

Research on the Shrimp Fishery of Panama

JUAN OBARRIO

Director de Pesca, República de Panamá

Introduction

FOR A SMALL COUNTRY LIKE PANAMA, whose population only recently reached one million inhabitants, its shrimp fishery is of great economic significance. It constitutes about one-third of our exports, next only to bananas. During last year our shrimp exports were 8,250,000 pounds with a value of \$6,127,000. An additional catch of about 600,000 pounds is sold locally. The industry is a source of employment for about 1,500 permanent workers and an additional 700 temporary workers. Ice suppliers, boat builders, parts suppliers, etc., derive benefits from this industry. The capital invested in boats, equipment, and plants is about \$10,000,000.

Shrimp Resources

The shrimp fishery of Panama is based primarily on the following three species of white shrimp: *Penaeus occidentalis*, *Penaeus stylirostris* and *Penaeus vannamei*; of these, the first accounts for more than 75 per cent of the catch of these species, which total about 50 per cent of the total shrimp catch.

The pink grooved shrimp, *Penaeus brevirostris*, appears during the dry season (January-April) when the upwellings occur in the ocean. During these periods, which may last from a few days to two months, the pink shrimp is caught in great quantities as it concentrates near the coast. The total catch of this species fluctuates widely from year to year, and is apparently related to the appearance of cold water brought to the coast by the upwelling.

The sea bob, *Xiphopenaeus riveti*, although it receives a small price, is of importance as it forms a fair portion of the catch. There are other species that appear in the catch, like *Trachypenaeus byrdi*, *Trachypenaeus faoe*, and *Penaeus californiensis*, but because of the small quantities caught are of little importance.

At present, jumbo white shrimp brings the highest price, 94 cents per pound to the fisherman for under 10 count (i.e. fewer than 10 shrimp, heads off, to the pound). The price paid for the pinks last season was 75 cents per pound for the larger sizes, and the sea bob brings about one-third the price of the white shrimp.

Fishing Grounds

The white shrimp is usually fished near the coast at depths ranging from four to twelve fathoms. The principal fishing grounds are located in the Gulf of Panama, which is cup-shaped. Panama City is located at the center of the bay, and the shrimp fleet operates from there.

Most of the catch occurs in the Panama-Darien area in the east part of the Gulf. In this area, *P. occidentalis* usually accounts for more than ninety per cent of the white shrimp catch; most of the sea bob catch is also made here. In the Anton-Chame area, on the west side of the Gulf, *P. occidentalis* forms a much lesser proportion of the catch of white shrimp since the proportion of *P. vannamei* and *P. stylirostris* increases in this area as compared to the former.

The Darien area has muddy shallow water while the Chame area is deeper and has a sandy and muddy bottom. A few boats fish in Chiriqui and Gubernadora, where the species composition is similar to the Chame area.

It seems that *P. stylirostris* and *P. vannamei* are caught slightly deeper than *P. occidentalis*. The small shrimp, *X. riveti*, is caught on shallow, muddy bottoms, in water of low salinity, near river mouths. At certain times during the dry season, *P. brevisrostris* is caught in depths less than thirty fathoms, even as shallow as fifteen fathoms.

Growth of the Fishery

The Panamanian shrimp fishery was started in 1950 when eight small trawlers began fishing; in 1952 there were fifty-three boats operating. During 1953, 1954 and 1955 the number of boats fishing were from eighty-two to eighty-nine. One of the reasons the boats did not increase during these years was because a law was passed prohibiting the importation of shrimp fishing boats. Before this, the boats fishing were used boats brought from the United States and Mexico.

During 1956 a shrimp boat construction industry was started which increased the number of boats to 122 in January of 1957, and to 200 this year. As a result of this fast expansion (from eighty-eight boats in early 1956 to 200 boats in 1958), the fishing intensity more than doubled. These were new, bigger boats, with more powerful motors and larger nets, whereas the earlier boats were smaller and older, with smaller nets and less powerful motors.

The increase in fishing intensity caused a decrease of nine per cent in the catch per unit of effort, of the white shrimp, in 1956. In the next year, when eighty boats were added to the fleet, the decrease in the catch per unit of effort was sixty per cent from the 1957 figure, and this year it has continued to drop.

The total catch of white shrimp, as compared to 1956, has been lower during this year and probably had a light drop in 1957. Statistical data will be completed shortly. During 1957, due to the highest catch of pink shrimp in the history of the fishery, the sharp decrease in the catch per unit of effort of the white shrimp was not felt until the end of that year. But in 1958 when the pink shrimp fishery failed, and the catch per unit of effort of the whites continued to drop, the industry has been in a critical situation. This year, the sea bob catch has been very good, but because of its low price, it has not prevented the present situation.

Some fifty boats have migrated to Brazil, Guatemala, Colombia, Honduras, Nicaragua and El Salvador. In 1957 with the high increase in the number of boats, a very low rainfall also occurred, and from January to April of 1958 a very poor upwelling took place. Since 1900 there were only three occasions where poor upwelling like this took place. The upwellings, which bring nutrients to the surface layers, are very important factors in the high productivity of the Gulf of Panama.

This year the rainfall is normal. If an average upwelling takes place, the pink shrimp catch should improve and the two factors would give clues as to the white shrimp situation.

WHITE SHRIMP

The white shrimp catch increases from May to August and then declines gradually to reach its lowest in December. During the dry season (January-

April), the white shrimp catch is low, and its abundance is dependent on the water temperatures associated with the upwelling in the gulf. In cold dry season years the white shrimp gets very scarce; there exists the possibility of a parallel to the coast and out of the gulf migration. During warm dry season years the white shrimp are more abundant.

There is evidence that the white shrimp spawns in the ocean floor in slightly deeper water than the commercial catches. *P. occidentalis* spawns throughout all the year, although there appears to be a peak from October to December.

P. occidentalis reaches the coast at an average size of 2.0 mm (carapace length), whereas *P. vannamei* and *P. stylirostris* arrive at an average size of 1.4 mm (carapace length). *P. occidentalis* spends its young stage at the edge of the tide in waters of high salinity (28 ‰ or more). In Panama there are very large tides ranging from 11½ to 18 feet.

P. vannamei and *P. stylirostris* enter with the tides and currents into interior brackish waters or river mouths, where they spend their juvenile phase. Those that enter the lagoons stay in the periphery of the lake, in the mangrove roots which furnish them with shade and protection. As they grow they move toward the center of the lake and after a fast growth return to the ocean. There they spend a short period in shallow water and then migrate to deeper water where they are available to the commercial catches. The young stages of *P. stylirostris* and *P. vannamei* occur mostly in salinities ranging from 5 to 15 per cent.

Growth rate experiments with *P. occidentalis* were carried on in the laboratory employing a method of Mr. Martin Burkenroad (Master, A., Graduation Thesis, Dinamica del Camaron Juvenil *P. occidentalis*). Live shrimp caught late in the afternoon were placed singly in gallon flasks containing water and mud from the same locality at which the shrimp were caught. It was assumed that the proportion of shrimp which molt during the first night after captivity represents the normal frequency of molting for those sizes at the place and time. The size of the carapace of the shrimp that molted was measured to compare it with the size of the molted carapace to get the per cent of linear growth. The molt frequency and the length increase at a given size gives the growth rate for this size.

Master calculated that it takes *P. occidentalis* about two months to grow from two to eleven mm (carapace length); then by applying the Waldorf Line and Equation, he estimated that a shrimp takes from nine to a maximum of fourteen months to reach a length of 45 mm, which is the average adult size for these species. At present, the laboratory is carrying on length frequency studies which will furnish a comparison to the above studies.

PINK SHRIMP

The pink shrimp *P. brevivrostris*, lives at depths greater than 30 fathoms, from April to November; where they seem to be so dispersed as to be unprofitable for commercial catches. During the dry season (January to April) the north wind blows often and with intensity, pushing the top water masses from the coast in the gulf offshore. This causes certain physical phenomena, studied by Fleming in 1940 and recently by the Inter-American Tropical Tuna Commission. The phenomena associated with the intensity of the winds are a drop in sea-level and water temperatures on the coast due to upwelled cold water, rich in nutrients which replaces the water masses blown offshore.

The average water temperatures from May to December are above 80°F.

They drop below this from January to April, reaching an average of about 74°F in March.

The pink shrimp migrates to depths less than thirty fathoms during this period. We have observed a relationship in the amount of the catches with the number of days of cold surface water below 76°F. When the surface temperature drops below this, the pink shrimp is found closer to shore and in big concentrations and catches as high as nine tons in three to four days have been reported. During the dry season of 1957 in which there were sixty days of cold water, the total catch of pink shrimp was near 3,000,000 pounds, and in 1958 when there were only eight days of cold water the catches did not reach 500,000 pounds.

Most of these shrimp caught in the dry season have ripe ovaries.

DISCUSSION

Shrimp Session

Discussion Leader: DONALD MCKEE

Discussion Panel: L. W. STRASBURGER, J. S. CARINHAS, JR., L. C. RINGHAVER,
J. C. FERGUSON, F. FRITZ KOCZY

Marking Pink Shrimp (*Penaeus duorarum*) With Biological Stains—A Field Experiment

THOMAS J. COSTELLO

- Q. Strasburger: There appear to be certain definite limitations to the use of dyes for marking shrimp. I wonder if you would give us a better evaluation of those limitations.
- A. Costello: We have only three dyes that are cleared by the Food and Drug Administration, which limits the number of experiments we can run at one time. Our chemists now are working on a method of mixing dyes so that we may have as many as seven combinations and possibly many more, so that it would be possible, for instance, to use trypan red and fast green and trypan blue independently, and then mix them so that we can have a number of combinations. Since a shrimp's life cycle doesn't exceed fourteen months we would have a possibility of making 15 or 18 combinations in the same area without any possible confusion of data. By marking a group of shrimp in a narrow size range it is possible to get growth data which will apply to that whole group. The big advantage in staining is that we can stain approximately seven times as fast as we can tag shrimp.
- Broadhead: You are talking in terms of how many more stained