Annotated Bibliography of Biological and Economic Literature Related to The Gulf of Mexico Shrimp Fishery

by:

John M. Ward
National Marine Fisheries Service
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702

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Abramson, Norman J. and Patrick K. Tomlinson (197?). "An Application of Yield Models to a California Ocean Shrimp Population." Fishery Bulletin, 70(3):1021-1041.

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 the 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.

Adams, Charles M. (1984). "Price Dynamics in the U.S. Shrimp Market." Ph.D. dissertation, Department of Food and Resource Economics, University of Florida, Gainesville, FL.

Understanding the mechanism of price determination in a dynamic setting is imperative to formulating effective policy and assessing price impacts at each market level. This study examines the monthly and quarterly price determination process for raw-headless shrimp of the 31-40 and 21-25 size classes. Price response between market levels for both size classes was found to be symmetric. However, policy measures that alter the quantity or size distribution of shrimp through import quotas, tariffs, or seasonal restrictions, will have a greater price impact on the smaller shrimp. Increased supplies of maricultural shrimp will have a greater relative price impact on the 31-40 size class.

Adams, Charles M. (1985). "Selected Economics Research Needs of the Gulf and South Atlantic Shrimp Industry — A Workshop." Summary of a workshop held September 12-13, 1985, Madeira Beach, Florida. Technical Paper No. 42, Project No. SGEP-8, Grant No. NA85AA-D-SG059, November, 55 pp.

The workshop report focuses on (1) the impact of the development of foreign shrimp mariculture on the various sectors (production, processing, wholesaling, etc.) of the domestic shrimp industry, (2) the impact of future development of seafood based analog products and surimi on the domestic shrimp industry, and (3) the status of and problems associated with the development and improvement of econometric and bioeconomic modeling efforts concerning the domestic shrimp industry.

Adams, Charles M. (1993). "A Preliminary Assessment of Ex-vessel Price Movements in the South Atlantic Rock Shrimp Fishery." Report to the Staff of the South Atlantic Regional Fisheries Management Council, November 23, 13 pp.

The primary objective of this study is to examine the dockside pricing structure of rock shrimp and determine if dockside prices per pound are an increasing function of size of shrimp. Secondarily, the importance of demand shifters (income and availability of substitutes) in the determination of dockside prices is determined. The benefits of a closure that allows shrimp to grow into the larger size category is questionable because of the long life of the rock shrimp (20-22 months) and the common property nature of the fishery.

Adams, Charles M. and Fred J. Prochaska (1985). "Principle Economic Factors Determining U.S. Shrimp Prices at Alternative Market Levels." Draft report, Tropical and Subtropical Fisheries Tech. Conf. Proceedings.

This paper (1) reviews trends in prices, margins, and market shares for 21-25 and 31-40 count (tails per pound) raw, headless shrimp, (2) determines the direction of price flows and the nature of upward and downward price response between ex-vessel, wholesale, and retail market levels, and (3) determines the factors affecting prices for the two size classes at the three market levels.

Adkins, Gerald (1990). "A Comprehensive Assessment of Bycatch in the Louisiana Shrimp Fishery." Final report, MARFIN Grant No. NA89WC-H-MF006, Louisiana Department of Wildlife and Fisheries, Office of Fisheries, Post Office Box 189, Bourg, Louisiana.

This project was designed to survey nearshore, inshore and wingnet shrimp fishermen in coastal Louisiana, and assess the number, species composition, and weight of all incidentally caught organisms. The project objective was to assess the groundfish bycatch of the Louisiana shrimp fishery, including effects of gear type, season, and location. In trawls, an average fish/shrimp ratio by weight was 3.21:1, yielding an estimated total annual bycatch of 228 million pounds. The report contains a review of previously conducted bycatch trawl survey results and suggestions for reducing bycatch discarding including utilization, reduced trawl time, and limited entry.

Ajuzie, Emmanuel I.S., Raymond J. Rhodes, James C. Hite, and Mark S. Henry (1989). "The Economic Impact of South Carolina's Commercial Shrimp Industry, 1987." Technical Report 70, Marine Resources Division, South Carolina Wildlife and Marine Resources Department, Charleston, South Carolina and the Department of Agricultural Economics and Rural Sociology, Clemson University, Clemson, South Carolina, June.

An input-output model is used to assess the economic impact of the commercial shrimp fishery on South Carolina and subregions within the state, specifically 1) output ($31.4 million in sales), 2) total income ($16.3 million), 3) value-added ($17.8 million), and 4) employment (1,672 seasonal and full-time jobs).

Allen, T.S. (1985). "Financial Services Program." A Presentation to the Louisiana Shrimp Association Annual Meeting, New Orleans, LA, March.

A presentation refuting the contention that the National Marine Fisheries Service financial services program has contributed substantially to the overcapitalization of the Gulf and south Atlantic shrimp fleets.

Allen, T.S. (1994). "Shrimp Data Trends." Financial Services Office, National Marine Fisheries Service, St. Petersburg, FL.

Collection of figures and charts concerning shrimp data trends based on government loan guarantee program information.

Alvarez, Jose, Chris O. Andrew, and Fred J. Prochaska (1976). "Dual Structural Equilibrium in the Florida Shrimp Processing Industry." Fishery Bulletin, 74(4):879-883.

Stability, entry, exit, and mobility patterns for six size categories of firms in the Florida shrimp processing industry for the 1959-71 period were studied by utilizing Markov Chain analysis. Forecasts over time predict that a structural equilibrium in the industry will be achieved by 1985. The forecasted changes in firm distribution suggest that Florida shrimp industry sales will become increasingly concentrated due to expansion in number of both small and large firms. A dual equilibrium, resulting in fewer medium size firms and more small and large size firms, can be explained by the tendency for small firms to develop a specialty product and/or services to differentiate their markets from those of the very large firms. Medium sized firms, then, tend to expand in size, or decline and either move to specialty products and services or exit the industry.

Alvarez, Jose, Chris O. Andrew, and Fred J. Prochaska (1976). "Economic Structure of the Florida Shrimp Processing Industry." Report No. 9, State University System of Florida, Sea Grant Program, February, 46 pp.

This report provides information about the Florida shrimp processing industry based on 1972 data including the raw product supply situation, marketing channels and market structure, and conduct and performance. Changes and trends are identified to assist firms and potential investors in planning future participation in the industry. Specifically, the objectives are (1) delineate the organization and behavior of firms in the Florida shrimp processing industry by studying entry and exit, market concentration, product differentiation, and vertical integration; (2) identify emerging changes and important trends in procurement, processing activities, and product markets that will influence the shrimp processing industry in Florida.

Anderson, Lee G. (ed.) (1981). Economic Analysis for Fisheries Management Plans. Ann Arbor Science, Ann Arbor, Michigan.

The results of a workshop at the University of Delaware to address the level of economic analysis required to institute a fishery management plan.

Anderson, Lee G. (1989). "Optimal Intra- and Interseasonal Harvesting Strategies when Price Varies with Individual Size." Marine Resource Economics, 6(2):145-162.

A major concept in fisheries management is the optimal age for first capture. Because there can be separate market categories for fish of different sizes and different costs for their harvest, a more rational statement of the problem would be to find the optimal range of harvest sizes in any given year. Two models for solving this problem are presented. The shrimp model discusses optimal harvest of a single cohort of shrimp as it grows through a season. The lobster model discusses optimal simultaneous harvest of several cohorts over several seasons. The difficulty of defining a cost per fish in the lobster model makes it a much more complex undertaking.

Anderson, William W. (1970). "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, iii + 24 pp., 15 figs, 12 tables.

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 State, and by species, for the ten 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 1931-1935, 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.

Anderson, William W. and G. Robert Lunz (1965). "Southern Shrimp...A Valuable Regional Resource." Marine Resources of the Atlantic Coast, Leaflet Number 4, Atlantic States Marine Fisheries Commission, P.O. 2784, Tallahassee, Florida, October, 6 pp.

An overview of the south Atlantic shrimp fishery including the species of shrimp, management, and existing and on-going research.

Andrew, Chris O., Fred J. Prochaska, Jose Alvarez (1975). "Florida Shrimp: From the Sea Through the Market." SUSF-SG-75-005, Department of Food and Resource Economics, Florida Agricultural Experiment Station, Florida Sea Grant Program, Marine Advisory Program, May, 15 pp.

Even though shrimp are the most valuable seafood species landed in Florida, landings have not kept pace with growth of the shrimp processing industry. Landings from Florida waters have remained constant over time, but has declined as a share of total shrimp processed due to increased imports and the decline in Florida landings from Campeche and the Caribbean.

Anonymous (19??). "Fin Fishes Caught Incidental to Shrimp Trawling in the Western Gulf of Mexico." Draft report.

A discussion of the shrimp trawl bycatch of finfish and potential markets for the discarded catch.

Anonymous (19??). "Feasibility Study of Mariscos Del Carmen, S.A. and Pescadores De Mariscos Del Carmen, S.A." A prospectus prepared for a Mexican fishing firm.

A description of the plant, boatyard, and trawlers of a Mexican shrimp fishing firm with a statement of the net worth of the company and potential for future earnings.

Anonymous (1972). "Report of the National Marine Fisheries Service Gulf Coastal Fisheries Center, Fiscal Years 1970 and 1971." NOAA Technical Memorandum NMFS SER-1, July, iii + 26 pp., 14 figs., 4 tables.

Progress is reported at the NMFS 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.

Anonymous (1982). "Shrimp 1981." Marine Fisheries Review, 44(9-10):58-59.

A review of the 1981 shrimp fishery, harvesting sector to final consumer with emphasis on prices, imports and inventory levels, and landings in the United States.

Anonymous (1985). "Foreign Trade: Meaning Imports Take 69 Percent of the Market." The Fish Boat, August, 3 pp.

United States imports of shrimp in 1984 set a record at 422.3 million pounds.

Anonymous (1985). "Less Exports From Ecuador." The Fish Boat, August, 2 pp.

Ecuador shrimp exports declined primarily due to a reduced wild harvest of shrimp.

Anonymous (1985). "Shrimping '84: A Matter of More Shrimp Less Money." The Fish Boat, August, 4 pp.

A review of domestic production and consumer demand for shrimp.

Anonymous (1986). "Shrimping '85." The Fish Boat, August: 17-21.

A review of price declines as domestic production and consumer demand for shrimp increase.

Anonymous (1986). "Foreign Trade." The Fish Boat, August: 22-49.

A review of shrimp imports including country of origin and tends over time.

Anonymous (1987). "Philippine Shrimp Culture." Draft report, Office of International Fisheries, Foreign Fisheries Analysis Branch, National Marine Fisheries Service, Washington, D.C. 11 pp.

Shrimp imports have recently become an important source of foreign exchange for the Philippines. An unstable wild catch makes increasing production from aquaculture essential in maintaining these exports. While most sectors of the Philippine economy have shown little or no growth in recent years because of political instability, the shrimp culture industry has grown steadily, more than enough to offset recent fluctuations in the wild shrimp catch. Strong government and official international support, along with active private investment, has contributed much to this growth, and this support is expected to continue.

Anonymous (1988). Shrimp Farming in the United States. Aquaculture Digest, San Diego, CA.

The latest information on the major players in United States shrimp farming and a brief overview of the industry.

Anonymous (1994). "Management Options for the Royal Red Shrimp Fishery in the Gulf of Mexico." Draft report, Southeast Regional Office, National Marine Fisheries Service, St. Petersburg, FL, July, 13 pp.

A review of the existing data for the royal red shrimp fishery in the Gulf of Mexico. This paper on Phase 1 of the management approach is prepared by NMFS at the request of the Council to provide scientific information and advice and fishery management options for the royal red shrimp fishery resource. Phase 1 is the first step in a series of four steps that are intended to provide the Council with the material for a management plan for this species.

Anonymous (1994). "Options for Reduction of Bycatch in Shrimp Trawls." Tab D, No. 3, Gulf of Mexico Fishery Management Council Briefing Book for the New Orleans Meeting, November, 19 pp.

Briefly discusses the trends in finfish bycatch in the shrimp fishery and proposes bycatch reduction device management regulations to control and reduce the level of finfish bycatch in the fishery. Alternative management measures such as individual transferable quotas for shrimp or license limitation programs to directly control effort or correct the market failure are not presented or discussed.

Anonymous (1994). "Preliminary Alternatives for Management of the Royal Red Shrimp Fishery in the Gulf of Mexico." Preliminary draft report, December, 13 pp.

This amendment provides for management of the fishery for royal red shrimp in the U.S. Gulf of Mexico. Management alternatives include respecification of maximum sustainable yield (MSY), setting total allowable catch (TAC), restricting participation in the fishery, and establishing reporting requirements.

Anonymous (1995). "Shrimp License Management." In An Act Relating to the Authority to Establish License Management Programs for Commercial Fishing, Section 1, Chapter 77, Parks and Wildlife Code, Subchapter F, January.

A law proposed by the Texas State Legislature requiring transferable licenses for inshore, commercial bay and bait shrimp boats.

Antozzi, William O. (1993). "Import and Export Trends for Selected Seafood Products of Interest to the Southeast, January to June, 1993." Draft report, Southeast Regional Office, National Marine Fisheries Service, St. Petersburg, FL.

This report is a six month update to the annual report on import and export trends. Products and countries were selected based on relevance to current trade negotiations. Original trade data has been compiled by the Bureau of the Census and the National Marine Fisheries Service. Sources of explanatory information include U.S. foreign embassy reports and U.S. seafood product exporters and importers.

Aquatic Farms, Ltd (1989). "Asia-Wide Shrimp Agro-Industry Sector Study. "Final report submitted to The World Band, 1818 H Street, N.W., Washington, D.C. 20433, June, 283 pp.

This study provides an analysis of global marketing trends in demand and supply for shrimp exports including price and volume projections; and a review of the shrimp subsector in seven Asian countries (India, Bangladesh, Thailand, Malaysia, Indonesia, Philippines, and China), indicating potential areas of financial and technical assistance in the development of shrimp agro-industries. The study assesses the scope for the expansion of shrimp exports from the seven countries and determines assistance needs in the development of shrimp aquaculture.

Arnold, Vic (196?). "Shrimp." Unpublished working paper.

In this study, vessels from 13 major Gulf of Mexico shrimp ports were surveyed to determine their cost and earning structure. This information was combined with effort data for a sample of vessels spending 50 percent or more of their time on the Tortugas shrimp grounds. Using both these series of data, broken down into vessel size categories and specifying the distribution of landings between three Florida ports, a linear programming model was developed for the expressed purpose of determining the optimal patterns, the distribution of species and the cost components of vessel operations. Using constraints based on various

assumptions, results were derived that suggested considerable differences from current port use patterns. Social benefits derived from their application demonstrate the value of this technique.

Baron-Mounce, E.A., W.R. Keithly, and K.J. Roberts (1991). "Shrimp Facts." Louisiana State University Sea Grant Report.

The information presented in this booklet has been compiled from several sources to best illustrate many aspects of the shrimp fishery in past years. The material is presented in charts and graphs to give the reader a quick and easy reference for trends occurring in the shrimp fishery. A brief narrative is provided at the beginning of each of the following sections: (1) shrimp species, (2) shrimping seasons in inshore and offshore waters, (3) shrimp size, (4) shrimping effort, (5) participation in the commercial shrimp fishery, (6) recreational shrimping, and (7) shrimp supply and processing.

Barr, Louis (1970). "Alaska's Fishery Resources - The Shrimps." U.S. Fish and Wildlife Service, Fishery Leaflet 631, January, iii + 10 pp., 7 figs., 1 table.

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 Alaskan 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 the shrimp. They are sampling the commercial catch, trying to improve the product, and conducting exploratory fishing and biological research.

Barr, Louis (1973). "Studies of Spot Shrimp, Pandalus platyceros, at Little Port Walter, Alaska." Marine Fisheries Review, 35(3-4):65-66.

A summary of the existing and planned biological research being conducted on and the life history of spot shrimp at Little Port Walter, Alaska.

Baxter, Kenneth N. and Elizabeth Scott-Denton (eds.) (1992). Proceedings of the Southeast Fisheries Science Center Shrimp Resource Review, NOAA Technical Memorandum, NMFS-SEFSC-299, August, 186 pp.

This report serves as an official record of the shrimp research program review. Each program component of the shrimp research program is presented in abstract form. Hard copies of visual aids and the questions/clarifications session immediately follow each abstract.

Baxter, Kenneth N., Carlton H. Furr, Jr., and Elizabeth Scott (1988). "The Commercial Bait Shrimp Fishery in Galveston Bay, Texas, 1959-87." Marine Fisheries Review, 50(2):20-28.

Information about landings and species composition associated with the bait shrimp industry of the Galveston Bay system has been collected on a weekly schedule from 1959 through 1984 and on a more limited basis since 1985. Collectively, the bait index and the postlarval index provide: 1) a reliable indication of the subsequent offshore harvest and 2) a long term correlation between juvenile abundance and changing environmental conditions. In addition, insight into local fishing practices and trends provide background for continuing research needed to enhance production value of the shrimp stock.

Bearden, C., R. Low, R. Rhodes, R. Van Dolah, C. Wenner, E. Wenner, and D. Whitaker (1985). "A Review and Analysis of Commercial Shrimp Trawling in the Sounds and Bays of South Carolina." South Carolina Marine Resources Center, Technical Report No. 62, October, 51 pp.

There has been a commercial trawl fishery for shrimp in South Carolina's sounds and bays for over thirty years, and the controversy surrounding this practice is a longstanding one. Major issues of concern are related to potential ecological effects and impacts upon commercial and recreational fisheries. The prevailing management philosophy has been to permit shrimp trawling at appropriate times in offshore waters, sounds, and bays while prohibiting it in the tidal creeks and rivers that serve as nursery areas. This summary presents the historical background of the sound and bay policy, describes the rationale for allowing inside trawling, provides information on the issues, specifies recommendations, and lists alternatives for the management of the sound and bay resources.

Bielsa, Lourdes M., William H. Murdich, and Ronald F. Labisky (1983). "Pink Shrimp." Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (South Florida), Performed for Coastal Ecology Group, Waterways Experiment Station, U.S. Army Corps of Engineers, Vicksburg, MS and National Coastal Ecosystems Team, Division of Biological Services, Research and Development, Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C. October, 21 pp.

This species profile is one of a series on coastal aquatic organisms, principally fish, of sport, commercial, or ecological importance. The profiles are designed to provide coastal managers, engineers, and biologists with a brief comprehensive sketch of the biological characteristics and environmental requirements of the species and to describe how populations of the species may be expected to react to environmental changes caused by coastal development. Each profile has sections on taxonomy, life history, ecological role, environmental requirements, and economic importance, if applicable. A Habitat Suitability Index (HSI) model is being prepared by the U.S. Fish and Wildlife Service for the pink shrimp. HSI models are designed to provide a numerical index of the relative value of a given site as fish or wildlife habitat.

Blomo, Vito J. (1983). "Economic Criteria Regarding Diversification Through Public and/or Private Sector Financing." Report V in Assessment of Shrimp Industry Potentials and Conflicts, Volume II, Shrimp Notes Incorporated, 417 Eliza Street, New Orleans, Louisiana, August, 22 pp.

Cyclical swings in the profitability of shrimp harvesting operations has prompted an evaluation of diversifying the scope of fishing activities. This report first develops economic criteria the vessel owner can use to determine the profitability of any additional investment including the advisability of borrowing additional investment funds. Secondly, with financing for diversification from public and/or private sources being likely, economic criteria will be developed so that funds from these sources are loaned out and committed with minimal risk and with a high degree of accountability to the public for public funds.

Blomo, Vito J. and James E. Easley (1983). "Awareness Program for Shrimp Harvesters as to the Uses of Various By-Catch, The On-Going Development of the Turtle Excluder Device (TED) Information Program." Report IV in Assessment of Shrimp Industry Potentials and Conflicts, Volume II, Shrimp Notes Incorporated, 417 Eliza Street, New Orleans, Louisiana, August, 23 pp.

The purpose of this report is to discuss alternatives for an awareness program for shrimp fishermen regarding bycatch utilization. Bycatch reduction of undesirable sizes and species is an integral part of the problem, hence is also addressed. The first section below briefly summarizes recent information on bycatch,

its utilization and problems surrounding bycatch utilization. The second section discusses possible objectives of an awareness program and types of information that would be required. The third section then addresses strategies that might be pursued in terms of vehicles for conducting an awareness program. The next section discusses possible content and delivery methods for a Turtle Excluder Device (TED) information program. As such, it emphasizes bycatch reduction. The last section then discusses techniques for monitoring the effectiveness of an awareness program. Monitoring will be important to future decisions concerning whether to continue such a program.

Blomo, Vito J. and Wade L. Griffin (1978). "Costs and Returns Data: Florida-Based Gulf of Mexico Shrimp Trawlers, 1977." TAMU-SG-79-604, Department of Agricultural Economics, Texas Agricultural Experiment Station, Texas A&M University, October, 33 pp.

This report summarizes estimates of costs and returns for vessels of different characteristics that anchor in Florida and trawl in the Gulf of Mexico. Data for the calendar year 1977 were collected from vessel owners. Results are presented in self explanatory tables. No attempt is made to draw inferences or discuss implications of trends, or relationships that may be apparent in the data.

Blomo, Vito J. and John P. Nichols (1974). "Utilization of Finfishes Caught Incidental to Shrimp Trawling in the Western Gulf of Mexico, Part I: Evaluation of Markets." Department of Agricultural Economics and Rural Sociology, Texas Agricultural Experiment Station, Texas A&M University, June, 85 pp.

Discarded trawl fish can be processed into fish meal, fish solubles, fish oil, pet food, and various forms of seafood. This study evaluates the nature of the markets potentially available for trawl fish and estimates potential volumes that could be marketed through these channels. Price flexibilities were estimated for each market to evaluate impact of increased supplies on price. Based on these estimated relationships, current market conditions and the availability of trawl fish in the Western Gulf of Mexico, potential volumes that could move through each market were determined. For example, the total catch of trawl fish by shrimpers of 368 million pounds could move through the reduction market with only a negligible effect on price. The lack of viable marketing facilities along the Texas Coast for many product forms is an important limitation on flow of trawl fish into market channels.

Blomo, Vito J., Wade L. Griffin, and John P. Nichols (1978). "Catch-Effort and Price-Cost Trends in the Gulf of Mexico Shrimp Fishery: Implications on Mexico's Extended Jurisdiction." Marine Fisheries Review, 40(8):24-28.

This paper reviews the trends in the catch-effort and price-cost relationships in the Gulf of Mexico shrimp fishery. In addition, these relationships provide a rudimentary framework for analyzing the effect of Mexico's extended 200-mile jurisdiction. This paper updates the data series presented by Nichols and Griffin (1975) and also provides a more accurate estimate of fishing effort by shrimp vessels (Griffin, 1977).

Blomo, V.J., J.P. Nichols, W.L. Griffin, and W.E. Grant (1982). "Dynamic Modeling of the Eastern Gulf of Mexico Shrimp Fishery." American Agricultural Economics Association, 64(3):475-482.

The impact of alternative management schemes on the shrimp fishery of the eastern Gulf of Mexico is analyzed and compared to a baseline using simulation techniques (GBFSM). The fishery's biological and economic functions are modeled including intraseasonal shrimp growth rates, differences in demand for shrimp by size, and a heterogenous fishing fleet. Using consumer and producer surplus techniques, new fishing regulations appear socially optimal compared to the baseline. A rent maximization scheme

increases social surplus to its highest level. However, applying such a scheme to one part of the total Gulf of Mexico shrimp fishery is not recommended.

Blomo, V., K. Stokes, W. Griffin, W. Grant, and J. Nichols (1978). "Bioeconomic Modeling of the Gulf Shrimp Fishery: An Application to Galveston Bay and Adjacent Offshore Areas." Southern Journal of Agricultural Economics, 10(1): 119-125.

This article incorporates a nonlinear optimization procedure into the simulation model developed by Grant and Griffin (1979). The simulation model that integrates the biological relationships and shrimp fleet characteristics is combined with economic theory into a 12 month analysis that maximizes net income to the industry (gross returns over costs) over a shrimping season. The analysis can also evaluate changes in several institutional parameters that affect the utilization of the common property shrimp resource.

Bockstael, Nancy E. and Ivar E. Strand, Jr. (1993). "Free Trade and Global Resources: The Case of Protected Marine Species." Paper prepared for the IDB/ECLAC Project on Trade Liberalization, June, 1993.

The authors determine the impacts of institutional rules for the international trade of seafood on protected and endangered species focusing on the dolphin/tuna and shrimp/turtle controversies. Because of differences in the processing and harvesting industries for tuna and shrimp, essentially different results were obtained to protect endangered turtles and protected dolphins.

Branstetter, Henry R. (1976). "Statement Before the United States International Trade Commission." President Ocean Garden Products, Inc., January, 53 pp.

The National Shrimp Congress proposes that duties and quota restrictions be placed upon shrimp products imported to the United States to provide market stability for the domestic producers and to assist them in combating the major increases in operating costs that have occurred during the past several years.

Branstetter, Steve (1993). "Update of Foundation Activities for Bycatch Reduction Program." Memorandum from the Gulf and South Atlantic Fisheries Development Foundation, Inc., September 17.

An update on the Foundation's activities concerning the bycatch reduction research program. A total of 1,000 observer days for both characterization and BRD work aboard cooperating commercial vessels have been completed. A summary of the data collected to date is included in the report.

Browder, Joan A. (1983). "Vessel Activity Relative to the Texas Closure, 1981 and 1982." NOAA Technical Memorandum, NMFS-SEFC-118, U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Laboratory, 75 Virginia Beach Drive, Miami, Florida 33149-10999.

A quantitative description of shrimp vessel activity in the Gulf of Mexico relative to the Texas closure in 1981 and 1982 has been prepared to determine if Louisiana ports are more heavily utilized because of the closure, if Louisiana offshore fishing grounds are more heavily utilized because of the closure, if vessels have been prevented from fishing by the closure, and if benefits of the closure accrue to only a small proportion of the fleet. This is a brute force analysis of some extremely large data sets.

Browder, Joan A., L. Nelson May, Jr., Alan Rosenthal, James G. Gosselink, and Robert H. Baumann (1989). "Modeling Future Trends in Wetland Loss and Brown Shrimp Production in Louisiana Using Thematic Mapper Imagery." Remote Sens. Environ., 28:45-59.

The land-water interface of coastal marshes may influence the production of estuarine dependent fisheries more than the area of these marshes. To test this hypothesis, we created a spatial model to explore the dynamic relationship between land-water interface and degree of land loss in disintegrating coastal marshes of Louisiana's Barataria, Terrebonne, and Timbalier basins. Calibrating our model with Landsat Thematic Mapper satellite imagery, we found a parabolic relationship between land-water interface and marsh disintegration. Aggregated simulation data suggested that the land-water interface in the study area will soon reach its maximum and then decline. We found a statistically significant positive linear relationship between brown shrimp catch and total interface length over the past 28 years. This relationship suggests that shrimp yields will decline when interface declines, possibly beginning about 1995.

Brown, Gary L. (1981). "A Survey of Recreational Shrimping in the Bay and Sound Systems of the Gulf Coast for 1980." Final report, HSR-RR-81/2-PON prepared for Gulf States Marine Fisheries Commission, Gulf Coast Research Laboratory, Ocean Springs, Mississippi 29564, April, 28, 140 pp.

This paper reports the results of a 1980 survey of recreational shrimpers along the bay and sound systems of the Gulf Coast in 1979 and 1980 that was conducted complementarily with the NMFS recreational finfish survey (MRFSS?).

Bryan, C.E. (1983). "Abundance of Brown Shrimp (Penaeus aztecus) as Related to the 1982 Closure of the Texas Territorial Sea to Shrimping." Management Data Series Number 52, Coastal Fisheries Branch, Texas Parks and Wildlife Department.

To determine the closing and opening dates of the shrimping season in the Texas territorial sea in 1982 and relative abundance of brown shrimp in 1981 and 1982, samples were taken with 18.3 m bag seines along shorelines of seven bay systems; with 6.1 m trawls in the deeper portions of three bay systems and in five passes leading from the bays to the Gulf; and with 12.2 m trawls in Gulf of Mexico waters off the central coast. The purpose of the closed season was to protect small shrimp from fishing until they reached a larger, more valuable size and to minimize waste caused by discarding smaller sizes during the harvest. Based on biological sampling in April the closed season dates were set for 25 May to 14 July 1982. Additional sampling through July verified that these dates were appropriate to accomplish the purpose of the closure.

Bryan, C.E. and Terry J. Cody (1975). "Discarding of Shrimp and Associated Organisms on the Texas Brown Shrimp (Penaeus Aztecus Ives) Grounds." Draft report, Texas Parks and Wildlife Department.

From June 1973 through June 1975, the Texas Parks and Wildlife Department took 89 samples with the commercial shrimping fleet in the northwestern Gulf of Mexico to provide more information on the discarding of shrimp and associated organisms in the Texas brown shrimp fishery. Shrimp discards averaged 40% by number and 26% by weight in 1973 and 37% by number and 22% by weight in 1974 samples. Most of the shrimp discarding took place in June, July, and August. Using the average yearly landings of brown shrimp for the last nine years, an estimated 14.9 million kilograms (32.8 million pounds) of small shrimp and 116 million kilograms (255 million pounds) of associated organisms were discarded per year. Comparisons of catch rates for various types of trawls is also discussed.

Bryan, C.E., Terry J. Cody, and Gary C. Matlock (1982). "Organisms Captured by the Commercial Shrimp Fleet." Technical Series No. 31, Texas Parks and Wildlife Department.

During June-December 1973 and 1974, 81 samples were collected with a 13.7 m. wide otter trawls from aboard a research vessel in the same areas that commercial shrimp vessels were fishing on the Texas

brown shrimp grounds. This study was done to estimate the amounts and kinds of organisms captured during shrimping operations and to estimate the amounts discarded and times when most discarding occurred. Economic waste of small shrimp discarding could be minimized if legal size limitations were removed and waters were closed to shrimping when small, less preferred shrimp predominated. Under present conditions, no monetary incentive to market other invertebrates and fish species captured on the brown shrimp grounds appears to exist because of their relatively low volume and small size.

Byrne, Richard, Wade Griffin, and Joy Clark (1988). "Four Teds and Analysis of Variance." Natural Resource Working Papers Series, Natural Resource Workgroup, Department of Agricultural Economics, Texas A&M University, College Station, Texas 77843.

The Cape Canaveral data is analyzed statistically to determine the effects of the four TEDs. First, we describe the structure of the experiment. Then, we present the Anova table and perform tests of hypotheses. Next, we analyze the percent of shrimp retention of the four TEDs using confidence intervals. Finally, we perform multiple comparisons to determine which TEDs have the highest yields.

Caillouet, Charles W., Jr. and Kenneth N. Baxter (1973). "Gulf of Mexico Shrimp Resource Research." Marine Fisheries Review, 35(3-4):21-24.

This paper describes shrimp resource research presently being conducted by the Galveston Laboratory of the National Marine Fisheries Service Gulf Coastal Fisheries Center. Discussed are plans for development of a mathematical model capable of explaining and predicting changes in shrimp catch, and on-going mark recapture experiments, prediction of catch, stock identification studies, and study of spawning grounds. Trends in Texas and Louisiana brown and white shrimp catches and catch rates are presented.

Caillouet, Charles Wax, Jr. and Dennis Brian Koi (1983). "Ex-Vessel Value and Size Composition of Reported May-August Catches of Brown Shrimp and White Shrimp from 1960 to 1981 as Related to the Texas Closure." Gulf Research Reports, 7(3):187-203.

Indices were used to test for trends in ex-vessel price spread (value per shrimp by size category), size composition, and ex-vessel value composition of the reported May-August catches (inshore and offshore combined) of brown shrimp (Penaeus aztecus) and white shrimp (P. setiferus) from the Texas coast, the Mississippi River to Texas, and Pensacola to the Mississippi River, from 1960 to 1981. Levels of reported May-August catch and ex-vessel value of the catch also were examined for the same period. Statistical tests were conducted to determine if 1981 was an outlier as compared to other years, in the context of impacts of closure of the fishery conservation zone (FCZ) off Texas to shrimping from May 22 to July 15, 1981, a management measure referred to as the Texas Closure.

Caillouet, Charles W., Frank J. Patella, and William B. Jackson (1979). "Relationship Between Marketing Category (Count) Composition and Ex-Vessel Value of Reported Annual Catches of Shrimp in the Eastern Gulf of Mexico." Marine Fisheries Review, (May-June): 1-7.

The relationship between estimated ex-vessel value of reported annual shrimp catches and weight of these catches is used to show the effects of regional differences in count composition of these catches, a function of differences in shrimp laws and harvesting strategy. It seems clear that the strategy of harvesting large proportions of larger shrimp in Texas increases both the weight and ex-vessel value of these catches. Social impacts and economic inputs beyond the ex-vessel level also require consideration in studies of effects of harvesting strategy.

Caillouet, Charles W., Frank J. Patella, and William B. Jackson (1980). "Trends Toward Decreasing Size of Brown Shrimp, Penaeus Aztecus, and White Shrimp, Penaeus Setiferus, in Reported Annual Catches from Texas and Louisiana." Fishery Bulletin, 77(4):985-989.

An exponential model adequately characterized the size composition (expressed as a regression of transformed cumulative percentage of weight on size category) of reported annual catches of brown and white shrimp in Texas and Louisiana from 1959 to 1976. Louisiana catches contained considerably greater proportions of small shrimp than did Texas catches. For both species and states, there was a significant trend toward increases in the proportion of small shrimp in the catches over the period.

Caillouet, Charles W., Jr., B.J. Fontenot, Jr., W.S. Perret, R.J. Dugas, and H.F. Hebert (1971). "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. Department of Commerce, NOAA, NMFS, Data Report 64, July, 39 pp.

A small trawl towed in a semicircle of 30.5 m (100 ft) radius in 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.

Caillouet, Charles W., Jr., Marcel J. Duronslet, Andre M. Landry, Jr., Dickie B. Revera, Donna J. Shaver, Kerry M. Stanley, Erich K. Stabenau, and Robert W. Heinly (1990). "Sea Turtle Strandings and Shrimping Effort in the Northwestern Gulf of Mexico, 1986-1989." Draft report, National Marine Fisheries Service, Galveston Laboratory, Galveston, Texas 77551-5997.

The purpose of this paper was an examination of sea turtle strandings and shrimping effort in the northwestern Gulf of Mexico during 1986-1989 to determine the relationship if any between them. The study apparently confuses correlation with causation.

Caillouet, Charles W., Jr., Marcel J. Duronslet, Andre M. Landry, Jr., Dickie B. Revera, Donna J. Shaver, Kerry M. Stanley, Robert W. Heinly, and Erich K. Stabenau (1991). "Sea Turtle Strandings and Shrimp Fishing Effort in the Northwestern Gulf of Mexico, 1986-1989." Fishery Bulletin, 89(4):712-718.

Incidental capture of sea turtles in shrimp trawls is the most important human cause of sea turtle mortality. In this study, a product-moment correlation analysis to test the null hypothesis that there was no relationship between monthly sea turtle strandings and shrimp fishing effort on the northwestern Gulf of Mexico coast during 1986-89. A positive, statistically significant result was found causing the null hypothesis to be rejected. Several caveats to the analysis are cited including the effects of wind, waves, tides, and scavengers on the stranding levels of turtles. These caveats tend to reduce the implied causation that shrimp fishing effort levels affects turtle stranding levels.

Campbell, Page, Ted Storck, Vanenise Price, and Lance Robinson (1992). "Trends in Texas Commercial Fishery Landings, 1972-1991." Management Data Series No. 86, Texas Parks and Wildlife Department, Fisheries and Wildlife Division, 4200 Smith School Road, Austin, Texas.

This report summarizes annual commercial landings and ex-vessel value statistics of finfish and shellfish harvested from Texas bays and the Gulf of Mexico off Texas. These landings and value data for individual species groups are summarized according to bay system or Gulf area from which the product was

taken and by month landed. Total coast wide landings in 1991 were more than 102 million pounds and ex-vessel value was over $199 million. These values were 11% and 19%, respectively, below the record values of 1986. Shrimp accounted for 89% of the weight and 94% of ex-vessel value of all seafood landed in calendar year 1991. During 1991 blue crabs, Eastern oysters and finfish made up 6%, 3%, and 2% of total landings and 1%, 4%, and 1% of the total ex-vessel value, respectively. Compared to 1990 prices, the 1991 average unit price for shrimp increased; the unit prices of blue crabs did not change, while the unit price of Eastern oysters decreased 22%. Finfish unit prices generally declined.

Capps, Oral, Jr. (1982). "Consumer Expenditure Patterns for Fish and Shellfish." Marine Fisheries Review, 44(3):1-6.

       This study investigates the nature and magnitude of the influence of household income, and socioeconomic and demographic variates on aggregate seafood expenditure in the United States.

Carothers, Paul E. and William E. Grant (1987). "Fishery Management Implications of Recruitment Seasonality: Simulation of the Texas Fishery for the Brown Shrimp, Penaeus aztecus." Ecological Modeling, 36:239-268.

       The relationship between recruitment seasonality and ordination of alternative management policies for the Texas brown shrimp (Penaeus aztecus) fishery is explored through utilization of a general stochastic simulation model developed for annual crop marine fisheries. The model represents harvest dynamics within the fishery through a series of finite difference equations representing recruitment, growth, migration, and mortality of brown shrimp, and fishing effort. The model is parameterized to reflect two alternative representations of brown shrimp recruitment dynamics, and the behavior of each model version is explored under four management policy options. The alternative recruitment representations differ in temporal pattern of postlarval brown shrimp immigration into coastal estuaries, and the management policy options reflect variations in seasonal closures and minimum size restrictions for the fishery. Analysis of model outputs identified a statistically significant interaction between recruitment representation and the performance of the alternative management policies based upon predicted harvests within the fishery. This interaction indicates the failure of the alternative recruitment model versions to produce a consistent predicted harvest response over all management policy options. Under an average representation of postlarval recruitment pattern, no significant differences in management option performance were detected, while two of four management options produced significantly lower harvests under a seasonally variable recruitment pattern.

Centaur Associates Inc. (1985). Commercial Fishing Cost Return Profiles for Gulf Coast Areas. Prepared for Army Corps of Engineers Mobile District, 109 St. Joseph Street, Mobile, Alabama. Under Contract No. DACW01-84-C-0111.

       Final report of a shrimp vessel cost and returns survey contract of selected ports in Mississippi and Alabama. Summarized data is provided in the form of tables with some preliminary analysis of wage rates, returns to owner for management, returns to the vessel, daily operating costs, and unit operating costs.

Chauvin, William D. (1985). "The World Market, How 1985 Shrimp Production May Affect 1986 Supplies." Seafood Leader, (Winter): 81-96.

       The impact of international supply and demand conditions, such as shrimp farming, on prices is discussed in this paper.

Chauvin, William D. (1992). "Asia's Aquaculture Success has Taken the World Shrimp Market By Storm." Seafood Business, (July/August): 45-89.

A market report on the impact of black tiger shrimp aquaculture on the world demand for shrimp and shrimp prices.

Chauvin, William D. and Kenneth J. Roberts (1983). "Impact of Pond-Raised Shrimp, Particularly from South America, On the U.S. Market." Report VII in Assessment of Shrimp Industry Potentials and Conflicts, Volume One, Shrimp Notes Incorporated, 417 Eliza Street, New Orleans, Louisiana, August, 106 pp.

This paper discusses the impact of pond raised (aquaculture) shrimp on U.S. markets with special emphasis on Ecuador and other international markets for shrimp.

Cheng, Hsiang-tai and Oral Capps, Jr. (1987). "Demand for Disaggregate Fish and Shellfish Species in the United States." Bulletin 87-2, Virginia Agricultural Experiment Station, Virginia Polytechnic Institute and State University.

The primary objective of this research is to provide quantitative information, notably own-price, income, and household size elasticity measures, about consumer behavior relating to specific fish and shellfish products.

Cheng, Hsiang-tai and Oral Capps, Jr. (1988). "Demand Analysis of Fresh and Frozen Finfish and Shellfish in the United States." American Journal of Agricultural Economics, 70(3):533-542.

Household expenditures for at home consumption on three species of shellfish and five species of finfish were analyzed. Factors explaining the variation of expenditures on seafood commodities were own price, household income, coupon value, household size, geographic region, urbanization, race, and seasonality. Own-price elasticities ranged from -0.45 (flounder/sole) to -1.13 (oysters). Expenditures on fishery products were more sensitive to changes in household size than to changes in household income. Cross-price effects of red meat and poultry were not statistically significant. For comparison purposes, estimates of own price, income, and household size elasticities from the literature were made with this set of elasticities.

Chittenden, Mark E., Jr. and John D. McEachran (1976). "Composition, Ecology, and Dynamics of Demersal Fish Communities on the Northwestern Gulf of Mexico Continental Shelf, with a Similar Synopsis for the Entire Gulf." TAMU-SG-76-208, Department of Wildlife and Fisheries Sciences, Texas Agricultural Experiment Station, Texas A&M University, College Station, Texas 77843, July, 104 pp.

Relative biomass was much higher on the brown shrimp grounds than on the white shrimp grounds. Relative biomass was much higher in summer than during winter, especially on the white shrimp grounds. Overall, 11.35 volumes of discard were landed to one volume of headed shrimp. We estimate that about 219,050 metric tons of fish were discarded annually in the Gulf by Texas-based shrimp trawlers during the period 1962-71. Typical life spans appear to be only one or two years, so that these fishes must mature rapidly. Their theoretical total annual mortality rates are about 90-100%, so that there must be a rapid turnover of biomass on the shrimp grounds. Fishes with this type of life cycle tend to withstand extensive fishing without danger of over harvesting, so that they apparently have great fisheries potential. The Gulf shrimp fishery at present does not appear to be over harvesting the demersal fishes.

Christensen, Steen and Niels Vestergaard (1993). "A Bioeconomic Analysis of the Shrimp Fishery of Greenland in the Davis Strait." Presented at the International Conference on Fisheries Economics, Os, Norway, May 26-28.

     Shrimp (Pandalus borealis) is by far the most important species in the Greenland fisheries and the present basis of Greenland's economy (90% of total exports and 30% of the world supply of cold water shrimp). To provide guidance on the effects of yield from management measures designed to reduce the quota by 20% for 1993, this paper presents a bioeconomic analysis based on estimates of the total mortality, growth, discard, and the 1991 operating costs that determines the resource rent and optimum effort of the shrimp fishery in the Davis Strait. Effort must be reduced by at least 40% compared to the 1991 level to obtain MEY. The gain in economic rent is estimated to be at least 19% compared to the economic rent of 1991.

Christensen, Steen and Niels Vestergaard (1993). "A Bioeconomic Analysis of the Greenland Shrimp Fishery in the Davis Strait." Marine Resource Economics, 8(4):345-365.

     This paper presents a bioeconomic analysis determining the resource rent and optimum effort of the shrimp (Pandalus borealis) fishery in the Davis Strait taking into account the discard behavior of the fleet. It is demonstrated that from an economic point of view the shrimp stock in the Davis Strait is substantially overfished. To obtain the maximum economic yield, the effort must be reduced by at least 40% compared to the effort level of 1991. The gain in resource rent by reducing effort is estimated to be at least 20% compared to the resource rent of 1991.

Christmas, J.Y. and David J. Etzold (eds.) (1977). "The Shrimp Fishery of the Gulf of Mexico United States: A Regional Management Plan." Technical Report Series, No. 2, Gulf Coast Research Laboratory, Ocean Springs, Mississippi, August, 128 pp.

     The regional Gulf of Mexico shrimp fishery management plan documents the problems and lists the goals and objectives necessary to manage the shrimp resources of the Gulf of Mexico and provide optimum sustained benefits for the nation. The fishery is described, shrimp producing zones of the region are identified for preservation and improvement, and statistics collection is facilitated. The report promotes research in bio-social-economic model development, development of a regional management plan, and extension education of shrimp fishermen.

Clark, Joy Lynn McCoy (1988). "The Economic Impact of Proposed Ted Regulations on Texas Shrimp Fishermen." Dissertation, Department of Agricultural Economics, Texas A&M University, College Station, TX, 185 pp.

     Shrimp fishermen trawling in the Gulf of Mexico and south Atlantic inadvertently capture and kill turtles that are classified as endangered species. Recent legislation requires the use of a Turtle Excluder Device (TED) that when placed in the shrimp trawl prevents turtle mortality. The impact of the TED on shrimp production is not known. Analysis of TED regulations using an annual firm level simulation model indicated that the average gulf fleet had a low probability of being an economic success before enacting the regulations. An assumption that the TED regulations result in decreased production aggravated this condition, while an analysis assuming a positive impact on production slightly improved the economic viability of the firm. When an analysis was conducted on a monthly basis considering industry wide interaction between landings per vessel in one time period and available shrimp stock the next, the impact of the TED regulations was mitigated. A decrease (increase) in effective effort each time period, as the result of using a TED, increased (decreased) available stock in succeeding time periods and reduced the

negative (positive) impact upon production. In both analyses, a negative impact of the TED on shrimp production resulted in a decline in the economic viability of the firm. Likewise, a positive impact improved the firm's economic viability.

Clark, Joy and Wade Griffin (1987). "Costs and Returns of Seven Texas Shrimp Vessels." Natural Resources Working Papers Series, Natural Resource Workgroup, Department of Agricultural Economics, Texas A&M University, College Station, Texas 77843.

This report presents summaries of costs and returns information for seven categories of vessels shrimping off the Texas coast. This information can be compared with a vessel of similar type. Trends of revenue, variable costs and pounds landed for these categories are also presented.

Clark, Joy, Wade Griffin, Jerry Clark, and James Richardson (19??). "Economic Impact of TED on the Shrimp Industry in the Gulf of Mexico." Draft report, Texas A&M University, College Station, Texas.

The purpose of this paper is to estimate the costs and returns to individual gulf vessels of using a turtle excluder device, a key issue in the ongoing debate over whether TEDs should be used. The results of four scenarios indicated a decline for negative impacts and an increase for positive impacts on shrimp production.

Clark, Joy, Wade Griffin, Jerry Clark, and James Richardson (1991). "Simulated Economic Impact of TED Regulations on Selected Vessels in the Texas Shrimp Fishery." Marine Fisheries Review, 53(2):1-8.

Shrimp fishermen trawling in the Gulf of Mexico and south Atlantic inadvertently capture and kill sea turtles that are classified as endangered species. Recent legislation requires the use of a Turtle Excluder Device (TED), that when in place in the shrimp trawl, reduces sea turtle mortality. The impact of the TED on shrimp production is not known. This intermediate analysis of the TED regulations using an annual firm level simulation model indicates that the average Texas shrimp vessel had a low probability of being an economic success before regulations were enacted. An assumption that the TED regulations resulted in decreased production aggravated this condition and the change in Ending Net Worth and Net Present Value of Ending Net Worth before and after a TED was placed in the net was significant at the 5 percent level.

However, the difference in the Internal Rate of Return for the TED and non-TED simulations was not significant unless the TED caused a substantial change in catch. This analysis did not allow for interactions between the fishermen in the shrimp industry, an assumption that could significantly alter the impact of TED use on the catch and earnings of the individual shrimp vessel.

Clark, Stephen H. and Charles W. Caillouet, Jr. (1973). "White Shrimp (Penaeus setiferus) Population Trends in a Tidal Marsh Pond. Marine Fisheries Review, 35(3-4):27-29.

Ketchen's modification of the Leslie fishing success method was used to estimate initial population and rates of immigration, fishing, and other losses (emigration and natural mortality) in a white shrimp population in a Texas tidal marsh pond. The significant decline in catch rates of marked and unmarked shrimp during the experiment was due to fishing and other causes (emigration and natural mortality), but the reduction due to fishing was less than that due to other causes. We believe that this or similar methods offer considerable promise in future studies of this nature.

Clement Associates, Inc. (1989). " "Shrimp Trawling Requirements" Rulemaking: Initial Technical Review." Report prepared by Clement Associates, Inc., 9300 Lee Highway, Fairfax, Virginia 22031, September 14, 16 pp.

An analysis of the data and analysis underlying the shrimp trawling requirements proposed by NMFS that indicates the technical basis for the rule is not solid and additional analysis and data collection is necessary before trawl time limitations and TED regulations be imposed on the industry.

Cobb, Stephen P., Charles R. Futch, and David K. Camp (1973). "The Rock Shrimp, Sicyonia Brevirostris Stimpson, 1871 (Decapoda, Penaeidae)." Memoirs of the Hourglass Cruises, Vol. III, Part I, February, 38 pp.

Rock shrimp were collected monthly from the west Florida shelf during Project Hourglass. A total of 973 rock shrimp were weighted, measured, sexed, and examined for morphological variation. Ovaries of 463 females were removed and classified and studies of carapace length for males and females were conducted. Rock shrimp is a generalize carnivore feeding primarily on mollusks and crustaceans. Feeding activity is nocturnal and occurs yearlong. No economically important concentrations of rock shrimp were found in the study area, but populations with apparent economic potential have been reported off Cape St. George, Florida, Cape Canaveral, and Isla Contoy, Mexico.

Cody, Terry J., Paul C. Hammerschmidt, Gary C. Matlock, C.E. Bryan, Jerry E. Clark, and R. Page Campbell (1989). "Fishery Management Plan for the Shrimp Fishery in Texas Waters. Texas Parks and Wildlife Department, Coastal Fisheries Branch, 4200 Smith School Road, Austin, Texas 78744.

A proposed shrimp fishery management plan for the Texas territorial sea.

Condrey, Richard E. (198?). "Shrimp Population Models and Management Strategies: Potentials for Enhancing Yields." Draft report, Coastal Fisheries Institute, Center for Wetland Resources, Louisiana State University, Baton Rouge, Louisiana 70803-7503.

The use of models in management of the U.S. Gulf of Mexico shrimp fishery is reviewed and deficiencies discussed. The historical use has been primarily limited to a continuing reevaluation of two narrowly constructed management measures that were designed to provide moderate increases in yield. Areas of major social or ecological concern and areas in which yield can be dramatically enhanced have received little attention. Specific examples discussed include wetland loss, the use of TEDs, and the excessive growth-overfishing that occurs in some states.

Condrey, Richard E., James G. Gosselink, and Harry J. Bennett (19??). "Comparison of the Assimilation of Different Diets By Penaeus setiferus and P. aztecus." Fishery Bulletin, 70(4):1281-1292.

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.

Conroy, Patricia D. and John R. Poffenberger (1986). "Estimated Impacts of Texas Closure Regulation on Ex-Vessel Prices and Value of Shrimp, 1983 and 1984." NOAA Technical Memorandum NMFS-SEFC-171, U.S. Department of Commerce, National Oceanic and Atmospheric Administration,

National Marine Fisheries Service, Southeast Fisheries Center, 75 Virginia Beach Drive, Miami, FL, February, 16 pp.

The Fishery Conservation Zone (FCZ) off the coast of Texas has been closed to shrimping since 1981 (mid May to mid July) to coincide with the closure of the Texas territorial sea. These areas were closed to increase the size of commercially harvested brown shrimp. The econometric analysis of brown shrimp supply-demand relationships for three shrimp sizes (small: more than 67 tails per pound; medium: 31-67 tails per pound; and large: less than 31 tails per pound) estimated the changes in exvessel prices associated with simulated changes in landings. The estimate 0.4 million pound increase in landings due to the FCZ closure resulted in an increase in revenue of $6.7 million for May 1983 through April 1984. Preliminary estimates of the closure effect for May-August 1984 show a decrease in landings of 0.8 million pounds with an increase in revenue of $5.8 million. Changes in landings and value are due to the estimated decrease in catch of lower valued small shrimp with an increase in higher valued medium and large shrimp. The combined closure of the Texas territorial sea and the Texas FCZ in 1983 was estimated to have increased brown shrimp landings by 3.5 million pounds, with a resulting increase in revenue of $31.7 million for May 1983 through April 1984.

Cook, Harry L. and M. Alice Murphy (19??). "Early Development Stages of the Brown Shrimp, Penaeus aztecus Ives, Reared in the Laboratory." Fishery Bulletin, 69(1):223-239.

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.).

Cooper, Christopher (1991). "Shrimpers Search for Inexpensive and Simple Fish Excluder." National Fisherman, January: 40-43.

Shrimpers on the East and Gulf coasts have been given a three year breather. They have until at least 1994 to develop a way to reduce finfish bycatch.

Coste, Sharon (1995). "News Release." South Atlantic Fishery Management Council, 1 Southpark Circle, Suite 306, Charleston, S.C., February, 16.

Update on issues affecting the south Atlantic fisheries. Live Rock aquaculture permit system approved by Council. Wreckfish TAC status quo maintained. Rock shrimp final action deferred.

Corbett, Michael G. (1970). "Machine for Separating Northern Shrimp, Pandalus borealis, from Fish and Trash in the Catch." Fishery Industrial Research, 6(2):53-62.

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 extend 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.

Crouch, Ben M. (1989). "Mexican Shrimp, Texas Shrimpers, and Maritime Conflict: The Creation of a White Collar Crime." Deviant Behavior, 10:211-232.

Though not its specific intent, the 1981 amendment of the Lacey Act transformed a traditional practice among south Texas shrimpers-fishing in Mexican waters—into a violation of federal maritime law. Prior to the amendment this practice was overlooked by U.S. authorities and only sporadically controlled by Mexican authorities. Federal strategies for Lacey Act enforcement in the northern Gulf of Mexico and shrimper reactions to them led to an escalation of conflict between U.S. fishermen and authorities. Drawing on official documents and extensive interviews with both shrimpers and federal agents, the analysis examines federal authority and shrimper interaction over time and applies Turk's theory of normative-legal conflict to explain the course of that interaction.

Cummins, Robert C., Jr. and Albert C. Jones (1973). "Distribution of Commercial Shrimp off the Northeastern Coast of South American." Marine Fisheries Review, 35(3-4):31-35.

A report on the RV Oregon II survey of the shrimp fishing grounds off the coasts of Guyana, Surinam, and French Guiana in June and July of 1972.

Dahlstrom, W.A. (1973). "Status of the California Ocean Shrimp Resource and Its Management." Marine Fisheries Review, 35(3-4):55-59.

The development and history of regulation and management for ocean shrimp (Pandalus jordani) fishery off the U.S. Pacific coast are described. Biological data on distribution, migration, life history, size, age, growth, and mortality is summarized. The status of the resource is questionable with low yields expected in the future.

Danville Research Associates, Inc. (1982). "Work Plan for the Development of Cost, Revenue and Income Profiles for the Gulf and South Atlantic Shrimp Fleets." Contract No. NA82-GA-C-00041, National Marine Fisheries Service, Southeast Fisheries Center, 75 Virginia Beach Drive, Miami, Florida 33149, December 1.

A work plan for developing statistically sound data on the operating costs and revenues of the Gulf of Mexico and south Atlantic shrimp fleets.

Danville Research Associates, Inc. (1984). "Survey of the Shrimp Processing Industry in the Southeast." Chapter 3, Draft final report, Contract No. NA84-WC-C-06032, National Marine Fisheries Service, Southeast Fisheries Center, 75 Virginia Beach Drive, Miami, Florida 33149, September 30, 1984.

Summary of data set collected under contract for a study of shrimp processors in the Southeast Region.

Darcy, George H. (1984). "Problems in the United States Shrimp Industry: Are Import Restrictions the Answer." Draft report.

Because of fluctuating and generally decreasing profitability of producers (fishermen) in the U.S. shrimp industry, the industry has requested that import restrictions be placed on foreign shrimp. The analysis that follows considers the problem of profitability, attempts to identify the underlying causes, addresses the issue of import restrictions, and suggests alternative means for solving the economic problems of the industry.

De Sylva, Donald P. (1954). "The Live Bait Shrimp Fishery of the Northeast Coast of Florida." Technical Series, No. 11, Marine Laboratory, University of Miami, Coral Gables 34, Florida.

This investigation studied the biological and economic aspects of the fishery in relation to the shrimping areas involved, the species of shrimp caught, fishery methods and gear, catch composition ecology of the shrimp area, effects of certain gear on the ecology of shrimp areas, especially pushnets, statistics and economics of the fishery, and methods of holding and transporting live shrimp. During this three month study from June to August, 1953, 47 fishermen and dealers were interviewed and field studies were conducted to collect and observe the fishing methods.

Division of Economic Research (1970). "Basic Economic Indicators: Shrimp, Atlantic and Gulf, Master Plan Fishery 50 10 27." Working Paper No. 57, Bureau of Commercial Fisheries, May, 70 pp.

Pertinent economic, technological, and biological data are assembled in this report for the Atlantic and Gulf of Mexico shrimp fishery for the years 1947 to 1968.

Division of Marine Fisheries (1990). "Super Shooters Pass Test." News Release, North Carolina Department of Environment, Health, and Natural Resources, Morehead City, N.C. 2 pp.

A report on the successful testing of the super shooter turtle excluder device in Pamlico Sound.

Doll, John P. (1972). "An Econometric Analysis of Shrimp Ex-Vessel Prices, 1950-1968." American Journal of Agricultural Economics, 54(August):431-440.

A five equation demand model of the U.S. shrimp market was estimated using annual data for the period from 1950 to 1968. Prices, consumption, and ending stocks were the jointly determined variables; predetermined variables were shrimp supplies and consumer income. Ex-vessel price variations resulted largely from variations in domestic landings. Imports reduced the general level of ex-vessel prices but did not contribute substantially to price variability except in isolated instances. Large price drops occurred during periods of recession when increases in demand were slowed and stocks began to build, while landings and imports increased substantially over the previous year.

Doll, John P. and Sean B. Chin (????). "A Use for Principal Components in Price Analysis." Research Notes, ?:591-593.

The purpose of this note is to show how principal components can be used as an aid in understanding the nature of the fluctuations present in several series of annual shrimp prices.

Dore, Ian (1993). "Shrimp Futures." American Seafood Institute Report, 4(7):23-25.

A basic description of hedging in the newly opened shrimp futures market.

Duffy, John, Jr. and David B. Johnson (1979). "Study of Costs and Earnings of Bay Shrimp Fishermen in Louisiana." Contract Number 03-7-042-35132, Louisiana State University, Baton Rouge, Louisiana.

This survey was conducted to develop 1977 economic data on the inshore shrimping industry located in the Louisiana parishes of St. Mary, Lafourche, and Terrebonne. Economic information was gathered on mean average landings of shrimp for various boat sizes, as well as mean family size and total family income due to shrimping. Data were also gathered on total variable costs, total fixed costs, and net revenue by vessel size. Other data gathered included information on marketing channels, and subjective

appraisals of the problems confronted by recreational and commercial shrimpers. Although much data were obtained, and despite elaborate measures taken to obtain the cooperation of the interviewees, there was considerable reluctance on the part of the shrimpers to reveal catch, income, or even cost data.

Dyer, Christopher L. and Mark Moberg (1992). "The 'Moral Economy' of Resistance: Turtle Excluder Devices and Gulf of Mexico Shrimp Fishermen." Forthcoming: Marine Anthropological Studies.

This article examines how shrimp fishermen in two communities on the Gulf of Mexico have responded to federal regulations requiring the use of Turtle Excluder Devices (TEDs) on shrimp trawlers. Coming at a time of contraction in the fishery due to low producer prices and high operating costs, TED regulations have engendered intense opposition in many areas. Resistance to TEDs stems from shrimpers' perception that the regulations are an unjust threat to their livelihoods. Such beliefs are not unlike those underlying other spontaneous resistance movements, such as agrarian uprisings of the poor and dispossessed. Recommendations for alternatives are made that would provide incentives for conservation while lessening the economic hardship of shrimpers and their families.

Eales, James and James E. Wilen (1986). "An Examination of Fishing Location Choice in the Pink Shrimp Fishery." Marine Resource Economics, 2(4):331-351.

This article analyzes fishing location choices made by pink shrimp (Pandalus jordani) fishermen fishing off the coast of northern California. Data were gathered for 17 commercial vessels making 3000 net sets over a season. A simple multiple choice logit model was used to examine whether recent information on success in various regions aids in explaining location choice. Results suggest that fishermen do account for economic factors in a manner consistent with economic theories of choice.

Easley, J.E., Jr. (1982). "A Preliminary Estimate of the Payoff to Investing in a Turtle Excluder Device for Shrimp Trawls." Final report prepared for Monitor International and The Center for Environmental Education in cooperation with the National Marine Fisheries Service.

This analysis looks at the economic feasibility of adoption of a turtle excluder device (TED) based on private costs and benefits. That is, can fishermen be expected to adopt the gear on its own merits. This analysis excludes social costs that affect the decision to require TED use.

Economic Research Laboratory (1973). "Basic Economic Indicators, Shrimp 1947-72." Current Fisheries Statistics No. 6131, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, United States Department of Commerce, Washington, D.C., June, 55 pp.

This report brings together pertinent economic, technological, and biological data that reflects the behavior of the U.S. shrimp fishery.

Edwards, Steven F. (1994). "An Economics History of U.S. Fisheries and Their Management." Draft report, Northeast Fisheries Science Center, National Marine Fisheries Service, Woods Hole, MA.

The history of fisheries management in the U.S. and its implications for the future. Five case studies are presented, including Gulf of Mexico shrimp, and conclusions are drawn based on the success of fisheries management in these fisheries. Overall, a bleak future is predicted for the fishing industry.

Eldridge, Peter J. (19??). "The Relationship of (M), the Instantaneous Natural Mortality Rate, to Population Stability of Highly Fecund Species." Draft report, National Marine Fisheries Service, 15 pp.

This article explores the relationship between the natural mortality rate (M) and recruitment under the hypothesis that the recruitment process determines the natural mortality rate. Under this hypothesis if one understands the relationship between the natural mortality rate and recruitment, one will be able to determine the impact of fishing upon recruitment because fishing can be considered as a controllable component of the natural mortality rate. Stated somewhat differently, the natural mortality rate, set by the recruitment process, determines how much fishing a resource can sustain.

Ellis, James E. (1972). "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, iv + 10 pp., 11 Figs., 4 Tables.

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. (1977). " Equipment for Holding and Releasing Penaeid Shrimp During Marking Experiments." Fisheries Bulletin, 69(1):247-251.

Personnel of the National Marine Fisheries Service, Biological Laboratory at Galveston, Texas, have conducted numerous mark recapture experiments to obtain information on the movement, growth, and mortality of penaeid shrimp. These experiments were carried out under a variety of conditions at sea and in coastal bays. Several types of specialized equipment were developed to overcome problems of holding, handling, and releasing shrimp during the marking phase of these experiments. Some of this equipment has been described previously by Costello (1964). Holding tanks, a cooling unit, and two devices used to transport shrimp to the sea floor are described here.

Etzold, David J. and J.Y. Christmas (eds.) (1977). "A Comprehensive Summary of The Shrimp Fishery of the Gulf of Mexico United States: A Regional Management Plan." Technical Report Series, No. 2, Part 2, Gulf Coast Research Laboratory, Ocean Springs, Mississippi, November, 20 pp.

This document lists the goals and objectives of the regional plan to manage the shrimp resources of the Gulf of Mexico and to provide for optimum sustained benefits for the nation. The fishery is described, shrimp producing zones of the region are identified for preservation and improvement, and statistics collection is facilitated. The plan promotes research in bio-social-economic model development, development of a regional management plan, and extension education of shrimp fishermen.

Etzold, David J., J.Y. Christmas, and Vito Blomo (1983). "Analysis of Environmental and Demand Factors on Shrimp Production in the Gulf and South Atlantic United States, Impact on Harvesters and Processors." Report I in Assessment of Shrimp Industry Potentials and Conflicts, Volume One, Shrimp Notes Incorporated, 417 Eliza Street, New Orleans, Louisiana, August, 191 pp.

The basic purposes of this study are to review the relevant literature and using the best available data provide estimates of the impact of these environmental and demand changes on the future potential size composition and volume of the harvest from wild shrimp in the South Atlantic and Gulf of Mexico. Also, to estimate the impact of future domestic supply from the harvest of U.S. wild stocks on the movement of harvesters in and out of the shrimp industry in the study area.

Fee, Russ (1992). "Shrimp-Bycatch Conference Explores the Options." National Fisherman, August: 23-25.

An article summarizing the international conference on bycatch in Buena Vista, Florida. The meeting consensus is that finfish bycatch is real and that it either will be eliminated or used in ways that will be biologically and economically sound. Yet three days of talk led to no definite solutions. Bycatch does not lend itself to simple answers.

Fee, Russ (1993). "Shrimpers can Expect a Decline as Louisiana Marshland Recedes." National Fisherman, 73(11):18-19.

Louisiana's coastal wetlands are slowly sinking into the sea and with them may be going the future of the $400 million a year shrimping industry of the northern Gulf of Mexico.

Fontaine, Clark T. (1971). "Conversion Tables for Commercially Important Penaeid Shrimp of the Gulf of Mexico." U.S. Department of Commerce, NOAA, NMFS, Data Report 70, December, 9 pp.

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.

Fonyo, Carolyn M., Joan A. Browder, and Susan L. Brunenmeister (1983). "Dynamics of the Gulf of Mexico Shrimp Fleet, 1981." U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, Florida.

This study was designed to describe shrimp vessel mobility in the Gulf of Mexico in 1981 and to gain a better understanding of the dynamics of the shrimp fleet on a gulf wide scale toward the purpose of more effective management of the fishery.

Fonyo, Carolyn M., Joan A. Browder, and Susan L. Brunenmeister (1983). "Mobility Patterns and Characteristics of Shrimp Vessels Fishing Off Texas, 1981." NOAA Technical Memorandum NMFS-SEFC-120, U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami Laboratory, 75 Virginia Beach Drive, Miami, Florida 33149-1099.

This study identifies vessels fishing off Texas in 1981. Their mobility patterns in the Gulf of Mexico are determined. Seasonal fishing and port use patterns are determined. Physical vessel characteristics according to mobility pattern are identified. Vessel activity according to mobility pattern is determined. Relationships between vessel characteristics and activity are discovered. Lastly, the suitability of available data bases for further studies of fleet structure and behavior is assessed.

Food and Agriculture Organization of the United Nations and International Development Research Centre
(1982). Fish ByCatch: Bonus from the Sea, Report of a Technical Consultation on Shrimp Bycatch
Utilization held in Georgetown, Guyana, October 27-30, 1981. Ottawa Ont., IDRC, 163 pp.

The problem of postharvest loss derives from the carrying capacity of the shrimp trawlers, reflecting
design, size, operational system, and cost. The term bycatch refers to all the fish and other organisms
incidentally harvested by the trawling operations. In the past, all the bycatch was discarded into the sea
and only the shrimp retained. This practice resulted in high losses from the discards. Now, it has become
increasingly common to select and retain some marketable fish. Bycatch quantities are, therefore, no
longer the same as the discards in every area where shrimp trawling occurs. Assessment is necessary for
both the bycatch and the discards.

Galveston Laboratory (1992). "Shrimp Trawl Bycatch Characterization, Sampling Protocol Manual for
Data Collection." National Marine Fisheries Service, Southeast Fisheries Science Center, September,
62 pp.

Onboard data collection for the purpose of bycatch characterization will consist of sampling trawl
catches taken from commercial shrimp fishery vessels operating in the U.S. Gulf of Mexico and U.S. south
Atlantic. Data relevant to species composition, abundance and life history will be gathered from each tow.
Sample size and allocation of samples by stratum (i.e. fishing location, season, trawl type, and TED type)
have been included in the sampling design and are discussed in the National Marine Fisheries Service's
(NMFS) "Shrimp Trawl Bycatch Research Requirements Document", 1991. The procedures outlined here
for sampling trawl catches have been prepared by personnel at NMFS, and are consistent with the Southeast
Area Monitoring and Assessment Program's (SEAMAP) data management system. This protocol or similar
data collection methods are recommended for use in all regional bycatch assessment programs to facilitate
the accessibility and analysis of integrated data sets.

Galveston Laboratory (1992). "Evaluation of Bycatch Reduction Devices, Sampling Protocol Manual for
Data Collection." National Marine Fisheries Service, Southeast Fisheries Science Center, September,
62 pp.

The Southeast Area Monitoring and Assessment Program (SEAMAP) has a standard data collection
system used by state and federal research labs and universities in the southeast region. This method of data
collection is recommended for the regional bycatch research program to standardize data collection
procedures, analyses, and allow data to be pooled into a common data base using existing hardware and
software. Procedures are outlined here for sampling catch from different bycatch reduction devices.

Galveston Laboratory (1993). "Biological Review of the 1993 Texas Closure." Report to the Gulf of Mexico
Fishery Management Council, National Marine Fisheries Service, Southeast Fisheries Science Center,
December, 23 pp.

This report contains an overview of recruitment, fishing trends, distribution of catch from Texas
waters, shrimp landings by port, and white shrimp catch off Texas as impacted by the Texas closure regulation.

Galveston Laboratory (1994). "Biological Review of the 1994 Texas Closure." Report to the Gulf of Mexico
Fishery Management Council, National Marine Fisheries Service, Southeast Fisheries Science Center,
December, 26 pp.

This report contains an overview of recruitment, fishing trends, distribution of catch from Texas
waters, shrimp landings by port, and white shrimp catch off Texas as impacted by the Texas closure regulation.

Garcia, S. (1983). "The Stock-Recruitment Relationship in Shrimps: Reality or Artifacts and Misinterpretations?" Oceanogr. Trop., 18(1):25-48.

After a detailed review of the information available on stock-recruitment relationships and environmentally driven variations of abundance in shrimp, the impact of this variability on the apparent shape of the SRR is examined. The existence of a strong autocorrelation in yearly data is stressed and it is concluded that the presently available relationships do not demonstrate that the recruitment of shrimps is a function of stock size. Examination of the particular case when seasonal relationships have been established with monthly data shows that despite a certain similarity in shape they should not be interpreted as SRR sensu stricto and a three dimensional interpretation is proposed instead. The other possible sources of error and bias are finally examined and the consequences of the above findings on management strategies are briefly discussed.

Garcia, S. (1984). "A Note on Environmental Aspects of Penaeid Shrimp Biology and Dynamics." In Penaeid Shrimps - Their biology and management, J.A. Gulland and B.J. Rothschild (eds.), Fishing News Books Limited, Farnham, England.

Shrimps are short-lived animals living in highly variable inshore areas during the juvenile phase and are therefore subject to particularly strong environmentally driven variability in recruitment and stock size. This paper examines the likely consequences of this fact on the surplus yield production and stock-recruitment modeling underlining the high risk of generating artifactual models when the data series are short.

Garcia, S. (1988). "Tropical Penaeid Prawns." Chapter 9 in Fish Population Dynamics, 2nd Edition, J.A. Gulland (ed.), John Wiley & Sons ltd., New York.

The main characteristics of penaeids as tropical short-lived animals are pointed out here to show differences and similarities with the better known resources of temperate waters.

Gillespie, William C., James C. Hite, and John S. Lytle (1969). "An Econometric Analysis of the U.S. Shrimp Industry." Economics of Marine Resources No. 2, Department of Agricultural Economics and Rural Sociology, South Carolina Agricultural Experiment Station, Clemson University, Clemson, South Carolina in cooperation with Coastal Plains Regional Commission.

This study assesses the economic feasibility of imposing a quota on shrimp imports. Thai study was based on the primary hypothesis that a quota on shrimp imports, if used by itself and not coordinated with a program designed to limit the entry of more craft into the industry, would not improve the economic position of the average shrimp fisherman in the industry. More specifically, it was hypothesized that a quota would increase wholesale and ex-vessel prices more than they would have increased without the quota; the increase in prices would encourage the entry of more craft into the industry; and the increase in the number of craft in the industry and rising cost would prevent the real revenue per craft from increasing. A secondary objective of this study was to assess the economic feasibility of imposing a limit on the number of craft in the industry. It was hypothesized that a limit on the number of craft in the industry, if used by itself, would not increase the deflated revenue per craft. Another secondary objective was to assess the effect on the shrimp population of increases in fishing effort. It was hypothesized that increases in fishing effort would overfish the shrimp population and actually reduce the quantity of shrimp supplied.

Grant, W.E. and W.L. Griffin (1979). "A Bioeconomic Model of the Gulf of Mexico Shrimp Fishery." Transactions of the American Fisheries Society, 108(1):1-13.

A bioeconomic model of the brown shrimp fishery in Galveston Bay, Texas and adjacent offshore waters accurately predicts the general trends in the seasonality of shrimp harvest and the distribution of the harvest in relation to size of shrimp and water depth.

Grant, W.E., K.G. Isakson, and W.L. Griffin (1981). "A General Bioeconomic Simulation Model for Annual Crop Marine Fisheries." Ecological Modeling, 13:195-219.

A generalized bioeconomic simulation model (GBFSM) of annual crop marine fisheries is described and its use in marine fisheries management is demonstrated. The biological submodel represents the recruitment of new organisms into the fishery, the movement of organisms from one fishing area to another and from one depth to another, the growth of organisms and the mortality of organisms resulting from both natural causes and from fishing. The economic submodel represents the fishing effort exerted on each resource species, the monetary costs of fishing, the value of the harvest and the rent (or excess profits) to the fishery.

Basic dynamics of the model result from changes in the number of organisms in the fishery over time, which can be summarized as a set of difference equations of the general form

$$CN/Ct = R + I - E - M - F$$

where CN/Ct is the net change in number of organisms in the fishery over time (t), R is recruitment, I is immigration, E is emigration, M is natural mortality, and F is fishing mortality. The driving variable is R whereas I, E, M, and F are functions of the state of the system at any given point in time. The model can be run in a deterministic or stochastic mode. Values for parameters affecting rates of recruitment, movement, growth, natural mortality and fishing mortality can be selected from uniform, triangular or normal distributions.

Use of the model within a fisheries management framework is demonstrated by evaluating several management alternatives for the pink shrimp fishery on the Tortugas grounds in the Gulf of Mexico. Steps involved in use of the model, including parameterization, validation, sensitivity analysis and stochastic simulations of management policies are explained.

Griffin, Wade L. (1977). "Time Trends in the Harvesting Sector of the Gulf of Mexico Shrimp Industry." DIR 77-1, SP-2, The Texas Agricultural Experiment Station, Texas A&M University, College Station, Texas, March, 32 pp.

Time trends in pounds landed, days fished, fleet size, fishing effort index numbers, and value are presented and discussed.

Griffin, Wade L. (1994). "Shrimp Fishing Cost and Returns in Texas." Department of Agricultural Economics, Texas A&M University, College Station, Texas.

Trends in costs and returns for vessels greater than 60 feet operating off the Texas coast.

Griffin, Wade L. and Bruce R. Beattie (1978). "Economic Impact of Mexico's 200-Mile Offshore Fishing Zone on the United States Gulf of Mexico Shrimp Fishery." Land Economics, 54(1)27-38.

A simple static equilibrium model of the Gulf of Mexico shrimp fishery is developed using cost data collected for 1974 and 1975 to determine the impact of the 200-mile limit imposed by Mexico on shrimp fishermen operating out of Texas and Florida. Given the present shrimp price and cost of production situation, the adjustment to the Mexican 200 mile limit will not result in negative rents for the U.S. Gulf shrimp fleet.

Griffin, Wade L. and William E. Grant (1976). "A Profile of Bio-Economic Models of the Gulf of Mexico Shrimp Resource." Proposal, RF-77-11, submitted by the Texas A&M Research Foundation to the National Marine Fisheries Service, September, 7 pp.

The two objectives of the proposed study are (1) to develop a profile of various bioeconomic models of the Gulf of Mexico shrimp resource, determine the data requirements of each model, the cost of each model, and the time frame in which each can be developed and (2) to provide a framework for coordination and development of multidisciplinary studies of the shrimp fishery of the Gulf of Mexico and management strategies related to it.

Griffin, Wade L. and William E. Grant (1991). "General Bioeconomic Fisheries Simulation Model." Developed at Texas A&M University, College Station, Texas 77843-2124.

This manual describes in detail a General Bioeconomic Fisheries Simulation Model (GBFSM) Version 2.0 designed for use in management programs of marine fish species that do not exhibit a significant relationship between the size of the parental population and the number of young recruited into the fishery.

Griffin, Wade L. and Holly Hendrickson (1992). "Bycatch Related Data Set Descriptions and Formats." Department of Agricultural Economics, Texas A&M University, College Station, Tx.

A description of data sets related to finfish bycatch in the Gulf of Mexico shrimp fishery as part of a on-going S/K contract.

Griffin, Wade L. and Holly Hendrickson (1992). "Potential for Reduction of Shrimp Trawl Bycatch of Selected Finfish Species in the Gulf of Mexico." Final Report, Saltonstall-Kennedy Project No. NA17FL0099, U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

The General Bioeconomic Fisheries Simulation Model was used to estimate the changes in bycatch and economic rent that would result under different fishery management policies. Bycatch reduction devices were found to be more effective than closures at reducing bycatch and also less costly to fishermen. The September version incorporates editorial comments based on a review of the August version.

Griffin, Wade L. and L.L. Jones (1975). "Economic Impact of Commercial Shrimp Landings on the Economy of Texas." Marine Fisheries Review, 37(7):12-14.

This report focuses on the economic contribution that shrimp producers make to Texas to evaluate the potential economic value of shrimp production.

Griffin, Wade L. and John P. Nichols (1976). "An Analysis of Increasing Costs to Gulf of Mexico Shrimp Vessel Owners: 1971-75." Marine Fisheries Review, 38(3):8-12.

This report is intended to provide current information on the economics of owning and operating a shrimp vessel in the Gulf of Mexico. Lower shrimp prices coupled with rapidly escalating prices for fuel and other input items have brought about a cost-price squeeze that has put the vessel owners in a struggle for economic survival. Cost and returns estimates are based on 1971 and 1973 data collected from shrimp vessel owners. More specifically, this report includes: 1)Estimated break-even annual shrimp catches with various ex-vessel shrimp prices for 1971, 1973, 1974, and 1975; and 2) Evaluation of expected cost and returns in 1975.

Griffin, W.L. and Chris Oliver (1991). "Evaluation of the Economic Impacts of Turtle Excluder Devices (TEDs) on the Shrimp Production Sector in the Gulf of Mexico." Draft report, MARFIN Project NO. NA-87-WC-H-06139. Agricultural Economics Dept., Texas A&M University College Station, TX 77843-2124.

By accounting for the dynamics of the shrimp population, a more accurate representation of the gains and losses from the implementation of TED regulations was provided. Percent loss by region varied with the fishing pressure of each region; the higher the fishing pressure the less the overall loss to each region. Across all regions, an estimate by the NMFS of a 10% loss in shrimp retention due to the use of TEDs translated only to an overall 5.3% loss in landings in the entire Gulf region. In economic terms, this renders a 16.2 million dollar loss of rent to vessels and crew in the shrimp fishing industry in the Gulf of Mexico. Regional compliance ranged from 61 to 91% based on Coast Guard estimates, therefore, overall loss in rent was reduced to 12.8 million dollars. However, the loss in rent to vessel owners and crew who complied with the TED regulation was 15.7 million dollars, while the gain in rent to non-complying owners and crew was 2.9 million dollars. The overall loss to the Gulf of Mexico shrimp industry, based on the 1990 individual tow losses of 0.7%, was a decline in rent of 4.5 million dollars most of which was due to the purchase of the TEDs. These short run results indicate that nominal days fished in the long run must decrease for the industry to move to a new equilibrium. This is true across all vessel classes and regions, since they all incurred negative rents. Estimating the net present value for this adjustment process, over time, is reserved for future analysis.

Griffin, W.L. and Chris Oliver (1991). "Evaluation of the Economic Impacts of Turtle Excluder Devices (TEDs) on the Shrimp Industry in the Gulf of Mexico." MARFIN Project NO. NA-87-WC-H-06139. Agricultural Economics Dept., Texas A&M University College Station, TX 77843-2124.

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Griffin, Wade L. and Arvind K. Shah (1994). "Estimation of Standardized Effort in the Heterogeneous Gulf of Mexico Shrimp Fleet." MARFIN Project No. NA37FF0053-01, National Marine Fisheries Service, St. Petersburg, FL, April, 24 pp.

This project estimates standardized effort in the Gulf of Mexico shrimp fishery. Specifically, it develops a method to estimate standardized effort from the vessel operating units files and the interviewed shrimp landings file, develops a method to expand days fished from the interviewed shrimp landings files to the total landings files, and characterizes the historical trends of the shrimp fishery relative to vessel configuration, nominal effort (nominal days fished) and standardized effort.

Griffin, Wade L. and Arvind K. Shah (1995). "Estimation of Standardized Effort in the Heterogeneous Gulf of Mexico Shrimp Fleet." MARFIN Project No. NA37FF0053-01, National Marine Fisheries Service, St. Petersburg, FL, February, 50 pp.

This project estimates standardized effort in the Gulf of Mexico shrimp fishery. Specifically, it develops a method to estimate standardized effort from the vessel operating units files and the interviewed shrimp landings file, develops a method to expand days fished from the interviewed shrimp landings files to the total landings files, and characterizes the historical trends of the shrimp fishery relative to vessel configuration, nominal effort (nominal days fished) and standardized effort.

Griffin, Wade L. and N. J. Wardlaw (1974). "Economic Analysis of Costs and Returns of Gulf of Mexico Shrimp Vessels: 1973." Final report, Contract No. 03-4-042-18, National Marine Fisheries Service, NOAA, U.S. Dept. of Commerce, September, 107 pp.

This study develops a vessel classification system, evaluates each vessel class with respect to costs and returns, determines break-even quantities of shrimp landed for each class, investigates the implications of price changes for each class, and determines the optimal vessel configuration with respect to profitability.

Griffin, Wade L. and N. J. Wardlaw (1975). "Economic Analysis of Costs and Returns of Gulf of Mexico Shrimp Vessels: 1973." Departmental Technical Report Number 74-3, Texas Agricultural Experiment Station, Texas A&M University, College Station, Texas, 43 pp.

Throughout the Gulf shrimp fleet there is a wide range in vessel size, construction, power, and capability. There is also a wide range of variable costs, fixed costs, investment requirements, and profitability associated with the various vessel configurations. The overall objectives of this study, using 1973 data, are to (1) develop a vessel classification system, (2) evaluate each vessel class with respect to costs and returns, (3) determine break-even quantities of shrimp landed for each class, (4) investigate the implications of price changes for each class, and (5) determine the optimal vessel configuration with respect to returns to the owner.

Griffin, Wade L., Melvin L. Cross, and John P. Nichols (1977). "Effort Measurement in the Heterogeneous Gulf of Mexico Shrimp Fleet." Department Technical Report Number 77-5, Texas Agricultural Experiment Station, Texas A&M University.

To calculate the total effort of the fleet, the effort index of vessels operating in the shrimp fishery must be determined where effort is defined as the amount of fishing power that a vessel can exert in a day fished relative to that of a standard vessel.

Griffin, Wade L., Melvin L. Cross, and George W. Ryan (1974). "Seasonal and Movement Patterns in the Gulf of Mexico Shrimp Fishery." Department Technical Report Number 74-4, Texas Agricultural Experiment Station, Texas A&M University.

This study describes the migration trends and production patterns for brown, pink, and white shrimp in the Gulf of Mexico for 1963 to 1971.

Griffin, Wade L., Linda A. Jensen, and Charles M. Adams (1983). "Installation Manual for Budget Simulation System." In "A Generalized Budget Simulation Model for Fishing Vessels." Draft Version 1, Sea Grant No. 04-8-M01-133, Texas A&M University, Department of Agricultural Economics, Texas Agricultural Experiment Station, College Station, Texas.

This manual is designed to enable the user to install and test either the Aquaculture Budget Simulation System or the Vessel Budget Simulation System.

Griffin, Wade L., Linda A. Jensen, and Charles M. Adams (1983). "User Manual for Data Management System." Volume 1 in "A Generalized Budget Simulation Model for Fishing Vessels." Draft Version 1, Sea Grant No. 04-8-M01-133, Texas A&M University, Department of Agricultural Economics, Texas Agricultural Experiment Station, College Station, Texas.

This manual discusses the mechanics of operating the data management program (DMP) and provides detailed descriptions of the variables to be entered into the direct access (D-A) files.

Griffin, Wade L., Linda A. Jensen, and Charles M. Adams (1983). "User Manual for Budget Simulation System." Volume 2 in "A Generalized Budget Simulation Model for Fishing Vessels." Draft Version 1, Sea Grant No. 04-8-M01-133, Texas A&M University, Department of Agricultural Economics, Texas Agricultural Experiment Station, College Station, Texas.

This manual contains three sections: the general descriptions of the operations of the budget simulator program, a description of each agenda, including operations performed in the called subroutines, and the Appendix tables containing codes for variables, data description and data format information.

Griffin, Wade L., Linda A. Jensen, and Charles M. Adams (1983). "A Generalized Budget Simulation Model for Fishing Vessels." TAMU-SG-83-203, Marine Information Service, Sea Grant College Program, Texas A&M University, College Station, Texas, January, 113 pp.

The Vessel Budget Simulator System (VBSS) enables a user to select and equip a vessel to be operated in any fishing ground normally frequented by U.S. owned vessels. The physical flow of inputs into the production process aboard a vessel is simulated to produce the information required for financial reports. This system consists of two programs; a data management program (DMP) in COBOL that is used to create and update direct access (D-A) physical inventory files and a budget simulation program (BSP) in FORTRAN that performs all operational procedures. Part 1 of the manual describes the use of the DMP while Part 2 describes the use of the BSP.

Griffin, Wade L., Ronald D. Lacewell, and Wayne A. Hayenga (1974). "Estimated Costs, Returns, and Financial Analysis: Gulf of Mexico Shrimp Vessels." Marine Fisheries Review, 36(12):1-4.

This report results from an economic evaluation of shrimp landings in the Gulf of Mexico based on data available from the National Marine Fisheries Service and is intended for financial institutions, shrimp vessel owners, and prospective shrimp vessel owners. The first part of this report indicates costs and returns of shrimp vessels in 1971. The second part is an investment analysis including cash flow and rate of return on a shrimp vessel entering the Gulf shrimping fleet. The last section reflects cost changes in the base 1971 data to account for cost levels experienced in early 1974.

Griffin, Wade L., Ronald D. Lacewell, and John P. Nichols (1976). "Optimum Effort and Rent Distribution in the Gulf of Mexico Shrimp Fishery." American Journal of Agricultural Economics Nov: 644-652.

Traditional methods used to estimate fishing effort that maximize rent to an open access resource have almost universally assumed all costs are directly proportional to effort. When crews receive a fixed share of gross returns, labor costs are proportional to catch. Hence, rent accrues to crews as well as vessel owners under limited entry. A model that allows costs to be proportional to effort and catch is applied to the Gulf of Mexico shrimp fishery. This study indicates that traditional analysis would result in management schemes that overtax vessels and ignore rent accruing to crews.

Griffin, Wade L., J. Nichols, and Ronald D. Lacewell (1973). "Trends in Catch/Effort Series: Gulf of Mexico Shrimp Fishery." Project Number 03-3-042-19, Department Technical Report Number 74, Texas Agricultural Experiment Station, Texas A&M University, December, 85 pp.

The objective of this study is to determine time series relationships for the Gulf of Mexico shrimp resource with respect to catch, effort, and catch per unit effort.

Griffin, Wade L., J. Nichols, and Joe Bob Smith (1975). "Economic Analysis of Returns to Gulf of Mexico Shrimp Vessel Owners for the Period 1971-1975." Dir 75-1, SP-4, The Texas Agricultural Experiment Station, Texas A&M University System, College Station, Texas, July.

This report provides current information on the economics of owning and operating a shrimp vessel in the Gulf of Mexico for the period 1971-1975. The break-even annual shrimp catches with various ex-vessel shrimp prices for 1971, 1973, 1974, and 1975 are estimated and the expected cost and returns in 1975 are evaluated.

Griffin, Wade L., Deborah Tolman, and Chris Oliver (1993). "Economic Impacts of TEDs on the Shrimp Production Sector." Society and Natural Resources, 6:291-308.

The economic impact of the effects of the Turtle Excluder Device (TEDs) used in the Gulf of Mexico to control the numbers of turtles caught in shrimp trawl nets is analyzed. This is a major concern to the shrimp fishing economy due to the potential loss of shrimp. A simulation modeling technique is used which estimates the changes in landings, revenues, costs, and the economic rents. A base scenario in which no TEDs are used is compared with five different scenarios where the TED is used by vessels in the Gulf of Mexico. The analysis was based on a single year impact. The implementation of the TED comes with costs to the vessel owners and crew in the Gulf of Mexico. Since the implementation of the TEDs does cause negative rent, it is a certainty, all other things remaining equal, that some vessel owners and crew will leave the industry. The number to leave the industry will depend on how effective they are at learning to use the TED effectively.

Griffin, Wade L., Newton J. Wardlaw, and John P. Nichols (1976). "Economic and Financial Analysis of Increasing Costs in the Gulf Shrimp Fleet." Fishery Bulletin, 74(2):301-309.

The 115 Gulf of Mexico shrimp vessels used in this study were grouped into classes I (larger vessels) through V (smaller vessels) based on their type of construction, length of keel, and index of effort. In 1973, class II vessels were the only vessels able to register a positive return to owner's labor and management, $560; the other four classes registered negative returns. The payback period occurred during

the eighth year due to the sale of the vessels in classes II, III, and V, whereas payback did not occur for classes I and IV. A positive rate of return on investment was experienced by the vessels in classes II, III, and V in the amount of 13.21, 2.65, and 2.63%, respectively. The internal rate of return on investment was negative for vessels in classes I and IV.

Input prices increased some 20% from 1973 to 1974 whereas production remained approximately constant and ex-vessel shrimp prices were lower. Thus, none of the classes of vessels would have experienced a break-even cash flow for 1974. Increasing input cost another 10% above the 1974 level, and assuming normal production, the average vessel in class II seems to be operating at a better than a break-even level in 1975 assuming ex-vessel shrimp prices remain constant at 1973 levels. Classes I, III, IV, and V experienced less than break-even cash flows under the same conditions in 1975.

Griffin, Wade L., Newton J. Wardlaw, and John P. Nichols (1976). "Cost and Return Analysis By Selected Vessel Characteristics: Gulf of Mexico Shrimp Fishery, 1971-1975." MP-1253C, The Texas Agricultural Experiment Station, Texas A&M University, College Station, Texas.

This report is intended to provide current information concerning the economics of owning and operating a shrimp vessel for use by owners, managers, financial institutions and public policy makers.

Griffin, Wade L., Jim Cato, John Gates, and Fred Prochaska (1981). "Socioeconomic Budget Simulator." Final report, Contract No. NA80-GA-C-00011, NMFS, SEFC, Miami, Florida, pp. 269.

This project develops an enterprise budget simulator for commercial fishing vessels using collected cost and earning information on the Gulf shrimp, Florida paying passenger and New England fishing fleets, and compares the predicted results to actual data.

Griffin, Wade L., Jerry Clark, Joy Clark, and James Richardson (1988). "Economic Impact of TED on the Shrimp Industry in the Gulf of Mexico." Final report, National Marine Fisheries Service, Grant No, NA-WC-H-06130.

This research project estimates the costs and returns to individual shrimpers for their adoption of the turtle excluder device (TED).

Griffin, Wade L., Melvin L. Cross, Ronald D. Lacewell, and John P. Nichols (1973). "Effort Index for Vessels in the Gulf of Mexico Shrimp Fleet." Texas Agricultural Experiment Station, Texas A&M University.

A total effort index based on vessel characteristics is calculated for the shrimp fishery in the Gulf of Mexico. The report includes an extensive review of the literature; a description of the model, associated data sets, and the statistical procedure employed; the empirical results; and lastly, a summary and conclusions.

Griffin, W.L., W.E. Grant, R.W. Brick, and J.S. Hanson (1984). "A Bioeconomic Model of Shrimp Maricultural Systems in the U.S.A." Ecological Modelling, 25:47-68.

A general conceptual model of a marine shrimp farming system representing important relationships between the engineering design of facilities, the environmental and managerial factors affecting shrimp growth and survival, and the factors affecting production costs and profit is presented. Based upon this conceptual model, a bioeconomic simulation model is developed to assess the economic feasibility of a projected penaeid shrimp maricultural operation along the Texas coast, and to evaluate the effects of changes in an important managerial variable rate of water flow, on the biological and economic productivity of the system.

The conceptual model consists of five interconnected parts including environmental, production, engineering, marketing, and profit submodels. The bioeconomic simulation model is coded in FORTRAN to simulate system behavior with a daily time step on a digital computer.

Results of simulations of a projected penaeid shrimp maricultural operation along the Texas coast suggest that such an operation would be marginally economically feasible when based upon the particular assumptions of this study. Baseline simulations predict a mean annual profit of US $275 per acre with a standard deviation of US $122 per acre, which represents a 2% chance of economic loss. The predicted annual return on investment is 4.5%.

The role of modeling in development of shrimp maricultural systems in the United States is discussed.

Griffin, Wade L., Johannes A.D. Lambregts, M.W. Yates, and A. Garcia (1993). "The Impact of Aquaculture Pond Engineering Design on the Returns to Shrimp Farms." Journal of the World Aquaculture Society, 24(1):23-30.

The effects of a pond design on the internal rate of return of a 40 ha shrimp farm is evaluated. The influence of four pond construction parameters (pond size, pond shape, levee crown size, and canal bank slope) on the total amount of earth moved and construction cost is determined using an engineering design model. The bioeconomic model, MARSIM, calculates returns to farms with the design modifications. Of the four parameters, the pond shape is the most influential over the range considered (from 17% to 8%). Pond size is the second most important parameter (from 17% to 21%). Levee width and canal bank slope influence are of lesser importance (<1% change).

Griffin, Wade L., John P. Nichols, Robert G. Anderson, James E. Buckner, and Charles M. Adams (1978). "Costs and Returns Data: Texas Shrimp Trawlers Gulf of Mexico 1974-1975." TAMU-SG-79-601, Texas A&M University, Sea Grant College Program, September, 97.

This report summarizes estimates of costs and returns for vessels of different characteristics that anchor in Texas and shrimp trawl in the Gulf of Mexico. Data for 1974 and 1975 were obtained from vessel owners. Results are presented in self explanatory tables. No attempt is made to draw inferences or discuss implications of trends or relationships that may be apparent in the data.

Griffin, W., J. Warren, J. Nichols, W. Grant, and C. Pardy (1983). "The Texas Shrimp Fishery: Analysis of Six Management Alternatives Using the General Bioeconomic Fishery Simulation Model (GBFSM)." TAMU-SG-84-202, Sea Grant College Program, Texas A&M University, College Station Texas, Oct., 66 pages.

Six management alternatives were evaluated in terms of their impact on total landings, amount of discards, cost and returns, and fishing effort employed. Management alternatives consisted of closure of specified areas for particular periods of time, changes in count size regulations, or both. The analyses were conducted using the General Bioeconomic Fishery Simulation Model designed to represent the important biological and economic processes of the Texas shrimp fishery. Impacts were estimated both for the first year and for a long run situation, that gave the industry time to adjust by increasing or decreasing the number of bay boats and Gulf vessels.

Griffin, Wade L., Kenneth Roberts, Antonio B. Lamberte, John M. Ward, and Holly M. Hendrickson (1992). "Considerations for the Potential Use of Individual Transferable Quotas in the Gulf of Mexico Shrimp Fishery." Volume 3 of a report prepared for the NOAA, NMFS, Silver Spring MD, January 17, pp. 125.

The report investigates the possibilities of developing an individual transferable quota system for the Gulf of Mexico shrimp fishery. If industry cooperation can be developed through a comanagement system, then the potential for generating substantial net benefits for the fishery and the nation exist through the increase in harvesting sector profits, declines in bycatch of endangered species, and the increase in production of finfish in commercial and recreational fisheries for bycatch finfish species. However, substantial changes will have to occur in the shrimp fishery institutions that presently exist. For example, a credit card system to record landings and price information through a central clearing house will have to be implemented and fishermen organizations will have to be developed by the industry.

Griffin, W.L., Holly Hendrickson, Chris Oliver, Gary Matlock, C.E. Bryan, Robin Riechers, and Jerry Clark (1992). "An Economic Analysis of Texas Shrimp Season Closures." A draft and revisions submitted to the Marine Fisheries Review.

Management of the Texas penaeid shrimp fishery is aimed at increasing revenue from brown shrimp (Penaeus aztecus) landings and decreasing the level of discards. Since 1960 Texas has closed its territorial sea for 45 to 60 days during peak migration of brown shrimp to the Gulf of Mexico. In 1981, the closure was extended to 200 miles to include the U.S. Exclusive Economic Zone. In this study, simulation modeling was used to estimate the changes in landings, revenue, costs, and economic rent attributable to the Texas closure. Four additional analyses were conducted to estimate the effects of closing the Gulf 1-4 fathom zone for 45 to 60 days, with and without effort redirected to inshore waters. Distributional impacts were analyzed in terms of costs, revenues, and rents, by vessel class, shrimp species, vessel owner, and crew..

Two problems with the theoretical discussion of the model appear to exist in the article. The movement along the preclosure yield curve should actually occur on the post closure yield curve. This leads to an incorrect interpretation of short run rent generated by the regulation. That is, effort increases prior to the management regulation. Secondly, the costs curves are incorrectly defined. The equilibriums and the resulting interpretations of rent appear to be different for each curve.

Griffin, W.L., Holly Hendrickson, Chris Oliver, Gary Matlock, C.E. Bryan, Robin Riechers, and Jerry Clark (1993). "An Economic Analysis of Texas Shrimp Season Closures." Marine Fisheries Review, 54(3):21-28.

Management of the Texas penaeid shrimp fishery is aimed at increasing revenue from brown shrimp, Penaeus aztecus, landings and decreasing the level of discards. Since 1960 Texas has closed its territorial sea for 45-60 days during peak migration of brown shrimp to the Gulf of Mexico. In 1981, the closure was extended to 200 miles to include the U.S. Exclusive Economic Zone. Simulation modeling is used in this paper to estimate the changes in landings, revenue, costs, and economic rent attributable to the Texas closure. Four additional analyses were conducted to estimate the effects of closing the Gulf 1 to 4 fathom zone for 45 and 60 days, with and without effort redirected to inshore waters. Distributional impacts are analyzed in terms of costs, revenues, and rents, by vessel class, shrimp species, vessel owner, and crew.

Griffin, Wade, Chris Oliver, Bruce McCarl, Gary Matlock, C.E. Bryan, Robin Riechers, and Jerry Clark (1989). "Shrimp Fisheries Management to Increase Economic Returns." Final report, MARFIN Project No. NA88WC-H-MF199, USDOC, NOAA, NMFS, SERO, St. Petersburg, FL.

This report analyzes the effects of various management alternatives on the shrimp fishery for Texas. A simulation modeling technique is used that estimates the changes in landings, revenues, costs, and ultimately, economic rents (profits to the fishery taking into account all costs including opportunity

costs of fishing) attributable to the fishery under the various management alternatives set forth. The simulation model is programmed to depict the average fishery conditions for the period 1963-1980. This is based on average patterns and levels of fishing effort for this period under average environmental conditions and the model generates average landings for the same period for comparison to actual data.

Gross, George B. (1973). "Shrimp Industry of Central America, Caribbean Sea, and Northern South America." Marine Fisheries Review, 35(3-4):36-55.

This report reviews the shrimp fishery of South and Central America and the Caribbean on a country by country basis for 1961 to 1971. The ten year trend in pounds and value are discussed, the activities of major harvesters are summarized, and a description of each fishery is provided.

Groth, Philip (1980). "The Socio-Demographic Characteristics of the Shrimp Fishing Community in South Central Louisiana." A report of continued work on socio-demographic aspects of the "Shrimp Mark-Recapture Study," NMFS, NOAA, Contract Number 03-7-042-35132, May, pp. 87.

This report summarizes the demographic characteristics of residents of a three parish shrimp community of south central Louisiana.

Gulf and South Atlantic Fisheries Development Foundation, Inc. (1988). "Seafood from the Gulf and South Atlantic States." Gulf and South Atlantic Fisheries Development Foundation, Inc., Lincoln Center, Suite 669, 5401 West Kennedy Boulevard, Tampa, Florida, November, 27 pp.

This packet of material provides facts and figures about the 1987 seafood products of the Gulf and south Atlantic states of Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas. This is an updated version of a packet originally based on 1984 data. To identify trends, the 1984 data is frequently referenced after providing the 1987 data. Data on landings and value of catch, their relation to the U.S. total, unique attributes of the region's species, the impact they contribute to the nation's economy, and a discussion of the people producing the products and the gear they use is included in the first section. Also included is an overview of present and projected seafood consumption. This is followed by a summary of the importance and characteristics of the seafood industry in each of the nine states that form the Gulf and south Atlantic region.

Gulf and South Atlantic Fisheries Development Foundation, Inc. (1994). "Organization and Management of a Gulf of Mexico and South Atlantic Ocean Fishery By-Catch Management Program." Gulf and South Atlantic Fisheries Development Foundation, Inc., Lincoln Center, Suite 669, 5401 West Kennedy Boulevard, Tampa, Florida, April.

This one year project provided for the initiation of research designed to gather information which will eventually lead to the successful reduction of finfish bycatch in the shrimp fishery. Such a result is ecologically and economically beneficial to the industry, the region, and the Nation. Successful completion of a bycatch reduction program will economically benefit the shrimp industry and other fisheries affected by the incidental mortality that occurs in the shrimp fishery, and have a positive ecological impact on the marine faunal community that inhabits the shrimp grounds.

Gulf of Mexico Fishery Management Council (1981). "Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico, United States Waters." Draft Update, Lincoln Center, Suite 881, 5401 West Kennedy Boulevard, Tampa, Florida, November.

The fishery management plan for shrimp whose goal is to manage the shrimp fishery of the United States waters of the Gulf of Mexico to attain the greatest overall benefit to the nation with particular reference to food production and recreational opportunities on the basis of maximum sustainable yield as modified by relevant economic, social, or ecological factors.

Gulf of Mexico Fishery Management Council (1988). "Amendment 4 to the Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico United States Waters, Includes Environmental Assessment and Regulatory Impact Review." Lincoln Center, Suite 881, 5401 West Kennedy Boulevard, Tampa, Florida 33609, August.

Amendment No. 4 identifies additional problems which have developed in the fishery and revises the objectives of the FMP accordingly. The annual review process for the Tortugas sanctuary is simplified, and the Council and Regional Director review for the Texas closure is extended to February 1st. White shrimp taken in the EEZ are to be landed in accord with a state's size possession regulations to provide consistency and facility of enforcement with the State of Louisiana. This latter action is to be implemented at such time when Louisiana provides for an incidental catch of undersized white shrimp in the fishery for seabobs.

Gulf of Mexico Fishery Management Council (1990). "Supplement to Amendment 4 to the Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico United States Waters, Includes Environmental Assessment and Regulatory Impact Review." Lincoln Center, Suite 881, 5401 West Kennedy Boulevard, Tampa, Florida 33609, February.

White shrimp taken in the EEZ and transported into Louisiana are to be landed in accord with Louisiana's size possession regulations when possessed within the jurisdiction of that state.

Gulf of Mexico Fishery Management Council (1991). "Amendment Number 5 to the Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico United States Waters, Includes Environmental Assessment and Regulatory Impact Review." Lincoln Center, Suite 881, 5401 West Kennedy Boulevard, Tampa, Florida 33609, January.

A definition of overfishing and measures to restore overfished stocks is proposed for brown and pink shrimp. Seabobs and rock shrimp are removed from the management unit.

Gulf of Mexico Fishery Management Council (1991). "An Options Paper for a Limited Access System for the Shrimp Fishery of the Gulf of Mexico." Lincoln Center, Suite 881, 5401 West Kennedy Boulevard, Tampa, Florida 33609, August.

A paper that discusses several limited access systems for the Gulf of Mexico shrimp fishery.

Gulf of Mexico Fishery Management Council (1991). "An Options Paper for a Limited Access System for the Shrimp Fishery of the Gulf of Mexico." Lincoln Center, Suite 881, 5401 West Kennedy Boulevard, Tampa, Florida 33609, August.

A revision of the options paper cited above that discusses several limited access systems for the Gulf of Mexico shrimp fishery.

Gulf of Mexico Fishery Management Council (1992). "Amendment Number 6 to the Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico United States Waters Includes Environmental Assessment and Regulatory Impact Review." Lincoln Center, Suite 331, 5401 West Kennedy Boulevard, Tampa, Florida 33609.

Definition to prevent the overfishing of white shrimp and reestablish the Tortugas shrimp sanctuary.

Gulf of Mexico Fishery Management Council (1994). "Amendment Number 7 to the Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico, United States Waters, Includes Environmental Assessment with Regulatory Impact Review and Initial Regulatory Flexibility Analysis." Lincoln Center, Suite 331, 5401 West Kennedy Boulevard, Tampa, Florida, January, 28 pp.

This amendment provides a definition of overfishing for white shrimp and provides for remedial action to restore the stock if overfishing should occur. It provides for revising the overfishing indices for brown, white, and pink shrimp when new data become available. A total allowable level of foreign fishing for royal red shrimp is to be terminated to allow a higher level of catch by the domestic fleet. A revised definition of overfishing and a procedure for updating maximum sustainable yield (MSY) for royal red shrimp is provided. Environmental and economic impacts are evaluated.

Gulf of Mexico Fishery Management Council (1996). "Draft Amendment Number 9 to Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico, U.S. Waters With Supplemental Environmental Impact Statement, Regulatory Impact Review, Initial Regulatory Flexibility Analysis, and Social Impact Assessment." Lincoln Center, Suite 331, 5401 West Kennedy Boulevard, Tampa, Florida, May, 53 pp.

The Gulf of Mexico Fishery Management Council proposes an amendment to the fishery management plan for the shrimp fishery of the Gulf of Mexico, U.S. waters, to require a reduction of the unwanted bycatch of finfish, particularly the red snapper. The requirement of fish escapement devices in the shrimp trawl is proposed to allow rebuilding of the overfished stock of red snapper.

Gulland, John A. and Brian J. Rothschild (eds.) (1984). Penaeid shrimps -their biology and management, Fishing News Books Ltd., Farnham, Surrey, UK.

Proceedings of an international workshop on the scientific basis for the management of penaeid shrimp held at Key West, Florida, in November, 1981. Primarily biological papers were presented covering policy in different countries, behavior, types of analysis, interaction with other species, environmental factors, and management.

Gutherz, Elmer J. and Gilmore J. Pellegrin (19??). "Report on Snapper-Grouper Mortality by Shrimp Trawlers in the U.S. Gulf of Mexico." Report prepared for the Gulf of Mexico Fishery Management Council. Mississippi Laboratories, Pascagoula Laboratory, Southeast Fisheries Center, National Marine Fisheries Service, NOAA, Pascagoula, MS 39567-0112.

The purpose of this report, utilizing available commercial discard and resource assessment data, is to provide a more precise estimate of juvenile red snapper mortality caused by shrimp trawlers than that reported in the Gulf of Mexico Fishery Management Council Reef Fish Management Plan. In addition, the information provided can be used to establish timing of recruitment into the fishery; not the snapper fishery, but the first exploitation of red snapper by the shrimp fishery.

Gutherz, Elmer J. and Gilmore J. Pellegrin (1988). "Estimate of the Catch of Red Snapper, Lutjanus campechanus, by Shrimp Trawlers in the U.S. Gulf of Mexico." Marine Fisheries Review, 50(1):17-25.

This paper, utilizing available commercial bycatch and resource assessment data, provides a more precise estimate of the catch of juvenile red snapper by shrimp trawlers than that reported in the Gulf of Mexico Fishery Management Council (1980) Reef fish Management Plan. In addition, the information provided may be useful for estimating the timing of first exploitation of red snapper by the shrimp fishery.

Haby, Michael G. and Richard E. Tillman (1992). "The Texas Shrimp Industry: A Briefing Report." TAMU-SG-92-501, Texas Marine Advisory Service, July, 18 pp.

This report presents current trends and conditions in the Texas shrimp industry and evaluates how these factors impact individual production, processing, and marketing firms for 1991.

Haby, Michael G., Richard E. Tillman, and Lucy Gibbs (1991). "The Texas Shrimp Industry: A Summary of Production, Processing, and Marketing Activities." Report, Department of Agricultural Economics, Texas Agricultural Extension Service, Texas A&M University, College Station, Texas.

Shrimp is the backbone of the Texas seafood economy, and is easily the most valuable fishery in the state. Shrimp are harvested year round with 70 percent harvested between July and December. With increased production came investment in shore side processing facilities. Lender participation has been essential in making the Texas shrimp industry an economic success. Every attempt has been made to incorporate the most recent data into this report.

Haby, Michael G., Russell J. Miget, and Gary L. Graham (1992). "A Preliminary Assessment of the 1992 Shrimping Season." Departments of Agricultural Economics and Wildlife and Fisheries Sciences, Texas Agricultural Extension Service, Sea Grant College Program, Texas A&M University, September, 51 pp.

This report quantifies current and anticipated shrimp production in 1992 and offers reasons why landings in some ports are significantly below historic expected values. It begins with a review of shrimp production in Texas from both a long run and seasonal perspective followed by a discussion of habitat requirements of larval and subadult penaeid shrimp. Next, the methods used to evaluate the 1992 season are enumerated. The report concludes with a discussion of the 1992 season (both realized and anticipated) from both a coastal and county perspective. Detailed data tables that support this section are found in the appendix. All data pertaining to each county are presented alphabetically, followed by a coastal summary.

Haby, Michael G., Richard A. Edwards, E. Anthony Reisinger, Richard E. Tillman, and William R. Younger (1993). "The Importance of Seafood-Linked Employment and Payroll in Texas." TAMU-SG-93-503, Texas Marine Advisory Service, May, 10 pp.

This report quantifies the employment and payroll attributable to businesses that depend on the Texas seafood industry for sales or purchases. Seafood linked in 1989 is estimated at 30,036 full time jobs with an annual payroll of $326.5 million. Among coastal counties, the seafood industry is often the largest taxpayer as well as the largest employer.

Hanson, J.S., W.L. Griffin, J.W. Richardson, and C.J. Nixon (1985). "Economic Feasibility of Shrimp Farming in Texas: An Investment Analysis for Semi-Intensive Pond Grow-Out." Journal of World Mariculture, 16:129-150.

A firm level simulation model (MARSIM) was developed to analyze the survival of different shrimp farm sizes in Texas. The model simulates the annual activities of a shrimp farm: production, finances, cash receipts, capital replacement and depreciation, cash flows, income taxes, balances, and growth. A firm is replicated 50 times over a 10 year planning horizon. Random values for shrimp growth and survival, temperature, hurricanes, and prices received in each of 10 years are generated from multivariate empirical probability density functions (pdf) for these variables. For the analysis summarized here, a shrimp farm was simulated using 3 different size systems and 4 different pond sizes. Results indicate that higher rates of return and faster payback are associated with larger total farm size and larger ponds. For large farms (400 surface hectares), pond size becomes less critical to obtaining an acceptable rate of return to investment. The amount of time taken to construct a facility significantly impacts the rate of return. Hurricanes, prices, production, and temperature variation are also critical factors affecting the firm's returns and survival.

Hardy, Linda (1995). "Data Request." National Marine Fisheries Service, Southeast fisheries Science Center, Beaufort Laboratory, 101 Pivers Island Road, Beaufort, N.C., March.

Formats describing south Atlantic shrimp landings data for 1991 to 1993 and the vessel operating units file for the southeastern region for 1990 to 1993.

Harrington, Dave (1994). "Bycatch Reduction of TEDS." Presented to the Gulf of Mexico Fishery Management Council, Corpus Christi, TX, May, 7 pp.

This paper reviews the reduction in finfish bycatch in shrimp trawls that are equipped with turtle excluder devices. It argues that finfish bycatch should be reduced as much as possible without harm to the shrimp fishery since the impact of bycatch on finfish stock size may not be as great as is sometimes claimed.

Hayenga, Wayne A., Ronald D. Lacewell, and Wade L. Griffin (1974). "An Economic and Financial Analysis of Gulf of Mexico Shrimp Vessels." MP-1138, The Texas A&M University System, Texas Agricultural Extension Service, Texas Agricultural Experiment Station.

This report includes budgeted estimates of variable and fixed costs of landing shrimp, estimated break-even annual shrimp catches with various shrimp prices for the vessel sizes of 53-65 foot and 66 to 72 foot lengths, evaluation of a prospective investment in a shrimp vessel entering the Gulf shrimping fleet, using internal rate of return and payback procedures of investment analysis, and an updated estimated cost level for spring 1974.

Haynes, Jos and Sean Pascoe (1988). "A Policy Model of the Northern Prawn Fishery." Occasional Paper 103, Australian Bureau of Agricultural and Resource Economics, GPO Box 1563, Canberra 2601.

The northern prawn fishery has been subject to management since the early 1970's in an attempt to control the expansion of effort and prevent the overexploitation of the resource. Many of the management policies developed over this period have proved to be ineffective in controlling effort. Moreover, the increasing cost of management and the need to avoid costly and ineffective measures will lead to increasing demands for analysis of the cost effectiveness of such policies. This report outlines the mathematical programming model of the fishery designed to assess current and alternative management policies on both effort and profitability. Then the short and long run effects of the current and alternative management policies on the fishery are assessed.

Hendrickson, Holly M. and Wade L. Griffin (1993). "An Analysis of Management Policies for Reducing Shrimp Bycatch in the Gulf of Mexico." North American Journal of Fisheries Management, forthcoming.

Every year the Gulf of Mexico shrimp fleet catches and discards millions of pounds of finfish. Dwindling populations of some commercially and recreationally valuable fish species have raised concerns over the effects of shrimp bycatch on fish stocks. The General Bioeconomic Fisheries Simulation model was used to estimate the changes in economic rent and bycatch of red snapper Lutjanus campechanus, king mackerel Scomberomorus cavalla, and Atlantic croaker Micropogonias undulatus, that would result under two fishery management policies: Bycatch Reduction Devices (BRDs) and season/area closures. The BRDs were found to be more effective than closures at reducing bycatch and also less costly to fishermen. Under the BRD scenarios, reductions in discards ranged from 20.2 to 42.5% for red snapper, king mackerel discards fell approximately 89%, and Atlantic croaker discards fell about 45%. Under closure policies, the change in discards ranged from a 2.1 to 15% decline for red snapper, a 1.9% increase to a 39.3% decrease for king mackerel, and a 0.1 to 12.9% decline for Atlantic croaker. The BRD policies produced present value 10 year rent streams (1985 US$) ranging from -$16.434 to -$27.007 million, and closure policies generated 10 year rent streams ranging from -$35.181 to -$54.563 million.

Hendrickson, Holly M. and Wade L. Griffin (1993). "An Analysis of Management Policies for Reducing Shrimp Bycatch in the Gulf of Mexico." North American Journal of Fisheries Management, 13:686-697.

Every year the Gulf of Mexico shrimp fleet catches and discards millions of pounds of finfish. Dwindling populations of some commercially and recreationally valuable fish species have raised concern over the effects of shrimp bycatch on fish stocks. The general bioeconomic fisheries simulation model was used to estimate the changes in economic rent and bycatch of red snapper Lutjanus campechanus, king mackerel Scomberomorus cavalla, and Atlantic croaker Micropogonias undulatus, that would result under two fishery management policies: Bycatch Reduction Devices (BRDs) and season/area closures. The BRDs were found to be more effective than closures at reducing bycatch and also less costly to fishermen. Under the BRD scenarios, reductions in discards ranged from 20.2 to 42.5% for red snapper, king mackerel discards fell approximately 89%, and Atlantic croaker discards fell about 45%. Under closure policies, the change in discards ranged from a 2.1 to 15% decline for red snapper, a 1.9% increase to a 39.3% decrease for king mackerel, and a 0.1 to 12.9% decline for Atlantic croaker. The BRD policies produced present value 10 year rent streams (1985 US$) ranging from -$16.434 to -$27.007 million, and closure policies generated 10 year rent streams ranging from -$35.182 to -$54.561 million.

Henwood, Tyrrell A. and Warren E. Stuntz (1987). "Analysis of Sea Turtle Captures and Mortalities During Commercial Shrimp Trawling." Fishery Bulletin, Notes, 85(4):813-816.

This report provides a preliminary analysis of existing data collected by fisheries observers during commercial U.S. shrimp trawling. Estimated turtle CPUE and mortalities for loggerhead, Kemp's ridley, and green turtles are provided.

Henwood, Tyrrell A., Warren E. Stuntz, and Nancy Thompson (1991). "Evaluation of U.S. Turtle Protective Measures Under Existing TED Regulations, Including Estimates of Shrimp Trawler Related Mortality in the Greater Caribbean." Draft Report, USDOC, NMFS, SERO, 9450 Koger Blvd., St. Petersburg, FL 33702, 20 pp.

Sea turtle catch and mortality by U.S. shrimp trawlers under current sea turtle conservation regulations and import restrictions were evaluated. This required a rather complex analysis of shrimping

effort, turtle catch rates, turtle mortality rates, effectiveness of TEDs and tow time restrictions, and compliance with existing regulations. Results of these analyses were used in determining (1) whether changes in existing regulations to provide additional protection to endangered and threatened sea turtles were warranted and (2) the rates with which foreign, shrimp importing nations would have to comply under P.L. 101-162.

Henwood, Tyrrell A., Warren E. Stuntz, and Nancy Thompson (1992). "Evaluation of U.S. Turtle Protective Measures Under Existing TED Regulations, Including Estimates of Shrimp Trawler Related Mortality in the Wider Caribbean." NOAA Technical Memorandum NMFS-SEFSC-303, USDOC, NMFS, SEFC, 75 Virginia Beach Drive, Miami, Florida 33149, March, 15 pp.

Sea turtle catch and mortality by U.S. shrimp trawlers under current sea turtle conservation regulations were evaluated. This required a rather complex analysis of shrimping effort, turtle catch rates, turtle mortality rates, effectiveness of TEDs and tow time restrictions, and compliance with existing regulations. Results of these analyses were used in determining whether changes in existing regulations to provide additional protection to endangered and threatened sea turtles were warranted.

Hildebrand, Henry H. (19??). "A Study of the Fauna of the Brown Shrimp (Penaeus aztecus Ives) Grounds in the Western Gulf of Mexico." Institute of Marine Science, The University of Texas, Port Aransas, Texas.

A major undertaking was the collection and compilation of information on the distribution and relative abundance of the animals taken in trawls in the brown shrimp fishery as a base for ecological studies and more generally they add considerably to the general picture of the fauna of the western Gulf.

Hildebrand, Henry H. (1980). "Report on the Incidental Capture, Harassment, and Mortality of Sea Turtles in Texas." Final report, NMFS Contract No. NA80-GG-A-00160, Pascagoula, laboratory, SEFC, NMFS.

This report attempts to evaluate the impacts of all types of fishing gear on the five species of sea turtles by gear, locality, and season.

Hoagland, Porter, Di Jin, Patricia Lee, Christopher Croft, Lyn Davidson, and Sarah Wallis (1996). "Market-Based Incentives to Reduce Fisheries Bycatch." NOAA Contract No. 50-DGNF-5-00172, National Marine Fisheries Service, Silver Spring, MD, February, 120 pp.

This report represents a first step at considering the potential for the use of market based incentives to aid in the resolution of fishery bycatch problems. Market-based incentives have several advantages over more traditional command and control approaches, including cost effective allocations of environmental controls; incentives for firms to seek technological solutions; flexibility; returns to the public for the use of its resources; and lower administrative costs in some cases.

Hoar, Peter, John Hoey, Jim Nance, and Chris Nelson (eds.) (1992). "A Research Plan Addressing Finfish Bycatch in the Gulf of Mexico and South Atlantic Shrimp Fisheries." Final report, Gulf and South Atlantic Fisheries Development Foundation, Inc., Lincoln Center, Suite 669, 5401 West Kennedy Boulevard, Tampa, Florida, August.

The program of study to address the biological, economic, and social impacts of reducing the incidence of bycatch in the southeastern region shrimp fishery. The plan emphasizes biological research and gear modifications, but does recognize the need for economic analysis and nongear bycatch reduction alternative regulations.

Hoar, Peter, John Hoey, Chris Nelson, and Jim Nance (eds.) (1992). "A Research Plan Addressing Finfish Bycatch in the Gulf of Mexico and South Atlantic Shrimp Fisheries." Draft report, Gulf and South Atlantic Fisheries Development Foundation, Inc., Lincoln Center, Suite 669, 5401 West Kennedy Boulevard, Tampa, Florida, May.

The program of study to address the biological, economic, and social impacts of reducing the incidence of bycatch in the southeastern region shrimp fishery. The plan emphasizes biological research and gear modifications, but does recognize the need for economic analysis and nongear bycatch reduction alternative regulations. An executive summary is included as a separate document.

Hopkins, Jane Chadwick (1983). "An Analysis of the Impact of Alternative Import Management Policies for Shrimp." Thesis, Department of Agricultural Economics, Texas A&M University, December, 117 pp.

A five equation econometric model was specified and estimated using 1955-1980 data to analyze restrictive import policies. Benefits of such measures were found to be tenuous in simulations with benefits dissipated through new entrants. While all of the policies led to only modest improvements in the price level, the variability in prices was reduced. The benefits from restricting imports may not be as readily apparent as has been suggested by some advocates.

Houston, Jack E. and Amelia E. Nieto (1988). "Regional Shrimp Market Responses to Domestic Landings and Imports." Journal of Food Distribution Research, Feb:99-107.

U.S. shrimp landings are divided into four geographic regional markets and may be further subdivided into species and size characteristics. Seemingly unrelated regressions are used to analyze regional price responses of variable annual landings of shrimp. The contemporaneous correlation of competing market supplies and demands accounted for an improvement in forecasting reliability in each area and for species and size relationships. Imports were shown to affect regional markets unevenly, having a significantly higher impact on south Atlantic shrimp prices than on Gulf of Mexico, West Coast, or New England markets. Real disposable personal income affected West Coast and south Atlantic prices much more dramatically than those of Gulf Coast markets. The composition of the catch by size and species in each season introduced variable responses by regional market. Also, south Atlantic appeared least price-sensitive to its own catch.

Houston, Jack E., Amelia E. Nieto, James E. Epperson, Ho-Shui Li, and George W. Lewis (1989). "Factors Affecting Local Prices of Shrimp Landings." Marine Resource Economics, 6:163-172.

Variation in the species and size composition of local and regional shrimp landings result in uncertain and sometimes volatile ex-vessel prices paid to fishermen. A seemingly unrelated regressions price-modeling framework was used to forecast contemporaneous price effects of the composition of shrimp landing in closely associated market regions. Price responses to U.S. regional shrimp landings and to imports were significantly related to differentiated markets by species and location. Regional consumer income impacts on average ex-vessel prices for each species were also significantly different. Implications of shrimp price response differences in related local markets are also discussed.

Hu, Teh-Wei, Donald R. Whitaker, and D. Lynne Kaltreider (1983). "The U.S. Shrimp Industry, An Economic Profile for Policy and Regulatory Analysts." Final report, Saltonstall/Kennedy Project, National Fisheries Institute, Washington, D.C.

While other studies have discussed the economic status and problems of the U.S. shrimp harvesting sector (e.g. Hutchinson, 1978), this study focuses on the U.S. shrimp processing industry. Three separate economic profiles of the shrimp industry are contained in this volume: (1) a profile of the overall shrimp industry with special reference to headless and peeled shrimp, (2) a profile of the breaded shrimp industry, and (3) a profile of the southern canned shrimp industry. In each profile, the data were obtained from processors whose plants made at least 95 percent of their sales from the particular shrimp product profiled.

Huang, Hann-Jin, Wade L. Griffin, and David V. Aldrich (1984). "A Preliminary Economic Feasibility Analysis of a Proposed Commercial Penaeid Shrimp Culture Operation." Journal of World Mariculture, 15:95-105.

This analysis utilized the production data obtained in 1982 from ponds at the Cedar Bayou Texas A&M Mariculture Facility, east of Baytown, Texas. The Aquaculture Budget Simulation System developed at Texas A&M University was applied to create budgetary information including the net return, economic profit, break even quantities and prices, and net present values over a 10 year horizon. This information was used to evaluate the economic feasibility of different stocking strategies at a proposed 76 ha commercial penaeid shrimp culture operation. The stocking strategies consist of monoculture of Penaeus stylirostris at 10 and 20/m² respectively and polyculture of P. stylirostris with P. vannamei at two ratios (3:1 and 1:3) with a total density of 20/m².

The results indicated that only the polyculture of 75% P. vannamei with 25% P. stylirostris is economically profitable. This stocking strategy yields an economic profit of $54,589 for the first year of operation. The break even production of 1,526 kg/ha is less than the expected annual production of 1,919 kg/ha. The break even price of $6.11/kg is less than the market price of $8.23/kg. The net present value is $839,424 over 10 years considering the beginning $20,000 cash and 20% of the total investment as owner's investment. The payback occurred following the second year's harvest.

Hudson, J. Harold, Donald M. Allen, and T.J. Costello (1970). "The Flora and Fauna of a Basin in Central Florida Bay." U.S. Fish and Wildlife Service, Special Scientific Report - Fisheries, No. 604, May, iii+14 pp., 2 Figs., 1 Table.

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.

Hutchinson, Roger W. (1978). "Status and Problems of the American Shrimp Industry." Marine Fisheries Review, 40:29-31.

The shrimp industry of the U.S. enjoyed two successful years in 1976 and 1977 and expectations are that 1978 will also prove to be successful. This account gives the current status of the U.S. shrimp industry plus a brief description of various problems facing it.

International Trade Centre (1983). Shrimps: A Survey of the World Market. UnCtad, Gatt, Geneva.

Market study of frozen and canned shrimps; international coverage gives summary of market opportunities for developing countries; comments and data on world supply and demand, market characteristics, competition, prices, distribution network; production for major producing areas and countries;

gives recommendations on quality and marketing aspects; and specifically for Belgium, France, Germany F.R., Italy, Netherlands, Spain, UK, USA, Japan, Hong Kong, and Australia gives comments and data on production, foreign trade, market characteristics and access, competition, distribution network, food standards and regulations; and gives an annotated bibliography of publications relevant to shrimp marketing.

Isaakson, K.G., W.I. Grant, and W.L. Griffin (1982). "General Bioeconomic Fisheries Simulation Model: A Detailed Model Documentation." Journal of the International Society of Ecological Modeling, 4(1-2):61-85.

A general bioeconomic fisheries simulation model (GBFSM) designed for use in annual-crop marine fisheries management programs is described. The purpose of the model is to predict the effects of alternative management policies on a fishery. Effects are assessed in terms of total harvest; species, size class, and seasonal distributions of the harvest; total revenue, fishing costs, and rent in the fishery; and the distribution of revenue, costs, and rent among different classes of fishing vessels. A variable number of species, size-classes, fishing areas, depths, and vessel classes can be represented in the model at the user's discretion. The model can be deterministic or can have stochastic components.

Information needed and the steps involved in use of the model are presented in two sections. The first section provides user documentation and indicates the model's capabilities, General program structure, available options, data requirements, and an example problem are presented. The second section provides programmer documentation. Model algorithms are presented in detail and the fisheries system processes represented in each subroutine are described.

Itano, Glen, Richard Condrey, and James Geaghan (198?). "Count Laws on Overwintering White Shrimp: Effect on Yield-Per-Recruit." Draft report, Louisiana State University, Baton Rouge, LA.

The study was designed to assess the change in yield associated with existing state laws that prevent the landing of "small" white shrimp during the winter months. This evaluation has been accomplished using a yield per recruit analysis in which estimates of natural and fishing mortality, average initial number of shrimp recruited to the overwintering fishery, and the annual temperature regime with temperature and size dependent growth rate equation (Phares, 1980) have been combined.

Iversen, E.S., D.M. Allen, and J.B. Higman (1993). Shrimp Capture and Culture Fisheries of the United States. John Wiley & Sons, Inc., New York.

A simplistic discussion of the biology and the fisheries for shrimp from the Carolinas to Texas is presented. Primarily warm water species are included with limited discussions on the cold water species of shrimp. The commercial fisheries are described, but little economic information is included. The section on fisheries management outlines many of the problems facing shrimp managers and biologies, but does not indicate the root causes of growth overfishing of shrimp or bycatch of finfish in the shrimp fishery. Overall, it is a good general discussion of the southeastern region shrimp fishery from a biological point of view.

Jamison, Judy (1994). "Foundation Conducts Shrimp Meeting: Bycatch Found Highly Exaggerated." News release, Gulf and South Atlantic Fisheries Development Foundation, Inc., October, 2 pp.

Results of the shrimp trawl bycatch study workshop indicate that the correct bycatch ratio is three to four pounds of finfish to one pound of shrimp. Testing of proposed bycatch reduction devices have indicated that gear modifications can reduce bycatch by as much as one-third.

45

Johnson, Ronald N. and Gary D. Libecap (1982). "Contracting Problems and Regulation: The Case of the Fishery." The American Economic Review, 72(December):1005-1022.

This paper addresses why fisheries retain common property aspects with overcapitalization and excessive labor input given the large and growing literature on the persuasiveness of the economic efficiency criteria. The failure of the regulatory response to address these problems is also addressed.

Jones, Albert C. and James R. Zweifel (1982). "Shrimp Fleet Mobility in Relation to the 1981 Texas Closure." Marine Fisheries Review, 44(9-10):50-54.

This study was undertaken to provide information on the seasonal fishing activities of the Gulf shrimp fleet. The study describes the mobility of western Gulf shrimp vessels, compares fleet mobility in 1981 with that in earlier years, and relates the results to the 1981 closure of the Texas brown shrimp fishery. Companion studies in this series address the effect of this fishing activity on catch rates and utilization of shoreside facilities.

Jones, Albert C., Edward F. Klima, and John R. Poffenberger (1982). "Effects of the 1981 Closure on the Texas Shrimp Fishery." Marine Fisheries Review, 44(9-10):1-4.

An introduction that summarizes the results of the Texas Closure Analysis for the 1981 shrimp fishing season.

Jones, Albert C., James M. Nance, and William O. Antozzi (1994). "A Review of the Royal Red Shrimp Resource and Fishery in the Gulf of Mexico." Report prepared for the Gulf of Mexico Fishery Management Council by the Southeast Fisheries Science Center and the Southeast Regional Office, National Marine Fisheries Service, September 19.

Possible management options for royal red shrimp are reviewed in this report. The report also presents information on the biology, fishery, and market situation for royal red shrimp.

Jones, Lonnie L., John W. Adams, Wade L. Griffin, and Jeffrey Allen (1974). "Impact of Commercial Shrimp Landings on the Economy of Texas and Coastal Regions." TAMU-SG-75-204, NOAA Grant No. 04-3-158-18, December, pp. 18.

The value of commercial shrimp landings for 1971 in the state of Texas was $63.9 million. In the three coastal regions of Brownsville-Aransas, Port Lavaca-Galveston, and Beaumont-Port Arthur in 1971 this value was $37.6, $23.6, and $2.7 million, respectively. These commercial shrimp landings have a significant impact on the economy of Texas and on the economies of the three coastal regions. The estimated direct, indirect and induced impact of 1971 commercial shrimp landings on the Texas economy was $197.2 million in output; $56.8 million in personal incomes; and 6,083 persons employed. Within the Brownsville-Aransas region, the $37.6 million landings by the commercial shrimp industry stimulated total economic output of $92.5 million. The $23.6 million landings by the commercial shrimp industry within the Port Lavaca-Galveston region stimulated total economic output of $55.9 million. Total economic output of $8.5 million was stimulated by the $2.7 million landings by the commercial shrimp industry within the Beaumont-Port Arthur region.

Jones, Robert P., Chris Doolin, Barbara Jean Gravlee, Malinda U. Jones, and Kayce Stewart (1992). "An International Conference on Bycatch in the Shrimp Industry." Conference Schedule & Abstracts, May 24-27, Lake Buena Vista, Florida, Southeastern Fisheries Association, Inc. and National Oceanic and Atmospheric Administration.

Abstracts from an international conference on bycatch whose objectives were to summarize information on the status of the bycatch problem and alternative shrimp harvesting techniques for bycatch reduction, identify future research needs for addressing bycatch, obtain input from scientists, fishermen, fishery managers, and environmentalists on future management strategies, and provide for the dissemination of research and conference recommendations for evaluation by representatives of the scientific, commercial and recreational, and environmental communities.

Jones, T.M., J.W. Hubbard, and K.J. Roberts (1979). "Productivity and Profitability of South Carolina Shrimp Vessels, 1971-75." Marine Fisheries Review, 41:8-14.

This study uses data from a 45 vessel sample of South Carolina's double rig resident shrimp trawlers to analyze resource productivity and profitability in the fishery from 1971 to 1975. Smaller vessels (<55 feet) were more profitable, and averaged 14 years older than the larger (>55 feet) vessels and had lower operating costs. Placing vessels of both size classes on the same risk and financing cost basis would result in slightly higher percentage returns, i.e. lower losses, to investment in the larger trawlers than to investment in the smaller trawlers. The opportunity cost analysis indicated that shrimping labor is earning less than its opportunity income, as is new capital investment, but that management (the vessel captains) is earning above what it would in its best alternative. The larger vessels typically possessed about 1.4 times the fishing power of the typical smaller vessels; engine horsepower was the most significant predictor of fishing power. However, multiplication of the vessel fishing power index by the transformed fuel consumption variable showed that the average larger vessel exerted only 15 percent more effort in the fishery than did the typical smaller vessel.

Josupeit, Helga (1989). "The European Shrimp Market - Coldwater Versus Warmwater." Globefish Research Programme, Vol. 3, Food and Agriculture Organization of the United Nations, Fishery Industries Division, 00100 Rome, Italy, November, pp. 48.

This study examines current markets and future market prospects for coldwater and warmwater shrimp in the European Community. The study is divided into 4 parts. A brief analysis is given of the present production situation for coldwater shrimp in European countries, the general supply patterns as well as brief information on competing markets for European coldwater shrimp.

Juan, Ya-Sheng, Wade L. Griffin, and Addison L. Lawrence (1988). "Production Costs of Juvenile Penaeid Shrimp in an Intensive Greenhouse Raceway Nursery System." Journal of the World Aquaculture Society, 19(3):149-160.

This analysis compared the use of an intensive nursery raceway system with direct stocking of post-larval shrimp (PLS) into growout ponds. The intensive raceway system allows two crops to be produced in Texas where only one crop is feasible with direct stocking. Both investment and operational costs are analyzed for three types of greenhouses and three types of raceways where the types vary in cost and lengths of life. Three growout pond stocking densities and two farm sizes were evaluated for each combination of greenhouse and raceway type. Investment costs ranged from $142,000, for the small farm using the least expensive greenhouse and raceway and utilizing the lowest stocking density, to about $2.3 million, for the large farm using the most expensive greenhouse and raceway, respectively, per 1,000 one gram juveniles produced. Under technology available at the time of this analysis, direct stocking growout ponds with PLS and producing one crop per year is more profitable than stocking one gram juveniles and producing two crops per year on the Texas coast.

Juhl, Rolf and Shelby B. Drummond (197?). "Shrimp Bycatch Investigation in the United States of American, A Status Report." National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Pascagoula Laboratory, Pascagoula, Mississippi.

Shrimp have supported the most valuable fishery in the United States for many years. Although the fishery for the cold water species Crangon and Pandalus has increased in recent years in the New England and Alaska areas, the mainstay is still the penaeid shrimp of the southeastern United States. Three species make up the bulk of the catch, Penaeus aztecus, P. duorarum, and P. setiferus. The center of this fishery is in the Gulf of Mexico and along the southeastern seaboard of the United States. The average annual catch of penaeids over the past 25 years has been close to 100,000 tons in those areas. Production in recent years from other countries in the CICAR area, including Brazil, has been 70,000 tons; worldwide the total annual catch is close to 700,000 tons. Minor periodic annual variations in production have occurred, attributed generally to adverse environmental or economic factors. Although the shrimp bycatch problem was long known in the United states, it was not until late 1972 that a project was implemented to study the situation. Basic information was needed for management purposes, for possible use of bycatch and for application to design of gear that would reduce the catch of fish (savings gear), e.g., electric or separator trawls. In view of the relevance of the bycatch problem to other nations in the CICAR area, a description of the ongoing work and preliminary results are presented.

Juneau, Conrad L. Jr. and Judd F. Pollard (1981). "A Survey of the Recreational Shrimp and Finfish Harvests of the Vermilion Bay Area and Their Impact on Commercial Fishery Resources." Technical Bulletin No. 33, Louisiana Department of Wildlife and Fisheries, New Orleans, Louisiana, July, 40 pp.

A creel survey was conducted within a portion of Vermilion Bay, Louisiana, that included data on both finfish and shrimp. Data collected included instantaneous counts and pertinent information from field interviews. Effort, catch per hour, and harvest were calculated for both recreational and commercial finfish fishermen and shrimpers. Comparisons of catch, effort, and harvest were also made among user groups and how each related to the resource. Recommendations are made concerning the management of the associated fisheries.

Kallio, John R. (1973). "European Demand Helps Spur New England Shrimp Catches." Marine Fisheries Review, 35(3/4):7-8.

A review of shrimp landings in Massachusetts, New Hampshire, and Maine.

Karp, Larry, Arye Sadeh, and Wade L. Griffin (1986). "Cycles in Agricultural Production: The Case of Aquaculture." American Journal of Agricultural Economics, 68(3):553-561.

The problem of determining optimal harvest and restocking time and levels is considered. A continuous time deterministic control problem is used to study the case where production occurs in a controlled environment. A stochastic control problem is then used to determine rules for the cultivation of P. stylirostris which occurs in a stochastic environment. The deterministic analog of the problem is also solved. The two solutions are used to develop a measure for the value of a controlled environment and for the value of information about the stochastic environment.

Kearney/Centaur (1984). "Economic Impact of the Commercial Fishing Industry in the Gulf of Mexico and South Atlantic Regions." Final report, Gulf and South Atlantic Fisheries Development Foundation, Inc., February, 202 pp.

This report describes and estimates the overall economic impact of the commercial fishing industry in the South Atlantic and Gulf region.

Kearney/Centaur (1986). "Socio-Economic Analysis of Commercial and Recreational Fisheries in Everglades National Park." Final report, Everglades National Park, National Park Service, U.S. Department of Interior, September, 146 pp.

This report examines the economic impact of fishing in Everglades National Park. The first section describes the methods that were employed to make the various economic impact estimates. The second section summarizes the economic impact trends for the various Park fisheries and compares the economic impact of fishing in the Park with the surrounding Florida areas. Section 3 presents more detailed economic impact estimates for the Park and the surrounding areas. Section 4 briefly summarizes background demographic and land use trends for the Florida areas surrounding the Park. Literature cited is presented in section 5. Exhibits presenting tabular and graphic data are presented in Appendices 1,2, 3, and 4 corresponding to the material covered in sections 1, 2, 3, and 4.

Kearney/Centaur (1989). "The First Ten Years: An Overview of U.S. Fisheries Managed Under The Magnuson Act, 1976-1986." Final Report prepared for the National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Silver Spring, MD, Purchase Order No. 40AANF900823, by Kearney/Centaur, Division of A.T. Kearney, 225 Reinekers Lane, Alexandria, VA 22313, July, 153 pp.

This report summarizes the key factors and status associated with each of 28 Fishery Management Plans initiated between 1976 and 1986. This document summarizes the biological status, management measures, key economic information, and the overall status of the resources in each Fishery Management Plans.

Keiser, Richard K., Jr. (1976). "Species Composition, Magnitude and Utilization of the Incidental Catch of the South Carolina Shrimp Fishery." South Carolina Marine Resource Center, Technical Report Number 16, September, 1976.

The quantity of fish caught incidental to shrimping activities in South Carolina was estimated by determining fish/whole shrimp ratios from commercial catches. The overall median fish/shrimp weight ratio was 1.94:1; however, the median ratio varied seasonally being smaller from September to December (1.24:1) than from May to August (3.58:1). The confidence interval for this estimate was defined by the 25th and 75th percentiles. An estimated fish catch of between 3,358,000 and 15,197,000 kgs was derived from expansion of detailed ratio estimates derived from this study. Sciaenids were the predominant family during the study except for the months of January and April when clupeids and gadids, respectively, comprised the greatest percentage of the catch. In general, fish caught incidental to shrimping were small; mean total lengths of 25 species ranged from 6.90 to 18.58 cm. At the present time, only a fraction of the total incidental catch is landed; the majority is discarded at sea. This apparently reflects a lack of demand for most species captured. It is estimated that 74% of the flounder catch is landed and sold as food fish compared to less than 2% of the sciaenids and scombrids.

Keiser, Richard K., Jr. (1977). "The Incidental Catch from Commercial Shrimp Trawlers of the South Atlantic States." South Carolina Marine Resources Center, Technical Report Number 26, October, 38 pp.

Fish:shrimp (heads-on) ratios ranged from a low of 1.2:1 to a high of 4.0:1. Expansion of ratios indicated that an average of 69.4 million pounds of fish were caught by shrimp trawlers each year from 1973 to 1975. This was more than 24 times the 2.9 million pounds reportedly landed each year. Flounders and edible size kingfish, spot, and croaker were the predominant species landed, while industrial size fish (primarily small sciaenids) were discarded.

Keithly, Walter R. (198?). "An Analysis of Foreign Competition and Implications for the U.S. Shrimp Industry." Draft report, Coastal Fisheries Institute, Center for Wetland Resources, Louisiana State University, Baton Rouge, LA.

Imports represent a large and growing component of the total U.S. shrimp supply. Industry, concerned with their trend, has in the past attempted to control imports. Before national policy can be made, policy makers must have an understanding of the role of imports in the U.S. market. The purpose of this study was to provide an understanding of the U.S. shrimp industry, the underlying factors responsible for the recent rise in imports, the role of imports in establishing prices, and the effects of alternate policy options. Results indicate that tariffs, at least within realistic ranges, would be only marginally successful in limiting imports and increasing domestic prices. Quotas would be more successful than tariffs at achieving the aforementioned objectives.

Keithly, Walter (1991). "Louisiana Seafood Industry Study, A Summary." Report prepared for the Louisiana Seafood Promotion and Marketing Board New Orleans, Louisiana, June, 32 pp.

A summary of commercial seafood and aquaculture production, employment, processing and wholesaling activity, and economic impacts of commercial fishing industry in Louisiana.

Keithly, Walter R. (1994). "Report to the Panel and Meeting Participants on a Test for Possible Bias Due to Interview Frequency." Draft report, Center for Coastal, Energy, and Environmental Resources, Louisiana State University, Baton Rouge, LA.

There is a significant, but subtle trend from a flat or slightly more frequent sampling of high CPUE vessels in the early 1980's to a more frequent sampling of low CPUE vessels in the late 1980's and 1990's. This trend is in the direction that would be expected to inflate the estimates of shrimp fishing effort. The overall effect may not be great, but this remains as one potential source of bias.

Keithly, Walter R. (1994). "Report to the Gulf Council on Shrimp Effort." Presented at the Gulf of Mexico Fishery Management Council Meeting in Corpus Christi, Texas, May, 30 pp.

This report presents the results of a review of the Gulf of Mexico shrimp landings data set. The panel of experts found that a bias in the data of between 0 and 20 percent exists in the data set. A number of recommendations are included in the report including the suggestion that another panel be created to determine the exact magnitude of the bias and methods that could correct it.

Keithly, Walter R., Jr. and Liz Baron-Mounce (1990). "An Economic Assessment of the Louisiana Shrimp Fishery." Final Report, National Marine Fisheries Service, NA88WC-H-MF179, Coastal Fisheries Institute, Louisiana State University, October, 129 pp.

The goal of this report is to provide a general economic evaluation of Louisiana's shrimp harvesting sector focusing on the inshore component since it is not well understood and because of the possibilities for management available to the state.

Keithly, Walter R., Jr. and Liz Baron-Mounce (1991). "Louisiana's Shrimp Fishery: An Economic Perspective with Emphasis on the 1987 Inshore Fleet." Draft Report, Coastal Fisheries Institute, Center for Wetland Resources, Louisiana State University, Baton Rouge, Louisiana.

Louisiana leads the nation in the poundage of shrimp produced. Its fleet, numbering upwards of 20 thousand in total, is exceedingly diverse which complicates any attempt at developing an "optimal" management strategy. For example, the smaller boats in the fleet tend to fish in and around the shoreline of the state and target relatively small shrimp as they migrate offshore. The larger boats are more offshore based and tend to target a larger shrimp which has a higher per pound price. Actions taken by the smaller inshore and near-shore boats impact the performance of the offshore fleet through a reduction in shrimp availability in offshore waters. This paper provides a general economic evaluation of the Louisiana shrimp fishery; particularly the inshore component. It was accomplished though the use of secondary and primary data. The secondary data consisted of National Marine Fisheries Service data on shrimp landings and related effort data and also the Louisiana Department of Wildlife and Fisheries data on commercial shrimp license sales. The primary data were obtained through a 1987 survey of the Louisiana shrimp fleet. Such an evaluation is necessary before sound policy and management can be implemented.

Keithly, W.R. and K.J. Roberts (1991). "An Economic Analysis of U.S. Shrimp Imports and Dockside Prices with Policy Implications." Draft Report, Center for Wetland Resources, Louisiana State University, Baton Rouge, La.

U.S. imports of shrimp have been increasing at record levels during the 1980's. These increased imports, and their potential impact on the domestic dockside price structure, have been of significant concern to the U.S. shrimp harvesting sector and have recently led to a Federal investigation conducted under Section 332(g) of the Tariff Act of 1930 which evaluated conditions of competition affecting the Gulf and south Atlantic shrimp fishery. This paper presents a model, developed within an appropriate statistical and economic framework, that explains the growth in U.S. imports of shrimp and their impact on dockside shrimp prices. Significant factors which were found to determine annual levels of shrimp imports include: (1) the price of imports, (2) southeastern shrimp landings, (3) beginning shrimp inventories, (4) U.S. real disposable income, (5) exchange rates, (6) the Japanese import price of shrimp, (7) world production of shrimp, and (8) foreign real income. Increased imports were found to have a significant negative impact on southeast shrimp dockside prices.

Keithly, Walter R. and Kenneth J. Roberts (1994). "Shrimp Closures and Their Impact on the Gulf Region Processing and Wholesaling Sector (Expanded to Include South Atlantic). Draft final report, MARFIN Contract No. NA17FF0376-01, Coastal Fisheries Institute, Louisiana State University, October, 94 pp.

The overall goal of the report is to provide an analysis of the Southeast shrimp processing sector at a level of detail sufficient to examine the impacts associated with seasonal/area closures. Specifically, the proposal called for the collection of data from a representative sample of Gulf Region processors and wholesalers pertaining to monthly production activities and impacts related to potential closures.

Keithly, Walter R. and Kenneth J. Roberts (1994). "Shrimp Closures and Their Impact on the Gulf Region Processing and Wholesaling Sector (Expanded to Include South Atlantic). Final report, MARFIN Contract No. NA17FF0376-01, Coastal Fisheries Institute, Louisiana State University, October, 107 pp.

The overall goal of the report is to provide an analysis of the Southeast shrimp processing sector at a level of detail sufficient to examine the impacts associated with seasonal/area closures. Specifically, the proposal called for the collection of data from a representative sample of Gulf Region processors and wholesalers pertaining to monthly production activities and impacts related to potential closures.

Keithly, Walter R., Jr. and Yunsheng Song (1996). "A Review of World Shrimp Production and Trade, 1980-93." Center for Coastal, Energy, and Environmental Resources and the Department of Oceanography and Coastal Science, Louisiana State University, Baton Rouge, Louisiana.

Shrimp is one of the world's largest fisheries when measured in terms of the value of output. With the increased success of farming activities throughout the world, during the 1980's, world shrimp production, i.e., combined wild and farm raised harvests, expanded substantially. Trade in this important seafood commodity simultaneously expanded and became more complex in nature. First, shrimp production by primary producing areas of the world (i.e., Central America, South America, and Asia) are examined in this paper during the 1980-93 period and changes therein are related to farming activities. Then, exports of shrimp products by region of the world are analyzed with respect to the two primary import markets, the United States and Japan. Changes in volume of trade, export prices and product composition are evaluated and related to production trends.

Keithly, Walter R., Kenneth J. Roberts, and Hope Eyster-Kearney (1993). "The Southeastern Seafood Processing Industry: An Economic Assessment for Private and Public Management Decision Making." Final Report to National Marine Fisheries Service Contract # NA90AA-H-SK-53, Coastal Fisheries Institute, Center for Coastal, Energy, and Environmental Resources, Louisiana State University, Baton Rouge, Louisiana, December.

This report provides the results of an economic analysis of the southeastern seafood processing sector and uses this analysis for the purpose of examining historical and potential processor level impacts related to harvesting constraints; either natural or man induced.

Keithly, Walter R., Kenneth J. Roberts, and Hope Eyster-Kearney (1994). "Structural Changes in the Southeast U.S. Shrimp Processing Industry." Draft report, Coastal Fisheries Institute, Center for Coastal, Energy, and Environmental Resources, Louisiana State University, Baton Rouge, Louisiana.

The purpose of this paper is to examine structural changes in the southeast shrimp processing industry. The analysis, based on NMFS end-of-the-year surveys of seafood processing establishments, covers the 1973-90 period. Issues considered in the analysis included (1) changes in numbers of firms and shrimp products produced, (2) changes in productivity measured in terms of firm output and output per worker, and (3) changes in industry concentration and specialization. In general, results indicate a decline in the absolute number of southeast shrimp processors but a large increase in productivity per firm, measured on a poundage basis. Because of a decline in the per pound price of the processed products, however, deflated shrimp processing revenues per firm have remained essentially unchanged since the late 1970's.

Keithly, W.R., K.J. Roberts, and J.M. Ward (1991). "Farm-Raised Shrimp Production and Its Impact on the U.S. Market." Draft Report, Louisiana State University, Baton Rouge, Louisiana 70803.

A simultaneous model including the U.S. and Japan shrimp import markets and U.S. dockside demand was used to quantify the impacts of highly successful shrimp farming activities in the 1980's on U.S. imports and domestic warm water dockside shrimp prices. Results of the modeling effort suggest that current, i.e., 1988-1989, U.S. shrimp import levels would be in the neighborhood of 200 million pounds below observed levels in the absence of farm raised shrimp production on the world market and that the import price would be about 80% higher. The domestic dockside warm water shrimp price would also be significantly higher. Any rise in domestic warm water shrimp prices, brought about by a reduction in imports of the farm based product, was shown to encourage additional effort in the domestic shrimp fleet and a concurrent decline in industry profit.

Keithly, W.R., K.J. Roberts, and J.M. Ward (1991). "Effects of Shrimp Aquaculture on the U.S. Market: An Econometric Analysis." Draft Report, Louisiana State University.

Rapid expansion in the production of farm-raised shrimp during the 1980's concerns the domestic shrimp industry and is the basis for recent attempts at limiting imports. A simultaneous equation model including the U.S. and Japan shrimp import markets and U.S. dockside demand was used to quantify the impacts of shrimp aquaculture on U.S. imports and domestic warm water dockside shrimp prices. Results suggest that current, i.e., 1988-1989, U.S. shrimp import levels would be about 175 million pounds below observed levels in the absence of shrimp aquaculture and that the U.S. import price would be about 70% higher. The domestic dockside warm water shrimp price would also be significantly higher. Quotas and tariffs were also shown to positively influence domestic dockside prices. It was suggested, however, that any rise in domestic warm water shrimp prices, brought about by a reduction in imports would encourage additional effort in the domestic shrimp fleet and a dissipation of initial gains in profit.

Kelly, Carolyn E. and Anthony W. Harmon (19??). "Method of Determining Carotenoid Contents of Alaska Pink Shrimp and Representative Values for Several Shrimp Products." Fisheries Bulletin, 70(1):111-113.

An extraction method is described for estimating the amount of carotenoid 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.

Kennedy, F.S., J.J. Crane, R.A. Schlieder, and D.G. Barber (1977). "Studies of the Rock Shrimp, Sicyonia Brevirostris, A New Fishery Resource on Florida's Atlantic Shelf." Florida Marine Research Publications, Florida Department of Natural Resources, Marine Research Laboratory, Number 27, June, 69 pp.

Life history, fishery dynamics, and potential stock locations of the Florida east coast continental shelf population of rock shrimp were studied over a two year period.

Khilnani, Arvind (1979). "Evaluation of the Data Availability and Data Needs of the Tortugas Shrimp Model (FISYS Version T)." Stanford University, Department of Engineering-Economic Systems, Stanford, California, November, 8 pp.

In this report a qualitative evaluation of the data availability and needs of the Tortugas Model is considered. The model is a quantitative tool for estimating and evaluating the effects of alternative management policy options prior to actual policy implementation. The combination of a quantitative methodology and a policy orientation provide a natural framework to evaluate present data availability. Furthermore, the model indicates areas of data paucity together with a list for future data gathering activities.

Khilnani, Arvind (1980). "Estimation of Price Elasticity and Flexibility of Demand with Respect to the Tortugas Shrimp Fishery." Memorandum for Edison Tse, John Poffenberger, and Jim Tom, Stanford University, Stanford, California.

The memorandum discusses the relationship between price elasticity of demand and price flexibility estimates using pink shrimp data from the Tortugas shrimp fishery to estimate statistical relationships. No preference vis a vis a choice of independent variables was found in the data or theoretically.

Khilnani, Arvind and Edison T.S. Tse (1980). "Integrated Approaches to Fishery Policy Analysis: A Case Study of the Tortugas Shrimp Fishery." Executive Summary of the final report prepared for Southeast Fisheries Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Virginia Key, Miami, Florida, by Stanford University, Department of Engineering-Economic Systems, Stanford, CA, January, pp. 14-20.

An executive summary of the management characteristics and adaptability of a Fisheries System Management Model (FISYS) as applied to the Tortugas shrimp fishery off the southwest coast of Florida.

Khilnani, Arvind and Edison T.S. Tse (1980). "Integrated Approaches to Fishery Policy Analysis: A Case Study of the Tortugas Shrimp Fishery." Final report prepared for Southeast Fisheries Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Virginia Key, Miami, Florida, by Stanford University, Department of Engineering-Economic Systems, Stanford, CA, January, 2?1 pp.

This report discusses the application and implementation of the FISYS model. The FISYS model was developed at Stanford University as an analytical framework to address issues of policy choice mandated by the Fishery Conservation and Management Act of 1976. The model embodied a methodology to combine the diverse characteristics of a fishery into a single quantitative framework to best suit the needs of fishery analysts, fishery managers, and statistical experts. The model technology employed a computer to assemble and process the best available information as required by the law.

Khilnani, Arvind, Shu Dong He, and Edison T. S. Tse (1983). "The Gulf of Mexico Shrimp Fishery, An Integrated Approach." Report prepared for the Southeast Fisheries Center, National Marine Fisheries Service, Miami, Florida by the Department of Engineering-Economics Systems, Stanford University, Stanford, California, November, 76 pp.

This report discusses an application and implementation of the Fisheries System Management (FISYS) model. Three regional models for Texas, Florida, and the northern Gulf of Mexico have been integrated via the fleet mobility model to produce this integrated Gulf wide model. The report discusses the parameters used to represent the three regional fisheries and the integrated model with special emphasis on the northern Gulf component since that fishery has not been covered in earlier reports on the project.

Kim, Dae K. (1983). "Energy Substitution in the Gulf of Mexico Shrimp Fishery." Southern Journal of Agricultural Economics, December: 1-6.

The elasticities of substitution among fuel, capital, and labor are estimated for the Gulf of Mexico Shrimp fishery using a translog cost function fit to observed data.

Kitner, Kathi R. (1987). "TEDS: A Study of the South Atlantic Shrimp Fishermen's Beliefs, Opinions and Perceptions Regarding the Use of Turtle Excluder Devices." Report to the South Atlantic Fishery Management Council, Charleston, South Carolina, September, pp. 47.

Determining the beliefs and perceptions that South Atlantic shrimpers hold relative to the federal regulations mandating TED usage prior to actual implementation is the objective of this study. It also addresses the more generic questions of how to successfully implement technology transfer, the role that class plays in structuring different behaviors and reactions to new fisheries policies, and why and how the goals of some regulations can foment conflict and dissent among and between various groups.

Klima, Edward F. (1986). "Review of Ecuadorean Shrimp Fisheries and Suggestions for Management and Research." National Marine Fisheries Service, Southeast Fisheries Center, Galveston Laboratory, 4700 Avenue U, Galveston, Texas, June, 18 pp.

At the request of the University of Rhode Island that is under contract to USAID, an evaluation is made of the offshore shrimp fisheries of Ecuador and recommendations are made concerning their management and research. This paper reviews, in a general sense, the information available for the offshore shrimp fishery of Ecuador, synthesizes some of the major findings and makes recommendations concerning their management and research.

Klima, Edward F. (1989). "Approaches to Research and Management of U.S. Fisheries for Penaeid Shrimp in the Gulf of Mexico." Chapter 4 in John F. Caddy (ed.) Marine Invertebrate Fisheries: Their Assessment and Management. John Wiley & Sons, New York.

This paper summarizes the results of current shrimp management and research programs, including estuarine research programs in the U.S. Gulf of Mexico.

Klima, Edward F., K. Neal Baxter, and Frank J. Patella (1982). "A Review of the Offshore Shrimp Fishery and the 1981 Texas Closure." Marine Fisheries Review, 44(9-10):16-30.

Prohibition of shrimp fishing within 200 miles of the Texas coast on 22 May 1981 resulted in large brown shrimp catches off Texas when the season reopened on 15 July. Catch per unit effort off Texas in late July and August 1981 ranged from 1,349 to 2,250 pounds per fishing day, compared with only 820 to 858 pounds per fishing day for the Louisiana offshore brown shrimp fishery. The July-August 1981 relative abundance (CPUE) off Texas was greater than during similar time periods for any other year. Shrimp caught and landed off Louisiana were also predominantly smaller than those caught and landed off Texas.

Recruitment from Texas bays to the offshore fishery appeared average to good, but was not sufficient to account for the outstanding abundance levels found offshore. The closure of Texas waters to fishing appears to have been a major reason for the large catches and high catch rates in July and August off Texas in 1981.

Klima, Edward F., K. Neal Baxter, Frank J. Patella, and Geoffrey A. Matthews (1984). "Review of the 1983 Texas Closure for the Shrimp Fishery off Texas and Louisiana." NOAA Technical Memorandum NMFS-SEFC-136, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Galveston Laboratory, Galveston, Texas, March, 28 pp.

The objectives of whether the Texas Closure regulation increased shrimp yield and reduced discarding of undersized shrimp were determined for 1982 and 1983. This report reviews and analyzes the characteristics of the Texas and Louisiana fisheries west of the Mississippi River and describes the catch, fishing effort, relative abundance and recruitment to the offshore fishery from June 1982-August 1983.

Klima, Edward F., James M. Nance, Eduardo X. Martinez, and Terrance Leary (1990). "Workshop on Definition of Shrimp Recruitment Overfishing." NOAA Technical Memorandum, NMFS-SEFC-264, 21 p.

This report summarizes the findings of a two day workshop undertaken to (1) draft scientific definitions of overfishing for each of the shrimp species in the management unit of the Fishery Management Plan and (2) to recommend action that might be taken if overfishing occurred in any of these stocks.

Knowlton, Clifford J. (1971). "Preliminary Studies of a Potential finfish Industry from Commercial Shrimp Landings." Report for the Commercial Fisheries Research and Development Act (PL 88-309), U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, St. Petersburg, FL, October.

A study was conducted to determine species composition and weights of fish taken during trawling for shrimp by the commercial fishery in Georgia's close inshore waters. For all species combined and considering the state as a unit, the average pounds per hour of trawling had a large seasonal variation. The months of January, March, April, October, and December all averaged less than 100 pounds per hour of trawling with December the low month at about 29 pounds followed by March at about 52 pounds. In all remaining months the catches averaged over 120 pounds per hour of trawling with peaks in May at 245 pounds and in November at 192 pounds. Four families of fish each represented 3 percent or more of the yearly average catch over the state. These are Sciaenidae 73.8 percent, Clupeidae 8.5 percent, Dasyatidae 3.6 percent, and Ariidae 3.3 percent — a combined total of 89.2 percent of the yearly average catch. The Sciaenidae contributed 95.0 pounds per hour of trawling, Clupeidae 10.9 pounds, Dasyatidae 4.7 pounds, and Ariidae 4.3 pounds or a combined total of 114.9 pounds of the yearly average of 128.8 pounds per hour of trawling. Nine species of fish were captured in greatest abundance over the state and together contributed 111.6 of the 128.7 pounds per hour of trawling and represented 86.4 percent of the yearly average catch.

Kortbech-Olesen, R. (1984). "World Shrimp Trade Continues to Expand." The Fish Boat, August: 22-98 (7 pages).

A review of the world trade in shrimp, the effect of aquaculture, and the International Trade Center study "Shrimps: A Survey of the World Market."

Krauthamer, Judith T., William E. Grant, and Wade L. Griffin (1984). "Characteristics of the Texas Shrimp Fleet, 1979-82." Marine Fisheries Review, 46(2):53-59.

Sound management of the Texas shrimp fishery requires an understanding of the composition of the shrimp fleet and its response to changing economic conditions and regulations. This study utilized Texas Parks and Wildlife Department licensing data to quantitatively describe and evaluate the commercial fleet from 1979 to 1982. Tables representing the number of vessels in the fleet, the license (bay, bait, Gulf) or license combinations that they maintain, the home ports of vessels, and the counties of residence of vessel owners, are presented. Despite yearly fluctuations, the shrimp fleet has been increasing, as have been the purchases of single and multiple licenses. Decreases in the number of vessels in the fleet for any given year resulted primarily from vessels less than 25 feet in length and vessels 55-70 feet in length leaving the fishery. The expansion of the fleet in 1981 and its relationship to 1981 fisheries legislation is discussed.

Krauthamer, Judith T., William E. Grant, and Wade L. Griffin (1987). "A Sociobioeconomic Model : The Texas Inshore Shrimp Fishery." Ecological Modeling, 35:275-307.

A sociobioeconomic model (SBM) of the Texas inshore shrimp fishery is developed as an extension of a General Bioeconomic Fisheries Simulation Model (GBFSM) for annual crop fisheries. The SBM is a heuristic model which redefines the traditional concept of a vessel class to include social and cultural variables that describe the vessel operators. Sociocultural variables that are hypothesized to affect harvesting capability of fishermen, or relative fishing power (RFP) of vessels that they operate, are identified and referred to as Fishing Advantage variables. Fishing Advantage variables, age of operator, years of experience, and innovativeness, are quantified and incorporated into the GBFSM through modification of an equation

that calculates RFP for different SBM vessel classes. Sociocultural variables hypothesized to affect decisions of vessel operators to exert fishing effort, or nominal days fished (NDF) are identified and referred to as Motivational variables. These include deferred gratification orientation, work orientation, and vessel ownership status of the vessel operator. A method using decision trees to direct decision making based on Motivational variables and economic feedback is incorporated into the GBFSM to adjust NDF for different vessel classes. Five idealized inshore vessel classes representing different types of Texas inshore shrimp vessels, whose operators differ in Fishing Advantage and Motivation, are included in the SBM. Examination of the performance of individual inshore vessel classes indicated that policy changes have different economic impacts on different groups of fishermen, with revenue and rent of the lowest producers being most sensitive to policy changes.

Lacewell, Ronald D., Wade L. Griffin, James E. Smith, Wayne A. Hayenga (1974). "Estimated Costs and Returns for Gulf of Mexico Shrimp Vessels: 1971." Departmental Technical Report No. 74-1, The Texas Agricultural Experiment Station, Texas A&M University, College Station, Texas, January, 36 pp.

This study is an analysis of expected vessel costs, returns, and economic implications of alternative shrimp price situations. Costs and return estimates were based on 1971 data taken from 29 vessels separated into two classifications: (1) 53 to 65 foot and (2) 66 to 72 foot. Annual landings of shrimp were 41,551 and 56,933 heads-off pounds for small and large vessels, respectively. Total annual variable cost was $30,031 for small vessels and $51,632 for large vessels. Based on an expected 20 year life and 1971 vessel costs, annual fixed cost was $8,144 and $10,421 for small and large vessels, respectively. Gross revenue was $46,800 for smaller vessels based on a price of $1.13 per pound and $69,869 for large vessels based on a price of $1.23 per pound. The resulting net per vessel was $8,625 and $7,816 for small and large vessels, respectively. The investment analysis indicated that the internal rate of return for a small vessel was 24 percent without external financing and 50 percent with normal financing arrangements of an 80 percent loan at 8 percent interest for 6 years. This compares to an internal rate of return for large vessels of 7 percent without financing and 32 percent with the financing arrangement described above.

Lam, C.F., J.D. Whitaker, and F.S. Lee (1989). "Model for White Shrimp Landings for the Central Coast of South Carolina." North American Journal of Fisheries Management, 9:12-22.

A stock recruitment relationship (SRR) was developed for white shrimp Penaeus setiferus in the central coastal area of South Carolina. The SRR is a Beverton-Holt type curve for which May and June commercial fishery landings represent stock and August-January landings represent recruitment. A variable, August salinity in Charleston Harbor, was selected by the stepwise regression process, and it was combined with the Beverton-Holt equation to produce a model that explained 86.8% of the variation in August-January landings. The final model was used to develop a family of SRR curves in which each curve corresponded to a different salinity. This model was sufficiently robust to forecast below average, average, and above average fall landings from readily obtainable data collected in spring and summer. These findings support South Carolina's existing management strategy of protecting spring spawners as much as possible after severe winter weather when the brood stock has suffered heavy mortality.

Lambregts, Johannes A.D., Sayra G. Thacker, and Wade L. Griffin (1993). "Economic Evaluation of Different Densities for Various Sized Shrimp Farms in Texas." Journal of the World Aquaculture Society, 24(1):12-22.

There has been a trend toward intensification of shrimp farming in the U.S. Fifteen simulated farms were used to evaluate economies of scale and to compare three Penaeus vannamei commercial production strategies: semi-intensive, intensive, and very intensive. Large economies of scale were associated with each production strategy. Over the range of farm sizes considered, investment cost per hectare decreased

approximately 50% and production cost decreased approximately 25%. Farms' returns were measured with Internal Rate of return (IRR). When investment was greater than $0.75 million, the intensive strategy provided slightly better returns to the investor than semi-intensive or very intensive strategies. At investment levels less than $0.75 million, the semi-intensive strategy provided the highest IRR.

Langmo, R. Donald, Christopher N. Carter, and Ronald O. Bailey (1975). "Marketing Characteristics of Oregon's Fresh Frozen Shrimp Industry." Oregon State University, Sea Grant College Program, Publication No. ORESU-T-75-002, Agricultural Experiment Station, Special Report No. 440, August, 23 pp.

This work consolidates from many sources features of the fresh frozen shrimp industry in terms of its product volume, growth trends, and position relative to other Oregon seafood commodities. Market structure and functions are described as the product moves from the fisherman through the processor, broker, wholesaler, and retailer to the consumer. There is brief speculation on needs for future studies of marketing.

Lea, J.D. and J.S. Shonkwiler (1988). "Misspecification in Simultaneous Systems: An Alternative Test and Its Application to a Model of the Shrimp Market." Southern Journal of Agricultural Economics, 20(2):65-72.

Concern over the effects of public policies based on misspecified econometric models motivates interest in a procedure to test, diagnose, and improve the specification of models that have been estimated with three stage least squares. A test of system wide specification based on Hausman's specification test is employed in a test of the a priori restrictions placed on the parameters of a structural model of the U.S. shrimp market. The null hypothesis of proper specification is rejected. After diagnosis via a comparison of unrestricted and restricted reduced forms and respecification, the null hypothesis cannot be rejected.

Leary, Terrance R. (1983). "Review of the Gulf of Mexico Management Plan for Shrimp." Second Australian National Prawn Seminar.

Seasonal closures in the western gulf are estimated to have increased gulf wide yield of Penaeus aztecus by 9% in 1981 and 6% in 1982. Monitoring spring water temperatures and salinities allows some degree of accuracy in predicting annual abundance of this species. Salinities about 10 parts per hundred and temperatures above 20 degrees C are favorable. Benefits of management of P. duorarum in the eastern Gulf are less clearly defined, and relationships to environmental factors are not clearly understood. Restriction on U.S. vessels access to former foreign fishing grounds and increased imports from mariculture may require a reassessment of the management program.

Liao, David S. (1979). "An Economic Analysis of Mobility of Shrimp Vessels in the South Atlantic States." South Carolina Marine Resources Center, Technical Report Number 35, May, 38 pp.

The study develops economic information concerning mobility of shrimp trawlers in the south Atlantic states. The study examined the mobility patterns of trawlers, factors associated with the trawler mobility, and the economic performance of various types of shrimping operations. It was hoped that the study would provide benchmarks for decision-making to improve the shrimping industry and to utilize the resources more efficiently. In addition, the study analyzed some existing and alternative management programs that were related to the mobility of trawlers in the region. However, the general objective is to provide information and analysis to policy makers, not to make policies.

Liao, David S. and Theodore I.J. Smith (1981). "Test Marketing of Freshwater Shrimp, Macrobrachium Rosenbergii, in South Carolina." Aquaculture, 23:373-379.

A market testing study was conducted to examine the consumer and retailer acceptance for locally produced freshwater shrimp in South Carolina. The majority of consumers evaluated freshwater shrimp as similar to saltwater shrimp and about 89% were willing to purchase these shrimp from seafood stores. All retailers indicated that freshwater shrimp demonstrated high salability in their outlets and that they would add this aquafood to existing product lines.

Lindall, Bill (1995). "Gulf of Mexico Fishery Management Council Actions." Memorandum for distribution, National Marine Fisheries Service, Southeast Regional Office, 9721 Executive Center Drive, North, St. Petersburg, FL.

A list of actions, by fishery, approved by the Gulf of Mexico Fishery Management Council at their January 16-19, 1995 meeting.

Lipton, Douglas W. (198?). "U.S. Shrimp Market for Domestic Production and Imports." Chapter III of a draft report.

A review of trends in commercial landings, imports, and aquaculture affecting the domestic market for shrimp.

LiPuma, Edward and Sarah Keene Meltzoff (1985). "The Social Economy of Shrimp Mariculture in Ecuador." Draft report, Department of Anthropology and the Rosenstiel School of Marine and Atmospheric Science, University of Miami, May, pp. 35.

This report provides an initial account of the social economy of the Ecuadorian shrimp industry and lays the foundation for more comprehensive analyses to complement existing biological studies to strengthen the management of the shrimp resources.

Louisiana Department of Wildlife and Fisheries (1994). "Enhancing the Benefits Derived from Shrimp in the Gulf of Mexico Through Optimizing Shrimp Management in Louisiana." A Fisheries Management Plan for Louisiana's Penaeid Shrimp Fishery, MARFIN Project NA90AA-H-MF726 Final Report, December, 231 pp.

This management plan addresses the problems and potentials of Louisiana's penaeid shrimp fishery. The plan was developed by a project jointly funded by the U.S. Department of Commerce, Louisiana State University (LSU), and the Louisiana Department of Wildlife and Fisheries. LSU experts including a biologist, an economist, and an attorney provided the scientific information necessary to evaluate the management options suggested by the Department of Wildlife and Fisheries. The early development of the plan was guided by the goal of maximizing the economic benefits of the fishery to Louisiana and the region. Subsequent review of the draft plan by the Louisiana Wildlife and Fisheries Commission's Shrimp Management Committee resulted in refining the set of feasible management actions and a elaboration of the management goals. After review by the committee, public comment was solicited. The final product of this process is a set of proposed actions to be addressed by the Louisiana Wildlife and Fisheries Commission and the Louisiana Legislature in the future management of the fishery.

Low, R.A., D. Theiling, and E.B. Joseph (1987). "South Carolina Marine Fisheries, 1977-1986." South Carolina Marine Resources Center, Technical Report Number 67, November, 78 pp.

This report is an information summary of important developments in South Carolina's marine fisheries since 1977. Economic consideration has been confined to trends in landed value.

Lyles, Charles H. (1967). "Historical Statistics (Shrimp Fishery)." Division of Economics, Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C., May, 63 pp.

A compendium of shrimp fishery statistics for the United States from 1887 to 1965 covering domestic landings, foreign trade, prices, processed products, and frozen trade.

McCarty, Gene (1995). "Biological Benefits of the 200 Mile Closure for Red Snapper and Brown Shrimp." Texas Parks and Wildlife Department, January.

For the years when the 200 mile closure was in effect there were significant increases in the number of juvenile red snapper found in the Texas Territorial Sea and in the number of juvenile brown shrimp found in the estuaries during April following the year of the closure. Increases in red snapper may be attributed to increased spawning due to protection in the spawning grounds or to the reduction of bycatch associated with juvenile red snapper.

McKee, David A., Addison L. Lawrence, and Wade L. Griffin (1989). "Stocking Strategies and an Investment Analysis for Producing Penaeus setiferus as a Live Bait-Shrimp on the Texas Coast." Journal of the World Aquaculture Society, 20(2):72-80.

An economic and investment analysis was performed to determine the viability of bait-shrimp farming in Texas. A single pond analysis producing 5 - 5.5 g shrimp always had higher returns above selected cost (RASC) than producing 4 - 4.5 g shrimp. Stocking 0.01 g shrimp had a higher RASC than stocking 0.25 g, 0.50 g, or 0.75 g shrimp. In the 20 pond analysis, which accounted for marketing considerations, stocking 0.25 g shrimp had the highest RASC. The investment analysis, assuming average management, was declared bankrupt by the end of the fifth year. Under "excellent" management the internal rate of return was only 11.7%. It is unlikely that bait-shrimp farming will become a viable industry in Texas in the near future.

Macinko, Seth (1993). "Investigation of the Basic Bioeconomic Dynamics of Bycatch Problems in Gulf of Mexico Fishery Management." Final report, S/K Award No. NA27FD0068-01, November, 44 pp.

A stylized model of a set of Gulf fisheries is developed to investigate the bioeconomic characteristics of bycatch problems. The simulation run isolate three distinct effects attributable to the introduction of a bycatch reduction device (BRD) into the fishery for stock X; a bycatch catchability effect; an operating cost effect; and a target species catchability effect. The BRD does not result in increases in stock size for species Y, it does increase recreational and commercial fishing effort for species Y substantially, and it increases fishing pressure in the fishery for species X.

Maharaj, Vishwanie (1989). "The By-Catch in the Artisanal Shrimp Trawl Fishery, Gulf of Paria, Trinidad." Masters Thesis, Department of Fisheries, Aquaculture, and Pathology, University of Rhode Island, Narragansette, Rhode Island.

Annual ratio estimates were 9:1 finfish to shrimp and 14.7:1 bycatch to shrimp, with the highest ratios observed during August to December and the lowest during late January to May, the dry season. Extrapolation of ratios, using shrimp catch statistics indicate that for 1986, 974,000 kg finfish and 620,000

kg crabs (Callinectes spp.) were caught incidentally by artisanal shrimp trawlers fishing in the Gulf of Paria. Of this total incidental catch (1,594,000 kg), approximately 1,500,400 kg were discarded (94%).

Maharaj, V and C. Recksiek (1991). "The Bycatch from the Artisanal Shrimp Trawl Fishery, Gulf of Pria, Trinidad." Marine Fisheries Review, 53(2):9-15.

Samples of shrimp trawl catches were collected from a commercial artisanal vessel fishing inside the 6 fm isobath in the Gulf of Paria, Trinidad. Annual ratio estimates were 9 finfish: shrimp and 14.7 bycatch:shrimp, with the highest ratios observed August through December and the lowest from late January through May, the dry season.

Mahood, Robert K. (1977). "Socioeconomic Impact on the White Shrimp Fishery by Opening and Closing Sounds." Coastal Fisheries Section, Coastal Resources Division, Georgia Department of Natural Resources, 45 pp.

The study was divided into two phases to accurately assess the economic and social benefits derived from opening and closing sounds to commercial shrimping. Phase I consisted of field work, publicity, shrimp tagging, and monitoring environmental factors. Phase II evaluated shrimp movements from the estuaries and economic and social benefits derived from opening and closing sounds.

Manar, Thomas A. (ed.) (1973). "Shrimp '73 - A Billion Dollar Business." Marine Fisheries Review, March-April, 35(3-4):1-80.

An issue of the journal devoted to a single topic; shrimp.

Margavio, A.V. and Shirley Laska (1992). "The Louisiana Shrimp Fishery: A Management Challenge." Draft report, The Environmental Social Science Research Institute, Department of Sociology, University of New Orleans, New Orleans, LA 70148, 50 pp.

The paper explores the lessons learned about the TED controversy using data collected under contract.

Margavio, A.V., Shirley Laska, James Mason, and Craig Forsyth (1992). "A Sociopolitical Analysis of Marine Management: The TEDs Case." Draft report, University of New Orleans.

A sociopolitical model of marine resource conflicts was elaborated using the Turtle Excluder Device (TED) conflict and protest as an illustrative case. The model is grounded in the theories and perspectives of four relevant sociopolitical perspectives: 1) public policy/public administration, 2) environmental sociology, 3) collective behavior, and 4) economic power and labor organization/labor disputes. The approach combines the four perspectives into a single vision. The model focuses (1) both objective interests and subjective values in conflict, (2) conflict history as the unit of analysis, (3) the roles of government; (4) the role of science, and (5) the social impacts.

Marullo, Frank (1973). "An Automatic Pumping Device for Sampling Postlarval Shrimp (Penaeus spp.)." Marine Fisheries Review, 35(3-4):24-26.

Described is an automatic sampling device used to collect and preserve postlarval shrimp. At timed intervals, seawater is pumped through collecting nets that retain samples of organisms including

shrimp. A maximum of 12 samples can be collected in 24 hours. Each sample is preserved immediately in 10 percent Formalin. These samples may be removed once after each 24 hours of operation, or they may be accumulated with similar samples over a longer period of time. Comparisons is made between catches with the automatic device and those made with the Renfro beam trawl.

Matlock, Gary C. (1992). "A Model for Forecasting Brown Shrimp Landings in Texas." Draft report, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744.

The brown shrimp harvest from the Gulf of Mexico off Texas is predicted annually by the National Marine Fisheries Service using a forecasting model that relates juvenile shrimp abundance in the Galveston Bay system during each spring (April-June) to the subsequent annual (July-June) offshore harvest. Predictions since 1981 when a closure of the Exclusive Economic Zone off Texas (Texas Closure) was implemented to compliment the closure of the Texas territorial Sea during June through mid-July have underestimated the actual reported landings. A revised model that incorporates the effect of the Texas Closure on yield should improve the reliability and precision of forecasted yields. The relationship between yield and juvenile shrimp abundance changed significantly after the Texas Closure was implemented; the slope of the relationship almost doubled from the pre-Closure years to the Closure years.

Matthews, Geoffrey A. (1982). "Relative Abundance and Size Distributions of Commercially Important Shrimp During the 1981 Texas Closure." Maine Fisheries Review, 44(9-10):5-15.

Relative abundances of commercial shrimp, Penaeus spp., and lengths of brown shrimp, Penaeus aztecus, are determined for Texas shelf waters during the 1981 Texas closure, 22 May-15 July. A total of 274 samples were collected in water where bottom depths ranged from 4 to 45 fathoms in four statistical subareas covering the Texas Gulf coast. Greatest abundances of Penaeus were found between 10 and 20 fathoms in each subarea. Shrimp were more abundant in the southern subareas (20 and 21) than in the northern ones (18 and 19). Relative abundances during the 1981 closure were usually greater than those calculated from the 1961-65 Bureau of Commercial Fisheries' and the 1975-80 Texas Parks and Wildlife Department's historical shrimp collections for similar months. Mean total lengths of brown shrimp in waters where bottom depths were from 4 to 10 fathoms were close to 100 mm, those in 11-20 fathoms were close to 115 mm, and those in 21-30 fathoms were close to 130 mm. When mean total lengths of brown shrimp were compared among the three data sets, means of the 1981 closure surpassed those of the two historical data sets where bottom depths were from 4 to 10 fathoms during June. Closure mean lengths between 11 and 20 fathoms were less than those from Bureau of Commercial Fisheries data and were greater than those from Texas Parks and Wildlife Department data. Closure mean lengths in 21-30 fathoms were smaller than those from both agencies' data.

Matthews, Geoffrey A. (1992). "Brown Shrimp Harvest Prediction - Western Gulf of Mexico." Abstract in Kenneth N. Baxter and Elizabeth Scott-Denton (eds.), Proceedings of the Southeast Fisheries Science Center Shrimp Resource Review, NOAA Technical Memorandum, NMFS-SEFSC-299, August, 186 pp.

The prediction of brown shrimp harvest is based on the Baxter Bait Shrimp Index that has provided accurate estimates of shrimp catch for the last 30 years, explaining 67% of the annual variation in landings off Texas. Other methods have been tested, but have not been able to match the BBSI method in predictive ability.

Miller, George C. (1971). "Commercial Fishery and Biology of the Freshwater Shrimp, Macrobrachium, in the Lower St. Paul River, Liberia, 1952-53." U.S. Department of Commerce, NOAA, NMFS, Special Scientific Report - Fisheries No. 626, February, iii+13 pp., 8 Figs., 7 Tables.

The biological population parameters and characteristics of a family of fresh water shrimp that is harvested commercially in Liberia.

Miller, Morton M. (1975). "Recovery from a Crisis—A Fishing Industry Perspective." National Marine Fisheries Service, Economic and Marketing Research Division, Washington, D.C., July.

The shrimp industry by virtue of its being the most valuable U.S. fishery is faced with problems that typify the general problems facing the industry during this recovery period; e.g. costs, market strength, and import competition. For these reasons, and for the practical reason of data availability, shrimp operations were selected for a summary graphic analysis that would put the status of the U.S. fishing industry in current perspective.

Miller, Morton M. (1975). "The Role of Shrimp Imports in a Declining Sea Foods Market - A Background Paper." U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Division of Economic and Marketing Research, April, 50 pp.

The report provides a summary of the general market picture for fishery products in the U.S., a discussion of the shrimp situation, and the impact of imports on shrimp markets in the U.S.

Miller, Morton M. (1975). "Recovery from a Crisis—A Fishing Industry Perspective." Report, Economic and Marketing Research Division, National Marine Fisheries Service Washington, D.C., July.

The financial predicament in the shrimp fishery predicated upon the energy crisis and the resulting industry wide recovery problem are summarized in a series of charts and graphs. The fuel cost situation is worsening and overshadowing uncertain gains in the market place. The immediate future promises continued economic hardship for the shrimp industry, and others in fishing.

Miller, Morton M. and John E. Greenfield (1975). "Prognosis for the Financial Ills of the Gulf Shrimp Industry." Report, Division of Economics and Marketing Research, National Marine Fisheries Service.

The trends in the shrimp industry are analyzed within the context of the national economy to predict when the impact of the energy crisis on vessel operating costs will subside or consumer demand will increase leading to a reduction in the cost-price squeeze that caused vessel owner-operators to be in a financial crisis. Trends indicate that a recovery had already begun by the time the analysis was completed.

Miller, Morton M. and Richard Marasco (1976). "Statement on Applying Import Controls on Shrimp Products Entering the United States." Economics and Marketing Research Division, National Marine Fisheries Service, Washington, D.C., April, 10 pp.

This is an economic discussion paper that attempts to place the problem of shrimp import controls in perspective. The International Trace Commission is conducting an investigation of the shrimp import situation, under authority of Section 201 (b) (1) of the Trade Act of 1974, in which a determination will be made as to whether those imports have caused economic injury to the U.S. Shrimp industry. The principal issue addressed are the justification for intervention, the potential effectiveness of intervention, and the long term implications.

Miller, Morton M. and Darrel A. Nash (1971). "Regional and Other Related Aspects of Shellfish Consumption - Some Preliminary Findings From the 1969 Consumer Panel Survey." U.S. Department of Commerce, NOAA, NMFS, Circular 361, June, iv+18 pp., 21 Figs., 3 Tables, 10 apps.

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

Miller, Morton M. and Richard W. Surdi (1974). "Shrimp-A New Picture for 1974." U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, June, 42 pp.

The shrimp industry was undergoing a period of adjustment to altered conditions within the industry and the general economy. This report summarizes the general trends in the economy and their likely impacts on the prices, inventories, substitute commodities, and consumer demand for shrimp.

Miller, Morton M. and Richard W. Surdi (1981). "Productivity in the Gulf of Mexico Shrimp Fishery." National Marine Fisheries Service, Office of Policy and Planning, Economic Analysis Staff, Washington, D.C., July, 117 pp.

Because of data constraints this analysis of the productivity of the Gulf shrimp fishery was limited to an analysis of several partial measures of productivity. The analysis indicates that productivity in the industry has declined in recent years.

Miranda, Marie Lynn (1986). "United States Shrimp Imports, 1980-1986." Draft report, Economics and Statistics Office, Southeast Fisheries Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Miami, FL, August, 7 pp.

This report discusses the role and influence of shrimp imports on the U.S. shrimp production industry, with reference to the January 1981 to June 1986 period. Most of the analysis is done for count sizes 26-30 and 41-50 as well as total shrimp imports.

Mitchell, John F. and Arvind Shah (1992). "Report on TED Efficiency Trials Aboard a Mexican Shrimp Trawler, A U.S./Mexico Cooperative Study November 9-20, 1992." Foreign TED Technology Transfer Program, National Marine Fisheries Service, Southeast Fisheries Science Center, Mississippi Laboratory, Pascagoula Facility, P.O. Drawer 1207, Pascagoula, MS, 20 pp.

Gear specialists with the National Marine Fisheries Service and the National Fisheries Institute of Mexico collected information on catch rates of shrimp and bycatch from trawls equipped with super Shooter and Anthony Weedless style TEDs aboard a Mexican shrimp trawler in November 1992. Trawling operations were conducted in Mexican waters of the Gulf of Mexico along the northern coast of the state of Tamaulipas.

Catch data was collected from TED versus non-TED equipped trawls during 179 hours of comparative towing. Shrimp catch per unit effort (CPUE = lb/h) for the Super Shooter TED and corresponding control net was 5.34 and 5.53 lb/h respectively resulting in a difference of 3.4 percent. Shrimp CPUE for the Anthony Weedless TED and corresponding control net was 6.42 and 6.66 lb/h respectively resulting in a difference of 3.6 percent. Differences in the catches of shrimp and bycatch between TED equipped nets and their corresponding control nets were not statistically significant over all phases of the test.

Mock, C.R. (1973). "Shrimp Culture in Japan." Marine Fisheries Review, 35(3-4):71-76.

A presentation on Japanese shrimp aquaculture and the progress being made by researchers to perfect their techniques.

Moffett, A.W. (1970). The Shrimp Fishery in Texas. Texas Parks and Wildlife Department, Austin, Texas.

This bulletin is designed to introduce the reader to the biology of the commercial species of shrimp and the fishery in Texas.

Moncol, N. Dolores, J.W. Tate, Barbara C. Barbour, N.B. Webb, and F.B. Thomas (19??). "Investigations on the Mechanical Processing and Additive Treatment of Shrimp." Draft Chapter III.

The objectives of this study were to evaluate the efficiency of a relatively small, portable, shrimp processing machine and the effect of selected food grade additives on the quality of shrimp.

Montegut, R.S. (1979). "Planning To Buy a Shrimp Boat." Louisiana Cooperative Extension Service Sea Grant Publication LSU-TL-79-005, Louisiana State University, Baton Rouge, La, 11 pp.

The shrimp industry in the Gulf of Mexico is dominated by owner operated shrimp boats. These businessmen are interested in a lifestyle as well as earning a profit. The lifestyle is one not faced by the investor choosing not to operate his shrimp boat. Absentee owners generally experience higher repair and maintenance costs, higher insurance costs and lower shrimp catches. Understanding the situation faced by an absentee owner compared to the experienced owner operator will be helpful in making your investment decisions. Also, there are already a large number of shrimpers competing with expensive boats for a fully utilized supply of shrimp. Thus, the skills and number of your competitors in shrimping must be considered before you invest in the business.

Morrison, N.A., D.H. King, M.L. Quinto, and N.B. Webb (19??). "Effect of Various Additives and Temperature Applications on the Texture of Shrimp." Draft Chapter IV.

The main objective of this investigation was to determine the influence of cooking, PH, and frozen storage on the texture of shrimp.

Murphy, Thomas M. and Sally R. Hopkins-Murphy (1989). "Sea Turtle and Shrimp Fishing Interactions: A Summary and Critique of Relevant Information." Center for Marine Conservation.

This report examines the interactions between sea turtle populations and the shrimp fleet, particularly from North Carolina to Florida, by analyzing major aspects of each that relate to this interaction. The major aspects examined are the density and distribution of marine turtle nesting, marine turtle carcass strandings, incidental captures of marine turtles in shrimp trawls, shrimping effort, and aerial observations

of turtles at sea. Each section on these major aspects looks at historic and current information, values and uses for the information and shortcomings and cautions regarding these data. The report also summarizes and critiques the primary source documents upon which management and research decisions are made by the two federal agencies that have legal jurisdiction over sea turtles.

Murray, James D., James J. Bahen, and Roger A. Rulifson (1992). "Management Considerations for Bycatch in the North Carolina and Southeast Shrimp Fishery." Fisheries, 17(1):21-26.

Many observers believe that commercial shrimp bycatch will be the most important issue southeastern U.S. fishery managers must address during the next several years. Although the biological impact of bycatch on finish stocks is uncertain for many species, there is evidence that it may already be affecting red snapper, mackerel, and weakfish stocks. Available management measures to reduce bycatch include area and season closures and gear modification requirements. Recent experiences in the southeast with turtle excluder devices are instructive for developing policy and implementing management regimes. Through a 1990 amendment to the Fishery Conservation and Management Act, Congress established a 3 year program to assess the impact on fishery resources of incidental harvest by the shrimp trawl fishery. The Gulf and South Atlantic Fisheries Development Foundation is forming a steering committee to develop a strategic plan and to establish criteria for evaluating gear for the management of bycatch in the southeast shrimp fishery. The North Carolina Marine Fisheries Commission (NCMFC) recently required the Division of Marine Fisheries to establish the goal of reducing bycatch to the absolute minimum, and appointed a scrap-fish committee to develop draft recommendations for affected fisheries. To achieve an acceptable compromise by the fishery constituency, good coordination, communication, and citizen participation processes are required. The committees offer an important opportunity for developing bycatch management systems.

Nance, James M. (1991). "Shrimp Recruitment Overfishing Analysis." Report for the Gulf of Mexico Fishery Management Council, June, 5 pp.

Recruitment and parent stock estimates are proposed as measures of overfishing in the shrimp fishery.

Nance, James M. (1991). "Gulf of Mexico White Shrimp Analysis." Report for the Gulf of Mexico Fishery Management Council, February, 9 pp.

This report was prepared to respond to questions about the catch of Gulf of Mexico white shrimp in the state managed territorial sea and the federal managed exclusive economic zone.

Nance, James M. (1991). "Estimation of Effort for the Gulf of Mexico Shrimp Fishery." Report to the Gulf of Mexico Fishery Management Council, December.

Description of the shrimp fishing effort trends in the Gulf of Mexico and how they are estimated.

Nance, James M. (1991). "Estimation of Effort for the Gulf of Mexico Shrimp Fishery." Galveston Laboratory, Southeast Fisheries Center, National Marine Fisheries Service, May, 12 pp.

Description of the shrimp fishing effort trends in the Gulf of Mexico and how they are estimated. Only the mathematical models and the analytical techniques applied in the effort estimation will be explained. Thus, it is advisable to become familiar with the fishery data utilized in these procedures. Therefore, this effort review should be read in conjunction with a companion report that provides a detailed description of

both the data and the procedures employed to collect these data from the Gulf of Mexico shrimp fishery (Poffenberger, 1991) attached.

Nance, James M. (1992). "Shrimp Recruitment Overfishing Analysis for 1991." Report for the Gulf of Mexico Fishery Management Council, July, 6 pp.

Recruitment and parent stock estimates are proposed as measures of overfishing in the shrimp fishery.

Nance, James M. (1992). "Estimation of Effort for the Gulf of Mexico Shrimp Fishery." NOAA Technical Memorandum, NMFS, SEFSC, 300, February, 12 pp.

Description of the shrimp fishing effort trends in the Gulf of Mexico and how they are estimated.

Nance, James M. (1992). "Biological Review of the 1992 Texas Closure." Report to the Gulf of Mexico Fishery Management Council, Galveston Laboratory, Southeast Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, December, 28 pp.

This report contains an overview of selected effects of the 1992 Texas closure.

Nance, James M. (1992). "Analysis of White Shrimp Closure in the Gulf of Mexico." Report to the Gulf of Mexico Fishery Management Council, Galveston Laboratory, Southeast Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, December, 28 pp.

The GMFMC requested that NMFS investigate the feasibility of improving economic returns from the white shrimp fishery through cooperative management measures with Gulf coast states. The General Bioeconomic Fisheries Simulation Model (GBFSM) developed at Texas A&M University (Grant et al. 1981) was used to simulate various white shrimp closures in the Gulf of Mexico. This report contains the results of this analysis.

Nance, James M. (1992). "Shrimp Fishing Effort Estimation Workshop." Report of a Workshop, NMFS Galveston Laboratory, Galveston, TX, June 17-19.

Shrimp fishing effort workshop final report.

Nance, James M. (1993). "Analysis of White Shrimp Closures in the Gulf of Mexico." NOAA Technical Memorandum, NMFS-SEFSC-321, Galveston Laboratory, Southeast Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce, March, 12 pp.

In response to a Gulf of Mexico Fishery Management Council request, the National Marine Fisheries Service investigated the feasibility of improving economic returns from the white shrimp fishery through cooperative management measures with Gulf coast states. The General Bioeconomic Fisheries Simulation Model (GBFSM) developed at Texas A&M University (Grant, et al., 1981) was used to simulate various white shrimp closures in the Gulf of Mexico. Each of the white shrimp closure options have a positive benefit to the shrimp fishery (profits to the vessel owners) in the Gulf of Mexico.

Nance, James M. (1993). "Gulf of Mexico Shrimp Fishery Recruitment Overfishing Definition Workshop
2." NOAA Technical Memorandum, NMFS-SEFSC-323, Galveston Laboratory, Southeast Fisheries
Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric
Administration, Department of Commerce, April, 12 pp.

This report summarizes the findings of a two day workshop required by the Gulf of Mexico Fishery
Management Council to review the current definitions of overfishing; recommend changes, if needed, to
the current definitions of overfishing; and recommend action that might be taken if overfishing levels are
surpassed in any of these stocks for three of the four shrimp species named in the fishery management plan.

Nance, James M. (1993). "Review of the Rock Shrimp Fishery off the East Coast of the United States."
NOAA Technical Memorandum, NMFS-SEFSC-324, Galveston Laboratory, Southeast Fisheries
Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric
Administration, Department of Commerce, April, 18 pp.

The report summarizes the landings and effort data for south Atlantic rock shrimp from 1981
through 1991. Although several species of rock shrimp exist along the east coast of the United States, most
are either too small in size or not abundant enough for commercial harvest. The majority of the rock shrimp
landed from the east coast are Sicyonia brevirostris. The weights reported are in pounds of headed shrimp.
The dollar values are in actual dollars reported in each year. No attempt has been made to standardize the
dollar values reported in each year. No attempt has been made to standardize the dollar values for comparisons
between years. The effort values are in days fished as reported by the NMFS and state port agents. Days
fished represent the actual time fishing and not the length of a trip (i.e., days out of port). No attempt has
been made to standardize the effort data by vessel class or trawl type.

Nance, James M. (1993). "Biological Review of the 1992 Texas Closure." NOAA Technical Memorandum,
NMFS-SEFSC-325, Galveston Laboratory, Southeast Fisheries Science Center, National Marine
Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce,
April, 30 pp.

This report contains an overview of selected effects of the 1992 Texas Closure that is designed to
increase the yield of brown shrimp and eliminate the waste of the resource caused by discarding undersized
shrimp caught during a period in their life cycle when they are growing rapidly. The western Gulf of
Mexico should experience a combined annual brown shrimp production level of between 44.9 and 55.4
million pounds during the 1992-1993 season. This estimate is below the 55.9 million pound average for
the area.

Nance, James M. (1993). "Shrimp Trawl Bycatch Characterization Study." MARFIN Final Report, Grant
Number 93NMFS20, December, 10 pp.

Sixty seven trips have been completed for this bycatch research project during the period from
May 1992 through September 1993. Trip length varied from 1 to 27 days. A total of 770 sea days were
used to collect the data from 1027 tows during these 67 trips. Thirty nine different vessels have been used
in the study. Data files produced from all 67 trips are complete and archived in the computer. Only data
collected from May 1992 through April 1993 in the Gulf of Mexico has been summarized (i.e. species
composition).

Nance, James M. (1993). "Council Effort Presentation." Memorandum for Andy Kemmerer, Regional
Director, Southeast Regional Office, National Marine Fisheries Service, St. Petersburg, FL, November.

Copies of the visual material that may be included in the SEFSC presentation to the Gulf of Mexico Fisheries Management Council on shrimp fishing effort estimation.

Nance, James M. (1993). "Stock Assessment Report 1993, Gulf of Mexico Shrimp Fishery." National Marine Fisheries Service, Southeast Fisheries Science Center, Galveston Laboratory, Galveston, Texas, June.

The need to better manage the penaeid shrimp stocks of the United States, to insure that all involved in the fishery may benefit from this common resource, has prompted this research effort. This stock assessment report deals only with the 1960-1993 commercial catch statistics for brown shrimp (Penaeus aztecus), white shrimp (Penaeus setiferus), and pink shrimp (Penaeus duorarum) from the U.S. Gulf of Mexico shrimp fishery. This analysis provides the annual update of the status of the shrimp stocks first presented at the Southeast Fisheries Center's Second Stock Assessment Workshop (Nichols, 1984).

Nance, James M. (1994). "Stock Assessment Report 1994, Gulf of Mexico Shrimp Fishery." National Marine Fisheries Service, Southeast Fisheries Science Center, Galveston Laboratory, Galveston, Texas, June.

The need to better manage the penaeid shrimp stocks of the United States, to insure that all involved in the fishery may benefit from this common resource, has prompted this research effort. This stock assessment report deals only with the 1960-1994 commercial catch statistics for brown shrimp (Penaeus aztecus), white shrimp (Penaeus setiferus), and pink shrimp (Penaeus duorarum) from the U.S. Gulf of Mexico shrimp fishery. This analysis provides the annual update of the status of the shrimp stocks first presented at the Southeast Fisheries Center's Second Stock Assessment Workshop (Nichols, 1984).

Nance, James M. (1995). "Royal Red Landings by Month as a Function of Percentage of the MSY Value (392,000 pounds of tails)." A letter, National Marine Fisheries Service, Southeast Fisheries Science Center, Galveston Laboratory, Galveston, Texas, July.

A letter in response to an information request from the Gulf of Mexico Fishery Management Council presenting landings of royal red shrimp as a percentage of MSY, monthly from January, 1993 to March, 1995.

Nance, James M. (1995). "A Biological Review of the Tortugas Pink Shrimp Fishery Through December 1994." National Marine Fisheries Service, Southeast Fisheries Science Center, Galveston Laboratory, Galveston, Texas, July.

The trends in landings and fishing effort for the Tortugas pink shrimp fishery are presented. Landings have been depressed in recent years, catch per unit effort has been below average, and while yield per recruit has been enhanced since the Tortugas closure, recruitment has been low. No cause for the decrease in the pink shrimp fishery can be established at this time, although problems within the habitat are suspected.

Nance, James M. (1995). "Shrimp Recruitment Overfishing Analysis for 1994." National Marine Fisheries Service, Southeast Fisheries Science Center, Galveston Laboratory, Galveston, Texas, July.

Summary of results from the recruitment overfishing analysis of landings for brown, white, pink, and royal red shrimp. No stocks have been overfished according to the report.

Nance, James M. (1996). "Biological Review of the 1995 Texas Closure." NOAA Technical Memorandum, NMFS-SEFSC-379, Galveston Laboratory, Southeast Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce, April, 27 pp.

In 1981, the Gulf of Mexico Shrimp Fishery Management Plan (FMP) was implemented with a primary objective being to increase the yield of brown shrimp harvested from Texas offshore waters. Since then, various aspects of the Texas Closure management measure have been analyzed and reported on by scientists at the Southeast Fisheries Science center (SEFSC). This report contains an overview of selected effects of the 1995 Texas closure and will be presented to the Gulf of Mexico Fishery Management Council (GMFMC) in January 1996.

Nance, James M. and E.F. Klima (1990). "Shrimp Recruitment Overfishing Definition." Report Prepared for the Gulf of Mexico Fishery Management Council.

The purposes of this paper are to highlight recent fishery trends observed in the Gulf of Mexico shrimp stocks and explore possible critical index values that could be used to monitor the possibility that recruitment overfishing could be occurring in the fishery.

Nance, James M., Nina Garfield, and J. Anthony Paredes (1991). "A Demographic Profile of Participants in Two Gulf of Mexico Inshore Shrimp Fisheries and Their Response to the Texas Closure." Marine Fisheries Review, 53(1):10-18.

A social study of the shrimp fisheries of Galveston Bay, Texas, and Calcasieu Lake, La., was made during the summer of 1987 to examine the impacts of the seasonal closure of the Federal waters off Texas and to understand the infrastructure and demographic processes of these two diverse fisheries. Survey instruments were administered to 159 shrimp boat captains; 89 from Galveston Bay and 70 from Calcasieu Lake. Shrimp-house owners were interviewed in each region as well.

The results suggest that the inshore fisheries are distinct from the offshore fisheries. The infrastructure of the two inshore fisheries examined differ in that the market distribution of shrimp from Galveston Bay was more diffuse than from Calcasieu Lake. Much more of the shrimp harvested from Galveston Bay was channeled into the surrounding community than from Calcasieu Lake.

The distribution of age, years as a commercial fisherman, and family involvement in fishing suggest that participation in Calcasieu Lake's and Galveston Bay's inshore fisheries have expanded concurrent with declining economies. While overall the Texas closure had little impact on either of the inshore fisheries, the Galveston Bay shrimpers experienced more of a direct impact on their livelihood than Calcasieu Lake shrimpers.

Nance, James M., E.F. Klima, and Thomas E. Czapla (1989). "Gulf of Mexico Shrimp Stock Assessment Workshop." NOAA Technical Memorandum, SEFC-NMFS-239, USDOC, NOAA, NMFS, SEFC, Galveston Laboratory, October, 41 pp.

A technical review of the biological status of the brown, pink, and white shrimp fisheries was recommended by the Gulf of Mexico Fishery Management Council. This workshop was convened to assess the present status of the fisheries, review stock assessment techniques and make recommendations about areas of focus for research. The workshop panel was comprised of national experts, state and federal officials, and the scientific support staff from the NMFS, Galveston Laboratory.

Nance, James M., E.F. Klima, and E.X. Martinez (1990). "Impacts of Proposed Brown Shrimp Fishery Management Closures in the Gulf of Mexico." Report for the GMFMC, January 1991. NMFS, Galveston Laboratory, December, 27 pp.

In January, 1990, the Gulf of Mexico Fishery Management Council requested that the Southeast Fisheries Center investigate the feasibility of improving the economic returns from the brown shrimp fishery through cooperative management measures with Louisiana and other Gulf coast states. During the past year, a simulation model was developed at the Galveston Laboratory to study the impact of closure options on the brown shrimp fishery. The basic premise of the model was to prohibit fishing on emigrating juvenile brown shrimp and allow the population to increase to a larger and more valuable average size. The complete analysis involved four phases: 1) construction of the biological model to simulate yields in numbers of shrimp and pounds; 2) calculation of revenues from simulated landings and regional price structure; 3) determination of fishing costs based on published cost information and data regarding the size of the fishery (i.e., number and type of fishing vessels); and 4) simulation of four separate time period closure options in the brown shrimp fishery for different regional areas within the Gulf of Mexico.

Nance, James M., Edward F. Klima, and Frank J. Patella (1991). "Biological Review of the 1991 Texas Closure." Report to the Gulf of Mexico Fishery Management Council, December.

A review of the 1991 Texas Closure regulation with a discussion of the reallocation of shrimp within Texas.

Nance, James M., Edward F. Klima, and Frank J. Patella (1992). "Biological Review of the 1991 Texas Closure." NOAA Technical Memorandum, NMFS-SEFSC-301, February, 18 pp.

A review of the 1991 Texas Closure regulation with a discussion of the reallocation of shrimp within Texas.

Nance, James M., Edward F. Klima, Peter F. Sheridan, K. Neal Baxter, Frank J. Patella, and Dennis B. Koi (1988). "Review of the 1987 Texas Closure for the Shrimp Fishery Off Texas and Louisiana." Report, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Galveston Laboratory, Galveston, Texas, January, 116 pp.

This report provides information to determine how well the objectives of the Texas closure regulation were achieved in 1986 and 1987 and to determine if a 15 nautical mile closure meets all the objectives of the closure regulation as effectively as a 200 nautical mile closure. Social as well as economic impacts are discussed.

Nash, Darrel A. and Frederick W. Bell (1969). "An Inventory of Demand Equations for Fishery Products." Bureau of Commercial Fisheries, Economic Research Working Paper Series, No. 10, July, 31 pp.

This paper contains demand equations that were selected as the most representative of all those submitted to the conference on fishery product demand. The respective demand functions were chosen as the best function for each species so far developed in that area.

National Marine Fisheries Service (1974). "Status of Shrimp Industry: August 1974", Southeast Regional Office, St. Petersburg, Florida, September, 7 pp.

The shrimp industry in the Gulf and south Atlantic is suffering severe economic hardship. Vessel owners are caught in a unprecedented cost-price squeeze and the average vessel is not even covering variable costs at present. Since September 1973, Gulf shrimp prices have fallen an average of 41 percent, while variable costs have risen substantially. Nonetheless, most vessels continue to fish for reasons that include the fisherman's eternal hope for the "big catch." If conditions do not change, many vessel operators will probably be forced out of the fishery by January 1975. Shrimp processors, principally breaders, have suffered losses totaling millions of dollars and hundreds of employees of these firms have lost their jobs. The total effect on the associated local economies is not known, but many counties have applied or asked for disaster assistance in the form of food stamps, low cost loans or other temporary economic relief. Further up the marketing chain the losses are not quite as severe, principally because the restaurants and retailers do not depend so heavily on shrimp as their principal livelihood. Still, loses have been suffered at all marketing levels.

National Marine Fisheries Service (1976). "Gulf Coast Shrimp Data Annual Summary, 1975." Current Fisheries Statistics No. 6925, National Oceanic and Atmospheric Administration, Washington, D.C., July, 26 pp.

Tabulations in this bulletin contain data on the shrimp catch landed by U.S. craft at U.S. ports along the Gulf of Mexico for trips completed during the period indicated. The figures include the species, size, depth, area fished, and actual fishing time in number of days.

National Marine Fisheries Service (1978). "Gulf Coast Shrimp Data Annual Summary, 1976." Current Fisheries Statistics No. 7225, National Oceanic and Atmospheric Administration, Washington, D.C., November, 13 pp.

Tabulations in this bulletin contain data on the shrimp catch landed by U.S. craft at U.S. ports along the Gulf of Mexico for trips completed during the period indicated. The figures include the species, size, depth, area fished, and actual fishing time in number of days.

National Marine Fisheries Service (1979). "Gulf Coast Shrimp Data Annual Summary, 1977." Current Fisheries Statistics No. 7523, National Oceanic and Atmospheric Administration, Washington, D.C., December, 13 pp.

Tabulations in this bulletin contain data on the shrimp catch landed by U.S. craft at U.S. ports along the Gulf of Mexico for trips completed during the period indicated. The figures include the species, size, depth, area fished, and actual fishing time in number of days.

National Marine Fisheries Service (1984). "United States Imports of Fishery Products." Office of Industry Services, International Trade Staff Report 84-3, May.

This paper reports on trends in imports of fishery products to the United States through 1983, with particular attention to (1) imports' effects on the United States fishing and processing sectors, (2) tuna, shrimp, salmon, and northeast and northwest groundfish species, and (3) present import restricting measures applied by the United States government.

National Marine Fisheries Service (1987). "Fishing Trends and Conditions in the Southeast Region, 1987." U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Southeast Fisheries Center, 75 Virginia Beach Drive, Miami, Florida.

This report contains information on existing conditions and developments in the commercial fishing industry in the southeastern United States during 1987. The information was provided by Federal and state fishery reporting specialists located in major fishing ports throughout the southeast. The landings and value data provided at the end of the report are preliminary and subject to change.

National Marine Fisheries Service (1987). "Status of the Fishery Resources off the Northeastern United States for 1987." NOAA Technical Memorandum NMFS-F/NEC-50, Northeast Fisheries Center, Conservation and Utilization Division, Woods Hole, Massachusetts, October, 132 pp.

This report describes trends in recreational and commercial fisheries in the overview section and summarizes the general status of the major finfish and shellfish resources off the northeast coast of the United States from Cape Hatteras to Nova Scotia through 1986 in the species synopses section. Many of the assessments are described in Laboratory Reference Documents at the Woods Hole Laboratory and may be obtained upon request. The most recent complete assessments for each stock are cited in the appropriate species synopsis.

National Marine Fisheries Service (1988). "Aquaculture and Capture Fisheries: Impacts in U.S. Seafood Markets." Report Prepared Pursuant To The National Aquaculture Improvement Act of 1985 (P.L. 99-198), National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Washington, D.C., April, 230 pp.

The objective of the National Aquaculture Improvement Act of 1985 was to stimulate development of a domestic aquaculture industry. However, concerns that marine aquaculture could affect certain traditional capture fisheries exist. This report examines U.S. seafood markets for shrimp and salmon that are supplied with products from commercial capture fisheries and aquaculture enterprises (domestic and foreign).

National Marine Fisheries Service (1989). "Summary Report from Trawl Tow Time Versus Sea Turtle Mortality Workshop." Draft report, Southeast Fisheries Center, Mississippi Laboratories, Pascagoula, Mississippi, August 10-11, 22 pp.

Except under certain conditions where trawling periods are limited by fishing conditions to about 45 minutes bottom time, synchronized tow times may not be a practical management option for the conservation of sea turtles in offshore shrimp fisheries of the southeast region. Furthermore, there seems to be little room for reasonable compromise. Jeopardy of sea turtles increases rapidly at bottom tow times above 45 minutes, while on the other hand, production capabilities of the shrimp fisheries decrease rapidly at bottom tow times less than about 105 minutes. The extremes of the situation seem too great to reasonably expect a practical solution predicated on enforceable maximum tow times.

National Marine Fisheries Service (1991). "Shrimp Trawl Bycatch Research Requirements." National Oceanic and Atmospheric Administration, Department of Commerce, November, 66 pp.

This paper provides a scientifically sound basis for developing and implementing a comprehensive, research plan for understanding and reducing shrimp bycatch in the Southeast Region as required by the 1990 Amendments to the Magnuson Fishery Conservation and Management Act.

National Marine Fisheries Service (1991). "Our Living Oceans." NOAA Tech. Memo. NMFS-F/SPO-1, November, 123 pp.

This report is a status review of U.S. living marine resources that have commercial, recreational, and ecological significance. The report is broken down into five distinct regions reflecting the Northeast Atlantic, Southeast Atlantic and Gulf of Mexico, Hawaii and the Pacific Islands, and Alaska.

National Marine Fisheries Service (1991). "Environmental Assessment and Supplemental Regulatory Impact Review of Proposed Regulations Expanding Sea Turtle Conservation Requirements in the South Atlantic and Gulf of Mexico." National Oceanic and Atmospheric Administration, U.S. Department of Commerce, September, 55 pp.

This assessment examines the environmental impact of regulations proposed by the National Marine Fisheries Service that require increased conservation measures year round by shrimp trawlers in the south-Atlantic and Gulf of Mexico to reduce the incidental catch and mortality of sea turtles in shrimp trawls. This proposed rule would amend those requirements currently contained in the 1987 sea turtle conservation regulations (52 FR 24244, June 27, 1987). This report recommends that TEDs be required for all shrimp trawls at most places and most times of the year from Cape Hatteras, North Carolina, to the Texas-Mexico border to protect sea turtles as recommended by a National Academy of Science study and required under the Endangered Species Act of 1973.

National Marine Fisheries Service (1992). "Environmental Assessment and Supplemental Regulatory Impact Review of Proposed Regulations Expanding Sea Turtle Conservation Requirements in the South Atlantic and Gulf of Mexico." National Oceanic and Atmospheric Administration, Department of Commerce, September.

A qualitative discussion of the costs associated with various proposed sea turtle conservation regulations. Benefits are defined to be numbers of sea turtle deaths prevented relative to the status quo in the fishery. No use is made of economic theory as it applies to the fishery in the report. Alternatives considered are restricted to the use of turtle excluder devices or no shrimp harvesting. Alternative measures to restrict turtle mortality such as property rights are not discussed.

National Marine Fisheries Service (1992). "Evaluation of Bycatch Reduction Devices, Sampling Protocol Manual for Data Collection." Southeast Fisheries Science Center, Galveston Laboratory, Galveston, Texas, September.

The Southeast Area Monitoring and Assessment Program (SEAMAP) has a standard data collection system used by state and federal research labs and universities in the southeast region. This method of data collection is recommended for the regional bycatch research program to standardize data collection procedures, analyses, and allow data to be pooled into a common data base using existing hardware and software.

National Marine Fisheries Service (1993). "Review of the Rock Shrimp Fishery 1981-1991." Report to the South Atlantic Fishery Management Council, Galveston Laboratory, Southeast Fisheries Science Center, NMFS, NOAA, March, 4 pp.

The report presents a summary of landings, value, and effort data for south Atlantic rock shrimp during the eleven year period from 1981 through 1991 and suggests possible recruitment overfishing levels that could be used for this species.

National Marine Fisheries Service (1992). "Shrimp Trawl Bycatch Characterization, Sampling Protocol Manual for Data Collection." Southeast Fisheries Science Center, Galveston Laboratory, Galveston, Texas, September.

Onboard data collection for the purpose of bycatch characterization will consist of sampling trawl catches taken from commercial shrimp fishery vessels operating in U.S. Gulf of Mexico and U.S. south Atlantic waters. Data relevant to species composition, abundance, and life history will be gathered from each tow. Sample size and allocation of samples by stratum have been included in the sampling design and are discussed in the National Marine Fisheries Service's "Shrimp Trawl Bycatch Research Requirements Document," (1991). The procedures outlined below for sampling trawl catches have been prepared by personnel at NMFS and are consistent with the Southeast Area Monitoring and Assessment Program's (SEAMAP) data management system. This protocol or similar data collection methods are recommended for use in all regional bycatch assessment programs to facilitate the accessibility and analysis of integrated data sets.

National Marine Fisheries Service (1992). "Status of Fishery Resources off the Southeastern United States for 1991." NOAA Technical Memorandum NMFS-SEFSC-306, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, Florida 33149, April, 75 pp.

A review of stock assessment techniques and fishery trends for important commercial and recreational fisheries in the southeastern region.

National Marine Fisheries Service (1992). "World Shrimp Culture." Vol 1 and Vol 2, Parts 1-3, NOAA Technical Memorandum NMFS-F/SPO-4, U.S. Department of Commerce, National Oceanic & Atmospheric Administration, Office of International Affairs, Silver Springs, Maryland, November.

The National Marine Fisheries Service, Office of International Affairs began monitoring world shrimp culture developments in 1983 as part of an effort to both assess the potential economic impact on the important U.S. commercial trawl fishery and to provide basic information to U.S. companies and academic researchers. The shrimp trawl fishery is one of the most important U.S. commercial fisheries. Shrimp landings exceeded $0.5 billion in 1991 and play a key role especially in many Gulf of Mexico coastal communities. The massive increases in cultured shrimp harvests during the 1980's have had a major impact on world shrimp markets. The increases have played a major role in the decline of real (inflation adjusted) prices for shrimp. This book and previous assessments are an effort to provide the fishing community sufficient information to understand past trends and make economic projections based on likely future prospects for cultured harvests.

National Marine Fisheries Service (1993). "Gulf of Mexico Shrimp Fishery Recruitment Overfishing Definition Workshop 2." Report to the Gulf of Mexico Fishery Management Council, Shrimp Stock Assessment Panel, Galveston Laboratory, Southeast Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce, March, 12 pp.

This report summarizes the findings of a two day workshop and provides recommendations from the working group on the current definitions of overfishing for the brown, white, pink, and royal red shrimp stocks, changes to current definitions of overfishing, and action that might be taken if overfishing levels are surpassed in any of these stocks.

National Marine Fisheries Service (1996). "Our Living Oceans." NOAA Tech. Memo. NMFS-F/SPO-19, February, 160 pp.

This report is a status review of U.S. living marine resources that have commercial, recreational, and ecological significance. The report is broken down into a national overview with two feature articles on Pacific Northwest Salmon and the Marine Mammal Protection Act and a section on living marine resources.

National Research Council (1990). "Decline of the Sea Turtles: Causes and Prevention." Committee on Sea Turtle Conservation, Board on Environmental Studies and Toxicology, Board on Biology, Commission on Life Sciences, National Academy Press, Washington, D.C.

This report presents scientific and technical information on the population biology, ecology, and reproductive behavior of five endangered or threatened species of sea turtles. It evaluates population declines, causes of turtle mortality, and the effectiveness of past and current mitigation efforts, and recommends conservation measures to protect or increase turtle populations. The committee was not charged or constituted to address and did not analyze social and economic issues related to sea turtle conservation.

Neal, Richard A. (1973). "Progress Toward Farming Shrimp in the United States." Marine Fisheries Review, 35 (3-4):67-70.

A review of the progress and problems in developing shrimp aquaculture in the United States. Primarily biological problems with maturation and growth of shrimp in pounds is discussed. Little economic information is provided at this early stage of development.

Niami, Farhad, Walter R. Keithly, and Kenneth J. Roberts (1992). "An Economic Review of the Southeastern Shrimp Processing Industry." Draft report, Coastal Fisheries Institute and Office of Sea Grant Development, Center for Wetland Resources, Louisiana State University, Baton Rouge, LA.

The southeast shrimp processing industry has been examined from an economic perspective. Results show that while the number of plants decreased during the 1973-88 period, the production activities, as measured by total pounds, increased. Most of this increased activity was due to peeled product. Though processing activities in terms of pounds being processed has been increasing, the deflated value of these processing activities has exhibited no growth since the mid 1970's due to a sharp decline in the deflated price of all forms of processed shrimp; i.e., raw headless, peeled, breaded, and others.

Nichols, John P. and Wade L. Griffin (1975). "Trends in Catch-Effort Relationships with Economic Implications: Gulf of Mexico Shrimp Fishery." Marine Fisheries Review, 37(2):1-4.

This paper reviews the recent trends relating to catch and fishing effort in the Gulf of Mexico shrimp fishery. The scope of this report is limited to presenting some of the basic findings in a descriptive format using simple time series and trends to illustrate the relationships developed. The analysis was limited to the years 1962 through 1971. However, most of the series have been extended to reflect conditions in 1972 and 1973. Detailed discussions of the basic research procedures and results will not be presented here as they are available elsewhere.

Nichols, John P. and Larry Johnston (1979). "The Influence of Alternative Pricing Methods on Ex-Vessel Shrimp Prices." DIR 79-1, SP-7, Departmental Information Report, The Texas Agricultural Experiment Station, Texas A&M University, College Station, Texas, August, 12 pp.

The relationship between ex-vessel pricing methods and interport price differentials for shrimp was examined. Ex-vessel prices were found to be significantly higher in ports using a pack-out method of establishing the value of landed shrimp. The size of differential varied by season and with price level.

Nichols, John P., Mary Gerlow, and A. Nelson Swartz (1980). "The Economics of Combination Swordfish Longlining and Shrimp Trawling in the Gulf of Mexico: Investment Requirements and Estimated Costs and Returns." DIR 80-1, SP-9, Staff Paper Series, Departmental Information Report, The Texas Agricultural Experiment Station, Texas A&M University System, College Station, Texas, December, 33 pp.

This report provides estimates of the economic aspects of swordfish longlining particularly as it relates to investment requirements and operating costs. These estimates are developed from interviews with vessel owners and captains who were active in the fishery during the 1979-80 season. Recent pressure on the shrimp trawling industry of Texas have caused shrimpers to consider alternative fishing opportunities. Among these, swordfish longlining was of particular interest in early 1980. The degree of fishing pressure that swordfish stocks can withstand is not known. Caution has been advised regarding rapid expansion of swordfish longlining even though the short run benefits to shrimpers may be favorable.

Nichols, John P., Wade L. Griffin, and Vito Blomo (1978). "Economic and Production Aspects of the Gulf of Mexico Shrimp Fishery." In Pushkar N. Kaul and Carl J. Sindermann (eds.) Drugs and Food from the Sea, Myth or Reality?, The University of Oklahoma Press, Norman, Oklahoma.

This paper describes the important trends in the Gulf of Mexico shrimp industry. Trends in production, imports, fishing effort, cost and returns, catch per unit effort, for 1962 to 1976 are presented and discussed. With production levels constant in the face of increasing fishing effort, increasing operating costs are squeezing profit margins even though prices are rising.

Nichols, John P., Melvin Cross, Vito Blomo, and Wade L. Griffin (1975). "Utilization of Finfishes Caught Incidental To Shrimp Trawling in the Western Gulf of Mexico, Part II: Evaluation of Costs." TAMU-SG-76-203, Department of Agricultural Economics, Texas Agricultural Experiment Station, Texas A&M University, College Station, TX, January, 42 pp.

This report presents estimates of the cost of operating several alternative systems for holding and landing finfish caught incidental to shrimp trawling operations. Freezer units, brine immersion tanks, and onboard fish meal plants, an extra crew member, and a mothership concept are the systems evaluated. Break-even prices are estimated that would be necessary to cover operating costs and a 10 percent return on investment. Additionally, problems in traditional work patterns, crew incentives, and institutional arrangements are discussed. Comparison of estimated break-even prices with recent market prices indicate that none of the proposed systems are viable except under very restrictive conditions. The mothership or tender vessel concept shows the most economic potential but is plagued with problems of coordinating a large number of vessels in an industry where independence of operation is valued highly. The analytical model presented may be used to evaluate other systems not considered directly in this study.

Nichols, Scott (1982). "Impacts on Shrimp Yields of the 1981 Fishery Conservation Zone Closure off Texas." Marine Fisheries Review, 44(9-10):31-37.

A yield per recruit analysis and a simulation model of shrimp fishing show that an increase in brown shrimp yield was realized from closure of the Fishery Conservation Zone (FCZ) off Texas during

May-July 1981. Yields were 11.7 million pounds greater (29 percent) than would have been expected with the FCZ open during May-August 1981. Some of the increase in yield was made at the expense of standing stock. Projections over the fishable lifespan of the shrimp indicate that yields will be increased 4 million pounds (7 percent) due to the FCZ closure.

Nichols, Scott (1986). "Stock Assessments for Brown, White, and Pink Shrimp in the U.S. Gulf of Mexico, 1960-1985." Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami Laboratory, 75 Virginia Beach Drive, Miami, Florida, June.

This paper analyzes the 1960-1985 commercial catch statistics for Penaeus aztecus (brown shrimp), Penaeus setiferus (white shrimp), and Penaeus duorarum (pink shrimp) from the U.S. Gulf of Mexico shrimp fishery. This analysis is an update of the assessment (Nichols, 1984) presented at the Southeast Fisheries Center's Second Stock Assessment Workshop (Miami, May, 1984).

Nichols, Scott (1986). "Updated Yield-per-Recruit Information on the Tortugas Pink Shrimp Fishery." North American Journal of Fisheries Management, 6:339-343.

Portions of a 1979 analysis dealing with optimum size considerations in the Tortugas, Florida, pink shrimp (Penaeus duorarum) fishery are updated. The 1979 management advice remains essentially the same. The current target minimum size of 103 mm total length theoretically should produce a 14 to 20% gain, compared to unregulated conditions, in weight yields from shrimp recruiting through the closure area during the peak fishing season. Gains in dollar value (ex-vessel gross revenue) due to closure would be from 45 to 64% during the peak season. However, because of the natural protection already provided by untrawlable bottoms in some areas where small shrimp are abundant, these percentage gains probably are overestimates.

Nichols, S. (1990). "The Spatial and Temporal Distribution of the Bycatch of Red Snapper by the Shrimp Fishery in the Offshore Waters of the US Gulf of Mexico." Draft report, National Marine Fisheries Service, Mississippi Laboratories, Pascagoula Facility, P.O. Drawer 1207, Pascagoula, Miss. 39568-1207, September, 66 pp.

Much of the data relevant to potential seasonal and areal closures of the shrimp fishery to reduce bycatch of red snapper are collected in this document including observations made by biologists aboard commercial shrimp vessels, research trawl data, and results derived from commercial statistics on the distribution of shrimp effort and fishing mortality rate. In general, if a closure can be reasonably expected to reduce the amount of shrimping effort in the offshore waters of the Gulf, there is a good chance that the closure will effect some reduction in red snapper bycatch. If a closure simply causes effort to move around in time or space without decreasing the amount of effort, little bycatch reduction can be expected, and some closures might turn out to be counter productive.

Nichols, S. (1993). "The 1993 Texas Closure - Results of SEAMAP Sampling." Report to the Gulf of Mexico Fishery Management Council, National Marine Fisheries Service, Mississippi Laboratories.

Increases in yield in pounds due to the closure were indicated for 1993 for both M values. Very low catch rates were observed in 1993, as was the case in 1992. Nevertheless, small shrimp again dominated the size composition sufficiently for the closure to generate an increase in yield.

Nichols, Scott (1994). "Fish:Shrimp Ratios in the Gulf of Mexico." Report to the Gulf of Mexico Fishery Management Council, National Marine Fisheries Service, Mississippi Laboratories.

While the National Marine Fisheries Service recommends against using fish:shrimp ratios whenever possible as a means of determining total bycatch levels, an analysis of finfish to shrimp catch ratios over time is presented.

Nichols, Scott (1994). "The 1994 Texas Closure - Results of SEAMAP Sampling." Report to the Gulf of Mexico Fishery Management Council, National Marine Fisheries Service, Mississippi Laboratories.

Increases in yield in pounds due to closure were indicated for 1994 for M values of 0.15 and 0.28 per month. The 1994 year class was strong compared to the last 2 years with small shrimp dominating the size composition sufficiently for the closure to generate an increase in yield.

Nichols, Scott (1993). "Shrimp Fleet Bycatch." Report to the Gulf of Mexico Fishery Management Council, July.

Hard copies of the overheads used in the presentation at the Council meeting. The presentation includes graphs of CPUE, catch rates, offshore shrimp effort, and red snapper bycatch estimates.

Nichols, Scott (1996). "An Update on Some Issues Relating to the Distribution of Red Snapper Bycatch." In Southeast Fisheries Science Center (1996). "Summary Report on the Status of Bycatch Reduction Device Development." National Marine Fisheries Service, Mississippi Laboratories, P.O. Drawer 1207, Pascagoula, Mississippi, March.

This paper updates the estimates of red snapper bycatch by the shrimp fishery in the offshore waters of the Gulf of Mexico through 1994, and presents spatial distribution information relevant to several matters that have arisen during debate on the status of red snapper stocks by the Council or its advisory committees.

Nichols, S. and G.J. Pellegrin, Jr. (1992). "Revision and Update of Estimates of Shrimp Fleet Bycatch, 1972-1991." Draft report, National Marine Fisheries Service, Mississippi Laboratories, P.O. Drawer 1207, Pascagoula, Mississippi, August.

New estimates of shrimp fleet bycatch are provided, using the GLM methods described by Nichols et al. (1987, 1990). Estimates are updated through 1991. Estimates for 1991 are preliminary, based on preliminary estimates of shrimping effort. Estimates for all previous years have been revised, following discovery that many observer data stations used in previous estimations were not completely worked up, resulting in underestimates of finfish catch rates in previous analyses of this data base. New estimates by number for 24 taxa are included, as well as total sharks and total finfish by weight.

Nichols, S., A. Shah, and G. Pellegrin, Jr. (1987). Estimates of Annual Shrimp Fleet Bycatch for Thirteen Finfish Species in the Offshore Waters of the Gulf of Mexico. Draft Report, NOAA, NMFS, SEFC, Mississippi Laboratory, Pascagoula, MS.

This paper presents estimates of annual bycatch levels for thirteen species for the offshore waters of the northern and western Gulf of Mexico.

Nichols, S., A. Shah, G. Pellegrin, Jr., and K. Mullin (1990). "Updated Estimates of Shrimp Fleet Bycatch in the Offshore Waters of the Gulf of Mexico, 1972-1989." Report to the Gulf of Mexico Fishery Management Council, NOAA, NMFS, SEFC, Mississippi Laboratory, Pascagoula, MS.

This paper presents updated and corrected estimates of annual bycatch levels for the offshore waters of the Gulf of Mexico. Qualitative or dummy variables are used to represent area, depth, season, year, and the data set in which the data were contained. The estimated coefficients and statistical significance of the model are not provided by the authors.

Nichols, Scott, James Nance, C. Phillip Goodyear, Arvind Shah, and John Watson (1995). "Some Considerations in Determining Bycatch Reduction Requirements." Southeast Fisheries Science Center, National Marine Fisheries Service, April, 18 pp.

The paper sets 1982-86 as the base year class for future calculations of F for finfish bycatch levels in the shrimp fishery The extended funnel and the fisheye are two identified effective gear options for bycatch reduction. In spite of the recognized need and the importance of forecasting future effort levels, the authors propose using a constant level of effort based on the 1982-86 average days fished in all future bycatch estimations for the shrimp fishery. Lastly, TED use is unlikely to have reduced red snapper F below the baseline value.

Nix, Harold L. and Muncho Kim (1982). "A Sociological Analysis of Georgia Commercial Shrimp Fishermen, 1976-77." Institute of Community and Area Development, The University of Georgia, Athens, Georgia, March, 182 pp.

This publication is both theoretical and practical. It is theoretical in that it provides a theoretical model for understanding the social behavior of an occupation. It is practical in that it describes the attitudes, behavior, and problems faced by Georgia shrimp fishermen as they approached an era of very rapid change. In addition, it is felt that this document will serve as a historical bench mark for additional studies and by which occupational change may be analyzed.

Noetzel, Bruno G. (1977). "Revenues, Costs, and Returns from Vessel Operation in Major U.S. Fisheries." PB 265 275, National Marine Fisheries Service, Washington, D.C., February, 23 pp.

The proceeds from operation of fishing vessels in selected U.S. fisheries in the Atlantic, Pacific, and Gulf of Mexico are evaluate. The report covers the groundfish fisheries of New England and the entire Pacific coast (including halibut fishing), the Pacific salmon fisheries, the tuna fisheries (albacore and tropical tuna), the shrimp fishery in the Gulf of Mexico, and the crab fisheries in the Northeast Pacific and Bering Sea. These fisheries accounted for 65% by quantity and 68% by value of total U.S. food fish landings in 1974. A total of 297 vessel years of operation were analyzed. The purpose of the analysis is to provide an insight into the earning capabilities of vessels operated in various U.S. fisheries during a period of time characterized by abruptly increasing prices of fuel and products made of oil derivatives, with a resulting general deterioration of the economic performance in fisheries in the United states and elsewhere.

Olsen, James C. (1973). "Pandalid Shrimp Life History Research at Kachemak Bay, Alaska." Marine Fisheries Review, 35(3-4):62-64.

The current shrimp research activity in Kachemak Bay will provide insight into the life history, population dynamics, and behavior of pandalid shrimp in the Gulf of Alaska. The general objectives of the research on larval and postlarval shrimp are to increase knowledge about pandalid shrimp life history

stages, behavior, and population dynamics; determine how fishing affects shrimp stocks; determine the causes of annual fluctuations in shrimp stock abundance; describe and quantify the characteristics and ecology of environments inhabited by shrimp; and increase the understanding of the role pandalid shrimp have in the organic production system of the North Pacific.

Onal, Hayri, Bruce A. McCarl, Wade L. Griffin, Gary Matlock, and Jerry Clark (1991). "A Bioeconomic Analysis of the Texas Shrimp Fishery and Its Optimal Management." American Agricultural Economics Association, (Nov.):1161-1170.

Overfishing in the Texas shrimp fishing industry by time period and fishing area is investigated. An optimal harvesting pattern is determined using a multiperiod mathematical programming model where prices, fishing effort, catch, and resource dynamics are treated endogenously. These results are then compared with actual effort. The comparison indicates substantial excess effort in spring and early summer, especially in the bays and shallow offshore areas. The peak fishing season also occurs later in the fall in optimal harvest pattern than in practice. The results indicate both producers and consumers gain from reduced fishing effort because of improved size composition of the harvest.

Osterbind, Carter C. and Robert A. Pantier (1965). "Economic Study of the Shrimp Industry in the Gulf and South Atlantic States." Final report, Contract No. 14-17-008-118, The Bureau of Commercial Fisheries, Fish and Wildlife Service, United States Department of the Interior, Washington, D.C.

This reports the findings of a study to discover the nature of the economic problems confronting the shrimp fishery of the United States during the period from 1956 to 1959. Special attention is given to the problems existing in 1959.

Pawlyk, Perry W. and Kenneth J. Roberts (19??). "Forecasting U.S. Shrimp Prices: A Comparison of Three Different Models." Draft Report, Center for Wetland Resources, Louisiana State University, Baton Rouge, Louisiana.

The size composition of shrimp imports has changed in recent years with the development of pond raised shrimp. The impact of these imports on U.S. shrimp markets is concentrated in the 26 to 40 count size range since the shrimp are usually raised to these sizes. So aquaculture has changed the quantity ratios between sizes of shrimp that would occur if all shrimp were harvested from wild stocks. This research was undertaken to understand the nature of these price fluctuations. Two different techniques for price forecasting are discussed in this paper: (1) time series models and (2) econometric models.

Pawlyk, Perry W. and Kenneth J. Roberts (1986). "Products and Markets for Small Louisiana Shrimp." Marine Fisheries Review, 48(4):65-70.

Louisiana has long been known for its sometimes controversial harvest of small shrimp from its inshore waters. With the trend toward landings of smaller shrimp from the Gulf, the economics of the small shrimp processing and marketing industry is of increasing importance. The production of three shrimp products, raw head-on, peeled, and canned, was found to be dependent on small shrimp supply. Over 20 percent of the shrimp moving through Louisiana's processing plants was shipped out of the state for further processing. Most of these were small, head-on shrimp. Louisiana is an important supplier of small shrimp products and small shrimp for processors in other Gulf states.

Pedersen, Sren Anker (1994). "Multispecies Interactions on the Offshore West Greenland Shrimp Grounds." C.M. 1994/P:2, Theme Session on Multispecies Interactions of Importance to the Groundfish Abundance Fluctuations, International Council for the Exploration of the Sea, St. John's, Newfoundland, Canada, September, 26 pp.

This paper gives a description of the exploited fishery system on the offshore West Greenland shrimp grounds, including recent findings of fish community structure and trophic relationships. Based on the analysis of fish stomachs from the key fish species and estimates of fish abundance obtained from assessment surveys the total annual consumption of northern shrimp (Pandalus borealis) and juvenile redfish by predatory fish in 1991-1992 has been calculated. A preliminary attempt to integrate the interrelationships between the main species and the fishery is made using a balanced, steady state model.

Pellegrin, Gilmore J., Jr. (1982). "Fish Discards from the Southeastern United States Shrimp Fishery." In Food and Agriculture Organization of the United Nations and International Development Research Centre (1982). Fish ByCatch: Bonus from the Sea, Report of a Technical Consultation on Shrimp Bycatch Utilization held in Georgetown, Guyana, October 27-30, 1981. Ottawa, Ont., IDRC, 163 pp.

Magnitude and species composition of fish bycatch are described for the Gulf of Mexico and south Atlantic shrimp fleets. Bycatch estimates for the Gulf were 15 times those for the south Atlantic. Highest estimates occurred in the north-central and northwestern Gulf and in the south Atlantic off the North Carolina and Georgia coasts. Catch compositions varied at the species level; however, Sciaenidae was the dominant family for both the Gulf and the south Atlantic. Gulf fauna included estuarine dependent species in subtropical environs and estuarine independent species in tropical environs.

Pellegrin, Gilmore J., Jr., Shelby B. Drummond, and Robert S. Ford, Jr. (1985). "The Incidental Catch of Fish By the Northern Gulf of Mexico Shrimp Fleet." Draft report, Mississippi Laboratories, Southeast Fisheries Center, National Marine Fisheries Service, NOAA, Pascagoula, MS 39568-1207.

The northern Gulf of Mexico shrimp fleet was monitored from 1972 to 1980 to estimate the magnitude and species composition of fish bycatch. The highest bycatch estimate occurred in the north central Gulf during the warm season inside of 18 m. The lowest estimate (3,944 mt) occurred in the eastern Gulf in the same depth zone and season. An estimated 576,028 mt of fish are caught incidentally by the northern Gulf shrimp fleet annually. The north central Gulf influenced the bycatch heavily; contributing 50.3% of the total. Sciaenids dominated, comprising 52.47% with Atlantic croaker, Micropogonias undulatus (33.6%); spot, Leiostomus xanthurus (7.64%); sand seatrout, Cynoscion arenarius (5.85%); and silver seatrout, Cynoscion nothus (2.99%) being the major species.

Penn, J.W. and N. Caputi (1986). "Spawning Stock-Recruitment Relationships and Environmental Influences on the Tiger Prawn (Penaeus esculentus) Fishery in Exmouth Gulf, Western Australia." Aust. J. Mar. Freshw. Res., 37:491-505.

A stock-recruitment relationship (SRR) between the spring spawning stock levels and the following autumn recruitment has been established for P. esculentus in Exmouth Gulf. The basic SRR fits the data well with the exception of 2 out of the 14 years when particularly severe cyclones occurred. This has been taken into account by using multiple regression techniques to incorporate the amount of rainfall in January and February as variables representing indices of cyclone activity (multiple correlation of 0.97). A hypothesis for the observed positive and negative effects of cyclones on recruit survival has been presented.

The relationship between autumn recruitment and resultant spring spawning stock (RSR) later that year and the effects of fishing, measured in effective effort units, has also been established (multiple correlation of 0.94). An examination of the interaction between the SRR and RSR relationships has been reported which suggests that, under average environmental conditions and high levels of effort, recruitment will move towards a new lower equilibrium level. The robustness of the relationships with respect to assumptions involved and potential sources of bias in the variables used have been evaluated and discussed.

Penson, John B., Jr., Ernest O. Tettey, and Wade L. Griffin (1987). "An Econometric Analysis of Net Investment in Gulf Shrimp Fishing Vessels." Technical Article No. TA-20803 of the Texas Agricultural Experiment Station, Texas A&M University System.

This study evaluated aggregate investment behavior by fishermen for steel, wooden, and fiberglass fishing vessels in the Gulf of Mexico shrimp fishery and examined the implications of changes in the cost of acquiring debt and equity capital on the industry's investment response. Macroeconomic policies that lead to high real interest rates depress real net investment in this fishery. While low real interest rates are desirable for stimulating investment activities in the general economy, they add to the overcapitalization problem that currently exists in the Gulf shrimp fishing industry. The theoretical model of aggregate investment behavior is justified statistically in this study.

Penson, John B., Jr., Ernest O. Tettey, and Wade L. Griffin (1988). "An Econometric Analysis of Net Investment in Gulf Shrimp Fishing Vessels." Fisheries Bulletin, 86(1)151-156.

The purpose of this study is to estimate an econometric model of annual real net investment in fishing vessels in the Gulf of Mexico and to determine the sensitivity of investment decisions in the industry to fluctuations in the cost of equity and debt capital. This study begins by examining the individual factors that affect the expansion of the stock of steel, wood, and fiberglass vessels in the Gulf fleet. The effects of alternative macroeconomic policies on investment expenditure trends in the Gulf shrimp fishery are then studied. The final section of the paper presents some concluding remarks.

Perez Farfante, Isabel (19??). "A Key to the American Pacific Shrimps of the Genus Trachypenaeus (Decapoda, Penaeidae), With the Description of a New Species." Fishery Bulletin, 69(3):635-646.

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 arthobranchia 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.

Perez Farfante, Isabel (1970). "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, iii+26 pp., 25 Figs.

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 Bermuda. Included is an account of the development of the petasmata, thelyca, and appendices masculinae.

Perez, Lisandro and Philip G. Groth (19??). "Socio-Demographic Study of the Shrimp Fishery in A Tri-Parish Area of Louisiana." Cooperative Agreement No. 03-7-042-35132, National Marine Fisheries Service, National Oceanic and Atmospheric Administration and Center for Wetland Resources, Louisiana State University.

This report presents the findings of a study of the social and demographic aspects of the shrimp fishery in a tri-parish area of Terrebonne, Lafourche, and St. May, Louisiana. These three parishes were selected so as to coordinate this sociological study with the studies being carried out by economists and biologists in the same region. The basis for the multidisciplinary project is a mark-recapture experiment conducted by a team of biologists from the Center for Wetland Resources at Louisiana State University in cooperation with the National Marine Fisheries Service. The socio-demographic aspect of the study, presented here is intended to provide information on the social and demographic setting of the mark-recapture experiment. Specifically, our goal was to analyze the existing body of data concerning three aspects of the fishery: (1) the demographic structure of the population residing in the tri-parish area; (2) the characteristics of "shrimping communities" and persons engaged in the fishery; (3) the social organization of the fishery - the norms and values that govern the patterns of interaction within the fishery. In addition, we were to identify areas in which additional data and research are needed to more fully understand the fishery.

Perkins, Garey B. (1984). "Value Added to Shrimp Processed in the Gulf of Mexico, 1982." Food and Fiber Center, Cooperative Extension Service, Mississippi State University, November, 24 pp.

This study assessed the value added through processing and consequently the economic contribution of shrimp harvested and processed in the Gulf of Mexico.

Perret, William S. (1987). "The U.S. Shrimp Fishery - Production and Management." Presented at Shrimp World III, Cancun, Mexico, November, 15 pp.

This paper presents a general overview of the shrimp fishery in the United States from a regional and state basis, by species composition, and by management regimes utilized to regulate this industry.

Phillips, Robert E. (1976). "A Study of Procedures for Development of Bio-Socio-Economic Models of the U.S. Gulf Coast Shrimping Industry for Use in Resource Management." Purchase Order No. 01-6-042-11202, U.S. Army Engineer District, Galveston, TX, funded by the National Marine Fisheries Service, Galveston, TX, November, 284 pp.

This report gives recommended procedures for the construction of bio-socio-economic models of the U.S. shrimping industry, with emphasis on the Gulf Coast shrimp fisheries. The kinds of models described are designed to aid in the formulation of optimal policies in public regulation of the shrimp resource. The focus in this report is on economic principles of the modeling problem, with biological and sociological aspects included as they relate to the economic analysis.

Picou, J. Steven, Christopher L. Dyer, and Mark A. Moberg (1992). "Bayou La Batre, Alabama: Socioeconomic Profile and the Social Impacts of Turtle Excluder Device Regulations." A final report prepared for the Bayou La Batre Chamber of Commerce by the Department of Sociology and Anthropology, University of South Alabama, Mobile, Alabama, January, 115 pp.

The primary objective of this research is an assessment of the social impacts of turtle excluder device regulations on the fishing community of Bayou La Batre, Alabama. Data for this research were collected from a stratified, random sample of households in the community and from all high school

sophomores and juniors. The social impact model evaluated perceptions of patterns of stress, disruption, social change, and projected behavior changes. Career goals and social alienation were investigated for local high school students.

Pile, Anthony (1981). "Shrimp Industry; An Analysis and Account of the Shrimp Market in the United Kingdom." London Business School, Sussex Place, Regent's Park, London N.W., June, 37 pp.

The question of growth in the shrimp industry is addressed using the markets in the U.K. as examples. The shrimp industry is described in part I and the U.K. market is described in part II with projects for the future provided.

Poffenberger, John R. (1981). "Economic Feasibility of the Marine Turtle Excluder Device." A report submitted in fulfillment of a project statement for the Marine Mammals and Endangered Species Program, NMFS, SEFC, 75 Virginia Beach Drive, Miami, Florida, August, 8 pp.

This report evaluates the economic feasibility of the Turtle Excluder Device developed during 1980.

Poffenberger, John R. (1982). "Economic Status of the Offshore Shrimp Fishery in the Gulf of Mexico." NOAA Technical Memorandum, NMFS-SEFC-99, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, 75 Virginia Beach Drive, Miami, Florida, March, 18 pp.

The purpose of this report is to present some basic indicators of the offshore shrimp fishery in the Gulf of Mexico on prices, production, and vessel costs and revenue that may provide some insight into the economic status of the fleet during 1991. A secondary purpose of the report is to present a general prognosis for the economic viability of the fishery during 1982.

Poffenberger, John R. (1982). "Estimated Impacts of Texas Closure Regulation on Ex-Vessel Prices and Value, 1981 and 1982." NOAA Technical Memorandum, NMFS-SEFC-111, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, 75 Virginia Beach Drive, Miami, Florida, December, 34 pp.

This report presents analytical findings regarding the Texas closure's effects on ex-vessel price and value. The primary purpose of this research is to empirically estimate the magnitude of the price change resulting from the estimated change in landings due to the closure regulation. The estimated change in price is used to provide empirical estimates of the amount that the ex-vessel value has changed as a result of the regulation. The report also provides the estimated effects of the 1981 closure regulation for the twelve month period beginning in May and ending in April, 1982.

Poffenberger, John R. (198?). "Estimated Impacts on Ex-Vessel Brown Shrimp Prices and Value as a Result of the Texas Closure Regulation." Draft report, Southeast Fisheries Center, National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, Florida.

Estimates of the effect on shrimp prices as a result of changes in offshore landings due to the Texas Closure regulation are presented. Also, the change in ex-vessel value (or gross revenue) to the brown shrimp fishery resulting from the closure regulation is calculated.

Poffenberger, John R. (1982). "Estimated Impacts on Ex-Vessel Brown Shrimp Prices and Value as a Result of the Texas Closure Regulation." Marine Fisheries Review, 44(9-10):38-43.

Estimates of the effect on shrimp prices as a result of changes in offshore landings due to the Texas Closure regulation are presented. Also, the change in ex-vessel value (or gross revenue) to the brown shrimp fishery resulting from the closure regulation is calculated.

Poffenberger, John R. (1983). "Review of the 1982 Shrimp Fishery in the Gulf of Mexico." Draft report, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami Laboratory, Miami, Florida, May, 7 pp.

The penaeid shrimp resources in the Gulf of Mexico provided 423 million dollars in gross income to shrimp fishermen that represented about 70 percent of the ex-vessel value reported for all fisheries in the Gulf in 1982. In addition to the ex-vessel value generated by the shrimp resources, this report summarizes four other aspects of the fishery; landings, prices, productivity and harvesting costs. Although landings were down substantially from 1981, the economic condition of the harvesting sector was good during 1982. The outlook for 1983 suggests a similar situation, albeit significant variations in domestic landings could alter that outlook.

Poffenberger, John R. (1986). "Estimated Impacts of Texas Closure Regulation on Ex-Vessel Prices and Value, 1984-1985." NOAA Technical Memorandum NMFS-SEFC-184, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Economics and Statistics Office, 75 Virginia Beach Drive, Miami, FL, October, 12 pp.

A federal regulation closes the fishery conservation zone (FCZ) in the Gulf of Mexico off the coast of Texas to fishing for brown shrimp beginning in late May until the middle of July when the area is reopened to commercial fishing. The objective of this regulation is to essentially eliminate fishing mortality on brown shrimp during a period of rapid growth in their life cycles. Analyses are preformed to estimate the effects of these regulations on the amount of shrimp caught and landed and the value of the catch. The effects on catch are estimated in Nichols (1986) and his estimates are used to estimate the effects of the closure on exvessel prices and value. According to Nichols, the closure during May through mid July, 1984 resulted in an increase of 1.4 million pounds of brown shrimp. This increase in landings is estimated to have resulted in an increase in total revenue to the fishery of about $18.7 million. Preliminary estimates for the May, to mid July, 1985 closure are also provided that indicate a range of impacts from a loss of $5.2 million to a gain of $756 thousand.

Poffenberger, John R. (1986). "Economic Impacts of the Texas Closure, 1981-1985." A report prepared for the Gulf of Mexico Fishery Management Council, Economics and Statistics Office, Southeast Fisheries Center, National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, Florida, December, 63 pp.

The impact of the Texas Closure on the western Gulf of Mexico in terms of trips, catches, revenues, domestic supplies at Texas ports, and employment in coastal counties of Texas are analyzed. No discernable effects are found in a descriptive analysis of the shrimp landings files.

Poffenberger, John R. (1987). "Economic Impacts of the Texas Closure, 1985-1986." A report prepared for the Gulf of Mexico Fishery Management Council, Economics and Statistics Office, Southeast Fisheries Center, National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, FL.

The impact of the Texas Closure on the shrimp fishery of the Gulf of Mexico is discussed in this report. The net effect of the modified area closure in 1986 is estimated to be an increase of $190 thousand compared to the net effects if the FCZ had been closed out to 200 nautical miles. The 1985 closure resulted in a loss of $170 thousand.

Poffenberger, John R. (1987). "Shrimp Management in the Southeastern United States." Draft report, National Marine Fisheries Service, Southeast Fisheries Center, Miami, FL.

The impacts of the shrimp fishery management plan for the Gulf of Mexico and the proposed plan for the south Atlantic are reviewed for 1981 to 1985. The management strategies in these two areas are the same. Area closures have been implemented in the Gulf of Mexico and are being considered in the south Atlantic region. The motivation for these closures is, however, different for the Gulf and south Atlantic regions. The purpose of the closure in the Gulf is to increase total revenue to the fishery on an annual basis. The closure in the south Atlantic is being developed to provide better recruitment to the fishery in years when environmental conditions are expected to severely reduce recruitment the following year.

Pollack, Susan (1995). "A Bycatch Success Story." In Brad Warren, Win-Win Bycatch Solutions. National Fisheries Conservation Center, Seattle WA.

The Nordmore grate used in New England shrimp (Pandalus borealis) trawls greatly reduces finfish bycatch and without any loss in shrimp harvest rates according to an NMFS study.

Prochaska, F.J. (198?). "Shrimp Imports...Impact On The Domestic Industry." Marine Log, Florida Sea Grant.

Impacts of shrimp imports on the domestic shrimp fishery. The report cites that a 10 cent per pound increase in ex-vessel prices results in the entry of 171 new boats and vessels into the Gulf of Mexico fishery. With new entrants offsetting income gains to existing fishing craft in the fleet.

Prochaska, F.J. (1985). "Shrimp Mariculture and Imports: Effects on U.S. Markets and Research Needs." Draft report, Department of Food and Resource Economics, University of Florida, Gainesville, FL.

A discussion of the impacts of maricultured shrimp on shrimp import levels and the shrimp industry. Much work remains to be done to quantify the impacts of shrimp mariculture on the domestic price for shrimp products.

Prochaska, Fred J. and Charles M. Adams (1984). "Analysis of U.S. Shrimp Prices at Ex-Vessel, Wholesale, and Retail Market Levels." Draft report, Department of Food and Resource Economics, University of Florida, Gainesville, FL.

Previously no research has been conducted to determine price relationships between market levels. Thus, differential market impacts of various price determinants and restrictive policy measures such as tariffs and quotas could not be analyzed at various market levels and for other market dimensions, such as markets defined by product size classes. The goal of the research reported in this paper was to provide information on which differential impacts can be estimated. The format of the present paper is to (1) review trends in prices, margins, and market shares for 21-25 and 31-40 count raw, headless shrimp, (2) determine direction of price flows and existence of asymmetric price response between ex-vessel, wholesale, and retail market levels, and (3) determine factors affecting prices for the two size classes at the three market levels.

Prochaska, Fred J. and Chris O. Andrew (1974). "Shrimp Processing in the Southeast: Supply Problems and Structural Change." Southern Journal of Agricultural Economics, July:247-252.

A growing deficit in shrimp landings relative to processing needs in the southeast region of the United States concerns both industry and government officials. Structural changes in the shrimp industry are encouraged by the growing supply deficit. The shrimp supply situation and resulting industry organization changes are the primary concerns of this paper.

Prochaska, Fred J. and James C. Cato (1981). "Economic Conditions in the Gulf of Mexico Shrimp Industry: 1960-1981." Staff Paper 180, Food and Resource Economics Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, Florida 32611.

This paper is designed to review the historical economic conditions contributing to the sever 1980-1981 financial situation. Historical movements in landings, values and prices are reviewed. The number of boats and vessels that have entered the fishery are noted and the relationship of this entry pattern to price movements is analyzed. Prices are discussed with respect to consumer demand and imports. In addition, the possible actions that can be taken to prevent a long term reoccurring situation are presented.

Prochaska, Fred J. and Walter R. Keithly (1984). "Market Impacts of U.S. Shrimp Imports." Draft report, Department of Food and Resource Economics, University of Florida, Gainesville, FL.

Imported shrimp accounted for over one half of the annual shrimp consumption in the U.S. through 1981. This relatively large proportion of the total market is alleged to cause serious financial problems for the domestic shrimp fishing sector by lowering prices, especially during periods of declining U.S. demand for shrimp. Tariffs and quotas have repeatedly been suggested by shrimp fishermen and their representatives as a solution to the fishermen's problems with the latest organized effort in the early 1980's. Since that time increased world shrimp supplies, principally from mariculture, have caused new concerns for the U.S. shrimp fishing industry. Imports increased dramatically since 1981 reaching a high of 421 million pounds (heads off) in 1983 that accounts for over 70 percent of the supply of shrimp in the U.S. Opposition to tariffs and quotas comes from three sources. Consumers feel shrimp available for consumption would be reduced and would be available only at considerably higher prices. Marketing and processing firms contend that the cost of operations would be increased due to a reduction in volume of shrimp for processing and marketing. Finally, industry analysis hypothesize that increased ex-vessel prices due to reduced imports will be at best a short run solution to the low or negative economic returns due to the expected increased entry into the fishery associated with the increased prices.

Prochaska, Fred J. and Walter R. Keithly (1984). "Market Impacts of U.S. Shrimp Imports." In Proceedings of the Workshop on Shrimp and Prawn Markets. International Institute of Fisheries Economics and Trade and the South Carolina Wildlife and Marine Resources Department, Charleston, South Carolina, July 26-27.

The domestic import demand for shrimp and world supply of shrimp to U.S. buyers is analyzed via a simultaneous model to determine principal factors affecting the import market. Import price, quantity, and tax revenue effects of proposed tariffs and/or quotas will then be analyzed. Finally an ex-vessel domestic shrimp price equation is developed to determine the effect of a set of economic factors on ex-vessel shrimp prices. Estimated changes in import quantities demanded under the second objective are incorporated in the ex-vessel model to estimate the effects of the proposed tariffs and quotas on ex-vessel prices.

Prochaska, Fred J. and Walter R. Keithly (1984). "Market Impacts of U.S. Shrimp Imports." In Proceedings of the Workshop on Shrimp and Prawn Markets, International Institute of Fisheries Economics and Trade, Oregon State University, International Institute of Fisheries Economics, Corvallis, OR.

The domestic import demand for shrimp and world supply of shrimp to U.S. buyers is analyzed via a simultaneous model to determine principal factors affecting the import market. Import price, quantity, and tax revenue effects of proposed tariffs and/or quotas will then be analyzed. Finally an ex-vessel domestic shrimp price equation is developed to determine the effect of a set of economic factors on ex-vessel shrimp prices. Estimated changes in import quantities demanded under the second objective are incorporated in the ex-vessel model to estimate the effects of the proposed tariffs and quotas on ex-vessel prices.

Prochaska, Fred J., Mauro Suazo, and Walter R. Keithly (1983). "World Shrimp Production Trends and the U.S. Import Market." Draft report, Tropical and Subtropical Fisheries Tech. Conf. Proceedings.

This paper (1) reviews world shrimp production trends in total and by major producers, (2) investigates U.S. shrimp supply sources and trends, (3) analyzes the U.S. market for imported shrimp, and (4) draws implications with respect to future conditions in the U.S. shrimp market.

Reese, Gladys B. (ed.) (1992). "1991 MARFIN Annual Report: Small Pelagics (Butterfish, Coastal Herrings and Associated Species), Shrimp Trawl Bycatch Reduction, TED Technology Transfer." U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Mississippi Laboratories, Pascagoula, MS, March, 258 pp.

This report encompasses the 1991 Annual Reports for the Small Pelagics, Shrimp Trawl Bycatch Reduction, and TED Technology Transfer projects. These projects are funded in part by MARFIN, and the 1991 Annual Reports have been combined and presented as the 1991 MARFIN Annual Report.

Renaud, Maurice, Gregg Gitschlag, Edward Klima, Arvind Shah, Dennis Koi, and James Nance (1992). "Loss of Shrimp by Turtle Excluder Devices (TEDs) in Coastal Waters of the United States from North Carolina through Texas: March 1988 through August 1990." Draft report, NMFS, SEFC, Galveston Laboratory, Galveston, TX, 71 pp.

Fishing areas, time of day and duration of tows were controlled by the captain of each vessel to simulate commercial conditions. A statistically significant mean loss in shrimp catch per unit effort of 0.39 - 0.17 lb/hr (5.1%) was experienced by all TED equipped nets combined, compared to standard nets. Analyzed separately, nets equipped with Georgia TEDs (with and without funnels) exhibited a reduction in shrimp CPUE of 3.6% and 13.6% respectively, compared to standard nets. There was no significant difference in shrimp CPUE between standard nets and nets equipped with Super Shooter TEDS with a funnel.

Renaud, Maurice, Gregg Gitschlag, Edward Klima, Arvind Shah, Dennis Koi, and James Nance (1992). "Loss of Shrimp by Turtle Excluder Devices (TEDs) in Coastal Waters of the United States from North Carolina through Texas: March 1988 through August 1990." Fishery Bulletin, 91:129-137.

Observers from the National Marine Fisheries Service collected information on catch rates of shrimp aboard commercial shrimp vessels during March 1988 to August 1990. Comparisons were made between nets equipped with Turtle Excluder Devices (TEDs) and standard shrimp nets. Three types of TEDs were tested: Georgia TEDs with and without accelerator funnels and Super Shooter TEDs with funnels.

Fishing area, time of day, and duration of tows were controlled by the captain of each vessel to simulate commercial conditions. A statistically significant ($P < 0.05$) mean loss in shrimp catch per unit effort (CPUE) of 0.24 lb/h (3.6%) and 0.93 lb/h (13.6%) was exhibited by nets equipped with Georgia TEDs (with and without funnels, respectively) compared with standard nets. There was no significant difference in shrimp CPUE between standard nets and nets equipped with Super Shooter TEDs with a funnel.

Renaud, Maurice, Gregg Gitschlag, Edward Klima, Arvind Shah, Dennis Koi, and James Nance (1991). "Evaluation of the Impacts of Turtle Excluder Devices (TEDs) on Shrimp Catch Rates in Coastal Waters of the United States Along the Gulf of Mexico and Atlantic, September 1989 through August 1990." National Marine Fisheries Service, Galveston Laboratory, 4700 Ave. U, Galveston, TX 77551.

Trained NMFS observers collected information from September 1989 to August 1990 on catch rates of shrimp and finfish from commercial shrimp vessels voluntarily participating in this study. Data were compared between TED equipped nets and standard shrimp nets using multivariate paired t-tests. Yield was modeled to determine what impact various levels of shrimp loss would have on the overall population.

Renaud, Maurice, Gregg Gitschlag, Edward Klima, Arvind Shah, James Nance, Charles Caillouet, Zoula Zein-Eldin, Dennis Koi, and Frank Patella (1990). "Evaluation of the Impacts of Turtle Excluder Devices (TEDs) on Shrimp Catch Rates in the Gulf of Mexico and South Atlantic, March 1988 through July 1989." NOAA Technical Memorandum, NMFS-SEFC-254, National Marine Fisheries Service, Galveston Laboratory, 4700 Ave. U, Galveston, TX 77551.

Trained NMFS observers collected information from March 1988 to July 1989 on catch rates of shrimp and finfish from commercial shrimp vessels voluntarily participating in this study. Data were compared between TED equipped nets and standard shrimp nets using multivariate paired t-tests. Yield was modeled to determine what impact various levels of shrimp loss would have on the overall population.

Rhodes, Ray (1980). "Preliminary Economic Analysis of the South Atlantic States' Shrimp Fishery: Current Trends and Outlook." Report prepared at the request of the South Atlantic Fishery Management Council by Marine Resources Division, S.C. Wildlife and Marine Resources Department, Charleston, S.C., May, 12 pp.

The paper is a review of the 1979 shrimp season for the south Atlantic fishery with a prediction that a long term decline in the economic productivity of commercial shrimp harvesting in the south Atlantic states could be expected.

Rhodes, Raymond J. and Valvy N. Grant (1992). "Mail Survey of the U.S. Seafood Wholesale Market Channel with an Emphasis on Whole Farmed Marine Shrimp." Marine Resources Division, Office of Fisheries Management, Technical Report Number 79, November, 68 pp.

The objectives of this research were to describe existing marine shrimp preferences in the wholesale market channel and to identify critical product attributes in the wholesale market when selling heads-on marine shrimp. Use and preference data were collected on U.S. seafood wholesalers, distributors, and others based on a 1989 mail survey.

Rhodes, Raymond J., K. McGovern-Hopkins, and C.L. Browdy (1992). "Preliminary Financial Feasibility Analysis of an Independent Marine Shrimp Hatchery Located in South Carolina." Technical Report Number 80, Marine Resources Division, South Carolina Wildlife and Marine Resources Department, December, 11 pp.

Prospective aquaculturists, investors, and perhaps lending institutions will desire information on financial feasibility of a commercial post larval production facility located in South Carolina. Although several economic studies have analyzed maturation and/or hatchery systems for penaeid shrimp (e.g. Johns et al., 1981), no studies have analyzed the financial feasibility of penaeid larviculture in South Carolina. The objective of this report is to present a preliminary projection of costs and income generated by an independent commercial hatchery operating in coastal South Carolina with enough capacity to produce some of the postlarvae needed by South Carolina farmers; about 45 million postlarvae during a 8-10 week period in 1992 (Rhodes, 1992). Annual income statements and cash flows have been projected to estimate accounting profitability, return on equity capital, and net present value.

Riechers, Robin K. and Gary C. Matlock (1990). "A Simple Method for Estimating the Benefits of the "Texas Closure"." Draft Report, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744.

Our paper will estimate change in landings attributable to the Texas closure using linear regression on recruitment data, and will present a model for predicting the annual changes in weight of brown shrimp and pink shrimp landed after each future closure.

Roberts, Kenneth J. and M. E. Sass (1979). "Financial Aspects of Louisiana Shrimp Vessels, 1978." Sea Grant Publication No. LSU-TL-79-007, Center for Wetland Resources, Louisiana State University, Baton Rouge, LA, December, 9 pp.

The excellent shrimp harvests of 1977 and 1978 have brought increased interest in shrimp vessels as investment opportunities. Adding to investor interest in 1978 were the favorable price and record dockside value of shrimp (the previous record value was exceeded by 16 percent). Shrimpers and other investors will respond to the record earnings by constructing new vessels. Financial incentives such as the Capital Construction Fund (CCF) and the sheltering of capital gains from vessel appreciation also attract investment. The CCF and capital gains incentives are long term, but the shrimp harvests vary from year to year. The result is that investment in the form of vessels drawn into the fishery due to tax incentives will negatively impact earnings per vessel when catches and prices return to normal. This may result in stress on the credit system and shrimp management alternatives, as well as bring about public assistance to help an ailing industry. Based on a survey of 129 operators, shrimp vessels harvested the same quantity of shrimp in 1978 as they did in the record year of 1977 with 1978 prices higher than 1977, resulting in an above average financial condition for shrimp vessels. The financial condition of shrimp vessels in 1978 may be hard to improve on as shrimp catches retreat from record levels, more vessels begin shrimping, and costs continue to increase.

Roberts, Kenneth J., Walter R. Keithly, and Charles M. Adams (1992). "The Impact of Imports, Including Farm-Raised Shrimp, on the Southeast Shrimp Processing Sector." NOAA Technical Memorandum NMFS-SEFC-305, USDOC, NOAA, NMFS, January.

Processing activities of southeastern shrimp processors increased in recent years. This activity was linked to an increase in shrimp imports. An initial source of the new supply was Ecuador. Farming of shrimp in pond systems there rapidly increased United States purchases to a record 101 million pounds by

1987. Shrimp from China and Taiwan added another 80 million pounds to US supplies by 1987. Imports primarily from shrimp farming nations were thereby recognized by some processors as a new source of raw material. Twelve of the surveyed processors in the southeast began use of imported shrimp after 1984. New sources of supply introduced an element of stability to the southeastern industry for those processors using the shrimp. Stability in terms of entry and exit among the region's establishments utilizing imports was found to be higher than non-users. Hence, as more establishments adopt the use of imports, especially farm-raised imports, in their processing activities, total industry stability in the southeast may be expected to rise. The analysis indicated a possible decline in industry concentration in 1987. This decline to the extent that it might be related to increasing raw material availability and hence, less ability among the larger firms to exhibit some control over input usage, suggests that an additional decline in concentration might be forthcoming as aquaculture supplies expand. Exporting countries with farmed shrimp supplies could at some point lessen these influences on southeastern processors if they increase their value added processing.

Roberts, Kenneth J.. Mark E. Thompson, and Perry W. Pawlyk (19??). "Structure Changes in U.S. Shrimp Markets." Draft report, Center for Wetland Resources, Louisiana State University, Baton Rouge, La.

This paper presents the results of a seven equation monthly model of the domestic shrimp market. Special emphasis was placed on sources of supply than evident in previous simultaneous models.

Roberts, Kenneth J., Mark E. Thompson, William D. Chauvin, and Vito J. Blomo (1983). "Assessment of User Conflicts Between Various Harvester Groups and with Other Fishing Industries." Report III in Assessment of Shrimp Industry Potentials and Conflicts, Shrimp Notes Incorporated, 417 Eliza Street, New Orleans, Louisiana, August, 90 pp.

This report addresses the conflicts between inshore and offshore shrimp fishermen and between shrimp fishermen and fishermen who use other gear types on shrimp fishing grounds, for example stone crab pots.

Roberts, Kenneth J., Mark E. Thompson, Fred J. Prochaska, and William D. Chauvin (1983). "Potential Actions of Tariff and Quota Legislation." Report V in Assessment of Shrimp Industry Potentials and Conflicts, Volume II, Shrimp Notes Incorporated, 417 Eliza Street, New Orleans, Louisiana, August, 143 pp.

The impact of shrimp imports on ex-vessel prices is discussed using the results of five different econometric studies. The paper reviews domestic production of all shrimp species from U.S. waters. It presents trends in shrimp imports by product type from 1970 to 1981 including marketing channels and retailing activities, and impacts on employment and capital invested in the harvesting sector of the shrimp fishery.

Roberts, Terrell W. (1986). "Abundance and Distribution of Pink Shrimp in and around the Tortugas Sanctuary, 1981-1983." North American Journal of Fisheries Management, 6:311-327.

Size and abundance of pink shrimp (Penaeus duorarum) in and around the Tortugas sanctuary in the Gulf of Mexico were surveyed monthly from September 1981 through July 1983. Samples were not taken in April and June 1983. Shrimp size varied widely at most stations and abundance varied between stations, but the average size increased with increasing depth and abundance decreased with increasing depth. A large proportion of small shrimp (<103 mm total length) in all samples combined monthly were

caught inside the sanctuary, but their abundance varied monthly and annually. Small pink shrimp dominated the catch from fewer than half the stations inside the sanctuary in September-December 1981 but increased in abundance and dominated half or more of the stations inside the sanctuary in January-December 1982 and February-May 1983. January and July were the only months in which catches from at least half the stations inside the sanctuary were composed mostly of shrimp at least 103 mm long in 1983. Recruitment was continuous but uneven throughout the survey. Peak months of recruitment varied annually, occurring in January and July-September 1982 and in January and March 1983. Small shrimp were less abundant outside the sanctuary but peaks in abundance at some stations outside the sanctuary, indicating strong recruitment, occurred in January and July-August 1982 and in March 1983. Conservative population estimates for the Tortugas fishing ground for September 1982-July 1983 varied from 11.8×10^6 pink shrimp in July to 52.7×10^6 pink shrimp in March. Although the trawlable area inside the southwestern sanctuary accounted for only 6% of the total trawlable area covered by the survey, the sanctuary contained an average of 36% of the total estimated pink shrimp population.

Roedel, Philip M. (1973). "Shrimp '73 - A Billion Dollar Business." Marine Fisheries Review, 35(3/4):1-6.

A presentation to the Louisiana Shrimp Association that discusses shrimp landings, imports, and cold storage holdings for 1972. The presentation also discusses other shrimp fisheries in New England and off the Pacific coast. A summary of a report by Miller and Nash (1971) on shrimp consumption and a U.S. Department of Commerce News article on shellfish shell salvaged for commercial uses are included.

Rulifson, Roger A., James D. Murray, and James J. Bahen (1991). "Bycatch Reduction in South Atlantic Shrimp Trawls Using Three Designs of "Finfish Separator Devices"." Final report prepared for NOAA, NMFS.

Standard shrimp trawls used in the southeastern USA commercial fishery were modified in an attempt to reduce the amount of unwanted fish and invertebrates (bycatch) retained during normal shrimp trawling procedures using the Parrish TED, square mesh FSD, and the diamond mesh FSD with and without hoops. No significant loss in marketable-sized fish was observed among the FSD designs compared to control catches. The objective of a 50% bycatch reduction with a shrimp loss of less than 5% was not consistently obtained.

Rulifson, Roger A., James D. Murray, and James J. Bahen (1992). "Finfish Catch Reduction in South Atlantic Shrimp Trawls Using Three Designs of By-Catch Reduction Devices." Fisheries, 17(1):9-26.

Standard shrimp trawls used in the southeastern U.S. commercial fishery were modified in an attempt to reduce the amount of unwanted fish (bycatch) retained during normal shrimp trawling procedures. A sampling design was used to test the effectiveness of bycatch reduction devices (BRDs) towed in combination with unmodified nets in coastal waters off Brunswick, Georgia, in 1990. Several problems hampered statistical analysis of the data, including slight differences in the towing of port and starboard nets, onboard modifications of BRDs during testing to correct design deficiencies, and seasonality of shrimp catches in combination with large masses of sargassum and jellyfish in trawls during fall sampling. The modified Parrish turtle excluder device (TED) was the only BRD that had a significant reduction (alpha = 0.05) in the percent difference in total biomass compared to the control net. Bycatch reduction was not consistent for other designs. No significant loss of marketable sized fish was observed among the BRD designs compared to control catches. The ability of smallest juvenile fish to escape from BRDs, thus shifting (increasing) the length-frequency distribution, was species specific. The normal Parrish TED was best suited for escapement of smallest menhaden, while the diamond-mesh BRD with hoops best minimized capture of the smallest Atlantic bumper, grey trout, and Atlantic croaker. The square-mesh net was most

effective in reducing retention of smallest-sized thread herring, and the modified Parrish TED retained less of the smallest-sized spot. The objective of 50% bycatch reduction with a shrimp loss of less than 5% was not consistently reached; however, BRDs show promise for bycatch reduction in South Atlantic coastal waters.

Sadeh, Arye, Hovav Talpaz, David A. Bessler, and Wade L. Griffin (1989). "Optimization of Management Plans with Short and Long Run Problems: The Case of Shrimp Production." European Journal of Operational Research, 40:22-31.

A management plan of continuous production is specified and optimized. An optimal control framework is used to solve for the decision variables. An economic interpretation of the optimality conditions is provided. The model is applied to the management of a shrimp pond. Results for different runs of the model are given and discussed.

Sage Associates, Inc. (1981). Economic Assessment of the U.S. Shrimp Industry with Associated Public Policy Recommendations. Washington, D.C.

This report contests the overcapitalization argument for the Gulf of Mexico and south Atlantic shrimp fishing fleet. It argues that a tariff and quota on shrimp imports would be economically efficient and have little impact on retail shrimp prices.

Saila, S.B. (1983). "Importance and Assessment of Discards in Commercial Fisheries." Fisheries Circular 765, Food and Agriculture Organization of the United Nations, Rome, October.

A review is made of the magnitude of the discarded catches from the major fisheries. Wide seasonal, geographic and gear-related variations were found in the discarded catch. Some simple field survey procedures for discard estimation are suggested. The probable biological consequences of discards are assessed on the basis of available information and suggestions for further studies are made. Some specific sampling and estimation methods applicable to the discard problem are suggested and some examples are provided.

Saila, S.B., H.A. Walker, E. Lorda, J. Kelly, and M. Prager (1982). "Analysis of Data on Shrimping Success, Shrimp Recruitment and Associated Environmental Variables, Shrimp and Redfish Studies: West Hackberry and Big Hill Brine Disposal Sites." Contract No. NA80-GA-00045, NMFS, SEFC, Galveston Laboratory, 4700 Avenue U, Galveston, Texas 77550, May, 238 pp.

This study attempts to identify plausible empirical relationships that may be used to build predictive models of how climatic variability can cause changes in certain population parameters, such as growth and mortality, fecundity, post larval recruitment, age at maturity, etc. Although statistical tests for the effects of various interventions that take climatic fluctuations into account are suggested, it is still not possible to distinguish between effects due to brine disposal and those due to the Texas closure since both were initiated in 1981. The suggested test procedure can be used to determine if the combined effects of the Texas closure and brine disposal are statistically significant once variations in landings due to climatic fluctuations have been taken into account.

Sanders, Nathaniel, Jr., David M. Donaldson, and Perry A. Thompson (eds.) (1990). "SEAMAP Environmental and Biological Atlas of the Gulf of Mexico, 1987." Number 22, Gulf States Marine Fisheries Commission, November, 337 pp.

The Southeast Area Monitoring and Assessment Program (SEAMAP) is a State/Federal/University program for the collection, management, and dissemination of fishery independent data in the United States waters of the Gulf of Mexico. A major SEAMAP objective is to provide the large, standardized data base needed by management agencies, industry, and scientists to wisely manage and develop fishery resources for the least possible cost. This report is the sixth in a series of SEAMAP environmental and biological atlases that presents such data in a summarized form collected during the 1987 SEAMAP surveys.

Schabram, Dennis (1995). "Texas Shrimpers Ready or Not for "Limited Entry and Bycatch"." The Herald, 6(4), February 16, 2 pp.

Will recreational fishermen do to the shrimp fishery what they did to the finfish fishery in Texas? Ultimately the consumer will share the price. Will free enterprise forces regulate the shrimp industry?

Schmied, Ronald L. (1994). "Report to Congress on the Cooperative Research Program Addressing Finfish Bycatch in the Gulf of Mexico and South Atlantic Shrimp Fisheries." Draft report, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, 9721 Executive Center Drive, North, St. Petersburg, FL, November, 27 pp.

This report updates members of Congress and other interested parties on progress made by the Secretary of Commerce in developing and implementing a cooperative shrimp trawl bycatch research program for the southeastern United States.

Schmied, Ronald L. (1995). "Report to Congress on the Cooperative Research Program Addressing Finfish Bycatch in the Gulf of Mexico and South Atlantic Shrimp Fisheries." Second draft report, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, 9721 Executive Center Drive, North, St. Petersburg, FL, January, 47 pp.

Revised Schmied (1994) report that updates members of Congress and other interested parties on progress made by the Secretary of Commerce in developing and implementing a cooperative shrimp trawl bycatch research program for the southeastern United States.

Schmied, Ronald L. (1995). "Report to Congress on the Cooperative Research Program Addressing Finfish Bycatch in the Gulf of Mexico and South Atlantic Shrimp Fisheries." Final draft report, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, 9721 Executive Center Drive, North, St. Petersburg, FL, February, 52 pp.

Revised Schmied (1995) report that updates members of Congress and other interested parties on progress made by the Secretary of Commerce in developing and implementing a cooperative shrimp trawl bycatch research program for the southeastern United States.

Sheridan, Peter F., Frank J. Patella, Jr., Neal Baxter, and Dennis A Emiliani (1987). "Movements of Brown Shrimp, Penaeus aztecus, and Pink Shrimp, P. duorarum, Relative to the U.S.-Mexico Border in the Western Gulf of Mexico." Marine Fisheries Review, 49(1):14-19.

Seasonal movement patterns of marked brown shrimp and pink shrimp relative to the U.S.-Mexico boarder in the western Gulf of Mexico are described from recaptures of shrimp tagged during 1978-1980. The intent was to determine the degree to which coastal shrimp movements would affect commercial

catches after implementation of new fishing regulations off Texas and Mexico. Shrimp were collected by trawl, marked with polyethylene streamer tags, and released during March-November at sites between Galveston, Texas, and Tampico, Tamaulipas, Mexico. Movements were examined by vector analysis and by recaptures per unit commercial landings. Over 121,500 shrimp were marked during seven releases in estuaries of which 1,827 (1.5 percent) were recaptured. Only 72 brown shrimp and 126 pink shrimp were recaptured offshore, but southerly movement patterns were indicated after five of those seven releases. Offshore releases of 71,485 brown shrimp and 19,185 pink shrimp resulted in 12.4 percent and 19.7 percent recapture proportions, respectively. Tagged brown shrimp moved up to 620 km from release sites and remained free up to 430 days. Tagged pink shrimp moved a maximum 428 km and were free up to 446 days. Recaptures were higher south of release sites after 20 of 30 releases of brown shrimp off Texas and Tamaulipas. In contrast, recaptures of pink shrimp were higher south of release sites after only 7 of 13 releases. The effectiveness of the Gulf of Mexico shrimp fishery management plan, enacted in 1981 to increase brown shrimp yield by seasonal prohibition of fishing could be diminished by the tendency for brown shrimp to migrate south.

Shrimp Notes Incorporated (1983). Assessment of Shrimp Industry Potentials and Conflicts. Volumes I, II, and III. Shrimp Notes Incorporated, 417 Eliza Street, New Orleans, Louisiana, August.

This report is intended to provide an update on the potentials and conflicts faced by the domestic shrimp industry with special attention directed at future actions that may significantly impact respective segments of the industry.

Sick, Lowell V., James W. Andrews, and David B. White (19??). "Preliminary Studies of Selected Environmental and Nutritional Requirements for the Culture of Penaeid Shrimp." Fisheries Bulletin, 70(1):101-109.

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.

Sinha, Sujata Bose (1988). "A Graphical Presentation of Economic Data for the Shrimp Fishery in the Gulf of Mexico January 1981 to December 1986." NOAA Technical Memorandum NMFS-SEFC-??, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, St. Petersburg, FL, August.

The data is presented here on an essentially macro scale aggregating over all species and sizes of shrimp found in the Gulf of Mexico. The first part of the presentation presents information extracted on an aggregated Gulf wide basis. The second part presents data on a state wide basis for the five individual states, i.e. Florida west coast, Alabama, Mississippi, Louisiana, and Texas. The third section presents the data on the basis of the number of trips taken by individual vessels in any year.

Six, Larry and Pam Buzan (1993). "The Status of Marine Fish Stocks and Conservation Efforts by Regional Fishery Management Councils." Pacific Fishery Management Council, July, 33 pp.

This report summarizes the status of marine fish stocks, species, or species groups harvested in the federal Exclusive Economic Zone (EEZ).

Sluczanowski, Philip R. (1984). "Modeling and Optimal Control: A Case Study Based on the Spencer Gulf Prawn Fishery for Penaeus latisulcatus Kishinouye." J. Cons. Int. Explor. Mer, 41:211-225.

Techniques of fish population dynamics, model building, and optimal control theory are applied to the problem of managing the Spencer Gulf prawn fishery in South Australia that involves the annual exploitation of a single year class of prawns. A model of the fishery is constructed that is then subjected to optimization techniques to derive optimal management strategies. Dynamic programming is used to derive optimal fishery closures for a given number of vessels. The derived controls take into account the major source of variation (variable recruitment). Their sensitivity to the uncertain parameters and to possible changes in costs is also considered, and the best number of vessels is determined taking into account parameter uncertainty, expected total profits, returns to capital, and the statistical distribution of returns.

Somers, Ian and You-Gan Wang (1995). "A Bioeconomic Analysis of Seasonal Closures in Australia's Multispecies Northern Prawn Fishery." Draft report submitted to the North American Journal of Fisheries Management.

In Australia's northern prawn fishery, seasonal closures are used to manage the size composition of the commercial catch. While primarily aimed at short term economic benefits of improved yield per recruit, they are also used to help reduce the risk of recruitment over fishing. Until recent years, seasonal closures took the form of a single closed season in late summer to protect juvenile banana prawns (Penaeus merguiensis) during months of peak recruitment. However, with the growing commercial importance of tiger prawns, (P. esculentus and P. semisulcatus) and concern for their recruitment over fishing, a second mid year closure was introduced to protect subadult tiger prawns until their main spawning season, which begins in August. In this paper, we use a simulation model of the northern prawn fishery to assess the biological and economic effectiveness of seasonal closures, specifically in yield, income, net operating income, and spawning stock indices. Because there is no reliable spawning stock recruitment relationship, recruitment was assumed to be constant; thus analysis was effectively per recruit. Our base model, with closures between 1 December and 1 April and between 25 June and 1 August, closely resembles the current seasonal closure regime in the fishery. Using this model, net operating income was found to increase by 3.7% with a single closed season between 28 November and 14 April, but tiger prawn spawning indices reduced by an average of 5.6%. A single closed season between 13 December and 8 May retained the same protection on subadult tiger prawns as the base model, but increased the net income by 2.3%. Net operating income was relatively insensitive to closure dates; any opening date between 17 March and 2 June would result in net operating income within 5% of the maximum.

South Atlantic Fishery Management Council (1981). "Profile of the Penaeid Shrimp Fishery in the South Atlantic." Final Report, Southpark Building, Suite 306, One Southpark Circle, Charleston, South Carolina 29407, November.

Review of the available data and a description of the shrimp fishery in the southern Atlantic states.

South Atlantic Fishery Management Council (1995). "Rock Shrimp Public Hearing Summary." Southpark Building, Suite 306, 1 Southpark Circle, Charleston, South Carolina 29407-4699, May, 49 pp.

Adds rock shrimp to the fishery management plan for shrimp, minimizes impacts of the rock shrimp fishery on coral, coral reefs, and live/hard bottom habitat, and implements permit and reporting requirements for the fishery.

Southeast Fisheries Science Center (1992). "Status of Fishery Resources off the Southeastern United States for 1991." NOAA Technical Memorandum NMFS-SEFSC-306, National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, Florida, November, 75 pp.

This report summarizes the general status of fishery resources through 1991. The report is divided into three major sections: Fishery Trends, Resource Surveys, and Species Synopses.

Southeast Fisheries Science Center (1993). "Gulf of Mexico Shrimp Fishery Effort Report." National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, Florida, November, 37 pp.

This report provides a description of the data and data collection procedures used to collect statistics from the shrimp fisheries in the Gulf of Mexico and discusses recent trends in fishing effort.

Southeast Fisheries Science Center (1996). "Summary Report on the Status of Bycatch Reduction Device Development." National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, Florida, January.

A compendium of reports made to the Gulf of Mexico Fishery Management Council on bycatch reduction device development. The goal of the gear development project is to develop shrimp trawl gear modifications and/or fishing tactics that are capable of reducing the bycatch of finfish with minimum loss of shrimp production. Specific objectives of the program were to evaluate existing bycatch reduction techniques, collect data on behavior of fish and shrimp in trawls, and to develop and evaluate new bycatch reduction techniques. The key species targeted for reduction are red snapper, weakfish, king and Spanish mackerel.

Southeast Fisheries Science Center (1996). "Technical Specifications and Minimum Requirements for the Extended Funnel, Expanded Mesh, and Fisheye BRDS." In "Summary Report on the Status of Bycatch Reduction Device Development." National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, Florida, January.

A technical explanation of the bycatch reduction devices proposed to reduce finfish bycatch in the Gulf of Mexico shrimp fishery.

Southeastern Fisheries Association (1993). International Conference on Shrimp Bycatch, May 24-27, 1992, Lake Buena Vista, Florida. Final Report, NOAA Grant No. NA-90AA-H-MF745.

The primary objectives of the conference are to (1) summarize information on the status of the bycatch problem and alternative shrimp harvesting techniques for bycatch reduction; (2) identify future research needs for addressing bycatch; (3) obtain input from scientists, fishermen, fishery managers, and environmentalists on future management strategies; and (4) provide for the dissemination of research and conference recommendations for evaluation by representatives of the scientific, commercial, recreational, and environmental communities.

South Atlantic Fishery Management Council (1994). "Draft Decision Document for Amendment 1 to the Fishery Management Plan for the Shrimp Fishery of the South Atlantic Region (Rock Shrimp)." 1 Southpark Circle, Suite 306, Charleston, South Carolina 29407-4699, 27 pp.

A discussion of management options for the rock shrimp fishery resource on the south Atlantic coast of the United States.

South Atlantic Fishery Management Council (1994). "Public Hearing Draft Amendment 1 to the Fishery Management Plan for the Shrimp Fishery of the South Atlantic Region (Rock Shrimp)." 1 Southpark Circle, Suite 306, Charleston, South Carolina 29407-4699, September, 96 pp.

This amendment considers (1) adding rock shrimp to the management unit of the shrimp FMP, (2) limiting harvest area in EEZ from Duval through St. Lucie (Stuart) counties, (3) implementing minimum

mesh size regulations for rock shrimp, (4) establishing a license limitation program for the rock shrimp fishery, and (5) establishing a co-management program for the rock shrimp fishery.

Sullivan, Mary Margaret (1993). "Texas Closure Revisited." Draft report, Department of Agricultural Economics, Texas A&M University, January.

A draft report that analyzes the economic impacts of the Texas Closure regulation using the General Bioeconomic Simulation Model developed by Grant and Griffin.

Summers, Charles (1995). "Learning From Other Fleets." In Brad Warren, Win-Win Bycatch Solutions. National Fisheries Conservation Center, Seattle WA.

A discussion of the bycatch and discard problem in Oregon's shrimp fishery. Various designs of finfish excluder devices are being tested to reduce bycatch in what is already considered to be a very clean fishery.

Surdi, Richard and Mort Miller (1981). "Productivity in the Gulf of Mexico Shrimp Fishery." Draft report, NMFS, Office of Policy and Planning, Economic Analysis Staff, Washington, D.C.

This report examines productivity in the Gulf shrimp fishery, which has undergone considerable expansion in recent years. The general concepts and measures of productivity are discussed first. Then, the trend in shrimp production is reviewed. Third, trends in major inputs to the shrimp fishery are reviewed. This is followed by a review of several partial productivity measures that indicate a significant decline in productivity in the shrimp fishery. The report concludes that the increased investment in fleet capacity has resulted in lower productivity over time.

Swallow, Stephen (1994). Renewable and Nonrenewable Resource Theory Applied to Coastal Agriculture, Forest, Wetland, and Fishery Linkages." Marine Resource Economics, 9(4):291-310.

This paper addresses tradeoffs in wetland development using a framework that integrates economic theory of renewable and nonrenewable resources. The theory treats wetland development as use of a nonrenewable resource, while wetland preservation protects critical fishery habitat. The framework recognizes that wetland quality may vary for either development or fisheries. An illustrative application assesses tradeoffs in converting pocosin wetlands to agriculture rather than maintaining wetlands to protect salinity in estuarine nursery areas. Results reveal the marginal value of salinity protection may be substantial, while location may affect a wetland's value to an estuarine shrimp fishery. Comparisons between agricultural and forestry land uses show that ecological links may cause wetland values to depend upon the land use chosen for the developed state. Future assessments of other development may reveal additional impacts through impacts on salinity.

Swartz, A. Nelson and Charles M. Adams (1979). "The Economics of Rockport Bay Texas Shrimping Vessels." Report, DIR 79-1, SP-6 Department of Agricultural Economics, Texas A&M University, August, 10 pp.

A cost and returns survey of Rockport, Texas shrimp fishermen that takes into account seasonal variation in abundance. The fall season is much more valuable to the shrimp fisherman than the spring season. However, a bay vessel operator could not economically survive in the long run without the spring season.

Swingle, Hugh A., Donald G. Bland, and Walter M. Tatum (1976). "Survey of the 16-foot Trawl Fishery of Alabama." Alabama Marine Resources Bulletin, 11(June):51-57.

Of the 19,120 owners of Class I and II boats registered in Mobile and Baldwin counties in 1972, 5,727 or 30% owned a 16-foot shrimp trawl. From 1972 to 1974, the estimated shrimp catch by these 16-foot trawls ranged from 204 to 291 thousand pounds (heads-on) or 15 to 25 percent of the total catch from the inside waters of Alabama.

Swingle, Wayne E. (1972). "Survey of the Live Bait Shrimp Industry of Alabama." Alabama Marine Resources Bulletin, No. 8, Alabama Marine Resources Laboratory, Dauphin Island, Alabama, June, 33 pp.

During 1968, there were 24 bona fide live bait shrimp dealers operating in Alabama who sold 1,544,000 live shrimp and 22,200 pounds of dead shrimp having a retail value of $76,540. The capital investment per dealer was $3,303 for facilities and equipment. No shrimp were exported from Alabama, and only a negligible amount was imported. Brown shrimp (Penaeus aztecus) and white shrimp (Penaeus setiferus) were the major species taken. Brown shrimp entered the estuaries first and were gradually replaced by white shrimp. The fishery normally operates from June through November. Length-weight relationships were determined for brown shrimp, white shrimp, and pink shrimp (Penaeus duorarum).

Swingle, Wayne E. (1991). "Shrimp Limited Entry Options Paper." Draft report, Gulf of Mexico Fishery Management Council, Lincoln Center, Suite 881, 5401 W. Kennedy Blvd., Tampa, Florida, 133 pp., Appendix.

A draft of the options paper for a limited access system for the shrimp fishery.

Swingle, Wayne E. (1996). "Issues the Shrimp AP Requested be Addressed in Bycatch Amendment." Gulf of Mexico Fishery Management Council, Lincoln Center, Suite 881, 5401 W. Kennedy Blvd., Tampa, Florida, 6 pp.

Summary of problems that need to be addressed in an analysis of the proposed regulations to reduce finfish bycatch in the Gulf of Mexico shrimp fishery including incorporating ecological models in the economic-cost benefit analysis.

Taylor, David L. (1979). "Preliminary Stock Assessment, North Carolina: Rock Shrimp (Sicyonia brevirostris)." North Carolina Department of Natural Resources and Community Development, Division of Marine Fisheries, Morehead City, NC, December, 19 pp.

During October, 1979, the R/V Dan Moore utilized a conventional shrimp trawl at 22 locations offshore North Carolina from south of Cape Hatteras to southwest of Cape Fear in search of rock shrimp. Data were compiled on distribution, relative abundance, size and sex composition, and cull rates. Rock shrimp were found to be more abundant in Long Bay than in Onslow and Raleigh Bays, and it was evident that catches decreased in numbers as latitude increased. Although the vast majority (94.8%) of rock shrimp captured were of commercial size, nowhere were they located in commercially significant concentrations. Males averaged slightly smaller in total length than females and females became more numerous than males in the larger size categories. Sex ratio did not vary significantly from 1:1.

Temple, Robert F. (1973). "Shrimp Research at the Galveston Laboratory of the Gulf Coastal Fisheries Center." Marine Fisheries Review, 35(3-4):16-20.

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A review of the history and present research responsibilities of the Galveston Laboratory.

Tettey, E.O. (1983). "The Gulf of Mexico Shrimp Fishery: An Econometric Analysis of Real Net Investment in Fishing Vessels." Dissertation, Department of Agricultural Economics, Texas A&M University, College Station, 140 pp.

The real net investment in fishing vessels in the Gulf of Mexico shrimp fishery is analyzed employing an econometric model. The model is simulated over a 17 year period to examine the short and intermediate run impacts of changes in such policy variables as the real rate of interest, cost of equity capital, investment tax credit and income tax on investment behavior in fishing vessels. A forecast over a 5 year period (1978 - 1982) for real net investment in fishing vessels is also developed.

Investment tax credit stimulates investment expenditure in the Gulf shrimp fishery. However, income tax exerts the greatest influence on investment decisions in the fishing industry. While both steel and wooden vessels are expected to show continuous growth from 1978 to 1982, the stock of steel vessels should grow about three times as fast as wooden ones over this period.

Tettey, E.O., and W.L. Griffin (1984). "Investment in Gulf of Mexico Shrimp Vessels, 1965-77." Marine Fisheries Review, 46(2):49-52.

This study examines implications of investment patterns in the Gulf shrimp fishery. Historical trends in capital stock of different vessel types are estimated for 1965-77 for use with landings and sales data. Specifically, annual trends in total and per vessel shrimp landings and sales are examined. Shrimp landings and sales per dollar of investment in fishing vessels are evaluated. Apparently, the perceived value of landings per vessel increased on average at a faster rate than production costs per vessel causing excess profit to exist. This created an incentive for investments, although there may be other reasons for stimulating investment. This expansion was interrupted only by poor economic conditions, such as in 1970 and 1973-75. Although data were not available to estimate real capital stock beyond 1977, other information suggests that substantial declines (large negative real investment) occurred in 1979-80.

Tettey, E.O., W.L. Griffin, and J.B. Penson (19??). "Real Net Investment in Gulf Shrimp Fishing Vessels." Technical Article No. TA-20803, Texas Agricultural Experiment Station, Department of Agricultural Economics, Texas A&M University, College Station, 18 pp.

An econometric model of annual real net investment in fishing vessels in the Gulf is developed to determine how the cost of equity and debt capital as well as other factors affect investment decisions in this industry. The cost of capital plays an important role in influencing investment decisions in the Gulf shrimp fishing industry. High real interest rates were found to depress real net investment in this fishery. Investment responses to changes in macroeconomic policy are greatest for steel vessels because steel vessels contribute the most to the productivity of the Gulf shrimp fishery. Finally, while low real interest rates are desirable for stimulating investment activities in the general economy, they would add to the overcapitalization problem that currently exists in the Gulf shrimp fishing industry. This suggests that expansionary policies designed to boost the growth of the general economy may actually lead to undesirable results for the Gulf shrimp fishing industry.

Tettey, Ernest, Christopher Pardy, and Wade Griffin (1982). "Economic Analysis of Investment Alternatives for the Gulf of Mexico Shrimping Vessels." Draft Report, Department of Agricultural Economics, Texas A&M University, College Station, Texas 77843.

The effects of inflation on the returns to investment and profitability in the shrimp industry is observed by analyzing investments in 1971, 1977, and 1979. Steel vessels generally did better in terms of financial performance than wooden ones and medium sized vessels were the most efficient vessels to operate in the Gulf of Mexico. This draft report also includes summarized raw data as a handwritten appendix.

Tettey, E.O., W.L. Griffin, J.B. Penson, and J.R. Stoll (1986). "Implications of Tax Policy on Investment in a Common Property Resource." North American Journal of Fisheries Management, 6:100-104.

This study employs a financial model to examine the aggregate investment expenditures for Gulf of Mexico shrimp vessels. Specifically, the impacts of tax policies - investment tax credits and income taxes - on investment decisions in the Gulf shrimp fishery are evaluated. Contractionary tax policy is an effective tool in limiting entry to the shrimp fishery and, thereby, controlling the problem of overcapitalization. Decreases in the investment tax credit rate, increases in the income tax rate, or a combination of both policies will curtail investment activities in the fishing industry. Implementation of such tax schemes should raise total revenues of vessel owners, in the long run, from what they otherwise would have been.

Tettey, Ernest, Christopher Pardy, Wade Griffin, and A. Nelson Swartz (1984). "Implications of Investing Under Different Economic Conditions on the Profitability of Gulf of Mexico Shrimp Vessels Operating Out of Texas." Fishery Bulletin, 82(2):365-373.

Due to the inflationary trend in recent years coupled with fluctuating shrimp prices, the shrimp business has become a highly uncertain undertaking. The financial performance of a sample of the Gulf of Mexico shrimping fleet, operating out of the Texas coast, was examined over a 10 year period (1971-80). the results indicate that investments made in the early part of the 1970's performed better than those made in the latter part. Periods of low inflationary levels appeared to be more favorable to investments in the shrimp fishery than periods of high inflationary levels. In terms of economic profits, steel vessels generally did better than wooden ones. Medium sized vessels (18.6 - 20.0 m in overall length) were the most efficient vessels to operate in the Gulf of Mexico.

Texas Parks and Wildlife (1991). "The Texas Shrimp Fishery, A Report to the Governor and the 72nd Legislature." Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744.

This report reviews the current status and recent developments that affect the Texas shrimp fishery.

Theiling, Dale L. (1977). "South Carolina's 1976 Shrimp Trawler Season." South Carolina Marine Resources Center, Technical Report Number 24, December, 31 pp.

Data concerning the shrimp trawler fishery of South Carolina were collected during the 1976 season by the Marine Resources Division. Of 62 shrimp buyer and shipper license holders, 37 were considered full time shrimp packers and were located on charts. Six hundred thirty two single rig and 497 double rig trawlers were registered. Length, horsepower, and other data on trawlers were compiled by home port and county along with age, race, and location information on captains. Owners' motivation (i.e. commercial or recreational) and locations were evaluated. Catch, effort, value, and location data on shrimp landings were summarized for use by shrimpers, dealers, and researchers. The 1976 season was reviewed on a monthly basis.

Theiling, Dale (1988). "Assessment of Participation and Resource Impact of Shrimp Baiting in Coastal South Carolina During 1987." South Carolina Marine Resources Center, Technical Report Number 69, September, 41 pp.

An estimated 21,735 South Carolinians utilized 6,406 boats to catch 1,8 million pounds of shrimp during the 1987 season of mid-August through mid-December. The typical shrimp baiting trip saw two people shrimping for 4 hours from a 14 foot boat using 12 to 15 bait marking poles and catching 30 to 35 quarts of shrimp (heads-on measure).

Thomas, J. Stephen, G. David Johnson, and Catherine Riordan (1994). "Executive Summary of Year One." In "Decision-Making by Shrimp Fishermen as Reasoned Action: Behavioral Determinants of Bycatch Characteristics and Projected Effects of Bycatch Regulations on Labor Decisions." Presentation, Gulf of Mexico Fishery Management Council, Shrimp Trawl Bycatch Session, Corpus Christi, May, 5 pp.

This material represents initial efforts to understand the potential effects of bycatch regulations on shrimp fishermen and are derived solely from Alabama. This research has two primary objectives, the first of which is to project fishermen's labor market decisions in light of proposed regulatory actions to reduce bycatch. To assess this, questions were constructed premised on the theory of reasoned action. The theory of reasoned action seeks to explain behavior on the basis of individual intentions to carry out the behavior in the future. In the case of shrimp fishermen, we test their intentions to remain or leave shrimp fishing given the possibility of future bycatch regulations. Secondly, with this research we are able to establish baseline data characterizing the economic, social, and psychological well being of shrimp fishermen first from Bayou La Batre, Alabama, and eventually for shrimp fishermen Gulf wide. Finally, we are able to compare data from this first year with data collected in a similar survey from 1987. Thus, we are able to discuss in this summary three major sets of findings: demographic comparisons for 1987 and 1993-94; well being comparisons for 1987 and 1993-94; and perceived effects of regulations on fishermen's intent concerning their future as fishermen.

Thomas, J. Stephen, Cecelia M. Formichella, G. David Johnson, and Catherine Riordan (1995). "Shrimp Fishermen on the Eve of Bycatch Regulations: A Report to the Gulf of Mexico Fishery Management Council." Draft report, College of Arts & Sciences, University of South Alabama, Mobile, AL.

The data presented here describes the current social conditions among shrimp fishermen, the perceptions fishermen have about how bycatch regulations may effect them, and provides an opportunity to suggest the potential consequences for fishermen should the current social conditions persist or worsen as a result of new regulations. To do this the following will be presented: 1. Background of the research and the methods used; 2. Basic demographic characteristics of fishermen; 3. Economic characteristics; 4. Occupational features; 5. Physiological and psychological indicators of health; 6. Perceptions fishermen have of the future; and 7. Conclusions, consequences and recommendations.

Thomas, J. Stephen, G. David Johnson, Cecelia M. Formichella, and Catherine Riordan (1995). "Shrimp Fishermen on the Eve of Bycatch Regulations: A Final Report." MARFIN Report #NA37FF0049, College of Arts & Sciences, University of South Alabama, Mobile, AL.

The purposes of the study are (1) To describe the current social, economic, and health status of boat captains operating in the Gulf of Mexico shrimp fishery; (2) To describe their perceptions concerning the likely effects of new regulations; (3) To solicit shrimp boat captains opinions regarding bycatch regulations; and (4) To anticipate potential consequences for fishermen of additional regulatory actions. Comparisons among three samples of shrimp fishermen are made: Alabama 1987, Alabama 1994, and Gulf-wide 1994. Changes observed for the Alabama fishermen are described and generalizations across the entire Gulf of Mexico are suggested.

Thompson, John R. (1967). "Development of a Commercial Fishery for the Penaeid Shrimp <u>Hymenopenaeus</u> <u>Robustus</u> Smith on the Continental Slope of the South-Eastern United States." <u>Proceedings of the Symposium on Crustacea</u>, Part IV: 1454-1459.

In the early 1950's, the U.S. Bureau of Commercial Fisheries vessel Oregon found large concentrations of royal red shrimp, <u>Hymenopenaeus</u> <u>Robustus,</u> in the northern Gulf of Mexico on the continental slope off the Mississippi River Delta. This finding was one result of a long term series of explorations for resources of commercial worth that began on the continental shelf of the northern Gulf and has since encompassed the shelf and slope from Cape Hatteras, North Carolina to Brazil in the Gulf, Caribbean, and Western Atlantic proper. Potentially commercial quantities of the royal red shrimp have been found on Florida's east coast, off the Dry Tortugas, and in the northern Gulf. Lesser quantities of the shrimp have been found throughout the area explored with some potential off Venezuela and Colombia in the Caribbean and off the Guianas in the Atlantic. By trawling the grounds where large concentrations occurred off the U.S., and making demonstration landings as well as publishing the results of the findings, the U.S. fishing industry has been encouraged to make use of the new resource. Vessels of the Bureau have fished alongside the commercial fleet on the new grounds to encourage them, and at present a growing interest and a small scale continuous utilization is being seen.

Thompson, Mark, Kenneth J. Roberts, and Perry W. Pawlyk (1984). "Structural Changes in U.S. Shrimp Markets." In <u>Proceedings of the Workshop on Shrimp and Prawn Markets</u>. International Institute of Fisheries Economics and Trade and the South Carolina Wildlife and Marine Resources Department, Charleston, South Carolina, July 26-27.

The research outlined in this paper is a more complete specification of the shrimp market interactions that incorporate recent data. A monthly seven-equation model was formulated as a closer approximation of the relationships that are endogenous to the shrimp market. More emphasis in this respect was placed on sources of supply than evident in previous simultaneous models (Doll, 1972; Batie, 1974).

Thompson, Russell G., Richard W. Callen, and Lawrence C. Wolken (1970). "Optimal Investment and Financial Decisions for a Model Shrimp Fishing Firm." TAMU-SG-70-205, Texas A&M University Sea Grant Program, April, 49 pp.

In this study, the shrimp industry is briefly reviewed historically, and some of the factors influencing the demand for shrimp as well as some of the factors affecting the supply are discussed. The need for better aids for investment planning is pointed out. This is followed by the development of a mathematical investment financial model for the shrimp fishing firm. Each facet of the model is discussed with a rigorous statement of the complete decision making model. It is then shown how this first model may be transformed into a form for computational purposes: a sequential linear programming model. An economic interpretation is provided for the possible corner solutions to this problem.

Thompson, R.G., M.D. George, R.J. Callen, and L.C. Wolken (1970). "A Stochastic Investment Model for a Survival Conscious Fishing Firm." TAMU-SG-70-218, Institute of Statistics Texas A&M University, Texas A&M University Sea Grant Program, July, 22 pp.

This study develops mathematical aids for investment-financial decision making in shrimp fishing. The model developed allows for random prices and catches per vessel and takes into account all of the information known to the decision maker at each time of decision. Vagrancies in landings per vessel seem to be much more important to the survival of the firm than unexpected variations in price.

Thompson, R.G., M.D. George, R.J. Callen, and L.C. Wolken (1973). "A Stochastic Investment Model for a Survival Conscious Firm Applied to Shrimp Fishing." <u>Applied Economics</u>, 5:75-87.

An operational stochastic capacity expansion model for a survival conscious firm is developed and applied to shrimp fishing in which the entrepreneur evaluates all the information known to him at the time of the decision. The results show the effect of survival on the growth in net worth of a firm making sequential and irreversible purchases of physical capital with uncertain future yields. The survival model is applied to shrimp fishing on the Texas Gulf coast and the results are compared to those of a simple model in which survival is not considered. Bankruptcy could clearly result from the use of the simple model; survival of the firm is guaranteed by use of the survival model.

Exit from the fishery may be restricted (sticky downward) because fishermen's attitudes toward risk are not symmetric with regard to favorable and unfavorable yields and prices. Low prices and small catches in fishing may be dreaded much more than high prices and large catches are desired. In the model, the firm maximizes expected net worth at the end of a finite planning period subject to the restriction that the only allowable purchases of capacity are those for which there is no chance of incurring bankruptcy. It is assumed that the firm is unwilling to assume any risk of failure. Thus, the survival restriction prohibits purchases of capacity which would lead to bankruptcy during the planning period if the worse possible yields or output prices occur in the future. Survival considerations may result in modest growth of capacity of a fishing firm, even if the expected profit of additional capacity is relatively large.

Tse, E. and A. Khilnani (1989). "An Integrated System Model for a Fishery Management Process - I." Computers Math. Applic., 17(8/9):1329-1343.

This paper describes the use of a system model in the support of a fishery management process. The system provides an integrated framework for describing the dynamic interactions among fish resources, fishermen, processors, and consumers through the notion of market equilibrium. In addition to giving a complete detail on the system components and the integration mechanism, the paper also describes how the integrated system can be used in supporting fishery management processing required by the Fishery Conservation and Management Act of 1976.

Tse, E. and A. Khilnani (1989). "An Integrated System Model for a Fishery Management Process - II. A Case Study." Computers Math. Applic., 18(6/7):675-690.

This paper describes the use of a fishery management system in policy analysis studies to support the shrimp fishery management process in the Gulf of Mexico. The studies were performed during the period 1979-1983 by a joint effort between a research team at Stanford and staff analysts at the Southeast Fisheries Center. The paper gives a brief account of the results for the 5 year period, as well as the insights derived through the process of using a mathematical economic model in support of the policy process.

Tse, Edison T.S., Arvind Khilnani, and Jim S.C. Tom (1980). "Integrated Approaches to Fishery Policy Analysis: A Case Study of the Tortugas Shrimp Fishery." Executive Summary from the Final Report on Implementation of the Fisheries System Management Model for the Southeast Shrimp Fishery, Contract No. NA79-GA-C-00006, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida, Stanford University, Department of Engineering-Economic Systems, Stanford, CA, January, pp. 14-20.

The executive summary summarizes the management characteristics and adaptability of a Fisheries System Management Model (FISYS) as applied to the Tortugas shrimp fishery off the southwest coast of Florida.

Turnbull, Deborah (1980). "Provisional Bibliography: Fish By-Catch From Shrimp Trawling." Prepared for Round Table on Non-Traditional Fishery Products for Mass Human Consumption, September 15-19, Washington, D.C. Compiled by I.D.R.C. 5990 Iona Drive, U.B.C., Vancouver, B.C. V6T1L4, Canada.

Many of the listed papers are part of the holdings of the IDRC fisheries library in Vancouver, B.C., Canada. The citations are listed alphabetically according to the author's name. The citations are numbered to facilitate the use of the subject and geographical indices.

Upton, Harry (1992). "Problems in the Gulf of Mexico Shrimp Fishery." Chapters 4 and 5 of a draft report, Center for Marine Conservation, 1725 DeSales St, NW, STE 500, Washington, D.C.

Problems associated with the Gulf shrimp fishery can be divided into two general categories. Those relating directly to the Gulf shrimp harvesting sector and those relating to other natural and human-induced changes occurring in the Gulf of Mexico coastal zone. The seven basic problems are: overcapitalization and overcapacity, incidental bycatch, overfishing, habitat loss, management/enforcement problems and gaps in research, increasing imports that are competing with domestic production, and introduction of alien species of shrimp or viruses. Problems in research and management may be tied to both of these categories.

Upton, Harry, Peter Hoar, and Melissa Upton (1992). The Gulf of Mexico Shrimp Fishery: Profile of a Valuable National Resource. Center for Marine Conservation, 1725 DeSales Street, NW, Washington, DC 20036.

This report provides an overview of the Gulf of Mexico shrimp fishery - its biology, habitat, economics, and management - and to show how these elements interact. After the overview, the primary problems of the fishery are defined and summarized. The final chapter provides some management alternatives and recommendations for solving some of the problems facing the fishery.

United States International Trade Commission (1976). Shrimp. USITC Publication 773, Washington, D.C., May, 111 pp.

This study analyses the impact of shrimp aquaculture imports on the domestic, open access fishery in the Gulf of Mexico and the south Atlantic. The commission determined that shrimp, fresh, chilled, frozen, prepared, or preserved is being imported into the United States in such increased quantities as to be a substantial cause of serious injury to the domestic industry catching and landing shrimp.

United States International Trade Commission (1985). Conditions of Competition Affecting the U.S. Gulf and South Atlantic Shrimp Industry. USITC Publication 1738, August, 277 pp.

This study analyses the impact of shrimp aquaculture imports on the domestic, open access fishery in the Gulf of Mexico and the south Atlantic.

Urner Barry (1995). "U.S. Imports of Shrimp (All Types) by Country." Fishery Market News Report, 5:10, Wednesday, January 25.

Table of imports of shrimp by country comparing November 1993 to November 1994 with cumulative totals.

Veal, C. David (1981). "Research Priorities in the Gulf Shrimp Industry." Mississippi State University, Mississippi Cooperative Extension Service, Sea Grant Advisory Services, 4646 W. Beach Blvd., Suite 1-E, Biloxi, MS 39531.

Nominal grouping is used to arrive at a list of priorities and a consensus of their importance. The ten items that were considered to be most important are (1) high cost of fuel, (2) market research to increase per capita consumption, (3) research on the impact of foreign shrimp imports and alternative solutions to minimize this impact, (4) excessive governmental regulation, (5) research on the impact of uniform conservation laws for all national and international fisheries, (6) pollution of estuaries, (7) increased utilization of bycatch, (8) loss of the fishing area (Texas closure), (9) the impact of high interest rates on vessels and inventory, and (10) possible overcapitalization of the shrimp fleet. A brief description of each problem by a technical specialist is provided.

Veal, David, Ron Lukens, and Dave Burrange (1984). "Structure, Strategy and Fuel Consumption in the Mississippi Alabama Shrimp Fleet." Final report, NMFS Award No. NA82-GA-H-00007, GASAFDFI Project No. 21-04-15000, January, 27 pp.

This study develops a base of information on present fuel use patterns and gear characteristics in the Mississippi and Alabama shrimp fleets as examples of operations that demand high mobility and are fuel intensive. The information can be used in planning fuel use patterns that may be more efficient and in the evaluation of potential needs for research and fuel conservation technology.

Veal, C. David and John R. Kelly (1983). "Fuel Conservation in the Gulf and South Atlantic Shrimp Fishing Fleet." Report VIII in Assessment of Shrimp Industry Potentials and Conflicts, Shrimp Notes Incorporated, 417 Eliza Street, New Orleans, Louisiana, August, 62 pp.

The problems associated with improving fuel efficiency in the Gulf and south Atlantic shrimp fishing fleet are complex. While the technology exists, the data necessary to do an adequate job of designing fuel efficient technologies for each vessel do not exist since they were not constructed in shipyards using marine engineers or naval architects. The authors propose the formation of a number of task forces and delivery mechanism that should provide adequate information to allow each individual vessel owner to make appropriate decision on fuel saving technologies that affect him.

Veal, David, Mac V. Rawson, Jr., and William Hosking (1981). "Structure, Strategy and Fuel Consumption in the Gulf Shrimp Fleet." The Society of Naval Architects and Marine Engineers, No. 3. Papers to be presented at Fishing Industry Energy Conservation Conference, Seattle, WA, October 26-27, 1981.

For the Gulf fleet, fuel and oil account for 40-54 percent of total operating cost for vessels over 15 m (50 ft.). The Gulf shrimp fleet consumes 33 percent of the diesel fuel used by the U.S. fishing industry; the shrimp industry is second only to the Maine lobster industry in energy inefficiency per unit of protein produced.

Veal, C. David, Gary Graham, J.E. Easley, and J.R. Kelly (1983). "Gear Development, Harvesting Strategies and Fleet Capacity of the Gulf and South Atlantic Shrimp Industry." Report II in Assessment of Shrimp Industry Potentials and Conflicts, Shrimp Notes Incorporated, 417 Eliza Street, New Orleans, Louisiana, August, 74 pp.

A discussion of limited entry options for the south Atlantic and Gulf of Mexico shrimp fisheries.

Veim, Anne Kjos, Knut Sunnana, Per Sandberg, and Peter Gullestad (1994). "Bycatch of Juvenile Fish in the Shrimp Fishery - Management Based on Bioeconomic Criteria." C.M. 1994/T:14, Theme Session on Improving the Link Between Fisheries Science and Management: Biological, Social, and Economic Considerations, International Council for the Exploration of the Sea, St. John's, Newfoundland, Canada, September, 14 pp.

The bycatch of juvenile fish can be a major problem in fisheries with small meshed trawls, such as fisheries for shrimp, (Pandalus borealis). A sorting grid that effectively removes most of the undersized fish has been developed for shrimp trawls and it is not legal to fish for shrimp in the Barents Sea without the use of this sorting grid. Apart from this, the existing catch regulation of the shrimp fishery in the Barents Sea is the closing of shrimp fisheries on fishing grounds when the bycatch of juvenile fish exceeds the criteria for allowable bycatch in numbers per ton of shrimp set by the Norwegian - Russian Fishery Commission.
In this paper, a new method for the calculation of a criteria for closing shrimp fisheries based on both biological and economic considerations is established. This bioeconomic approach is an alternative to the existing biological approach. The main concept in the bioeconomic approach is that if the expected future value of the bycatch exceeds the value of the shrimp catches, the shrimp fishery should be closed. In this paper, a joint criteria for allowable bycatch is developed and calculated, including all the commercially interesting species whose juveniles are caught as bycatch in the shrimp fisheries in the Barents Sea.

Vondruska, John (1981). "Drop in Shrimp Prices and Shrimp Business Survival." Memorandum, United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Washington, D.C., August, 4 pp.

A market situation and outlook report for 1981 covering 1973 to 1981 with special emphasis on July to August, 1981.

Vondruska, John (1983). "Fishery Commodity Report: Shrimp." National Marine Fisheries Service, Office of Utilization Research, August, 9 pp.

Report of the landings and imports of shrimp for 1983.

Vondruska, John (1986). "Shrimp Situation and Outlook." National Marine Fisheries Service, 9450 Koger Blvd., St. Petersburg, FL, August, 2 pp.

Situation and outlook for the shrimp processing and harvesting industries including landings, imports, inventories, consumption, prices, Japan's imports, and the outlook for the near future.

Vondruska, John (1986). "Investment in the Fishing Industry." Draft report, NMFS, SERO, 9450 Koger Blvd., St. Petersburg, FL 33702.

Estimated investment in U.S. commercial fishing increased sharply in the late 1970's, but has subsided in the 1980's. The smaller growth in number of vessels than in investment in vessels indicates that larger, more expensive vessels were being added to the fleet.

Vondruska, John (1987). "An Assessment of Gulf Shrimp Landings Data Published in New Orleans Market News Report." Report, National Marine Fisheries Service, Southeast Regional Office, 9450 Koger Blvd., St. Petersburg, FL, November, 5 pp.

An assessment of market news data for 1987 that seemed to indicate some errors in data collection.

Vondruska, John (1987). "The Gulf Shrimp Industry." Report presented at the Gulf States Marine Fishery Commission's Industry Advisory Committee Meeting, NOAA, NMFS, SERO, St. Petersburg, FL.

A review of harvesting and processing sector employment, production, and investment trends for 1986.

Vondruska, John (1989). "Shrimp Situation and Outlook — 1988." National Marine Fisheries Service, Southeast Regional Office, 9450 Koger Blvd., St. Petersburg, FL 33702.

A review of harvesting and processing sector employment, production, and investment trends for 1988.

Vondruska, John (1990). "Shrimp Situation and Outlook - 1990." Draft report, NMFS, SERO, 9450 Koger Blvd., St. Petersburg, FL 33702.

A review of harvesting and processing sector employment, production, and investment trends for 1990.

Vondruska, John (1991). "World Shrimp Situation 1990: Effects on Southeast Harvesting." U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, NOAA Technical Memorandum, NMFS-SERO-294, October, 22 pp.

U.S. shrimp landings and use fell slightly in 1990. Use was up slightly for Japan, Europe, and the world. Prices and production problems continued to plague shrimp farms that accounted for most of the growth in world supplies over the past decade. Shrimp fishermen faced problems too. Whether the price strength of larger shrimp will be overcome by supplies of farmed black tiger shrimp over the long haul as in 1988-89 is unclear, but along with the long-term downward trend in real prices this could affect decisions by fishery and business managers.

Vondruska, John (1991). "Trends in World Production and Major Markets for Shrimp." Draft report, Southeast Regional Office, National Marine Fisheries Service, St. Petersburg, Fl.

Trends in production, trade, and consumption are described for the world's three major shrimp markets; the U.S., Japan, and European Economic Community. Trends in world production are also described, including breakdowns for farmed shrimp and cold water shrimp.

Vondruska, John (1992). "Southeast Shrimp Fishery Market Conditions, 1991-1992." Preliminary draft report, National Marine Fisheries Service, Southeast Regional Office, December, 15, 16 pp.

Prices, market supplies, and aquaculture trends facing the shrimp wholesale market and harvesting industry for 1991 and 1992.

Vondruska, John (1994). "Southeast Shrimp Fishery Market Conditions, 1993." Preliminary draft report, National Marine Fisheries Service, Southeast Regional Office, December, 9 pp.

Prices, market supplies, and aquaculture trends facing the shrimp wholesale market and harvesting industry for 1993.

Voss, Gilbert L. (1955). "A Key to the Commercial & Potentially Commercial Shrimp of the Family Penaeidae of the Western North Atlantic & the Gulf of Mexico." M.L. 10017, The Marine Laboratory, University of Miami, Coral Gables, Florida, May, 23 pp.

This paper provides a key for nineteen of the 20 commercially valuable shrimp in the hopes that it may be of use to the field worker or fisherman in the identification of shrimp in their catches.

Walker, Henry A. and Saul B. Saila (1986). "Incorporating Climatic and Hydrographic Information into Shrimp Yield Forecasts Using Seasonal Climatic Component Models." In Landry, Andre M., Jr. and Edward F. Klima (eds.) Proceedings of the Shrimp Yield Prediction Workshop, TAMU-SG-86-110, April, Texas A&M University at Galveston, Mitchell Campus, Galveston, Texas.

Conditions were favorable for offshore brown shrimp production in the vicinity of the Texas and Louisiana boundary when there were strong northward winds and eastward Ekman transport during the winter, followed by a dry spring. These conditions may have resulted in higher survival rates for postlarvae and juvenile stages in the estuaries. High springtime river discharges and resulting low salinity in nursery areas reduced offshore brown shrimp yields regardless of wind direction.
White shrimp landings were positively correlated with summer river discharges in the region. Strong winds toward the northwest and northeast Ekman transport in the spring and summer during periods of spawning and larval transport into nursery areas correlated with decreased offshore yields of white shrimp. In the fall, strong easterly winds, low river discharge and relatively cold water temperatures correlated with increased offshore white shrimp landings.

Wallace, Richard K. and C. Lance Robinson (1994). "Bycatch and Bycatch Reduction in Recreational Shrimping." Northeast Gulf Science, 13(2):139-144.

Bycatch from recreational shrimping is estimated by quantifying the catch from fishery independent trawling and through a survey of licensed recreational shrimpers in Alabama during 1990. Paired trawls are used to test tow net modifications (fish shooter and Florida fisheye) for bycatch reduction. The mean fish bycatch was 5.4 kilograms per 20 minutes tow and contained 426 fish primarily from three families (Sciaenidae, Engraulidae, and Clupeidae). The total recreational shrimping effort for Alabama was an estimated 37,244 hours resulting in a potential fish bycatch of 603,000 kg or 47.6 million fish. The fish shooter did not significantly reduce the bycatch in either weight or numbers while the Florida fisheye significantly reduced bycatch in Both weight (26 percent) and number (46 percent). Further testing of the Florida fisheye with the position of the nets reversed revealed no significant reduction in weight but a significant reduction in bycatch number (36 percent).

Ward, John M. (1984). "A Synthesis of Cost and Revenue Surveys for Vessels Operating in the Gulf of Mexico Shrimp Fishery." Draft Report, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Miami Laboratory, 75 Virginia Beach Drive, Miami, FL, May, 22 pp.

Hedonic cost and revenue functions are estimated for the Gulf of Mexico shrimp fishery using data published in annual surveys of the fleet from 1971 to 1980. Comparable costs, revenues, and profits are estimated for three vessel size classes for the Texas, Louisiana, and Florida inshore and offshore fleets. The cost and revenue estimates indicate that fishing firms have generally been profitable over the time period of the analysis, exclusive of opportunity costs.

Ward, John M. (1988). "A Synthesis of Cost and Revenue Surveys for Gulf of Mexico Shrimp Vessels." Marine Fisheries Review, 50(1):47-52.

Since detailed cost data are not routinely collected and the published survey data from various sources are not easily compared, trends in costs and revenues for the Gulf of Mexico shrimp fishing fleet cannot be readily determined. A consistent data set for comparing vessel operating costs and revenues between states, vessel sizes, and years was estimated using weighted least squares regression analysis. Differences in the sample variance between the published cost and revenue data caused by time, type of survey, region surveyed, vessel size, sample size, or area of operation are accounted for in the econometric model. The coefficient of determination adjusted for the degrees of freedom and the F statistic indicate that the model specification provides a good statistical fit to the survey data.

Ward, John M. (1988). "Vessel Operating Behavior in the Gulf of Mexico Shrimp Fishery: Annotated Bibliography." National Oceanic and Atmospheric Administration Technical Memorandum NMFS-SEFC-212, National Marine Fisheries Service, Southeast Regional Office, St. Petersburg, FL.

An annotated bibliography of literature pertaining to an analysis of fleet size change over time that is divided into sections on economic theory, fisheries biology, statistical methodologies, and examples of their application.

Ward, John M. (1989). "Modeling Fleet Size in the Gulf of Mexico Shrimp Fishery, 1966 - 1979." National Oceanic and Atmospheric Administration Technical Memorandum NMFS-SEFC-229, National Marine Fisheries Service, Southeast Regional Office, St. Petersburg, FL.

The Gulf of Mexico shrimp fishing fleet is modeled extending the approach developed by Prochaska and Cato (1981) by including economic and biological variables. Changes in fleet size are found to be responsive to economic and biological conditions in the fishery. The model indicates that the fleet size is approximately three times that necessary to efficiently harvest the resource. While the model is handicapped by insufficient degrees of freedom, results suggest that alternative modeling approaches could be used to develop a model that successfully predicts changes in fleet size.

Ward, John M. (1990). "Reduction in Shrimp Bycatch: Effort/Stock Responses Based on the Elasticity of Demand," NOAA Technical Memorandum NMFS-SEFC-274, October, 1990.

The economic implications of adopting a bycatch reduction device in a fishery that discards a fish species that is the focus of a directed commercial fishery when demand is relatively elastic and inelastic are discussed. The stock of the bycatch species collapses when the bycatch reduction device increases the supply of fish in the directed fishery. This outcome is dependent on the assumptions of the model that link fishing effort levels in the two directed commercial fisheries.

Ward, John M. (1993). "The Bioeconomic Implications of A Bycatch Reduction Device as a Stock Conservation Management Measure." Draft report submitted to the Journal of Marine Resource Economics.

The proposed regulation to reduce bycatch and discarding of finfish in the southeastern region is a gear modification that excludes finfish from shrimp trawls. This regulation is analyzed using a simple theoretical model of a multispecies fishery whose bycatch is harvested in a directed fishery consisting of commercial and recreational fishermen. The costless reduction in bycatch fishing mortality imposed on the multispecies fishery does not result in an increased stock size for the bycatch fish species or a substantial increase in its level of harvest. Instead, the fish stock is reallocated from the multispecies fishery to the fishery directed at the bycatch species causing fishing effort to expand in the bycatch species fishery that

drives the stock size down to the previously existing equilibrium level. Recreational harvest and effort levels remain unchanged since the model is linear in effort and the commercial fishery is given access to the fishery first.

Ward, John M. (1994). "The Bioeconomic Implications of A Bycatch Reduction Device as a Stock Conservation Management Measure." Marine Resource Economics, 9(3):227-240.

The proposed regulation to reduce bycatch and discarding of finfish in the southeastern region is a gear modification that excludes finfish from shrimp trawls. This regulation is analyzed using a simple theoretical model of a multispecies fishery whose bycatch is harvested in a directed fishery consisting of commercial and recreational fishermen. The costless reduction in bycatch fishing mortality imposed on the multispecies fishery does not result in an increased stock size for the bycatch fish species or a substantial increase in its level of harvest. Instead, the fish stock is reallocated from the multispecies fishery to the fishery directed at the bycatch species causing fishing effort to expand in the bycatch species fishery that drives the stock size down to the previously existing equilibrium level. Recreational harvest and effort levels remain unchanged since the model is linear in effort and the commercial fishery is given access to the fishery first.

Ward, John M. (1994). "The South Atlantic Shrimp Stock Assessment and Fisheries Evaluation Report; 1994 Update." National Marine Fisheries Service, Southeast Regional Office, 9450 Koger Boulevard, St. Petersburg, FL, February.

An update of the south Atlantic shrimp SAFE report that includes an ex-vessel price analysis to determine if seasonal closures would enhance the economic return to the fishery and an annotated bibliography of biological, economic, and sociological research related to the shrimp fishery.

Ward, John M. (1994). "Economic analysis of Finfish Bycatch in the Gulf of Mexico Shrimp Fishery." MARFIN Cooperative Agreement Number 92NMFS11, Division of Economics and Trade Analysis, Southeast Regional Office, National Marine Fisheries Service, St. Petersburg, FL, July.

A primary data collection effort was contracted for using MARFIN funds. A request for proposals was prepared and Resource Economics Consultants were selected to interview and collect costs, returns, and bycatch information from a sample of shrimp fishermen in the Gulf of Mexico. Data was collected for the three most current years of vessel operation in the Gulf of Mexico shrimp fishery and combined with historic data from other sources. Preliminary data was analyzed to ensure that accurate information was collected and data entry errors were minimized. This information was then used to estimate a vessel operating cost model. This approach permits the estimation of costs and returns for individual vessels in the Gulf of Mexico shrimp fishery. Estimates of costs, revenues, and net revenues have been prepared and are presented in the Stock Assessment and Fishery Evaluation Report for the Gulf of Mexico Shrimp Fishery, 1994 Update (SAFE). The SAFE report also provides a discussion of the impacts of proposed fishery management regulations to reduce finfish bycatch in the shrimp fishery. The final contract report by Resource Economics Consultants is attached.

Ward, John M. (1995). "Cost and Revenues in the Gulf of Mexico Shrimp Fishery." Draft report, National Marine Fisheries Service, Southeast Regional Office, Economics and Trade Analysis Division, 9721 Executive Center Drive, North, St. Petersburg, FL

While cost and revenue data is not routinely collected in the southeastern region of the United States, many specialized data collection efforts have been funded by Sea Grant, Salstonstall/Kennedy grants, and Marine Fisheries Initiative cooperative agreements to collect data concerning the financial viability of

the shrimp fishery in the Gulf of Mexico. This study describes new data collection efforts in the Gulf of Mexico and presents a statistical analysis of a data set that combines the newly collected data with historical data sets provided by the authors of existing studies. The statistical analysis suggests that home port and hull construction material do not directly affect the total costs of operating in the shrimp fishery. The resulting statistical model allows the estimation of total operating costs for vessels operating in the Gulf of Mexico shrimp fishery so that the impacts of proposed fishery management regulations can be determined for cost-benefit analysis.

Ward, John M. and Wade L. Griffin (1994). "Transferable Limited License Market Model." Notes, National Marine Fisheries Service, Southeast Regional Office, 9721 Executive Center Drive, North, St. Petersburg, FL.

     Simple model of a market for transferable licenses to determine license prices and their impact on fishing effort levels. Capital stuffing in a fishery with transferable licenses can be determined.

Ward, John M. and Seth Macinko (1993). "Using Theory: Rethinking Fisheries Bycatch Problems." Presented at the International Conference on Fisheries Economics, Os, Norway, May 26-28.

     A dynamic bioeconomic model that incorporates a commercial and recreational fishery for a species of fish that is discarded in another directed commercial fishery is developed and used to determine the economic implications of a bycatch reduction device in a common property fishery.

Ward, John M. and James M. Nance (1994). "1994 Update to the Stock Assessment and Fishery Evaluation (SAFE) Report for the Gulf of Mexico Shrimp Fishery." National Marine Fisheries Service, Southeast Regional Office, 9721 Executive Drive, North, St. Petersburg, FL.

     A comprehensive review of the available economic and biological data for the Gulf of Mexico shrimp fishery. Trends in vessel level operating costs, total revenue, landings, and net revenue are provided over time. Net revenue per vessel is declining with the increase in operating costs and the decline in ex-vessel prices.

Ward, John M. and John R. Poffenberger (1982). "Survey of Ice Plants in Louisiana, Mississippi, and Alabama, 1980-81." Marine Fisheries Review, 44(9-10):55-57.

     This report presents the findings of the 1980-81 survey of ice plants in the coastal areas of Louisiana, Mississippi, and Alabama. The survey was undertaken by the National Marine Fisheries Service's Southeast Fisheries Center to determine the impact of the Texas Closure regulation on the level of ice sales in this region. The 1980 survey was limited to Louisiana ice plants during the 13 week period of the spring brown shrimp season. The 1981 survey of Louisiana, Mississippi, and Alabama ice plants covered an 18 week period. The two surveys were compared using the 13 week period of the 1980 Louisiana survey. Results of the analysis indicate that weekly ice sales did not exceed productive and storage capacity in either year despite both the increased shrimp landings and the Texas closure regulation in 1981.

Ward, John M. and Jon G. Sutinen (1992). "Modeling Vessel Mobility: The Gulf of Mexico Shrimp Fleet." NOAA Technical Report, National Marine Laboratory, F/AKC3, National Marine Fisheries Service, NOAA, 7600 Sand Point Way, N.E., Seattle, WA 98115-0070.

     Given the heterogeneous nature of the fishing fleet and the complex behavior of vessels, the traditional marginalist supply models are not well suited for modeling vessel mobility. A discrete choice model is utilized in this analysis to predict the probability that a vessel will enter, exit, or remain in the Gulf

of Mexico shrimp fishery based on a myopic profit maximization criteria. The multinomial logit model indicates that stock variability does not influence fisherman behavior in the Gulf of Mexico shrimp fishery. The crowding externality, represented by the size of the fishing fleet, exhibits a strong negative impact on the probability of entry by fishing vessels independent of changes in abundance, ex-vessel prices, or harvesting costs. Lastly, the Gulf of Mexico shrimp fishery is not the autonomous system of fishing vessels as was initially believed.

Ward, John M. and Jon G. Sutinen (1992). "Modeling Vessel Entry Exit Behavior in the Gulf of Mexico Shrimp Fishery." Draft report submitted to the <u>American Journal of Agricultural Economics</u>.

Given the heterogeneous nature of the fishing fleet and the complex behavior of vessels, the traditional marginalist supply models are not well suited for modeling vessel mobility. A discrete choice model is utilized in this analysis to predict the probability that a vessel will enter, exit, or remain in the Gulf of Mexico shrimp fishery based on a myopic profit maximization criteria. The multinomial logit model indicates that stock variability does not influence fisherman behavior in the Gulf of Mexico shrimp fishery. The crowding externality, represented by the size of the fishing fleet, exhibits a strong negative impact on the probability of entry by fishing vessels independent of changes in abundance, ex-vessel prices, or harvesting costs. Lastly, the Gulf of Mexico shrimp fishery is not the autonomous system of fishing vessels as was initially believed.

Ward, John M. and Jon G. Sutinen (1994). "Vessel Entry-Exit Behavior in the Gulf of Mexico Shrimp Fishery." <u>American Journal of Agricultural Economics,</u> 76(4):916-923.

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Ward, John M., Wade L. Griffin, and Teofilo Ozuna (1995). "Cost and Revenues in the Gulf of Mexico Shrimp Fishery." Draft report, National Marine Fisheries Service, Southeast Regional Office, Economics and Trade Analysis Division, 9721 Executive Center Drive, North, St. Petersburg, FL

While cost and revenue data is not routinely collected in the southeastern region of the United States, many specialized data collection efforts have been funded by Sea Grant, Salstonstall/Kennedy grants, and Marine Fisheries Initiative cooperative agreements to collect data concerning the financial viability of the shrimp fishery in the Gulf of Mexico. This study describes new data collection efforts in the Gulf of Mexico and presents a statistical analysis of a data set that combines the newly collected data with historical data sets provided by the authors of existing studies. The statistical analysis suggests that home port and hull construction material do not directly affect the total costs of operating in the shrimp fishery. The resulting statistical model allows the estimation of total operating costs for vessels operating in the Gulf of Mexico shrimp fishery so that the impacts of proposed fishery management regulations can be determined for cost-benefit analysis.

Ward, John M., Teofilo Ozunna, and Wade Griffin (1995). "Cost and Revenues in the Gulf of Mexico Shrimp Fishery." NOAA Technical Memorandum NMFS-SEFSC-???, National Marine Fisheries Service, Southeast Regional Office, Economics and Trade Analysis Division, 9721 Executive Center Drive, North, St. Petersburg, FL

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Wardlaw, N.J. and Wade L. Griffin (1974). "Economic Analysis of Costs and Returns for Gulf of Mexico Shrimp Vessels: 1973." Departmental Technical Report No. 74-3, Texas Agricultural Experiment Station, Texas A&M University, College Station, Texas, December, 43 pp.

A budget generating computer program was established to assimilate and report the data according to the desired vessel classifications, interest rate, percent financed, number of years financed, number of loan payments per year, depreciation method, crew share agreement, rate of packing charges, payroll tax rate, discount rate, planning horizon, and object year under consideration. The program reported results in the form of total costs and returns budgets, unit costs and returns budgets, and projected cash flow budgets.

Warren, Brad (ed.) (1994). Win-Win Bycatch Solutions. National Fisheries Conservation Center, Seattle WA.

The unintentional capture of nontarget organisms has become a critical issue in world fisheries. Our aim is to provide models, strategies, and information to help stakeholders in the fisheries join forces to fashion their own bycatch solutions. The problems faced are complex enough to require a broadly inclusive approach.

Warren, John P. and Wade L. Griffin (1978). "Costs and Returns Trends for Gulf of Mexico Shrimp Vessels." DIR 78-1, SP-4, Department of Agricultural Economics, Texas A&M University, College Station, Texas, September, 20 pp.

The profitability of Gulf shrimp vessels in recent years has been highly variable, due largely to changes in input costs, shrimp prices, landings, and the cost, financing terms, and configuration of vessels. Ownership of a Gulf shrimp vessel can be a satisfactory investment given the variation in landings over an extended period of time.

Warren, John P. and Wade L. Griffin (1980). "Costs and Returns Trends in the Gulf of Mexico Shrimp Industry, 1971-78." Marine Fisheries Review, (February): 1-7.

This report describes the magnitude and past performance of the Gulf of Mexico shrimp industry, the recent performance of an "average" Gulf shrimp vessel in terms of costs, returns, and basic investment analysis, summarizes data and analyses and, finally, discusses implications.

Warren, John P., Wade L. Griffin, and Ronald D. Lacewell (1974). "Applying An Index of Fishing Effort to Estimate 1971 Costs and Returns for Gulf of Mexico Shrimp Vessels." TAMU-SG-74-217, Department of Agricultural Economics, Texas Agricultural Experiment Station, Texas A&M University, February, 11 pp.

Shrimp vessels operating in the Gulf of Mexico are heterogeneous with respect to physical characteristics. In this study, the investigators developed a more effective and useful method of classifying vessels for costs and returns analysis by the introduction of an index of fishing effort. This effort index is defined as the fishing power of any given vessel relative to the fishing power of a base or standard vessel. The results indicate that the use of an effort index to establish relatively homogeneous groups of vessels for costs and returns studies, that are needed by the industry and by agencies responsible for management of the resource, constitutes an improvement over use of a classification based on a single criterion such as length only.

Waters, James (1982). "Review of the 1982 Shrimp Fishery Along the South Atlantic Coast." Draft report, National Marine Fisheries Service, Southeast Fisheries Center, Miami Laboratory, Miami, FL 33149, March, 21 pp.

This report summarizes available information about the 1982 shrimp fishery along the south Atlantic coast. Four aspects of the fishery are discussed in relation to historical trends: (1) ex-vessel value received by commercial shrimpers, (2) landings, (3) productivity of commercial vessels and (4) profitability. Overall, 1982 was a good year for commercial shrimpers in the south Atlantic, and the relatively mild winter of 1982-83 suggests that 1983 will be a good year as well.

Waters, James (1986). "Estimation of Production Functions for Shrimping Trips in Inshore Waters." Draft report, National Marine Fisheries Service, Southeast Regional Office, Beaufort Laboratory, Beaufort, North Carolina.

A production function describes the relationship between inputs and outputs. The concept of a production function could be used to describe the technology of the fishing firm or the technology of the entire industry. Empirical applications of fishery production functions usually have estimated either an industry wide production function or an annual production function for a representative vessel. For example, Griffin et al. (1976) estimated an annual industry production function for the shrimp fishery in the Gulf of Mexico. This study uses data from the inshore shrimp fisheries in Galveston Bay and Calcasieu Lake to estimate catch per trip as a function of fishing effort and some measure of population abundance or biomass as inputs. Doll (1988) discusses the fishery production function and its underlying assumptions.

Waters, James R. and James M. Nance (1989). "Production Functions for Shrimping Trips in Inshore Waters." Draft report, NOAA, NMFS, SEFC Beaufort Laboratory, Beaufort, NC 28516 and Galveston Laboratory, Galveston TX 77551, May, 34 pp.

Personnel at the NMFS Laboratory at Galveston, Texas, interviewed fishermen at dockside to collect economic information about fishing activities in two major estuaries of the Gulf of Mexico: Galveston Bay, Texas, and Calcasieu Lake, Louisiana. Interviews were conducted between May 20 and October 30, 1987. This study estimated production functions for trips with bay licenses in Galveston Bay and for trips with shrimp trawls in Calcasieu Lake. In one specification, catch per trip was estimated as a function of hours fished, trawl width, vessel length and time as a proxy for the unknown shrimp biomass. Another specification estimated catch per trip as a function of the number of tows per trip, average duration of each tow, trawl width, vessel length and time. These functions could be used in future analyses of the proposal to require fishermen to limit their tow times to 90 minutes or less. Data collection techniques (data collected exclusively between the hours of 8:00 am and 5:00 pm) allegedly biased the data set and may have led to erroneous results.

Waters, James R. and James M. Nance (1990). "A Description of Trip Data Collected from the 1987 Inshore Shrimp Fishery of Galveston Bay, Texas." NOAA, Technical memorandum NMFS-SEFC-257, 63 pp.

Economic information about inshore shrimping trips in Galveston Bay, Texas was collected from fishermen at dockside between May 20 and October 30, 1987. This study presents information about fishing effort, operating costs, landings and revenues per trip for trips with bay and bait licenses in Galveston Bay.

Waters, Jim and Jon Platt (1990). "Economic Analyses of Alternative Management Options for the Red Snapper Fishery in the Gulf of Mexico." Report prepared for the Gulf of Mexico Fishery Management Council by National Marine Fisheries Service, Southeast Regional Office, 9450 Koger Boulevard, St. Petersburg, FL 33702.

Biological investigations have determined that the red snapper (Lutianus campechanus) resource in the Gulf of Mexico has been significantly overfished and that regulations implemented in 1990 and earlier years will not restore the red snapper population to desired levels (Goodyear and Phares, 1990). This report describes economic implications of management alternatives to govern the directed commercial and recreational reef fish fisheries and to reduce the incidental catch and discard of juvenile red snappers and other species by the shrimp trawl fishery. Economic effects of various management alternatives on the commercial and recreational red snapper fisheries were based on projections of future landings made with a simulation model developed by Goodyear (1989). Economic effects of management alternatives on the commercial shrimp fishery were based on the results of a simulation model described by Griffin et al. (1990). This report was reviewed by a panel of economists that met at council headquarters on June 5-6, 1990.

Waters, James R., Leon E. Danielson, and J.E. Easley, Jr. (1978). "Economic Evaluation of the Shrimp Discard Problem in Pamlico Sound, North Carolina." Contribution Paper, AAEA Annual Meeting, VPI and SU, August, 12 pp.

In North Carolina, commercially undersized pink shrimp are incidentally landed, killed, and discarded during harvest of brown shrimp. This study analyzed the incidental catch (discard) problem and management policies to protect pink shrimp. Results showed incidental catch does not generally reduce fishermen's income sufficiently to adopt a discard abatement policy.

Waters, James R., Leon E. Danielson, and J.E. Easley, Jr. (1979). "An Economic Analysis of the Shrimp Discard Problem in Pamlico Sound." Economics Research Report No. 40, Department of Economics and Business, North Carolina State University, Raleigh, North Carolina, February, 47 pp.

The North Carolina shrimp catch is composed of three different species, brown (Penaeus aztecus), pink (P. duorarum), and white (P. setiferus). Brown shrimp mature and are harvested in the fall. During this same period the pink shrimp are primarily in juvenile stages and are below commercial size. However, because they utilize the same areas, pink shrimp are caught incidentally while harvesting brown shrimp and are killed. Hence they are lost to the fishery and represent foregone future earnings to the fishery since they would otherwise have reached commercial size in late fall and spring. This incidental (or discard) catch problem is analyzed to ascertain whether alternative shrimp management policies should be instituted that would reduce the extent of the discard problem. The basis for evaluating the policies was whether or not net income to the fishery increased. Because of the lack of required data, the analysis was primarily a sensitivity analysis on the parameters involved. Results showed that the potential for increasing income to the fishery through reduced discard exists only at high discard rates. This is primarily due to high natural mortality and the low probability of catching those pink shrimp that are save from being discarded.

Waters, James R., J.E. Easley, Jr., and Leon E. Danielson (1980). "Economic Trade-Offs and the North Carolina Shrimp Fishery." American Journal of Agricultural Economics, 62(1):124-129.

The purpose of this study is to analyze the incidental catch (or discard) problem to ascertain whether discard abatement policies should be instituted during August and September to protect juvenile pink shrimp. Interest is focused on whether or not the range of observed discard rates is sufficiently large to warrant protection. Because of the lack of required data, the study is primarily a simulation analysis.

Watson, John W. (1981). "Sea Turtle Excluder Trawl Project." Milestone Report, Division of Harvesting Systems and Surveys, Mississippi Laboratories, Southeast Fisheries Center, National Marine Fisheries Service.

This report presents the progress and status of the sea turtle excluder trawl development projects and describes the research objectives planned for FY81. Data are presented on comparative catch rates between two turtle excluder designs and standard shrimp trawls. Data are also presented on the effect of reduced tow time and resuscitation of comatose turtles on sea turtle mortality in shrimp trawls.

Watson, John W. (1983). "FY 1982 Project Report, Sea Turtle Excluder Trawl." Draft report, Division of Harvesting Systems and Surveys, Mississippi Laboratories, Southeast Fisheries Center, National Marine Fisheries Service.

The turtle excluder trawl project goal for FY 1982 was to encourage and accelerate voluntary use of the TED technology in the southeastern shrimp fishery by documenting and demonstrating potential benefits to the shrimping industry. Potential benefits of TED technology include reduction of unwanted and troublesome bycatch organisms including finfish, decreases in trawl drag due to improved water flow resulting in fuel savings, and increases in shrimp catch rates and quality of shrimp catch.

Watson, John W. (1983). "FY 1983 Project Report, Sea Turtle Excluder Trawl." Draft report, Division of Harvesting Systems and Surveys, Mississippi Laboratories, Southeast Fisheries Center, National Marine Fisheries Service.

Research was completed on the energy aspects of the TED and a model study and field testing aboard a chartered shrimp vessel completed in November, 1982. Lighter designs for TEDs were researched. Modifications to the TED resulted in finfish separation rates of as much as 53% during the day but only 10% or less at night.

Watson, John W. (1984). "Sea Turtle Excluder Trawl, FY 1984 Project Report." Draft report, Division of Harvesting Systems and Surveys, Mississippi Laboratories, Southeast Fisheries Center, National Marine Fisheries Service.

The TED project goal for FY 1984 was to encourage and accelerate voluntary use of the TED technology in the southeastern shrimp fishery by improving the handling and operational characteristics of the TED and improve and demonstrate the finfish reduction potential of the TED during both nocturnal and diurnal periods.

Watson, John W., John F. Mitchell, and Arvind K. Shah (1985). "Trawling Efficiency Device: A New Concept for Selective Shrimp Trawling Gear." Draft report, National Marine Fisheries Service, Southeast Fisheries Center, Mississippi Laboratories, Pascagoula, MS.

The Trawl Efficiency Device (TED) is inserted between the body and cod end of a shrimp trawl. A steel grid and trap door ejects unwanted shrimp bycatch such as turtles, sharks, rays, jellyfish, crabs, sponge, etc. The TED also can be used to reduce finfish bycatch by employing a finfish deflector grid, leading panels, and exit openings. The device eliminates finfish by taking advantage of the difference in swimming ability and behavior between finfish and shrimp. Shrimp are carried into the cod end by accelerating water flow through the device with a webbing funnel. Finfish are stimulated into an escape reaction by a finfish deflector grid and are guided to exit openings by leading panels. Finfish separation rates averaging 78 percent and 53 percent were achieved during day trawling and night trawling, respectively, with no significant difference in shrimp catch rates. Finfish separation rates varied by species and total separation varied as a function of catch composition. The TED is being introduced into the shrimp fishery in the southeastern United States to reduce incidental turtle captures, conserve finfish resources discarded by the shrimp fleet, and increase trawling efficiency.

Watson, John W., John F. Mitchell, and Arvind K. Shah (1986). "Trawling Efficiency Device: A New Concept for Selective Shrimp Trawling Gear." Marine Fisheries Review, 48(1):1-9.

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Watson, John W., Ian Workman, Dan Foster, Charles Taylor, Arvind K. Shah, James Barbour, and Dominy Hataway (1993). "Status Report on the Potential of Gear Modifications to Reduce Finfish Bycatch in Shrimp Trawls in the Southeastern United States, 1990-1992." NOAA Technical Memorandum NMFS-SEFSC-327, March, 131 pp.

This status report presents data from scuba diver evaluations and bycatch reduction/shrimp retention test results for prototype bycatch reduction device (BRD) designs. Fish bycatch and shrimp retention data are presented for 30 prototype BRD designs. Of these, 12 have demonstrated overall fish bycatch reduction rates between 43% and 67% and 7 had shrimp retention rates between 90% and 100%. Prototype designs that show the best potential for achieving a 50% reduction in total fish bycatch with better than 90% shrimp retention are the large mesh funnel design, the extended funnel design, the HSB design, and the fisheye design.

Watts, Noel H. and Gilmore J. Pellegrin, Jr. (1982). "Comparison of Shrimp and Finfish Catch Rates and Ratios for Texas and Louisiana." Marine Fisheries Review, 44(9-10):44-49.

A comparison was made between 1980 and 1981 commercial fishing to judge effects of the Texas closure on shrimp and finfish catches off Texas and Louisiana. Historical data (1973-78) for the two areas was used as baseline, and comparisons were made of finfish/shrimp catch ratios and species composition. Mean shrimp catch rates (heads-on) standardized to 100-foot trawls for Texas and Louisiana in 1980 were 42.56 pounds/hour and 42.53 pounds/hour, respectively, and in 1981 were 89.03 pounds/hour and 62.20

pounds/hour. Mean finfish catch rates for Texas and Louisiana in 1980 were 333.90 pounds/hour and 242.84 pounds/hour, respectively, and in 1981 were 156.19 pounds/hour and 408.88 pounds/hour. Average finfish/shrimp ratios for Texas were 12.94 in 1980 and 2.55 in 1981. For Louisiana, the average finfish/shrimp ratios were 22.15 in 1980 and 37.23 in 1981.

Differences between 1980 and 1981 shrimp catch rates off Texas and Louisiana, and between Texas and Louisiana in 1981, were significant at the 95 percent confidence level. Finfish catch rates off both states were significantly influenced by depth, with no significant differences found between years for either state when the effect of depth was removed. Species composition of the bycatch was removed. Species composition of the bycatch in waters 10 fathoms or less was relatively consistent regardless of state or year. The composition of bycatch from deeper waters was much more variable and significantly different from catches made in the shallower waters. Overall, the analyses supported a hypothesis of increased shrimp catch rates due to the Texas closure. Finfish catch rates and compositions, however, were not shown to change as a result of the closure. This latter conclusion assumes the distribution of fishing effort by depth zone was unaffected by the closure.

Weber, Michael (1989). "Presentation to the National Academy of Sciences' Committee on Sea Turtle Conservation." Center for Marine Conservation, Jekyll Island, Georgia, June 28, 14 pp.

A presentation to the National Academy of Science concerning sea turtle conservation efforts by the Center for Marine Conservation and the National Academy of Science's study of marine turtle mortality in shrimp otter trawls.

Weber, Michael, Deborah Crouse, Robert Irvin, and Suzanne Ludicello (1995). "Delay and Denial: A Political History of Sea Turtles and Shrimp Fishing." Center for Marine Conservation.

A management history of the turtle excluder device (TED) fishery management regulation. While accurately portraying events, causation is often confused and misguided. For example, the authors attempt to argue that fishery managers used short run economic criteria to justify not protecting sea turtle stocks which is in fact a ludicrous argument.

White, David R.M. (1990). "Sea Turtles and Resistance to TEDs Among Shrimp Fishermen of the U.S. Gulf Coast." Report, Environmental Affairs Division, Southern California Edison Company.

The National Marine Fisheries Service has issued regulations requiring southeast Atlantic and Gulf Coast shrimp fishermen to use Turtle Excluder Devices (TEDs) on their nets. Significant opposition has developed among Gulf Coast shrimpers. Ethnographic data, including observations of turtle capture and mortality, suggest reasons for resistance to the regulations.

Wigley, Roland L. (1973). "Fishery for Northern Shrimp, Pandalus borealis, in the Gulf of Maine." Marine Fisheries Review, 35(3-4):9-14.

A fishery for northern shrimp in the Gulf of Maine has grown rapidly during the last decade to become one of the most valuable fisheries in New England. American landings of this shrimp in the period 1962 to 1972 increased from 388,000 pounds to 24,295,000 pounds; correspondingly, value increased from $57,000 to $4,577,000. Trends in the total catch of northern shrimp in the past few years, plus decreased catch per unit effort during the past year, indicate the maximum utilization of this stock was attained in 1969. This paper briefly reviews the history and development of the fishery, landings, vessel types and gear, processing, and recent development in the fishery.

Willmann, R. and S. Garcia (1985). "Bioeconomic Model for the Analysis of Net Economic Benefits of Artisanal and Industrial Sequential Fisheries for Tropical Shrimp (Example of the Fisheries of Suriname). Draft report, 31 pp.

The paper presents the design and parameterization of a bioeconomic model for the analysis of net economic benefits of artisanal and industrial sequential fisheries for tropical shrimp. The model has been applied to the analysis of the artisanal and industrial shrimp fishery of Suriname. The main conclusions to be drawn from the simulation results are that an expansion of the artisanal dragnet fishery for juvenile penaeid shrimp in coastal swamps can have a strong negative impact on the industrial shrimp fishery and that Suriname's shrimp industry is overcapitalized.

Wilson, Robert R., Russell G. Thompson, and Richard W. Callen (1970). "Optimal Investment and Financial Strategies in Shrimp Fishing." TAMU-SG-71-701, Institute of Statistics, Texas A&M University, Dec.

In this study a deterministic optimal control model of a shrimp fishing firm (Thompson, Callen, and Wolken) is extended by requiring the purchase of integer (positive) numbers of vessels and is used in developing optimal investment strategies for shrimp fishermen.

Wolff, Maury (1972). "A Study of North Carolina Scrap Fishery." Special Scientific Report No. 20, Division of Commercial and Sports Fisheries, North Carolina Department of Natural and Economic Resources, March, 29 pp.

A total of 18,955 fish were tagged in an effort to obtain movement, growth, and mortality characteristics of young Atlantic croaker (Micropogon undulatus), Spot (Leiostomus xanthurus), and Weakfish (Cynoscion regalis). Samples were taken from trawler landed scrapfish. Sixty-three species of fish were identified. Spot, croaker, and weakfish comprised 48.2% by weight of the total scrap. Seventeen edible species totaled 71.0% of the trawler discard. Comparison of landings and discard samples indicated that nearly 100%, 65%, and 43% of landed spot, croaker, and weakfish, respectively, are discarded as scrap. Samples were collected to determine the ratio of discarded fish to shrimp and the species composition of the fish discard. Fifty-one species of fish were identified in the samples. Spot, croaker, and weakfish totaled 66.8% by weight of the discard. Fifteen edible species accounted for 84.2% of the discard. The overall fish/shrimp discard ratio expressed in pounds was determined to be 5.4:1. The ratio for night samples was 46:1, while that for day samples was 6.3:1. Samples of spot, croaker, and weakfish were retained during tagging operations for age analyses. Forty-one percent of all spot, 49% of all croaker, and 81% of all weakfish discarded as scrap were 0 age.

Workman, Ian and J. Watson (1991). "Shrimp Trawl Bycatch Reduction Annual Report." In 1991 Marfin Annual Report: Small Pelagics (Butterfish, Coastal Herrings and Associated Species), Shrimp Trawl Bycatch Reduction, Ted Technology Transfer, USDOC, NOAA, NMFS, SEFC, Mississippi Laboratories.

Report on the effectiveness of bycatch reduction devices in the Gulf of Mexico shrimp fishery.

Workman, Ian, John Watson, Dan Foster, Arvind Shah, Charles Taylor, and James Barbour (1994). "Status of Gear Modifications to Reduce Shrimp Trawl Finfish Bycatch in the Southeastern United States." 1993 Annual Report, National Marine Fisheries Service, Southeast Fisheries Science Center, Mississippi Laboratories, Pascagoula Facility, P.O. Drawer 1207, Pascagoula, MS, March.

A report on the fourth year of research into methods of reducing bycatch in the southeastern shrimp trawl fishery. Proof of concept bycatch reduction devices were found to reduce finfish bycatch rates between 43% and 67% with shrimp retention rates between 90% and 100%.

Young, Richard H. (1982). "Strategy for Shrimp By-Catch Utilization." FAO Fisheries Circular No. 745, Food and Agricultural Organization of the United Nations, Rome, March, 19 pp.

This paper summarizes conclusions based on field experience gained in various regions of the world on problems of bycatch utilization and on the recommendations emanating from the Technical Consultation on Shrimp Bycatch Utilization held in Georgetown, Guyana, 27-30 October 1981. In view of the considerable experience already gained, the paper proposes a strategy to promote a fuller use of shrimp bycatch and outlines the objectives and the structure of an initial two year coordinating project to achieve it.

Zein-Eldin, Zoula P. and Maurice L. Renaud (1986). "Inshore Environmental Effects on Brown Shrimp, Penaeus aztecus, and White Shrimp, P. setiferus, Populations in Coastal Waters, Particularly of Texas." Marine Fisheries Review, 48(3):9-19.

Our discussion compares and contrasts responses of the two species to single factors and their interactions, giving only limited literature citations. Implications for the two species are then explored. The purposes of this paper are to 1) provide, in an easily accessed tabular format, representative information and literature sources relating environmental factors to several inshore life stages of brown and white shrimp and 2) bring attention to those factors, their interactions, and life stages for which information is lacking.

Zimmerman, Roger (1993). "A Forecast for the 1993 Brown Shrimping Season in the Western Gulf of Mexico, from the Mississippi River to the U.S.-Mexico Border." Southeast Fisheries Science Center, Galveston Laboratory, 4700 Avenue U, Galveston, Texas, June, 2 pp., 7 tables.

The 1993 indices of postlarval and juvenile shrimp abundance indicate a below average brown shrimp harvest off both Texas and Louisiana for the July 1993-June 1994 season.