COMMERCIAL FISHERIES REVIEW

December 1954 **Washington 25, D.C.** **Vol. 16, No. 12**

THE 1953 JAPANESE KING-CRAB FACTORYSHIP EXPEDITION

By Takashi Miyahara*

CONTENTS

SUMMARY AND CONCLUSIONS

The 1953 Japanese factoryship expedition for king crabs (Paralithodes camtschatica) in Bristol Bay began operations on April 19, 1953. Fishing was conducted in the vicinity of Amak Island and in the areas north of Port Moller.

The fleet consisted of the factory-mothership, the S. S. Tokei Maru, with 6 small tangle-net boats and 6 trawlers.

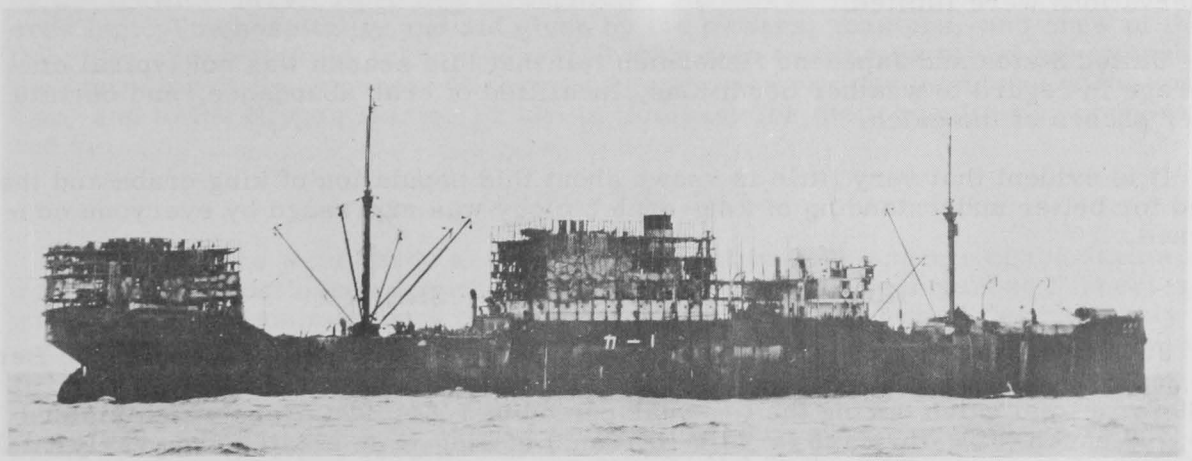


Fig. 1 - The S. S. Tokei Maru, factory-mothership of the 1953 Japanese King-Crab Expedition.

A total of 1,276,360 male king crabs were caught and canned--the pack was 58,240 cases (48 6½-ounce cans) of meat.

The tangle nets accounted for 948,482 male crabs or 74.3 percent of the catch while the trawls caught 327,878 or 25.7 percent.

Two types of trawls were used: (1) the Pacific Coast-type otter trawl and (2) the Danish seine-type trawl.

* Fishery Research Biologist, Pacific Salmon Investigations, Branch of Fishery Biology, U. S. Fish and Wildlife Service, Seattle, Washington.

The otter trawls were more effective than the seines, taking an average of 84 crabs per hour of drag, while the Danish seines caught an average of 54 per hour.

Typical crab-canning techniques were used for processing the crabs with very few variations, although the acid bath, common in crab canning, was thought to be unnecessary and therefore not used.

Wide variations in the condition of the crabs were observed during the expedition, ranging from soft recently-moulted individuals to barnacle- and weed-covered hard-shell crabs.

Wide variations in weights were also observed.

In view of these variations observed in crabs from different areas, it would appear that there were two or more stocks or age classes represented in the areas exploited, these groups having different moulting periods or intervals.

The female king crabs were observed to moult progressively later in the season as the expedition moved eastward.

The king-crab population in this area appears to be composed almost wholly of Paralithodes camtschatica--only one Paralithodes platypus and no Paralithodes brevipes were observed.

The expedition encountered a large population of tanner crabs (Chionoecetes sp.), especially in the vicinity of Amak Island. This population was thought to be considerably larger than previously observed.

The expedition departed for Japan on August 15, 1953, after 119 days on the fishing grounds.

Because of the nature of the facilities and because observations were conducted in a manner designed to interfere as little as possible with Japanese operations, the observations were limited.

United States and Japanese fishermen felt that this season was not typical or average in regard to weather conditions, localities of crab abundance, and certain other phases of the catch.

It is evident that very little is known about this population of king crabs and the need for better understanding of king-crab biology was expressed by everyone concerned.

KING-CRAB FACTORYSHIP FISHERY

Japanese floating factoryships began catching and canning king crabs in the Bering Sea near Alaska in 1930. Since 1932, operations were continued yearly through 1939 for a total catch during the ten-year period of 7,841,984 crabs which yielded 194,789 cases (96 $\frac{1}{2}$-lb. cans or 48 1-lb. cans) of king-crab meat. The yearly catch and pack of Japanese floating factoryships operated in the Bering Sea are shown in table 1.

During World War II all of Japan's crab-canning factoryships were sunk. In the years following the war their crab fisheries were limited to minor fishing grounds off the northern and eastern coasts of Hokkaido.

Early in 1953 three large fishing firms in Japan made a formal application to the Japanese Fisheries Agency to operate a joint mothership crab expedition to Bristol Bay during the summer. The application was approved, with some modifi-

cations, and a catch "target" of 50,000 cases (48 6½-ounce cans per case) was established. This "target" was later increased to 57,000 cases.

On March 30 of that year, six Japanese trawlers left Hakodate, Japan, as part of this first postwar Japanese crab factoryship fishing and canning expedition in Bristol Bay. Nine days later, the S. S. Tokei Maru, the factory-mothership of the expedition, deckloaded with 6 small fishing boats, departed from the same port, arriving at the fishing grounds approximately 11 miles northwest of Amak Island on April 19, 1953. Fishing was begun immediately upon arrival.

Table 1 - Catch and Pack of Japanese Floating Factoryships in the Bering Sea, 1930-39

Year	Ships Operated	Ship Days Operated	Crabs Caught	Cases Packed 1/
	(Number)			
1939	1	37	241,791	6,206
1938	1	67	461,040	13,385
1937	1	74	485,900	13,148
1936	1	51	290,900	7,849
1935	1	139	746,450	15,504
1934	2	242	1,347,025	30,364
1933	2	289	2,088,998	49,396
1932	1	125	1,178,280	34,365
1931	0	0	0	0
1930	1	95	1,001,600	24,572

1/ One case is equal to 96 ½-lb. cans or 48 1-lb cans.
Note: Information obtained from Japanese Fisheries Agency

To become familiar with this fishery and to initiate a scientific study of this population of crabs, the governments of Japan and the United States agreed to exchange biologists. It was decided that the U. S. Fish and Wildlife Service would place a biologist aboard the Tokei Maru, and the Japanese Fisheries Agency would assign a biologist to the M/V Deep Sea, a United States trawler. It was in this capacity that I accompanied the Japanese expedition from April 19 through August 5, 1953.

Transportation to and from the Tokei Maru and Cold Bay, Alaska, was provided by the trawler M/V Deep Sea through the courtesy of Wakefield's Deep Sea Trawlers, Inc. The hospitality and aid given by the owners, masters, and crew of the Deep Sea are gratefully acknowledged. I wish also to express my sincere thanks to the inspector of the Japanese Fisheries Agency, the various members of the expedition, and to the Nippon Marine Products Company for their hospitality, cooperation, and aid.

SOURCES OF DATA

Observations were made and records kept of various aspects of the Japanese operation, in most cases with the aid of the inspector of the Japanese Fisheries Agency or of various members of the fleet. In this report, I shall describe only the activities connected with the fishing operation, and present later the biological observations.

Crab catches landed aboard the mothership were examined daily, a record being kept of number and condition of the crabs, and of the differences in appearance of crabs from different areas. The tangle-net boats fished relatively close to the mothership and the information on area of catch is fairly accurate. The areas of trawling activity were usually determined by dead reckoning and are subject to some error. The fishing foreman and the fishermen were consulted to determine the area of origin of the crabs caught, and also to determine the amount of fishing effort expended.

Length and width of the carapace and the weights of approximately 3,900 male king crabs (Paralithodes camtschatica) were obtained. Only about 200 female crabs

were measured as they were generally released from the catcher boats and their appearance on the mothership was rare. All specimens measured were selected at random, usually from the landings of a single catcher boat in order to accurately determine the area of origin and to minimize interference with the crab handling and processing operations on the factoryships. Specimens of various types have been collected and preserved for later study. Additional observations and records were kept concerning fishing gear and methods, non-king crab forms that were caught, weather and sea conditions, and air and sea temperatures.

FISHING FLEET

The S. S. Tokei Maru, leased from the Towa Steamship Company of Kobe, Japan, was built in the United States in 1919; the length is 401 feet, with a gross tonnage of 4,998 (fig. 1). Navigating equipment consisted of a magnetic compass, radio-direction finder, and loran receiver. However, loran reception was very poor in the area of operation and was further complicated by almost unceasing transmission on the same or on nearby frequencies by the ship's or by the catcher boats' wirelesses. Loran readings were therefore confirmed by sun-sights whenever possible.

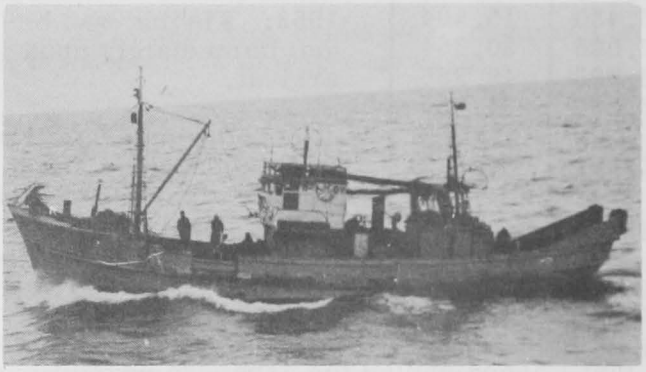


Fig. 2 - A trawler.

The conversion to a factoryship involved the building of temporary wooden platforms on the shelter deck over hatches Number 1, 2, and 4, to give better footing and to provide better drainage as the crabs were piled in these areas prior to processing. The remainder of the shelter deck was partitioned to provide living quarters, dining areas, and gear lockers. The canning equipment, consisting of racks and tables for the meat graders and can fillers, and the clinching, sealing, vacuum, and retort equipment were installed on the upper deck below the shelter deck in the areas of hatches Number 1 and 2. Other conversions included scaffoldings over the bridge and after poop decks to allow for hanging the nets for drying, untangling, and repairing.

A total of 337 men were quartered on the vessel, of which 44 were members of the ship's crew and 54 were fishermen who went out daily on deckloaded boats.

Fig. 3 - A "Kawasaki" boat bringing back a load of tangle net-caught crabs.

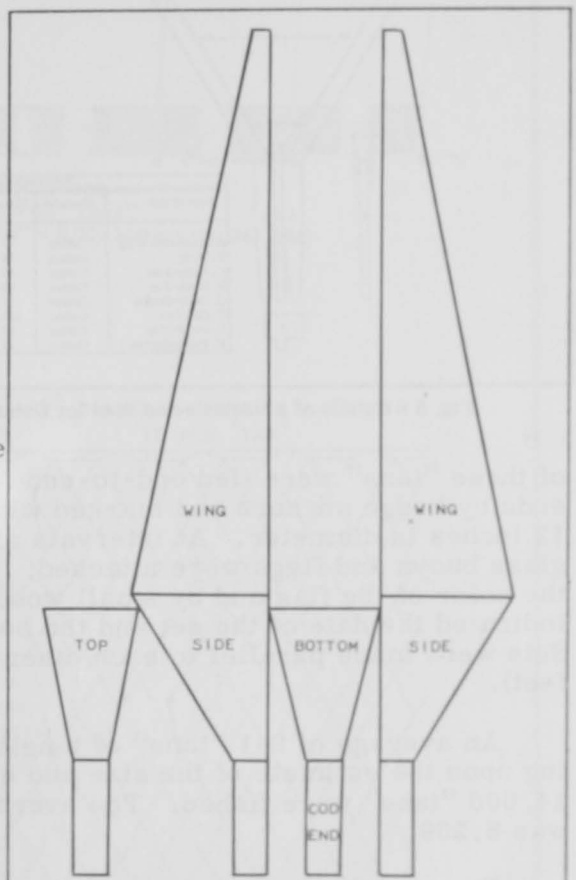
The 6 trawlers, 5 of wood construction and 1 of steel, ranged in gross tonnage from 56.48 to 75.43 (fig. 2). They were approximately 90 feet long and powered by Diesel engines of 130 to 210 horsepower. The largest was used in setting tangle nets or in picking up test sets of tangle gear. From time to time, two other trawlers were also used for this work. All were equipped with echo sounders, radio-direction finders, and radio transmitters of about 25- to 50-watt output. Fourteen men lived on each of these vessels for the duration of the expedition, boarding the mothership only on rare occasions for medical treatment, bathing, or other essential needs.

The six deckloaded "Kawasaki" boats which were used strictly for picking up the tangle nets were small vessels approximately 44 feet long and 10 feet in beam, powered with two-cylinder, 15-horsepower engines (fig. 3). The only navigational equipment on these boats was a magnetic compass, but as they were usually within five miles of the mothership, additional navigating equipment was not essential. These boats and their crews of eight men each were lowered from the mothership's davits every day at about 3 a.m. and picked up about 5 to 6 p.m.

FISHING GEAR

The trawls used were of two types; the otter trawl and the Danish seine. Four of the five boats engaged in trawling started the season with the Danish seine, but two of them were converted to otter trawls because of the better successes realized by this method.

OTTER TRAWLS: The otter trawls used were of the Pacific Coast type constructed of manila and cotton. Mesh sizes and other specifications are indicated in figure 4. The otter boards were angled sleds, $1\frac{1}{2}$ by 1 foot on the angle and $5\frac{1}{2}$ feet long. They were constructed of wood, strengthened and weighted with iron reinforcing straps and iron runners. The two one-inch diameter manila ropes used were pulled through two rollers mounted on heavy wooden beams rising above the poop. These ropes were then wound around horizontal gypsy heads on each side of the engine casing, just aft the pilothouse. When the boards were hoisted aboard, the lines from the nets were transferred to the port side, amidships, where they were guided around pulleys and to the capstans. During the period between April 19 and August 3, approximately 1,245 tows were made with this type trawl, averaging two hours per tow and six tows per day.



Net Specifications

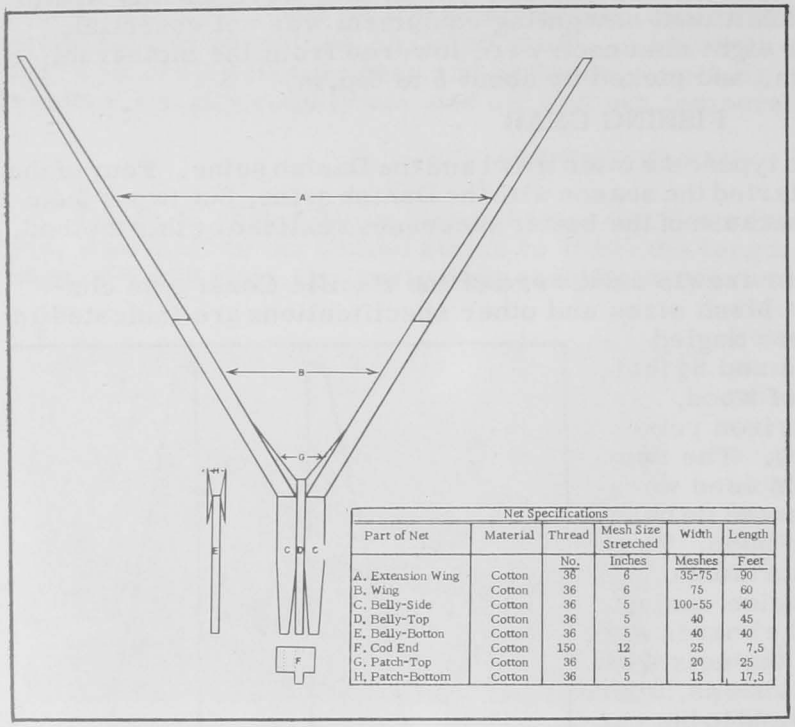
Part of Net	Material	Thread	Mesh Size Stretched	Width	Length
		No.	Inches	Meshes	Feet
Wing	Cotton	36	6	50	87.5
Sides	Cotton	45	6	50	25
Top	Cotton	45	6	35	24
Bottom ..	Cotton	75	8	30	24
Cod End ..	Manila	6	14	22	20

Fig. 4 - Details of a Japanese king-crab otter trawl.

DANISH SEINES: The Danish seine type of trawling involved laying the net on the sea bottom with the wings spread. When the seine was towed, the wings closed slowly and tended to drive the crabs into the belly of the net. In laying this gear, the starboard tow rope was shackled to a 55-gallon drum buoy, which was then thrown overboard and the rope paid out as the vessel moved away. When approximately one-half of this rope was paid out, the course was changed about 90 degrees to starboard. On this course the remainder of the starboard rope, the starboard wing, and part of the belly were thrown overboard. Another 90-degree turn to starboard was made and on this new course the remainder of the belly, the port wing, and about one-half of the portside tow rope was paid out. The course was again changed in the direction of the buoy, laying out the remainder of the port tow rope.

The buoy was picked up, the two tow lines made fast, and the ship proceeded to tow the net at a very slow speed. The ropes and wings closed slowly. When the tow ropes became parallel, the net was hauled in by pulling the two lines around windlasses. (See fig. 5.).

From April 18 to August 3, approximately 1,100 tows were made with this type of trawl, each tow averaging about 1 hour 40 minutes in duration and each vessel averaging 6.4 tows per fishable day.



Net Specifications

Part of Net	Material	Thread No.	Mesh Size Stretched Inches	Width Meshes	Length Feet
A. Extension Wing	Cotton	36	6	35-75	90
B. Wing	Cotton	36	6	75	60
C. Belly-Side	Cotton	36	5	100-55	40
D. Belly-Top	Cotton	36	5	40	45
E. Belly-Botton	Cotton	36	5	40	40
F. Cod End	Cotton	150	12	25	7.5
G. Patch-Top	Cotton	36	5	20	25
H. Patch-Bottom	Cotton	36	5	15	17.5

Fig. 5 - Details of a Danish seine used for fishing king crabs.

All trawl and seine catches were dropped on the deck where they were sorted. The undersize and female crabs, together with the scraps, were thrown overboard and the males butchered.

TANGLE NETS: The tangle nets (fig. 6) employed by this crab expedition were cotton netting, 18-inch stretched mesh, 7 meshes deep, hung between a $\frac{1}{8}$-inch becket twine float line, and a 6-thread $\frac{5}{16}$-inch manila lead line. The floats used were glass balls 3 to 3.2 inches in diameter and the weights were cement balls weighing about two pounds each. Ten glass balls and seven weights were tied to each "tan" (shackle) of net.

These nets were made up in "tans," 40 meters (131 feet) in length. Approximately 200 of these "tans" were tied end-to-end for each set. Each set was anchored at both ends by kedge anchors and marked with flags held in place by two glass buoys 10 or 12 inches in diameter. At intervals along the set, usually 1,600 meters (5,248 feet), glass buoys and flags were attached. Each set was distinguished from another by the color of the flag and by small wooden tags tied to the poles. The wooden tags indicated the date of the set and the boat from which the particular set was made. Sets were made parallel to each other at distances of 100 to 300 meters (328-984 feet).

An average of 941 "tans" of tangle net were picked up per fishing day. Depending upon the estimate of the size and quality of a school of crabs, from 3,000 to 14,000 "tans" were fished. The average number of "tans" left in the water per day was 6,209.

Because the current in the areas flowed southwesterly and northeasterly, all sets were made in the same direction to prevent the drifting of one set against another. All sets were made by one of the trawler-type boats which sailed in a northeasterly or southwesterly direction at a speed of about 6 knots, while 6 to 9 men on the afterdeck tied the glass balls and cement weights to the netting and threw it overboard.

After the tangle nets were fished from 5 to 10 days, "Kawasaki" boats were dispatched to pick them up. For the most part, the crabs were disentangled on the "Kawasaki" boats, and all but the larger male king crabs were thrown immediately overboard. On several occasions, the nets, with crabs entangled, were brought to the mothership where a group of laborers was assigned to disentangle them.

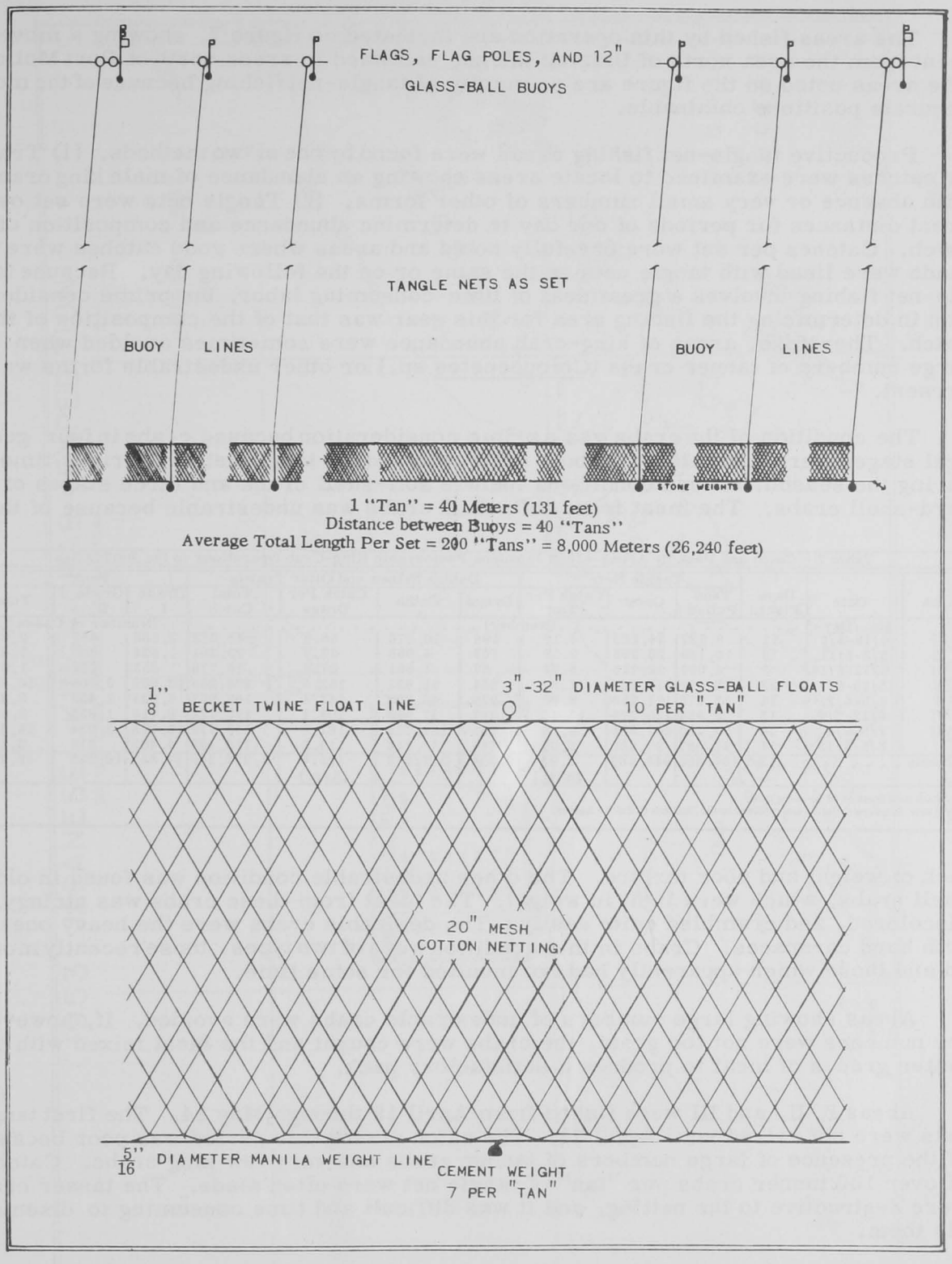


Fig. 6 - Details of tangle nets used for king-crab fishing.

FISHING AREAS AND CATCH

The areas fished by this operation are indicated on figure 7, showing a movement from the area north of Unimak Island, eastward to areas north of Port Moller. The areas noted on the figure are primarily of tangle-net fishing because of the more accurate positions obtainable.

Productive tangle-net fishing areas were found by one of two methods. (1) Trawler catches were examined to locate areas showing an abundance of male king crabs with absence or very small numbers of other forms. (2) Tangle nets were set over great distances for periods of one day to determine abundance and composition of catch. Catches per set were carefully noted and areas where good catches were made were lined with tangle nets on the same or on the following day. Because tangle-net fishing involves a great deal of time-consuming labor, the prime consideration in determining the fishing area for this gear was that of the composition of the catch. Therefore, areas of king-crab abundance were sometimes avoided when large numbers of tanner crabs (Chionoecetes sp.) or other undesirable forms were present.

The condition of the crabs was a prime consideration because crabs in four general stages were encountered by both the trawls and the tangle nets at various times during the season. These conditions include soft-shell crabs and three stages of hard-shell crabs. The meat from soft-shell crabs was undesirable because of the

Table 2 - Catch and Pack by Areas--1953 Japanese Factoryship King-Crab Operations in the Bering Sea

Area	Date	Days Fished	Tangle Nets			Danish Seines and Otter Trawls				Pack		
			Tans Pulled	Catch	Catch Per Tan	Drags	Catch	Catch Per Drags	Total Catch	Grade I	Grade II	Total
	Mo./Day	(Number)								(Number of Cases 1/)		
I	4/19-5/2	12	8,227	34,296	4.17	194	10,976	56.6	45,272	2,186	451	2,637
II	5/3-5/11	9	10,150	26,295	2.59	147	4,066	27.7	30,361	1,534	305	1,839
III	5/12-5/14	3	4,009	22,915	5.72	67	1,861	27.8	24,776	853	237	1,090
IV	5/15-6/7	22	18,440	212,663	11.53	561	85,622	152.6	298,285	12,966	3,705	16,671
V	6/8-6/21	14	12,178	121,258	9.96	279	46,709	167.4	167,967	6,925	1,459	8,384
VI	6/22-7/4	13	8,954	135,773	15.16	367	37,949	103.4	173,722	6,716	1,356	8,072
VII	7/5-8/4	30	32,260	297,996	9.24	755	121,782	161.3	419,778	12,275	2,054	14,329
2/	8/5-8/15	11	12,087	97,286	8.05	164	18,913	115.3	116,199	4,403	815	5,218
Totals		113	106,305	948,482	8.92 (Avg.)	2,534	327,878	129.4 (Avg.)	1,276,360	47,858	10,382	58,240

1/ Each case contains 48 6½-ounce cans.
2/ These data were collected and reported by the Japanese Fisheries Agency.

lack of weight and poor texture. The other undesirable condition was found in old-shell crabs, which were light in weight. The meat from these crabs was stringy, discolored, and crumbled quite easily. The desirable crabs were the heavy ones with hard carapaces. Crabs in this condition were of two types: those recently moulted and those which apparently had not moulted for some time.

Areas showing large numbers of undesirable crabs were avoided. If, however, the numbers were not too great, the crabs were caught and the meat mixed with the better grades of meat to produce a satisfactory pack.

Areas I, II, and III were fished from April 19 through May 14. The first tangle nets were not raised until April 22. The catch during this period was poor because of the presence of large numbers of tanner crabs and very few king crabs. Catches of over 100 tanner crabs per "tan" of tangle net were often made. The tanner crabs were destructive to the netting, and it was difficult and time consuming to disentangle them.

In April the eggs carried by the female crabs were brown in color and the eyes of the developing larvae could be seen. As the season progressed, there was a noticeable decrease in the number of eggs carried, presumably due to the eggs hatching. On these crabs new, soft, but well-formed shells could be observed under their

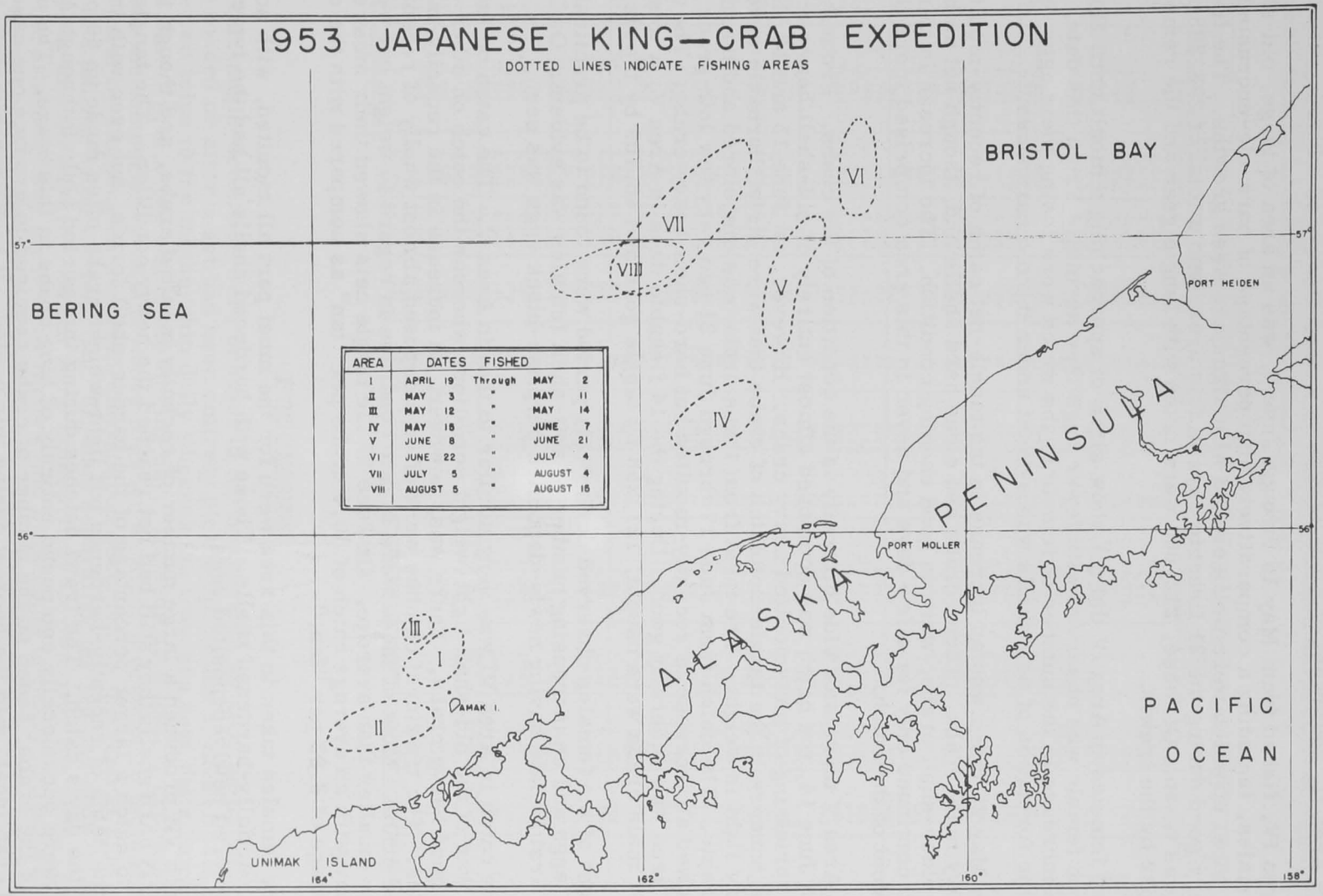


Fig. 7 - Map showing king-crab fishing areas.

old carapaces, indicating an approaching moult. This condition was especially prevalent in Area II, southwest of Amak Island.

Area IV, fished from May 15 through June 7, was an area of large, old-shell, heavy males, including a comparatively high percentage of barnacle-encrusted crabs, most of which were well covered with algae and weed growths. The fishing was very good during the 21 fishable days in this area, and a total of 298,285 male crabs was taken. Of these, 212,663 were taken with tangle gear and the remainder of 85,622 by the trawls.

The females in Area IV did not show signs of approaching a moult until May 20, when one female was observed with fewer eggs than normal. From this date, there was an increase in the number of female crabs which were losing their eggs or in which the formation of new shells was evident under the old carapaces.

On May 25 there was an increase in the tangle-net catch of recently-moulted but heavy male crabs. These crabs had clean hard shells and, though not as heavy as the older-shell crabs, were in good canning condition. The increase in this type of crab continued only for a few days and never in this area comprised more than 10 percent of the catch.

In Area V there was wide diversity in the condition of the crabs. From June 8 through June 14, the catch was composed almost entirely of old-shell heavy crabs with a sprinkling of just-moulted heavy crabs. However, on June 15 and 16 there was an increase in the tangle-net catch of crabs that were dirty, barnacle covered, and very light in weight. The meat from these crabs was discolored and therefore undesirable. The catch from June 17 through June 21 had very few low-grade crabs and showed an increase of recently-moulted but hard-shell heavy crabs. The catch in this area was generally good. During the 14 fishable days in Area V, a total of 167,967 male crabs were caught, 121,258 by tangle gear and 46,709 by trawls.

Most of the females observed during this period were found to be practically void of eggs and an increasing number of soft-shell females was evident. On June 20 the first female having newly-deposited purplish-black eggs was seen.

The catch in Area VI was very similar to that in Area V. The catch of June 24 and 25 was of the old-shell light-weight condition, whereas the catch on other days was of good heavy crabs. There was, however, an increase in the recently-moulted males. The trawlers' catches were often composed almost wholly of recently-moulted crabs. Most of these were in fair condition in regard to weight but were noticeably smaller than average. On June 27 the tangle nets showed their most efficient day with an average catch of 30.4 crabs per "tan" as compared with the overall average of 8.92 per "tan."

The females taken in this area were for the most part all moulted, with some having partially-hardened shells. Those with hardened shells all had the typical dark-colored newly-deposited eggs.

Area VII produced a large number of recently moulted crabs, and though they had fairly hard shells they still had not reached the heavy condition. The tangle nets tended to catch a larger percentage of the harder-shell forms, but even with this gear, the catch of recently-hardened but light-weight crabs often made up 60 percent of the day's catch. The trawl catches during this period (July 5 through August 4) were occasionally composed entirely of king crabs in this stage. The utilization of the crabs, based on the number of crabs required to produce one case of canned crab meat, was the poorest during this period. It took approximately $1\frac{1}{2}$ times as many crabs to produce one case in Area VII as was required in Area IV.

During this period females were reported to be in fewer numbers and were almost always of the new-shell form with newly-attached dark-colored eggs. Catch and pack data by areas are shown in tables 2 and 3.

Table 3 - Daily Catch and Pack--1953 Japanese Factoryship King-Crab Operations in the Bering Sea

Date	Catch			Pack			Date	Catch			Pack		
	Tangle Nets	Trawls	Total	Grade I	Grade II	Total		Tangle Nets	Trawls	Total	Grade I	Grade II	Total
	(Number of Crabs)			(Number of Cases 1/)				(Number of Crabs)			(Number of Cases 1/)		
Apr. 19	0	560	560	0	0	0	June 18	3,282	3,282	11,914	662	150	812
" 20	0	1,400	1,400	28	0	28	" 19	12,848	0	12,848	546	125	671
" 21	0	1,016	1,016	45	25	70	" 20	14,335	2,661	16,996	642	153	795
" 22	2,594	2,525	5,119	79	24	103	" 21	14,771	4,049	18,820	656	119	775
" 23	5,444	1,836	7,280	404	80	484	" 22	5,068	3,566	8,634	668	101	769
" 24	3,441	303	3,744	264	47	311	" 23	16,590	3,640	20,230	520	123	643
" 25	0	0	0	165	36	201	" 24	13,934	3,884	17,818	742	154	896
" 26	1,978	339	2,317	0	0	0	" 25	12,274	3,090	15,364	681	157	838
" 27	0	127	127	122	20	142	" 26	8,993	1,471	10,464	518	82	600
" 28	0	0	0	0	0	0	" 27	13,838	3,118	16,956	549	119	668
" 29	4,435	692	5,127	136	23	159	" 28	12,880	2,677	15,557	660	109	769
" 30	7,338	885	8,223	300	57	357	" 29	7,823	2,696	10,519	411	65	476
May 1	5,291	786	6,077	384	73	457	" 30	9,529	2,156	11,685	358	77	435
" 2	3,775	507	4,282	259	66	325	July 1	11,511	3,124	14,635	501	117	618
" 3	2,593	782	3,375	97	26	123	" 2	8,844	2,025	10,869	409	73	482
" 4	1,362	0	1,362	162	56	218	" 3	10,015	2,989	13,004	361	93	454
" 5	3,065	762	3,827	83	16	99	" 4	4,474	3,513	7,987	338	86	424
" 6	3,063	594	3,657	186	42	228	" 5	5,364	4,069	9,433	272	59	331
" 7	3,162	614	3,776	192	39	231	" 6	3,275	5,988	9,263	191	21	212
" 8	2,511	228	2,739	187	29	216	" 7	13,194	3,207	16,401	532	41	573
" 9	3,358	392	3,750	140	19	159	" 8	11,842	2,782	14,624	630	54	684
" 10	3,786	389	4,175	212	25	237	" 9	9,965	3,081	13,046	459	50	509
" 11	3,395	305	3,700	275	53	328	" 10	9,167	5,006	14,173	484	60	544
" 12	5,566	237	5,803	90	24	114	" 11	14,121	3,641	17,762	461	61	522
" 13	7,037	404	7,441	388	92	480	" 12	14,261	2,909	17,170	561	88	649
" 14	10,312	1,220	11,532	375	121	496	" 13	14,309	3,686	17,995	423	94	517
" 15	3,787	320	4,107	315	100	416	" 14	14,758	4,257	19,015	448	133	581
" 16	0	0	0	179	76	255	" 15	15,242	4,198	19,440	507	119	626
" 17	12,764	2,158	14,922	215	97	312	" 16	10,114	6,821	16,935	495	131	626
" 18	11,056	3,015	14,071	526	190	716	" 17	10,907	8,885	19,792	382	112	494
" 19	10,838	4,679	15,517	592	176	768	" 18	9,299	8,847	18,146	559	94	653
" 20	4,509	4,254	8,763	845	209	1,054	" 19	12,755	4,452	17,207	456	33	489
" 21	7,821	2,363	10,184	473	155	628	" 20	10,282	3,163	13,445	457	76	533
" 22	13,641	2,847	16,488	714	222	936	" 21	3,313	4,120	7,433	103	13	116
" 23	6,743	4,137	10,880	459	99	558	" 22	10,900	4,445	15,345	339	64	403
" 24	5,941	6,192	12,133	525	122	647	" 23	11,173	4,066	15,239	499	86	585
" 25	9,617	5,147	14,764	640	152	792	" 24	14,817	2,902	17,719	405	65	470
" 26	8,387	5,623	14,010	522	148	670	" 25	18,114	1,607	19,721	482	90	572
" 27	5,833	3,072	8,905	465	92	557	" 26	11,065	3,072	14,137	468	79	547
" 28	12,734	1,829	14,563	500	143	643	" 27	12,735	3,806	16,541	452	72	524
" 29	12,813	2,922	15,735	579	97	676	" 28	8,134	4,128	12,262	444	69	513
" 30	0	307	307	370	196	566	" 29	6,691	5,773	12,464	380	61	441
" 31	10,010	3,301	13,311	234	92	326	" 30	3,980	3,552	7,532	408	51	459
June 1	13,384	4,640	18,024	651	253	904	" 31	4,947	4,486	9,433	232	38	270
" 2	14,286	4,722	19,008	730	291	1,021	Aug. 1	7,340	3,449	10,789	391	68	459
" 3	10,150	5,221	15,371	742	173	915	" 2	0	0	0	197	31	228
" 4	13,403	2,490	15,893	695	160	855	" 3	2,118	511	2,629	80	21	101
" 5	10,046	2,923	12,969	676	171	847	" 4	3,814	873	4,687	78	20	98
" 6	8,846	7,123	15,969	651	150	801	" 5	3,525	0	3,525	84	19	103
" 7	6,054	6,337	12,391	667	141	808	" 6	11,585	1,783	13,368	370	69	439
" 8	8,053	1,515	9,568	478	98	576	" 7	11,515	3,156	14,671	424	83	507
" 9	7,514	1,050	8,564	441	85	526	" 8	10,213	3,354	13,567	503	115	618
" 10	10,563	735	11,298	433	93	526	" 9	9,667	3,202	12,869	496	112	608
" 11	6,015	680	6,695	349	108	457	" 10	10,528	3,438	13,966	512	109	621
" 12	11,121	4,316	15,437	509	121	630	" 11	7,705	3,980	11,685	477	129	606
" 13	9,407	4,131	13,538	690	138	828	" 12	9,710		9,710	478	103	581
" 14	5,401	7,568	12,969	388	62	450	" 13	10,461		10,461	486	76	562
" 15	1,982	0	1,982	441	52	493	" 14	8,327		8,327	438	0	438
" 16	4,786	8,377	13,163	156	38	194	" 15	4,050		4,050	135	0	135
" 17	5,830	8,345	14,175	534	117	651	Totals	948,482	327,878	1,276,360	47,858	10,382	58,240

1/ Each case contains 48 6½-ounce cans.

PROCESSING

The tangle-net crabs were brought to the mothership as soon as the small boats were loaded or after a set had been entirely picked up. Each of these boats usually made two trips to the mothership daily whereas the trawlers kept their catch until about 6 or 7 p.m., the end of the fishing day. As soon as a load of crabs was hoisted onto the temporary platform above Number 4 hatch, a crew of 10 to 20 men butchered them by stepping on the triangular-shaped abdomen on the ventral side of the crab and pulling up on the legs (fig. 8), thus separating the leg and body from the carapace and the viscera, which were immediately thrown over the side. The legs with the attached body meat were thrown into bags made of heavy netting which were then transferred from the butchering area to the cooking pots located on hatch Number 2.

In the transferring operation, a winch was employed to drop the bags overboard after they were secured to a line from a winch at Number 2 hatch. As the bags were

pulled through the water on the starboard side of the ship, much of the viscera which may have clung to the legs was washed off. The bags with their load of crab legs were then lifted out of the water at hatch Number 2 and placed into one of three large steel vats (5.1 feet on each side and 6 feet deep) mounted by the starboard railing. The vats were filled with sea water and kept hot by a coil of copper steam pipes graduated from 2 to $1\frac{1}{2}$ inches in diameter on the bottom of each vat. The crabs were cooked in the vats for a period of 20 to 25 minutes, after which they were again lowered into the sea to cool for about 7 to 8 minutes.

The next step in the processing of the crabs was to separate all the legs and to remove the major chela: the chelae were kept separate and counted as a check on number of crabs being processed. The legs were then cut at the joints and the meat shaken out and placed into straw baskets which were dipped twice in brine to wash

Fig. 8 - Views of butchering platform showing workers butchering crabs by stepping on the abdomen and pulling the legs.

off coagulated blood and bits of shell. The acid bath, common in crab canning, was deemed unnecessary when the cooked crab had been washed thoroughly. The baskets of meat were then passed below deck where they were graded and cut to the desired lengths. A prescribed quantity of each type of meat, such as chela meat, body meat, merus meat, etc., was then weighed and placed in plastic plates which were distributed by runners to other workers who put the meat from each plate into a "C enameled" can lined with parchment. Runners then carried tray loads of the filled cans to a spot inspection table, where they were inspected for weight, fill, and appearance. From this table the cans proceeded on a chain belt to the clincher, seamer, and vacuum machines, and finally to the retorts.

CHESTNUT BARK RETARDS RANCIDITY IN DRIED SALTED FISH

Experiments carried out in Greece on freshly-prepared salted fish showed that addition of commercially-prepared extract of chestnut bark added to the brine in proportion of 2 parts per thousand retarded the development of rancidity in dried salted fish.

--Chemical Abstracts, April 10,1953