

# Informational Leaflet 148

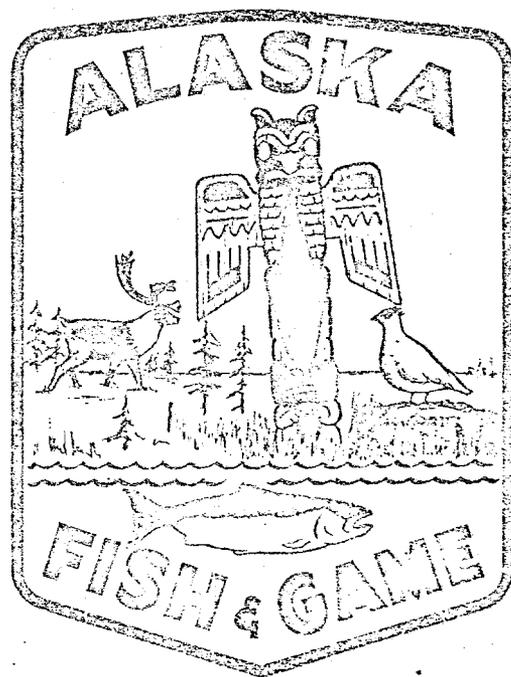
THE KING AND TANNER CRAB FISHERY OF THE ALASKA  
PENINSULA - ALEUTIAN ISLANDS MANAGEMENT AREA,  
1969-1970

By:

John C. McMullen  
and  
Harvey T. Yoshihara  
Division of Commercial Fisheries  
Research Section  
Kodiak, Alaska

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KEITH H. MILLER - GOVERNOR  
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FISH AND GAME  
SUPPORT BUILDING, JUNEAU 99801



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THE KING AND TANNER CRAB FISHERY OF THE ALASKA PENINSULA -  
ALEUTIAN ISLANDS MANAGEMENT AREA, 1969-1970

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John C. McMullen, Fishery Biologist  
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Harvey T. Yoshihara, Fishery Biologist  
Alaska Department of Fish and Game  
Division of Commercial Fisheries  
Research Section  
Kodiak, Alaska

INTRODUCTION

An active king crab, Paralithodes camtschatica, fishery has existed in the vicinity of the Alaska Peninsula since 1960. A second and simultaneous fishery for tanner crabs, Chionoecetes bairdi and C. opilio, began in 1969.

Alaska Department of Fish and Game management reports have documented past years' king crab fisheries of the Alaska Peninsula - Aleutian Island area which reached a maximum of 63.7 million pounds in 1966 (Davenport, 1970).

In July 1969, we were assigned to study crabs and crab fisheries of the above-mentioned area. This report documents some of our work with the commercial fisheries. We have not utilized previous years' data because changes in fishing seasons and minimum carapace size regulations have produced a variety of statistics not readily comparable with our data.

Objectives of this study were to provide the Department of Fish and Game with information for better fisheries management and to establish a procedure through which trends in the fishery and stock abundance may be understood. A third objective was to provide the fishing community with a description of their fishery and a record of the fishing year.

Descriptive terms are used in this report which require explanation. A "recruit" king crab is a male which has molted and increased in carapace length from less than 145 mm to a length of 145-164 mm (Nickerson, et al, 1965), and is in its first year of availability to the commercial fishery. An "exuviant" is a crab which molted at the last opportunity. An "anexuviant", or old-shell king crab is one which failed to molt at the last opportunity so

did not increase in carapace size. An aneuviant of recruit size would be in its second year of commercial availability so would not be designated a recruit.

### Geographical description of fishing areas

Waters of the Alaska Peninsula, Aleutian Islands have been designated as distinct king crab fishing areas by Alaska Department of Fish and Game regulation. This regulation stratifies vessels of the king crab fleet, which must fish an entire season in the area for which they register.

King crab regulatory areas may represent general boundaries of separate king crab stocks, which at least can be satisfactorily designated for management purposes. One exception to this scheme is the mid-Aleutians (Adak) fishery, which has been regulated with the eastern Aleutians fishery, centered at Unalaska. All "management stocks" are probably not biologically isolated, for newly hatched king crab larvae drift with ocean currents for 40 to 60 days before settling to the ocean bottom (Marukawa, 1933). An interchange of genes and recruitment contributions between stocks probably result from the translocation of larvae.

For this report we have described fishing sub-areas, to further define fleet distributions, and provide an arrangement of fishery data for comprehensive presentation. Each sub-area is comprised of several statistical fishing areas (Appendix A), which are used throughout the State of Alaska for the compilation of all fisheries catch information.

Fishing sub-areas are designated by roman numerals in this report (Figure 1). The 13 sub-areas discussed here are:

#### Alaska Peninsula (king crab registration area LM)

- I Shumagin Islands - Mainland
- II Eastern Shumagin Islands
- III Western Shumagin Islands
- IV Sanak Island
- V Davidson Bank-Pacific Ocean side of Unimak Island

#### Eastern Aleutians (king crab registration area O)

- VI Pacific Ocean waters - Fox Islands and Unimak Pass
- VII Bering Sea waters - Fox Islands and Unimak Pass

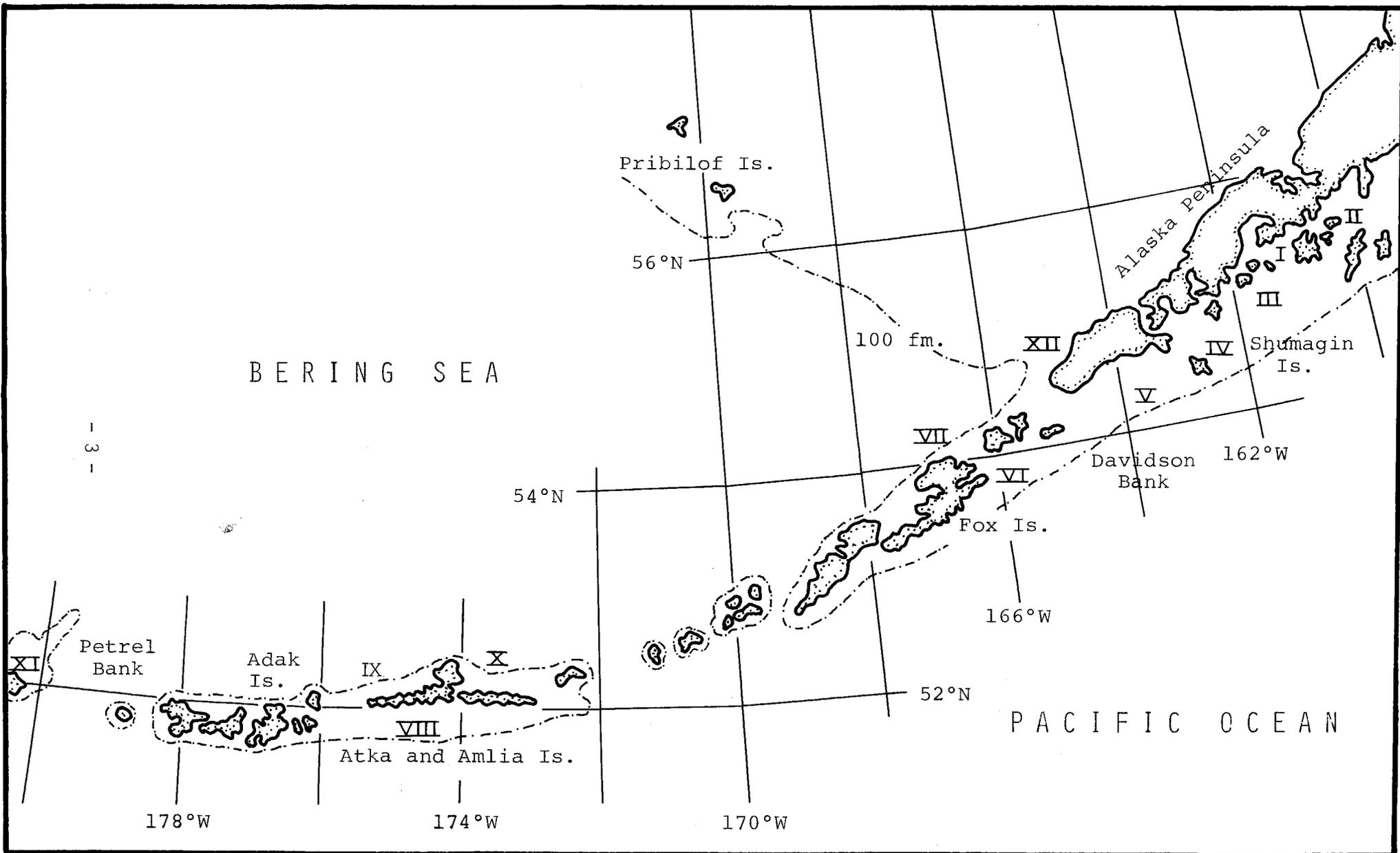


Figure 1. Location of crab fishing sub-areas I through XII of the Alaska Peninsula and Aleutian Islands.

Mid-Aleutians (king crab registration area R)

- VIII Pacific Ocean - Atka and Amlia Islands
- IX Bering Sea - Atka Island
- X Bering Sea - Amlia Island
- XI Petrel Bank

Eastern Bering Sea (open area above 54°36'N. latitude)

- XII Inshore - Alaska Peninsula

Industrialization of fisheries

Capital investment continued to increase for processing facilities and vessels of the Alaska Peninsula - Aleutian Islands crab fisheries in 1969. Fifteen crab processors were in operation during the early months of the 1969-1970 season. Three were located in the Shumagin Islands, seven in the Unalaska Island area, and an additional five floaters were stationed at Adak Island.

Fishermen struck for higher crab prices in November 1969 which resulted in a decreased processing effort that month. Three facilities in the eastern Aleutians and one in the mid-Aleutians did not process after the crab strike was settled. Later, in December, a fifth processor ceased operations, which reduced processing capacity at Adak to three floaters.

King crab vessels fishing in the Alaska Peninsula and Aleutians totaled 112, during the 1969-1970 season (Table 1). Thirty-three were based in the Shumagin Islands, 37 fished exclusively in the eastern Aleutians, and 33 in the mid-Aleutians, which also accrued an additional nine vessels from the eastern Aleutians in early season. Average vessel lengths ranged from 60 feet in the Shumagins to about 96 feet in the mid-Aleutians. Vessels of these two areas fished about 58 and 91 pots on the average, which represent the extremes for the crab fisheries west of Kodiak.

Average length figures do not adequately indicate relative sizes of vessels. Crab vessels operating in the Shumagin Islands averaged about 44 net tons while those in the mid-Aleutians averaged about 123 net tons. A more detailed comparison between wood, seine-type vessels and new, steel seine-type crabbers of the 85-foot class reveals net tonnages of about 74 and 135, respectively.

Table 1. Vessels and gear engaged in the 1969-1970 king crab fishery of the Alaska Peninsula and Aleutian Islands.

Area	Vessel Statistics			Crab Pots	
	Numbers	Average <u>length</u> feet	Average net tonnage	Average number <sup>1/</sup>	Total numbers
Shumagin Islands	33	60.0	43.6	57.6	1,901
Eastern Aleutians	37	83.4	100.0	80.3	2,971
Mid- Aleutians	33	96.2	122.7	90.6	2,990
East and Mid- Aleutians	9	92.4	117.9	78.3	705
Totals	112				8,567

<sup>1/</sup> Number of pots are continually changing due to loss and acquisition.

## STUDY METHODS

### Fish ticket data

Catch statistics and catch composition data utilized in this report were obtained from several sources, one of which was fish tickets. Each ticket lists vessel name and ADF&G number, statistical areas fished, date of landing, species, number and pounds of fish landed, type of gear used, and amount of effort expended in catching the delivered fish.

### Derived data

Fish ticket and interview data were used to estimate total king crab recruits, aneuvians, and numbers for each fishing area and month during the 1969-1970 season. Fish tickets provided totals of pounds landed. Average weights, from interview data, were divided into total pounds to arrive at estimates of total crabs. Finally, the percent composition of recruit and aneuviant crabs in the length-frequency data were expanded to estimates of total numbers.

### Carapace size-frequencies

Crab carapace size-frequency distributions were sampled during the offloading period in conjunction with vessel interviews. Generally, one sample of 50 crabs were measured from each vessel's hold or offloading bucket.

Methods of carapace measurement differed for king and tanner crabs. King crab lengths were measured from the right eye orbit to the medial posterior of the carapace. Lateral margins of the king crab carapace are not rigid, so are not suitable for accurate measurement. Tanner crab carapaces are rigid at all margins, and for biological studies are measured at the widest projection. Vernier calipers, graduated in a millimeter scale were used for all carapace measurements.

Exoskeletal age of king crabs were recorded with carapace length. Crabs which apparently molted in 1969 were classified as exuvians, and those which apparently had not molted in 1969 were classified as aneuvians.

Our examination of crab catch statistics utilized all fish ticket data except numbers of crabs landed. We preferred to obtain crab numbers directly from vessel skippers because numbers of crabs listed on fish tickets are usually estimates obtained by dividing total weight by average weight per crab.

### Interview data

Division of Protection personnel cooperated with us to interview vessel skippers landing crabs in the Alaska Peninsula and Aleutians areas. A standard set of questions comprised each interview (Appendix B). Data obtained dealt with catch and effort for numbers of crabs, instead of pounds, as provided by fish tickets. Interviewers also obtained information pertaining to vessel sizes and numbers of pots fished, which were discussed earlier in this report.

### Crab weights

Crabs offloaded from fishing vessels were handled in metal buckets or net bags. A weighing scale was usually suspended on the hoist cable above the offloading container, and each container of crabs was weighed and recorded.

Persons interviewing vessel skippers also gathered information concerning average weights of crabs. This was accomplished by counting the crabs loaded in one or more containers, after which the total weights of those crabs were recorded.

## RESULTS

### Fish ticket data

Preliminary statistics for the 1969-1970 king crab fishery of the Alaska Peninsula, Aleutians and Bering Sea were available from tabulated fish tickets. We received records of 1,271 landings for the entire fishery during the regular season (Table 2). Four hundred fifteen and 375 loads were delivered from the Shumagins and eastern Aleutians areas respectively and 435 loads were from the mid-Aleutians. Only 46 deliveries were made from the eastern Bering Sea, which is not heavily fished during the regular season for king crabs of 7 inches carapace width.

A recorded total of 248,826 pot lifts (Table 3) yielded 31,651,803 pounds of king crabs during the regular season in western Alaska (Table 4). The mid-Aleutians fleet lifted nearly 116,000 pots for about 18 million pounds of king crabs. In contrast, the Shumagin Islands fleet lifted 51,263 pots, two-thirds of which were handled during the first three months of the season. Approximately 4,137,000 pounds of king crabs were lifted from the Shumagin Island grounds, of which 2,151,000 pounds originated in the Unimak Bight - Davidson Bank overlap zone. The eastern Aleutians fishery

Table 2. King crab landings for the 1969-1970 fishery of the Alaska Peninsula and Aleutian Islands.

Fishing Area	King crab landings by month						Totals
	September	October	November	December	January	February	
Shumagin Is.	119 <sup>1/</sup>	106	8	70	51	17	415
East Aleutians	32	100	45	94	75	29	375
Mid-Aleutians	24	90	58	100	88	75	435
Bering Sea	20	-	2	-	4	20	46
Totals	239	296	113	264	218	141	1271

<sup>1/</sup> Late August landings included with total for September.

Table 3. King crab pot lifts for the 1969-1970 fishery of the Alaska Peninsula and Aleutian Islands.

Fishing area	Number	Pot lifts by month						Totals
		September	October	November	December	January	February	
Shumagin Islands	I	10,749*	3,885	185	1,691	1,129	--	17,639
	II	1,771	598	--	1,297	875	--	4,541
	III	2,998*	1,584	--	1,438	1,012	--	7,032
	IV	517	230	--	189	342	--	1,278
	V	3,561*	8,317	262	3,009	2,944	2,680	20,773
	sub-totals	19,596 <sup>1/</sup>	14,614	447	7,624	6,302	2,680	51,263
Eastern Aleutians	VI	6,146	9,100	3,144	6,352	1,206	735	26,683
	VII	2,567*	12,615	2,383	11,970	12,615	3,850	46,000
	sub-totals	8,713	21,715	5,527	18,322	13,821	4,585	72,683
Mid-Aleutians	VIII	1,847	12,629	8,353	14,639	9,145	9,214	55,827
	IX	4,626	6,626	1,896	5,947	8,413	5,176	32,684
	X	570	3,149	1,214	4,456	3,730	2,246	15,365
	XI	--	1,620	1,131	4,675	3,136	1,491	12,053
	sub-totals	7,043	24,024	12,594	29,717	24,424	18,127	115,929
Bering Sea	XII	2,391	--	52	--	2,197	4,311	8,951
	sub-totals	2,391	--	52	--	2,197	4,311	8,951
Totals		37,743	60,353	18,620	55,663	46,744	29,703	248,826

<sup>1/</sup> Late August landings included with data for September.

\* Data adjusted to include pots not listed on fish tickets.

Table 4. Pounds of king crabs landed during the 1969-1970 fishery along the Alaska Peninsula and Aleutian Islands.

Fishing area	Number	Pounds of king crab by month						Totals
		September	October	November	December	January	February	
Shumagin Islands	I	819,410	232,304	3,887	72,178	24,382	-	1,152,161
	II	90,359	36,312	-	97,482	31,296	-	255,449
	III	272,349	102,126	-	88,952	37,490	-	500,917
	IV	46,646	12,105	-	6,635	11,596	-	76,982
	V	480,106	1,033,834	28,545	268,915	237,932	101,664	2,150,996
	sub-totals	1,708,870 <sup>1/</sup>	1,416,681	32,432	534,162	342,696	101,664	4,136,505
Eastern Aleutians	VI	682,852	945,860	311,430	636,500	204,875	66,056	2,847,573
	VII	302,370	1,502,381	262,675	2,123,140	1,715,001	197,182	6,102,749
	sub-totals	985,222	2,448,241	574,105	2,759,640	1,919,876	263,238	8,950,322
Mid-Aleutians	VIII	323,325	2,041,184	1,074,890	2,046,912	2,285,330	1,582,845	9,354,486
	IX	797,755	1,029,743	305,305	871,960	1,361,045	594,192	4,960,000
	X	72,175	665,126	187,140	544,107	501,969	202,370	2,172,887
	XI	-	173,675	147,856	683,570	393,500	130,485	1,529,086
	sub-totals	1,193,255	3,909,728	1,715,191	4,146,549	4,541,844	2,509,892	18,016,459
Bering Sea	XII	169,301	-	9,025	-	201,920	168,271	548,517
	sub-totals	169,301	-	9,025	-	201,920	168,271	548,517
	Totals	4,056,648	7,774,650	2,330,753	7,440,351	7,006,336	3,043,065	31,651,803

<sup>1/</sup> Late August catches included with those for September.

remained very active through January and produced 8,950,322 pounds of king crabs in 72,683 pot lifts.

Each major fishing area contained one sub-area which was a "best" producer. About 52 percent of the Shumagins' catch came from sub-area V, and was taken in 40 percent of the total pots lifted in the major area. Sixty-three percent of the total pots, fished in sub-area VII, accounted for 68 percent of the catch from the eastern Aleutians. The mid-Aleutians fishery was centered in sub-area VIII south of Atka and Amlia Islands where 52 percent of the total catch was obtained from 48 percent of the pots lifted in that fishery. The eastern Bering Sea fishery produced only 548,517 pounds of crab in 8,951 pot lifts, and is not subdivided for the purposes of this report.

Fishermen struck against processing companies during November which probably lowered king crab production about 5 million pounds in western Alaska. This estimate was obtained by subtracting the November 1969 catch from that of either October or December 1969.

King crab production figures and pot lifts for the western Alaska fishery were converted to percentages of monthly contribution and compared to determine the effects of fishing on the availability of king crabs (Figure 2). Production appears to closely follow monthly increments of effort throughout the entire season. Relative increments of production and effort were at about 14 percent of their totals in September and 11 percent in February, as compared to increments of about 25 percent during the more productive months of October, December and January. The smaller increments reflect mid-month opening and closure of the crab season. The lowest contribution to monthly production and effort was about 7 percent, and occurred during November when crab fishermen were on strike.

Comparison of catch and effort statistics indicates that catch per effort was maintained during the course of the fishing season. Availability of king crabs appeared not to be adversely affected by cumulative fishing effort. Good monthly catches were maintained on the strength of the mid-Aleutians fishery (Table 5) where production in sub-area VIII reached an all-area high of 249.9 pounds per pot in January 1970. A resulting catch of about 4,582,000 pounds of king crab, another all-area high, was caught in the mid-Aleutians that month. Average seasonal catches ranged from 155.4 pounds per pot in the mid-Aleutians to 61.3 pounds per pot in the eastern Bering Sea.

#### Data from fisherman interviews

Alaska Department of Fish and Game personnel conducted 502 interviews with vessel skippers unloading king crabs in western Alaska during

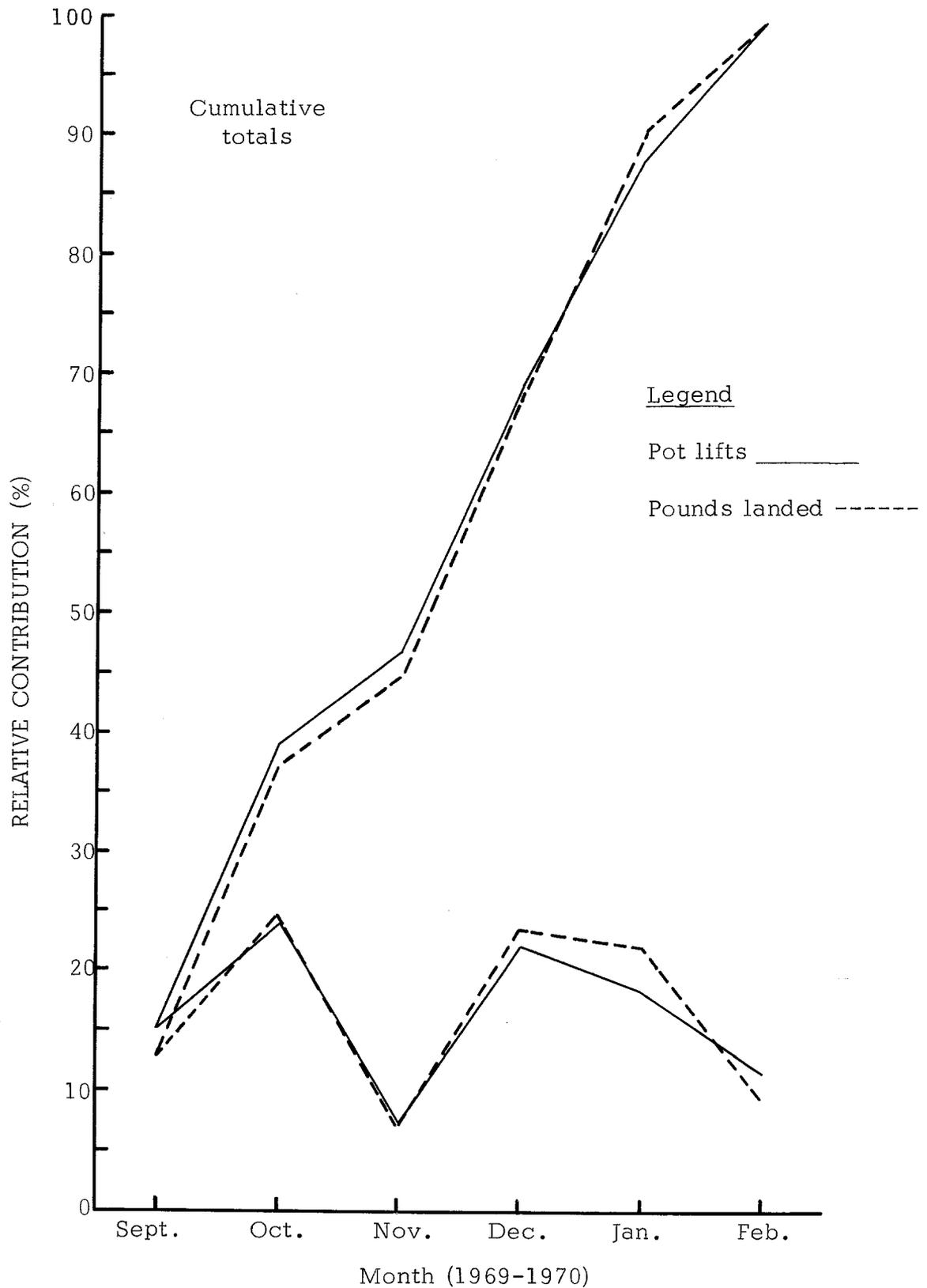


Figure 2. Monthly and cumulative totals for pots lifted and pounds landed during the 1969-1970 king crab fisheries of the Alaska Peninsula and Aleutian Islands.

Table 5. Pounds per pot of king crabs landed during the 1969-1970 season along the Alaska Peninsula and Aleutian Islands.

Fishing area	Number	Monthly averages of pounds per pot					Annual averages	
		September	October	November	December	January		February
Shumagin <sup>1/</sup> Islands	I	76.2	59.8	21.0	42.7	21.6	--	65.3
	II	51.0	60.7	--	75.2	35.8	--	56.3
	III	90.8	64.5	--	61.9	37.0	--	71.2
	IV	90.2	52.6	--	35.1	33.9	--	60.2
	V	134.8	124.3	109.0	89.4	80.8	37.9	103.5
annual average								80.7
Eastern Aleutians	VI	111.1	103.9	99.1	100.2	169.9	89.9	106.7
	VII	117.8	119.1	110.2	177.4	135.9	51.2	132.7
annual average								123.1
Mid- Aleutians	VIII	175.1	161.6	128.7	139.8	249.9	171.8	167.6
	IX	172.5	155.4	161.0	146.6	161.8	114.8	151.8
	X	126.6	211.2	154.2	122.1	134.6	90.1	141.4
	XI	--	107.2	130.7	146.2	125.5	87.5	126.9
annual average								155.4
Bering Sea	XII	70.8	--	173.6	--	91.9	39.0	61.3
annual average								61.3
Grand average								127.2

<sup>1/</sup> Data for late August included in September averages.

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regular season. Average deliveries ranged from 929 to 2,436 crabs for the five sub-areas of the Shumagin Islands fishery (Table 6). Average landings from these sub-areas were comprised of 51.4 to 67.2 percent recruits and average weights ranged from 7.4 to 8.2 pounds per crab.

Vessels operating in the eastern Aleutians delivered about 4,500 to 4,850 crabs per landing, of which 70 percent were recruits. Average weight of those crabs was 7.5 pounds.

Fourteen deliveries were recorded from the Bering Sea. Landings averaged 2,258 crabs, of which 62.8 percent were recruits with an average weight of 7.2 pounds.

Largest individual landings were from the mid-Aleutians. Vessels operating in the four sub-areas comprising that fishery averaged between 5,330 and 8,549 crabs per trip. Recruits comprised 58.5 to 77.5 percent of the catches from the different sub-areas and crab weights averaged 6.3 to 6.8 pounds.

Catches of crabs per pot lifted varied between the major fishing areas. Shumagin grounds produced between 7.8 and 12.4 crabs per pot, the eastern Bering Sea about 8.5 crabs per pot, and the eastern Aleutians between 16.8 and 23.1 crabs per pot. Catches were strongest in the mid Aleutians, where pot averages for sub-areas VIII to XI ranged from 20.1 to 31 crabs. These data, obtained by interviewing vessel skippers, compare favorably with fish ticket information, using average catch per pot as the comparable statistic. Interview data listing crabs per pot and pounds per crab were transformed to average pounds per pot for each sub-area, for direct comparison with fish ticket data. Pot averages derived from interviews for the 12 sub-areas data differed from fish ticket data by as much as -2 to +40 pounds per pot. More specifically, only four minus deviations occurred as opposed to nine positive deviations which ranged from 8.5 to 40 pounds per pot. This error may have represented crabs which died in vessel tanks, so were not listed on fish tickets.

#### Derived numbers of crabs

We calculated total numbers of recruit and aneuviant king crabs landed from each of the sub-areas of the four major fisheries. These statistics are the arithmetic products of average percent composition from all length-frequencies and numbers of crabs landed from each sub-area. Total number of crabs from each sub-area were calculated by dividing total pounds landed by corresponding average individual weights.

Table 6. King crab fisheries data obtained aboard vessels at landing locations during the 1969-1970 season along the Alaska Peninsula and Aleutian Islands.

Fishing area	Number	Interviews number	Averaged fishery data					
			Crabs per landing	Pots per landing	Crabs per pot	Percent recruits	Percent anexuvians	Pounds per crab
Shumagin Islands	I	46	1240	144.0	7.8	55.9	23.0	7.4
	II	19	929	113.4	8.2	51.4	21.6	7.9
	III	18	1176	110.1	12.4	54.4	26.6	7.4
	IV	7	857	110.1	7.8	53.8	28.8	7.5
	V	49	2436	190.6	11.9	67.2	19.4	8.2
Eastern Aleutians	VI	52	4498	272.5	16.8	70.9	12.0	7.4
	VII	76	4849	205.5	23.1	68.7	10.8	7.5
Mid-Aleutians	VIII	109	8549	292.5	31.0	77.5	17.2	6.3
	IX	58	7678	322.6	23.8	77.5	18.5	6.3
	X	31	5330	275.7	20.1	60.6	17.6	6.8
	XI	23	7254	347.9	22.4	58.5	33.0	6.5
Bering Sea	XII	14	2258	252.0	8.5	62.8	24.8	7.2

An estimated 4,629,921 king crabs were landed in western Alaska during the 1969-1970 regular season. A total of 528,304 crabs were caught in the Shumagins, of which 322,277 were recruits and another 114,645 crabs were anexuvians (Table 7). The remaining crabs were exuviant, post-recruits.

In the eastern Aleutians, 831,840 of an estimated 1,198,507 crabs were recruits, while only 134,057 crabs comprised the anexuviant category.

Recruit contributions in the mid-Aleutians reached a high for all fisheries with 2,092,169. An estimated 534,913 anexuvians were also landed in that fishery.

The eastern Bering Sea fishery produced an estimated 76,183 king crabs of which 47,843 were recruits, 18,893 were anexuvians, and 9,447 were exuviant, post-recruits.

Numbers of crabs from the mid-Aleutians and those landed from the eastern Aleutians and Shumagin Islands are not proportional to a comparison of pounds landed from those areas. Crabs from the mid-Aleutians averaged about one pound less than those landed in the other fisheries. Catch ratios of the mid and eastern Aleutians are about 2.0:1.0 for pounds, and about 2.4:1.0 for numbers of crabs.

#### King crab carapace length distribution

King crab carapace length-frequency distributions of commercial catches have been constructed for each fishing sub-area and are presented in Table 8. One exception is data from sub-areas II, III, and IV which were grouped in one carapace length-frequency because size distributions were similar and contributions to total production were small.

Carapace length-frequency distributions for commercially landed king crabs do not form symmetrical curves. Distributions are skewed to the right as a result of the minimum size restriction imposed on the commercial fishery. But, for the purpose of this report, we have assumed landed crabs to be components of a commercial population. We have sampled randomly from that population, and have calculated the standard deviation for each observed distribution.

Length-frequency observations for fishing sub-area I, of the Shumagin Islands, were collected from among a group of crabs comprising 20 landings. Average carapace length and standard deviation of that distribution (and all

Table 7. Contribution of male king crabs by size group and shell age, to total production of the 1969-1970 fishery of the Alaska Peninsula and Aleutian Islands.

Fishing area	Number	Numbers of crabs in catches			Sub-totals
		Recruits	Anexuvians	Others	
Shumagin Islands	I	87,035	35,810	32,852	155,697
	II	16,620	6,984	8,731	32,335
	III	36,823	18,006	12,862	67,691
	IV	5,522	2,956	1,786	10,264
	V	176,277	50,889	35,151	262,317
	sub-totals	322,277	114,645	91,382	528,304
Eastern Aleutians	VI	272,828	46,177	65,802	384,807
	VII	559,012	87,880	166,808	813,700
	sub-totals	831,840	134,057	232,610	1,198,507
Mid-Aleutians	VIII	1,150,750	255,392	78,697	1,484,839
	IX	610,159	145,651	31,492	787,302
	X	193,642	56,239	69,661	319,542
	XI	137,618	77,631	19,995	235,244
	sub-totals	2,092,169	534,913	199,845	2,826,927
Bering Sea	XII	47,843	18,893	9,447	76,183
	sub-totals	47,843	18,893	9,447	76,183
	Totals	3,294,129	802,508	533,284	4,629,921

Table 8. Relative frequency of carapace lengths for commercial king crabs landed from waters of the Alaska Peninsula, Aleutian Islands and Bering Sea during the 1969-1970 season.

Carapace length mm	Shumagin Islands sub-areas						Eastern Aleutians sub-areas			
	I		II, III, IV		V		VI		VII	
	shell new	age old	shell new	age old	shell new	age old	shell new	age old	shell new	age old
	%		%		%		%		%	
139	0.2	0.1	-	-	0.1	-	0.3	-	0.1	-
142	1.5	0.1	1.0	0.3	2.2	0.2	2.4	-	0.8	-
145	5.1	0.7	4.2	-	5.5	0.5	5.3	0.2	3.4	0.3
148	7.6	1.1	7.2	0.8	9.2	0.3	9.2	1.1	7.3	0.4
151	10.5	1.8	7.3	0.4	14.3	0.8	10.6	1.2	11.9	0.5
154	7.6	2.2	9.0	1.3	9.9	1.3	13.2	0.4	11.4	0.4
157	8.5	2.6	9.4	2.8	8.5	0.7	10.6	1.3	10.6	0.6
160	8.7	2.2	7.2	1.2	8.7	1.0	10.1	1.5	10.0	0.2
163	5.2	2.4	7.9	1.5	6.4	0.5	9.1	0.5	8.9	0.7
166	6.4	1.6	7.2	1.4	4.8	0.9	5.7	0.4	7.1	0.5
169	3.8	1.6	5.5	1.5	3.7	0.2	4.2	0.4	6.4	0.5
172	3.7	1.7	3.7	1.8	1.8	0.9	2.1	0.6	3.3	0.3
175	3.1	1.5	3.7	1.7	0.9	0.6	1.2	0.1	2.4	0.4
178	1.7	0.8	1.6	0.7	0.8	1.4	1.2	0.3	0.8	0.7
181	0.5	0.7	0.9	1.9	1.2	1.1	0.7	0.5	0.5	0.6
184	0.8	0.8	0.8	0.9	1.1	1.5	0.4	0.4	0.7	1.5
187	0.4	0.8	0.9	0.9	1.5	1.6	0.6	0.7	0.3	1.5
190	0.2	0.4	0.5	0.7	0.5	0.8	0.1	0.7	0.3	0.9
193	0.1	0.4	0.3	0.5	0.6	0.8	0.1	0.6	0.3	1.1
196	0.1	0.1	-	0.8	0.4	1.3	0.2	0.6	0.2	0.5
199	0.1	0.5	0.2	0.2	0.6	0.3	-	0.3	0.2	0.7
202	-	-	-	0.1	0.2	0.3	-	0.3	-	0.5
205	-	0.1	-	0.1	0.1	-	0.2	0.3	0.1	0.1
208	-	-	-	-	-	-	-	0.1	-	0.1
Total %	100		100		100		100		100	
Recruits (%)	54.9		53.2		64.8		70.8		64.4	
Anexuvians (%)	24.2		21.5		17.0		12.5		13.0	
Exuviant post-recruits (%)	20.9		25.3		18.2		16.7		22.6	

Table 8. (continued) Relative frequency of carapace lengths for commercial king crabs landed from waters of the Alaska Peninsula, Aleutian Islands and Bering Sea during the 1969-1970 season.

Carapace length mm	Mid-Aleutians sub-areas								Bering Sea sub-area	
	VIII		IX		X		XI		XII	
	shell new	age old	shell new	age old	shell new	age old	shell new	age old	shell new	age old
	%		%		%		%		%	
139	0.1	-	0.3	0.1	-	-	-	-	0.2	-
142	0.2	0.1	2.1	0.6	0.2	-	0.1	0.2	2.0	-
145	2.1	0.4	5.2	1.7	0.8	0.2	1.5	0.2	4.2	1.1
148	15.4	1.7	14.3	3.1	8.2	0.8	7.5	2.9	9.5	1.1
151	20.8	3.1	18.7	2.9	9.5	1.6	13.5	4.1	12.8	1.4
154	16.4	2.1	14.6	2.7	11.8	2.3	11.8	5.8	11.9	1.4
157	10.6	1.3	12.7	3.5	10.6	2.3	11.5	5.2	8.2	2.4
160	9.9	1.1	6.9	1.7	8.9	3.5	9.4	4.4	8.9	2.0
163	4.4	0.9	3.5	0.8	9.0	2.0	7.2	3.6	5.1	1.6
166	2.2	1.0	1.6	0.6	5.5	1.0	3.3	1.5	3.3	2.6
169	2.4	0.9	1.0	0.2	6.4	2.6	2.9	1.4	2.4	1.1
172	0.7	0.2	0.5	0.4	3.0	1.3	0.3	0.4	2.6	1.3
175	0.3	0.3	-	0.2	2.1	0.9	0.7	0.2	1.4	2.2
178	-	-	-	-	0.9	0.7	0.1	0.1	1.3	1.4
181	0.2	0.2	-	0.1	1.1	0.8	0.1	0.1	1.3	1.3
184	0.3	0.1	-	-	0.4	0.5	-	-	-	1.4
187	0.3	-	-	-	0.3	0.1	-	-	0.2	0.9
190	-	0.2	-	-	0.1	0.2	-	-	0.2	0.5
193	-	0.1	-	-	-	0.1	-	-	-	0.4
196	-	-	-	-	0.2	0.1	-	-	-	-
199	-	-	-	-	-	-	-	-	-	0.2
202	-	-	-	-	-	-	-	-	-	0.2
205	-	-	-	-	-	-	-	-	-	-
208	-	-	-	-	-	-	-	-	-	-
Total %	100		100		100		100		100	
Recruits (%)	79.9		78.3		59.0		62.5		62.8	
Anexuvians (%)	13.7		18.6		21.0		30.1		24.5	
Exuviant post-recruits (%)	6.4		3.1		20.0		7.4		12.7	

Table 9. Size-frequency statistics for king crabs landed from the Alaska Peninsula and Aleutian Islands area during the 1969-1970 season.

Fishing area	Number	Sample size n	Carapace lengths		Standard deviation
			Range mm	Average mm	
Shumagin Islands	I	1,000	139-205	160.3	11.3
	II, III, IV	1,000	141-205	161.8	13.4
	V	980	138-205	162.3	10.8
Eastern Aleutians	VI	1,000	139-207	159.0	11.6
	VII	1,000	140-208	161.6	10.5
Mid-Aleutians	VIII	1,000	141-192	155.0	7.1
	IX	1,000	138-182	153.4	5.5
	X	1,000	143-196	160.2	9.1
	XI	1,000	141-182	156.6	6.4
Bering Sea	XII	548	140-203	159.2	11.1

others) were calculated (Table 9). Observed carapace lengths ranged from minimum legal size to 205 mm and average length was 160.3 mm. Standard deviation for that distribution was 11.3 mm. The sample of crabs from sub-areas II, III, and IV also ranged to 205 mm carapace length. They averaged 161.8 mm length with a standard deviation of 13.4 mm. Sub-area V crabs displayed a similar distribution of carapace lengths.

Eastern Aleutians crabs were similar in size to those from the Shumagins. The observed range in carapace lengths of male crabs in sub-areas VI and VII was 139-208 mm. Calculated average length was 159.0 mm and 161.5 mm, and standard deviations of those distributions were 11.6 and 10.5 mm respectively.

Commercial king crabs of the mid-Aleutians appear to be of smaller average size and narrower size range than those in the remainder of western Alaska. Crabs from sub-area VIII, south of Atka and Amlia Islands, ranged from legal minimum size to 192 mm in carapace length. The average length was 155 mm with a standard deviation of 7 mm, which indicated that crabs large as 192 mm carapace length were rare. Crabs landed from sub-area IX, north of Atka Island also were small in size. Average carapace length was 153.3 mm, with a range of 182 mm. Standard deviation for that distribution was 5.5 mm.

Largest crabs found in the mid-Aleutians appear to be located in sub-area X, north of Amlia Island. We observed crabs to average 160.2 mm carapace length and range to 196 mm. A widened distribution of carapace lengths is indicated by a standard deviation of 9.1 mm.

Crabs from Petrel Bank, sub-area XI, were of similar size as those landed from sub-areas IX and X. Their lengths were observed to range to 182 mm, with a mean of 156.6 mm and a standard deviation of 6.4 mm.

The final size distribution is a compilation of carapace length measurements of king crabs from the Bering Sea. Only 548 measurements were available, so the usual sample size of 1,000 measurements were not obtained. Crabs of that sample ranged to 203 mm and averaged 159.2 mm. The standard deviation of the sample was 11.1 mm.

Composition of recruit and old-shell crabs was calculated for each length-frequency distribution. Relative frequency of recruits ranged from 53.2 percent in sub-areas II, III and IV of the Shumagins to 79.9 percent in sub-area VIII of the mid-Aleutians. Sub-areas V, VI, VII, VIII and IX produced relatively large numbers of recruits and were also the better producing crab areas.

## Tanner crabs

Tanner crabs were landed with king crabs in the Shumagins fishery during the latter months of the 1969-1970 season, but were not handled by processors in the eastern and mid-Aleutians. Totaled fish ticket statistics for tanner crabs are not available. However, 80 interviews were conducted with skippers of unloading vessels. Interviewed persons had landed a total of 251,664 tanner crabs which weighed an estimated 693,885 pounds. We recorded 9,248 pots lifted for those crabs, which were delivered from each of the five sub-areas of the Shumagin Islands fishery (Table 10). Observed loads averaged between 1,678 and 5,066 crabs for the different sub-areas. Associated pot catches averaged from 11.5 to 58.2 crabs and crab weights averaged between 2.7 to 2.9 pounds each.

Tanner crab production in the Shumagins increased after the king crab season closed because vessels fished exclusively for them. About 637,490 pounds were landed during March 1970.

## Width-frequency

A narrow distribution in observed weights of tanner crabs landed by the Shumagin Island fishery indicates uniformity of individual sizes. Because crabs from sub-area I to V are of similar size, it seemed appropriate to include all carapace size observations in one width-frequency distribution (Table 11).

Sizes of tanner crabs landed in the Shumagins ranged from 129-188 mm carapace width. Average observed width was 158.4 mm, or nearly  $6\frac{1}{4}$  inches. Standard deviation of our width-frequency distribution is 10.9 mm.

## DISCUSSION

King crab fishermen of the Alaska Peninsula, Aleutian Islands and Bering Sea lifted an estimated 248,826 pots and landed about 31,651,803 pounds of king crabs during the fall and winter of 1969-1970. The mid-Aleutians fishery contributed over 18,000,000 pounds of the total, and another 9,000,000 pounds were produced in eastern Aleutians. Catches may have exceeded the actual totals had not fishermen struck for higher crab prices during the month of November. Pot lifts during that month totaled about 18,600, or less than 1/3 the numbers lifted in either October or December. The corresponding catch was about 2.3 million pounds for November as compared to about 7.8 and 7.4 million pounds for October and December.

Table 10. Fishery statistics for tanner crabs landed from the Shumagin Islands during the 1969-1970 combined king and tanner crab season.

Fishing area	Number	Interviews number	Averaged fishery data			
			Crabs per landing	Pot lifts per landing	Crabs per pot	Pounds per crab
Shumagin Islands	I	24	2481	105	23.6	2.8
	II	36	3368	114	29.6	2.7
	III	10	5066	87	58.2	2.8
	IV	4	1678	146	11.4	2.8
	V	6	2250	195	11.5	2.9

Table 11. Carapace width-frequency of tanner crabs landed from the Shumagin Islands during the 1969-1970 king crab season.

Carapace width mm	Tanner crabs	
	number	percentage
130	8	0.8
133	5	0.5
136	20	2.0
139	20	2.0
142	60	6.0
145	49	4.9
148	55	5.5
151	76	7.6
154	101	10.1
157	81	8.1
160	117	11.7
163	106	10.6
166	95	9.5
169	69	6.9
172	59	5.9
175	44	4.4
178	11	1.1
181	17	1.7
184	1	0.1
187	7	0.7
sample size	1001 crabs	
average width	158.4 mm	
standard deviation	10.8851	

The data indicate that annual production was affected, and that not all available crabs were caught after the crab price strike was settled. This is illustrated through the examination of cumulative catch and effort statistics. There does not appear to be an appreciable decline in catch per unit of effort during the late season months, as would be expected if the number of available crabs declined.

The 1969-1970 king crab fisheries of the Alaska Peninsula and Aleutian Islands were dependent upon recruits. That dependence ranged from 51.4 - 67.2 percent for sub-areas of the Shumagin Islands to 58.5 - 77.5 percent for the mid-Aleutians. Sub-areas containing relatively high percentages of recruits were also the largest producers of king crab. Those crab fisheries might rapidly decline if one or two age groups entering the fisheries in a given year were of low relative abundance, providing most available recruits were caught annually. Possible fishery failures might be prevented by restricting catches so as to re-establish multi-age group crab stocks.

The king crab catch in the eastern Aleutians consisted of about 70 percent recruits, a figure comparable to that of the mid-Aleutians. However, eastern Aleutian crabs averaged about one pound larger than crabs landed from the mid-Aleutians. Weight differences were associated with differences in average carapace lengths of 161.5 mm and 154.9 mm for the bulk of the crabs landed from the two areas. The comparable dependence upon recruits, but observable difference in average sizes of crabs in the eastern and mid-Aleutians may indicate differences in growth patterns.

Comparability of fish ticket and interview data was examined. Generally, catches per unit effort calculated from interview data were greater than that obtained from fish tickets for the same landings. This difference may be the result of an overestimate of numbers of crabs by vessel skippers, but could also indicate the numbers of crabs prior to discounting dead-loss at landing sites.

Number of recruit and aneuviant king crabs were estimated for the Alaska Peninsula-Aleutian Islands fisheries. Approximately 3,257,000 and 786,514 crabs comprised the two categories. Annual estimates of numbers of recruits entering a commercial fishery may enable managers to compare recruit class strengths, detect impending fishery failures and predict long term cycles of abundance.

Aneuviant king crabs must be delineated to ensure that only crabs described as recruits are enumerated in that category. Estimates of aneuviants also permit annual molting frequencies to be compared, so that growth and weight increase of a population may lead to short term predictions of fishery production.

Tanner crabs are present in the Alaska Peninsula, Bering Sea and Aleutian Islands areas. However, the only steady markets are located in the Shumagin Islands.

Total catch figures are not available, but 80 landings of incidentally caught tanner crabs were examined during the king crab season. Average catches by sub-areas ranged from 11.5 - 58.2 crabs per pot, average weights of those crabs ranged from 2.7 - 2.9 pounds.

Presently, no size regulations nor production quotas are in existence for tanner crabs, but processors discourage their fleets from landing small males. It appears that until we obtain biological information which allows us to recommend a minimum size or quota, the economics of tanner crab processing may prevent the overharvest of young males.

#### ACKNOWLEDGMENTS

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Appendix A. Designation of fishing sub-areas of Alaska Peninsula and Aleutian Islands.

Fishing Area	Number	Statistical Areas
<u>Alaska Peninsula</u>		
Shumagin Island - mainland	I	<u>281</u> -34, 35, 36; <u>283</u> -61, 62, 63, 64, 70, 80, 90
East Shumagin Island	II	<u>282</u> -10, 11, 12, 13, 21, 22, 23, 24, 25, 26 <u>286</u> -21, 22
West Shumagin Island	III	<u>283</u> -11, 12, 20, 31, 32, 33, 34, 41, 42, 51, 52 <u>286</u> -32, 33, 34, 35, 36
Sanak Island	IV	<u>283</u> -10, 30; <u>286</u> -30, 31, 37
Davidson Bank-Unimak Is.	V	<u>284</u> -10, 20, 30, 40, 50, 60, 71, 72 <u>286</u> -41, 42, 43, 44, 45, 46
<u>Eastern Aleutians</u> <sup>1/</sup>		
Pacific Ocean waters	VI	<u>302</u> -18, 19, 50, 51, 60, 70, 80, 90; <u>303</u> -21, 22, 23, 35 <u>362</u> -11, 12, 16, 52, 61, 71, 76, 81, 91, 96
Bering Sea waters	VII	<u>302</u> -16, 17, 21, 22, 23, 24, 25, 30, 31 <u>303</u> -10, 31, 32; <u>353</u> -30
<u>Mid-Aleutians</u>		
Atka-Amlia Islands	VIII	<u>305</u> -15, 21, 22, 31, 32; <u>306</u> -16, 20, 30
Pacific Ocean		<u>365</u> -33, 34; <u>366</u> -10, 20, 30
Atka Island, Bering Sea	IX	<u>305</u> -41, 42; <u>306</u> -11
Amlia Island, Bering Sea	X	<u>305</u> -51, 52, 53
Petrel Bank	XI	<u>308</u> -41, 42, 43, 45, 46; <u>358</u> -41, 46, 47, 48, 71
<u>Bering Sea</u> <sup>2/</sup>		
Inshore	XII	<u>311</u> - ; <u>312</u> - ; <u>313</u> - ; <u>314</u> - ; <u>315</u> - ; <u>316</u> - <u>350</u> - ; <u>351</u> -

1/ Unalaska Island - Unimak Pass area

2/ North of 34°36'N. Latitude

Appendix B. Field form for collection of crab fishery data.

ALASKA DEPARTMENT OF FISH AND GAME  
CRAB FISHERMAN INTERVIEW

Crab length-frequency

Interviewer:

Date:

Crab no.	Carapace length (mm)	Shell age (0 or 1)	Carapace width (mm)	
1				1. Vessel:
2				2. ADF&G No.:
3				3. Processor:
4				4. Species landed:
5				5. Area fished:
6				6. Depth range:
7				7. Pots pulled:
8				8. Days fished:
9				9. Crab landed:
10				10. Ave. no. small males/pot:
11				11. Ave. no. females/pot:
12				12. Calculation of average weight:
13				<u>Sample I</u>
14				a. No. crab in bucket:
15				b. Weight of bucket:
16				c. Pounds per crab:
17				<u>Sample II</u>
18				a. No. crab in bucket:
19				b. Weight of bucket:
20				c. Pounds per crab:
21				13. Length-frequency data:
22				a. % recruits
23				b. anexuvians:
24				14. Vessel length:
25				15. Number pots fishing:
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