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THE ALASKAN KING CRAB

May 1942 Supplement

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INVESTIGATION STAFF

The general plan for the Alaska Crab Investigation was conceived by R. H. Fiedler, Chief, Division of Fishery Industries, Washington, D. C. The detailed investigative program was formulated and put into effect by the Investigation Staff, having headquarters at the Service's Fishery Technological Laboratory, Seattle, Washington. The members of the Investigation Staff and their respective responsibilities were as follows:

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ACKNOWLEDGMENT

Although not members of the Investigation Staff, Capt. Arthur V. Nelsen, Master of the cannery vessel Tondeleyo; Capt. Ellsworth F. Trafton, Master of the fishing vessel Dorothy; Capt. Harry Guffey, Master of the fishing vessel Locks; Capt. Anders Nilsen, Master of the fishing vessel Champion; and the members of the crews of these vessels, contributed much to the success of the field work.

Prof. Harvey McMillian, Seattle Pacific College, Seattle, Washington; Mr. Earl Ohmer, Petersburg, Alaska; Mr. C. J. Alexander, Alitak, Alaska; and many others, supplied valuable advice and information regarding king crabs.

Pacific American Fisheries, the Alaska Packers Association, and other salmon packers in Alaska, provided storage space and other facilities as needed.

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The Fisheries Experimental Commission of Alaska released Messrs. Christey and Carlson from cooperative work with that agency at the Fish and Wildlife Service's Fisheries Technological Laboratory at Ketchikan. The Commission cooperated further by payment of Mr. Carlson's salary during most of the survey.

To the above and the others too numerous to list, the Investigation Staff wishes to express its sincere thanks.

1/ Curator of Marine Invertebrates, Smithsonian Institution, Washington 25, D. C., detailed to the Fish and Wildlife Service to participate in the early field work.

REPORT OF THE ALASKA CRAB INVESTIGATION

By

Investigation Staff
Fishery Technological Laboratory, Division of Fishery Industries
Fish and Wildlife Service, Seattle, Washington

INTRODUCTION

Late in June 1940, the Congress approved a special appropriation authorizing the Fish and Wildlife Service to conduct for one year a technical, economic, and biological investigation of the king crab fishery off the coast of Alaska. The primary objectives were to locate the areas of abundance, and to develop satisfactory methods for taking and canning king crabs.

On July 1, 1941, additional funds were provided for continuing the exploratory crab fishing experiments during the remaining summer and fall months of that year. With the field work completed and the essential aspects of the Investigation given the maximum attention permissible within the time allotted, this report is submitted to make the practical findings immediately available.

The detailed biological data upon which some of the findings are based have not been incorporated. These data will be published in a separate and later report. However, certain data as to the location of substantial populations of edible bottom fishes, obtained incidentally to the regular crab studies, have been included. In a war economy requiring ample supplies of protein food, this information may be of as great interest as the location and abundance of the king crab populations.

BACKGROUND FOR INVESTIGATION

The average apparent consumption of the various types of crab meat marketed in the United States for the five years 1935-1939 has been: (1) imported canned crab meat, 10,456,000 pounds; (2) fresh crab meat of domestic origin, 8,241,000 pounds; and (3) domestic canned crab meat, 531,000 pounds. Thus, almost 95 percent of the canned and over 54 percent of all the crab meat consumed has been of other than domestic origin. 1/

Japan has been the principal source of canned crab meat imported into the United States, accounting for 78 percent of the total during the past 10 years. Most of the remainder came from the Soviet Union. The largest importation of canned crab meat on record occurred during 1939 when 13,507,000 pounds, including 10,720,000 pounds of the Japanese product, were entered for consumption. The imported crab meat for that year was valued at $4,582,000.

Practically all of the imported pack is prepared from the so-called king 2/ or Paralithodid crabs. Three species are canned: Paralithodes camtschatica, P. platypus, and P. brevipes. The first of these (Figure 1) is the largest and by far the most abundant. The "Abura Gani" and "Hanasaki" crabs, as the latter two are known in the Japanese fishery, yield meat similar in appearance and flavor. A small amount of Korean or horse crab (Erimacrus isenbeckii) is imported but is considered an inferior product.

Fresh crab meat is prepared primarily from blue crabs (Callinectes sapidus) and dungeness crabs (Cancer magister). Blue crabs are taken from Cape Cod to Louisiana and dungeness crabs along the whole Pacific coast. The sand crabs (Ovalipes ocellatus) which are taken

1/ The statistics cited in this section have been taken from United States Tariff Commission Report No. 147, Second Series, Crab Meat.
2/ These crabs should not be confused with the species known as the king or "horseshoe crab" (Limulus polyphemus) which is not properly a crab but, instead, is more closely related to the spiders. Horseshoe crabs are taken in the Middle Atlantic States for the manufacture of meal.

principally in Maine, the rock crabs (Cancer irroratus) principally in Massachusetts, and the stone crabs (Menippi mercenaria) of the South Atlantic and Gulf States, are of but minor importance. In 1939 the total production of fresh crab meat was composed of 8,851,000 pounds of blue crab meat, 946,000 pounds of dungeness crab meat, and 288,000 pounds of meat from other species.

Domestic canned crab meat has been prepared almost exclusively from the dungeness crabs and blue crabs. In 1939 the pack of canned dungeness crab meat amounted to 450,000 pounds and that of blue crab, including a small quantity of other species, totaled 190,000 pounds. Dungeness crabs are canned in Washington and Oregon, in Southeastern and Central Alaska. The principal Alaskan operations are at Petersburg, Wrangell, and Cordova. Blue crabs are canned in Virginia, South Carolina, and Louisiana. In 1940 a small pack of sand crabs was prepared in Maine.

For several years prior to 1939, occasional small packs of king crabs were put up in Cook Inlet, and during 1938 a floating canning operation for king crabs was attempted without financial success around Kodiak Island, the Shumagin area, and in the Bering Sea. A substantial number of crabs were caught and the quality of the pack was excellent, but the necessary exploratory work soon exhausted the limited capital of the enterprise. 1/

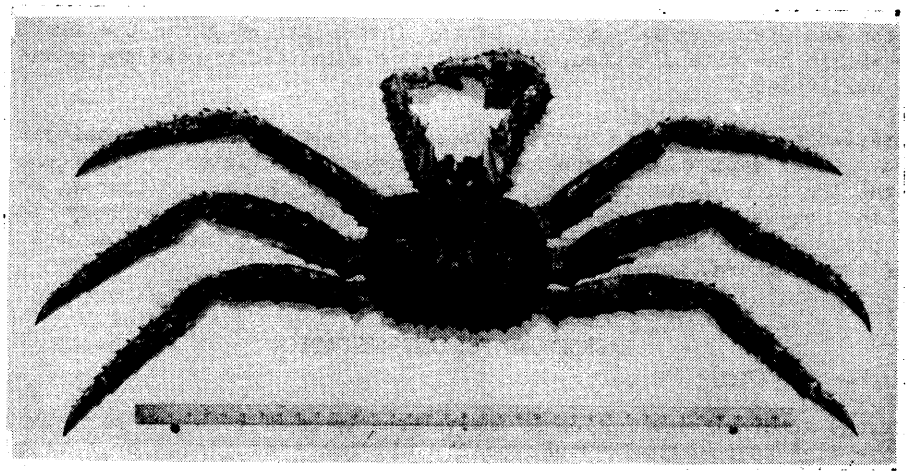

FIGURE 1.--Male king crab (Paralithodes camtschatica). The live weight of this specimen was 16 pounds. Note the 3-foot rule below.

Japanese crab canning started in 1892. It grew slowly, however, until the introduction of the floating cannery in 1923 which came as a result of several years of successful governmental investigation. This expanded the industry from the waters of Japan proper to the Bering Sea off Kamchatka and Siberia. About 1930, Japanese activities were farther extended across Bering Sea into the vicinity of the Pribilof Islands, the north side of the Alaska Peninsula, and Bristol Bay. As is well known, the last-mentioned area is the principal domestic center for canning red salmon.

Increasing exploration of a crab fishery by foreign nationals in water immediately adjacent to United States' territory for subsequent export into the United States, raised serious question as to whether American interests were making adequate use of domestic fishery resources. Accordingly, early in 1940, the President requested the Secretary of the Interior to investigate the practicability of establishing an American king crab canning industry in Alaska. Initial inquiry indicated that lack of information regarding areas of abundance, methods for taking and canning king crabs, and a general fear of not being able to compete with the imported product on a cost basis, were the primary obstacles retarding domestic development. Since the cost of necessary exploratory work would be prohibitive for private enterprise under conditions then prevailing, the Congress authorized the Fish and Wildlife Service to make the study.

1/ A related crab (Lithodes antarcticus), called the "centolla", forms the basis of a commercial fishery in Chile. (Radcliffe, 1922)

PLAN AND SCOPE OF INVESTIGATION

The known range of king crabs in American waters extends from Bering Strait to Southeastern Alaska. During the late fall, winter, and early spring months, weather conditions in many of the districts are too severe to permit operation of fishery vessels. To conduct fishing, canning, and biological studies over so vast an area in the limited period of good weather would require strict budgeting of time and effort, and would preclude detailed attention to any one phase or location. There was, then, the problem of deciding between a more detailed study of a restricted area or a more extended study of the whole area.

The duration of the initial appropriation was for the Federal fiscal year July 1, 1940, to June 30, 1941. This period, beginning and ending in the midst of successive fishing seasons, would prevent a continuous operation during the normal season of good fishing weather for any one year. A certain amount of time would be required for chartering vessels, hiring crews, purchasing supplies and equipment, and fabricating gear before an expedition could be placed in the field. The delay would prevent operations in Bering Sea until the following spring, because weather conditions after September 1 are too uncertain to assure opportunity for fishing activities. Thus, the amount of work which could be done in the area of greatest potential interest would be definitely limited. Fortunately, as indicated in the introduction, funds were provided later for extending the Bering Sea studies.

On the basis of the above conditions, a program was inaugurated which divided the Investigation into three seasonal operations: (1) a vessel expedition during the fall and early winter months to the area of Western Alaska south of the Peninsula; (2) a shore-based field investigation on Kodiak Island during the winter months, while the vessels of the first expedition returned to Seattle for reoutfitting; and (3) a second or spring expedition covering the area from Southeastern Alaska to Bering Sea. (Figure 2.) This option of general coverage was selected as most likely to meet the current need for information, because a one-year study would not supply enough detail about any particular locality to warrant disregarding other potential areas.

The first, or fall, expedition sailed from Seattle during the last week in August 1940. This expedition included a small floating cannery, the Tondeleyo, and a fishing vessel, the Dorothy. A third vessel, intended for fishing operations, was unable to accompany the expedition because of mechanical difficulties.

The Tondeleyo was a Diesel-powered motor ship of 396 net tons, 113.1 feet in registered length, with complete facilities for canning crabs on a commercial scale. Her complement consisted of a crew of 18, plus a technologist, a biologist, and an economist. The Dorothy, a 93-foot, 89-net ton fishing schooner with Diesel power and auxiliary sail, was equipped with typical east coast trawl gear. Her crew of eight was supplemented by a fishery engineer and a biologist.

The activities of the first expedition were confined to the waters between False Pass and Kodiak Island (Areas IX, X, VII and VIII, Figure 2). Although some prospecting was done along this entire area, work was particularly concentrated in Pavlof and Canoe Bays on the south side of the Alaska Peninsula, and near Alitak at the southwest tip of Kodiak Island. These places were selected to receive the greatest attention because king crab populations of undetermined size were known to be present in them at certain times of the year, and it was desirable to obtain crabs in sufficient number to permit crab canning.

A shore party, consisting of the biologist and one assistant, was established at Alitak, Alaska, about mid-November, to maintain observations on the movements of king crabs during the winter months. This location was selected because of the known existence of a crab population and the satisfactory facilities kindly made available by the salmon-cannery operators in this locality. The principal objectives of the winter work were to determine when the king crabs, then absent from Alitak Bay, returned, and to gather as much additional information regarding their habits as was possible. The shore party joined the second expedition early in March.

Experience gained during the fall demonstrated that any attempt to operate a floating cannery in conjunction with an exploratory fishing investigation so restricted the scope of the latter as to make it relatively ineffective. It was decided, therefore, to forego further

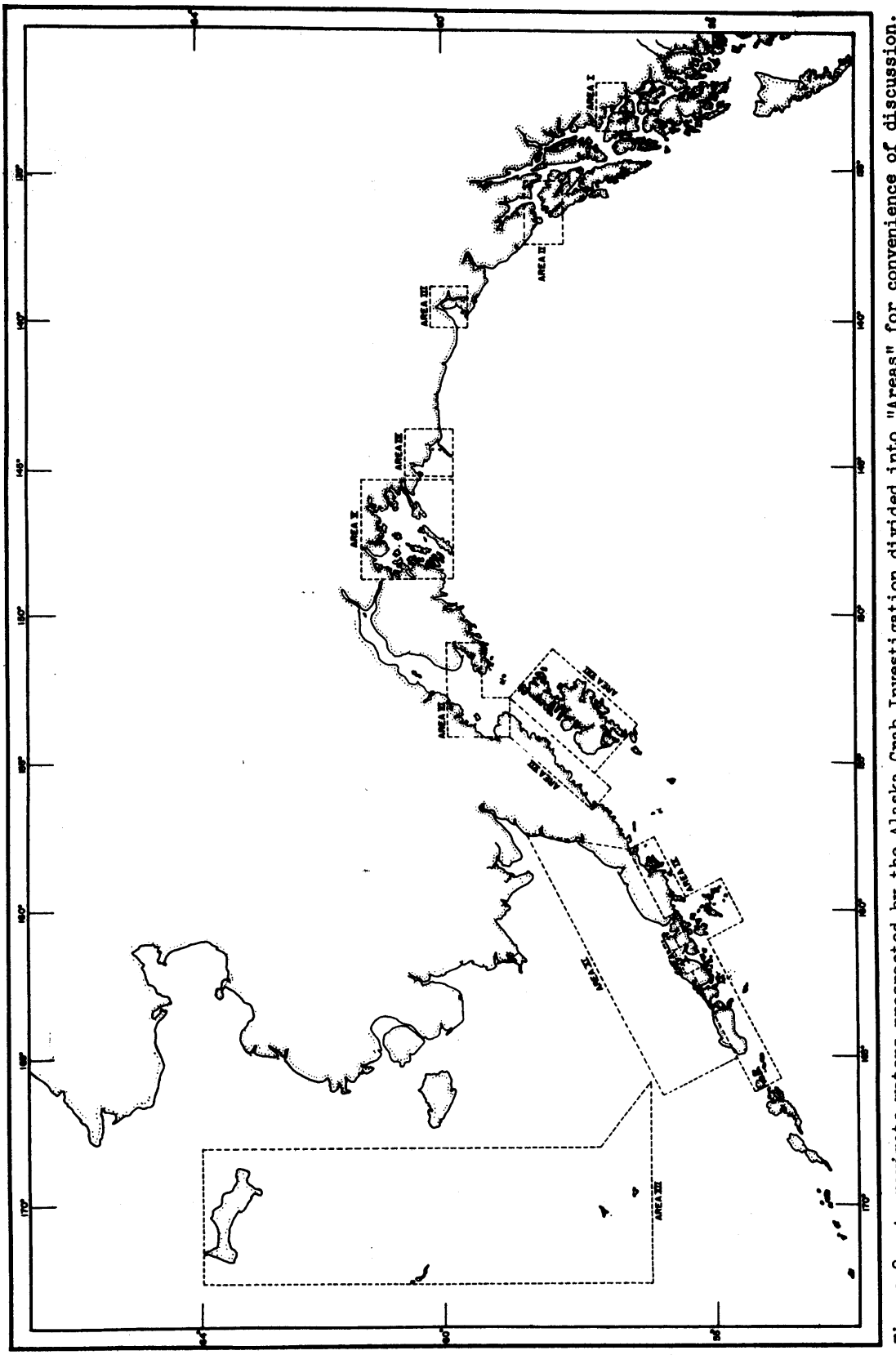

Figure 2.--Approximate waters prospected by the Alaska Crab Investigation divided into "Areas" for convenience of discussion.

operation of the cannery vessel and to concentrate the efforts of the second expedition on exploratory fishing work and supplemental biological investigations. Moreover, with the technological studies conducted during the fall--added to the information available from the previous commercial enterprise, and the knowledge of processing methods for other species of crabs--a technique for the canning of a product equal if not superior to the best imported crab meat had been developed, so that further attention to this phase of the Investigation was not essential.

The second, or spring expedition, included the vessels Dorothy, Champion, and Locks. The Champion and Locks were of the purse-seine type, 69.7 feet and 58.7 feet in registered length, respectively. Their otter-trawl gear was operated over the stern, as is customary with this type of vessel, in contrast to the schooner-type Dorothy's side-set apparatus. Each vessel carried a crew of seven as well as two investigators. The vessels were equipped with radiophone in order to correlate their activities and facilitate "outside" communication during the course of the field work.

The vessels sailed from Seattle during the latter part of February, with an itinerary planned to give some coverage to practically the entire known range of king crab in Alaskan waters. Fishing was begun in Frederick Sound, near Petersburg, and included banks and bays as far west as Unimak Pass and north to within sight of Siberia, off the northwest tip of St. Lawrence Island. Areas which showed productivity were revisited by one or more of the vessels as many times as possible in order to obtain a continuous picture of the changing conditions. Particular emphasis was placed on the productive sections of Bering Sea, previously exploited by the Japanese. Two vessels were in the Bering Sea area from mid-April until the first part of June, and from the first part of July until September. The vessels returned to Se tle the last week in September, after being in the field for seven months.

In the exploratory fishing work, the principal aims were to locate populations of king crabs, determine the limits of distribution and the apparent abundance in the populated areas, determine the depth of water and bottom characteristics where the crabs were found, and obtain information on migrations and other seasonal changes which would have influence on the conduct of a commercial fishery. Detailed records were kept of each fishing operation. These included the catch of king crabs, their size and sex; the catch of other crabs; the catch of fish; the depth and temperature of the water; the characteristics of the bottom; the time, location, and direction of the fishing effort; the condition of the tide; and the direction of the current.

Considerable attention was paid, also, to experimentation with various fishing methods. The employment of fishing vessels of different types and sizes made possible certain comparisons as to efficiency. Fishing operations included the use of trawls, tangle nets, and pots. An attempt was made to determine the relative merit of each type of gear as indicated by total catch, selectivity, and damage to crabs.

A number of trawls were constructed embodying different principles of design, and data were taken relative to their fishing characteristics. Experiments were also carried on to determine the suitability of sealed, "stubby" beer bottles as substitutes for glass ball floats, and to develop improved mechanical means for lifting tangle nets.

The canning studies were concerned essentially with the development of a satisfactory technique for canning king crabs. The attention of the technologist, therefore, was given to conditions influencing the survival of crabs after being removed from the water, to methods of handling king crabs preparatory to canning, to the yield of edible meat, to the chemical treatment of crab meat for preventing discoloration, and to determining the optimum conditions for processing the canned product. Experimental packs were prepared under controlled conditions, were incubated to accelerate any spoilage which might occur, and were then examined at frequent intervals in order to develop a satisfactory canning method.

Although the initial intent was to include a cost study of the crab fishery, it was soon apparent that reliable data could not be obtained under the conditions required for attaining the other objectives. When a good catch of crabs is made in exploratory fishing, the effort is not continued on the highly productive spot as would be the case in commercial fishing; instead, the vessel moves to fish some distance away to determine the extent of the body located. Also, if a general survey is to be carried out, fishing operations cannot be con-

tinued indefinitely in a productive area, for the vessels must proceed to discover and explore new grounds. Under these conditions the catch per unit of effort and, consequently, the cost of the crabs taken, is not a true measure of a strictly commercial situation.

Similarly, a cannery operation in conjunction with exploratory fishing studies is not comparable to a commercial situation. The time lost on account of the lower productivity of the fishing vessels and in running to the new areas being explored, threw the entire economic aspect so far off balance as to place serious question on the reliability of this type of data. Therefore, the cost phase of the study was largely eliminated from the general plan for Investigation.

A number of years of detailed and continuous study are normally required to establish a sound biological picture of the status of a fishery. The biological phase of the king crab investigation was limited, therefore, to those aspects having relation to the catching of crabs and to establishing a background for future study. In addition to the biological aspects of the exploratory fishing work previously mentioned, the studies were principally concerned with the movement or migration of the crab population, the moulting and mating seasons, and the rate of growth.

In the conduct of this work detailed records were kept regarding the abundance and condition of the crabs taken at various depths and in different localities in a given area from time to time during the season. Several thousand crabs were measured, tagged, and released for subsequent recapture as a means of indicating directional movement and growth. Some 40,000 measurements were taken in connection with the determination of age and rate of growth. Stomach contents were examined to establish food habits; and egg, ovary, and testis samples were systematically taken and preserved.

As time permitted, specimens of marine life, chiefly invertebrates, and fishes were preserved and turned over to the United States National Museum for study in connection with future reports on the biology of the region.

SUMMARY OF INFORMATION OBTAINED

Location and Abundance of King Crabs 1/

In a detailed biological study of a fishery extending over a period of years, it is possible, through larval counts or extensive tagging experiments associated with commercial fishing, to obtain a numerical estimate of abundance. Sufficient data of this type could not be expected in the time permitted for the present investigation. Accordingly, the indications of abundance given herein must be limited in terms of catch-per-unit-of-effort and area prospected.

King crabs range from Southeastern Alaska to the Sea of Japan. The fishing operations conducted by the Alaska Crab Investigation, from Wrangell Narrows to St. Lawrence Island, indicate that in this portion of the range the crabs are more or less confined to definite areas, certain of these much more productive than others. (Table 1.) That their occurrence and distribution is affected by the general physical characteristics of the locality should be reckoned with, but because of the limited time available for study, definite conclusions cannot be drawn in this respect.

For the most part, the crabs frequented sticky and muddy bottom in all areas except in Bering Sea (Area XI) and parts of Cook Inlet where the bottom was predominately sandy, and in Bering Sea (Area XII) where quantities of shell with sand exist.

Crabs were not found in areas generally poor in other fish life, but localities supporting potential food did not necessarily show evidence of crab populations.

1/ For detailed data on the fishing results in the various localities, see Appendix I.

TABLE 1.--Summary of King Crab Catch

Locality and Area	Trawl catch						Tangle net catch					Actual catch by both gear		
	Fishing 1/ efforts	Male	Female	Total	Total 2/ on hour basis	Average per effort on hour basis	Fishing 3/ efforts	Male	Female	Total	Average 4/ per effort	Male	Female	Total
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
Southeastern (I and II)	5	1	0	1	1	0.2	0	-	-	-	-	1	0	1
Yakutat (III)	6	2	2	4	5	0.8	0	-	-	-	-	2	2	4
Kayak Island (IV)	11	0	0	0	0	0.0	0	-	-	-	-	0	0	0
Prince William Sound (V)	40	112	72	184	257	6.4	3	26	8	34	11.3	138	80	218
Cook Inlet (VI)	43	568	371	939	993	23.1	16	446	95	541	33.8	1,014	466	1,480
Shelikof Strait (VII)	31	106	69	175	157	5.1	4	25	1	26	6.5	131	70	201
Kodiak Island (VIII)	133	1,243	1,442	2,685	4,378	32.9	29	54	7	61	2.1	1,297	1,449	2,746
Shumagin Islands (IX)	59	246	134	380	465	7.9	11	133	31	164	14.9	379	165	544
Pavlof Bay (X)	44	1,447	1,439	2,886	3,071	69.8	14	389	21	410	25.6	1,836	1,460	3,296
Canoe Bay (X)	88	3,611	3,190	6,801	12,040	136.8	14	762	292	1,054	75.2	4,373	3,482	7,855
Bering Sea (XI):														
Inshore	133	4,953	7,539	12,492	10,685	80.3	48	3,273	334	3,607	75.1	8,226	7,873	16,099
Offshore	80	5,159	1,513	6,672	6,670	83.4	0	-	-	-	-	5,159	1,513	6,672
Bering Sea (XII)	26	85	65	150	161	6.2	0	-	-	-	-	85	65	150
Total	699	17,533	15,836	33,369	38,883		141	5,108	789	5,897		22,641	16,625	39,266

1/ Does not include efforts when net snapped or fouled.
2/ Each effort calculated in terms of catch per hour net was on bottom.
3/ One effort includes two shackles of gear, each 100 fathoms long.
4/ Each fishing effort represents 30 to 45 minutes of vessel effort.

The rather extensive hydrographic data gathered by the Fish and Wildlife Service's Bristol Bay Salmon Investigation show a tongue of cold water extending down into the Sea between the Pribilof Islands and Cape Newenham in the direction of Port Moller. (Figure 3.) This condition causes rather rapid change in water temperature relatively close inshore, particularly in the region between Amak Island and Seal Islands where the greatest concentrations of crabs were found. However, since similar hydrographic data are not available for the other productive areas, the significance of this possible relationship cannot be evaluated.

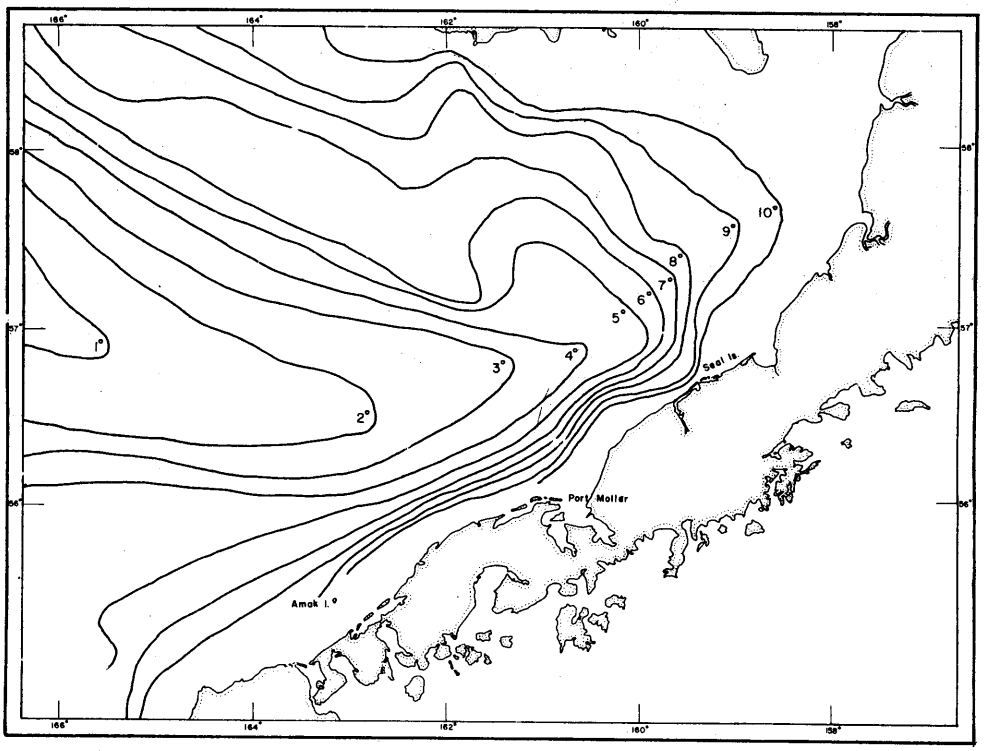

FIGURE 3.--Minimum bottom isotherms in degrees centigrade for the southeastern part of Bering Sea and Bristol Bay. (From unpublished data compiled by the Bristol Bay Salmon Investigation, Division of Fishery Biology, U. S. Fish and Wildlife Service.)

During the Investigation crabs were taken in depths ranging from five to 80 fathoms depending on the time of the year. This aspect will be discussed in a subsequent section dealing with seasonal movements.

Southeastern Bering Sea gave evidence of being by far the area of greatest abundance of all those covered. Limited by weather to spring and summer operations, the Investigation found the territory between Amak Island and Port Moller to a distance of 90 miles from shore gave exceptionally good crab fishing. A total of 22,771 crabs were taken here; and catches of several hundred, such as the one illustrated in Figure 4, were not unusual. The average catch per tow of one-hour duration was 79.7 crabs in the inshore, and 83.4 in offshore waters. Tangle nets averaged 75.1 crabs per set of two 100-fathom shackles. Such a high average in an area of over 15,000 square miles prospected demonstrates the existence of a tremendous population of crabs. This is further suggested when it is appreciated that the above yields were attained in an experimental fishing effort where the primary purpose was to explore as large an area as possible.

FIGURE 4.--Otter trawl catch of crabs lifted aboard and ready for dumping.

In practically all instances throughout the Investigation, no attempt was made to remain on a spot showing good productivity. Rather, the vessels moved on to another location in order to estimate the range of the concentration. Consequently, the average catches were much smaller than would be expected under commercial fishing conditions.

In three weeks of fishing operations off the Pribilof Islands and as far north as St. Lawrence Island (interrupted by weather and engine difficulties) in late July and early August, only a very small number of crabs, consisting entirely of the species Paralithodes platypus, were caught. However, the results of the hurried survey in this area are felt to be very inconclusive. A large quantity of cast king crab shells was found on the beach at St. Matthew Island, and Japanese floating cannery ships are known to have operated near the Pribilof Islands. It is believed that a more thorough examination of this area at a different season would show the presence of commercial quantities of king crabs. Except for the poor results around the Pribilofs, the areas of greatest abundance in Bering Sea were found to coincide very closely with the Japanese floating canneries reported in Alaskan waters during recent years.

Pavlof and Canoe Bays, Area X, gave evidence of having the largest concentration of crabs south of the Alaska Peninsula. Exploratory fishing conducted in the Pavlof area during the spring, summer, and fall show the existence of crabs in numbers sufficiently large to support substantial commercial operations. Actually, crabs were found in greater concentration per unit of area here than in Bering Sea; but because of the much smaller bodies of water, the total number must be assumed to be much smaller.

Both fishing and limited tagging results support the belief that many crabs remain within the area, especially Canoe Bay, throughout the year. Trawl- and tangle-net fishing was very productive in the spring and early summer in the shallower waters at the head of the bays. In the fall, best results were obtained when fishing the deeper portions. A total of 3,296 crabs were taken in 44 tows and 16 tangle-net sets in Pavlof Bay, and 7,855 crabs in 88 tows and 14 tangle-net sets in Canoe Bay. The average catch per hour of towing in Pavlof Bay was 69.8, and in Canoe Bay, 136.8. Tangle-net yields per set averaged 25.6 and 75.2, respectively. Figure 5 shows a typical Canoe Bay catch.

FIGURE 5.--Removing king crabs from a Canoe Bay tangle-net set.

Although over 500 crabs were tagged in Canoe Bay and extensive fishing was carried on, only 10 of these tagged crabs were recovered. This gives further support to the impression gathered from the fishing work that, despite its small area, Canoe Bay supports a very large population of king crabs.

In view of the abundance of crabs in Pavlof Bay, it might be expected that some would be found off the entrance and about the neighboring islands, Area IX. A hurried survey in this area produced only a few crabs in waters close at hand,but good fishing in more distant Eagle Harbor. It is felt that a more thorough examination of adjacent waters might produce more positive results. With the limited data at hand, however, the potentialities of the Shumagin area must remain in question, and its primary basis for interest be limited to its proximity to the highly productive Canoe and Pavlof Bays.

Occasional small catches of crabs were made in other waters along the Peninsula from Unimak Pass to Shelikof Strait, but no evidence of other sizable populations was obtained except in Cold Bay.

Kodiak Island,Area VIII,with its many bays and inlets, offers extensive fishing grounds. Good fishing was experienced during the spring months in nearly all the bays along the southeastern shore from Sitkalidak Island to Kodiak and along the northwestern shore from Uyak to Raspberry Strait. Crabs are found throughout the Alitak region and Olga Bay. Very few crabs were taken in the bays around Afognak Island. This scarcity may be due partly to the limited season in which fishing operations were carried on and, therefore, should not necessarily be interpreted as meaning that crabs are not there at other times during the year. Kodiak Island should be well able to support at least moderate commercial operations.

A total of 2,746 crabs, including some of the largest taken during the Investigation, were caught around Kodiak Island. Because of the extensive coast line to be covered, fishing was limited largely to trawl operations. An average catch of 32.9 crabs per hour of dragging under these conditions may be taken as reasonably encouraging.

Catch records show Cook Inlet, Area VI, to be an area of potential importance - perhaps next to Pavlof and Canoe Bays - on the basis of the average number of crabs caught per unit of gear. While no outstanding catches were taken here, fairly consistent results were obtained throughout the parts of the Inlet explored. Considering the expanse of fishing area involved, this locality must have a substantial supply of crabs.

A total of 1,480 crabs were taken in Cook Inlet, an average of 23.1 per hour of towing and 33.8 per set of tangle gear. The crabs here, also, ran rather large in size. The catch

results suggest the practicability of commercial fishing on the eastern side of Cook Inlet in Kachemak Bay and from Kamishak Bay to Cape Douglas on the western side of the Inlet.

During March and May when operations were conducted in Prince William Sound, Area V, only small catches of crabs at very scattered locations were made. It is felt, however, that fishing efforts during late winter might give better results in St. Matthews Bay, Orca Bay, and in some of the other bays in the vicinity.

Very little work was done in Frederick Sound, Area I, Icy Strait, Area II, Yakutat Bay, Area III, and around Kayak Island, Area IV. The results of this limited survey failed to show the existence of sufficient numbers of king crabs to justify a commercial operation.

Size of King Crabs

Perhaps the most spectacular and commercially important feature about king crabs is their large size. Male crabs with an over-all spread of four to five feet and weighing 15 or more pounds are not uncommon in Alaskan waters south of the Alaska Peninsula. One specimen caught in the Kodiak area weighed 22.2 pounds.

Weights taken of some 2,800 male specimens indicate a rather definite relationship between weight and width of carapace. (Figure 6.) The particular crabs measured were from random samples taken in the various localities fished during the period of the Investigation. The dotted portion of the curve represents a range where but limited data were available. As indicated, a male crab 5½ inches across the carapace at point of greatest width - formerly the minimum legal size in Cook Inlet - may be expected to weigh approximately 3.4 pounds. A male weighing 15 pounds would measure approximately 9½ inches, width of carapace.

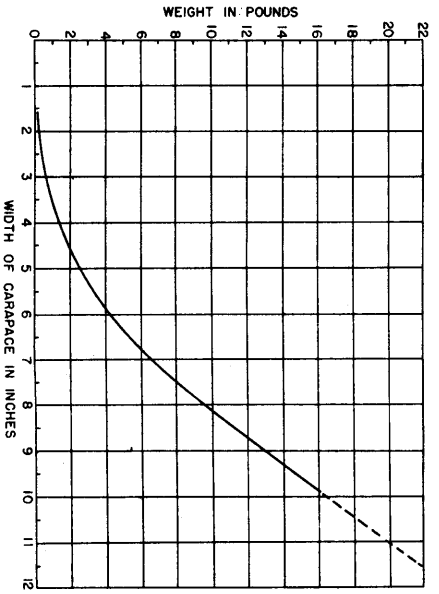

FIGURE 6.--Curve based on 2,800 male king crabs, showing average weight in pounds of male king crabs between 1.6 and 11.5 inches, width of carapace. The dotted portion is based on limited data.

Female king crabs not only run much smaller in size than the males but, because of their body proportions, contain much less edible flesh per inch of width. The largest female crab taken was 8½ inches in carapace width as compared with 11½ inches for the largest male. The majority of the females taken were under six inches, while the majority of the males ran from approximately six to nine inches.

From a preliminary survey of available data it would appear that the king crabs taken in Alaskan waters grow much more rapidly and, consequently, reach commercial size in much less time than is reported for the king crabs taken in Japanese waters (Marukawa, 1933). In the few instances where moulted tagged crabs were recovered, the increase in width of carapace was from two to four times greater than that reported for crabs of similar size taken in Japanese waters.

Because of the large size which the king crabs reach, a rather wide range of sizes may be expected in a commercial fishery unless selective gear is used. It was determined in the experimental fishing operations, however, that, in line with this wide range, the average size of the crabs taken in the several areas was subject to considerable variation; furthermore, the crabs from the Bering Sea were generally smaller than those taken on the south side of the Peninsula. Whether this latter condition is due to difference in environ-

ment or is the result of the Japanese fishing in Bering Sea removing the larger crabs has not yet been determined.

The largest female taken in the Bering Sea was $7\frac{1}{2}$ inches across the carapace as compared to nearly nine inches on the Pacific side of the Peninsula. No male crab weighing over 14 pounds was taken in the Bering Sea while, as indicated previously, crabs weighing 15 or more pounds were not infrequent in waters south of the Peninsula. The average weight of the male crabs taken by trawling in the Bering Sea was 5.7 pounds, and the males caught in tangle nets averaged 6.7 pounds. The average weight of the trawl caught crabs in the several areas south of the Peninsula varied between 5.1 and 10.6 pounds, while that for the tangle-net males varied between 9.3 and 11.6 pounds.

Seasonal Condition and Movements of King Crabs

The condition and apparent migratory movement of king crabs, factors which have important influence on the conduct of a crab fishery, are directly related to the moulting and mating processes. Moulting usually takes place frequently in small crabs and annually during much of the adult life. When a king crab moults no hard portion remains, since the entire exoskeleton, the lining of the mouth, esophagus, stomach, and its calceous structures, gills, tendons, and a portion of the intestine are shed. The leg muscles degenerate into a mass of flabby tissue greatly reduced in size. Because of the physiological phenomena which accompanies moulting, the crab flesh is rendered too poor in quality to be of commercial value for canning. Therefore, it is of great importance that operators do not plan or attempt to process crabs which are approaching, or have only recently accomplished, this act.

Moulting of individual crabs in a given population takes place over a considerable period of time, and mature males and females each have moulting periods peculiar to their sex. In the case of the females, the moulting season was found to vary with the different areas, being progressively later the farther they were taken westward along the Alaska Peninsula, and still later in southeastern Bering Sea. In Cook Inlet and around Kodiak Island, the height of the female moulting season appeared to be during late March and early April; while in Canoe and Pavlof Bays it was about the middle of April, and approximately May 1 in southeastern Bering Sea. Canning records of the Pacific Fisheries and Trading Company indicate the height of the female moulting period was during April, and show that extensive moulting of male crabs occurred during February 1938 in the Alitak Bay region.

No definite moulting of male crabs was observed during the period from March to October, although a few soft-shelled males were picked up inshore in Bering Sea in May, and one soft-shelled male and a recently cast shell were found offshore here in early September. In Canoe Bay in late October, two soft-shelled male crabs and a few which were believed to be approaching a moulting condition were found. From the meager data available, therefore, it is possible to say only that the males moult largely during the winter months. Those which moulted then are in hard-shelled condition by the mating season, which occurs practically simultaneously with the shedding of the females.

As the moulting period approaches, the crabs--first the male and then the female--migrate into shallower depths where they school together. They are often found in shoal areas near the heads of bays. In southeastern Bering Sea, where there are but few bays, moulting crabs were found in large quantities at intervals along the Alaska Peninsula shore in depths of 15 to 25 fathoms. However, it is not known that all crabs migrate toward shore, for the shedding and mating act which may sometimes occur in the shallow depths offshore. One crab recaptured in Bering Sea had migrated 80 miles offshore from the place it had been tagged during the moulting period, which gives some conception of these seasonal migrations.

One of the most profitable times to carry on fishing operations is the spring season. Male crabs are in fine canning condition during the female shedding period; but, since soft-shelled crabs are easily injured, it is necessary that thoughtful consideration be given to methods of fishing which will not kill large quantities of soft-shelled females.

After moulting and mating have been accomplished, the crabs disperse, presumably in search of food, and progressively work into greater depths. Catch records show that, except during the mating season, the sexes remain fairly well separated with the males inhabiting the greater depths. By September in Bering Sea, large quantities of mature crabs were being taken in 40 to 45 fathoms in a long gully which included the greatest depths within Area XI. At this same time, the best catches in Pavlof Bay were being taken in from 60 to 70 fathoms. The seasonal movement of king crabs into deeper water following the spring mating season is well demonstrated in Table 2.

TABLE 2.--Seasonal trawl catches at various depths in Bering Sea, Area XI

	April 28 to May 12		May 13 to June 3		July 10 to July 18		Aug. 16 to Sept. 4		
Depth	Fishing efforts	Average catch	Fishing efforts	Average catch	Fishing efforts	Average catch	Fishing efforts	Average catch	Weighted average catch
Fathoms	Number	Number	Number	Number	Number	Number	Number	Number	Number
10 to 19	15	32	2	4	1	0	-	-	27
20 to 29	45	149	24	41	7	78	2	9	106
30 to 39	5	27	28	95	6	1	9	52	68
40 to 49	-	-	5	12	5	19	53	105	91
50 to 59	-	-	-	-	-	-	6	15	15
Weighted average catch	113		63		34		88		84

In conducting a commercial operation, fishing should begin before the males leave the shoal mating areas. Operations can be carried on throughout the summer months and on into the fall by fishing in greater depths as the season progresses. Canning should be terminated in the late fall when new shell begins forming in the males, for at this time processing becomes difficult, yields are low, and the quality of the pack is very poor.

Gear for Catching King Crabs

At the time the Investigation was undertaken there was very little information available regarding suitable types of gear for catching king crabs.

According to reports, for their operations in Bering Sea, the Japanese had been using a type of submerged gill net commonly called a tangle net. Samples of this kind of gear had been picked up from time to time by American cod and salmon fishermen in these waters. Reports had been made, also, that the Japanese were fishing paranzella and otter trawls, but it could not be said whether they were used for taking king crabs or for catching bottom fish.

During 1938 and 1939 the Pacific Fisheries and Trading Company used tangle nets, crab pots, and a hand-knit trawl. Other American attempts at king crab fishing had been limited to experience with various modifications of the type of crab pot used for catching dungeness crabs.

In the present study considerable additional information has been obtained from rather extensive fishing of otter trawls and tangle nets. Crab pots also were tested, but the work was necessarily restricted because of the limitations on storage space aboard the exploratory fishing vessels. Although it is difficult to compare directly gear differing widely in principle of operation, it is believed the experience gained will be helpful to any potential operator attempting to determine the merit of each. 1/

1/ For detailed information on the design, construction, and operation of tangle nets, otter trawls, and crab pots, see Appendix II.

General Advantages and Disadvantages of Gear Tested

The otter trawl is a mobile type of gear. Its productivity depends upon overtaking the crabs while it is being towed over the bottom. By contrast, tangle nets and crab pots are fixed gear. Their productivity depends upon crabs walking into them. Obviously each may be expected to have certain advantages and disadvantages.

Otter-trawl fishing was found to be especially effective for locating and prospecting bodies of crabs. The large area of bottom which could be fished in a relatively short space of time permitted a more extensive and rapidly moving exploratory fishing effort than could be attained with the other types of gear. Also, when the trawl passed over an area where crabs were concentrated, very large catches could be made in a few minutes.

In general crab fishing, however, the otter trawl was found to have a number of disadvantages. Being mobile in action, it caught anything that happened in its way. When the crabs were concentrated inshore for mating and shedding, the soft-shelled females became easy prey and were taken in the net in large numbers. Because of their soft condition, most of them were killed before they could be released from the net, or probably died subsequently from injury sustained. Mature, hard-shelled females and small male and female crabs were taken along with the large males in operations in deeper water. Thus, unless the net encountered concentrations of large males, as was the case in Pavlof Bay and in a section of Bering Sea during September 1941, a relatively large proportion of the crabs taken in the otter trawl nets were not suitable for canning due to size, condition, or sex.[1/]

TABLE 3.--Selectivity of otter trawls and tangle nets

Locality	Otter trawls			Tangle nets		
	Portion of catch male crabs	Average weight of males	Range in weight of males	Portion of catch male crabs	Average weight of males	Range in weight of males
	Percent	Pounds	Pounds	Percent	Pounds	Pounds
Prince William Sound	60.9	8.6	1.8-15.7	76.5	-	-
Cook Inlet	60.5	10.6	1.0-19.5	82.4	11.6	3.8-15.9
Shelikof Strait	60.6	6.4	0.9-16.0	96.2	11.2	2.7-16.8
Kodiak Island	1/ 46.3	5.1	1.1-22.2	88.5	11.5	4.5-20.1
Shumagin Islands	64.7	5.3	1.0-13.2	81.1	9.3	2.7-16.8
Pavlof Bay	50.1	8.4	0.4-16.6	94.9	12.4	8.5-15.2
Canoe Bay	53.1	3.7	0.2-15.2	72.3	8.5	3.7-13.8
Bering Sea	2/ 52.8	5.7	0.4-13.1	3/ 90.7	6.7	3.8-12.5

1/ Much work done in bays in early spring when females were congregated for moulting and mating.
2/ Inshore catches, mostly during early spring, were but 39.6 percent male, while offshore catches, mostly during summer and early fall, were 77.3 percent male.
3/ All inshore catches, mostly during summer.

Also, because of the tendency for crabs to distribute themselves irregularly, the trawl yielded rather irregular production in areas where populations were located.

Tangle-net fishing was of but little use in the hurried exploratory work, but it proved to be definitely effective when the existence of crabs was established in an area. In contrast with the trawl results, the tangle-net catches were relatively consistent, and a high degree of selectivity was demonstrated. In general, the tangle nets caught mostly large, canning-sized males. The few females taken, also, were in good hard-shelled condition for canning. This high degree of selectivity prevailed even though the nets were set on bodies of moulting and mating crabs. (Table 3.)

1/ Female king crabs are relatively small when mature and, therefore, are not as economical to handle. Also, the greater relative importance of the female in sustaining the crab population makes their utilization in canning undesirable.

The selective action of the tangle net may be attributed to at least two conditions. First, since the net is immobile, the crabs have to be in motion to come in contact with it, and only hard-shelled crabs have sufficient leg rigidity to undertake any extensive movement. Second, due to the large mesh opening, only the larger size crabs (essentially males) will become enmeshed in the netting. There seems to be some evidence, too, that the larger male crabs are more active than the females.

The entanglement aspect of tangle-net fishing appeared to be its principal drawback: whereas crabs taken in the relatively small mesh trawls were readily dumped from the net when it was hauled in, crabs caught in tangle nets must be picked out individually by hand.

Crab pots were not fished enough to permit a great deal of comparison with the other types of gear. To be effective, the pots must be placed in very close proximity to crabs; and if females and undersized males are in the immediate area, the general tendency is to catch a larger proportion of the smaller crabs. However, for small operations, pots have proved an entirely satisfactory method for catching king crabs.

Comparative Effectiveness of Otter Trawls and Tangle Nets

In otter-trawl fishing the vessel provides the essential fishing effort, for unless the vessel and crew are at work no fishing is accomplished. In tangle-net fishing the crabs themselves provide an essential part of the fishing effort, even in weather when vessel operation is impractical. The principal activity of the fishing vessel and crew is to set the nets, to locate the nets again after they have fished for the desired length of time, and to haul the nets aboard. In comparing the fishing effectiveness of the two types of gear, therefore, the period the tangle nets are fishing in the water may be disregarded as chargeable fishing effort.

FIGURE 7.--A male king crab coming over the power roller developed for hauling tangle nets.

The average trawl tow during the Investigation was of about one hour duration. About one-half hour was required for setting and hauling the trawl, thus making a boat effort of 1½ hours per drag. In a similar period of boat effort the crew, using a specially designed mechanical roller which was developed during the Investigation (Figure 7), could set and haul approximately 400 fathoms of tangle net. When trawl- and tangle-net catches made under strictly comparable conditions with respect to immediate location and data were evaluated on this basis, it was found that tangle-net fishing yielded a considerably higher number of male crabs per hour of boat effort and, as indicated above, the tangle-net-caught crabs were larger in size.

In some 31 instances in which direct comparison was permissible, the tangle nets yielded an average of 204 male crabs per 1½-hour period spent in setting and hauling, while the trawl yielded but 136 per 1½-hour of vessel effort. (Table 4) For the entire survey, the tangle-net males averaged 10 pounds while the trawl-caught males averaged seven pounds in weight.

There was but one case in which the trawl-catch of male crabs exceeded that of the comparable tangle-net set, and this occurred in Canoe Bay when the trawl passed over a spot where crabs were extremely concentrated. However, the number of large canning-sized males taken in the trawl was but slightly higher than the number taken in the tangle net.

TABLE 4.--Average catch of male king crabs by trawl and tangle-net fishing[1/]

Area	Trawling				Tangle-net fishing			
	For all drags		Along tangle nets		For all sets		Along trawl drags	
	No. efforts	Avg. no. crabs	No. efforts	Avg. no. crabs	No. efforts	Avg. no. crabs	No. efforts	Avg. no. crabs
Southeastern Alaska	5	(2/)	0	-	0	-	0	-
Yakutat	6	1	0	-	0	-	-	-
Kayak Island	11	0	0	-	0	-	0	-
Prince William Sound	40	4	0	-	3	18	0	-
Cook Inlet	43	14	6	19	16	56	6	121
Shelikof Strait	31	3	0	-	4	12	0	-
Kodiak Island	133	15	0	-	29	4	0	-
Shumagin Islands	59	5	2	43	11	24	2	120
Pavlof Bay	44	35	5	94	16	49	5	152
Canoe Bay	88	73	6	3/ 376	14	109	6	220
Bering Sea, Area XI:								
Inshore	133	32	12	107	48	136	12	273
Offshore	80	65	0	-	0	-	0	-
Bering Sea, Area XII	26	3	0	-	0	-	0	-
Weighted average		29.5		136		72.5		204

1/ Calculated on the basis of each 1½ hour of actual boat effort devoted to such specific fishing operations as setting, towing, or hauling gear.
2/ Less than 1.
3/ Included a large number of small male crabs.

Although trawls of different design and mesh size were tested during the Investigation, time and conditions did not permit similar experimentation with tangle nets. Consequently, it cannot be said that the tangle nets used were the most effective possible.

Time Required for Picking Crabs from Tangle Net

As was stated earlier, the very satisfactory productivity of tangle nets must be penalized on account of the difficulty encountered in removing the crabs from the net. However, the degree of penalty cannot be readily evaluated in terms of vessel effort, because the most practical procedure would be to pick the crabs from the nets at the cannery. Otherwise, the care required to remove a crab from a tangle net without an injury which might cause death prior to landing at the cannery would make the net-picking operation aboard vessel prohibitive.

The time required for carefully picking crabs from the tangle nets aboard vessels of the crab investigation was as follows:

Days nets were fishing	Number of crabs caught	Man-hours to pick crabs from net	Crabs removed per man-hour
3	497	14.0	35.6
3	175	4.5	39.9
5	1,100	32.0	34.4
7	188	7.5	25.1

It is estimated that at least half the time was spent in freeing the meshes caught under the carapace. If the crabs were butchered (i.e., the carapace removed) in the net at the cannery, the rapidity with which the crabs would be freed probably would be several times greater than that reported here. It is regretted that conditions did not permit obtaining more detailed data on this aspect of the handling operation.

Total Gear Requirements

Tangle-net fishing requires a considerably larger initial investment in netting, while trawl fishing requires a greater investment in vessel equipment. Except for the usual fishing-vessel deck gear, the only additional fixed requirement for tangle-net fishing would be a power roller for hauling the nets. This can be constructed for not more than $50. To rig a small vessel for trawling requires about $1,500 additional for winch drums, cable, otter doors, and accessories.

A tangle-net vessel fishing commercially will be able to set and haul about 2,400 fathoms of gear per day of eight to 10 hours fishing. To provide for three- to four-day fishing for each set of nets and with one day's supply in reserve, a vessel would require a total of approximately 12,000 fathoms of hung gear. At current prices an initial investment of from $5,000 to $6,000 in gear would be involved. If properly cared for, the gear itself should last a season, although some gear will be lost on the fishing grounds.

For trawl fishing, two completed trawls should be aboard at all times, and sufficient spare netting, lines, etc., for the continual repair which is necessary. The trawls of the Alaska Crab Investigation, although fished most of the time in unfamiliar waters, lasted for an average of 70 tows. In localities where bottom hazards are known, much longer life can be expected. Under these conditions the trawl-net requirements for a vessel for a season should not exceed $2,000 to $3,000.

In view of the nature of the crab investigation studies, it is impossible to suggest what might be obtained in a strictly commercial fishing effort. It may be assumed, however, that fishing productivity should be several times higher than that attained under experimental conditions. That this is true is indicated by the marked improvement in productivity shown in Table 4 when trawls and tangle nets were fished in general areas where the presence of bodies of crabs had been demonstrated. This is not selected data, but includes every instance where tangle nets and trawls fished in an immediate area on the same date.

Vessel Requirements for Fishing King Crabs

A specific type of fishing vessel generally results from years of evolution and constructive development. The Atlantic coast trawler, the purse seiner, or the Pacific halibut schooner as seen today, were not conceived with the inception of the fisheries with which they are associated. Similarly, it is not to be supposed that the ultimate in a crab-fishing vessel can be specified on the basis of existing knowledge. However, during the crab investigation opportunity was permitted for observing the operation of several vessels of different size and design, and the conclusions reached from this experience may well serve as a starting point.

The Dorothy, the largest of the vessels used, was an able, schooner-type vessel with side-set trawling equipment. Because of its greater length and depth, and, therefore, greater stability, it was the most fishable boat in the exposed waters of Bering Sea. Although the deck gear interfered somewhat with tangle-net operations, no evidence was found otherwise to indicate unsuitability of the schooner-type vessel for tangle-net fishing.

In small bays and shallow water, the larger size of the Dorothy proved somewhat of a handicap. This was especially true for trawling operations, since the side-set trawl vessel required more space for paying out the gear.

For operations on the Pacific side of the Alaska Peninsula, the much smaller Locks was found to be entirely adequate. Its size, shallower draft, greater maneuverability, and stern-set trawling-rig made it especially good for working the many small bodies of water prospected. From these and other observations it is possible to suggest several desirable requirements of vessels to be used for fishing king crabs. The registered physical measurements of the vessels used for the crab survey are given in Table 5.

TABLE 5.--Registered measurements of fishing vessels used by the Alaska Crab Investigation

	Tonnage		Dimensions in feet			
	Gross	Net	Length	Beam	Depth	Horsepower
Dorothy	130	89	92.8	20.6	10.1	270
Champion	83	56	69.7	15.3	8.8	135
Locks	43	29	58.7	13.9	7.1	90

Suggested Vessel Requirements

Size and Maneuverability

A shore-based operation in Bering Sea would require able sea boats of such size, construction, and stability as to enable them to operate under the rather severe weather conditions encountered in that area. A vessel as large as the Dorothy would not necessarily be needed, but it is believed a sustained fishing effort there should not be attempted with vessels appreciably under 65 feet in length.

The same general size requirement would apply to a floating cannery operation on the grounds unless the "floater" were large enough to take the fishing craft aboard in heavy weather. Under these conditions rather small fishing boats would suffice, since the range of operation need not be far distant from the mother ship. One sturdy prospecting vessel, however, would be desirable.

For operations in the sheltered waters on the Pacific side of the Peninsula, smaller vessels of 30 to 40 feet in length should be adequate. Vessels for crab fishing should be adequate. Vessels for crab fishing should be provided with pilothouse or side-rail controls to permit efficient gear operation with a minimum of manpower.

Space Requirements for Fishing Operations and Gear

The vessels must have adequate space for gear operation, for gear storage, and for holding the catch. The specific requirements will depend upon the conditions of the operation.

For tangle-net fishing a platform or free deck space 4 x 5 feet is needed for laying out a 200-fathom length of net preparatory to setting. In addition, about four feet of clear space across deck is desirable for laying out such auxiliary gear as flag poles, buoy kegs, buoy lines, anchors, and shipshots. (Figures 8 and 9) Gear to be set may be stored where most convenient. A 100-fathom shackle of tangle net will occupy about four cubic feet of storage space.

If intermittent setting and hauling operations are contemplated for a vessel operating some distance from its base, space should be provided aft, either on deck or below deck,

for storage of the day's gear to be set. The hauled gear, including the catch, can be stored amidships; thus, the hauling crew would not interfere with the setting operation.

If the plan of operation calls for the vessel first to set the day's supply of gear and then pick up the nets from a previous set, less space would be needed and a smaller crew could be used.

The crab-trawling operation does not differ materially from any other type of trawl fishing. Accordingly, any vessel otherwise suitable which will satisfactorily meet the space requirements for this method of fishing should suffice for operating a crab trawl.

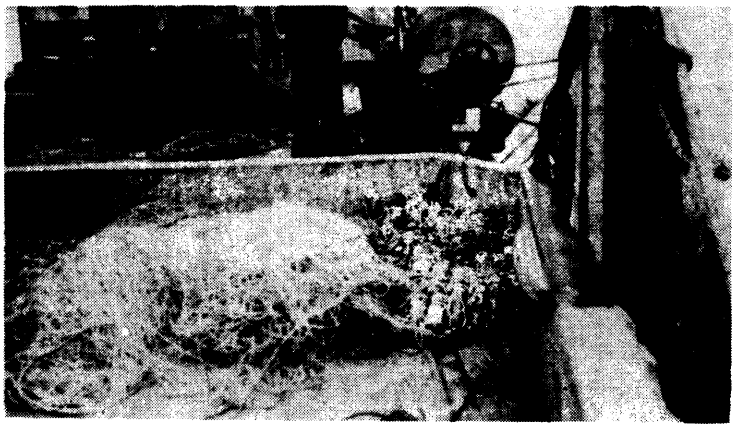

FIGURE 8.--Two hundred fathoms of tangle net laid out for setting. The arrangement of the bott'e floats is shown.

The crab-trawling operation does not differ materially from any other type of trawl fishing. Accordingly, any vessel otherwise suitable which will satisfactorily meet the space requirements for this method of fishing should suffice for operating a crab trawl.

FIGURE 9.--Setting tangle nets over the stern of the Locks.

It is believed the average purse-seiner or halibut schooner will have adequate space for either method of fishing, and the new combination trawler and halibut schooner being developed in the Pacific Northwest should be especially well suited for this industry.

Requirements for Storage and Transportation of Catch

Storage and transportation of king crabs offers an entirely different problem than is encountered in most fisheries, since the catch must be kept alive until landed. The experience gained during the crab investigation relates both to method of handling and space conditions.

Crabs live for considerable periods entrapped in tangle gear. In one fishing instance a tangle net lost for 50 days contained nearly 100 crabs, all of which were alive although a little lighter than average when recovered.

In holding crabs it is necessary to keep them as cool as possible and to provide a supply of fresh sea water. Crabs exposed to air temperature of approximately 40° F. lived for about 48 hours if kept wet with fresh sea water. At 50° F. they lived for only 18 hours. One hundred crabs held in a dory rapidly contaminated the water with excreted waste products and died within 12 hours when the water was not changed. In contrast, one crab was kept alive in a barrel for 10 days when the water was changed at six-hour intervals, and it was still in good condition when the experiment was discontinued on account of extreme weather conditions.

It would appear, then, that holding crabs in tanks of water aboard the fishing vessel is unnecessary. If the catch is to be held on deck, ample space must be available separate from other activities and provisions made for keeping the crabs wet. If the catch is to be kept in the hold, it would be well to have a raised floor and provide the hold with a spray-washing system, and an adequate bilge-pumping system to draw off the wash water and waste products continually or at frequent intervals. If it is desired to hold the crabs at the cannery, a floating live box should be used.

Crews

The number of men required for the crew of a commercial fishing vessel obviously will be less than that of the exploratory fishing expedition, as considerable effort was directed to taking data. Common practice in the Pacific otter-trawl fleet is to use a crew of four men for outside and three men for inside fishing.

Tangle-net operations can be carried on by two men in inside waters if the boat is provided with a power roller and side-rail control. One man can haul the gear and maneuver the boat while the other stows the gear. Two men are sufficient for laying out the nets for setting. Larger scale tangle-net operations might be more efficiently carried on with a crew of four or five men. Two of these men could haul while the others were laying out the gear or maneuvering the boat.

Weather Conditions Encountered

The weather is a factor which definitely limits the extent of crab fishing activities in Alaskan waters. This is true in the Bering Sea more than along the Alaska Peninsula, Kodiak Island, Cook Inlet, Prince William Sound, and Southeastern Alaska, where work is more or less confined to enclosed areas and operations can continue under more adverse conditions. The size of the fishing vessel would also determine to what degree trawls and tangle-net gear could be efficiently handled in inclement weather.

In general, the weather on the Pacific side of the Peninsula is bad during the winter and spring and good in the summer and early fall, with an occasional stormy period of short duration. May, June, and July are considered the best months; but the prevailing winds are southerly and, consequently, fog is quite prevalent. Although this would tend to impede offshore navigation, fishing in the bays and along the shore could be conducted without too great difficulty, since shore bearings particularly necessary for tangle-net operations are generally available.

The Investigation vessel, working Kodiak Island, Cook Inlet, and Prince William Sound from March through June 1941, lost 12 days because of strong winds. Fishing was curtailed 15 days during the three months (September through November) in 1940. From December to

March at Alitak, 43 percent of the days were stormy. No definite statement can be made as to the maximum velocity of wind in which fishing could continue because wind direction, tidal and current actions, and topography of the immediate vicinity produce varying effects.

Because of the danger of drifting ashore, wind forces of 35 miles per hour generally prevented operations in the bays, though there were several instances when trawling was successfully managed to the leeward under winds of this strength. Even in the bays, however, where no appreciable swell could be built up, a moderate blow will cause "williwaws"— violent gusts of wind that sweep down off the mountain slopes with great force--and make maneuvering of a boat difficult. In the cold winter months, vessels caught in a gale are in danger of icing down, the heads of the bays are liable to freeze over, and heavy snowing diminishes visibility.

Commercial navigation in the Bering Sea and Bristol Bay is discontinued from October to May because of ice floes and detached bergs which are continually moving, breaking, and piling up by the action of the winds and currents. Bristol Bay to St. George Island usually marks the southern limit of the ice, but it has been driven farther southward when northerly winds prevailed. Residents at Port Moller have stated that little or no ice is seen in that vicinity after mid-April. Crab operations in Bering Sea would thus be restricted to the late spring and summer months.

Generally, the late spring and summer weather is mild but foggy, with frequent periods of light weather and comparatively few strong blows. Winds are quite variable throughout the summer, and their intensities are equally strong from any quarter. The "westerlies" are usually more severe and harder to contend with when fishing. Because of the long, open sweep of the sea, the swells pile up and are choppy due to the large area of relatively shallow water and a strong cross tide and current.

It was found that winds above 25 miles per hour in force, especially after blowing for a few hours, made fishing quite difficult in open waters; and even after the blow had abated, some time was apt to be lost as the swell was slow in breaking up, particularly from a westerly direction. The crab investigation vessels that worked in the Bering Sea from April 15 to September 9 (June excluded) lost 15 percent of the time spent here due to weather too severe for the conduct of fishing operations. The days of bad weather were more or less evenly distributed. Fogs and thick drizzles were prevalent, and several days of tangle-net operations were prevented because of the poor visibility that obstructed the distant land bearings necessary for locating the gear which was generally set five miles apart.

The codfish schooners, which are in the Sea from mid-April to mid-August dory-fishing for gray cod, have found in the last five years that a range from 14 to 23 percent and an average of 17 percent of the days are lost due to bad weather.

Shelter along the Bering Sea side of the Alaska Peninsula is scarce. Port Moller offers the best harbor, but distances are great, and it is not always possible to reach protected waters for many of the winds are sudden. Amak Island offered considerable protection in almost any wind; there was some swell that ran around the Island, but the force of the wind and sea was greatly reduced. On the west side of the Island there was much better holding bottom than is indicated on the charts. Ten fathoms of water leads well up to the shore.

On the easterly blows, boats may anchor in the lee of the Peninsula shore; whereas smaller craft with local knowledge may enter Nelson Lagoon. North of Port Moller there are several other shoal bays which may be sought in a storm. Protection is offered by the Pribilof Islands and St. Matthew and St. Lawrence Islands as work is carried to the northward and westward in Bering Sea. St. Matthew Island was found to be considerable more protected and less hazardous on the north and east sides than is generally reported.

Canning Experience

The experience of operators who have packed small quantities of king crab meat during the past several years and the results of the present Investigation would indicate that the canning of this product does not offer any serious technical difficulties. The canning procedure developed previously for dungeness crabs, if but slightly modified, can be used

with entirely satisfactory results. The essential requirements, subject to seasonal variation, for a good quality pack are:

a. Keep the crabs alive until butchered.

b. Thoroughly wash away all blood and viscera before the butchered sections are boiled.

c. Boil in fresh water or 3 percent brine for approximately 15 to 17 minutes; then cool by dipping in cold water or weak brine for about 30 seconds.

d. Carefully break the shell successively at each leg and claw joint, and then pull the joints apart so that the tendons remain attached to the shell. The meat when subsequently shaken out will be free of tendons.

e. Thoroughly wash the picked meat to remove any debris.

f. Dip the picked meat for about 15 seconds in a weak organic acid solution-- for example, dilute acetic acid, two ounces to each gallon of fresh water.

g. Season by dipping the leg meat only in 90° to 100° brine for about 15 seconds.

h. Pack attractively in parchment-lined, "C" enameled, ½-pound cans.

i. Seal under vacuum.

j. Process at low temperature, i.e., at six pounds pressure (230° F.), for 75 minutes.

k. Cool the cans quickly after removing them from the retorts. Butchering live crabs, thorough washing, and the acid dip materially reduce the possibility of the meat becoming discolored in the can. As a further precaution against discoloration, the crab meat should not come in contact with steel or copper.1/

The yield of crab meat ranges between 20 and 35 percent of the live weight. Normally the recovery of leg meat and body meat is in the approximate proportion of two-to-one. Crabs taken in waters south of the Alaska Peninsula were found to run six to 15 per case of 48 ½-pound cans, while those taken in Bering Sea ran 10 to 20 per case. As indicated in the preceding discussion on fishing gear, the type of gear fished materially influences the size of crabs taken in a given area and, therefore, the number of crabs per case.

Cannery productivity per unit of labor is considerably higher for handling king crabs than for dungeness and blue crabs. The average cannery laborer, without any appreciable experience, can butcher 40 to 50 large king crabs per hour. If the crabs range from eight to 12 pounds in weight, each butcher should account for 100 to 150 pounds of crab meat in the shell per hour.

An experienced cannery worker can pick 60 to 70 pounds of king crab meat per hour as compared to 20 to 25 pounds of dungeness crab meat. A good packer will fill 70 to 85 cans per hour; if the filling operation is systematized, a much greater speed can be attained.

During the experimental canning work of the Investigation, inexperienced crews produced on an average of 12 to 17 cans of crab meat per man-hour of cannery labor. On the basis of data obtained from earlier commercial king crab canning operations, a productivity of at least 30 to 36 cans per man-hour of cannery labor seems well within reason.

Quality of Pack

Samples cut from the experimental pack and tested by some 83 different individuals on both the Pacific and Atlantic coasts were rated as follows:

1/ See Appendix III for a detailed discussion of canning procedure and other practical canning data.

Appearance of container	Good	80
	Average	3
	Poor	0
Fill	Good	78
	Average	5
	Poor	0
Color	Good	82
	Average	1
	Poor	0
Cleaning	Good	73
	Average	10
	Poor	0
Odor	Good	80
	Average	1
	Poor	0
Flavor	Good	75
	Average	5
	Poor	0
Salt	Insufficient	8
	Good	70
	Excessive	4
Quality as compared to imported king crab	Better than	63
	About same	7
	Poorer than	0

One of the most interesting aspects here was the fact that there were about the same number of returns from the east and west coasts, and that data from each were essentially identical.

Other Marine Products

Although the Investigation was intended primarily as a study of the king crab fishery and the work planned accordingly, a record was kept of the other marine products taken during the 1941 expedition. Over three quarters of a million pounds of "sole" were caught, almost half a million pounds in Bering Sea alone. Large numbers of Alaska pollock, gray cod, and dungeness and tanner crabs (over 37,000 of the latter) were also taken, and a large variety of species in lesser amounts. The fact that these results were purely incidental to king-crab-fishing makes the volume of the catches more impressive. (Table 6.)

TABLE 6.—Summary of otter trawl catches (other than king crab) by Area, 1941[1/]

Area	Tows	Crabs		Fish									
						Halibut		Flounders and "soles"					
		Dungeness	Tanner	Gray cod	Alaska pollock	Medium	Small	Starry	Rock	Lemon	Yellowtail	Sand	Flathead
	Number	Number	Number	Number	Pounds	Number	Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Southeastern	5	5	1,552	6	342	2	15	3,100	1,000	20	20	0	0
Yakutat	6	0	0	0	0	5	5	1,950	100	25	25	0	0
Kayak Island	11	111	120	53	50	6	29	20	0	0	55	0	25
Prince William Sound	40	1,559	1,169	17	18	11	69	2,985	1,375	965	1,450	150	275
Cook Inlet	43	161	6,173	83	120	48	94	12,300	125	3,450	3,500	2,750	125
Shelikof Straits—W side	31	19	532	62	0	20	37	345	250	80	350	0	75
Kodiak Island	133	1,960	9,300	380	25	24	66	22,000	15,300	6,900	18,800	0	9,000
Shumagin Islands and Alaska Peninsula	59	121	143	155	0	21	102	14,500	9,500	3,500	13,500	0	7,000
Pavlof Bay	44	42	2,425	400	75	19	31	6,500	17,700	1,800	38,000	0	2,500
Canoe Bay	88	0	10,066	57	5	1	14	36,500	8,000	1,300	44,200	0	1,000
Bering Sea, Area XI:													
Inshore	133	0	700	3,021	49,000	10	398	23,500	93,000	7,500	110,000	0	9,000
Offshore	80	0	2,800	3,200	13,300	15	244	0	54,000	8,000	123,000	0	16,000
Bering Sea, Area XII	26	0	2,700	300	11,000	4	1	0	850	50	9,700	0	0
Totals	699	3,987	37,690	7,734	73,935	186	1,105	123,700	201,200	33,600	362,600	2,900	45,000

1/ During the work in the fall of 1940 complete records were kept only on king crab catches.

Note:—In addition to the above, miscellaneous items were caught in approximate amounts as follows: 2,000 Korean or horse crabs (all from Bering Sea); 4,617 pounds of shrimp (practically all from Olga Bay, Kodiak Island); 590 scallops (practically all from Shelikof Straits); 11,800 pounds of rockfish (of which 11,000 pounds was from Kodiak Island); 210 pounds of sablefish (practically all from the Shumagin Islands); 276 pounds of tom cod (Bering Sea); 155 herring; 16,340 pounds of bullheads (mostly from Bering Sea); 90 dogfish; 700 sea poachers (Bering Sea); 1,011 skates (mostly from Bering Sea); 2,775 pounds of turbot; and 6 wolffish (Bering Sea).

In Bering Sea the quantity of edible flatfish was phenomenal. Two hundred and forty tows, spread at random over more than 100,000 square miles of area at depths ranging from 10 to 60 fathoms, averaged almost a ton to the drag. In the more productive sections of this area, average catches often ran as high as two tons, and single tows as high as 9,000 pounds were recorded. An average catch is illustrated in Figure 10.

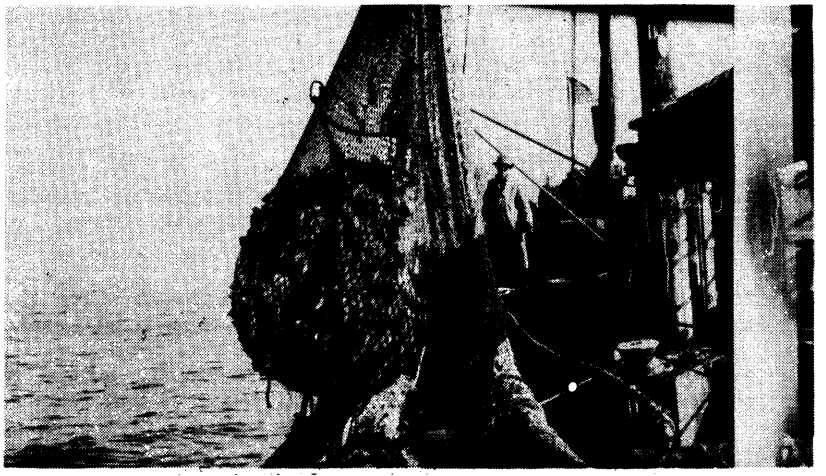

FIGURE 10.—Lifting the otter trawl fish bag aboard the Dorothy. This is an average Bering Sea catch of fish.

In contrast to the schooling of king crabs, which was pronounced during the mating and moulting season, the "sole" were spread quite uniformly over all the favorable bottom. They were taken in considerable quantity almost everywhere except where other organisms such as starfish, sponges, or crabs, predominated.

The section between Bristol Bay and the Pribilof Islands was the most productive, with the catches decreasing rapidly north of St. Matthew Island. The species taken in greatest abundance was the yellowtail (Limanda aspera). The rock "sole" (Lepidopsetta bilineata), starry flounder (Platichthys stellatus), flathead (Hippoglossoides elassodon), lemon "sole" (Pleuronectes quadrituberculatus), and sand "sole" (Psettichthys melanostictus) followed in the order given.

The gray cod, Gadus macrocephalus, is abundant in Bering Sea waters and provides the the only fishery other than for salmon prosecuted there by American fishermen. The Investigation made no large catches of cod, but it is probable that the trawls, designed to hold the bottom closely and with relatively little vertical opening, took only a small percentage of those available. If this percentage can be assumed constant for the sections explored, relative size of the catches, even though not very large, may have considerable significance in indicating the possibility of expanding the fishery.

Several tows were made on grounds usually fished by the codfish fleet and in other waters of Bering Sea. A comparison of the results indicate that cod were taken in equal quantity farther offshore, in deeper waters, and all the way across to the Pribilof Islands. Since the cod from deeper waters averaged substantially larger per fish than usual for commercial catch, considerable expansion of the range of this fishery would seem possible, using more flexible gear than the hand lines now used.

Catches of Alaska pollock (Theragra chalcograma) were made in Bering Sea in quantities up to 7,000 pounds per drag. While this fish has not been extensively used, it should be salable since the flesh is tender and palatable. There is reason to suppose that even the large catches of this species do not indicate fully its great abundance. While a bottom feeder like the cod, it is generally found several feet from the bottom, so that the trawls expressly designed for crabs might well have passed under many schools.

Halibut, too, are not easily taken in the conventional trawl. For example, in the Cook Inlet area, a widely known halibut ground, only 142 were captured in 43 tows--an average of

2. Sec. 3(c) is amended to read as follows:

(c) Wholesaler's mark-up for different classes of sales. Mark-up is the percentage over net cost set forth hereinafter for each class of wholesaler or the type of sale involved. To obtain the selling price, multiply the net cost by the percentage mark-up figure--the result added to the net cost is the selling price. The mark-up which applies in any particular sale depends on the class in which the wholesaler is and the kind of service performed in the particular sale. No wholesaler who purchases from another wholesaler may sell at a price higher than the maximum price permitted hereunder by the seller, except as provided in paragraph (d)(1) Primary wholesalers, under this section. The classes, types of service, and mark-ups are set forth in the following paragraph (d).

3. Sec. 3(e) is amended to read as follows:

(e) Imported frozen fish and seafood. The maximum price at which a wholesaler, including any agent of a foreign processor, may sell any imported frozen fish or seafood listed in section 14 shall be the base price listed in section 14 for the species and style of dressing plus or minus the differential for packaging provided for in section 13, plus the actual freight to the wholesaler's warehouse from the point at which the frozen fish enters the United States. If that freight is less than the carload rail freight rate from the shipping point in the United States closest to the processor's plant to the wholesaler's warehouse, the latter may be added in place of the actual freight. To this amount, may be added the mark-up provided for the class of sale in paragraphs (c) and (d) of sec. 3.

4. Sec. 3(f) is added to read as follows:

(f) Sales to war procurement agencies. The maximum price for sales to war procurement agencies shall be determined by reference to the class of sale and kind of service performed. Wholesalers or processors who had executed contracts prior to April 13, 1943 for the sale and delivery of frozen fish and seafood to war procurement agencies may continue to sell and deliver at prices set in the contracts for a period of forty-five days after April 13, 1943.

5. Sec. 4 is amended by deleting the words "United States, its territories and possessions" and inserting in their place the words "forty-eight states of the United States and the District of Columbia".

6. In Sec. 12(a), the "Processor" definition is amended to read as follows:

"Processor" means the person who owns the fish or seafood at the time they are frozen, or the person who becomes the owner before they leave the original freezing point.

7. Sec. 14, Schedule No. 15, Base price per pound for Items No. 3, 4, and 5 is amended by deleting the figures ".19", ".18", and ".18", and inserting in their respective places the figures ".20", ".19", and ".19".

8. Sec. 14, Schedule No. 28 is amended by adding Item No. 3, Steaks (Sliced), All sizes, .21, Base price per pound.

9. Sec. 14, Schedule No. 40, Item No. 1, Style of processing, is amended by deleting the word "Skinned" and inserting in its place the word "Dressed".

10. Sec. 14, Schedule No. 54, Name, is amended by deleting the words "Atlantic & Gulf Coasts (Peneus setiferus). (Peneus brasiliensis)." and inserting the words "and Prawn".

11. The Effective Date provision of the regulation is amended to read as follows:

This regulation shall become effective in the United States on April 13, 1943. This amendment shall become effective April 26, 1943. Issued this 26th day of April, 1943.

SALTED BLUE RUNNERS TO BE PURCHASED BY FDA

The Food Distribution Administration announced on March 27 in Cured Fish Announcement No. FSC-1354 (Salted Blue Runners) that it contemplated the purchase of Salted Blue Runners

It has been noted in this report that canned crab meat consumption has amounted to an average of 11½ million pounds annually, of which 95 percent was imported from the Orient. The recent defense activity has greatly increased the population of Alaska and so created considerable new markets. The much higher prices commanded by meat products should also aid in the sale of fishery products both in local and outside markets.

Meanwhile, several factors tend to increase the difficulty of fishery operations and heighten the risk involved. At the present time many materials are scarce or unobtainable. Labor and material costs are abnormally high. Transportation north is uncertain. There is a grave possibility that Alaskan waters may become the scene of belligerent action.

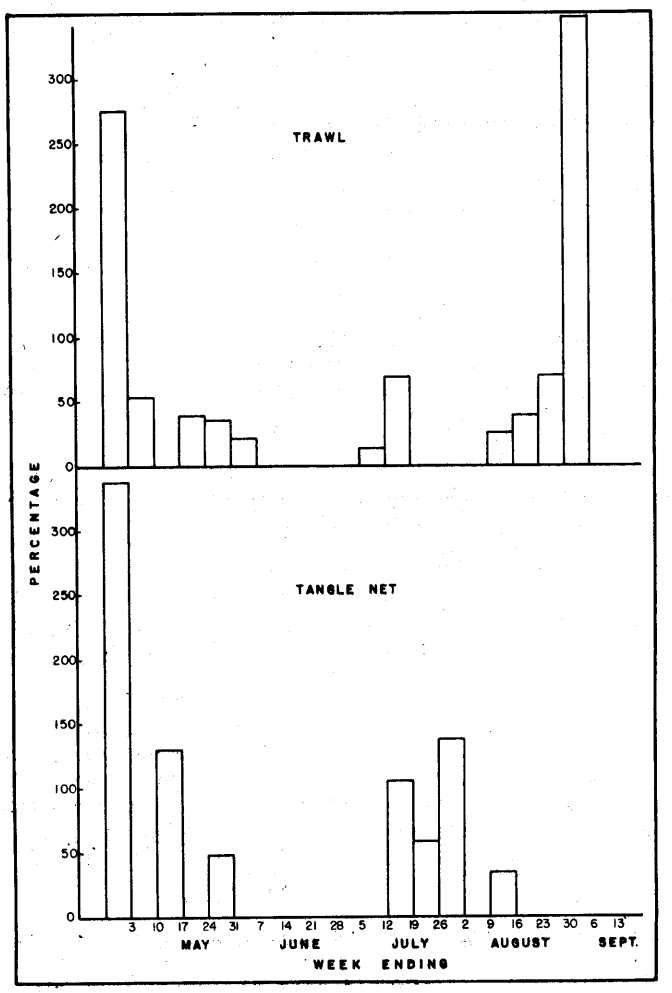

FIGURE 12.--Percentage relationship between average catch of king crabs for week ending on date specified and the weighted average for the entire time fishing was conducted in Bering Sea.

Since it would be fruitless to attempt any analysis of costs or profits under such disrupted conditions, the summary of commercial possibilities indicated by the Investigation will be presented without reference to their present practicability.

There is outstanding opportunity for a large-scale king crab enterprise in Bering Sea, and probably only a large-scale operation could be successfully conducted here. The best fishing lies along the exposed coast of the north side of the Alaska Peninsula between False Pass and Port Moller, and during much of the season a considerable distance offshore. Much adverse weather is to be expected, and shelter is scanty. The mainland offers lee only in easterly weather. The imperfectly charted reefs, absence of fresh water, and lack of a harbor protected from all winds make Amak Island unsuitable as a base. False Pass (Isanotski Strait), Izembeck Bay, and Nelson Lagoon can all be entered only by shallow draft boats. This leaves only Port Moller and adjacent Herendeen Bay as practical sites for shore-based operations within reasonable distance of the grounds. The 40- to 70-mile run would add to cost of raw materials, but this should not be prohibitive.

The other alternative would be the use of a floating cannery, perhaps with fishing boats small enough to be hoisted aboard for long runs or during rough weather. Such an operation would offer the advantages of being able to remain in contact with the crabs during their seasonal migration, and to use less expensive fishing boats, thus offsetting higher cannery and labor costs.

In either case, it would seem feasible to attempt the utilization of a variety of fishery products rather than concentrate on a single one. The tremendous runs of salmon tax available labor and canning facilities of this area to the utmost, but are of extremely short duration (approximately one month in Bristol Bay and two and one-half months in the Alaska Peninsula area). It would seem quite practical to develop the other fishery resources

of this area so as to utilize existing facilities and labor both before and after the salmon season rather than in competition with it. In the case of crabs, the records of the Investigation--while they are not so comprehensive as to be conclusive--do indicate that better catches can be made during these periods, and the mating and moulting habits discussed in preceding sections provide the basis why such results might be expected. (Figure 12.)

The "soles," too, were found both before and after the salmon season in such abundance and over such an immense area as to constitute a highly significant food resource. These fish could be marketed as frozen fillets. Since the yield is only about one-third of the round weight, the advantage of cutting in the field is obvious. There are at least two possible procedures which could be followed: in a "floater" operation facilities could be installed for freezing and frozen storage supplemental to crab canning; or vessels of the tuna-clipper type, equipped for freezing and frozen storage, could operate primarily for the production of pan or packaged fillets.

The utilization of crab and "sole" scrap eventually might also be profitable. Crab scrap has a high mineral content and so commands a market as a component of poultry feeds. The "sole" scrap will yield meal for animal feeds and contains a substantial amount of oil.

A large number of samples of the livers of the various fishes obtained in Bering Sea were preserved. While the livers of most species are too small to make profitable any fishery for them alone, their vitamin potency is high enough to make them a definitely valuable byproduct.

Bering Sea is unique in size of fishing grounds and in abundance of valuable marine life, yet several other localities showed promise for the development of new fishery resources on a smaller scale. Some of these possess distinct advantages as to protected fishing water, harbors, and proximity to existing facilities so that operations could be conducted with less expensive equipment.

As indicated in preceding sections, the most promising spot below Bering Sea is the Canoe and Pavlof Bay area. The winds occasionally draw down Pavlof and Canoe Bays with great force, but usually do not develop a large sea since these waters are protected from most directions. As Canoe Bay is particularly well sheltered, little time need be lost from fishing, and the hazard to gear is slight. There are several suitable sites for shore canneries or the secure anchorage of a cannery scow. Fresh water of good quality is abundant. This area is within reach of existing salmon canneries at King Cove and in the Shumagin Islands where other nearby populations of crabs are also indicated.

Several localities around Kodiak Island would also seem to provide opportunities. No such concentration of king crabs was found as in the Pavlof and Canoe Bay areas and, with the exception of Olga Bay, contact with the crab populations was lost after they moved offshore. However, substantial catches were made during the spring months, so that crab canning might well supplement the salmon or herring operations of several of the many packers now operating. The "soles," shrimp, dungeness and tanner crabs, which can be taken, offer desirable variety for supplying the considerable local market developing in this area.

A small king crab-canning operation has been conducted in Kachemak Bay, Cook Inlet, for a number of years. The crabs were taken only in wire pots fished in very restricted portions of the area. The work of the Investigation indicated that the crabs were available over a considerably larger area at various seasons of the year and could be taken successfully by tangle nets. The limited work done south of Augustine Island seemed promising for the extension of the fishery to this section.

Kachemak Bay is favorable to small-scale operations inasmuch as the well-protected waters would permit small boat operations. As previously reported the "sole" catches, while not large, were of excellent quality. Tanner crabs were very abundant, and the area is well known as a halibut producer. There would seem to be considerable probability of sale to the expanding local market and perhaps by rail shipment to the interior.

APPENDIX I--LOG OF FISHING OPERATIONS

The primary objective of an exploratory fishing study is to locate populations of fish or shellfish for the benefit of the fishing industry. To be of greatest assistance, information of this type must be specific with respect to location, season, and result. This section on "Log of Fishing Operations" has been prepared with this in mind. It is not intended as general reading material, and no attempt has been made to produce anything more than a detailed resume of the fishing operations in each bay, inlet, or body of water prospected. The factual information includes the time and exact location of the fishing effort, the depth of water, the type of bottom, and the catches obtained. In this latter respect, detailed attention has been given to the take of other fish, also, because knowledge of the abundance of all commercial species of fish is of definite practical value. It is hoped that it may provide useful reference material for anyone concerned with commercial fishing in Alaska, regardless of interest in catching king crabs.

Southeastern Alaska to Cape Hinchinbrook

So far as is known, the southern range of the king crab probably does not extend below Southeastern Alaska on the eastern shore of the Pacific Ocean. King crabs are taken occasionally in shrimp-trawling operations in Thomas Bay and Frederick Sound, and in limited numbers in crab pots in Icy Strait.

It is reported that some several hundred king crabs landed in Petersburg each year come largely from Thomas Bay. The crabs are sold locally as a fresh product.

A cannery operating at Hoonah has put up as many as 80 cases of canned king crab meat in a season, incidental to its regular dungeness crab pack. Most of the catches are made between Pleasant Island and the north shore of Icy Strait during July and August. Poorest fishing occurs during the period from December to February. Seal meat and scrap fish are reported to be the most effective baiting materials for the crab pot. The largest crab reported from this area weighed 18 pounds and had a spread of 60 inches.[1/]

In view of the rather extensive commercial fisheries prosecuted in Southeastern Alaska, the limited showing of king crabs would suggest that the species is neither abundant nor very widely distributed in the region. For this reason, experimental fishing was limited to a few days' operations by the vessels of the second expedition on their northward journey during late February 1941. (Table 7.)

Thomas Bay and Frederick Sound

One trawl drag was made in Thomas Bay and two drags in the deep water between Cape Strait and Wood Point.

The tow in Thomas Bay resulted in a bad snag; but even with a large section of the trawl net carried away, several hundred pounds of shrimp were taken. No king crabs were caught. The ability of local fishermen to trawl successfully in Thomas Bay suggests the advantage of knowing the whereabouts of the trawling hazards.

The two drags between Cape Strait and Wood Point, in depths of from 17 to 96 fathoms, yielded no crabs and but a few flatfish.

Icy Strait

Three drags were made off the east end of Pleasant Island in depths ranging from 45 to 75 fathoms. In two of the drags the nets fouled and were damaged on the hard, sharp bottom, as evidenced by the clean cuts in the trawl webbing. The one completed drag yielded but one crab, this belonging to the species Paralithodes platypus.

1/ The information on king crab fishing around Petersburg and in Icy Strait was supplied by Mr. Earl Ohmer of Petersburg and Mr. O. H. Woods of Hoonah.

TABLE 7.--Otter trawl operations: Southeastern Alaska to Cape Finchinbrook, 1941

Vicinity	Date	Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Location of tow: Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: Males	Catch of crabs: King Females	Catch of crabs: King Total	Catch of crabs: Hour basis	Catch of crabs: Dungeness	Catch of crabs: Tanner	Catch of fish: Halibut Medium	Catch of fish: Halibut Small	Catch of fish: "Sole"
								Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Number	Pounds
Southeastern Alaska:																		
Frederick Strait	Feb. 22	56°59.2'	132°58.2'	SExE½E	Flood	SE	fneG-Silt	17-6½	60	0	0	0	0	0	13	0	0	30
Do.	22	56°58.7'	133°00'	W	Flood	SE	fneG-Silt	65-96	60	0	0	0	0	0	0	0	3	20
Thomas Bay	22	57°00.6'	132°56'	WNW	Ebb	SW	G-rky 1/	48-31	30	-	-	-	-	-	-	-	-	-
Pleasant I.--E end	28	58°19'	135°30'	NWxW	-	-	M-M	75-30	60	1	0	1	1	0	50	2	8	1,000
Do.	28	58°21'	135°32'	NW	-	-	M-M 1/	32-35	5	-	-	-	-	-	-	-	-	-
Do.	28	58°19'	135°28'	WNW	-	-	M-fneG 1/	57-45	70	-	-	-	-	-	-	-	-	-
Idaho Inlet	Mar. 1	56°11'	136°13'	SE½E	Ebb	NW	M-M	38-34	60	0	0	0	0	0	723	0	2	1,600
Do.	2	58°08'	136°11'	Mid channel	Flood	SE	M-M 2/	34-22	60	0	0	0	0	5	766	0	2	1,500
Dundas Bay	2	58°20'	136°20'	NWxW	Flood	NW	SM-SG 1/	40-8	25	-	-	-	-	-	-	-	-	-
Totals									430	1	0	1	1	5	1,552	2	15	3/ 4,150
Yakutat Area:																		
Yakutat Bay--NW section	Mar. 5	59°44'	139°44'	WxN	Ebb	SSW	gyM-gyM	42-36	60	0	0	0	0	0	2	0	0	50
Do.	5	59°46'	139°47'	NxS½S	Flood	NNE	M-M	36-29	70	0	0	0	0	0	0	0	2	25
Do.	5	59°47'	139°54'	SxW½W	Flood	NNE	M-M	29-34	60	0	0	0	0	0	0	0	0	25
Do.	7	59°45'	139°56'	SWxS	Flood	NNE	gyS-gyS 1/	10-9	40	-	-	-	-	-	-	-	-	-
Monti Bay	6	59°33'	139°46'	Along Kantaak I.	Ebb	W	buCl-buCl	34-33	60	0	0	0	0	0	0	1	0	220
Do.	6	59°33'	139°46'	Along S shore	Ebb	W	buCl-buCl	32-8	60	0	0	0	0	0	8	1	3	1,600
Monti Bay Inlet	7	59°35'	139°46'	SE	Flood	NW	gyS-buM	17-30	50	2	2	4	5	9	0	3	0	180
Totals									400	2	2	4	5	9	10	5	5	4/ 2,100
Kayak Island Area:																		
Kayak I.--NE end	Mar. 7	59°53'	144°06'	NNW	Ebb	SE	buCl-buCl	35-27	60	0	0	0	0	0	0	1	0	0
Do.	7	59°55'	144°07'	WNW to SWxW	Ebb	SE	fneS-fneS	27-21	65	0	0	0	0	0	0	0	0	0
Wingham I. to Kayak I.	8	60°00'	144°25'	S-E	Ebb	SSW	buCl-buCl	15-17	60	0	0	0	0	0	0	0	0	0
Do.	June 1	59°57'	144°28'	S½E	Ebb	W	gyM-gyM	24-20	60	0	0	0	0	10	45	1	5	25
Wingham I.--W of	1	60°03'	144°29'	E½S	Ebb	SSW	gyM-gyM	25-23	60	0	0	0	0	20	36	0	8	0
Kanak I.	Mar. 8	60°05'	144°31'	WxN½W	Ebb	SSW	gyS-gyS	13-15	65	0	0	0	0	2	0	0	0	0
Do.	8	60°08'	144°36'	ENE	Flood	NE	gyS-gyS	15-6	50	0	0	0	0	1	0	0	0	30
Martin I.	May 31	60°08'	144°53'	NE	Slack	Nil	sftM-sftM	25-21	45	0	0	0	0	24	24	3	4	10
Do.	31	60°09'	144°45'	NExE	Slack	Nil	SM-SM	16-12	50	0	0	0	0	50	0	1	3	0
Sea Ranger Reef--N of	June 1	59°53'	144°35'	SSW	Flood	NW	gyM-SgyM	30-31	60	0	0	0	0	0	15	0	6	25
Okalee Spit	1	60°01'	144°14'	NExE½E	Flood	NW	S-S	4-5	25	0	0	0	0	4	0	0	3	10
Totals									600	0	0	0	0	111	120	6	29	5/ 100

1/ Net snagged and catch lost.
2/ Net snagged but catch saved.
3/ Approximate poundages: starry flounder 3,100; rock "sole" 1,000; lemon "sole" 30; yellowtail 20.
4/ Approximate poundages: starry flounder 1,950; rock "sole" 100; lemon "sole" 25; yellowtail 25.
5/ Approximate poundages: yellowtail 55; flathead 25; starry flounder 20.

Note:--In addition to the above, miscellaneous items were taken in approximate amounts as follows:
Southeastern Alaska: 137 Alaska pollock, 30 skates, 6 gray cod, and 300 pounds of shrimp;
Yakutat Area: 6 skates and 4 turbot;
Kayak Island Area: 53 gray cod, 23 dogfish, 20 Alaska pollock, 17 skates, 1 sea scallop, and 5 pounds of shrimp.

Two tows were made next in Idaho Inlet. These drags netted about 1,500 tanner crabs, several thousand pounds of varied flatfish, but no king crabs. A tow in Dundas Bay, across Icy Strait from Idaho Inlet, snagged.

The results in Southeastern Alaska bear out the reported experience of the commercial shrimp- and crab-fishing industry of the region, that king crabs are not generally prevalent and are not readily taken during the winter months.

Yakutat Bay

King crabs are caught occasionally in widely scattered sections of Yakutat Bay. The poor yields of the Investigation during March 1941, however, would indicate the number here to be relatively small, at least during the early spring. This is in line with the general belief that Southeastern Alaska represents the extremity of the southern range of the species.

In a total of seven trawling efforts only one yielded king crabs. This drag, leading from a small bay indenting Khantaak Island just northeast of Rurik Harbor out into Monti Bay Inlet, picked up four king crabs (two of each sex). Two drags in Monti Bay in mid-channel, between Point Carrew and Khantaak Island, and four drags along the west side of Yakutat Bay, between Blizhni Point and Knight Island were negative. Except for the drag along the south shore of Monti Bay in which 1,600 pounds of bottom fish, mostly starry flounders, were taken, fish catches were generally poor. In the shallowest tow attempted along the west side of Yakutat Bay, the net was badly torn. The take of dungeness crabs likewise was practically nil despite the reported presence of this species in quite large numbers.

Kayak Island

Although the shallow bank bordering along Katalla Bay, Kanak Island, Wingham Island, and both sides of Kayak Island, gives a large potential trawling area, no crabs and very few fish were taken here during either April or June. A total of 11 tows yielded not more than 100 pounds of marketable flatfish, 53 gray cod, 23 dogfish, 111 dungeness crabs and 120 tanner crabs. The bottom here was perhaps the most barren of any covered during the Investigation.

Prince William Sound

Prince William Sound is one of the principal dungeness crab-canning areas on the Pacific coast, the industry being centered at Cordova. In 1941 a pack of 7,711 cases prepared in Cordova represented 77 percent of the canned dungeness crab-meat production of Alaska and 24 percent of that for the entire coast.1/ Analogous with the situation at Petersburg, where a few king crabs are taken by shrimp fishermen, around Cordova king crabs are taken incidental to the dungeness crab fishery.

Cordova fishermen use crab pots exclusively, and although the dungeness pot is rather small for king crabs, some catches as high as 50 of the latter have been reported for a day's operations. Despite this fact, the work of the Alaska Crab Investigation in Prince William Sound does not indicate king crabs to be present in very large numbers.

Prince William Sound (Figure 13) includes innumerable bays, inlets, fiords, coves, et cetera. To prospect this area thoroughly would have been a task requiring much more time than was warranted by the productivity of the experimental fishing effort. In 51 trawl operations and three tangle-net sets, fished in 26 separate operations during the periods of March 9 to March 17 and May 24 to June 7, 1941, all but 22 operations were in the waters of the eastern portion of the Sound, extending into Port Gravina and Orca Inlet.

Eastern Entrance

A trawl tow during March just inside Cape Hinchinbrook in Port Etches captured two king crabs. Eleven weeks later another drag here and in Zaikof Bay were unproductive. Similarly, four tows on the Middle Ground Shoal, extending out from the southwest end of Hawkins Island, yielded six, three, two, and four crabs, respectively, during March; and two drags here during June were completely negative.

1/ Pacific Fisherman, 1942 Yearbook.

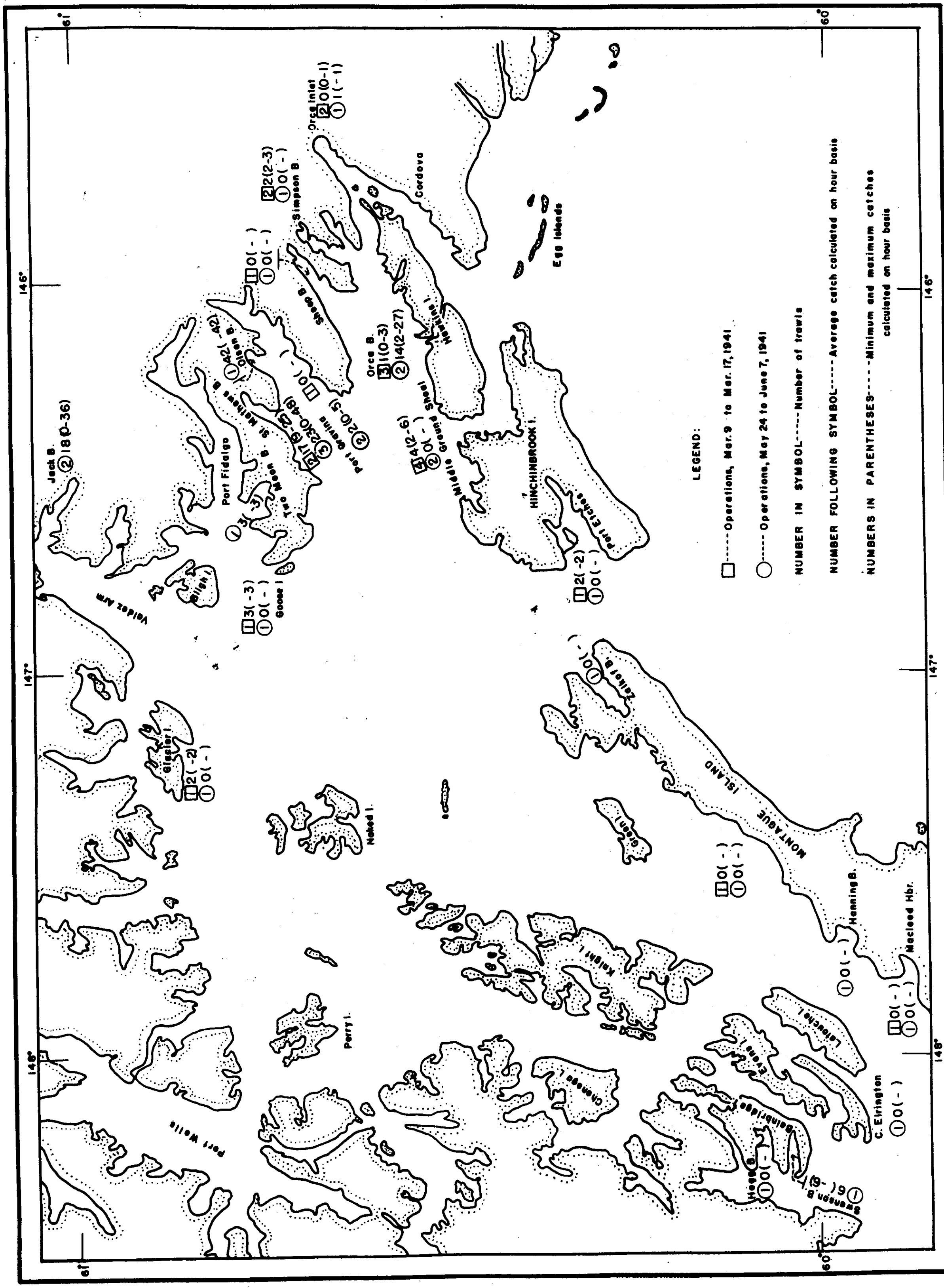

FIGURE 13.--Catch of King crabs and location of otter-trawl operations in Prince William Sound (Area V).

TABLE 8.--Otter trawl operations: Prince William Sound, 1941

Vicinity	Date		Location of tow: Starting point Lat.	Long.	Course	Tide	Current set	Soundings (Initial and final) Bottom	Depth	Time on bottom	Catch of crabs: King Males	Females	Total	Hour basis	Dungeness	Tanner	Catch of fish: Halibut Medium	Small	"Sole"
									Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Number	Pounds
Port Etches	Mar.	9	60°20.7'	146°33'	SWxS	Flood	NNE	stk-stk	12-35	50	1	1	2	2	30	40	0	0	30
Do.	May	24	60°20.5'	146°33'	SW½W	Ebb	SW	MSh-MSh	9-20	40	0	0	0	0	36	2	1	1	25
Zaikof Bay		24	60°16.2'	147°05.8'	NNE	Slack	Nil	MS-MS	22-20	40	0	0	0	0	2	5	0	2	40
Middle Ground Shoal	Mar.	9	60°32.3'	146°10.2'	SWxW½W	Ebb	WSW	stk-stk	20-35	75	0	0	0	0	2	3	0	0	0
Do.		9	60°32.2'	146°10.2'	SWxW½W	Ebb	WSW	sftM-sftM	16-26	60	0	0	0	0	2	2	0	0	15
Do.		14	60°33.7'	146°06.5'	SWxS	Flood	NE	stk-M	84-43	60	2	1	3	3	0	100	0	0	50
Do.		14	60°32.3'	146°12.8'	SWxW	Flood	NE	M-M	43-16	60	3	1	4	4	15	50	0	0	100
Do.		14	60°32'	146°16.5'	WxS¾S	Ebb	S	M-hrd	16-5	60	5	1	6	6	50	50	0	2	50
Do.		14	60°32.3'	146°21'	ExN¼N	Ebb	S	hrd-gyM	5-20	60	2	1	3	3	30	20	0	1	150
Do.		14	60°31.8'	146°24.8'	SxW	Ebb	NW	SM-M	16-33	60	1	1	2	2	10	40	0	3	0
Do.	June	7	60°32.6'	146°06.8'	SW¼W	Ebb	SW	M-M	22-45	60	6	21	27	27	12	10	0	3	50
Do.		7	60°31.9'	146°13.6'	WSW	Ebb	SW	M-M	13-25	45	0	0	0	0	25	30	0	3	25
Do.	May	29	60°32.3'	146°20'	ExN½N	Flood	NE	MS-MS	25-20	40	0	0	0	0	30	20	0	10	200
Do.		29	60°35.9'	146°16.7'	NExE½E	Slack	Nil	M-M	55-70	30	1	0	1	2	0	0	0	0	0
Along Shepard Pt. shore	Mar.	10	60°37.7'	145°42.3'	NNE	Flood	SW	M-M	17-6	45	0	0	0	0	2	10	0	0	0
Across from Shepard Pt.		10	60°39.3'	145°39.2'	SWxS½S	Flood	NE	stk-stk	15-35	60	1	0	1	1	950	300	0	0	35
Do.	May	26	60°39'	145°38.7'	SWxS	Flood	NE	M-M	23-30	45	0	1	1	1	125	250	1	0	100
Simpson Bay--E arm	Mar.	14	60°38'	145°51'	SWxS	Ebb	Nil	stk-sftM	15-42	60	3	0	3	3	25	50	0	2	1,450
Do. W arm		14	60°40.5'	145°51.9'	SxW½W	Ebb	Nil	sftM-sftM	17-42	60	2	0	2	2	0	0	0	0	1,500
Do. E arm	June	7	60°38'	145°50.8'	SWxS	Flood	NE	M-M	14-30	45	0	0	0	0	18	18	0	1	50
Sheep Bay	Mar.	14	60°39.6'	146°03'	SxW¼W	Ebb	Nil	buM-Sh	25-39	35	0	0	0	0	1	6	0	0	660
Do.	May	26	60°39'	146°04.1'	NExN	Slack	Nil	gyS-gyS 1/	18-20	30	-	-	-	-	-	-	-	-	- -
Do.--outer	Mar.	14	60°36'	146°03.6'	NE½E	Ebb	SW	buM-buM 1/	45-20	30	-	-	-	-	-	-	-	-	- -
Port Gravina--Head of	June	6	60°46.2'	146°04'	S¼W	Ebb	S	SG-M	35-70	60	0	0	0	0	12	12	1	2	175
Olsen Bay		6	60°43.8'	146°13.3'	S½E	Ebb	S	MSh-M	17-26	30	13	8	21	42	4	36	0	2	50
Port Gravina	Mar.	15	60°38.5'	146°20'	NxE	Slack	Nil	sftM-sftM	70-70	75	0	0	0	0	0	25	0	0	300
Do.	May	27	60°42'	146°21'	SxW¼W	Flood	NxE	gyS-M	18-22	35	2	1	3	5	3	4	0	0	25
St. Mathews Bay--E side	Mar.	15	60°45.5'	146°19'	SxE	Slack	Nil	sftM-sftM	18-25	60	9	0	9	9	6	6	0	0	400
Do. W side		15	60°45.8'	146°19'	SxE	Slack	Nil	sftM-sftM	6-25	38	16	0	16	25	6	6	0	0	400
Do.	May	27	60°45.5'	146°19'	SxE	Flood	N	M-M	16-22	60	13	9	22	22	48	0	0	1	295
Do.	June	6	60°45.8'	146°19'	S	Ebb	S	M-M	13-17	20	0	0	0	0	12	0	0	0	150
Do.		6	60°45.5'	146°19'	SxE	Ebb	S	M-M	17-25	45	16	20	36	48	30	0	6	0	500
Knowles Head	Mar.	15	60°39.5'	146°39'	W	Ebb	S	sftM-sftM 1/	18-20	25	-	-	-	-	-	-	-	-	- -
Goose I.		15	60°41.5'	146°43'	WNW	Ebb	SE	stk-stk 1/	18-18	5	-	-	-	-	-	-	-	-	- -
Do.	May	29	60°43.5'	146°45.5'	SExE½E	Flood	NW	SSh-SSh 1/	20-21	5	-	-	-	-	-	-	-	-	- -
Porcupine Point	Mar.	15	60°45'	146°43'	NE¼N	Ebb	SW	fneS-M	23-54	45	1	1	2	3	0	12	0	0	10
Two Moon Bay		15	60°46'	146°35'	-	-	-	bldg-GM 1/	27-22	0	-	-	-	-	-	-	-	-	- -
Do.	May	27	60°45.2'	146°32.6'	W¼N	Flood	E	SSh-SSh	20-22	40	1	1	2	3	0	0	0	0	25
Port Fidalgo	Mar.	15	60°48.5'	146°41'	NxW	Flood	NE	stk-stk 1/	46-46	10	-	-	-	-	-	-	-	-	- -
Jack Bay	May	28	61°00'	146°31'	W	Flood	E	M-M	28-40	25	12	3	15	36	36	24	2	1	150
Do.		28	61°02'	146°35.5'	WxS	Flood	E	M-SM 1/	12-9	15	-	-	-	-	-	-	-	-	- -
Glacier I.--W side	Mar.	17	60°54.5'	147°15'	SSW	Flood	SSW	M-M	18-50	60	2	0	2	2	0	0	0	1	50
Chamberlain Bay	May	28	60°52'	147°12'	S¼W	Ebb	S	MS-MS 1/	12-13	10	-	-	-	-	-	-	-	-	- -
Montague I.--W side	Mar.	16	60°07'	147°28.7'	N¼W	Slack	Nil	brkSh-rky 1/	26-38	30	-	-	-	-	-	-	-	-	- -
Do.	June	3	60°03.7'	147°33.7'	SSW	Flood	NNE	sftM-sftM 1/	35-30	35	-	-	-	-	-	-	-	-	- -
Hanning Bay		3	59°58'	147°40.6'	SSW	Ebb	SW	Sh-SM	7-15	30	0	0	0	0	5	0	0	0	25
Macleod Harbor	Mar.	16	59°52.9'	147°46.4'	SWxW	Ebb	SW	MS-S	17-26	45	0	0	0	0	12	3	0	3	40
Do.	June	3	59°52.7'	147°47'	SWxW½W	Ebb	SW	MS-MS	15-17	40	0	0	0	0	20	0	0	1	0
Pt. Elrington--SE of		4	59°53.5'	148°15'	SExS	Ebb	SW	MG-SM	46-55	50	0	0	0	0	0	35	0	30	0
Swanson Bay		4	60°02.2'	148°12.2'	WSW	Flood	NE	MG-MG 2/	24-25	10	0	1	1	6	-	-	-	-	50
Hogg Bay		4	60°04.6'	148°12.6'	SxW¼W	Flood	NE	M-M	23-27	30	0	0	0	0	0	0	0	0	25
Totals										2,083	112	72	184	257	1,559	1,169	11	69	3/ 7,200

1/ Net snagged and catch lost.
2/ Net snagged but part of catch saved.
3/ Approximate poundages: starry flounder 2,985; yellowtail 1,450; rock "sole" 1,375; lemon "sole" 965; flathead 275; sand "sole" 150.

Note:--In addition to the above, miscellaneous items were taken in approximate amounts as follows: 54 dogfish, 43 skates, 17 gray cod, 16 bullheads, 14 shrimp, 7 Alaska pollock, 3 scallops, 1 turbot, and 500 pounds of redfish.

TABLE 9.--Tangle net operations: Prince William Sound to Wide Bay including Kodiak Island, 1940 and 1941

Vicinity	Date 1/	Location of net		Direction of set	Current set	Soundings		Time on bottom	Catch of king crabs		
		Lat.	Long.			Bottom	Depth		Males	Females	Total
							Fathoms	Days	Number	Number	Number
Prince William Sound:											
St. Matthews Bay	May 27	60°45.9'	146°19'	ExN	N-S	M	14-14	2	14	3	17
Do.	June 6	60°44'	146°20'	ExN	N-S	M	25-25	1	12	5	17
Do.	6	60°42'	146°21'	N	N-S	MS	20-20	1	0	0	0
Totals								4	26	8	34
Cook Inlet:											
Port Graham	Mar. 24	59°20.5'	151°49'	ENE	Nil	stk	8-8	2	0	0	0
Kachemak Bay:											
Halibut Cove	May 8	59°36'	151°12.5'	NExN	NW-SE	M	17-17	1	0	0	0
Do.	8	59°37'	151°13'	NW	NW-SE	M	24-24	1	6	1	7
Coal Bay	Mar. 21	59°39.5'	151°16'	NE	NE-SW	M	11-11	3	123	42	165
Do.	21	59°40'	151°18'	NE	NE-SW	M	7-5	3	113	12	125
Do.	May 6	59°38.5'	151°19'	SSW	NE-SW	M	15-16	2	4	27	31
Do.	6	59°39.5'	151°19'	NE	NE-SW	MS	9-7	2	6	1	7
Bluff Point	12	59°36.5'	151°46'	NE	NE-SW	S	20-20	3	65	3	68
Do.	12	59°36'	151°47'	NW	NE-SW	S	20-20	3	35	2	37
Do.	20	59°32'	151°46'	NE	NE-SW	S	40-40	2	22	3	25
Do.	20	59°33.5'	151°51.5'	NE	NE-SW	gyS	20-20	2	20	0	20
Iniskin Bay	Mar. 22	59°39'	153°28'	SSE	N-S	SSh	5-4	2	0	0	0
Iliamna Bay	22	59°37'	153°32'	WSW	N-S	SSh	4-6	2	0	0	0
Do.	22	59°36'	153°26'	SSW	N-S	SSh	7-8	2	6	2	8
Kamishak Bay	May 3	59°19'	153°35'	NNW	E-W	MS	10-10	2	9	2	11
Do.	3	59°16'	153°34'	NNW	E-W	MS	13-13	2	37	0	37
Do.	3	59°12'	153°32'	NW½W	E-W	gyS	29-29	(2/)	-	-	-
Totals								34	446	95	541
Western side of Shelikof Straits:											
Halio Bay	Apr. 1	58°25'	154°03'	E	E-W	Sh	10-10	1	3	0	3
Kukak Bay--outside	Mar. 31	58°20.5'	154°07'	E	Nil	MS	9-9	2	11	1	12
Do.	31	58°19'	154°09'	SExE½E	Nil	gyS	12-12	2	2	0	2
Wide Bay	Apr. 2	57°25.3'	156°14.1'	ESE	Nil	S	9-9	1	9	0	9
Totals								6	25	1	26
Kodiak Island:											
Lazy Bay	Nov. 7	56°53'	154°12.8'	NE	NW-SE	MS	3-18	6	0	0	0
Do.	9	56°52.8'	154°13.9'	NxE	NW-SE	gyM	7-23	7	0	0	0
Do.	9	56°52.9'	154°13.9'	NxE	NW-SE	gyM	3-23	7	0	0	0
Do.	Mar. 17	56°53'	154°12.8'	NNE	NW-SE	SM	10-20	2	2	2	4
Kempff Bay	Apr. 12	56°54.6'	154°12.8'	NE	NW-SE	G	7-12	2	1	0	1
Deadman Bay	13	56°59'	154°03.5'	NE½N	N-S	SM	4-7	1	0	0	0
Portage Bay	13	56°57.5'	153°50.6'	WSW	N-S	G	2-4	(3/)	-	-	-
Sitkalidak Lagoon	Mar. 22	57°05.2'	153°19.6'	SxE	NE-SW	S	15-15	1	2	0	2
Midway Bay	Apr. 23	57°13.2'	153°13.7'	W½N	Nil	MS	2-4	1	0	0	0
Amee Bay	23	57°11.7'	153°12'	WNW	Nil	SSh	4-8	1	0	0	0
McDonald Lagoon	Mar. 23	57°10.3'	153°03.8'	W	N-S	S	10-10	1	7	0	7
Do.	Apr. 23	57°10.3'	153°03.8'	WSW	N-S	gyS	6-12	2	2	0	2
Shearwater Bay	Mar. 24	57°20.4'	152°53'	WNW	NE-SW	SM	6-6	1	0	0	0
Kiliuda Bay	Apr. 24	57°18.4'	153°11.7'	ESE	E-W	ashes	6-8	2	1	0	1
Do.	24	57°18.2'	153°09.6'	NW	E-W	buM	19-20	2	3	0	3
Do.	24	57°20.9'	153°09.5'	WSW	N-S	SM	19-21	2	6	1	7
Woody Island	20	57°47.3'	152°21.4'	NNE	NE-SW	SG	12-14	2	0	0	0
Do.	20	57°46.8'	152°22'	NNE	NE-SW	SM	12-12	2	0	0	0
St. Paul Harbor	20	57°46.9'	152°25'	WNW	NE-SW	SM	6-8	2	0	0	0
Monashka Bay	16	57°50'	152°25.6'	SE½E	Nil	gyS	10-19	1	0	0	0
Shakmanof Bay	15	57°54.8'	152°36.4'	N½E	Nil	gyS	3-8	2	0	0	0
Low Island Bay	15	57°54.5'	152°35'	ENE	Nil	MS	8-10	2	0	0	0
Sharatin Bay	1	57°50.4'	152°44'	SW	NW-SE	M	10-10	1	6	0	6
Dry Spruce Bay	3	57°56.9'	153°04.2'	NNE	NW-SE	gyS	6-15	2	13	3	16
Bluefox Bay	29	58°27.2'	152°40.7'	WSW	N-S	gyS	8-9	2	4	0	4
Do.	29	58°26.8'	152°41.6'	WNW	N-S	SG	5-5	2	0	0	0
Do.	29	58°26.1'	152°41.8'	N¼W	N-S	rky	5-5	2	4	1	5
Do.	29	58°25.8'	152°41.8'	WSW	N-S	SG	6-6	2	0	0	0
Do.	29	58°25.2'	152°41'	WSW	N-S	rky	3-3	2	0	0	0
Viekoda Bay	6	57°51.5'	153°06'	NW½N	NW-SE	SMSh	5-3	8	3	0	3
Totals								70	54	7	61

1/ November data are for 1940; all other data are for 1941.
2/ Gear lost.
3/ Strong tide drifted gear on beach so no catch was made.

Eastern Section

Operations in Orca Bay and Orca Inlet yielded from one to six king crabs per trawl effort except for one drag in early June, just out from the western entrance to Canoe Passage in depths from 22 to 45 fathoms, when 27 were taken. A total of only five crabs were taken in the three drags in Simpson Bay. Sheep Bay did not produce any crabs in the two drags made there.

St. Matthews and Olsen Bays provided the best catches of any made in the eastern section of the Sound, but the number taken was not sufficiently large to indicate populations of commercial size. Three drags in St. Matthews Bay around the end of May and first of June averaged 23 crabs per hour of towing with the best catch of the series being 36 crabs for a 45-minute tow. Earlier, in March, two drags gave similar results, averaging 17 crabs for each drag. One drag on June 6 in the opening to Olsen Bay, in depths of 17 to 26 fathoms, caught 21 crabs in a half-hour tow. In Port Gravina single tows in March and June failed to locate crabs, but the tow on May 27 took five.

Dungeness and tanner crabs were much more plentiful, and the cod end of the otter trawl after a drag often contained 100 or more of each of these two species. One trawl, on March 14, across from the Shepard Point Cannery, scooped up approximately 950 dungeness crabs, of which over 50 percent were in a soft condition and only 20 percent of commercial size. All species of bottom fish were scarce and, except for two catches of 1,500 pounds, one in Orca Inlet and the other from Simpson Bay, not more than 300 pounds were taken per trawl effort. Starry flounders, yellowtail, and flathead "sole" made up the bulk of the catches.

North Central Section

In several trawl operations during March and June around Goose Island, Two Moon Bay, Port Fidalgo, Jack Bay, and Glacier Island, the best catch was 15 king crabs picked up in a 25-minute tow in Jack Bay. Other tows in these places failed to catch more than three crabs in any one effort. The catches of other commercially important marine life here were equally small, as only a few hundred pounds of bottom fish, 36 tanner crabs, and a like number of dungeness crabs made up the total catch.

Western Section

Along the west central shore of Montague Island, in Hanning Bay, and Macleod Harbor, two drags during March and three near the end of May brought no king crabs, although a few moulted shells were picked up by the trawl in Macleod Harbor. Farther to the westward during June, one tow each off Cape Elrington, in Swanson Bay, and in Hogg Bay produced only one king crab--taken in Swanson Bay in a drag that snagged slightly after 10 minutes of towing.

The fish catches in the western part of Prince William Sound were equally as small as those taken in the eastern part, and the catches of dungeness and tanner crabs were much less. A total of 38 tanner crabs and 37 dungeness crabs were taken in eight drags, while the largest fish catch did not exceed 50 pounds.

Cook Inlet

King crabs have been taken in limited quantities at various times in Cook Inlet for the past twenty years. In 1920, the Arctic Packing Company established a small crab cannery in Seldovia and operated for a short time. The Alaska Year Round Cannery processed a small quantity of king crabs in 1924 before operations were terminated due to the lack of proper canning technique. Since the spring of 1937 a small cannery, the King Crab Company, has operated in Halibut Cove. The fishing operations in each instance were conducted with crab traps. The earlier companies used a rectangular dungeness type, while the last-mentioned has traps of round, hoop-like construction with the opening in the top. A small area in the vicinity of Glacier Spit was reported by these operators to have provided their major supply.

Cook Inlet was explored by ships of the crab investigation in the latter part of March and again in early May. Operations were conducted principally in and near Kachemak Bay, though some fishing was done also in the Kamishak Bay region from Cape Douglas to Chinitna Bay. (Figure 14 and Table 10.)

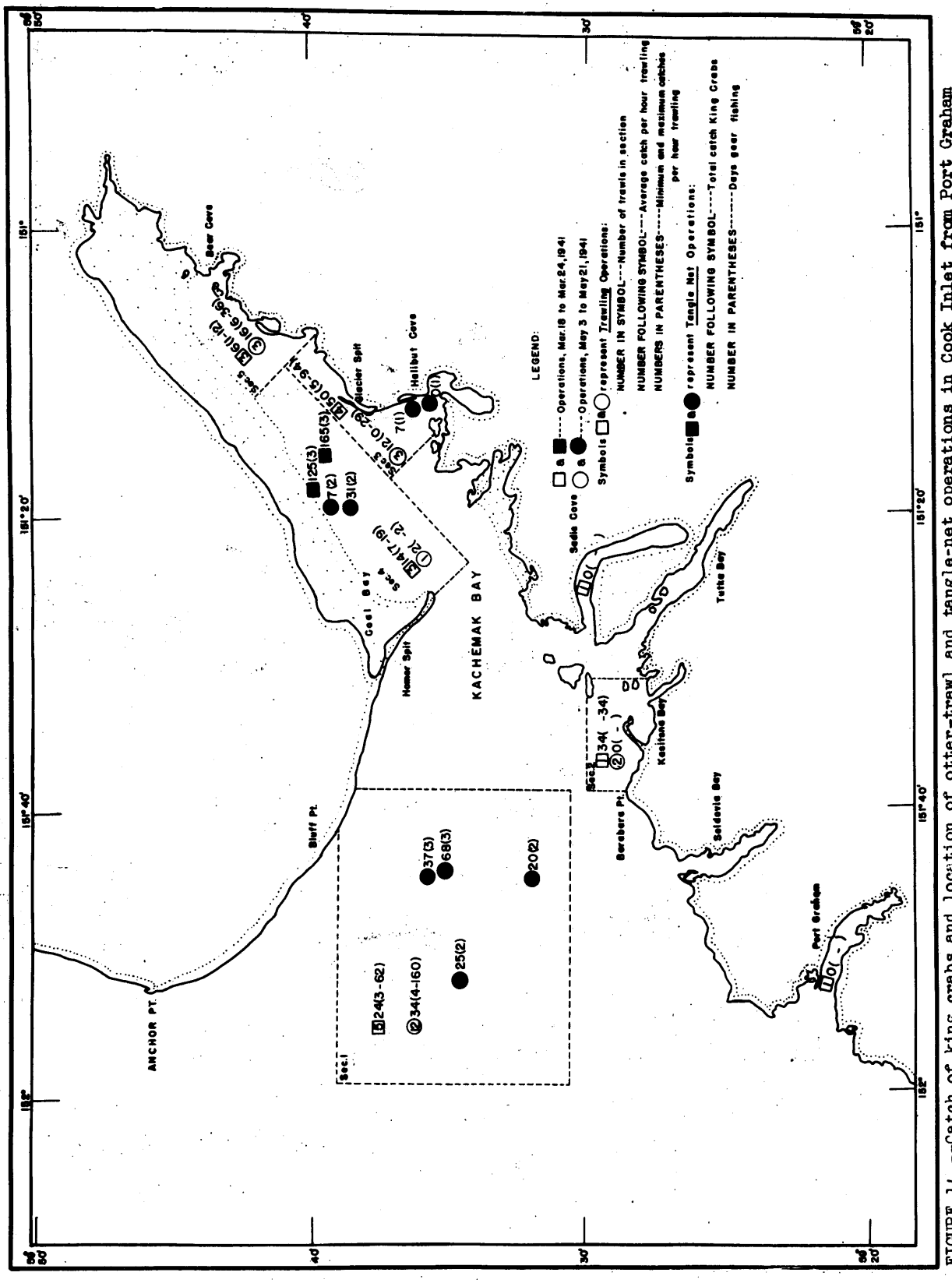

FIGURE 14.--Catch of king crabs and location of otter-trawl and tangle-net operations in Cook Inlet from Port Graham to Anchor Point (eastern part of Area VI).

TABLE 10.--Otter trawl operations: Cook Inlet, 1941

Vicinity	Date	Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Location of tow: Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: Males	Catch of crabs: King Females	Catch of crabs: King Total	Catch of crabs: Hour basis	Catch of crabs: Dungeness	Catch of crabs: Tanner	Catch of fish: Halibut Medium	Catch of fish: Halibut Small	Catch of fish: "Sole"
								Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Number	Pounds
Port Graham	Mar. 24	59°21.5'	151°52'	Mid channel	Ebb	Nil	MG-M	19-12	40	0	0	0	0	6	20	0	0	1,200
Kasitsna Bay	19	59°28.3'	151°34'	NExE½E	Slack	Nil	SSh-SSh	11-16	25	8	6	14	34	0	0	1	0	50
Do.	May 15	59°28.1'	151°34'	NExN¼N	Ebb	Nil	M-gyM	11-25	20	0	0	0	0	0	0	0	1	100
Barabara Point	15	59°28.8'	151°35.9'	W½N	Ebb	W	S-SM	5-10	30	0	0	0	0	10	0	1	0	80
Sadie Cove	Mar. 19	59°30.5'	151°24.6'	Mid channel	Flood	E	Cl-Cl 1/	30-12	70	-	-	-	-	-	-	-	-	-
Halibut Cove	20	59°36'	151°12'	Along shore	Ebb	W	M-stk	16-17	60	10	50	60	60	0	0	0	0	210
Do.	20	59°38'	151°14.6'	SExE	Ebb	SW	stk-stk	35-25	60	10	84	94	94	0	0	2	0	300
Do.	20	59°36.2'	151°13'	WNW	Flood	NE	stk-hrd	25-37	60	3	2	5	5	0	100	0	0	425
Do.	May 7	59°35.7'	151°10.3'	WSW	Ebb	W	stk-M	21-12	10	0	0	0	0	2	25	2	2	50
Do.	7	59°36'	151°12.4'	Along shore	Ebb	NW	M-M	16-22	60	3	4	7	7	2	400	0	9	225
Glacier Spit	Mar. 20	59°39'	151°13.5'	NNE	Flood	NE	stk-stk	30-30	60	21	21	42	42	0	500	0	0	500
Do.	May 7	59°39.3'	151°12'	NExN½N	Flood	SW	gyS-G	20-16	45	4	18	22	29	35	400	1	0	35
Aurora Lagoon	Mar. 20	59°40.6'	151°10.4'	NNE	Flood	NNE	sft-sft	30-15	120	1	0	1	1	5	10	0	0	100
Do.	20	59°41'	151°04'	SWxW to SSW	Ebb	SSW	buM-buM	15-24	110	6	4	10	6	0	0	0	0	0
Do.	May 7	59°42.4'	151°08.6'	NxE½E	Ebb	SW	sft-M	34-28	60	10	26	36	36	10	300	1	0	275
Bear Cove	Mar. 20	59°43'	151°02'	Mid channel	Ebb	Nil	stk-S	12-12	30	3	3	6	12	6	0	0	0	50
Do.	May 7	59°43.7'	151°08'	NExE½E	Flood	Nil	sftM-sftM	15-15	45	1	4	5	7	25	25	1	0	100
Do.	7	59°43'	151°02'	Mid channel	Flood	Nil	sftM-sftM	12-28	60	3	3	6	6	50	300	0	0	750
Kachemak Bay	Mar. 19	59°35.5'	151°25'	NNE	Flood	NNE	crsS-M	23-27	60	14	5	19	19	4	0	0	6	700
Do.	19	59°39.3'	151°20'	NExE	Flood	NNE	M-M 1/	7-17	60	3	4	7	7	-	-	-	-	-
Do.	20	59°39'	151°20'	E	Flood	NNE	sftM-sftM	12-17	60	10	7	17	17	6	12	0	0	200
Do.	May 8	59°38.1'	151°19'	SxW½W	Slack	Nil	sftM-M	19-35	80	0	3	3	2	0	1,000	5	0	1,000
Do.	8	59°44'	151°07.5'	SSW	Flood	S	M-M 1/	15-12	60	-	-	-	-	-	-	-	-	-
Kachemak Bay--outer	Mar. 17	59°38.5'	151°45'	E	Flood	E	hrdS-hrdS	17-17	54	39	17	56	62	0	0	0	0	150
Do.	17	59°36'	151°42'	WxS to SSW	Flood	E	hrdgyS-S	18-18	93	61	13	74	48	0	10	2	0	400
Do.	18	59°33.1'	151°44.2'	ExN	Flood	NE	S-S	40-45	60	2	2	4	4	0	12	3	4	2,100
Do.	18	59°31'	151°43'	SW½W	Slack	Nil	gyS-gyS	52-45	60	2	2	4	4	0	400	3	20	600
Do.	19	59°34'	151°57'	SE	Ebb	S	crsS-SSh	19-40	90	4	0	4	3	0	0	0	10	300
Do.	19	59°36'	151°56.3'	SW½S	Flood	NE	hrdS-hrdS 2/	17-20	85	-	-	-	-	-	-	-	-	-
Do.	21	59°29.6'	151°41.8'	SWxS	Ebb	SWxS	SG-brkSh 1/	17-14	35	-	-	-	-	-	-	-	-	-
Do.	21	59°30'	152°12'	SExE	Slack	Nil	S-brkSh 1/	25-27	60	-	-	-	-	-	-	-	-	-
Do.	May 6	59°38.5'	151°44'	SExS¼S	Flood	E	gyS-gyS 1/	17-18	15	-	-	-	-	-	-	-	-	-
Do.	6	59°37'	151°45'	SExE½E	Ebb	SW	gyS-gyS	18-22	60	20	16	36	36	0	15	0	3	300
Do.	6	59°34.8'	151°41'	SWxW	Ebb	SW	gyS-gyS	22-26	60	22	7	29	29	0	10	0	0	550
Do.	9	59°35.5'	151°38.5'	SWxW	Flood	NE	MS-Rks	17-17	30	1	1	2	4	0	0	1	0	125
Do.	9	59°34.2'	151°48'	NWxN½N	Flood	E	fneS-fneS	23-17	55	100	47	147	160	0	75	0	0	300
Do.	9	59°36'	151°51'	SExS¼S	Slack	Nil	gyS-gyS	15-21	65	57	9	66	61	0	12	0	0	550
Do.	12	59°36'	151°45'	NW	Flood	NE	SM-S	20-17	60	25	5	30	30	0	25	0	16	800
Do.	12	59°38.5'	151°48.5'	SSE	Flood	NE	SSh-S	17-19	70	28	0	28	24	0	0	5	0	200
Do.	12	59°35'	151°49'	SWxS¼S	Flood	NE	S-S	19-21	75	17	1	18	14	0	12	4	0	550
Do.	20	59°35'	151°47.4'	NxE	Slack	Nil	gyS-gyS	20-18	70	20	0	20	17	0	0	0	0	4,000
Do.	21	59°34.4'	151°41'	SWxW½W	Flood	NE	S-S	30-40	45	10	2	12	16	0	2,000	4	4	200
Do.	21	59°33.9'	151°51'	SW¼W	Flood	NE	S-S	20-21	60	6	1	7	7	0	12	2	0	3,500
Do.	21	59°36.1'	151°56'	E	Slack	Nil	SSh-SSh	17-16	50	5	2	7	8	0	0	4	8	500
Chinitna Bay	May 15	59°46.4'	152°47'	NW	Slack	Nil	gyS-gyS 1/	18-14	15	-	-	-	-	-	-	-	-	-
Do.	16	59°51'	152°58'	E	Ebb	S	M-MS	7-10	60	0	0	0	0	0	48	0	6	50
Do.	16	59°46.5'	152°36'	SxW	Ebb	S	gyS-gyS 1/	19-19	80	-	-	-	-	-	-	-	-	-
Iliamna Bay	Mar. 22	59°32.8'	153°25.5'	WSW	Ebb	S	SSh-SSh 1/	12-6	50	-	-	-	-	-	-	-	-	-
Iliamna Bay--outside	May 16	59°37'	153°04'	SWxS	Slack	Nil	gyS-SM	18-16	60	1	1	2	2	0	50	0	0	200
Do.	16	59°34'	153°08'	SW¼W	Flood	N	M-M	16-14	60	2	1	3	3	0	50	1	3	325
Kamishak Bay	3	58°59.5'	153°26'	NW¼W	Flood	W	MS-fneS	36-25	20	5	0	5	15	0	250	3	0	100
Do.	3	59°08'	153°30'	NW½W	Flood	W	bkM-gyS	24-29	30	31	0	31	62	0	100	2	2	100
Totals									2,912	568	371	939	993	161	6,173	48	94	3/ 22,250

1/ Net snagged and most of catch lost, but any king crabs salvaged are shown.
2/ Strong tide and wind kept net off the bottom so that no catch was made.
3/ Approximate poundages: starry flounder 12,300; yellowtail 3,500; lemon "sole" 3,450; sand "sole" 2,750; flathead 125; rock "sole" 125.

Note:--In addition to the above, miscellaneous items were taken in approximate amounts as follows: 83 gray cod, 48 Alaska pollock, 24 bullheads, 6 herring, 5 dogfish, and 4 skates.

Kachemak Bay Region

The work in this general locality included prospecting in Port Graham, the open waters across the mouth of Kachemak Bay between Seldovia Bay and Bluff Point, and various bays in Kachemak Bay proper.

Port Graham was fished only during March, at which time no crabs were taken in a drag extending up the middle of the bay. A large quantity of flatfish consisting largely of yellowtail was caught here, as were a few dungeness and tanner crabs. A set of tangle nets, near the head of the bay, also failed to yield any king crabs.

Exploratory fishing was carried on in the mouth of Kachemak Bay, between Bluff Point and Seldovia Bay, during late March and again in early May. On the two occasions somewhat comparable results were obtained, in that only a very few crabs were caught on the Seldovia Bay side, while good quantities were found off the opposite shore. Fishing was not consistent for, as experienced elsewhere, crabs were found to be concentrated at certain points while catches a short distance away yielded entirely different results.

A catch of 74 crabs, the largest haul during March, was made at a depth of 18 fathoms on sandy bottom 1¼ miles SSW of Bluff Point. The largest catch made in May consisted of 147 crabs which were taken in 17 to 23 fathoms of water five miles farther SSW of Bluff Point. This suggests that the crabs were probably moving farther offshore into somewhat deeper water. The best trawl results in Cook Inlet were experienced here, which indicates there is a substantial population of crabs located in the vicinity during this season.

Tangle nets off the mouth of Kachemak Bay did not make any spectacular catches, but did consistently take from 20 to 68 crabs per set. Nearly all of the crabs taken in these nets were large-sized males.

Foul bottom, which was encountered along the Seldovia shore, practically ruined two trawls. By contrast, the whole central portion of this area, to within a mile of Bluff Point, was found to be excellent trawling bottom.

As many as 2,000 tanner crabs were taken per hour of trawling in the deepest portion of this area. Only small amounts were caught in drags which were made in the shallower depths.

Catches of flatfish consisting largely of starry flounder, yellowtail, and lemon "sole" (named in order of abundance) were taken in amounts ranging from a few to 4,000 pounds per drag. While apparently not quite as abundant as in some localities, no finer flatfish were found anywhere in Alaska. It is interesting to note that very few flatfish were taken in the largest catches of king crabs, and only small numbers of crabs were caught in the large hauls of flatfish. This observation was made on many occasions during later operations.

Kasitsna Bay (Section 2) was rather unproductive both times it was visited, as five canning-sized crabs, a few small ones; one halibut; and a few flatfish constituted the entire catch. Only short runs can be made in this small bay.

A trip was made into Tutka Bay with the intention of trawling there, but when repeated soundings showed much rocky bottom, it seemed inadvisable to risk the gear.

Sadie Cove was a very poor trawling area as rocks are prevalent throughout the length of the bay. Fishing efforts here resulted only in torn web and broken foot ropes.

King crabs were taken in quantities, ranging from five to 94 per drag, along Glacier Spit and in Halibut Cove (Section 3) during March. In sharp contrast to these results, during May a total of only 14 crabs were caught in two drags and two sets of tangle nets in Halibut Cove. This would indicate that the population moves out, possibly to deeper water, during the late spring months.

Tanner crabs were more abundant in Halibut Cove during May than they were in March, but along Glacier Spit several hundred were taken per drag on both occasions. Flatfish catches, consisting largely of starry flounder, ranged from 200 to 500 pounds per drag in March,

while in May only very small amounts of yellowtail and a few lemon "sole" were caught. No snags were encountered while fishing in depths ranging from 16 to 37 fathoms.

Only small catches were taken with trawls in the shoal Coal Bay area (Section 4). Catches in March varied from seven to 19 crabs to the drag, and a total of only three females were caught while trawling here in May.

Tangle-net fishing, in contrast to the above results, was found to be very effective during March, as two sets of gear caught nearly 300 crabs, with 80 percent of them large-sized males. These sets, ranging in depth from five to 11 fathoms, caught the largest amount of crabs in the shallow inshore end of the nets. This indicated very strongly that crabs were probably abundant even closer in to shore; but as no work was done in these shallower depths, it cannot be said with certainty that such conditions existed. However, the tangle-net catches do show crabs to be present here early in the spring in large numbers within limited depths.

The same location yielded entirely different results when tangle nets were fished again during May, as only 38 crabs were caught. Nearly all the crabs were taken in the deepest end of the net, which suggested the crabs had moved into greater depths than those in which they had been found in March.

Mud bottom was encountered throughout Coal Bay, but occasional boulders or coal outcroppings are evidently present as the trawl became badly torn during one drag.

Seven hundred pounds of starry flounder and 100 pounds each of rock and lemon "sole" constituted the fish catch, all of which was taken in three drags in March. More than a thousand tanner crabs and 500 pounds each of lemon and yellowtail "sole" were caught in a drag made here in May.

Many local reports told of large quantities of crabs having been seen in Bear Cove (Section 5) during the spring. However, the results were discouraging on both occasions this area was fished, as only small catches were made in depths ranging from 12 to 28 fathoms. A drag beginning just below Bear Cove and progressing along Aurora Lagoon at a depth of 30 fathoms gave the best yield with a catch of 36 crabs, of which 10 were large males.

The relatively large catches per unit of effort, both by trawling and by tangle-net fishing in the mouth of Kachemak Bay during March and May, and around Glacier Spit and in Halibut Cove and Coal Bay during March, indicate a relatively large population of king crabs in the east side of Cook Inlet south of Anchor Point. The poorer catches in the inner waters of Kachemak Bay during May were due, no doubt, to migration of the crabs into deeper water, a condition which could be followed in the course of a continued fishing effort.

Kamishak Bay Region

In the Kamishak Bay region, limited fishing was carried on in Chinitna Bay, off Iliamna Bay between Augustine and Shaw Islands.

Fifty pounds of flatfish taken in the mouth of Chinitna Bay during May constituted the total catch in this vicinity. Two attempted drags in the deeper water east of the Bay resulted in snags.

Very few crabs were caught on the two occasions that northern Kamishak Bay was visited. A single tow four miles off Iliamna Bay during March yielded no crabs, and only five were caught in May when two drags were made 12 miles east of this bay. Tangle-net results were similarly poor. Nets placed in the mouth of both Iliamna and Iniskin Bays took no crabs, but eight were taken in a set located three miles east of Iliamna Bay.

The catch of flatfish in this vicinity also was poor, as a 325-pound haul was the largest single catch made while trawling here.

The portion of Kamishak Bay south of Augustine Island was fished only during May, at which time crabs were caught both in tangle nets and in trawls.

While trawling on mud and sand bottom at a depth of approximately 30 fathoms just off Shaw Island, five male crabs were caught. Another drag located midway between Augustine and Shaw Islands, and made under similar conditions of depth and bottom, gave the very encouraging catch rate of 62 large male crabs per hour.

Three hundred and fifty tanner crabs and about 200 pounds of flatfish were caught in these drags.

A tangle net located one mile off the SW tip of Augustine Island caught nine large male and two female crabs. This net was set at a depth of 10 fathoms on mud and sand bottom. Another set of gear at a depth of 13 fathoms, three miles south of the southwest corner of the Island, caught 37 large male crabs.

While the catches on the west side of lower Cook Inlet were far less favorable than those on the east side, the results of the several drags and tangle-net sets in the southern portion of Kamishak Bay should not be overlooked. This region is unsurveyed and the U. S. Coast Pilot states: "great caution should be exercised if attempting to pass south of the (Augustine) Island." However, commercial effort in the area might well show that a fairly substantial number of king crabs exist here.

Western Side of Shelikof Strait

Several locations in Shelikof Strait were fished in November 1940 and again during the spring of 1941. A total of 201 king crabs were caught, most of which were taken in waters between Cape Douglas and Cape Ugyak and in Wide Bay. (Figure 15 and Table 11.)

Cape Douglas to Cape Ugyak

Fishing in this region was concentrated off Capes Chiniak and Nukshak, in Hallo and Kukak Bays. Also, single drags were made offshore from Kiukpalik Island and inshore from Shakun Rock. In these last-mentioned operations, during November and April, respectively, no king crabs were caught.

The fishing results off Cape Ciniak were rather erratic. During November, a total of 12 drags were made in this locality, in depths ranging from 18 to 77 fathoms. Of the 74 crabs caught here, 52 (14 males and 38 females) were taken in a single tow, running in a southerly direction off Ninagiak Island. Repeated tows in the immediate vicinity failed to yield crabs, but catches of four to seven large males were made in drags more nearly abreast of the Cape and a little closer inshore.

The take of other marine life in this region was relatively small, the total for the 12 drags being 64 tanner crabs, 20 pounds of flatfish, and approximately 250 large scallops, The edible portion of the latter weighed about one-quarter of a pound each.

A total of 20 king crabs and approximately 350 pounds of flatfish were taken in three tows in Hallo Bay during April. Fishing was on mud and sand bottom at depths ranging from two to 22 fathoms. In May, a 50-minute tow caught three male king crabs and 25 tanner crabs. At the same time, a tangle net set midway along the south shore of the Bay caught three king crabs.

The waters off Cape Nukshak were fished during November and again in May, two tows being made on each occasion. The total catch of king crabs consisted of five large males taken in one tow during the spring visit. Fishing was on sand and mud bottom at depths ranging from 20 to 50 fathoms. No trawling hazards were encountered, but the catch of marine life was relatively small, totaling only 86 tanner crabs, four dungeness crabs, and a little over 200 pounds of flatfish for the four drags.

A drag was made in Kukak Bay in November and again in May, 200 pounds of flatfish constituting the total catch on both occasions. Although trawling proved completely ineffective, two tangle nets set in the mouth of the Bay during the spring visit did catch 14 king crabs in two days' fishing, thus showing crabs to be present in the vicinity.

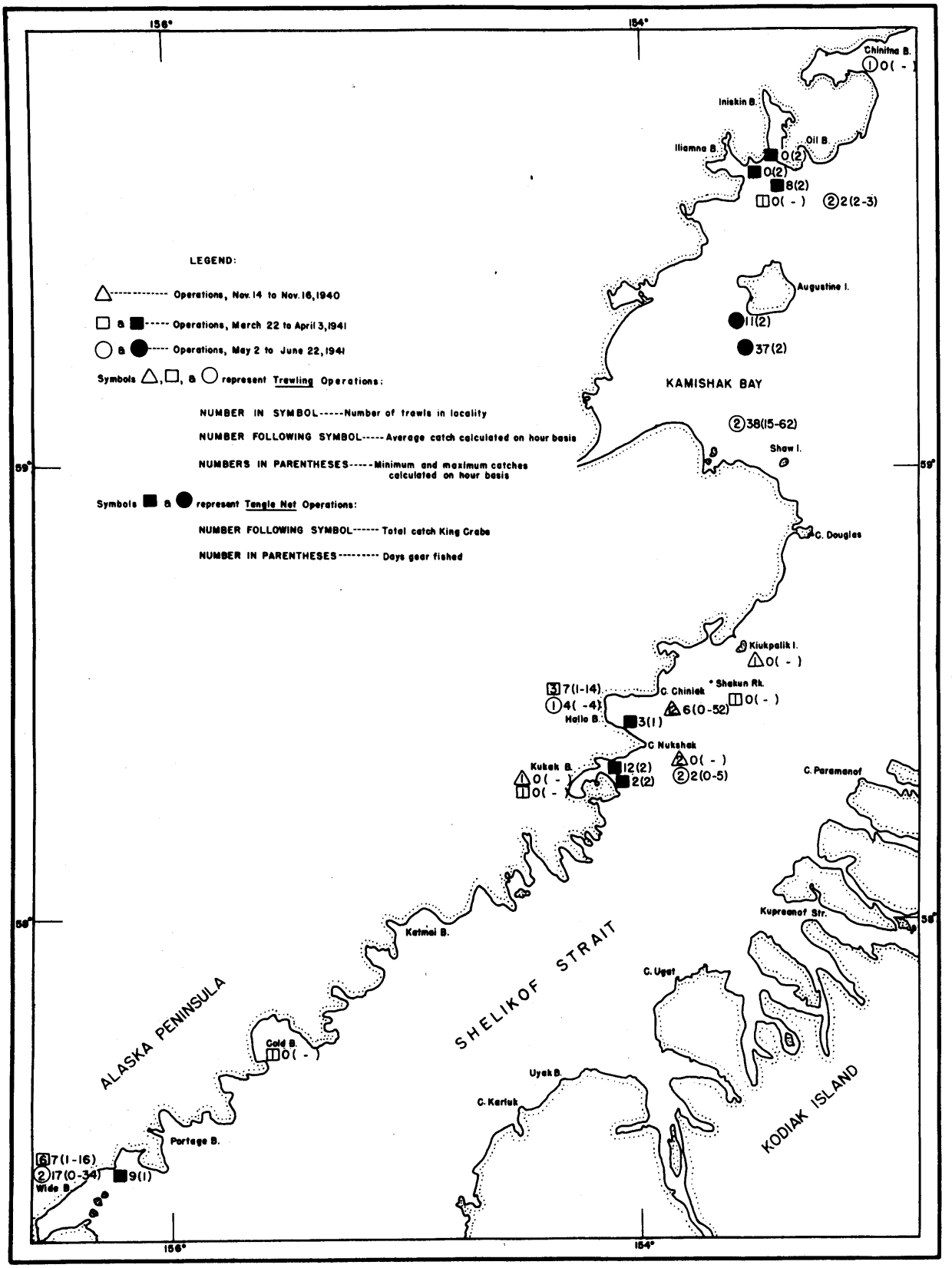

FIGURE 15.--Catch of king crabs and location of otter-trawl and tangle-net operations in the western side of Cook Inlet (Area VI) and Shelikof Strait (Area VII).

TABLE 11.--Otter trawl operations: Western side of Shelikof Straits, 1940 and 1941

Vicinity	Date 1/	Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: Males	Catch of crabs: King Females	Catch of crabs: King Total	Catch of crabs: Hour basis	Catch of crabs: Dungeness	Catch of crabs: Tanner	Catch of fish: Halibut Medium	Catch of fish: Halibut Small	Catch of fish: "Sole"
								Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Number	Pounds
Kiukpalik I.--outside	Nov. 14	58°33'	153°32'	ExS	Ebb	S	M-S	55-80	60	0	0	0	0	0	0	0	0	0
Cape Nukshak	15	58°26'	153°54'	SxE	Flood	SW	stk-S	37-50	90	0	0	0	0	0	60	0	1	35
Do.	15	58°21.5'	153°56'	SW½W	Slack	Nil	G-stk	35-48	75	0	0	0	0	0	10	0	0	0
Do.	May 2	58°24.3'	153°56'	W	Ebb	N	SM-M	47-20	60	5	0	5	5	4	15	2	8	150
Do.	2	58°19'	154°04'	NE	Ebb	S	S-S	39-40	65	0	0	0	0	0	1	0	2	60
Cape Chiniak	Nov. 15	58°29'	153°47'	SWxS½S	Flood	SW	gM-stk	50-37	120	8	0	8	4	0	20	0	0	10
Do.	16	58°28'	153°51'	NNW	Flood	S	M-M	35-32	60	0	1	1	1	0	12	0	1	0
Do.	16	58°31'	153°42'	E	Flood	S	hrd-hrd	45-77	60	0	0	0	0	0	0	0	0	0
Do.	16	58°29'	153°49'	S½W	Flood	S	hrd-hrd	55-55	90	14	38	52	35	0	16	0	0	0
Do.	20	58°25'	153°52'	NxE	Slack	Nil	stk-stk	55-40	60	0	0	0	0	0	0	0	0	0
Do.	20	58°28'	153°48'	NE½E	Flood	S	stk-stk	40-48	80	1	0	1	1	0	1	0	2	0
Do.	20	58°30.5'	153°45'	SxE½E	Slack	Nil	stk-stk	48-75	60	0	0	0	0	0	3	0	0	0
Do.	20	58°30'	153°51'	SExE	Flood	S	stk-stk	25-50	60	4	0	4	4	0	0	1	0	10
Do.	21	58°27'	153°53'	E	Flood	SE	stk-stk	40-28	90	0	0	0	0	0	0	0	0	0
Do.	21	58°29'	153°48'	SSW	Flood	W	stkM-stkM	28-40	60	1	0	1	1	0	12	0	0	0
Do.	21	58°27'	153°52'	NNE	Flood	W	stk-hrd	40-28	105	0	0	0	0	0	0	0	0	0
Do.	21	58°29'	153°45'	SWxW	Flood	W	stk-SGSh	48-18	90	7	0	7	5	0	0	0	0	0
Shakun Rocks--inside	Apr. 1	58°33.5'	153°47'	SxW½W	Ebb	S	MS-MS 2/	14-22	50	-	-	-	-	-	-	-	-	-
Halle Bay	1	58°26.5'	154°07'	ExS	Flood	S	M-SSh	20-5	42	9	1	10	14	3	0	0	0	100
Do.	1	58°26.5'	154°06.5'	SExE	Flood	S	S-Sh	12-2	40	1	0	1	1	6	0	0	0	100
Do.	1	58°26'	154°02'	ESE	Flood	S	stk-S	22-22	65	4	2	6	6	0	0	2	0	100
Do.	May 2	58°26'	154°06'	NW	Flood	Nil	MS-MS	7-7	50	3	0	3	4	1	25	3	0	50
Kukak Bay	Nov. 16	58°17.5'	154°17.5'	In	Slack	Nil	stk-M	53-27	25	0	0	0	0	0	0	0	0	225
Do.	Mar. 31	58°16.5'	154°15.5'	Out	Ebb	N	sft-M	3-30	60	0	0	0	0	4	1	0	0	200
Cold Bay	Apr. 4	57°44'	155°35.5'	E½S	Ebb	ESE	SSh-ashes 2/	14-18	20	-	-	-	-	-	-	-	-	-
Wide Bay	1	57°25.5'	156°14.5'	SW½S	Ebb	Nil	S-SG	9-6	60	2	3	5	5	0	0	0	0	25
Do.	1	57°24'	156°20'	SxE½W	Slack	Nil	SG-SM	6-24	60	12	4	16	16	1	0	0	12	10
Do.	1	57°22'	156°23.3'	S½W	Flood	Nil	SM-M	24-15	60	2	0	2	2	0	10	0	0	0
Do.	1	57°20.5'	156°25.5'	NE	Flood	Nil	M-M	20-30	60	0	2	2	2	0	10	0	2	0
Do.	1	57°22'	156°23'	NExE	Flood	Nil	M-MG	30-15	60	1	0	1	1	0	36	0	0	0
Do.	1	57°23'	156°18'	NWxN½W	Slack	Nil	MG-MG	15-7	60	8	8	16	16	0	0	0	0	25
Do.	June 22	57°19.6'	156°24'	NNE	Slack	Nil	gM-bkM	12-33	60	0	0	0	0	0	300	12	0	0
Do.	22	57°22'	156°20.5'	NNE	-	-	bkM-bkM	33-12	60	24	10	34	34	0	0	0	0	0
Totals									2,117	106	69	175	157	19	532	20	37	3/ 1,100

1/ November data are for 1940; all other data are for 1941.
2/ Net snagged and catch lost.
3/ Approximate poundages: yellowtail 350; starry flounder 345; rock "sole" 250; lemon "sole" 80; flathead 75.

Note:--In addition to the above, miscellaneous items were taken in approximate amounts as follows: 583 scallops, 62 gray cod, 20 bullheads, 60 skates, 10 herring, 7 dogfish, 6 tomcod, and 5 turbot.

Cape Ugyak to Wide Bay

Fishing was carried on in this region during the spring expedition only. Except for an unsuccessful attempt to trawl Cold Bay, prospecting was limited to operations in Wide Bay.

There are extensive reefs in the mouth of Cold Bay, and soundings inside the Bay showed rocky bottom in several places. In an attempted drag, the trawl became so badly fouled that great difficulty was encountered in regaining the gear.

During April, a series of six drags which twice traversed the length of Wide Bay gave catches of from one to 16 crabs per tow. Most of the crabs were small, only eight being of canning size. The drags were made on mud and sand bottom at depths running from six to 30 fathoms. A set of tangle net in the mouth of the Bay took nine crabs in one day's fishing.

When the Bay was revisited the following June, one of two drags netted 34 crabs, 10 of which were canning size. These two drags produced 300 tanner crabs and a few shrimp.

Although the largest single catch of crabs was taken off Cape Chiniak, the highest yield per unit of fishing effort was attained in Wide Bay. Since the two visits to Wide Bay may not have included the season when crabs could be found in greatest quantity, the consistently small catches and the good trawling bottom suggest this as being the most desirable fishing location on the north shore of Shelikof Strait.

Kodiak Island

The many bays surrounding Kodiak and Afognak Islands were investigated during the period between November 1940 and September 1941. A canvass of Alitak Bay and Olga Bay was made early in November, and a shore party operated here during the winter months. In the early spring (March and April) a rather extensive survey was made over practically the entire area. Again, in late June, one trawling effort was made each in Alitak Bay, Larsen Bay, Raspberry Strait, and Viekoda Bay. Raspberry Strait, Marmot Bay, and Kizhuyak Bay werere-visited in mid-September for a small series of drags. Thus, at one time or another, practically every bay in this area was prospected, and the most likely king crab localities ascertained. (Table 12.) The results indicate seasonal movement out of the bays, thus limiting an inshore fishery to but a short period of operation.

It may be assumed that the presence of crabs in offshore waters increases with the exodus from the bays, and that fishing can be continued for a greater period by following the offshore movement and determining the points of concentration, if any. Time did not permit such operation by the Alaska Crab Investigation; but in locating the most productive inshore areas, the starting points for industry have been established. The catches of king crabs, tanner crabs, dungeness crabs, shrimp, and large quantities of market fish, suggest that the fishing industry of this region need not be limited to salmon and herring.

Alitak Bay Region

The Alitak Bay region (Figure 16) is known to support a king crab population of indefinite size. Between January and May 1939 a small floating cannery operation, supplied from pots and tangle nets, packed some 500 cases of crab meat from 6,400 king crabs taken from Lazy Bay and off Tanner Head, which are at the southwest entrance of Alitak Bay. This ground, covering approximately six square miles ranging from seven to 36 fathoms in depth, has a sand and mud bottom.

Four drags made by a vessel of the crab investigation off Lazy Bay in October 1940 were non-productive, and pot fishing carried on by the winter shore party from November 1940 to February 1941 yielded only nine small males. In mid-March, however, four more drags made in this locality netted an average of 13 king crabs per hour and one tow two miles west of Cape Trinity, four crabs per hour. Tangle nets set during these periods gave similar results, thus indicating the absence of crabs during the late fall and early winter months, and their appearance beginning probably sometime in late January or February.

Except for Sulua Bay, where 38 crabs were taken by one tow in April, and Lazy Bay, the fishing effort about Alitak Bay was relatively unproductive. Two crabs were picked up

TABLE 12.--Otter trawl operations: Kodiak Island Area, 1940 and 1941--Continued

Vicinity	Date 1/	Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Location of tow: Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: Males	Catch of crabs: King Females	Catch of crabs: King Total	Catch of crabs: Hour basis	Catch of crabs: Dungeness	Catch of crabs: Tanner	Catch of fish: Halibut Medium	Catch of fish: Halibut Small	Catch of fish: "Sole"
								Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Number	Pounds
Kalsin Bay	Mar. 27	57°35.7'	152°26.3'	W to N	Flood	Nil	wh$M-wh$M	5-10	35	0	3	3	5	6	24	0	0	20
Do.	27	57°35.7'	152°27.4'	NxE½E	Flood	Nil	M$-M$	5-25	30	8	1	9	11	3	0	0	0	500
Middle Bay	27	57°39.6'	152°29'	NxE½E	Slack	Nil	M$-M$	7-15	20	1	1	2	6	6	0	0	0	25
Albatross Bank	28	57°17'	151°55'	ENE	Flood	W	fne$hS-S$h	38-36	60	0	0	0	0	0	0	0	1	0
Do.	28	57°08'	151°36'	SxE	Ebb	S	G-S	57-75	60	0	0	0	0	0	0	0	2	0
Do.	28	56°57'	151°32'	SSW	Ebb	S	gy$G-gy$	100-125	60	0	0	0	0	0	0	0	2	0
Do.	29	56°49'	152°09'	NNExE½E	Slack	Nil	gy$bkG-cr$S	55-49	60	0	0	0	0	0	0	0	0	0
Do.	29	56°44'	152°23'	WxS½S	Flood	NNW	SG$-SG$	100-88	60	0	0	0	0	0	0	2	0	500
Monashka Bay	Apr. 16	57°09.1'	152°25.4'	NExE½E	Ebb	ENE	gy$-gy$	9-19	45	0	0	0	0	0	2	0	3	525
Low Island Bay	16	57°04.8'	152°35'	NxE½W	Flood	Nil	gy$-gy$	5-35	25	0	0	0	0	36	0	0	0	200
Anton Larsen Bay	Mar. 31	57°00.9'	152°37.7'	NNExE½E	Flood	Nil	M$-M$	20-19	40	7	13	20	30	5	1	0	0	340
Sharatin Bay	Apr. 1	57°00.7'	152°43.7'	WxN	Slack	Nil	M-M$	6-12	35	11	5	16	27	16	0	0	0	50
Do.	17	57°00.8'	152°46.2'	NNW	Flood	S	gy$G-M	12-15	30	1	7	8	16	2	42	0	0	100
Kiskuyak Bay	Mar. 31	57°07.3'	152°53.3'	SxE½E	Ebb	NNW	M$-M$	23-15	50	71	61	132	158	0	28	0	0	2,000
Do.	31	57°02.7'	152°00.5'	SExE½E	Ebb	N	M$-M$	15-15	25	19	1	20	48	5	4	0	0	110
Do.	Apr. 16	57°08.2'	152°53.2'	NWxN	Flood	SSE	gy$-S	11-12	35	1	0	1	2	40	8	0	1	75
Do.	16	57°06.2'	152°51.8'	SExE½S	Flood	SSE	M-M	18-18	50	24	39	63	76	0	0	0	0	2,000
Do.	17	57°04.6'	152°53.7'	Along W shore	Ebb	NNW	M$-M$	5-15	60	46	45	91	91	24	0	0	0	2,050
Do.	17	57°05.6'	152°53'	NxE½W	Ebb	NNW	bk$-M$	16-32	65	16	18	34	31	3	200	1	0	600
Do.	Sept. 12	57°06.1'	152°53'	NNW	Slack	Nil	M$-fne$	22-23	35	0	0	0	0	6	0	0	0	100
Do.	12	57°07.3'	152°52.2'	NxW	Slack	Nil	fne$-fne$	23-20	30	0	0	0	0	24	0	0	0	50
Marmot Bay	12	57°59.4'	152°31.7'	SWxS	Flood	SW	M-M	92-95	35	0	0	0	0	0	6	2	0	200
Do.	13	57°55'	152°43'	NNE	Ebb	NNE	SC$-SC$	67-66	30	0	0	0	0	0	0	0	0	1,000
Afognak Bay	Apr. 1	58°04.1'	152°47'	SExE	Flood	NW	M$-M$	7-12	30	11	3	14	28	200	0	0	1	100
Dry Spruce Bay	1	57°55.8'	153°02.2'	WxE	Ebb	Nil	gy$-S$h	13-22	20	107	112	219	657	0	75	0	0	25
Do.	2	57°55.3'	153°00.5'	NWxN	Slack	Nil	gy$-S	10-17	20	4	2	6	18	10	10	2	0	200
Kupreanof Strait	2	57°58'	153°08.5'	WxS	Slack	Nil	gy$-S$h 2/	13-14	10	-	-	-	-	-	-	-	-	-
Do.	2	58°02.4'	153°18.5'	ExN½N	Flood	Nil	gy$-S 2/	8-20	10	-	-	-	-	-	-	-	-	-
Onion Bay	2	58°03.4'	153°14.8'	Mid channel	Flood	Nil	gy$-SM	20-16	30	7	3	10	20	40	30	0	0	110
Raspberry Strait	3	58°04.8'	153°06'	NW½W	Flood	ExS	SM-S	22-32	50	147	213	360	432	0	0	0	1	5,000
Do.	3	58°00.1'	153°07.6'	SWxS½S	Flood	ExC	S-S	10-36	30	6	1	7	14	0	0	0	0	900
Do.	5	58°04.9'	153°05.6'	SSE	Flood	ExS	gy$-SM	17-14	65	3	3	6	6	0	0	0	0	180
Do.	5	58°05.1'	153°05.7'	NWxN	Flood	ExS	gy$-gy$	17-35	60	4	0	4	4	0	30	2	0	2,900
Do.	5	58°07.1'	153°11.3'	NNExE½W	Slack	Nil	S-gy$	33-46	65	0	0	0	0	0	6	0	8	2,000
Do.	Sept. 14	58°03.1'	153°02.8'	NW½W	Ebb	WSW	M$-SM	23-30	45	0	0	0	0	60	0	0	0	3,300
Do.	14	58°05'	153°05.9'	NNxW	Ebb	WNW	S$-SM	30-40	40	0	0	0	0	10	10	0	0	1,500
Do.	14	58°07.1'	153°10.4'	ENE	Flood	SE	wh$-wh$	46-40	40	0	0	0	0	4	0	0	0	2,000
Do.	June 21	58°03'	153°02.4'	WNW	Flood	SE	wh$-wh$	22-22	60	0	0	0	0	4	3	0	0	2,000
Do.	Apr. 28	58°04.1'	153°05.6'	ExS½S	Slack	Nil	SM-gy$	27-19	35	2	0	2	3	13	3	0	5	3,050
Tukuk Bay	3	58°01.3'	153°00.4'	NW½W to ExS	Slack	Nil	GSM-M	4-21	40	0	0	0	0	0	0	0	0	600
Malina Bay	28	58°10'	152°54.2'	WxN	Slack	Nil	gy$-SM	4-10	25	0	0	0	0	13	0	1	0	3,000
Do.	28	58°13.6'	153°04.2'	WNW	Ebb	NW	gy$-gy$	17-35	35	0	0	0	0	0	0	0	0	1,550
Malka Bay	28	58°10.2'	153°00.2'	NWxW	Flood	Nil	M$-M	10-17	30	1	0	1	2	50	0	0	0	200
Paramanof Bay	29	58°17'	152°49.5'	WxS½S	Ebb	W	M-M	34-50	35	0	0	0	0	0	0	0	0	0
Black Cape	30	58°25.6'	152°54.5'	SSW	Flood	NNW	gy$-S$h	37-70	35	0	0	0	0	0	0	0	0	5
Bluefox Bay	30	58°25.5'	152°41.3'	WSW	Flood	Nil	M-M$ 2/	13-13	5	-	-	-	-	-	-	-	-	-
Redfox Bay	30	58°27.1'	152°36.8'	NxW	Slack	Nil	S$h-S$h	4-6	15	0	0	0	0	4	0	0	0	5
Port Williams	30	58°29'	152°35.3'	SExE½S	Slack	Nil	SM-S	18-16	15	0	0	0	0	0	0	0	0	5
Viekoda Bay	Sept. 13	57°56.3'	153°17.7'	SExE	Flood	SE	stk-stk	83-76	30	0	0	0	0	0	6	0	0	725
Do.	13	57°50.3'	153°05.7'	NWxW	Slack	Nil	fne$-fne$	13-22	30	0	0	0	0	36	0	0	0	1,000
Do.	13	57°51.7'	153°07.6'	WNW	Ebb	NW	fne$-M	40-43	30	0	0	0	0	150	0	0	0	2,575
Do.	Apr. 6	57°50.4'	153°06'	NW½W	Slack	Nil	SM-SM	12-25	48	9	1	10	12	20	0	0	0	500
Do.	6	57°49.6'	153°04.3'	NNxW	Ebb	NW	SM-SM	4-4	53	5	40	45	51	0	0	0	0	10
Do.	6	57°56.4'	153°14.6'	ExS	Slack	Nil	fne$-fne$	12-12	30	0	0	0	0	0	1	0	0	75
Terror Bay	6	57°44.1'	153°12.9'	NNW	Flood	S	M$-M$	5-30	53	17	54	71	80	0	0	0	0	500
Do.	7	57°44.5'	153°13'	NNW	Slack	Nil	M$-S	15-40	70	35	45	80	69	50	0	0	0	1,050
Uganik Bay--NE arm	8	57°42.9'	153°19.1'	NW½W	Flood	Nil	SG-SG	16-35	30	2	18	20	40	0	0	0	0	110
Do.	8	57°42.3'	153°19.6'	WxS½W	Slack	Nil	SG-SG	12-23	30	0	1	1	2	0	0	0	0	75
Uganik Bay--E arm	8	57°42.5'	153°26.7'	WxE½E	Ebb	WSW	S-S	8-35	55	0	0	0	0	2	0	1	0	550
Uganik Bay--S arm	8	57°37.8'	153°30.3'	NWxN	Ebb	NWxN	S-S	4-30	45	69	117	186	247	0	0	0	0	450
Cape Kuliuk--W of	9	57°47.8'	153°58.8'	WxS½S	Flood	N	S-S$h	28-32	20	0	0	0	0	0	0	0	0	25
Spiridon Bay	9	57°35.7'	153°37.2'	NWxN to NxE	Ebb	NW	M-M	8-10	65	0	0	0	0	40	0	0	0	125
Zachar Bay	10	57°32.5'	153°14.2'	NE½E	Ebb	WxN	M-M	11-25	40	6	3	9	14	0	0	1	0	1,050
Larsen Bay	10	57°31.7'	154°04.6'	Half circle	Flood	E	M-M	25-35	65	0	0	0	0	0	2	2	0	825
Do.	June 22	57°21.8'	154°04.3'	NE½E	Slack	Nil	M-gy$h	37-22	45	0	0	0	0	0	0	0	0	5,100
Uyak Bay	Apr. 10	57°18.1'	153°44'	WNW	Flood	Nil	G-G	4-8	25	0	0	0	0	2	0	0	0	600
Do.	10	57°19.5'	153°46.1'	NW½W	Slack	Nil	M-MSh	12-25	45	1	0	1	1	35	0	0	0	550
Totals									6,198	1,243	1,442	2,685	4,378	1,960	9,300	24	66	4/ 72,000

1/ October and November data are for 1940; all other data are for 1941.
2/ Net snagged and catch lost.
4/ Approximate poundages: starry flounder 22,000; yellowtail 18,800; rock "sole" 15,300; flathead 9,000; lemon "sole" 6,900.

Note:--In addition to the above, miscellaneous items were taken in approximate amounts as follows: 11,000 pounds of redfish, 4,300 pounds of shrimp, and 600 pounds of turbot; also, 380 gray cod, 200 bullheads, 10 Alaska pollock, 10 black cod, 9 herring, 3 scallops and 2 skates.

TABLE 12.--Otter trawl operations: Kodiak Island Area, 1940 and 1941

Vicinity	Date 1/	Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: King Males	King Females	King Total	King Hour basis	Dungeness	Tanner	Catch of fish: Halibut Medium	Halibut Small	"Sole"
								Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Number	Pounds
Cape Alitak--outside	Nov. 6	56°51.7'	154°28.3'	ExS	Flood	W	gyM-gyMG	40-38	60	0	0	0	0	0	0	0	0	100
Do.	6	56°50'	154°24'	SWxW½W	Flood	W	gyM-gyM	35-38	60	0	0	0	0	0	0	0	1	225
Do.	6	56°49.5'	154°32.5'	NExE½N	Slack	Nil	gnM-gnM	38-40	60	0	0	0	0	0	0	0	0	100
Do.	6	56°47.5'	154°29'	NWxW½N	Ebb	E	M-gyM	33-38	60	0	0	0	0	0	0	0	4	150
Do.	6	56°47.5'	154°24'	WSW	Ebb	E	gnM-gnM	33-33	60	0	0	0	0	0	0	0	0	0
Do.	8	57°05.5'	154°58'	NNE	Ebb	S	gyM-SG	68-68	60	0	0	0	0	0	0	0	4	75
Do.	8	57°02'	154°58'	NxE	Slack	Nil	gyM-S	68-75	60	0	0	0	0	0	0	0	6	0
Do.	8	56°59'	155°01'	NNW	Flood	N	gyM-S	75-82	50	0	0	0	0	0	0	0	0	75
Do.	Mar. 20	56°45.4'	154°19'	ExN½N	Ebb	E	fneS-fneS	25-25	50	0	0	0	0	0	0	0	0	125
Do.	20	56°48.4'	154°29.6'	SSW	Flood	W	fneS-fneS	35-35	70	4	1	5	4	0	10	1	0	300
Alitak Bay	Oct. 31	56°53'	154°13.5'	SxE to S	Flood	N	M-M	25-25	60	0	0	0	0	0	0	0	4	550
Do.	31	56°52'	154°11.4'	NWxW½W	Flood	N	hrd-SG	30-18	60	0	0	0	0	0	0	0	5	550
Do.	31	56°51.5'	154°08'	E	Flood	N	stk-M	30-29	60	0	1	1	1	0	36	0	4	25
Do.	31	56°52.3'	154°03.7'	NxE½E	Slack	Nil	hrd-M	30-40	60	0	0	0	0	0	3	0	0	25
Do.	31	56°53.5'	154°00'	W	Ebb	SW	hrd-S 2/	30-30	60	-	-	-	-	0	-	0	-	-
Do.	31	56°53.5'	154°08.3'	W½S	Ebb	SW	SM-SM	22-22	60	0	0	0	0	8	0	0	1	10
Do.	Nov. 1	56°52'	154°07'	S	Flood	NE	SM-SM	36-20	60	0	0	0	0	1	1	0	0	350
Do.	1	56°48.5'	154°10'	NNW	Flood	NE	SM-SM	20-28	90	0	0	0	0	0	5	0	0	100
Do.	1	56°53.7'	154°09.3'	N to NE	Slack	Nil	MRks-rky 2/	20-46	60	-	-	-	-	0	0	0	0	-
Do.	2	56°51.4'	154°11'	SxE½W	Flood	N	M-S	22-6	45	0	0	0	0	0	0	0	0	0
Do.	2	56°48.4'	154°17.4'	SExE½E	Slack	Nil	SM-SSh	15-30	120	0	1	1	1	0	0	1	7	0
Do.	2	56°46'	154°12.1'	W½N	Ebb	SE	SSh-SM	50-24	90	0	0	0	0	0	0	0	0	100
Do.	7	56°51.6'	154°10.6'	SxE	Ebb	S	gyM-gySM	37-22	60	0	0	0	0	6	7	0	6	600
Do.	Mar. 16	56°50.5'	154°15.3'	NE	Flood	N	fneS-sftM	19-35	55	15	8	23	25	1	5	0	0	550
Do.	18	56°51.5'	154°13.5'	SWxS to SE½S	Ebb	SW	fneS-fneS	18-18	75	15	14	29	23	0	0	0	0	100
Do.	18	56°50.5'	154°11.6'	NNE	Slack	Nil	fneS-fneS	22-30	75	2	3	5	4	0	0	0	0	25
Do.	30	56°53'	154°13.7'	Along shore	Flood	Nil	bkSM-gyS	15-16	60	4	1	5	5	0	0	0	0	25
Do.	30	56°53'	154°13.1'	Along shore	Slack	Nil	SM-bkSM	22-15	60	3	3	6	6	0	0	0	0	0
Do.	June 24	56°51.4'	154°13.3'	SExE	Ebb	SW	MS-M	26-24	60	0	0	0	0	0	48	1	0	1,350
Alitak Bay--Moser Bay	Mar. 16	56°59'	154°09'	Mid channel	Slack	Nil	SSh-fneS	18-12	30	0	0	0	0	0	0	0	0	6,000
Sulua Bay	Apr. 13	57°07'	153°51'	S	Flood	N	M-M	44-25	40	12	26	38	57	50	35	0	0	150
Olga Bay	Nov. 4	57°04.2'	154°06.2'	NW	Slack	Nil	MSh-rky 3/	38-28	20	5	2	7	21	-	1	-	-	100
Do.	4	57°09'	154°11'	SSW	Ebb	Nil	gnM-S	38-90	60	3	0	3	3	0	36	0	0	25
Do.	4	57°07.5'	154°18'	W	Slack	Nil	gnM-gnM	95-45	40	4	3	7	10	0	0	0	0	25
Do.	4	57°07'	154°05'	NNExE½E to ~E	Flood	Nil	M-M	55-35	55	110	131	241	263	0	0	0	0	25
Do.	5	57°07'	154°04.6'	SE	Slack	Nil	M-M	50-60	30	4	3	7	14	0	6	0	0	0
Do.	5	57°05.7'	154°03.8'	NExN	Ebb	Nil	M-MShale	60-26	60	24	36	60	60	0	3	0	0	100
Do.	5	57°06.7'	154°00'	SW	Ebb	Nil	M-gnMrky 3/	35-38	50	1	2	3	4	-	5	-	-	20
Do.	Mar. 18	57°08.3'	154°17'	WSW	Slack	Nil	fneSG-M 2/	22-21	15	-	-	-	-	-	-	-	-	-
Do.	19	57°09.1'	154°14'	SSW	Flood	Nil	fneS-fneS 3/	19-19	10	10	13	23	138	-	1	-	-	-
Do.	19	57°07.7'	154°22.9'	NxE½E to WNxE	Slack	Nil	SG-SG	10-15	35	10	4	14	24	0	10	0	0	0
Do.	19	57°07.7'	154°22.7'	NxE½E to NExE	Slack	Nil	S-S	25-30	30	2	0	2	4	0	5	0	0	0
Kaguyak Bay	21	56°52.4'	153°44.9'	NExN½W	Flood	Nil	fneS-M	20-25	70	0	0	0	0	24	0	2	0	80
Do.	21	56°55.3'	153°40.1	ExN½W	Slack	Nil	fneS-fneS	20-25	55	0	0	0	0	3	2	0	0	100
Two Headed I.--NW of	21	56°56.2'	153°31.6'	NNW	Ebb	SW	gyS-gyS	50-60	25	0	0	0	0	0	5	0	0	0
Rolling Bay	21	57°02'	153°20'	SW½S	Ebb	Nil	gyS-gyS	10-40	60	0	0	0	0	0	2	0	0	500
Natalia Bay	22	57°04.7'	153°20'	SSW	Ebb	Nil	SG-SG	15-24	60	0	0	0	0	26	4	0	0	300
Kaiugnak Bay	22	57°04.5'	153°37'	W½W	Ebb	Nil	SG-SG	10-10	30	0	0	0	0	0	0	0	0	60
Three Saints Bay	22	57°08.1'	153°30.7'	SSE to S½E	Slack	Nil	fneS-M	30-20	45	0	0	0	0	0	0	0	0	50
Sitkalidak Strait	22	57°10.1'	153°19.1'	W to E	Flood	NE	S-M	10-16	55	0	0	0	0	0	0	0	0	300
Midway Bay	Apr. 23	57°13.5'	153°14.5'	Along E shore	Flood	Nil	M-M	4-8	35	0	0	0	0	60	0	0	0	100
Amee Bay	Mar. 23	57°11.3'	153°13'	NxE	Slack	Nil	stk-stk	6-11	14	24	68	92	396	4	3	0	0	50
Do.	23	57°12.3'	153°12.4'	NNE	Flood	Nil	GM-GM	12-12	35	0	0	0	0	0	0	1	0	500
Do.	24	57°11.3'	153°13'	NxE½E	Flood	Nil	stk-stk	6-12	35	215	186	401	687	13	0	0	0	50
Do.	Apr. 23	57°11.3'	153°13.2'	NxE	Slack	Nil	M-MS	4-10	55	6	3	9	10	0	0	0	0	150
Do.	23	57°11.3'	153°13.2'	NxE½E	Slack	Nil	M-M	4-4	30	8	3	11	22	75	0	0	0	500
Port Hobron	Mar. 23	57°08.6'	153°12.6'	NxE½E	Ebb	NNE	G-G	15-20	45	0	1	1	1	28	36	0	0	2,000
Do.	24	57°08.3'	153°13.1'	NxE½E	Flood	SSW	MS-MS	10-10	30	0	0	0	0	12	48	0	0	335
Do.	Apr. 23	57°08.0'	153°12.6'	NNE	Ebb	NNE	MS-MS	20-34	40	1	0	1	2	10	12	1	0	500
McDonald Lagoon	Mar. 24	57°08.3'	153°05.5'	Mid channel	Ebb	N	MS-MS	5-15	30	24	3	27	54	300	0	0	0	50
Do.	Apr. 24	57°10.2'	153°01.5'	NW½W	Ebb	N	G-G	4-20	30	2	3	5	10	23	0	0	0	0
Kiliuda Bay	25	57°20.7'	153°09.7'	SSE	Flood	Nil	MS-MS	20-36	45	0	1	1	1	1	1,500	1	0	25
Do.	25	57°20.3'	153°09.9'	SSE	Flood	Nil	MS-MS	8-30	65	10	10	20	18	0	1,000	0	0	0
Do.	25	57°20.2'	153°09.5'	SExS	Slack	Nil	MS-MS	11-20	40	10	10	20	30	0	3,000	0	0	0
Do.	25	57°18.3'	153°11.6'	NExE	Slack	Nil	ashes-ashes	8-16	25	2	6	8	19	0	1,500	0	0	50
Do.	25	57°18.1'	153°01'	NNE	Ebb	ESE	S-S	18-30	35	0	0	0	0	0	36	0	0	10
Do.	Mar. 25	57°20.7'	153°09.6'	SxE½E	Flood	Nil	fneS-M	20-20	40	29	48	77	115	250	1,000	0	0	25
Do.	25	57°18.3'	153°11.6'	ENE	Flood	Nil	buM-S	10-20	25	12	18	30	72	50	200	0	0	0
Shearwater Bay	Apr. 25	57°20.3'	152°53.6'	SSW	Ebb	SW	SG-SG	8-8	30	15	1	16	32	36	0	0	0	25
Do.	Mar. 24	57°20.4'	152°53.6'	SSW to NNE	Ebb	SW	MS-MS	6-15	50	0	0	0	0	0	0	0	0	0
Ugak Bay	26	57°26.5'	153°01.8'	NExN½W	Slack	Nil	MS-MS	10-10	50	0	2	2	2	50	250	0	0	25
Do.	26	57°29.1'	152°44.2'	WxS½S	Ebb	SSE	G-MS	8-10	50	16	17	33	40	14	0	0	0	10

1/ October and November data are for 1940; all other data are for 1941.

2/ Net snagged and catch lost.

3/ Net snagged but part of catch saved.

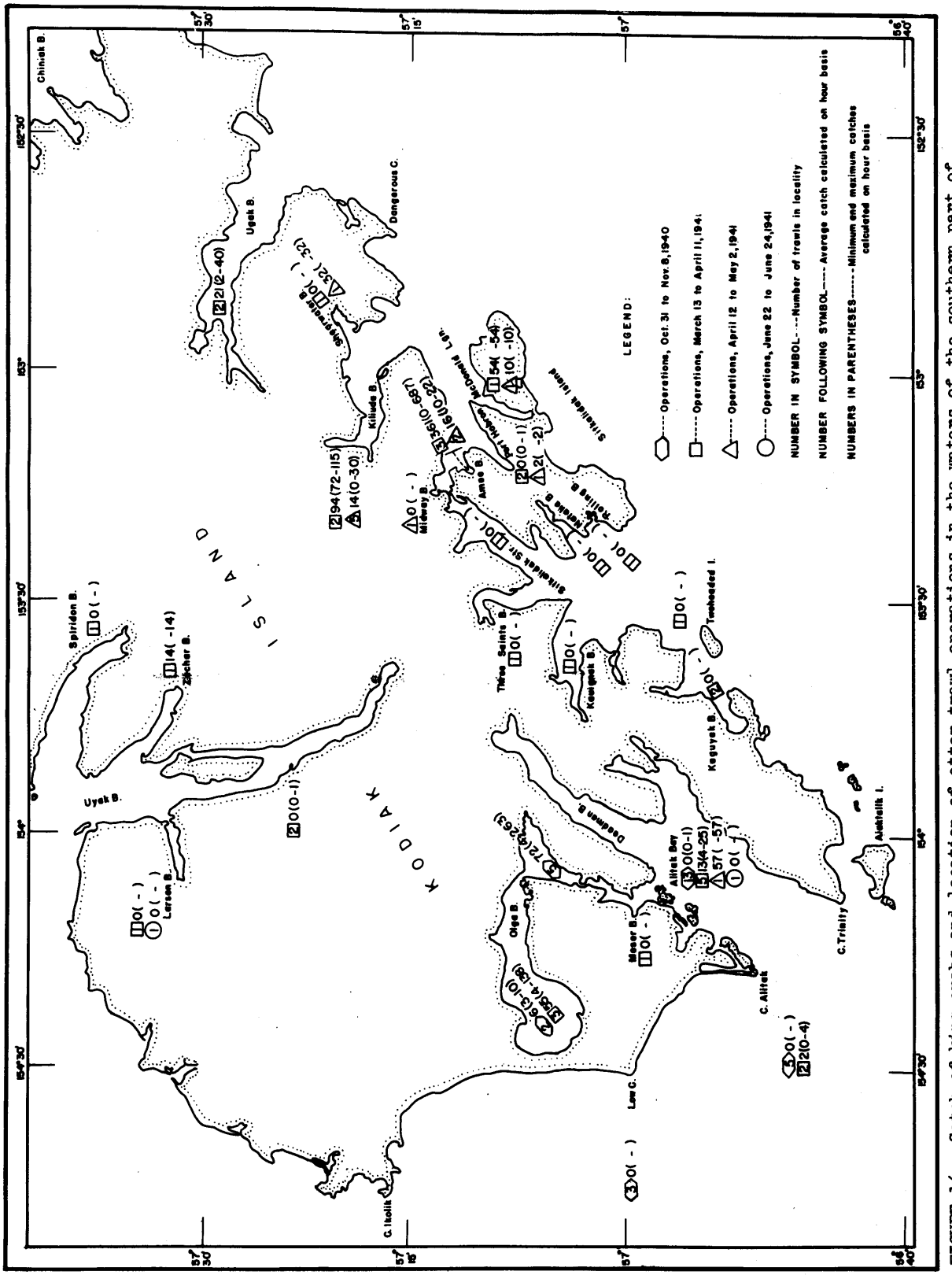

FIGURE 16.--Catch of king crabs and location of otter-trawl operations in the waters of the southern part of Kodiak Island (Area VIII).

in the central portion of the Bay in the 1940 prospecting, and one crab was taken by tangle net in Kempff Bay during April. Three drags 15 miles west of Low Cape in November, winter tangle-net and pot-fishing in Moser Bay, tangle-net fishing in Deadman Bay in April, and a tow off Tanner Head in June all gave negative results.

The southern open end of Alitak Bay, particularly on the west shore along Tanner Head, is good trawling bottom, being sandy inshore and giving over to mud in the deepest portion. The central part of the Bay is somewhat reefy, but two out of four drags between these partly submerged reefs were managed without snagging. The two snags were within and beyond Middle Reef along the east shore. The head of the Bay is rocky, but the bottoms of Moser and Sulua Bays are clear.

Aside from Moser Bay, where in one-half hour trawling effort three tons of starry flounders were taken, no extensive fish catches were made. Each drag netted an average of but a few hundred pounds of flatfish, mostly starry flounders and yellowtail. Fifty, large gray cod were taken at one time off Cape Alitak, but other efforts in the same vicinity did not produce corresponding results.

Olga Bay

The presence of king crabs in Olga Bay also has been known for some time. For a number of years local residents have trapped crabs for canning at home, and in the winter and spring of 1938 and 1939 the floating cannery mentioned in the preceding section packed 400 cases of crab meat from 5,000 crabs taken in pots in these waters. Also, between October and December 1941, following the return of the crab expedition to Seattle, 300 cases were canned commercially.

The history of crab fishing in Olga Bay and the results of the Alaska Crab Investigation would indicate that a year-round crab population exists here, probably on account of its physical nature. Save for a very narrow and shallow passage at its southeast end, connecting it to Moser Bay and thence to Alitak Bay, it is completely land-locked, thus forming a large natural trap some 17 miles in length and several miles in width with depths reaching 90 fathoms. In addition to P. camtschatica, the related species P. platypus, found only in a few localities in Alaska, occurs here in approximately equivalent quantities.

Another singular aspect about Olga Bay is the much greater quantity of immature crabs in the catches. The presence of both mature and immature crabs in the Bay the year around suggests the possibility that the crab population is largely localized and, therefore, may be less likely to withstand a sustained fishery than would be indicated by the relatively favorable catches per unit of effort.

The trawl work in the fall of 1940 disclosed the greater abundance of crabs at the eastern part of the Bay known locally as Horse Marines. In five attempts on an hour basis, an average of 72 king crabs per effort was taken in depths of 30 to 50 fathoms. In March 1941, four trawls in the mid-western part of the Bay netted an average of 57 crabs per hour, whereas in 1940, an average of six per hour was fished. Using four crab pots set out from the cannery cove in the northern part of the Bay, a total of 56 king crabs were caught in three weeks of fishing during the latter part of February 1941.

The greater portion of Olga Bay does not lend itself to effective trawling because of the number of snags encountered. The east end, Horse Marines, is particularly rocky; but a drag in any part of the entire Bay is liable to snag or pick up large boulders which, if they do not tear the net, will make lifting difficult. Three drags, which did not snag, were made in depths of 10 to 30 fathoms close to the northern shore off what is known as Diamond Lake. The bottom here is of a sandy character; elsewhere in the Bay a soft muddy bottom prevails amongst the boulders.

No large catches of fish were taken, but very promising shrimp hauls were made with as much as 800 to 1,000 pounds in one trawl. This, in light of the fact that a trawl of relatively large mesh was used, would indicate the presence of shrimp in considerable abundance.

Kaguyak Bay to Sitkalidak Strait

The several bays in this region prospected in late March 1941 produced only two crabs and 960 pounds of flatfish. This is the only section in the Kodiak area that produced negative results. Trawls were made north of Two Headed Island and in Kaguyak Bay, Kaiugnak Bay, Three Saints Bay, Rolling Bay, Natalia Bay, and in Barling Bay across Sitkalidak Strait immediately south of the village of Old Harbor. One tangle net, set at the head of Natalia Bay across the small, unnavigable entrance to shallow Sitkalidak Lagoon, snared two 15-pound king crabs after one day's fishing. The best fish catches were made in Rolling Bay and Natalia Bay.

Sitkalidak Island to Cape Chiniak

In contrast to the negative results obtained on the southern side of Sitkalidak Island, the bays to the northward were promisingly productive. Prospected first in late March 1941, this section was revisited one month later, and the comparative results at these two times bear out the general indication of an outward migration of king crabs.

Amee Bay, the smallest in this section with approximately one square mile of dragging area, yielded the highest average catch, not only for this locality but also for the entire Kodiak Island region. In March, three drags averaged 361 king crabs per drag on an hour basis, 53 percent canning-sized males. In April the average dropped to 16. With a maximum depth of 10 fathoms and shoaling off gradually to mud flats at the head of the Bay, the soft, sticky mud bottom is clear but permits only short tows.

Port Hobron gave only single crab specimens during both periods of operation; but McDonald Lagoon, the easternmost indentation on Sitkalidak Island, yielded an average catch of 54 crabs per hour of towing during March and 10 in April. Both areas have good trawling bottoms of sandy mud and small gravel, but McDonald Lagoon can be entered only at high tide and by boats of relatively shallow draft. Also, its small size limits the extent of operations.

Kiliuda Bay likewise gave similar periodic changes in catches of king crabs. Two drags during March in the northwest and west arms at the head of the Bay (10 to 20 fathoms) produced 115 and 72 crabs, respectively; whereas, five efforts in late April averaged 14 crabs per hour of trawling. Findings in Shearwater Bay, the northeast arm of Kiliuda Bay, were the exact reverse for, in March, negative results preceded a catch of 32 king crabs in April. This might be explained as a transient occurrence during the outward migration of king crabs from the extreme head of the Bay. The bottom of Kiliuda Bay in the arms prospected is of fine sand and mud and is clear.

Ugak Bay was not revisited in April, but in March two trawls were made there. One in the southwest arm, at a depth of 10 fathoms, on mud and sand bottom, yielded two king crabs; another along the north shore (Saltery Cove), at a depth of eight to 10 fathoms, on mud and sand bottom, caught 33 crabs. Prevailing southeast weather prevented further work at the time.

Although Port Hobron did not produce crabs, approximately 3,000 pounds of starry flounders were taken there. In addition to crabs, Amee Bay gave some 1,000 pounds of flounders and yellowtail "sole", while the other bays in this section furnished scanty fish hauls.

The work in the west and northwest arms of Kiliuda Bay uncovered a large tanner and dungeness crab population. As many as 1,500 to 3,000 tanner crabs and 50 to 250 large dungeness crabs were taken in each drag. McDonald Lagoon and Amee Bay also had high catches of dungeness crabs--300 and 75, respectively--while Shearwater and Ugak Bay gave 36 and 54.

Albatross Bank

Several halibut schooners have reported the taking of individual king crabs on their gear in sporadic operations on Albatross Bank and in Albatross Gully. With the time allotted, this large area could not be thoroughly investigated. In late March 1941, however, five one-hour trawls were made 26 miles east of Dangerous Cape in an area extending 30 miles south and 15 miles east. The depths ranged from 36 to 125 fathoms, and the bottom was primarily fine sand with some shell, gravel, and mud. No king crabs were captured, but 8,000 pounds of red rockfish (Sebastodes) and several hundred pounds of turbot were landed.

Chiniak and Marmot Bays

Because of its rocky character, Chiniak Bay (Figure 17) cannot be adequately surveyed with trawls. Kalsin and Middle Bays, southwest branches of Chiniak Bay, presented the only signs of king crabs in late March by this method. Tangle nets were fished for two days in late April between Woody Island and Near Island, and in St. Paul Harbor, the bight south of the town of Kodiak, with negative results. At the same time, negative results also were obtained in both Monashka Bay and Low Island Bay in one tow and one tangle-net set made in each.

Only the southern and southeastern reaches of Marmot Bay were investigated. Encouraging results were obtained. Anton Larsen Bay was visited in late March, and a single tow of 40-minute duration produced 20 king crabs of which 35 percent were canning-sized males. Three hundred pounds of starry flounders also came up in the catch. The opening to this Bay is shallow and restricted by a number of reefs, which make entering hazardous to all but the smaller and more maneuverable boats. Once in, a depth of 20 fathoms, mud and sand bottom, is general.

Twice in April single drags were made in Sharatin Bay yielding, respectively, 27 and 16 king crabs per hour at depths of six to 15 fathoms on mud and sand bottom. A tangle net set for 23 hours on the first occasion captured six large male crabs. Some caution must be exhibited in handling a trawl here, for a number of rocks occur in the central portion and along the east shore of the Bay; however, short drags between these points can be successfully made.

In this section, Kizhuyak Bay gave the best king crab yield. Drags attempted in all parts of the Bay in very late March and mid-April gave good catches, averaging 68 king crabs per hour with slightly more than 50 percent canning-sized males. In mid-September, two tows down the middle of the Bay lacked king crabs, indicating again the outward movement of the population by this time.

A slight snag occurred along the mid-western shore of Kizhuyak Bay; otherwise, no difficulty was encountered on mud and sand bottom at a depth of 32 fathoms. The Bay harbors a great deal of starry flounders, dungeness and tanner crabs.

As a follow-through to two unproductive tows made in Kizhuyak Bay in September, two tows were made in the 70-fathom gully between Whale Island and Anton Larsen Bay, but no crabs were found. It would appear that the population frequenting the Bays earlier had not moved into these particular waters.

A single 30-minute drag made in Afognak Bay in late March took 14 king crabs of which 11 were large males. In the same effort 200 dungeness crabs were taken, thus indicating an abundance of this species.

Kupreanof Strait and Dry Spruce and Onion Bays

Kupreanof Strait proper is unsuited to trawling not only because of foul bottom but also because of the strong tides, especially in the eastern end. Attempts at dragging here proved futile.

Dry Spruce Bay and Onion Bay, though not presenting large working areas, can with caution be worked with trawls. Both Bays, particularly the former, gave promising results when fished during early April. Two 20-minute tows toward the head of Dry Spruce Bay in 10 to 22 fathoms yielded 219 and six king crabs, respectively; the latter drag ended in a snag which badly cut the webbing of the trawl. A set of tangle nets across the entrance to the Bay in six to 15 fathoms of water caught 13 large males in 36 hours. It was in Dry Spruce Bay that the largest king crab caught by the expedition was taken--11.4 inches in carapace width, and 22.2 pounds in weight.

Onion Bay, though small, has a clear, sandy, mud bottom; however, it can be entered only at the higher stages of the tide and by boats drawing not more than nine feet of water. Keeping a depth of 16 to 20 fathoms, a drag of 30 minutes was made and took 10 king crabs.

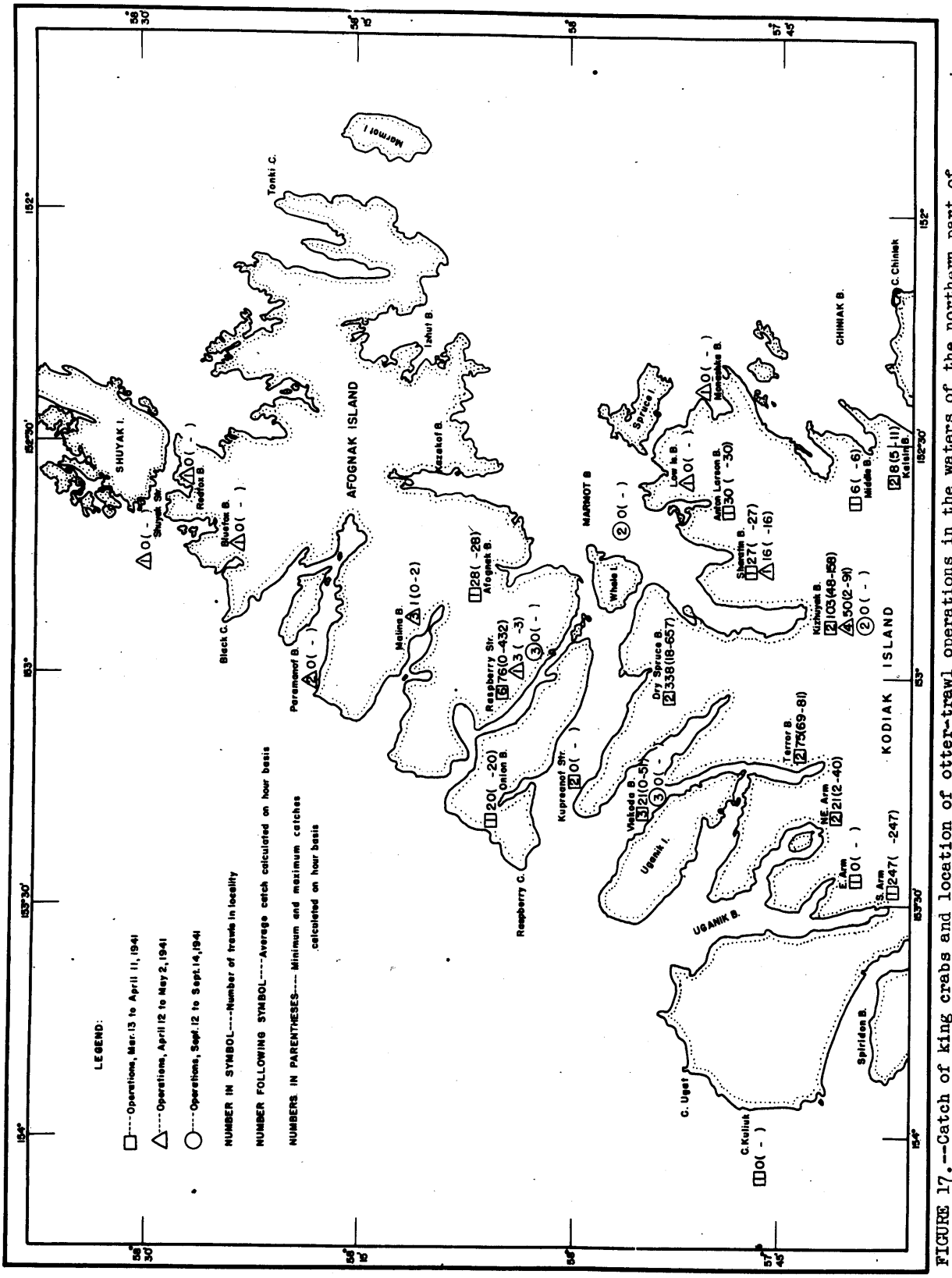

FIGURE 17.--Catch of king crabs and location of otter-trawl operations in the waters of the northern part of Kodiak Island (Area VIII).

Raspberry Strait

Raspberry Strait lends itself excellently to fishing both with trawls and tangle gear. The bottom of sandy mud reaches a depth of 45 fathoms in spots, and work in April 1941 indicates that a crab population exists here, at least during the spring. In seven tows, only one yielded a large catch--360 king crabs--and those were small in size. The presence of the smaller crabs would seem to suggest that the adult crabs were missed or had previously moved out. The latter possibility was further indicated when, in September, three drags over the same locations, primarily in the long reach opposite the herring plants there, produced no king crabs.

An average of 2,100 pounds of flatfish were taken in each of 11 drags conducted in Raspberry Strait in April and September. Flathead, yellowtail, lemon and rock "sole", constituted the greatest part of these catches which are of commercial proportions.

Malina Bay to Shuyak Strait

This line of bays along the north side of Afognak Island was explored in the latter part of April with relatively poor results, perhaps because of earlier movement of the crabs. In trawling operations Malina Bay, only, yielded crabs--two specimens in three trials. Malina Bay and Paramanof Bay were the only places where tows were successfully made, for in Bluefox Bay, Redfox Bay, and Shuyak Strait every tow led to a snag.

Because of a number of rumors that king crabs had been seen in great quantities in Bluefox Bay in the past, tangle gear was used here, also. Five sets were distributed through the Bay among its many small rock islands, and fished for two days. Since only nine large male crabs were taken, and these in the two nets at the entrance to the Bay, further support is contributed to the general evidence that in the Kodiak Island area king crabs leave the enclosed bays very early in the spring.

Bottom life was scarce in this section except in Malina Bay where, in the three tows, 4,750 pounds of market-sized rock and lemon "sole" were netted along with several dozen dungeness crabs.

Viekoda, Uganik, and Uyak Bays

These Bays along the north side of Kodiak Island offer relatively large fishing areas. Explorations here were in early to mid-April; and, whereas work at an earlier time might have resulted in larger catches, fairly satisfactory results nevertheless were obtained.

The drags in Viekoda Bay during this period averaged 21 crabs per hour, with a maximum catch of 51 crabs taken in four fathoms of water and the smaller catches in 12 to 25 fathoms. In September, a recanvass gave negative results.

Terror Bay, the long reach down from Viekoda Bay, connected to Uganik Bay by a narrow passage at its central part, gave two good catches of 69 and 80 crabs per hour of fishing effort in five to 40 fathoms on mud and sand bottom early in April. Of the catch, 23 were canning-sized males.

In the south arm of Uganik Bay one tow yielded 247 king crabs per hour of trawling. One tow each in the East and Northeast Arms, under somewhat similar conditions, in eight to 35 fathoms on sandy bottom, netted no crabs and 20, respectively, when calculated on an hourly basis.

In Uyak Bay, single tows in Spiridon Bay, Zachary Bay, and Uyak Reach netted none, 14, and one crab per hour, respectively. Smaller Larsen Bay, within the west entrance of Uyak Bay, did not yield king crabs in either April or June; but some 5,000 pounds of flounders were taken here in a single tow during June. The residents about Larsen Bay report the presence of large numbers of king crabs at the head of Uyak Bay, but such was not the case at the time fishing was attempted there.

Shumagin Islands and Alaska Peninsula
(Exclusive of Canoe and Pavlof Bays)

No fishing operations were carried on between Wide Bay and Chignik Bay, but from here westward along the Alaska Peninsula numerous trawl- and tangle-net operations were made in all the major bays to False Pass, a distance of 205 miles. In addition, offshore operations

were conducted in the vicinity of the Shumagin and Pavlof Islands, one in Otter Cove on Unimak Island, and two in Akutan Bay on Akutan Island.

Pavlof and Canoe Bays, geographically situated within this area, are treated separately as very extensive operations were undertaken there, and commercially significant catches were made.

The Shumagin Islands and Alaska Peninsula area was first investigated in October 1940, when 43 trawl operations and three sets of tangle gear failed to locate any large king crab populations. Two subsequent periods of prospecting, one during April and the other during June 1941, also met with generally poor results except for several bays to the westward. (Figure 18 and Tables 13 and 14.)

Alaska Peninsula, Chignik to Stepovak Bay

Three of the larger bays--Chignik Bay, including Castle Bay; Ivanof Bay; and Stepovak Bay--though fished at these three different times, failed to show evidence of king crab populations. The only indication of their presence in the region was one crab picked up in Castle Bay during June.

Much of the bottom in these bays is too rough and uneven for trawling. This is especially true in Chignik and Stepovak Bays. Two drags in the former ended in bad snags, while most of the western half of the latter was avoided because of reported shoals and rocky bottom.

Besides the negative crab catches, very meager hauls of fish were obtained. Only a few of the tows had marketable fish in excess of 500 pounds.

Shumagin and Pavlof Islands

In October, after failing to locate crabs in the shallow inshore waters, the expedition made two drags out in the deeper water while en route from the Shumagin Islands to Kodiak Island. One was in a deep hole located approximately 22 miles east of Castle Rock. After paying out all the cable so as to reach down to the 105-fathom depth, an hour tow yielded only a few redfish and some turbot. The other drag, located about 13 miles NNE of Mitrofania Island, in depths ranging from 55 to 68 fathoms, snagged soon after the gear had been set out.

In operating among the Shumagin Islands, a group of 15 sizable islands extending for a distance of 60 miles from the coast of the Alaska Peninsula, 11 trawl tows and four tangle-net sets located a crab population in Eagle Harbor and a few crabs in Falmouth Harbor. Both of these bays are on the west side of Nagai Island. Other crabs caught in this vicinity were from Zachary Bay, indenting the north side of Unga Island.

Both tangle nets and trawls made fair catches in the shallow water at the head of Eagle Harbor. In April, a set of tangle gear dropped in 10 to 13 fathoms on volcanic ash bottom caught 111 king crabs, of which 103 were males. A trawl drag in slightly deeper water, dropped in 15 to 20 fathoms, caught 37 crabs, of which 23 were males, after only 20 minutes of dragging. These crabs were in excellent condition for canning and weighed between 10 and 13 pounds each.

Though neighboring Falmouth Harbor is physically similar to Eagle Harbor (possessing the same type of volcanic ash and being shallow at the head of the bay), considerably lower crab catches were taken here. One set of tangle gear left soaking for five days captured but 12 crabs of which nine were males.

Zachary Bay is a comparatively shallow body of water, very little of it being over 20 fathoms in depth. One drag along the east shore in depths from four to seven fathoms caught five crabs, while another in the outer section of the Bay snagged. The best catch in this vicinity, 17 males, was obtained by a set of tangle gear placed in five fathoms near the center of the Bay.

Other places prospected in the Shumagin Islands were the southwest shore of Big Koniuji Island, Mist Harbor, Larsen Bay indenting Nagai Island, and Popof and Korovin Straits. No king crabs were taken, and the fish catches were very poor except in Mist Harbor where 1,500 pounds were caught.

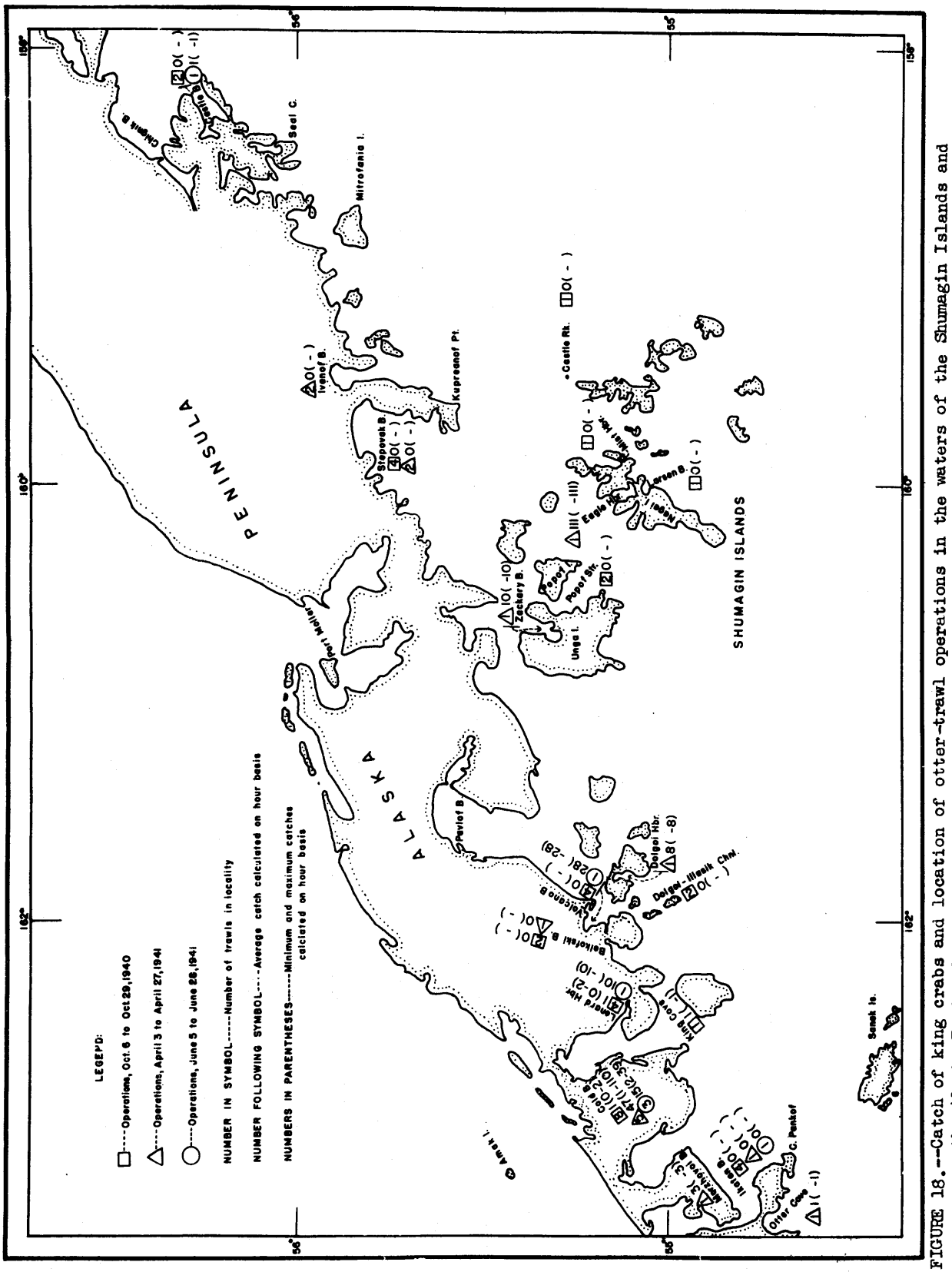

FIGURE 18.--Catch of king crabs and location of otter-trawl operations in the waters of the Shumagin Islands and the Alaska Peninsula--exclusive of Pavlof and Canoe Bays--(Area IX).

TABLE 13.--Otter trawl operations: Shumagin Islands and Alaska Peninsula, 1940 and 1941

Vicinity	Date 1/	Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: King Males	King Females	King Total	Hour basis	Dungeness	Catch of fish: Gray cod	Halibut Medium	Halibut Small	"Sole"
								Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Number	Pounds
Chignik Bay	June 24	56°26.7'	158°20'	NExE½N	Ebb	Nil	orsS-Sh 2/	20-18	15	-	-	-	-	-	-	-	-	-
Do.	24	56°18.2'	158°11.9'	NWxW½W	Ebb	ESE	M-M 2/	27-27	0	-	-	-	-	-	-	-	-	-
Castle Bay	Oct. 29	56°15.3'	158°10.5'	SWxS	Ebb	Nil	M-SC1	60-50	50	0	0	0	0	0	0	0	0	0
Do.	29	56°13.9'	158°16'	W	Slack	Nil	M-M	45-40	60	0	0	0	0	0	0	0	6	350
Do.	June 24	56°13.5'	158°22.3'	NExE	Flood	Nil	bkM-bkM	31-21	60	1	0	1	1	0	0	1	2	300
Do.	24	56°13.3'	158°15'	NExE½N	Flood	SW	sftCl- 2/	46-44	20	-	-	-	-	-	-	-	-	-
Mitrofania I.--ENE of	Oct. 29	55°50'	158°20'	NExE	Slack	Nil	SG-Sh 2/	68-55	70	-	-	-	-	-	-	-	-	-
Castle Rock--E of	28	55°10'	158°50'	NNE	Ebb	SW	buM-buM	105-105	60	0	0	0	0	0	6	0	0	0
Ivanof Bay	Apr. 3	55°52'	159°31'	NNW	Ebb	Nil	S-SM	7-20	60	0	0	0	0	1	2	0	0	35
Do.	3	55°53'	159°31'	NNE to E	Ebb	Nil	buSM-sftM	20-20	60	0	0	0	0	0	0	0	0	800
Stepovak Bay	Oct. 24	55°43'	159°43'	NxW to N	Ebb	Nil	stk-M	15-15	60	0	0	0	0	0	0	1	5	0
Do.	24	55°45'	159°44'	W	Ebb	Nil	-	90-40	90	0	0	0	0	0	0	0	2	0
Do.	24	55°45'	159°48'	WSW	Slack	Nil	stk-M	90-25	60	0	0	0	0	0	0	1	2	105
Do.	24	55°40'	159°45'	NExE½N	Flood	Nil	stk-M 2/	25-10	45	-	-	-	-	-	-	-	-	-
Do.	24	55°48'	159°45'	S to SE	Flood	Nil	-	90-90	60	0	0	0	0	0	0	0	0	0
Do.	Apr. 4	55°50'	159°50'	ENE	Ebb	Nil	M-M 2/	9-9	50	-	-	-	-	0	-	-	-	-
Do.	4	55°50'	159°44'	E	Ebb	Nil	M-M	44-13	140	0	0	0	0	0	2	0	0	100
Do.	4	55°48'	159°39'	SxW	Slack	Nil	M-M	13-31	60	0	0	0	0	0	0	0	0	10
Big Koniuji I.--N side	Oct. 22	55°03'	159°38'	E	Ebb	Nil	hrd-rky 2/	25-55	20	-	-	-	-	-	-	-	-	-
Big Koniuji I.--SW of	22	55°02'	159°35'	E	Slack	Nil	hrdS-hrdS 2/	30-30	60	-	-	-	-	-	-	-	-	-
Nagai I.--Mist Harbor	21	55°07.7'	159°51'	ESE	Flood	Nil	hrdS-hrdS	38-38	60	0	0	0	0	1	0	0	0	1,500
Nagai I.--Larsen Bay	21	55°04.2'	160°00'	SExE½E	Ebb	Nil	sftM-sftM	5-25	30	0	0	0	0	0	3	0	0	25
Eagle Harbor	Apr. 10	55°05.6'	160°04'	WxN	Ebb	WxN	ashes-ashes	15-20	20	23	14	37	111	50	0	0	0	0
Popof Strait	Oct. 25	55°18.4'	160°31.5'	S	Flood	-	hrdS-Sh	40-20	75	0	0	0	0	0	4	1	5	175
Do.	26	55°14.2'	160°33'	ENE	Slack	Nil	MSh-Grky 2/	15-21	35	-	-	-	-	-	-	-	-	-
Korovin Strait	25	55°24'	160°25.5'	SE	Ebb	-	buM-rky 2/	45-35	50	-	-	-	-	-	-	-	-	-
Do.	Apr. 11	55°22.5'	160°28.5'	E	Flood	-	S-S 2/	26-26	5	-	-	-	-	-	-	-	-	-
Zachary Bay	11	55°19.7'	160°38.5'	Mid channel	Flood	Nil	hrdS-hrdS	4-7	30	3	2	5	10	0	0	1	0	400
Do.	11	55°22'	160°37'	NNW	Flood	Nil	S-rky 2/	12-24	20	-	-	-	-	-	-	-	-	-
Volcano Bay	Oct. 8	55°13.6'	161°58.2'	W to SW	Ebb	Nil	sftM-sftM	25-30	35	0	0	0	0	12	0	0	0	500
Do.	8	55°13.7'	162°05'	NE to E	Ebb	Nil	sftM-sftM	25-25	45	0	0	0	0	1	6	4	0	900
Do.	8	55°13'	161°59.5'	ExN	Ebb	Nil	SM-SM	25-30	60	0	0	0	0	36	0	0	8	1,300
Do.	8	55°13.5'	162°00.5'	SE	Slack	Nil	SM-SM	25-35	50	0	0	0	0	6	0	0	6	650
Do.	June 27	55°12.1'	161°56'	WxN	Slack	Nil	sftM-sftM	45-40	60	18	10	28	28	0	0	0	0	1,500
Dolgoi Harbor	Apr. 13	55°09'	161°47'	SxE½E	Flood	Nil	bkM-bkM	6-10	45	5	1	6	8	0	10	0	0	100
Dolgoi I.--SW of	Oct. 8	55°06.5'	161°57.2'	SxE	Flood	N	bkS-Sh 3/	17-25	40	-	-	-	-	-	-	-	-	-
Do.	8	55°04.6'	161°56.3'	E½S	Flood	NW	SM-SM	25-30	60	0	0	0	0	0	4	0	0	0
Do.	8	55°04.4'	161°52.3'	SExS½S	Flood	NW	S-Sh	16-19	45	0	0	0	0	0	0	0	0	0
Do.	8	55°01.6'	161°51.3'	NxE	Flood	NW	S-Sh 2/	19-30	45	-	-	-	-	-	-	-	-	-
Belkofski Bay	6	55°03'	162°06'	E	Flood	NNW	stk-stk	40-20	60	0	0	0	0	0	0	0	0	200
Do.	6	55°04'	162°01.2'	ESE to SE	Slack	Nil	S-GSh	25-20	60	0	0	0	0	0	8	0	1	400
Do.	Apr. 14	55°08.8'	162°08'	SW	Flood	N	Sh-sft 4/	30-23	10	-	-	-	-	0	-	0	-	-
King Cove	Oct. 16	55°03.3'	162°19'	SExS to SSE	Ebb	Nil	stk-Sh	15-35	60	1	0	1	1	0	0	1	6	2,000
Lenard Harbor	10	55°08.4'	162°27.7'	SExE½E	Ebb	NW	sftM-sftM	65-45	60	0	0	0	0	0	12	0	0	1,000
Do.	10	55°06.7'	162°24.7'	E	Ebb	NW	sftM-sftM	25-18	60	1	0	1	1	0	2	0	0	2,500
Do.	10	55°06.7'	162°22.2'	WxN	Ebb	NW	sftM-sftM	20-25	60	2	0	2	2	15	1	0	0	2,000
Do.	10	55°06.6'	162°23.7'	ExN	Ebb	NW	S-M	25-20	60	2	0	2	2	0	0	0	0	500
Do.	June 28	55°08.2'	162°27'	Mid channel	Ebb	NW	sftM-sftM	37-23	60	4	6	10	10	0	0	0	0	1,000
Cold Bay	Oct. 10	55°10'	162°35'	SE	Flood	NW	-	6-12	25	1	0	1	2	0	0	0	0	50
Do.	10	55°11.6'	162°36'	SxE	Flood	NW	SSh-SSh	11-18	60	1	0	1	1	0	0	1	3	50
Do.	11	55°13.7'	162°32.3'	NW to WNW	Flood	NW	hrdS-SSh	28-12	60	1	0	1	1	0	2	0	8	1,000
Do.	11	55°14'	162°36.7'	WSW to SW	Slack	Nil	bkSM-bkSM	20-15	60	0	0	0	0	0	0	0	14	150
Do.	11	55°12.1'	162°36.6'	SxE	Ebb	SE	S-bkM	15-26	60	0	0	0	0	0	0	1	1	1,200
Do.	17	55°11.4'	162°33'	WNW	Flood	NW	gyM-gyM	32-15	90	0	1	1	1	0	0	1	4	2,000
Do.	17	55°14.8'	162°36'	SExE	Flood	NW	gyM-gyM	13-35	60	1	0	1	1	0	0	0	0	100
Do.	17	55°13'	162°39'	NxE½E	Slack	Nil	gyM-gyM	12-14	50	0	0	0	0	0	0	0	0	0
Do.	Apr. 14	55°13'	162°40.7'	NE½E	Flood	Nil	bkM-gyS	16-8	60	65	45	110	110	0	2	0	0	1,200
Do.	14	55°14.4'	162°36.5'	ExN	Flood	Nil	bkM-bkM	20-12	75	25	8	33	26	0	25	1	0	2,000
Do.	14	55°15'	162°33'	W½N	Flood	Nil	Sh-CoG 5/	8-7	50	34	16	50	60	-	-	-	-	200
Do.	14	55°04'	162°31'	WNW	Flood	NNW	Sh-S	14-10	45	1	0	1	1	0	12	0	3	100
Do.	14	55°12.6'	162°40.8'	NE½N	Ebb	Nil	SM-SM	12-13	60	31	8	39	39	0	3	0	3	300
Do.	June 28	55°12.5'	162°39'	NExN	Flood	NW	sftM-sft	27-31	60	1	3	4	4	0	5	3	5	1,000
Do.	28	55°33.6'	162°35.3'	E	Flood	NW	sftM-Sh	30-22	60	1	1	2	2	0	0	0	0	1,000
Do.	28	55°11'	162°32.3'	SExE½E	Slack	Nil	sftM-Sh	40-59	60	21	18	39	39	0	5	1	2	1,500

1/ October data are for 1940; all other data are for 1941.

2/ Net snagged and catch lost.

3/ Doors crossed in setting so that net did not fish.

4/ Net mudded down so that no catch was made.

5/ Net torn on coral growth but part of catch saved.

TABLE 13.--Otter trawl operations: Shumagin Islands and Alaska Peninsula, 1940 and 1941--Continued

Vicinity	Date 1/	Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: Males	Catch of crabs: King Females	Catch of crabs: King Total	Catch of crabs: King Hour basis	Catch of crabs: Dungeness	Catch of fish: Gray cod	Catch of fish: Halibut Medium	Catch of fish: Halibut Small	Catch of fish: "Sole"
								Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Number	Pounds
Morshovoi Bay	Apr. 15	55°02.4'	163°10.5'	WExN½N	Slack	Nil	MS-MS	13-22	60	2	1	3	3	0	0	0	0	500
Do.	15	55°04.3'	163°07.4'	ExN	Flood	Nil	fmgyS-Sh 2/	22-14	60	-	-	-	-	-	-	-	-	-
Ikatan Bay	Oct. 18	54°55'	163°03.5'	SWxS½S	Slack	Nil	Cl-Cl	38-24	60	0	0	0	0	0	6	0	1	2,000
Do.	18	54°51.7'	163°08'	SWxS	Flood	W	M-M	34-40	80	0	0	0	0	0	0	0	0	2,500
Do.	18	54°50.1'	163°10.3'	SWxW	Flood	W	bkS-bkS	51-13	55	0	0	0	0	0	0	0	0	1,000
Do.	18	54°48.2'	163°15.3'	SWxW	Slack	Nil	sft-sft	24-12	60	0	0	0	0	0	0	0	14	500
Do.	Apr. 16	54°46'	163°07'	NExE½E	Ebb	SE	SMSh-Sh	15-20	60	0	0	0	0	0	12	0	0	500
Do.	June 5	54°55.5'	163°02.6'	SxW	Slack	Nil	SM-SM	32-42	60	0	0	0	0	0	20	0	4	150
Otter Cove	Apr. 16	54°44.2'	163°21.4'	SxW	Flood	Nil	S-S	17-19	60	1	0	1	1	0	10	0	0	150
Akutan Bay	27	54°08'	165°48'	ExN	Flood	W	stk-stk	20-29	60	0	0	0	0	0	0	0	0	5,000
Do.	27	54°07.7'	165°43'	WxS	Flood	W	stk-stk	29-23	60	0	0	0	0	0	24	0	0	5,500
Totals									4,055	246	134	380	465	121	155	21	102	6/ 48,000

1/ October data are for 1940; all other data are for 1941.
2/ Net snagged and catch lost.
3/ Approximate poundages: starry flounder 14,500; yellowtail 13,500; rock "sole" 9,500; flathead 7,000; lemon "sole" 3,500.

Note:--In addition to the above, miscellaneous items were taken in approximate amounts as follows: 300 red cod, 200 small black cod, 143 tanner crabs, 35 skates, 30 bullheads, 1 dogfish and a few shrimp.

TABLE 14.--Tangle net operations: Shumagin Islands and Alaska Peninsula including Pavlof and Canoe Bays, 1940 and 1941

Vicinity	Date 1/	Location of net		Direction of set	Current set	Soundings		Time on bottom	Catch of king crabs		
		Lat.	Long.			Bottom	Depth		Males	Females	Total
							Fathoms	Days	Number	Number	Number
Alaska Peninsula and Shumagin Islands:											
Stepovak Bay	Apr. 4	55°50'	159°50'	E	N-S	M	10-10	1	0	0	0
Mist Harbor	Oct. 27	55°07.8'	159°51.4'	SE	N-S	M	30-45	6	0	0	0
Falmouth Harbor	Apr. 10	55°04.6'	160°07.3'	WxN	E-W	ashes	15-15	5	9	3	12
Eagle Harbor	10	55°05.6'	160°04'	NW	E-W	ashes	13-10	5	103	8	111
Zachary Bay	11	55°19.3'	160°39'	NNE	N-S	stk	3-5	5	17	0	17
Balboa Bay	11	55°36'	160°36'	S	N-S	M	7-7	5	0	0	0
Do.	11	55°32'	160°42.5'	E	E-W	M	13-13	5	0	0	0
Volcano Bay	Aug. 24	55°12'	161°56'	NNE	Nil	M	45-45	8	1	0	1
Do.	24	55°13'	161°58'	ExS	Nil	M	41-41	8	1	20	21
Lenard Harbor	Oct. 16	55°07'	162°24'	W	E-W	bldr	21-21	1	1	0	1
Cold Bay	16	55°10.7'	162°36'	E	NW-SE	hrd	24-24	1	1	0	1
Totals								50	133	31	164
Pavlof Bay:											
Section 1:											
Ukolnoi Island--W of	Aug. 24	55°13'	161°16'	SE	N-S	ashesgM	64-64	8	1	0	1
Do.	24	55°16'	161°18'	N	N-S	ashesgM	55-55	8	2	0	2
Do.	24	55°18'	161°14'	E	N-S	ashesM	63-63	6	22	0	22
Ukolnoi Island--N of	24	55°17'	161°10'	NNE	N-S	ashesS	58-58	6	12	0	12
Do.	24	55°18'	161°37'	NNE	W-E	gsM	55-55	6	0	0	0
Section 2:											
South of Black Point	Aug. 24	55°20'	161°10'	N	N-S	ashesgM	77-77	6	75	0	75
Do.	Sept. 3	55°23'	161°09'	NNE	N-S	ashesM	59-59	4	0	0	0
North of Black Point	3	55°26'	161°09'	E	N-S	ashes	59-59	4	245	0	245
Do.	3	55°29.2'	161°36'	N	N-S	ashes	47-47	7	1	2	3
Do.	June 27	55°29'	161°36'	ExN	N-S	ashes	42-42	2	27	13	40
Section 3:											
South of Black Point	Aug. 24	56°17.5'	161°30'	NNW	N-S	ashesgM	43-43	6	0	0	0
Do.	24	55°20.5'	161°28'	N	N-S	ashes	38-38	6	0	0	0
Do.	24	55°21'	161°33'	NNW	N-S	ashes	38-38	6	0	0	0
North of Black Point	June 27	55°29.4'	161°31'	WxS	N-S	ashes	31-31	2	4	2	6
Section 4:											
Southwest portion	June 6	55°32'	161°31.2'	NNE	N-S	MS	20-20	2	0	0	0
Southeast portion	27	55°34'	161°29'	NNE	N-S	MS	17-17	3	0	4	4
Totals								82	389	21	410
Canoe Bay:											
Section 6	Sept. 17	55°35.5'	161°19'	NE	E-W	MS	30-30	1	37	1	38
Do.	19	55°35.6'	161°19'	NE	E-W	MS	30-30	3	55	2	57
Do.	Oct. 14	55°35.3	161°19.5'	NNW	E-W	MS	25-25	1	0	0	0
Do.	14	55°34.5'	161°19.5'	W	E-W	MS	25-25	1	0	1	1
Do.	Apr. 7	55°35.9'	161°19.7'	NExE	E-W	crsG	7-5	2	0	0	0
Do.	7	55°35'	161°18.5'	ExN	E-W	MS	36-35	2	4	1	5
Do.	June 9	55°35.2'	161°19'	ExN	E-W	bldM	36-36	2	35	21	56
Do.	28	55°34.7'	161°17.7'	NNE	E-W	bldM	37-37	3	105	28	133
Do.	Sept. 5	55°34.8'	161°17.2'	W	E-W	MS	37-37	6	7	0	7
Do.	5	55°34.5'	161°17.1'	W	E-W	bldMS	34-34	6	112	50	162
Do.	6	55°34.4'	161°17.2'	W	E-W	bldM	32-32	5	180	49	229
Do.	6	55°34.4'	161°17.8'	W	E-W	bldMS	32-32	6	12	7	19
Do.	6	55°35'	161°18'	W	E-W	S	40-40	5	215	131	346
Section 7	June 9	55°33.1'	161°15.8'	ExN	E-W	M	21-21	2	0	1	1
Totals								45	762	292	1,054

1/ Data September 17 to October 27 are for 1940; all other data are for 1941.

Five drags in the Pavlof Islands, one in Dolgoi Harbor, and four in the channel between Dolgoi and Iliasik Islands, gave poor results. Except for one tow down the middle of Dolgoi Harbor when six crabs were caught in six to 10 fathoms of water, the effort here gave negative results. Likewise, the fish catches continued to be small, the total poundage of the four drags not exceeding 100 pounds.

Balboa Bay to Akutan Bay

Eight other bays farther to the westward along the Peninsula were explored, but Volcano and Cold Bays were the only ones that showed promise of supporting king crab populations. The bodies of water yielding from none to only a few crabs were Balboa Bay, Belkofsky Bay, King Cove, Lenard Harbor, Morzhovoi Bay, and Ikatan Bay.

Although Volcano Bay lies but a few miles to the south of Pavlof Bay, where good king crab catches were obtained, six trawl operations and two sets of tangle gear fished here at three different periods were much less productive. In October, a series of four drags, circling the Bay over mud bottom in depths ranging between 25 and 35 fathoms, gave negative results. The following June, a drag down the center of the Bay netted 28 crabs, 18 of which were males. Two months later, near the end of August, a set of tangle gear, dropped in 41 fathoms in the center of the Bay near the east shore, entangled 21 crabs, of which 20 were females. Another tangle net, set in 45 fathoms in the middle of the opening into the Bay, caught one male crab. This reversal in proportion of males and females indicates that the male crabs had migrated out from the shoal to deeper water.1/

1/ Fishing operations in a 60-fathom gully at the entrance to Pavlof Bay yielded good catches, at this time, mostly composed of large male crabs.

Fair fish catches were obtained during all of these operations. Two of the tows caught over 1,300 pounds of mixed, marketable flatfish.

With the exception of Pavlof and Canoe Bays, Cold Bay showed more promise than any bay along the south side of the Alaska Peninsula. Crabs were found in greatest abundance during the spring and summer operations.

Eight drags and one tangle-net set were made in Cold Bay during October 1940. Five tows in the head of the Bay north of Delta Point and in a depth range of 15 to 32 fathoms over gray mud and sand bottom, caught two crabs and fair quantities of marketable flatfish. Yields of 1,000 pounds per tow were not unusual.

Other fall tows were located just south of Delta Point and followed the west shore. Each drag captured one crab, and the fish "take" was similar to that in the head of the Bay. A set of tangle gear in this location failed to trap any crabs.

The vicinity at the head of Cold Bay was revisited in April, and moulting female crabs mating with the males were taken in shallow water. Four drags picked up 232 crabs of which 155 were males. Another, out in the center of the Bay south of Kaslokan Point and in 10 to 14 fathoms, caught one crab.

Two months later, further prospecting indicated the male crabs were moving out from the shoals. Two drags in the north central part of the Bay in depths from 22 to 31 fathoms, caught six crabs (two males and four females) and 2,000 pounds of bottom fish, most of which were starry flounders. A tow in deeper water (40 to 59 fathoms), over a mud and shell bottom out from Lenard Harbor, caught 39 king crabs of which 31 were males. This operation likewise yielded a catch of starry flounders in excess of 1,500 pounds.

Three drags in the Aleutian Islands, one in Otter Cove, and the other two in Akutan Bay met with negative crab results. The operations in Akutan Bay yielded good fish catches, both taking more than 5,000 pounds of bottom fish, chiefly flathead and rock "sole".

Pavlof and Canoe Bays

Pavlof and Canoe Bays were the most promising of all the Pacific regions visited. Fishing operations revealed an abundant king crab population which is well able to support profitable commercial operations. The only private fishing known to have taken place here was during August 1938. At that time, 315 cases were processed from approximately 4,000 male crabs.1/ Most of these were caught in traps in Canoe Bay; a few, however, including 200 taken in tangle nets, were caught in Pavlof Bay near Gull Island.

This area was prospected by the first expedition of the Alaska Crab Investigation during September and October 1940, and during the second expedition in April, June, August, and early September 1941. (Figures 19, 20, and 21, and Tables 14, 15, and 16.)

Pavlof Bay

To facilitate discussion, Pavlof Bay has been arbitrarily divided into four sections with the following approximate boundaries: Section 1 includes the territory from Dolgoi Island to a line extending roughly between North Ukolnoi Island and Black Rock; Section 4, which is in the head of the Bay, includes all the territory north of Ivan Island; the central portion, lying between these sections, is longitudinally divided near Flat Island to form Section 2 in the west and Section 3 in the east portion of the Bay.

Crabs which had migrated into shallow depths preparatory to moulting and mating were caught in large numbers in Section 4 during April trawling operations. Later on, during summer and fall explorations, the crabs had moved into deeper water, and the best fishing was then found in Section 2 in the deep gully extending past Gull and Flat Islands. Sections 1 and 3 gave relatively poor results whenever fished.

No crabs were caught in Section 1 in four drags during October 1940, and only 25 in three tows in September the following year. A total of 37 were caught in tangle nets at this later date. It is interesting to note that only male crabs were taken while fishing here in depths ranging from 55 to 64 fathoms.

1/ Operations of the Pacific Fisheries and Trading Company.

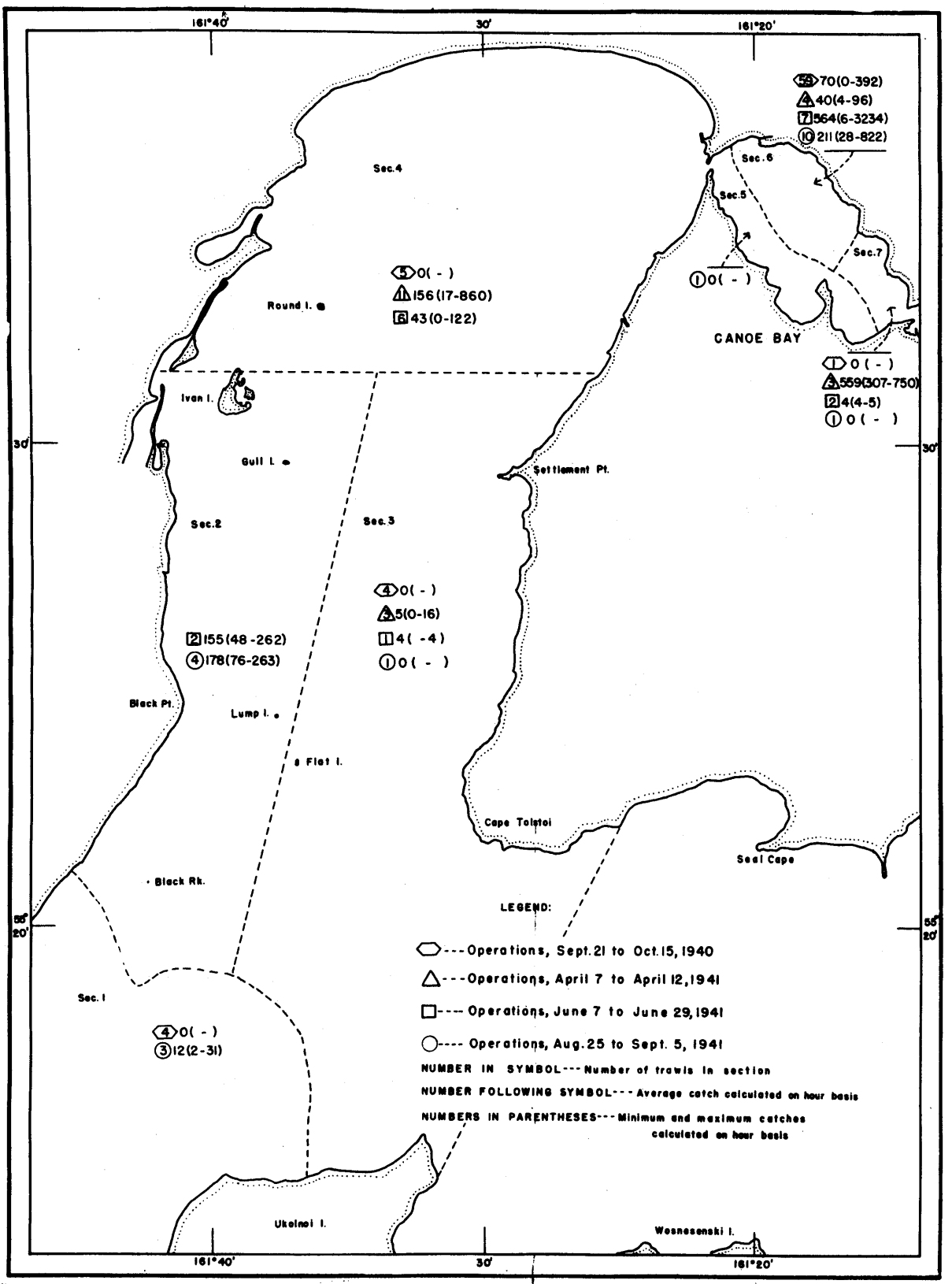

FIGURE 19.--Catch of king crabs in otter-trawl operations in various section of Pavlof and Canoe Bays--(Area X).

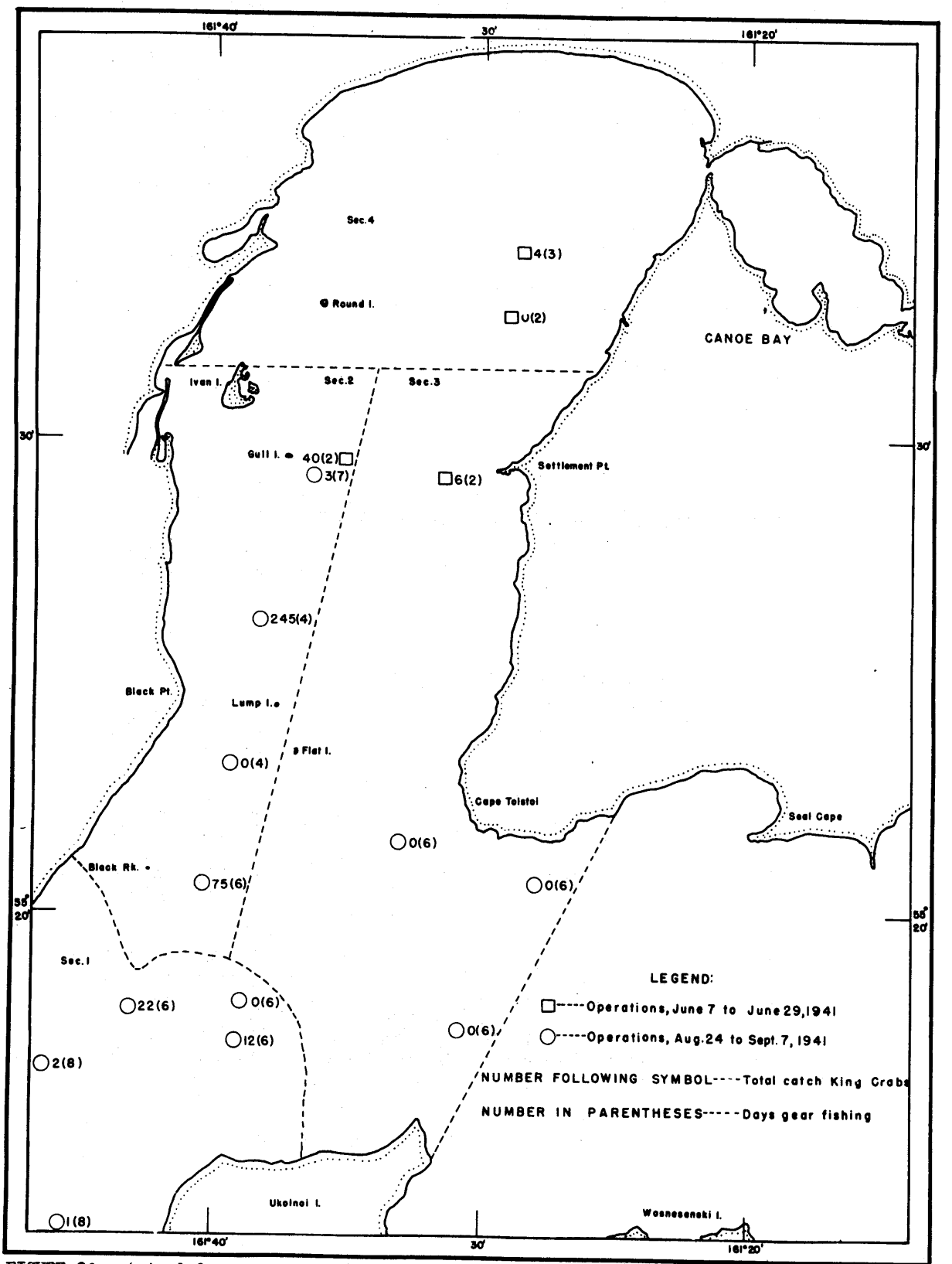

FIGURE 20.--Actual locations of the various tangle-net operations in Pavlof Bay--(Area X), showing catch of king crabs.

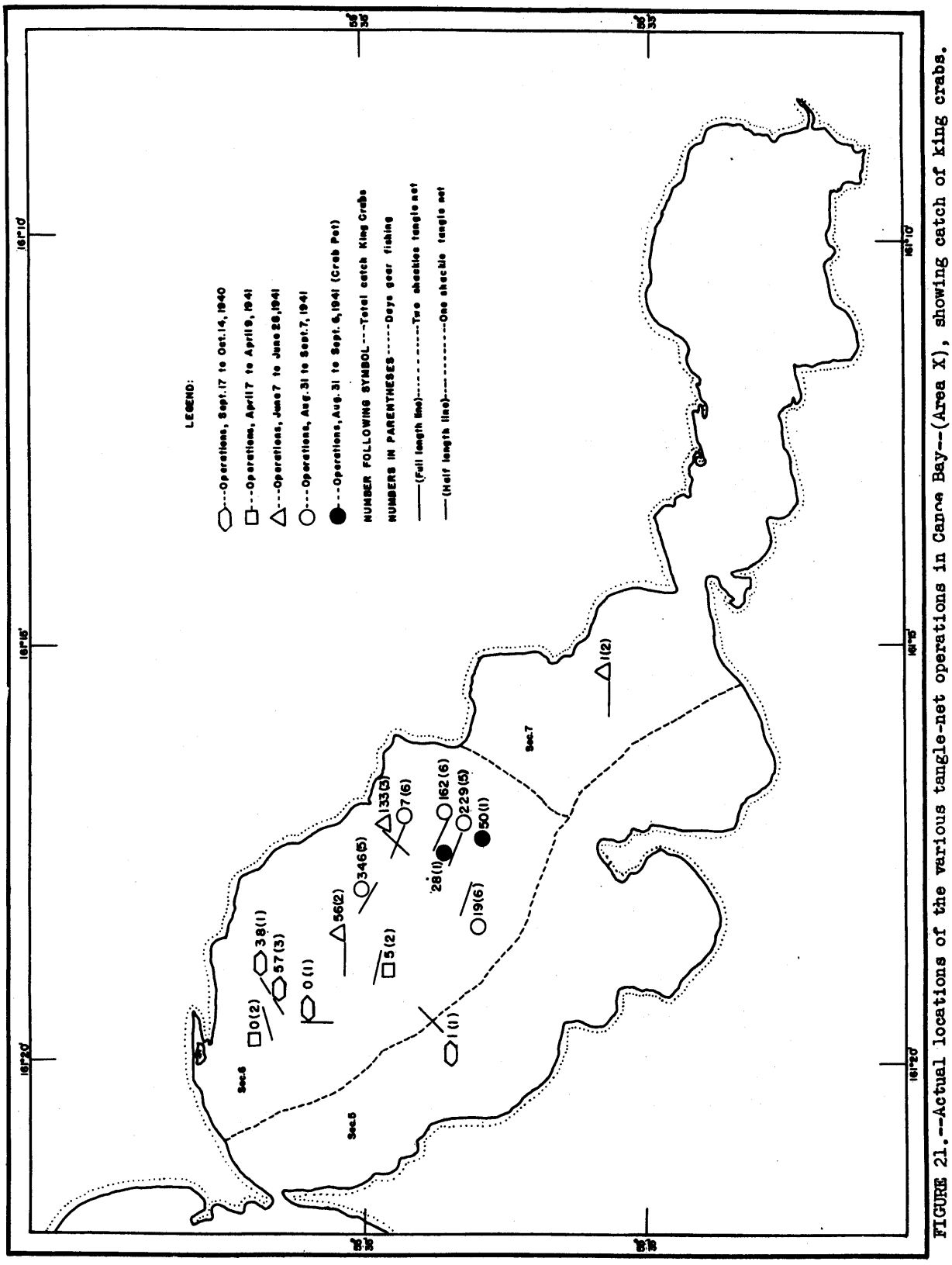

FIGURE 21.--Actual locations of the various tangle-net operations in Canoe Bay--(Area X), showing catch of king crabs.

TABLE 15.--Otter trawl operations: Pavlof Bay, 1940 and 1941

Vicinity	Date 1/	Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: King Males	King Females	King Total	King Hour basis	Dungeness	Tanner	Catch of fish: Halibut Medium	Halibut Small	"Sole"
								Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Number	Pounds
Section 1:																		
Ukolnoi to Arch Point	Oct. 7	55°11'	161°51.5'	E¼N	Flood	N	-	40-65	60	0	0	0	0	0	2	0	0	50
Do.	7	55°15.3'	161°42.6'	WxS¼S	Flood	N	sftS-sftS	58-55	60	0	0	0	0	0	0	0	4	1,000
Do.	7	55°15.5'	161°47.7'	SW¼S	Flood	N	sftS-sftS	55-40	60	0	0	0	0	0	3	1	0	100
Do.	7	55°16.7'	161°47'	ExS	Slack	Nil	MS-MS	57-60	60	0	0	0	0	0	0	0	0	0
Ukolnoi to Black Rock	Sept. 3	55°19.2'	161°40.4'	SWxS	Ebb	S	M-ashesM	62-62	40	21	0	21	32	0	50	0	0	2,500
Do.	4	55°17.1'	161°39.7'	SWxS¼S	Ebb	SW	ashesM-ashesM	56-58	40	1	0	1	1	0	50	0	1	2,400
Do.	4	55°18.7'	161°43.7'	NExW¼N	Flood	N	ashesM-M	62-67	40	3	0	3	4	0	0	1	1	2,700
Section 2:																		
South of Black Point	Sept. 3	55°23.7'	161°39.9'	SxE	Ebb	S	M-M	58-72	40	51	0	51	76	0	300	0	0	3,100
Do.	3	55°21.6'	161°40.2'	SxE	Ebb	S	M-M	72-62	45	198	0	198	263	0	0	0	0	550
Do.	4	55°21.1'	161°40'	SxE¼E	Ebb	S	ashesM-ashesM 2/	76-72	20	6	0	6	18	0	50	0	0	200
North of Black Point	June 8	55°30.1'	161°34.8'	S	Ebb	S	ashes-ashes	28-36	60	78	184	262	262	0	200	0	12	3,000
Do.	29	55°31'	161°35.5'	S	Slack	Nil	bkashes-bkashes	36-50	60	24	24	48	48	0	0	1	4	4,300
Do.	Sept. 3	55°26'	161°39.3'	S¼E	Flood	N	ashesM-ashesM	57-58	35	71	0	71	122	6	200	3	0	4,100
Do.	5	55°26'	161°39.3'	NxE	Flood	N	ashes-ashes	57-56	45	113	75	188	250	0	50	0	0	1,500
Section 3:																		
South of Black Point	Sept. 25	55°23.7'	161°35.1'	SExE¼E	Ebb	S	ashes-MS	50-45	60	0	0	0	0	0	0	0	0	1,500
Do.	25	55°21.3'	161°30.3'	E¼N	Slack	Nil	buSG-bkSSh	22-27	60	0	0	0	0	0	0	0	0	300
Do.	25	55°23.5'	161°31.5'	NxW	Flood	N	-	25-18	120	0	0	0	0	0	0	0	0	2,000
Do.	June 7	55°22.7'	161°32.7'	NxW	Ebb	S	ashesM-orsS 3/	41-23	20	-	-	-	-	-	-	-	-	-
Do.	Sept. 4	55°19.8'	161°30.6'	SW¼W	Ebb	SE	ashesM-ashesM	76-56	30	0	0	0	0	0	1,500	0	0	500
North of Black Point	25	55°29.5'	161°36'	SExS	Ebb	S	ashes-ashesM	47-40	60	0	0	0	0	0	0	0	0	600
Do.	Apr. 12	55°28.2'	161°31'	SExS¼S	Flood	N	S-ashes	25-17	60	15	1	16	16	0	0	3	0	200
Do.	12	55°26.6'	161°30.4'	WxN¼N	Flood	N	ashes-ashes	20-29	60	0	0	0	0	0	20	1	0	1,300
Do.	12	55°25.7'	161°32'	WSW	Flood	N	MS-MS	35-39	35	0	0	0	0	0	0	0	0	100
Do.	June 8	55°30.5'	161°31.2'	SxE	Ebb	S	S-fneG	26-36	60	4	0	4	4	0	0	3	0	3,500
Section 4:																		
Southwest portion	Sept. 24	55°31.1'	161°32.9'	WxN¼W	Ebb	S	ashes-sft	17-12	60	0	0	0	0	0	0	0	0	0
Do.	26	55°32.4'	161°37'	N	Flood	N	stkM-stkM	15-10	40	0	0	0	0	1	0	0	3	1,100
Do.	Apr. 12	55°31.8'	161°36.5'	NExN to N	Slack	Nil	SM-orsS	19-10	60	54	49	103	103	2	0	1	0	400
Do.	12	55°34.1'	161°31.7'	E¼S	Flood	N	MS-SbrkSh	15-13	60	31	16	47	47	0	0	0	0	300
Do.	12	55°31.9'	161°28.7'	WSW	Flood	N	S-ashes	15-20	60	25	19	44	44	0	0	0	0	5,600
Do.	12	55°32'	161°33.9'	NNE	Flood	N	ashes-ashes	18-17	57	9	7	16	17	0	0	0	0	1,000
Do.	June 8	55°32.1'	161°34.8'	NE	Flood	N	M-M	23-17	65	3	3	6	6	0	0	2	0	600
Southeast portion	Sept. 24	55°33.3'	161°29.6'	SSW	Ebb	S	ShM-ashes	17-17	60	0	0	0	0	0	0	0	0	350
Do	Apr. 11	55°34.6'	161°31.8'	ExS	Flood	N	stk-orsS	15-11	60	39	28	67	67	0	0	1	0	1,200
Do.	11	55°33.3'	161°28'	NNE	Flood	N	orsS-SM	11-14	60	46	26	72	72	0	0	0	0	1,100
Do.	11	55°35.5'	161°25.4'	SW¼S	Ebb	S	SM-bkM	15-17	60	45	35	80	80	0	0	0	0	1,400
Do.	June 8	55°34.5'	161°25.8'	SWxS	Slack	Nil	bkashes-bkM 4/	14-12	20	-	-	-	-	-	-	-	-	-
Do.	8	55°33.2'	161°28.7'	NxE	Ebb	S	M-S	17-14	60	4	118	122	122	0	0	0	0	7,000
Northwest portion	Apr. 11	55°36.1'	161°29.2'	SWxS¼S	Flood	N	M-stk	12-14	60	28	12	40	40	12	0	1	0	900
Do.	June 8	55°35.7'	161°29.9'	SW	Flood	N	M-M	14-12	60	13	22	35	35	0	0	0	0	2,000
Northeast portion	Sept. 25	55°35.8'	161°24.5'	SW	Slack	Nil	stk-stk	13-17	60	0	0	0	0	0	0	0	0	300
Do.	26	55°35.9'	161°26'	SWxW¼W	Slack	Nil	stk-stk	14-14	30	0	0	0	0	0	0	0	6	250
Do.	Apr. 11	55°36.1'	161°25.1'	WxS¼S	Ebb	S	M-bkM	13-12	60	138	98	236	236	5	0	1	0	800
Do.	11	55°34.6'	161°28.5'	NNW to E	Ebb	S	bkM-bkM	17-14	60	82	68	150	150	15	0	0	0	300
Do.	12	55°35.8'	161°24.6'	WxS¼S	Flood	N	MS-MS	13-12	63	341	562	903	860	0	0	0	0	300
Do.	June 8	55°35.6'	161°24.7'	WxS¼S	Flood	N	M-M	14-14	60	3	90	93	93	1	0	0	0	5,000
Do.	29	55°35.1'	161°26.2'	SWxS	Ebb	S	gyS-bkashes	15-18	60	1	2	3	3	0	0	0	0	1,100
Totals										2,465	1,447	1,439	2,886	3,071	42	2,425	19	31	5/ 66,500

1/ Data September 24 to October 7 inclusive are for 1940; all other data are for 1941.
2/ Net snagged but part of catch saved.
3/ Net snagged and catch lost.
4/ Net filled with heavy growth of kelp so that no catch was made.
5/ Approximate poundages: yellowtail 38,000; rock "sole" 17,700; starry flounder 6,500; flathead 2,500; lemon "sole" 1,800.

Notes:--In addition to the above, miscellaneous items were taken in approximate amounts as follows: 400 gray cod, 100 bullheads, 30 Alaska pollock, and a few shrimp and turbot. The sections referred to under "Vicinity" are those designated in Figure 19.

TABLE 16.—Otter trawl operations: Canoe Bay, 1940 and 1941

Vicinity	Date 1/	Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: King: Males	King: Females	King: Total	King: Hour basis	Tanner	Fish "Sole"
								Fathoms	Minutes	Number	Number	Number	Number	Number	Pounds
Section 6	Sept. 21	-	-	-	Ebb	W	stk-stk	40-40	15	0	0	0	0	-	-
	21	-	-	WNW	Flood	E	stk-stk	35-35	60	0	0	0	0	-	-
	21	-	-	-	Ebb	W	stk-stk	22-40	75	30	120	150	120	-	-
	22	55°34.8'	161°18.3'	WNW	Flood	E	stk-stk	35-7	30	52	61	113	226	-	-
	22	55°34.7'	161°18.5'	WNW	Flood	E	M-M	31-5	30	0	0	0	0	-	-
	22	55°35.1'	161°18.0'	WNW	Flood	E	stk-stk	36-4	60	5	7	12	12	-	-
	23	55°35.4'	161°17.5'	WxN to NW	Ebb	W	bkS-fneG	9-13	30	2	0	2	4	-	-
	23	55°35.7'	161°19.2'	ExS	Ebb	W	-	25-25	15	30	30	60	240	-	-
	23	55°35.7'	161°20.0'	ExS	Slack	Nil	stk-stk	14-34	30	2	2	4	8	-	-
	23	55°35.5'	161°18.7'	Half circle W	Flood	E	stk-hrd	35-25	90	8	5	13	9	-	-
	23	55°35.2'	161°19.1'	WNW to NW	Flood	E	stk-stk	34-21	30	4	8	12	24	-	-
	23	55°34.1'	161°16.5'	W	Slack	Nil	stk-stk	25-25	40	48	100	148	222	-	-
	24	55°34.0'	161°17.2'	Half circle N	Ebb	W	stk-stk	25-40	30	31	9	40	80	-	-
	24	55°35.8'	161°20.5'	ExS to S	Ebb	W	stk-stk	4-40	30	6	4	10	20	-	-
	24	55°35.5'	161°20.1'	ExS to S	Ebb	W	stk-stk	6-40	30	7	3	10	20	-	-
	24	55°34.5'	161°17.5'	"S" curve	Flood	E	stk-stk	36-22	90	0	0	0	0	-	-
	26	55°35.7'	161°19.9'	SExS to S	Slack	Nil	stk-stk	20-20	42	1	69	70	100	-	-
	26	55°35.1'	161°17.4'	SExS to S	Ebb	W	stk-stk	25-25	50	96	6	102	122	-	-
	26	55°35.2'	161°19.8'	SExS to S	Ebb	W	stk-stk	25-25	50	7	3	10	12	-	-
	27	-	-	NE to SE	Flood	E	stk-stk	25-25	30	30	15	45	90	-	-
	27	-	-	WxN to WSW	Slack	Nil	stk-stk	30-30	45	24	12	36	48	-	-
	27	-	-	NE to SE	Ebb	W	stk-stk	32-32	28	30	15	45	96	-	-
	27	-	-	-	Ebb	W	stk-stk	30-28	45	12	6	18	24	-	-
	27	-	-	-	Ebb	W	stk-stk	31-29	40	30	15	45	68	-	-
	27	-	-	NE to ESE	Slack	Nil	stk-stk	25-27	15	40	26	66	264	-	-
	27	-	-	-	Flood	E	stk-stk	28-22	15	60	38	98	392	-	-
	27	-	-	NE to ExS	Flood	E	stk-stk	26-24	40	20	8	28	42	-	-
	28	55°35.7'	161°20.0'	NE to SExS	Flood	E	stk-stk	9-35	40	22	23	45	68	-	-
	28	55°35.1'	161°18.5'	WxN	Flood	E	stk-stk	35-5	40	46	46	92	138	-	-
	28	55°35.3'	161°19.8'	NE to SE	Ebb	W	stk-stk	18-39	40	39	39	78	117	-	-
	28	55°34.6'	161°16.9'	W	Ebb	W	stk-M 2/	27-10	55	57	57	114	124	-	-
	30	55°34.6'	161°18.7'	WxN to W	Ebb	W	stk-rky 3/	31-5	42	35	11	46	66	-	-
	30	55°35.9'	161°20.6'	E to SE	Ebb	W	stk-stk	4-36	40	23	6	29	44	-	-
	30	55°35.6'	161°18.5'	SW to WSW	Ebb	W	stk-stk	17-6	30	35	13	48	96	-	-
	Oct. 1	55°34.8'	161°17.4'	W	Flood	E	stk-stk 4/	34-7	35	4	2	6	10	-	-
	1	55°35.3'	161°20.6'	ENE to ESE	Flood	E	stk-stk	7-34	30	1	1	2	4	-	-
	1	55°35.2'	161°17.9'	WxN to WxS	Flood	E	stk-stk	36-7	40	0	0	0	0	-	-
	1	55°35.7'	161°20.0'	Follow N shore	Ebb	W	M-stk	7-27	45	20	9	29	39	-	-
	1	55°35.7'	161°18.7'	Follow W shore	Ebb	W	stk-M 2/	15-9	40	5	3	8	12	-	-
	1	55°35.7'	161°19.5'	S to ESE	Ebb	W	stk-stk	27-20	60	4	2	6	6	-	-
	1	55°34.6'	161°18.0'	W	Ebb	W	stk-stk	34-4	60	100	40	140	140	-	-
	2	55°34.4'	161°17.0'	W	Flood	E	M-G	27-7	60	56	7	63	63	-	-
	2	55°35.5'	161°20.0'	E to ESE	Flood	E	stk-stk	10-27	25	5	1	6	14	-	-
	2	55°34.6'	161°17.0'	W	Flood	E	stk-stk	27-10	50	8	4	12	14	-	-
	2	55°34.6'	161°17.2'	SExS	Flood	E	stk-stk	27-7	60	20	5	25	25	-	-
	2	55°35.3'	161°20.8'	ExS	Slack	Nil	stk-stk	7-32	65	12	2	14	13	-	-
	2	55°34.5'	161°17.6'	WxN	Ebb	W	stk-stk	30-10	60	20	5	25	25	-	-
	2	55°35.7'	161°20.0'	ENE to SE	Ebb	W	stk-stk	10-36	60	17	4	21	21	-	-
	3	55°35.1'	161°20.2'	ENE to SE	Flood	E	stk-stk	8-36	60	8	3	11	11	-	-
	3	55°35.2'	161°17.8'	WxS to WSW	Flood	E	stk-stk	36-8	40	2	1	3	4	-	-
	3	55°35.2'	161°20.2'	ENE to ExS	Flood	E	stk-stk	8-39	45	45	20	65	87	-	-
	3	55°34.8'	161°18.0'	WxN to SWxW	Flood	E	stk-stk	39-8	45	173	60	233	311	-	-
	3	55°35.2'	161°20.4'	NExE to ExS	Ebb	W	stk-stk	7-39	50	60	28	88	106	-	-
	3	55°34.7'	161°17.9'	WxN to SWxW	Ebb	W	stk-stk	39-7	55	39	18	57	62	-	-
	3	55°34.7'	161°17.7'	NExE to SExS	Ebb	W	stk-stk	39-7	50	75	40	115	138	-	-
	15	55°35.2'	161°20.4'	NE to ESE	Flood	E	stk-stk	7-34	55	21	0	21	23	-	-
	15	55°34.3'	161°17.2'	W	Flood	E	stk-stk	27-13	50	39	30	69	83	-	-
	15	55°34.9'	161°20.3'	NE to SE	Flood	E	stk-stk	13-39	50	16	0	16	19	-	-
	15	55°34.7'	161°17.2'	W	Ebb	W	stk-stk	34-5	55	6	1	7	8	-	-
	Apr. 7	55°35.0'	161°19.7'	E	Ebb	W	S-M	25-23	60	20	20	40	40	300	3,700
	8	55°34.9'	161°17.9'	W	Ebb	W	S-S	39-9	60	72	24	96	96	1,500	3,000
	8	55°34.7'	161°17.3'	WxN	Ebb	W	S-S	34-29	50	2	1	3	4	800	7,000
	9	55°35.3'	161°19.7'	SExS to E	Flood	E	M-M	22-27	30	9	2	11	22	300	3,100
	June 8	55°34.8'	161°17.1'	W	Flood	E	bkM-M	28-8	60	32	75	107	107	12	5,500
	7	55°35.4'	161°19.0'	SExS to E	Flood	E	MS-MS	37-21	40	23	27	50	100	0	600
	7	55°34.5'	161°18.0'	NWxW	Ebb	W	MS-MS	36-12	50	40	11	51	61	0	8,000
	7	55°35.9'	161°19.1'	SW to SE	Ebb	W	S-S	12-24	40	20	2	22	33	0	2,000
	7	55°33.7'	161°18.1'	NNE	Ebb	W	MS-MS	24-24	30	3	0	3	6	0	200
	28	55°34.6'	161°17.1'	Follow NE shore	Ebb	W	bkMS-bkMS	33-34	30	822	795	1,617	3,234	4,000	200
	28	55°34.3'	161°17.7'	WNW	Flood	E	bkMS-bkMS	30-29	30	47	155	202	404	500	3,700
	Aug. 25	55°34.7'	161°17.1'	WNW	Flood	E	bkMS-S	33-38	20	8	7	15	45	48	1,500
	25	55°34.5'	161°17.1'	WNW	Flood	E	bkMS-bkMS 5/	30-35	30	-	-	-	-	-	-
	27	55°34.8'	161°17.6'	WNW	Ebb	W	bkMGS-bkMS	38-36	30	15	6	21	42	700	3,000
	27	55°34.3'	161°16.3'	SSW to NNE	Flood	E	bkMS-bkMS	23-25	30	8	11	19	38	0	5,500
	27	55°34.6'	161°16.6'	SSW	Flood	E	bkMS-bkMS	27-18	30	55	46	101	202	50	3,300
	28	55°34.8'	161°16.9'	SSW	Ebb	W	bkMS-bkMS	18-27	30	158	253	411	822	500	4,800
	28	55°35.0'	161°17.2'	SSW	Flood	E	SSh-bkM	22-28	30	35	36	71	142	700	4,700
	29	55°35.1'	161°17.3'	SSW	Ebb	W	bkMS-bkMS	25-29	30	51	61	112	224	200	4,500
	29	55°35.0'	161°17.0'	SSW	Ebb	W	bkMS-bkMS	18-27	30	34	75	109	218	0	4,600
	29	55°34.5'	161°16.6'	WxN to N	Flood	E	bkMS-bkMS	27-37	30	76	100	176	352	0	4,200
	29	55°34.3'	161°17.4'	NWxW	Flood	E	bkMS-bkMS	27-37	30	10	4	14	28	100	3,000
Section 7	Sept. 23	55°34.5'	161°16.9'	W to N	Flood	E	stk-stk	30-5	40	0	0	0	0	-	-
	Apr. 9	55°33.3'	161°15.6'	Circle	Ebb	W	M-M	19-25	30	160	150	310	620	50	300
	9	55°33.5'	161°15.8'	Circle	Ebb	W	M-M	25-18	30	202	173	375	750	0	300
	9	55°33.1'	161°15.3'	Circle	Ebb	W	M-rky	18-6	45	120	110	230	307	200	0
	June 7	55°33.3'	161°15.7'	W to N	Ebb	W	MS-MS	21-25	30	0	2	2	4	0	800
	28	55°33.2'	161°16.0'	NWxN	Flood	E	bkMS-stk	22-26	25	1	1	2	5	6	2,500
	Aug. 27	55°33.9'	161°15.9'	Circle	Flood	E	bkM-bkM	20-25	30	0	0	0	0	100	4,000
Section 5	28	55°33.6'	161°17.3'	WxN to N	Flood	E	bkM-bkM	26-14	30	0	0	0	0	0	7,000
Totals										3,677	3,611	3,190	6,801	12,040	10,066	6/ 91,000

1/ September and October data are for 1940; all other data are for 1941.
2/ Net tore due to mudding down.
3/ Net snagged but part of catch saved.
4/ Cables fouled so that net did not fish properly.
5/ Draw rope closing bottom of net parted and catch lost.
6/ Approximate poundages: yellowtail 44,200; starry flounder 36,500; rock "sole" 8,000; lemon "sole" 1,300; flathead 1,000. These data are for 1941 work only since systematic records were not kept in 1940 for catches of other than king crabs. Field notes indicate that 1940 catches of bottom fish were comparable to those of 1941.

Notes:—In addition to the above, miscellaneous items were taken in approximate amounts as follows (1941 data only): 57 gray cod, 14 small and 1 medium halibut, 2 Alaska pollock, a few shrimp, and some 3,400 pounds of bullheads. No dungeness crabs were taken. Sections referred to under "Vicinity" are those designated in Figure 19.

Section 2, which was fished only in June and September, supplied comparable catches on both occasions. Two 60-minute drags in June caught an average of 155 crabs, while 178 were taken per hour in the four tows made during September. In June, fishing was conducted in depths ranging from 28 to 50 fathoms, and in September in depths of 56 to 72 fathoms.

A tangle-net catch of 40 crabs in 42 fathoms was taken here in June. During September, only three crabs were caught in a set in 47 fathoms, but two other sets in 59 and 77 fathoms, respectively, caught 245 and 75 large male crabs.

Section 3 was fished with very meager results on all the four occasions Pavlof Bay was visited.

Two of the three drags made here during April in from 20 to 39 fathoms were negative, and the third caught only 16 crabs. An hour of trawling in 26 to 36 fathoms in June produced only four male crabs. No crabs were caught in depths ranging from 18 to 76 fathoms. Six crabs were taken in one tangle net which was set here in June, but nothing was caught in four more sets made in September.

The effects of seasonal migration upon the productivity of a fishing area was very clearly illustrated in shallow Section 4. April catches for 11 drags made in depths from 10 to 20 fathoms averaged 156 crabs per hour. At this time one 63-minute drag caught 903 crabs, of which many were large males. By the first part of June, the catch rate per hour for six tows had dropped to 43, and only four crabs were caught in two tangle-net sets at that time. Although 48 percent of the crabs caught in April were males, in June only eight percent were of that sex.

In September, no females were caught in five drags in these same shallow depths. It may be assumed that a greater portion of the crabs found here during the April effort had since migrated to the deeper Section 2 where good catches were made during the later prospecting work.

Nearly all of Pavlof Bay is well-suited for trawling. The only difficulties encountered were two snags between Flat Island and the shore from Cape Tolstoi to about three miles above Two Pinnacle Rocks.

An average of 1,500 pounds of flatfish was caught per drag in Pavlof Bay. Catches of 4,000 and 5,000 pounds were not uncommon. Yellowtail constituted over half the catch, with rock "sole" and starry flounders coming second and third. Only small amounts of flathead and lemon "sole" were taken. Halibut, 31 small and 19 medium-sized; 42 dungeness crabs; and 2,425 tanner crabs, made up the remaining portions of the catches.

Canoe Bay

Canoe Bay, with fishing grounds less than two miles across at the widest point and five miles long, was fished more intensively than any other area of similar size. Nearly 7,000 crabs were caught here, and only two percent of approximately 500 tagged crabs were recovered. This, along with the 4,000 large males canned in 1938, indicates a very large concentration of king crabs in this Bay.

For simplicity of comparison and because of characteristic fishing results, the Bay has been divided into three sections (Figures 19 and 21). Section 5 covers about one-third the width of the Bay and extends the entire length of the southwest shore. Much of this Section is shallow and in places too rocky for trawling. Section 6, which includes the deepest portion of the Bay, starts near the entrance and extends two-thirds the length of the northeast shore. Section 7 continues on from Section 6 and is bounded by the remaining one-third of the northeast shore. This Section in the head of the Bay is shallow and extends into the very shoal area at the mouth of the lagoon.

Although not always taken in the same places, large quantities of crabs were caught on every occasion Canoe Bay was visited. While fishing here in April, large quantities of crabs were caught near the head of the Bay in Section 7, and only small amounts were caught in the deep water near the middle of the Bay. However, on all occasions other than during the spring mating season, the best fishing was found in Section 6 in depths ranging from 25 to 40 fathoms. No crabs were caught in Section 5 in the one drag that was made there. More specifically, the results in Sections 6 and 7 follow.

In September and October, the catches in Section 6 ranged from none to 233 crabs to the drag. An average catch of 70 crabs per hour of trawling was attained in 59 drags completed at this time. Four tangle-net sets, extending north and south across this Section at a point two miles in from the entrance, caught 96 crabs. All except two of these were taken in 30 fathoms in the two sets nearest the northeast shore.

The following April, 150 crabs were caught in four drags. Two of these drags, which never fished shallower than 22 fathoms, caught a total of only 14 crabs. At this same time, five crabs were caught in two sets of tangle nets.

In June, seven drags averaged 564 crabs per hour of trawling effort with individual catches ranging from three to 1,617 crabs. This latter amount was obtained in 30 minutes and is the largest catch taken, per unit of time, during the Investigation. Fair tangle-net catches were also made with two sets in 36 fathoms yielding 189 crabs.

Fishing was very good in this Section of the Bay during August, also, as individual catches ranged from 14 to 411 crabs to the drag for an average of 211 per hour of trawling. September tangle-net fishing was also very good. A total of 763 crabs were caught in five sets in depths ranging from 32 to 40 fathoms. These nets were all located in the north central portion of the Bay in the head end of Section 6. A catch of 78 crabs consisting primarily of small ones was taken in two pots located near these tangle nets.

Abundant quantities of crabs apparently migrate into the shallower waters at the head of Canoe Bay, Section 7, during the early spring; and, as mentioned previously, large catches were made here during April 1941. These ranged from 230 to 375 crabs in drags of shorter than one-hour duration and averaged 559 per hour of trawling effort. By summer, however, the population had returned to the deeper waters of Section 6, since the June effort yielded but four crabs in two tows and one crab in a set of tangle net. Single tows in August and September were completely negative.

From the results of the above observations and limited tagging returns, it is believed many of the crabs remain in this Bay throughout the year.

In addition to the large catches of king crabs, consistently good catches of marketable flatfish also were made in Canoe Bay. Drags of 30- to 40-minute duration averaged 4,000 pounds of these fish, and catches of 7,000 and 8,000 pounds were not uncommon. Starry flounder was the most prevalent species, with yellowtail and rock "sole" coming second and third in abundance. Catches of 500 to 800 tanner crabs per drag were very common. One record-breaking catch containing 4,000 of these crabs was taken here in 30 minutes of trawling.

The fishing results in Canoe Bay suggest this small Bay to be one of the most productive in king crabs and fish life for its size in the whole of Alaska.

Bering Sea

Fishing operations in the Bering Sea were carried on from mid-April to mid-September except for a time during June when the vessels were rechecking regions south of the Peninsula en route to and from Kodiak. Two major areas were investigated: one included the waters up to 100 miles offshore between Cape Mordvinof and Cape Newenham (Area XI); the other extended from the waters around the Pribilof Islands to St. Lawrence Island (Area XII). (Figure 2.) Area XI yielded the largest catch taken during the Investigation, and proved more promising than any others for sustaining a large-scale, commercial king crab fishery. This result is not surprising, since reports of Japanese crab fishing along the Alaska Peninsula indicate greatest activity in these waters.

Cape Mordvinof to Cape Newenham (Area XI)

The greater amount of the prospecting in this Area was carried on in the region extending some 30 miles offshore between Cape Mordvinof and Ugashik (Sections 1 to 15, inclusive, and Sections 19, 20, and 24). (Figures 22 and 23.)

Recurring fishing operations were conducted within the region during the periods April 28 to May 12, May 13 to June 13, and July 10 to August 19.

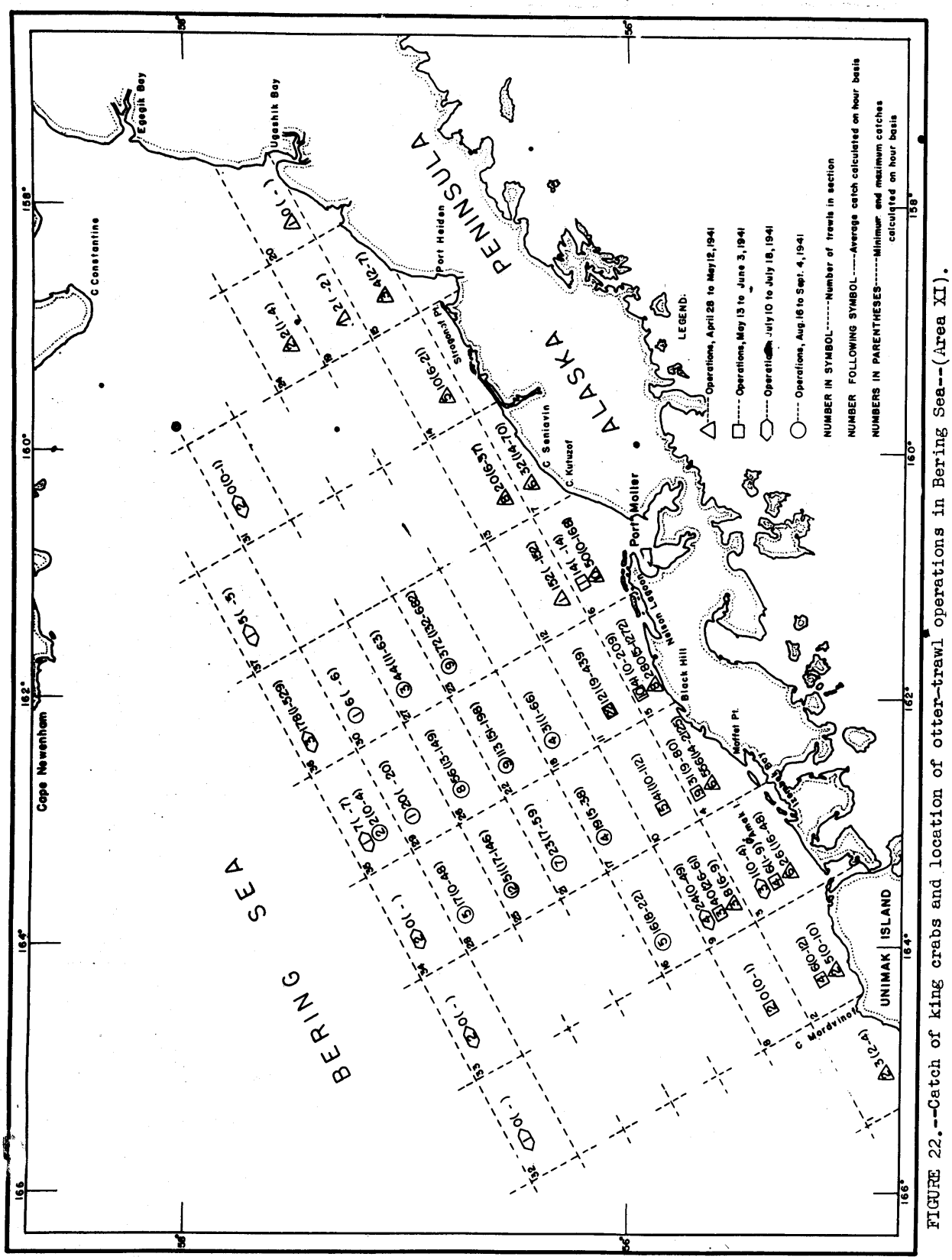

FIGURE 22.--Catch of king crabs and location of otter-trawl operations in Bering Sea--(Area XI).

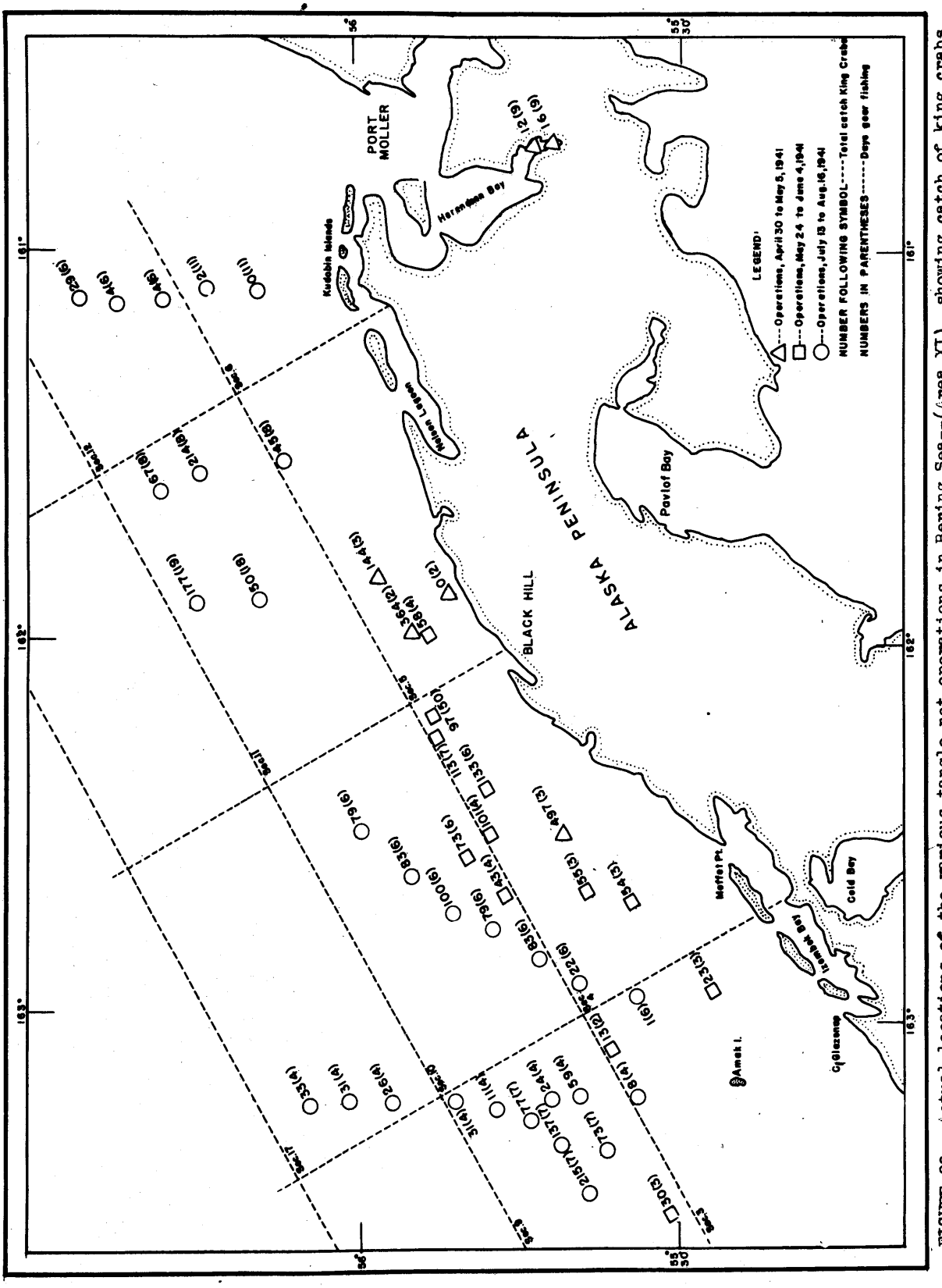

FIGURE 23.--Actual locations of the various tangle-net operations in Bering Sea--(Area XI), showing catch of king crabs.

From July 10 to July 18 and again August 16 to September 4, fishing was done in a region 30 to 100 miles offshore between 56° 00' and 57° 40' N. latitude. (Sections 16 to 18, 21 to 23, and 25 to 37, inclusive.) In order to simplify discussion of the fishing effort within the general area, the work in the two regions will be referred to as the "inshore operations" and the "offshore operations" and will be reported separately. The results of the inshore operations (Tables 17 and 18) follow.

Inshore Operations in Area XI

(Cape Mordvinof to False Pass--Sections 1, 2, and 8.)

Fishing was started a few miles to the westward of Cape Mordvinof, off Cave Point, in the latter part of April. Seven drags, three of which resulted in snags, were made in depths from 14 to 34 fathoms and, of the 24 crabs caught, 20 were taken in depths of less than 29 fathoms.

Later, in the first week of June, six more drags were made, and similar results were obtained over the same Sections. Three tows in depths less than 31 fathoms netted 23 crabs, while the same number of drags in depths from 44 to 47 fathoms caught but one crab.

However, at the same time one set of tangle net in 36 fathoms of water caught 17 crabs of which 15 were males of canning size. This catch would indicate that there were crabs out in the deeper water at this time of year but perhaps not in as great numbers as nearer inshore.

The bottom between Cave Point and Cape Mordvinof is rocky in spots and is treacherous for trawling, as evidenced by the three snags occurring in this vicinity. Above Cape Mordvinof, the bottom is composed mostly of coarse sand and fine gravel.

In addition to the catch of crabs, each drag picked up 1,000 pounds or more of marketable flatfish, and catches of 3,000 pounds were not unusual. Rock "sole" made up the bulk of the catch, followed in importance by yellowtail and starry flounders.

(False Pass to Moffet Point--Sections 3, 9, and 17.)

The work in this region was centered about Amak Island. The Island served as a focal point for taking bearings and, in the case of bad weather, offered some protection from the elements.

Northeast of False Pass the bottom gradually changes to fine, gray sand, but a few patches of coarse sand are still found, particularly in the shoaler areas.

Three series of trawl operations, carried on around May 1, indicate the distribution of king crabs for this locality during the early spring.

In the first series, three drags were made between Amak Island and Izembek Bay in depths from 16 to 19 fathoms and on bottom of coarse and fine sand. The catches averaged 24 crabs per hour of dragging of which approximately 75 percent were males. Northeast and north of Amak Island in a depth range of 17 to 34 fathoms, a second series of three more drags averaged 28 crabs, 45 percent of these being males. Beyond Amak Island in still deeper water, 34 to 39 fathoms, the average dropped to eight crabs for three drags. Although the catches were not particularly large, the results do indicate that the crabs here are mostly inside the 34-fathom depth at this time of the year.

Later operations over these same Sections showed a complete reversal of catches in relation to depth.

One month later, the first of June, four drags in the shallower depths, at 18 to 31 fathoms, averaged only six crabs compared to the previous averages of 24 and 28 per hour of dragging in May. No drags were made at this time out in deeper water. However, some six weeks later, around the middle of July, four drags and four sets of tangle gear north of Amak Island, fished between depths of 39 to 45 fathoms, averaged 24 crabs per hour dragging and 125 crabs per set, respectively.

TABLE 17.--Otter trawl operations: Bering Sea, Area XI--Inshore, 1941

Vicinity	Date		Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: King: Males	Catch of crabs: King: Females	Catch of crabs: King: Total	Catch of crabs: Hour basis	Catch of fish: Halibut: Medium	Catch of fish: Halibut: Small	Catch of fish: Gray cod	Catch of fish: Alaska pollock	Catch of fish: "Sole"
									Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Pounds	Pounds
Cape Mordvinof to False Pass:																			
Section 1	Apr.	28	54°18'	161°13'	N½W	Slack	Nil	SbkG-SbkG 1/	30-34	130	-	-	-	-	-	-	-	-	-
		28	54°58'	161°24'	E	Ebb	S	orsbkS-orsbkS 1/	15-18	60	-	-	-	-	-	-	-	-	-
		28	54°57'	161°17'	NE	Ebb	S	orsbkS-orsbkS 2/	15-15	70	1	0	1	1	-	-	-	-	1,700
		28	54°48'	161°44'	NE	Ebb	S	bkG-orsS	31-25	120	2	1	3	2	0	30	80	500	1,500
		28	54°52'	161°38'	NxE to NNE	Flood	NE	orsS-fneG	25-29	120	7	2	9	4	3	8	100	500	2,000
Section 2		28	55°00'	161°04'	NE to N	Flood	NE	fneGS-Sh	14-16	135	0	0	0	0	0	0	0	0	300
		28	55°06'	161°01'	N	Slack	Nil	bkS-orsSG	20-21	65	6	5	11	10	0	0	40	2,000	2,000
	June	3	55°10'	161°22'	NExN	Ebb	SW	orsG-S	40-39	95	0	0	0	0	0	0	25	0	600
		3	55°13'	163°37'	NWxW	Ebb	SW	fnegS-orsS	26-31	60	3	8	11	11	0	6	0	0	3,500
		3	55°15'	163°47'	SW	Ebb	SW	orsS-fnegS	31-31	60	5	7	12	12	0	0	0	0	3,700
	July	10	55°07'	163°35'	NNE	Ebb	SW	gyS-gyS	17-19	60	0	0	0	0	0	48	12	0	1,100
Section 8	June	3	55°15'	161°20'	NExN	Ebb	SW	orsG-S	45-44	90	0	0	0	0	0	0	25	7,000	400
		3	55°22'	163°58'	NExN	Flood	NE	fneG-S	45-47	70	1	0	1	1	0	0	8	50	100
False Pass to Moffet Point:																			
Section 3	Apr.	29	55°20'	163°07'	NNE	Flood	NE	gyS-gyS	17-19	60	28	3	31	31	0	1	24	0	650
		29	55°23'	163°02'	NNE	Flood	NNE	gyS-orsSG	19-16	60	11	9	20	20	0	0	6	0	700
		29	55°25'	162°57'	NNE	Flood	NNE	fneSG-fneGSh	16-16	60	17	4	21	21	0	0	6	0	100
		30	55°31'	163°06'	WNW	Ebb	SW	bkGgyS-fnegyS	25-34	120	20	13	33	16	0	0	12	0	2,000
	May	1	55°37'	162°58'	ESE	Ebb	SW	S-fnegyS	25-24	120	57	40	97	48	0	0	12	0	3,700
		1	55°32'	162°53'	ESE	Slack	Nil	fnegyS-fnegyS	24-17	120	30	8	38	19	0	0	24	0	4,000
	June	1	55°35'	163°03'	SW	Ebb	SW	fnegyS-fnegyS	31-31	90	12	2	14	9	0	0	0	0	400
		1	55°25'	163°00'	SSW	Flood	NE	orsS-orsSG	18-25	60	1	0	1	1	0	0	0	0	2,500
		2	55°22'	163°10'	SWxS	Flood	NE	fnegyS-fnegyS	18-16	60	3	5	8	8	0	3	5	0	1,000
		3	55°19'	163°27'	SWxS	Ebb	SW	fnegyS-fnegyS	27-27	60	1	5	6	6	0	12	5	25	4,000
	July	10	55°15'	163°33'	NExN	Flood	NE	fnegyS-fnegyS	26-28	60	0	0	0	0	0	24	6	0	3,700
		10	55°18'	163°34'	NExE	Flood	NE	orsS-fnegyS	32-30	60	0	0	0	0	0	14	6	0	1,500
		10	55°24'	163°24'	NExE½E	Slack	Nil	fnegyS-fnegyS	31-28	60	2	2	4	4	0	12	12	0	3,500
Section 9	Apr.	30	55°37'	163°17'	NW	Ebb	SW	fnegyS-fnegyS	34-39	120	12	6	18	9	0	0	24	500	1,700
		30	55°45'	163°18'	NE	Flood	NE	fnegyS-fnegyS	39-38	60	6	0	6	6	0	0	5	0	700
		30	55°45'	163°13'	ESE	Flood	NE	fnegyS-orsS	38-35	140	12	6	18	8	0	0	10	0	3,300
	June	1	55°34'	163°20'	SW	Flood	NE	bkS-bkS	35-37	95	30	66	96	61	0	0	0	300	700
		2	55°32'	163°30'	SW	Ebb	SW	fnebkS-fnebkS	39-41	90	28	11	39	26	0	0	0	0	1,000
		2	55°30'	163°42'	SW	Ebb	SW	fnebkS-fnebkS	41-44	50	9	18	27	32	0	0	0	0	800
	July	10	55°25'	163°46'	NxW	Slack	Nil	fnegyS-fnegyS	43-45	60	0	0	0	0	0	0	3	0	500
		10	55°33'	163°38'	NE½E	Ebb	SW	fnegyS-fnegyS	44-42	90	20	0	20	13	0	0	1	0	400
		10	55°36'	163°28'	NE½E	Ebb	SW	fnegyS-fnegyS	42-42	60	8	25	33	33	0	0	3	0	500
		10	55°39'	163°21'	ESE	Flood	NE	fnegyS-fnegyS	42-39	60	17	32	49	49	0	0	0	0	600
Moffet Point to Black Hill:																			
Section 4	May	1	55°35'	162°35'	NxW	Flood	NE	fnegyS-fnegyS	21-24	90	1,373	1,815	3,188	2,125	0	0	0	0	200
		2	55°36'	162°35'	NWxN	Flood	NE	fnegyS-fnegyS	22-23	45	36	36	72	96	0	0	0	0	400
		2	55°39'	162°35'	NE	Flood	NE	fnegyS-fnegyS	23-24	60	71	100	171	171	0	1	0	0	1,000
		3	55°37'	162°32'	ENE	Slack	Nil	fnegyS-fnegyS	23-21	60	289	387	676	676	0	0	0	0	500
		3	55°40'	162°26'	NNW	Slack	Nil	fnegyS-fnegyS 2/	23-25	60	148	106	254	254	0	0	2	0	1,200
		5	55°42'	162°21'	N	Flood	NE	fnegyS-fneG	21-25	60	10	4	14	14	0	0	0	0	700
		24	55°52'	162°18'	SWxW	Slack	Nil	S-Sh	34-36	65	8	79	87	80	1	0	45	500	1,000
		24	55°51'	162°22'	SExS	Ebb	SW	fnegyS-P	33-29	60	17	3	20	20	0	0	50	300	1,000
		24	55°48'	162°21'	SExS	Slack	Nil	P-P	29-29	50	19	1	20	24	0	0	30	0	500
		31	55°41'	162°43'	SE	Ebb	SW	fnegyS-fnegyS	36-29	70	9	23	32	28	0	3	90	1,000	3,500
		31	55°39'	162°30'	SWxS	Flood	NE	fnegyS-fnegyS	22-21	60	51	0	51	51	0	22	5	0	1,500
	June	1	55°42'	162°42'	SW	Ebb	SW	fnegyS-fnegyS	26-26	90	11	4	15	10	0	0	8	0	1,000
		1	55°38'	162°52'	SW	Ebb	SW	fnegyS-fnegyS 3/	26-31	90	-	-	-	-	-	-	-	-	-
		1	55°38'	162°40'	SWxW	Ebb	SW	fnegyS-fnegyS	21-20	60	39	1	40	40	0	0	12	0	2,500
		1	55°34'	162°44'	SSW	Ebb	SW	fnegyS-fnegyS	20-23	60	9	0	9	9	0	6	30	0	2,300
		1	55°31'	162°49'	SSW	Flood	NE	fnegyS-fneG	23-21	60	15	2	17	17	0	6	46	0	1,500
Section 10	May	24	55°53'	162°28'	SExS	Ebb	SW	fnegyS-fnegyS	36-33	65	8	26	34	31	0	0	20	100	800
		24	55°52'	162°33'	SE	Ebb	SW	fnegyS-fnegyS	32-30	60	23	89	112	112	0	12	24	500	1,000
		31	55°48'	162°40'	SE	Flood	NE	fnegyS-fnegyS	29-26	60	8	2	10	10	0	0	0	500	1,700
		31	55°45'	162°44'	ESE	Flood	NE	fnegyS-fnegyS	29-26	60	9	16	25	25	0	0	0	0	1,500
		31	55°46'	162°42'	NxN	Ebb	SW	fnegyS-fnegyS	29-35	80	8	25	33	25	0	0	0	200	500
Black Hill to Nelson Lagoon:																			
Section 5	Apr.	30	55°58'	161°54'	NExN½N	Ebb	SW	fnegyS-fnegyS	23-29	65	205	288	493	455	0	3	5	0	1,500
		30	56°00'	161°49'	NExN½N	Ebb	SW	SfneG-SfneG	30-29	90	65	100	165	110	0	0	20	0	2,300
	May	1	55°53'	161°53'	SW	Flood	NE	fneG-fneG 1/	16-16	15	-	-	-	-	-	-	-	-	-
		1	55°54'	161°50'	NNE	Flood	NE	orsS-orsS 1/	20-20	70	-	-	-	-	-	-	-	-	-
		1	55°57'	161°47'	WSW	Ebb	SW	SfneG-SfneG	17-17	90	34	88	122	81	0	0	0	25	400
		2	55°59'	161°33'	NxE	Ebb	SW	SfneG-SfneG	18-24	120	215	137	352	176	0	0	0	0	300
		2	56°02'	161°34'	NE	Flood	NE	fnegyS-fnegyS	25-24	67	378	1,044	1,422	1,272	0	0	0	0	50

1/ Net snagged and catch lost.

2/ Net snagged but part of catch saved.

3/ Net failed to hold bottom so no catch made.

TABLE 17.--Otter trawl operations: Bering Sea, Area XI--Inshore, 1941--Continued

Vicinity	Date	Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: Males	Catch of crabs: King Females	Catch of crabs: King Total	Catch of crabs: Hour basis	Catch of fish: Halibut Medium	Catch of fish: Halibut Small	Catch of fish: Gray cod	Catch of fish: Alaska pollock	Catch of fish: "Sole"
								Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Pounds	Pounds
Black Hill to Nelson Lagoon:																		
Section 5--Continued	May 2	56°05'	161°33'	SxW	Slack	Nil	fnegyS-fnegyS	27-26	65	29	21	50	46	0	0	0	0	500
	5	55°55'	162°00'	NE	Flood	NE	fneG-fneG	22-19	60	5	0	5	5	0	0	0	0	600
	6	56°05'	161°27'	NExN	Flood	NE	fnegyS-fnegyS	22-20	60	58	36	94	94	0	0	0	1,000	2,200
	13	55°56'	161°56	WNW	Flood	NE	fnegyS-fnegyS	23-25	60	85	124	209	209	1	0	8	0	500
	17	56°01'	161°11'	SExS	Ebb	SW	fnegyS-fnegyS	23-23	60	14	3	17	17	0	0	94	0	5,000
	20	56°00'	161°39'	NWxN	Ebb	SW	fneG-fneG	20-23	65	0	0	0	0	0	0	0	0	12,000
	20	56°04'	161°38'	NWxN	Ebb	SW	fneG-fneG	23-28	65	2	0	2	2	0	0	0	0	9,500
	20	56°09'	161°18'	NWxN	Ebb	SW	gyS-fneG	21-24	60	12	3	15	15	0	0	6	0	6,000
	21	56°10'	161°30'	SSE	Flood	NE	fnegyS-fnegyS	26-24	60	13	22	35	35	0	0	15	800	900
	22	55°58'	162°00'	SExS	Flood	NE	gyS-fneG	26-25	60	33	3	36	36	0	10	12	1,500	2,500
	22	55°59'	161°55'	NWxN	Ebb	SW	fneSG-S	26-30	60	30	14	44	44	1	12	25	1,500	1,500
	22	56°01'	161°50'	WxN	Ebb	SW	fnegyS-fnegyS	30-32	60	11	37	48	48	1	12	5	200	100
	24	55°54'	162°04'	NxW	Ebb	SW	orsS-fneG	18-25	60	7	0	7	7	0	24	24	100	2,000
Section 11	May 13	56°00'	161°58'	NExE	Flood	NE	fnegyS-fnegyS	25-24	60	51	148	199	199	0	0	6	0	5,000
	20	56°07'	161°40'	NWxN	Flood	NE	fneG-fneG	28-32	70	28	163	191	164	0	0	45	0	2,000
	20	56°11'	161°44'	NWxN	Flood	NE	fnegyS-fnegyS	32-35	75	29	209	238	190	0	0	45	150	500
	20	56°12'	161°47'	NWxN	Flood	NE	fnegyS-fnegyS	35-36	60	31	377	408	408	0	0	20	0	400
	20	56°13'	161°23'	NW	Flood	NE	SG-fneS	29-32	60	14	8	22	22	0	25	30	2,000	300
	20	56°15'	161°30'	SWxW	Flood	NE	fnegyS-fnegyS	34-36	60	29	410	439	439	0	0	0	300	100
	21	56°15'	161°49'	NWxN	Slack	Nil	fnegyS-fnegyS	36-36	65	18	73	91	84	0	3	10	50	150
	21	56°19'	161°34'	NWxN	Ebb	SW	fnegyS-fnegyS	36-36	60	9	39	48	48	0	0	0	0	500
	21	56°15'	162°00'	SExS	Ebb	SW	fnegyS-fnegyS 4/	43-38	65	-	-	-	-	-	-	-	-	-
	21	56°12'	161°59'	SExS	Ebb	SW	fnegyS-fnegyS	38-32	74	22	2	24	19	0	15	25	200	1,000
	21	56°10'	161°56'	SExS	Flood	NE	fnegyS-fnegyS	32-31	65	18	65	83	77	0	0	0	500	1,500
	21	56°14'	161°36'	NWxN	Ebb	Nil	fnegyS-fnegyS	34-36	60	25	77	102	102	0	10	15	500	800
	21	56°16'	161°30'	NWxN	Ebb	SW	fnegyS-fnegyS	34-34	60	6	19	25	25	0	2	3	200	400
	21	56°13'	161°36'	SExE	Ebb	SW	fnegyS-fnegyS	34-32	60	48	228	276	276	0	0	15	800	800
	21	56°11'	161°34'	SE	Ebb	SW	fnegyS-fnegyS	32-30	60	69	288	357	357	0	24	40	4,000	2,500
	21	56°08'	161°39'	SE	Slack	Nil	fnegyS-fnegyS	30-28	60	18	56	74	74	0	0	12	1,000	300
	22	56°08'	161°51'	SExS	Flood	NE	fnegyS-fneG	40-36	60	13	3	16	16	0	0	0	0	8,000
	22	56°05'	161°53'	SExS	Ebb	Nil	fnegyS-fnegyS	32-29	60	13	13	26	26	0	0	50	0	2,000
	22	55°59'	162°07'	NWxN	Ebb	SW	orsgyS-orsgyS	31-36	60	8	26	34	34	0	0	50	0	1,000
	22	56°04'	162°08'	NWxN	Ebb	SW	orsgyS-orsgyS	36-39	60	9	0	9	9	0	0	20	500	500
	22	56°04'	162°17'	SExS	Flood	NE	fnegyS-fnegyS	41-41	60	7	4	11	11	0	12	0	0	300
	22	56°03'	162°03'	SE	Ebb	Nil	fnegyS-fnegyS	35-32	60	28	27	55	55	0	0	12	800	700
	22	56°01'	162°02'	SE	Flood	-	fnegyS-fnegyS	32-28	60	17	5	22	22	0	0	0	1,000	1,000
Nelson Lagoon to Cape Kutusof:																		
Section 6	May 6	56°09'	161°15'	NxW	Flood	NE	fnegyS-fnegyS	20-23	60	112	56	168	168	0	0	150	0	4,000
	6	56°13'	161°06'	NxE	Flood	NE	fnegyS-fnegyS	23-26	60	36	25	61	61	0	3	80	0	7,000
	6	56°18'	160°54'	NE½N	Ebb	SW	orsgyS-orsgyS	27-27	60	38	18	56	56	0	0	25	0	0
	7	56°16'	161°04'	NExN	Ebb	SW	fnegyS-fnegyS	26-26	60	0	0	0	0	0	0	12	2,000	50
	7	56°20'	160°40'	N	Flood	NE	gyS-orsS	22-25	60	22	15	37	37	0	4	12	500	2,000
	7	56°23'	160°31'	NExN	Flood	NE	fnegyS-orsS	20-20	60	38	16	54	54	0	0	15	0	2,500
	7	56°19'	160°49'	NE½N	Ebb	SW	orsgyS-orsgyS	27-26	60	13	9	22	22	0	0	23	0	1,000
	7	56°20'	160°45'	NE½N	Ebb	SW	orsgyS-orsgyS	26-24	60	27	19	46	46	0	0	23	0	1,500
	7	56°21'	160°42'	ExN	Ebb	SW	orsgyS-orsgyS 4/	24-19	65	1	0	1	1	-	-	-	-	-
	7	56°19'	160°36'	ExN	Flood	NE	orsgyS-orsgyS	19-18	65	31	7	38	35	0	0	200	0	4,000
	7	56°18'	160°34'	ExN	Flood	NE	orsgyS-orsgyS	18-18	65	21	5	26	24	0	0	50	0	2,000
	8	56°15'	160°40'	ExN	Ebb	SW	fnegyS-fnegyS 1/	18-17	10	-	-	-	-	-	-	-	-	-
	17	56°13'	160°58'	SW	Flood	NE	fnegyS-orsS	25-24	60	4	10	14	14	0	0	50	300	4,500
Section 12	May 7	56°21'	160°53'	NE	Ebb	SW	fnegyS-fnegyS	30-28	60	62	90	152	152	0	0	0	0	4,500
Cape Kutusof to Ugashik:																		
Section 7	May 8	56°23'	160°21'	ENE	Ebb	SW	orsS-fneG	17-15	60	13	7	20	20	0	3	4	0	4,500
	8	56°23'	160°25'	NxE	Ebb	SW	orsgyS-fneG	18-15	60	36	34	70	70	0	0	110	0	2,500
	8	56°20'	160°24'	NNW	Ebb	SW	orsgyS-fneG	17-23	74	32	13	45	36	0	12	112	0	3,000
	8	56°30'	160°15'	E	Flood	-	orsgyS-fneG	18-17	65	25	1	26	24	0	0	85	0	2,500
	8	56°31'	160°05'	E	Flood	NE	orsgyS-fneG	15-10	60	11	3	14	14	3	0	12	0	7,000
	9	56°40'	159°41'	NNE	Flood	NE	fnegyS-G	20-21	60	21	6	27	27	0	0	30	0	7,500
Section 13	May 8	56°33'	160°12'	N	Flood	NE	orsS-orsS	19-23	60	4	2	6	6	0	0	80	2,500	100
	8	56°38'	160°14'	N	Flood	NE	orsS-orsS	23-26	60	14	2	16	16	0	0	40	1,500	400
	8	56°42'	160°17'	NE	Flood	NE	orsS-orsS	26-27	60	25	12	37	37	0	0	36	4,000	400
	9	56°43'	160°11'	N	Flood	NE	orsS-orsS	27-28	60	13	3	16	16	0	3	15	2,000	800
	9	56°47'	160°12'	NE	Slack	Nil	orsS-gyS	28-28	60	12	3	15	15	0	0	7	1,500	200
	9	56°48'	160°07'	NE	Ebb	SW	gyS-orsS	28-26	60	24	2	26	26	0	0	16	1,500	400
	9	56°49'	160°00'	NE	Ebb	SW	orsS-gyS	26-26	60	17	6	23	23	0	0	15	1,000	1,000
	9	56°50'	159°55'	E	Ebb	SW	gyS-orsS	26-24	60	15	6	21	21	0	6	20	1,000	600
Section 14	May 9	56°45'	159°36'	N	Flood	NE	fnegyS-fnegyS	22-25	65	17	6	23	21	0	0	35	0	1,000

1/ Net snagged and catch lost.

4/ Draw string parted; so no catch made.

TABLE 17.--Otter trawl operations: Bering Sea, Area XI--Inshore, 1941--Continued

Vicinity	Date		Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: Males	Catch of crabs: King Females	Catch of crabs: King Total	Catch of crabs: Hour basis	Catch of fish: Halibut Medium	Catch of fish: Halibut Small	Catch of fish: Grayood	Catch of fish: Alaska pollock	Catch of fish: "Sole"
									Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Pounds	Pounds
Cape Kutusof to Ugashik:																			
Section 14--Continued	May	9	56°48'	159°37'	SW	Ebb	SW	fnegyS-fnegyS	25-26	75	15	2	17	14	0	0	45	0	4,000
		11	56°46'	159°31'	SW¾W	Ebb	SW	fneG-fneG	20-21	60	6	0	6	6	0	0	85	100	1,000
		11	56°52'	159°26'	SW¾S	Ebb	SW	fneG-crsS	21-21	65	7	1	8	7	0	5	60	0	2,000
		11	56°54'	159°16'	SW	Ebb	SW	fneG-crsS	21-21	60	9	0	9	9	0	0	20	0	500
Section 15	May	11	57°05'	158°50'	SW	Ebb	SW	S-S	15-18	70	2	0	2	2	0	0	20	0	3,500
		11	57°09'	158°47'	SW	Ebb	SW	SSh-fnegyS	22-22	65	3	0	3	3	0	1	30	0	1,000
		11	57°15'	158°46'	SW	Ebb	SW	S-S	23-23	60	5	2	7	7	0	0	20	0	4,000
Section 19		12	57°26'	158°32'	NExN	Slack	Nil	gyS-gyS	22-22	65	2	0	2	2	0	1	0	0	2,000
Section 20		12	57°40'	158°13'	NExN	Flood	WE	crsS-crsS	19-16	60	0	0	0	0	0	0	12	0	600
Section 24		12	57°48'	158°44'	SW	Ebb	SW	fnegyS-S	22-24	60	1	0	1	1	0	0	2	0	1,000
		12	57°41'	159°05'	SW	Ebb	SW	S-S	26-26	60	3	1	4	4	0	0	48	0	1,700
Totals										9,490	4,953	7,539	12,492	10,685	10	398	3,021	49,000	5/ 243,000

5/ Approximate poundages: starry flounder 23,500; yellowtail 110,000; rock "sole" 93,000; flathead 9,000; lemon "sole" 7,500.

Note:--In addition to the above, miscellaneous items were taken in approximate amounts as follows: 10,000 pounds of bullheads; 700 tanner crabs, 200 Korean crabs (Erimacrus isenbeckii); 100 herring; 6 wolf fish; and a few skates.

TABLE 18.--Tangle net operations: Bering Sea, 1941

Vicinity	Date	Location of net: Lat.	Location of net: Long.	Direction of set	Current set	Soundings: Bottom	Soundings: Depth	Time on bottom	Catch of king crabs: Males	Catch of king crabs: Females	Catch of king crabs: Total
							Fathoms	Days	Number	Number	Number
Unimak Pass to Cape Nordvinof:											
Section 1	June 3	55°01'	164°37'	SW.	NE-SW	crsSG	36	1	15	2	17
False Pass to Moffet Point:											
Section 3	June 3	55°37'	163°05'	-	NE-SW	S	31	2	12	1	13
	4	55°28'	162°54'	SW	NE-SW	fneG	21	3	23	0	23
	July 13	55°35'	162°56'	SW	NE-SW	crsgyS	22	6	0	1	1
	Aug. 16	55°36'	163°12'	NNE	NE-SW	fnegyS	37	4	6	2	8
Section 9	June 3	55°32'	163°31'	-	NE-SW	S	36	3	28	2	30
	July 18	55°45'	163°17'	SW	NE-SW	gyS	39	7	75	2	77
	18	55°38'	163°20'	SW	NE-SW	gyS	42	7	63	10	73
	18	55°40'	163°25'	SW	NE-SW	gyS	43	7	169	46	215
	18	55°42'	163°21'	SW	NE-SW	fnegyS	43	7	96	41	137
	Aug. 16	55°40'	163°13'	ENE	NE-SW	fnegyS	39	4	45	14	59
	16	55°43'	163°13'	NNE	NE-SW	fnegyS	44	4	19	5	24
	16	55°48'	163°13'	ENE	NE-SW	fnegyS	46	4	11	0	11
	16	55°52'	163°13'	NNE	NE-SW	fnegyS	49	4	31	0	31
Section 17	Aug. 16	55°57'	163°15'	ENE	NE-SW	fnegyS	49	4	23	3	26
	16	55°59'	163°16'	NNE	NE-SW	fnegyS	48	4	26	5	31
	16	56°05'	163°14'	ENE	NE-SW	fnegyS	49	4	32	1	33
Moffet Point to Black Hill:											
Section 4	May 2	55°38'	162°34'	SW	NE-SW	fnegyS	24	3	491	6	497
	24	55°53'	162°14'	-	NE-SW	SfneSh	34	1/ 50	94	3	97
	24	55°52'	162°16'	-	NE-SW	SfneSh	35	7	104	9	113
	24	55°40'	162°24'	NNW	NE-SW	fneG	29	6	131	2	133
	24	55°48'	162°32'	NE	NE-SW	fnegyS	32	4	91	10	101
	June 4	55°39'	162°40'	SW	NE-SW	fnegyS	21	3	55	0	55
	4	55°35'	162°41'	SW	NE-SW	fnegyS	20	3	54	0	54
	July 13	55°40'	162°54'	SW	NE-SW	fnegyS	32	6	22	0	22
Section 10	May 24	55°50'	162°35'	NE	NE-SW	crsS	30	6	69	4	73
	June 4	55°46'	162°40'	SW	NE-SW	fnegyS	26	4	43	0	43
	July 13	55°44'	162°50'	SxW	NE-SW	fnegyS	34	6	80	3	83
	13	55°48'	162°45'	SxW	NE-SW	fnegyS	38	6	68	11	79
	13	55°52'	162°42'	SxW	NE-SW	fnegyS	42	6	89	11	100
	13	55°55'	162°35'	SxW	NE-SW	fnegyS	43	6	76	7	83
	13	56°00'	162°31'	SxW	NE-SW	fnegyS	43	6	74	5	79
Black Hill to Nelson Lagoon:											
Section 5	Apr. 30	55°58'	161°52'	-	NE-SW	gySfneG	29	3	138	6	144
	May 1	55°52'	161°53'	WxN	NE-SW	crsgySG	12	2	0	0	0
	1	55°56'	161°57'	S	NE-SW	fnegyS	27	2	321	43	364
	24	55°54'	162°00'	NE	NE-SW	fneG	25	4	58	0	58
	July 23	56°04'	161°31'	NE	NE-SW	fnegyS 2/	26	-	-	-	-
	23	56°07'	161°32'	N	NE-SW	fnegyS	31	8	44	1	45
	31	56°01'	161°54'	NE	NE-SW	gySfneG 2/	22	-	-	-	-
	31	55°56'	161°53'	NE	NE-SW	G 2/	13	-	-	-	-
Section 11	July 23	56°11'	161°33'	NE	NE-SW	fnegyS 2/	33	-	-	-	-
	23	56°15'	161°33'	N	NE-SW	fnegyS	35	8	184	30	214
	23	56°19'	161°34'	NE	NE-SW	fnegyS	44	8	64	3	67
	31	56°14'	161°58'	NE	NE-SW	fnegyS	48	19	163	14	177
	31	56°12'	161°55'	NE	NE-SW	fnegyS 2/	36	-	-	-	-
	31	56°09'	161°54'	NE	NE-SW	fnegyS	33	18	34	16	50
Section 18	July 31	56°20'	161°57'	NE	NE-SW	fnegyS 2/	49	-	-	-	-
Nelson Lagoon to Cape Kutuzof:											
Section 6	July 20	56°09'	161°05'	NNW	NE-SW	fnegyS	22	11	0	0	0
	20	56°14'	161°05'	N	NE-SW	fnegyS	27	11	1	1	2
Section 12	July 20	56°18'	161°07'	NE	NE-SW	fnegyS	29	6	4	0	4
	20	56°22'	161°07'	N	NE-SW	fnegyS	34	6	4	0	4
	20	56°25'	161°07'	N	NE-SW	fnegyS	37	6	22	7	29
Cape Kutuzof to Ugashik:											
Section 7	May 9	56°40'	159°49'	-	NE-SW	fnegyS 2/	20	-	-	-	-
	9	56°41'	159°45'	-	NE-SW	fnegyS 2/	20	-	-	-	-
Herendeen Bay	May 5	55°42'	160°41'	-	NE-SW	sftbkM	26	9	11	5	3/ 16
	5	55°44'	160°41'	-	NE-SW	sftbkM	26	9	10	2	4/ 12
Totals								327	3,273	334	3,607

1/ This gear was lost for a period of 50 days during which time it drifted 12 miles. All crabs were still alive in spite of the length of time entangled.
2/ Gear lost.
3/ Of this catch 12 were P. platypus.
4/ Of this catch 6 were P. platypus.

During the early part of August, a series of eight sets of tangle gear were set out ENE of Amak Island, extending from a 37-fathom depth to 49 fathoms, thereby linking the inshore region with the offshore one. Average catches of about 30 crabs per set along the entire string, which covered a distance of over 30 miles, indicated a good-sized population over an immense area.1/

Fish catches within the 20-fathom depth in this vicinity were very poor, averaging only a few hundred pounds for an hour of dragging. However, out beyond this depth exceptionally promising catches were continually brought up. These averaged better than 2,000 pounds of marketable flatfish consisting of rock "sole", yellowtail, and starry flounders. Besides the flatfish, oftentimes 20 or more fine Bering Sea codfish would be included in the catch.

(Moffet Point to Black Hill--Sections 4 and 10.)

The largest catches of the entire Investigation were made in this region during the first part of May. In one drag of 1½-hour duration, 3,188 crabs were taken. The weight of the catch was estimated at nine tons, and the load in the trawl was so heavy that while dragging it along the bottom, the boat, powered with a 270 horsepower engine, was brought to a stop. Five other drags were made at this time on fine, gray, sand bottom all in depths of less than 25 fathoms. With the exception of one drag which yielded only 1/ crabs, very good catches were made. The six tows caught 4,377 crabs, or an average of 556 crabs per hour of dragging.

During the same period a set of tangle net was fished in the approximate location of the large trawl drag, and 497 king crabs were obtained. Of these, 491 were males of canning size. This large proportion of male crabs in the tangle-net catch is in marked contrast to the trawl operations in this locality, where 40 percent of the crabs caught in the trawl fishing were females and most of these were in a soft-shelled or moulting state. The condition of the crabs undoubtedly accounted for the large catches, as well as for the high percentage of females taken by the trawl and the low percentage taken in tangle nets.

Evidently huge beds of moulting females are mating with the males at this time of the year, and they are massed together in such a manner as to make them easy prey for a type of gear like the otter trawl, which scrapes along the bottom. The males being hard-shelled are capable of moving about on the bottom. Therefore, such a contrivance as a tangle net, which depends on crabs coming in contact with it to become entangled, would catch a far greater proportion of this sex.

When the region was fished again one month later, about June 1, most of the females had moulted and were in a fairly firm condition. Also, fewer crabs were taken per unit of effort. The crabs appeared to be more widely distributed, and the larger catches were made in deeper water. Five tows in water shallower than 26 fathoms yielded an average of 25 crabs per hour of dragging. Nine tows made in depths from 26 to 36 fathoms averaged 38 crabs per hour.

The catches of tangle nets set in the region at this time further demonstrate an apparent movement of the population into deeper water. Three sets within the 26-fathom range averaged 50 crabs, while five sets in depths from 29 to 35 fathoms averaged 103 crabs.

The last period of operation in this locality was during mid-July. Good catches were obtained, most of which were in deeper water. Six sets of tangle gear, spread over a distance of 27 miles, fishing in depths ranging from 32 to 43 fathoms, averaged 75 crabs. Although the females were generally hard-shelled, males still far outnumbered them in the tangle gear.

In addition to the large catches of crabs, consistently good catches of marketable flatfish also were made. Drags of 1-hour duration averaged 2,000 pounds of choice food fish. The more abundant species were rock "sole" and yellowtail.

The bottom was of fine gray sand in most of this area, except in depths of 20 fathoms or less where some fine gravel and coarse sand was encountered. The rocky area northwest of Black Hill is considerably larger than is indicated on the chart, since snags were encountered several miles on each side of this spot.

1/ This gear was fishing approximately the same time that good catches were occurring in the offshore region which was prospected by another boat.

(Black Hill to Nelson Lagoon--Sections 5 and 11.)

Extensive operations were carried on in these Sections, and more trawl- and tangle-net prospecting was accomplished here than in any other comparable sections in the Bering Sea. Forty drags and nine sets of tangle gear fished intermittently over a period of 4½ months, showed results very similar to those obtained between Moffet Point and Black Hill.

During the early part of May, here also, most of the females were in a soft or moulting state; and although the catches were not as large as those from Moffet Point to Black Hill for this time of the year, they still were exceptionally good. Eight trawls, all inside the 30-fathom depth and still on bottom of fine and coarse sand, averaged better than 280 crabs to the hour of dragging. Two tangle-net sets likewise were very successful; one in 27 fathoms caught 364 crabs; and the other set in 29 fathoms captured 144 crabs. Another two shackles, set in 12 fathoms, did not catch any; apparently the crabs were out in deeper water.

Only 10 days elapsed before the second survey in this region was begun, and in this short time a definite outward movement of large bodies of crabs into deeper water was noticeable.

From the middle of May and into June, 12 drags were made within the 30-fathom depth, and the average catch dropped from the 280 crabs taken earlier to 67. Now, too, out in depths from 30 fathoms to 40 fathoms the average catch per hour was 113 crabs, the best results obtained for any region in the Bering Sea at this period. Also, as this average was based on many drags, 20 to be exact, it is safe to assume that a large population existed here at this time of the year.

One tangle net set during this period in 25 fathoms brought up 58 crabs, all of which were males.

Final operations in this region during the latter part of July, consisted of five sets of tangle gear. They indicated a large population still present in depths from 31 to 48 fathoms, averaging better than 111 crabs per set.

The customary large catches of marketable flatfish, consisting chiefly of rock "sole", yellowtail, and starry flounder, continued in these Sections. An average of 2,000 pounds of these flatfish was taken in each drag, and the maximum was 12,000 pounds. Sixteen thousand pounds of Alaska pollock were also caught. A few herring were taken, which is of interest when one considers the large mesh used in the otter trawl.

(Nelson Lagoon to Cape Kutuzof--Sections 6 and 12.)

Though not producing such spectacular catches as did the Sections from Moffet Point to Nelson Lagoon, this vicinity, out from Port Moller, did provide catches per unit of effort having commercial significance.

Of 11 drags in depths between 17 and 30 fathoms on typical Bering Sea sand bottom, two yielded catches in excess of 150 crabs for hour tows. The average for all 11 was 50, and this is fair fishing when one considers that the Investigation was fishing from an exploratory rather than a commercial standpoint. These operations were conducted between May 6 and May 8. Nine days later another trawl drag in 25 fathoms caught only 14 crabs, which again could be interpreted as a sign that the crabs were moving away.

On July 20, five tangle-net sets hauled on board after soaking over six days, not only showed the crabs had moved but strongly indicated they had moved out into the deeper water. This string of tangle-net sets ran from a depth of 22 fathoms out to 37 fathoms; the four shallowest sets altogether caught only 10 crabs; the outermost one, set in 37 fathoms, yielded 29 crabs.

Reports of crab populations in Herendeen Bay prompted the dropping of two sets of tangle nets in the extreme south end of the Bay. Both were set off Gull Point in 26 fathoms of water--one out from Portage Valley, and the other out from Grass Valley. The one on the Grass Valley side caught 12 crabs while the other brought up 16 crabs. All these were small crabs, none large enough to can. Also, most of these were of the species, P. platypus, the only specimens of this species caught in Area XI.

Good catches of flatfish continued to be taken, averaging approximately 3,000 pounds per tow.

(Cape Kutuzof to Ugashik--Sections 7, 13, 14, 15, 19, 20, and 24.)

The bottom topography changes quite radically from Cape Kutuzof to the eastward. Whereas to the westward, all down the north side of the Alaska Peninsula, the 40-fathom depth varied only from nine to 25 miles out from shore; here a shallow flat, all under 40 fathoms in depth, extends to St. Matthew Island and into the Arctic Ocean to the north. It cannot be said definitely that this physical factor is correlated with the crab population; but from Cape Kutuzof eastward to Ugashik the catches kept diminishing until a drag off Ugashik resulted in a "skunk" haul.

Fourteen drags centered off Cape Seniavin in depths from nine to 30 fathoms, averaged 25 crabs per hour of dragging, or a yield of only half as many as caught off Port Moller.

Fifteen to twenty miles west of Strogonof Point five other tows, all in depths between 20 to 26 fathoms, averaged only 10 crabs per hour of dragging, a decrease of 60 percent from the former series.

Still more drastic reductions occurred between Port Heiden and Ugashik where practically negative catches resulted. Here six drags, ranging in depths from 15 to 26 fathoms, averaged but three crabs per drag. Off Ugashik, one long drag towed in from 16 to 19 fathoms did not catch any crabs.

All the operations in this region were made between May 7 and May 11.

Even though the crab catches fell off, the catches of flatfish increased, if anything. A few hauls contained as much as 8,000 pounds of flatfish, and hauls of 2,000 to 3,000 pounds were ordinary. Yellowtail and rock "sole" were the two chief species, with flathead "sole", a strong third. Fair catches of codfish were also taken, some drags catching over a hundred large specimens.

Offshore Operations in Area XI

Offshore operations in the general area of Cape Mordvinof to Cape Newenham consisted of: (1) a series of 12 trawl drags in Sections 31 to 37, inclusive (Figure 22), during the period July 14 to 18; and (2) during the period August 16 to September 4, a total of 70 drags in Sections 16 to 18, 21 to 23, 25 to 30, inclusive, and 35 (Table 19).

The first series of tows, starting in 27 fathoms of water midway between Port Heiden and Cape Newenham, extended in a southwest direction for 208 miles to a position 105 miles WNW of Amak Island.[1/] The catch of crabs along this line was essentially nil, except for a very small spot some 110 miles NW ¼ W of Port Moller. Here, the fourth tow of the series netted 529 crabs, practically all of which were small ones, averaging not more than three inches in width of carapace.

The first seven drags of the series, to a point 115 miles NW by W ½ W of Port Moller, were on fine, gray sand at depths of 27 to 31 fathoms. Besides the one large catch of small crabs, the other six netted a total of but 19 crabs, all large. The five remaining drags of the series, to the position off Amak Island, were on green mud bottom at depths of 36 to 42 fathoms. No crabs were taken.

The finding of a nursery area so far offshore in an otherwise quite barren crab ground at this time of year is a matter of considerable interest. Two possible explanations may be given: (1) This shoal region may represent an offshore mating and moulting ground during the winter and early spring months, or (2) the accumulation of small crabs may result from the drifting of larvae from the inshore moulting and mating areas. Since fishing operations were not carried on in the offshore area during the moulting and mating season and very little information is available on currents in Bering Sea, a positive opinion cannot be given.

Although the offshore tows in July resulted in relatively poor crab fishing, the catch of fish was large on both the gray sand and green mud bottoms. Two drags yielded over 8,000 pounds of fish each, and several individual catches registered between 4,000 and 6,000 pounds.

1/ This series of drags actually continued 25 miles farther SW and then turned to W ½ S toward St. George Island. The latter data, however, will be covered in the discussion for Area XII.

TABLE 19.--Otter trawl operations: Bering Sea, Area XI--Offshore, 1941

Vicinity	Date	Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Location of tow: Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: Males	Catch of crabs: King Females	Catch of crabs: King Total	Catch of crabs: Hour basis	Catch of fish: Halibut Medium	Catch of fish: Halibut Small	Catch of fish: Cod	Catch of fish: Alaska pollock	Catch of fish: "Sole"
								Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Pounds	Pounds
Cape Kordvinof to False Pass:																		
Section 32	July 18	56°33'	165°18'	SW	Ebb	SW	grM-fneS	42-42	60	0	0	0	0	0	0	40	500	400
False Pass to Moffet Point:																		
Section 16	Aug. 16	55°41'	163°57'	NExN	Slack	Nil	fnegyS-fnegyS	52-52	60	8	13	21	21	0	0	30	0	500
	16	55°46'	163°52'	NNW	Flood	NE	fnegyS-fnegyS	53-53	60	17	5	22	22	0	0	35	100	1,500
	17	55°46'	163°40'	N	Ebb	SW	fnegyS-fnegyS	51-51	60	13	3	16	16	0	0	30	50	1,000
	17	55°54'	163°35'	N	Flood	NE	fnegyS-fnegyS	50-50	60	10	3	13	13	0	0	35	100	1,000
	17	56°02'	163°31'	N	Flood	NE	gyM-fnegyS	50-50	60	8	0	8	8	0	0	20	50	800
Section 33	July 17	56°15'	164°33'	SW	Flood	NE	gnM-gnM 1/	39-39	60	-	-	-	-	-	-	-	-	-
	17	56°35'	164°40'	SW	Flood	NE	gnM-gnM	39-39	60	0	0	0	0	0	0	10	5,000	8,000
Moffet Point to Black Hill:																		
Section 17	Aug. 23	56°02'	163°02'	SExS	Ebb	SW	fnegyS-fnegyS	47-47	60	8	13	21	21	0	5	20	25	200
	24	56°06'	162°55'	N	Flood	NE	fnegyS-fnegyS	45-46	60	2	3	5	5	0	0	15	25	100
	24	56°15'	162°51'	N	Flood	NE	fnegyS-fnegyS	44-44	60	7	6	13	13	0	0	15	0	200
	31	56°14'	162°30'	N	Slack	Nil	cregyS-fneG	41-41	60	36	2	38	38	0	10	15	0	500
Section 21	Aug. 18	56°08'	163°27'	N	Flood	NE	fnegyS-fnegyS	50-49	60	6	1	7	7	0	0	40	50	500
	18	56°14'	163°23'	N	Ebb	SW	fnegyS-fnegyS	48-47	60	11	1	12	12	2	0	30	50	500
	18	56°22'	163°17'	N	Ebb	SW	fnegyS-fnegyS	47-47	60	7	0	7	7	0	3	10	0	500
	23	56°25'	163°04'	SExS	Ebb	SW	fnegyS-fnegyS	45-45	60	16	1	17	17	0	7	12	0	600
	23	56°15'	163°08'	SExS	Ebb	SW	fnegyS-fnegyS	46-46	60	15	0	15	15	0	5	8	25	400
	24	56°23'	162°45'	N	Ebb	SW	fnegyS-fnegyS	41-41	60	28	15	43	43	0	0	12	0	100
	24	56°26'	162°43'	N	Ebb	SW	fnegyS-fnegyS	42-42	60	35	24	59	59	0	0	20	25	800
Section 25	Aug. 18	56°28'	163°14'	N	Ebb	SW	gySdkM-gySdkM	46-46	60	8	70	78	78	0	0	10	0	1,200
	18	56°31'	163°13'	W	Ebb	SW	gySdkM-gySdkM	46-46	60	30	116	146	146	0	0	15	50	1,500
	19	56°31'	163°19'	W	Flood	NE	gySdkM-gySdkM	46-46	60	34	1	35	35	0	0	100	300	2,000
	19	56°33'	163°21'	W	Slack	Nil	gySdkM-gySdkM	46-45	60	29	1	30	30	0	0	200	200	1,500
	19	56°34'	163°28'	N	Ebb	SW	gySdkM-gySdkM 2/	45-45	30	-	-	-	-	-	-	-	-	-
	19	56°36'	163°27'	N	Ebb	SW	gySdkM-gySdkM	45-45	60	21	1	22	22	0	0	150	500	3,000
	19	56°38'	163°27'	N	Ebb	SW	gySdkM-gySdkM	45-45	60	18	0	18	18	0	0	100	500	2,000
	19	56°38'	163°18'	E	Flood	NE	fnegyS-fnegyS	45-45	60	36	15	51	51	0	0	100	0	2,000
	20	56°37'	163°10'	N	Flood	NE	gySdkM-gySdkM	45-44	60	30	67	97	97	1	0	50	0	1,000
	20	56°40'	163°08'	N	Slack	Nil	fnegyS-fnegyS	44-45	60	17	38	55	55	0	1	100	50	800
	20	56°42'	163°07'	N	Ebb	SW	fnegyS-fnegyS	45-44	60	20	15	35	35	1	0	30	0	500
	20	56°45'	163°06'	N	Ebb	SW	fnegyS-fnegyS	44-44	60	24	5	29	29	0	8	50	0	1,000
	23	56°33'	162°58'	WxS	Flood	NE	fnegyS-fnegyS	45-45	60	17	0	17	17	0	5	20	100	800
Section 28	Aug. 20	56°47'	163°05'	W	Ebb	SW	fnegyS-fnegyS	44-44	60	28	8	36	36	0	10	100	0	1,000
	21	56°50'	163°21'	W	Slack	Nil	fnegyS-fnegyS	43-43	60	36	12	48	48	0	15	200	200	3,000
	21	56°52'	163°37'	W	Ebb	SW	gyS'-gySM	42-42	60	0	0	0	0	0	4	200	500	4,000
	21	56°54'	163°26'	N	Ebb	SW	fnegyS-fnegyS 1/	42-41	60	-	-	-	-	-	-	-	-	-
	21	56°57'	163°23'	N	Flood	NE	fnegyS-fnegyS	41-41	60	2	0	2	2	0	10	150	500	4,000
Section 34	July 17	57°00'	163°51'	SW½S	Ebb	SW	gnM-gnM	36-36	60	0	0	0	0	0	0	10	250	2,000
	17	56°54'	164°10'	SW½S	Ebb	SW	gnM-gnM	36-36	60	0	0	0	0	0	0	6	0	8,500
Black Hill to Nelson Lagoon:																		
Section 18	Aug. 19	56°21'	161°53'	SW	Ebb	SW	fnegyS-fnegyS	47-48	60	28	13	41	41	0	6	50	50	2,500
	19	56°15'	162°02'	S	Ebb	SW	fneSG-dkSG	44-45	60	17	0	17	17	0	0	40	0	1,300
	31	56°11'	162°18'	N	Ebb	SW	bkS-bkS	43-41	60	1	0	1	1	0	6	30	0	1,000
	31	56°[illegible]	162°26'	N	Flood	NE	gyS-gyS	42-38	60	42	24	66	66	0	0	10	50	3,000
Section 22	Aug. 24	56°29'	162°41'	N	Slack	Nil	fnegyS-fnegyS	42-42	60	40	27	67	67	0	0	15	0	1,000
	25	56°31'	162°40'	N	Flood	NE	fnegyS-fnegyS	42-43	60	59	29	88	88	0	0	30	0	1,500
	25	56°34'	162°39'	N	Flood	NE	fnegyS-fnegyS	43-43	60	52	34	86	86	0	0	20	0	1,500
	25	56°36'	162°38'	N	Flood	NE	fnegyS-fnegyS	43-42	60	45	63	108	108	0	2	30	0	2,000
	31	56°27'	162°23'	N	Flood	NE	fnegyS-fnegyS	40-39	60	103	67	170	170	0	15	15	0	3,000
	31	56°31'	162°21'	N	Slack	Nil	fnegyS-fnegyS	39-39	60	50	44	94	94	0	0	15	0	3,000
	Sept. 1	56°38'	162°16'	N	Ebb	SW	fnegyS-fnegyS	42-41	60	46	5	51	51	0	0	20	50	6,000
	2	56°15'	161°57'	SxE½E	Flood	NE	fnegyS-fnegyS	42-38	60	183	15	198	198	0	10	15	50	4,000
	3	56°46'	162°02'	ExN½N	Slack	Nil	fnegyS-fnegyS	42-41	60	124	30	154	154	0	12	15	0	5,000
Section 26	Aug. 22	56°50'	162°52'	SExS	Ebb	SW	fnegyS-fnegyS	44-44	60	37	3	40	40	3	0	30	100	2,000
	22	56°47'	162°50'	SExS	Slack	Nil	fnegyS-fnegyS	44-44	60	27	5	32	32	0	0	30	50	1,500
	23	56°38'	162°52'	SExS	Flood	NE	fnegyS-fnegyS	45-45	60	10	3	13	13	1	6	20	50	800
	25	56°39'	162°36'	N	Slack	Nil	fnegyS-fnegyS	42-41	60	31	9	40	40	0	7	15	0	1,500
	25	56°41'	162°34'	N	Ebb	SW	fnegyS-fnegyS	41-38	60	56	93	149	149	0	0	50	0	4,000
	25	56°44'	162°33'	N	Ebb	SW	fnegyS-fnegyS	38-37	60	12	28	40	40	0	0	10	0	6,000
	Sept. 1	56°47'	162°12'	N	Ebb	SW	fnegyS-fnegyS	38-36	60	49	39	88	88	0	5	0	0	2,000
	1	56°50'	162°11'	N	Slack	Nil	fnegyS-fnegyS	38-36	60	38	12	50	50	0	10	15	50	7,000
Section 29	Aug. 22	57°00'	162°56'	SExS	Ebb	SW	fnegyS-fnegyS	41-42	60	14	6	20	20	0	7	25	100	2,000
Section 35	July 15	57°18'	162°50'	SW½S	Flood	NE	fnegyS-fnegyS	27-27	60	5	2	7	7	1	0	30	0	3,000
	Aug. 22	57°05'	163°18'	N	Flood	NE	fnegyS-fnegyS	39-39	60	0	0	0	0	0	0	40	1,000	3,000
	22	57°06'	163°07'	E	Slack	Nil	fnegyS-fnegyS	36-39	60	4	0	4	4	0	0	20	500	4,000

1/ Draw string parted so no catch made.

2/ Net fouled in setting so no catch made.

TABLE 19.--Otter trawl operations: Bering Sea, Area XI--Offshore, 1941--Continued

Vicinity	Date	Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: King: Males	Catch of crabs: King: Females	Catch of crabs: King: Total	Catch of crabs: Hour basis	Catch of fish: Halibut: Medium	Catch of fish: Halibut: Small	Catch of fish: Cod	Catch of fish: Alaska pollock	Catch of fish: "Sole"
								Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Pounds	Pounds
Nelson Lagoon to Cape Kutuzof:																		
Section 23	Sept. 2	56°48'	161°56'	SxE½E	Flood	NE	fnegyS-fnegyS	43-42	60	419	55	474	474	0	0	10	0	3,000
	3	56°46'	161°57'	ExN½N	Ebb	SW	fnegyS-fnegyS	41-41	60	242	20	262	262	0	0	20	0	5,000
	3	56°46'	161°53'	ExN½N	Ebb	SW	fnegyS-fnegyS	41-42	60	509	22	531	531	0	8	4	50	4,000
	4	56°46'	161°46'	ExN½N	Flood	NE	fnegyS-fnegyS	42-36	60	127	43	170	170	0	0	10	100	2,000
	4	56°46'	161°40'	NxW½W	Slack	Nil	fnegyS-fnegyS	36-41	60	114	18	132	132	0	7	5	100	1,000
	4	56°50'	161°40'	NxW½W	Ebb	SW	fnegyS-fnegyS	41-45	60	184	20	204	204	0	0	15	0	5,000
	4	56°53'	161°40'	WxS½S	Ebb	SW	fnegyS-fnegyS	45-41	60	219	25	244	244	0	0	20	0	5,000
	4	56°53'	161°45'	SxE½E	Slack	Nil	fnegyS-fnegyS	41-41	60	651	31	682	682	0	0	20	0	3,000
	4	56°50'	161°44'	WxS	Flood	NE	fnegyS-fnegyS	41-41	60	634	19	653	653	0	0	15	0	2,500
Section 27	Sept. 1	56°57'	162°06'	N	Flood	NE	fnegyS-fnegyS	36-38	60	25	38	63	63	0	0	20	1,000	9,000
	1	57°03'	162°02'	N	Flood	NE	fnegyS-fnegyS	29-29	60	0	11	11	11	0	20	5	0	3,000
	2	56°53'	161°56'	SxE½E	Ebb	SW	fnegyS-fnegyS	40-42	60	26	31	57	57	0	20	5	50	5,000
Section 30	2	57°11'	161°58'	N	Ebb	SW	fnegyS-fnegyS	28-26	60	0	6	6	6	0	20	5	0	2,000
Section 36	July 15	57°32'	162°00'	SW¼S	Ebb	SW	fnegyS-fnegyS	27-27	60	352	177	529	529	1	0	350	100	500
	15	57°31'	162°08'	SW¼S	Flood	NE	fnegyS-fnegyS	27-28	90	2	0	2	1	1	0	8	0	6,000
	15	57°25'	162°28'	SW¼S	Flood	NE	fnegyS-fnegyS	27-27	60	2	3	5	5	0	0	13	100	2,000
Cape Kutuzof to Ugashik:																		
Section 37	July 14	57°48'	161°06'	SW¼S	Flood	NE	fnegyS-SG	29-30	75	3	3	6	5	2	0	0	0	6,000
Section 31	14	57°45'	160°00'	WxS	Ebb	SW	fnegyS-fnegyS	27-28	65	0	0	0	0	1	0	97	500	3,000
	14	57°47'	160°25'	WxS	Flood	NE	fnegyS-fnegyS	30-31	60	0	1	1	1	1	0	0	100	5,000
Totals									5,000	5,159	1,513	6,672	6,670	15	244	3,200	13,300	3/ 201,000

3/ Approximate poundages: yellowtail 123,000; rock "sole" 54,000; flathead 16,000; lemon "sole" 8,000.

Notes:--In addition to the above, miscellaneous items were taken in approximate amounts as follows: 2,000 pounds of turbot and 250 pounds of tomcod; 2,800 tanner crabs and 1,000 Korean or horse crabs; 1,000 bullheads; 800 skates; 700 sea poachers or alligator fish and 20 herring.

Yellowtail accounted for approximately 80 percent of the catches. The remainder was composed chiefly of rock "sole". Besides the flatfish, some 10 to 50 codfish were taken in each tow.

The offshore fishing, during the period August 16 to September 4, was between the line of drags described immediately above, and the outer range of the inshore fishing between False Pass and Cape Kutuzof. This region includes a large basin with fine gray sand bottom and water depths ranging from 40 to 50 fathoms. The rather satisfactory catches here suggest the possibility that during the late summer months crabs tend to move into this basin from the shallower depths. Furthermore, the catches follow a somewhat definite pattern.

Beginning in Section 16, catches tended to increase as fishing progressed farther offshore and toward the northeast. Similarly, beginning with the line of 12 offshore drags made during July, the catches tended to increase as fishing progressed toward the Peninsula, thus indicating an increasing concentration of crabs in the general location of Sections 22, 23, 25, and 26. This particular region is at the eastern extremity of the basin, not far distant from shoal waters extending west from Port Heiden and south from Cape Newenham.

The 70 tows in the basin netted a total of 6,172 crabs, of which 5,433 were taken in Sections 22, 23, 25, and 26, including 3,352 taken in Section 23 alone. The catch per haul varied between none to 682 crabs, while sectional averages ranged from six to 372 crabs per hour of trawling.

The composition of the catches in the region under discussion is also of considerable interest. The catches made during April and May in the shallower water inshore from the basin were largely female crabs. During the period August 16 to September 4, the proportion of females to males was nearly equal, there being a slightly greater percentage of females in the catches. There was, however, one singular exception. The larger catches made in Section 23 around the first of September were over 90 percent male crabs. Also, one recently moulted male crab and one sloughed shell were taken in these later drags. Unfortunately, the lateness of the season and heavy weather prevented continued operations to obtain further data as to the significance of this situation.

The marketable fish catches were larger within the basin region than in any comparable-sized locality investigated. An unusual occurrence was that the drags yielding large crab catches also gave good catches of fish. The total quantity of edible flatfish taken in the 70 drags in this offshore region was estimated to be approximately 156,600 pounds. Yellowtail was the most prevalent species.

Fair catches of codfish and pollock also were taken. Several drags brought up 200 or more large codfish, and catches of 30 to 40 were average. Likewise, some drags netted 500 to 1,000 pounds of pollock, the average being about 100 pounds per drag.

The Pribilofs to St. Lawrence Island (Area XII)

This vast area (Figure 24) comprises some 125,000 square miles of fishing grounds, but there is little likelihood of rapid development of any fishery resources. It is remote from markets and population centers, poorly served by transportation facilities, and subject to severe ice and weather conditions. To permit as much work as possible in areas more likely to be exploited, little time was allotted to this survey. The work accomplished was further restricted by engine trouble and bad weather.

In general, depths are moderate--usually under 30 fathoms--with the soundings decreasing north and east. Much of the same fine, gray sand bottom so prevalent in Bristol Bay was found, though the green mud indicated in the southwest section persists much farther northeast than indicated on Chart 9302. Particularly near the various islands, the bottom is overlaid by heavy shell growth which chafed the trawls quite badly and in some cases tore several meshes. No other fishing hazards were encountered.

The work was conducted over a three-week period from late July to early August. Fog was prevalent during the entire time. Only for a few moments at a time did it ever clear to give a visibility range of 10 miles and usually was less than one. Under such circumstances tangle-net sets could not have been relocated; thus, trawling was the only type of fishing utilized.

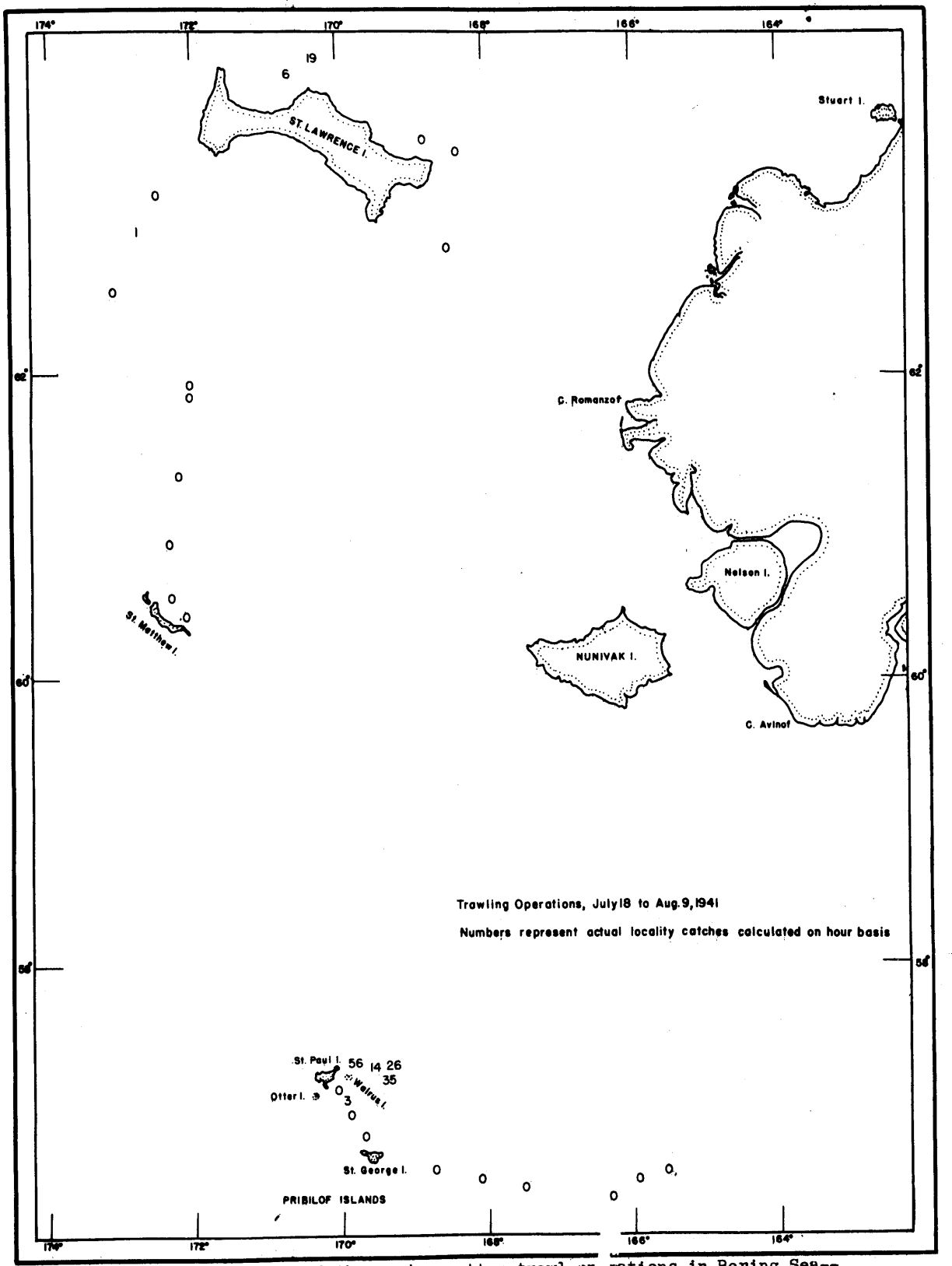

FIGURE 24.--Actual locations of the various otter-trawl operations in Bering Sea--(Area XII), showing catch of king crabs.

Series of tows were made: (1) to St. George Island from a position 125 miles east; (2) between St. George and St. Paul Islands; (3) for 25 miles northeast of St. Paul Island; (4) from St. Matthew Island north to St. Lawrence Island; and (5) north and east around St. Lawrence Island about 10 miles offshore. No work was done between the Pribilofs and St. Matthew Island.

The six tows east of St. George Island were a continuation of the work done southwest from Cape Newenham and produced similar results: no crabs were taken, and large catches of fish--predominantly pollock and yellowtail "sole"--were made. Thirty to fifty large market cod were also usually found. The depths ranged from 37 to 59 fathoms over a green mud bottom. (Table 20.)

Four drags were made between St. George and St. Paul Island in 33 to 42 fathoms on fine, gray sand bottom with much shell. The quantity of flatfish was greatly reduced; and horse crabs, hermit crabs, starfish, and sea squirts comprised the greater part of the catch. Of this series, a tow made 11 miles southeast of St. Paul Island yielded the only three crabs captured.

The six drags northeast of St. Paul Island all produced crabs. The largest number was 56 for one hour of fishing in 28 fathoms eight miles off Northeast Point. The other five tows, in an area roughly 48 miles square from 19 to 24 miles from St. Paul Island, produced 35, 26, 14, 1, and 1. It is in this area that Japanese fishing vessels had previously been reported. It is not felt that these few data--all obtained at the same time of year--are adequate to determine the size of the crab population which could have been spread out east, north, and west of this point.

The nine tows made from three miles north of St. Matthew Island to within 26 miles of Southwest Cape on St. Lawrence Island were devoid of crabs except for one taken 39 miles southwest of Southwest Cape. Prevailing depths were somewhat less ranging from 25 to 37 fathoms. The bottom was generally a soft gray to green mud. Flatfish were sparse, but 20 to 30 gray cod were taken in the three drags nearest St. Matthew Island. The weather was foggy but remarkably calm.

Along the north and east sides of St. Lawrence Island the bottom was very similar to that found off the Pribilofs, i.e. fine, gray sand with much heavy shell, so that considerable damage was done to the trawl nets. Depths were shoaler--13 to 23 fathoms--but the same marine forms were associated in the catches. A small number of crabs were taken in two drags near Cape Kukuliak, but three along the east side of the Island were blank.

There is evidence that the results of this investigation, made only in the three-week period in late July and early August, were inconclusive, and that the actual population of crabs in Area XII is much larger than the results indicate. The presence of Japanese fishing boats off the Pribilof Islands in earlier years has been referred to. Agents of the Service stationed there report that to their actual knowledge, large catches of crabs were made by these boats. The Eskimos at both Savoonga and Gambell on St. Lawrence Island were interviewed, and reported catching up to five crabs in an hour's fishing by hook and line through the ice. These catches were made between February and April and were anticipated each year. Several of these natives reported that much larger catches were made by the Eskimos farther north. It was not possible to obtain precise information, but apparently the reference was to the natives of the Norton Sound area, where the presence of crabs is substantiated by the experience of a local resident.1/ During the summer of 1941, he fished some tangle gear over a wide area and reports that though his boat was inadequate for much work in offshore waters, he did catch crabs in such widely separated places as Stuart Island (off St. Michael in Norton Sound) and near the Diomede Islands in Bering Strait.

St. Matthew Island is uninhabited so that no reports were available from this section. A shore party landed by small boat at several points on the north side of the Island and, in contrast to the negative results obtained by trawling in this section, observed a large number of moulted shells in a very good state of preservation on the beach--far more than had been observed in any other place. McKay and Weymouth (1935) found that shells of the Pacific or dungeness crab (Cancer magister) fell to pieces in less than a week when exposed in the tidal range. The king crab shells were found above normal high tide mark, and possible difference in shell composition and the cool, moist weather prevalent might well have combined to extend this period; it does not seem plausible, however, that they had survived the ice

1/ Mr. Charles C. Parrot.

TABLE 20.--Otter trawl operations: Bering Sea, Area XII, 1941

Vicinity	Date		Location of tow: Starting point Lat.	Location of tow: Starting point Long.	Course	Tide	Current set	Soundings (Initial and final): Bottom	Soundings (Initial and final): Depth	Time on bottom	Catch of crabs: King: Males	Catch of crabs: King: Females	Catch of crabs: King: Total	Catch of crabs: Hour basis	Catch of fish: Halibut: Medium	Catch of fish: Halibut: Small	Catch of fish: Gray cod	Catch of fish: Alaska pollock	Catch of fish: "Sole"
									Fathoms	Minutes	Number	Number	Number	Number	Number	Number	Number	Pounds	Pounds
Cape Mordvinof	July	18	56°27'	165°37'	SW	Ebb	SW	gnM-gnM	42-42	60	0	0	0	0	0	0	18	4,000	4,000
Do.		18	56°22'	165°58'	SW	Flood	NE	gnM-gnM	44-45	60	0	0	0	0	0	0	24	4,000	4,000
Do.		18	56°16'	166°18'	SW	Flood	NE	gnM-gnM	49-50	30	0	0	0	0	0	0	10	800	1,500
St. George I.--E of		17	56°21'	167°29'	W¼S	Flood	N	gnM-gnM	56-37	60	0	0	0	0	1	0	45	25	100
Do.		19	56°24'	168°07'	W¼S	Ebb	S	gnMS-gnMS	59-59	60	0	0	0	0	0	0	18	25	0
Do.		19	56°28'	168°45'	W¼S	Flood	N	gnMS-gnMS	58-58	60	0	0	0	0	0	0	19	25	0
St. George I.--NW of		21	56°43'	169°42'	NW	Slack	Nil	fnegyS-fnegyS 1/	40-42	60	-	-	-	-	-	-	-	-	-
Do.		21	56°54'	169°56'	NW½N	Flood	NE	fnegyS-fnegyS 2/	36-40	60	-	-	-	-	-	-	-	-	-
Do.		21	57°01'	169°59'	NW½N	Flood	NE	fnegyS-fnegyS	40-34	60	1	2	3	3	3	0	1	0	200
Do.		21	57°03'	170°02'	WNW	Flood	NE	fnegyS-fnegyS	34-33	60	0	0	0	0	0	0	0	0	150
St. Paul I.--NE of		23	57°17'	169°53'	NE	Flood	NE	bkSG-crsSG	27-30	60	28	28	56	56	0	0	0	0	25
Do.		23	57°19'	169°35'	NE	Flood	NE	gySSh-gySSh 2/	34-39	60	-	-	-	-	-	-	-	-	-
Do.		23	57°21'	169°31'	NE	Flood	NE	gnMSh-gnMSh	39-39	60	1	0	1	1	0	0	5	25	50
Do.		24	57°13'	169°33'	SxE	Flood	NE	gySSh-gySSh	33-34	60	7	7	14	14	0	0	4	25	25
Do.		24	57°11'	169°28'	NE	Flood	NE	gySSh-gySSh	35-37	60	20	15	35	35	0	0	0	0	200
Do.		24	57°13'	169°24'	SE	Slack	Nil	fnegyS-fnegyS	37-39	60	16	10	26	26	0	0	0	0	200
St. Matthew I.		29	60°24'	172°08'	NW	Ebb	SE	gy½-gy½	29-31	60	0	0	0	0	0	0	45	1,500	25
Do.	Aug.	3	60°31'	172°20'	N	Flood	NE	sftgnM-sftgnM	25-26	60	0	0	0	0	0	0	35	25	15
St. Matthew I. to St. Lawrence I.		3	60°52'	172°20'	N½W	Flood	NE	gy½-gyM	35-26	60	0	0	0	0	0	0	20	500	0
Do.		4	61°20'	172°15'	N½W	Slack	Nil	gnM-gnM	36-34	60	0	0	0	0	0	0	0	0	0
Do.		4	61°51'	172°06'	N½W	Flood	N	fnegySM-fnegySM	30-29	60	0	0	0	0	0	0	6	0	0
Do.		4	61°54'	172°06'	N½W	Flood	N	fnegyS-fnegyS	29-29	60	0	0	0	0	0	1	4	0	0
Do.		5	62°30'	173°08'	NxE	Flood	N	gnM-gnM	36-36	60	0	0	0	0	0	0	13	0	10
Do.		5	62°52'	172°48'	NxE	Ebb	S	gnM-gnM	37-37	60	1	0	1	1	0	0	0	0	0
Do.		5	63°07'	172°32'	NxE	Ebb	S	gnM-gnM	37-31	60	0	0	0	0	0	0	1	0	0
St. Lawrence I.--N of		7	63°47'	170°53'	NExE	Ebb	S	fneSSh-ShG	15-16	60	5	1	6	6	0	0	0	0	0
Do.		8	63°55'	170°18'	NE	Flood	NW	SG-rky	19-19	25	6	2	8	19	0	0	0	0	0
St. Lawrence I.--NE of		8	63°24'	168°49'	ExS	Ebb	E	gySSh-gySSh	13-13	60	0	0	0	0	0	0	2	0	0
Do.		8	63°19'	168°23'	SE	Ebb	S	GSh-GSh 3/	17-17	0	-	-	-	-	-	-	-	-	-
St. Lawrence I.--E of		9	62°45'	168°32'	S	Flood	NE	gySSh-gySSh	22-23	60	0	0	0	0	0	0	30	50	100
Totals										1,675	85	65	150	161	4	1	300	11,000	4/ 10,600

1/ Net torn and catch lost.
2/ Net fouled in setting so no catch made.
3/ Net snagged immediately.
4/ Approximate poundages: yellowtail 9,700; rock "sole" 850; lemon "sole" 50.

Notes:--In addition to the above, miscellaneous items were taken in approximate amounts as follows: 2,700 tanner crabs; 800 horse crabs; 500 sea poachers; 80 bullheads; 30 turbot; 20 tomcod; 10 skates; and 10 herring. All the king crabs taken in Area XII were of the platypus specie as contrasted with the camtschatica taken in Area XI.

and surf action of winter gales on this exposed beach. Accordingly, it is reasonable to assume that a large population of crabs was present in this immediate vicinity during the most recent moulting period. Presumably by the time of the survey, moulting was complete, and they had migrated to different grounds which were not located.

In the other areas surveyed Paralithodes camtschatica had been the dominant species, with P. platypus appearing only in Herendeen and Olga Bays except for one specimen taken in Frederick Sound. In Area XII every crab captured and all the cast shells which could be identified were of the latter species. Their brighter coloration was quite noticeable, and it was interesting that it blended well with the rather vivid hues of the other forms on the shell bottom where they were found. Those found by the crab investigation were of noticeably smaller size than the P. camtschatica species (as is supposed to be generally true), yet residents of St. Paul Island state that the crabs caught by the Japanese near there had been much larger than the largest specimens of P. camtschatica brought in by the Investigation from Area XI. Also, Marukawa (1933) lists P. camtschatica as being the most numerous species in the oriental fishery and indicates its presence in Area XII.

All of these facts would indicate the presence of substantially more crabs in Area XII than this survey showed, and would suggest the presence of P. camtschatica as well as P. platypus. Thus, the data for this area must be considered inconclusive.

APPENDIX II--FISHING GEAR

Tangle nets, otter-trawl nets of varied design, and crab pots were fished with considerable success during the Investigation. Since all three types of gear appear to have possible application in any subsequent development of the king-crab fishery in Alaskan waters, the present section has been prepared to supply details regarding their construction and operation.

Tangle Nets

Tangle nets are large mesh nets weighted and buoyed in such a manner that when placed in the water they will form a vertical curtain rising from the bottom. Crabs moving about on the bottom become entangled in the netting.

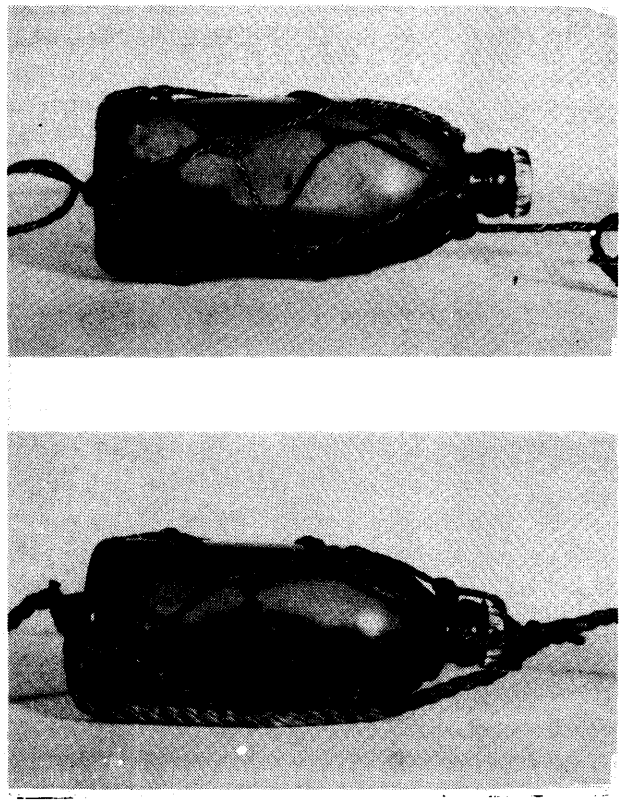

FIGURE 25.--Method used by the Investigation for netting stubby beer bottles and attaching them to the float line.

Construction of Tangle Nets

The nets employed by the crab investigation were 18-inch mesh, seven meshes deep, 18-thread medium-laid cotton netting, hung with 27-thread cotton hanging twine on $\frac{1}{4}$-inch-diameter cotton float and lead lines. Stubby beer bottles were used at two-fathom intervals as floats, and two-ounce lead weights were cast on the lead line 12-ounces to the fathom. The auxiliary gear consisted of anchors, buoy lines, slipshots, buoy kegs, and flag poles.

Pretreatment of Net Materials

Prior to fabrication, the netting, lines, and hanging twine were treated for a period of 12 hours in a hot water extract of cutch and tanbark. The surplus turns in the float and lead lines were removed by "running" the lines while still wet. The lead weights were cast on and finished after the tanning treatment.

Fabrication of Float Lines

The stubby bottles used as substitutes for glass-ball floats were sealed with ordinary lacquered metal caps having cork gaskets. They were then netted with No. 900, tarred, hemp, becket twine, and securely fastened to the float line as indicated in Figure 25. About $8\frac{1}{2}$ feet of twine were required for each bottle, which allowed approximately seven inches and 18 inches surplus at the base and cap, respectively, for fastening.

The several steps were as follows:

A ring was fashioned around the neck of the bottle by making a loop and square knot 18 inches from one end of the piece of hemp twine, fitting the loop over the neck of the bottle and casting on three meshes. Two additional rows of netting were cast to the above meshes and the last row drawn together and fastened at the base.

The netted bottles were fastened to the float line by taking a clove hitch around the line at the center of the bottle cap, leading the line along the side of the bottle directly

opposite the square knot in the netting ring, and taking several half-hitches around the netting and line at the base of the bottle. To assure centering at the cap end, the surplus twine remaining from the clove hitch was passed successively through each mesh adjoining the square knot and fastened to the line at the center of the cap.

With some practice one man can net about 40 bottles per hour. Approximately the same rate can be attained in fastening the netted bottles to the float line. The stubby bottles have a buoyancy of approximately seven ounces each, and cost about 20 cents per dozen at the time they were purchased.

Hanging the Net

The nets were made up in 100-fathom shackles by hanging 200 fathoms of netting--stretched measure--to 100 fathoms each of float and lead line. The float-line hangings were of usual proportions, but those on the lead lines were made short in order to hold the netting close to the bottom. (Figure 26.) The experience of the Investigation indicated that 50-fathom shackles would be more desirable since they would allow greater range in length of set and would reduce the time required to lay out the gear for setting.

The float and lead lines were extended two fathoms at each end to provide for fastening two or more nets together or to serve as bridles to the slipshot. A six-foot breast line was hung at each end of the net to prevent rolling and tearing.

As an experiment to check the advantage of using preservative on the netting materials, a few of the nets were hung with untreated twine. This twine became unserviceable after but three months of exposure, while the treated twine lasted approximately six months.

Auxiliary Gear

Anchors

The selection of suitable anchors for tangle nets depends largely upon current conditions in the waters being fished. Thirty-five-pound kedge anchors were used during the experimental fishing work, but a certain amount of drifting occurred in the strongest currents of Cook Inlet and Bering Sea. Heavier anchors are recommended for these areas.

Anchor flukes should be sharp at the point in order to penetrate the bottom, and should be smooth at the base to minimize chafing in case the buoy lines become fouled. A four-foot anchor strap of 21-thread, manila rope was used to take the normal chafe at the junction of the anchor ring and the line.

Slipshots

A slipshot is a section of line inserted between the net and anchor to facilitate setting the gear. Its use permits setting the nets and auxiliary equipment separately in the most convenient manner, and when the gear is in the water, it tends to keep the net clear of the anchor, thus avoiding snarls.

In the experience of the crab investigation, a 15-fathom slipshot of 21-thread, manila rope proved most successful. This length allowed fastening the buoy line five fathoms from the anchor, thus giving sufficient spacing to prevent fouling and chafing on the anchor when current direction changed. This arrangement did not appear to lift the ends of the net enough to affect their fishing efficiency adversely.

Buoy Lines

Nine-thread, hard-laid, tarred, hemp buoy lines were used for attachment between the slipshots and the buoy kegs. These were made up in lengths of 10, 25, and 50 fathoms to permit suitable combinations for different fishing depths. The length of buoy line used was generally 20 percent greater than the depth of the water. On the basis of the experience gained, a heavier weight line should be used for the bottom section, since in all instances where the buoy lines parted, failure could be attributed to chafing on the anchor. A glass float was attached about 10 fathoms from the lower end of the buoy line to keep it clear of the anchor.

Buoy Kegs

The buoy kegs were strapped in the usual manner, with 21-thread, manila rope loops and nine-thread buoy line for lacing. Both 10- and 15-gallon kegs were used. The smaller kegs were adequate for sheltered waters and most outside work. In strong currents and severe weather the larger kegs were more satisfactory.

Flag Poles

The flag poles were the standard type used in the halibut fishery. Each pole was buoyed with 18 to 20 seine corks and caused to stand vertical by being weighted with a 10-pound sash weight.

Operation of Tangle Nets

Preparation for Setting

The first essential of the tangle-net fishing operation is to lay out the gear in proper position for setting. This and the actual setting will be greatly facilitated by having a suitable platform as discussed earlier in the report.

The float line should be laid in an elongated coil thwartships in such a manner that the bottles are in an orderly arrangement and resting on their bases. The remainder of the float line should be coiled with the body of the net.

The netting should be piled in the usual bights, care being taken to keep the bottles clear. The lead line should be laid in a coil free of the netting.

The flag poles, buoy kegs, buoy lines, anchors, and slipshots should be fastened as indicated in Figure 26. By using the 15-fathom slipshot the auxiliary gear can be kept amidships and the net proper be kept aft.

Setting the Net

In setting the net, the flag pole, buoy keg, buoy line, and anchor were dropped overboard amidships in the order named. The net, attached to the anchor by the slipshot, was then paid out over the stern of the vessel.

Occasionally, under severe current conditions the strain on the nets and buoy line would cause the anchor to drag for some distance. If the anchors were in direct line with the tide, the net would foul and aggravate the drifting condition. This situation was overcome by setting the net from two to four compass points off the current direction and by using long slipshots. Under these conditions the net could bow and sweep between the anchors with changes of tide without snarling.

The tangle nets were fished from one to seven days per set, depending upon time available and weather conditions.

Lifting Tangle Nets

In lifting the tangle nets it was found advantageous first to break out the down-tide anchor and make the end of the net fast direct to the buoy keg. The vessel then moved to the up-tide end, broke out the up-tide anchor, and began the actual net hauling operation. This procedure reduced the strain on the net during hauling and avoided the danger of parting the net lines.

Several methods for lifting the nets were tried. Both lifting by hand and strapping from the boom were found to require too much man-power, to be excessively time-consuming and, therefore, necessitate such reduced vessel speed that steerageway could not be maintained. A far more satisfactory method was to lift by means of a power-driven roller. After experimentation with several types, a large diameter roller having a center "V" groove was constructed which gave such satisfactory results that it is described in detail.

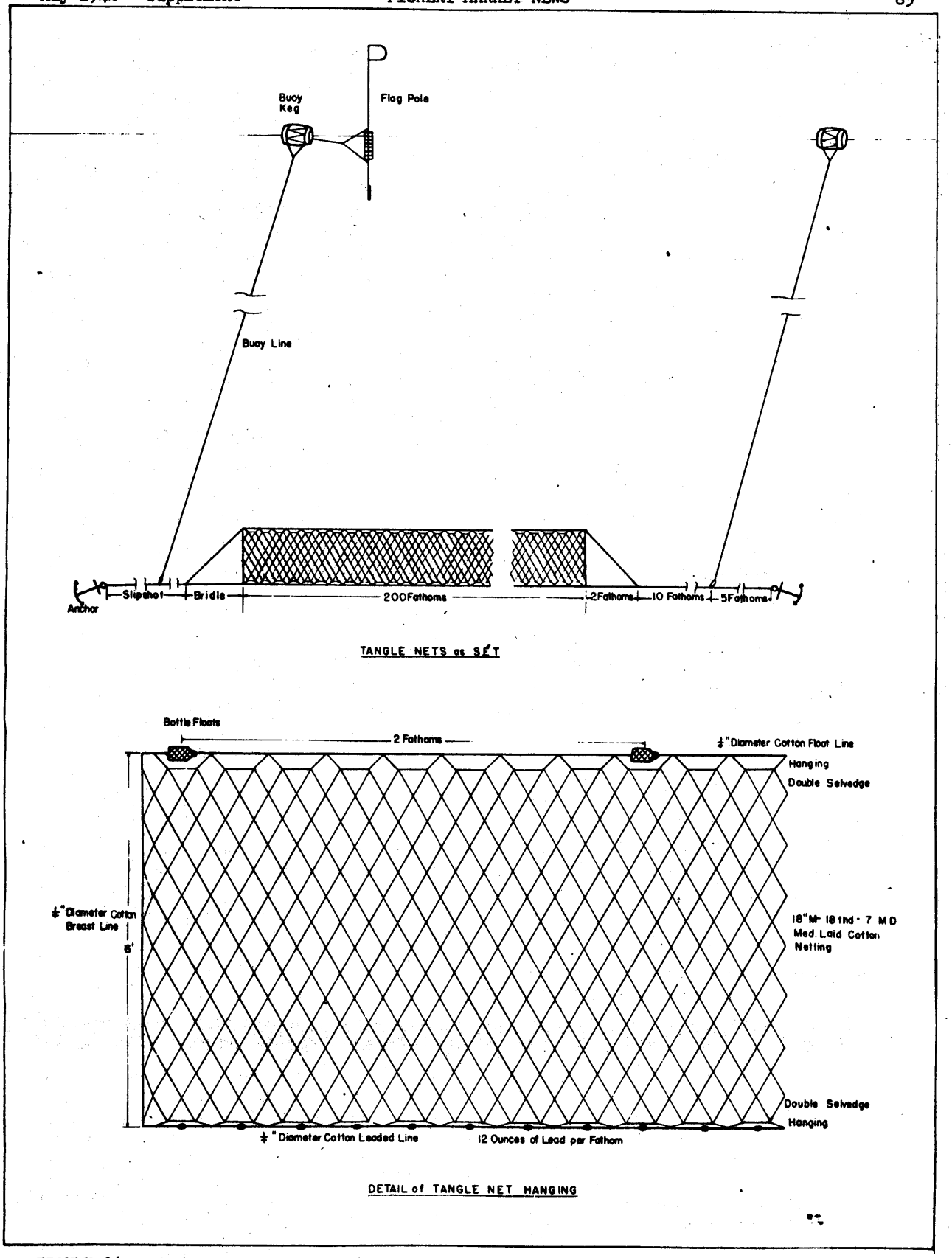

FIGURE 26.—Above, Tangle net and auxiliary gear as set. Below, detail of a section of tangle net showing the materials and method of construction.

The roller was in reality a combination of a halibut sheave and a common roller. The theory of the design was that the roller would provide space for the catch to pass, and the pull of the gear emerging from the water would force the net into the groove opening. This provided the necessary purchase to fully utilize the mechanical driving force applied.

The roller proper was constructed from two-inch lumber and was 36 inches long.(Figure 27.) It consisted of a solid center section or partial core (18 inches in diameter by six inches thick) and two end-pieces (a solid 12-sided disk, 18 inches in diameter by two inches thick centered on another solid disk, 24 inches in diameter by two inches thick) to which were nailed two-inch-thick spacing slats which made up the working surface. This was 12-sided and 22 inches in diameter. The groove was approximately 2-3/4 inches wide at the working surface and 2½ inches deep. It extended partly into the center section, which was equidistant between the two end-pieces. The groove was lined with 3/8-inch-thick belting. For a permanent installation, the center section might well be made of metal in the general shape of a sheave.

The roller was centered on a 1-5/16-inch shaft and set in a well-braced frame constructed of 1½-inch angle iron and ½-inch by two-inch strap iron. The frame was set in such a manner that the center line of the roller was immediately above, and in line with, the rail of the vessel opposite the deck winch. Being 22 inches in diameter, the face of the roller extended outside the rail and thus minimized chafing of the gear against the side of the vessel. Two fair-leads made of 1½-inch pipe were fastened to the water side of the frame to lead the net to the roller groove.

In the temporary installation aboard the vessels of the crab investigation, the power for driving the roller was transmitted from the winch by means of an endless twist-link chain. Several turns were taken around the winch drum to provide the necessary purchase, and the chain was directed from the roller through a block which served to adjust tension and reduce slippage. In a permanent installation a sprocket drive using suitable roller chain would be preferable.

The device described permitted one man to haul nets from a depth of 80 fathoms, his principal duty being to lead the gear from the roller. In average weather it was possible to haul both buoy lines and 200 fathoms of net in less than one-half hour.

The cost of constructing the roller was approximately $50. 1/

Otter Trawls

An otter trawl is essentially a large, flattened, conical bag of netting, with side leads or "wings," which is dragged behind a vessel to catch marine life living or feeding on the bottom. The mouth of the net is buoyed at the top and weighted at the bottom. This provides vertical opening, and the weight is sufficient to cause the net to hold bottom. Horizontal spread is obtained through the action of a pair of otter boards, or "doors", attached through ground lines to the wings. The boards are in turn attached to towing cables in such a manner that they are forced apart when towed through the water. Since the average otter trawl with wings spread is some 100 to 125 feet wide and is towed at a speed of two to four miles per hour, extensive bottom coverage is obtained in a relatively short time.

Otter trawls have been used extensively in the North Atlantic for all types of bottom fish. For many years large trawler fleets operating out of Boston, Gloucester, and other New England fishing ports have been the principal source of food fish for the eastern United States. On the Pacific coast the situation has been quite the reverse, and until recently

1/ Patented net-lifters have been used by Great Lakes gill net fishermen for a number of years. These lifters, which have the lifting wheel on a vertical axis, can be operated from the boat engine or by independent drive from gas or steam engine. The lifting wheel has a number of jaws which grip the twine when tension is applied and which release the turn when tension is relieved. Push-off plunges automatically clear the twine from the wheel after the jaws open. Operation of the lifter is controlled through a clutch. The net is directed aboard the vessel over an idler roller with guides extending over the side, and continues in a trough-like platform to the lifting wheel. These patented net-lifters sell for $250 to $600, depending on size and method of drive.

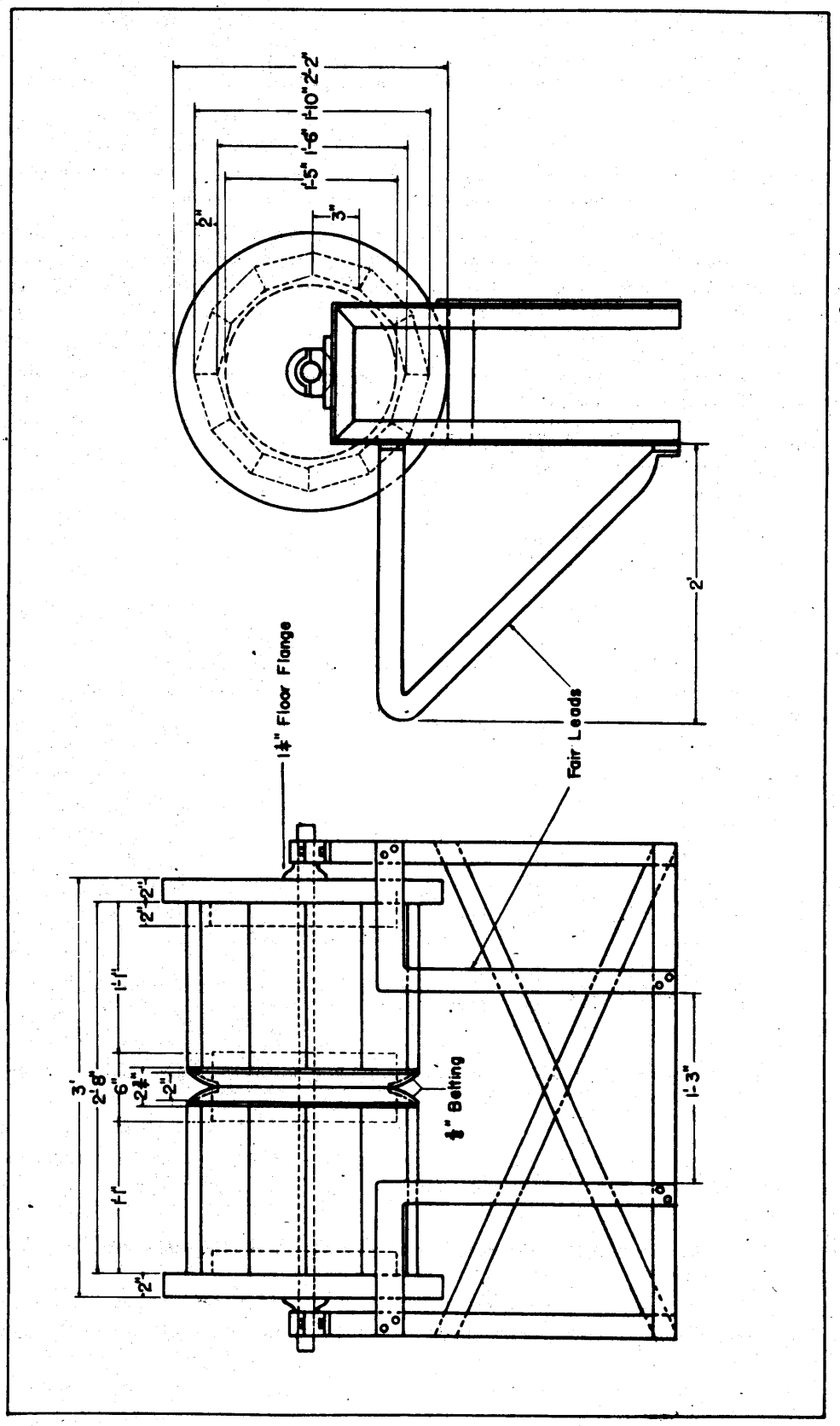

FIGURE 27.--Details of the power-driven roller developed by the crab investigation for hauling tangle nets.

otter-trawl fishing has been of rather minor importance. A reason for this is that except for halibut, the more important commercial species have not been bottom fish. However, in the past several years a pronounced increase in fishing for flounder-like market fish has occurred, and otter trawls are becoming more widely used.

Through long experience trawl fishing on the Atlantic coast has been quite definitely standardized. In general, Atlantic coast trawlers have evolved into rather large fishing craft especially designed for trawling in the open ocean. These vessels are equipped to permit what is termed a "side-set" operation.

So far, on the Pacific coast, trawl fishing has been adapted largely to vessels designed for other types of operations--in many cases purse-seiners. It is the general practice to rig them for setting the net over the stern although a few schooner-type vessels have been equipped for side setting. Since the west coast trawlers are in most cases much smaller vessels, lighter trawls and auxiliary gear have been used.

In the conduct of the Alaska Crab Investigation, the Fish and Wildlife Service operated both side-set and stern-set vessels. The schooner Dorothy had authentic Atlantic coast trawl gear, and the vessels Champion and Locks were rigged for stern setting. Since there was no precedent for design of a crab trawl, several types were tried. These included a typical Atlantic coast trawl, a modified Atlantic coast trawl, and several modifications of Pacific coast trawls.

Description of Trawls Used

General Design

The types of Atlantic coast otter trawls have been standardized through many years of use. A typical net is made up of a top and bottom side, each of which consists of several prepared and replaceable sections, generally referred to as top and lower wings, "bellies," "cod ends," and top "square".

The Pacific coast trawl is of different general design in that it is a four-sided net. However, because of its recent development it has not as yet reached a marked degree of standardization. The sections of the sides are cut to the desired size from strips of netting of various mesh and weight according to individual preference.

The Atlantic coast trawl used by the Investigation was constructed from prepared sections of hemp netting of the mesh sizes shown in Figure 28. The foot rope was 3/4-inch-diameter, steel cable made up in three sections, i.e., one bosom section and two wing sections, with eye splices and connecting links. It was "served" (wrapped for protection against chafing) with ½-inch-diameter sisal. The head rope was a single piece of 3/4-inch-diameter wire rope, cut and spliced to proper length. The quarter rope, splitting strap, and breast lines were 3½-inch-diameter manila rope, and the rib lines and auxiliary foot rope were 27-thread manila rope. Hemp twine was used for sewing and hanging.

The auxiliary parts of the trawl consisted of cylindrical steel floats for the head rope and two-inch-diameter iron purse rings for closing the cod end.

The Atlantic coast trawl was the most rugged and durable trawl used by the crab investigation. The hemp netting was the most resistent to chafing when towed over the bottom. Also, there was no noticeable kinking or distorting of the meshes due, probably, to the soft and pliable nature of the twine used in constructing the meshes.

During the exploratory fishing 243 tows, including 15 snags, were made with this net. It was necessary to renew the bottom side of the net on two occasions, but the same top side was used for all of the 243 tows.

Many small or baby fish were taken with this net, probably because of the small mesh opening of the cod end. While the meshes were 3½ inches, stretched measure, between knot centers, the double twine used in fabricating the cod end resulted in large knots and a comparatively small, effective mesh opening.

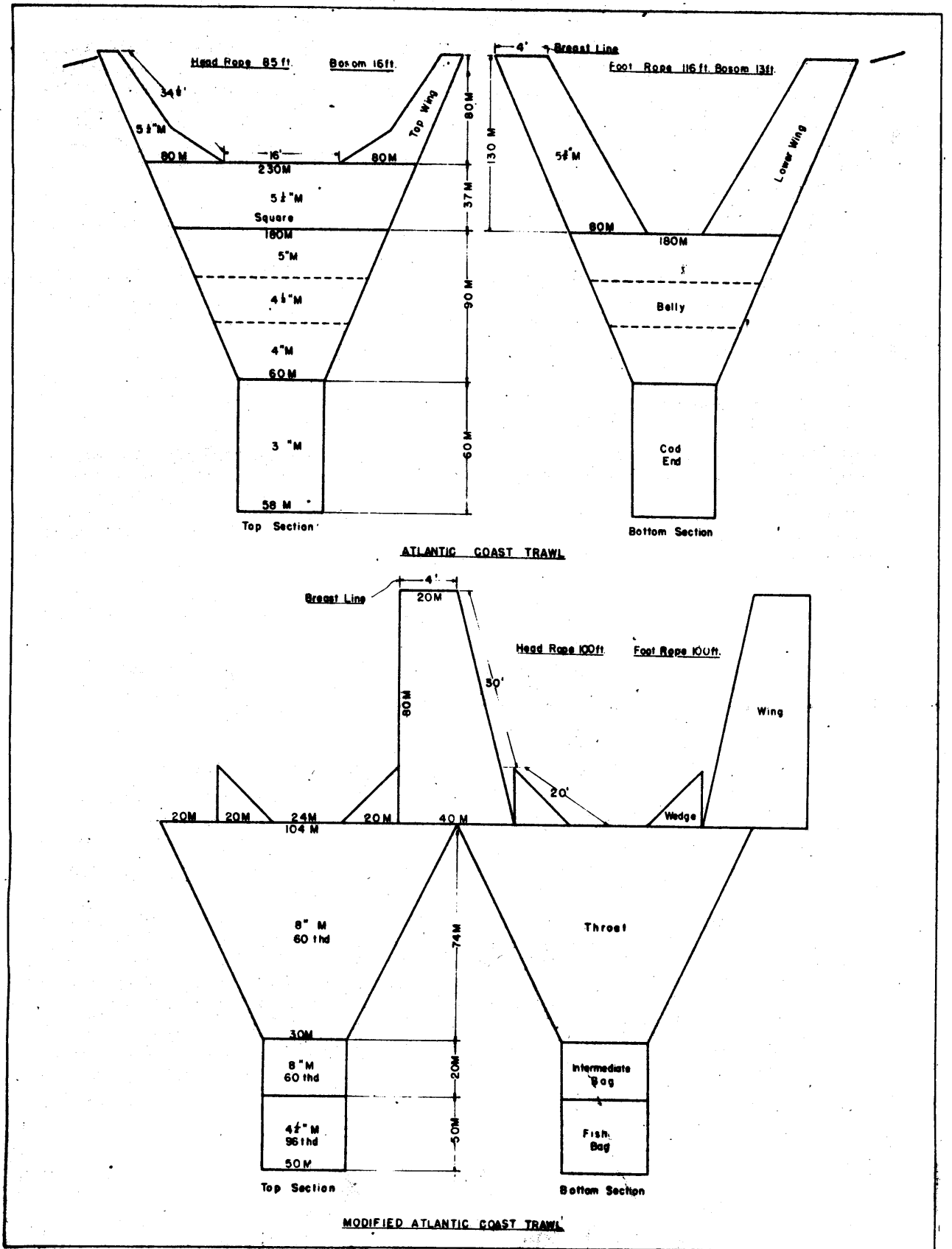

FIGURE 28.--Detail of an Atlantic coast-type trawl (above) and a modified Atlantic coast-type trawl (below).

The modified Atlantic coast trawl and the several modifications of Pacific coast trawls were fabricated by the Investigation's personnel. The various sections were cut from medium-laid, cotton netting of the mesh sizes and weights of twine shown in Figures 28 and 29. The nets were sewed and hung with 60- and 96-thread cotton twine, depending upon the weight of the netting. Foot ropes and head ropes were of four-inch- and three-inch-circumference manila rope, respectively. The quarter ropes, breast lines, and splitting straps were of 2-3/4-inch-circumference manila cordage, and the rib lines and auxiliary foot rope were of 27-thread manila cordage.

The auxiliary parts consisted of three-foot lengths of 3/8-inch iron chain for weighting the foot ropes, floats for buoying the head rope, and two-inch-diameter purse rings for closing the cod end.

The modified Atlantic coast trawl had only a top and bottom section of large mesh and no overhang. Consequently, it was the easiest net to construct of those fabricated by the crab investigation personnel.

The large mesh, i.e., eight-inch, used in this trawl was undesirable, because considerable numbers of marketable "sole" gilled in the meshes. Also, the large mesh complicated the splitting procedure used in landing big catches, and the crabs became entangled in the meshes and would not readily fall into the fish bag.

The modified Atlantic coast trawl was used for 56 tows, nine of which resulted in snags.

The Pacific coast-type trawl, illustrated in Figure 29, was of the general size common for boats of 50 to 90 horsepower. The head ropes and foot ropes were about the same length as those used with the Atlantic coast trawl. The section removed from the bottom throat to give recess was cut in two and added to the top side to complete the overhang.

The use of six-inch mesh in the wings and throat was quite satisfactory, as very few market-sized fish were gilled; yet practically no baby or small fish were taken with this net. The 4½-inch-mesh netting of the intermediate bag and fish bag eliminated the splitting difficulties encountered with the eight-inch-mesh trawls. However, considerable chafing was observed in the lower part of the side sections, indicating that the trawl was not completely open. This may have been caused by too few floats or improper design.

A total of 76 tows were made with this net. Of these, two tows ended in serious snags which rendered the net unsuitable for further service.

The sides of the enlarged Pacific coast-type trawl, also shown in Figure 29, were made exceptionally high as an experiment to capture round fish which seemed partially, at least, to elude other trawls. This net proved to be the most successful for catching cod and because of its greater horizontal opening was one of the most effective crab trawls. No undue chafing was noticed on the sides of the trawl.

The greater size of this net would probably necessitate the use of larger otter boards and more power than are common to the average Pacific coast trawler.

A number of other trawl nets also were tried. They were of the general size and shape of the nets which have been described. One of these had wings and throat constructed of 4½-inch-mesh, 27-thread cotton netting commonly used by Pacific coast trawlers in fishing for flounders. This trawl was unsatisfactory because the netting was not strong enough to withstand the hazards of exploratory fishing.

Materials Used in Construction

The materials required for constructing trawl nets of the types described were essentially as follows:

Modified Atlantic coast trawl

100 lb. - 8-inch-mesh, 60-thread cotton netting, 80 meshes deep
25 lb. - 4½-inch-mesh, 96-thread cotton netting, 50 meshes deep
110 ft. - 4-inch-circumference manila rope

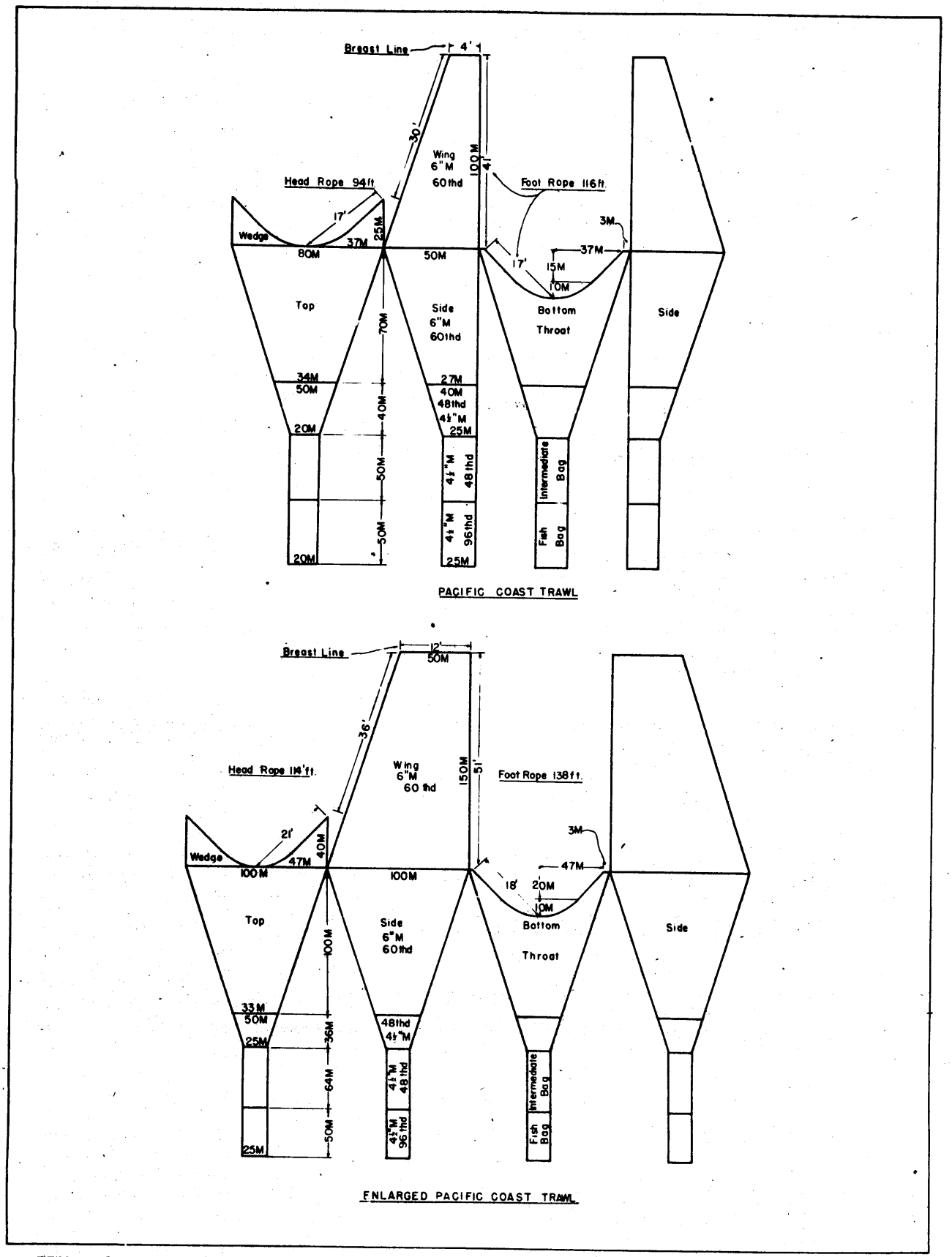

FIGURE 29.—Detail of a Pacific coast-type trawl (above) and an enlarged Pacific coast-type trawl (below).

210 ft. - 2-3/4-inch-circumference manila rope
525 ft. - 27-thread manila rope
15 lb. - hanging twine

Pacific coast-type trawl

115 lb. - 6-inch-mesh, 60-thread cotton netting, 70 meshes deep
27 lb. - 4-inch-mesh, 48-thread cotton netting, 50 meshes deep
25 lb. - 4½-inch-mesh, 96-thread cotton netting, 50 meshes deep
124 ft. - 4-inch-circumference manila rope
215 ft. - 2-3/4-inch-circumference manila rope
440 ft. - 27-thread manila rope
15 lb. - hanging twine

Enlarged Pacific coast-type trawl

260 lb. - 6-inch-mesh, 60-thread cotton netting, 100 meshes deep
36 lb. - 4-inch-mesh, 48-thread cotton netting, 100 meshes deep
25 lb. - 4½-inch-mesh, 96-thread cotton netting, 50 meshes deep
148 ft. - 4-inch-circumference manila rope
233 ft. - 2-3/4-inch-circumference manila rope
550 ft. - 27-thread manila rope
25 lb. - hanging twine

Method of Hanging

In constructing the trawls, the various sections of netting comprising a side were sewed together in the arrangement shown in Figures 28 and 29. The sides were then securely hung on rib lines to form the typical funnel-shaped bag of netting. The head and auxiliary foot ropes were next hung on the top and bottom sections of the trawl throat (or bosom) and wings. Breast lines terminating in eye splices were hung across the end of each wing. The hanging of the trawl was completed by lashing the auxiliary foot rope to the main foot rope and securing them and the head rope to the breast line.

A splitting strap was provided for dividing the catch in the net in case of large hauls. This was a large loop passed around the fish bag and connected to the float line so as to be accessible. The loop was held in position by eye straps lashed to the rib lines about five feet from the fish bag opening.

A draw rope, passed through rings at the end of the fish bag, permitted opening the net and dumping the catch.

The Atlantic coast trawl was provided with two quarter ropes long enough to permit full opening of the net and reaching to the winch after the wings were hove to the gallows frame. Each was fastened to the junction of the bottom bosom and the lower wing, then passed through an eye strap lashed to the junction of the top bosom and the top wing, then continued along the wing and fastened to the breast line.

Quarter ropes are needed to facilitate the lifting of the trawl when fished from side-set gear. When the wings are hauled up to the gallows frames, the net itself is still submerged. To lift this great weight the quarter ropes are passed through lead blocks and then to the winch where the necessary power is applied to lift the bosom or throat over the rail. The remainder of the net is taken aboard with a suitable fall or tackle.

Auxiliary Trawl Gear

The otter boards for the stern-set trawlers were 6½ feet long by 3¼ feet high and weighed 425 pounds each. They were constructed from full two-inch fir and strengthened and further weighted with iron reinforcing straps and iron runners. Four short lengths of chain fastened to four eye bolts located on "quarters" on the inner side of each board served as suspending bridles. The spreading force of the boards in the water could be regulated by adjustment of the length of the various chains, thus altering the points of suspension.

The trawl winch, located immediately forward of the fish hold, was equipped with double winch drums mounted on a single shaft. Brakes and frictions for each drum permitted independent or synchronous operation as desired.

Steel cable, ½ inch in diameter, was used for the towing lines. The lines emerging from the drums passed through blocks attached to sturdy upright towing posts, one on each side of the stern, and thence to the corresponding otter boards where attachment was made by a swivel connection at the point of suspension. Rope ground lines, 20 fathoms long of 2-3/4-inch-circumference manila rope, were used between the trawl wings and otter boards to increase the spread. Attachment was effected by rope straps through the after section of each board.

The boards for the side-set trawler were considerably larger. These were eight feet long by four feet high and weighed 900 pounds each. They were constructed from three-inch eastern lumber and were heavily weighted and strengthened with iron reinforcing pieces. Two triangular brackets of 1½-inch-diameter iron rod attached to the inner side of each served as means of suspension, regulation of sheer, and connection to the towing cable. In addition, the boards were rigged in a special manner which permitted direct connection between the towing cables and ground lines so that the latter could be drawn in on the winch drums after the boards had been lifted and secured to the gallows. The ground lines were ½-inch steel cables, 20 fathoms long.

The winch for the side-set vessel was of much heavier construction than those on the stern-set vessels, and the steel towing cable was 7/8 inches in diameter.

The rugged iron gallows, or "A" frames, were about seven feet high and both were located in an upright position on the port side, one forward and one aft. They were made fast to the deck and strongly braced at such an angle that the top of the frame was directly above the side of the vessel.

The towing cables were led from the winch drums, through steel sheaves and blocks for fair-leads, to their respective gallows frames; there each passed over a block suspended from the top of the frame, and thence to the boards for attachment by means of the special method mentioned previously.

The procedure for attachment between the boards, the towing cables, and ground lines was essentially as follows:

The towing cable was attached to the board by means of a flat close-mouth hook which could be readily released when tension was relieved. The ground lines were passed through a heavy ring or "Kelly eye" attached by heavy straps to the after-section of the board. A shackle on the ends of the ground lines prevented their slipping back through the ring when tension was applied, thus forming a positive connection between the trawl and the board.

A supplemental piece of cable, called a "messenger line," was shackled at one end to the towing cable immediately adjacent to the flat hook, making connection with the board, and the other end was attached to the shackle on the ends of the ground lines. Thus, after the board was made fast to the gallows frame, it could be unhooked from the towing line and the ground line wound onto the drum.

Operation of Trawl Gear

In setting the stern-type gear, the vessel was given headway, and the trawl and ground lines dropped directly over the stern. When the net was clear, the boards were dropped overboard, and the desired length of cable released from the winch drums. The brakes were then locked and the actual fishing commenced. Normally, the ratio between length of towing cable and depth was three-to-one. The towing speed was about three miles per hour.

With the side-set trawler, the vessel was maneuvered to bring the working side to the windward so that the gear would drift clear; the net was dumped overboard; the vessel given moderate headway in a sharp arc; and the ground and messenger lines released from the winch drums. Then the vessel was practically stopped, and the towing cables were hooked to the otter boards which were dropped overboard and allowed to sink.

After the boards and cables were sufficiently clear of the vessel's propeller, forward motion was resumed until the vessel neared the direction of the tow. Then the towing cables were paid out and, when the desired lengths were set, they were passed through a towing block near the stern.

In hauling the stern-set gear, the vessel was slowed down while the towing cables were rewound on the winch drums and until the boards were up to the towing posts. After the boards were made fast the vessel was given full power ahead to raise the net. The vessel was then backed rapidly toward the net while the ground lines were overhauled by hand and carried around the stern to a position alongside under the boom. The ground lines and net were strapped in.

When heavy catches were made it was sometimes impossible to raise the net by the forward movement of the vessel and prevent its sinking before the ground lines could be overhauled. It was then necessary to hook the lifting tackle to the ground lines, release them from the boards and, finally, maneuver the vessel alongside the net for a subsequent lifting operation.

In hauling the side-set gear, the vessel was maneuvered down wind from the net, forward motion was stopped, the towing cables released from the towing block, and rewound on the drums until the boards were lifted. Then the boards were made fast to the gallows frames and disconnected from the towing cable. The messenger and ground lines were then taken in on the drums until the trawl wings were lifted up to the gallows frames. Finally, the head rope and foot rope were lifted aboard by heaving on the quarter ropes, and the net lifted aboard using a suitable fall.

FIGURE 30.--A catch of small king crabs in the conical type of pot.

Crab Pots

A crab pot is a type of trap consisting of an iron framework covered with iron fencing or textile netting, in which an opening is provided for the crabs to enter. A bait sack, usually containing clams or fish, is suspended within to serve as a lure.

Crab pots are fished extensively on the Pacific coast and in Alaska for the capture of dungeness crabs. This type of gear also has been the principal means for taking king crabs in the small, domestic canning operations which have been carried on in Alaska from time to time during recent years. The size and shape of crab pots varies according to the preference of individual fishermen.

Description of Crab Pots

The crab pots used during the Alaska Crab Investigation were of lighter framework than would be recommended for a commercial operation. This was because the pots were constructed on the vessels in the field, and it was necessary to use rod which could be readily shaped without prior heating. The framework of pots intended for commercial crab fishing should be fabricated from iron rod not less than one-half inch in diameter.

Two types of pots were tried for the investigative work. One of these was a rectangular or box type; the other was a circular type similar to the lower portion of a cone. An example of the circular type is shown in Figure 30.

The frame of the rectangular pot was of ¼-inch-diameter steel rod and was four feet long, three feet wide, and three feet deep. The four sides were covered with two- by three-inch mesh, 16-gauge, galvanized, chicken wire, fastened to the framework with hog rings. The ends were closed with pieces of two-inch-mesh salmon trap webbing, except for an opening in the middle formed by an iron frame eight inches high and 14 inches wide. The frames in the two end pieces were partially drawn together, thus forming a tunnel-like entrance at each end of the trap.

The framework for the circular pot consisted of a base ring four feet in diameter and a top ring 2½ feet in diameter joined by several spacing rods 20 inches long. Two additional rods spaced eight inches apart across the top ring served to support an eight-inch by 14-inch opening. The framework was covered with galvanized iron fencing.

Each type of pot was provided with a bait sack and a bridle for attachment to the buoy line.

While the pots were fishing, their respective positions were marked by buoy kegs. The line leading from the trap to the market kegs also served as a lifting or hauling line.

APPENDIX III--CANNING KING CRABS

By correlating information available at the time of the Investigation with data obtained during the Investigation, a procedure for canning king crabs can be recommended which, if carefully carried out, will enable the packer to produce a canned crab meat product of good quality. These principles were employed in preparing a small commercial pack which, when offered for sale, was judged to be superior to the imported canned crab meat known to the trade.

Canning Procedure

The several steps essential to preparing a satisfactory canned king crab meat product are preliminary handling of crabs, butchering, cooking, removal of meat, washing picked meat, acid dip, brine treatment, packing and sealing, and retorting and cooling.

Preliminary Handling of Crabs

It is of utmost importance that crabs to be used for canning be kept alive until immediately before starting canning operations. The flesh of crabs contains certain natural enzymes which cause rapid color changes after death. These color changes may begin even before bacterial decomposition sets in. Certain crustacea contain a little ammonia even in the living condition and, if allowed to die before canning, the greater amount that is formed by enzymatic and bacterial action is responsible for a phenomenon generally known as "blackening". This occurs when the iron in the can comes in contact with the product. If enough ammonia is present, water-soluble sulfides contained in the flesh will combine with the iron to form black iron sulfide which has a strong coloring power and shows up as a black ring on the parchment paper and product. As a rule, this development starts along the corners and in the seams of the can where the iron is exposed as a result of the lacquer and the underlying tin being pulled apart by contraction and expansion during the heating and cooling operations.

A "blue" discoloration of crab meat has oftentimes been noted. It is believed that this is due to the presence of copper (haemocyanin) in the blood of crustaceans. The copper combines with the earlier-mentioned sulfides and, in the presence of ammonia, forms a blue-colored copper compound. This appears as a deep blue coloring inside the white musculature and in the legs and claws of crabs after cooking. Therefore, as a precautionary measure against abnormal discoloration of canned crab meat, only live crabs should be used.

Butchering

The crabs are butchered while alive. The first step is the removal of the carapace or back shell. This is done by grasping the walking legs, one set in each hand, in such a manner that the posterior end of the carapace can be jammed down over the butchering iron. 1/ The legs, still adhering together as a unit, are pulled clear of the carapace and abdomen and so freed of most of the organs and viscera. With a butcher knife the legs are then divided into two equal portions (each composed of three walking legs and a cheliped--the leg terminating in a claw), and the gills, remaining viscera, and excess shell are trimmed away.

Much care should be exercised in this operation, for as much as 10 percent of the edible meat can be lost through careless butchering. The yellow gelatinoid substance which clings to the body meat is quite easily removed with a stiff brush while washing the legs with water under pressure.

Cooking

After cleaning and washing, the carcasses are placed in a vat of boiling water and cooked for 15 to 17 minutes. The time is calculated from the moment the water resumes boiling and is subject to variation according to the seasonal condition of the crabs.

1/ The butchering iron, developed by previous commercial enterprises and adopted by the Investigation, was made of a piece of two-inch by $\frac{1}{4}$-inch strap iron. It was fastened to the front of the table from which it projected to give sufficient clearance and then was bent vertically upward to form a blade $3\frac{1}{2}$ inches high and sharpened on the top edge.

Immediately after boiling, the carcasses are cooled for about 30 seconds. Proper regulation of cooking and cooling loosens the meat so that it will shake out readily. The Japanese floating canneries are reported to use sea water for the cooking and washing, and their success is proof of its suitability. However, where ample fresh water is available its use or a weak (three percent) brine solution is recommended since there is less chance of contamination. Both the three percent brine solution and straight fresh water were used by the Investigation with good results.

Removal of Meat

Care should be exercised in the removal of the meat from the shell. When removed in large pieces, a more attractive product is obtained. Also, the quality of the pack is greatly enhanced if the leg meat is removed free of tendon material.

The white body meat, which is contained in the large basal portion of the legs and claws, can be removed in one piece from each. Tendons are removed from the legs and claws prior to shaking out the meat. This is accomplished by breaking the shell successively at each leg and claw joint and pulling the joints apart. The tendons remain attached to the shell at the joint and are thereby removed from the leg section containing the meat. The operation is based on the same general idea as the pulling of tendons in turkey legs.

Following removal of the tendons, the meat is shaken out into white enamel pans by means of a sudden jarring motion. The leg and body meat are kept separate to facilitate later operations.

Washing Picked Meat

The picked meat, as originally obtained, contains a certain amount of debris, consisting essentially of shell particles, coagulated blood, viscera, gills, etc. The meat, therefore, must be thoroughly washed before subsequent treatment. This can be accomplished by placing the meat on a perforated, non-corrosive metal table or in wire trays made of galvanized iron, and spraying from above with water under pressure.

Acid Dip

After washing, the meat is weighed and dipped for 15 seconds in a weak acid solution. Acetic acid is recommended, although citric acid and possibly other organic acids are suitable. The acid treatment minimizes the tendency toward formation of basic ammoniacal compounds and is therefore a further precaution against discoloration of the meat.

The acetic acid solution is made up in the proportion of two ounces (approximately 56 cc.) of glacial acetic acid to one gallon of fresh water. In experiments using 30-gallon batches of dip solution, it was found that each 100 pounds of crab meat treated removed an equivalent of two to three ounces of glacial acetic acid from the acid solution. To maintain the strength of the acid at a constant level, therefore, it is necessary to replenish the acid at this rate. By keeping the acid concentration of the dip solution at a fairly constant level, a more certain and uniform treatment is obtained.

White enamel pans measuring about 16 x 8 x 5 inches, fitted with a removable $\frac{1}{2}$-inch mesh, galvanized wire top, were found to be effective containers for dipping the meat into the acid solution. After dipping, the pans were inverted so that the acid solution remaining in the pan drained off.

Brining Treatment

Following the acid treatment the leg and claw meat is dipped for a period of 15 seconds into a brine measuring 90° salinometer, i.e., 90 percent saturated. The brine bath should be checked several times during the day and replenished with additional salt when necessary. Excess brine is removed by inverting the pan and dropping the meat into $\frac{1}{4}$-inch mesh, galvanized wire bottom packing trays where the meat is allowed to drain for a few minutes before being packed into the cans.

The white meat is not dipped in brine because the salt absorbed by the leg and claw meat is sufficient to flavor the canned product to the right degree for the majority of consumers.

Questionnaires received from 82 persons, on both the Atlantic and Pacific coasts, who had examined the pack, showed that the degree of salting was satisfactory to 70 persons, was insufficient for eight, and excessive for four.

Packing and Sealing

The crab meat is packed in ½-pound flat, "C" enamel (seafood formula) cans. The cans are first lined with vegetable parchment paper. This may be in the form of a crimped cup with a separate disc cover, or a one-piece cup with fold-over top.

In packing, the largest leg and claw pieces are used for the top and bottom layers, and the center of the can filled with body and broken leg meat. The paper cover is put on, and the cans are then sealed. A vacuum sealing machine is recommended.

Immediately after sealing, the cans are piled in retort trays for processing.

Retorting and Cooling

Retorting (processing) should be regarded as an operation requiring particular care for, if the meat is overcooked, the taste, texture, odor, and color of the canned product will be impaired. A recording thermometer or an automatic, steam pressure regulator should be installed on the retorts so that the processing temperature can be kept at a constant level. A processing temperature of 230° F. (6 lbs. pressure) for 75 minutes is sufficient to sterilize the product and not adversely affect the color, odor, taste, or texture.

After processing, the cans should be cooled quickly. Cans should be washed in hot water first to remove any grease or other foreign matter, and then plunged immediately into cold water. It is believed that slow cooling will cause the red color of the leg and claw meat to diffuse into the white body meat, thus resulting in an inferior product. Cans should be thoroughly dried before packing into cases.

Precautionary Measures

Metal of Utensils

Utensils that come in contact with the crab meat should in no case be made of steel or copper. It is believed that utensils made of these metals play a part in the abnormal discolorations that are sometimes reported in canned crab meat. White enamel pans and heavily coated, galvanized iron trays have been found to produce satisfactory results. Crab meat should be removed from the cooked crabs as quickly as possible, and in no instance should it be allowed to remain in the cans for prolonged periods of time previous to retorting.

Control of Canning Process

The appearance, quality, and uniformity of a canned crab meat product is influenced to a considerable extent by careful control of the various steps in the process, a fact which should not be overlooked.

Consumption of Acetic Acid

In the canning of king crabs it is important to give the picked meat a proper acid dip. Experience has shown that an acid bath maintained at a concentration of two ounces of glacial acetic acid to each gallon of water gives entirely satisfactory results. However, as indicated previously, the acid is taken up by the crab meat, and it becomes necessary to replenish the bath periodically in order to maintain a uniform concentration. To check the rate of removal of acid, several experiments were made.

Starting with 30 gallons of acid-water solution, successively weighed quantities of crab meat were dipped for intervals of 15 seconds and drained. After each treatment, measured portions (5 cc.) of solution were removed and titrated with standard sodium hydroxide solution. The normality of the solution, i.e., concentration of acid present, was thus obtained.

In one experiment 11 batches of meat, totaling 519 pounds, caused the normality to drop from 0.2054 to 0.1518, or approximately 0.0107 per 100 pounds of meat dipped. This would indicate that an equivalent of 72.6 cc., or approximately 2½ ounces of glacial acetic acid, was removed by each 100 pounds of meat.

A check experiment in which acid was added at this rate showed that after dipping 540 pounds of meat the normality of the acid bath has dropped only from 0.2054 to 0.1990. The result essentially substantiates the estimated rate of removal. This rate, however, may be expected to vary with differences in the crab meat since large firm pieces will remove less acid than an equal weight of smaller broken pieces. A packer of crab meat, therefore, should not depend entirely upon a predetermined rate of replenishment but should occasionally determine the strength by titration.

The acid bath should be controlled on the basis of acid concentration rather than acidity, i.e., pH, because the buffering action of the crab meat makes pH an unreliable estimation of acid concentration. In test experiments it was found that while fresh dipping solution had an acidity of about pH 3.0, the apparent acidity would decrease to as much as pH 4.0, even though the acid was replenished periodically, and the concentration as indicated by titration remained relatively constant.

The acid bath should be made up fresh daily.

Changes in Brine Solution

No data were recorded on the rate salt was removed from the brine dip because the strength of the brine can be controlled readily in commercial practice without recourse to chemical analysis. Although a 90° brine has been suggested, a saturated solution can be used, in which case the excess salt in the bottom of the vat will keep the solution up to proper strength.

In the experimental canning operations about 50 to 55 pounds of salt were used initially with about 30 gallons of water. Since the rate of salt removed is not great, some 400 to 500 pounds of meat generally were dipped before additional small quantities of salt were added.

Tests showed that there was very little exchange of acid from the acid-dipped meat to the brine-dipping solution. The fresh brine solution was generally about pH 5.7 at the start of operations. The first 50 pounds of meat dipped increased the acidity to about pH 4.7, and the next 50 pounds to about pH 4.2; thereafter the pH remained essentially constant as a result of the buffering action of the meat in the solution. After a day's operation the acid concentration of the brine solution was less than 0.01 normal.

The brine solution should be made up fresh daily.

Acidity of Crab Meat During the Canning Process

As had been explained, the object of the acid dip is to prevent the meat from becoming alkaline and liberating ammoniacal compounds which contribute to discoloration. The acidity of the crab meat during the various steps in the canning process was found to be approximately as follows:

Uncooked leg and body meat	pH 6.0
Cooked leg meat	6.0
Cooked body meat	6.2
Cooked leg and body meat after acid dip	5.4
Cooked leg meat after brine dip	5.7
Canned meat (after processing)	6.4 - 6.6

Fill

The standard "½-pound flat" can of crab meat is supposed to contain not less than 6½ ounces of meat, drained weight. To attain this content it is necessary to pack approximately 8.0 ounces of meat initially. Due to variation in free liquid, an amount less than 7.7 to 7.8 ounces is apt to give less than the required drained weight, and an amount much in excess of 8.0 ounces will cut down head space and cause low vacuum. Table 21 shows the averages for 12 cans from each of the 10 experimental codes tested.

TABLE 21.--Variation in fill of experimental packs

Code	Net weight	Drained weight	Free liquid	Head space	Vacuum
	Ounces	Ounces	Cubic centimeters	Inches	Inches
A18	8.5	7.0	44.4	1/8	6.9
A21	8.6	7.1	40.8	1/8	6.2
A24	7.6	6.5	32.8	1/4	19.5
A24	7.8	6.5	34.4	1/4	18.4
A27	7.6	6.4	31.9	1/4	18.0
A28	7.7	6.7	26.5	1/4	20.5
A30	7.6	6.5	29.0	1/4	21.6
B3	7.5	6.4	31.0	1/4	20.6
B4	7.5	6.3	31.3	1/4	19.3
C6	7.8	6.8	29.8	1/4	21.2

Yields and Productivity

In the discussion of the plan and scope of the Investigation it was pointed out that conditions prevented obtaining extensive or reliable cost data with regard to the canning of king crabs. However, certain information which gives some indication of minimum expectations has been assembled both from the present investigative work and from earlier commercial efforts 1/ to develop a king crab fishery. These data are given here to supplement the preceding discussion.

Yield of Crab Meat

The majority of the canning-sized males, i.e., about 5½-inch carapace width, taken on the Pacific side of the Alaska Peninsula, varied between eight and 16 pounds in weight while those taken in Bering Sea varied between five and 10 pounds.

If the crabs are in good hard-shelled condition, the recoverable meat will range between 20 and 35 percent of the live weight. The proportion of leg meat to body meat was found to be in the approximate ratio of two-to-one, although data from an earlier commercial effort indicated a ratio more nearly six-to-four. (Table 22.)

Crabs approaching moulting or just completing the moulting process are unsuitable for canning because the meat loses texture, becomes watery, and there is a much smaller recovery. Difficulty from this situation, however, does not appear very likely in a commercial operation, because but few moulting male crabs were encountered during the period between late March and early October, the season when weather would permit operation.

TABLE 22.--Composition of king crabs

Vicinity	Date 1/	Number of crabs	Sex	Average weight	Edible meat			Recoverable waste	Meat proportion	
					Leg	Body	Total		Leg	Body
				Pounds	Percent	Percent	Percent	Percent	Percent	Percent
Bering Sea	June 1941	2	Male	11.2	15.9	7.1	23.0	-	68.7	31.3
Do.	May 1941	1	Male	10.1	14.2	6.8	21.0	-	67.6	32.4
Do.	May 1941	2	Male	7.0	20.9	8.4	29.3	-	71.3	28.7
Canoe Bay	Apr. 1941	2	Male	10.2	15.9	7.6	23.5	-	67.7	32.3
Do.	Oct. 1940	5	Male	11.0	17.4	10.0	27.4	56.0	63.7	36.3
Do.	Oct. 1940	5	Female	4.7	18.3	9.7	28.0	70.0	65.4	34.6
Do.	Sept.1940	50	Male	8.8	14.8	8.8	23.6	-	63.0	37.0
Wide Bay	Apr. 1941	2	Male 2/	11.7	10.4	5.9	16.3	-	63.8	36.2
Lazy Bay	Jan. 1939	160	Male	11.1	20.1	13.8	33.9	-	59.3	40.7
Alitak Bay	Dec. 1938	102	Male	6.7	18.4	13.1	31.5	-	58.4	41.6
Do.	Dec. 1938	18	Female	3.8	13.9	9.5	23.4	-	59.4	40.6
Do.	Dec. 1938	1	Male	15.0	-	-	38.3	-	-	-

1/ Data prior to 1940 from personal records of M. Marvin Wallace and Clarence Gott. 2/ Soft-shelled crabs.

1/ Many of the data in this section were obtained by one of the members of the Investigation staff, Mr. M. Marvin Wallace, during operations of the Pacific Fisheries and Trading Company.

On the basis of the actual amount of canned product obtained during the Investigation's canning studies and in previous commercial operations (Table 23), and from estimates calculated from the average weight of canning-sized males (Table 24), the number of crabs required per case of canned product, 48 ½-pound cans, is subject to considerable variation, especially when different types of gear are used.

TABLE 23.--Number of crabs required per case of canned crab meat

Vicinity	Date 1/		Gear	Sex	Number of codes	Number of crabs	Number of cases	Crabs per case	
								Average	Range
Canoe Bay	Sept.-Oct.	1940	Nets	Male	2	87	7-16/48	11.9	11.4 - 12.5
Do.	Sept.-Oct.	1940	Trawl	Male and female	6	1,998	131-11/48	15.2	11.4 - 19.3
Do.	Aug.-Sept.	1938	Pots	Male	20	3,880	318-18/48	12.2	11.3 - 13.6
Alitak Bay proper	November	1938	Pots	Male	2	240	18-18/48	13.1	12.8 - 13.4
Do.	December	1938	Trawl	Female	1	18	25/48	34.6	- - -
Do.	December and January	1938 1939	Trawl	Male	2	184	14-35/48	12.5	11.7 - 14.9
Lazy Bay	Jan.-Feb.	1939	Nets	Male	4	1,109	134-38/48	8.2	8.0 - 8.4
Do.	January	1939	Nets	Female	1	6	11/48	26.2	- - -
Olga Bay	Sept.-Oct.	1938	Pots	Male	14	3,566	230-46/48	15.4	13.4 - 17.3
Alitak Bay General 2/	December and January	1938 1939	Trawl, pots, and nets	Male and female	6	817	66-21/48	12.3	8.6 - 16.9
Do. 2/	Jan.-May	1939	Nets	Male and female	15	5,220	499-33/48	10.4	8.2 - 13.3

1/ Data prior to 1940 from personal records of M. Marvin Wallace.
2/ Crabs from general Alitak Bay region, including Alitak Bay proper and several tributary bays, but not Olga Bay.

Yields were found to vary from as low as 20 or more crabs per case to as high as six to eight crabs per case. Trawl- and trap-caught crabs taken south of the Alaska Peninsula generally ran between nine and 15 per case, while the tangle-net crabs averaged about six to 11 per case. In Bering Sea all crabs taken were under 14.0 pounds in weight, and the average sizes of the trawl- and tangle-net caught males were essentially the same. On the basis of the data available, yields in Bering Sea would be expected to vary between 10 and 20 crabs per case with an average of not better than 15 per case.

Because of their small size, from 25 to 35 female crabs would be required per case if the taking of females for canning purposes should be allowed.

In some areas large quantities of tanner crabs were taken. On an average these crabs contain as much meat as medium-sized dungeness crabs, requiring about 50 crabs to the case. Since the recoverable meat is from the legs, it is possible that a mechanical method of picking could be devised which might well make the tanner crab an important potential source of crab meat for canning.

TABLE 24.--Estimated number of crabs per case based on average weight of canning-sized male crabs 1/ caught during entire Investigation

Locality	Caught in otter trawls		Caught in tangle nets	
	Average weight	Estimated 2/ crabs per case	Average weight	Estimated 2/ crabs per case
	Pounds	Number	Pounds	Number
Prince William Sound	9.0	10.7	-	-
Cook Inlet	11.3	8.5	11.5	8.3
Shelikof Strait	9.9	9.7	11.7	8.2
Kodiak Island	6.3	15.2	3/15.2	6.3
Shumagin Islands	6.3	15.2	0.6	10.0
Pavlof Bay	9.6	10.0	12.4	7.7
Canoe Bay	7.4	13.0	8.5	11.3
Bering Sea	6.8	14.1	6.8	14.1

1/ Above 5½ inches in width of carapace.
2/ Based on a yield of 25 percent of edible meat when packed in the can.
3/ Although the few crabs taken in the limited tangle-net fishing around Kodiak Island were exceptionally large, the canning-sized males taken in trawls averaged smaller than in most other areas. A representative sample, of 160 canning-sized, male crabs taken in tangle nets by the Pacific Fisheries and Trading Company in Alitak Bay, averaged 11.1 pounds.

Productivity per Unit of Effort

There are in general three time-consuming steps in the crab canning process: butchering, picking, and packing.

TABLE 25.--Productivity per unit of effort[1/]

	Total	Average	Minimum	Maximum
Number of codes	40	-	-	-
Number of crabs canned	9,525	-	-	-
Number of crabs butchered per man-hour	-	44.7	28.6	53.4
Pounds of meat picked	23,401	-	-	-
Pounds of meat per crab	-	2.46	1.82	3.67
Pounds of meat picked per man-hour	-	43.7	27.7	68.6
Number of cans filled	37,185	-	-	-
Number of cans filled per man-hour	-	71.2	44.4	139.6
Number of codes	50	-	-	-
Number of cans packed	47,496	-	-	-
Number of man-hours	2,603	-	-	-
Hours cannery operated	173	3.5	1.08	8.0
Number of cans per man-hour of cannery operation	-	18.2	6.2	31.3

1/ Except for part of the data on cans packed per man-hour, the information is from the personal records of M. Marvin Wallace.

The data available show that a butcher, with limited experience, can handle 40 to 50 crabs per hour. The larger the crabs the lower the number butchered per unit of time.

An inexperienced picker will remove about 15 to 20 pounds of meat per hour when beginning. However, with practice a speed of 40 to 50 pounds per hour is soon attained, and those more adept will pick 70 or more pounds of meat per hour.

Filling cans with crab meat so as to give the most attractive appearance is more tedious than the hand-filling for many other fishery products. After some experience, workers can fill between 70 and 85 cans per hour and those more adept, a somewhat higher number. By dividing the filling operation so that one worker places in the lower layer of leg meat, another the center layer of body meat, and the third the top layer of leg meat, a speed of 140 cans per man-hour was attained in one instance.

Considerable data have been assembled permitting estimation of productivity for the entire packing operation, taking in the various steps from butchering to sealing the cans. It was found that when charging the full time for the cannery crew--butchers, cooker man, pickers, dip man, utility man, and fillers--from the time butchering was started until the fillers completed their work, the productivity averaged 18.2 cans of crab meat per man-hour of cannery labor with a maximum of 31.3 cans per man-hour. This low average was due to the number of small packs when no attempt was made to rush the operation to completion, and to charging the time of the butchers and packers for the full period until the fillers completed their work. In view of this, and the fact that although the help was inexperienced, preparation of 20 or more cans per hour was not uncommon, it is believed that with an efficient operation cycle, canning productivity could be increased to at least three-fourths case per man-hour of cannery labor. This is borne out by calculation based on the more accurate records regarding the several steps in the canning process.

One butcher handling 50 crabs per hour, yielding 2.5 to 3.0 pounds of meat per crab, will account for approximately 135 to 150 pounds of meat per hour. This quantity of meat will require the services of two pickers at 70 pounds per hour and two fillers at 1/ 115 cans per hour, each. However, to attain this high rate of filling, the operation should be carried on by three fillers, working as a team, thus the most equable cannery crew unit would be three butchers, six pickers, and six fillers. In addition, there would be required one cooker man, one dip man, and one utility man to line cans and perform other incidental duties. This would give 690 cans per hour (18 man-hours) or between 38 and 39 cans per man-hour. From this figure deductions should be made for sealing, processing, cooling, and

1/ Allowing for shrinkage between picking and packing operations.

stowing, which should still permit a productivity of around 30 cans per man-hour of effort for a complete canning operation handling 1,200 or more large crabs per day yielding 100 or more cases.

King Crab Waste

The waste material accumulated from the butchering and picking operations need not be discarded because it can be converted into dried scrap having definite utility as a component of poultry feed.

The waste (viscera, carapace, and leg shells) of 36 crabs weighing a total of 288 pounds was found to be 140 pounds. This material was cooked in flowing steam, ground through a meat chopper, and hot-air dried. The weight of the dried product was 30 pounds.

In this particular instance, the wet waste and dried scrap amounted to 48.5 percent and 10.4 percent, respectively, of the weight of the whole crabs. In other experiments reported under the section on Yield of Crab Meat, the percentage of wet waste obtained from five male crabs and five females was found to be 55.7 and 69.0 percent, respectively. In general, therefore, it may be assumed that recovery of dried scrap will range between 10 and 13 percent of the weight of the live crabs.

Data on the proximate composition of dried king crab scrap and dried dungeness crab scrap are shown in Table 26.

TABLE 26.--Proximate composition of king and dungeness crab scrap

	King crab scrap	Dungeness crab scrap
Percent moisture	12.4	6.0
Percent fat (other extract)	2.0	1.5
Percent protein (N x 6.25)	33.0	28.4
Percent ash	1/ 30.7	49.7
Percent crude fiber	2/ 21.9	15.2
Total	100.0	100.8

1/ 11.0 percent $Ca_3(PO_4)_2$, 18.8 percent $CaCO_3$, 0.9 percent other mineral, based on analysis showing 16.6 percent CaO and 4.7 percent PO_4.

2/ By difference.

APPENDIX IV--BRIEF REVIEW OF THE JAPANESE KING CRAB FISHERY

According to the Japanese literature, canning of king crab meat had its inception in 1892 in Hokkaido Prefecture, Japan. Samples of this pack were forwarded to the Cornwall (England) Fishery Exhibition the following year. This marked the first Japanese export of canned crab meat to a foreign country. The year 1908 saw a number of canneries started on the islands of Hokkaido and Karafuto, and there was a continuous increase thereafter. The increase was particularly striking after 1923 with the development of the floating cannery, and by 1930 production had reached some 580,000 cases per year. Prior to 1923, the pack remained below the 200,000-case level and even this quantity had rather drastically depleted the fishing grounds within the limited range of the shore-based canneries.

TABLE 27.--Floating crab canneries 1/

Country and date	Number of vessels	Total tonnage	Number of cases 2/
JAPANESE			
1921	2	689	5,230
1922	3	1,236	9,360
1923	15	9,075	33,561
1924	6	9,561	40,917
1925	8	15,835	105,262
1926	12	28,473	219,284
1927	17	40,922	330,662
1928	14	35,049	303,679
1929	15	37,443	346,813
1930	19	63,987	407,542
1931	9	29,410	240,207
SOVIET UNION			
1928	2	-	35,002
1929	3	-	72,000
1930	10	-	73,000 (96,000)
1931	9	-	67,000

1/ Reference: The Japan Times and Mail, February 1935 Aquatic Industry Number.
2/ Converted to standard cases, each of 48 half-pound, flat cans.

The Japanese Government had interested itself in the expansion of the industry and had engaged in research since 1914, looking toward the development of new grounds and better canning methods. In 1920 a set of canning machinery was installed on a sailboat of some 150 tons, and a small pack of tinned crab was put up. As a result of this, and subsequent investigational work on a much larger scale, shore canneries were based along the coast of Kamchatka to develop the new grounds discovered there, and the "floater" was proven practical. This permitted the expansion of the industry to the Bering Sea, and eventually brought vessels of several thousand tons displacement to within sight of our Bristol Bay salmon canneries.

Tables 27 to 30, inclusive, indicate the growth of the floating cannery, the corresponding growth of the Japanese canned crab meat pack, exports from Japan by country of destination, and United States imports from Japan and other countries. Table 27 also lists certain sketchy data available on Russian production. It should be noted that Japanese exports to the United States were abnormally increased in 1939 in anticipation of the restrictions subsequently adopted, but the dominant position of the United States market is clearly evident.

Japanese Fishing and Canning Methods

The typical Japanese floating cannery operation consists of a factory ship of some 3,000 - 5,000 tons, with a complement of two to five hundred men, including fishermen, and ranging from physicians to janitors. The vessel carries a completely equipped cannery and is accompanied by more than a dozen fishing boats. These boats, from which the actual fish-

ing is done, are of two types--the oriental "kawasaki" 1/ boat, and a modification of the western trawler.

The kawasaki boat is some 45 feet in length by nine feet in beam, and is manned by seven to nine men. It is usually powered by a semi-Diesel engine of 10 horsepower. Each boat carries 500 to 600 tangle nets. These nets have a mesh size of 1.5 feet and are 10 feet high by 168 feet long. A cannery ship is supplied with 120,000 to 130,000 of these nets. 2/

TABLE 28.--Average annual Japanese canned king crab meat pack in standard cases

Period	Shore	Floating	Total
1916 to 1919	138,549	-	138,549
1920 to 1924	137,552	18,084	155,636
1925 to 1929	150,582	265,971	416,553
1930 to 1934	182,173	230,559	412,732
1935 to 1939	254,585	209,647	464,232

Source: Pacific Fisherman, 1939 Yearbook.

The nets are set out with the ends fastened together to make a vertical wall several miles long. To give some concept of the amount of gear set, it has been stated that although the distance between ships is set at 10 miles, the nets of one ship often become entangled with those of an adjacent one. The nets are allowed to fish for four or five days before

TABLE 29.--Exports of canned crab meat from Japan 1/ in standard cases

Destination	1940 First half	1939 First half	1939 Second half
Manchukuo and China	52,142	8,383	12,856
Europe	14,740	81,574	88,942
United States	36,929	77,527	335,811
Canada	1,103	1,097	2,012
Africa	263	820	1,048
Australia	7,955	7,977	9,975
Hawaii	2,372	1,395	1,443
Other	1,076	302	1,688
Totals	117,242	179,075	453,775

1/ Reference: Pacific Fisherman, 1941 Yearbook.

hauling. The hauling is done over a wooden roller powered from the main engine of the fishing boat. When the fishing boats return, the tangle of nets and crabs is loaded aboard the mother ship where the crabs are picked out and the nets washed, hung up to dry, and repaired in readiness for the next setting.

In addition to the kawasaki boats, each cannery has two or three occidental-type motor vessels or some 60 tons that are constantly engaged in scouting for new favorable locations. These vessels usually carry otter-trawl gear.

1/ "Kawasaki" means, literally, "river cape".
2/ This description is taken from the February 1935 Aquatic Industry number of the Japan Times and Mail. The figures on amount of gear seem open to question as unreasonably high.

The Japanese method of canning is thought to be quite similar to the method worked out by the Alaska Crab Investigation and described in detail elsewhere in this report. One difference worthy of note is the Japanese practice of cutting the legs at the joints. This results in a considerable quantity of cartilage finding its way into the pack. The policy adopted by the Investigation, of breaking the joints and pulling them apart, practically eliminated this.

TABLE 30.--United States canned crab imports 1/

Year 2/	Japan	Russia	Canada
	Pounds	Pounds	Pounds
1939	6,645,982	2,754,801	8,066
1938	5,996,900	2,061,083	15,800
1937	8,293,252	2,378,365	39,703
1936	8,223,762	1,960,585	-
1935	8,126,969	1,814,242	-
1934	5,231,832	2 112,844	-
1933	7,038,637	2,703,828	

1/ Reference: Pacific Fisherman, 1941 Yearbook.
2/ 12-month period ending September 30 each year.

Japanese Activities in Waters Adjacent to Alaska

The expansion of the Japanese king crab fishery to waters adjacent to Alaska raised a storm of protest, not so much because of their taking crabs as because of their threatened exploitation of the red salmon runs of Bristol Bay and their scarcely concealed interest in the geography of this vital defense area.

No statistics are available as to the extent of Japanese operations in these waters, but certain reports of observed locations are available. With reference to the sections outlined in Figure 22 for Area XI, the greatest concentration of ship locations was officially observed in Section 12; followed by seven in Section 11; four in Section 5; three each in Sections 4, 6, 10, and 20; two each in Sections 3 and 9; and one in Sections 1 and 26. Other official reports include one observation some 20 miles south of Hagemeister Strait and eight observations off the Pribilofs. Six of these were from 20 to 45 miles east of the St. Paul Island group, and the other two about 100 miles N. by E. from St. Paul.

In addition to these reports, the captains of the various American codfish schooners have made frequent mention of Japanese fishing activity which sometimes interfered with their own codfishing activities in the area from Cape Mordvinof to Ugashik. The United States Fish and Wildlife Service personnel stationed at the Pribilof Islands stated that on several occasions Japanese fishing vessels had been sighted from the Islands, and the school-teacher at Gambell on the northwest tip of St. Lawrence Island reported seeing Japanese vessels pass as recently as the spring of 1941.

Particularly in later years, American visitors were not welcomed aboard these vessels, so that exact information as to equipment is meager. It is known that they have utilized several types of fishing gear, including tangle nets and surface gill nets; beam, otter, and paranzella trawls; and pots. They are known to have processed meal and oil from bottom fish, salted cod, and canned crabs and salmon.

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ABSTRACT

Between 1931 and 1940 the United States paid to Japan over twenty-seven million dollars for canned crab meat. For the latter five years of that decade, imports have accounted for 95 percent of our canned and over half our entire crab meat consumption--and to this must be coupled the fact that much of the Japanese pack was obtained from Alaskan waters.

During 1940 and 1941 an extensive investigation was conducted to determine the practicability of American enterprise successfully engaging in this industry. Three fishing vessels and a floating cannery were employed and, during 10 months in the field, explored likely areas from Southeastern Alaska to within sight of Siberia.

The results of the Investigation establish the presence of a large crab population in Bering Sea and smaller, but still commercially important, populations (1) in Pavlof and Canoe Bays on the south side of the Alaska Peninsula, (2) around Kodiak Island, and (3) in lower Cook Inlet.

King crabs may be taken in commercial quantity by trawls, tangle nets, and pots. The first is particularly useful in prospecting new areas; the second, more selective and more productive on established grounds; and the third is applicable in small-scale operations.

The male crabs are suitable for canning except near their moulting season, from December to March. The best catches can be made in the spring and early fall; thus, this fishery may well supplement the established salmon industry. Canning a product equal or superior to the best Japanese grade presents no serious technical problem.

Alaskan waters hold an enormous reserve of edible fish--notably "sole" and pollock--which is at present wholly unutilized.

FEDERAL SOURCES OF COMMERCIAL FISHERY DATA

Fish and Wildlife Service

Current Fishery Statistics:

Landings at Important Fishing Ports.--Monthly and annual detailed data: Landings at Boston and Gloucester, Mass., and Portland, Maine, by poundage and value, and catch by species, gear and bank; and receipts and landings at Seattle, Wash., and operations of Pacific Halibut Fleet.

Freezings and Cold-storage Holdings of Fishery Products.--Monthly and annual data on fishery products frozen and held.

Production of Manufactured Fishery Products.--Annual information on production of canned fishery products and byproducts; production of fresh and frozen packaged fish; summary of quantity and value of all manufactured fishery products; and preliminary statements on canned salmon and oyster packs and production of fresh-water mussel-shell products.

Sectional Surveys.--Annual information on number of commercial fishermen; kind and quantity of fishing gear operated; poundage and value of catch; employment in fishery wholesale and manufacturing establishments; and data on the production of manufactured fishery products for: New England, Middle Atlantic, Chesapeake Bay, South Atlantic and Gulf, Pacific Coast and Lake States, and Alaska.

Fishery Market News:

Market News Reports.--Daily, monthly and annual mimeographed reports on production, movement, prices, storage and canning of fishery products from 6 field offices.

Market News Review.--Fishery Market News, a periodic current review of fishery marketing information.

Annual Statistical Digest:

Fishery Statistics of the United States.--Summary of Current Fishery Statistics, usually in greater detail.

Food Distribution Administration

Purchase Reports.--Daily, weekly, and monthly mimeographed releases covering vendor, f.o.b. point, packaging, type, quantity, and price.

Bureau of the Census

*Imports of Fish and Fish Products.--Monthly advance statement on poundage and value of imported edible fishery products by country of origin.

*Exports of Meat and Canned Fish.--Monthly advance statement on exports of canned salmon, sardines, shrimp, and other shellfish, to individual foreign countries.

Monthly Summary of Foreign Commerce of the United States.--Report on total poundage and value of fishery products imported and exported.

*Quarterly Canned Foods Stock Report.--Information on canners and distributors stocks of canned salmon, sardines, and tuna.

Foreign Commerce and Navigation of the United States.--Annual report on imports and exports with principal items shown separately.

Production, Consumption, and Stocks of Fats and Oils.--Quarterly statement on domestic production, and stocks of cod and cod-liver oil. whale oil, and other fish oils.

Factory Consumption of Primary Animal and Vegetable Fats and Oils, by Classes of Products.--Advance annual report on poundage of marine-animal (whale oil) and fish oil utilized in manufacture of various edible and industrial products.

Animal and Vegetable Fats and Oils.--Annual summary combining two reports above, plus comparative figures for preceding years.

Bureau of Labor Statistics

Wholesale Prices.--June and December issues contain average monthly wholesale prices of canned pink and red salmon, pickled cod and herring, salt mackerel, and smoked salmon for each of the preceding six months.

The Cost of Living.--Mid-month report containing retail prices of pink and red salmon, and fresh and frozen fish.

Bureau of Foreign and Domestic Commerce

Foreign Commerce Weekly.--Special textual and statistical reports by country, industry, and commodity in the interests of promotion of foreign trade.

Tariff Commission

Periodic Reports.--Include studies on specific fisheries or fishery problems.

The National Archives

Federal Register.--Daily publication containing regulatory orders issued by all Government agencies. Available by subscription from the Superintendent of Documents, Washington, D. C.

*Available at present for official use of other Government agencies only.

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