Louisiana's Brown Shrimp Monitoring and Management Program

William S. Perret, *Assistant Secretary of Fisheries, Louisiana Department of Wildlife and Fisheries, 2000 Quail Drive, Baton Rouge, LA 70898*

Philip E. Bowman, *Louisiana Department of Wildlife and Fisheries, 2000 Quail Drive, Baton Rouge, LA 70898*

L. Brandt Savoie, *Louisiana Department of Wildlife and Fisheries, 2000 Quail Drive, Baton Rouge, LA 70898*

Abstract: The Louisiana Department of Wildlife and Fisheries has conducted long term monitoring for shrimp since the mid 1960's. For the purpose of monitoring shrimp populations, the State was divided into 7 Coastal Study Areas. Each of these Areas represented a distinct hydrological basin within the coastal zone. Data collected from sampling locations within each of these Study Areas was used to set shrimp seasons on a statewide basis. Data collected during the early years of the monitoring program indicated that the State's shrimp resources could be divided into 3 distinct management zones. In 1975, the Department instituted the zone concept of shrimp management and began opening shrimp seasons at different times along the coast. This program is the basis on which shrimp are managed in Louisiana.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 47:502–510

The shrimp fishery in Louisiana began as an industry over a century ago. While the Houma Indians and the early Cajuns probably used dried shrimp for barter during the 1700's, it was not until the mid 1860's that the first commercial shrimp drying platform was completed on Barataria Bay. Not long after this, in 1868, the first shrimp canning factory began successful operation near Grand Terre Island. From these beginnings the shrimp industry has grown and is now Louisiana's largest and most valuable fishery, accounting for over 85% of the value of the State's edible fisheries production. Today, the shrimp industry is the cornerstone of the economic and social base for many of Louisiana's coastal communities, and provides both direct and indirect employment for thousands of the state's citizens.

Since the turn of the century, the gear used to harvest shrimp has undergone a dramatic change. Prior to the introduction of the otter trawl in 1917, the seine was

the principle gear used to harvest shrimp. The introduction of the otter trawl changed the fishery virtually overnight, and by 1920 the trawl was used almost exclusively. In the 1950's the wing net (butterfly net, "paupier") was developed. These nets are attached to a rigid frame and fished primarily during the night in the upper portion of the water column. Initially, these nets were fished on a falling tide from a stationary position or pushed by boat into the current to increase water flow through the net. As time progressed fishermen found that these nets could be fished effectively, at certain times, by pushing into rising tides. Also, since they were fished primarily at night, they were especially suited for Louisiana's rapidly expanding part-time shrimp fishery. Roberts and Sass (1980) reported that 12,122 of the 17,203 wing net effort days were attributed to part-time fishermen. The wing net fishery has expanded to the point that competition for ideal fishing locations has become keen and conflicts among competing fishermen have erupted.

The most recent change in the fishery came with the introduction of "skimmers" in about 1990. The skimmer is very similar to the wing net except that it employs the use of a lead line along the bottom and has a large skid on the bottom outside corner instead of the net being attached to a rigid frame. This allows the net to fish the entire water column and allows for fishing in very shallow water which would be inaccessible to traditional gear or wing nets. Additionally, the skimmer appears to work equally well during both daylight and nighttime.

One of the more important factors affecting the shrimp industry in Louisiana and the Gulf of Mexico is competition. In 1950, Louisiana sold 2,358 shrimp trawl licenses, 4,215 in 1960, 12,500 in 1970, 18,388 in 1980, and 17,320 in 1992. In addition to trawl licenses there were 4,778 wing net and 3,790 skimmer licenses sold in 1992.

Louisiana also has a large contingent of recreational shrimpers. Since 1987 recreational shrimpers have been required to purchase a license for trawls 16 feet or smaller, and during 1992, 4,224 recreational shrimp trawl licenses were sold. Prior to the implementation of this license it was estimated that as many as 5,000 recreational fishermen were using small trawls.

The Louisiana shrimp fishery consists primarily of a small boat/part-time fleet. In 1989, 12,788 (81%) of the 15,722 resident commercially licensed shrimp vessels in Louisiana were ≤30 feet in length (Keithly and Baron-Mounce 1990). Sass and Roberts (1979) reported the mean length of shrimp boats fishing inshore was 21 feet, inshore/offshore combination was 53 feet, and offshore was 78 feet. The average boat length of the inshore, full-time shrimper was 32 feet, while the average boat length for inshore part-time shrimpers was 20 feet. Eighty-nine percent of the shrimpers interviewed stated that they did not shrimp full-time during the 1978 season (Roberts and Sass 1980).

Landings and Value

From 1960 to 1991, Louisiana shrimp landings ranged from 31.0 million pounds in 1961 to 147.0 million pounds in 1986, and averaged 84.7 million pounds

(heads on) for the 32-year period. The value of Louisiana's shrimp landings has also steadily increased from $8.9 million in 1961 to $206.7 million in 1986, averaging $80.2 million annually for the 32-year period.

From the late 1800's to the 1940's, nearly 90% of the Gulf of Mexico shrimp production was attributed to Louisiana. St. Amant (1979) reported shrimp catch in Louisiana averaged 73 million pounds from 1940 to 1979. In the late 1940's and early 1950's, significant supplies of brown shrimp (*Penaeus aztecus* (Ives)) were discovered in the waters offshore of Louisiana and Texas. Harvest from these waters increased total Gulf of Mexico production to over 200 million pounds and Gulf production averaged 195 million pounds from 1940 to 1979 (St. Amant, 1979).

During the period 1965–1991, Louisiana's share of the Gulf of Mexico shrimp landings averaged 50% by weight and 46% by value (Fig. 1). In 1992, 47% (97.4 million pounds) of the shrimp harvested in the Gulf of Mexico were landed in Louisiana (Fig. 1). Typically, brown shrimp average about 50% of the annual Louisiana catch and white shrimp (*Penaeus setiferus* (Linnaeus)) average about 44% (Fig. 2). The remainder is made up primarily of seabobs (*Xiphopenaeus kroyeri* (Heller)). Louisiana's reported shrimp landings have always been lower than the reported catch. Therefore, many are obviously not reported as harvested from Louisiana waters, including some taken from the Federal Exclusive Economic Zone (EEZ) adjacent to Louisiana waters and then landed in other states. For example, from 1973 to 1983 Louisiana shrimp landings averaged 82.8 million pounds while catch in the same time frame averaged 104.7 million pounds. Juneau

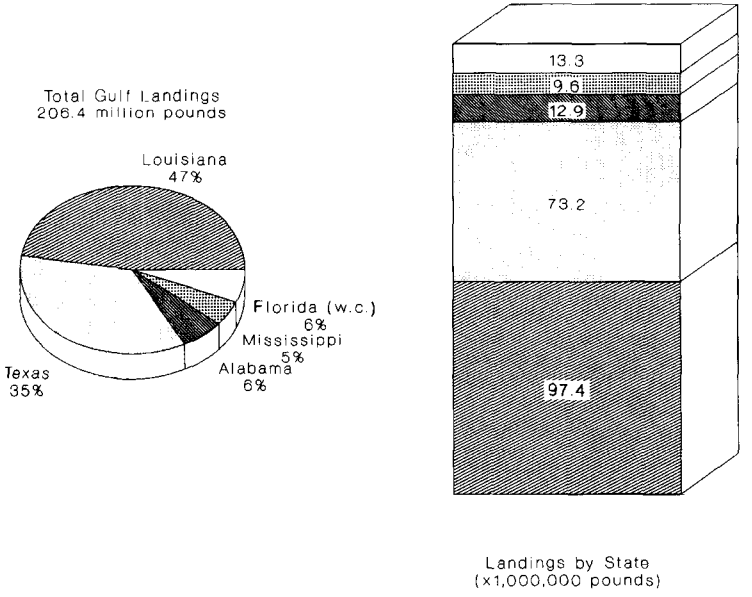

Figure 1. 1992 Gulf States shrimp landings by state.

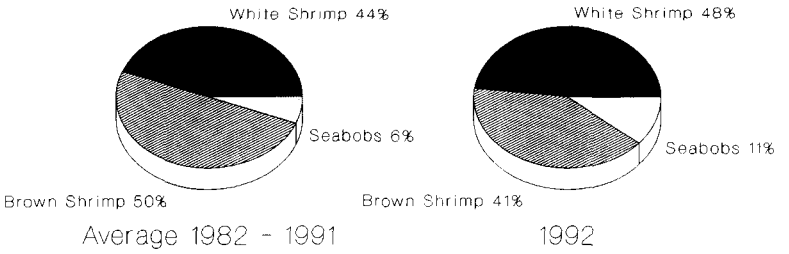

Figure 2. 1982–1991 and 1992 Louisiana shrimp landings species composition.

(1977) reported that catch statistics indicate approximately 90% of the seabobs taken in the northern Gulf of Mexico were caught in Louisiana, and most were taken within five fathoms of the shoreline.

Research

Due to extremely poor shrimp production in the late 1950's and again in 1961, the shrimp industry demanded a program of research that would provide an explanation for the tremendous fluctuations in the annual abundance of shrimp. As a result, funds became available to initiate a shrimp monitoring and research program.

From 1960 through 1966 shrimp research was concentrated in the Barataria Bay System and coordinated at the Department of Wildlife and Fisheries Lyle S. St. Amant Marine Laboratory. These studies (George 1962, St. Amant, et al. 1962, 1966) were designed to yield scientific information concerning postlarvae recruitment and growth characteristics of juvenile brown shrimp. Also, from 1962 through 1968, a series of mariculture studies were conducted to determine salinity and temperature tolerances, as well as various aspects of pond raising shrimp commercially in south Louisiana (Broom 1968).

In 1962, following numerous meetings with industry representatives, management guidelines for brown shrimp were established. Shrimp larger than 100 count (whole shrimp per pound) were designated as marketable, while shrimp smaller than 100 count were considered as non-marketable. In 1963, shrimp sampling was expanded from the Barataria Bay area to other areas of the state using amphibious airplanes, a "mother ship", and various smaller vessels. Studies to determine population density and distribution of juvenile shrimp were conducted in conjunction with studies to examine population cycles of the ensuing adult stages. In 1970, management guidelines for predicting brown shrimp production were presented (Ford and St. Amant 1970).

In 1966, federal funds (Commercial Fisheries Research and Development Act, PL 88-309) allowed expansion of research activities throughout coastal Louisiana. Initially, coastal Louisiana was divided into 6 study areas for monitoring and assessment work. A seventh area was later added and this areal concept remains in effect and unchanged today (Fig. 3).

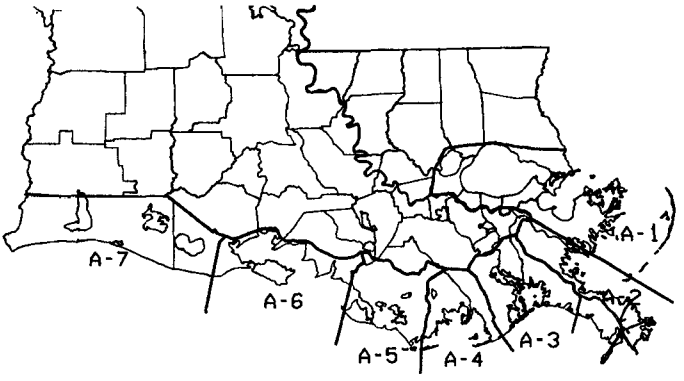

Figure 3. Louisiana Coastal Study Areas.

One of the first coast-wide research projects undertaken was the Cooperative Gulf of Mexico Estuarine Inventory and Study, GEMI, (Perret, et al. 1971). The GEMI was conducted in cooperation with the Gulf States Marine Fisheries Commission (GSMFC), the states of Alabama and Mississippi, and the National Marine Fisheries Service (NMFS) laboratories at Galveston, Texas and St. Petersburg, Florida. This project was designated to provide biological, hydrological and sedimentological descriptions of the northern Gulf of Mexico Estuarine Area.

At the initiation of the 1966 fishery-independent sampling program, a commitment was made to follow standardized sampling methods and procedures recommended by the Technical Coordinating Committee (TCC) of the GSMFC. Due to the configuration and ecological conditions of coastal Louisiana, modifications were necessary, but once established, standardized methods were adhered to and have remained unchanged through 1992.

Specific coast wide fishery independent shrimp monitoring and research was initiated following the estuarine inventory. Projects conducted by Gaidry and White (1973), Barrett and Gillespie (1973, 1975), Gaidry (1974), White (1975), Barrett and Ralph (1976, 1977), White and Boudreaux (1977), Juneau (1977), Barrett, et al. (1978), and Juneau and Pollard (1981) examined the life cycle of penaeid shrimp, recruitment patterns, hydrological patterns (which affect growth and survival), and provided data allowing development of an areal management plan for shrimp in Louisiana. These studies identified salinity and April water temperature as the 2 primary limiting factors for the survival and growth of juvenile brown shrimp. Seven parameters were used to describe these 2 critical limiting factors (Fig. 4). The shrimp industry in Louisiana has become keenly interested in and watches closely the number of acres of estuarine habitat above 10 ppt each year. This parameter has proven to be a good qualitative measure of brown shrimp production; generally the more acres ≥10 ppt, the greater shrimp production (Fig. 5).

From 1977 through 1980, Louisiana entered into a cooperative mark-recapture project with NMFS which greatly improved the knowledge of shrimp movement patterns along the Louisiana coast (Lyon and Boudreaux 1983). Shrimp monitoring

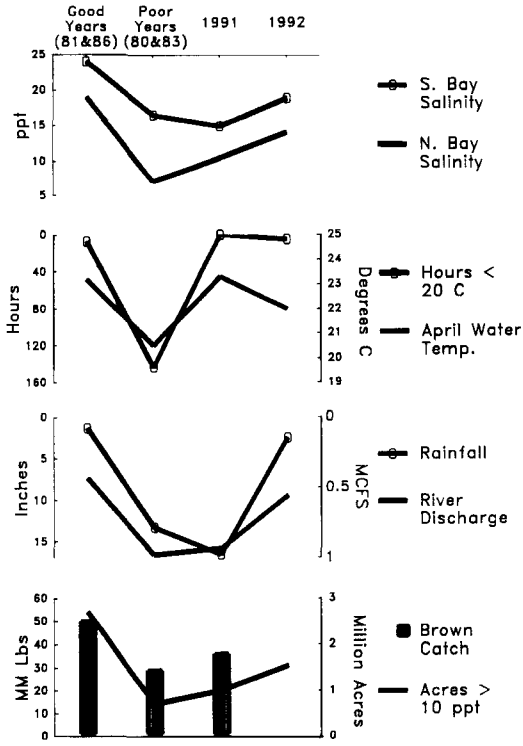

Figure 4. April environmental parameters important for brown shrimp production: Good brown shrimp production years (1981 and 1986), Poor brown shrimp production years (1980 and 1983), 1991, and 1992.

in the territorial sea was intensified during 1981 in an effort to collect data necessary to formulate sound management measures for penaeid shrimp in both inshore and offshore state waters. The Department of Wildlife and Fisheries is currently recommending season frameworks for both inshore and offshore territorial waters.

Past research has led to enactment of a number of management measures. In 1975, the Louisiana coast was divided into 3 zones for the purpose of shrimp management (Fig. 6). The zone approach has increased the Department's management options by allowing for (1) staggered openings of the shrimp season; (2) enactment of special seasons to more efficiently harvest large over-wintering white shrimp and pink shrimp (*Penaeus duorarum* (Burkenroad)); (3) special seasons to allow selective harvest of larger shrimp with particular gear (butterfly nets, etc.); and (4) special closures of ongoing seasons to reduce fishing pressure on undersized shrimp. The zone concept also allows for a uniform statewide opening of shrimp seasons when data indicate that shrimp sizes are similar in all 3 zones. The value of special seasons can be quantified by looking at the historical data. For example, during the period from 1970 through 1983, there were 21 season modifications enacted. Thirteen of these special seasons, for which quantitative information is available, have led to the additional harvest of 3.2 million pounds of shrimp valued at $5.7 million dockside.

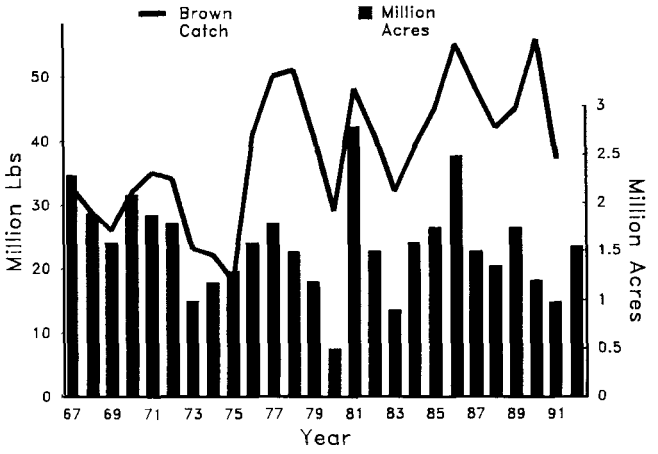

Figure 5. April acres of Louisiana estuary above 10 ppt salinity vs. observed Louisiana brown shrimp production.

Monitoring

Louisiana maintains a vigorous fishery-independent shrimp monitoring program in both the inshore waters and the territorial sea. This monitoring program is supplemented with specific research projects designed to better manage Louisiana's shrimp industry. Currently, the monitoring program consists of 2 phases: (1) biological and hydrological sampling at 106 stations in inshore waters and in the territorial sea on a year-round basis; and (2) a "crash" phase which is a 2-month period of intense sampling during which weekly sampling is significantly increased in inshore waters just prior to the setting of the spring inshore season.

Three basic gear types are used to collect biological data: (1) a 1/2 m circular plankton net is used to collect post-larval shrimp (8–15 mm in length) as they enter the estuary; (2) a 6-foot otter trawl constructed of 3/8-inch bar mesh wings and 1/4-inch bar mesh cod end is used to sample juvenile populations in the interior shallow marshes; and (3) a 16-foot otter trawl constructed of 3/4-inch bar mesh

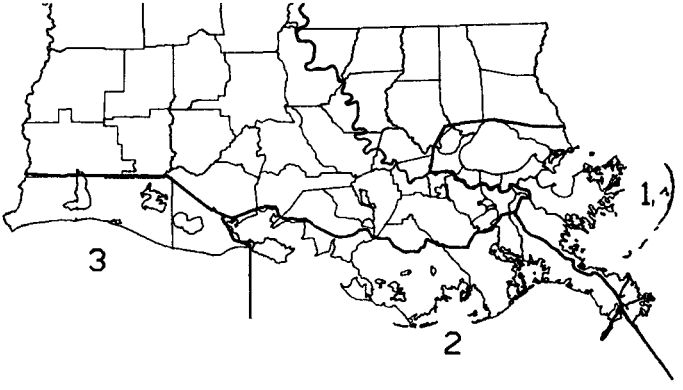

Figure 6. Louisiana shrimp management zones.

wings and a 1/4-inch bar mesh cod end is used to sample sub-adult populations in staging areas (larger inshore lakes and bays) and in the territorial sea. A salinometer is used to collect hydrological data (salinity and water temperature) each time a biological sample is taken. Data from other ongoing research and monitoring programs conducted by the Department, such as sampling in conjunction with the Louisiana Offshore Oil Port (LOOP), are used to supplement data from the shrimp monitoring program in formulating management recommendations.

Both the 6-foot and the 16-foot trawls are towed for 10 min at each of their respective stations. The contents of the trawl are sorted by species, counted, and 50 specimens are selected at random and measured in 5-mm groups. All species from the 16-foot trawl samples are identified and measured while only the commercially important shrimp species from the 6-foot trawl samples are processed.

The information collected from the Department's shrimp monitoring program is used to formulate the Department's recommendation of the opening and closing dates for the shrimp seasons. The monitoring information along with the Department's recommendation for spring season dates are presented to the Wildlife and Fisheries Commission and the shrimp industry in a public meeting which takes place during the first week of May each year. The timing of the opening date has become crucial given the magnitude of the inshore fishery. It has been estimated that as much as 75% of the shrimp on the inshore fishing areas is harvested during the first week of the season (Louisiana Department of Wildlife and Fisheries, unpubl. data).

The Louisiana Department of Wildlife and Fisheries currently has over 20 years of trawl data from this sampling program in a computerized data base which, in addition to being used to manage Louisiana's shrimp resources, has been used by state and federal fishery management agencies as well as university scientists in a variety of research applications. The program has been meticulously maintained and many original sampling sites continue to be utilized since the inception of the program. Information from this fishery-independent data base is currently being used to evaluate long term trends in fisheries production and how changes in habitat are affecting Louisiana's renewable fishery resources.

Literature Cited

Barrett, B. B. and M. C. Gillespie. 1973. Primary factors which influence commercial shrimp production in coastal Louisiana. La. Wildlife and Fish. Comm., Tech. Bull. No. 9.

——— and ———. 1975. Environmental conditions relative to shrimp production in coastal Louisiana. La. Wildlife and Fish. Comm., Tech. Bull. No. 15.

——— and E. Ralph. 1976. Primary factors which influence commercial shrimp production in coastal Louisiana. La. Dept. of Wildlife and Fish. Comm., Tech. Bull. No. 31.

——— and ———. 1977. Environmental conditions relative to shrimp production in coastal Louisiana along with shrimp catch data for the Gulf of Mexico. La. Dept. of Wildlife and Fish., Tech. Bull. No. 26.

———, J. L. Merrell, T. P. Morrison, M. C. Gillespie, E. R. Ralph, and J. F. Burdon. 1978. A study of Louisiana's major estuaries and adjacent offshore waters. La. Dept. of Wildlife and Fish., Tech. Bull. No. 27.

Broom, J. G. 1968. Pond culture of shrimp on Grand Terre Island, Louisiana, 1962–1968. La. Wildlife and Fish., Marine Lab at Grand Terre Island, La., 15pp.

Ford, T. B. and L. St. Amant. 1970. Management guidelines for predicting brown shrimp, *Penaeus aztecus*, production in Louisiana. La. Wildlife and Fish. Comm., 13pp.

Gaidry, W. 1974. Correlations between inshore spring white shrimp population densities and offshore overwintering populations. La. Wildlife and Fish. Comm., Tech. Bull. No. 12.

——— and C. J. White. 1973. Investigations of commercially important penaeid shrimp in Louisiana estuaries. La. Wildlife and Fish. Comm., Tech. Bull. No. 8.

George, M. J. 1962. Preliminary observations of the recruitment of postlarvae and growth of juveniles of the brown shrimp *Penaeus aztecus* Ives in Barataria Bay. La. Wildlife and Fish. Comm., 9th Bienn. Rep. 9 (1960–1961): 160–163.

Juneau, C. 1977. A study of the seabob, *Xiphopenaeus kroyeri* (Heller) in Louisiana. La. Dept. of Wildlife and Fisheries, Tech. Bull. No. 24.

——— and J. F. Pollard. 1981. A survey of the recreational shrimp and finfish harvests of the Vermillion Bay Area and their impact on commercial fishery resources. La. Dept. of Wildlife and Fisheries, Tech. Bull. No. 33.

Keithly, W. R. and L. Baron-Mounce. 1990. An economic assessment of the Louisiana shrimp fishery. MARFIN Contract NA88WC-H-MF179 Final Report, Coastal Fisheries Institute, Louisiana State University, Baton Rouge. 68pp.

Lyon, J. M. and C. J. Boudreaux. 1983. Movement of tagged white shrimp, *Penaeus setiferus* in the northwestern Gulf of Mexico. La. Dept. of Wildlife and Fisheries, Tech. Bull. No. 39.

Perret, W. S., B. B. Barrett, W. R. Latapie, J. F. Pollard, W. R. Mock, G. B. Adkins, W. J. Gaidry, and C. J. White. 1971. Cooperative Gulf of Mexico Estuarine Inventory and Study, Louisiana. Phase I, Area Description and Phase IV, Biology. La. Wildlife and Fish. Comm., New Orleans, LA. 175pp.

Roberts, K. S. and M. E. Sass. 1980. Louisiana's offshore shrimp fishery. Sea Grant Publication No. LSU-TL-80-003, September 1980.

Sass, M. E. and K. S. Roberts. 1979. Characteristics of the Louisiana shrimp fleet, 1978. Sea Grant Publication No. LSU-TL-79-006, December 1978.

St. Amant, L. S. 1979. The effect of competition among user groups on the establishment of optimal fishery management. La. Dep. of Wildl. Fish., New Orleans, La.

———, K. C. Corkum, and J. G. Broom. 1962. Studies on growth dynamics of the brown shrimp, *Penaeus aztecus*, in Louisiana waters. Bull. Mar. Sci. Gulf Carib. 15:14–26.

———, J. G. Broom, and T. B. Ford. 1966. Studies of the brown shrimp, *Penaeus aztecus*, in Barataria Bay, Louisiana, 1962–1965. Bull. Mar. Sci. Gulf Carib. 18:1–16.

White, C. J. 1975. Effects of 1973 river flood waters on brown shrimp in Louisiana waters. La. Wildlife and Fish. Comm., Tech. Bull. No. 16.

——— and C. J. Boudreaux. 1977. Development of an areal management concept for Gulf penaeid shrimp. La. Dept. of Wildlife and Fisheries, Tech. Bull. No. 22.