

The New Shrimp Industry of Washington*

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A RECENT EDITORIAL in the Bellingham, Washington *Herald* (Anon., 1957) stated:

"Shrimp fishing has become an important Washington industry. Possibly few Washingtonians realize this state has passed California and now is the No. 1 shrimp state of the Pacific Coast. Two years ago, a United States Fish and Wildlife Service exploratory ship located huge quantities of shrimp on a shelf off Grays Harbor . . .

"The Washington coast shelf is estimated to be 100 miles long and 15 miles wide. The tasty pink shrimp is there by the billions. Introduction this year of a mechanical shrimp peeler is credited with making Washington's shrimp commercially practicable. Now the industry is rated in the multimillion dollar class."

This, in an extremely condensed version, is the story of the Washington shrimp industry. An industry which produced but a few hundred pounds in 1955, a few thousand pounds in 1956, an estimated two to two-and-one-half million pounds in 1957, and which has an estimated sustained annual production potential of approximately twenty million pounds.

Historically, the pink shrimp (*Pandalus jordani*), which compose the bulk of the shrimp landed in Washington, have been known to be abundant off the Columbia River and off the Grays Harbor area since 1904 (Rathbun, 1904). However, the difficulties of profitably catching and processing large quantities of the small or "cocktail size" shrimp, which average 120 to 140 count heads-on per pound, prevented exploitation of the fishery. A local, relatively inconsequential industry developed in Washington utilizing the incidental catches of the otter trawlers and the production of a few pot fishermen. The shrimp, in general, were handled similarly to the Alaskan operations which have been existent since 1915 (Wigutoff, 1953). The whole shrimp, immediately upon receipt, were cooked in boiling fresh water, cooled, picked by hand, salted either by cooking for a few minutes in a 25°-30° Salinometer brine or by dipping in a saturated salt solution for a few minutes followed by cooking in steam. The shrimp were cooled again, blown by mechanical means to remove fragments of shell and antennae, and then packed in metal containers. These were shipped under ice to fresh markets or else were frozen and distributed as a frozen product.

The birth of what has been termed "the new shrimp industry of Washington" dates to the two exploratory trips by the United States Fish and Wildlife Service vessel, M/V JOHN M. COBB, in the fall of 1955 and the spring of 1956, and to the installation in November, 1956, of a single mechanical peeler in a cannery located at Westport, Washington.

The explorations, which were carried out in cooperation with the State of Washington Department of Fisheries, demonstrated that the shrimp were abundant along the coast of Washington (Schaefers and Johnson, 1957; Tegelberg and Smith, 1957). Catches of shrimp were recorded as great as 2,200 pounds per hour drag. The most productive bottom was found to be green mud or green mud and sand, and the better catches were obtained at depths of 60-85 fathoms. Perhaps the greatest significance of the exploratory trips was the dem-

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onstration of the suitability and, in fact, superiority of the 40-foot flat Gulf shrimp trawl for catching of the pandalid shrimp.

Examination of the hauls, which in many cases were composed solely of shrimp, indicated that the protandrous pandalids begin life as males and change to females between the second and third year. The females may become egg bearing as early as the second year but, in general, do not become sexually mature until the third year. The egg bearing period of the year was found to be from late fall to early spring. Three separate year classes were reported to be present in the fall and four separate year classes in the spring.

Preliminary experiments concerning the keeping quality of the shrimp were made during the exploratory trips. The results of these experiments indicated that the shrimp could be held in ice for periods up to 96 hours with but slight changes in the texture of the shrimp meat either before or after cooking, or in the flavor and color of the cooked meat. However, after 48 hours on ice, the pink color of the whole shrimp was found to have faded to a paler shade. It was noted that the shrimp were easier to peel after a day on ice than when first landed.

Shortly after the results of the exploratory trips became known, an operation began in Westport, canning the shrimp rather than freezing them as had been done in the past. During the summer of 1956 production was limited because the shrimp were hand picked. The product found a ready market and demand for production increased. The installation of the first peeling machine (The Peelers Company, New Orleans, Louisiana) on the Pacific Coast north of Mexico which was capable of handling approximately 1,000 pounds per hour was the start of large-scale production ("Petrale," 1956).

The fishery in Washington is carried out by 40 to 70 foot boats with capacities up to 80,000 to 90,000 pounds. The Gulf Coast trawl with a 1.5 inch mesh is used extensively in Washington, which is the only state at present permitting the use of this type of gear. Generally, the crew consists of three or four men, including the skipper. It has not been uncommon for a boat to land 25,000 pounds of shrimp in a three day trip. The ex-vessel price, at present, in Washington is 7½ cents per pound of heads-on shrimp. Since the product retails locally at 39 cents per seven ounce can (4.5 ounces of shrimp meat), there is a satisfactory profit for all concerned.

Aboard ship, the shrimp are not headed but are given a preliminary washing and sorting on deck and then packed in shallow layers in ice in the hold. The present United States Fish and Wildlife Service recommendations, which are based on additional work beyond that of the exploratory trips, are that the shrimp be held no longer than five days and preferably for a maximum of three days in iced storage. Only slight differences in quality have been found to occur during the first three days of iced storage, but softening and discoloration become a problem during the fourth and fifth days. It is important, however, that the shrimp be iced at least overnight to obtain the best results from the peeling machine.

At the canneries the shrimp are stacked in shallow layers with ice. The first step in processing is the mechanical separation of the shrimp from the ice, which is accomplished by the first operation of the peeling machine. The shrimp are next peeled. The yield is approximately 20 per cent of the heads-on weight when peeling is done by the mechanical peeler and 25 per cent when done by hand.

There are two problems involved in the mechanical peeling operation. The

first is the excessive breakage which is due to the abrasive action of the machine and the extreme tenderness of the shrimp. The second is the loss of color of the shrimp, which is also due to the abrasive action and to the excessive use of water.

The raw shrimp are given a minimal cook which serves the purposes of merely coagulating the protein or, in other words, firming the shrimp. The recommended processes are either a two minute continuous exposure to steam at atmospheric pressure, or a 1.5 to two minute immersion in water at 212°F. The shrimp are next rapidly air cooled, either by exposure to still air in shallow pans, or in moving air. Following this operation, the shrimp pass through a fanning or blowing machine where fragments of shell and antennae are removed. The shrimp are then placed in wire baskets and dipped for 15 seconds in cold 50° Salinometer brine.

Many requests have been received by the packers for intensification of the color of shrimp which, as a result of the peeling machine action, are generally a very light pink. As a result, some canneries are adding food coloring to the shrimp. The United States Fish and Wildlife Service recommendations are at present, that if food color is to be added, it should be added either to the brine in which the shrimp are dipped, or that the shrimp be dipped for 10 to 20 seconds in a separate, cold color solution. The Service recommends a 1:10,000 concentration (one ounce of dry food coloring to 75 gallons of water) of the Imperial Orange shade (Crescent Manufacturing Company, Seattle) which is a blend of FD&C Yellow No. 5 (Tartrazine), FD&C Red No. 1 (Panceau 3 R), and FD&C Red No. 2 (Amaranth).

The shrimp are then drained and packed in 201x113 "C" enamel cans. The final steps in the processing are vacuum sealing and retorting, in accordance with National Canners Association recommendations (Anon., 1950) for 24 minutes at 240°F. followed by water cooling.

The "infill" of the cans is 4½ ounces of shrimp meat, 10 to 12 milliliters of 2½ per cent citric acid solution, and 2½ ounces of 10 to 15° Salinometer brine. The drained weight of the shrimp following processing should be 4.5 ounces and, while shrinkage is not a problem, the "cutout" weight should be checked since slight variations in texture and quality of the shrimp, and in the cooking and processing procedures of the individual canneries, will affect the shrinkage. Similarly, the salt content of the finished product should be checked, for personal tastes will differ and slight variations in the processes will affect the salt content. However, it is doubtful that a salt content greater than two per cent of the drained weight would be desired by the consumers.

The use of citric acid was originally suggested by Mr. L. G. Germain of the American Can Company, Seattle. The purpose of the citric acid is to lower the pH of the final product to approximately 7.0. It has been found that if the pH of the processed shrimp is greater than 7.1, there is a tendency for the shrimp to discolor, becoming grey, and to develop an off or undesirable odor which is reminiscent of the start of sulfide spoilage. Of course, if the shrimp are of poor quality at the start of processing, the citric acid will not control the sulfide breakdown nor the loss of color in the canned product.

The present United States Fish and Wildlife Service recommendations are that the pH of the final product be between 6.85 and 6.90. A fairly representative sampling of commercial packs available on the market indicate that the pH of the final products range from 6.9 to 7.1.

The two major technological problems which remain to be solved concern the shrimp texture, which is somewhat mealy, and the relatively short time it is possible to hold the shrimp in ice prior to processing. It is possible that an additive or an improvement in process could make the shrimp somewhat firmer. It is also possible that refrigerated brine holding of the shrimp could extend the storage life following capture. Work is being carried out along these lines by the Seattle Technological Laboratory of the United States Fish and Wildlife Service.

Even though the canning operations appear to have taken over the shrimp industry in Washington, fairly large quantities of the shrimp are still sold as a frozen product. Locally, the process is almost identical with that of canning. The problems of frozen storage and maintenance of quality have been discussed by Carlson and Dassow (1956), who concluded that the product could be maintained in excellent condition for a least nine months.

The pink shrimp industry, which at present is the most important shrimp fishery, is not, however, the only shrimp fishery of the state. Other species of shrimp found in local waters include the "side-stripe" (*Pandalopsis dispar*), the "hump-back" (*Pandalus hypsinotus*), the "prawn" or "spot" (*Pandalus platyceros*), the "coon-stripe" (*Pandalus danae*), and the other "pink" (*Pandalus borealis*) (Butler, 1950). In Washington, a small but growing industry (30,000 to 50,000 pounds per year) has developed, utilizing the "prawn" or "spot" from the waters of Hood Canal and the port waters of the city of Seattle (Elliott Bay). These shrimp generally range from 3 to 20 count of heads-on shrimp per pound, and the present ex-vessel price is 35 cents per pound. The shrimp, which are found on rocky bottoms and are captured by pots, are landed alive, boiled without heading or peeling, and sold in this condition as a fresh refrigerated product for the hotel and restaurant trade.

The other species of shrimp which were mentioned above, as well as the pink shrimp (*Pandalus jordani*), are distributed in greater or lesser quantities all along the Pacific Coast of North America. Local industries have developed wherever one or more of these species are captured in quantity. These fisheries have not expanded beyond local requirements because of the high labor cost of preparing the shrimp meat by hand methods. The major exploited areas for Pacific shrimp have been Bodega Bay, Eureka, and Crescent City in California, Coos Bay in Oregon, Grays Harbor and Willapa Bay in Washington, the inland waterways of British Columbia, and Petersburg and Wrangell in Alaska. The majority of the catch has either been frozen or sold on the fresh market. Now with the success of the Washington industry, expansion and exploration is going on throughout the whole Pacific Coast. New beds have been reported in British Columbia, supposedly equaling those found off Washington (Anon., 1954). Fantastic catches have been reported off the Alaskan Coast. The United States Fish and Wildlife Service exploratory vessel M/V TORDENSKJOLD, reported catches as high as 3,800 pounds per half hour tow with a 40-foot Gulf shrimp trawl in areas around the Shumagin Islands ("Petrale," 1957), and our own vessel, the M/V COMMANDO, landed 1,300 pounds of shrimp in a 20 minute drag with an otter trawl off Yakutat this past summer. In both cases, the catch was almost entirely shrimp. A conservative estimate of the potential of the Pacific shrimp fishery would be 100,000,000 pounds per year, most of which would be the pink or "cocktail type" shrimp.

At present California is the only state which has weight restrictions on the catch with an annual quota of one-and-one-half million pounds. Both Oregon

and California restrict the gear to a 20-foot beam trawl; in Alaska, the beam trawl is used extensively because of the type of bottom. The demonstrated success of the Gulf type shrimp trawl may change this situation. The Pacific Marine Fisheries Commission has under consideration minimum mesh regulations as a means of conservation, but sufficient information as to the occurrence and biology of the various species of shrimp is lacking for rational regulation of the fishery. At present, no regulations are under consideration either in Washington, Oregon, or Alaska. In the future, the situation may change and an area quota system or seasonal restrictions in addition to mesh regulations may be imposed on the fisheries.

At present there are six canneries in operation in the states of Washington and Oregon, four with two peelers, and two with one peeler each. The canneries in Washington are located in Aberdeen, Hoquiam, and Westport. In Oregon, two canneries are located in Warrenton, and one in Astoria. A third plant is planned for Warrenton, and an operation in Coos Bay is imminent. A cannery with a peeling machine is already in operation in Wrangell, Alaska, and an operation is planned for Petersburg.

The products are presently being marketed only west of the Rocky Mountains, and even with greatly increased production, the market shows no signs of weakening. Supposedly, the advantages of the use of artificial color decreases with the time of shelf storage. However, to date the turnover of the products has been so rapid there has been no test as to the true shelf life of the product.

With production potential excellent and a market which appears to be unlimited in that the majority of the United States has yet to be tried, the future of the Pacific shrimp industry is exceedingly bright. Whether or not Washington retains its position as the leading producer of Pacific shrimp is of relatively little importance. Of course, this would be desirable from the point of view of state pride, but of most importance is that the Pacific shrimp industry has been established and is expanding in Washington. As such, it has contributed a new source of income to our fishermen, our processors, our distributors and, therefore, to the material welfare of our state.

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Research on the Biology of the Tortugas Shrimp

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ABSTRACT

This is an interim report describing the program of biological research and some of the preliminary findings on the Tortugas shrimp fishery. Analysis of historical records of dealers selling only large shrimp brings to light the possibility that the trend in the average catch per boat per night for each year has not changed greatly since the fishery began. Also, the distribution of sizes landed by dealers has not undergone a regular change over this same time. A rather clear cut size-depth relationship existed early in 1957, i.e., the majority of small shrimp are found in shallow water and the majority of large in deep water. There is evidence to suggest that the fishery at times markedly reduces the number of various sizes of shrimp available. A program of tagging, using Petersen tags, to study growth and migration is described.
