

## KING CRAB, SHRIMP, AND BOTTOM FISH EXPLORATIONS FROM SHUMAGIN ISLANDS TO UNALASKA, ALASKA - SUMMER AND FALL, 1957

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### SUMMARY

Exploratory fishing to determine the availability and abundance of king crab, shrimp, and bottom fish in certain waters from the Shumagin Islands to Unalaska, Alaska, was conducted by the U. S. Bureau of Commercial Fisheries from July 18 to October 1, 1957. The M/V *Tordenskjold*, a Seattle commercial trawler, was chartered with Saltonstall-Kennedy Act funds for the work.

A variety of fishing gear was used, including circular and rectangular king-crab pots, large-mesh otter trawls, and a Gulf of Mexico-type shrimp trawl.

During the investigations, 61 otter-trawl drags and 36 shrimp trawl drags were made and 534 individual king-crab pots were set.

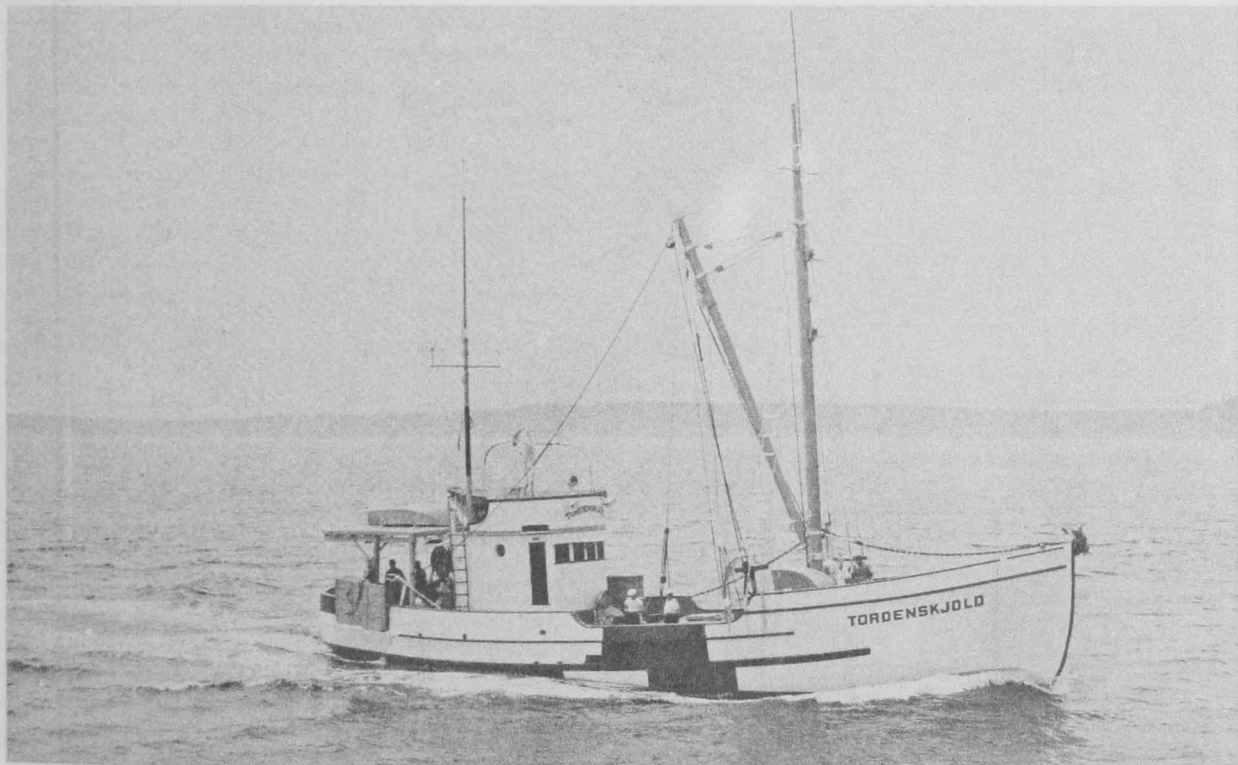


Fig. 1 - Chartered vessel M/V Tordenskjold.

The best catch of king crab using an otter trawl occurred between Umga and Cherni Islands. Other catches of king crabs with the trawl were generally small and not considered productive enough to warrant commercial exploitation. Localities that yielded promising king crab catches while fishing with pots included Stepovak Bay, Dorenoi Bay, and vicinity, off Chichagof Bay, between Umga and Cherni Islands, and Cold Bay.

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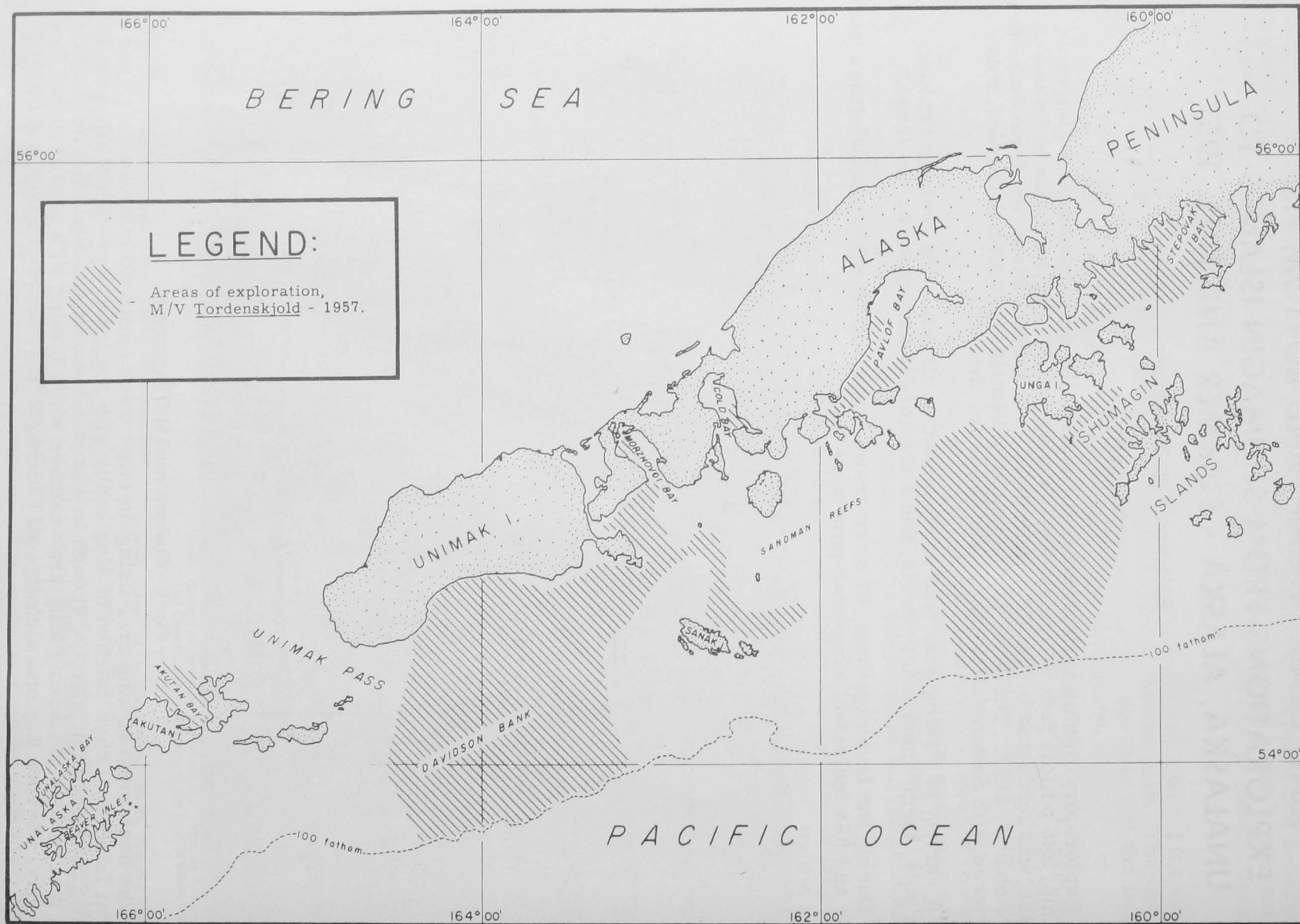


Fig. 2 - Areas of exploration.

Excellent catches of shrimp were made using the lined otter trawl and the Gulf of Mexico-type shrimp trawl. Large catches of pink shrimp were made in Balboa Bay, Unga Strait, Stepovak Bay, near Sealion Rocks, and in the vicinity of Beaver and Pavlof Bays. The best shrimp trawl drag of the cruise produced a catch of 3,800 pounds of shrimp in 30 minutes. A number of drags were made which yielded shrimp at rates exceeding 5,000 pounds an hour. Fair signs of larger size varieties such as side-stripe shrimp and coon-stripe shrimp were, at times, mixed with the pink shrimp.

With the exception of a 5-day storm, which occurred during the latter part of August, little time was lost due to adverse weather conditions. As many of the areas fished were in semiprotected waters, small squalls did not hamper fishing activities.

INTRODUCTION

Exploratory fishing for king crab, shrimp, and bottom fish was carried out from July 18 to October 1, 1957, from the Shumagin Islands to Unalaska Bay, Alaska (fig. 2), by the schooner-type trawler *Tordenskjold*. The vessel was chartered by the U. S. Bureau of Commercial Fisheries with funds provided by the Saltonstall-Kennedy Act of 1954.

The primary objective of this exploratory fishing was to determine the distribution and availability of king crab in waters beyond the range of those now commercially fished. In addition, information on the distribution and availability of bottom fish and shrimp inhabiting the area was collected.

The work was carried out in cooperation with the Bureau's King Crab Investigations, and during part of the cruise a biologist was aboard the *Tordenskjold* to tag king crab and collect pertinent information.

BACKGROUND INFORMATION

The presence of king crab in the inshore waters near the Shumagin Islands and Alaska Peninsula has been known for many years. Approximately 4,000 male crabs were reported taken from Pavlof Bay and Canoe Bay in 1938. In 1940 and 1941 fishing operations carried out in Pavlof Bay and Canoe Bay by the Alaska Crab Investigations of the Fish and Wildlife Service revealed a crab population sufficient to support a profitable commercial operation (Anonymous 1942). During the same investigation, Cold Bay and Volcano Bay were also reported to have fair concentrations of king crab.

In the ensuing years the king crab fishery in this area developed slowly. Landings in recent years, however, have increased rapidly and between 1954 and 1956 the catch from the Shumagin area rose from 316,660 pounds to 2,043,967 pounds.

Shrimp and bottom fish, with the exception of halibut and true cod, have not been commercially exploited in the Shumagin Islands or in the areas explored along the Alaska Peninsula.

Species of Fish and Shellfish Mentioned in this Report	
Common Name	Scientific Name
<b>Crab:</b>	
Dungeness . . . . .	<i>Cancer magister</i>
King . . . . .	<i>Paralithodes camtschatica</i>
Tanner . . . . .	<i>Chionoecetes bairdii</i>
<b>Shrimp:</b>	
Coon-stripe . . . . .	<i>Pandalus hypsinotus</i>
Humpy . . . . .	<i>Pandalus goniurus</i>
Pink . . . . .	<i>Pandalus borealis</i>
Side-stripe . . . . .	<i>Pandalopsis dispar</i>
<b>Food and Miscellaneous Bottom Fish:</b>	
Alaska pollock . . . . .	<i>Theragra chalcogramma</i>
Arrow-toothed flounder (turbot) . .	<i>Atheresthes stomias</i>
Eelpout . . . . .	<i>Lycodes</i> sp.
Halibut . . . . .	<i>Hippoglossus stenolepis</i>
Lemon "sole" . . . . .	<i>Pleuronectes quadrituberculatus</i>
Rex "sole" . . . . .	<i>Glyptocephalus zachirus</i>
Rock "sole" . . . . .	<i>Lepidopsetta bilineata</i>
Sand dab . . . . .	<i>Citharichthys sordidus</i>
Sand "sole" . . . . .	<i>Psettichthys melanostictus</i>
Sculpin . . . . .	<i>Hemilepidotus</i> sp.
True cod . . . . .	<i>Gadus macrocephalus</i>

## FISHING GEAR AND METHODS

**OTTER TRAWLS:** Standard 400-mesh eastern and western otter trawls were used to carry out trawling operations for king crab and bottom fish. The eastern trawl had  $4\frac{1}{4}$ -inch mesh<sup>1/</sup> in the wings, square, and body, and  $3\frac{1}{2}$ -inch mesh in the intermediate and cod end. Details of the eastern trawl have been described by Greenwood (1958). The western trawl was constructed of  $4\frac{1}{2}$ -inch mesh throughout.



Fig. 3 - The otter trawl on the surface showing the aluminum floats.

Specifications of this trawl have been described by Alverson (1951). From 16 to 22 aluminum-alloy 8-inch-diameter spherical floats were spaced evenly along the head rope of each net. The last six feet of each cod end of both style trawls were lined with  $1\frac{1}{2}$ -inch cotton webbing to retain shrimp and immature king crab encountered during the exploration. All drags were made for a period of one hour, when possible, and the average towing speed was 2.4 knots.

**GULF SHRIMP TRAWL:** Shrimp drags were made with a 43-foot flat Gulf of Mexico-type shrimp trawl (Schaefers and Johnson 1957) constructed from  $1\frac{1}{2}$ -inch mesh cotton

**KING CRAB POTS:** Circular pots similar to those used in the commercial king-crab fishery of Alaska and patented box-shaped collapsible pots were used during the investigation. The circular pots were 72 inches in diameter, and 24 inches high with two tunnels located opposite each other on the 24-inch side. The framework was constructed of  $\frac{3}{4}$ -inch mild steel rod, and covered with 4-inch (open mesh) webbing handwoven from 16-gauge stainless steel wire. A hinged access lid, approximately 30 inches by 36 inches, was located on the top of the pot.



Fig. 4 - Commercial-type crab pots as used by the Tordenskjold.

Several variations of the standard circular pot were fished, including a 3-tunnel pot and a number of pots with the top frame 12 inches less in diameter than the bottom frame.

<sup>1/</sup>All mesh sizes in this report refer to stretched measure.



The patented box-shape, collapsible pots were 36 by 72 inches at the base, 36 by 60 inches on top, and 30 inches high. The frames were fabricated of  $\frac{5}{8}$ -inch-diameter galvanized mild steel rods (Schaefers et al 1955). The box-type pots proved too light for fishing in offshore waters and it was necessary to add approximately 25 pounds of chain to the bottom of each pot to prevent drifting.

#### BUOYS AND BUOY LINES:

Most pots were fished using rubberized canvas bags 14 to 18 inches in diameter as buoys. A single buoy served as a surface float for each pot to hold at the surface the line from the pot on the bottom and provide a marker. Cotton belting or manila rope were used as harnesses for these buoys but the latter proved undesirable because of excessive chafing (see fig. 7). Cylindrical oxygen tanks of stainless steel, painted yellow and having  $1\frac{1}{2}$  to 2 cubic feet displacement, were also used as buoys, but these were difficult to see under certain light and water conditions.



Fig. 5 - Weaving the webbing of stainless steel wire on a crab pot.

Buoy lines were assembled from 50-fathom lengths of  $\frac{9}{16}$ -inch or  $\frac{5}{8}$ -inch-diameter manila rope joined to a 25-fathom length of  $\frac{15}{32}$ -inch diameter manila rope. Sufficient sections were joined end-to-end so that the heavier lines were always longer than the depth of water. A gill-net type, 8-inch plastic float was threaded on the lower section of each buoy line and allowed to run free between the pot and a stopper above the pot. This method of rigging prevented chafing of the buoy line on the bottom or against the pot.

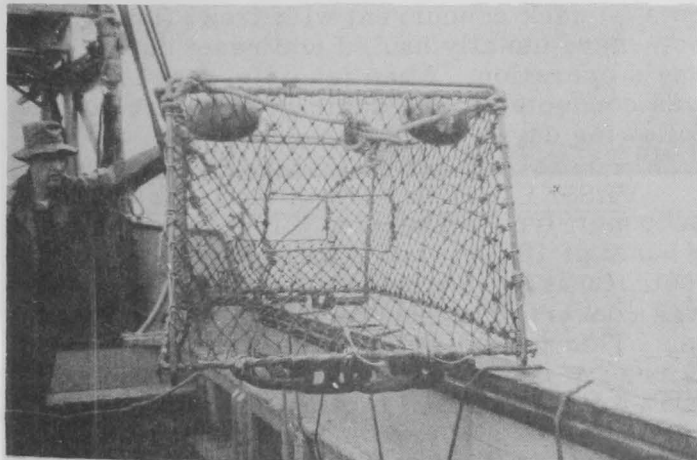


Fig. 6 - Collapsible-type pot with extra weight added to the bottom to prevent drifting from its set position.

sisted of a taped bamboo pole 15 to 18 feet long, with a square red flag and a life raft-type radar reflector on top. Locating gear in offshore waters proved to be relatively simple with the aid of radar reflectors (see fig. 8).

**BAITING AND FISHING THE KING CRAB POTS:** Bait bags consisted of  $1\frac{1}{2}$ -inch mesh, 42-thread, treated cotton webbing, 23 meshes long and 20 meshes wide. To form the bag, square-cut webbing was folded in half and sewed along the open side and bottom. The throat was closed by threading an 18-gauge stainless steel wire through the selvage meshes so that it would operate in a slip-knot fashion.

The bag, baited with about  $2\frac{1}{2}$  pounds of fresh or fresh frozen chopped fish was placed inside the pot midway between the tunnel entrances, and held in place by a

double wire-hook arrangement. One hook was attached directly to the bait bag while a short section of heavy rubber was used between the bait bag and the other hook. The hooks, formed from eight-gauge wire, were secured to the top and bottom of the bait bag and fastened to opposite tunnel entrance frames during fishing. The rubber section provided tension to hold the bait in place and allowed easy handling of the bag.

Sculpin, arrow-toothed flounder, and Alaska pollock were the principal baits, although occasionally other species of flat fish and roundfish were tried.

The pots were usually set in strings or rows composed of 8 to 20 individual pots. The total number of pots in a string is called a pot set, although for purposes of clarity in the text and tables, some continuous strings are divided into two sets and other non-continuous strings are included as a single and numbered accordingly.

Distances between individual pots in a string usually ranged from one-fourth to one-half mile.

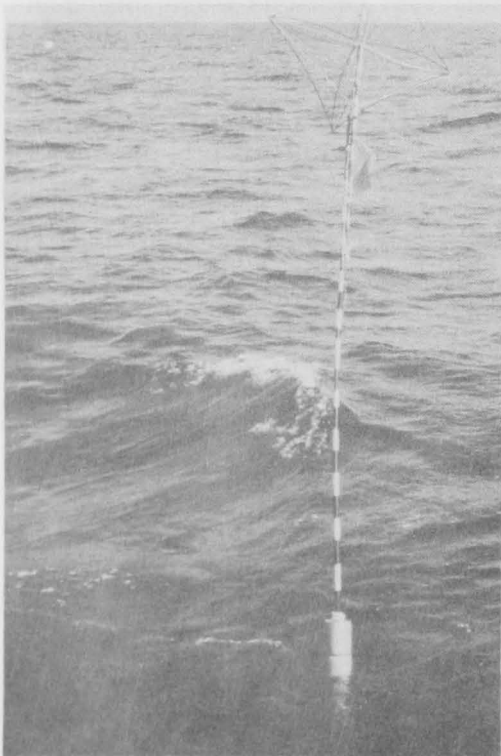


Fig. 8 - Radar reflectors on the marker buoys proved an aid for locating the gear.

534 individual king crab pots were set.

The location of each otter-trawl drag and king crab pot is diagrammatically illustrated in figures 9 and 11, and of each Gulf shrimp trawl drag in figure 12.

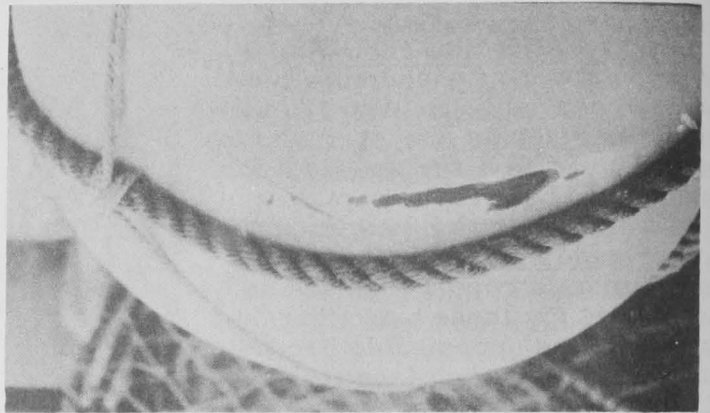


Fig. 7 - Excessive chafing caused by a rope harness.

As it was difficult to accommodate crab pots on deck concurrent with trawl fishing, the pots were usually hauled and reset during one day's operation. When feasible, trawl fishing was conducted in the same general area on the following day.

**VESSEL USED:** The *Tordenskjold*, a schooner-type vessel, is 75 feet in length, with a beam of 18 feet, and a mean-load draft of 9 feet. Built for the halibut fishery, the vessel was converted in 1942 for use in trawl fisheries. This vessel was chartered by the U. S. Bureau of Commercial Fisheries earlier in 1957 for bottom-fish explorations off South-eastern Alaska (Greenwood 1958).

#### FISHING RESULTS

Exploratory operations were conducted along the south side of the Alaska Peninsula from Stepovak Bay westerly to Unalaska Island in the Aleutian group. (See fig. 2.) Fishing was carried out in most of the major bays within this area and in offshore waters extending out to the 100-fathom contour. During the exploration, 61 otter-trawl drags were made for king crab and bottom fish, 36 drags were made with a Gulf of Mexico-type shrimp trawl, and

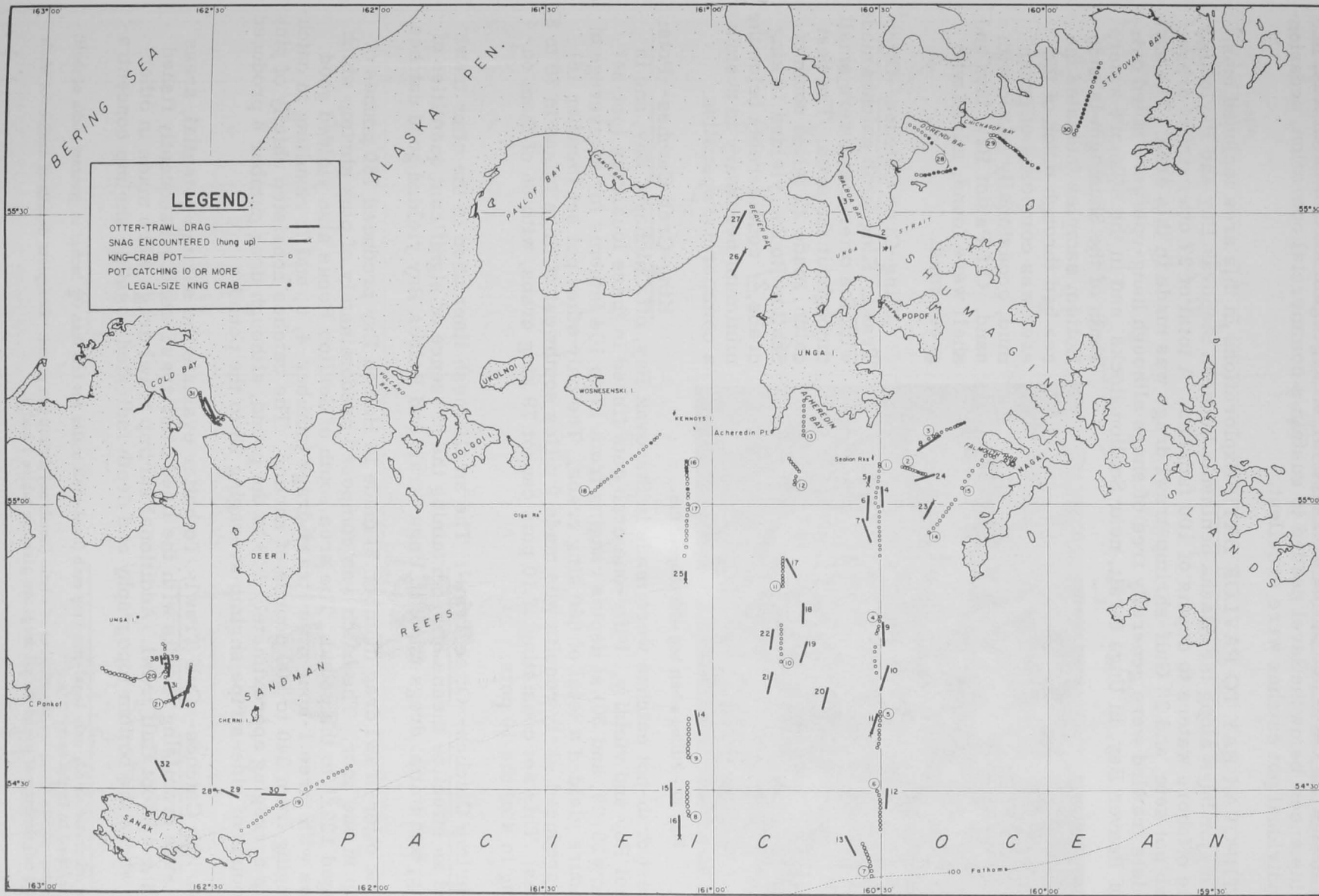


Fig. 9 - Location of otter-trawl drags and king-crab pot sets from Stepovak Bay to Sanak Island.

Although the catch per pot as averaged for an aggregate station catch was, in many instances, below the level needed to sustain a commercial operation, occasionally individual pot catches were excellent.

STEPOVAK BAY TO PAVLOF BAY: Explorations in this area included most of the major bays along the Alaska peninsula between Stepovak Bay and Pavlof Bay, and the offshore waters to depths of 100 fathoms. A total of 27 otter-trawl drags, 18 crab pot sets, and 28 Gulf-shrimp-trawl drags was made in this area. The bays and inlets trawled were generally free of snags although hang-ups were noted outside of Beaver Bay, in Unga Strait, near Sealion Rocks, and in the offshore waters



Fig. 10 - Filling a bait bag with chopped fish.

south of the Shumagin Islands. Bottom samples indicated the sea bed through much of the area was composed of green mud, occasionally mixed with sand. Off Pavlof Bay, lava and shell were found, mixed with green mud.

King-Crab Catches--Otter Trawl: King-crab catches made with the otter trawl were small throughout the area. The best catch, made 22 miles south of Sealion Rocks, yielded 10 king crabs,<sup>2/</sup> considerably below the minimum necessary to sustain a commercial operation.

King-Crab Catches--Pots: The best crab-pot catches were made in Stepovak Bay, off Chichagof Bay, and in Dorenoi Bay and vicinity. Fifty-one crab pots fished in these localities (pot-set numbers 28, 29, and 30) at depths ranging from 17 to 104 fathoms for an average of 92.6 hours yielded a total of 660 king crabs. The only other pot set (number 16) which produced likely results was made 9 miles southwest of Unga Island in 70 to 87 fathoms. This set consisting of 10 pots caught 79 king crabs, with 66 of them occurring in 4 of the 10 pots.

Shrimp Catches--Otter Trawl: The small-mesh liner used in the otter trawl proved an effective means of ascertaining the presence of significant quantities of shrimp, and initial drags made in Unga Strait and Balboa Bay yielded good catches.

One otter-trawl drag (number 3) made in Balboa Bay produced 760 pounds of shrimp in one hour. The catch was composed predominately of pink shrimp which averaged 122<sup>3/</sup> to the pound. The area south of Sealion Rocks also yielded good catches with three 1-hour otter-trawl drags (number 4, 6, and 7) resulting in catches ranging from 240 to 900 pounds of shrimp. The catches consisted chiefly of pink shrimp averaging approximately 113 to the pound, although drag number 4 produced 100 pounds of side-stripe shrimp averaging 28 to the pound.

Shrimp Catches--Gulf Trawl: To better evaluate the shrimp potential, areas which gave promising results with the lined otter trawl were subsequently fished using the 43-foot Gulf trawl. Additional shrimp trawl drags were made in other areas where the bottom topography and depth indicated possible shrimp concentrations.

<sup>2/</sup>Unless otherwise noted, only legal-size king crab (hard-shell males not less than 6 $\frac{1}{2}$  inches in greatest width of shell) are referred to in the text.

<sup>3/</sup>All shrimp counts given are the number of whole (heads on) shrimp per pound. Complete details of number of whole (heads on) shrimp per pound for all drags are given in tables 1 and 3.



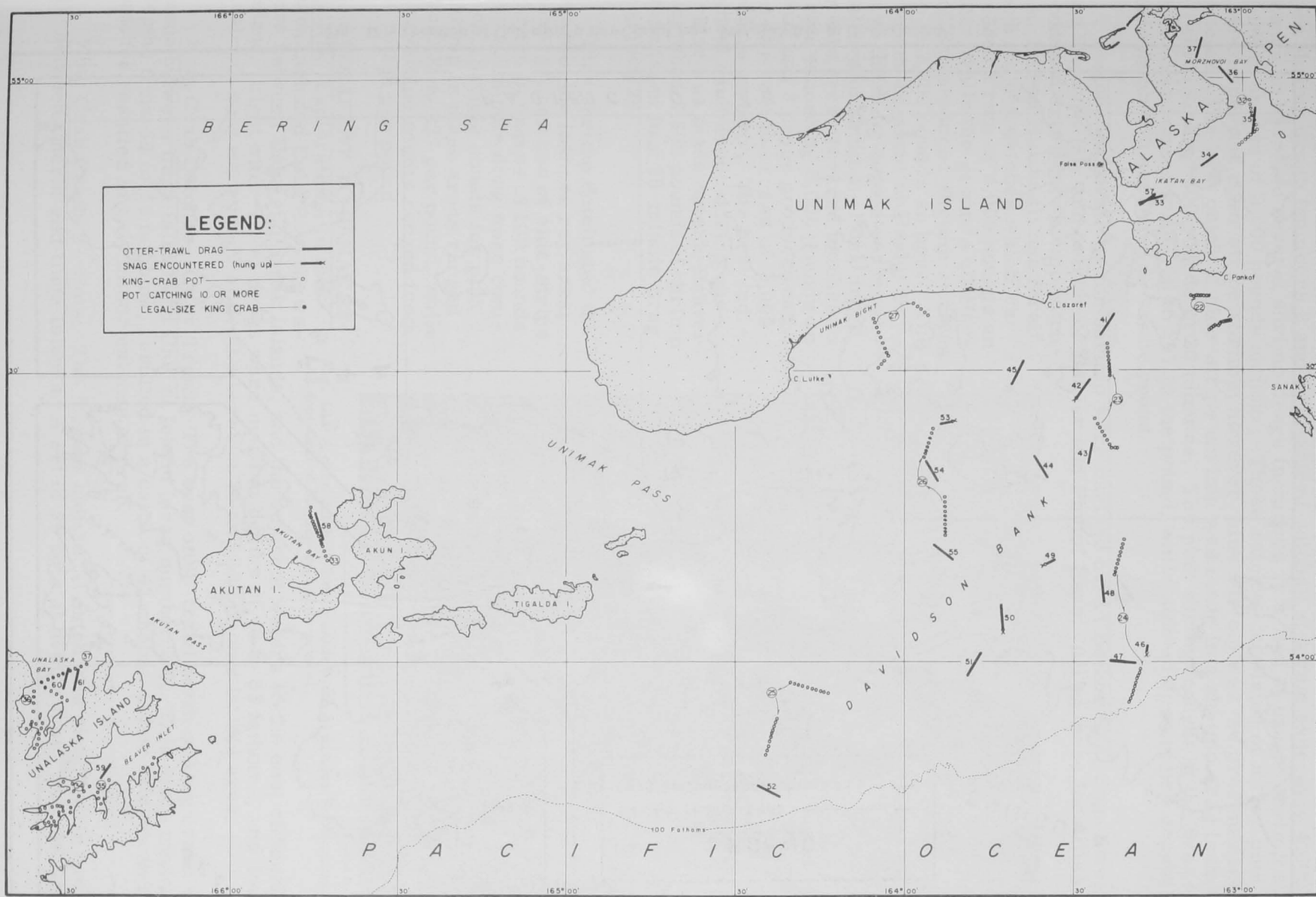


Fig. 11 - Location of otter-trawl drags and king-crab pot sets from Sanak Island to Unalaska Bay.

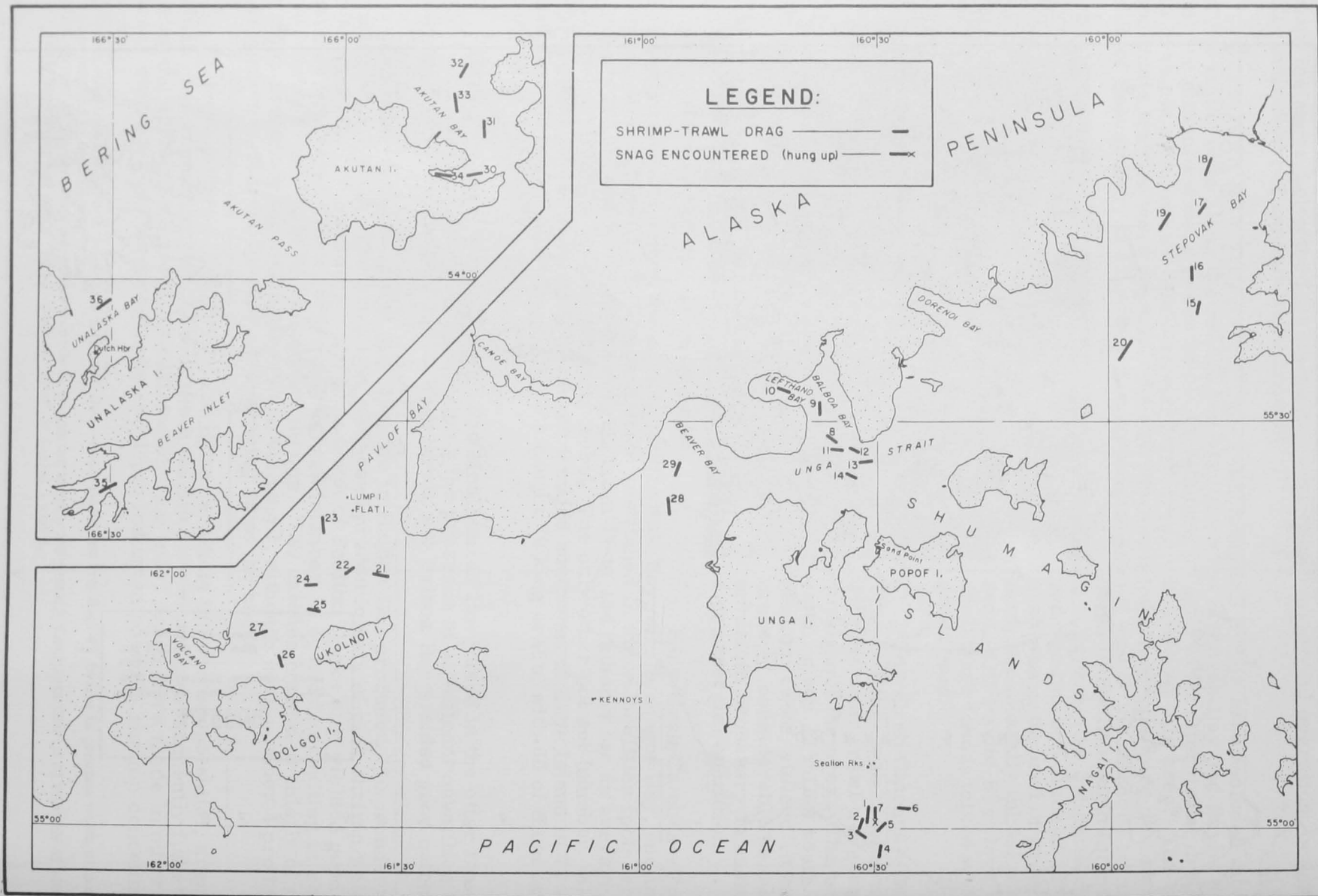


Fig. 12 - Location of Gulf shrimp trawl drags from Stepovak Bay to Unalaska Bay.

Good catches of shrimp were made with the Gulf trawl south of Sealion Rocks. Two shrimp drags (numbers 2 and 5) produced catches at a rate exceeding 4,000 pounds an hour and several shrimp drags (numbers 1, 3, and 4) caught shrimp at rates in excess of 2,000 pounds an hour. These catches consisted of mixed pink, side-stripe, and coon-stripe shrimp; however, pink shrimp was the predominant species. The best catch of side-stripe shrimp was made in a shrimp drag (number 5), which yielded 400 pounds in 20 minutes. The pink shrimp caught in the Sealion Rock area ranged from 118 to 157 to the pound, while side-stripe shrimp caught in drag number 5 averaged 57 to the pound.

Inshore explorations for shrimp were carried out in Balboa Bay, Unga Strait, and Stepovak Bay and outside of Beaver and Pavlof Bays. All of these localities produced excellent shrimp catches. Balboa Bay and Unga Strait both yielded catches which exceeded a rate of 4,000 pounds an hour, while the grounds off Pavlof Bay produced shrimp at rates up to 7,300 pounds an hour. The grounds adjacent to Pavlof Bay gave the most consistent large catches of shrimp. Four drags in this area produced catches at rates exceeding 5,000 pounds an hour and 3 drags produced catches at a rate in excess of 3,000 pounds an hour. The best individual catch made during the cruise was made outside Beaver Bay when 3,800 pounds of shrimp were taken in a 30-minute drag (number 29).

Pink shrimp dominated the catch in the inshore bay area; however, catches of side-stripe shrimp in excess of 100 pounds per 20-minute drag were common. Sample counts for pink shrimp in these areas ranged from 92 to 227 per pound, while side-stripe counts ranged from 26 to 135 per pound.

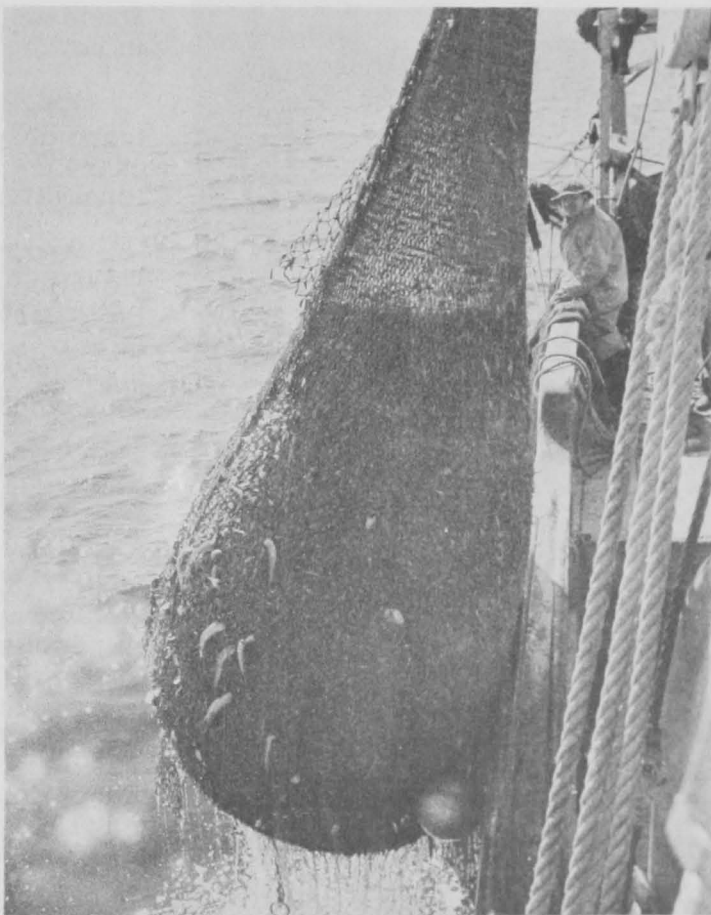


Fig. 13 - A good catch of shrimp made south of Sealion Rocks using the 43-foot Gulf of Mexico-type shrimp trawl.

COLD BAY TO SANAK ISLAND: Explorations in this area included Cold Bay, the waters between Unga and Sanak Islands, and the adjacent waters to the east of Sanak Island. Eight otter-trawl drags were made at depths of 40 to 83 fathoms, and four crab-pot sets were made at depths between 38 and 82 fathoms in this area.

King Crab Catches--Otter Trawl: The best otter-trawl catch of king crabs was made between Unga Island and Cherni Island (drag number 39). This drag, made at depths from 66 to 74 fathoms, resulted in a catch of 42 crabs. Other otter-trawl catches resulted in only minor catches of crab.

King Crab Catches--Pots: The largest individual catch was made (set number 21) between Cherni and Unga Islands. A set of 20 pots at depths from 58 to 78 fath-

oms caught 333 king crabs. The next largest catch, 164 was made with 16 pots fished for 26 hours in Cold Bay (set number 31).

Shrimp Catches: Insignificant catches of shrimp were noted in the lined otter trawl drags made in this area, and no attempts were made to locate shrimp with the Gulf shrimp trawl.

MORZHVOI BAY TO DAVIDSON BANK: Exploratory fishing in this region was conducted in Morzhovoi Bay and Ikatan Bay and on Davidson Bank, south of Unimak Island. A total of 21 otter-trawl drags and 7 sets of king crab pots was made in the area. The drags made in Morzhovoi Bay and Ikatan Bay were free of snags and most of Davidson

Bank was found suitable for trawling. A considerable amount of gravel bottom was noted on Davidson Bank, while green mud was common in bottom samples taken from the bay areas.



Fig. 14 - A catch of 3,300 pounds of shrimp on the deck of the *Tordenskjold*. This catch was the result of a 30-minute drag outside Paylof Bay with the 43-foot Gulf of Mexico-type shrimp trawl.

Crab and Shrimp Catches: Both otter-trawl drags and pot sets resulted in insignificant king crab catches. Shrimp catches in the lined otter-trawl were also unfavorable.

AKUTAN BAY TO UNALASKA BAY: Explorations in this area were made in Akutan Bay, Beaver Inlet, and Unalaska Bay. Four otter-trawl drags, 5 pot sets, and 7 drags with the Gulf shrimp trawl were made. No snags were encountered during trawl operations; however, the bottom topography was irregular and only a limited amount of trawling ground was located.

Crab and Shrimp Catches: Crab catches made with the otter-trawl were poor. Although the average catch of crabs per pot in this area was low, a few pots fished in Akutan Bay and Unalaska Bay yielded fair catches. In Akutan Bay, 2 pots caught 31 crabs, and in Unalaska Bay, 4 pots caught 86 crabs. Only 1 drag produced any quantity of shrimp. One drag (number 35) made in Beaver Inlet with the Gulf trawl resulted in a catch of 175 pounds of mixed pink and side-stripe shrimp.

INCIDENTAL FISH AND SHELLFISH CATCHES: The best catch of food fish made during the explorations was taken 7 miles southeast of Cape Lazaref in 59 to 62 fathoms where 5,000 pounds of true cod were caught with the otter-trawl (drag number 41). Other catches of food fish were generally small. Species of fish captured in small amounts included rock sole, pollock, sculpin, and turbot.

Tanner crabs were distributed throughout most of the region explored. In Unalaska Bay, 13 pots produced a catch of 1,109 tanner crabs with 169 crabs taken in 1 pot. A catch containing 555 tanner crabs was also taken in 1 otter-trawl drag made in Ikatan Bay.

Dungeness crabs were taken only in sets made in close proximity to the beach and in comparatively shallow water, such as Unimak Bight and Acheredin Bay. Catches of Dungeness crabs were small even in these areas.



## WEATHER CONDITIONS

With the exception of a five-day storm during the latter part of August, little time was lost because of adverse weather conditions. The weather was generally overcast and cloudy with intermittent rain and fog. As many of the areas explored were in semi-protected waters, small squalls did not interfere with fishing activities.

## APPENDIX

Detailed fishing logs which give details for each drag are not included in the Review, but are available upon request as an appendix to the reprint of this article. Write for Separate No. 543, which contains these tables:

Table 1 - Fishing Log--Otter-Trawl Drags Made from Shumagin Islands to Unalaska Bay, Alaska, July 18 to September 29, 1957, U. S. Bureau of Commercial Fisheries Chartered Vessel Tordenskjold.

Table 2 - King Crab Pot Sets Made from Shumagin Islands to Unalaska Bay, Alaska, July 20 to October 1, 1957, U. S. Bureau of Commercial Fisheries Chartered Vessel Tordenskjold.

Table 3 - Gulf Shrimp Trawl Fishing Log--Shumagin Islands to Unalaska Island, Alaska, September 6 to 30, 1957, U. S. Bureau of Commercial Fisheries Chartered Vessel Tordenskjold.

Table 4 - Individual Pots Catching 10 or More Legal-Size King Crab, Shumagin Islands to Unalaska Bay, Alaska, July 20 to October 1, 1957, U. S. Bureau of Commercial Fisheries Chartered Vessel Tordenskjold.

## LITERATURE CITED

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