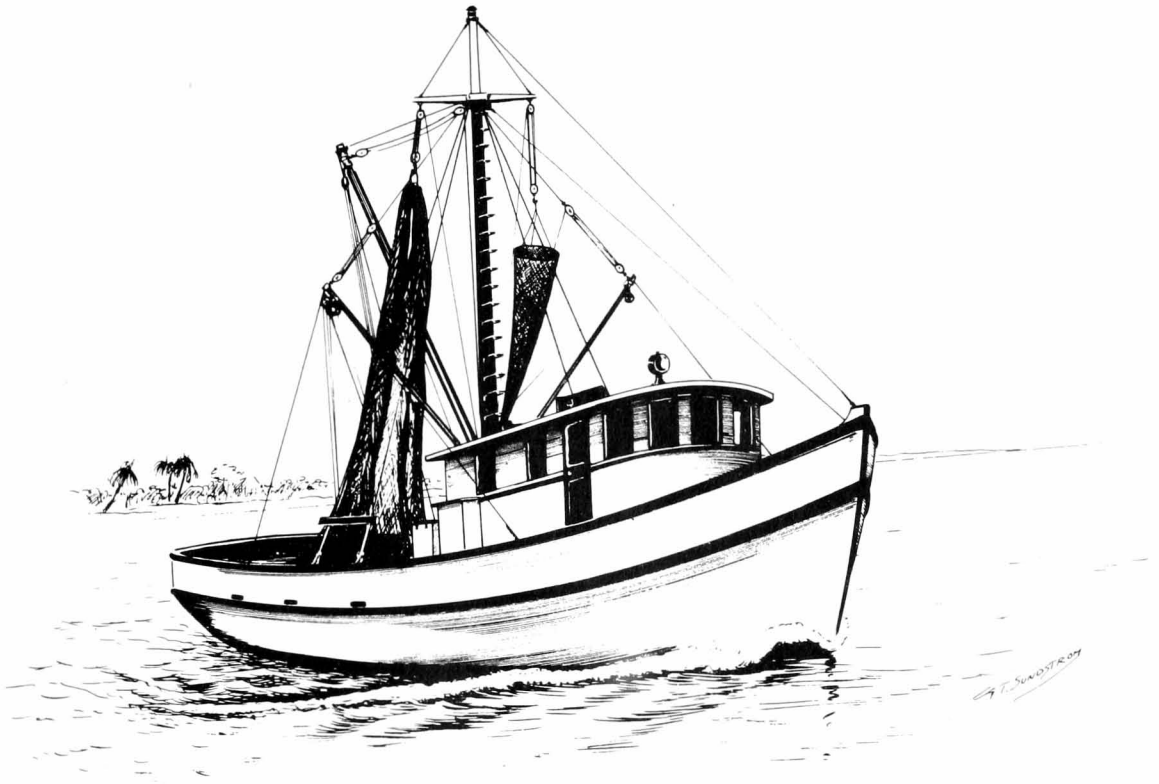


THE SHRIMP AND THE SHRIMP INDUSTRY OF THE SOUTHERN UNITED STATES



FISHERY LEAFLET No. 472

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES
WASHINGTON 25, D. C.

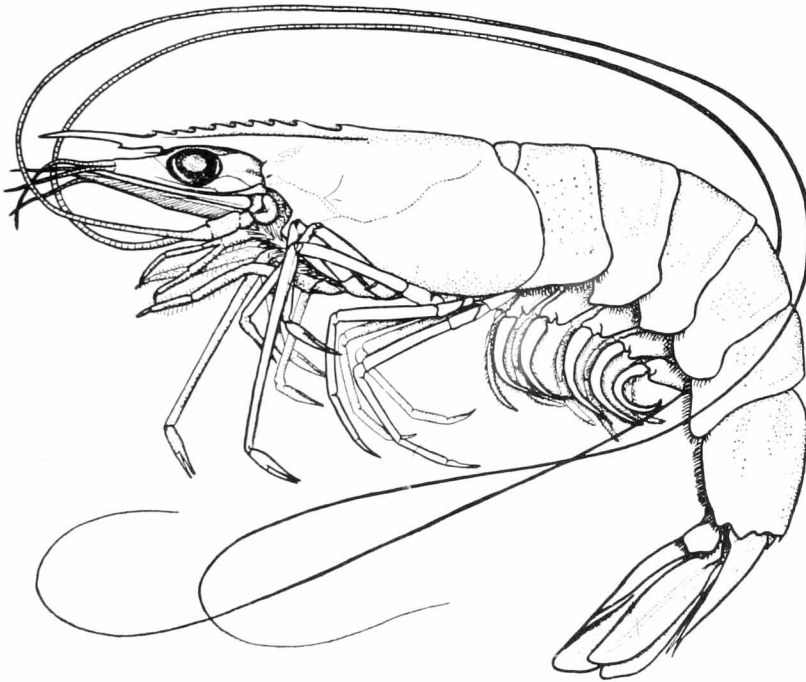


THE SHRIMP AND THE SHRIMP INDUSTRY OF THE
SOUTHERN UNITED STATES

by

William W. Anderson
Fishery Research Biologist

The shrimp fishery of the United States is centered primarily in the eight South Atlantic and Gulf States (North Carolina to Texas) where about 240 million pounds valued at approximately \$60,000,000 are taken annually. It ranks first in value of all the fisheries of the United States, including Alaska.



There are three principal species of shrimp, all members of one family (Penaeidae), which are of the greatest commercial importance. Separation of the catch by species in recent years indicates that the common or white shrimp (Penaeus setiferus) is no longer the dominant species in the catches, yielding about 22 percent of the catch in the Gulf of Mexico and about 45 percent along the South Atlantic. The

brown shrimp (Penaeus aztecus) comprises about 50 percent of the catch in the Gulf and about 48 percent along the South Atlantic; and the pink or brown spotted shrimp (Penaeus duorarum) yields about 26 percent of the Gulf catch (largely in the Tortugas area) and 7 percent of the South Atlantic. A fourth shrimp, the sea bob (Xiphopeneus kroyeri), is taken mainly in Louisiana and comprises only about 1 percent of the catch. Exploratory fishing by the Service has indicated commercial concentrations of another species, the royal red shrimp (Hymenopenaeus robustus), in deep waters off the Continental Shelf in the Gulf and South Atlantic regions. These occur from about 175 to 300 fathoms and have not as yet been fished extensively, although a few vessels have worked the grounds to a limited extent.

All of these species of shrimp have the first three pairs of thoracic or walking legs (of which there are five pairs in all) ending with chelae or pincers. The white, brown, and pink shrimp have teeth both above and below on the rostrums or head spine, whereas the sea bob and royal red shrimp have teeth only on the upper surface. The brown and pink shrimp can be distinguished from the white by the presence of grooves on either side of the rostrum which extend to the back margin of the carapace or head shell; in the white shrimp these grooves do not extend more than half the length of the carapace. The brown and pink shrimp are not so readily separated, the best field character being the width of the grooves each side of the top ridge on the sixth tail segment--in the brown shrimp this is wide open (permitting entry of a fingernail in fair sized specimens), whereas in the pink shrimp it is almost closed. In the sea bob the last two pairs of walking legs are slender and much elongated. It was from these four elongate legs and the antennae or feelers that the name "sea bob" was apparently derived. Sea bob is a corruption of the French "sis barbes" or six beards, the name given to this shrimp by the French fishermen of Louisiana. The sea bob does not attain near the size of the other commercial species.

The males can be distinguished from the females by the presence of a structure called the petasma which appears as a projection on the inner side of the first pair of swimming legs (underneath first tail segment).

We know much more about the white shrimp (Penaeus setiferus) than any of the others, and a brief outline of its life history will be given as an example of penaeid shrimp development.

Life History of the Common or White Shrimp

Habitat.--The white shrimp is most abundant in areas that are characterized by having an inland, brackish marsh connected by passes with an adjacent shallow, offshore area of relatively high salinity and

mud or clay bottoms. The offshore characteristics seems to be required by adults and perhaps also by the larvae, while the inland marshes appear to be required by the post-larval pre-adult. The adults are rarely found in abundance in the Gulf of Mexico in depths greater than 30 fathoms, and along the South Atlantic Coast the distribution appears limited to a narrow coastal belt not more than 8 to 10 miles off the coast (less than 10 fathoms). The pre-adults inhabit brackish water and at times are found in water that is almost fresh.

Spawning.--The white shrimp, unlike the crab and crayfish, does not carry the eggs attached to appendages on the ventral surface of the abdomen but lays them directly into the water. The eggs issue from the bases of the third walking legs of the female and are apparently fertilized on emission by sperm contained in a capsule called a spermatophore--this capsule was transferred to the female by the male and, apparently with the aid of the petasma, attached between the last several pairs of walking legs. A female will produce from 500,000 to 1,000,000 eggs in a single spawning, and it is probable that there is more than one spawning--at least for some females. Most, if not all, spawning takes place at sea and not in the estuarine inland waters, and occurs mainly from the late March or early April to the end of September.

Eggs and larvae.--The eggs are spherical, about 1/75 of an inch in diameter, and sink to the bottom. The larval development apparently covers at least ten distinct stages excluding the egg. These consist of five naupliar, three protozoal, and two mysis stages (technical terms for stages of growth).

In brief, the larval development of the white shrimp requires from 2 to 3 weeks. Some 20 to 24 hours after the eggs is spawned the young shrimp, called nauplius and resembling a tiny mite, breaks the egg membrane and emerges. This minute organism (about 1/75 of an inch long) is to a great extent at the mercy of the prevailing currents. During the next 24 to 36 hours the nauplius undergoes five successive molts to become a protozoa about 1/25 of an inch long. It now has seven pairs of appendages, a pair of sessile compound eyes, and a complete alimentary tract. Prior to this stage the food of the nauplius has been the yolk material carried over from the egg. This food supply is now exhausted, and henceforth the protozoa must capture its own food in order to survive. This transitional period is without doubt a critical one. After several more molts and stages the organism ends its larval phase and assumes the general proportions of a miniature adult. At the end of two post-larval stages and 15 to 20 days after hatching, the young shrimp is only about 1/5 of an inch long and is still planktonic. During this period of early development the young shrimp have moved from the saline offshore spawning area to the brackish inside marshes, bays, and estuaries. Upon reaching these

"nursery grounds" they adopt for the first time, it is believed a benthic or bottom existence.

Young shrimp.--Young shrimp about 1/3 of an inch long are found during the spring and summer months in the brackish inside areas which serve as their nursery grounds. This habitat is a rich feeding ground characterized by shallow water, muddy bottoms, rather widely fluctuating seasonal temperatures, and moderate to low salinity.

As the young grow, they move from the shallow waters of the marsh, bayou, and lagoon into the deeper creeks, rivers, and bays, making their first appearance on the inside fishing grounds when about 2 inches long. The young first appear in the estuarine fishing grounds in June or July, depending upon the area, and by July or August they have begun to appear in outside waters. Generally in the estuarine waters there are all sizes of shrimp, smaller shrimp occurring in those waters farther inland and larger shrimp in those waters nearest the open ocean. These differences in size appear more closely associated with locality than with salinity.

Growth.--Growth is rapid during spring, summer, and early fall, and negligible during winter. This suggests that the periods of rapid and slow growth are associated with temperature, and this being so, we could expect them to vary somewhat from year to year and with locality. A general statement of growth is further complicated by the fact that shrimp of different sizes grow at different rates. We believe that shrimp reach a little over 3 inches (80 mm.) in length (from tip of rostrum to the end of telson) about 2 months after spawning. On this basis and applying established growth rates, an example of growth is presented: Spawning on May 1; young shrimp reach a length of approximately 80 mm. by July 1, 110 mm. by August 1, 130 mm. by September 1, 145 mm. by October 1, and 158 mm. (over 6 inches) by November 1. Growth from November 1 to March 1 would be negligible, but if we assume that 2 mm. growth occurred during this period, our shrimp would be about 160 mm. in length on March 1, the beginning of the spring rapid growing season. The shrimp would then reach a length of about 168 mm. by April 1 and 173 mm. (about 7 inches) by May 1. It would be about 1 year old, mature and spawning during this spring season. Since the spawning season covers a period of about 6 months, any number of combinations of growth are possible, depending on the month spawned.

Migrations.--The white shrimp has very definite patterns of movements, but these vary in different areas.

In one respect the movements are similar in all localities--after the young shrimp first make their appearance on the inland fishing grounds they gradually work their way towards the sea. Once the shrimp have reached the outside waters their movements vary with the size of the shrimp, the locality and apparently also the time of the year.

Small shrimp 130 mm. (about 5 inches) or less in total length do not seem to undertake any extensive movements. The large shrimp, more than 130 mm. in total length, show quite distinct behavior patterns which vary with locality.

On the Atlantic Coast, the bulk of the white or common shrimp, after migrating from inshore to offshore waters, do not move into very deep water far from the coast. Instead, they move parallel to the shoreline with the seasons, moving southward during the fall and early winter and northward in late winter and early spring. In our tagging experiments, the longest southward migration was performed by a shrimp released in North Carolina in October and recaptured 95 days later off the east coast of Florida--about 360 miles south of where it was released. The greatest northward migration was recorded for a specimen released in central Florida in January and recaptured 168 days later off the coast of South Carolina after it had gone about 260 miles.

Along the Louisiana coast west of the Mississippi River the large shrimp move offshore and scatter out during the fall and winter. At all times they seem to be drifting about, like cattle on open range land. The only definite patterns seem to be offshore and on-shore movements, which evidently are associated with temperature changes and spawning, and a tendency to concentrate in certain areas, probably because of better feeding conditions. We believe the more or less aimless wanderings of the shrimp (but not the offshore and onshore movements) represent a search for food. There appears to be a natural barrier at the Mississippi River for no east-west nor west-east crossings were found from tagged individuals.

In Texas there is indicated a possible movement of shrimp from the central and southern part to the coast of Mexico during the fall and early winter, probably comparable to the movement along the South Atlantic Coast of the United States. Likewise there is evidence of a springtime south-to-north migration from northern Mexican waters to Texas waters.

Longevity.--Mortality of shrimp is apparently high, and the number that live more than one year is small with respect to the total population and is probably not of great importance. Some shrimp live at least 16 months and possibly longer, but as far as the fishery is concerned the common or white shrimp can be considered an annual.

Food.--The shrimp is omnivorous in its feeding habits--plant detritus, worms, crustaceans, small mollusc, mud, and sand can be found in their intestinal tracts. In aquaria they have been observed to attack and devour small fish and other shrimp. A shrimp is particularly susceptible to attack from another member of the same

species during the process of molting when the old shell has been discarded and the new one is still soft.

Miscellaneous.--The shrimp, like other crustaceans, wears its skeleton on the outside of the body and in order to grow must cast off this shell and replace it with a new and larger one. The frequency with which these shells are cast is not known, but with young shrimp during the rapid growing season the interval between molts appears to be relatively short. In the process of shedding, all of the hard structures of the shrimp are cast off and renewed.

The common shrimp swims in a forward direction by the use of the pleopods or abdominal feet. When frightened or when rapid movement is desired the shrimp, with a flip of the abdomen, can propel itself backward with remarkable speed. With this flexing of the powerful muscular abdomen, the shrimp is also able to leap clear of the water.

Nutritive Value of Shrimp

Shrimp possess the same general food properties that are commonly attributed to fishery products. In general, marine products are an excellent and economic source of highly digestible proteins, a good source of vitamins, and an excellent source of minerals in quantity and variety. Shrimp are unusually rich in minerals and contain a high natural content of iodine. As a consequence, shrimp like other marine foods are ideal for those areas in which goiter is prevalent. It is well known that iodine deficiency in the diet is the cause of the most prevalent type of goiter. Shrimp also contain vitamins A and D.

Iodine Shrimp

Shrimp occasionally possess a characteristic iodoform odor (the typical odor associated with hospitals) which is commonly thought to be caused by preservatives put on the shrimp. On the contrary this is a result of the shrimp having eaten various marine organisms which impart this odor. Croakers and other bottom living fish frequently have been noted to possess this same iodoform smell which is undoubtedly caused by a source similar to that of the shrimp. Although possibly unpleasant, it is not harmful.

Methods of Capture

Until the otter or shrimp trawl was introduced some time between 1912 and 1915, the most efficient gear for catching shrimp was the haul seine. At about that time, the Bureau of Fisheries, at its station in Beaufort, North Carolina, had been using a small otter trawl for

collecting marine forms. Fishermen, noting that shrimp were being taken by these nets, adopted the idea, and larger trawls were constructed for use in the commercial shrimp fishery. Apparently, the first shrimp trawling took place at Fernandina, Florida. Use of the trawl spread rapidly throughout the South Atlantic and Gulf regions and by 1917 had become the standard commercial use.

With the development and widespread use of the shrimp trawl, the haul seine gradually disappeared. Louisiana was the last locality in which it was employed. During the early 1930's, a few seines were still being used, but these dropped out one by one until at present there appears to be none in operation, and the trawl remains the exclusive gear for commercial operations.

Introduction of the trawl completely revolutionized the shrimp industry. Whereas the haul seine could be used only in shallow waters, required a large crew of men, and could be operated for only a limited time during the summer and fall months, the shrimp trawl was adaptable for use over a much greater range, could be operated with fewer men, yielded a greater production per man, and was a much more efficient type of gear. Its introduction opened up entirely new grounds, and led to a rapid expansion of the fishery.

Trawls now in use vary in size from the 10-foot try net, used for locating schools of shrimp, to the vessel's main trawl which may have a spread of 120 feet at the mouth. Its dimensions depend largely on the size and power of the vessel. A recent innovation is the use of two smaller trawls (about 40 feet), one on each side of the vessel, in place of one larger trawl.

White shrimp are fished for almost entirely during daytime, whereas trawling for the brown and pink shrimps is conducted at night.

The following publications contain further and more detailed information on the shrimp and shrimp industry of the southern United States:

ANDERSON, WILLIAM W.

1956. January to April distribution of the common shrimp of the South Atlantic Continental Shelf. U. S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report--Fisheries No. 171, 14 pp.

ANDERSON, WILLIAM W., JOSEPH E. KING, and MILTON J. LINDNER.

1949. Early stages in the life history of the common shrimp, Penaeus setiferus (Linnaeus). *Biological Bulletin*, vol. 96, no. 2, pp. 168-172.

ANDERSON, WILLIAM W., and MILTON J. LINDNER.

1943. A provisional key to the shrimps of the family Penaeidae with especial reference to American forms. *Transactions of the American Fisheries Society*, vol. 73, pp. 284-319.

ANDERSON, W. W., M. J. LINDNER, and J. E. KING.

1949. The shrimp fishery of the southern United States. U. S. Department of the Interior, Fish and Wildlife Service, Sep. No. 121 from *Commercial Fisheries Review*, vol. 11, no. 2, 17 pp.

BULLIS, HARVEY R., Jr.

1957. Royal red shrimp--A new South Atlantic resource. *Proceedings of the Gulf and Caribbean Fisheries Institute, Marine Laboratory, University of Miami, 9th Annual Session*, pp. 56-60.

IDYLL, CLARENCE P.

1950. A new fishery for grooved shrimp in southern Florida. U. S. Department of the Interior, Fish and Wildlife Service, Sept. No. 247 from *Commercial Fisheries Review*, vol. 12, no. 3, pp. 10-16.

1957. The commercial shrimp industry of Florida. Florida State Board of Conservation and University of Miami Marine Laboratory, Educational Series No. 6 (reissue), 30 pp.

JOHNSON, FRED F., and MILTON J. LINDNER.

1934. Shrimp industry of the South Atlantic and Gulf states. U. S. Bureau of Fisheries, Investigational Report No. 21, 83 pp.

KING, JOSEPH E.

1948. A study of the reproductive organs of the common marine shrimp, Penaeus setiferus (Linnaeus). Biological Bulletin, vol. 94, no. 3, pp. 244-262.

LINDNER, MILTON J., and WILLIAM W. ANDERSON

1956. Growth, migrations, spawning and size distributions of shrimp, Penaeus setiferus. U. S. Department of the Interior, Fishery Bulletin of Fish and Wildlife Service, vol. 56, Bulletin 106, pp. 553-645.

PEARSON, JOHN C.

1939. The early life histories of some American Penaeidae, chiefly the commercial shrimp, Penaeus setiferus (Linnaeus). Bulletin of the U. S. Bureau of Fisheries, vol. XLIX, no. 30, 73 pp.

SPRINGER, STEWART.

1955. Exploitation of deep-water shrimp of the Gulf of Mexico. Proceedings of the Gulf and Caribbean Fisheries Institute, Marine Laboratory, University of Miami, 7th Annual Session, pp. 67-71.

VOSS, GILBERT L.

1955. A key to the commercial and potentially commercial shrimp of the family Penaeidae of the western North Atlantic and the Gulf of Mexico. Florida State Board of Conservation and University of Miami Marine Laboratory, Technical Series No. 14, 23 pp.

WEYMOUTH, F. W., MILTON J. LINDNER, and W. W. ANDERSON.

1933. Preliminary report on the life history of the common shrimp, Penaeus setiferus (Linnaeus). Bulletin of the Bureau of Fisheries, vol. XLVIII, no. 14, 26 pp.

July 1958