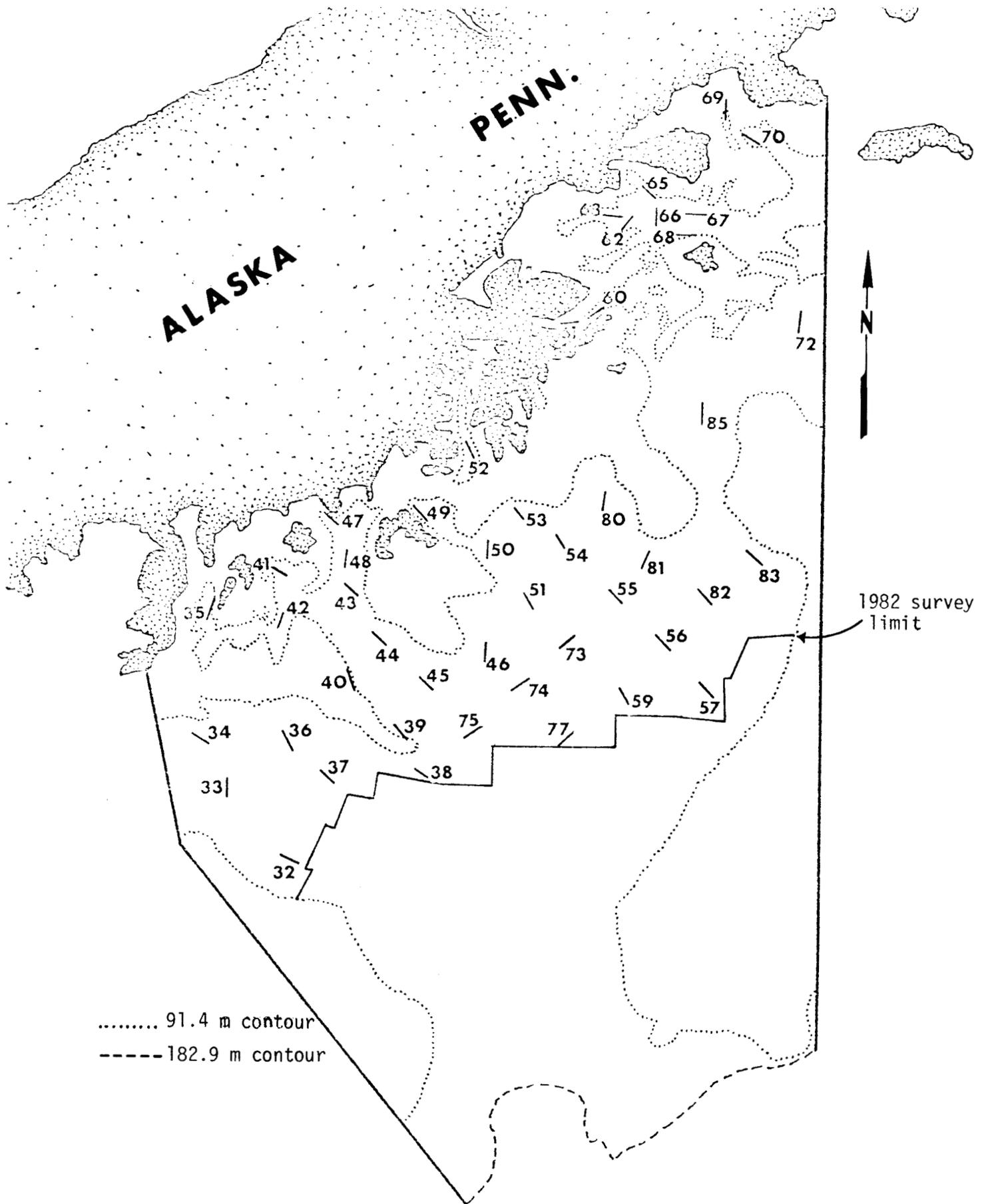


Figure 13. Tow locations, 1981 Chignik Management District trawl survey (in area comparable to area surveyed in 1982).

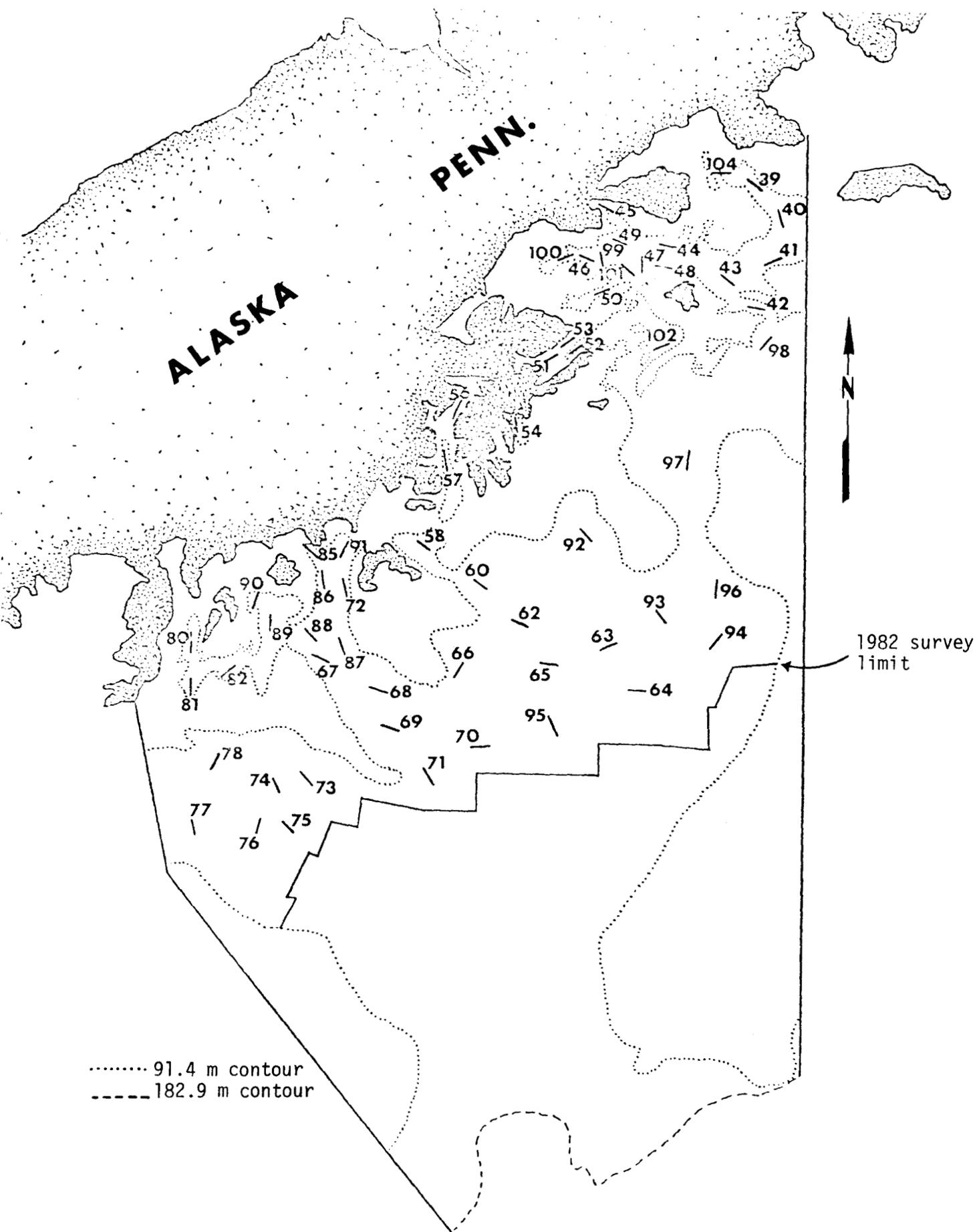


Figure 14. Tow locations, 1982 Chignik Management District trawl survey.

Table 11. Common and scientific name, rank, and catch per unit of effort (CPUE) of taxa captured on the 1982 Chignik Management District trawl survey.

Common Name	Scientific Name	Rank	CPUE kg/hr
Walleye pollock	<i>Theragra chalcogramma</i>	1	491
Flathead sole	<i>Hippoglossoides elassodon</i>	2	420
Arrowtooth flounder	<i>Atheresthes stomias</i>	3	265
Pacific cod	<i>Gadus macrocephalus</i>	4	147
Yellowfin sole	<i>Limanda aspera</i>	5	78
Tanner crab male	<i>Chionoecetes bairdi</i>	6	63
Pacific halibut	<i>Hippoglossus stenolepis</i>	7	55
Rock sole	<i>Lepidopsetta bilineata</i>	8	36
Great sculpin	<i>Myoxocephalus</i> spp.	9	31
Sablefish	<i>Anoplopoma fimbria</i>	10	24
Bigmouth sculpin	<i>Hemitripterus bolini</i>	11	18
Eelpout (unident.)	Family Zoarcidae	12	15
Big skate	<i>Raja binoculata</i>	13	10
Starfish (unident.)	Class Asteroidea	14	8
Yellow Irish Lord	<i>Hemilepidotus jordani</i>	15	7
Rougheye rockfish	<i>Sebastes aleutianus</i>	16	6
Tanner crab female	<i>Chionoecetes bairdi</i>	17	5
Shrimp (unident.)	Order Decapoda (Suborder Natantia)	18	5
Plain sculpin	<i>Myoxocephalus</i> spp.	19	5
Rex sole	<i>Glyptocephalus zachirus</i>	20	4
Weathervane scallop	<i>Patinopecten caurinus</i>	21	4
Mud starfish	<i>Ctenodiscus crispatus</i>	22	4
Dungeness crab	<i>Cancer magister</i>	23	3
Oregon triton	<i>Fusitriton oregonense</i>	24	3
Hermit crab	Family Paguridae	24	3
Eulachon	<i>Thaleichthys pacificus</i>	26	2
Spinyhead sculpin	<i>Dasycottus setiger</i>	27	2
Red king crab male	<i>Paralithodes camtschatica</i>	28	2
Alaska plaice	<i>Pleuronectes quadrituberculatus</i>	29	1
Longsnout prickleback	<i>Lumpenella longirostris</i>	29	1
Sea anemone	Order Actiniaria	31	.9
Northwest neptune	<i>Neptunea lyrata</i>	32	.7
Searcher	<i>Bathymaster signatus</i>	33	.6
Sculpin	Family Cottidae	34	.5
Longnose skate	<i>Raja rhina</i>	35	.4
Giant wrymouth	<i>Delolepis gigantea</i>	36	.2
Jellyfish (unident.)	Phylum Cnidaria	36	.2
Dusky rockfish	<i>Sebastes ciliatus</i>	36	.2
Prickleback	Family Stichaeidae	36	.2
Spiny dogfish shark	<i>Squalus scanthius</i>	40	.1
Dover sole	<i>Microstomus pacificus</i>	40	.1
Pacific sandfish	<i>Trichodon trichodon</i>	40	.1
Pacific Ocean perch	<i>Sebastes alutes</i>	40	.1
Northern rockfish	<i>Sebastes polyspinis</i>	40	.1
Poacher	Family Agonidae	40	.1
Octopus	<i>Octopus dofleini</i>	40	.1
Capelin	<i>Mallotus villosus</i>	40	.1
Nudibranchs	Order Nudibranchia	40	.1
Pacific herring	<i>Clupea harengus pallasii</i>	40	.1
Basket starfish	<i>Gorgonocephalus caryi</i>	40	.1

Table 12. Number of Tanner crabs, *Chionoecetes bairdi*, captured per 1.85 km, 1981 Chignik Management District trawl survey.

Tow No.	Juv. ♀	Adult ♀	Total Female	Pre-recruit Four ♂	Pre-recruit Three ♂	Pre-recruit Two ♂	Pre-recruit One ♂	Recruit Legal ♂	Post-recruit Legal ♂	Total Legal ♂	Total Male	Total Crabs
32	12	19	31	6	1	11	23	1	1	2	43	74
33	1	1	2	3	6	6	3	0	0	0	18	20
34	10	26	36	13	1	4	9	0	1	1	28	64
35	13	21	34	1	26	92	127	91	2	93	339	373
36	20	0	20	23	1	1	2	0	0	0	27	47
37	17	4	21	12	1	3	7	0	1	1	24	45
38	11	2	13	8	2	1	0	0	0	0	11	24
39	1	1	2	1	0	1	1	0	0	0	3	5
40	1	0	1	2	0	0	0	0	0	0	2	3
41	6	29	35	9	3	8	21	1	3	4	45	80
42	2	1	3	0	0	0	2	1	0	1	3	6
43	3	0	3	3	0	0	2	0	0	0	5	8
44	2	2	4	3	1	1	3	2	1	3	11	15
45	1	5	6	0	0	1	8	2	4	6	15	21
46	5	1	6	9	0	0	0	0	0	0	9	15
47	1	0	1	1	0	1	1	1	0	1	4	5
48	0	1	1	0	0	2	11	6	3	9	22	23
49	0	1	1	1	1	5	21	11	0	11	39	40
50	4	1	5	1	1	1	5	12	3	15	23	28
51	0	1	1	3	0	1	1	3	1	4	9	10
52	0	0	0	2	1	10	13	4	0	4	30	30
53	5	3	8	4	1	3	9	5	1	7	24	32
54	25	3	28	21	1	6	6	2	0	2	36	64
55	5	1	6	5	0	3	3	0	1	1	12	18
56	3	1	4	0	0	3	8	1	1	2	13	17
57	0	1	1	1	0	1	9	1	2	3	14	15
59	0	0	0	1	0	3	6	3	0	3	13	13
60	4	207	211	1	1	24	88	28	23	51	165	376
61	18	1	19	13	6	4	14	14	2	16	53	72
62	0	6	6	1	0	5	12	8	1	9	27	33

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-Continued-

Table 12. Number of Tanner crabs, *Chionoecetes bairdi*, captured per 1.85 km, 1981 Chignik Management District trawl survey (continued).

Tow No.	Juv. ♀	Adult ♀	Total Female	Pre-recruit Four ♂	Pre-recruit Three ♂	Pre-recruit Two ♂	Pre-recruit One ♂	Recruit Legal ♂	Post-recruit Legal ♂	Total Legal ♂	Total Male	Total Crabs
63	7	2	9	3	11	21	35	24	1	25	95	104
65	4	2	6	0	6	28	80	59	6	65	179	185
66	1	1	2	1	0	1	13	5	1	6	21	23
67	7	0	7	7	0	1	7	5	0	5	20	27
68	1	3	4	2	0	1	20	11	3	14	37	41
70	1	2	3	1	1	1	3	1	0	1	7	10
72	2	0	2	1	0	1	0	0	0	0	3	5
73	1	1	2	1	0	1	2	0	0	0	4	6
74	3	0	3	3	1	2	1	1	0	1	8	11
75	0	0	0	0	0	1	0	0	0	0	1	1
77	3	2	5	3	1	4	4	1	0	1	13	18
80	1	1	2	1	0	0	2	2	0	2	5	7
81	1	1	2	1	0	0	0	0	0	0	1	3
82	1	0	1	2	1	1	3	0	0	0	7	8
83	2	0	2	1	0	0	1	0	0	0	2	4
85	0	6	6	0	0	1	11	16	2	18	30	36
Totals	205	360	565	175	75	265	602	322	65	387	1,500	2,065

Table 13. Number of Tanner crabs, *Chionoecetes bairdi*, captured per 1.85 km, 1982 Chignik Management District, trawl survey.

Tow No.	Juv. ♀	Adult ♀	Total Female	Pre-recruit Four ♂	Pre-recruit Three ♂	Pre-recruit Two ♂	Pre-recruit One ♂	Recruit Legal ♂	Post-recruit Legal ♂	Total Legal ♂	Total Male	Total Crabs
39	35	18	53	22	33	5	10	22	3	25	95	148
40	3	1	4	8	0	1	0	1	0	1	10	14
41	27	2	29	19	2	2	11	12	3	15	49	78
42	4	21	25	4	4	6	32	29	6	35	81	106
43	24	2	26	19	2	0	3	9	1	10	34	60
44	16	5	21	3	1	3	16	27	7	34	57	78
45	4	9	13	3	0	1	9	9	2	11	24	37
46	6	25	31	5	2	10	22	14	9	23	62	93
47	3	6	9	4	0	3	21	25	6	31	59	68
48	20	6	26	24	0	0	12	45	21	66	102	128
49	12	3	15	20	8	2	23	22	11	33	86	101
50	17	2	19	14	16	12	20	40	8	48	110	129
51	42	1	43	45	26	1	1	2	0	2	75	118
52	6	78	84	3	1	3	12	7	4	11	30	114
53	107	46	153	27	79	30	26	40	16	56	218	371
54	105	1	106	95	3	0	22	47	9	56	176	282
56	21	0	21	21	35	43	45	16	1	17	161	182
57	0	4	4	3	1	7	59	86	4	90	160	164
58	3	0	3	2	0	3	7	26	0	26	38	41
59	4	1	5	5	2	2	6	5	0	5	20	25
60	0	0	0	1	0	0	0	0	0	0	1	1
62	1	1	2	0	0	0	5	0	4	4	9	11
63	1	0	1	0	0	1	8	0	4	4	13	14
64	0	0	0	0	0	2	7	4	0	4	13	13
65	0	0	0	0	0	1	8	1	1	2	11	11
66	1	0	1	1	1	2	1	0	0	0	5	6
67	5	1	6	4	0	2	2	0	0	0	8	14
68	19	1	20	10	0	3	8	1	2	3	24	44
69	9	7	16	13	2	2	8	0	1	1	26	42
70	5	7	12	4	1	3	6	0	2	2	16	28
71	3	4	7	0	0	3	7	2	3	5	15	22
72	5	12	17	1	0	2	36	145	13	158	197	214

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Table 13. Number of Tanner crabs, *Chionoecetes bairdi*, captured per 1.85 km, 1982 Chignik Management District, trawl surveys (continued).

Tow No.	Juv. ♀	Adult ♀	Total Female	Pre-recruit Four ♂	Pre-recruit Three ♂	Pre-recruit Two ♂	Pre-recruit One ♂	Recruit Legals ♂	Post-recruit Legal ♂	Total Legal ♂	Total Male	Total Crabs
73	1	0	1	0	0	1	0	0	0	0	1	2
74	9	0	9	6	0	2	6	0	0	0	14	23
75	6	1	7	3	0	1	2	0	0	0	6	13
76	9	4	13	9	0	1	6	3	0	3	19	32
77	15	4	19	14	0	4	7	0	1	1	26	45
78	2	0	2	1	0	2	3	0	1	1	7	9
80	22	0	22	27	0	1	3	5	1	6	37	59
81	1	0	1	4	0	0	6	13	7	20	30	31
82	8	1	9	10	0	2	2	0	0	0	14	23
85	22	0	22	22	1	0	9	7	2	9	41	63
86	18	52	70	14	0	5	24	38	4	42	85	155
87	2	3	5	4	1	0	8	1	0	1	14	19
88	29	2	31	19	3	6	4	1	0	1	33	64
89	2	0	2	0	0	0	4	1	0	1	5	7
90	21	9	30	28	1	19	19	9	9	9	76	106
91	10	0	10	11	1	3	16	24	0	24	55	65
92	3	5	8	1	1	8	20	19	6	25	55	63
93	0	0	0	0	0	2	9	0	0	0	11	11
94	2	0	2	3	0	3	3	0	1	1	10	12
95	0	0	2	1	1	3	12	3	2	5	22	24
96	0	1	1	0	0	4	16	0	2	2	22	23
97	3	23	26	5	1	9	34	14	14	28	77	103
98	6	4	10	5	1	5	23	20	7	27	61	71
99	13	8	21	12	0	2	19	16	23	39	72	93
100	23	16	39	21	5	25	47	45	10	55	153	192
101	3	3	6	6	0	1	8	26	18	44	59	65
102	5	0	5	6	0	4	8	24	5	29	47	52
104	8	3	11	7	0	0	3	0	1	1	11	22
Totals	753	403	1,156	619	235	268	774	906	246	1,152	3,048	4,204

60 tows, as compared to 46 tows in 1981. More sampling was done in nearshore areas in 1982 where crab catches were generally larger. On both surveys the portion of the total Tanner crab captured that were males was 73%.

Looking at the male portion of the catches by size and age groups (Table 14), a fair amount of variation was observed between the two surveys. In 1981, pre-recruit one crabs accounted for the largest portion of the male catch, 39.9%, while recruits were most abundant in the 1982 catch with 29.7% of the total. This trend makes sense since the 1981 pre-recruit one group should have molted into the recruit category in 1982. Another interesting observation occurred in the pre-recruit three and two crab groups in 1981 and 1982, respectively. Pre-recruit threes comprised a low 5.0% of the male catch in 1981. In 1982, the subsequent size group, pre-recruit twos, comprised only 8.8% of the catch. This indicates an apparent weak year class which will be further described below. The catch of small sized crabs, pre-recruit fours, improved between 1981 and 1982 both in terms of numbers of crabs captured and the portion of the total catch which it comprised (Table 14). The observed increase was from 175 males in 1981 to 619 males in 1982, a 254% increase. Hopefully, this indicates a recovery from the relatively low numbers of pre-recruit three and two crabs captured on the first survey. Percentage-wise the increase in the portion of the total male catch that was pre-recruit four was 8.6%. Of the legal sized portion of the male catch, recruits accounted for 83.2% in 1981 and a slightly lower 78.6% in 1982. It is apparent that we are in a recruit type fishery for Tanner crab in the Chignik Management District. Breaking down the male catch by shell age composition (Table 15) revealed a relatively stable picture between 1981 and 1982, with the exception of the pre-recruit one group. The portion of pre-recruit ones that was oldshell increased from 17.2% in 1981 to 27.5% of the pre-recruit one catch on the 1982 survey. This represented a higher proportion of skip molting in that crab group than was observed on the first survey. The portion of post-recruits that were oldshell decreased from 70.8% to 48.4% between the two surveys.

Of the female Tanner crabs captured on the two Chignik surveys 565 females per 1.85 km were captured in 1981 while 1,156 were captured per 1.85 km in 1982 (Tables 12 and 13). The disparity between the two survey catches may be a result of clumping of the female population and tow distribution on the surveys. One of the locations producing a high catch of females on both surveys was tow 60 in 1981 (Figure 13 and Table 12) which captured 211 females and tow 52 in 1982 (Figure 14 and Table 13) which caught 84 females. This towing location was in the trough at the mouth of Castle Bay which also produced significant numbers of crabs during the commercial fishery. Essentially, all of the adult females had egg clutches. Juvenile females comprised 36.3% (205 individuals) of the female catch in 1981 and 64.1% (753 individuals) of the 1982 female catch. The difference can be attributed to the greater sampling intensity inshore where most of the higher catches of juvenile females were made.

One way of examining reproductive potential is by observing the relative egg clutch size of females. In Chignik, females with full egg clutches (90-100% full) accounted for 86.0% of the total females measured on the 1981 survey (Table 16), while in 1982 this group accounted for 80.8% of the total adult females measured. If females carrying partial egg clutches are included, females carrying eggs comprised 99.8% and 99.6% of the adult females measured on the 1981 and 1982 trawl surveys. It is probably accurate to conclude that, at the present time, the reproductive potential of the female Tanner crab stock in the Chignik Management District is in a healthy state.

Table 14. Number of male Tanner crabs, *Chionoecetes bairdi*, captured per 1.85 km by size and age group and percent total male catch, 1981 and 1982 Chignik Management District trawl surveys<sup>1</sup>.

Group	1981		1982		Percent of Legals	
	No.	%	No.	%	1981	1982
Pre-recruit Fours	175	11.7	619	20.3		
Pre-recruit Threes	75	5.0	235	7.7		
Pre-recruit Twos	265	17.7	268	8.8		
Pre-recruit Ones	598	39.9	774	25.4		
Recruit Legals	322	21.5	906	29.7	83.2	78.6
Post-recruit Legals	65	4.3	246	8.1	16.8	21.4
Total Legals	387	25.8	1,152	37.8		
Total Males	1,500	100.0	3,048	100.0		
No. of Tows		46		60		

<sup>1</sup> From comparable survey area.

Table 15. Number and percent male Tanner crabs, *Chionoecetes bairdi*, measured by size and age group and exoskeletal age, 1981 and 1982 Chignik Management District trawl surveys.

Group	NEWSHELL				OLDSHELL				VERY OLDSHELL				TOTAL			
	1981		1982		1981		1982		1981		1982		1981		1982	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Pre-recruit Fours	418	100.0	650	100.0	0	-	0	-	0	-	0	-	418	16.6	650	21.2
Pre-recruit Threes	132	98.5	225	98.7	2	1.5	3	1.3	0	-	0	-	134	5.3	228	7.4
Pre-recruit Twos	374	85.4	233	86.9	64	14.6	35	13.1	0	-	0	-	438	17.4	268	8.7
Pre-recruit Ones	775	82.8	543	70.5	161	17.2	212	27.5	0	-	15	2.0	936	37.2	770	25.1
Recruit Legals	495	100.0	903	100.0	NA		NA		NA		NA		495	19.7	903	29.5
Post-recruit Legals	28	29.2	117	47.9	68	70.8	118	48.4	0	-	9	3.7	96	3.8	244	8.0
Total Legals	523	88.5	1,020	88.9	68	11.5	118	10.3	0	-	9	0.8	519	23.5	1,147	37.4
Total Males	2,222	88.3	2,671	87.2	295	11.7	368	12.0	0	-	24	0.8	2,517	100.0	3,063	100.0

Table 16. Number of female Tanner crabs, *Chionoecetes bairdi*, measured by shell age and percent fullness of egg clutch, 1981 and 1982 Chignik Management District trawl surveys.

		1981																	
		0			1-24%			25-49%			50-74%			75-89%			90-100%		
Juvs.		N	O	VO	N	O	VO	N	O	VO	N	O	VO	N	O	VO	N	O	VO
No. measured	501		1			1			2	2	5	1		55	15	1	37	469	1
% (of adults)			0.2			0.2			0.3	0.3	0.8	0.2		9.3	2.5	0.2	6.3	79.5	0.2
% by class			0.2			0.2			0.6			1.0			12.0				86.0

		1982																	
No. measured	770	1	0	1	0	0	1	0	4	1	27	0	2	28	10	3	4	308	14
% (of adults)		0.2	-	0.2	-	-	0.2	-	1.0	0.2	6.7	-	0.5	6.9	2.5	0.7	1.0	76.3	3.5
% by class			0.4			0.2			1.2			7.2			10.1				80.8

The size frequency distribution of the male component of the Tanner crab catches on the 1981 and 1982 trawl surveys (Figure 15) showed the potential for a major decline in recruitment to legal size in 1984 (for the 1985 fishing season). This is based on the low numbers of pre-recruit three crabs captured in 1981 which was again seen in the pre-recruit two population observed during the 1982 survey. The final outcome of this growth schedule will be modified by skip molting, particularly in the pre-recruit one group. Unfortunately, we do not know enough about the mechanics of the molting schedule in Tanner crabs to state what the actual recruitment will be in 1984. It should also be noted that poor recruitment may last more than 1 year if the size frequency distribution is an accurate reflection of the male Tanner crab population structure. Pre-recruit four crabs were present in very low numbers in the 1981 catch. While the showing of pre-recruit three crabs in 1982 was low it was higher than the 1981 survey would have forecast. The variation may be due to tow distribution or the fact that the pre-recruit four and three crabs are not fully vulnerable to the trawl so may be captured in numbers which are not an accurate reflection of their true abundance; this problem increases as the size of the crabs being observed decreases.

The size frequency distribution of the female component of the Tanner crab catches on the 1981 and 1982 trawl surveys (Figure 16) essentially corroborated the observations made on the male component (Figure 15). It seems that low population levels of crabs 45-90 mm CW were present in the Chignik Management District. It should be kept in mind that the number of females used to generate the size frequency diagrams was not high (565 in 1981 and 1,156 in 1982). Another thing that should be pointed out (Figure 16) is that the observed frequency distribution of oldshell and very oldshell females (> 90 mm CW) in 1982 were not what would have been expected from the 1981 survey data. The oldshell crab population observed in 1981 should have appeared as very oldshell crabs in 1982. Instead of the expected observation, the 1982 survey showed a very low population of very oldshell crabs (Figure 16). The problem may have been a result of inconsistent shell aging by survey personnel; however, the same personnel were present on both surveys and were conscious of the need to be consistent in their shell aging. Since this problem may have also been responsible for some of the shell age data discrepancies seen in the 1980-1982 trawl survey catches in the North Mainland fishing section of the Kodiak Management District, it would seem that our shell aging procedure should be thoroughly examined and changes made when necessary. One approach might be to tag primiparous females and hold them over a considerable length of time photographing them monthly to get a good picture of the changes in the condition of the shell over time. This could also be done by tagging a local natural population though a great number of females would have to be tagged in order to obtain the required information. This method would be expensive in that considerable amounts of vessel time would be required over the course of such a study; however, it might be worth pursuing since the information obtained would reflect the situation in the natural environment which is always preferable to artificial situations.

Population estimates were calculated for female and several size and age groups of male Tanner crab using the standard area swept technique (Table 17). The area was stratified into inshore and offshore sampling areas (Figure 12) in order to lessen the variability between tow catches.

Male Tanner crab estimates in 1981 ranged from 344,882  $\pm$  30.1% for post-recruit legal crabs to 3,012,374  $\pm$  21.9% for pre-recruit one crabs. In 1982 the estimates

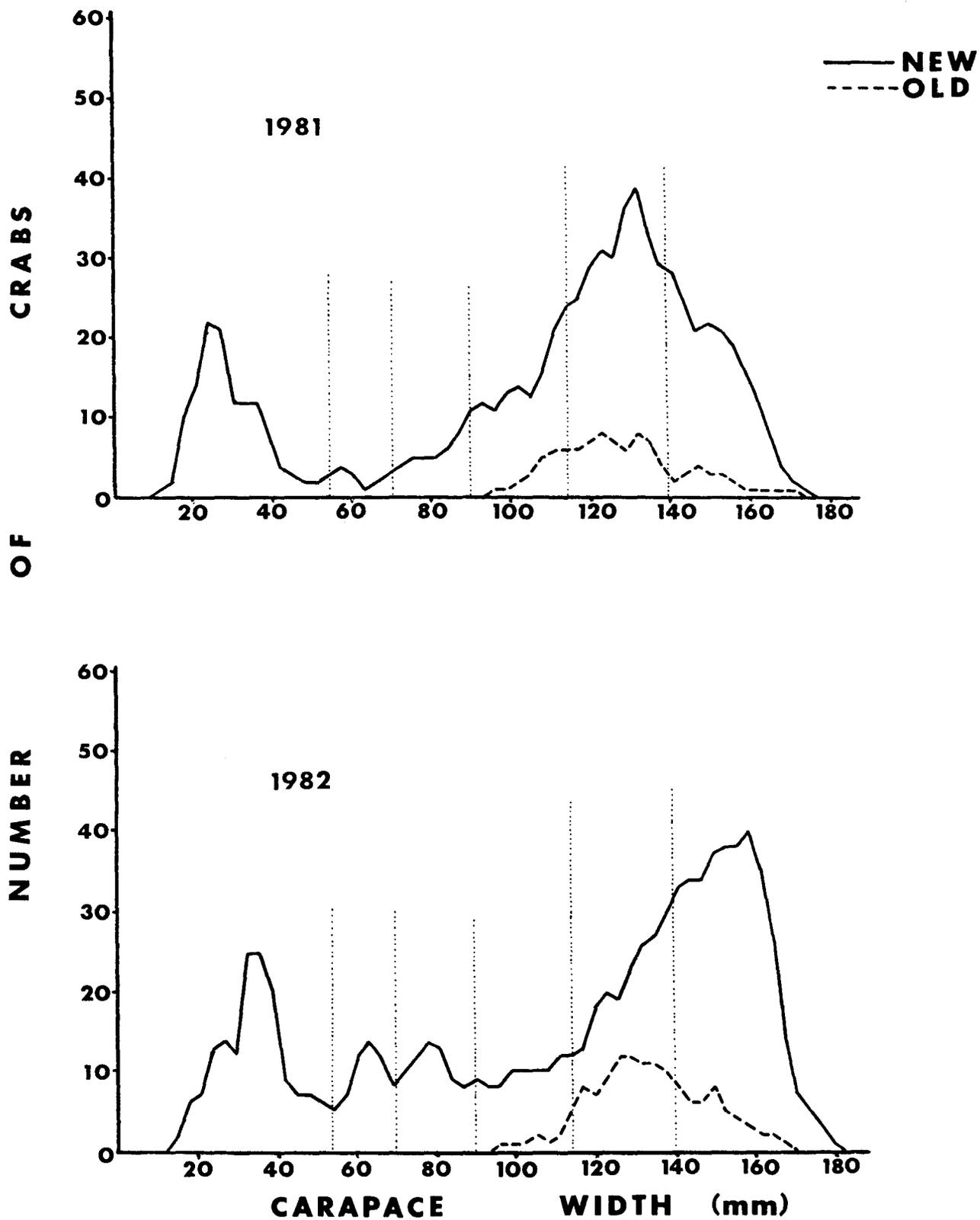


Figure 15. Carapace width frequencies of male Tanner crabs, *Chionoecetes bairdi*, measured on 1981-1982 Chignik Management District trawl surveys. Dotted lines separate size groups (see Explanation of Terms).

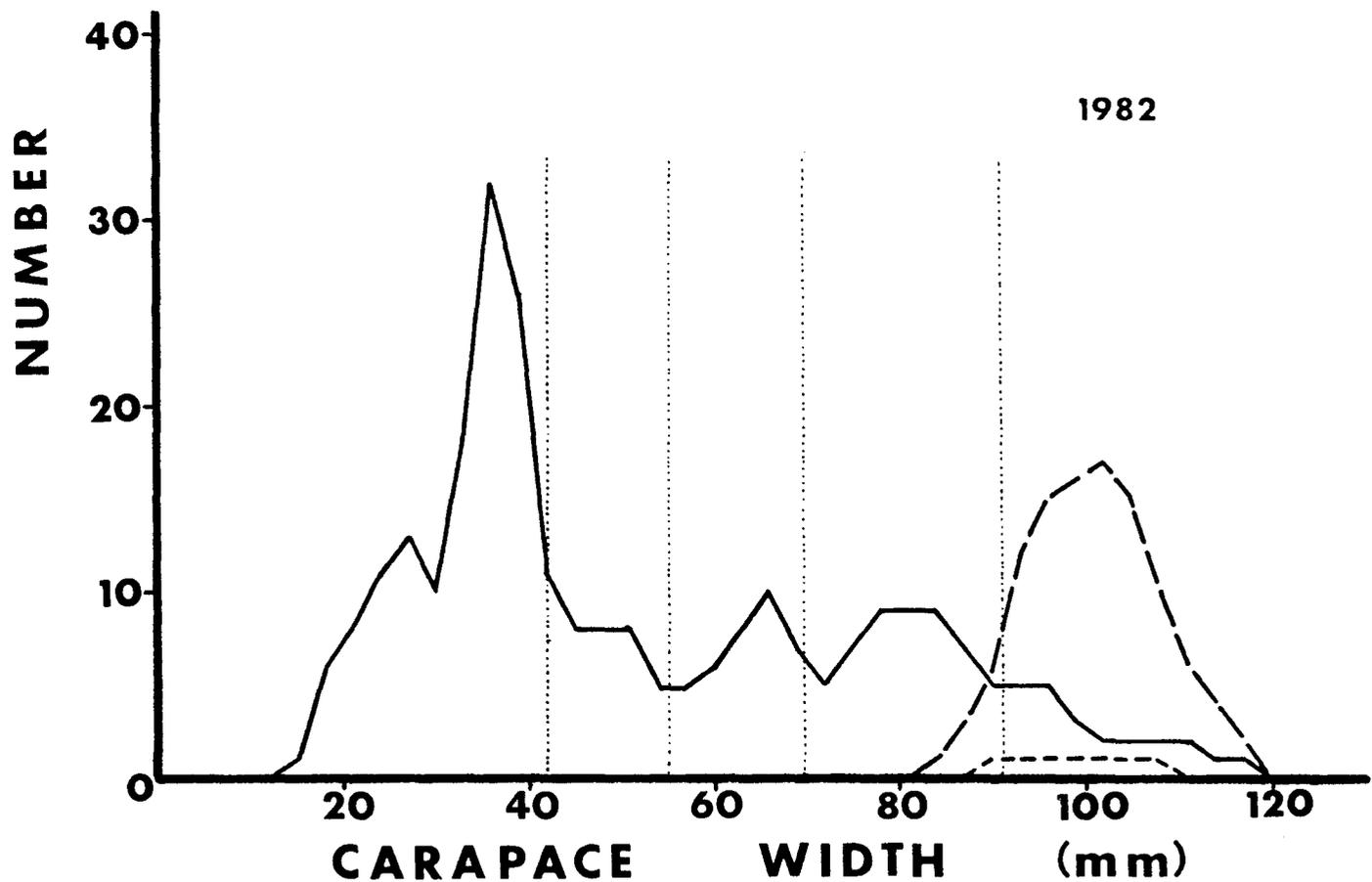
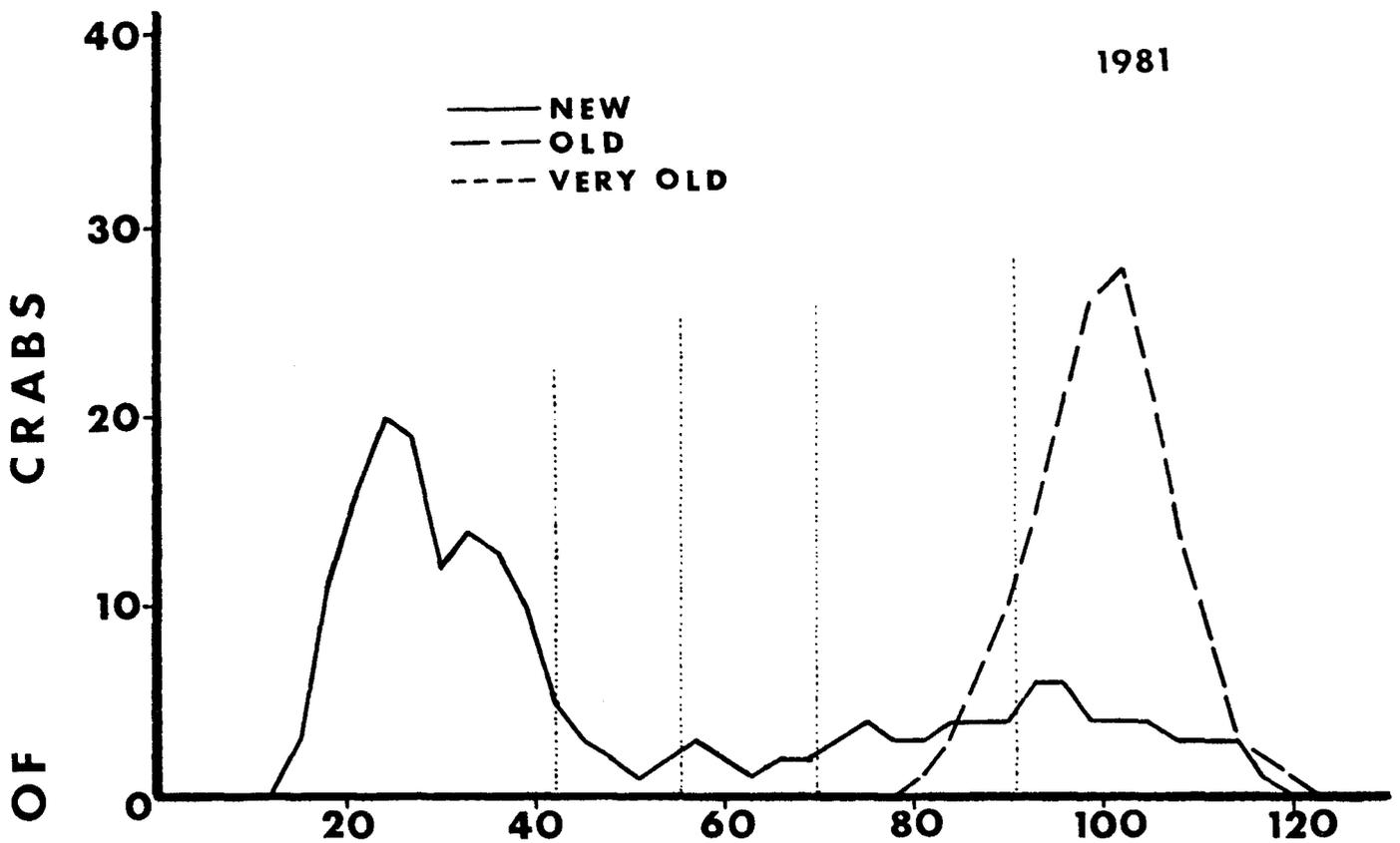


Figure 16. Carapace width frequencies of female Tanner crabs, *Chionoecetes bairdi*, measured on 1981-1982 Chignik Management District trawl surveys. Dotted lines separate size groups (see Explanation of Terms).

Table 17. Population estimates for female and various size and age groups of male Tanner crabs, *Chionoecetes bairdi*, 1981 and 1982 Chignik Management District trawl surveys<sup>1</sup>.

Group <sup>2</sup>	population estimate (number of crabs) ± percent error	
	1981	1982
Juvenile ♀	1,388,683 ± 21.1%	2,301,246 ± 16.0%
Adult ♀	1,834,282 ± 49.1%	1,306,278 ± 23.4%
Total ♀	3,226,018 ± 30.2%	3,607,524 ± 14.3%
Pre-recruit Four ♂	1,233,029 ± 21.5%	1,886,167 ± 15.0%
Pre-recruit Three ♂	390,662 ± 32.0%	546,317 ± 34.6%
Pre-recruit Two ♂	1,349,006 ± 29.9%	1,016,333 ± 15.0%
Pre-recruit One ♂	3,012,374 ± 21.9%	3,110,040 ± 12.9%
Recruit Legal ♂	1,556,546 ± 29.0%	2,350,079 ± 18.4%
Post-recruit Legal ♂	344,882 ± 30.1%	875,939 ± 19.2%
Total Legal ♂	1,907,532 ± 25.9%	3,225,018 ± 16.9%
Total Males	7,892,603 ± 20.3%	9,784,875 ± 11.2%

<sup>1</sup> From comparable survey area.

<sup>2</sup> See "Explanation of Terms" for Tanner crab size and age group descriptions.

ranged from  $546,317 \pm 34.6\%$  for pre-recruit three crabs to  $3,110,040 \pm 12.9\%$  for pre-recruit one crabs. The total legal male crab population was estimated to be  $1,907,532 \pm 25.9\%$  crabs in 1981 and  $3,226,018 \pm 16.9\%$  crabs in 1982. Female Tanner crab population estimates varied from  $1,388,683 \pm 21.1\%$  for juveniles to  $1,834,282 \pm 49.1\%$  for adults in 1981 and from  $1,306,278 \pm 23.4\%$  for adults to  $2,301,246 \pm 16.0\%$  for juveniles on the 1982 survey. In general, the percent errors of the estimates were considerably lower on the 1982 survey than on the 1981 survey. The difference can be attributed to the greater sampling intensity in 1982 which tended to lessen the overall variability between tow catches.

Since the Department is interested in forecasting future recruitment into the legal crab size group, we tried to determine what recruitment should have been in 1983 from the ratio of oldshell pre-recruit one to recruit legal crabs on the 1981 survey (Table 18). This should give us an idea of the extent of skip molting in the pre-recruit one group which is then applied to the pre-recruit one group which would be expected to molt to legal size the following year. This method suggests a population of 1,550,770 recruits at the start of the 1983 commercial season. Adjusting the 1982 survey population estimate for recruit crabs to the start of the 1983 fishing season gives an estimate of 2,115,071 crabs which was considerably higher than the forecast from the earlier data. Even looking at the range of this estimate which is 1.7 - 2.5 million crabs, the lower end is 0.2 million crabs higher than the earlier forecast. This would suggest that the 1980 trawl survey in the Chignik Management District undersampled (thereby underestimating) the pre-recruit one crab group. This may have been a result of making fewer tows than were subsequently taken in 1982.

One way of checking the population estimate derived from the trawl survey is to monitor the commercial fishery and compare the catch with the survey population estimate. This can give an indication of the exploitation rate one is using in harvesting the resource. The population estimate of legal sized crabs calculated for the entire survey area (not the smaller area used to compare 1981 and 1982 data) and adjusted for natural mortality was 1,859,099 crabs. The 1981-82 commercial catch totaled 1,343,500 crabs. Thus, these figures would suggest an exploitation rate of 0.72. The goal of the Department for Tanner crab is an exploitation rate of 0.40. It would seem that the Chignik crab stocks are being heavily exploited, however, certain cautions in interpreting the data must be considered. The trawl gear probably does not capture 100% of the legal size crabs in its path. Some crabs may move out of the path over the dandy lines and the net may pass over some of the crabs, particularly crabs that are partially buried in the sediment. Gear mensuration work to accurately define the working specifications of the net plus a tag/recapture study to define the vulnerability of crabs to the gear would help to give us a better idea of how efficient our gear is under normal towing conditions. Losses of crabs from the potential catch because of net performance would result in a lower population estimate for legal size crabs which would inflate the exploitation rate derived from the commercial fishery.

Another cause of artificial inflation of the exploitation rate would be a lower than adequate sampling intensity combined with enough clumping of the legal size population to result in underestimating the actual population size. Testing for the degree of clumping of the Tanner crab population is something we have not adequately addressed in this study. Hopefully, conditions will be such, in 1983, that we will be able to take more tows in each of our study areas.

Table 18. Legal male Tanner crab, *Chionoecetes bairdi*, recruitment forecast from pre-recruit one crab population estimate to their respective commercial fishery, 1981 Chignik Management District trawl survey.

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Recruitment forecast from 1981 survey

$$\text{Recruitment Coefficient (RC)} = 0.715$$

$$\text{Recruitment to 1983 fishery} = A \times \text{RC, where } A = 3,012,374 \times .72^1$$

$$= 0.715 \times 2,168,909$$

$$= 1,550,770 \text{ crabs}$$

Population estimate of recruits at start of 1983 fishery from 1982 trawl survey data = 1,725,898 - 2,504,244 crabs, midpoint of 2,115,071 crabs.

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<sup>1</sup> Survival after 1-1/2 years at 20% annual natural mortality.

A third problem which would result in raising the observed exploitation rate during the subsequent fishing season would occur if some of the areas which produce a significant commercial harvest proved untrawlable. While this is similar to the problem of inadequate sampling intensity cited above, it is potentially more problematic in that it cannot be overcome by increasing effort. Some other way of sampling that portion of the legal size crab population would have to be devised. In fact, this problem has occurred in the Chignik Management District; the extensive gut area seaward of Chignik and Kujulik bays (Figure 13, area in vicinity of tows 72 and 85; Figure 14, area in vicinity of tows 97 and 98) is a fairly productive area during the commercial fishing season (about 130,654 lbs during 1981-82 season). We cannot adequately sample this area with trawls because of the presence of many pinnacles on the sea bed. The substrate between the pinnacles is soft and is apparently reasonably good Tanner crab habitat. In searching the area for enough suitable terrain for trawling, we have only found two such locations on each of the Chignik trawl surveys. We are going to have to look at this problem in more detail since similar problems could exist in a number of the areas of the Gulf of Alaska.

A final method of monitoring the performance of the trawl survey is to use information from the commercial fishery to derive a Leslie population estimate which can then be compared to the survey derived population estimate. This method has been used in the North Mainland fishing section of the Kodiak Management District (Figure 9). The method depends on a declining CPUE (when compared with the cumulative catch over time) during the course of the fishery. An attempt was made to use the method with the 1981-82 commercial fishery data (Figure 17) and the results were disappointing. Unfortunately, CPUE did not decline over the course of the fishery which precluded us from calculating a meaningful Leslie population estimate to compare with our survey estimate. It is not uncommon to observe an increase in CPUE toward the end of the Tanner crab season which may be the result of strong tides during the middle part of the season causing crabs to stay out of pots (CPUE then increases after the strong tide period). The approach of the molting season can also affect the behavior of crabs which might enter pots, but it is not clear to what extent this may have an effect on the commercial catch. Hopefully, the commercial fishery in the Chignik Management District, during 1983, will proceed in a manner that will lend itself to a meaningful analysis and comparison with our trawl survey data.

#### POPULATION SURVEYS USING POTS

Tanner crab populations have been quantitatively surveyed using pots as an adjunct to the ADF&G's annual king crab population survey since 1973. The primary purpose of the surveys is to determine distribution and abundance of king and Tanner crab, particularly in areas which are historically fished by the commercial fleet.

##### Methods and Procedures

One chartered fishing vessel and one State of Alaska research vessel were used to conduct the Westward Region population surveys during the summer of 1982 (Table 19). No surveys were conducted in the Eastern or Western Aleutians Management Districts during 1982 (Figure 18). Station distribution was determined from a

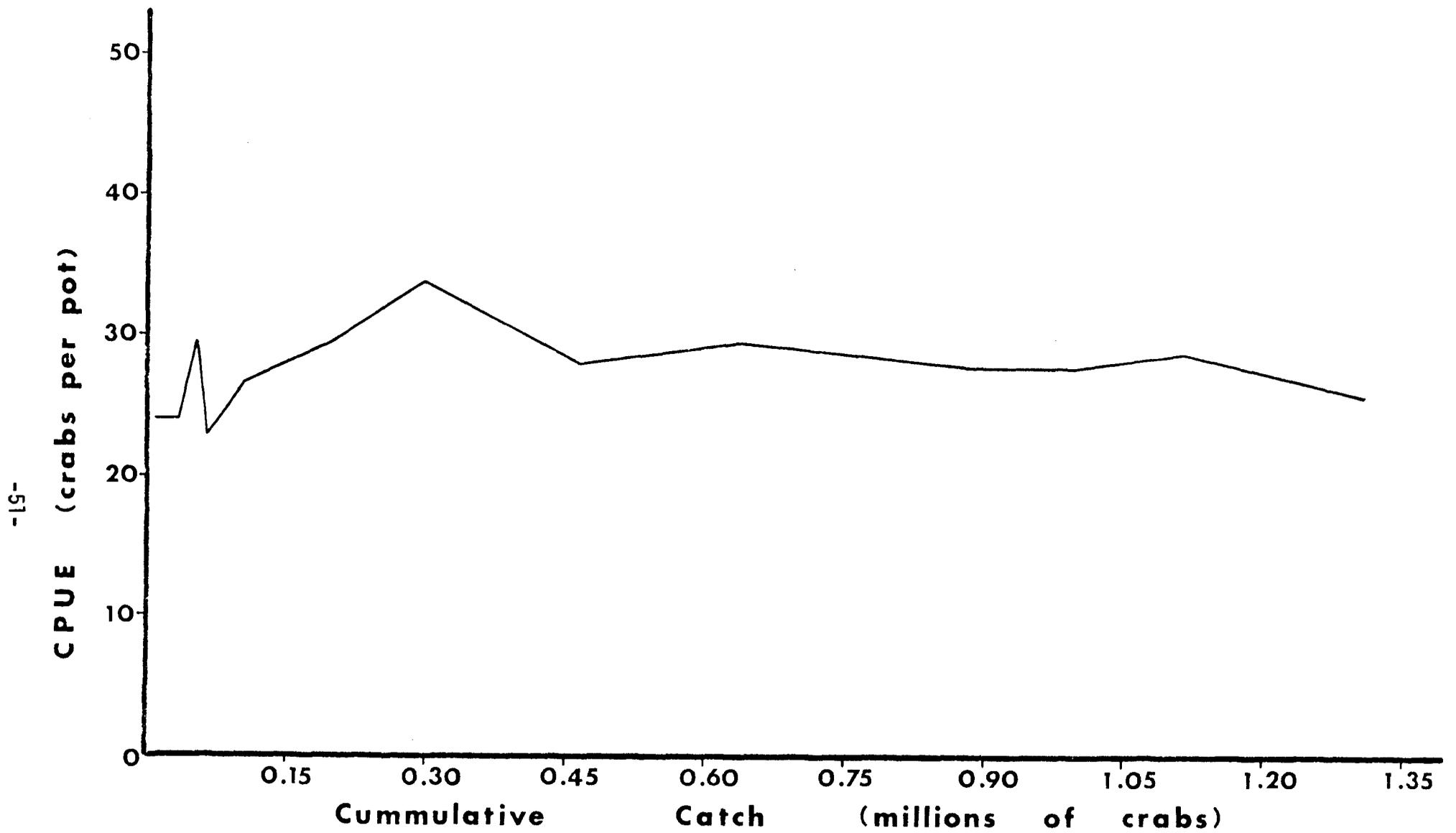


Figure 17. Catch per unit of effort (CPUE) and cumulative catch by week during the 1981-82 commercial fishery for Tanner crab, *Chionoecetes bairdi*, in the Chignik Management District.

Table 19. Research fishing information and related catch data, 1982 Westward Region pot surveys.

District/ Date	Vessel	Keel length (ft)	Scientific Crew leader	Number ocean stations fished	Avg. No. pots per all ocean stations	Number of bay stations fished	Avg. No. pots per all bay stations	Total pot lifts	Depth range (fms)	No. male Tanner crab <i>C. bairdi</i> captured	No. female Tanner crab <i>C. bairdi</i> captured	
										Juv.	Adult	
Kodiak (7/8-8/28)	Determined	90	F. Blau	143	9.94	102	2.93	1,721	9-142	21,021	15	1,919
South Peninsula (7/16-8/13)	Resolution	81	J. Hilsinger	42	9.98	71	2.97	630	14-85	2,646	7	518

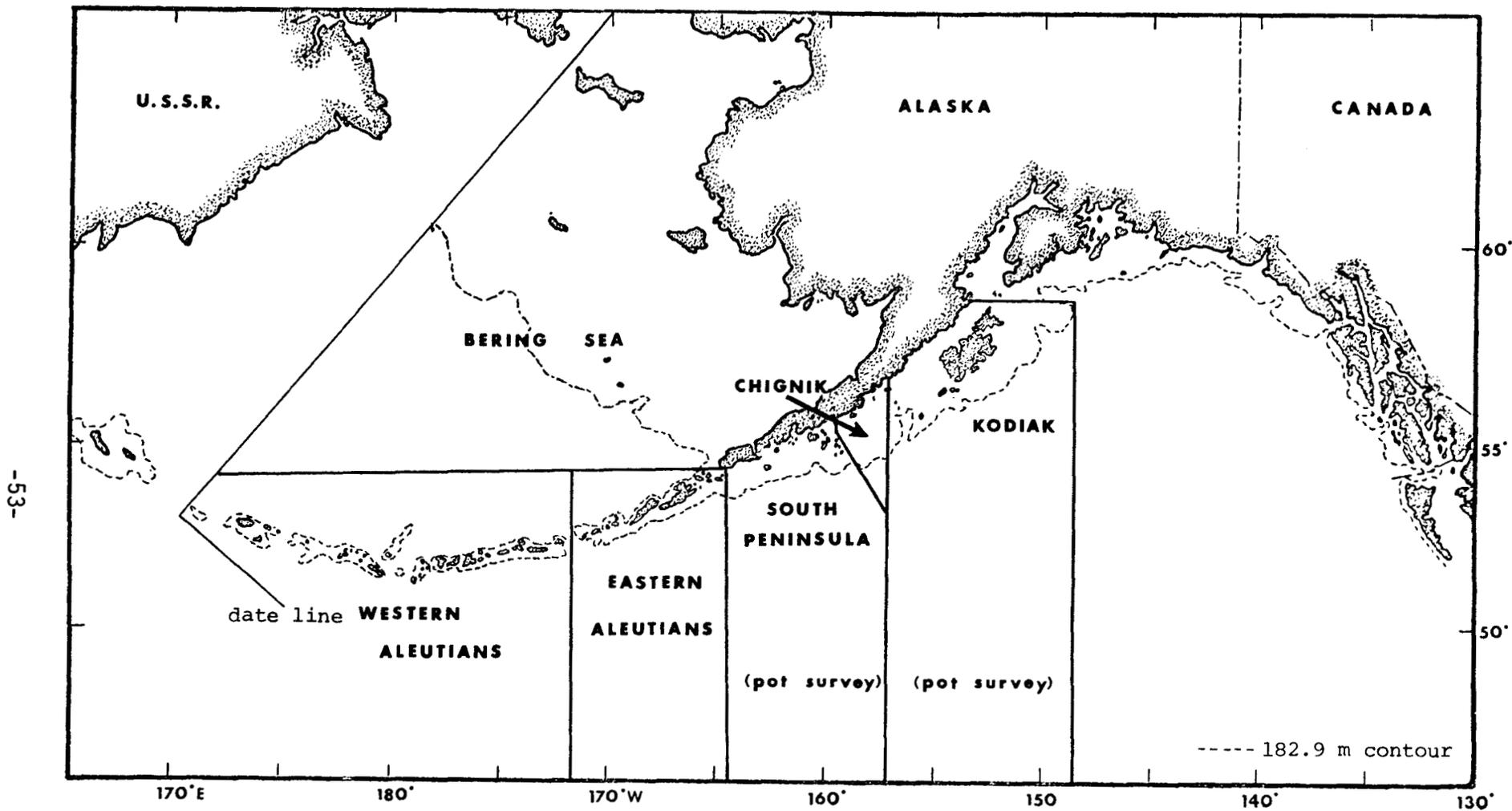


Figure 18. Tanner crab management districts of the Westward Region, Alaska, in which population surveys using crab pots conducted during 1982.

permanent sampling grid pattern in most cases. Targeted sampling areas were selected based on the historic distribution of the king crab resource and, to a lesser extent, the Tanner crab resource. Within the sampling areas regions of higher population levels received the greatest sampling effort.

The number of stations fished varied between bay and ocean areas. Generally, four ocean stations of 10 pots each were fished per day. Pots were spaced 0.40 km apart in an east-west direction. Stations were spaced 11.27 km east-west and 4.83 km north-south. Bay stations consisted of a three pot string with pots spaced 0.40 km apart, usually in an east-west direction. Ten bay stations were sampled daily.

Sampling gear consisted of 2.1 x 2.1 m crab pots weighing 318 kg and covered with 8.9 cm webbing. Two 1-liter perforated plastic jars were filled with chopped frozen herring, *Clupea harengus*, and placed inside each pot as bait.

Ideally, baited pots were set and allowed to fish for 24 hours. Individual pot identification, environmental conditions, depth, and soak time were recorded for each pot.

Upon retrieval of each pot all organisms were sorted and species and number of individuals were noted. Crabs caught in each pot were separated by species, sex, and exoskeletal age. Subsampling was used in instances where the catch was large. Carapace width measurements were obtained for male and female Tanner crabs (Figure 3). Measurements were taken to the nearest millimeter using Vernier calipers. Exoskeletal age, egg clutch size (percent fullness of the brood chamber), and egg condition were also recorded. A number of commercial sized Tanner crabs were tagged with a carapace dart tag and released while still on station. All crabs were released after the necessary data was collected.

Catch figures for individual pots were adjusted to reflect a 24-hour fishing period (Table 20). These factors represent an approximation of a function derived from Kodiak king crab logbook data (Rothschild et al. 1970).

## Results and Discussion

The following are the results of the 1982 Tanner crab population assessment surveys in the Kodiak and South Peninsula Management Districts.

### Kodiak Management District:

Of the 245 stations fished on the 1982 Kodiak pot survey, 143 were ocean stations and 102 were located in various bays around the island (Table 19). A total of 1,721 pots were pulled during the survey, a slight decline from the 1981 pot survey when 1,793 pots were fished (Table 21).

Male Tanner Crabs. A total of 21,021 male Tanner crabs was captured on the 1982 pot survey (Table 21). This was the highest total male catch since the 1977 survey when 22,009 male crabs were captured. The same situation occurred with the legal size catch. A total of 10,652 legal size crabs was captured on the 1982 survey while in 1977 the total amounted to 15,261. The 1982 legal size crab catch was 50.7% of the total male catch. The breakdown of legal crabs into recruits and

Table 20. Soak factors used to standardize individual pot soak times.

<u>Days Pots Soaked</u>	<u>Soak Factor<sup>1</sup></u>
0-----	0
1-----	1.00
2-----	1.50
3-----	2.00
4-----	2.33
5-----	2.67
6-----	3.00
7-----	3.25
8-----	3.50
9-----	3.75
≥ 10-----	4.00

<sup>1</sup> The catch is divided by the soak factor to determine the catch in a standard 24-hour soak.

Example: If pot soaked 2 days and contained 12 crabs, the number of crabs captured in a standard 24-hour soak would be,

$$12 \text{ crabs} \div 1.50 \text{ (soak factor from table)} \\ = 8 \text{ crabs in 24 hours.}$$

Table 21. Number of male Tanner crabs, *Chionoecetes bairdi*, by size and age group and percent of total male catch, 1975-1982 Kodiak Management District pot surveys.

Group	1975		1976		1977		1978 <sup>1</sup>		1979		1980		1981		1982	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Pre-recruit Fours	7	.0	6	.0	4	.0	1	.0	5	.0	26	.2	11	.1	6	.0
Pre-recruit Threes	122	.4	185	.6	36	.0	4	.0	70	.5	179	1.5	83	.8	82	.4
Pre-recruit Twos	1,836	6.2	2,195	6.6	561	2.6	281	3.5	813	6.2	1,317	11.4	947	9.1	1,735	8.3
Pre-recruit Ones	8,829	29.7	10,088	30.1	6,135	27.9	3,053	37.2	4,782	36.2	4,814	41.6	4,316	41.6	8,546	40.7
Recruit Legals	5,288	17.8	6,931	20.7	7,293	33.1	2,184	26.6	2,409	18.2	2,390	20.6	3,873	37.3	8,850	42.1
Post-recruit Legals	13,564	45.6	14,097	42.0	7,968	36.2	2,662	32.5	5,115	38.7	2,848	24.6	1,146	11.0	1,802	8.6
Total Legals	18,852	63.3	21,028	62.8	15,261	63.3	4,846	59.1	7,524	57.0	5,238	45.3	5,019	48.4	10,652	50.7
Total Males	29,734		33,504		22,009		8,194		13,193		11,572		10,376		21,021	
Pot Lifts	1,895		1,946		1,646		895		1,709		2,339		1,793		1,721	

<sup>1</sup> Funding problems limited the scope of the 1978 survey to the south end of Kodiak Island.

post-recruits showed an interesting picture, historically (Table 21). A total of 8,850 recruit crabs was captured in 1982. A pot survey record (the 1973 and 1974 surveys) were not included in Table 21. Recruit totals for those surveys were 5,822 and 7,035 crabs, respectively. The number of recruit crabs had been low since 1977 and recruitment to legal size in 1982 was apparently excellent. On the other hand, the number of post-recruit crabs captured, 1,802 individuals, was the second lowest since the 1975 pot survey. The population index of post-recruit crabs has shown a fairly consistent decline since 1976. This is a result of the commercial fishery. The Tanner crab fishery in the Kodiak Management District is and will probably remain a recruit-dependent fishery under present management practices.

The sublegal portion of the male Tanner crab catch accounted for 49.4% of the total. Catches of pre-recruit two and pre-recruit one crabs showed marked increases over the 1981 pot survey (Table 21). Totals for both of these size groups were the highest since the 1976 survey. Sublegal crabs smaller than pre-recruit three size showed little change from the 1981 pot survey though it should be noted that we do not capture small size Tanner crabs in pots in numbers proportional to their expected numbers in the population. This is an unfortunate aspect of using pots to assess Tanner crab populations in that we are not able to predict future recruitment trends from observations on the few small size individuals captured. Research on possible modifications to the pot survey in terms of the gear used, the fishing method (bait, soak time, and hanging bait), and fishing locations might provide insight into how we might expand our data gathering abilities for Tanner crab.

Looking at annual population trends for total legal, recruit, and pre-recruit one Tanner crab in the Kodiak Management District was complicated by the lack of a district-wide survey in 1978. That year the survey was limited to the south end of Kodiak Island. Consequently, all other annual data have to be standardized to the 48 stations fished all survey years in order to compare the results (Figure 19). The slight increases, in catch per pot, observed for each group of crabs in 1981 became more pronounced during 1982. Therefore, it seems that recruitment into the pre-recruit one and recruit legal crab groups was excellent. If this trend is an accurate representation of the Tanner crab populations of these two groups of crabs district-wide, the 1983 and 1984 commercial fisheries should be considerably better than the last two or three fisheries.

Looking at the mean catch per pot of legal size crabs by school and stocks shows that the recovery seen in the total crab catches applied to all but one of the Kodiak Management District crab schools (Table 22 and Figure 2). The Portlock school (Number 6) showed no change from the 0.1 legals/pot captured on the 1981 pot survey. It should be noted that only three stations were fished in the Portlock area which may not accurately reflect the abundance of legal size Tanner crabs in that area. School 17 (Twoheaded Island) showed the most dramatic increase in catch/pot of legal size crabs between 1981 and 1982. Mean catch/pot was 0.8 crabs in 1981 and 15.1 crabs in 1982 (Table 22).

Because of variations in survey fishing effort between years, it was generally more accurate to compare crab stocks using only those stations fished both survey years. Doing this for 1981 and 1982 (Table 23) shows considerable variation in the number of legals per pot in the five stocks surveyed in the Kodiak Manage-

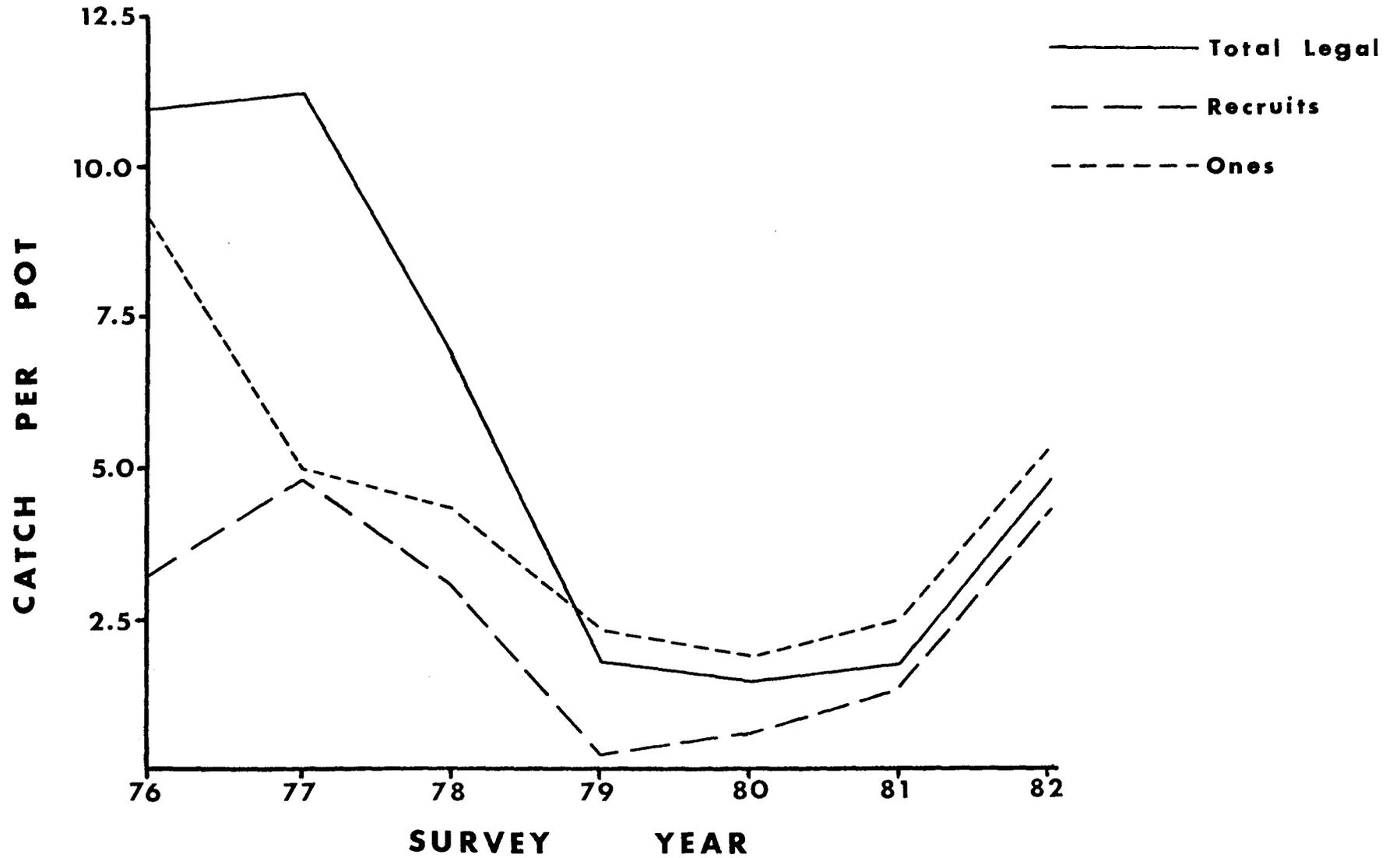


Figure 19. Catch per pot of total legal, recruit legal, and pre-recruit one male Tanner crabs, *Chionoecetes bairdi*, from 48 stations fished at the south end of Kodiak Island, 1975-1982 Kodiak Management District pot surveys.

Table 22. Mean catch/pot of legal size male Tanner crabs, *Chionoecetes bairdi*, by school and stock by year.

KODIAK SURVEYS

School	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
6 Portlock	0.0	0.2	9.9	2.9	2.2	-	1.4	0.5	0.1	0.1
5 Marmot Bay	8.0	10.4	11.6	10.9	6.9	-	2.9	4.4	3.6	9.8
10 Marmot Gully	4.6	5.4	-	6.4	9.2	-	10.3	3.1	1.0	4.8
12 Outer Marmot Gully	8.7	18.9	7.7	0.9	1.1	-	3.0	0.5	0.2	0.8
9 Chiniak Bay	16.7	8.1	11.9	8.2	1.8	-	6.4	2.0	1.6	7.8
14 Chiniak Gully	30.9	19.0	5.0	11.3	7.0	-	4.1	2.9	0.9	2.0
STOCK A	11.9	10.3	9.2	6.8	4.7	-	4.7	2.2	1.2	4.2
18 Ugak/Barnabas	13.1	24.8	10.0	4.4	6.3	-	6.7	2.8	3.8	15.3
19 Eastside Other	8.4	-	-	-	-	-	-	-	-	-
STOCK B	10.8	24.8	10.0	4.4	6.3	-	6.7	2.8	3.8	15.3
17 Twoheaded Island	26.1	15.7	25.2	14.5	28.6	-	0.7	2.1	0.8	15.1
20 Horses Head	4.3	10.4	15.2	6.1	13.7	2.8	4.6	1.1	0.7	1.9
22 South Trinity Island	2.6	7.6	8.0	15.1	4.9	7.5	0.8	2.9	0.6	1.8
STOCK C	11.0	11.2	16.1	11.9	15.7	5.2	2.0	2.0	0.7	6.3
21 Alitak Bay	8.7	34.1	2.7	31.1	18.2	-	2.9	8.1	13.3	14.1
34 Ikolik/Alitak	9.2	6.8	5.1	5.1	6.2	3.8	0.5	1.3	2.8	3.7
30 Compass Rose	8.4	15.6	10.6	7.7	12.8	5.3	3.5	2.9	3.7	8.2
STOCK D	8.8	18.9	6.1	14.6	12.4	4.6	2.3	4.1	6.6	8.7
40 Kupreanof/Uganik	1.0	3.3	14.1	12.7	7.1	-	3.1	3.2	8.7	14.1
42 West Afognak	-	-	-	33.4	-	-	8.9	-	-	-
STOCK F	1.0	3.3	14.1	23.1	7.1	-	6.0	3.2	8.7	14.1
ALL SCHOOLS	10.0	12.9	10.5	12.1	9.0	4.8	5.6	2.9	3.0	7.1

Table 23. Mean catch/pot of legal male Tanner crabs, *Chionoecetes bairdi*, by stock from stations fished on both the 1981 and 1982 Kodiak Management District pot surveys.

Stock	1981	1982	Percent Change
A - Northeast	1.4	4.8	+ 254
B - Eastside	5.0	14.0	+ 171
C - Southeast	0.8	3.4	+ 349
D - Southwest	4.6	7.7	+ 69
F - Westside	13.0	14.1	+ 8
Kodiak Total	3.0	6.7	+ 121

ment District. Stock F (Westside) on the west side of Kodiak and Afognak Islands showed a small gain in the legal Tanner crab population in 1981. The 14.1 crabs/pot observed in 1982 remained the highest in the Kodiak Management District. The greatest percentage increase in stock catch/pot of legal crabs was seen in Stock C (Southeast) on the southeastern side of Kodiak Island in the Gulf of Alaska. This stock showed a 349% increase in abundance. Although this stock showed a recovery in the legal size population from the last few surveys, the catch/pot was still relatively low when considered from the perspective of commercial fishing operations. In this regard the stock which showed the most growth was Stock B (Eastside) on the eastern side of Kodiak Island (Figure 2). The catch/pot of legal crabs rose from 5.0 in 1981 to 14.0 in 1982, a sizable increase.

In the Kodiak Management District as a whole, the mean catch/pot of legal size crabs increased 121% between the 1981 and 1982 index surveys. The magnitude of the increase was not expected from previous pot survey data as will be explained below.

The ability to predict future recruitment into legal size or even growth in smaller size groups is problematic in the Tanner crab for two major reasons. First, using the pot method to assess the Tanner crab population seemed to favor the capture of the larger size portion of the Tanner crab population. Smaller sized crabs, that is, crabs two or more molts (< 115 mm) from legal size were not captured in predictable numbers from survey to survey. Second, the phenomenon of skip molting was common in pre-recruit one crabs. This hampered our ability to predict recruitment into legal size the following year since we did not know what portion of the pre-recruit one population would molt in any given year.

Problems associated with the pot method or surveying the Tanner crab population are seen dramatically in the width frequency distributions of the male component of the survey catches by shell age (Figure 20). It is immediately apparent that very few juvenile males (roughly crabs < 110 mm CW) were captured by the pot method of fishing. Also, the extent of recruitment into legal size (> 139 mm CW) in 1982 wasn't indicated by the index of pre-recruit ones captured on the 1981 survey. This is especially significant when one observes that the portion of 1981 pre-recruit one crabs that were captured as oldshell pre-recruit ones in 1982 was quite high.

One of the ways fisheries managers have been able to monitor the commercial exploitation of a species during the fishing season is through a tag release and recovery program. Although such a program has been in existence in the Kodiak Management District since 1973, the results have generally been too poor to justify the use of tag recoveries as an effective management tool for Tanner crabs. Looking at tag recoveries during the 1981 and 1982 commercial fisheries (Table 24) illustrates the problem clearly. Keeping in mind that an exploitation rate of 40% is the goal of management, it is immediately apparent that no Tanner crab school produces the proper recovery rate. Chiniak Gully came closest in 1981 with 38.5% of the tags recovered during the commercial fishing season. Most of the areas around the District fell far short of the 40% goal. It is interesting that there was a fair amount of consistency of percentage returns between years in certain schools (Chiniak Bay, Ugak/Barnabas, Ikolik/Alitak, Kupreanof/Uganik, and North Mainland). Two of the schools, Ugak/Barnabas and Kupreanof/Uganik (each having a good number of tagged crabs at liberty) showed relatively high and con-

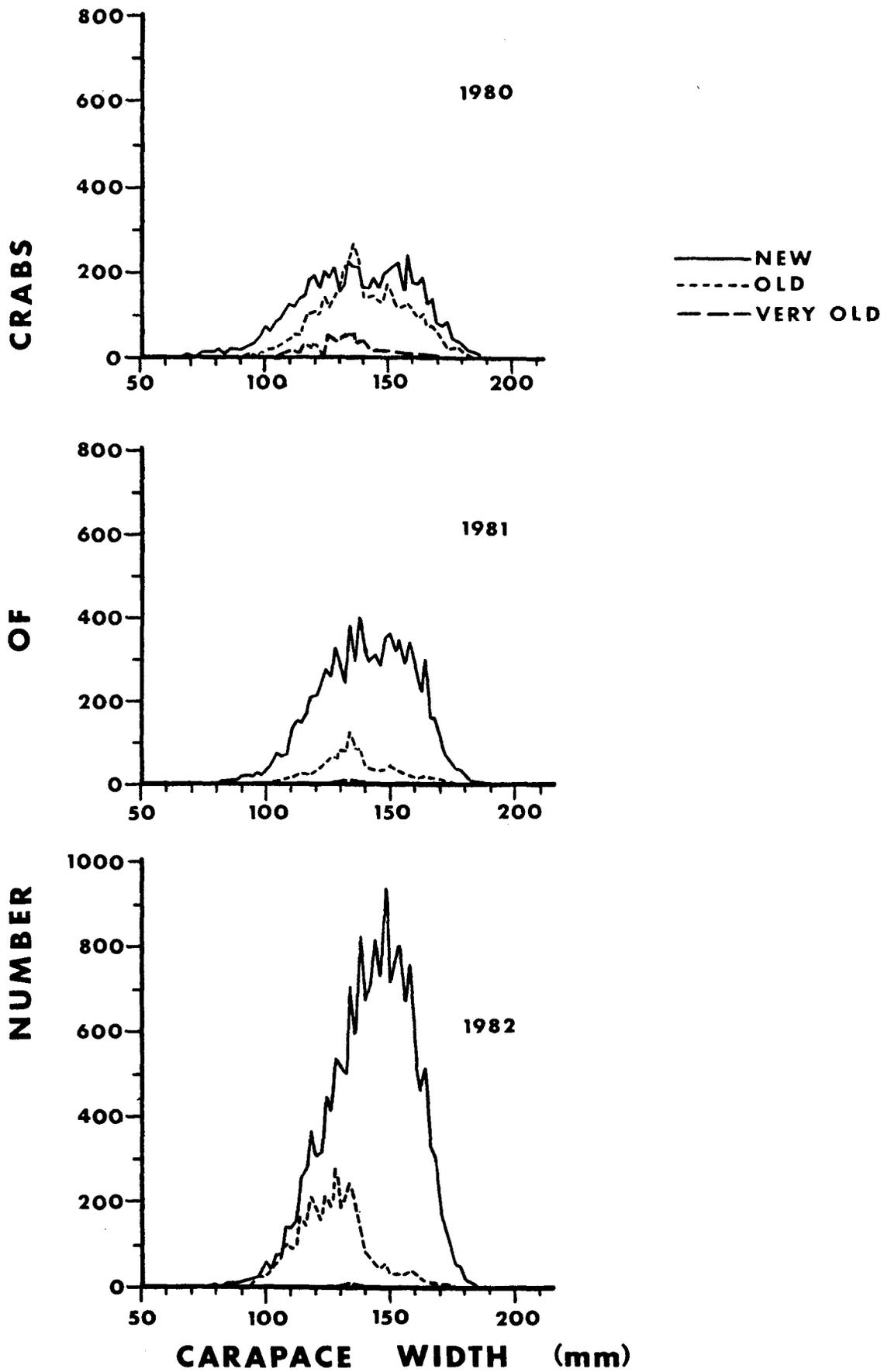


Figure 20. Carapace width frequencies of male Tanner crabs, *Chionoecetes bairdi*, measured on 1980-1982 Kodiak Management District pot surveys.

Table 24. Releases and recoveries of tagged Tanner crabs, *Chionoecetes bairdi*, in the Kodiak Management District, 1980-81 and 1981-82.

1980 Releases, 1981 Fishing Season Recoveries/1981 Releases, 1982 Fishing Season Recoveries

School	Number Released						Number Recovered						Percent Recovered						
	Recruits		Postrecruits		Total		Recruits		Postrecruits		Total		Recruits		Postrecruits		Total		
	1980	1981	1980	1981	1980	1981	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982	
6 Portlock	1	1	5	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0
5 Marmot Bay	42	19	14	7	56	26	9	3	5	0	14	3	21.4	15.8	35.7	0	25.0	11.5	
10/12 Marmot Gully	25	19	41	7	67	26	12	4	11	1	23	5	48.0	21.1	26.8	14.3	34.3	19.2	
9 Chiniak Bay	11	16	7	9	18	25	0	1	1	0	1	1	0	6.2	14.3	0	5.6	4.0	
14 Chiniak Gully	12	11	27	8	39	19	7	0	8	0	15	0	58.3	0	29.6	0	38.5	0	
18 Ugak/Barnabas	30	48	53	44	83	92	9	14	19	17	28	31	30.0	29.2	35.8	38.6	33.7	33.7	
17 Twoheaded Island	6	5	4	0	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0
20 Horses Head	16	20	30	22	46	42	3	1	3	0	6	1	18.7	5.0	10.0	0	13.0	2.4	
22 South Trinity Island	2	15	10	3	12	18	0	2	0	0	0	2	0	13.3	0	0	0	11.1	
21 Alitak Bay	62	55	25	12	87	67	2	4	0	1	2	5	3.2	7.3	0	8.3	2.3	7.5	
34 Ikolik/Alitak	15	41	21	11	36	52	1	1	0	1	1	2	6.7	2.4	0	9.1	2.8	3.8	
30 Compass Rose	35	107	83	24	118	131	9	10	18	4	27	14	25.7	9.3	21.7	16.7	22.9	10.7	
40 Kupreanof/Uganik	18	63	21	28	39	91	6	19	7	9	13	28	33.3	30.2	33.3	32.1	33.3	30.8	
41 North Mainland	82	0	68	45	150	45	0	-	11	4	11	4	0	-	16.2	8.9	7.3	8.9	
31 Other Southwest	6	7	16	1	22	8	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	363	427	426	221	789	648	58	59	83	37	141	96	16.0	13.8	19.5	16.7	17.9	14.8	

sistent percentage recovery. These areas are heavily fished and we suspect that the exploitation rate may be higher than the 40% management goal. The district-wide percentage recoveries for 1981 and 1982 were a typical and disappointing 17.9 and 14.8, respectively. A good example of how poor the tag recovery program is for Tanner crab can be seen in the North Mainland fishing section of the Kodiak Management District where 150 and 45 tags were released on the 1980 and 1981 trawl surveys, respectively (Table 24). Recoveries during the respective subsequent commercial fisheries was 7.3% and 8.9% indicating an exploitation rate less than 10% based on tag returns. We were able to analyze the North Mainland commercial fishing information by the Leslie method after the 1981 and 1982 seasons (Figure 9). Using the resulting Leslie population estimates, the trawl survey population estimates of legal size crabs, and the commercial crab catches, we can derive estimates of the harvest exploitation rates for the 1981 and 1982 seasons. Comparing exploitation rates from the three methods (tags, Leslie, and survey) gives startling results in Table 25.

Exploitation rates for the 1981 and 1982 commercial fisheries were similar when derived from the two population estimation methods. More importantly, for management purposes they suggest much higher exploitation rates in the North Mainland fishing section in 1981 and 1982 than was suggested by tag recoveries. This would seem to indicate that tagging Tanner crabs with carapace disc tags is not worth the effort considering the amount of information it provides managers.

Female Tanner Crabs. The total number of female Tanner crabs measured on the 1982 Kodiak Management District pot survey was 1,934. Juvenile females numbered 15 individuals which was 0.8% of the female catch. Considering the small number of individuals and the erratic catches of small sized crabs by pots it is doubtful whether the juvenile female catches represent any kind of abundance pattern.

Observations on egg clutch size (Table 26) showed females with full (90-100%) egg clutches comprised 71.1% of the total female catch during the 1982 Kodiak Management District pot survey. This is slightly lower than the 1981 survey (78.0%) but considerably higher than the 1979 (58.8%) and 1980 (56.8%) survey observations (Table 26). Barren females (i.e., mature females with no eggs at the time of the survey) made up 1.8% of the adult females measured on the 1982 pot survey. This is the lowest percent barrenness observed in the last four survey years. It seems that the reproductive potential for the female Tanner crab population has been in a healthy state over the 1979 to 1982 survey periods in the Kodiak Management District.

South Peninsula Management District:

Of the 113 stations fished on the 1982 pot survey in the South Peninsula Management District, 42 were ocean stations and 71 were located in various bay areas of the District.

A total of 630 pots were pulled during the survey, a 16% decline in effort from the 1981 pot survey when 750 pots were fished (Table 27).

Male Tanner Crab. A total of 2,751 male Tanner crabs was captured on the 1982 pot survey (Table 27). This was lower than the total catch during the 1980 and 1981 surveys when 2,851 and 4,965 males were captured, respectively. In the legal size crab groups, the 1,398 legal size crabs captured during the 1982 pot

Table 25. Exploitation rates from tag recovery, Leslie, and survey methods, 1981 and 1982.

Method used to derive exploitation rate	1981 Fishing			1982 Fishing		
	1981 tag recoveries	1981 Leslie est.	1980 survey est.	1982 tag recoveries	1982 Leslie est.	1981 survey est.
Exploitation rate	.10	.63	.50	.10	.60	.66

Table 26. Number of female Tanner crabs, *Chionoecetes bairdi*, measured by shell age and percent fullness of egg clutch, 1979 - 1982 Kodiak Management District pot surveys.

	Juveniles	Percent fullness of egg clutch																Total Adults		
		0		1-24		25-49		50-74		75-89		90-100								
	N	0	VO	N	0	VO	N	0	VO	N	0	VO	N	0	VO	N	0	VO		
<u>1979</u>																				
No. measured	42	31	76	29	15	15	8	10	86	41	33	289	26	96	777	68			1,600	
% (of adults)	-	1.9	4.8	1.8	0.9	0.9	0.5	0.6	5.4	2.6	2.1	18.1	1.6	6.0	48.6	4.2				
% by class		6.7		2.7		1.4		8.6		21.8		58.8								
<u>1980</u>																				
No. measured	160	8	16	92	15	48	8	13	29	79	57	60	79	59	29	196	477	106	1,371	
% (of adults)		0.6	1.2	6.7	1.1	3.5	0.6	0.9	2.1	5.8	4.1	4.4	5.8	4.3	2.1	14.3	34.8	7.7		
% by class		8.5		4.6		3.6		14.3		12.2		56.8								
<u>1981</u>																				
No. measured	43	3	19	3	1	1	4	7	18	22	51	32	267	304					732	
% (of adults)		0.4	2.6	0.4	0.1	0.1	0.5	0.9	2.6	3.0	7.0	4.4	36.5	41.5						
% by class		3.4		0.2		1.4		5.6		11.4		78.0								
<u>1982</u>																				
No. measured	15	3	28	3	1	17	1	6	22	1	115	74	4	106	171	2	412	947	6	1,919
% (of adults)		0.2	1.5	0.2	0.1	0.9	0.1	0.3	1.1	0.1	6.0	3.8	0.2	5.5	8.9	0.1	21.5	49.3	0.3	
% by class		1.8		1.0		1.5		10.1		14.5		71.1								

Table 27. Number of male Tanner crabs, *Chionoecetes bairdi*, captured by size and age group and percent total male catch, 1980-1982 South Peninsula Management District pot surveys.

Group	1980		1981		1982	
	No.	%	No.	%	No.	%
Pre-recruit Fours	5	0.2	2	0.04	2	0.1
Pre-recruit Threes	63	2.2	13	0.3	7	0.3
Pre-recruit Twos	229	8.0	193	3.9	166	6.0
Pre-recruit Ones	1,300	45.6	1,360	27.4	1,178	42.8
Recruit Legals	310	10.9	1,963	39.5	666	24.2
Post-recruit Legals	944	33.2	1,435	28.9	732	26.6
Total Legals	1,254	44.0	3,398	68.4	1,398	50.8
Total Males	2,851	100.0	4,965	100.0	2,751	100.0
Pot Lifts	700		750		630	

survey was less than half the 3,398 legals caught on the 1981 survey and only slightly higher than the 1,254 legals captured in 1980. In 1982 the legal size portion of the catch accounted for 50.8% of the total. Again, this fell between the 1980 and 1981 survey results which were 44.0% and 68.4%, respectively. How much of the variation in the survey results since 1979 can be attributed to variations in sampling intensity (pots lifted) is unknown.

Looking at the survey in terms of mean catch/pot of legal size crabs over several years (Table 28) shows that the 1982 survey catch/pot in bay and ocean areas was the second lowest since 1974. The bay areas produced 2.6 legals/pot and 2.0 legals/pot were captured from the ocean areas of the District. This situation was a direct result of poor recruitment from the portion of the population that was pre-recruit one in 1981 (Figure 21). The large group of recruits in 1981 was apparently harvested to a large extent during the subsequent commercial fishery. The pre-recruit one portion of the 1982 survey does not look promising for recruitment in 1983, however, it is difficult to appraise possible recruitment because of the high degree of skip molting in the pre-recruit one crab group.

Female Tanner Crab. The total number of female Tanner crabs measured on the 1982 pot survey was 525. This observation falls between the 720 individuals measured on the 1980 survey and the 316 females measured during the 1981 survey. Juvenile females comprised 1.3% (7 individuals) of the female catch in 1982. As in the Kodiak Management District, it is doubtful whether the juvenile female catches represent any kind of pattern of abundance in the South Peninsula Management District.

Observations on egg clutch size (Table 29) showed that females with full (90-100%) egg clutches comprised 59.6% of the total adult female catch during the 1982 pot survey. This compares with 53.9% on the 1981 survey and 48.4% on the 1980 survey. Barren females (i.e., mature females with no eggs at the time of the survey) made up 2.3% of the adult females measured in 1982, the lowest incidence observed in the last 3 years and a considerable decrease from the 7.9% barren females observed during the 1981 survey. Since more than 97% of the adult female Tanner crab population carried eggs, it would seem that the reproductive potential of the population is being maintained in a healthy state at this time.

## COMMERCIAL FISHERY

In order to assess the performance of the commercial fishery most areas of the Westward Region have dockside sampling programs during Tanner crab season which supplement the information gathered from fish tickets. Such observations as the number of pot lifts, average crab weight, number of vessels fishing, and the size and shell age composition of the commercial harvest give the ADF&G an idea of how well fishing performance reflects observations gathered on the Department's population indexing surveys.

### Kodiak Management District

The Kodiak Management District is located in the northcentral region of the Gulf of Alaska. Specifically, it is one of six management districts of the Westward

Table 28. Mean catch per pot of legal size male Tanner crabs, *Chionoecetes bairdi*, captured on the 1974 - 1982 South Peninsula Management District pot surveys.

Year	Mean catch per pot (legals/pot)								
	1974	1975	1976	1977	1978	1979	1980	1981	1982
Bay	33.9	21.8	27.1	20.5	12.8	4.1	1.5	8.4	2.6
Ocean	15.1	17.5	14.4	24.6	10.4	4.8	1.9	2.9	2.0
Overall	24.5	19.6	20.8	22.6	11.6	4.4	1.8	4.5	2.2

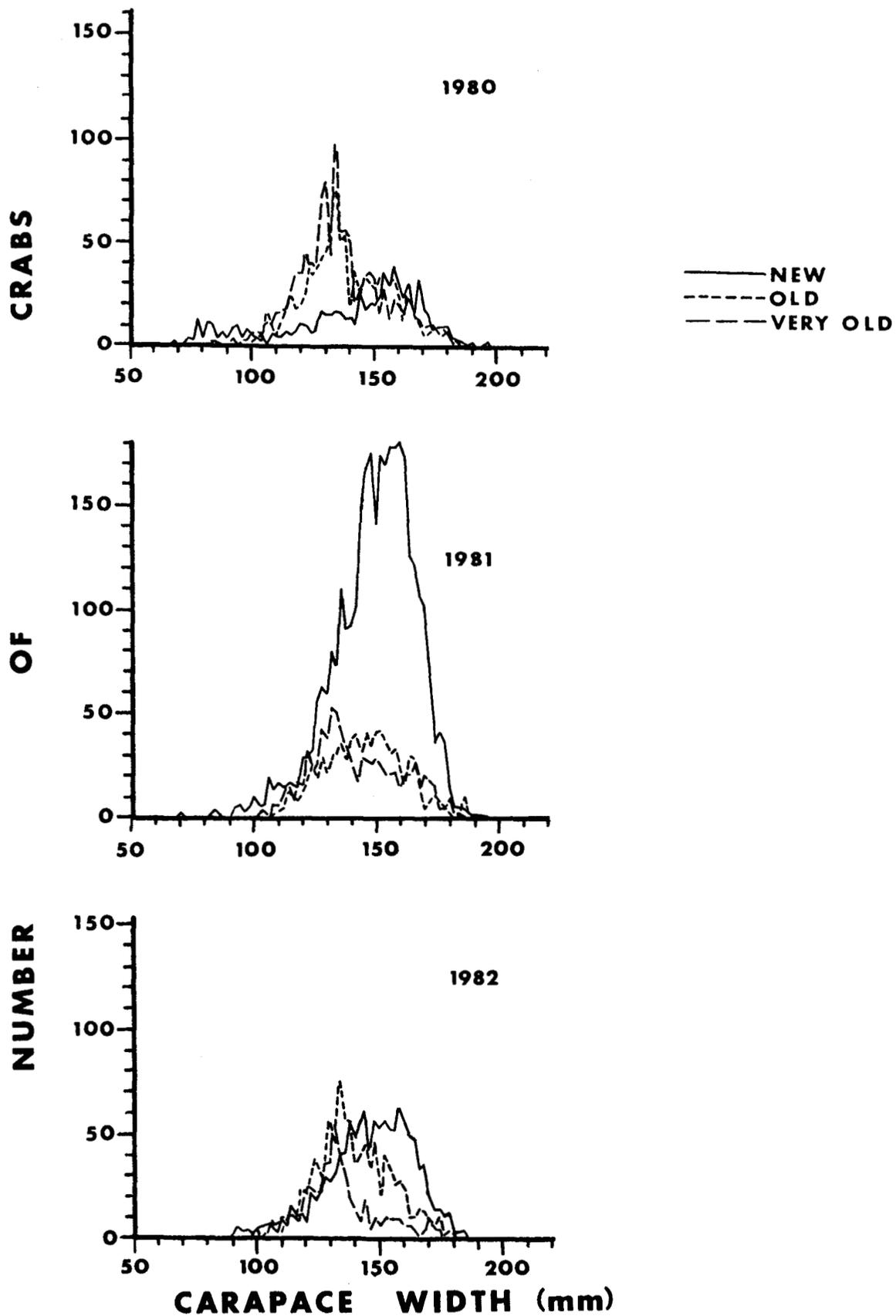


Figure 21. Carapace width frequencies of male Tanner crabs, *Chionoecetes bairdi*, measured on 1980-1982 South Peninsula Management District pot surveys.

Table 29. Number of female Tanner crabs, *Chionoecetes bairdi*, measured by shell age and percent fullness of egg clutch, 1980 - 1982 South Peninsula Management District pot surveys.

	Juvenile	percent fullness																	
		0			1 - 24			25 - 49			50 - 74			75 - 89			90 - 100		
		N	O	VO	N	O	VO	N	O	VO	N	O	VO	N	O	VO	N	O	VO
<u>1980</u>																			
No. measured	22			20			25	1		20	16	2	132	3		130	10		317
% (of adults)				3.0			3.7	0.1		3.0	2.4	0.3	19.5	0.4		19.2	0.1	1.5	46.8
% by class			3.0			3.7			3.1				22.2			19.6			48.4
<u>1981</u>																			
No. measured	13	1		22			7			11	8	48	1	7	29		20		136
% (of adults)		0.3		7.6			2.4			3.8	2.7	16.5	0.3	2.4	10.0		6.9		47.0
% by class			7.9			2.4			3.8				19.2			12.7			53.9
<u>1982</u>																			
No. measured	7			12			14			9	9	1	47	26	2	89	5	20	284
% (of adults)				2.3			2.7			1.7	1.7	0.2	9.1	5.0	0.4	17.2	1.0	3.9	54.8
% by class			2.3			2.7			1.7				11.0			22.6			59.6

Region Registration Area "J" and located south of the latitude of Cape Douglas on the Alaska Peninsula ( $58^{\circ} 52'$  N. latitude), east of the longitude of Cape Kumlik ( $157^{\circ} 27'$  W. longitude), and west of  $150^{\circ}$  west longitude. For management and reporting purposes the catch statistics are summarized from fish tickets and divided into eight major Tanner crab fishing sections from stocks based on historic fishing locations (Figure 2).

#### Total Harvest:

The 1981-82 Tanner crab season catch in the Kodiak Management District surpassed the 1980-81 season by over 910 metric tons at 6239.75 mt (Table 30). While higher than the previous year, this harvest was the second lowest in the last 7 years. The slight upward trend in the 1981-82 season was welcomed and is hopefully a sign of stock recovery. Fishing began on 10 February and the last fishing section was closed by emergency order on 13 April with a season average price per kilogram of \$3.64. The Southwest and North Mainland fishing sections were the two high producers with 2353.40 and 1000.30 metric tons delivered, respectively (Table 31). The Northeast section declined dramatically from the 1083.86 mt landed in 1980-81 to 526.60 mt landed in 1981-82. The Northeast section has been one of the major producing stocks in the past, but recruitment has been poor in recent years. The number of vessels fishing the Kodiak Management District during the 1981-82 season was an all time high at 221 (Table 30). The declining king crab stocks statewide and the high price per kg paid for Tanner crab this season contributed to the higher than normal effort in the Kodiak Management District.

#### Pot Lifts and Landings:

Pots lifted during the 1981-82 fishery totaled 230,403 (Table 30). This ranks fourth highest in the past seven seasons and an increase of about 56,000 pots over the previous season. Crab landings were 950 in 1981-82, a 23% increase over the 771 landings reported in 1980-81. The catch per pot for the 1981-82 season was 24 crabs, a decline of one crab per pot from the 1980-81 season when 25 crabs per pot were caught.

#### Crab Weight:

Average crab weight for the Kodiak Management District during the 1981-82 season was 1.13 kg, a 6-year low (Table 30). The three preceding season's average weight per crab was 1.22 kg, while the 1976-77 and 1977-78 commercial seasons produced an average crab weight of 1.18 kg.

#### Dockside Sampling:

Alaska Department of Fish and Game shellfish management biologists sample the commercial catches to determine the size frequency distribution and shell age of the catch. During the 1981-82 fishery, shellfish personnel sampled 7,118 crabs (Figure 22). The previous two season sample sizes were 7,480 and 7,576 crabs. The mean shell width at 152 mm for the 1981-82 fishery continued to drop 2 mm per year from the previous two fishing years at 154 and 156 mm, respectively. Recruit crabs accounted for 67% of the total crabs sampled in the 1981-82 season.

Table 30. Commercial catch and effort for Tanner crab, *Chionoecetes bairdi*, Kodiak Management District, 1967-1982<sup>1</sup>.

Year	No. of vessels	No. of landings	No. crab	Metric tons	Pots Lifted	Avg. wt. (kg)	CPUE	Price per kg
1967		83		50.33				0.15
1968		817		1,161.52				0.22
1969	85	955		3,096.85	72,748		43	0.24
1969-70 <sup>2</sup>	67	833	3,237,224	3,817.83	78,266	1.18	42	0.24
1970-71	82	453	2,686,067	3,059.13	60,967	1.13	44	0.24
1971-72	46	505	3,878,618	4,298.24	65,907	1.09	59	0.29
1972-73	105	1,466	13,609,688	13,925.33	188,158	1.04	67	0.37
1973-74 <sup>3</sup>	123	1,741	11,857,573	13,526.67	217,523	1.13	59	0.44
1974-75 <sup>3</sup>	74	471	5,459,940	6,191.59	73,826	1.13	83	0.37
1975-76 <sup>4</sup>	104	1,168	10,748,958	12,399.94	199,304	1.13	64	0.44
1976-77 <sup>5</sup>	102	998	7,830,727	9,398.57	164,213	1.18	48	0.73
1977-78 <sup>6</sup>	148	1,483	12,401,243	15,096.38	251,621	1.18	49	0.95
1978-79 <sup>7</sup>	218	1,225	10,702,829	13,233.15	275,455	1.22	38	1.21
1979-80 <sup>7</sup>	211	1,385	6,813,128	8,447.73	282,946	1.22	24	1.21
1980-81 <sup>8</sup>	188	771	4,398,631	5,329.14	174,351	1.22	25	1.43
1981-82 <sup>9</sup>	221	950	5,413,467	6,239.75	230,403	1.13	24	3.64
Total	-	13,449	99,038,093	119,272.15	2,262,940	-	-	-
Average	130	1,035	7,618,315	7,454.51	174,072	1.15	48	0.88

<sup>1</sup> Data source: Alaska Department of Fish and Game Annual Board of Fish and Game Reports and Annual Kodiak Area Management Report.

<sup>2</sup> Fishing year 1 July - 30 June.

<sup>3</sup> Legal season 1 November - 30 June. Season terminated 15 May due to onset of mating season.

<sup>4</sup> Legal season 1 November - 30 April.

<sup>5</sup> Legal season 1 January - 30 April.

<sup>6</sup> Legal season 1 January - 15 May.

<sup>7</sup> Legal season 5 January - 15 May.

<sup>8</sup> Legal season 22 January - 15 May.

<sup>9</sup> Legal season 10 February - 16 April.

Table 31. Tanner crab, *Chionoecetes bairdi*, catch in metric tons by fishing section for the Kodiak Management District 1972-73 through 1981-82 fishing season<sup>1</sup>.

	1972-73 <sup>2</sup>	1973-74 <sup>3</sup>	1974-75 <sup>3</sup>	1975-76 <sup>4</sup>	1976-77 <sup>5</sup>	1977-78 <sup>6</sup>	1978-79 <sup>6</sup>	1979-80 <sup>6</sup>	1980-81 <sup>7</sup>	1981-82 <sup>8</sup>
Northeast	2,059.07	2,790.55	1,253.80	1,838.94	1,302.38	1,760.76	2,884.76	2,261.69	1,083.86	526.60
Eastside	2,436.05	2,548.89	1,099.17	2,282.84	1,393.38	1,773.62	1,375.34	961.28	594.22	617.93
Southeast	750.70	854.55	283.04	2,658.00	2,680.18	2,368.94	1,147.29	442.22	225.11	249.25
Southwest	4,192.99	3,349.23	1,786.67	1,567.20	813.59	4,005.75	2,352.23	1,200.80	1,154.17	2,353.40
Semidi Island	-	-	-	-	-	-	372.77	586.17	487.84	549.16
North Mainland	3,119.37	3,179.31	1,604.31	2,072.40	1,557.27	3,080.49	3,225.76	2,121.81	947.53	1,000.30
South Mainland	54.49	22.87	86.89	10.72	9.37	26.88	126.06	226.91	179.69	118.23
Westside	1,312.66	781.27	77.70	1,969.84	1,642.39	2,079.93	1,793.92	646.84	656.72	824.87
Total	13,925.33	13,526.67	6,191.58	12,399.94	9,398.57	15,096.38	13,278.13	8,447.73	5,329.14	6,239.75

<sup>1</sup> Table revised 1/79 to reflect creation of Semidi, Southeast, and Southwest sections from old "Southern" section and minor modification of Eastside section description, Semidi Island section added beginning 1978-79 fishing season.

<sup>2</sup> Fishing season 1 July - 30 June.

<sup>3</sup> Fishing season 1 November - 30 June.

<sup>4</sup> Fishing season 1 November - 30 April, shortened due to price negotiations and market conditions.

<sup>5</sup> Fishing season 1 January - 30 April.

<sup>6</sup> Fishing season 5 January - 15 May.

<sup>7</sup> Fishing season 22 January - 15 May, shortened due to price negotiations.

<sup>8</sup> Fishing season 10 February - 16 April.

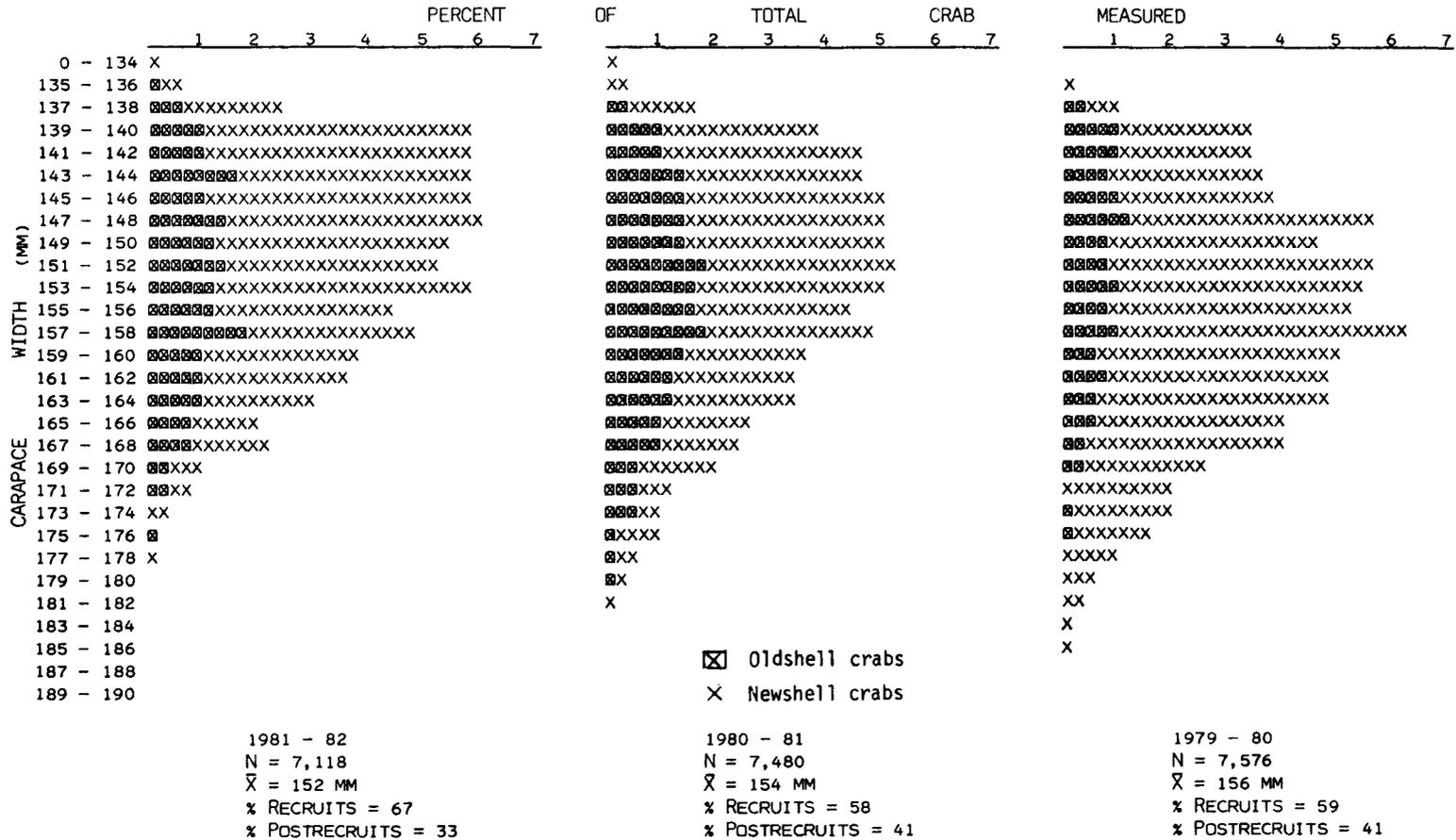


Figure 22. Carapace width frequencies of commercially caught Tanner crabs, *Chionoecetes bairdi*, 1979-80 through 1981-82 Kodiak Management District fishing seasons.

## South Peninsula Management District

The South Peninsula Management District includes all waters west of a line running from the southernmost tip of Kupreanof Point to the easternmost point of Castle Rock then 135° southeast, west to the longitude of Scotch Cap light on Unimak Island (Figure 18).

### Total Harvest:

The Tanner crab catch in the South Peninsula Management District was up 30% over the catch the previous year. The total harvest for 1981-82 was 2081.6 mt while the 1980-81 catch was only 1494.2 mt (Table 32). This increase was due primarily to increased effort and better recruitment over the 1980-81 season. Fishing began on 15 December with the major production areas being the same as the previous year. Pavlof Bay, Deer Island, and the Sanak Island areas (Table 33). Pavlof Bay had the highest catch with 657.6 mt, while Deer Island produced 412.5 mt and Sanak Island produced 351.7 mt. Effort in the South Peninsula Management District reached a 9-year high during the 1981-82 season. Some 72 vessels fished the District in 1981-82, a 40% increase over the previous season (Table 32).

### Pot Lifts and Landings:

The 72 vessels fishing the South Peninsula Management District during the 1981-82 season pulled 81,058 pots, an increase of 21,498 over the previous season (Table 32). Although this effort was higher than the previous season, it ranked third highest in 9 years of fishery statistics. Tanner crab landings totaled 365 for the 1981-82 season or an increase of 97 landings over the 1980-81 season. The catch per pot for the 1981-82 season increased to 22 crabs while 21 was the 1980-81 season's average (Table 32). This CPUE is dramatically lower than the pre-1980 averages when catches of 40 crabs per pot and higher were the norm.

### Crab Weight:

Average Tanner crab weight dropped to 1.13 kg/crab for the 1981-82 season (Table 32). This average weight is similar to the crab weights exhibited in the pre-size limit years and is a reflection of the recruit fishery status in 1981-82.

## Chignik Management District

The Chignik Management District of Tanner crab Registration Area "J" includes all waters bounded on the west by a line extending from Kupreanof Point to Castle Rock and from Castle Rock extending 135° southeast and bounded on the east by the longitude of Cape Kumlik (Figure 18).

### Total Harvest:

The 1981-82 Tanner crab harvest for the Chignik Management District totaled 1469.9 mt (Table 34). This modest harvest was 11% lower than the 1980-81 season though within the guideline harvest range of 907 - 2268 mt. Effort was at an all time high during the 1981-82 season with 45 vessels participating. In 1980-81, only 24 vessels fished the Chignik Management District. The Mitrofanina area received the bulk of the effort and accounted for 669.9 mt, just under half the total Chignik harvest (Table 35). The Ivanof area was second in production at 319.3 mt.

Table 32. Nine year comparison of Tanner crab, *Chionoecetes bairdi*, catch statistics for the South Peninsula Management District by fishing season, 1973-74 through 1981-82.

<u>Year</u>	<u>Vessels</u>	<u>No. of Landings</u>	<u>No. of Crab</u>	<u>Metric tons</u>	<u>Pots Lifted</u>	<u>Avg. Wt. (kg.)</u>	<u>CPUE</u>
1973-74	36	488	3,981,135	4310.7	70,047	1.13	57
1974-75	44	131	2,053,530	2356.8	38,153	1.13	54
1975-76	36	217	4,434,381	5081.2	59,377	1.13	75
1976-77	28	389	2,524,565	3072.6	63,143	1.22	40
1977-78	36	374	2,847,948	3377.6	70,587	1.18	40
1978-79	48	332	3,267,122	3939.2	82,374	1.22	40
1979-80	61	363	2,581,544	1796.8	96,989	1.22	27
1980-81	43	268	1,274,539	1494.2	59,560	1.18	21
1981-82	72	365	1,815,060	2081.6	81,058	1.13	22

Table 33. South Peninsula Management District Tanner crab, *Chionoecetes bairdi*, catch statistics by major fishing areas, 1981-82 fishing season.

<u>Area</u>	<u>Vessels</u>	<u>No. of Landings</u>	<u>No. of Crab</u>	<u>Metric tons</u>	<u>Pots Lifted</u>	<u>Avg. Wt. (kg.)</u>	<u>CPUE</u>
Unimak Bight	10	36	119,295	133.3	5,623	1.13	21
Sanak Island	17	34	315,768	351.7	16,163	1.13	19
Ikatan-Morzhovoi	10	18	93,903	110.5	5,351	1.18	18
Deer Island	19	112	358,043	412.5	14,565	1.13	25
Pavlof Bay	17	114	542,603	657.6	19,364	1.22	28
Beaver-Balboa	11	12	47,416	54.4	2,168	1.13	22
Mountain Point	15	42	138,486	151.3	6,083	1.09	23
Stepovak	17	43	138,886	146.2	8,613	1.04	16

Table 34. Nine year comparison of Tanner crab, *Chionoecetes bairdi*, catch statistics for Chignik Management District by fishing season, 1973-74 through 1981-82.

<u>Year</u>	<u>Vessels</u>	<u>No. of Landings</u>	<u>No. of Crab</u>	<u>Metric tons</u>	<u>Pots Lifted</u>	<u>Avg. Wt. (kg.)</u>	<u>CPUE</u>
1973-74	15	141	1,643,669	1906.3	32,067	1.18	51
1974-75	25	91	1,438,508	1655.4	22,675	1.13	63
1975-76	35	288	2,724,509	3141.7	52,381	1.13	52
1976-77	21	141	2,098,226	2573.2	40,604	1.22	52
1977-78	32	140	1,725,042	2129.1	38,414	1.22	45
1978-79	39	126	926,253	1150.4	28,378	1.22	33
1979-80	42	155	2,340,004	1595.7	54,627	1.18	25
1980-81	24	112	1,534,847	1657.3	44,022	1.09	35
1981-82	45	174	1,343,500	1469.9	47,830	1.09	28

Table 35. Chignik Management District Tanner crab, *Chionoecetes bairdi*, catch statistics by major fishing areas, 1981-82 fishing season.

<u>Area</u>	<u>Vessels</u>	<u>No. of Landings</u>	<u>No. of Crab</u>	<u>Metric tons</u>	<u>Pots Lifted</u>	<u>Avg. Wt. (kg.)</u>	<u>CPUE</u>
Ivanof	12	20	309,232	319.3	10,572	1.04	29
Mitrofanina	32	74	611,267	669.9	21,678	1.09	28
Chignik	14	44	210,547	235.7	7,949	1.13	26
Kujulik	9	23	150,627	173.8	5,060	1.13	30

The Chignik and Kujulik Bay areas followed with 235.7 and 173.8 mt delivered, respectively (Table 35).

#### Pot Lifts and Landings:

Pots lifted in the Chignik Management District during the 1981-82 season exceeded the preceding year by 3,808 lifts for a total of 47,830 (Table 34). While the number of vessels fishing varied considerably from 1980-81 (24 vessels) to 1981-82 (45 vessels) the increase in effort in terms of the number of pots lifted was not dramatic. The landings increased by 36% over the 1980-81 season (from 112 to 174). The CPUE dropped from 35 crabs per pot during the 1980-81 season to 28 crabs per pot for the 1981-82 fishery (Table 34), the second lowest in 9 years.

#### Crab Weight:

Average crab weight for the Chignik Management District was 1.09 kg during the 1980-81 and the 1981-82 seasons (Table 34). It was the lowest average weight in our 9 years of catch statistics in the Chignik Management District.

#### Eastern Aleutians Management District

The Eastern Aleutians Management District extends from the longitude of Scotch Cap light on the east to 172° west longitude excluding the waters of the Bering Sea north of Cape Sarichef (Figure 18).

#### Total Harvest:

The 1982 Tanner crab catch in the Eastern Aleutians Management District was about 11% higher than the 1981 catch because of better recruitment and a slight increase in effort. The total 1982 harvest was 335.5 mt which was the fifth highest in 9 years of catch statistics (Table 36). The number of vessels involved in the 1982 fishery reached an all time high of 31, however, effort has not increased dramatically over the past 3 or 4 years (29 vessels fished in 1981, Table 36).

#### Pot Lifts and Landings:

Pots lifted for the 1982 fishing season was another record at 30,109 (Table 36). This was a 28% increase in effort over the 1981 season when 21,771 pots were lifted. Landings totaled 138 for the District in 1982 compared to 119 in 1981. The catch per unit of effort was 11 crabs in 1982, the lowest CPUE in 9 years of statistics, but only one crab per pot less than the 1981 season. The CPUE has been steadily declining since the 1977 season when the catch per pot was 51 crabs (Table 36).

#### Crab Weight:

Average crab weight in the Eastern Aleutians Management District had been constant at 1.09 kg during the 1979 through 1981 seasons; however, in 1982 the average dropped to a low of 1.00 kg/crab (Table 36). This low equaled the previous low observed in 1975 when no size limit for Tanner crab was in effect.

Table 36. Nine year comparison of Tanner crab, *Chionoecetes bairdi*, catch statistics for the Eastern Aleutians Management District by fishing season, 1974 through 1982.

Year	Vessels	Landings	No. of Crabs <sup>1</sup>	Metric tons <sup>1</sup>	Pots Lifted	Avg. wt (kg)	CPUE
1974	6	14	219,539	226.2	-	1.09	60
1975	2	2	32,612	32.6	758	1.00	43
1976	8	13	219,166	242.3	4,646	1.09	47
1977	12	48	572,792	590.3	11,300	1.04	51
1978	14	185	1,076,144	1,101.8	27,863	1.04	39
1979	20	174	542,081	580.6	18,618	1.09	29
1980	18	107	352,819	402.0	18,040	1.09	20
1981	29	119	264,238	296.8	21,771	1.09	12
1982	31	138	332,260	335.5	30,109	1.00	11

<sup>1</sup> Deadloss included.

## Western Aleutians Management District

The Western Aleutians Management District includes all waters west of 172° west longitude and south of the latitude of Cape Sarichef (Figure 18).

### Total Harvest:

Fishing in the Western Aleutians Management District for Tanner crab was usually done in conjunction with the red king crab fishery and most vessels delivered both species. For the 1982 fishing season, however, the Tanner and king crab opening dates did not coincide. The Tanner crab season did not begin until 15 January. Despite the later opening date for Tanner crab in the Western Aleutians Management District a record high harvest of 380.4 mt was achieved (Table 37). This harvest was more than double the previous high of 153.0 mt landed in 1980. The number of vessels harvesting crab during the 1982 season was the highest, at 17, in the 9 years of fishing statistics. The 1980 fishing season had the previous record with 10 vessels fishing (Table 37).

### Pot Lifts and Landings:

Total vessels fishing the Western Aleutians Management District increased in 1982 as did the amount of effort they expended. Pot lifts increased threefold over the 1981 season to a high of 21,910 (Table 37). The CPUE rose in 1982 to 17 crabs per pot. Despite the increased effort the 1982 CPUE was four crabs per pot higher than the 1981 season. Either crab recruitment into the fishery was good or the fleet expanded its efforts into areas of the Western Aleutians Management District which received less fishing effort in past years, or a combination of the two.

### Crab Weight:

Average crab weight for the Western Aleutians Management District remained constant at 1.04 kg for the last five seasons (Table 37).

## ABUNDANCE AND DISTRIBUTION OF BLACK MAT SYNDROME

### Introduction

Over 99,000 male and female Tanner crab have been examined for the presence of Black Mat Syndrome (BMS), *Trichomarix invadens*, in the Westward Region during the past 3 years, 1980-1982. This previously unidentified genus of ascomycete has been known to infect certain species of the genus *Chionoecetes*, since the Alaskan fishery began in 1961. The disease is seen primarily on *Chionoecetes bairdi*, but there is evidence that it does exist on *Chionoecetes opilio* and *Chionoecetes tanneri* from the Bering Sea and Western Aleutian Islands (Figure 18).

The initial description of BMS was done by Van Hying and Scarborough in 1973 (Van Hying and Scarborough 1973). They incorrectly identified it as the soil born microfungus, *Phoma fimeti*. Ralph Brown of ADF&G also did some early abundance and distribution work with BMS and published this data in an Informational Leaflet in 1971 (Brown 1971). He found up to 75% of the male crabs in specific areas of Kodiak to be infected with BMS.

Table 37. Nine year comparison of Tanner crab, *Chionoecetes bairdi*, catch statistics for the Western Aleutians Management District by fishing season, 1974 through 1982.

<u>Year</u>	<u>Vessels</u>	<u>Landings</u>	<u>No. of Crab<sup>1</sup></u>	<u>Metric tons<sup>1</sup></u>	<u>Pots Lifted</u>	<u>Avg. wt. (kg)</u>	<u>CPUE</u>	
1974	7	12	31,079	32.6	2,390	1.04	13	
1975	1	1	1,216	1.5	25	1.27	49	
1976	2	2	24,977	28.2	671	1.13	37	
1977			-----No fishing-----					
1978	6	7	103,190	107.7	2,700	1.04	38	
1979	6	9	84,129	89.5	4,730	1.04	18	
1980	10	12	147,843	153.0	5,952	1.04	25	
1981	9	23	95,102	100.1	7,327	1.04	13	
1982	17	43	364,164	380.4	21,910	1.04	17	

<sup>1</sup> Deadloss included.

In the early description and distribution work done with BMS the only problem noted was the tendency of the black tarlike nodules encrusting the crab shell break off into the meat while processing, creating an aesthetically inferior product and often a reduced price paid to the fishermen. The disease was known to be highly area-specific so it could be avoided if processors didn't want to buy it.

It is now evident from work done by Sparks and Hibbits (1979) that the pathology of the disease has greater implications than previously thought. The syndrome has been found to invade not only the carapace but most of the internal organs creating debilitation. It is also highly suspect of being a molt inhibitor and perhaps lethal in many cases. This recent finding on the possible impact of the disease on the health of the Tanner crab led to this ongoing study of the abundance and distribution of BMS.

### Materials and Methods

Three collection methods have been used to sample Tanner crabs in the Westward Region for the presence of BMS.

Initially random samples were collected from commercial catches delivered to the Kodiak processing plants. Dockside samples have been used to distinguish BMS in the region since the 1980 commercial season. Samples were selected from the Kodiak, Chignik, and South Peninsula Management Districts (Figure 18). All commercial samples were pot caught legal sized male crabs.

Additionally crab specimens have been examined for BMS on the ADF&G annual king and Tanner crab population index surveys since 1980 in the Kodiak area and 1981 in the South Peninsula area. Crabs from these surveys were obtained by fishing 2.1 x 2.1 m commercial style pots fished at predetermined stations. The data from the 1980 Kodiak pot survey was obtained by only one of the two vessels conducting the survey so the results are for that portion of the cruise.

The final source of data for the BMS study was the Tanner crab trawl surveys. Crabs were captured in bottom tows made with a 400 mesh eastern otter trawl which was towed for 30 minutes at each station fished. The northern Shelikof Strait area of Kodiak was surveyed in 1980-1982 and the Chignik Management District was surveyed in 1981 and 1982. The trawl method of collecting crab samples most segments of the population whereas the pot survey and commercial catches primarily sample legal size males. The smallest crabs captured on any of the pot surveys were about 60 mm (carapace width) compared to 9 mm in the trawl caught samples.

Tanner crabs were noted as having BMS if the black tarlike nodules of *Trichomaris invadens* were observed visually on the external surface of the crab. No judgment was made as to the extent of the infection.

### Results and Discussion

It has been found that the best way to discuss the results was to compare each sampling method as a separate study since we had multiple years of sampling for each method. It was also best to treat the males and females separately.

The commercial samples taken from the Kodiak Management District since 1980 to 1982 exhibited the highest incidence of BMS. The sample sizes were very small in 1980 with only 1,400 legal sized males examined (Table 38 and Figure 2). These samples represented nine schools and the percentage infection ranged from 0% to 65%. The most heavily infected schools seen that year were schools 10 and 12 from the northeast section of the island and schools 22 and 30 from the southern end of Kodiak Island.

Commercial catch sampling continued through the 1981 season when 7,240 legal males from the Kodiak Management District and one sample of 103 crabs from the Chignik Management District were examined (Table 38). The Kodiak samples were from 18 crab schools and showed similarities with the 1980 samples. The most heavily diseased schools in 1980 were the most infected areas in 1981. The offshore schools of the northeast section were again the hot spots (schools 10, 12, and 14). School 30 from the offshore southwest section was heavily diseased at 24.1% infection (Table 38). The one commercial sample of 103 crabs from the Chignik Management District had 4.9% BMS.

The 1982 commercial catch samples in the Kodiak Management District were similar in size to the 1981 samples and included many of the same schools (Table 38). Overall incidence of BMS went down in 1982, though the same schools that were highly diseased in 1980 and 1981 also were the hot spots in 1983. It has become clear that BMS is relatively area specific with the highest incidence of the disease occurring in offshore schools of Tanner crabs. The bay schools of Kodiak are virtually devoid of the disease. The Island-wide occurrence of BMS ranged from 26.4% in 1980 to 4.0% in 1982 (Table 38). Each school has to be looked at individually year to year for best comparisons. Schools 10, 12, and 14 (Table 38) have a relatively high occurrence of BMS for all years sampled. Schools 22 and 30 on the south end of Kodiak Island are also major BMS areas.

Pot survey observations on BMS were initiated in 1980 and have continued each year. In 1980 the Kodiak pot survey was conducted by two vessels, one of which took BMS data. The survey observed crabs from nine crab schools and 4,484 male Tanner crab were examined (Table 38). School 14 had a sample size of 690 crabs and 53.5% were diseased. The offshore schools, 22 and 30, at the south end of Kodiak Island had 54.0% and 35.5% infection, respectively. The 1981 Kodiak pot survey sampled 10,375 male Tanner crabs. The highest BMS occurrence in 1981 was found in school 12 with 45.0% infection. The crab group with the highest percentage of BMS was the post-recruit legal crabs with 18.3% (Table 39). It is interesting to note that 94.3% of all the very oldshell age crabs had BMS (Table 39). The disease has been found on the oldshell and very oldshell age crabs more often than on new-shell crabs.

The 1982 Kodiak Management District pot survey sampled 21,022 crabs or about twice that of the 1981 survey (Table 38). The District-wide BMS occurrence of 6.0% was lower than either the 1980 or 1981 surveys. The offshore schools that showed heavy infection rates with BMS in 1980 and 1981 were, for the most part, also the most heavily infected during the 1982 survey. In 1982, 882 of the 1,262 males with BMS captured (70%) were oldshell crabs (Table 40). The sublegal oldshell crabs showed the highest percentage occurrence of BMS in 1982 with pre-recruit fours exhibiting 100% BMS and pre-recruit threes 76.9%. Sample sizes of these smaller crabs were very small.

Table 38. Percent occurrence of Black Mat Syndrome by district and school for the 1980-82 male Tanner crab, *Chionoecetes bairdi*, sampling efforts in the Westward Region.

Kodiak Management District		1980 Comm. Catch		1981 Comm. Catch		1982 Comm. Catch		1980 Trawl Survey		1981 Trawl Survey		1982 Trawl Survey		1980 Pot Survey		1981 Pot Survey		1982 Pot Survey	
School	No. <sup>1</sup>	No.	% BM	No.	% BM	No.	% BM	No.	% BM	No.	% BM	No.	% BM	No.	% BM	No.	% BM	No.	% BM
Marmot Bay	5	-	-	256	1.2	451	2.2	-	-	-	-	-	-	-	-	413	1.4	1,049	0.4
Portlock	6	-	-	50	0	100	0	-	-	-	-	-	-	-	-	5	20.0	91	60.4
Chiniak Bay	9	-	-	51	0	176	4.0	-	-	-	-	-	-	391	21.7	116	1.7	798	0.5
Marmot Gully	10	100	40.0	854	18.1	457	4.8	-	-	-	-	-	-	-	-	489	33.9	1,340	15.6
Outer Marmot Gully	12	100	65.0	100	29.0	51	2.0	-	-	-	-	-	-	-	-	40	45.0	100	22.0
Chiniak Gully	14	-	-	805	33.0	101	8.9	-	-	90	11.1	-	-	690	53.3	407	36.1	584	9.8
Two Headed	17	-	-	50	0	50	0	-	-	-	-	-	-	191	0.7	290	1.0	1,415	0.3
Ugak/Barnabas	18	200	5.0	639	1.9	600	1.3	-	-	-	-	-	-	471	12.5	1,360	2.0	4,944	0.5
Eastside Other	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Horse's Head	20	-	-	249	10.0	101	6.9	-	-	-	-	-	-	477	21.5	371	21.6	986	1.7
Alitak Bay	21	-	-	100	0	-	-	-	-	-	-	-	-	881	0.5	1,290	0.1	1,005	0.1
S. Trinity Islands	22	200	58.0	-	-	106	4.7	-	-	-	-	-	-	193	54.0	536	42.4	757	14.8
Compass Rose	30	200	27.0	505	24.1	688	12.4	-	-	-	-	-	-	1,150	35.5	3,031	7.1	5,404	12.8
Southwest Other	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ikolik/Alitak	34	-	-	503	2.8	518	2.1	-	-	-	-	-	-	40	0	836	4.1	1,248	4.0
Semidi Islands	35	200	11.5	502	6.0	214	5.6	-	-	-	-	-	-	-	-	-	-	-	-
Uyak Bay	38	100	1.0	352	3.7	199	6.0	-	-	-	-	618	1.0	-	-	-	-	-	-
South Mainland	39	-	-	202	11.9	250	1.2	-	-	-	-	-	-	-	-	-	-	-	-
Kupreanof/Uganik	40	100	0	706	8.3	836	4.4	-	-	-	-	601	0	-	-	1,191	0.6	1,302	0.6
North Mainland	41	200	30.0	1,216	5.3	766	2.6	2,922	2.3	2,309	3.5	5,746	1.9	-	-	-	-	-	-
West Afognak	42	-	-	100	1.0	79	1.3	312	1.3	461	5.2	-	-	-	-	-	-	-	-
<b>TOTAL</b>		<b>1,400</b>	<b>26.4</b>	<b>7,240</b>	<b>11.3</b>	<b>5,743</b>	<b>4.0</b>	<b>3,234</b>	<b>2.2</b>	<b>2,860</b>	<b>4.0</b>	<b>6,965</b>	<b>1.7</b>	<b>4,484</b>	<b>25.2</b>	<b>10,375</b>	<b>9.0</b>	<b>21,022</b>	<b>6.0</b>
<b>Chignik Management District Total</b>		<b>-</b>	<b>-</b>	<b>103</b>	<b>4.9</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2,517</b>	<b>2.5</b>	<b>3,079</b>	<b>1.6</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>South Peninsula Management District Total</b>		<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>3,812</b>	<b>0.8</b>	<b>2,752</b>	<b>2.1</b>

<sup>1</sup> See Figure 2 for school location.

Table 39. Number of male Tanner crabs, *Chionoecetes bairdi*, captured by size and age group by exoskeletal age and percent occurrence of Black Mat Syndrome, 1981 Kodiak Management District pot survey.

Group	Number of Crabs				Number with Black Mat				Percent with Black Mat			
	N	0	V0	Total	N	0	V0	Total	N	0	V0	Total
Pre-recruit Fours	9	0	1	10	0	0	0	0	0.0	-	0.0	0.0
Pre-recruit Threes	80	2	0	82	11	1	0	12	13.5	50.0	-	14.5
Pre-recruit Twos	831	114	3	948	42	48	3	92	5.1	42.1	100.0	9.7
Pre-recruit Ones	3,453	802	61	4,316	96	398	60	554	2.8	49.6	98.4	12.8
Recruit Legals	3,873	0	0	3,873	63	0	0	63	1.6	NA	NA	1.6
Post-recruit Legals	684	440	22	1,146	8	183	19	210	1.2	41.6	86.4	18.3
Total Legals	4,557	440	22	5,019	71	183	19	273	1.6	41.6	86.4	5.4
Total Males	8,930	1,358	88	10,375	220	630	83	933	2.5	46.4	94.3	9.0
% of Total	86.1	13.1	0.8	100.0	23.6	67.6	8.9	100.0				

Table 40. Number of male Tanner crabs, *Chionoecetes bairdi*, captured by size and age group by exoskeletal age and percent occurrence of Black Mat Syndrome, 1982 Kodiak Management District pot survey.

Group	Number of Crabs				Number with Black Mat				Percent with Black Mat			
	N	0	V0	Total	N	0	V0	Total	N	0	V0	Total
Pre-recruit Fours	5	2	0	7	0	2	0	2	0.0	100.0	0.0	28.6
Pre-recruit Threes	69	13	0	82	6	10	0	16	8.7	76.9	0.0	10.5
Pre-recruit Twos	1,027	697	11	1,735	39	229	4	272	3.8	32.9	36.4	15.8
Pre-recruit Ones	6,107	2,396	43	8,546	116	551	29	812	1.9	23.0	67.4	9.5
Recruit Legals	8,848	NA	NA	8,848	178	NA	NA	178	2.0	NA	NA	2.0
Post-recruit Legals	1,214	562	28	1,804	7	90	1	98	0.6	16.0	3.6	5.4
Total Legals	10,062	562	28	10,652	185	90	1	276	1.8	16.0	3.6	2.6
Total Males	17,270	3,670	82	21,022	346	882	34	1,262	2.0	24.0	41.5	6.0
% of Total	82.2	17.5	0.4	100.0	27.4	69.9	2.7	100.0				

Female Tanner crabs have been studied on three consecutive pot surveys. In the Kodiak Management District the overall incidence of BMS on female crabs has been high. In 1980 the BMS infection rate was the highest recorded with 50.1% diseased crabs (Table 41). The 1981 survey had 34.8% of the females diseased (Table 42), while in 1982 only 22.5% were infected (Table 43). The relative occurrence has declined each year though the incidence was still considerable in 1982. Looking at very oldshell females, it is apparent that BMS is very common. In 1980 94.5% of the very oldshell females had BMS (Table 41) while in 1981 100% had BMS (Table 42). In 1982 only 25% were infected (Table 43). However, the 1981 and 1982 sample sizes were small with only 3 and 16 very oldshell observed. It became even more evident when the old and very oldshell females were summed up and compared to the newshells. The newshell females had less than 10% BMS for all years surveyed. In 1981 about half of all the adult females recorded as barren (zero percent egg clutch) also had BMS and in 1982 94.4% of the barren females had the disease.

The South Peninsula Management District pot surveys recorded BMS data on the 1981 and 1982 surveys. The incidence among males was relatively low both years, as compared to the Kodiak area, with only 0.8% infection in 1981 and 2.1% in 1982 (Table 38). The size and age group data taken in 1982 (Table 44) showed that the pre-recruit one and post-recruit crabs were the most heavily infected groups with 2.4% and 3.8% BMS, respectively (Table 44). It was in these two groups of crabs that skip molting was most common.

Female Tanner crabs collected from the South Peninsula pot surveys of 1981 and 1982 also had relatively little BMS occurrence. During the 1981 (Table 45) survey 8.9% of the females were diseased while 4.0% had BMS in 1982 (Table 46). In 1981 and 1982 only the very oldshell females from the South Peninsula survey had BMS.

Tanner crab trawl surveys have been conducted in the northern Shelikof Strait area of Kodiak (Figure 2, School 41) since 1980. Results from these surveys have shown relatively low BMS incidence among the male Tanner crab population. These trawls pick up a higher proportion of small size crabs than are captured on pot surveys which affects the resulting overall incidence of the disease recorded. The percentage incidence of BMS for the 1980, 1981, and 1982 northern Shelikof Strait male Tanner crab was 2.2%, 4.0%, and 1.7%, respectively (Table 38). By comparing the same size groups of crabs from consecutive trawl surveys (Tables 47, 48, and 49) it was evident that the pre-recruit one and post-recruit legal males were diseased to a greater extent than most of the other groups. Also, the old and very oldshell crabs were affected more than the newshells. In the 1980 and 1982 surveys the post-recruit legal males were the most heavily infected with 9.6% and 9.5% BMS, respectively.

Female Tanner crabs from the Kodiak trawl surveys had similar BMS occurrence for 1980 and 1981 at 8.7% and 9.2%, respectively (Tables 50 and 51), while in 1982 the incidence dropped to 5.2% (Table 52). Sample sizes were similar each year and ranged from 2,455 to 3,030 crabs. The very oldshell female components were the most heavily diseased each year with 46.2%, 39.2%, and 19.9% BMS, respectively. The newshell crabs consistently showed the least amount of disease (Tables 50, 51, and 52).

Female crabs captured on the 1982 Kodiak trawl survey that were barren (no external eggs) totaled 60 crabs. Of these, 23% had BMS. Most of these females were

Table 41. Number of female Tanner crabs, *Chionoecetes bairdi*, measured by exoskeletal age and occurrence of Black Mat Syndrome, in a portion of the Kodiak Management District, 1980 Kodiak Management District pot survey.

Group	Number crabs				Number with Black Mat				Percent with Black Mat			
	N	0	V0	Total	N	0	V0	Total	N	0	V0	Total
Juveniles	111	7	0	118	6	6	0	12	5.4	85.7	-	10.2
Adults	194	321	165	680	10	222	156	388	5.2	69.2	94.5	57.1
Total	305	328	165	798	16	228	156	400	5.2	69.5	94.5	50.1
% of Total	38.2	41.1	20.7	100.0	4.0	57.0	39.0	100.0				

Table 42. Number of female Tanner crabs, *Chionoecetes bairdi*, measured by exoskeletal age and occurrence of Black Mat Syndrome, 1981 Kodiak Management District pot survey.

Group	Number crabs				Number with Black Mat				Percent with Black Mat			
	N	0	V0	Total	N	0	V0	Total	N	0	V0	Total
Juveniles	37	6	0	43	2	5	0	7	5.4	83.3	-	16.3
Adults	350	379	3	732	25	235	3	263	7.1	62.0	100.0	35.9
Total	387	385	3	775	27	240	3	270	7.0	62.3	100.0	34.8
% of Total	49.9	49.7	0.4	100.0	10.0	88.9	1.1	100.0				

Table 43. Number of female Tanner crabs, *Chionoecetes bairdi*, measured by exoskeletal age and occurrence of Black Mat Syndrome, 1982 Kodiak Management District pot survey.

Group	Number crabs				Number with Black Mat				Percent with Black Mat			
	N	0	V0	Total	N	0	V0	Total	N	0	V0	Total
Juveniles	16	0	0	16	2	0	0	2	12.5	0.0	0.0	12.5
Adults	638	1,260	16	1,914	62	367	4	433	9.7	29.1	25.0	22.6
Total	654	1,260	16	1,930	64	367	4	435	9.8	29.1	25.0	22.5
% of Total	33.9	65.3	0.8	100.0	14.7	84.4	0.9	100.0				

Table 44. Number of male Tanner crabs, *Chionoecetes bairdi*, measured by size and age group by exoskeletal age and occurrence of Black Mat Syndrome, 1982 South Peninsula Management District pot survey.

Group	Number Crabs				Number with Black Mat				Percent with Black Mat			
	N	0	V0	Total	N	0	V0	Total	N	0	V0	Total
Pre-recruit Fours	2	0	0	2	0	0	0	0	0.0	0.0	0.0	0.0
Pre-recruit Threes	5	1	1	7	0	0	0	0	0.0	0.0	0.0	0.0
Pre-recruit Twos	71	50	46	167	0	0	2	2	0.0	0.0	4.3	1.2
Pre-recruit Ones	339	497	342	1,178	0	7	21	28	0.0	1.4	6.1	2.4
Recruit Legals	666	NA	NA	666	0	NA	NA	0	0.0	NA	NA	0.0
Post-recruit Legals	149	446	137	732	0	25	3	28	0.0	5.6	2.2	3.8
Total Legals	815	446	137	1,398	0	25	3	28	0.0	5.6	2.2	2.0
Total Males	1,232	994	526	2,752	0	32	26	58	0.0	3.2	4.9	2.1
% of Total	44.8	36.1	19.1	100.0	0.0	55.2	44.8	100.0				

Table 45. Number of female Tanner crabs, *Chionoecetes bairdi*, measured by exoskeletal age and occurrence of Black Mat Syndrome, 1981 South Peninsula Management District pot survey.

Group	Number crabs				Number with Black Mat				Percent with Black Mat			
	N	0	V0	Total	N	0	V0	Total	N	0	V0	Total
Juveniles	13	0	0	13	0	0	0	0	0.0	-	-	0.0
Adults	2	34	254	290	0	0	27	27	0.0	0.0	10.6	9.3
Total	15	34	254	303	0	0	27	27	0.0	0.0	10.6	8.9
% of Total	5.0	11.2	83.8	100.0	0.0	0.0	100.0	100.0				

Table 46. Number of female Tanner crabs, *Chionoecetes bairdi*, measured by exoskeletal age and occurrence of Black Mat Syndrome, 1982 South Peninsula Management District pot survey.

Group	Number crabs				Number with Black Mat				Percent with Black Mat			
	N	0	V0	Total	N	0	V0	Total	N	0	V0	Total
Juveniles	7	0	0	7	0	0	0	0	0.0	0.0	0.0	0.0
Adults	40	23	455	518	0	0	21	21	0.0	0.0	4.6	4.1
Total	47	23	455	525	0	0	21	21	0.0	0.0	4.6	4.0
% of Total	8.9	4.4	86.7	100.0	0.0	0.0	100.0	100.0				

Table 47. Number of male Tanner crabs, *Chionoecetes bairdi*, measured by size and age group by exoskeletal age and occurrence of Black Mat Syndrome in northern Shelikof Strait, 1980 Kodiak Management District trawl survey.

Group	Number Crabs				Number with Black Mat				Percent with Black Mat			
	N	0	V0	Total	N	0	V0	Total	N	0	V0	Total
Pre-recruit Fours	1,226	6	0	1,232	19	3	0	22	1.5	50.0	-	1.8
Pre-recruit Threes	640	7	0	647	3	0	0	3	0.5	0.0	-	0.5
Pre-recruit Twos	521	27	1	549	4	6	0	10	0.8	22.2	0.0	1.8
Pre-recruit Ones	497	160	15	672	2	19	1	22	0.4	11.9	6.7	3.3
Recruit Legals	230	-	-	230	1	-	-	1	0.4	-	-	0.4
Post-recruit Legals	18	112	6	136	0	10	3	13	0.0	8.9	50.0	9.6
Total Legals	248	112	6	366	1	10	3	14	0.4	8.9	50.0	3.8
Total Males	3,132	312	22	3,466	29	38	4	71	0.9	12.2	18.2	2.0
% of Total	90.4	9.0	0.6	100.0	40.8	53.5	5.6	100.0				

Table 48. Number of male Tanner crabs, *Chionoecetes bairdi*, measured by size and age group by exoskeletal age and occurrence of Black Mat Syndrome in northern Shelikof Strait, 1981 Kodiak Management District trawl survey.

Group	Number Crabs				Number with Black Mat				Percent with Black Mat			
	N	0	V0	Total	N	0	V0	Total	N	0	V0	Total
Pre-recruit Fours	613	1	0	614	7	1	0	8	1.1	100.0	-	1.3
Pre-recruit Threes	738	2	0	740	26	1	0	27	3.5	50.0	-	3.6
Pre-recruit Twos	462	40	4	506	12	18	3	33	2.6	45.0	75.0	6.5
Pre-recruit Ones	372	154	11	537	3	26	4	33	0.8	16.9	36.4	6.1
Recruit Legals	275	NA	NA	275	0	-	-	0	0.0	-	-	0.0
Post-recruit Legals	36	61	1	98	0	3	0	3	0.0	4.9	0.0	3.1
Total Legals	311	61	1	373	0	3	0	3	0.0	4.9	0.0	0.8
Total Males	2,496	258	17	2,770	48	49	7	104	1.9	19.0	41.2	3.8
% of Total	90.1	9.3	0.6	100.0	46.2	47.1	6.7	100.0				

Table 49. Number of male Tanner crabs, *Chionoecetes bairdi*, measured by size and age group by exoskeletal age and occurrence of Black Mat Syndrome in northern Shelikof Strait, 1982 Kodiak Management District trawl survey.

Group	Number Crabs				Number with Black Mat				Percent with Black Mat			
	N	0	VO	Total	N	0	VO	Total	N	0	VO	Total
Pre-recruit Fours	819	8	0	827	2	8	0	10	0.2	100.0	-	1.2
Pre-recruit Threes	992	24	6	1,022	4	17	5	26	0.4	70.8	83.3	2.5
Pre-recruit Twos	1,138	115	12	1,265	3	17	7	27	0.3	14.8	58.3	2.1
Pre-recruit Ones	1,612	197	34	1,843	7	17	11	35	0.4	8.6	32.3	1.9
Recruit Legals	634	NA	NA	634	5	NA	NA	5	0.8	NA	NA	0.8
Post-recruit Legals	71	76	8	155	NA	3	4	7	NA	4.4	66.7	9.5
Total Legals	705	76	8	789	5	4	4	13	0.7	5.3	50.0	1.6
Total Males	5,266	420	60	5,746	21	63	27	111	0.4	15.0	45.0	1.9
% of Total	91.6	7.3	1.1	100.0	18.9	56.8	24.3	100.0				

Table 50. Number of female Tanner crabs, *Chionoecetes bairdi*, measured by exoskeletal age and occurrence of Black Mat Syndrome in northern Shelikof Strait, 1980 Kodiak Management District trawl survey.

Group	Number crabs				Number with Black Mat				Percent with Black Mat			
	N	0	V0	Total	N	0	V0	Total	N	0	V0	Total
Juveniles	1,555	3	0	1,558	21	1	0	22	1.4	33.3	-	1.4
Adults	298	270	329	897	2	37	152	191	0.7	13.7	46.2	21.3
Total	1,853	273	329	2,455	23	38	152	213	1.2	13.9	46.2	8.7
% of Total	75.5	11.1	13.4	100.0	10.8	17.8	71.4	100.0				

Table 51. Number of female Tanner crabs, *Chionoecetes bairdi*, measured by exoskeletal age and occurrence of Black Mat Syndrome in northern Shelikof Strait, 1981 Kodiak Management District trawl survey.

Group	Number crabs				Number with Black Mat				Percent with Black Mat			
	N	0	V0	Total	N	0	V0	Total	N	0	V0	Total
Juveniles	1,338	13	0	1,351	23	11	0	34	1.7	84.6	-	2.5
Adults	607	540	199	1,346	13	123	78	214	2.1	22.8	39.2	15.9
Total	1,945	553	199	2,697	36	134	78	248	1.9	24.2	39.2	9.2
% of Total	72.1	20.5	7.4	100.0	14.5	54.0	31.5	100.0				

Table 52. Number of female Tanner crabs, *Chionoecetes bairdi*, measured by exoskeletal age and occurrence of Black Mat Syndrome in northern Shelikof Strait, 1982 Kodiak Management District trawl survey.

Group	Number crabs				Number with Black Mat				Percent with Black Mat			
	N	0	V0	Total	N	0	V0	Total	N	0	V0	Total
Juveniles	1,082	18	0	1,100	6	17	0	23	0.6	94.4	0.0	0.1
Adults	661	1,048	221	1,930	2	90	44	136	0.3	8.6	19.9	7.0
Total	1,743	1,066	221	3,030	8	107	44	159	0.5	10.0	19.9	5.2
% of Total	57.5	35.2	7.3	100.0	5.0	67.3	27.7	100.0				

very oldshell animals and the barrenness may or may not be related to the presence of BMS.

Chignik Management District trawl surveys were conducted in 1981 and 1982. The overall BMS occurrence for male Tanner crabs in Chignik was much lower than in Kodiak. In 1981 only 2.5% of the males had the disease and in 1982 it dropped to 1.6% (Tables 53 and 54). Sample sizes were large, 2,517 and 3,079 crabs, and included most size groups of the population. Similar to the Kodiak Management District the 1981 survey was unusual in that the pre-recruit two crabs had the highest occurrence of BMS with 7.3% (Table 53). In 1982 the pre-recruit ones showed the highest occurrence although the 3.9% incidence was relatively low (Table 54).

Female Tanner crabs from the Chignik trawl surveys seem to be virtually uninfected by BMS (Tables 55 and 56). In 1981 only 1.3% of the females were diseased. In 1982 it dropped to 0.6%. The very few crabs that did have the disease (14 in 1981 and 7 in 1982) were almost entirely old or very oldshell adult females.

We are planning to continue our observations on the incidence and distribution of Black Mat Syndrome on the Tanner crab and hope to also define, experimentally, the degree to which the disease may affect the ability of Tanner crabs to molt successfully.

#### SUMMARY

A pilot trawl survey program, initiated in 1980, to assess Tanner crab populations continued during 1983. The North Mainland fishing section of the northern Shelikof Strait area of the Kodiak Management District was surveyed for the third year. The Chignik Management District was sampled for the second time while preliminary surveys were conducted in the Uyak and Uganik Bay areas of the Kodiak Management District. In terms of crab catch, many more crabs were captured on the 1982 survey than were caught during previous efforts in the North Mainland fishing section and the Chignik Management District. Sampling effort in 1982 was approximately equal to that in 1980 in the North Mainland fishing section, however, it was considerably higher than the 1981 effort in the same area. Effort in 1982 was higher than the effort expended during 1981 in the Chignik Management District. Information was gained on small sized (< 115 mm CW) crabs which was one of the main objectives of the experimental trawl program. Recruitment predictions for subsequent commercial fisheries have been substantiated in some areas and years by commercial fishery data while they have proven to be problematic in other areas and seasons. The female portion of the population seems to be in a healthy state, in the areas surveyed, with regard to reproductive potential. A number of problems have come to light which must be addressed in the future. How many tows do we need to adequately assess the population? How critical is within-stratum tow distribution when survey accuracy needs to be maintained from year to year? How can we improve or standardize our ability to shell age crabs from year to year? What is the best way to verify survey results during the subsequent commercial fishery?

Population indexing surveys using pots were conducted in the Kodiak and South Peninsula Management Districts in 1982. In Kodiak, more crabs were captured

Table 53. Number of male Tanner crabs, *Chionoecetes bairdi*, measured by size and age group by exoskeletal age and occurrence of Black Mat Syndrome, 1981 Chignik Management District trawl survey.

Group	Number Crabs				Number with Black Mat				Percent with Black Mat			
	N	0	VO	Total	N	0	VO	Total	N	0	VO	Total
Pre-recruit Fours	418	0	0	418	1	-	-	1	0.2	-	-	0.2
Pre-recruit Threes	132	2	0	134	4	2	-	6	3.0	100.0	-	4.5
Pre-recruit Twos	374	64	0	438	9	23	-	32	2.4	35.9	-	7.3
Pre-recruit Ones	775	161	0	936	3	17	-	20	0.4	10.5	-	2.1
Recruit Legals	495	NA	NA	495	1	-	-	1	0.2	-	-	0.2
Post-recruit Legals	28	68	0	96	0	3	0	3	0.0	3.1	0.0	3.1
Total Legals	523	68	0	591	1	3	-	4	0.2	4.4	-	0.7
Total Males	2,222	295	0	2,517	18	45	-	63	0.8	15.3	-	2.5
% of Total	88.3	11.7	0.0	100.0	28.6	71.4	0.0	100.0				

Table 54. Number of male Tanner crabs, *Chionoecetes bairdi*, measured by size and age group by exoskeletal age and occurrence of Black Mat Syndrome, 1982 Chignik Management District trawl survey.

Group	Number Crabs				Number with Black Mat				Percent with Black Mat			
	N	O	VO	Total	N	O	VO	Total	N	O	VO	Total
Pre-recruit Fours	650	0	0	650	0	0	0	0	0.0	0.0	0.0	0.0
Pre-recruit Threes	232	2	1	235	0	2	1	3	0.0	100.0	100.0	1.3
Pre-recruit Twos	233	35	0	268	0	9	0	9	0.0	25.7	0.0	3.4
Pre-recruit Ones	544	215	15	774	5	23	2	30	0.9	10.7	13.3	3.9
Recruit Legals	907	NA	NA	907	1	NA	NA	1	0.1	NA	NA	0.1
Post-recruit Legals	121	115	9	245	0	4	1	5	0.0	3.5	11.1	2.0
Total Legals	1,028	115	9	1,152	1	4	1	6	0.1	3.5	11.1	0.5
Total Males	2,687	367	25	3,079	6	38	4	48	0.2	10.4	16.0	1.6
% of Totals	87.3	11.9	0.8	100.0	12.5	79.2	8.3	100.0				

Table 55. Number of female Tanner crabs, *Chionoecetes bairdi*, measured by exoskeletal age and occurrence of Black Mat Syndrome, 1981 Chignik Management District trawl survey.

Group	Number crabs				Number with Black Mat				Percent with Black Mat			
	N	0	V0	Total	N	0	V0	Total	N	0	V0	Total
Juveniles	501	0	0	501	1	0	0	1	0.2	0	0	0.2
Adults	97	489	4	590	1	11	1	13	1.0	2.2	25.0	2.2
Total	598	489	4	1,091	2	11	1	14	0.3	2.2	25.0	1.3
% of Total	54.8	44.8	0.4	100.0	14.3	78.6	7.1	100.0				

Table 56. Number of female Tanner crabs, *Chionoecetes bairdi*, measured by exoskeletal age and occurrence of Black Mat Syndrome, 1982 Chignik Management District trawl survey.

Group	Number crabs				Number with Black Mat				Percent with Black Mat			
	N	O	VO	Total	N	O	VO	Total	N	O	VO	Total
Juveniles	770	0	0	770	0	0	0	0	0.0	0.0	0.0	0.0
Adults	60	322	23	405	0	4	3	7	0.0	1.2	13.0	1.7
Total	830	322	23	1,175	0	4	3	7	0.0	1.2	13.0	0.6
% of Total	70.6	27.4	2.0	100.0	0.0	57.1	42.9	100.0				

than in any survey year since 1977. Effort was 1,721 pot lifts which is close to the 1,683 pot lift average of the last six surveys. All stocks of legal size crabs showed increases in relative abundance between 1981 and 1982. Island-wide the percent increase in the legal population of crabs was substantial (+121%). The increase was accounted for by good recruitment since the relative abundance of post-recruit legal size crabs continued to decline. Kodiak female reproductive potential was apparently in a healthy state in 1982. The relative abundance of pre-recruit one males was the highest since the 1976 survey and would suggest continued improvement of the Tanner crab resource in the Kodiak area. In the South Peninsula Management District all categories of crabs sampled showed declines in relative abundance. Fishing effort was somewhat lower than in the past 2 years. The relative abundance of the legal size portion of the population was significantly lower in 1982 compared with the 1981 survey (-52%). The female portion of the population seemed to be reproductively healthy in 1982. Future recruitment for the South Peninsula Management District looks poor at present.

Observations on the 1982 commercial fishery in the Kodiak Management District showed a 17% increase in the harvest over the 1981 catch. The number of vessels fishing also increased by 17% while the number of pots lifted showed a 32% increase. The Chignik Management District catch in 1982 showed a 10% decline over the previous year's harvest despite an 87% increase in the number of vessels fishing and a 9% increase in the number of pots lifted during the commercial season. The South Peninsula Management District commercial harvest in 1982 was 39% higher than the previous year. Fishing effort in 1982 was considerably higher than in 1981 with a 57% increase in the number of vessels participating in the fishery and a 36% increase in the number of pots lifted. The 1982 harvest in the Eastern Aleutians Management District was 13% higher than the 1981 catch. The number of vessels increased by 7% while the number of pot lifts showed a 38% increase over the 1981 effort. The Western Aleutians Management District catch in 1982 was the historical high in the district. Fishing effort was much higher than in 1981 with the number of vessels increasing by 99% and the number of pots lifted during the season showing a 199% increase.

Studies on Black Mat Syndrome (*Trichomaris invadens*) have shown a highly area specific incidence of infection. The disease is not found at all on crabs from certain bay areas while crabs from offshore areas may show an infection rate as high as 60%. The disease is more common in the Kodiak Management District than in the Chignik or South Peninsula Management Districts. The incidence generally showed declines in all areas in 1982.

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## LITERATURE CITED

- Balsiger, J.W. 1974. A computer simulation model for the eastern Bering Sea king crab population. Ph.D. Thesis, University of Washington. 197 pp.
- Brown, R. 1971. The development of the Alaskan fishery for Tanner crab, *Chionoecetes bairdi*, with particular reference to the Kodiak Area, 1967-1970. ADF&G Informational Leaflet No. 153. 26 pp.
- Cochran, W. 1977. Sampling techniques. John Wiley and Sons, New York. 428 pp.
- Colgate, W.A. and D.M. Hicks. 1982. Investigations of life history and fishery for Tanner crab, *Chionoecetes bairdi*, in Alaska. Alaska Department of Fish and Game report for Project No. 5-47-R, Commercial Fisheries Research and Development Act. 160 pp.
- Leslie, P.H. and D.H. Davis. 1939. An attempt to determine the absolute number of rats on a given area. J. Anim. Ecol. 8:94-113.
- Otto, R.S., A.H. Fukuyama, T.M. Armetts, and R.A. MacIntosh. 1979. Report to industry on 1978 eastern Bering Sea survey, Tanner crab. Northwest and Alaska Fisheries Center Processed Report. Nat. Mar. Fish. Ser. 31 pp.
- Paul, A.J., A.E. Adams, J.M. Paul, H.M. Feder, and W.E. Donaldson. 1983. Some aspects of reproductive biology of the crab *Chionoecetes bairdi*. Sea Grant Rpt. No. 83-1. Univ. of Alaska. 32 pp.
- Reeves, J.E. 1979. Assessment of Tanner crab stocks in the eastern Bering Sea for the 1979 fisheries from the 1978 NMFS trawl survey. Northwest and Alaska Fisheries Center Processed Report. Nat. Mar. Fish. Ser. 17 pp.
- Rothschild, B.J., G. Powell, J. Joseph, N. Abramson, J. Buss, and P. Eldridge. 1970. A survey of the population dynamics of king crab in Alaska with particular reference to the Kodiak area. Alaska Dept. of Fish and Game Informational Leaflet No. 147. 149 pp.
- Sparks, A.K. and J. Hibbits. 1979. Black Mat Syndrome, an invasive mycotic disease of the Tanner crab, *Chionoecetes bairdi*. J. Invert. Path. 34:184-191.
- Van Hying, J.M. and A.M. Scarborough. 1973. Identification of fungal encrustation on the shell of the snow crab (*Chionoecetes bairdi*). J. Fish. Res. Bd. Can. 30:1738-1739.

APPENDICES

Appendix Table 1. Trawl record, 1982 Westward Region trawl surveys.

Trawl Number	Mo/Day/Yr.	Starting Position Loran C <sup>1</sup>		Compass Heading	Time Towed Min.	Depth-fms Avg.	Seas Ft.	Swell Ft.	Comments
North Mainland (Kodiak Management District)									
1	07 19 82	322510	438181	090	30	45	0 - 2	0 - 2	
2	07 19 82	322541	437881	045	25	68	2 - 4	2 - 4	
3	07 19 82	322481	437694	315	25	100	2 - 4	2 - 4	
4	07 19 82	322402	437003	000	30	120	2 - 4	2 - 4	
5	07 19 82	322382	437231	000	30	121	2 - 4	2 - 4	
6	07 19 82	-	-	-	-	-	-	-	Abandoned
7	07 19 82	322685	438832	045	25	63	0 - 2	0 - 2	
8	07 20 82	-	-	-	-	-	-	-	Abandoned
9	07 20 82	322136	436827	000	30	95	2 - 4	2 - 4	
10	07 20 82	321784	436624	340	30	89	2 - 4	2 - 4	
11	07 20 82	321574	436880	315	30	80	2 - 4	2 - 4	
12	07 20 82	322104	438197	021	30	45	0 - 2	0 - 2	
13	07 22 82	322030	438130	020	25	56	0 - 2	0 - 2	
14	07 25 82	321810	437622	000	25	45	2 - 4	4 - 6	
15	07 25 82	321632	437342	000	25	65	2 - 4	4 - 6	Hung up-Abandoned
16	07 25 82	321640	437253	010	30	73	2 - 4	4 - 6	
17	07 25 82	321530	437214	015	30	67	2 - 4	2 - 4	
18	07 25 82	321417	437204	015	25	59	2 - 4	2 - 4	
19	07 25 82	321212	437032	030	25	62	2 - 4	2 - 4	
20	07 25 82	321022	436940	015	30	53	0 - 2	0 - 2	
21	07 26 82	320582	436822	000	30	70	2 - 4	6 - 8	
22	07 26 82	320510	436768	345	30	98	4 - 6	6 - 8	
23	07 27 82	320289	436887	320	30	100	2 - 4	2 - 4	
24	07 27 82	320212	436558	330	30	81	4 - 6	6 - 8	
25	07 27 82	320000	436430	225	30	85	0 - 2	2 - 4	
26	07 27 82	320221	436248	330	25	83	0 - 2	2 - 4	
27	07 27 82	320671	436136	225	30	90	0 - 2	2 - 4	
28	07 28 82	320844	436533	020	30	95	0 - 2	2 - 4	
29	07 28 82	321096	436547	010	30	93	2 - 4	2 - 4	
30	07 28 82	321081	436369	000	30	90	2 - 4	2 - 4	
31	07 28 82	321457	436340	018	30	101	2 - 4	2 - 8	

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-Continued-

Appendix Table 1. Trawl record, 1982 Westward Region trawl surveys (continued).

Trawl Number	Mo/Day/Yr.	Starting Position Loran C <sup>1</sup>		Compass Heading	Time Towed Min.	Depth-fms Avg.	Seas Ft.	Swell Ft.	Comments	
<u>Uganik Bay</u> (Kodiak Management District)										
32	07 31 82	323529	434868	354	30	90	0 - 2	0 - 2		
33	07 31 82	323483	434300	330	10	59	0 - 2	0 - 2	Hung up	
34	07 31 82	323457	434798	330	30	85	0 - 2	0 - 2		
35	07 31 82	323310	434900	270	25	90	0 - 2	2 - 4		
36	07 31 82	323420	435277	000	30	107	0 - 2	2 - 4		
37	07 31 82	323300	435150	270	30	100	0 - 2	2 - 4		
<u>Uyak Bay</u> (Kodiak Management District)										
38	08 02 82	324751	436177	350	30	82	0 - 2	0 - 2		
<u>Chignik</u> (Chignik Management District)										
39	08 03 82	321392	451502	090	30	61	0 - 2	0 - 2		
40	08 03 82	331354	450900	290	30	83	0 - 2	0 - 2		
41	08 03 82	331619	451081	090	30	105	0 - 2	0 - 2		
42	08 03 82	331882	451353	235	30	105	0 - 2	0 - 2		
43	08 03 82	331875	451803	090	30	105	0 - 2	0 - 2		
44	08 03 82	332000	452544	099	30	110	0 - 2	0 - 2		
45	08 04 82	332015	453310	095	30	53	0 - 2	0 - 2		
46	08 04 82	332351	453600	090	30	79	0 - 2	0 - 2		
47	08 04 82	332230	452930	270	30	99	0 - 2	0 - 2		
48	08 04 82	332150	452702	315	30	115	0 - 2	0 - 2		
49	08 04 82	332156	453147	080	30	93	0 - 2	0 - 2		
50	08 04 82	332451	453380	180	30	65	0 - 2	0 - 2		
51	08 05 82	332892	453982	210	30	42	0 - 2	0 - 2		
52	08 05 82	332785	453668	205	30	54	0 - 2	0 - 2		
53	08 05 82	332801	453812	200	30	40	2 - 4	2 - 4		
54	08 05 82	333340	454566	330	25	42	2 - 4	8 - 10		
55	08 06 82	333914	455387	130	30	94	2 - 4	4 - 6	Mudded down-Abandoned	
56	08 06 82	333540	455243	205	30	87	2 - 4	2 - 4		
57	08 06 82	333900	455480	315	30	95	0 - 2	6 - 8		

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Appendix Table 1. Trawl record, 1982 Westward Region trawl surveys (continued).

Trawl Number	Mo/Day/Yr.	Starting Position Loran C <sup>1</sup>		Compass Heading	Time Towed Min.	Depth-fms Avg.	Seas Ft.	Swell Ft.	Comments
58	08 06 82	111599	313172	270	30	70	2 - 4	6 - 8	
59	08 06 82	334388	456496	000	30	63	2 - 4	4 - 6	
60	08 07 82	334365	455370	290	25	59	2 - 4	2 - 4	
61	08 07 82	334199	454946	250	15	60	2 - 4	2 - 4	Hung up-Abandoned
62	08 07 82	334192	454532	280	30	67	2 - 4	4 - 6	
63	08 07 82	334033	453972	090	30	68	2 - 4	2 - 4	
64	08 07 82	111224	312530	225	30	68	2 - 4	4 - 6	
65	08 07 82	334193	454372	225	30	65	2 - 4	4 - 6	
66	08 07 82	334522	454200	210	30	70	2 - 4	4 - 6	
67	08 08 82	335158	457051	270	30	78	2 - 4	2 - 4	
68	08 08 82	335150	456541	270	30	82	2 - 4	2 - 4	
69	08 08 82	335100	456400	225	30	90	2 - 4	2 - 4	
70	08 08 82	335051	455540	270	30	90	2 - 4	2 - 4	
71	08 08 82	335300	456010	010	30	86	2 - 4	2 - 4	
72	08 08 82	334910	456960	000	30	75	0 - 2	2 - 4	
73	08 09 82	335854	457690	135	30	68	0 - 2	2 - 4	
74	08 09 82	335980	457778	310	30	90	2 - 4	2 - 4	
75	08 09 82	336202	457902	150	30	107	2 - 4	4 - 6	
76	08 09 82	336239	458129	180	30	100	2 - 4	4 - 6	
77	08 09 82	336550	458980	315	30	88	2 - 4	4 - 6	
78	08 09 82	336202	458680	000	30	70	2 - 4	2 - 4	
79	08 10 82	335625	459022	150	30	43	0 - 2	0 - 2	
80	08 10 82	335700	458810	343	30	55	0 - 2	2 - 4	
81	08 10 82	335910	458842	340	30	61	2 - 4	4 - 6	
82	08 10 82	335770	458530	020	30	59	4 - 6	6 - 8	
83	08 10 82	335146	457922	020	30	39	2 - 4	8 - 10	
84	08 10 82	334923	457602	030	30	40	2 - 4	8 - 10	
85	08 10 82	334820	457224	270	30	52	2 - 4	4 - 6	
86	08 11 82	334900	457101	000	30	70	0 - 2	2 - 4	
87	08 11 82	335139	457000	315	30	80	0 - 2	2 - 4	
88	08 11 82	335263	457289	315	30	82	0 - 2	2 - 4	

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Appendix Table 1. Trawl record, 1982 Westward Region trawl surveys (continued).

Trawl Number	Mo/Day/Yr.	Starting Position Loran C <sup>1</sup>		Compass Heading	Time Towed Min.	Depth-fms Avg.	Seas Ft.	Swell Ft.	Comments
88	08 11 82	335263	457289	315	30	82	0 - 2	2 - 4	
89	08 11 82	335302	457854	180	30	59	0 - 2	0 - 2	
90	08 11 82	335427	458155	355	30	57	0 - 2	2 - 4	
91	08 11 82	334760	456911	030	30	73	0 - 2	0 - 2	
92	08 12 82	333541	453771	235	30	98	2 - 4	4 - 6	
93	08 12 82	333733	453116	120	30	67	0 - 2	2 - 4	
94	08 12 82	111018	312215	000	30	72	0 - 2	2 - 4	
95	08 12 82	111033	312095	270	30	78	2 - 4	2 - 4	
96	08 12 83	111086	312363	335	30	70	2 - 4	4 - 6	
97	08 13 82	111390	312990	355	30	106	2 - 4	4 - 6	
98	08 13 82	111564	313378	000	30	100	2 - 4	4 - 6	
99	08 13 82	332310	453312	270	30	95	2 - 4	2 - 4	
100	08 13 82	332384	453760	090	30	75	2 - 4	2 - 4	
101	08 14 82	332216	453115	090	30	112	2 - 4	4 - 6	
102	08 14 82	332100	452570	045	30	130	4 - 6	4 - 6	
103	08 14 82	331210	451832	135	30	23	0 - 2	2 - 4	
104	08 14 82	331352	451579	075	30	48	2 - 4	4 - 6	
<u>Uyak Bay (Kodiak Management District)</u>									
105	08 15 82	324801	436115	320	30	78	0 - 2	0 - 2	
106	08 15 82	111894	314142	330	25	72	0 - 2	0 - 2	
107	08 15 82	324345	436450	135	30	100	2 - 4	2 - 4	
108	08 15 82	324466	436139	315	30	75	0 - 2	2 - 4	
109	08 16 82	324415	435890	110	30	44	0 - 2	0 - 2	
110	08 16 82	324300	436465	030	30	100	2 - 4	4 - 6	
111	08 16 82	324128	436877	180	10	115	2 - 4	4 - 6	Bad bottom-Abandoned
112	08 16 82	324000	437150	020	30	100	2 - 4	4 - 6	
<u>Uganik Bay (Kodiak Management District)</u>									
112	08 16 82	323115	435883	045	30	79	2 - 4	4 - 6	

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<sup>1</sup>Loran readings were frequently erroneous in bays and inshore areas as well as periods when the transmitter station was having problems of an unspecified nature. Tow locations as depicted on the various figures in this report were plotted by radar and should be considered accurate.

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