

SHRIMP FISHERY OF SOUTHEAST ALASKA¹

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DEVELOPMENT OF THE SHRIMP FISHERY

So far as is known, no attempt to utilize the Alaskan shrimp commercially had ever been made prior to 1915. In that year a man named Gardner, backed by Chinese capital, commenced drying shrimp at Thomas Bay, a short distance from Petersburg. The enterprise was not successful, however, and was soon discontinued. Unfortunately, no data are available regarding the details of the venture.

In 1916 the two men that are now at the head of the industry, E. N. Ohmer and Karl I. Sifferman, entered the field. They brought a small beam trawler from Puget Sound and began pickling shrimp at Petersburg under the firm name of Alaskan Glacier Sea Food Co. For two years this was the only concern in Alaska engaged in the business of packing shrimp. Higher labor and transportation costs made it exceedingly difficult to meet competition from other shrimp-producing sections of the United States having the advantages of unlimited cheap labor and long-established markets, and except for the excellent quality of the Alaska product the enterprise must surely have met with failure. Operations during this period were necessarily conducted on a very small scale, the market for the product being limited, as were also the finances of the company. Gross re-

¹ Appendix I to the Report of the U. S. Commissioner of Fisheries for 1929. B. F. Doc. No. 1032

turns from the sale of meat and by-products exported during 1916 and 1917 were a little less than \$8,000.

The industry began to expand in 1918, three new concerns having commenced operations. These were the Glacier Fish Co. at Scow Bay, the Ripley Fish Co. at Petersburg, and H. Van Vlack & Co. at Thomas Bay. The combined output of all the plants for the year was valued at \$14,000. The era of expansion was short-lived, however, market conditions in Pacific coast cities and the keen competition from southern waters combining to discourage the new packers, with the result that all of them discontinued operations, leaving the field to the Alaskan Glacier Sea Food Co. during 1919 and 1920. In 1919 the latter company was still operating the one original trawler, but, owing to increased efficiency both in trawling and preparing the product for market, receipts reached a total of \$21,000. The year 1920 proved to be even better; three additional trawlers were employed, and the product for the year was valued at \$49,000. A greater demand for Alaska shrimp meat was manifested in the cities of the Pacific coast, and the fishery seemed to be firmly established at last.

The growing prosperity of the Alaskan Glacier Sea Food Co. resulted in bringing three new competitors into the industry in 1921—the Petersburg Sea Products Co. and the Ness Fish Co. began packing shrimp meat at Petersburg, and the Olympic Fisheries Co. commenced operations at Wrangell, using a floating plant. Five trawlers were employed. The product of all the plants for the year was valued at \$132,000. The Petersburg Sea Products Co. did not operate in 1922, but the other plants nearly equaled the 1921 production, exporting meat to the value of \$126,000, after sustaining losses totaling more than \$7,000 because of inadequate shipping facilities.

Production in 1923 exceeded that of any previous year. In addition to the three canneries operating in 1922, a new plant, called the Wrangell Shell Fish Co., was built at Wrangell. This company began exporting shrimp meat early in the year but encountered difficulty in marketing and did not pack during the summer months. The Olympic Fisheries Co. discontinued business in November, selling its floating plant to the Alaskan Glacier Sea Food Co. The value of the product for the year was in excess of \$178,000. In 1924 the Alaskan Glacier Sea Food Co. operated its shore plant in Petersburg and the floating cannery at Wrangell; the Wrangell Shell Fish Co. also continued packing in the latter place. The value of the product exceeded that of 1923 by approximately \$50,000. These two concerns continued operations through 1925. The floating plant was towed to the Haines district in Lynn Canal, where shrimp had been found in considerable quantities; but, owing to unusually bad weather, the trawlers accompanying the plant could not catch sufficient shrimp to keep it in operation. This failure resulted in a decrease of about \$20,000 in the value of the year's production as compared with 1924.

During the first months of 1926 the Alaskan Glacier Sea Food Co. was alone in the field once more, operating only its shore plant at Petersburg. The Wrangell Shell Fish Co. again met with difficulty in marketing and did not pack for several months, finally selling two-thirds of its capital stock to the Alaskan Glacier Sea Food Co., under whose management the plant resumed operations in August. A new

cannery, called the Reliance Shrimp Co., was built at Wrangell and commenced packing in June. This is the smallest of those now in operation. The total value of the product for the year was \$195,000.

Owing to the continued weak market, the Alaskan Glacier Sea Food Co. operated only the Petersburg plant during 1927, its floating plant and the Wrangell Shell Fish Co. both being idle throughout the year. The Reliance Shrimp Co. continued packing at Wrangell. In 1927 employment was given to 172 persons, and products consisted of 491,825 pounds of shrimp meat, valued at \$196,732.

Shrimp were unusually plentiful in 1927, and, had it not been for the poor market, this would probably have been the year of greatest production since the beginning of the industry.

The following table shows the progress of the fishery from its beginning in 1916 to 1927, giving the increase in men employed and investment, total yield, and value of products. It is compiled from data collected yearly by the Bureau of Fisheries.

Investment, persons engaged, and products of the southeast Alaska shrimp fishery, 1916 to 1927

Year	Investment	Persons engaged	Form of product	Pounds	Value
1916	(¹)	(¹)	In brine.....	68,845	\$2,770
			Dried.....	3,060	831
			Meat.....	100	35
			Shells.....	3,880	114
1917	(¹)	(¹)	In brine.....	65,000	3,400
1918	(¹)	(¹)	Fresh.....	48,204	
			Canned.....	524	14,006
1919	\$41,776	17	Fresh.....	60,000	21,000
1920	105,700	40	do.....	112,045	49,123
1921	147,814	111	do.....	844,986	132,077
1922	168,111	118	do.....	386,880	126,690
1923	268,665	243	do.....	460,560	178,474
1924	326,683	173	do.....	528,432	227,979
1925	318,353	146	do.....	519,585	207,315
1926	315,752	163	do.....	490,185	185,828
1927	303,396	172	do.....	491,825	196,732

¹ No statistical data available. Investment covers value of plants, boats, gear, and wages paid.

² Cases.

FISHING METHODS

Motor vessels equipped with beam trawls are used exclusively in the Alaska shrimp fishery. These are of three types—the Puget Sound purse seiner, the halibut schooner, and a nondescript model that is a sort of combination of the others but, because of its small size, probably more nearly resembles the salmon troller than any other. At present 11 boats devote full time to the capture of shrimp, and 3 others engage in the fishery at irregular intervals, depending upon the condition of the market.

The halibut schooners are the largest, between 60 and 70 feet in length, and are used in handling the huge 60-foot trawls. The salmon-troller type, which are from 35 to 40 feet in length, are equipped with the lightest gear, having beams measuring 20 feet or less. It is in the intermediate-sized trawls, however, that most of the catch is taken—those with beams measuring from 25 to 40 feet. Here the purse seiner excels the others; it is easier to handle and more economical than the halibut schooner and can be used virtually anywhere that the salmon-troller type can be operated, taking nearly

twice as many shrimp with but little additional expense, as the number of men required is the same in each case. For the above reasons and because more than half the fleet are purse seiners, the description that follows deals only with this type. In any case, the gear used on all the boats is essentially the same, with the exception of a few minor details in arrangement.

The shrimp trawlers average more than 50 feet in length and are strongly built, seaworthy vessels. A few are sheathed in ironbark below the water line to protect them from floating ice—a constant source of danger on fishing grounds that are adjacent to live glaciers. They are powered with heavy-duty engines of standard makes burning gasoline or distillate and developing from 50 to 60 horsepower. These boats are built more for general utility than for speed, and few of them will make more than 8 knots. Usually the engine is

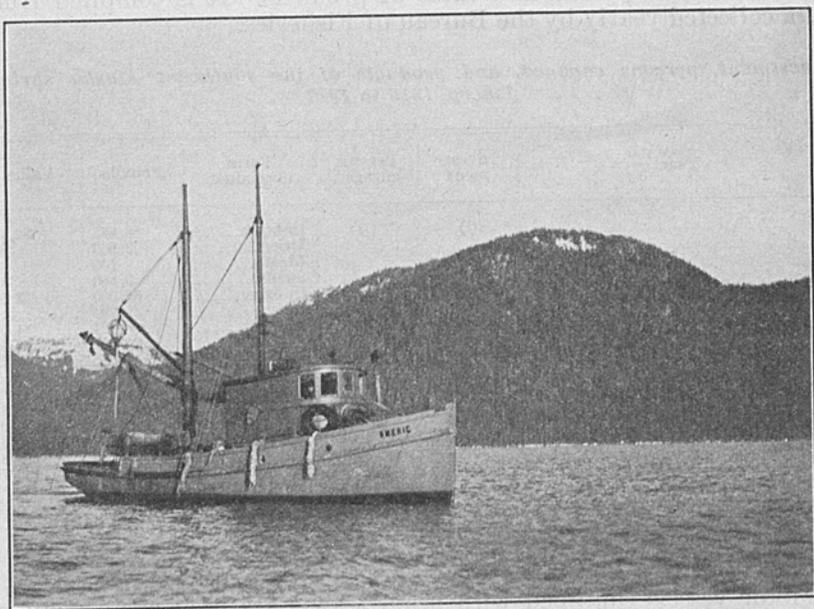


FIG. 1.—Typical Alaska shrimp trawler

controlled from the pilot house, thus dispensing with the services of an engineer. The pilot house, engine room, and living quarters are in the fore part of the boat, leaving the greater portion of the deck space free for handling the fishing gear. Under the main deck and aft of the engine room is a large hold in which extra drums of fuel and spare gear may be carried. Most of the trawlers have two masts, much stronger and heavier than are usually found in boats of the same size used for other purposes. Each mast supports a boom and hoisting tackle and is strongly braced with fore-and-aft and port-and-starboard stays in addition to a heavy steel cable or bar, which runs between them just below the mastheads. These braces are necessary because at times tremendous loads of mud or rock must be lifted to free the trawl, and without them the strain on the mast would be too great.

The hoist for lifting the trawl is located amidships, just aft of the deck house. It is driven by a chain or gears from the engine and is usually set so that the cable runs straight from the drum to the stern of the boat. Various sizes of cable are used, depending upon the weight of the trawl, but the average is about seven-sixteenths of an inch in diameter. The trawl cable leads from the drum to a block fastened to the main mast about 8 feet above the deck, and thence along the main boom, through another block near its outer end, to the hauling ring of the trawl. This boom is very heavy, since it must bear, more or less directly, the weight of the trawl and whatever may be in it. It is fastened to the mast with a strong iron collar and clevis, which allows it to be swung in a wide arc about the stern of the boat. Further support is rendered by ropes that pass through blocks near the outer end of the boom to others near the masthead. There is also the usual arrangement for holding the boom in any desired position—blocks and cleats fastened to the deck on each side of the stern, with lines running through other blocks on the boom.

Considerable ingenuity has been displayed by the shrimp fishermen in the specialization of the gear so that it can be handled efficiently by two men. All of the operations required in handling the trawl, brailing the shrimp from the bag, and unloading the catch at the cannery are performed by power transmitted from the engine through cleverly arranged gears, pulleys, and blocks.

FISHING APPLIANCES

The beam trawl, for a great many years identified with the ground fisheries of other parts of the world, is the only appliance used in the capture of shrimp in Alaskan waters. It has been modified to some extent to meet conditions not encountered elsewhere, but the principle remains the same. Various sizes are used, ranging from 16 to 60 feet in beam, but except in the matter of size all are constructed on exactly the same lines. The dimensions of the trawl carried by the *Charles T.*, a boat of the purse-seine type owned by the Alaskan Glacier Sea Food Co., are as follows: Beam 36 feet in length, 7 inches in diameter at the middle, and tapering to 5½ inches at the ends; bottom line, 7-inch manila 41 feet long; hauling cable, ½-inch woven wire; shoes, or runners, ½ by 6 inch black iron; bag, heavy tarred hemp web 1¼-inch mesh, 200 meshes deep.

The shoes, or runners, upon which the trawl slides along the bottom, are in the form of half circles about 4 feet in height and are fastened to each end of the beam by iron collars. Braces running from the highest point of the shoe to about midway of the beam serve to prevent the shoes being knocked off when the trawl slides sideways down a declivity on the bottom. The top of the bag is fastened to the beam by a series of lashings about 1 foot apart, and the bottom is fastened to the ground line. This line hangs loosely between the shoes and forms an opening into the bag as long as the beam and as wide as the shoes are high. Owing to the rapidity with which the bag and ground line wear out when dragged over rough bottoms, it is the practice to protect them with old pieces of web or canvas. However, care is taken not to use any material on the trawl that might prove stronger than the hoisting cable; for, in the event of fouling on a reef or boulder, this might break and

result in the loss of the entire trawl. Losing a trawl is a serious matter, as they are expensive. The smaller rigs, complete—gears, winch, cable, beam, and web—cost about \$800; the largest—those with 50 and 60 foot beams—cost from \$1,000 to \$1,200.

A few years ago one of the shrimp packers experimented with the otter trawl, believing that with its advantage in spread over the beam rig it would catch more shrimp. It was not successful, however, as the fishermen were unable to regulate it to the variety of bottom conditions encountered. The Chinese bag nets and traps, so successful in the San Francisco Bay shrimp fishery, can not be used on the Alaska grounds owing to the great depths from which most of the catch is taken, and this circumstance also prevents the use of cast nets and seines. On the whole, even though the beam trawl is

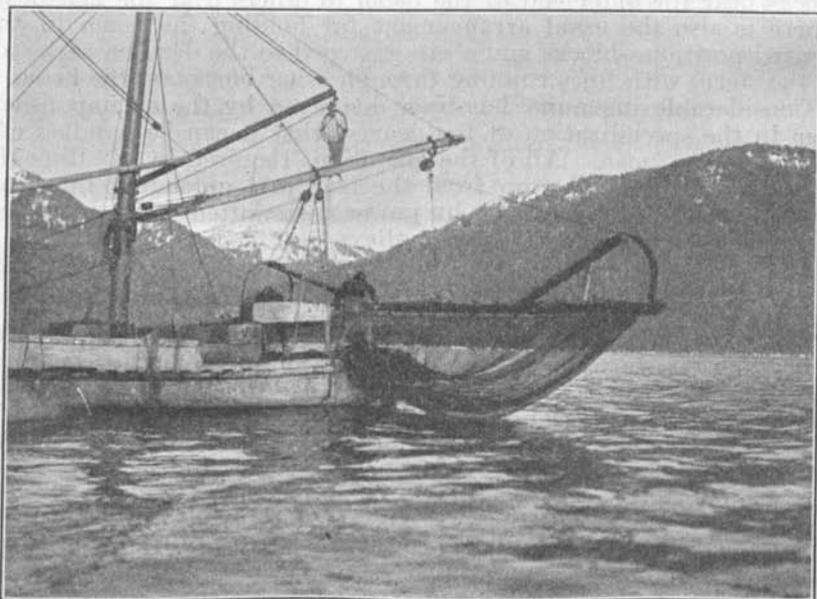


FIG. 2.—Preparing to drop the trawl

regarded as an antiquated appliance by shrimp fishermen in other localities, it comes nearer to meeting the requirements of the Alaskan fishery than any equipment thus far devised.

TRAWLING

The shrimp trawler leaves the cannery early in the morning, usually before 6 o'clock, and proceeds to some locality where the captain thinks he can make a good catch. Upon arrival at the grounds the engine is reduced to half speed, the trawl is hoisted from its place on the deck, swung around over the stern, and dropped. When it reaches the bottom the brake on the hoist is set, and the boat, retarded by the dragging trawl, travels slowly ahead at speeds ranging from $\frac{1}{2}$ mile to $1\frac{1}{2}$ miles an hour, depending upon the depth of the water and the character of the bottom.

On grounds with which the fishermen are familiar, regular courses are followed so as to avoid reefs and ledges where the trawls have been fouled at some previous time. Hauls of various lengths are made, depending upon the area of the shrimp bed and the amount of débris collected. If no difficulty is encountered, such as fouling the trawl or having it fill with mud or rocks, as it frequently does, the boat may continue on one haul for an hour or more. When the captain thinks the trawl is sufficiently full the boat is stopped and the net hoisted to the surface of the water. If the haul has been made on soft bottom, the trawler goes ahead again at full speed, dragging the bag through the water until it is thoroughly washed. The clutch is then thrown out, and as the boat loses headway the men

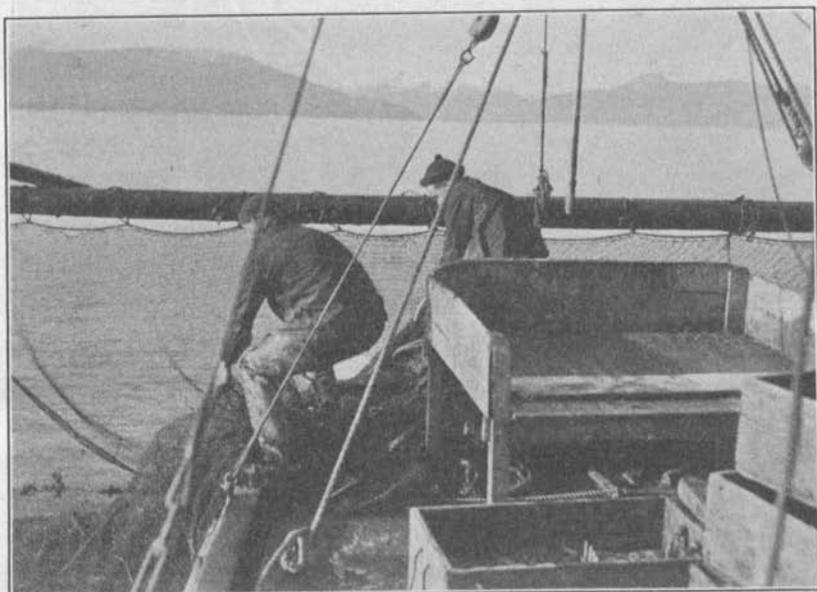


FIG. 3.—Getting ready to brail the catch from the bag

haul in the slack of the bag until the contents are all in one small section of the web.

Then, with the aid of the power brailer (a dip net worked by one of the winch pulleys), the catch is transferred to the cleaning table and all undesirable material, such as sticks, rocks, seaweeds, shells, and unmarketable fish, is thrown overboard. As the shrimp are cleaned they are raked by hand from the table into heavy wooden boxes, each of which holds about 200 pounds of shrimp. No effort is made to segregate the various species. If there are any salable crabs in the catch, they are taken to the cannery along with the shrimp and sold to the crab canners or fish dealers. As soon as the last of the catch is brailed from the trawl, it is dropped again and a new haul begun. After each haul the decks are thoroughly washed, and water is poured through the boxes of shrimp to wash out any mud or other foreign substance that may be clinging to the shells.

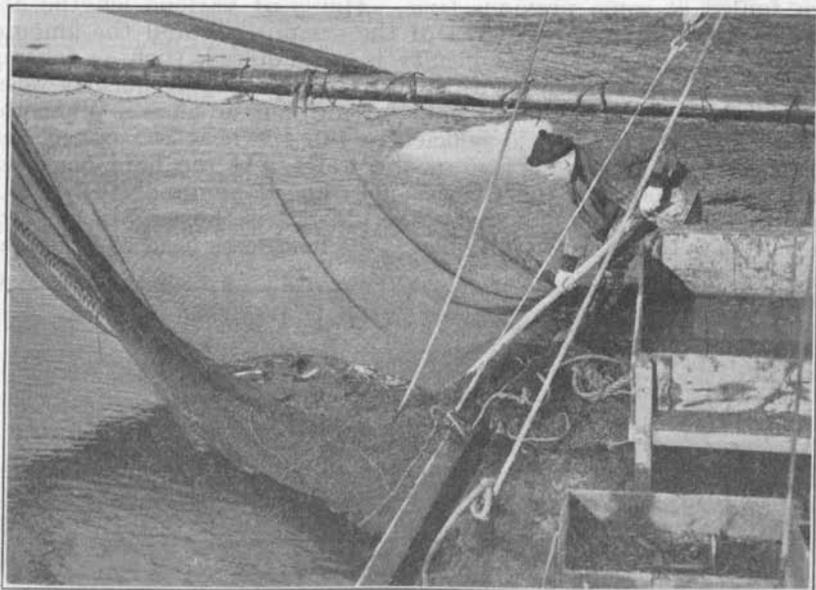


FIG. 4.—Method of handling the brail

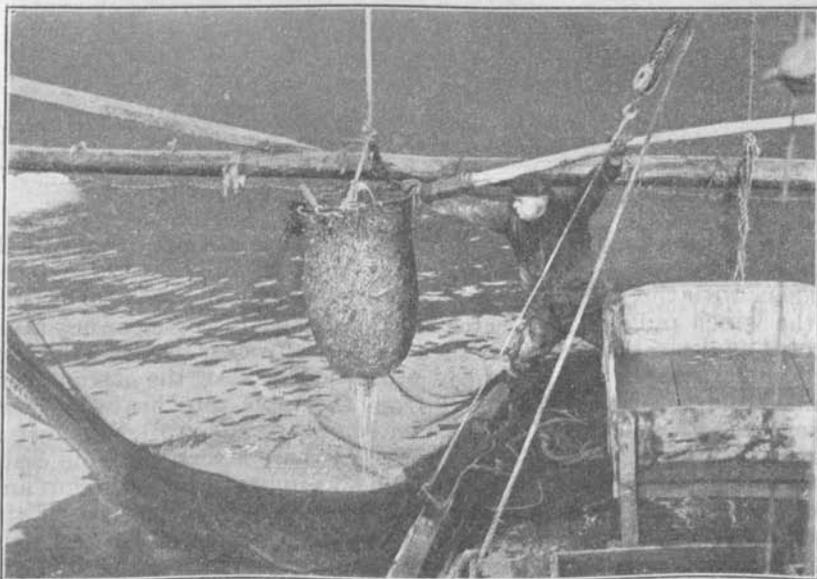


FIG. 5.—Brailing the shrimp from the trawl

Ten 200-pound boxes constitute a good day's catch for a boat, though sometimes that amount may be taken in one drag of the trawl. On the other hand, many hauls may be made on grounds that have yielded large quantities of shrimp a day or two earlier and catch virtually nothing. It is more or less a matter of luck, as in any kind of fishing, some of the boats making good catches consistently while others on the same grounds are making mediocre hauls.



FIG. 6.—Cleaning the shrimp; removing sticks, rocks, etc.

As a rule, the crew of a trawler consists of two men, the captain and a cook, who is also general assistant. They take turns at steering, looking after the engine, and handling the brailer. The work is arduous and the hours long, but the pay is good and the food provided by the canneries is the best. At times, when market conditions are good and no catch limit is set by the canneries, the fishermen receive a bonus of \$1 a box for all over 10 in the day's catch. This is divided equally between them and sometimes amounts to \$20 or \$25 a month for each.

In connection with trawling, it has been frequently asserted by persons engaged in the other ground fisheries that the trawls destroy large quantities of young food fish. The observations of the writer, however, have been that very few fish other than flounders, tomcod, and sculpins are ever taken in the trawls, and in most cases these are returned to the water uninjured except when sold as fox food or crab bait. Virtually none of the more alert ground fishes are caught, as the trawl moves along the bottom so slowly they have ample time to escape.

PLANTS AND PROCESSES

At present there are three shore plants and one floating cannery in southeast Alaska that have been built and equipped for the packing of shrimp meat. Two of the former (the Wrangell Shell Fish Co. and the Reliance Shrimp Co.) are located on the McCormack dock at Wrangell; one shore plant (the Alaskan Glacier Sea Food Co.,

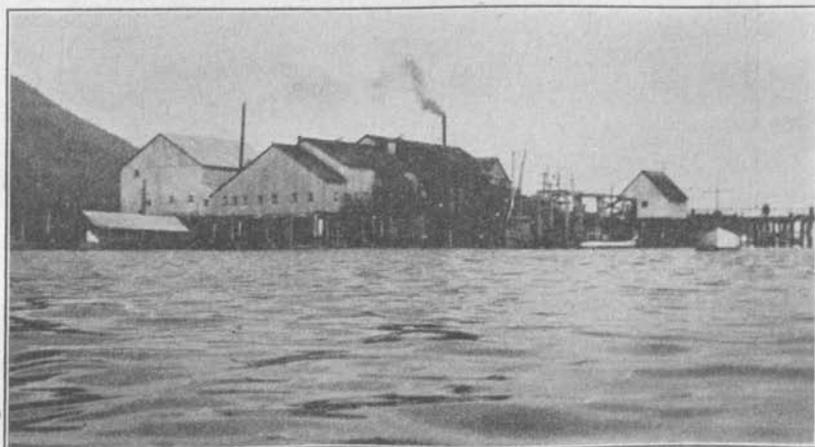


FIG. 7.—Shrimp cannery, Petersburg, Alaska

which is the largest of those now in operation) occupies a part of the steamship dock at Petersburg. The floating cannery, which is also owned by the Alaskan Glacier Sea Food Co., has been tied up at Petersburg for the past three years, during which time it has seldom been operated. The shore plants are all frame buildings, inexpensively constructed of rough lumber, the dock planking serving as floors and the roofs being of tar paper. The floating plant is a large scow with canning machinery below and living quarters above. It is a complete unit and can be towed to any outlying district and commence packing without delay. The larger plants are divided into five sections—a platform where the trawlers unload, a large room where the meat is cooked, weighed, and packed, and a picking room, cold room, and office. Very little machinery is needed in packing the product by the process now in use, the only requirements being a boiler with a few short steam lines, a retort, seamer, fanning machine, and scales. The arrangement of this machinery is optional, as each step in the process requires hand labor.

When the shrimp are unloaded from the boats they are immediately immersed in open wooden tanks of fresh water kept at the boiling point by injections of live steam, where they are cooked for 4 or 5 minutes, or until air spaces develop inside the shells and the shrimp



FIG. 8.—Weighing and packing the shrimp meat

rise to the surface. After this cooking (which greatly facilitates picking, as it frees the meat from the shell), the shrimp are dipped from the tanks into small wooden trays with wire-screen bottoms, which are set in racks until the shrimp are dry and cool (usually overnight), after which they go to the picking room.

The picking room is usually the best in the plant—well lighted and warm, to insure the comfort of the pickers. The equipment consists of rows of wooden tables divided into sections, with a stool, upon which the picker sits, before each section. Every picker brings his own supply of shrimp from the drying racks to the tables. In picking the shrimp, the cephalothorax, or "head," is first broken or twisted off, the picker's finger thrust between the swimmerets and a piece of the shell torn off; a slight squeeze on the end of the abdomen, or "tail," is then sufficient to force the meat from the shell, and it is dropped into a container. At present, no commercial use is made of the shells, and unless they are taken by the townspeople to be used as fertilizer they are thrown into the water through a hole in the cannery floor. Most of the pickers are Alaska native women or orientals, though occasionally white men and women are seen at the tables. They receive 10 cents a pound for picking, and an average worker will earn about \$3 a day.

When the meat leaves the picking room it is thoroughly washed in clean water and placed in a saturated brine solution for 3 minutes, after which it goes to the retort and is cooked for 3 minutes at a temperature of 320° F. After leaving the retort it is again put into the trays and left until the next day to dry, when it is put through the fanning machine and all bits of shell and antennæ (the "feelers") are blown out. The meat is then hand packed in 5-pound tin cans lined with parchment paper, which are single-seamed and packed in crushed ice for shipment. The product is known as "fresh shrimp" and is as good in every way as the freshly cooked article, even after months in storage. It is an excellent food substance, rich in protein, and every effort is made by the packers to see that it reaches the consumer in a clean, wholesome condition.

Marketing is done through brokers in Seattle, and most of the meat goes to the hotel and restaurant trade in cities west of the Rocky Mountains, though at present an effort is being made to introduce it in middle western and Atlantic coast cities in competition with the Atlantic and Gulf States product from the south. The packers receive about 40 cents a pound, on an average, and this price, if it were not for the limited demand, would enable them to make a very fair profit. However, the retail price is necessarily so high that the product is classed as a luxury and is beyond the buying power of most families, which no doubt accounts for the frequent periods of depression and slow expansion of the industry as compared with the other Alaska fisheries.

FISHING GROUNDS

Since the beginning of the shrimp-packing industry in southeast Alaska it has been centered at Petersburg and Wrangell, and, with the exception of a short period during the summer of 1925, when the floating plant of the Alaskan Glacier Sea Food Co. operated in the Haines district, all the shrimp exported from the Territory have been taken from the waters adjacent to these towns. During the first two years of the fishery, when only one small plant was in operation, the grounds in the immediate vicinity of Thomas Bay produced all the shrimp needed, but with the beginning of expansion in 1918 and

consequent increase in the number of trawlers it became necessary to find new grounds.

The boats began prospecting in hitherto untried sections of Frederick Sound and neighboring waters with the result that many very

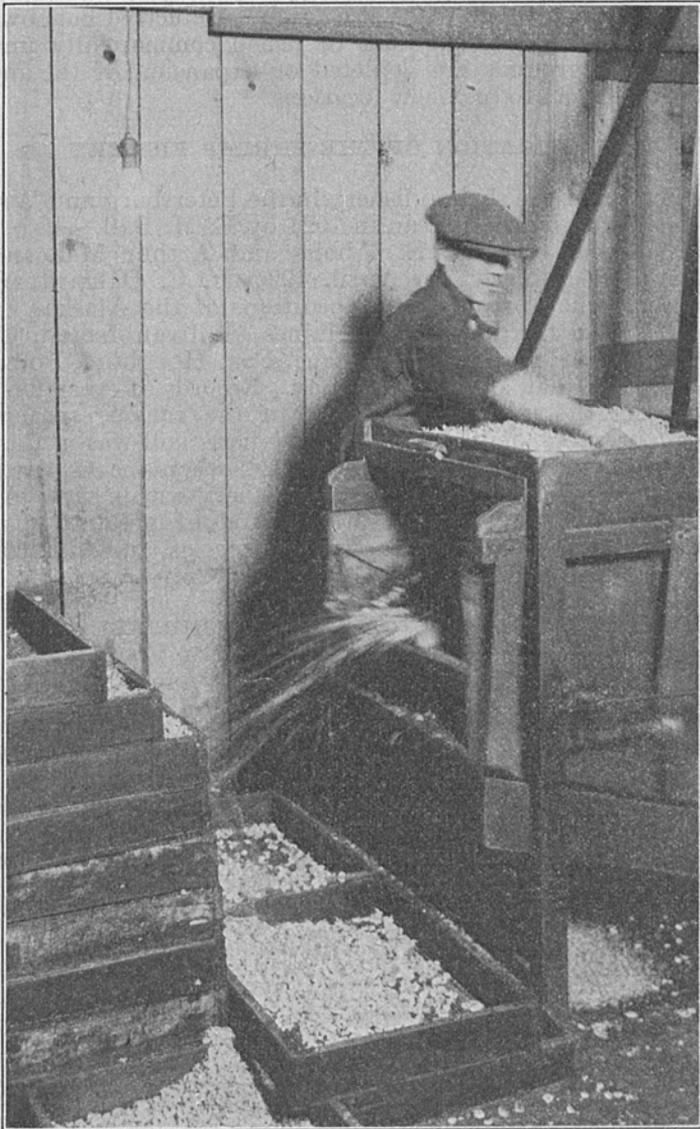


FIG. 9.—Running the meat through the fanning machine to remove pieces of shell and antennæ

productive areas were found; good catches were made in Farragut Bay, along the mainland shore from Wood Point to the Stikine Flats, and on the northeast side of Mitkof Island from Ideal Cove to the north end of Wrangell Narrows. Subsequently, excellent shrimp

grounds were found in Duncan Canal, Sumner Strait, and the Eastern Passage. These grounds are all within a radius of about 25 miles from the packing centers and constitute the areas from which the entire catch is taken at present. Other sections, notably Keku Strait, Lynn Canal, El Capitan Passage, and Seymour Canal, all of which were prospected in 1925, are fairly productive but, owing to their isolation, will probably not be fished commercially until the more accessible grounds are depleted or expansion of the industry forces the operators to seek new locations.

INVESTIGATION OF THE SHRIMP FISHERY

Investigation of the shrimp fishery in the Petersburg and Wrangell region was begun by the bureau in 1924 by E. M. Ball. Also, in the fall of that year, Charles E. Tibbits and Arthur McLean made inquiries on the subject. In April, 1925, P. C. Dalgard and the writer accompanied prospecting expeditions of the Alaskan Glacier Sea Food Co. in the vicinity of Haines, Sullivan Island, Chilkat Inlet, Keku Strait, El Capitan Passage, Port Houghton, Port Beauclerc, Seymour Canal, and Gambier Bay. Records of every haul were kept, showing the relative abundance of the various species, percentage of spawners, depth, and vicinity where haul was made. Further investigation was deferred until 1926, when the writer undertook a more comprehensive study of the fishery with a view to determining as definitely as possible the season of greatest spawning activity, relative abundance of the various species, and whether there was evidence of overfishing.

NATURAL HISTORY OF THE SHRIMP

SPECIES

A number of species of shrimp are found in Alaskan waters, 13 having been identified during this investigation, which covered only a comparatively small area. All of these species and many more from other sections of Alaska are described by M. J. Rathbun in volume 10 of the report of the Harriman Alaska Expedition. The work of identifying these species, which are listed below, was done by Dr. Waldo Schmitt, curator of marine invertebrates at the National Museum, Washington, D. C.

- Pandalus borealis* Krøyer.
- P. hypsinotus* Brandt.
- P. platyceros* Brandt.
- P. gonivurus* Stimpson.
- P. gurneyi* (Stimpson).
- Pandalopsis dispar* Rathbun.
- Spirontocaris grænlandicus* (Fabricius).
- S. suckleyi* (Stimpson).
- S. polaris* (Sabine).
- Crago communis* (Rathbun).
- C. franciscorum angustimana* (Rathbun).
- C. franciscorum* (Stimpson).
- Nectocrangon dentata* Rathbun.

No study of the life history of any of the Alaska shrimps has been made, nor is there any satisfactory knowledge of any of the European or other more familiar species on which such work might be based. That such a study will be difficult is indicated by the work of G. O. Sars, who found in *Pandalus borealis* no less than eight larval stages. Accordingly, all possible data bearing on the economically more valuable species, *Pandalus borealis* ("pink") and *Pandalopsis dispar* ("side stripe"), have been preserved. Although these data indicate something of the habits, the approximate duration of the spawning season, and other important questions, and will form the basis of future studies on life history, they are as yet too fragmentary to be presented.

DISTRIBUTION

These species are found on all of the Alaskan grounds where trawling is carried on, some of them being very abundant while others are exceedingly rare. That they are by no means confined to these waters, however, is proved by the *Albatross* investigations, in the report of which Rathbun gives their distribution as follows:

Pandalus borealis.—Circumpolar. Bering Sea and North Pacific, southward on American coast to the Columbia River, 29½ to 350 fathoms. On the Atlantic coast of North America from Greenland to Massachusetts Bay, 40 to 160 fathoms. Scandinavia.

Pandalus hypsinotus.—Bering Sea to Strait of Juan de Fuca and Kurile Islands, 3 to 20 fathoms. Unalaska (Brandt).

Pandalus platyceros.—From Unalaska (Brandt) to off San Diego, Calif.; Strait of Juan de Fuca, Wash. (Dana). The specimens from north of the Strait of Juan de Fuca were found in shallow water, while in the strait and along the coast of California the species occurred in considerable depths—from 48 to 266 fathoms.

Pandalus goniurus.—Closely allied to *borealis*; ranges from the Arctic coast of Alaska southward to Okhotsk Sea on the one side and Puget Sound on the other in 3 to 100 fathoms. Its occurrence below 50 fathoms is exceptional, however.

Pandalus gurneyi.—Southern California, 9 to 55 fathoms (rare). Taken at Monterey Bay, 9 fathoms; off Santa Barbara, 21 fathoms; off Santa Cruz Island, 30 fathoms; off Santa Rosa Island, 52 fathoms.

Pandalopsis dispar.—From Bering Sea to Washington, 53 to 351 fathoms.

Spirontocaris grænlandicus.—Arctic coast of America; Bering Sea to Puget Sound; Kamchatka; Okhotsk Sea. Atlantic coast of North America from Greenland to Narragansett Bay; Rhode Island; from 1 to 72 fathoms.

Spirontocaris suckleyi.—From Arctic coast of Alaska southward to Washington, 6 to 156 fathoms.

Spirontocaris polaris.—Circumpolar. Atlantic coast of North America southward to Cape Cod, 10 to 218 fathoms. Northern Europe; Bering Sea; Aleutian Islands eastward to Kodiak to a depth of 283 fathoms.

Crangon communis.—From Bering Sea to San Diego, Calif., including Puget Sound and Strait of Juan de Fuca, 20 to 309 fathoms; more abundant in the northern localities than in the southern.

Crangon franciscorum.—From Tomales Bay, Calif., to Sitka, Alaska.

Crangon franciscorum angustimana.—From Bering Sea southward to Sitka and southeast coast of Kamchatka, 96 fathoms; Aleutian Islands and Siberia.

Nectocrangon dentata.—From Bering Sea southward to Sitka and southeast coast of Kamchatka, 96 fathoms; Aleutian Islands and Siberia.

RELATIVE ABUNDANCE OF SPECIES

From a commercial standpoint only five species of the Alaska shrimp are of importance. These are *Pandalus borealis*, *Pandalopsis dispar*, *Pandalus goniurus*, *Crangon franciscorum angustimana*, and *Pandalus platyceros*. Twelve samples were taken during the months of July and August, 1926, and twice a month from May to November, 1927, to determine the relative abundance of these species. During both periods, *Pandalus borealis* was found to be the most abundant, 60 per cent of the catch being of this species. *Pandalopsis dispar* ranked next, making up 22 per cent of the take, and the others were as follows: *Pandalus goniurus*, 8 per cent; *Crangon franciscorum angustimana*, 6 per cent; and *Pandalus platyceros*, 4 per cent. The other eight species listed were found in such small numbers as to compose no more than a fraction of 1 per cent of the catch. In sampling the catch the following method was employed: A few specimens were taken from various portions of each box of shrimp in the day's take, without regard to species or size, until 10 pounds was secured. The various species composing the sample were then counted and weighed separately and the resulting amounts compared with the weight of the entire sample to ascertain the percentage of each species in the catch.

SIZE AND NUMBER OF EGGS

Measurements were made of a number of specimens of each species, their eggs were counted, and notes were kept regarding the development of the spawn, while analyzing the samples and at other times as opportunity offered. Size-frequency records of *Pandalus borealis* and *Pandalopsis dispar* were compiled during 1927, 300 specimens of each being measured twice a month from May to November.

All specimens were measured, to the nearest millimeter, from the outer edge of the last joint of the abdomen to the eye stalk, the long, slender spine projecting forward from the head, and the antennæ not being included for the reason that these vary in length, even in individuals that are otherwise of about the same size. The eggs were counted by separating them from the body of the shrimp and placing them in a warm oven for a few minutes to harden, after which they were rolled on a flat surface until separated from each other. The mass of eggs was then crowded together, one deep, squared and measured. It was then divided into equal sections; the eggs in one or two sections were counted individually, after which it was only necessary to multiply the number of eggs in one section by the number of sec-

tions to get a close estimate of the number of eggs carried by the specimen under examination.

The following table gives a preliminary determination of the average length of each of the 13 species identified, number of specimens measured, egg count, and number of specimens from which eggs were counted.

Size and egg production of commercial species of shrimp in Alaska

Species	Number measured	Average length, centimeters	Number of eggs	Number of specimens counted
<i>Pandalus borealis</i>	4,500	7.5	2,150	25
<i>Pandalopsis dispar</i>	4,500	9.1	4,150	25
<i>Pandalus goniurus</i>	50	7.0	2,000	5
<i>Crangon franciscorum angustimana</i>	50	7.6	2,100	5
<i>Pandalus platyceros</i>	50	10.5	3,900	5
<i>Pandalus hypsinotus</i>	50	8.9	4,000	5
<i>Pandalus gurneyi</i>	50	6.2	1,900	5
<i>Spirontocaris suokleyi</i>	50	5.7	1,450	5
<i>Spirontocaris groenlandicus</i>	50	5.1	1,300	5
<i>Spirontocaris polaris</i>	4	5.3		
<i>Crangon communis</i>	50	6.3	1,600	5
<i>Crangon franciscorum</i>	50	5.9	1,200	5
<i>Nectocrangon dentata</i>	15	6.9	1,850	1

SEASONAL VARIATIONS IN ABUNDANCE

As far as the available evidence shows, there is little, if any, seasonal variation in the abundance of the commercially important species, the catches being as large at one season of the year as at another, weather conditions being equal. The shrimp do, however, move from one portion of the grounds to another very rapidly, as is proved by the fact that a trawler may catch nothing to-day on grounds that yesterday produced record hauls; the reverse is also true. These movements are not seasonal in character, as they do not occur in regular cycles, but possibly are occasioned by the exhaustion of the food supply in one area and its abundance in another, usually not far removed.

CONSERVATION PROBLEMS

The question of depletion has been raised from time to time during the past three years, generally by persons not engaged in the shrimp fishery and prompted more by a desire to prevent depletion before it actually becomes imminent than because of any indication that the shrimp are less numerous now than formerly. Unfortunately, no records are available showing the catch per boat since the beginning of the industry, areas from which the catch was taken, or periods during which the boats were operated on a limit basis. Without these data it is not possible to show, in statistical form, whether greater catches were made per unit of gear during the earlier days of the fishery than are being made at present over the same grounds. However, fishermen and packers alike are unanimous in the belief that shrimp are as numerous now as they have ever been, claiming that the trawlers have no more difficulty to-day than they had in the beginning in securing a load on grounds that have been fished for 10 years.

REGULATION OF FISHERY

Under the existing regulations commercial shrimp fishing is prohibited in Alaskan waters between March 15 and April 30 each year. This period has been proven to be the season of greatest spawning activity for the important species on all grounds where trawling is carried on at present. As this regulation has only been in effect for three years and was promulgated as a precautionary measure, its effectiveness can not be measured as yet.



National Oceanic and Atmospheric Administration

Report of the United States Commissioner of Fisheries

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