Causes of seasonal fluctuations and abundance in shrimp populations in the estuaries are studied to determine how changes in the estuarine environment affect annual and continued production.

(Project Continuing)

**Maine**

Chief Investigator: Ronald G. Rinaldo

*Northern shrimp—biological and technical research*—Studies were made on waters adjacent to the Maine coast to determine the relative abundance of species of northern shrimp, particularly *Pandalus borealis*, and life history and seasonal availability of the several species. Technical problems associated with economical and efficient harvesting and marketing these species were also investigated.

(Project Completed 1970)

**Maine**

Chief Investigator: Ronald G. Rinaldo

*Northern shrimp—assessment of some population parameters*—This project is designed to establish shrimp population parameters by sampling and enhancing the collection, catch, and data from survey cruises.

(Project Continuing)

**Mississippi**

Chief Investigator: J. Y. Christmas

*Investigation of commercial important penaeid shrimp in Mississippi estuaries*—Under this project a study is made of the environmental requirements and relationships of penaeid shrimp with special reference to variations in commercial catch in an attempt to improve predictions of the availability of shrimp to the fishery.

(Project Continuing)

**North Carolina**

Chief Investigator: Edward G. McCoy

*Shrimp studies*—Information was obtained on population dynamics, including migratory behavior, for pink, brown, and white shrimp marked with biological stains and fluorescent pigments and released in nursery areas tributary to Core Sound and Lower Cape Fear River estuaries. A combined total of 26,989 shrimps were marked and released, of which 1,671 or 6.2 percent were recaptured. Mark and recapture studies on brown shrimp were conducted in Pamlico Sound and Bogue Sound estuaries, including Newport River.

(Project Completed 1969)

**North Carolina**

Chief Investigator: Edward G. McCoy

*Studies of commercial penaeid shrimp*—This study is undertaken to determine the effect on the resulting commercial catch when pre-commercial-size pink shrimp are harvested and discarded while fishing for commercial-size brown shrimp.

(Project Continuing)

**Oregon**

Chief Investigator: Gary Milburn

*Study on the distribution and abundance of pink shrimp, Pandalus jordani, in the Pacific Ocean off Oregon*—Sampling of commercial pink shrimp landings at Warrenton, Newport, and Coos Bay has been completed. Length-frequency, catch, and effort data by area of catch were reported. The vertical distribution and migratory behavior of this species by diel, lunar, and seasonal periods, and the environmental factors which may influence these movements were investigated off the Oregon coast near Astoria and Newport.

(Project Completed 1970)

**Oregon**

Chief Investigator: Robert Loeffel

*An evaluation of methods for determining movements of shrimp*—This study was twofold: (1) to evaluate the feasibility of various techniques of determining the movements of Pacific pink shrimp, and (2) to develop holding and rearing techniques of pink shrimp in aquaria.

(Project Completed 1971)

**Texas**

Chief Investigator: Gary M. Stokes

*The population and distribution of penaeid shrimp in Lower Laguna Madre*—The purpose of this study is to determine the population and distribution of juvenile penaeid shrimp in Lower Laguna Madre and its watershed with relation to ecological factors, and conduct a brief survey of the bait shrimp fishery in the Lower Laguna Madre in preparation for future studies dealing with the relationship between juvenile production in the Lower Laguna Madre, the bait fishery, and commercial production in the Gulf of Mexico.

(Project Continuing)

# NMFS Publications on Shrimp, 1970-72

A number of scientific reports on shrimp have appeared in recent NMFS publications. All are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC, 20402. An alphabetical list, by author, follows:

**Abramson, Norman J.,** and **Patrick K. Tomlinson,** "An application of yield models to a California ocean shrimp population," Fishery Bulletin, Vol. 70, No. 3, p. 1021-1041.

ABSTRACT

Two types of yield models were utilized to analyze fishery data from California's northern-most bed of ocean shrimp, *Pandalus jordani*. The Schaefer form of stock production model was applied to catch and effort data for the years 1954 through 1969. Age-structured catch data for 1955 through 1968 were analyzed by the Murphy method to obtain mortality rates and biomass estimates. Catchability coefficients and a growth curve were also estimated. Attempts to fit spawner-recruit models to estimates obtained from the age-structured catch data were inconclusive; so, age specific mortality and growth estimates were only used to fit a yield-per-recruit model.

After comparing the results from the two models, the Schaefer model was deemed most suitable for managing this fishery. The model estimated the maximum sustainable yield at 2.46 million pounds. A strategy for managing the fishery under a quota system was proposed.

**Anderson, William W.,** "Contributions to the life histories of several penaeid shrimps (Penaeidae) along the south Atlantic coast of the United States." U.S. Fish and Wildlife Service, Special Scientific Report—Fisheries No. 605, May 1970, iii+24 p., 15 figs., 12 tables.

ABSTRACT

Shrimp, the most valuable fishery resource of the south Atlantic coast of the United States, contributed about 40 percent of the $27 million exvessel value of all fishery landings in the area in 1966. Three species of shallow-water penaeid shrimps are of greatest commercial importance: white shrimp, *Penaeus setiferus;* brown shrimp, *P. aztecus;* and pink shrimp, *P. duorarum*. The shrimp fishery is reviewed for trends in yield for the area as a unit, by States, and by species, for the 10-year period 1958-67. A trend toward steady decline in total shrimp landings is indicated. During studies on the white shrimp along the south Atlantic coast of the United States in 1931-35, data were obtained on the brown shrimp; the sea bob, *Xiphopeneus kroyeri;* and *Trachypeneus constrictus*. Observations were also made on the pink shrimp from operations of the Bureau of Commercial Fisheries R/V

*Oregon* of northeast Florida near Cape Kennedy in 1965-67. This report presents size distribution, ovary development, and sex ratios of the several species of shrimp, and includes limited information on spawning season.

**Anonymous,** "Report of the National Marine Fisheries Service Gulf Coastal Fisheries Center, fiscal years 1970 and 1971." NOAA Technical Memorandum NMFS SER-1, July 1972, iii+26 p., 14 figs., 4 tables.

ABSTRACT

Progress is reported at the National Marine Fisheries Service Gulf Coastal Fisheries Center (formerly the Biological Laboratory, Galveston, Texas). Emphasis is placed on shrimp, and the research involves the fields of mariculture, population dynamics, ecology, and oceanography.

**Barr, Louis,** "Alaska's fishery resources—the shrimps." U.S. Fish and Wildlife Service, Fishery Leaflet 631, January 1970, iii+10 p., 7 figs., 1 table.

ABSTRACT

Shrimp fishing began in Alaska over 50 years ago. Recently the annual domestic catch has been as high as 40 million pounds. Japanese and Soviet Union fishermen operating in Alaska waters have caught as much as 70 million pounds annually in recent years.

The five commercially important shrimp of Alaska belong to the family Pandalidae; the most important is the pink shrimp, *Pandalus borealis.* The complicated life histories of these shrimp are all similar. The shrimp develop first as males and after several years transform to females, which they remain for the rest of their lives.

United States fishermen use otter trawls, beam trawls, and pots, and deliver their catch to ports in Alaska; foreign fishermen use larger otter trawls and process the catch at sea.

The Alaska Department of Fish and Game and the Bureau of Commercial Fisheries are studying shrimp. They are sampling the commercial catch, trying to improve the product, and conducting exploratory fishing and biological research.

**Caillouet, C.W., Jr., B.J. Fontenot, Jr., W.S. Perret, R.J. Dugas,** and **H.F. Hebert,** "Catches of postlarval white shrimp *Penaeus setiferus* (Linn.), and brown shrimp, *P. aztecus,* Ives, and temperature and salinity observations in Vermilion Bay, Louisiana, March 1963 to April 1967." U.S. Dep. Commer., NOAA, NMFS, Data Report 64, July 1971, 39 p. on 1 microfiche. $0.95.

ABSTRACT

A small trawl towed in a semicircle of 30.5-m (100 ft) radius in the shallow water near the shoreline was used to collect postlarval white shrimp and brown shrimp. Dates and hour of sampling, catches of postlarvae, species composition and subsamples of the catches, and water temperature and salinity data are presented.

**Condrey, Richard E., James G. Gosselink,** and **Harry J. Bennett,** "Comparison of the assimilation of different diets by *Penaeus setiferus* and *P. aztecus.*" Fishery Bulletin, Vol. 70, No. 4, p. 1281-1292.

ABSTRACT

Juvenile penaeid shrimp showed high and comparable assimilation efficiencies (80-85%) on a variety of plant and animal diets. In general assimilation efficiencies for proteins and lipids were consistently high; for carbohydrates, low. Organic assimilation per gram organic weight of white shrimp, *Penaeus setiferus,* proceeded at 3.7 mg $hr^{-1}$ on an axenic diatom and 8.4 mg $hr^{-1}$ on an artificial diet. The assimilation efficiency was lower for shrimp feeding on the algal mat coating *Spartina alterniflora* than on two components of the mat. Feeding mechanisms and probable natural diets are discussed as a basis for further study.

**Cook, Harry L.,** and **M. Alice Murphy,** "Early developmental stages of the brown shrimp, *Penaeus aztecus* Ives, reared in the laboratory." Fishery Bulletin, Vol. 69, No. 1, p. 223-239.

ABSTRACT

The larval and first postlarval stages of the brown shrimp, *Penaeus aztecus* Ives, reared from eggs spawned in the laboratory, as well as the eggs themselves, are described and illustrated. The larvae and first postlarva are compared with those of the pink shrimp, *P. duorarum* Burkenroad, and white shrimp, *P. setiferus* (Linn.).

**Corbett, Michael G.,** "Machine for separating northern shrimp, *Pandalus borealis,* from fish and trash in the catch." Fishery Industrial Research, Vol. 6, No. 2, May 1970, p. 53-62, 8 figs.

ABSTRACT

Because of the labor required in separating northern shrimp from the unwanted components of the catch that are taken along with it, this valuable resource in the Gulf of Maine is not harvested to the extent possible. Consequently, a machine was developed to separate the shrimp from the bulk of groundfish and other species taken in trawl catches during exploratory and commercial fishing. Its use eliminates the laborious task of sorting the catch by hand, yet the separator recovers about 95 percent of the shrimp that are fed into it, while eliminating about 90 percent of the trash.

**Ellis, James E.,** "The use of electricity in conjunction with a 12.5-meter (headrope) Gulf-of-Mexico shrimp trawl in Lake Michigan." NOAA Technical Report NMFS SSRF-653, March 1972, iv+10 p., 11 figs., 4 tables. $0.25.

ABSTRACT

The catching efficiency of a 12.5-meter standard shrimp trawl and the same trawl fitted with three different electrode array systems with power on and power off was investigated.

The standard trawl caught 1.54 times or 54.2% more kilograms of fish than the electrode-equipped trawl with power off. The electrode array hanging across the mouth area of the trawl acted as a visual stimulant and thus reduced the trawl's catch rate.

Overall the electrical trawl with power on caught 1.19 times or 19.0% more kilograms of fish than the electrical trawl with power off. Array 2 with power on had the best catch rate—1.86 times or 86.9% more kilograms of fish than the power off catch rate. The avoidance of fish to an electrode array was more than offset with the catch rate of array 2 with power on. The dominance patterns of the catches with each system tested did not change significantly with the exception of chub catches with array 2 with power on.

Length selectivity was highly significant for chubs caught with arrays 2 and 3 with power on. No significant length selectivity occurred with the other species landed.

**Emiliani, Dennis A.,** "Equipment for holding and releasing penaeid shrimp during marking experiments." Fishery Bulletin, Vol. 69, No. 1, p. 247-251.

(NO ABSTRACT)

**Fontaine, Clark T.,** "Conversion tables for commercially important penaeid shrimp of the Gulf of Mexico." U.S. Dep. Commer., NOAA, NMFS, Data Report 70, December 1971, 9 p. on 1 microfiche. $0.95.

ABSTRACT

Tables are divided by classifications commonly used by the industry to designate landings of whole or headless brown *(Penaeus aztecus),* white *(P. setiferus),* and pink *(P. duorarum)* shrimp. Data presented by sex and sexes combined for each species include shrimp that range from 70 to 235 mm total length.

**Fontaine, C.T., S.E.P. Gislason,** and **W.L. Trent,** "A system for collecting large numbers of live postlarval shrimp." Fishery Bulletin, Vol. 70, No. 4, p. 1298-1302.

(NO ABSTRACT)

**Hudson, J. Harold, Donald M. Allen,** and **T.J. Costello,** "The flora and fauna of a basin in central Florida Bay." U.S. Fish and Wildlife Service, Special Scientific Report—Fisheries No. 604, May 1970, iii+14 p., 2 figs., 1 table.

ABSTRACT

One hundred ninety-six species of plants and animals are reported from a nursery area for pink shrimp, *Penaeus duorarum duorarum,* in a basin of central Florida Bay. Many of the organisms are benthic and associated with shallow beds of turtle grass, *Thalassia testudinum.* Although abrupt habitat variations may affect species distribution, the general distribution of organisms in the basin and bay defines environments influenced by different water masses.

**Kelly, Carolyn E.,** and **Anthony W. Harmon,** "Method of determining carotenoid contents of Alaska pink shrimp and representative values for several shrimp products." Fishery Bulletin, Vol. 70, No. 1, p. 111-113.

ABSTRACT

An extraction method is described for estimating the amount of carotenoids in pink shrimp. The carotenoid index is useful as a measure of quality and as an indicator of changes during storage. Values for several shrimp products are reported.

**Love, Travis D., Mary H. Thompson,** and **Melvin E. Waters,** "Report of the National Marine Fisheries Service Fishery Products Technology Laboratory, Pascagoula, fiscal years 1970 and 1971." NOAA Technical Memorandum NMFS SER-3, June 1972, iii+12 p., 7 figs., 4 tables.

(NO ABSTRACT)

**Miller, George C.,** "Commercial fishery and biology of the freshwater shrimp, *Macrobrachium*, in the lower St. Paul River, Liberia, 1952-53." U.S. Dep. Commer., NOAA, NMFS, Special Scientific Report—Fisheries No. 626, February 1971, iii+13 p., 8 figs., 7 tables.

ABSTRACT

A small fishery was conducted for the large commercial fresh-water shrimp, *Macrobrachium vollenhovenii*, using traps. A second smaller species, *M. macrobrachion*, was culled from the trap catch for the fishermen's use. The estuarine fishery was seasonal (May to January), during the period of low salinity. Cost of raw tail meats to the consumer was over $1.00 (U.S.) per pound. The fishermen derived more than $7,500 from the fishery.

Commercial shrimp, *M. vollenhovenii*, spawned in the estuary from May to January. Fecundity was estimated at 12,000 to 45,000 eggs per female. As the embryo developed the color of the egg changed from red to brown. Embryonic and larval development to time of setting of *M. vollenhovenii* was believed similar to that of *M. rosenbergii*, 50 to 65 days. An intensive push-net fishery was conducted by women on the zero age group soon after the juveniles had set. Juvenile shrimp were not caught by traps. Monthly length distributions indicated that the fishery was supported by age group one, which was replaced at the end of the season by age group zero. Age group zero grew rapidly and reached a modal length of 75 to 80 mm. in 9 months in January; and adults grew slowly and increased in length to 85 to 90 mm. in May, and 100 to 105 mm. in November. The weight-length relation of *M. vollenhovenii* ovigerous females was expressed by the equation Log W = −4.656603 + 3.011392 Log L, and males and nonovigerous females by Log W = −4.829560 + 3.092213 Log L.

The characters used to distinguish *M. macrobrachion* from the commercial shrimp are given. The smaller species (modal length 50 to 54 mm.), constituted 88 percent of the shrimp discarded from the commercial catch. The trap fishery harvested the adults of the two species, which differed considerably in length, without harm to either species.

**Miller, Morton M.,** and **Darrel A. Nash,** "Regional and other related aspects of shellfish consumption—some preliminary findings from the 1969 consumer panel survey." U.S. Dep. Commer., NOAA, NMFS, Circular 361, June 1971, iv+18 p., 21 figs., 3 tables, 10 apps.

ABSTRACT

A consumer survey panel, consisting of representative households throughout the United States, recorded their fishery product purchases for a 12-month period, beginning in February 1969. They were participants in a study conducted under the aegis of the National Marine Fisheries Service, Division of Economic Research. This paper deals mainly with study findings respecting the consumption of major species of shellfish, at home and away from home.

Findings of the study indicate marked regional preferences for individual shellfish items. For example, oysters are consumed in South Atlantic States at nearly double the national per capita rate. Similarly, clams enjoy a high rate of consumption in Middle Atlantic and New England areas. All of which suggests an important correlation between consumption and tradition as well as a persistent tendency for seafood varieties, particularly those consumed in a "fresh" form, to be consumed in the area of catch.

The study also indicated an association between high income households and shellfish consumption, with oysters a single notable exception. Age of consumer, too, has an apparent bearing on shellfish consumption as it was found that older consumers are the more disposed toward consumption of these products.

With respect to consumption away from home, it appears that half or more of the crabs and lobsters are consumed in meals outside the home, but the majority consumed of other products was at home.

**Pérez Farfante, Isabel,** "A key to the American Pacific shrimps of the genus *Trachypenaeus* (Decapoda, Penaeidae), with the description of a new species." Fishery Bulletin, Vol. 69, No. 3, p. 635-646.

ABSTRACT

Study of American Pacific members of the genus *Trachypenaeus* reveals that variation in armature of the telson includes not only movable spines, but also fixed spines and even no spines at all. It also confirms that the eighth somite bears two arthrobranchiae instead of one arthrobranchia and one pleurobranchia. A new species, *Trachypenaeus fuscina*, is described, the specific features of *T. faoea* Loesch and Avila are presented, and a key to the five members of the genus occurring in the region, together with their ranges, is included.

**Pérez Farfante, Isabel,** "Diagnostic characters of juveniles of the shrimps *Penaeus aztecus aztecus, P. duorarum duorarum,* and *P. brasiliensis* (Crustacea, Decapoda, Penaeidae)." U.S. Fish and Wildlife Service, Special Scientific Report—Fisheries No. 599, February 1970, iii+26 p., 25 figs.

ABSTRACT

Illustrated tables are presented for the identification and sex determination of juveniles (with carapace lengths of 8 mm or more) of three grooved shrimps of the genus *Penaeus* occurring in various areas along the North American Atlantic coast, in the Gulf of Mexico, and in the Bermudas. Included is an account of the development of the petasmata, thelyca, and appendices masculinae.

**Sick, Lowell V., James W. Andrews,** and **David B. White,** "Preliminary studies of selected environmental and nutritional requirements for the culture of penaeid shrimp." Fishery Bulletin, Vol. 70, No. 1, p. 101-109.

ABSTRACT

Types of substrate, type of aeration, and stocking density were compared as prerequisites for high-density culture studies with penaeid shrimps. Neither sand-shell substrate nor brick subdivisions of culture tank bottoms produced significantly higher survival rates than bare fiber glass tanks. Forced air supplied via airstones proved to be a more suitable form of aeration than did physical agitation of the water column in culture tanks by high-pressure nozzles. Survival rates of 80 to 90% were achieved when biomass densities did not exceed 40 g/m$^2$.

Semipurified pelleted diets (i.e., containing defined chemical ingredients plus one or more natural products) having a complement of nutrients including minerals and vitamins, various ratios of shrimp to fish meal, protein hydrolysates, and such diets fed at three percentages of total biomass daily were compared for their ability to produce increases in growth. Diets without fish or shrimp meal sustained biomass while those diets having the highest proportion of shrimp to fish meal in addition to added vitamins produced over 60% increase in total biomass over a 3-month period. Animals fed a combination of yeast, soy, and casein hydrolysates increased 39% in biomass over the same period of time while those fed each of the above hydrolysates during the 3-month period separately showed only an average of 18% increase in weight. Feeding shrimp with a fish-shrimp base with added vitamins at a rate of 15% daily of the total biomass produced a 164% increase in weight with 95 to 100% survival during the 3-month period. Using semipurified pelleted diets, a food conversion ratio of 5.5 was obtained.

Establishing selected preliminary environmental and nutritional requirements for penaeid shrimp resulted in the successful and reproducible production of major biomass increases with relatively high survival rates and low food conversion ratios.

—Compiled by Lee C. Thorson