FISHERY MANAGEMENT PLAN

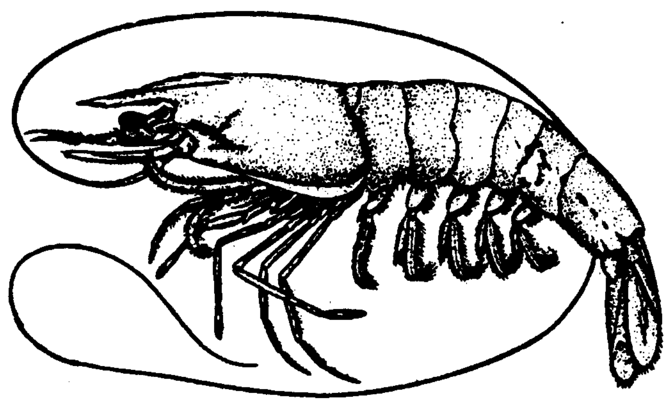
FOR THE

SHRIMP FISHERY

OF THE

SOUTH ATLANTIC REGION

INCLUDING A
FINAL ENVIRONMENTAL IMPACT STATEMENT
AND REGULATORY IMPACT REVIEW



JUNE 1993

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prepared by the
South Atlantic Fishery Management Council

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1.0 PREFACE

This document contains all elements of the Fishery Management Plan (FMP), Final Environmental Impact Statement (FEIS) and Regulatory Impact Review (RIR). The FMP is based on the detailed scientific, technical, and other supportive documentation contained in the Profile of the Penaeid Shrimp Fishery which also serves as the Source Document. Information from the profile is updated, where necessary, in the FMP. The numbering system in both the Profile and FMP are essentially the same in Section 5.0 through 11.0. The FMP and Profile are available for review at the following locations:

South Atlantic Fishery Management Council
1 Southpark Circle, Suite 306
Charleston, South Carolina 29407-4699

National Marine Fisheries Service
Southeast Regional Office
Duval Building
9450 Koger Boulevard
St. Petersburg, Florida 33702

National Marine Fisheries Service
Southeast Fisheries Center
75 Virginia Beach Drive
Miami, Florida 33149

National Marine Fisheries Service
1335 East west Highway
Silver Spring, Maryland 20910

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3.0 SUMMARY

Background. The management program proposed by this plan is designed to benefit white shrimp, one of five species in the fishery. The white shrimp population is periodically decimated by severe winter cold kills. Following these events, continued fishing on the few remaining adults may affect recruitment and reduce the more valuable fall production. Although affected states generally take emergency action to close their waters following such kills, the effectiveness and enforceability of the closures are compromised by lack of concurrent closure of adjacent Federal waters. Management measures proposed by this plan would allow the states to request implementation of concurrent Federal closures following cold kills.

Fishery Status. The commercial species of *Penaeus* shrimp in the South Atlantic region are believed to be fully utilized. Shrimp are a highly fecund, annual crop not believed susceptible to overfishing with current fishing technology. Population size is believed to be related to environmental conditions rather than fishing. However, the white shrimp population is occasionally decimated by severe winter weather, following which subsequent recruitment appears to be related to the adult population size. Continued fishing on the few remaining adults is believed to reduce subsequent fall recruitment.

Management Unit. The management unit is the population of white shrimp occurring along the U.S. Atlantic coast from the east coast of Florida to the North Carolina/Virginia border. Brown, pink, rock, and royal red shrimp are included in the fishery but not in the management unit because regulations in this plan only address white shrimp at this time. Although all three species of penaeid shrimp are also harvested in the Gulf of Mexico, it is believed that the Atlantic and Gulf populations are essentially isolated from one another.

Optimum Yield. Optimum yield for the white shrimp fishery is defined as the amount of harvest that can be taken by U.S. fishermen without reducing the spawning stock below the level necessary to ensure adequate reproduction.

Definition of Overfishing. Overfishing is indicated when the overwintering white shrimp population within a state's waters declines by 80 percent or more following severe winter weather resulting in prolonged cold water temperatures. Continued fishing following such a decline may reduce the reproductive capacity of the stock affecting subsequent recruitment and would be considered overfishing. Relative population abundance will be determined by catch per unit effort (CPUE) during standardized assessment sampling.

Problems in the Fishery Addressed by this Plan. The major problems in the fishery identified by this management plan are:

1. Unregulated commercial fishing in the EEZ on overwintering white shrimp following severe winter cold kills may reduce subsequent recruitment and fall shrimp production.

2. Shrimp trawls have a significant bycatch of nontarget finfish and invertebrates, most of which are discarded dead. This is wasteful and may significantly reduce yield in other fisheries directed at these discard species. In addition, shrimp trawls have a bycatch of endangered, threatened, and/or protected species (e.g., leatherback turtles) that are too large to be excluded by TEDs.

3. Shrimp mariculture operations may inadvertently release exotic species and/or diseases or parasites into local waters. The impact of such releases on domestic shrimp stocks is unknown, but potentially serious.

4. Habitat alteration (including beach renourishment and dredge and fill projects) and pollution in coastal areas may reduce shrimp production.

Management Objectives. The following objectives address the above problems:

1. Eliminate fishing mortality on overwintering white shrimp following severe winter cold kills.

2. Reduce the bycatch of non-target finfish, invertebrates and threatened, protected and endangered species.

3. Encourage states with mariculture facilities to carefully monitor these operations, and require safeguards to prevent exotic species from escaping and/or diseases from entering the environment.

4. Reduce or eliminate loss and/or alteration of the habitat on which shrimp depend or degradation of water quality through pollution that would reduce shrimp production.

Management Measures.

1. States may request concurrent closure of the EEZ adjacent to their closed state waters following severe winter cold weather that results in an 80 percent or greater reduction in the population of overwintering white shrimp.

a. Exempt royal red and rock shrimp fisheries from any closures of the EEZ for the harvest of white shrimp.

b. Exempt the whiting fishery (*Menticirrhus* sp.) from a closure for white shrimp.

2. Establish a buffer zone extending seaward from shore 25 nautical miles, inside of which no trawling would be allowed with a net having less than 4 inch stretch mesh during an EEZ closure. Vessels trawling inside this buffer zone could not have a shrimp net aboard (i.e., a net with less

than 4 inch stretch mesh) in the closed portion of the EEZ. Transit of the closed EEZ with less than 4 inch stretch mesh aboard while in possession of *Penaeus* species will be allowed provided that the nets are in an unfishable condition which is defined as stowed below deck.

Recommendations to the States. The council requests that the states in the south Atlantic region adopt the following recommendations:

1. The Council requests that states having shrimp mariculture facilities, either research or commercial, institute strict controls and guidelines to minimize the possibility of inadvertently introducing either exotic shrimp species or diseases into the environment. The Council further recommends that states comply with Amendment 1 to the Atlantic States Marine Fisheries Commission's (ASMFC) Procedural Plan to Control Interjurisdictional Transfers and Introductions of Shellfish.

2. The Council recommends that states minimize or eliminate alteration of shrimp habitat, especially the fragile and highly productive salt marsh and estuarine areas. These areas are considered critical habitat for all species of penaeid shrimp addressed by this FMP.

Research Recommendations.

1. Determine the possible impacts on indigenous shrimp species of inadvertent introductions of exotic shrimp species and diseases from mariculture operations, and develop methods and protocol to prevent such introductions.
2. Assess the potential utility of releasing maricultured white shrimp into the environment to supplement natural reproduction, especially following cold kills.
3. Assess the potential of controlled closures and other measures to enhance the production and economics of the south Atlantic shrimp fishery.
4. Determine the effects of beach renourishment projects on subsequent shrimp production.
5. Evaluate the impacts of habitat and water quality alteration on shrimp growth, survival, and productivity.
6. Investigate the costs, benefits, and utility of limited entry programs in the shrimp fishery of the south Atlantic.
7. Determine the impact of shrimp trawl bycatch on the habitat and all nontarget species of fish and invertebrates (i.e., expand the congressionally mandated study to include impacts on habitat and all incidental species, not just the impact on other "fishery resources").
8. Determine the relationship between absolute number of adults (or adult biomass) and subsequent recruitment to allow development of a threshold level of population size to serve as a trigger to request a closure of the EEZ.
9. Determine the biological, economic, and sociological status of the rock shrimp fishery.

Summary of Impacts

The aggregate economic impacts on shrimp harvesters of proposed concurrent closures of Federal waters following freeze winters are conceptually the difference between what fishermen give up in terms of spring shrimp revenues and what they gain from fall shrimp revenues. Available evidence suggests that concurrent closures during freeze years may bring about landings for that year that are characteristic of normal years rather than freeze years. If concurrent closures do bring this intended result, then the potential net increase in south Atlantic white shrimp catch from a concurrent closure involves an average increase of approximately 6.8 million lb and a potentially large increase in annual white shrimp revenue compared to what revenues would have been without the closure. These potential catch and revenue increases are supported by statistical inferences about the difference between catch in an average freeze year and catch in an average non-freeze year and the potential ability of a closure to bring about a catch representative of a normal year. The magnitude of net landings and revenues far exceeds catch and revenues sacrificed during closures.

The negative economic impacts of proposed concurrent closures are that EEZ closures will force shrimpers who normally count on revenues from white shrimp in the spring months in EEZ waters to seek alternative sources of revenue during closure years. An estimated range for these catch and revenue disruptions from an EEZ closure is a high of 181,797 lb and a low of 44,577 lb and in terms of revenues a high of $759,973 to a low of $577, 911. This range is thought to be an upper bound for impacts because it is assumed that a closure would be enacted for all south Atlantic states which is unlikely at this point. Another mitigating factor is that although catch patterns are certainly disrupted by an EEZ closure, at least some of the overwintering white shrimp that cannot be legally taken during an EEZ closure will be available to shrimpers when the closure ends. Estimated cumulative natural mortalities during that portion of the year range from 27 to 62% for a two month closure. Thus in a worst case scenario, only 62% of the catch and revenues described above would actually be lost to fishermen.

The disruptive effects of not being able to fish for a portion of the traditional fishing season cannot be minimized because fishermen are facing difficult economic conditions such as high costs for variable cost inputs and relatively low exvessel prices associated with high levels of shrimp imports in recent years. Available evidence suggests that some fishermen are barely surviving economically in the fishery. Fishermen who count on roe shrimping will still have to make boat mortgage and other payments despite the fact that they will not be able to fish for white shrimp during the closure.

The availability of alternative fishing opportunities during the spring months in freeze years will ultimately determine the degree of disruptive effects from concurrent closures. No studies to assess the profitability of alternative fishing opportunities for shrimp fishermen in the south Atlantic are available at this time. Potential candidates for affected fishermen are the shrimp fisheries in non-affected states such as the pink shrimp fishery in North Carolina, the white shrimp fishery in Florida, or the rock and royal red shrimp fisheries. Shrimpers have also been involved in fishing for whiting, wreckfish, and whelk when state waters have been closed in the past.

Provided closures bring about the anticipated increase in yields compared to no action, then from the point of view of total revenues fishermen are better off with closures. At the level of individual firms, however, this may not always prove to be correct. For instance, there may be some distributional effects that complicate this issue for fishing firms. The distribution of these increased revenues will, in fact, favor operations which traditionally catch more in the fall and will impact disproportionally operations with a comparative advantage to fish for roe shrimp in the spring. Adjustments in fishermen's strategies and modifications in gear and fishing practices, however, can be expected to decrease the actual degree that catch is redistributed.

Although under the closure scenario aggregate revenues will increase compared to no action, increases in net producer benefits are not expected from proposed closures. Access to the south Atlantic fishery for shrimp is not subject to any management controls and the fishery is highly overcapitalized. Lacking existing or new measures (no measures to control access are proposed in this fishery management plan), the inherently inefficient solution of too many vessels using too much capital to produce annual yields is not remedied by proposed revenue-enhancing measures in the plan. In this sense, the effect of the increased revenues compared to no action may be to prevent exit of marginal firms from the fishery. These firms may not have been able to continue fishing under reduced white shrimp abundance had a closure not been implemented following a freeze. Thus socio-economic disruptions resulting from egress from the fishery may be avoided with closures, but the inherent inefficiency of not having property rights in the fishery is not remedied by proposed measures.

Considering aggregate employment, concurrent closures will be beneficial to fishermen because they will probably stabilize annual employment associated with the white shrimp fishery instead of more variable shrimp abundance and landings without closures. Variability in abundance without closures is disruptive to employment of crew members and captains. Another benefit associated with concurrent closures is expected enforcement savings and greater compliance with state closures following freeze years.

NMFS, during informal review of this plan, concluded that the proposed action offers evidence that there will be no significant effect on small buisnesses.

The proposed action is not expected to; result in cumulative adverse effects that could have a substantial effect on the shrimp resource or any related stocks; affect adversely an endangered or threatened species or marine mammal population; have any substantial adverse impact on public health or safety; allow substantial damage to ocean and coastal habitats; or jeopardize the long-term productive capacity of any stocks that may be affected by the proposed action.

4.0 ENVIRONMENTAL IMPACT STATEMENT

( ) Draft (X) Final

Responsible Agencies

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Southeast Regional Office
Duval Building
9450 Koger Boulevard
St. Petersburg, Florida 33702
(813) 893-3141

Name of Action:

(X) Administrative ( ) Legislative

Abstract:

The proposed management program is designed to benefit the white shrimp (*Penaeus setiferus*) resource, one of five species in the fishery. White shrimp is the only species in the management unit. Other species in the fishery are brown shrimp (*P. aztecus*), pink shrimp (*P. duorarum*), rock shrimp (*Sicyonia brevirostris*), and royal red shrimp (*Hymenopenaeus robustus*). The principal problem addressed by the proposed management regime is that unregulated commercial fishing in the EEZ on overwintering white shrimp following severe winter cold kills may reduce subsequent recruitment and fall shrimp production. The white shrimp population in the south Atlantic region is periodically decimated by severe winter cold kills. Following these events, continued fishing on the few remaining adults may affect recruitment and reduce the more valuable fall production. Although the affected states (usually South Carolina and Georgia) generally take emergency action to close their waters following such kills, the effectiveness and enforceability of these closures is compromised by lack of concurrent closure of adjacent Federal waters. Management measures proposed by this plan would allow the states to request implementation of concurrent Federal closures when state waters are closed and standardized assessment sampling indicates that the overwintering white shrimp abundance has declined by 80 percent or more due to severe winter weather. This action will allow maximum protection of the remaining adult population. Other problems in the fishery are: there is a significant bycatch of nontarget finfish and invertebrates and a small bycatch of endangered, threatened, and/or protected species; there is a potential problem with the inadvertent release of exotic species and or diseases or parasites into local waters from shrimp mariculture operations; and there is a continuing threat to critical shrimp habitat from human activities including beach renourishment, dredge and fill projects and pollution of coastal waters.

Comments requested by: **September 13, 1993**

FINAL ENVIRONMENTAL IMPACT STATEMENT

This integrated document contains all elements of the Fishery Management Plan (FMP), Final Environmental Impact Statement (FEIS) and Regulatory Impact Review (RIR). The table of contents for the FEIS is provided separately to aid the reviewer in referencing corresponding sections of the FMP.

List of Preparers

The FMP, RIR and EIS were prepared by the South Atlantic Fishery Management Council. This document was prepared by the following Council staff :

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Assistance in preparation of the RIR was obtained from Dr. John M. Ward. Southeast Regional Office, NMFS.

The profile (source document) was prepared by :
Michael D. McKenzie, Editor, Project Coordinator
J. David Whitaker, Biology of the species and habitat descriptions
Charles M. Bearden, Fishery Management Jurisdiction, Laws and Policies

Dale L. Theiling, Description of Fishing Activities, Gear Types and Landings
David S. Liao, Economic Characteristics and Social/Cultural Framework
Raymond J. Rhodes, Economics and Description of Businesses and Markets
Emily S. Schroeder, Typing and Editorial Support
Karen Swanson, Graphics
Gregg T. Waugh, Project Officer
Susan Shipman, Technical Committee
Frank S. Kennedy, Technical Committee
Dennis Spitsbergen, Technical Committee

The Social Impact Assessment (SIA) was prepared by Patrick Stanforth on contract with East Carolina University.

List of Agencies and Organizations to Whom Copies of the Statement are Sent:

Atlantic Coast Conservation Association
Atlantic States Marine Fisheries Commission
U.S. Army Corps of Engineers
U.S. Department of Commerce
    Office of Coastal Zone Management
U.S. Department of the Interior
    Bureau of Land Management
    Fish and Wildlife Service
    National Park Service
U.S. Department of State
U.S. Department of Transportation
    Coast Guard
U.S. Environmental Protection Agency, Region IV
Center for Marine Conservation
Conservation Council of Angling Clubs
Regional Fishery Management Councils
Florida League of Anglers
Gulf & South Atlantic Fisheries Development Foundation
Marine Advisory Agents
Marine Mammal Commission
National Coalition for Marine Conservation
National Fisheries Institute
North Carolina Fisheries Association, Inc.
Organized Fishermen of Florida
South Carolina Aquaculture Association
South Carolina Shrimpers Association
South Carolina Recreational Shrimper's Association
Southeastern Fisheries Association
Sportfishing Institute
State Coastal Zone Management Agencies (North Carolina through Florida)
State Resource Agencies
    North Carolina
    South Carolina
    Georgia
    Florida
Florida Conservation Association

Draft Statement to EPA: March 31, 1993

Final Statement to EPA: August 5, 1993

5.0 DESCRIPTION OF THE STOCKS COMPRISING THE MANAGEMENT UNIT AND THE FISHERY

5.1 Description of The Species and their Distribution

5.1.1 Identity

Penaeid shrimp are distributed worldwide in tropical and temperate waters. In the southeastern United States, the shrimp industry is based almost entirely on three shallow-water species of the family Penaeidae: the white shrimp, *Penaeus setiferus*, the brown shrimp, *Penaeus aztecus*, and the pink shrimp, *Penaeus duorarum*. The rock shrimp, *Sicyonia brevirostris* (family Sicyoniidae), and the royal red shrimp, *Hymenopenaeus robustus* (family Solenoceridae) occur in deeper water than the three species of *Penaeus* and are of lesser importance to the fishery. Other common names for the white shrimp include gray shrimp, lake shrimp, green shrimp, green-tailed shrimp, blue tailed shrimp, rainbow shrimp, Daytona shrimp, common shrimp, and southern shrimp. The brown shrimp is also known as brownie, green lake shrimp, red shrimp, redtail shrimp, golden shrimp, native shrimp and also the summer shrimp in North Carolina. Other names for the pink shrimp include spotted shrimp, hopper, pink spotted shrimp, brown spotted shrimp, grooved shrimp, green shrimp, pink night shrimp, red shrimp, skipper, and pushed shrimp.

5.1.2 Morphology

All penaeid shrimp are similar in appearance (Figure 1). They are typically shrimp-like in appearance with a well developed and toothed rostrum which extends to, or beyond the distal edge of the eyes. There are ten periopods (walking legs) that are slender and relatively long. Five pairs of pleopods (swimming legs) are located on the ventral surface of the abdomen.

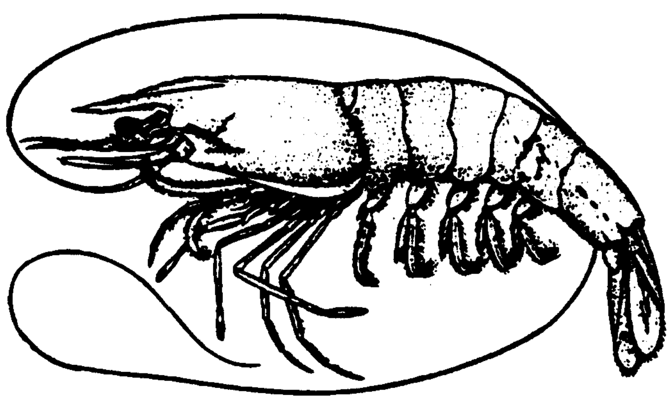

Figure 1. Generalized drawing of penaeid shrimp

The three species can be divided into non-grooved (white shrimp) and grooved shrimp (brown and pink). The grooves occur on the dorsal surface of the carapace on either side of the

Spawning

In Georgia and northern Florida, some white shrimp spawning may occur inshore, although most spawning occurs more than 1.2 miles from the coastline. Off Florida, spawning occasionally takes place inshore, at or near inlets, but most occurs offshore in depths of 6.1-24.4 m (20-80 ft). In South Carolina most spawning occurs within about four miles of the coast. Some shrimp with spermatophores attached have been found inside Charleston harbor (Whitaker, SCWMRD 1991, pers. comm.).

Spawning is correlated with bottom water temperatures and has been reported to occur at bottom temperatures of between 17° and 29° C although spawning generally occurs between 22° and 29° C. White shrimp begin spawning in April in Florida and Georgia and late April or May in South Carolina. Spawning may continue into September or October.

Brown shrimp spawn in relatively deep water. In the Gulf of Mexico, it was concluded that brown shrimp did not spawn in water less than 13.7 m (45 ft) and the greatest percentage of ripe females were at 45.7 m (150 ft). Spawning season for brown shrimp is uncertain, although there is an influx of postlarvae into the estuaries during February and March. Mature males and females have been found off South Carolina during October and November.

Pink shrimp apparently spawn between 3.7 and 15.8 m (12 and 52 ft). Off eastern Florida, peak spawning activity seems to occur during summer. In North Carolina, roe-bearing females are found as early as May, and by June most pink shrimp are sexually mature.

5.1.5.2 Larval and Postlarval Phases

All three species addressed by this plan have eleven larval stages (5 nauplier, 3 protozoan, and 3 mysid) before developing into postlarvae. Duration of the larval period is dependent on temperature, food, and habitat. Records suggest larval periods of 10-12 days for white shrimp, 11-17 days for brown shrimp, and 15-25 days for pink shrimp. Brown shrimp postlarvae appear to overwinter in offshore bottom sediments (Whitaker, SCWMRD, pers. comm. 1991)

Postlarval size ranges from approximately 2.9 to 12 mm (0.1-0.5 in)TL, with pink and white shrimp sizes overlapping and brown shrimp usually larger.

Movement of Postlarvae

The mechanism by which postlarvae are brought from distant spawning areas to inside estuaries is not well-known. Shoreward countercurrents north of Cape Canaveral have been suggested as the mechanism for transport of pink shrimp larvae from spawning areas to nursery areas along the northeast Florida coast. Movement of white shrimp postlarvae into the estuary is a result of nearshore tidal currents as white shrimp spawn relatively close to shore. There is some data on brown shrimp that suggests postlarvae may overwinter in offshore waters and migrate into estuaries the following spring. White and pink shrimp move into the estuary during late spring and early summer.

5.1.5.3 Juvenile and Adult Phases

After entering the estuaries, postlarval shrimp occupy nursery areas which offer abundant food, suitable substrate, and shelter from predators. In the south Atlantic these areas are generally dominated by the marsh grass *Spartina alterniflora*.

White and pink shrimp enter the estuaries at about the same time, usually beginning in April and early May in the southern part of their range and in June and July in North Carolina sounds, where white shrimp are uncommon. Large white shrimp begin emigrating out of the estuary to the commercial fishing areas in August and continue through December. Smaller white and pink shrimp may remain in the estuary during winter and are termed overwintering stocks.

In the south Atlantic, juvenile and adult brown shrimp are rarely affected by severe winter weather because most have been captured by fishermen or predators, and others have moved offshore prior to the onset of cold weather.

Pink shrimp bury deeply in the substrate with the onset of cold weather and thus are protected to some extent from winter mortalities. However, pink shrimp can be adversely affected by low temperatures as evidenced by the mass mortalities in North Carolina during the winters of 1976-77 and 1977-78.

Pink and white shrimp that survive the winter grow rapidly in late winter and early spring before migrating to the ocean. The migrating white shrimp, called roe shrimp, make up the spring fishery and also produce the summer and fall crops of shrimp. When a majority of white shrimp do not survive the winter, the North Carolina and South Carolina fisheries are believed to be dependent on a northward spring migration of white shrimp from more southerly areas to form the spawning stock. However, tagging data are inconclusive on the extent of this northward movement.

5.1.5.4 Growth Patterns

Rates of growth in penaeid shrimp are highly variable and depend on factors such as season, water temperature, shrimp density, salinity, size, and sex. Adolescent shrimp grow rapidly with estimates ranging from 1.0 - 2.3 mm per day for white shrimp, 0.5 - 2.5 mm per day for brown shrimp, and 0.25 - 1.7 mm per day for pink shrimp. Larger white shrimp may grow more than an inch per month. Published growth rates are shown in Table 1.

Salinity is also a factor determining growth rate in white shrimp. High salinities appear to inhibit growth. Density also affects growth of white shrimp. During years of low densities, the average size is generally larger.

Temperature also affects brown shrimp growth rates, with rates as high as 3.3 mm per day recorded when temperature exceeded 25° C but less than 1.0 mm per day when water temperature was below 20° C. Table 2 summarizes published growth rates for brown shrimp. Salinity also affects growth rates in brown shrimp. Salinities in excess of 10 ppt seems to enhance growth rate.

Pink shrimp in Florida Bay were found to grow 3.5 mm CL (carapace length) in winter and only 1.9 mm CL in spring. In North Carolina, maximum pink shrimp growth rates were recorded in summer.

5.1.5.5 Population Size, Distribution, and Movement Patterns

Shrimp of the genus *Penaeus* are an annual crop and as such have an ever changing size distribution. Once shrimp leave the nursery they migrate seaward with increasing size. They are almost always greater than 100 mm (3.9 in) when they emigrate, and continue to grow until they die.

After entering the estuary as postlarvae, growth is rapid. Prior to the onset of maturation, shrimp begin moving from the inshore habitat to higher salinity offshore waters.

White shrimp begin moving seaward through the summer and fall with a gradient of increasing size from fresh water to water of higher salinity. They begin entering the commercial catch in high salinity water at about 90 mm (3.5 in). In North Carolina, white shrimp begin entering the commercial fishery in July and continue to be caught through December. In Florida, white shrimp leave inshore waters at about 120 mm (4.7 in). Movement to offshore waters may be caused by cold, storms, high tides, and/or large influxes of fresh water, but size is the principal determinant. Peaks in movement offshore appear to be related to drops in water temperature.

Brown shrimp first enter the commercial fishery in North Carolina in June at about 100 mm. Movement of brown shrimp appears to take place primarily at night with peak movement at, or shortly after dusk.

Pink shrimp leave Florida estuaries two to six months after having arrived as postlarvae. In North Carolina, young pink shrimp enter the commercial catch in August. Shrimp that overwinter in estuaries migrate to sea in May and June, at which time spawning takes place. Recruitment to the area offshore of Cape Canaveral begins in April and May and again during October and November.

5.1.5.6 Length-Weight Relationships

Length-weight relationships for white, brown, and pink shrimp are shown in Table 3.

5.1.5.7 Mortality Rates

Mortality rates derived from several studies are shown in Table 4. Note that these are instantaneous weekly rates. Since shrimp are an annual crop, natural mortality rates are very high, and even without fishing, virtually the entire year class will be dead at the end of one year.

5.2 Abundance and Present Condition

5.2.1 Abundance

All three species of shrimp included in this FMP are essentially an annual crop. Population size is regulated by environmental conditions, and while fishing certainly reduces the population size over the course of the season, fishing is not believed to have any impact on subsequent year class strength unless the spawning stock has been reduced below a minimum threshold level by environmental conditions. Estimates of population size are not available but since the fishery is considered to be fished at near maximum levels, annual landings are probably a good indication of relative abundance. Annual variations in catch are presumed to be due to a combination of prevailing environmental conditions and fishing effort.

Annual landings of the three penaeid species and rock shrimp vary considerably from year to year (Table 5), as do the proportions of the four species. The contribution of each species to total landings varies in a relatively consistent pattern among the four southeastern states. In North Carolina, brown shrimp is the principal species while white shrimp are a minor component of the overall catch. In some years, pink shrimp are an important component of the catch. In South Carolina and Georgia, there are virtually no pink shrimp in the landings which are dominated by white shrimp. The relative contribution of brown shrimp to the catch varies yearly, but rarely exceeds the catch of white shrimp. In northeast Florida, some pink shrimp enter the catch, primarily as a bycatch of the rock shrimp fishery, but as in Georgia and South Carolina, white shrimp predominate. In recent years, landings of rock shrimp have become an increasing component of shrimp landings, particularly in Florida.

5.2.2 Present Condition

Shrimp production by species, state, and year is shown in Tables 6, 7, 8, and 9. Freeze years are noted on the tables. Years following freeze years generally show reduced landings. Mean catch for all three penaeid species for 1985-89 is 23.0 million lb. White shrimp landings have averaged 11.3 million lb for the same period. Rock shrimp has averaged 4.5 million lb for 1978-89, and 4.6 million lb for the last five year period.

Brown shrimp landings are unaffected by severe winter weather because juveniles are not in the estuary during this time of year. As can be seen in Table 7 and Appendix I catches following freeze years are not lower than following non-freeze years and in some cases they are higher.

Pink shrimp landings may also be affected by severe winter weather. The 1977 and 1978 pink shrimp landings, for example, were below normal because of the mass mortalities of overwintering pink shrimp resulting from the severe winters in North Carolina.

5.3 Ecological Relationships

5.3.1 Food

Juvenile and adult penaeids are omnivorous (eating both plants and animals) bottom feeders with most feeding activity occurring at night although daytime feeding may occur in turbid waters. Food items may consist of polychaetes, amphipods, nematodes, caridean shrimps, mysids, copepods, isopods, amphipods, ostracods, mollusks, foraminiferans, chironomid larvae, and various types of organic debris.

5.3.2 Substrate

White shrimp appear to prefer muddy or peaty bottoms rich in organic matter and decaying vegetation when in inshore waters. Offshore they are most abundant on soft muddy bottoms. Brown shrimp appear to prefer a similar bottom type and as adults may also be found in areas where the bottom consists of mud, sand, and shell. Pink shrimp are found most commonly on hard sand and calcareous shell bottom. Both pink and brown shrimp generally bury in the substrate during daylight, being active at night. White shrimp do not bury with the regularity of pink or brown shrimp.

5.3.3 Predation

Shrimp are preyed on by a wide variety of species at virtually all stages in their life history. Predation on post larvae has been observed by sheepshead minnows, water boatmen, and insect larvae. Grass shrimp, killifishes, and blue crabs prey on young penaeid shrimp, and a wide variety of finfish are known to prey heavily on juvenile and adult penaeid shrimp.

5.4 Maximum Sustainable Yield

Because the three principal species of shrimp dealt with by this plan are annual crops that fluctuate considerably from year to year depending primarily on environmental factors, maximum sustainable yield (MSY) is not a particularly useful concept. Although there is a good historical time series of catch data, the associated effort data is not considered adequate to calculate MSY. Nevertheless, mean total landings are considered to be a reasonable proxy for MSY. The harvest of shrimp in the region has fluctuated around a relatively flat plateau over a long time period during which time the fleet size and fishing power has increased tremendously. Thus, it appears that additional effort will not result in increased catch suggesting that the resource has been fully exploited for many years.

For management purposes, then, MSY is considered to be the mean total landings for the southeast region. In calculating total landings, an additional ten percent (an estimate made by state shrimp biologists) has been added to the commercial catch to account for recreational landings that are unreported. Since implementation of a shrimp baiting permit for recreational harvesting of white shrimp in South Carolina, recreational catch of white shrimp for this state can be accounted for, and it was unnecessary to add the ten percent. Using this methodology, MSY is estimated as follows:

White Shrimp: 14.5 million lb
Brown Shrimp: 9.2 million lb
Pink Shrimp: 1.8 million lb

5.5 Probable Future Condition

Shrimp stocks in the south Atlantic at present are near normal levels. Annual variations in white and pink shrimp stocks caused by severe winter weather continue to occur. Similar conditions existed periodically during the 1960s followed by several unusually warm years in the early 1970s. These warm years were marked by high shrimp production until the severe winter of 1976-77. Future white and pink shrimp production will continue to fluctuate with climatic conditions.

Brown shrimp stocks appear to be stable despite considerable inter-annual variation in abundance. Nevertheless, there is no reason to anticipate any major change in abundance. Annual production appears to be most influenced by late winter and early spring environmental conditions as has been observed in the Gulf of Mexico.

Because of high fecundity and migratory behavior, the three species are all capable of rebounding from a very low population size in one year to a large population size in the next, provided environmental conditions are favorable. Landings over the last thirty or forty years have remained stable while fishing pressure has increased dramatically (Figure 4). Fluctuations in abundance resulting from changes in environmental conditions will continue to occur. Perhaps the most serious potential threat to the stocks is loss of habitat due to pollution or physical alteration. Especially vulnerable and critical to shrimp production is the salt marsh (for white and brown shrimp) and inshore seagrass habitat (especially for pink shrimp) which comprise the nursery areas for juvenile shrimp.

During years when inshore overwintering white shrimp stocks are greatly reduced because of severe winter weather, management action may accelerate recovery of the stocks and increase fall production. Under these circumstances, closure of Federal waters off the south Atlantic would protect the few remaining spawners that survive a freeze. Also, elimination of winter and spring fishing mortality off southern Georgia and Florida may enable a greater quantity of potential spawners to move north, possibly resulting in larger regional white shrimp stocks the following fall. An offshore or deep estuarine water reserve of overwintering white shrimp may also contribute significantly to the spawning stock. In either case, while fishing does not by itself appear to be a factor in determining subsequent year class strength, in years when the overwintering adult population is significantly reduced due to severe winter weather, the additional mortality caused by fishing can result in a further reduction in subsequent fall production (Lam et al., 1989, Appendix II).

6.0 HABITAT AND ENVIRONMENTAL REQUIREMENTS

6.1 Habitat and Environmental Requirements

6.1.1 Habitat Description (Taken verbatim from SAFMC 1981)

"The three commercially important penaeid shrimp of the southeastern United States occupy similar habitats with the greatest differences being in optimal substrate and salinity. (See Section 5.1 and 5.3). Apparently all three species can tolerate a wide range of habitat conditions; however, there appear to be optimal conditions which result in the highest growth rates and greatest survival.

Shrimp have a life cycle which requires a variety of habitats. The habitats can basically be divided into offshore and inshore (see Section 5.1.5). The high salinity, oceanic waters serve as habitat for large mature shrimp which will spawn offshore. Brown and pink shrimp apparently move to relatively deep continental shelf water and white shrimp appear to remain nearshore in shallower water (see Section 5.1.4).

The relative abundance of the three shrimp species in the South Atlantic may be related to offshore bottom sediment composition. Kennedy and Barber (in press) suggest that spawning pink shrimp may be most abundant off Cape Canaveral and Cape Lookout because that species has an affinity for hard, coarse, and particularly calcareous bottom sediments which occur in those areas. They also note that the nearshore soft sediments correlate well with white and brown shrimp distribution from northern Florida to Pamlico Sound, North Carolina.

Offshore water also serves as habitat for larval and postlarval shrimp. These shrimp are planktonic and feed on zooplankton in the water column. There is some evidence that postlarval brown shrimp may overwinter in nearshore bottom sediments (Temple and Fischer, 1967). Aldrich et al. (1968) demonstrated that brown shrimp postlarvae buried in laboratory experiments when water temperature was reduced to 12°-16.5°C (54°-62°F). For their experiments, they used substrate material taken from Galveston Bay which was 75 percent clay, 22 percent silt and 3 percent sand.

The inshore phase of the life cycle is perhaps the most critical because most of the rapid growth occurs here. This critical habitat is dominated on the Atlantic coast by smooth cordgrass (Spartina alterniflora) and Juncus (in North Carolina's Pamlico Sound) which produce most of the primary production. Schelske and Odum (1961) stated that up to 10 tons of Spartina plant tissues are produced per acre per year. Turner (1977) found a direct relationship between commercial landings to absolute area and type of estuarine-intertidal vegetation. He suggested that the "...measurements of intertidal areas are relative indices of the amount of "edge" in an area and thus indirect measurement of the habitat."

Shrimp enter the inshore habitat as postlarvae and maintain a benthic existence. The areas where juveniles appear most abundant have a mud-silt substrate and intermediate salinities. Gunter et al. (1964) found that juvenile white shrimp were most abundant in waters of salinities less than 10 ppt in Alabama and Texas bays. Truesdale (1970) presented somewhat contradictory information. He concluded that salinity, per se, had no effect on postlarval distribution and abundance in Trinity Bay, Texas except during periods of high river discharge. Zein-Eldin and Aldrich (1965) and Zein-Eldin and Griffith (1970) found that salinity, per se, did not affect the growth of postlarval shrimp.

Apparently white shrimp have a great tolerance to low salinity than brown shrimp. Gunter (1961) attributes the predominance of white shrimp in Louisiana to the lower estuarine salinities. Conversely, brown shrimp dominate in the waters around the much drier Texas. Gunter points out that the connection between rainfall and Texas white shrimp production was dramatically illustrated in 1957 when a long drought was broken and landings jumped from 2,229,000 pounds in 1957 to 7,370,000 pounds in 1958. Parker (1970) reported brown shrimp in areas where bottom salinity ranged from 0.9 to 36.5 ppt. Gaidry and White (1973) reported that commercial catches of brown shrimp were poor in those years when salinities where less than 15 ppt at the time postlarvae were present in the estuaries. They also stated that years of low commercial landings of brown shrimp were associated with prolonged estuarine temperatures of less than 20° C (68°F) at the time of postlarval immigration into the estuary. Laboratory studies with juvenile and adult brown and white shrimp indicate that white shrimp are better adapted to tolerate low salinity, wheras, brown shrimp are better adapted to higher salinities (McFarland and Lee, 1963). Gunter et al. (1964), found that juvenile white shrimp were more abundant in areas with waters of salinities less than 10 ppt while brown shrimp juveniles were more abundant in salinities between 10.0 and 19.9 ppt.

Juvenile shrimp appear to be most abundant at the Spartina grass-water interface. This "estuarine edge" is the most productive zone in many estuaries. Because there is a minimum of wind generated turbulence and stabilization of sediments, rich bands are found that along the edges of marshes (Odum, 1970). Furthermore, Odum (1970) found the percentages of organic detritus in sediments along the shore in the Everglades estuary are several times greater than a few meters offshore. Mock (1967) examined two estuarine habitats, one natural and one altered by bulk-heading. He found a 0.6 m (2 ft) band of rich organic material along the natural shore and very little organic material along the bulkheaded shore. White shrimp were 12.5 times and brown shrimp 2.5 times more numerous in the natural area as in the altered area. Loesch (1965) found that juvenile white shrimp in Mobile Bay were most abundant nearshore in water less than 0.6 m (2 ft) deep containing large amounts of organic detritus. Brown shrimp were congregated in water 0.6 to 0.9 m (2-3 ft) deep where there was attached vegetation.

As shrimp increase in size, they begin migrating toward high salinity, oceanic waters. Parker (1970) observed that size of brown shrimp at the time of emigration is apparently related to density of individuals but smaller individuals tended to concentrate in shallow peripheral zones. St. Amant et al. (1966) observed that as juveniles increased in size they move into deeper, larger bays, through the lower bays and to offshore waters. Lindner and Anderson (1956) stated that shrimp size increased from inside to outside waters. The largest shrimp were in the outside waters where salinity values were highest."

6.1.2 Environmental Requirements (Taken verbatim from Muncy 1984)

"Water temperature directly or indirectly influences white shrimp spawning, growth, habitat selection, osmoregulation, movement, migration, and mortality. Spring water temperature increases trigger spawning, and rapid water temperature declines in fall portend the end of spawning (Lindner and Anderson 1956). Growth is fastest in summer and slow or negligible in winter. Water temperatures below 20°C inhibit growth of juvenile shrimp (Etzold and Christmas 1977) and growth is virtually nil at 16°C (St. Amant and Lindner 1966). Growth rates increase rapidly as temperatures increase above 20°C. Increased water temperatures affects molting rate (Perez-Farfante 1969). Good correlation between heating-degree-days and catch/effort ratio for penaeid shrimp was similar to correlations of yield-per-hectare versus latitude (Turner 1977). Temperature and food supply limited the growth of white shrimp postlarvae more than did salinity differences between 2 and 35 ppt (Zein-Eldin 1964).

Severe winters in 1939-40, 1966, 1976-77, and 1977-78 caused mass mortality and reduced catches in the South Atlantic white shrimp fishery (McKenzie 1981; Shipman 1983a; Whitaker 1983a). The Georgia Department of Natural Resources (1983) reported a 34% drop in white shrimp landings in 1981 and a 99% drop in 1981 spring catch of roe shrimp after the unusually cold 1980-81 winter. White shrimp are more tolerant of high temperatures and less tolerant of low temperatures than either brown or pink shrimp (Etzold and Christmas 1977). Among postlarvae, brown shrimp were more resistant than white shrimp to higher temperatures.

White shrimp mortality was reported at water temperatures of 8°C and lower (Joyce 1965). Mortality of white shrimp is total at 3°C or lower, regardless of salinity. White shrimp survival at low temperatures depends on ambient temperature, the rate of temperature decline, the duration of low temperatures and salinity (Joyce 1965). The impact of low water temperature and low salinity on white shrimp was discussed by Music (1979) and Shipman (1983a). Adult white shrimp (>90mm long) may be more susceptible than juveniles to cold temperatures (Whitaker 1983a). Wiesepape (1975) found the 24-h LC_{50} (temperature causing 50% mortality in 24 h) to be 36° and 37°C for white shrimp acclimated at 29° and 34°C, respectively. Postlarvae and 30-mm long juveniles have similar but higher resistance times than 50-mm juveniles.

Adult white shrimp spawn offshore where salinities are at least 27 ppt. The larvae move shoreward and become second-stage postlarvae as they enter estuaries on flood tides. Juvenile white shrimp moved 160 km upstream into water of less than 1.0-ppt salinity waters in the St. Johns River, Florida (Joyce 1965). Juvenile white shrimp have even been recovered from Lake Monroe Power Station filter screens located 270 km from the mouth of the St. Johns River -- especially when low rainfall and low river stages caused reverse tidal flow (Edwin Joyce pers. comm., February 1984). The high calcium ion concentrations in the St. Johns River may explain the relative ease with which marine species enter and remain in low salinity waters (Joyce 1965). The lowest salinity in which white shrimp were recorded in the northern Gulf of Mexico was 0.42 ppt (Perez-Farfante 1969). Although field studies indicate that juvenile white shrimp prefer low salinities, laboratory studies have revealed that white shrimp appear to tolerate a wide range of salinities; they have been successfully reared at salinities of 18 to 34 ppt (Perez-Farfante 1969). McKenzie (1981) cited several studies in which fast growth was reported for white shrimp at salinities of 7 to 15 ppt.

White shrimp in Georgia move toward higher salinity waters as sexual development progresses, and most spawn offshore in the sea (Harris 1974).

Temperature-salinity tolerance ranges for white shrimp vary at different life stages, but the interactions are more pronounced at the extremes of tolerance. For example, Couch (1978) reported that broken-back syndrome (dorsal separation of the third and fourth pleural plates on abdominal) appears after sudden drops in salinity (from 15 ppt to 3 ppt) in cold water (8°C). The critical thermal maxima for white shrimp are influenced largely by acclimation temperatures, and to a lesser extent by salinity and size of test animal (Laney 1973). Freshwater inflow may affect coastal water temperatures, which in turn affect the growth rates (White and Boudreaux 1977) and migration of white shrimp (Shipman 1983b). Spring spawning of white shrimp coincides with a rapid rise in bottom water temperatures in high salinity offshore waters (McKenzie 1981).

White shrimp prefer shallow, muddy-bottom substrate. Landings of shrimp along the Louisiana coast were highest in areas where substrates were highly organic (Barrett and Gillespie 1973; Gaidry 1974). A relative higher linear correlation ($R^2 = 0.69$) between intertidal land area and average annual shrimp catch along Louisiana's inshore regions was reported by Turner (1977). The relation between inshore catches and hectares of vegetated estuarine habitat in the northeastern Gulf of Mexico (Tampa Bay, Florida, to Mobile Bay and Perdido Bay, Alabama) also showed a strong correlation ($R^2 = 0.64$). A direct relationship between commercial shrimp landings and intertidal vegetated areas and degrees latitude was reported by Turner (1977). The annual landings (kg/ha) in 1955-64 were 19.7 in North Carolina, 7.9 in South Carolina, 13 in Georgia, and 22.4 in east Florida. White shrimp undoubtedly composed most of the landings except in North Carolina. Southward fall migration probably account for the high landings from Florida waters. The area of nearshore soft sediments correlate well with white and brown shrimp distribution from Pamlico Sound, North Carolina to northern Florida (McKenzie 1981).

Temporal and spatial shifts by brown, white, and pink shrimp help reduce direct interspecific competition especially for certain substrates (Lassuy 1983). White shrimp burrow less deeply into muddy substrates and are more active in daylight than are brown or pink shrimp. Staggered seasonal recruitment of brown and white shrimp into the south Atlantic estuaries would reduce competition (Baisden 1983)."

6.1.3 Spatial and Temporal Distribution and Relative Abundance in Estuarine Habitat

NOAA's Estuarine Living Marine Resource Program (ELMR), through a joint effort of National Ocean Service and NMFS, conducts regional compilations of information on the use of estuarine habitat by select marine fish and invertebrates. A report prepared through the ELMR program (NOAA 1991b), presents information on the spatial and temporal distribution and relative abundance of fish and invertebrates using southeast estuarine habitats. Twenty southeast estuaries selected from the National Estuarine Inventory (NOAA 1985) are included in the analysis which resulted from a review of published and unpublished literature and personal consultations. The resultant information further emphasizes the importance of estuarine habitat to all life stages of white, brown and pink shrimp and is presented in Tables 45 and 46.

6.2 Condition of the Habitat

Shrimp occupy oceanic waters (beach seaward) along the Atlantic coast as adults. Offshore areas used by adults are probably the least affected by habitat alterations and water quality degradation. Currently, the primary threat comes from oil and gas development and production, offshore dumping of dredged material, disposal of chemical and other wastes, and the discharge of contaminants by river systems.

Many nearshore areas appear to be in good condition, although many local problem areas exist. For example, water quality may be reduced in areas affected by plumes of major rivers. Local disturbances occur during construction related to periodic beach nourishment, dredged material disposal, and dredging. Some areas also are affected by thermal effluents and sewage outfalls.

Probably the most critical habitat is the inshore nursery area where most of their growth takes place. The estuarine nursery areas appear to be the most impacted of the habitats used by shrimp. Natural and man-induced alterations of the fragile environment have altered much of the area that would be considered suitable habitat. The amount of remaining wetlands suitable for shrimp production along the Atlantic coast has not been quantified. However, as of 1986 only about 4.2 million acres of salt marsh, fresh marsh, tidal flats, and swamp wetlands are estimated to remain (Alexander et al. 1986). This figure is conservative since open-water and flats generally have not been quantified, but it does represent about 46% of the wetlands of these types that remain in the coterminous United States. The overall rate of wetland loss similarly is not known since adequate mapping programs and baseline data are not available. However, for the last 25 years, coastal wetlands within the coterminous United States have been depleted at a rate of 20,000 acres per year (Alexander et al. 1986).

Lindall et al., (1979) described activities that impact the estuarine zone including: construction and maintenance of navigation channels; discharges from wastewater plants and industries; dredge and fill for land use development; agricultural runoff; ditching, draining, or impounding wetlands; oil spills; thermal discharges; mining, particularly for phosphate, and petroleum; entrainment and impingement from electrical power plants; dams; marinas; alteration of freshwater inflows to estuaries; saltwater intrusion; and non-point source discharges of contaminants. Most Atlantic coast estuarine systems have been impacted to varying degrees by one or more of these activities.

Impoundment of wetlands for spoil and waste containment, roadways and causeways, aquaculture, and mosquito control ditches may limit the amount of nursery area available to shrimp. Management of water levels and exchange in impounded tidal marshes often severely restricts marsh accessibility to juvenile shrimp when water levels are stabilized during waterfowl and fur harvesting seasons in fall and early winter (Gulf of Mexico Fishery Management Council 1987). Consequently these activities could adversely impact shrimp production.

Water quality degradation from the discharge of sewage, heavy metals, and other industrial and chemical wastes and from septic tanks and urban runoff threaten shrimp habitat. Urban and agricultural runoff can be laden with toxic substances such as petrochemicals, pesticides, heavy metals, and herbicides. The aerial spraying of large areas for mosquito control in Florida and elsewhere results in the addition of pesticides to estuarine waters. These pesticides are extremely toxic to larval aquatic organisms. Thermal effluent from power generating facilities using "once-through" cooling can raise the temperature of estuarine waters making them less suitable or uninhabitable, especially during summer. Sewage discharge may degrade the environment by eutrophication, decreased dissolved oxygen, and introduction of diseases.

6.3 Habitat Areas of Particular Concern

Habitat areas of particular concern include those areas required during shrimp life cycles. Estuarine tidal creeks and salt marshes that serve as nursery grounds are perhaps the most important habitats occupied by penaeid shrimp. The major factor controlling shrimp growth and production is the availability of nursery habitat. Remaining wetland habitat as of 1987 (Table 10) must be protected if present production levels are to be maintained. In addition, impacted habitats must be restored if future production is to be increased. Other areas of specific concern are the barrier islands since these land masses are vital to the maintenance of estuarine conditions needed by shrimp during their juvenile stage. Passes between barrier islands into estuaries also are important since the slow mixing of sea water and fresh water are also of prime importance to estuarine productivity.

In North Carolina, habitat areas of particular concern include estuarine shoreline habitats since juveniles congregate here. Seagrass beds, prevalent in the sounds and bays of North Carolina and Florida, are particularly critical areas. Core Sound and eastern Pamlico Sound, based on a preliminary aerial survey funded through the Albemarle-Pamlico Estuarine Study, have approximately 200,000 acres of seagrass beds making North Carolina second only to Florida in abundance of this type of habitat (Department of Commerce 1988b). In subtropical and tropical regions shrimp and spiny lobster postlarvae recruit into grass beds from distant offshore spawning grounds (Fonseca et al. 1992).

South Carolina and Georgia lack seagrass beds. Here, the nursery habitat of shrimp is the high marsh areas with shell hash and mud bottoms. In addition, there is seasonal movement out of the marsh into deep holes and creek channels adjoining the marsh system during winter. Therefore, the area of particular concern for early growth and development encompasses the entire estuarine system from the lower salinity portions of the river systems through the inlet mouths.

Offshore and nearshore areas of particular concern include those habitats required during larval, postlarval, and adult stages. Although these areas are generally less vulnerable to habitat alteration than the salt marsh and estuarine nursery areas, dredging activity and dredge spoil disposal can result in habitat and water quality degradation.

Dredging of nearshore bottoms may also have a negative impact on shrimp. A biological consequence of the dredging of entrance channels may be to direct shrimp farther offshore than normal, resulting in a displacement of white shrimp spawners and a decrease in recruitment of postlarvae to the estuary (South Atlantic Fishery Management Council 1981).

6.4 Habitat Protection Programs

6.4.1 Coastal Zone Management Programs

6.4.1.1 North Carolina

The Coastal Area Management Act was passed in 1974 to protect North Carolina's fragile coastal resources through planning and management at the state and local level. The Department of Environment, Health and Natural Resources administers the program. Policy direction is provided by the Coastal Resources Commission, a 15 member group of citizens appointed by the Governor. The coastal program requires that land use plans be developed and adopted by county governments. Municipalities may also elect to develop plans. The Coastal Resources Commission has authority to prepare plans should the county fail to do so. Once approved, these plans are the basis for permitting. Currently, there are approved land use plans for all 20 coastal counties and approximately 55 coastal municipalities. These plans are revised regularly to address new management concerns. The regulatory program applies in areas designated as Areas of Environmental Concern which are considered the most sensitive. Activities occurring in these areas require coastal development permits. Permits for "major development" are issued by the Department of Environment, Health and Natural Resources. All other development activity is considered "minor development" and the corresponding permits are issued by local government (Department of Commerce 1987).

6.4.1.2 South Carolina

The South Carolina Coastal Council implements the Coastal Management Act. The Coastal Council has authority to formulate and implement a comprehensive coastal management program. The Coastal Council has direct control through a permit program that oversees activities in critical areas that include coastal waters, tidelands, beaches, and primary ocean-front sand dunes. Indirect management authority of coastal resources is granted to the Coastal Council in counties containing one or more of the critical areas. In issuing permits, the Coastal Management Act requires that the Coastal Council consider the effects of proposed alterations on the production of fish, shrimp, oysters, crab, or any marine life, wildlife, or other natural resources (Department of Commerce 1988a).

6.4.1.3 Georgia

The State of Georgia, until recently, did not participate in the Federal Coastal Zone Management Program. However, the Coastal Marshlands Protection Act of 1970 and the Shore Assistance Act of 1979 were passed to protect the state's beaches, dunes, and marshes. These acts created two statutory committees to consider permit applications for developing or altering marshes or sand sharing systems (beaches, sand dunes, or nearshore sand bars). The committees are composed of two top managers of the Georgia Department of Natural Resources, an oceanographer, and a professional engineer, who regularly convene at monthly public meetings.

Under authority of these acts, the Marsh and Beach Section, the Coastal Resources Division of the Georgia Department of Natural Resources, has resource management responsibility for marshes, dunes, and beaches. Management is administered by a permit system for all activities and structures that alter any marshland, sand dunes, beaches, and submerged sandbars and shoals.

In January 1992, Georgia Department of Natural Resources was designated as the lead agency to develop and implement Georgia's coastal management program. A management plan and program for the state is being developed with the input of an 18 member advisory committee appointed by the Governor. The goals of the program will be to protect coastal resources, manage coastal resources, and simplify the permitting process.

6.4.1.4 Florida

The Florida Coastal Management Program was approved by the Secretary of Commerce in September 1981. The Department of Environmental Regulation is responsible for coordinating and monitoring implementation of the laws and rules which comprise the Coastal Management Program. The Department of Natural Resources and the Department of Community Affairs, as well as the Department of Environmental Regulation, are responsible for implementation of the core statutes which comprise the Coastal Management Program.

6.4.1.5 The National Estuarine Research Reserve System

Section 315 of the Coastal Zone Management Act of 1972, established the National Estuarine Reserve Research System to provide financial assistance to states to acquire, develop, and operate estuarine areas as natural field laboratories. The System protects hundreds of thousands of acres of estuarine waters, marshes, shorelines, and adjacent uplands, with education and research being the primary goals of the program. Reserves throughout the U.S. and its territories are operating with long-term scientific and educational programs that provide information essential to coastal management decision making. Reserves contained in the management unit include Sapelo Island, Georgia; Albemarle-Pamlico Sound; North Carolina, and the Ashepoo; Combahee and South Edisto (ACE) river basins and North Inlet-Winyah Bay, South Carolina. Reserves provide indoor and outdoor classrooms for educators and students, and offer several advantages to researchers including natural field stations, an existing environmental monitoring database, onsite support facilities and staff assistance, and protected status for long-term projects and comparative studies.

6.4.2 Federal Programs

The National Marine Fisheries Service through the Habitat Conservation Division, the U.S. Fish and Wildlife Service through its field offices, and the Environmental Protection Agency through regional offices are the Federal agencies that analyze projects proposing wetland alterations for potential impacts on resources under their purview. Recommendations resulting from these analyses are submitted to the U.S. Army Corps of Engineers where they are included in a public interest review that determines whether or not a permit is issued for a proposed alteration (Goodyear 1987). Government agencies, including the South Atlantic Fishery Management Council, provide their recommendations on whether or not a permit should be issued although this authority does not grant veto power in the permitting process.

The amount and rate of man-induced wetland losses have not been quantified, but can be controlled by state and/or Federal regulatory agencies. U.S. Environmental Protection Agency (EPA) for example, can regulate wastewater discharges and the Army Corps of Engineers (COE) can regulate physical wetland alterations (dredging, filling, impounding, etc.). The amount of shrimp habitat affected by EPA's program is unknown, but data on the effect of the COE's regulatory program in the southeast is available (Mager and Hardy 1988). Five years of NMFS data on the COE's program providing proposed alterations by state and habitat type were summarized by Mager and Thayer (1986). For the south Atlantic states, almost 15,714 acres of wetland losses were proposed by more than 3,123 projects (Table 11). This provides an indication of the significance of the COE's program and the cumulative effect of wetland losses. Mager and Thayer (1986) further surveyed 857 projects where permits had been issued by the Army Corps of Engineers Districts in the Southeast to find out the degree to which NMFS recommendations had been incorporated into issued permits. They found that 50% of the recommendations were accepted, 24% of the recommendations were partially rejected, and 25% of the recommendations were totally rejected. In addition, 80% of the permit holders had not complied with the habitat provisions of the permit. Therefore, many of the recommendations pertaining to habitat preservation made by NMFS were either rejected by the Corps of Engineers or ignored by the permit holders. The most recent analysis of compliance with NMFS recommendations (Mager and Rackley 1991) concludes that "The current rate of wetland loss also indicates that existing regulatory programs are not overly restrictive and are not adequate to fulfill the national goal of no net-loss of wetlands."

Other Federal agencies involved in habitat matters affecting shrimp are directed by legislation discussed in Section 7.0. NOAA's Office of Ocean and Coastal Resource Management may aid in establishing standards for approval to designate estuarine sanctuaries. The National

Park Service may establish coastal and nearshore national parks and monuments, such as Everglades National Park Florida. The EPA estuarine programs may protect fish habitat by regulating discharge of pollutants; the Corps of Engineers also regulates dredging, construction, and the discharge of spoil and disposal materials in wetlands in association with their water development programs (Gulf of Mexico Fishery Management Council 1987).

6.5 Pollution and Habitat Degradation along the Atlantic Coast

6.5.1 Concerns in the South Atlantic States

Effects of pollution on shrimp are not well documented, yet generally it can be assumed that degradation of water quality and sediments in estuarine, nearshore, and offshore environments will impact adults, juveniles, larvae, and eggs to some degree. Pollutant-related stresses may reduce fecundity or viability of ova; decrease survival of larvae, postlarvae, juveniles, and adults, increase vulnerability to disease and predation; and reduce growth rates.

The Council's habitat and environmental protection advisory panel has developed a list of major fishery habitat concerns:

<u>North Carolina</u>
- Non-point source pollution (i.e., nutrient loading).
- Impacts of high density development on barrier islands and ocean outfalls for island development.
- Marina development.
- Ulcerative mycosis and its occurrence in virtually all species in specific parts of the estuarine system.
- Identification of critical habitats such as nursery habitats.
- Hydrologic changes in instream flow.
- Land use changes resulting in freshwater impacts changing salinity regimes, phosphate mining, and loss of 404 wetlands.
- Chemical discharges from offshore phosphate mining.
- Impacts of peat mining.

<u>South Carolina</u>
- Dredged material disposal for port development.
- Increased barrier island development.
- Impacts of beach renourishment projects.
- Non-point source pollution.
- Impoundment of wetland areas.
- Lack of chemical water quality standards.
- Instream flow and aquaculture in pumping water from the estuarine system.

<u>Georgia</u>
- Freshwater drainage from silvaculture.
- Changing time period of water affecting low salinity nursery areas.
- Siting of marinas.
- Port development.
- Dredge disposal.
- Increased salinity of Savannah River.

<u>Florida</u>
- Impoundments for mosquito control and need to pursue increased rotational impoundment management.
- Impacts of beach renourishment.
- The designation of a marine sanctuary in the Indian River Area.
- Dredge and fill operations.
- Freshwater inflow alterations.
- Water pollution.
- Seagrass dieoffs.
- Extensive coastal development and related problems.

6.5.2 SAFMC Habitat Priorities

In cooperation with the four state habitat advisory panels, the SAFMC developed a list of habitat priorities to aid in the review of projects or policies affecting fisheries habitat and in development of policy statements on such activities. The following list in priority order was approved by the SAFMC:

1. impoundment, dredging, or filling of wetlands
2. point and non-point source pollution
3. identification and acquisition of important fishery habitats
4. chemical water quality standards
5. beach renourishment
6. dredge and fill of seagrass beds
7. ocean incineration
8. offshore mineral mining
9. silvaculture
10. plastic pollution
11. ocean outfalls
12. aquaculture in wetlands
13. habitat restoration, enhancement, and artificial reefs
14. hurricane Hugo impacts on fisheries habitat
15. anchoring on reefs and groundings
16. habitat utilization documentation
17. impacts of fishing techniques
18. sea level rise
19. impacts of jetties and groins
20. mandatory boat access

6.5.3 Habitat Loss

Degradation of estuarine, nearshore, and offshore environments is in direct conflict with attempts to maintain optimal habitat conditions for shrimp spawning, survival, and growth. The loss of seagrass beds in North Carolina and Florida has reduced preferred habitat areas available to larval, juvenile, and adult shrimp. These losses are due in part to dredge and fill operations; to increased turbidity resulting from discharges of waste materials and runoff; and from elevated levels of suspended solids. In addition to seagrass losses, the entire Atlantic Coast has had a large portion of its salt marsh and estuarine systems degraded or lost to development through dredge and fill operations. In South Carolina and Georgia the marsh systems are of principal importance as nursery areas. Major threats to shrimp habitat include: impoundment of unaltered estuarine wetlands and the reimpoundment of wetlands that have reverted to productive estuarine wetlands; open water disposal of dredged material in shallow water estuarine bottom; and agricultural practices that allow rapid introduction of soil and pesticides into the marine environment. Table 12 and Appendix III present baseline estimates of coastal wetland acreage by estuarine drainage area in the South Atlantic region compiled through a cooperative effort of NOAA and USFWS (NOAA 1991a). This compilation of existing wetland habitat may, as refined to hydrological units, begin to serve as a baseline upon which to implement the policy directive of no net loss and the long-term objective of a net gain of wetland habitats in the South Atlantic region. One program that is presently being developed in response to the National Wetlands Policy Forum recommendation to improve inventory, mapping, and monitoring programs by USFWS and NOAA is Coastwatch. The Coastwatch program's purpose is to develop a nationally standardized geographic information system using ground-based and remote sensing data to assess changes in land cover and habitat in U.S. coastal regions to improve understanding of coastal uplands, wetlands, and seagrass beds and their links to distribution, abundance, and health of living marine resources.

One way to control wetland loss is through restoration, generation, or enhancement of habitat (Lindall et al. 1979). Mitigation, however, often may not be desirable since some of the mitigation technologies still are poorly understood. Wetland creation technology is an emerging science that requires more development before it can be applied routinely (Mager and Thayer 1986). Moreover, optimum habitat and environmental conditions must be determined for each estuary so that the best habitat conditions can be created when the methodologies are adequately developed (Gulf of Mexico Fishery Management Council 1987).

6.5.4 Plastic Pollution (Persistent Marine Debris)

The production of plastic resin in the U.S. increased from 6.3 billion lb in 1960 to 47.9 billion lb in 1985. The increased production, utilization, and subsequent disposal of petrochemical compounds known as plastics has created a serious problem of persistent marine debris. Marine ecosystems have, over the years, become the final resting place for a variety of plastics originating from many ocean and land-based sources including the petroleum industry, plastic manufacturing and processing activities, sewage disposal, and littering by the general public and government entities (commercial fishing industry, merchant shipping vessels, the U.S. Navy, passenger ships, and recreational vessels) (Department of Commerce 1988c).

The impacts of persistent marine debris on the Atlantic Coast shrimp population are not well known at this time, but might include pollution related mortality resulting from ingestion of plastic materials. As part of the NMFS Marine Entanglement Research Program in the northern Gulf of Mexico, fish samples are being collected and evaluated to determine the presence of plastic particles small enough to be ingested by larval and juvenile fish. Researchers have noted the possibility of mapping the distribution and abundance of plastic particles relative to larval and juvenile fish concentrations (Department of Commerce 1988b). Effective January 1, 1989, the disposal of plastic into the ocean is regulated under the Plastic Pollution Research and Control Act of 1987 implementing MARPOL Annex V (Table 13).

Recognizing worldwide concern for preservation of our oceanic ecosystems, the Act prohibits all vessels, including commercial and recreational fishing vessels, from discharging plastics in U.S. waters and severely limits the discharge of other types of refuse at sea. This legislation also requires ports and terminals receiving these vessels to provide adequate facilities for in-port disposal of non-degradable refuse, as defined in the Act.

The utilization of plastics to replace many items previously made of natural materials in commercial fishing operations has increased dramatically. The unanticipated secondary impact of this widespread use of plastics is the creation of persistent marine debris. Commercial fishing vessels have historically contributed plastics to the marine environment through the common practice of dumping garbage at sea before returning to port and the discarding of spent gear such as lines, traps, nets, buoys, floats, and ropes. Two types of nets are routinely lost or discarded drift gill nets and trawl nets (Department of Commerce 1988c). These nets are durable and may entangle marine mammals and endangered species as they continue to fish or when lost or discarded.

An estimated 16 million recreational boaters utilize the coastal waters of the United States (Department of Commerce 1988c). Disposal of spent fishing gear (e.g. monofilament fishing line), plastic bags, tampon applicators, six pack yokes, styrofoam coolers, cups and beverage containers, etc. is a significant source of plastic entering the marine environment.

In the mid 1970s, the National Academy of Science (NAS) estimated that approximately 14 billion pounds of garbage was disposed of annually into the world's oceans. Approximately 85% of total trash is produced from merchant vessels, with 0.7% of that total, or eight million pounds annually being plastic. The use of plastics has risen dramatically since the NAS study. At present, 20% of all food packaging is plastic and by the year 2000 this figure may rise to 40% (CEE 1987).

The main contribution of plastic to the marine environment from cruise ships is the disposal of domestic garbage at sea. Ships operating today carry between 200 and 1,000 passengers and dispose of approximately 62 million pounds of garbage annually, of which a portion is plastics (CEE 1987).

The U.S. Navy operates approximately 600 vessels worldwide, carrying about 285,000 personnel and discharging nearly four tons of plastic refuse into the ocean daily (Department of Commerce 1988a). The U.S. Coast Guard and NOAA operate 226 vessels which carry nearly 9,000 personnel annually and have internal operating orders prohibiting the disposal of plastic at sea. MARPOL Annex V does not apply to public vessels although the Plastic Pollution Research Control Act of 1987 requires all Federal agencies to come into compliance by 1994 (CEE 1987).

6.5.5 Oil and Gas Exploration

Exploration for oil and gas in South Carolina and Georgia's coastal plain has not occurred. The major interest on the Atlantic coast lies within offshore areas. Oil and gas exploration is presently under way along the Atlantic coast outer continental shelf. Four offshore areas on the Atlantic coast are being investigated: the Blake Plateau, the Southeast Georgia Embayment, Baltimore Canyon, and Georges Bank. Forty three tracts totaling 244,812 acres have been leased in the South Atlantic region (Fish and Wildlife Service 1980). Potential adverse effects associated with offshore petroleum production include development effects from the construction of the pipeline, chronic small spills, and catastrophic spills of crude oil or refined products (Fish and Wildlife Service 1980). Impacts associated with drilling include the introduction of large amounts of drilling muds into the marine environment. Secondary impacts include the proliferation of on-shore support facilities that could result in greater pressure to develop wetlands. If a pipeline is constructed from the site to the mainland, it is estimated that approximately one to three million cubic yards of dredge material will result from laying the line which would be 150 to 320 miles long. A large oil spill can be lethal to sea birds, marine mammals, marsh vegetation, fish, and invertebrates. Wetland vegetation may suffer from smothering or toxicity. Benthic marine life and larval fishes are often eliminated (Fish and Wildlife Service 1980). In addition to leases previously mentioned, pre-sale information and Environmental Impact Statements have been prepared for Mid-Atlantic Sale 121 and South Atlantic Sale for the exploration of oil and gas offshore of Cape Hatteras, North Carolina. Mobile Oil Company currently plans to drill an exploratory well off North Carolina's Outer Banks. Should gas or oil be found, the laying of pipe to North Carolina's shoreline facilities would likely have to traverse wetlands and/or barrier island grass flats. Since juvenile shrimp occur along most shoreline habitats, local production could be adversely affected by dredging and pipe laying activities. Increased industrial activities could also affect adult migrations and behavior, since they react to man-made disturbances. Minerals Management Service has developed an Environmental Impact Statement for 1992-1997 offshore drilling leases and SAFMC recommendations submitted to MMS pertaining to this EIS are contained in Section 6.6.4.

6.5.6 Atmospheric Nitrogen and Sulfur Deposition (Acid Rain)

Acid rain occurs when atmospheric precipitation has a chemical composition that includes oxides of the elements sulfur and nitrogen (Department of Commerce 1987). Burning of fossil fuels is the main contributor to acid rain, although seaspray, volcanic activity, and bacterial and chemical decomposition of organic matter are other sources. The effects of acid deposition on marine ecosystems have been difficult to quantify yet significant pH changes may cause fish kills, and additional nutrients from the rain may result in eutrophication of estuarine systems.

Deposition of atmospheric nitrogen (as nitrates) into coastal watersheds results mainly from nitrogen oxide emissions from fossil fuel combustion. Nitrogen oxide production has increased continuously since the 1900s (Fisher et al. 1988). In a recent study evaluating nitrogen inputs into Chesapeake Bay, researchers determined that 25% of the nitrogen entering the bay is linked to acid rain (Fisher et al. 1988). Associated problems include the acidification of sensitive freshwaters and some Chesapeake Bay headwaters. It is predicted that nitrogen emissions will increase by 40-60% over the next 40 years.

The National Audubon Society monitors rainfall in 41 U.S. states. In July 1988, 17 states were identified as having highly acidic rainfall. Normal rainfall is generally slightly acidic (pH=5.6) and the designation of high levels of acid rain are assigned when rainfall is almost 100 times as acidic (pH >4.0). All coastal New England and Mid-Atlantic states showed acid concentrations to be high with South Carolina being the southern-most state to show a high level of acid rain for May, June, and July of 1988. Officials with the South Carolina Department of Health and Environmental Control noted that acidity has also increased due to extended drought conditions occurring in the southeast. This condition allows pollutants to be more concentrated in the rainfall.

6.5.7 Ocean Dumping

The western Atlantic Ocean, including state territorial seas and the EEZ off the eastern United States, have long been used for disposal of such wastes as dredged material, sewerage sludge, chemical waste, plastic waste, and radioactive material. Approximately 149 million metric tons (wet) of dredge material is disposed in estuaries, the territorial seas, and areas of the EEZ along the entire Atlantic coast and Gulf of Mexico. Approximately 27.8 million metric tons (wet) of dredge spoil, is presently disposed of in the EEZ. Composition of dredge material varies among areas with some being contaminated with heavy metals and organic chemicals originating from industrial and municipal discharges and non-point source pollution. The U.S. Army Corps of Engineers classifies only a small portion of the total dredge material as contaminated, but presently has no specific numerical criteria to define such contamination (Office of Technology and Assessment 1987). The SAFMC has adopted a policy statement on ocean dumping (Section 6.6.2).

6.5.8 Trends in Human Population and Recreational Boat Registration in the South Atlantic Region

As coastal populations in the South Atlantic region continue to increase so does recreational boating and fishing activity. Shrimp, with their extended residence in estuarine waters, are vulnerable to harvest by an ever-increasing number of coastal recreational fishermen. Recreational boat registrations in the south Atlantic states increased 70% between 1976 and 1986. As numbers of recreational vessels increase, so will the need for increased boat landings and marinas to afford access to the ocean, rivers, harbors, bays, and estuaries. All these factors will result in increased pressure on the south Atlantic shrimp resource and habitat.

6.5.9 Relationship of Habitat Quality to the Ability to Harvest Shrimp

Preservation of quantity and environmental quality of estuarine, nearshore, and offshore habitat in the South Atlantic region is essential to maintaining shrimp stocks. Discharge of pollutants may result in direct mortality of shrimp at various stages of their life history. Exposure to certain chemicals could limit the desirability or the possibility of consumption, as occurred in bluefish with PCBs. Presently there is limited information on the concentrations or occurrence of chemicals such as PCBs or Dioxin in shrimp coastwide. Research is underway and as information becomes available; the Council will readdress the issue and include information in subsequent amendments to the shrimp management plan.

6.5.10 National Status and Trends Program

The Mussel Watch Project, a component of NOAA's National Status and Trends Program (NSTP) (NOAA 1989) has annually collected contaminant data for 12 fixed stations along the

Atlantic Coast. The chemical contaminants analyzed included polyaromatic hydrocarbons, polychlorinated biphenyls, chlorinated pesticides, and 12 trace elements. Aquatic organisms, especially shellfish like mussels and oysters, accumulate contaminants within their tissue at higher levels than surrounding waters. Contaminant levels therefore increase or decrease depending on the condition of the surrounding waters. The NSTP was initiated to monitor and assess temporal trends in coastal and estuarine waters of the United States. Based on data compiled from 1986 through 1988, the following trends were noted for some southeast estuaries: cadmium levels in the Charleston Harbor (SC) and the Sapelo Sound (GA) sites were decreasing; chromium levels in the Savannah River estuary and Matanzas River (FL) sites were increasing; copper levels in Sapelo Sound were decreasing; levels of mercury for Roanoke Sound (NC), Cape Fear (NC) and Matanzas River were increasing; nickel concentrations were increasing in both the Pamlico Sound (NC) and Savannah River sites; silver levels were decreasing at both the Roanoke River and Cape Fear (NC) sites; zinc concentrations were shown to be decreasing in the Matanzas River site; and only the Matanzas River site was shown to have concentrations of more than two contaminants showing statistically significant changes with arsenic, chromium, and mercury increasing and zinc decreasing.

6.5.11 National Coastal Pollutant Discharge Inventory Program

NOAA's National Coastal Pollutant Discharge Inventory Program (NCPDI) was developed and started in 1982 to assess the sources, magnitudes, and impacts of point and nonpoint source pollutant discharges into the United States coastal and estuarine areas (NOAA 1992a). A major component of the NCPDI is the comprehensive data base which contains pollutant estimates for point and nonpoint and riverine sources located in coastal counties or the United States Exclusive Economic Zone. Seasonal and annual discharge estimates are currently made for 17 pollutant parameters including runoff, sediment, and nutrients for urban, agricultural, forest, pasture, and range lands discharging into riverine estuarine and coastal waters. The entire inventory has been updated through 1991 and when available the information pertaining to the southeast will be included in subsequent amendments to this plan. Table 47 describes the pollutants included in the NCPDI, their definition and effects on the environment, marine organisms, and humans.

6.5.12 Agricultural Pesticide use in Coastal Areas

Pesticides including herbicides, insecticides, fungicides, nematicides, algicides, wood preservatives, and fumigants have been used extensively in the southeast coastal zone. Despite the fact that most organochlorine pesticides are no longer approved for agricultural use in the U. S., 29.4 million pounds of pesticides were applied to U.S. coastal watersheds in 1987 (NOAA 1992b) with over 33% or 9.8 million pounds being applied in the southeast coastal region alone. As part of the NCPDI, NOAA has undertaken a comprehensive review of pesticide use in coastal areas. Detailed information on use and impacts of pesticides in the southeast based on NOAA's final national summary of agricultural pesticide use in coastal areas will be available in 1993 and will be included in a subsequent amendment to this plan.

6.6 Habitat Preservation Recommendations

6.6.1 SAFMC Habitat and Environmental Protection Policy

In recognizing that shrimp are dependent on the quantity and quality of their essential habitats, it is the policy of the SAFMC to protect, restore, and develop habitats upon which shrimp fisheries depend; to increase the extent of their distribution and abundance; and to improve their productive capacity for the benefit of present and future generations. For purposes of this policy, "habitat" is defined as the physical, chemical, and biological parameters that are necessary for continued productivity of the species that is being managed. The objectives of the SAFMC policy will be accomplished through the recommendation of no net loss or significant environmental degradation of existing habitat. A long-term objective is to support and promote a net-gain of fisheries habitat through the restoration and rehabilitation of the productive capacity of habitats that have been degraded, and the creation and development of productive habitats where increased fishery production is probable. The SAFMC will pursue these goals at state, Federal, and local levels. The Council shall assume an aggressive role in the protection and enhancement of habitats important to shrimp, and shall actively enter Federal, decision-making processes where proposed actions may otherwise compromise the productivity of fishery resources of concern to the Council.

6.6.2 SAFMC Policy Statement on Ocean Dumping

The SAFMC is opposed to ocean dumping of industrial waste, sewage sludge, and other harmful materials. Until ocean dumping of these materials ceases, the SAFMC strongly urges state and Federal agencies to control the amount of industrial waste, sludge, and other harmful materials discharged into rivers and the marine environment , and these agencies should increase their monitoring and research of waste discharge. The SAFMC requests that the Environmental Protection Agency continue to implement and enforce all legislation, rules, and regulations with increased emphasis on the best available technology requirements and pretreatment standards. The SAFMC requests that EPA require each permitted ocean dumping vessel (carrying the above described material) to furnish detailed information concerning each trip to the dump site. This might be monitored with transponders, locked Loran C recorder plots of trips to and from dump sites, phone calls to the EPA when a vessel leaves and returns to port, or other appropriate methods. Also the EPA should take legal action to enforce illegal (short or improper) dumping. The SAFMC requests that fishermen and other members of the public report to the EPA, Coast Guard, and the Councils any vessels dumping other than in approved dump sites. The SAFMC supports the phase out of ocean dumping of the above described materials.

6.6.3 SAFMC Policy Statement on Open Water Disposal of Dredged Materials

The SAFMC is opposed to the open water disposal of dredged material into aquatic systems which may adversely impact fisheries habitat for species under Council jurisdiction. The Council urges state and Federal agencies, when reviewing open water disposal permits to identify the direct and indirect impacts such projects could have on fisheries habitat. The SAFMC believes that the creation of new habitat at the expense of another naturally functioning system (e.g., marsh creation through dredge material disposal) must be justified, given best available information.

6.6.4 SAFMC Policy on Oil & Gas Exploration, Development and Transportation

The SAFMC urged the Secretary of Commerce to uphold the 1988 coastal zone inconsistency determination of the State of Florida for the respective plans of exploration filed with Minerals Management Service (MMS) by Mobil Exploration and Producing North America, Inc. for Lease OCS-G6520 (Pulley Ridge Block 799) and by Union Oil Company of California for Lease OCS-G6491/6492 (Pulley Ridge Blocks 629 & 630). Both plans of exploration involve lease blocks lying within the lease area comprising the offshore area encompassed by Part 2 of Lease Sale 116, and south of 26° North latitude. The Councils objection to the proposed exploration activities is based on the potential degradation or loss of extensive live bottom and other habitat essential to fisheries under Council jurisdiction.

The SAFMC also supports North Carolina's determination that the plans of exploration filed with MMS by Mobil Exploration and Producing North America, Inc. for Lease OCS Manteo Unit are not consistent with North Carolina's Coastal Zone Management program.

The Council has expressed concern to the Outer Continental Shelf Leasing and Development Task Force about the proposed area and recommends that no further exploration or production activity be allowed in the areas subject to Presidential Task Force Review (the section of Sale 116 south of 26° N latitude).

The SAFMC recommends the following to the MMS when considering proposals for oil and gas activities for previously leased areas under Council jurisdiction:

1) That oil or gas drilling for exploration or development on or closely associated with live bottom habitat, or other special biological resources essential to commercial and recreational fisheries under Council jurisdiction, be prohibited.

2) That all facilities associated with oil and gas exploration, development, and transportation be designed to avoid impacts on coastal wetlands and sand sharing systems.

3) That adequate spill containment and cleanup equipment be maintained for all development and transportation facilities and, that the equipment be available on site within the trajectory time to land, and have industry post a bond to assure labor or other needed reserves.

4) That exploration and development activities should be scheduled to avoid northern right whales in coastal waters off Georgia and Florida as well as migrations of that species and other marine mammals off South Atlantic states.

5) That the EIS for lease Sale 56 be updated to address impacts from activities related to specifically natural gas production, safety precautions which must be developed in the event of a discovery of a "sour gas" or hydrogen sulfide reserve, the potential for southerly transport of hydrocarbons to nearshore and inshore estuarine habitats resulting from the cross-shelf transport by Gulf Stream spin-off eddies, the development of contingency plans to be implemented if problems arise due to the very dynamic oceanographic conditions and the extremely rugged bottom, and the need for and availability of onshore support facilities in coastal North and South Carolina, and an analysis of existing facilities and community services in light of existing major coastal developments.

The SAFMC recommends the following concerns and issues be addressed by the MMS prior to approval of any application for a permit to drill any exploratory wells in Lease Sale 56 and that these concerns and issues also be included in the Environmental Impact Statement for the Outer Continental Shelf (OCS) Leasing Plan for 1992-1997:

1) Identification of the on-site fisheries resources, including both pelagic and benthic communities, that inhabit, spawn, or migrate through the lease sites with special focus on those specific lease blocks where industry has expressed specific interest in the pre-lease phases of the leasing process. Particular attention should be given to critical life history stages. Eggs and larvae are most sensitive to oil spills, and seismic exploration has been documented to cause mortality of eggs and larvae in close proximity.

2) Identification of on-site species designated as endangered, threatened, or of special concern, such as shortnose sturgeon, striped bass, blueback herring, American shad, sea turtles, marine mammals, pelagic birds, and all species regulated under federal fishery management plans.

3) Determination of impacts of all exploratory and development activities on the fisheries resources prior to MMS approval of any applications for permits to drill in the Exploratory Unit area, including effects of seismic survey signals on fish behavior, eggs and larvae; temporary preclusion from fishing grounds by exploratory drilling; and permanent preclusion from fishing grounds by production and transportation.

4) Identification of commercial and recreational fishing activities in the vicinity of the lease or Exploratory Unit area, their season of occurrence and intensity.

5) Determination of the physical oceanography of the area through field studies by MMS or the applicant, including on-site direction and velocity of currents and tides, sea states, temperature, salinity, water quality, wind storms frequencies, and intensities and icing conditions. Such studies must be required prior to approval of any exploration plan submitted in order to have an adequate informational database upon which to base subsequent decision making on-site specific proposed activities.

6) Description of required existing and planned monitoring activities intended to measure environmental conditions, and provide data and information on the impacts of exploration activities in the lease area or the Exploratory Unit area.

7) Identification of the quantity, composition, and method of disposal of solid and liquid wastes and pollutants likely to be generated by offshore, onshore, and transportation operations associated with oil and gas exploration development and transportation.

8) Development of an oil spill contingency plan which includes oil spill trajectory analyses specific to the area of operations, dispersant-use plan including a summary of toxicity data for each dispersant, identification of response equipment and strategies, establishment of procedures for early detection and timely notification of an oil spill including a current list of persons and regulatory agencies to be notified when an oil spill is discovered, and well defined and specific actions to be taken after discovery of an oil spill.

9) Studies should include detailing seasonal surface currents and likely spill trajectories.

10) Mapping of environmentally sensitive areas (e.g., spawning aggregations of snappers and groupers); coral resources and other significant benthic habitats (e.g., tilefish mudflats) along the edge of the continental shelf (including the upper slope); the calico scallop, royal red shrimp, and other productive benthic fishing grounds; other special biological resources; and northern right whale calving grounds and migratory routes, and subsequent deletion from inclusion in the respective lease block(s).

11) Planning for oil and gas product transport should be done to determine methods of transport, pipeline corridors, and onshore facilities. Siting and design of these facilities as well as onshore receiving, holding, and transport facilities could have impacts on wetlands and endangered species habitats if they are not properly located.

12) Develop understanding of community dynamics, pathways, and flows of energy to ascertain accumulation of toxins and impacts on community by first order toxicity.

13) Determine shelf-edge down-slope dynamics and resource assessments to determine fates of contaminants due to the critical nature of canyons and steep relief to important fisheries (e.g., swordfish, billfish, and tuna).

14) Discussion of the potential adverse impacts upon fisheries resources of the discharges of all drill cuttings that may result from activities in, and all drilling muds that may be approved for use in the lease area or the Exploration Unit area including: physical and chemical effects upon pelagic and benthic species and communities including their spawning behaviors and effects on eggs and larval stages; effects upon sight feeding species of fish; and analysis of methods and assumptions underlying the model used to predict the dispersion and discharged muds and cuttings from exploration activities.

15) Discussion of secondary impacts affecting fishery resources associated with on-shore oil and gas related development such as storage and processing facilities, dredging and dredged material disposal, roads and rail lines, fuel and electrical transmission line routes, waste disposal, and others.

6.6.5 Joint Agency Habitat Statement

The SAFMC has endorsed a "Joint Statement to Conserve Marine, Estuarine, and Riverine Habitat" to promote interagency coordination in the preservation, restoration, and enhancement of fishery habitat. This statement as adopted by state, Federal, and regional bodies concerned over fishery habitat, is presented in Appendix VII along with the Atlantic States Marine Fisheries Commission policy on marine, estuarine, and riverine habitat.

6.6.6 Additional Recommendations to Protect Shrimp Habitat

1) Alteration of coastal wetlands and shallow water areas will be discouraged. Coastal construction and dredging projects should employ best engineering and management practices (e.g., seasonal restrictions, dredging methods, disposal options, wetland revegetation, etc.).

2) The best available technology should be utilized to control industrial wastewater and sewage discharges in areas important to the reproduction and survival of shrimp.

3) Except in designated mixing zones, industrial and power generating facilities should not discharge thermal effluents that would raise ambient water temperatures to levels harmful to shrimp stocks or their food sources.

4) Important shrimp habitat should be protected from significant adverse impacts from offshore oil and gas exploration and non-energy mineral exploration and development.

5) Dredge and fill permits issued by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act and Section 10 of the River and Harbor Act should require that project proponents address the full range of impacts on shrimp, their habitat, or food source which may be associated with project implementation.

6) The U.S. Soil and Conservation Service, U.S. Forest Service, and other Federal and State agencies should evaluate present agricultural and forestry standards for best management practices to prevent further degradation of shrimp habitat by non-point source pollution.

7) Agencies involved in permits and licenses to alter aquatic or benthic habitat for any shrimp life stage should consider the economic value of the shrimp resource in their deliberations.

6.6.7 Habitat Research Recommendations

Research conducted to date establishes the direct link of the shrimp resource to estuarine habitat. Research efforts should assess localized habitat improvement and conservation needs.

Preservation of remaining habitat and restoration of degraded habitat should therefore direct state, Federal, and private research efforts in order to allow the SAFMC to develop measures that best manage shrimp and their essential habitat.

6.7 Environmental Significance and Impact of the Fishery, Proposed Action, and Alternatives

Long-Term Productive Capacity

The proposed action, and alternatives which are variations of that action, are not expected to jeopardize the long-term productive capacity of any stocks that may be affected by the proposed action. The action is anticipated to have a positive impact by enhancing the short-term productive capacity of the white shrimp stock in years where a closure is implemented. Protection of remaining white shrimp spawning stock in freeze years would not only benefit the stock but also the harvesting sector. In addition to benefiting shrimp populations, closures may also reduce fishing time and potential exposure to threatened and endangered sea turtles. The action may therefore enhance existing regulations and result in a positive factor affecting the long-term productive capacity of these species. For additional justification see Sections 5.2, 5.4, 5.5, 6.0, 6.1.3, 6.2, 6.3, 6.5, 6.6, 8.2.2.3, 8.2.2.4, 8.2.7, 8.2.8, 8.2.9, 12.0, 12.1, and 13.0.

Damage to Ocean and Coastal Habitats

The proposed action, and alternatives which are variations of that action, are not expected to allow substantial damage to ocean and coastal habitats. In contrast, the plan identifies activities which result in the degradation or loss of essential shrimp habitat, and sets forth recommendations for Federal, state, and private entities to eliminate or reduce impacts on essential habitat.

Shrimp trawl gear, when modified to harvest finfish, can potentially impact live or hard bottom fishery habitat (SAFMC 1988). The fishery as presently prosecuted nearshore on sand and mud bottoms does not significantly impact this live bottom habitat essential to reef and pelagic species under council management. This essential fishery habitat was protected when the Secretary of Commerce approved Amendment #1 to the council's snapper grouper fishery management plan (SAFMC 1988) which prohibits the use of roller trawls in the south Atlantic region on live bottom. For additional justification see Sections 6.0, 6.1.3, 6.2, 6.3, 6.4, 6.5.4, 6.6, 7.3.14, 12.8.2, and 15.0.

Public Health and Safety

The proposed action, and alternatives which are variations of that action, are not expected to have any substantial adverse impact on public health or safety. A possible positive safety benefit of the proposed action is that when closures are implemented they will occur during historically poor winter weather periods. For additional justification see Sections 6.0, 12.8.2, 13.0, 14.0, and 15.0.

Endangered Species and Marine Mammals

The proposed action, and alternatives which are variations of that action, are not expected to affect adversely an endangered or threatened species or marine mammal population. For additional justification see Sections 7.3.5, 7.3.15, 8.2.2.4, 16.0, and Appendix VIII and IX.

Cumulative effects

The proposed action, and alternatives which are variations of that action, are not expected to result in cumulative adverse effects that could have a substantial effect on the shrimp resource or any related stocks including sea turtles. For additional justification see Sections 6.0, 7.3.5, 7.3.15, 8.2.2.4, 13.0, and 16.0.

7.0 FISHERY MANAGEMENT JURISDICTION, LAWS, AND POLICIES

7.1 Management Institutions

7.1.1 State Management Institutions

7.1.1.1 North Carolina

The Division of Marine Fisheries, an agency within the Department of Environment, Health, and Natural Resources, has responsibility for managing coastal fisheries including the shrimp fishery. The division is governed by the North Carolina Marine Fisheries Commission, a body composed of 15 members appointed by the Governor, which is responsible for promulgating regulations for management, protection, preservation, and enhancement of marine and estuarine resources of the state including commercial and sport fisheries regulations.

General statutes deal primarily with licenses, taxes, record keeping, enforcement, and leasing procedures. All other aspects of shrimp management, including opening or closing of seasons and areas to shrimping and gear and equipment restrictions, are promulgated by the Division.

7.1.1.2 South Carolina

The South Carolina Wildlife and Marine Resources Department (SCWMRD), Division of Marine Resources, is responsible for conservation and management of the state's marine resources. The Department is governed by a nine member board, the South Carolina Wildlife and Marine Resources Commission. The Division is responsible for managing and developing South Carolina's commercial and recreational shellfish, crustacean, and finfish resources; collecting and analyzing fisheries statistics; evaluating permit applications from the Coast Guard, Corps of Engineers; and the South Carolina Coastal Council; developing environmental impact statements; and developing marine recreational fisheries. The Department is also responsible for enforcing fishery regulations.

Most of the regulatory authority of the Division is specified by statute, including provisions for legal trawling areas, gear restrictions, licenses, and taxes. The Division has control over the shrimp season in coastal waters and any area where trawling is permitted may be opened or closed at any time.

7.1.1.3 Georgia

The Georgia Department of Natural Resources, Coastal Resources Division, is responsible for conservation and management of Georgia's estuarine and marine resources. The Department is headed by a Commissioner and a 15 person board. The Georgia General Assembly, in 1989, passed Act 644 which empowered the Board of Natural Resources to adopt rules and regulations to control the harvest of seventeen species of marine fish. Enforcement of fishery regulations is the responsibility of the Georgia Game and Fish Division. Many of the regulations pertaining to the shrimp fishery are specified by state legislation. The board has authority to promulgate regulations pertaining to coastal fisheries not contrary to existing statutes.

7.1.1.4 Florida

The Florida Marine Fisheries Commission, created in 1983 and composed of seven members appointed by the governor and cabinet, has full rule-making authority over fisheries and marine life (except endangered species), subject to final approval by the governor and cabinet. The Florida Department of Natural Resources, Division of Marine Resources is charged with administration, supervision, development, and conservation of natural resources within the state. Within the Department, the Marine Research Institute conducts research directed toward fisheries management. The Florida Marine Patrol is responsible for enforcing all marine resource-related laws and all rules and regulations of the Department.

7.1.2 Federal Management Institutions

7.1.2.1 Regional Fishery Management Councils

The South Atlantic Fishery Management Council, under the Magnuson Act, is charged with preparing fishery management plans for fisheries within its area of management authority, from the Florida East coast to the North Carolina/Virginia border. The Council prepares plans that cover foreign and domestic fishing, and submits them to the Secretary of Commerce for approval and implementation. Once implemented, it is the responsibility of the National Marine Fisheries Service (NMFS) and the U.S. Coast Guard to enforce the laws and regulations.

7.1.2.2 Atlantic States Marine Fisheries Commission

The Atlantic States Marine Fisheries Commission's Interstate Fishery Management Program was initiated through a cooperative agreement with the NMFS in 1980 and promotes cooperative management of marine, estuarine, and anadromous fisheries in east coast state waters. This program determines priorities for territorial sea fisheries management; develops, maintains, and reviews management plans for high priority fisheries; recommends to states, regional fishery management councils, and the Federal government, management measures to benefit such fisheries; and provides a means of conducting short-term research to facilitate preparation or review of fishery management plans. The Interstate Fishery Management Program board is comprised of fisheries administrators from the fifteen Atlantic coast member states, a representative from NMFS, and a representative from the U.S. Fish and Wildlife Service.

7.1.2.3 National Marine Fisheries Service (NMFS)

NMFS, under the National Oceanic and Atmospheric Administration (NOAA), collects commercial and recreational fishery statistics, develops fish stock assessments, and provides technical expertise to facilitate the regional councils' conservation and management of fisheries through the development of fishery management plans. NMFS responsibilities also include habitat, marine mammals, and endangered species. NMFS shares responsibility for enforcing Magnuson Act regulations with the U.S. Coast Guard.

7.1.2.4 Office of Ocean and Coastal Resource Management

The Office of Ocean and Coastal Resource Management asserts authority through National Marine Sanctuaries pursuant to Title III of the Marine Protection, Research, and Sanctuaries Act. Several sites have been designated marine sanctuaries along the Atlantic coast (e.g., Florida Keys National Marine Sanctuary). This office also establishes standards for approving and funding state coastal zone management programs. A fishery management plan is forwarded to the states to determine if the plan is consistent to the maximum extent practicable with their approved coastal zone management program.

This shrimp management plan has been distributed to North Carolina, South Carolina, and Florida. The State of Georgia is developing a state coastal zone management plan and program.

7.1.2.5 National Park Service

The National Park Service, under the Department of Interior, establishes coastal and nearshore national parks and monuments such as the Everglades National Park, and retains authority to regulate fishing practices within their area of jurisdiction.

7.1.2.6 U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service, under the Department of Interior, manages fish pursuant to the Endangered Species Act (Section 7.4.5) and the Fish and Wildlife Coordination Act (Section 7.4.7). They review and comment on proposed activities affecting navigable waters that are sanctioned, permitted, assisted, or conducted by Federal agencies, focusing on impacts to fish, wildlife, and the habitat on which they depend.

7.1.2.7 Environmental Protection Agency

The Environmental Protection Agency regulates the discharge of pollutants into marine waters. Certain standards must be met before a National Pollutant Discharge Elimination System permit will be issued by the agency.

7.1.2.8 Corps of Engineers

The U.S. Army Corps of Engineers (COE), pursuant to the Clean Water Act, regulates the disposal of dredged material. A number of state and Federal agencies comment on proposed projects which are considered by COE before issuing permits.

7.1.2.9 U.S. Coast Guard

The U.S. Coast Guard shares the responsibility for enforcing regulations promulgated pursuant to the Magnuson and Lacey Acts with the NMFS.

7.2 Summary of State and Local Laws, Regulations and Policies

A summary of shrimp regulations for North Carolina, South Carolina, Georgia, and Florida is shown in Table 14.

7.3 International Treaties and Agreements

Foreign fishing is prohibited within the EEZ for anadromous species and continental shelf fishery resources beyond the EEZ out to the limit of United States jurisdiction under the Convention of the Continental Shelf unless authorized by an international agreement which existed prior to passage of the Magnuson Act and is still in force and effect or authorized by a Governing International Fishery Agreement which has been issued subsequent to the Magnuson Act. There are no pre-Magnuson Act agreements affecting Atlantic coast shrimp.

7.4 Federal Laws, Regulations, and Policies

7.4.1 Magnuson Fishery Conservation and Management Act of 1976

The Magnuson Act provides a national program for the conservation and management of fisheries to allow for optimum yield (OY) on a continuing basis and to realize the full potential of the nation's fisheries resources. Under the Act, eight Regional Fishery Management Councils are charged with preparing fishery management plans for the fisheries within their areas of management authority. The Councils prepare management plans that cover foreign and domestic fishing and submit them to the Secretary of Commerce for approval and implementation. Once implemented, it is the responsibility of the NMFS and the U.S. Coast Guard to enforce the laws and regulations.

7.4.2 Marine Protection, Research, and Sanctuaries Act of 1972

The Marine Protection, Research, and Sanctuaries Act of 1972 (16 U.S.C. 1431-1434) authorizes the Secretary of Commerce to designate as marine sanctuaries those areas of ocean waters within U.S. jurisdiction determined to be necessary for preserving or restoring their conservation, recreational, ecological, or esthetic values. On November 7, 1988 this Act was amended and reauthorized through 1992 by PL 100-627.

7.4.3 Oil Pollution Act of 1961

The Oil Pollution Act regulates intentional discharge of oil or oily mixtures from ships registered in the U.S. and thus provides some degree of protection to fishery resources. Tankers cannot discharge oil within 92 km (50 nm) of the nearest land. Ships other than tankers must discharge as far as practicable from land. The quantity of oil which can be discharged is also regulated.

7.4.4 Coastal Zone Management Act

The Coastal Zone Management Act of 1972 (16 U.S.C. 1451) establishes a national policy placing responsibility for comprehensive land and water management of the coastal zone upon the coastal states. Federal actions directly affecting a state's coastal zone must be as consistent as possible with approved state coastal zone management plans. In the south Atlantic region, North Carolina, South Carolina, and Florida have programs approved by the Secretary of Commerce. In January 1992, Georgia Department of Natural Resources was designated as the lead agency to develop and implement Georgia's coastal management program.

7.4.5 Endangered Species Act of 1973

The Endangered Species Act provides for the listing of plant and animal species as threatened or endangered. The taking or harassment of listed species is prohibited. The Act establishes a process which seeks to ensure that projects authorized, funded, or carried out by Federal agencies do not jeopardize the existence of these species or result in destruction or modification of habitat determined by the Secretary to be critical.

7.4.6 National Environmental Policy Act

The National Environmental Policy Act requires that Federal agencies prepare environmental impact statements prior to undertaking major activities which might significantly affect the quality of the human environment. These impact statements are to evaluate any alternatives to the proposed action which may better safeguard environmental values.

7.4.7 Fish and Wildlife Coordination Act

Under the Fish and Wildlife Coordination Act, the U.S. Fish and Wildlife Service and the NMFS review and comment on fish and wildlife aspects of proposals by Federal agencies which take place in or affect navigable waters. The review focuses on potential damage to fish and wildlife and their habitat.

7.4.8 Fish Restoration and Management Projects Act

The Fish Restoration and Management Projects Act appropriates funds to state fish and game agencies for fish restoration and management projects. Additional funds for the protection of threatened fish communities located within state waters, including marine areas, could be made available under the Act.

7.3.9 Lacey Act Amendment of 1981

The Lacey Act Amendments of 1981 strengthen and improve enforcement of Federal fish and game laws and provides Federal assistance in enforcement of state laws. The Act prohibits import, export, and interstate transport of illegally taken fish or wildlife.

7.3.10 Commercial Fishing Industry Vessel Liability Act of 1987

The Commercial Fishing Industry Vessel Compensation and Safety Act establishes guidelines for timely compensation for temporary injury incurred by seamen on fishing vessels.

7.3.11 Plastics Pollution Research and Control Act (MARPOL Annex 5)

The Marine Plastics Pollution Research and Control Act of 1987 implements Annex V of the International Convention for the Prevention of Pollution by Ships and prohibits all vessels, including commercial and recreational fishing vessels, from discharging plastics in U.S. waters and severely limits the discharge of other types of refuse at sea. This legislation also requires ports and terminals receiving these vessels to provide adequate facilities for in-port disposal of non-degradable refuse, as defined in the Act.

7.3.12 Clean Water Act & Water Quality Act of 1987

The Clean Water Act requires that a National Pollutant Discharge Elimination System permit be obtained before any pollutant is discharged from a point source into U.S. waters. Issuance of this permit is based primarily on the effluent guidelines found in 40 CFR 435. However, additional conditions can be imposed on permit issuance on a case by case basis to protect valuable resources in the discharge area (Department of Commerce 1987).

The Water Quality Act of 1987 reauthorized and amended the Clean Water Act. The amendment requires the Environmental Protection Agency to identify and establish numerical limits for each toxic pollutant in sewage sludge and establish management practices to achieve the set limits. It also authorized the National Estuary Program to address estuarine pollution, which is probably the greatest threat to the shrimp population on the Atlantic coast.

7.3.13 The National Aquaculture Improvement Act of 1985

The intent of the National Aquaculture Act, is to stimulate development of the domestic aquaculture industry, replenish depleted fisheries, and reduce the trade deficit in fishery products. Research and development continues on shrimp mariculture.

7.3.14 The Coastal Barrier Resources Act of 1982

The Coastal Barrier Resources Act established a system of 186 undeveloped barrier units comprising 452,839 acres along 667 miles of the Atlantic and Gulf of Mexico shoreline. The barrier island legislation was enacted to create economic disincentives for developing coastal barrier islands by prohibiting expenditure of Federal funds for flood insurance, road and channel construction, and utility construction. Preservation of coastal barriers and associated wetlands helps protect essential shrimp habitat.

7.3.15 The Marine Mammals Protection Act Amendments of 1988

The Marine Mammal Protection Act of 1982 prohibited the taking of marine mammals incidental to commercial fishing unless authorized by a general incidental take permit or a small take exemption. On November 23, 1988, PL 100-711 was signed into law reauthorizing and amending the act. The amendments replace existing provisions for granting incidental take authority by commercial fishermen with an interim exemption system valid until October 1, 1993. Exemptions are available only to U.S. vessels or foreign vessels with valid fishing permits issued under Section 204(b) of the Magnuson Act.

8.0 DESCRIPTION OF FISHING ACTIVITIES

8.1 History of Exploitation

Commercial exploitation of shrimp began around the turn of the century. South Carolina was the leading producer in 1880, the first year the Bureau of Commercial Fisheries compiled records, producing 630,000 lb. The primary gear in the fishery beginning in 1872 through the first decade of the twentieth century was the haul seine. The otter trawl, developed in England, was introduced into the fishery in the early 1900s and rapidly replaced the haul seine as the principal gear.

Shrimp catches increased dramatically with the introduction of trawl gear and by the middle 1920s, the fishery was producing at a level of about 30 million lb. Although landings have fluctuated considerably since then due to a variety of factors, landings have generally been less than this despite increasing number and size of vessels, expanded geographic range, improved gear, etc.

The fleet in the four south Atlantic states and the Gulf Coast of Florida in 1931 consisted of 647 vessels most of which were less than five net tons and between 40 and 60 ft in length. All were rigged with a single trawl of 22 - 100 ft mouth width.

The geographic range of the fishery began to increase during the years prior to 1949, particularly in North Carolina where expansion of the brown and pink shrimp fisheries had occurred. In the late 1940s, there were two types of trawling vessels, smaller nearshore trawlers (30-45 ft) and large offshore vessels (50-65 ft). The larger boats pulled single nets with up to 120 ft mouth opening. Eventually the single rig was replaced by the, now standard, double trawl rig.

8.2 Domestic Commercial and Recreational Fishing Activities

8.2.1 Participating User Groups

In the south Atlantic area there are essentially three user groups: commercial, recreational, and licensed bait shrimp trawlers. Each of these groups is discussed below.

8.2.1.1 Commercial

Commercial shrimp fishermen who shrimp in state waters are required to purchase a commercial license in all states in the south Atlantic region. In North Carolina, in 1990 there were 1,956 full-time commercial and 1,832 part-time commercial shrimping licenses issued (Table 15); however, active trawlers are believed to be many fewer. Licenses are required to use gear that is considered commercial regardless of whether or not the shrimp are sold. In South Carolina in 1990 there were 579 resident and 378 non-resident commercial shrimp trawling licenses issued for a total of 957 (Table 16). In Georgia 501 commercial shrimp trawling licenses were issued in 1990 (Table 17). In Florida there were 299 commercial shrimp trawlers in 1990 (Table 18). The number of commercial vessels historically employing shrimp otter trawls in the region is shown in Table 19.

8.2.1.2 Recreational

Recreational shrimpers are only licensed in South Carolina, where a license is required to fish for shrimp over bait. Thus, it is very difficult to estimate the total number of recreational shrimp fishermen. In South Carolina, a license to shrimp over bait has been required since 1988. A summary of permits issued, participation, and catch in this fishery is shown in Table 20. In 1991 there were over 12,000 permits issued and more than 34,000 participants in the fishery.

In Georgia, a telephone and access intercept survey conducted in 1989 estimated that 47,723 individuals participated in the recreational cast net shrimp fishery in summer and 23,298 in fall. These cast netters were estimated to have taken 184,887 total trips and caught 576,000 pounds of shrimp, most of which were white shrimp (Williams 1990).

8.2.1.3 Commercial Bait Fishery

There is very little effort directed specifically for commercial bait shrimp in either North or South Carolina. In Georgia, there were 62 licensed bait shrimpers in 1991-92. These fishermen are allowed to trawl in designated zones with nets up to 20 ft wide and possess up to 50 quarts of shrimp, no more than 10 percent of which can be dead.

The commercial bait shrimp fishery in Florida is much larger than in the other south Atlantic states. Live shrimp for bait are caught in Dade County and in the six county area around the St. Johns River. A total of over 36 million live shrimp (mostly pink shrimp) was estimated to have been taken from Biscayne Bay (Dade County) in 1983 (Berkeley et al., 1985). Bait shrimp licenses have varied between 52 and 110 in the St. Johns River area between 1976 and 1981 with an additional 28 boats fishing in Biscayne Bay (estimated number in 1983).

8.2.2 Catches and Landings

8.2.2.1 Seasons

Shrimp landings vary seasonally, governed primarily by the life cycles of the particular species. The peak shrimping season generally runs from July through October. In North Carolina, commercial quantities of pink shrimp appear in early spring with peak catches usually in mid-May. By mid-July, the season for brown shrimp reaches its peak and continues until late fall, when shrimp leave coastal waters. Relatively small catches of white shrimp occur in the Southport-Cape Fear area in North Carolina in fall.

In South Carolina, overwintering white shrimp appear in early spring, with the season generally opening in May. These roe shrimp will be fished until June or early July when brown shrimp begin to occur in offshore waters. Brown shrimp will be fished until early autumn at which time white shrimp predominate in the catch until the fishery closes in December.

In Georgia, the seasonality of the fishery is similar to South Carolina. On the east coast of Florida, the fishery is dominated by white shrimp, which may be available as late as March in central Florida.

8.2.2.2 Commercial Catches and Landings

Reported landings by species by month for the region are shown in Tables 21-24, and by state by year in Tables 25-27. In general, brown shrimp are most important in North Carolina, with significant catches of pinks and small catches of white shrimp. In South Carolina, Georgia, and the Florida East Coast, white shrimp are almost always the most important species in the catch, although in some years of low white shrimp abundance, brown shrimp may predominate (e.g., 1977 in South Carolina). Pink shrimp are always a minor component of the catch in these states.

8.2.2.3 Discards and Bycatch

The discarded bycatch of fish and crustaceans in the shrimp trawl fishery is highly variable by season and area. Previous studies of the ratio of finfish (lb) to shrimp (lb heads on) in North Carolina indicate that the daytime ratios are consistently higher than nighttime ratios due to an increase in shrimp catch rather than a decrease in fish. Combining data from a variety of studies, the median ratio was 4.1:1 with 95% confidence limits of 1.7:1 and 15.1:1 (Keiser 1977).

For South Carolina, the ratio estimates were 2.58:1 for May to August and 1.20:1 for September to December with confidence limits (25th and 75th percentiles) of 1.24:1 and 5.43:1 and 0.56:1 and 2.66:1 respectively (Keiser 1977).

For Georgia a mean ratio of 2.55:1 with 95% confidence limits of 0.33:1 and 19.54:1 was calculated. The median was calculated as 2.56:1 with confidence limits of 0.98:1 and 4.43:1. In Florida, the estimated fish to shrimp ratio was 3.8: 1 (Keiser 1977).

All of the above estimates were made prior to the mandated use of TEDs and thus may not be representative of the current finfish bycatch. A more recent study in South Carolina waters was conducted to evaluate catches of fish and shrimp using a 72 ft Falcon trawl with the NMFS TED and the Georgia Jumper TED, and a control net (Wenner 1987). Sampling during July-August 1986 indicated a ratio of 6.77:1 pounds of finfish to pounds of heads on shrimp (almost entirely brown shrimp), using a NMFS TED. On another series of experimental tows using the Georgia Jumper TED the ratio was 8.35 : 1. On another series of tests, the ratios were 7.02:1 and 10.43:1 for the NMFS and Georgia Jumper TEDs respectively.

Another series of tests was conducted during September - October 1986 when the principal shrimp species was white shrimp (Wenner 1987). Results with the NMFS TED, when towed along with a control net, indicated a ratio of fish to shrimp of 1.20:1. For the Georgia Jumper towed along with the control net the ratio was 6.60:1. When the NMFS and Georgia Jumper TEDs were towed together, ratios were 2.33:1 for the NMFS TED and 2.40:1 for the Georgia Jumper.

Fishes of recreational interest caught during this study included crevalle jack, Atlantic spadefish, weakfish, spot, southern kingfish, gulf kingfish, Atlantic croaker, summer flounder, southern flounder, bluefish, king mackerel, Spanish mackerel, red drum, and Florida pompano. The proportion of fish of recreational interest to total finfish bycatch ranged between 52% and 74% for brown shrimp tows and between 17% and 56% for white shrimp tows.

8.2.2.4 Turtle Interactions and TEDS

While the proposed regulations contained in this fishery management plan will not themselves have any impact on threatened or endangered species, the fishery itself does have a significant interaction with sea turtles, all species of which are listed as either threatened or endangered under the ESA of 1973, 16 U.S.C., 1531 et seq. Incidental capture by shrimp trawlers has been documented for loggerhead, Kemp's ridley, green, leatherback, and hawksbill turtles in coastal waters of the southeastern United States and Gulf of Mexico.

Regulations promulgated by NMFS under the authority of the Endangered Species Act, required shrimp trawlers in Federal or state waters off the southeastern Atlantic coastal states to comply with Federal sea turtle conservation requirements. The final rule as published in the Federal Register is presented in Appendix VIII.

NMFS estimated that prior to 1987, commercial shrimp trawlers killed more than 11,000 sea turtles annually in waters off the south Atlantic and Gulf of Mexico states (Henwood and Stuntz 1987). A more recent review and analysis of existing information by the National Academy of Sciences (1990) found that the NMFS estimates were conservative, and that the number of turtles killed by shrimp trawlers could be as high as 44,000 each year which makes this is the largest human-caused source of turtle mortality in U.S. waters.

A biological opinion on the implementation of the 1987 Sea Turtle Conservation Regulations (52 FR 24244, June 29, 1987) was submitted on September 30, 1987. The 1987 opinion addressed the potential adverse effects to listed species of implementation of the rule, and concluded that the regulations would have a positive impact on sea turtles by substantially reducing mortalities.

NMFS issued regulations under the ESA on June 29, 1987 [52 FR 24244], to reduce the incidental capture of sea turtles by shrimp trawlers. Trawlers 25 feet or longer were required to use TEDs in offshore waters, and were required to limit tow times to 90 minutes or use TEDs in inshore waters (landward of the COLREGS line). Trawlers less than 25 feet in length were required to use 90 minute tow times or TEDs in inshore and offshore waters. These conservation measures were required in the waters off the southeastern Atlantic United States (North Carolina through Florida) from May 1 through August 31, except for the Canaveral area where the regulations were in place year round. In addition to the Federal TED regulations, Florida required the use of TEDs year round in all state waters, and Georgia required TEDs in all shrimp trawls used in inside waters. In waters seaward of the sounds, TEDs were to be used from April 1 to December 31 south of 31°20' N latitude and from April 1 to November 30 north of this latitude.

Research and sea turtle stranding reports from North Carolina through Florida have shown a strong correlation between sea turtle mortality and shrimp and other bottom trawling efforts along the Atlantic coast when TEDs or restricted tow times were not required. In 1991, NMFS estimated annual sea turtle captures and mortalities by shrimp trawlers under the original 1987 sea turtle conservation regulations assuming 100 percent regulation compliance and 100 percent survival of all comatose turtles (Henwood et al. 1992). NMFS estimated that in the Atlantic area offshore fishery, 2,204 sea turtles are killed annually in shrimp trawls. Of these, 2,126 are estimated to be killed in shrimp trawls during the months of September through April, when TEDs or restricted tow times are not generally required. NMFS also estimated that 996 turtles are killed in shrimp trawls in inshore Atlantic Ocean waters under the 90 minute tow time requirement and seasonal conservation requirements. Based on these findings, an estimated 3,200 turtles are killed annually in U.S. Atlantic Ocean shrimp trawl fisheries even with implementation of the 1987 sea turtle conservation regulations, assuming 100 percent compliance. Although these estimates did not take into account the additional protection provided by Georgia's TED regulations (Florida's year round TED requirement was accounted for), they were still likely to be conservative given the N.A.S. conclusion that the NMFS estimate may be low by a factor of up to four times. NMFS analyzed whether the measures shrimp trawlers were required to employ to reduce the mortality of sea turtles incidentally taken in the shrimp trawl fishery were adequate to conserve sea turtles. Because of extensive strandings of turtles during periods when TEDs were not required, NMFS issued regulations on September 4, 1991 [56 FR 43713], extending the sea turtle conservation regulations from September 1, 1991, through April 30, 1992 in the Atlantic area.

On April 9, 1992, Endangered Species Act (ESA) Section 7 consultation was initiated by the South Atlantic Fishery Management Council. This consultation was to address the potential adverse effects to listed species of both the proposed management action (adoption of a Shrimp Fishery Management Plan for the South Atlantic) and the shrimp fishery itself. At about the same time, the Gulf of Mexico Fishery Management Council requested that NMFS initiate consultation on Amendment 6 to the Gulf of Mexico Shrimp Fishery Management Plan (FMP). ESA Section 7 consultation is required prior to implementation of new FMPs or amendments to existing FMPs.

Proposed regulations under the ESA were published by NMFS on April 30, 1992 (57 FR 18446). NMFS held public hearings on the proposed regulations in each state where shrimp trawlers would be affected. NMFS subsequently extended the comment period to October 23, 1992. On September 8, 1992 (57 FR 40861) NMFS issued a final rule effective September 1, 1992 that extended the sea turtle regulations in the Atlantic area to year-round rather than May 1 through August 31. Effective November 1, 1992 in all areas where tow times were used in place of TEDs, tow times were reduced from 90 to 75 minutes. The interim rules also eliminated the exemption for the rock shrimp fishery in the Atlantic and provided for exemptions for vertical barred beam trawls, roller trawls, wing nets, skimmer trawls, pusher-head trawls, and bait shrimpers.

NMFS indicated that since both consultations address shrimp fisheries in the southeastern United States, the potential adverse effects of South Atlantic and Gulf of Mexico shrimp fisheries are similar, and because effects to sea turtles must be considered cumulatively in determining whether any species might be jeopardized by this activity, a single consultation was prepared. Although management actions under shrimp FMPs for the South Atlantic and Gulf of Mexico only apply to Federal waters, this consultation extends beyond political boundaries and applies to all areas where shrimp trawling occurs. In addition to the proposed FMP actions this consultation also considers the fishery as it would be conducted under the 1992 Revised Sea Turtle Conservation Regulations.

A Biological Opinion regarding the implementation of the Shrimp Fishery Management Plan for the South Atlantic Region and Amendment 6 to the Gulf of Mexico Shrimp Fishery Management Plan was issued on August 19, 1992 (Appendix IX). NMFS concluded that shrimp trawling in the southeastern United States is in compliance with the 1992 Revised Sea Turtle Conservation Regulations and the proposed management actions under the South Atlantic shrimp FMP and Amendment 6 to the Gulf of Mexico shrimp FMP were not likely to jeopardize the continued existence of threatened or endangered species under NMFS jurisdiction.

As of December 1, 1992 shrimp trawlers must comply with sea turtle conservation measures throughout the year in all areas. Where limited tow times may be used as an alternative to TEDs tows must be limited to 55 minutes or less from April 1 through October 31 and 75 minutes all other times. Effective January 1, 1993 shrimp trawlers under 25 feet in offshore waters can no longer use limited tow times as an alternative to using TEDs. Also effective January 1, 1993, is the requirement that shrimp trawlers in inshore waters must use TEDs unless they are equipped with a single net with a headrope length less than 35 feet and a footrope length less than 44 feet then they can use limited tow times until December 1, 1994. Final ESA regulations for the shrimp fishery were published on December 4, 1992 (FR Doc. 92-29370)(Appendix VIII).

8.2.2.5 Recreational Catches

The extent of the recreational shrimp fishery is not well known. In South Carolina a recreational shrimp license has been required since 1988 to cast net over bait. The season is restricted to 60 days during the white shrimp season (between September and November). However, even in South Carolina, total recreational shrimp landings are not well documented because landings of other species by other gears, or even of white shrimp not taken over bait, are not recorded. Estimated catch and effort in this fishery is shown in Table 20. In 1991, it was estimated that the recreational shrimp baiting fishery in South Carolina took 2.14 million pounds of shrimp in 71,034 trips for an average of 30 pounds (whole) per trip. This comprised 36 percent of the total fall shrimp harvest.

In a survey in North Carolina (Maiolo and Faison 1980), it was estimated that recreational shrimpers caught 91,000 pounds of shrimp, or less than 3 percent of the reported commercial catch.

In a telephone survey and access intercept survey in coastal Georgia, Williams (1990) estimated recreational shrimp catch and effort for 1989. Total cast netting participation was estimated at 47,723 and 23,298 individuals during the summer and fall waves respectively. Total effort was 184,887 cast netting trips for both waves combined and total harvest by cast netters using boats was estimated to be 576,000 pounds. The average participant made eight trips in 1989, spent two hours casting, and caught 7.9 pounds of shrimp per trip. September was the peak month for both catch and effort.

There are no estimates of recreational shrimp catches for Florida, but it is believed that the recreational catch is significant.

8.2.3 Fishing and Landing Areas

8.2.3.1 Commercial Fishing Areas

The commercial fishing area for penaeid shrimp species covered by this plan extends from Fort Pierce, Florida to Pamlico Sound and Ocracoke Inlet, North Carolina. The most important fishing area in Florida is in the northeastern part of the state, between Fernandina Beach and Melbourne, just south of Cape Canaveral. In Georgia, shrimping takes place along the entire coast. In South Carolina, the most important shrimping areas are from Georgetown (Winyah Bay) south, while in North Carolina, the important shrimping areas are in Pamlico Sound and off the southern coast, south of Ocracoke Inlet.

Commercial shrimp catches in all four states are taken from internal waters, state waters out to three miles, and from the EEZ. In Georgia, commercial shrimping is generally allowed in internal waters only for bait.

The proportion of each state's shrimp production from inside and outside the EEZ is shown in Tables 25-27. According to "Fisheries of the United States 1988", in 1988, 9,531 mt of shrimp were landed in the south Atlantic region from state waters (87%) compared to 1,466 mt (13%) from the EEZ (DOC 1989). In the 1991 edition of the same publication 1990 shrimp landings in the south Atlantic region were 8,927 mt inside three miles (69%) and 3,979 outside three miles (31%) (DOC 1991). These figures presumably include rock shrimp and royal red shrimp landings.

In North Carolina, almost all of the shrimp catch comes from internal waters. In South Carolina, it has been estimated that about 5 to 10 percent of the shrimp catch is taken in the EEZ. In Georgia, because of extensive nearshore shoaling, significant effort is expended beyond three miles, and a higher percentage of the catch is taken from the EEZ (Tables 25-27). In Florida, it has been estimated that 12-15 percent of the non-rock shrimp catch comes from the EEZ.

8.2.3.2 Recreational Fishing Areas

The major areas for recreational shrimping in North Carolina are from Carteret County south to the state line and to a lesser extent in the tributaries of Pamlico Sound. In South Carolina, recreational shrimping takes place along the entire coast, with most activity from Winyah Bay south. Georgia's sport bait trawling zones occur throughout the coastal area. Recreational beach seining is concentrated on Tybee, Sapelo, St. Simons, Jekyll, and Cumberland Islands. In Florida, major sport shrimping areas are the St. Johns River area, the area around Ponce De Leon Inlet, and in the southern part of the state in Biscayne Bay.

8.2.4 Vessels and Gear

8.2.4.1 Trawl Vessels

The number of permitted commercial trawl vessels is shown in Tables 15-18. Most newer trawl vessels are 75-80 feet in length and are rigged to tow two nets simultaneously. The double-rigged shrimp trawler has two outrigger booms from whose ends, through a block, the cable from the winch drum is run to the two nets. Vessels used in inshore shrimping are usually smaller than those which work offshore, and are frequently rigged to tow a single net from the stern. Figure 5 shows a double rigged shrimp vessel towing two nets and a try net. Figure 6 shows in detail how a double-rigged shrimp trawler is rigged.

8.2.4.2 Fishing Gear and Operation

Essentially the only gear used in the commercial fishery is the otter trawl. There are four basic designs used in the south Atlantic shrimp fishery: flat, semi-balloon, balloon, and tongue or mongoose trawls.

The otter trawl consists of (1) a cone-shaped bag in which the shrimp catch is gathered into the tail or cod end; (2) wings on each side of the net for herding shrimp into the bag; (3) trawl doors at the extreme end of each wing for holding the wings apart and holding the mouth of the net open; and (4) two lines attached to the trawl doors and fastened to the vessel. A ground line extends from door to door on the bottom of the wings and mouth of the net while a float line is similarly extended at the top of the wings and mouth of the net. With flat nets, the mouth is rectangular, with the ground line more or less straight. With the balloon net, the float line forms an arc when the net is towed. The mongoose net has a triangular tongue or wing attached along the midsection of the float line and connected to a center towing cable. This configuration allows the net to spread wider and higher than conventional nets and as a result has gained much popularity for white shrimp fishing.

A flat net is more often used when fishing for brown shrimp since they burrow into the bottom to escape the trawl. This net has a wider horizontal spread than other designs and is believed more effective for this species. White shrimp try to escape by jumping off the bottom so the semi-balloon, balloon, and mongoose nets are most often used for this species.

Some vessels use twin trawls, which are essentially two trawls on a single set of doors, joined together at the head and foot ropes to a neutral door connected to a third bridle leg. Thus, instead of towing two 70 foot nets the vessel tows four 35 foot nets. This rig has some advantages in ease of handling and increased efficiency.

The length of tows varies depending on many factors including amount of bycatch species and concentration of shrimp. Small boats fishing inshore waters make much shorter drags than the larger, offshore vessels whose tows generally last several hours.

In some areas, primarily North and South Carolina, channel nets are also used for commercial shrimping. Channel nets are essentially anchored shrimp trawls which fish at or near the surface, being held open by currents. Another minor gear, butterfly nets, which are rectangular nets held open by a frame and attached to the side of the vessel, are used in a few areas. Haul or beach seines are also used to a minor extent for commercial fishing in some areas.

8.2.4.3 Participation in Other Fisheries

Participants in the commercial shrimp fishery are involved in a wide variety of other fisheries. Small boats may be involved in virtually any inshore fishery from clamming and oystering to crab trap fishing and a variety of net fisheries. Larger vessels often participate in other trawl fisheries including whelk, rock shrimp, and calico scallop as well as other hook and line fisheries for bottom fishes (including wreckfish), and longline fisheries for tuna and swordfish. In addition to participating in fisheries for other species, many of the larger shrimp vessels in the region are very mobile within the shrimp fishery and may move anywhere throughout the south Atlantic states and the Gulf of Mexico.

8.2.5 Bait Shrimp Fishing

In Georgia, permits are required for both sport and commercial bait shrimp fishermen. Sport bait shrimpers are allowed to use a 10 foot otter trawl in designated areas, cannot sell or consume the shrimp caught under this permit, and are limited to 2 quarts of shrimp per person or 4 quarts per boat per day. Commercial bait shrimp fishermen may use nets up to 20 feet and take up to 50 quarts of live shrimp per day with a small allowance for dead shrimp.

In Florida, the bait shrimp fishery is much larger than in the other south Atlantic states. A variety of gear is used in this fishery, but otter trawls and roller frame trawls are the most commonly used gears. Landings of live shrimp taken by the bait shrimp fishery is shown in Table 18.

In North and South Carolina, while some shrimp are sold as bait, there is no organized bait shrimp fishery, nor specific laws pertaining to shrimping for bait.

8.2.6 Competition and Conflict

8.2.6.1 Among Shrimpers (Taken verbatim from SAFMC 1981)

"As long as two or more people are attempting independently to obtain the greatest portion possible of a limited resource, there will be competition. When the activities of one person affect negatively the ability of another to harvest the resource, other than by affecting the amount available for him to harvest, there is a conflict. In the shrimp fishery a good example of competition is the relationship between an inshore commercial channel netter and an offshore trawler operator; they affect only the amount of shrimp the other can catch. A conflict exists between a channel net operator and a trawler operator who attempt simultaneously to fish in the same river channel. They affect not only how much the other catches but also the ability to catch shrimp in the future by negatively affecting gear. Though competition is very great among shrimpers, conflicts are generally less common and isolated. This is the case due to management of shrimping methods, gears, areas, and times by regulatory state agencies with the prevention of conflict as a major objective. Without such management controls, conflicts would be inevitable.

Several specific forms of competition among shrimpers involve wastes, or perceived wastes, of portions of the shared resource. The problem of discards of pre-commercial size shrimp taken along with commercial size shrimp exists primarily in the inshore North Carolina waters but occurs occasionally in South Carolina as well. In North Carolina's sounds during the fall of some years major migrations of brown shrimp enter sandy bottom, high salinity pink shrimp nursery grounds near inlets. To continue working on the brown shrimp, a shrimper is actually competing with himself as he is destroying a portion of the source of his future earnings, the spring pink shrimp stock. A similar situation occurs infrequently in South Carolina when small whites enter fishing areas in large numbers. Management actions differ in these situations depending on a variety of factors. The results of a North Carolina study (Waters et al. 1979) state that the potential for increasing income in the fishery through reduced discards exists only at very high discard rates due primarily to high mortality in succeeding months and the low probability of catching those pink shrimp that are saved from discard. It also states the problem is not severe enough to warrant adoption of a management policy to protect juvenile pinks during normal seasons.

Another form of competition involving possible waste is that between seiners and cast netters who harvest and retain or discard pre-commercial size shrimp which could possibly be a more valuable future catch. Operators of large trawlers maintain that netters in nursery areas destroy potentially valuable shrimp to little or no benefit, and they often suggest that the minimum recreational gear mesh size be equal to that imposed on commercial trawlers. In South Carolina, where the minimum mesh (bar) allowed in nursery areas is 1.3 cm (1/2 in), McKenzie and Whitaker (1981) determined that any increase in mesh size probably would eliminate capture of creek shrimp except just before they move into deeper water during later stages of development. Such action would reduce substantially the recreational shrimp catch.

Some general statements can be made concerning the desires of various user groups on the subject of competition. Recreational and bait shrimpers want to utilize moderate size mesh in a wide geographic area for as long a season as possible. Operators of small and medium size trawlers want inshore trawling areas opened as early and as long as reasonable. Some want restrictions put on the activity in nursery areas, and some want limits put on the maximum size trawlers and nets allowed inshore. Operators of large trawlers, in many cases, want inshore areas kept permanently closed, broad restrictions on nursery area activity, and long off-shore seasons. Many trawler operators want out-of-state entry limited but want no limitations which would prevent them from obtaining larger or additional boats, or their sons from entering the fishery."

8.2.6.2 With Other Fisherman (Taken verbatim from SAFMC 1981)

"Competition to a lesser degree than mentioned above and conflicts to a greater degree exist between shrimpers and other fisherman. Shrimpers compete with other fisherman simply by removing such incidental catches as blue crabs and juveniles of commercially and recreationally important finfish, often to the benefit of no one. Conflict for gear space may exist in areas where moving and stationary gear are utilized, a good example being shrimp trawlers and stationary crab traps."

8.2.7 Assessment and Specification of Domestic Annual Harvesting Capacity

The average landings of shrimp in the south Atlantic states has not increased over several decades despite significant increases in the number and efficiency of vessels. Thus, it is believed that the capacity of the domestic fleet considerably exceeds the amount of available resource.

8.2.8 Assessment of Extent to which U.S. Fishermen will Harvest Optimum Yield

Optimum yield is the amount of harvest that can be taken by U.S. fishermen without reducing the brood stock below the level necessary to ensure adequate reproduction. In practice, optimum yield is the amount of shrimp that the fishery can harvest during the legal fishing season which may vary from year to year based on both state regulations and regulations promulgated pursuant to this plan (i.e., closures due to cold kills). Historically this level has averaged approximately 25 million lb. Even if environmental conditions were such that the available resource were to increase to significantly higher levels, the domestic fleet would be capable of harvesting at his level. Thus, under any foreseeable levels of stock, the domestic fleet will harvest optimum yield.

8.2.9 Assessment and Specification of Domestic Annual Processing Capacity

Domestic processing capacity at present far exceeds the availability of domestic shrimp.

8.2.10 Historical and Projected Transfers from U.S. harvester to Foreign Vessels

There is no evidence of historical or projected transfers of shrimp or shrimp products from U.S. harvesters to foreign vessels.

8.3 Foreign Fishing Activity

There is no foreign fishing activity or foreign catch of Atlantic coast shrimp. There are no shrimp in the EEZ in excess of the domestic fishery's ability to harvest optimum yield, thus, total allowable level of foreign fishing (TALFF) is zero.

8.4 Interactions between Foreign and Domestic Participants

As there are no foreign participants in the shrimp fishery of the southeastern Atlantic coast, there are no interactions between foreign and domestic participants. Neither are there interactions between domestic shrimp fisherman and foreign fishermen of other fisheries.

9.0 DESCRIPTION OF THE ECONOMIC CHARACTERISTICS OF THE FISHERY

See Regulatory Impact Review (Section 13).

10.0 DESCRIPTION OF BUSINESSES, MARKETS, AND ORGANIZATIONS ASSOCIATED WITH THE FISHERY

See shrimp profile (SAFMC 1981) and Regulatory Impact Review (Section 13).

11.0 SOCIAL AND CULTURAL FRAMEWORK OF DOMESTIC FISHERMEN

The following material describing the social and cultural framework of south Atlantic shrimpers is a summary of material presented in the Profile of the Penaeid Shrimp Fishery in the south Atlantic (SAFMC 1981) as updated with literature available through 1991.

11.1 Ethnic Character, Family Structure, and Community Organization

11.1.1 Ethnic Character

Ethnic minorities among trawler captains are relatively few. In South Carolina, for example, blacks represented only about 9 percent of total trawler captains in 1980 (Table 28). White captains predominated, particularly for the owner captains (94 percent). In North Carolina 5.2 percent of full-time captains are black while only 1.3 percent of the part-time captains are black. A total of 3.4 percent of all full and part-time captains are black in North Carolina (Maiolo, 1981). In Georgia, approximately 12 percent of trawler captains in 1980 were black (S. Shipman, GA Dept. Nat. Res., Coastal Res. Div., Brunswick GA, pers. comm.). A study of two counties (McIntosh and Glynn) by Nix and Kim (1981) indicated that 24.1 percent of the captains and 33.7 percent of the strikers were black.

11.1.2 Community Organization

There is little information available on community organization. Nix and Kim (1981) found that social participation and community involvement along the Georgia coast is quite limited among shrimp fishermen. They suggest an apparent "community disinvolvement" which is associated with very few social ties, including social organizations or occupational associations. Political participation among shrimp fishermen in the above survey was also limited.

Although the same kinds of social organization typical among other occupational groups are not prevalent among shrimp fishermen, one should not assume that fishermen pursue their occupation in isolation from one another, or from their communities. The extensive amount of time fishermen spend on the water may limit their interaction with other members of their communities, but it also strengthens the social ties between them. Shrimpers frequently share the same churches and schools, and socialize at local fish houses and on the docks (Bradley M. P. Fellows 1992; Sabella et al. 1979). Johnson and Orbach (1990) documented the existence of definite social networks and informal social groups among shrimp fishermen in North Carolina. These social networks are the pathways by which new information is introduced and dispersed within the fishing community and are often important in determining such behavior as fishing patterns and adoption of technological innovations (Johnson and Orbach 1990; Johnson 1986). In most networks there are specific individuals that serve as links between the community and the outside world. Because such individuals are a key source of new information, they are able to influence the opinions of those in shrimping communities and thus to influence the relationship between shrimpers and those outside their occupational group (Bradley M. P. Fellows 1992).

11.2 Age, Education, and Experience of Commercial Fishermen

There is some evidence to indicate that the life styles of participants in the south Atlantic shrimp fishery are changing. New entrants into the fishery are more educated and a greater portion of them come from families in which the father was not a fisherman. Such newcomers are typically born outside of their current community of residence, and tend to average slightly higher income. These new fishermen are more likely to take advantage of financial assistance programs (i.e., Small Business Administration loans) to enhance and maintain the fishery (Fisch and Maiolo, 1981).

Surveys from the early 1980s indicate that captains in North Carolina range in age from 18 to 80. Most are in their forties or younger, with an average age slightly under 47 years (Table 29). About 21 percent are 61 years or older. Part-time captains are generally older than their full-time counterparts. The average level of education (10.5 years) corresponds to less than a high school diploma (Table 30), although 21 percent of the captains have more than a high school education. There is no significant difference between full-time and part-time captains in educational level. The average age of captains in South Carolina is 39 years (Table 31), with about 5 percent 61 years or older. Owner-captains are slightly older than hired captains.

The captains of shrimp vessels in Georgia also tend to be middle-aged (Table 32). More than one-half of the captains (58 percent) are between 26 and 45 years of age, and about 4 percent are 81 years or older.

The average age of trawler captains in the south Atlantic states is 43 years (Table 33). Only slight differences are apparent among the captains of the various types of vessels. The categories of captains are similar in terms of years of formal education. The average experience in commercial fishing is 21 years, of which 10 years were worked as captain and 11 years as crew.

A survey of 29 crew members of North Carolina shrimp vessels (Maiolo 1980) indicates that the average age is 27 years and the average education level is 11 years, somewhat less than a high school education. This reveals that crew members are somewhat younger and marginally better educated than the captains. About 83 percent of crews in the survey identified themselves as full-time fishermen and have been engaged in fishing for 8 years. The general picture is of a middle-aged group of captains with younger crews, both with relatively low levels of formal education which may limit their occupational alternatives.

11.3 Employment Opportunities and Unemployment Rates

Coastal counties in the South Atlantic states had a higher unemployment rate in 1990 than the statewide rate except for Georgia (Table 34). In South Carolina, the unemployment rate for the coastal counties as a whole was 5.8 percent and for the state was 5.6 percent. In North Carolina, the coastal county unemployment rate was 6.5 percent, compared with 4.8 percent for the state as a whole. The unemployment rate for Florida's east coast counties was slightly higher, 5.9 percent, than the state's average rate of 5.8 percent. Georgia's statewide unemployment rate of 6.8 percent was higher than that of coastal counties as a whole, 5.7 percent. However, these general unemployment rates may not be indicative of the employment rate among commercial shrimpers.

Data are not available to indicate the extent of unemployment among commercial fishermen. However, since at least 1980, commercial fishermen have been facing a critical economic situation caused by rising fuel costs and declining shrimp prices in real dollars. This tends to increase the unemployment rate for commercial fishermen. Employment opportunities for commercial fishermen in non-fishery sectors depends upon the individual fisherman's skill either from currently held part-time jobs or alternative jobs held in the past, level of education, age and capacity to learn new skills. Shrimpers willingness to switch to some other source of income is affected by other than remunerative factors. More than an industry, commercial shrimping is a way of life for many of the individuals. Through long, historic participation in the shrimp industry by fishermen, fish dealers, gear suppliers, etc., shrimping has become tradition and a part of group identity in many coastal communities (Sabella et al. 1979).

11.4 Crew Structure and Function

The size, structure, and functions of crews employed in commercial shrimping varies somewhat from vessel to vessel, but several variables appear to be fairly universal throughout the fishery. Small boats (18-35 ft) typically are run by the captain alone, while larger boats have crews of one to four. Tasks performed by the crew include rigging and repairing the boat and equipment, setting and hauling the nets, cooking meals on board, and culling, icing, and heading the shrimp. The crew is typically paid through a share system. The share system divides the costs for fuel, groceries, and other expenses among the captain and crew, then goes on to divide the profits from the catch in the following manner: a certain percentage up front goes to the captain, a certain percentage to the owner of the boat, and the crew and captain divide the rest among themselves (Bradley M. P. Fellows 1992).

Crews are frequently recruited from the shrimp fishermens relatives(Johnson and Orbach 1990; Sabella et al. 1979). Young shrimpers are enculturated, or versed, in their trade and its ways by working with and listening to their older, more experienced kin. New shrimpers work as crew until they are able to secure a loan from a friend, fish house, or bank, or earn enough money to buy a boat of their own (Bradley M. P. Fellows 1992). First boats are usually small (less than 18 ft.), and are used as a means of earning more money to finally upgrade to a large boat and rig.

11.5 Dealer Structure and Function

Seafood dealers perform many services for the fishermen engaged in shrimp fishing and play important roles in the fishing community. Most seafood dealers handle more than one species in their operations. In this case the dealers shrimp fishermen work with may also deal in species such as clams, oysters, and finfish (Bradley M. P. Fellows 1992). Taken from an example in

North Carolina, a dealer typically has around four permanent staff members: a manager, a bookkeeper, and two multi-purpose employees. Additional seasonal staff are hired from the married women and school age youths in the community. In the case of the shrimp fishery, these seasonal employees are hired to remove the heads of the shrimp, a process which has not been mechanized. Usually payment in this system is by the unit (e.g., per bucket) of processed shrimp (Bradley M. P. Fellows 1992). We can assume that these temporary workers' wages are directly related to the abundance of shrimp harvested by the fishermen. The more shrimp there is to process, the more opportunities for work they have.

Drawing again from the example of Carteret county in North Carolina, one can see the intricate relationship that dealers and fishermen share. In order to encourage fishermen to sell catches to them, dealers provide fishermen with numerous services including fuel, ice, dock space, fishing supplies, repair parts, and credit (Bradley M. P. Fellows 1992). Of these services, credit plays a dominant and influential role in the relationship between fishermen and dealer. The shrimper who borrows is expected to sell his catch to the lender exclusively. In this system, the shrimper may set aside a part of his catch to pay off his loan (Bradley M. P. Fellows 1992). This symbiotic relationship benefits the shrimper, for whom it is extremely difficult to obtain loans from commercial banks due to the high risks involved in fishing, by giving him a secure source of credit and access to necessary materials. The dealer benefits from the relationship because he is ensured of a fairly steady supply of shrimp.

11.6 Recreational Fishing

In North Carolina, a typical recreational fisherman is a native North Carolinian (Maiola and Faison 1980). His average age is 45 (range 18 to 78). Average years of education is just under 12, indicating that he has slightly more formal education than his full and part-time fisherman counterparts. Further, 29 percent of the recreational fishermen have experienced some schooling beyond high school. More than a third, 38 percent are employed in white collar occupations, and 52 percent in blue collar jobs most of which are semi-skilled and skilled work roles. Six percent of them were unemployed and 17 percent were retired. Forty-five percent of the respondents spouses work; half are in professional or semi-professional positions (teachers, saleswomen, etc.). About 90 percent of recreational fishermen are married and have two or three children.

About 66.5 percent of total recreational shrimp fishermen were private boat fishermen. The remaining 33.5 percent engaged in shrimping operations on shore, pier, dock, or bridge. The demographic profiles of these fishermen and private boat fishermen utilizing boats less than 8m (26 ft) are not available.

In Georgia, no survey exists concerning socio-economic characteristics of recreational shrimpers.

In Florida, sport fishing for shrimp is primarily a cast netting and seining operation. In the St. Johns River area, there is a significant amount of recreational shrimping. There were 127 recreational shrimping license holders in the area during the 1980-81 season (S. Kennedy, FL Dept. of Nat. Res., Marine Res. Lab., St. Petersburg, FL; pers. comm.). However, demographic data of recreational shrimpers in Florida are not available.

11.7 Economic Dependence and Strategy Among Shrimpers

11.7.1 Economic Dependence

In 1974, 48 percent of Florida commercial fishermen surveyed fished full-time; the remainder reported that some of their income was earned from employment outside of fishing. Owners of shrimp fishing firms earned 21 percent of their income from sources outside of fishing. Many fishermen are not fully dependent on fishing for employment and instead rely on fishing income to supplement that from other industries. A study by Prochaska and Cato (1977) showed that fishermen with income from non-fishing activities had widely varied employment. Based on those who specifically reported type of employment, eight percent were in residential or commercial construction; 17 percent were employed in marine-related jobs such as tugboat captains, marina operators, and boat builders; ten percent were involved in agriculture; nine percent were employed in security type jobs; seven percent held jobs as mechanics and repairmen; and 22 percent had other occupations such as teachers, chemists, optometrists, broadcasters, and flight instructors. Only 21 percent of the respondents said that their non-fishing employment was seasonal.

In 1976, 65 percent of trawler captains in the south Atlantic states were full-time commercial fishermen (Liao 1979). Approximately 50 percent of all captains in mobility Class I trawlers in the region had non-fishery employment. Only 13 and 21 percent of the captains for mobility Classes II and III, respectively, had non-fishery employment. No captain in mobility Class IV trawlers worked outside the fishery; thus, every captain in this category was a full-time commercial fisherman. Eighty-eight of 176 captains in mobility Class I had spent, on the average about 8 months in non-fishery jobs (Table 35). Thus, these are persons who are in occupations other than fishing, but take time off from regular employment, or use their holidays or spare time after working hours, to shrimp commercially. Shrimping is usually done to supplement income from employment outside the commercial shrimping industry for Class I captains. Most of these captains held blue collar jobs. About 12 of 91 captains in mobility Class II had non-fishery jobs in 1978.

In 1980, 81 percent of trawler captains in Georgia were full-timers and the remaining 19 percent had employment outside of shrimping. (Susan Shipman, GA Dept. of Nat. Res., Coastal Res. Div., Brunswick, Ga.; pers. comm.). Only 55 percent of captains in the North Carolina shrimp fishery were found to be full-time fishermen. About 27 percent of the part timers were in maritime related jobs, i.e., seafood processing, boat repair, etc. (Table 36). The remainder reported that they had widely varied non-maritime employment.

11.7.2 Fishing Strategy and Patterns

Shrimping is typically a seasonal activity lasting from spring through fall. In order to stay productive year round, many commercial fishermen participate in other types of fisheries while not shrimping. As stated elsewhere in the FMP (Section 8.2.4.3), these fisheries can include finfishing, oystering, clamming, crabbing, whelk (also known as conch) and scallop trawling, and gill netting. Most of these fisheries are seasonal, with fishermen emphasizing one specific fishery during a particular time of year. Various combinations of these seasonal fisheries are used by the shrimpers to fill out their annual round, or yearly cycle, of fishing activities. Unfortunately, at this time there is little information available pertaining to the exact structure of these annual cycles for the South Atlantic shrimp fishery. Without such information it is difficult to fully understand the significance of shrimping to the fishermen involved.

Fisherman migration is an additional adaptation to the seasonal nature of the shrimp fishery. Rather than switch over to other fisheries available to them locally, some shrimpers choose to temporarily migrate to other states or regions with greater abundances of shrimp. At times, especially for larger vessels, these migrations can last for extended periods of time and take them far up the Atlantic coast or far south to the Gulf of Mexico (Johnson and Orbach 1990). Smaller vessels migrate as well, though their search for shrimp frequently takes them only to states adjacent to their home states.

One example of this type of migratory behavior is taken from a group of shrimpers from southeast North Carolina who travel to South Carolina in the course of their annual round. This migration is partially prompted by increasing competition for resources within the fisherman's home county, and the combination of higher prices and greater abundance of shrimp in South Carolina (Johnson and Orbach 1990). The migration is not, however, undertaken solely for economic purposes. Work life or working conditions are also of key importance in making the decision to migrate for these North Carolina shrimpers. Factors or aspects of the improved work life given by the fishermen included day work (as opposed to night trawling in North Carolina), and a general relaxed air among the migratory fishermen. Without the responsibilities of family and home, the fishermen have more time for leisure and social activities while docked in South Carolina. The overall experience is referred to as a "working vacation" by some of the fishermen (Johnson and Orbach 1990).

11.8 Competition and Conflict

As long as two or more people are attempting independently to obtain the greatest portion possible of a limited resource, there will be competition. When the activities of one person affect negatively the ability of another to harvest the resource, other than by affecting the amount available for him to harvest, there is conflict (Maiolo 1981). In the shrimp fishery a good example of competition is the relationship between an inshore commercial channel netter and an offshore trawler operator; they affect only the amount of shrimp the other can catch. A conflict may exists between a channel net operator and a trawler operator who attempt simultaneously to fish in the same river channel. They affect not only how much the other catches, but also the ability to catch shrimp in the future by negatively affecting gear. Though competition is great among shrimpers, actual conflicts are generally less common and more isolated. This is the case due to management of shrimping methods, gears, areas, and times by regulatory state agencies with the prevention of conflict as a major objective. Without such management controls, conflicts would be inevitable.

Competition and conflicts also occur between shrimpers and other fishermen. Shrimpers compete with other fishermen simply by removing such incidental catches as blue crabs and juveniles of commercially and recreationally important finfish, often to the benefit of no one. Conflict for gear space may exist in areas where moving and stationary gear are utilized, a good example being shrimp trawlers and stationary crab traps.

12.0 MANAGEMENT PROGRAM

12.1 Background

The proposed management program is designed to benefit *Penaeus setiferus*, the white shrimp. Although three species of penaeid shrimp comprise the shrimp fishery in the south Atlantic region, only the white shrimp appears biologically amenable to management action at this time. This is due to the white shrimp's life cycle which makes the population vulnerable to periodic decimation by winter cold kills. Available data suggests that once environmental conditions decimate the adult population, continued fishing on the few remaining adults can further reduce subsequent year class production (Appendix II). Since the value of the few spring roe shrimp that may be caught is small compared to the potential fall production that may be sacrificed by allowing continued fishing after a freeze, it is biologically and economically beneficial to protect the parent stock at these times.

Some data suggests that pink shrimp may be reduced by prolonged cold water conditions. However, unlike with white shrimp, there does not appear to be a biological justification for closing the fishery following cold kills. This is because significant pink shrimp production occurs only in North Carolina, and it is believed that overwintering shrimp that are not harvested before reaching the ocean may simply be lost to the fishery. Further, being at the northern end of their range, larvae produced by these overwintering North Carolina pink shrimp may be carried north by prevailing currents and lost to the system.

The majority of white shrimp caught in the south Atlantic region are caught in state waters (Table 25). Further, shrimp are a highly fecund annual crop and as such are generally not considered subject to overfishing. Fluctuations in abundance reflect year class strength, which is largely determined by environmental conditions. Development of a management plan has been postponed for these and other reasons. However, a number of issues have arisen that require preparation of a fishery management plan.

Recent plan development centered on two issues: requiring use of turtle excluder devices (TEDs) and Federal zone closures when adjacent state waters were closed. The necessity for developing a plan requiring the use of TEDs to reduce turtle mortality was eliminated when their use was required under the Endangered Species Act. The rationale for closing Federal waters was that following winter freezes, while many overwintering white shrimp are killed, small numbers survive off the coast and others move offshore and south to the area off southern Georgia and northeastern Florida. In spring some of the remaining adults are thought to move north to spawn, providing some of the postlarval recruitment for northern Georgia, South Carolina, and lower North Carolina. If Federal waters were not closed, vessels could continue to fish on the roe shrimp, legally in Federal waters and illegally in state waters, due to enforcement difficulties. Available data suggest that in freeze years this could significantly reduce the capacity of the fall white shrimp crop to rebound. Revenue generated by the increased abundance of white shrimp in the fall is expected to exceed the revenue generated by the smaller spring harvest of roe shrimp that might occur in the absence of a closure.

Two tagging experiments were conducted to determine whether white shrimp move north from northeastern Florida in spring prior to spawning (Whitaker 1987, 1988). Both experiments, funded by the South Atlantic Council, failed to establish any significant northward movement, although one shrimp tagged off Cape Canaveral was recaptured 105 days later off the Doboy Sea Buoy in Georgia, a distance of 190 miles. Whether or not there is a significant northward movement of shrimp from northeast Florida remains uncertain. Nevertheless, it appears that in years following severe winter freezes, continued fishing on the remaining adult white shrimp may result in severely reduced recruitment to the fishery the following fall. Further, during the winter of 1990, the states requested, and the Secretary of Commerce approved, an emergency closure of Federal waters off Georgia and South Carolina due to severe winter mortality of white shrimp. The notice was published in the Federal Register on April 9, 1990. A substantial fall 1990 fishery suggested total recovery of the stock even though the spring spawning stock had been severely reduced due to the winter mortalities. In granting the emergency closure, the Secretary indicated that further requests for closure would have to be associated with a fishery management plan. To meet this mandate from the Secretary, a management plan is necessary which would allow the states to request the Council to consider closure of Federal waters when environmental conditions necessitate such action.

All new plans and amendments must contain a definition of overfishing that protects the long-term reproductive capacity of the stock. Overfishing must be defined in a way that enables the Council and Secretary to monitor and evaluate the condition of the stock relative to the definition, and specify the action to be taken to prevent overfishing from occurring. This plan fulfills that requirement.

Shrimp trawlers have a relatively large bycatch of finfish, most of which is discarded. For some species of fish, this may be a major source of mortality. Regulation of the shrimp fishery may be the only way to effectively control this source of mortality. Such regulations would logically be included in the shrimp plan. However, the 1990 reauthorization of the Magnuson Act requires the Secretary to establish a 3-year program to assess the impact of incidental harvest by the shrimp trawl fishery on fishery resources in the South Atlantic and Gulf Council's areas of jurisdiction. Until January 1, 1994, the Secretary may not implement any measures under the Magnuson Act to reduce incidental mortality of nontarget fishery resources in the course of shrimp trawl fishing which would restrict the period during which shrimp are harvested or would require use of any technological device or other change in fishing technology.

Between now and January 1, 1994, the National Marine Fisheries Service is charged with conducting research on finfish bycatch in the shrimp fishery. To accomplish this congressional mandate, a 30-member finfish bycatch steering committee was established by the Gulf and South Atlantic Fisheries Development Foundation. Based on the recommendations of this steering committee, NMFS Southeast Fisheries Science Center and Southeast Regional Office have developed a comprehensive research plan to address this issue (National Marine Fisheries Service 1991). Measures to address finfish bycatch are not included in this plan but will be considered in future amendments after study results are available.

12.2 Management Unit

The management unit is the population of white shrimp occurring along the U.S. Atlantic coast from the east coast of Florida to the North Carolina/Virginia border. Brown, pink, rock, and royal red shrimp are included in the fishery but not in the management unit because regulations in this plan only address white shrimp at this time. Although all three species of penaeid shrimp are also harvested in the Gulf of Mexico, it is believed that the Atlantic and Gulf populations are essentially isolated from one another.

Rock shrimp have increased in importance in recent years and are now the most valuable species of shrimp landed on the east coast of Florida. Both royal red and rock shrimp are caught in water considerably deeper than any of the principal penaeid shrimp species, and as such are not taken as bycatch of these fisheries. When taken, they are the target species. The rock shrimp fishery does, however, have a bycatch of pink shrimp.

12.3 Optimum Yield

Optimum yield for the white shrimp fishery is defined as the amount of harvest that can be taken by U.S. fishermen without reducing the spawning stock below the level necessary to ensure adequate reproduction. This level has been estimated only for the central coastal area of South Carolina, and only in terms of subsequent fall production (assumed to represent recruitment). Therefore, in actual application, optimum yield for the white shrimp fishery is the amount of harvest that can be taken by the U.S. fishery during the fishing season which may vary from year to year based on both state regulations and regulations promulgated pursuant to this plan (i.e., closures due to cold kills).

12.4 Definition of Overfishing

Preferred Alternative:

1. Overfishing is indicated when the overwintering white shrimp population within a state's waters declines by 80 percent or more following severe winter weather resulting in prolonged cold water temperatures. Continued fishing following such a decline may reduce the reproductive capacity of the stock affecting subsequent recruitment and would be considered overfishing. Relative population abundance will be determined by catch per unit effort (CPUE) during standardized assessment sampling.

Discussion: Shrimp are an annual crop in which abundance is determined primarily by environmental conditions. Thus, commonly used definitions of overfishing (e.g., $F_{0.1}$, spawning potential ratio, etc.) are probably not appropriate. Available data suggest that subsequent year class strength is unrelated to adult biomass except at very low levels of adult abundance. These low levels of abundance are associated with winter freezes rather than with fishing, but continued fishing at times of low abundance will further reduce the already small population, increasing the likelihood of poor recruitment and reduced fall production.

The shrimp fisheries in Georgia and South Carolina are most dependent on white shrimp. A relationship between low adult biomass and subsequent fall production has been documented in South Carolina (Appendix II). A decline in adult biomass of 80 percent would occur only following extreme winter weather resulting in prolonged cold water temperatures, and would be indicative of a severe winter kill. Although Georgia has not been able to demonstrate a similar relationship, one is believed to exist nevertheless. Following severe overwintering shrimp mortalities, reducing the remaining adult population by fishing will increase the likelihood of poor recruitment and subsequent fall landings. In years when the overwintering population is not significantly impacted by severe winter weather, fishing with current technology is not believed capable of reducing the population enough to affect recruitment. Table 21 shows monthly white shrimp production since 1978 with freeze years noted. It can be seen that in freeze years, production the following fall is generally below average.

South Carolina and Georgia have ongoing assessment sampling programs which allow continual monitoring of relative abundance of shrimp populations. Absolute levels of shrimp catch or CPUE cannot be compared directly between states because of differences in boats, gear, trawling techniques, etc. Further, the absolute level of abundance in one state or one part of the state may mean something different than in another state or part of the same state in terms of subsequent recruitment. However, expressing the impact in terms of a percentage reduction eliminates the need to standardize sampling across states, or the need to interpret the absolute level of abundance or CPUE that will affect recruitment.

Alternatives Considered and Rejected:

1. Overfishing is indicated when CPUE during standardized assessment sampling in winter is less than some absolute value.

Discussion: This alternative was considered because it has been shown that small numbers of adults in spring result in poor recruitment and catches in fall. An 80 percent decrease in adult abundance during years when the population is very large may not be as critical to subsequent recruitment as it would be in years when population levels are small. Because of this, overfishing may be better defined in terms of abundance (as reflected by CPUE) rather than as a percentage change in abundance.

The Council considered this option but determined that while sampling was relatively standardized within states, it was not standardized among states. Thus, it would not be possible to determine the significance of any particular absolute value of CPUE relative to subsequent recruitment. Further, the significance of a particular level of CPUE varies within each state by area. Thus, it is not possible at this time to know what level of CPUE in any given area or state should trigger a closure. For these reasons, the Council rejected this alternative in favor of the preferred alternative which is dependent only on a relative change within the year that can be easily monitored through routine assessment sampling. Also, considerations for closure by the council are triggered by a state request, not just an 80 percent reduction in the shrimp population. If a significant population exists after heavy mortalities, a state may not request a Federal closure.

2. Overfishing is indicated when the overwintering population within a state's waters declines by 80 percent or more for any reason.

Discussion: This was suggested to broaden the definition of overfishing to include other events that may result in a severe reduction in shrimp populations, such as oil spills. It was rejected in favor of the preferred alternative because events other than those related to weather were generally considered to be local in nature. Should an oil spill reduce the shrimp population by the requisite amount in one area, the entire EEZ adjacent to that state would have to be closed. This is not the intent of the plan.

12.5 Problems in the Fishery Addressed by This Plan

1. Unregulated commercial fishing in the EEZ on overwintering white shrimp following severe winter cold kills may reduce subsequent recruitment and fall shrimp production.

2. Shrimp trawls have a significant bycatch of nontarget finfish and invertebrates, most of which are discarded dead. This is wasteful and may significantly reduce yield in other fisheries directed at these discard species. In addition, shrimp trawls have a bycatch of endangered, threatened, and/or protected species (e.g., leatherback turtles) that are too large to be excluded by TEDs.

3. Shrimp mariculture operations may inadvertently release exotic species and/or diseases or parasites into local waters. The impact of such releases on domestic shrimp stocks is unknown, but potentially serious.

4. Habitat alteration (including beach renourishment and dredge and fill projects) and pollution in coastal areas may reduce shrimp production.

12.6 Management Objectives

The following objectives address the above problems:

1. Eliminate fishing mortality on overwintering white shrimp following severe winter cold kills.
Discussion: Presently, states have the ability to close their waters to shrimping should conditions warrant. Management measures contained in this plan will allow the states to request the Council to implement concurrent closures of Federal waters following cold kills, thus affording maximum protection to the remaining adult population which is expected to increase subsequent fall production to the extent possible.

2. Reduce the bycatch of non-target finfish, invertebrates and threatened, protected and endangered species.
Discussion: The 1990 Amendment to the Magnuson Act prevents the Council from implementing any measures to control bycatch in the shrimp fishery until January 1, 1994. Thus, there are no measures in this plan to address this objective. During the interim, the Secretary of Commerce is required to establish a 3-year program to assess the impact of the shrimp trawl fishery on nontarget fishery resources (see Section 12.7.3).

3. Encourage states with mariculture facilities to carefully monitor these operations, and require safeguards to prevent exotic species from escaping and/or diseases from entering the environment.
Discussion: Regulation of mariculture facilities is beyond the scope of Council authority and as such, there are no regulations in this plan to address this problem. Nevertheless, the Council is concerned that the accidental introduction of exotic species and/or diseases may occur and result in increased competition with and/or mortality of native shrimp stocks. This is addressed through recommendations to the states (Section 12.5.3) and through research recommendations (Section 12.9).

4. Reduce or eliminate loss and/or alteration of the habitat on which shrimp depend or degradation of water quality through pollution that would reduce shrimp production.
Discussion: The habitat areas of greatest concern are nearshore and estuarine wetlands and waters within state jurisdiction. Through the habitat mandate in the Magnuson Act, the Council will provide recommendations to permitting agencies relative to projects that may adversely impact

shrimp habitat. This objective is further addressed through recommendations to the states and research recommendations.

12.7 Management Measures

12.7.1 Management Measure 1

12.7.1.1 Concurrent Closures

Preferred Alternative: States may request concurrent closure of the EEZ adjacent to their closed state waters following severe winter cold weather that results in an 80 percent or greater reduction in the population of overwintering white shrimp.

Generally, South Carolina and Georgia would request closure of their entire EEZs. North Carolina would not normally close its state waters, because following a severe freeze, there would be few if any white shrimp remaining. However, unusual circumstances might exist in which North Carolina might close state waters in the southern end of the state. If this were to occur, North Carolina could request closure of adjacent EEZ waters for this limited area if closure criteria were met. The population of white shrimp in Florida is limited primarily to the northern three or four counties. Although Florida does not currently monitor the shrimp population or close state waters to shrimping on an emergency basis, this measure would not prevent Florida from requesting a concurrent EEZ closure for a limited area if other criteria were met.

When EEZ closures are requested, the Council will evaluate the request prior to closure based on the specific criteria detailed below. **To determine whether these criteria have been met, upon receiving the request from one or more states, the Council will convene a review panel to evaluate data supporting the request to determine compliance with the criteria. The review panel will be comprised of one Council staff, one NMFS Southeast Fisheries Science Center scientist, one member of the Council's scientific and statistical committee, and one state shrimp biologist from each of the states in the South Atlantic Council's area of jurisdiction.**

No predetermined lead time is required in making the request. After receiving the report of the review panel, the shrimp committee will review the request and make recommendations to the Council. The Council will make a decision, and if warranted, request the Regional Director to proceed with the EEZ closure by Notice Action. Requests for an EEZ closure would be on a state by state basis but every effort should be made to coordinate these requests among states.

Criteria for reopening would be based on the state's request after the state determines, through monitoring programs, that conditions warrant reopening of the fishery or the state's regulations require a set opening date. A state's territorial sea and EEZ would generally open at the same time, although a state may request the Council consider an earlier opening of the EEZ if conditions warrant and concurrent opening of state waters is not possible because of state regulatory policy. Requests for reopening of the EEZ would be on a state by state basis but every effort should be made to coordinate openings among states.

The criterion for requesting the Council to consider closure of the EEZ is: the Council may consider a state's request for closure of the EEZ if a drop in catch rate resulting from severe winter weather is indicated during standardized assessment sampling and reveals a reduction of 80 percent or greater of the overwintering white shrimp abundance as reflected by CPUE.

Currently, only South Carolina and Georgia have routine shrimp monitoring programs. North Carolina is at the northern end of the range of white shrimp and following a freeze severe enough to reduce the population in South Carolina and Georgia by 80 percent, would have few, if any, white shrimp surviving. Thus, there is no reason to close the EEZ off North Carolina to protect roe white shrimp. Florida does not have a routine shrimp monitoring program at this time. However, should Florida initiate a shrimp monitoring program and meet the criteria for requesting a closure, the Council could request that the Regional Director close the EEZ off some or all of the east coast of Florida. Alternatively, monitoring results from southern Georgia may be used as a proxy for northeast Florida. However, since northeast Florida is usually not as severely affected by winter weather as areas to the north, Florida would be expected to meet the 80 percent reduction criterion only following the most severe freezes.

Appendix XI and XII give a brief description of the shrimp sampling regimes of Georgia and South Carolina. Georgia proposes to compare relative abundance following a winter cold kill with the historical long-term mean CPUE for that month. South Carolina proposes to compare total number or average catch per tow (CPUE) in samples taken prior to the onset of cold weather and those taken immediately after and within two weeks of the winter kill. The review panel will determine which, if either (or both), of these methodologies is most appropriate to determine if the 80 percent decline has occurred, and recommend to the states that they analyze their shrimp trawl data accordingly. The data collected by both South Carolina and Georgia are similar and either analytical approach could be used by both states.

During a closure the possession aboard a fishing vessel of any species of the genus *Penaeus* is prohibited. Trawling for any species of penaeid shrimp is prohibited in the closed portion of the EEZ. **Transit of the closed EEZ with less than 4 inch stretch mesh aboard while in possession of *Penaeus* species will be allowed provided that the nets are in an unfishable condition which is defined as stowed below deck. Streched mesh size means the distance between the centers of the two opposite knots in the same mesh when pulled taut.**

Discussion: Shrimp are a highly fecund annual crop in which year class strength is determined primarily by environmental conditions. By itself, fishing probably cannot reduce the population to a level low enough to affect subsequent recruitment. Available data suggest that except at very low levels of adult abundance, year class strength is unrelated to adult biomass (Appendix II). These low levels of adult abundance are only known to occur as a result of winter freezes. However, when these freezes occur, subsequent recruitment and fall production may be reduced. Continued fishing during these times of low abundance increase the likelihood of poor recruitment and fall production. It is the fall production that accounts for most of the harvest and revenue in this fishery. Spring catches of white shrimp are small compared to fall production, and are very small following winter cold kills (Table 21). Monthly white shrimp landings by state are shown in Appendix IV. To afford maximum protection to the small remaining adult population during these unusual conditions, the Council believes that Federal, as well as state waters, should be closed to harvest.

The effect of winter freeze conditions on overwintering white shrimp is generally more severe in the northerly part of their range, diminishing to the south. It is generally believed that shrimp that survive the initial wave of cold move offshore and possibly south to deeper, warmer water. A cold snap that kills almost all white shrimp in South Carolina, for example, may result in almost no mortality off northeast Florida. It is thought that these surviving shrimp in the southern end of their range may contribute recruitment to areas to the north where the adult population may be almost entirely gone. If this is the case, then it may be important to protect brood stock in the southern part of their range to allow recruitment to estuaries to the north, even if the southern population has not been severely impacted by the cold weather.

In 1987, the Council funded a white shrimp tagging study to test the hypothesis that shrimp tagged in winter off Cape Canaveral, Florida would move north and be recaptured in the spring roe shrimp fishery in Georgia and South Carolina. White shrimp are known to migrate south from the Carolina's and Georgia to Florida. Many migrants have been captured as far south as Cape Canaveral, Florida (Lindner and Anderson 1956), leading biologists to conclude that this area may be an overwintering ground for large, migratory white shrimp (Whitaker 1987). No significant northward movement was documented in this study (Whitaker 1987). The study was repeated in 1988 with similar results, although one shrimp tagged off Cape Canaveral was recaptured 190 miles to the north, off the coast of Georgia (Whitaker 1988). Despite the fact that most returns came from very close to the area of release, the studies were not considered definitive because of the relatively small number of shrimp tagged, the mild winters, and the possibility that northward movement of shrimp may have already occurred before the tagging experiments began (February 19-27, 1987 and February 19-22, 1988). The question of northward shrimp movement in spring remains unresolved.

In December 1989, a severe freeze occurred in the southeast killing an estimated 90 percent of the overwintering white shrimp population off South Carolina and Georgia. Both South Carolina and Georgia closed their state waters to shrimp trawling and requested an emergency Federal closure of the EEZ. The EEZ off Georgia and South Carolina was closed on April 3, 1990 [FR 50CFR 659] (Federal Register Vol. 55 No. 68), which provided additional protection to the remaining population. These prompt management actions resulted in maximum spawning potential of the remaining brood stock and an average harvest the following fall (1990). Despite the closure, white shrimp landings in June and July 1990 (after reopening) were higher than during the same months following other freeze years (i.e., 1977, 1978, 1984, and 1985), and total landings in June and July were comparable to, or greater than, total spring landings (April-July) following other freeze years (Table 21). Thus, it appears that little, if any, spring production was lost despite the closure that protected the shrimp long enough to allow them to spawn. Subsequent fall production was higher than following other comparable freeze years, rebounding to levels comparable to non-freeze years in both Georgia and South Carolina (Appendix IV). While it can never be known what the 1990 fall production would have been in the absence of a closure, state shrimp biologists believe that the EEZ closure contributed to the recovery of the stock.

Although this management measure would only allow closure of the EEZ adjacent to closed state waters, the Council believes that a closure extending south to the EEZ off northeastern Florida may provide additional benefit to the white shrimp resource. While there is insufficient data on sources of postlarval recruitment to the estuaries to reach a definitive conclusion at this time, the Council will reconsider the geographic extent of closures in future amendments should new information become available.

Alternatives Considered and Rejected:

1. No change (i.e., No Federal closures).

Discussion: Some members of the South Atlantic Council shrimp advisory panel opposed Federal closures expressing the following reasons:

a) They do not want more Federal regulations.
b) They refute evidence that closures are beneficial to the stock.
c) They do not want to protect shrimp in Federal waters to ultimately benefit recreational shrimpers.
d) Closures are unnecessary because when there is a kill, there are not enough shrimp to fish for, so it is self-regulating.

The Council considered all these arguments but rejected this alternative because most shrimp biologists and many fishermen believe that closures during freeze years do, in fact, benefit the resource. It was also noted that contrary to the opinion that shrimpers will not fish if there are not enough shrimp available to be profitable, many shrimpers will fish despite very low population sizes, even if at a loss, rather than sit idle at the dock. This continued fishing when adult stocks are depressed further reduces the spawning potential and jeopardizes subsequent fall production. The Council also felt that taking no action was not justified simply because another user group (recreational shrimpers) might accrue some of the benefit resulting from that action.

2. Concurrent closure of Federal waters adjacent to state waters to aid law enforcement.

Discussion: State waters are closed to shrimping at times of the year which vary by state but generally during winter-spring. During state closures, boats continue to fish legally outside three miles and illegally inside three miles. Without an additional Federal closure, vessels landing white shrimp can contend that their catches were made legally outside three miles. A closure of Federal waters out an additional five miles would remove this argument as white shrimp are not found this far offshore in most areas. With this additional closure, vessels would not have a legal reason for trawling in or near state waters, nor could they contend that their catch of white shrimp was taken legally. Vessels legitimately fishing for pink shrimp, rock shrimp, or royal red shrimp would not be impacted as these species are found further offshore. Enforcement of state shrimp closures would be greatly aided by this measure.

The Council heard a great deal of public testimony opposing this alternative. Members of the commercial industry that testified were unanimously opposed to this alternative. They did not want Federal waters to be closed except for biological reasons. They felt that this alternative allowed the states to close Federal waters for reasons that may not conform to National Standards or for biological reasons. They also contended that since the vast majority of roe shrimp are in state waters, if there are enough shrimp outside state waters to allow them to fish, there are certainly enough shrimp inside three miles for spawning. Considering these arguments and the strong and unanimous opposition of the industry, the Council rejected this alternative.

3. Closure of the EEZ throughout the range of the white shrimp when requested by two or more states.

Discussion: This was the preferred option taken to public hearings. The Council ultimately rejected this alternative as North Carolina opposed closing the EEZ off North Carolina because it was felt that there would be no useful purpose since weather severe enough to kill most shrimp in South Carolina and Georgia would certainly leave few if any shrimp in North Carolina. Further, the period of time during which a closure would occur is an important time for pink shrimp trawling in both state and Federal waters off the state. Regulations prohibiting shrimp trawling and possession of penaeid shrimp would unnecessarily restrict this fishery without any benefit to the white shrimp resource. Further, NMFS noted that the 1990 emergency closure of the EEZ only applied to South Carolina and Georgia, and was apparently very successful. Without strong rationale, NMFS did not believe this alternative was justified.

4. Closure of the EEZ to include northeastern Florida when requested by two or more states.

Discussion: The Council considered this option in lieu of closing the EEZ throughout the range of white shrimp, but ultimately rejected it in favor of the preferred alternative because the data do not currently exist to strongly support the benefit of this action to the resource. NMFS noted that the emergency EEZ closure in 1990 applied only to the EEZ off Georgia and South Carolina, and was apparently successful. Although it is not possible to know what would have happened had the EEZ off Florida also been closed, there is insufficient data available to conclude that any significant improvement in fall production would have resulted. Thus, until such time as the utility of closing the EEZ off northeastern Florida is established, this option was rejected. However, Florida may request closure of all or part of the EEZ adjacent to closed state waters if the closure criteria are met.

12.7.1.2 Clarification of Management Measure 1

Preferred Alternatives:

1. Exempt royal red and rock shrimp fisheries from any closures of the EEZ for the harvest of white shrimp.

Discussion: The purpose of closing the EEZ following severe winter freezes is to protect the overwintering, adult white shrimp stock so that the maximum spawning potential can be realized. There is no intent on the part of the Council to impact fisheries for other species unless these fisheries have a bycatch of white shrimp or, if necessary, for enforcement of the regulation. Royal red shrimp are caught in water depths of 250-475 m (820-1560 ft), well beyond the range of white shrimp. There is no white shrimp bycatch in the royal red shrimp fishery. Further, the appearance of this species is very different from any penaeid shrimp. Thus, there should be no confusion on the part of law enforcement officials as to the species of shrimp involved.

Rock shrimp are also completely different in appearance from white shrimp or any other penaeid shrimp. Allowing vessels to fish for and possess rock shrimp during a closure of the EEZ for white shrimp will not create an enforcement problem. Rock shrimp are also found in deeper water than white shrimp. In Florida, a series of research cruises found them to be most abundant between 34 and 55 m (112 and 180 ft), with declining abundance in deeper and shallower water (Kennedy et al. 1977). The commercial fishery is currently limited almost entirely to the area off the northeast Florida coast in depths ranging from 33-73 m (108-240 ft) (Dennis 1992). While this overlaps the known depth range of white shrimp, the vast majority of the white shrimp population in the south Atlantic is found in water less than 27 m (90 ft). Thus, there would be virtually no white shrimp bycatch associated with the rock shrimp fishery. However, there could well be a bycatch of pink shrimp. These would have to be discarded, since the possession of any penaeid species is prohibited during a closure.

While the Council's intent is to allow rock shrimp fishing during a closure, it was pointed out during development of the plan that allowing shrimp gear aboard vessels would create an enforcement problem since vessels could legally trawl in closed Federal waters with shrimp nets and contend they were fishing for rock shrimp. If approached by an enforcement officer they would merely dump their white shrimp catch overboard. If not approached they could land these shrimp and contend they were caught in Florida where white shrimp fishing would be legal. Since neither Georgia nor South Carolina prohibits possession or landing of white shrimp during a closure, this could create an enforcement problem. The Council's law enforcement committee considered this issue and determined that the best way to address the problem was to create a buffer zone extending from the outside edge of state waters to the inside edge of the rock shrimp grounds in which no trawling with a shrimp net would be allowed. The committee recommended that the further offshore it could be placed without interfering with legitimate rock shrimp fishing would maximize the effectiveness of the buffer zone. This concept has been adopted as Management Measure 2 and is discussed in detail below.

2. Exempt the whiting fishery (*Menticirrhus* sp.) from a closure for white shrimp.
Discussion: Whiting (also called kingfish) landings are small, and confined mostly to North Carolina and northeast Florida (Table 37). Whiting landings by year for all states combined are shown in Table 38. Most Council and advisory panel members believe the whiting fishery is not of sufficient value to risk damaging the white shrimp crop by allowing vessels to fish during a white shrimp closure. The opinion was also expressed that the whiting fishery is really just an excuse for vessels to be out trawling for white shrimp during a closure and should not be allowed any exemption. Nevertheless, the Council believes that trawling for whiting with a four inch minimum mesh size net would not endanger the white shrimp population and would be consistent with Georgia and South Carolina state regulations. Therefore, trawling for whiting (*Menticirrhus* sp.) inside the 25 nautical mile buffer zone (see Management Measure 2) is allowed during a closure for white shrimp, but it is illegal to have aboard any net with a mesh size smaller than four inch stretch in the wings or bag or to possess any species of penaeid shrimp in the closed portions of the EEZ.

Alternatives Considered and Rejected:
1. Prohibit all trawling during a white shrimp closure.
Discussion: The Council considered a prohibition on all trawl fishing during an EEZ closure for white shrimp. However, the Council recognized that rock and royal red shrimp fishing would not affect the white shrimp population because their depth distributions do not overlap. While there is currently little effort directed at either rock or royal red shrimp off South Carolina or Georgia, the Council did not want to preclude a fishery for either species and therefore rejected this alternative. Further, although the Council heard testimony that the whiting fishery is really just an excuse to be trawling for white shrimp, the Council rejected the alternative of prohibiting trawling for whiting during a closure in favor of the preferred alternative which would allow fishing for whiting with a minimum of a four inch mesh net, a mesh size that will not retain shrimp.

2. Exempt pink shrimp from an EEZ closure for white shrimp.
Discussion: The shrimp committee and advisory panel considered exempting pink shrimp from EEZ closures imposed to protect overwintering white shrimp but ultimately rejected this alternative. While closures are not intended to restrict fishing for species other than white shrimp, the committee recognized that there would be a significant enforcement problem if fishing and possession of any species of *Penaeus* was allowed during a closure for white shrimp because of the difficulty in identifying different species. The emergency regulation closing the EEZ in 1990

was expressed as a prohibition on the possession of *Penaeus* shrimp which the Council believes is the most effective way of protecting the white shrimp population.

Appendix VI presents pink shrimp landings by state and month for recent years; landings during the likely closure months are very small. The Council agreed with the advisory panel members who felt that protecting the far more valuable white shrimp fishery was more important to the industry than allowing the small harvest of pink shrimp during a closure which would make enforcement of the closure much more difficult. However, since most pink shrimp in the South Atlantic are caught off Florida and North Carolina and the EEZ closures would not likely apply to these states, this restriction is not expected to have a significant impact.

12.7.2 Management Measure 2: Buffer Zone

Preferred Alternative: Establish a buffer zone extending seaward from shore 25 nautical miles, inside of which no trawling would be allowed with a net having less than 4 inch stretch mesh during an EEZ closure. Vessels trawling inside this buffer zone could not have a shrimp net aboard (i.e., a net with less than 4 inch stretch mesh) in the closed portion of the EEZ. Transit of the closed EEZ with less than 4 inch stretch mesh aboard while in possession of *Penaeus* species will be allowed provided that the nets are in an unfishable condition which is defined as stowed below deck. (Stretched mesh size is defined as the distance between the centers of the two opposite knots in the same mesh when pulled taut.)

This management measure is intended to allow legitimate trawling for rock and royal red shrimp without compromising the enforceability of the EEZ white shrimp closure. As noted above, it is not the Council's intent that a closure for white shrimp preclude fishing for rock shrimp. However, if vessels are allowed to trawl for rock shrimp, they must be allowed to have shrimp nets aboard. And, unless otherwise specified, there would be no restrictions on where they can trawl in the EEZ (ostensibly for rock shrimp), as long as they do not have penaeid shrimp aboard. However, without the buffer zone, any vessel could trawl just outside state waters and discard its catch of white shrimp if approached by an enforcement officer. If not approached, the catch, although illegally caught, could be legally transported through state waters and landed and sold. Unless it could be determined where the shrimp were caught (they could have been legally caught in Florida state or adjacent EEZ waters), it would be difficult to establish illegal activity.

On a series of exploratory rock shrimp trawling trips off South Carolina, Anderson and Whitaker (1980) reported that although commercial concentrations were not located, highest catches occurred between 38-46 m (21 and 25 fm). Keiser (1976) summarized the available information on rock shrimp distribution in the southeastern U.S. and determined that rock shrimp were most abundant off Florida and least abundant off Georgia, and the greatest number of successful trawls occurred in depths between 37-53 m (20 and 29 fm). Off South Carolina, the greatest concentrations of rock shrimp were found in depths between 37-71 m (20 and 39 fm).

As of 1993, the only significant commercial fishery for rock shrimp in the southeast is off northeastern Florida. However, rock shrimp have been fished off Georgia and South Carolina, and it is not the Councils intent to restrict fishermen from trawling for rock shrimp during an EEZ closure. To allow for rock shrimp fishing and still maintain maximum protection for the white shrimp resource and enforceability of the EEZ closure, a buffer zone will be established. Although some rock shrimp have been caught inside 108 ft (18 fm), commercial concentrations are apparently not found in waters shallower than 108 ft (18 fm). However, to ensure that regulations do not unnecessarily restrict legitimate rock shrimp fishermen, the buffer zone will extend from the inside edge of the EEZ to a distance of 22 nautical miles offshore (i.e., a distance of 25 nautical miles from shore). The outside edge of this buffer zone corresponds approximately to 15 fm or less in most areas off Georgia, South Carolina, and northeast Florida and should provide an ample buffer without interfering with legitimate rock shrimp fishing activity.

The 15 fathom depth contour comes closer than 25 nautical miles to shore in the vicinity of Cape Canaveral, Florida, an important area for rock shrimp fishing. While it is not anticipated that this area would ever be included in an EEZ closure, it should be noted that the buffer zone is meant to be as wide as possible without interfering with legitimate rock shrimp fishing. Should it be determined that the 25 nautical mile buffer zone is inconsistent with this objective, the Council will modify it by plan amendment.

Commercial rock shrimp landings by month and state are shown in Appendix V. Royal red shrimp landings cannot be listed by month because of data confidentiality. Small landings of royal red and significant landings of rock shrimp are made during the likely closure months (i.e., January-June).

Alternatives Considered and Rejected

1. No Action (i.e., no buffer zone).

This was the Council's preferred alternative when the first draft of the plan was taken to public hearings. However, it was rejected when the Council realized that a significant enforcement loophole would exist if no action were taken to address the problem of trawling inside the EEZ. When the Council's Law Enforcement Advisory Panel developed the concept of the buffer zone to address the problem, that became the preferred alternative.

12.7.3 Other Management Measures Considered and Rejected

1. Require annual vessel permit to harvest shrimp in the EEZ.

Discussion: The Council considered requiring Federal permits at the urging of the Regional Director of NMFS and was the preferred alternative when the draft shrimp plan went to public hearings. Requiring Federal permits to trawl for shrimp serves several purposes. First, permits establish the universe of current fishermen for future eligibility requirements should a limited entry program be developed. Second, by requiring permits to fish for shrimp, the option of Federal fines for violations becomes available. This might also help states enforce state shrimping laws. Third, permits allow scientists to identify the universe of fishermen which enables better data collection and statistics. Nevertheless, despite these reasons, the Council ultimately rejected this alternative because there was strong opposition to Federal permits within the industry; because all states already require a state license to trawl for shrimp and thus have the universe of fishermen defined; and because in the informal review comments NMFS stated that the agency would not implement a permit system even if requested because of insufficient staff and funds.

2. Regional shrimp permits.
Discussion: This was discussed by both the shrimp committee and advisory panel and it was noted that this issue had been under discussion for many years. It was rejected because it was considered to be a state and/or ASMFC issue, not a Federal issue. Further, it was noted that the states were unlikely to ever agree on a single regional permit.

3. Control Date.
Discussion: The Council's preferred alternative when the plan went to public hearings was to establish a control date as a benchmark date for possible future limited entry. The actual control date was to have been the date of publication of the proposed rule in the Federal Register. The purpose of establishing a control date is to put the public on notice that the Council may consider limiting entry into the fishery in the future. The Council ultimately rejected this measure because it was clear that there was no possibility of developing a limited entry system in the foreseeable future. By the time a limited entry system could be considered, so much time would have elapsed that the control date established now would not be useful.

4. Incorporate TED regulations into FMP.
Discussion: The NMFS Regional Director requested the Council to consider incorporating TED regulations, promulgated under the Endangered Species Act (ESA), into the shrimp FMP. The rationale was that by having the regulations contained under the Magnuson Act there would be additional enforcement options available that are not afforded under the ESA. Currently, under the ESA, violations are treated as civil violations unless they are extreme. If a fisherman is cited and he elects not to pay the fine, it is very difficult for the government to collect the fine. Under the Magnuson Act, the catch and/or vessel could be seized. This would provide more of a deterrent than currently afforded by the ESA. Further, it has been pointed out that TED regulations specify allowable excluders based solely on their ability to reduce turtle catches. Should a TED be developed that is superior in its ability to reduce finfish bycatch as well as turtles, there would be no mechanism to require its use in place of any other approved TED.

Despite these reasons for including TED regulations in the shrimp plan, NOAA General Counsel (Southeast) advised the Council that recent changes to the Magnuson Act precluded the Council from taking any action on TEDs at that time.

5. Finfish bycatch

Discussion: The NMFS Regional Director suggested that the issue of finfish bycatch be included in the shrimp management plan because logically, the best approach to addressing bycatch of the shrimp fishery was through the shrimp plan. However, the November 1990 reauthorization of the Magnuson Act specifically prohibits the Councils from taking any action on finfish bycatch in the shrimp fishery until 1994. Instead, the Act requires the following:

(1) Within 9 months after the date of enactment of the Fishery Conservation Amendments of 1990, the Secretary shall, after consultation with the Gulf of Mexico Fishery Management Council and South Atlantic Fishery Management Council, establish by regulation a 3-year program to assess the impact on fishery resources of incidental harvest by the shrimp trawl fishery within the authority of such Councils.

(2) The program established pursuant to paragraph (1) shall provide for the identification of stocks of fish which are subject to significant harvest in the course of normal shrimp trawl fishing activity.

(3) For stocks of fish identified pursuant to paragraph (2), with priority given to stocks which (based upon the best available scientific information) are considered to be overfished, the Secretary shall conduct --
(a) a program to collect and evaluate data on the nature and extent (including the spatial and temporal distribution) of incidental mortality of such stocks as a direct result of shrimp trawl fishing activities;
(b) an assessment of the status and condition of such stocks, including collection of information which would allow the estimation of life history parameters with sufficient accuracy and precision to support sound scientific evaluation of the effects of various management alternatives on the status of such stocks; and
(c) a program of data collection and evaluation for such stocks on the magnitude and distribution of fishing mortality and fishing effort by sources of fishing mortality other than shrimp trawl fishing activity.

(4) The Secretary shall, in cooperation with affected interests, commence a program to design, and evaluate the efficacy of, technological devices and other changes in fishing technology for the reduction of incidental mortality of nontarget fishery resources in the course of shrimp trawl fishing activity. Such program shall take into account local conditions and include evaluation of any reduction in incidental mortality, as well as any reduction or increase in the retention of shrimp in the course of normal fishing activity.

(5) The Secretary shall, upon completion of the programs required by this subsection, submit a detailed report of the results of such programs to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Merchant Marine and Fisheries of the House of Representatives.

(6) (a) Except as provided in this paragraph, the Secretary may not implement any measures under this Act to reduce incidental mortality of nontarget fishery resources in the course of shrimp trawl fishing which would restrict the period during which shrimp are harvested or would require the use of any technological device or other change in fishing technology.
(b) The prohibition contained in subparagraph (a) shall cease on January 1, 1994.

(c) This paragraph does not apply to any law or regulation in effect on the date of enactment of this paragraph, nor does it limit in any way the Secretary's authority to take action, including any limitation on entry permitted by this Act, for the conservation and management of the shrimp fishery resource.

To accomplish this mandate, NMFS funded the Gulf and South Atlantic Fishery Development Foundation to develop and coordinate a bycatch research plan. This plan was developed in cooperation with NMFS, commercial and recreational fishing industries, universities, state and Federal fishery management agencies, and environmental organizations through a 30-member finfish bycatch steering committee (National Marine Fisheries Service 1991).

6. Implement partial EEZ closures.

Discussion: It has been suggested that a total closure of the EEZ is unnecessary to protect white shrimp. In lieu of a total closure, a closure would need only apply 5-12 miles offshore (depending on the state) to encompass the range of the white shrimp. The Council rejected this alternative largely based on the experience in the Gulf of Mexico shrimp fishery. A partial closure of the EEZ off Texas proved unenforceable. The Council believes that the preferred alternative is the only enforceable action that still allows, to the extent possible, other legal trawling activity. Establishment of a 25 mile buffer zone is not intended to serve as a partial closure to white shrimp trawling. White shrimp trawling and retention of any species of shrimp of the genus *Penaeus* is prohibited throughout the closed portion of the EEZ during a closure. The buffer zone is established only for the purpose of allowing trawling for rock shrimp.

12.8 Recommendations to the States

12.8.1 Introduction of Exotic Species

The Council requests that states having shrimp mariculture facilities, either research or commercial, institute strict controls and guidelines to minimize the possibility of inadvertently introducing either exotic shrimp species or diseases into the environment. The Council further recommends that states comply with Amendment 1 to the Atlantic States Marine Fisheries Commission's (ASMFC) Procedural Plan to Control Interjurisdictional Transfers and Introductions of Shellfish (Atlantic States Marine Fisheries Commission 1990).

Discussion: Shrimp mariculture operations, both research and commercial, often using exotic species, are proliferating in the south Atlantic area. Exotic species from these facilities have escaped into the environment. One such inadvertent introduction came from the Waddell Mariculture Facility, a state research facility in South Carolina, and involved a relatively large accidental release of the Asian tiger prawn *Penaeus monodon*. Shrimp trawlers subsequently began capturing these very large shrimp which were exhibiting unusually rapid growth. A great deal of concern was expressed for the ability of native species to compete with this introduced species. Fortunately, it appears that the species did not survive the winter, as no reports of their capture were received the next spring.

Another exotic species, the Pacific white shrimp *Penaeus vannamei* is raised in a number of commercial mariculture facilities in South Carolina. Escapes have occurred annually since these aquaculture facilities began raising this species. While Pacific whites are not believed to survive the winter in South Carolina, they often appear in commercial catches.

Introductions of exotic species, should they become established, almost always create ecological havoc. There is also a great deal of concern that even if the exotic shrimp species being raised in these mariculture facilities do not become established, exotic diseases may be introduced to indigenous shrimp species for which they have no resistance.

The ASMFC amendment states:

> Uncontrolled and unapproved introductions of *Crassostrea* sp. or any non-indigenous molluscan or crustacean species to the waters of the Atlantic coastline of the United States should be prohibited under any circumstances.

Further, the ASMFC plan was amended to include the following:

1. Effective enforcement and, where required, strengthening of legal authorities of Federal and state agencies to prevent uncontrolled introductions.
2. Comparative research to recognize deficiencies in data bases including but not limited to ecological, economical, and sociological impacts of potential introduction relative to similar endemic species.
3. Until a time that the Shellfish Transport Committee develops standards for field testing and project protocols, experimental use of *Crassostrea* sp. and other molluscan and crustacean species should be limited to experimental laboratory facilities having quarantine systems with no untreated effluent discharging into natural waters.
4. Until such time as data bases are adequate and quarantine hatchery facilities are available, introductions for commercial purposes should be prohibited.

12.8.2 Habitat Alteration and Environmental Degradation

The Council recommends that states minimize or eliminate alteration of shrimp habitat, especially the fragile and highly productive salt marsh and estuarine areas. These areas are considered critical habitat for all species of penaeid shrimp addressed by this FMP.

Discussion: Juvenile and sub-adult stages of penaeid shrimp are spent in inshore estuarine nursery areas. These wetland and nearshore habitats are being eroded continuously by the encroachment of a growing population in the southeastern U.S. Dredging, filling, draining, and impounding of wetlands and timbering, mining, development of adjacent upland areas, and stormwater runoff are major sources of detrimental effects on shrimp productivity and survival. This environmental degradation is certainly the biggest threat to the long-term well-being of the shrimp resource.

12.8.3 Additional Recommendations to the States Considered and Rejected

12.8.3.1 Federal Permit to Shrimp in State Waters

The Council considered recommending to the states that they require a Federal permit to fish for shrimp in state waters.

Discussion: Harvest of penaeid shrimp in the management unit occurs primarily in state waters. Although shrimping also takes place in the EEZ during part of the year, some vessels do not fish outside state waters and would not be required to have a Federal permit. The effectiveness of the Federal permit in identifying the universe of shrimp fishermen and in aiding enforcement would be greatly increased if all commercial shrimpers were required to obtain a permit. If a permit sanction meant only that the vessel could not fish in Federal waters, the deterrent effect is greatly reduced. If, however, the states required a Federal permit to obtain a state permit, then the deterrent effect of a permit sanction would be much greater. Since the cost of the permit is minimal (currently estimated at $34), this requirement would not be economically burdensome. It was rejected, however, because it was felt that the states, through their licensing requirements, already know the universe of shrimpers. Further, it was noted that most states would likely reject the recommendation.

12.8.3.2 Recreational Shrimping

The Council was asked by some members of the commercial industry to recommend to the states that recreational shrimp fishing over bait be curtailed.

Discussion: The Council's shrimp advisory panel recommended this measure be included in the shrimp plan for the following reasons: recreational shrimp fishermen are allowed to fish in the bays and sounds where trawling is illegal, thus, shrimp are caught before they move offshore where commercial fishermen have the opportunity to catch them; shrimp caught over bait are sold illegally lowering the price and putting a lower quality product on the market; bait holds shrimp in inside waters longer than they would otherwise stay, putting them at greater risk of being killed by severe winter weather; and the bait used to attract shrimp is a pollutant.

Of the above contentions, the first, that recreational fishermen are allowed to fish in inside waters where trawling is illegal, is certainly true. There is no documentation of the validity of the other perceived problems. Regardless, the Council believes this to be an allocation issue within the jurisdiction of the individual states and is not considered a biological, resource, or environmental issue, and therefore rejected including this as a recommendation.

12.8.3.3 Stock Enhancement

Some members of the commercial industry suggested that the Council recommend to the states that stock enhancement (addition of maricultured shrimp to the natural environment) programs be initiated, especially following cold kills.

Discussion: The shrimp advisory panel suggested that releasing maricultured shrimp following cold kills would significantly enhance natural reproduction and might eliminate the need for Federal closures.

The Council has not taken a position on this issue. At this time there is insufficient information to evaluate either the biological or economic benefits, if any, that might result from such stock enhancement. However, preliminary results of research conducted by South Carolina Wildlife and Marine Resources Department (Whitaker 1990) indicate that such a program may be feasible. The minimum number of spawners necessary for adequate spawning was estimated to be between 8,000 and 12,000 individuals per major ocean inlet area, a number that could easily be maintained in a quarter acre pond. In practice, there are problems with maintaining the shrimp over winter, especially during extreme cold winters when they would be needed. Actual survival of released shrimp is not known, although in the preliminary experiments, a number of the released (and tagged) shrimp were subsequently recaptured.

12.9 Research Recommendations

1. Determine the possible impacts on indigenous shrimp species of inadvertent introductions of exotic shrimp species and diseases from mariculture operations, and develop methods and protocol to prevent such introductions.
2. Assess the potential utility of releasing maricultured shrimp into the environment to supplement natural reproduction, especially following cold kills.
3. Assess the potential of controlled closures and other measures to enhance the production and economics of the south Atlantic white shrimp fishery.
4. Determine the effects of beach renourishment projects on subsequent shrimp production.
5. Evaluate the impacts of habitat and water quality alteration on shrimp growth, survival, and productivity.
6. Investigate the costs, benefits, and utility of limited entry programs in the shrimp fishery of the south Atlantic.
7. Determine the impact of shrimp trawl bycatch on the habitat and all nontarget species of fish and invertebrates (i.e., expand the congressionally mandated study to include impacts on habitat and all incidental species, not just the impact on other "fishery resources").
8. Determine the relationship between absolute number of adults (or adult biomass) and subsequent recruitment to allow development of a threshold level of population size to serve as a trigger to request a closure of the EEZ.
9. Determine the biological, economic, and sociological status of the rock shrimp fishery.

13.0 <u>REGULATORY IMPACT REVIEW</u>

13.1 Introduction

The Regulatory Impact Review (RIR) is part of the process of developing and reviewing fishery management plans and amendments and is prepared by the Regional Fishery Management Councils with assistance from the National Marine Fisheries Service, as necessary. The RIR provides a comprehensive review of the level and incidence of economic impact associated with the proposed regulatory actions. The purpose of the analysis is to ensure that the regulatory agency or Council systematically considers all available alternatives so that public welfare can be enhanced in the most efficient and cost effective way.

The RIR also serves as the basis for determining if the proposed regulations are major under Executive Order 12291. If the proposed regulations are deemed to have a significant impact on a substantial number of small entities, then an Initial Regulatory Flexibility Analysis (IRFA) must be prepared and incorporated into a joint document that meets the requirements of the Regulatory Flexibility Act (RFA). The purpose of the Regulatory Flexibility Act is to relieve small businesses, small organizations, and small governmental entities from burdensome regulations and record-keeping requirements, to the extent possible. In as much as Executive Order 12291 encompasses the RFA requirements, the RIR usually meets the requirements of both.

13.2 Section I. General Economic Conditions in the South Atlantic Shrimp Fishery

<u>Global Shrimp Supply Trends</u>

In recent years, commercial fishermen harvesting shrimp in south Atlantic waters have been affected by generally decreasing dockside shrimp prices and increasing prices for inputs such as fuel, ice, and insurance (Vondruska 1991). These conditions would be expected to decrease the aggregate profitability of commercial shrimping and reduce fleet size. Whether a trend of decreased aggregate profits has induced some active vessels to exit the fishery in some south Atlantic states is not known because changes in the number of state commercial harvest permits do not reflect entry and exit of vessels active in the shrimp fishery. The number of vessels active in the Gulf of Mexico shrimp fishery is believed to be declining in recent years, possibly reflecting decreases in profitability in that fishery (Vondruska 1991). Changes in vessel level profits would depend on the number of vessels active in the fishery for a given year and vessel specific differences in landings and cost structures.

The extent of further changes in the profitability of commercial shrimp fishing over the next decade will depend on levels of shrimp imports, changes in prices of variable and fixed cost items to shrimp producers, and global economic trends. Other factors such as environmental degradation and habitat destruction will also play a role in defining the economic future of a capture fishery for shrimp in the south Atlantic. Finally, future measures to control bycatch, prevent further habitat degradation and loss, and to introduce measures to limit access to the shrimp fishery will also influence the livelihoods of shrimpers in the coming years.

To understand how imports affect south Atlantic shrimp harvesters, one has to understand prevailing world shrimp market trends. Shrimp is produced throughout the world with more than 100 countries reporting production in 1989 (Food and Agriculture Organization). United States shrimp imports have expanded from about 260 million lb (headless, shell on basis) in 1980, to 563 million lb in 1989 and 579 million lb in 1990 (Vondruska 1991). At present, over 70% of total U.S. shrimp supply is imported (Aquatic Farms Ltd., 1989). Much of the increase in imports has come from farm-raised production, and most of the increase in the last few years has originated from Asian countries. China is currently the largest shrimp exporter to the United States and is also the world's leading producer of farm-raised shrimp. Latin America and Asia combined account for roughly 90% of U.S. foreign supplies of shrimp (Aquatic Farms Ltd., 1989).

Utilization of world shrimp production, while diverse, tends to be concentrated in two highly developed countries, Japan and the United States. These two countries have accounted for roughly 50% of world shrimp use since 1986 (Aquatic Farms Ltd., 1989). European countries have utilized around 15% of world production in recent years, but consumption in Europe tends to be composed of cold water species of shrimp (Aquatic Farms Ltd., 1989). Japan and the United States show a strong preference for warm water shrimp species, such as the species that are harvested in south Atlantic waters. Remaining world production appears to be consumed largely in the country in which it is produced (Aquatic Farms Ltd., 1989).

A recent study examined the economic consequences of shrimp imports to shrimp harvesters in the south Atlantic and Gulf of Mexico (Keithly et al. 1989). An econometric model including U.S. and Japanese shrimp import markets and U.S. dockside demand was used to quantify effects of shrimp aquaculture on U.S. imports and domestic warm water dockside shrimp prices. Results demonstrate that U.S. import levels would be about 175 million lb below their 563 million lb (1989) level in the absence of imports of farm-raised shrimp. The model indicates that import prices and domestic dockside prices would be roughly 70% higher in the short run in the absence of imports of farm-raised shrimp. The authors also suggest, however, that any rise in domestic warm water exvessel prices brought about by a reduction in U.S. shrimp imports would encourage additional effort in the domestic shrimp fleet and this would dissipate initial gains in profits as well as increase total harvest costs.

Another econometric study directly evaluated the impact of shrimp imports on prices to south Atlantic shrimpers (Houston and Nieto 1988). Results suggest that shrimp imports affect regional markets differently, having a significantly greater impact on south Atlantic shrimp prices, than on Gulf of Mexico, West Coast, or New England markets. The estimated flexibility coefficients (the percentage change in exvessel price for a 1% change in quantity or income) for the south Atlantic indicate that prices in the south Atlantic are not affected significantly by either the quantity of shrimp landed in the south Atlantic or other domestic sources of shrimp supply. Imports, however, had a statistically significant effect on exvessel prices in the south Atlantic. This suggests that south Atlantic shrimpers are not only price takers, but that other sources of domestic supply such as the

Gulf of Mexico have little influence on exvessel shrimp prices in the south Atlantic. Although the authors conclude that restricting imports of shrimp would increase dockside prices in the short run, the merits of that action are debatable because new entrants would be expected to dissipate any economic rents derived from the fishery in the long run.

From the point of view of shrimp fishermen, imports decrease benefits by depressing dockside prices as demonstrated by Keithly et al. (1989). However, imports increase the aggregate U.S. supply of shrimp leading to lower retail prices for consumers (for a review of how markets for imports and domestic supply are related, see Anderson 1986). Thus, consumers in this country clearly benefit from imports although there are also balance of trade considerations with imports which affect the buying power of U.S. consumers in the long run. Import restrictions would probably raise both dockside and retail prices, and increased retail prices would decrease benefits to consumers as well as creating deadweight losses to society. In addition, import restrictions would also impact U.S. wholesalers who currently depend on imports for a substantial portion of their sales volume.

Evaluating Economic Conditions In the South Atlantic Shrimp Fishery

One way to evaluate profitability of the shrimp fleet rigorously would involve collecting current cost and earnings data for each south Atlantic state since the shrimp fishery in this region differs by state as to the species targeted, seasonality, number of boats, and other factors. From cost and earnings data, an indirect cost function (Ward 1992) could be developed to analyze harvester profit levels. Net benefit changes to the shrimping industry and consumers which result from proposed management measures could then be calculated using a system of supply equations based on production information and cost and earnings data. Unfortunately, the cost and earnings data necessary to build such an equation system are not generally available at this time. For this reason, the analysis that follows will use available proxy information for the data identified above, and an indirect cost function model approach will not be attempted.

An extensive study of profitability and mobility of south Atlantic shrimp fishing firms undertaken in 1979 (Liao 1979) was evaluated as a source of economic information for this RIR. The consideration that import levels and other factors affecting shrimp harvesting have changed markedly since 1979 led to the decision not to use that cost and returns profile. The only source of reasonably current cost and earnings information known to be available for the commercial shrimp fishery in south Atlantic waters was collected in 1988 by the South Carolina Wildlife and Marine Resources Department, Marine Resources Division. That study was a random survey of south Atlantic shrimpers holding permits to fish for shrimp in South Carolina waters. It should be noted, however, that those data were originally collected to evaluate the expenditure impact of South Carolina's commercial shrimp industry through an input-output model (Ajuzie et al. 1989). Input/output studies are not designed to determine costs and benefits of management actions. Information presented below on economic conditions in the shrimp harvesting sector is based on an analysis of the raw cost and earnings data collected in the South Carolina Wildlife and Marine Resources Department survey, and no attempt is made to extrapolate from the input/output study results.

Cost and earnings data for the South Carolina shrimp fishery were collected via a questionnaire distributed by mail, with telephone and interview follow ups. The questionnaire produced a 16% usable response rate for the 866 solicitations, based on an estimated population of 630 resident commercial shrimpers in South Carolina in 1988 (Table 16). According to a Marine Resource Division analyst who supervised the data collection effort, data were only analyzed for the percentage of expenditures in South Carolina, and were never used to compare revenues to variable and fixed costs or to evaluate aggregate fleet profitability (Ray Rhodes, SCWMRD, Marine Resources Division; pers. comm.).

Although cost and return profiles indicate profitability at a point in time, they are less than ideal for evaluating the profitability of shrimping under different proposed management measures unless those measures or similar ones were in effect at the time of the collection. In addition, the degree to which economic returns to South Carolina shrimpers reflect conditions in other states, and as such are an adequate proxy, is not known precisely. In general, however, the shrimp fishery in South Carolina is probably similar to the shrimp fishery in Georgia (Walter Shaffer, South Carolina Shrimpers Association; pers. comm.). Because the management measures proposed in the shrimp plan at this time involve the fishery for white shrimp, cost and earnings information from South Carolina are thought to be appropriate because white shrimp is an important species in South Carolina, comprising, on average, roughly 60% of state shrimp landings 1957-1990.

Questionnaire response data were manipulated in the following manner before analysis for this fishery management plan was undertaken. Available data described fishing year 1987, when a greater number of small vessels were active in the fishery, prior to the permanent closure of bay and sound areas to shrimp trawling (Walter Shaffer, South Carolina Shrimpers Association; pers. comm.). For this reason, responses indicating vessel lengths less than 37 ft (LOA) were removed from the database for this analysis. Rationale for removing smaller vessels is that proposed measures involve trawling in Federal waters and smaller vessels are not likely to fish there, hence would not be directly affected by the proposed concurrent closures. A vessel of 37 ft (LOA) is believed to be about the minimum length that would make participation in the trawl fishery in Federal waters off South Carolina feasible (Walter Shaffer, South Carolina Shrimpers Association; pers. comm.).

Further, observations that indicated landings more than one and one-half standard deviations below the mean reported vessel landings in 1987 were eliminated from the data set under the premise that those observations represent vessels that were not truly active in the offshore shrimp fishery in 1987. Although there is little empirical work that can be used to characterize outliers in fisheries, one can assume that the distribution of landings is skewed in a heterogeneous offshore fishery because some minimum level of vessel landings is needed to sustain the capital investment. The one and one-half standard deviation rule amounted to eliminating seven observations from the data and making an observation reporting 8,500 lb (heads off) the smallest catch in the data set.

Data obtained from respondents to the South Carolina survey were divided into four categories for analytical purposes: vessel characteristics, operator/effort characteristics, variable and fixed cost estimates, and revenue and net revenue calculations. The use of "respondents" as a qualifier here is to point out that respondents may not necessarily represent the population of shrimp harvesters in South Carolina perfectly. At this time, no effort has been made to estimate how well respondents represent the population to which they belong.

A description of the vessels owned or operated by respondents is available in Table 39. Mean length, horsepower, reported average market value of vessel, and reported vessel purchase price can be found in that table. According to survey results, the typical vessel in the trawl fishery is 60 ft (LOA), has a power plant of 286 horsepower, and was built in 1970. Average market value (1987) was reported to be roughly $89,000 with some vessels at the high value end of over $200,000.

Operator and effort information provided in Table 40 show that in 1987, the average offshore commercial shrimp trawler owner or operator derived 75% of his household income from shrimping. Nearly 80% of respondents reported that they owned the vessel they operate. This percentage of owner/operators is probably higher than in other fisheries with similar vessel size since the fishery is predominantly a single day trip fishery. In other fisheries where longer trips are necessary, hiring captains to operate vessels for some or all of the fishing season occurs more frequently. Vessels used, on average, about one and one-half crew members in addition to the captain. In 1987, vessels fished an average of 120 days in South Carolina waters and an average of 75 days in other states. It is not known whether the degree to which South Carolina vessels fish outside state waters was particularly high in 1987, or typical of the degree of activity across state borders in the shrimp fishery in recent years. Fluctuation in fishing areas could result from a variety of possible factors: biological, management related, and economic. Examining the reported high and low values for shrimping days in South Carolina, it is observed that some vessels fished as many as 250 days in South Carolina waters while some respondents holding a South Carolina shrimp permit did not report fishing in that state in 1987. This points to the possibility that shrimp vessels are quite mobile and may fish up and down the coast regardless of their home port. An earlier assessment of mobility of the shrimp fleet in the south Atlantic confirms the finding that shrimp trawlers frequently fish in waters outside the state in which the captain or owner resides (Liao 1979).

On the question of whether shrimp vessels enter other fisheries, survey results indicate that this activity is minimal. An average number of eight days was reported fishing for species other than shrimp, with the majority of respondents reporting zero days (mode and median values are zero). In 1989 and 1990, however, a number of shrimp vessels in south Atlantic states are known to have entered the wreckfish fishery (SAFMC 1990).

Annual fixed and variable cost estimates are reported in Table 41. When examining these data, it is important to note that these expenditures are in 1987 dollars and reflect production costs at that time. Available cost and earning data are essentially a "snap shot" of economic performance in the fishery at that time. Instead of using it as a direct measure of current profitability, it is perhaps better to use it to describe profitability at that time and then compare 1987 to other years in terms of factors expected to influence profitability.

The most significant variable cost expenditures for shrimp trawlers in South Carolina appear to be fuel and oil, engine maintenance and repair, ice, and miscellaneous supplies (Table 41). Note also that standard deviations for reported variable costs are large relative to mean estimates. This variability in reported trip costs indicates that vessels have considerably different cost structures and requirements because of their gear specifications, differences in vessel types, or differences in travel distances to and from the fishing grounds.

Net revenues before taxes were estimated by subtracting the sum of variable (exclusive of crew share) and fixed costs (exclusive of depreciation) from total annual revenues reported by a given respondent. Total revenue for a respondent was calculated by multiplying total pounds (heads off) of shrimp reported landed in 1987 by average price across different counts (heads off) and adding any revenues reported from sales of bycatch (Table 42). These revenues are returns to vessel, captain, and crew for owner-operated vessels, or are returns to vessel, owner, captain, and crew, for vessels that are not owner-operated. Although actually a cost in the harvesting of shrimp, the survey did not collect specific information on crew share, perhaps because the South Carolina Wildlife and Marine Resources Department designed the study to perform an input-output analysis where determining net returns may not have been of importance.

According to calculations performed on the data after the manipulations as described above were performed, the average vessel landed roughly 24,000 lb of shrimp (heads off) in 1987 and received an average of $3.20 per lb for shrimp landed (Table 42). Total revenue from the average vessel's annual landings was roughly $74,000. Net revenues to owner/operator (or owner and operator), crew, and vessel (before taxes) are estimated to be $38,750. Note here that the standard deviation for net revenues, as calculated, amounts to nearly the same value as the mean value for net revenues. This indicates that the distribution of net revenues is fairly wide, as is expected in a fishery with heterogeneous fishing firms. Net returns range from slightly negative returns to as large as $75,200.

Median net revenues as calculated were $35,900. Normally, when the arithmetic mean is fairly close to the median value, this is an indication that outlier values (values that are very different from the central tendency) are not serving to distort the mean value. In this case, the arithmetic mean for annual net returns is a good measure of central tendency for the distribution of estimated net returns. The lack of outlier values for this calculation was convincing evidence that the observations in the data set should not be divided into vessel or performance strata for separate analysis of portions of the fishing fleet such as when returns are found to be bi-modally distributed. The removal of observations for vessels under 37 feet (LOA) presumably obviated the need for stratifying the data in this case.

Finally, reported revenues from sales of species other than shrimp by commercial shrimpers are relatively small (Table 42). The average shrimp trawler received less than $1,500 from sales of bycatch in 1987. The reported high value was $2,800 and the reported low was zero.

Profitability of Shrimping in the South Atlantic as Represented by Available Data

Recognizing the difficulty of using the available survey data as a proxy for cost and earnings data on a state by state basis, no firm conclusions on profitability in the south Atlantic can be drawn at this time. However, if data are accurate and no large strategic or response biases exist, one can conclude that before tax returns of $38,750 to captain, crew, and vessel in 1987 in South Carolina were probably lower than one might reasonably expect for a fishery involving capital expenditures of the magnitude needed for shrimp trawling. Recent economic studies of open access fisheries have underscored the notion that profits in strongly heterogeneous fisheries can be significant (Anderson 1985, 1986).

There are inherent difficulties with evaluating profitability when net returns to captain, crew, and vessel are described in aggregate rather than separately. Lacking a breakdown of returns to captain, crew, and vessel, economic conditions in the fishery are difficult to characterize because there is no way to isolate return on investment for a shrimp fishing vessel. To gain some insights to this information, a spokesman for the shrimp industry in South Carolina was consulted. From that discussion, it was learned that trip settlements are normally conducted such that 30% of gross revenues (revenues before variable and fixed cost deductions) on a per trip basis are divided between captain and crew as compensation for the trip. The remaining 70 percent are assigned to the vessel, from which variable and fixed costs will be deducted (Walter Shaffer, South Carolina Shrimpers Association; pers. comm.). The 30% of gross revenues is apparently commonly split such that half goes to the captain and the other half to the crew. The exact division here would depend on the number of crew members, their level of experience, and other factors (Walter Shaffer, South Carolina Shrimpers Association; pers. comm.).

For purposes of this analysis, earnings of the captain are not of specific interest because the captain can presumably receive roughly those same terms as a hired captain on another vessel. In this sense, the captain's earnings are equal to his opportunity cost (what he could be making somewhere else) and not part of the resource rent (defined here as profits derived from the resource beyond normal profits, or in essence, the net value of the resource) generated from the shrimp fishery. Of interest here is the net return to the vessel after all costs are deducted and specifically how that return compares to what could be earned by investing what the vessel and gear are worth in an alternative investment. An alternative investment, for example, might be an investment in another type of small business, or in a certificate of deposit or municipal bond.

To evaluate profitability in this manner, fixed and variable costs were subtracted from 70% of annual gross revenues per observation in the South Carolina Wildlife and Marine Resources data set, i.e., following the trip settlement formula described above. The effects of depreciation were included into this calculation as a cost by subtracting the reported vessel purchase price from what the respondent estimated the vessel was worth in 1987 and dividing this by the number of years between the year the vessel was purchased and 1987, the fishing year the data represent. This calculation of depreciation accounts for depreciation in nominal dollars. Results from the subtraction for each observation were averaged to describe the central tendency of estimated annual returns to the vessel. On average, annual return to vessel was $11,685, with $30,457 being the highest annual return and the smallest being a negative return of $20,850 (Table 42).

Recalling that the average vessel was reported to be worth $89,000 (Table 39), this means that annual return to the typical vessel as an investment in 1987 were roughly 13%, on average. The highest monthly average prime rate in 1987 was 9.25% and the lowest was 7.75% (Economic Report of the President 1991). Using a midpoint of 8.5% for the prime rate that year, and assuming that a certificate of deposit or municipal bond would have a return of approximately two or three points above the prime rate at that time, then investing in a shrimp vessel was only a slightly better investment than simply investing in a certificate of deposit or bond. One's assessment of risk would, of course, affect the relative wisdom of owning a shrimp vessel as an investment. From the perspective of a shrimp fishermen, however, owning a shrimp trawling vessel may seem less risky than investing in a financial instrument such as a bond.

One factor affecting aggregate and vessel level profits in a particular year is, of course, abundance of shrimp. South Carolina shrimp abundance in 1987 when compared to other years was evaluated as a factor affecting profitability, assuming entry into the fishery is not completely elastic and profits are not necessarily dissipated completely in a given year. For this evaluation, total annual reported landings of all shrimp species in South Carolina was used to categorize shrimp abundance. Total reported landings in 1987 for all shrimp species in South Carolina was 3,675,000 pounds (heads off), roughly 3% greater than average total shrimp harvest for 1975-1990 (average of 3,579,700). Hence, to the degree that annual abundance affects profitability, 1987 would be representative of at least an average year. As outlined above, a number of other factors could affect vessel profits over time such as: relative quantity of shrimp imports, relative quantity of other sources of domestic production, the number of vessels in the fishery that year, and management constraints. Since the survey is a snapshot of fleet profitability in 1987, these other factors affecting vessel profits over time cannot be addressed in this discussion.

13.3 Section II. Analysis of Management Measures

PROBLEMS AND OBJECTIVES

Problems in the fishery, as well as the objectives for this FMP, have been outlined in previous sections. Economic impacts resulting from this FMP are attributable to the combined effects of the objectives and the management measures to accomplish those objectives. As such, those impacts are described under the management measures themselves.

The following headings track the numbering system in the management measures section. The RIR analysis of management measures begins with 13.7 to aid in reviewing the shrimp management plan. Additional information for any measure can be found by referring to the same number in Section 12 (e.g., 13.7.1 in the RIR corresponds to 12.7.1 in the management measures section).

13.7 Management Measures

13.7.1 Management Measure 1

13.7.1.1 Concurrent Closures

Preferred Alternative:

States may request concurrent closure of the EEZ adjacent to their closed state waters following severe winter cold weather that results in an 80 percent or greater reduction in the population of overwintering white shrimp.

Discussion: The aggregate economic impacts on shrimp harvesters of proposed concurrent closures of Federal waters following freeze winters are essentially the difference between what fishermen give up in terms of spring shrimp revenues and what they gain from fall shrimp revenues. What is sacrificed by shrimpers is the revenues from fishing on a reduced roe shrimp crop after a freeze has taken place. "Gain" of revenues in the fall refers to the increase in revenues attributable to the closure over what they would have been without the closure in that fall season following a freeze. When describing the loss of revenues during the spring closure, just those attributable to trawling in Federal waters should be counted because closures of state waters are not the result of the proposed management measure. Available data, however, do not provide any means of separating EEZ catch from catch taken illegally from state waters during state waters closures. Some fishermen speculate that a considerable portion of landings during spring months are really landings from state waters although official evidence of the magnitude of illegal catch is not available.

To adhere to an economic perspective, comparing the impacts with and without a Federal closure should be thought of in terms of aggregate profits forfeited from the spring closure in a freeze year compared to expected aggregate gains in profits from having a better fall season than would have been possible if fishing on the spring roe white shrimp had been allowed. The merits of an assumption that larger fall trawling revenues following a winter freeze translate directly into larger profits to an individual fishing firm or in aggregate for the fishery will be discussed in this section. Difficulties encountered attempting to measure profit changes under the proposed measures as compared to no action in a cost/benefit framework will also be discussed.

Stock recruitment relationships for white shrimp in the south Atlantic and Gulf of Mexico have been identified (Lam et al. 1989; Gracia 1991). Available information suggests that year class strength is related to adult biomass only at low levels of abundance. The only known cause of low levels of abundance is a winter freeze. Following a winter freeze, the abundance of roe white shrimp in the spring is thought to affect subsequent abundance of white shrimp in the fall, which in turn would be expected to reduce fall harvest of white shrimp. Continued fishing (no action) following a freeze would further reduce the abundance of roe white shrimp and consequently reduce the fall crop considerably. Spring catches of roe white shrimp are small compared to fall production and are thus presumably less important to fishermen despite the fact that price per pound tends to be higher in the spring months with the greater average size of white shrimp (see Appendix IV and discussion that follows).

To examine the tradeoff between closing Federal waters to shrimp fishing in freeze years and expected fall white shrimp landings, some statistical tests were performed on south Atlantic white shrimp landings data in past freeze and non-freeze years, and with a closure of EEZ waters for one year (1990). The findings of these statistical tests lend a great deal of validity to assumptions about harvests in freeze years and to the potential merits of concurrent closures. However, conclusive determinations about the validity of closures will only be possible if concurrent closures after freezes are successful in bringing about close to normal fall harvests on a repetitive basis.

To examine the merits of concurrent closures in the south Atlantic white shrimp fishery, it is first important to determine if catches of white shrimp in freeze years are significantly different from those in non-freeze years. The most appropriate manner to evaluate that question would be to compare fall catches of white shrimp following winter freezes to fall catches where winter freezes did not occur to see if freeze years are significantly different from non-freeze years. Unfortunately, comparison is not possible because monthly catch data for all south Atlantic states from which to separate fall white shrimp landings are not available for all states until 1978. That means that only 12 years of data would be available which would limit the statistical significance of any tests set up to compare fall landings directly.

Although fall catches cannot be compared directly, comparison of total annual south Atlantic white shrimp catches for freeze years and non-freeze years should approximate the effect of freezes. This is because although spring and fall catches differ from year to year, spring catch is always considerably smaller than fall catch in terms of relative contribution to the total pounds landed in a given year. Thus most of the variation in white shrimp landings from year to year results from the magnitude of fall landings. Comparing total annual white shrimp landings following freezes and for years where freezes did not occur should therefore serve as an adequate proxy for comparing fall catches.

Inspection of white shrimp landings data suggests that white shrimp landings in freeze years appear smaller than in normal years over the time period 1957-1990 (Table 5). Closer inspection, however, reveals that in some years which are not recorded as freeze years, such as 1963, 1964, and 1966, landings were only 7.3, 8.1 and 9.2 million lb (heads on) respectively and do not appear to be that different from those of freeze years where mean landings are approximately 6.8 million lb (heads on). Whether the mean of landings in freeze years (mean of 6.8 million lb, heads on) is significantly different from the mean of landings in non-freeze years (13.6 million lb, heads on) for the 1957-1990 period in terms of statistical significance is a relevant question. Leaving potential explanations for variation in catch that are not related to white shrimp abundance out of the analysis for the moment, a test to compare the two means to determine whether catches in freeze years are actually statistically different from non-freeze years was performed.

Tests to compare means from different samples or populations were evaluated based on whether the tests were designed for small sample properties and whether sampling regimes and assumptions about variances matched the data and the question being examined. A statistical routine was selected which is essentially an analysis of variance test (commonly referred to as ANOVA) performed by creating a dummy variable which was set to the value of one if the year was not a freeze year and zero if the year was a freeze year. Then annual white shrimp catch was set as the dependent variable in a regression where the dummy variable for whether observations were freeze years or not was the only explanatory variable. The observation for 1990 was left out of the regression because although 1990 was a recorded freeze year, it was the only year where a closure of EEZ waters to the harvest of shrimp was in effect (until respective state waters opened). Treating the observation for 1990 as a normal freeze year would have violated the assumptions of the test as well as countered the logic of the relationship being tested.

The potential significance of the dummy variable determines, in effect, that the mean for catch in non-freeze years is statistically different from that of freeze years. Seen alternatively, the null hypothesis that the means were the same would be rejected if the coefficient for the dummy variable was significant. In that case, the alternative hypothesis that the means are significantly different could be accepted.

The coefficient for the dummy variable was highly significant at the 99% level (Table 44) according to the T test (null hypothesis is that the coefficient for the dummy variable is not significantly different from zero). Because empirical work has suggested that shrimp catches when plotted against effort are log-linearly distributed (Nichols 1986), a log-linear specification for the dependent variable was tested in a separate regression. The results of that alternative regression (when the anti-log was calculated) were essentially the same both in terms of results and statistical significance, so only the results of the linear regression are reported.

Catches in freeze years are significantly different from normal years according to the results of the test that were performed. The degree to which the difference in catch between freeze years and normal years is explained by other potential explanatory variables such as changes in effort is not known. Data on south Atlantic white shrimp fishing effort trends are not available. Although number of participants is sometimes used as a proxy for more direct measures of effort trends, changes in the number of state shrimping licenses do not necessarily reflect active participation in the fishery. Thus the number of state license holders over the time period in question is not a suitable index for effort trends.

After statistical testing was performed on the question of whether landings in freeze years are significantly different from landings in normal years, a confidence interval was constructed around the mean of normal (or non-freeze) years. The purpose of this confidence interval was to test whether observed landings during 1990, the only year for which a concurrent closure has been in place, fit into the range of what can be characterized statistically as landings for a non-freeze year. The confidence interval and its derivation based on a probability level of 95% (z of 1.96) are shown in Table 44. After comparison to the calculated confidence interval, landings for 1990 of 13.1 million lb fit into the center of the interval of 12.7 to 14.6 million lb (head on), suggesting that the observation belongs to the category of non-freeze or normal years.

Available evidence thus suggests that concurrent closures during freeze years may bring about landings for that year that are characteristic of normal years rather than freeze years, although this relationship cannot be established firmly because it is based upon a single observation. Perhaps the best way to describe the implications of the results of the statistical test is that 95% of the time, white shrimp landings in freeze years where a concurrent closure is in effect would not be statistically different from landings during a normal year (mean of 13.6 million lb for 1957-1990). If landings in freeze years where closures are used in the future are evaluated via the framework set out in Table 44, then after a significant number of concurrent closures (holding factors constant such as effort and carrying capacity of habitat, or compensating for the direction and expected magnitude of changes), results can be evaluated systematically to verify the expected effect of the closure. Because the relationship between closures and white shrimp catches within the range of a normal fishing season is based on plausible but scant evidence, it is recommended that in the future, the success of closures in freeze years be evaluated by the statistical framework above. Alternatively, a framework based on the more appropriate comparison of fall landings in freeze and normal years could be used, provided a sufficient number of data points are available to make that more direct comparison.

Accepting for the moment that closures do result in normal white shrimp landings rather than low landings associated with freeze years, the next question is what is the economic effect of normal landings levels as opposed to landings under no action. There is an inherent tendency to associate avoiding low white shrimp landings with the notion of greater net economic benefits for the fishery. That is, however, not necessarily the outcome. The remainder of this section discusses the effects of closures on the harvesting and processing/distribution sector from the perspective of the revenue and net economic benefit changes from closures as opposed to no action. Impacts on the harvesting and processing/distribution sectors will be considered separately because net benefit implications depend on different factors.

For the harvest sector, assuming closures result in the expected gains in catch over no action, there is still the disruptive effects of not being able to fish in closed EEZ waters during Federal closures. EEZ closures will force shrimpers who normally count on revenues from white shrimp in the spring months in EEZ waters (off states that are likely to request a closure of Federal waters) to seek alternative sources of revenue during closure years.

To bound the extent of these spring catch and revenue disruptions, catch data for white shrimp landed from 1978 to 1990 during the months when state waters are normally closed (varies by state) and associated revenues are reported in Table 43. Catches and revenues for freeze years are indicated by boxes around the years with freeze years being indicative of the level of white shrimp catches during likely closure months in freeze years. Catch for 1990, which was a freeze year where an EEZ closure was in force, is not representative because the closure obviously impacted catch.

Ignoring 1990, catches in freeze years range from a high of 181,797 lb to a low of 44,577 lb and revenues range from a high of $759,973 to a low of $577, 911. Table 43 assumes that a closure of all south Atlantic states would be undertaken, which is unlikely because white shrimp is not an important species in North Carolina where the more important pink shrimp harvest would be affected by the closure. In addition, Florida does not presently monitor winter temperature effects on white shrimp and does not have a system in place to request a closure. Thus considering all the catch reported in south Atlantic states during the period of likely closure gives an upper bound estimate of short run catch and revenue impacts. If North Carolina and Florida are unlikely to request a closure in the future, then catches and revenues for Georgia and South Carolina are more indicative of likely impacts. The range of affected catch and revenue for freeze years using South Carolina and Georgia alone (again ignoring 1990) is a low of 10,634 lb and high of 91,786 lb, and a low of $19,634 and high of $234,098 for revenues.

A mitigating factor in using figures from Table 43 to characterize revenue impacts from the closure of spring roe harvest is that some of the reported catch and revenue is undoubtedly from illegal state waters fishing, and conceptually should not be considered as caused by an EEZ closure as was discussed above. Another mitigating factor which is significant is that although catch patterns are certainly disrupted by an EEZ closure, at least some of the overwintering white shrimp that cannot be legally taken when an EEZ closure is in place will be available to shrimpers when the closure ends. Estimated cumulative natural mortalities during that portion of the year range from 27 to 62% for a two month closure (derived from survival rates in Table 4). Thus in a worst case scenario, only 62% of the catch and revenues represented in Table 43 would actually be lost to fishermen.

There are disruptive effects of not being able to fish for a portion of the traditional fishing season which cannot be minimized because marginal fishing firms are experiencing difficult economic conditions already and still have to make boat mortgage and other payments throughout the year, whether they fish or not. The availability of alternative fishing opportunities during the spring months in freeze years will ultimately determine the degree of disruptive effects from concurrent closures. Potential candidates for affected fishermen are the shrimp fisheries in non-affected states such as the pink shrimp fishery in North Carolina or the white shrimp fishery in Florida if Florida does not request a closure of EEZ waters. Traveling to fish off other states requires greater expenditures in terms of fuel (which would not be that large if the boat is operated out of that state rather than returning on a trip by trip basis) and probably adds additional risk into fishing operations.

Rock and royal red shrimp fisheries are potential candidates (see discussion of buffer zone that follows) but information on the potential profitability of those fisheries as alternatives is not available at this time. Shrimpers have also been involved in fishing for whiting, wreckfish, and whelk when state waters are closed in the past. Wreckfish is managed under a controlled access regime and only shrimpers originally granted allocations or willing to purchase percentage shares and wreckfish catch coupons would have that option available to them. No information regarding the potential profitability of fishing for whiting or whelk is available at this time.

For purposes of illustration, there are some merits to viewing the tradeoff of foregone spring catch in freeze years from EEZ waters as compared to the expected gains in terms of the concurrent closure increasing annual catch and revenue (over what catch and revenue would have been). Given the nature of the information involved in making this comparison, however, the tradeoff must be evaluated cautiously and one cannot make any definitive determinations as to the exact magnitude of the tradeoff at this time. With this caveat understood, an upper bound range of spring roe shrimp catch and revenue affected by the concurrent closure is, once again, roughly 44,500 to 182,000 lb and $578,000 to $760,000. According to available evidence, the potential catch increase from a concurrent closure over what catch would have been without a closure involves an increase of approximately 6.8 million lb, and a potentially large increase in annual revenue from the white shrimp fishery compared to no action, as described in the discussion above concerning statistical inferences about the difference between catches of white shrimp in freeze years and normal years.

It stands to reason that even if catch is increased twofold compared to no action as a result of the closure, revenues would not be increased by the same magnitude. By effectively decreasing the length of the white shrimp fishing season in closure years, fishermen may experience some exvessel price decreases due to production gluts. Although existing handling, packing, and processing capacity can theoretically accommodate the aggregate quantity of white shrimp landings because landings are in reality only at normal levels as a result of the closure, the shorter season may create some product flow problems associated with the distribution of a perishable product. Supply gluts would put fishermen at a disadvantage in terms of negotiating prices with shrimp dealers.

Supply gluts from a short season could also increase the percentage of product that would likely have to be frozen. Locally produced shrimp mainly fills the fresh shrimp market niche, although a small percentage of the catch is normally frozen (heads offs) either plain or breaded. Local shrimp has a comparative disadvantage in the frozen shrimp market which is dominated by imported frozen shrimp from large-scale operations in South America and Asia. Effectively forcing a greater percentage of shrimp into the frozen shrimp market will likely mean lower prices to fishermen, holding all other factors equal.

The magnitude of exvessel price decreases from short run supply gluts depends on the price flexibility of exvessel demand and other factors. The estimated price flexibility for shrimp in the south Atlantic suggests that prices are relatively inflexible, meaning that a less than unit price response would be expected from a unit increase in the quantity supplied (Houston and Nieto 1988). That price flexibility, however, was estimated with annual data which is not ideal for examining the effects of compressing the catch into a shorter period of time.

Assume for the moment that the closure is successful in bringing about landings in the range of a normal year. Under that scenario, revenues would not be expected to increase by the same magnitude as catch (compared to no action), but would certainly be greater than without a closure due simply to the scale of the increase in catch compared to no action (approximately 6.8 million lb). Hence, despite the fact that exvessel prices may be somewhat lower because production outstrips processing and handling capacity in the short run (or because more product requires freezing than before), the overall effect of the closure on revenues will be positive because the quantity effect will very likely exceed the effects of somewhat lower per-unit prices.

Provided the closure brings about the anticipated increase in yields compared to no action, then from the point of view of total revenues fishermen are better off with closures. At the level of individual firms, however, this may not always prove to be correct. For instance, there may be some distributional effects that complicate this issue for fishing firms. The distribution of these increased revenues will, in fact, favor operations which traditionally catch more in the fall and will impact disproportionally operations with a comparative advantage to fish for roe shrimp in the spring. Adjustments in fishermen's strategies and modifications in gear, however, can be expected to decrease the actual degree that catch is redistributed.

Although under the scenario of the closure, aggregate revenues will increase compared to no action, increases in net producer benefits are not expected from proposed closures. Access to the south Atlantic fishery for shrimp is not subject to any state or Federal management controls and the fishery is highly overcapitalized. Lacking existing or new measures (no measures to control access are proposed in this fishery management plan), the inherently inefficient solution of too many vessels using too much capital to produce annual yields is not remedied by proposed revenue-enhancing measures in the plan. In this sense, the only economic effect of the increased revenues compared to no action may be to prevent exit of marginal firms from the fishery firms. These firms may not have been able to continue fishing under reduced white shrimp abundance had a closure not been implemented following a freeze. Thus socio-economic disruptions resulting from egress from the fishery may be avoided with closures, but the inherent inefficiency of not having property rights in the fishery is not remedied by proposed measures.

The effects of proposed closures for the processing/distribution sector of the fishery differ within that sector. Fish houses in south Atlantic states generally head, pack, and grade shrimp they purchase from fishing vessels. Fish houses then sell that shrimp to large volume buyers who represent seafood restaurant chains, secondary processors, or brokerage firms. Fish houses also sell some shrimp through their own retail operations as well as local seafood restaurants and fish retailers who do not operate docks.

Fish houses which depend heavily on white shrimp catches for their annual sales volume will be impacted by the closures. For South Carolina and Georgia, where concurrent closures are more likely to be implemented, fish houses are not likely to have any shrimp to sell during the closure because there is presently little or no production of rock or royal red shrimp in those states. Fish houses where vessels also land finfish may be able to make up some of the lost sales volume by increasing the quantity of finfish brought to their dock through price incentives to vessels or other types of incentives. Fish houses also make part of their earnings by selling fuel, ice, and other support services to vessels that dock there. If shrimp vessels remain tied to the dock rather than attempting to switch to other species, then fish houses will forfeit sales of support services at that time of year. If shrimp vessels leave the state to fish where closures are not in effect, then fish houses in states with closures will also lose sales of support services. Fish houses that own vessels which normally fish for white shrimp are expected to be impacted the most from closures because losses are potentially incurred on several fronts.

If closures bring about the expected increases in fall white shrimp catches compared to no action, then fish houses will have far greater white shrimp sales during the fall months than would otherwise have been possible. As was mentioned before, it is possible that the compressed season will stress the handling and primary processing capacity of fish houses. This will probably allow fish houses to pay lower prices to fishermen but it will also likely mean higher operating costs for fish houses because of induced inefficiencies. In addition, fish houses may receive lower prices for the shrimp they sell because a production glut would mean more shrimp will have to be frozen than in normal years. If the large supply of south Atlantic shrimp coincides with a period of heavy supply of imported shrimp, it is possible that prices fish houses received will be considerably lower than in normal years when local catch is more evenly spread throughout the year.

Large volume buyers who represent seafood restaurant chains, secondary processors, or brokerage firms will only be minimally affected by proposed closures. Because south Atlantic production is insignificant compared to imports and shrimp landings from the Gulf of Mexico, both the disruption in supply during the closure and the increase in landings in fall months compared to no action are not expected to affect prices paid to fishouses or prices received from their clients.

From an annual aggregate employment point of view, however, concurrent closures will be beneficial to fishermen and fish house employees because they will probably stabilize annual employment in the white shrimp fishery instead of more variable shrimp abundance and landings without closures which is disruptive to employment of crew members and captains. Overall, entry into the fishery is not expected to be spurred by the increased fall shrimp crop with closures during freeze years because abundance of white shrimp is not expected to be increased over mean conditions characterized by landings in non-freeze years. Thus employment in the fishery is probably not going to be increased over normal employment levels.

The effect of concurrent closures on consumers will be negligible because imports make up roughly 80% of total United States supply and thus have a much more significant effect on prices consumers pay than landings from the Gulf of Mexico or the south Atlantic. To the extent that some consumers differentiate between local fresh shrimp from imported shrimp, there will be some losses to consumers during closures resulting from decreases in local shrimp availability. Consumer benefit losses from decreases in local shrimp production cannot be documented or quantified at this time because demand studies are not available to evaluate the extent to which consumers differentiate local product from other sources of shrimp or the relative importance of that product attribute. There is significant anecdotal evidence that some consumers in coastal communities prefer locally produced shrimp but no systematic attempt to establish or measure this preference has ever been undertaken for the south Atlantic region.

Lastly, one final benefit associated with concurrent closures is expected enforcement savings and greater compliance with state closures following freeze years compared to no action. Savings compared to no action may be substantial because a great deal of state enforcement resources are needed to deter illegal spring trawling inside state waters under the guise of fishing in Federal waters. Under the current scenario, state closures are enforced primarily by state enforcement agencies both from shore points where vessels operating in state waters can be observed and on the water in states where vessels and other enforcement resources are available.

The proposed measures will require some at-sea enforcement efforts from the NMFS and U.S. Coast Guard. These Federal enforcement efforts will mainly take the form of making sure vessels whose captains claim to be landing shrimp that were caught in the EEZ waters adjacent to a state not participating in a closure, were not actually fishing in EEZ waters of a state participating in the closure. Some enforcement effort will also be required to make sure vessels transiting EEZ waters from fishing waters not affected by a closure have shrimp trawl gear stored according to the provisions specified in Management Measure 2 below. The primary area where this problem may require enforcement expenditure is in Georgia because it is unlikely that Florida will participate in closures in the near future. At this time, the NMFS Law Enforcement Division believes that no additional Federal enforcement expenditures are required for the proposed closure and buffer zone provisions (see below) because closures would be enforced via patrols already planned for other purposes.

For the most part, however, it should be possible to enforce the closure dockside because no landings of white, pink, or brown shrimp will be legal at that time unless there is reason to believe that the vessel fished in waters not part of the closure. Prior to concurrent closures, enforcement had to prove that a vessel captured white shrimp in state waters, and this virtually necessitated at-sea enforcement which is significantly more expensive.

Alternatives Considered and Rejected:

1. No change (i.e., No Federal closures).

Discussion: The discussion above compares the proposed alternative to no action. As noted, effects of the proposed measure cannot be described in precise terms such as increased yield per pound sacrificed, but the expected increased yields associated with concurrent closures should result in greater aggregate revenues to shrimp harvesters over no action. Increased net economic benefits are not expected because the fishery is managed under open access and excess capacity is great.

2. Concurrent closure of Federal waters adjacent to state waters to aid law enforcement.
Discussion: This option does not necessarily have the biological benefits associated with closures after freezes and hence does not have economic benefits associated with having more to harvest in the fall than would have been available if roe shrimp harvest were not allowed. In addition, this option would have greater economic impacts on harvesters than the preferred alternative because Federal waters would always be closed when state waters are closed, whether a freeze had occurred or not. From a purely economic point of view, however, large cost savings to state enforcement agencies would be associated with this option. It is not known whether improvements or cost savings in enforcement in state waters could not be accomplished through means other than automatic closures of Federal waters when state waters are closed. Because the magnitude of cost savings in state enforcement cannot be quantified at this time, there is no way to compare them to the increased negative impacts on harvesters under this alternative.

3. Closure of the EEZ throughout the range of the white shrimp when requested by two or more states.
Discussion: This rejected alternative would have created larger impacts on fishermen in North Carolina and Florida, where closures would not likely be requested under the preferred alternative. Greater impacts would occur in North Carolina where the pink shrimp fishery is consistently more important in terms of catch and revenues to North Carolina fishermen than the white shrimp fishery, because a white shrimp closure would close the pink shrimp fishery for enforcement purposes. According to public comment, North Carolina shrimp fishermen report substantial pink shrimp catches in EEZ waters of that state occurring during likely EEZ closure months. Under the preferred alternative, these pink shrimp could be landed because North Carolina is not likely to request an EEZ closure and would only close a portion of its EEZ waters, south of where fishermen report pink shrimp landings. In the case of Florida, only extreme cold spells might jeopardize white shrimp in the waters of northeastern Florida. Closing EEZ waters there if states north of Florida requested a closure might unnecessarily impact Florida fishermen as well as fishermen from other states who migrate south to fish there because under normal freeze conditions, a white shrimp kill probably would not have occurred in Florida. The benefit originally envisioned for a closure of the entire EEZ was that enforcement costs would be lower and effectiveness higher if the entire EEZ was closed. After the magnitude of pink shrimp EEZ catches were taken into account and after the probability of a request for a closure by the state of Florida was better understood, it became clear that the benefits of the approach of the preferred alternative (with some other clarification's for enforcement purposes that will be discussed below) outweighed enforcement cost savings of a closure of the entire EEZ.

4. Closure of the EEZ to include northeastern Florida when requested by two or more states.
Discussion: The argument for this measure stems from enforcement cost savings and increases in effectiveness as well as the rationale that if two or more states requested a closure, the freeze that occurred would probably have affected white shrimp in Florida as well. To the contrary, however, it is now believed that the measures detailed in the clarification of the preferred alternative outlined below will tighten some of the potential enforcement loopholes associated with an EEZ closure as originally proposed. In addition, because the probability of a freeze affecting Florida waters adversely is low in normal freeze years, potentially subjecting EEZ waters off Florida to closures promulgated by requests from other states, based on conditions in those states, is probably unnecessarily burdensome for Florida fishermen and fishermen from other states who fish for overwintering white shrimp in EEZ waters off Florida. Hence the cost savings for enforcement are not thought to outweigh the negative impacts on fishermen.

13.7.1.2 Clarification of Management Measure 1

Preferred Alternatives:

1. Exempt royal red and rock shrimp fisheries from any closures of the EEZ for the harvest of white shrimp.
Discussion: Exempting the royal red and rock shrimp fisheries from the proposed management measures under the preferred alternative does not appear to decrease benefits associated with concurrent closures because there is apparently no bycatch of white shrimp in those fisheries. Royal red and rock shrimp harvesting is done in much deeper water and allowing those fisheries to remain open during a closure should not increase enforcement costs or non-compliance with the concurrent closure. At the same time, allowing those fisheries to remain open may serve to decrease impacts on white shrimp harvesters because the royal red and rock shrimp may serve as alternative fisheries when white shrimp cannot be harvested. The degree to which royal red and rock shrimp fisheries are viable alternative fisheries in terms of profitability is not known at this time.

2. Exempt the whiting fishery (*Menticirrhus* sp.) from a closure for white shrimp.
Discussion: Allowing the whiting fishery to continue during an EEZ closure allows alternative employment opportunities for shrimpers who would normally be fishing for white shrimp. Provisions for no allowable bycatch of penaeid shrimp of any species and no possession of nets with smaller than 4 inch mesh in the wings or bag should make the targeting of white shrimp difficult. Because fishing for whiting normally occurs in waters where white shrimp fishing would take place if a closure were not in effect, enforcement concerns are probably justified with this exemption. With possession of mesh rather use of mesh stipulated in the proposed measure, and because penaeid shrimp cannot be in possession, enforcement at the dock should be effective, and will serve to decrease potential enforcement problems. Allowing alternative fisheries to remain open may serve

to decrease impacts on white shrimp harvesters, and this probably outweighs the detracting elements associated with this measure in terms of creating potential enforcement problems. The degree to which the whiting fishery represents a viable alternative fishery in terms of profitability is not known at this time.

Alternatives Considered and Rejected:

1. Prohibit all trawling during a white shrimp closure.

Discussion: Although this measure would provide the greatest deterrent against illegal fishing for white shrimp during an EEZ closure, measures to make fishing for white shrimp illegal during a closure enforceable under the preferred alternative while preserving as many opportunities for legitimate alternative fishing opportunities as is possible appears to be more beneficial. For this reason, the enforcement advantages of this proposed measure are not thought to outweigh the negative effects associated with prohibiting all trawling during closures. Under this rejected alternative, however, enforcement costs would have been lower because enforcement could have been undertaken almost exclusively at the dock, while this will not be possible under the preferred alternative.

2. Exempt pink shrimp from an EEZ closure for white shrimp.

Discussion: Because pink shrimp harvest takes place in the same waters that white shrimp are harvested, this alternative involves much higher enforcement costs than the preferred alternatives. Pink shrimp catches by month and state are reported in Appendix VI. To avoid forfeiting pink shrimp revenue, a loophole in the closure regulations would be created. If that loophole were used by shrimpers, the effectiveness of the proposed concurrent closures might be jeopardized and enforcement costs associated with ensuring that shrimpers were really targeting pink shrimp might be much larger than the loss of benefits associated with prohibiting fishing for pink shrimp during concurrent closures. This is particularly true because outside of North Carolina and Florida, which would not likely be subject to closures, pink shrimp catches are small. Thus the loophole created with allowing an exception for pink shrimp fishing would not create very large benefits in terms of allowing alternative fishing opportunities and might sacrifice potentially large benefits associated with EEZ closures.

13.7.2 Management Measure 2: Buffer Zone

Preferred Alternative: Establish a buffer zone extending seaward from shore 25 nautical miles, inside of which no trawling would be allowed with a net having less than 4 inch stretch mesh during an EEZ closure. Vessels trawling inside this buffer zone could not have a shrimp net aboard (i.e., a net with less than 4 inch stretch mesh) in the closed portion of the EEZ. Transit of the closed EEZ with less than 4 inch stretch mesh aboard while in possession of *Penaeus* species will be allowed provided that the nets are in an unfishable condition which is defined as stowed below deck.

Discussion: This measure, along with the provisions on trawling for whiting and other provisions which allow royal red and rock shrimp fishing during an EEZ closure, are designed to allow legitimate alternative fishing activities to continue while making the EEZ closure more effective from an enforcement perspective. Because this measure restricts trawling inside of 25 nautical miles in EEZ waters where a closure is in effect, legitimate royal red and rock shrimp fishing should not be impacted because the vast majority of royal red and rock shrimp catch occurs in depths far deeper than 15 fathoms, and outside 25 nautical miles for the most part. The shallowest reported rock shrimp catches are from depths of 18 fathoms while the majority of the catch comes from waters significantly deeper than 18 fathoms. As was mentioned earlier, royal red shrimp are caught at depths which far exceed 15 fathoms.

The provision not to allow nets with mesh of less than 4 inches to be in a fishable condition (stretched mesh) should make trawling for white shrimp illegal, while transiting EEZ waters or fishing under the guise of trawling for whiting far more difficult and more cost effective to enforce. In essence, this measure should not impact legitimate fishing practices for the species the Council seeks to exempt from the closure so as to minimize negative impacts on fishermen. At the same time, the buffer zone and associated restrictions described above should help make enforcement of the white shrimp closure more feasible, and ensure that the increased catch and revenue benefits associated with the closure are attained.

Alternatives Considered and Rejected

1. No Action (i.e., no buffer zone).

Discussion: As outlined above, establishment of a buffer zone will provide for legitimate alternative fishing opportunities thus decreasing impacts of the EEZ closure on affected fishermen to the greatest degree possible while not compromising the benefits that are expected from EEZ closures. For this reason, the preferred alternative is more beneficial for the fishery than no action.

13.7.3 Other Management Measures Considered and Rejected

1. Require annual vessel permit to harvest shrimp in the EEZ.

Discussion: The expected benefits from requiring permits are to obtain a better estimate of fleet size, potentially better biological and economic data, and better information on participation (should limited entry be promulgated for the fishery). These benefits do not appear to apply to Federal permits for shrimp trawling because relatively little shrimp is harvested there and many shrimpers would probably not purchase a Federal permit. Thus, requiring Federal permits will not necessarily solve some of the information needs of management unless Federal permits were required of all shrimp vessels working in the south Atlantic, whether in state or Federal waters. There also appears to be little benefit from requiring Federal permits from an enforcement point of view because enforcement sanctions to remove permits for non-compliance would presumably apply only to the vessels fishing in Federal waters, which would only impact violators for a portion of the fishing season, and hence would not be a very effective deterrent.

2. Regional shrimp permits.

Discussion: The advantages of regional permits over Federal permits for the south Atlantic are not clear at this time. If regional permits were essentially designed to be the same as Federal permits where a better understanding of total participation would not be obtained because not all participants would likely obtain permits, then the above discussion of Federal permits applies to regional permits as well.

3. Control Date.

Discussion: One recurrent problem in the shrimp fishery that has contributed to difficult economic conditions for shrimpers is that returns have regularly been dissipated by open access. By not establishing a control date, a first step toward controlled access was not taken. Additional entry over time will dissipate returns in the fishery and increase the pool of potentially eligible participants, should limited entry be promulgated some time in the future.

In a strict sense, establishing a control date simply provides an option for management in the future and has no costs or benefits. Seen in a broader light, however, a control date is probably a necessary first step toward setting up a limited entry program for the shrimp fishery in the south Atlantic, hence the benefits associated with establishing a control date can be construed to be much the same as those associated with limited entry. Clearly, some sort of access control system would increase aggregate net benefits from the fishery by controlling entry so that benefits are not regularly dissipated by entry when shrimping is profitable.

The vesting aspects of limited access might help to decrease enforcement costs in the long run and benefit the fishery by potentially increasing conservation incentives. Some fishery experts evaluating the finfish bycatch issue also have predicted that there are benefits in terms of decreases in finfish bycatch as a result of decreases in redundant fishing effort in the shrimp fishery under controlled access.

Some short run economic disruptions also typically occur with establishment of a control date because entry into the fishery can be spurred as fishermen attempt to ensure they are not excluded from the fishery in the future. Some of these new entrants may not have otherwise entered the fishery. This type of speculative behavior is disruptive because it usually means fishermen make expenditures on gear in order to make catches prior to the control date. Another disruption is in terms of opportunity cost because fishermen who are induced to enter are usually moving away from a more profitable fishing opportunity that they would have otherwise undertaken in order to be eligible for shrimp fishing. The motivation for incurring these opportunity costs is that a potentially valuable and marketable asset can be obtained by qualifying for limited entry.

To the degree that not establishing a control date impedes future efforts to develop controlled access systems for the shrimp fishery, then benefits are being sacrificed by not going ahead with establishment of a control date. Without doubt, there are inherent problems with attempting to create controlled access regimes from the Federal level when most shrimp fishing activities take place inside state waters. Yet Federal managers would benefit the shrimp fishery in the future by doing whatever is feasible to persuade state agencies to explore controlled access options for the shrimp fishery and to take steps to circumvent any state/Federal problems associated with moving toward controlled access.

4. Incorporate TED regulations into this FMP.
Discussion: Recent Magnuson Act changes preclude taking action on turtle excluder devices (TED) at this time. For this reason, economic analysis of the issue of incorporating TED regulations is not germane to the decision process at this time.

5. Finfish bycatch.
Discussion: Recent Magnuson Act changes preclude taking action on finfish bycatch. For this reason, economic analysis of the issue of incorporating finfish bycatch regulations is not appropriate. Under the Magnuson Act reauthorization language, studies to evaluate the economic tradeoffs of regulating finfish bycatch in shrimp trawls are mandated.

6. Implement partial EEZ closures.
Discussion: Partial closures of 5-12 miles (depending on the state) would probably increase enforcement costs over what they will be under the preferred alternative for concurrent closures while not necessarily resulting in an effective EEZ closure. This rejected alternative would not make possession of penaeid shrimp illegal during a closure, and hence enforcement would be based upon at-sea enforcement techniques which would involve the same costs and difficulties associated with enforcing state closures presently. For this reason, partial closures will probably not accomplish the benefits of the preferred alternative while necessitating greater expenditures for enforcement.

13.8 Recommendations to the States

13.8.1 Introduction of Exotic Species

The Council requests that states having shrimp mariculture facilities, either research or commercial, institute strict controls and guidelines to minimize the possibility of inadvertently introducing either exotic shrimp species or diseases into the environment. The Council further recommends that states comply with Amendment 1 to the Atlantic States Marine Fisheries Commission's (ASMFC) Procedural Plan to Control Interjurisdictional Transfers and Introductions of Shellfish.

Discussion: Because of the potential for large economic impacts on the shrimp fishery should mariculture of exotic species introduce either species that compete with indigenous species or diseases to indigenous shrimp species, it is important that the Council take all steps available to prevent this from occurring. Shrimp harvesters are facing difficult economic conditions, and introductions of competing species or diseases will further aggravate this situation. To the degree that recommendations will help to prevent the introduction of new species or diseases, recommendations are beneficial and involve little cost.

13.8.2 Habitat Alteration and Environmental Degradation

The South Atlantic Council recommends that states minimize or eliminate alteration of shrimp habitat, especially the fragile and highly productive salt marsh and estuarine areas. These areas are considered critical habitat for all species of *Penaeus* shrimp addressed by this FMP.

Discussion: Habitat alteration or loss is an important factor in the health of the shrimp fishery in the south Atlantic and the economic well being of shrimp harvesters. Shrimp harvesters are facing difficult economic conditions, and habitat destruction and degradation contribute to this problem. To the degree that recommendations help prevent further habitat damage, recommendations are beneficial and involve little cost.

13.8.3 Additional Recommendations to the States Considered and Rejected

13.8.3.1 Federal Permit to Shrimp in State Waters

The Council considered recommending to the states that they require a Federal permit to fish for shrimp in state waters.

Discussion: Requiring Federal permits to shrimp in state waters or to obtain a state shrimping permit would have made Federal permits a more effective means of identifying the universe of shrimpers. The measure would have helped management obtain a better estimate of fleet size, and help researchers obtain better biological and economic data. In addition, with Federal permits required of all shrimpers, regardless of whether they fish in Federal waters, management would have had better information on participation should limited entry be promulgated for the fishery. In this way, requiring Federal permits to shrimp in state waters would have increased benefits associated from requiring Federal permits far more than the annual cost of renewing permits (between $17 and $34 per year) plus the burden hours costs of filling out applications for permits (no estimate for this is available at this time).

13.8.3.2 Recreational Shrimping

The Council was asked by some members of the commercial industry to recommend to the states that recreational shrimp fishing over bait be curtailed.

Discussion: Because the economic and social tradeoffs involved with this recommendation are not well understood, this recommendation may not involve promoting the highest valued use of the shrimp resource. No rigorous studies of the consumer benefit (consumer surplus) values attributable to recreational shrimping over bait have been undertaken. Nor have any studies of the social and socioeconomic changes involved with eliminating shrimp baiting (in states where it is allowed) been undertaken. In addition, no studies are known to exist that look at the producer and consumer benefits associated with the commercial harvest of shrimp at present levels or the increases from allocating the entire white shrimp harvest to the commercial sector. After these studies have been accomplished, management might undertake to allocate the resource differently based on comparisons of marginal benefit society derives from the shrimp resource under different allocation schemes.

13.8.3.3 Stock Enhancement

Some members of the commercial industry suggested that the Council recommend to the states that stock enhancement (addition of maricultured shrimp to the natural environment) programs be initiated, especially following cold kills.

Discussion: Because there is insufficient information to evaluate the biological or economic benefits associated with stock enhancement, it is impossible to develop economic rationale for promoting stock enhancement or not promoting it at this time. As information becomes available to evaluate the biological benefits of stock enhancement, then the economic merits from recommending that course of action to the states can be developed.

13.9 Summary

The aggregate economic impacts on shrimp harvesters of proposed concurrent closures of Federal waters following freeze winters are conceptually the difference between what fishermen give up in terms of spring shrimp revenues and what they gain from fall shrimp revenues. Available evidence suggests that concurrent closures during freeze years may bring about landings for that year that are characteristic of normal years rather than freeze years. If concurrent closures do bring this intended result, then the potential net increase in south Atlantic white shrimp catch from a concurrent closure involves an average increase of approximately 6.8 million lb and a potential large increase in annual white shrimp revenue compared to what revenues would have been without the closure. These potential catch and revenue increases are supported by statistical inferences about the difference between catch in an average freeze year, and catch in an average non-freeze year and the potential ability of a closure to bring about a catch representative of a normal year. The magnitude of net landings and revenues far exceeds catch and revenues sacrificed during closures.

The negative economic impacts of proposed concurrent closures are that EEZ closures will force shrimpers who normally count on revenues from white shrimp in the spring months in EEZ waters to seek alternative sources of revenue during closure years. An estimated range for these catch and revenue disruptions from an EEZ closure is a high of 181,797 lb and a low of 44,577 lb, and in terms of revenues a high of $759,973 to a low of $577, 911. This range is thought to be an upper bound for impacts because it is assumed that a closure would be enacted for all south Atlantic states which is unlikely at this point. Another mitigating factor is that although catch patterns are certainly disrupted by an EEZ closure, at least some of the overwintering white shrimp that cannot be legally taken during an EEZ closure will be available to shrimpers when the closure ends. Estimated cumulative natural mortalities during that portion of the year range from 27 to 62% for a two month closure. Thus in a worst case scenario, only 62% of the catch and revenues described above would actually be lost to fishermen.

The disruptive effects of not being able to fish for a portion of the traditional fishing season cannot be minimized because fishermen are facing difficult economic conditions such as high costs for variable cost inputs and relatively low prices exvessel associated with levels of shrimp imports in recent years. Available evidence suggests that some fishermen are barely surviving economically in the fishery. Fishermen who count on roe shrimping will still have to make boat mortgage and other payments despite the fact that they will not be able to fish for white shrimp during the closure.

The availability of alternative fishing opportunities during the spring months in freeze years will ultimately determine the degree of disruptive effects from concurrent closures. No studies to assess the profitability of alternative fishing opportunities for shrimp fishermen in the south Atlantic are available at this time. Potential candidates for affected fishermen are the shrimp fisheries in non-affected states such as the pink shrimp fishery in North Carolina, the white shrimp fishery in Florida, or the rock and royal red shrimp fisheries. Shrimpers have also been involved in fishing for whiting, wreckfish, and whelk when state waters have been closed in the past.

Provided the closure brings about the anticipated increase in yields compared to no action, then from the point of view of total revenues fishermen are better off with closures. At the level of individual firms, however, this may not always prove to be correct. For instance, there may be some distributional effects that complicate this issue for fishing firms. The distribution of these increased revenues will, in fact, favor operations which traditionally catch more in the fall and will impact disproportionally operations with a comparative advantage to fish for roe shrimp in the spring. Adjustments in fishermen's strategies and modifications in gear and fishing practices, however, can be expected to decrease the actual degree that catch is redistributed.

Although under the scenario of the closure aggregate revenues will increase compared to no action, increases in net producer benefits are not expected from proposed closures. Access to the south Atlantic fishery for shrimp is not subject to any management controls and the fishery is highly overcapitalized. Lacking existing or new measures (no measures to control access are proposed in this fishery management plan), the inherently inefficient solution of too many vessels using too much capital to produce annual yields is not remedied by proposed revenue-enhancing measures in the plan. In this sense, the only economic effect of the increased revenues compared to no action may be to prevent exit of marginal firms from the fishery firms. These firms may not have been able to continue fishing under reduced white shrimp abundance had a closure not been implemented following a freeze. Thus socio-economic disruptions resulting from egress from the fishery may be avoided with closures, but the inherent inefficiency of not having property rights in the fishery is not remedied by proposed measures.

Considering aggregate employment, concurrent closures will be beneficial to fishermen because they will probably stabilize annual employment associated with the white shrimp fishery instead of more variable shrimp abundance and landings without closures. Variability in abundance without closures is disruptive to employment of crew members and captains. Another benefit associated with concurrent closures is expected enforcement savings and greater compliance with state closures following freeze years.

13.10 Public and Private Costs

The preparation, implementation, enforcement, and monitoring of this and any Federal action involves expenditure of public and private resources which can be expressed as costs associated with the regulation. Costs associated with this specific action include:

Council costs of document preparation, meetings, public hearings, and information dissemination.................................$115,000.

NMFS administrative costs of document preparation, meetings, and review...$25,000.

NMFS Law Enforcement costs......................$0.
(no new costs)

Public burden associated with permits, etc.........$0.

TOTAL..$140,000.

14.0 VESSEL SAFETY CONSIDERATIONS

P.L. 99-659 amended the Magnuson Act to require that a management plan consider access to the fishery for vessels otherwise prevented from harvesting because of weather or other ocean conditions affecting vessel safety. Imposition of management measures set forth in this FMP will not force vessels to participate in the fishery under adverse weather or ocean conditions. Therefore, no management adjustments for fishery access will be provided.

There are no fishery conditions, management measures, or regulations contained in this plan which would result in the loss of harvesting opportunity because of crew and vessel safety effects of adverse weather or ocean conditions. No concerns have been raised by the people engaged in the fishery or the Coast Guard that the proposed management measures directly or indirectly pose a hazard to crew or vessel safety under adverse weather or ocean conditions.

14.1 Fishery Access and Weather Related Safety

There are no fishery conditions, management measures or regulations contained in this plan that would result in the loss of harvesting opportunity because of the effects on crew or vessel safety as a result of adverse weather or ocean conditions. There have been no concerns raised by the Coast Guard or by persons engaged in the fishery that the proposed management measures directly or indirectly pose a hazard to crew or vessel safety under adverse weather or ocean conditions.

14.2 No Impact Determination

Vessel safety has not been identified as a relevant or significant issue in the shrimp fishery or in the management measures set forth.

14.3 Adjustments

There are no procedures for making adjustments in this plan because no person will be precluded from a fair or equitable harvesting opportunity by the management measures contained herein.

14.4 Coast Guard Evaluation

No vessel safety issues have been identified by the Coast Guard.

14.5 Procedures

There are no procedures proposed to monitor, evaluate, or report on the effect of management measures on vessel or crew safety under adverse weather or ocean conditions.

14.6 Other Safety Issues

There have been no significant or relevant safety issues raised by fishery users, other public, or the Coast Guard; therefore, there are no social or economic safety implications.

15.0 COASTAL ZONE CONSISTENCY

Section 307(c)(1) of the Federal Coastal Zone Management Act of 1972 requires that all Federal activities which affect the coastal zone be consistent with approved state coastal zone management programs to the maximum extent practicable. This fishery management plan was submitted to the states of Florida, South Carolina, and North Carolina to determine if the plan is consistent to the maximum extent practicable with their approved coastal zone management programs. In January 1992, Georgia Department of Natural Resources was designated as the lead agency to develop and implement Georgia's coastal management program. States have 45 days in which to agree or disagree with the Council's evaluation of consistency. If a state fails to respond within 45 days, the state's approval is presumed.

The state of Florida has reviewed the management plan including and environmental impact statement and regulatory impact review and has concurred with the council determination that the plan is consistent with the Florida's Coastal Management Program to the maximum extent practicable.

The state of South Carolina has determined that the management plan including an environmental impact statement and regulatory impact review is consistent with the South Carolina's Coastal Management Program to the maximum extent practicable.

The state of North Carolina has reviewed the draft management plan including an environmental impact statement and regulatory impact review but does not issue a statement of consistency on draft documents.

The correspondence to the state coastal managment programs and their responses are included in Appendix XIII.

16.0 ENDANGERED SPECIES AND MARINE MAMMAL PROTECTION ACT

The proposed actions will have no anticipated impacts on threatened or endangered species or marine mammals. Further, NOAA initiated consultation under Section 7 of the Endangered Species Act (ESA) regarding the impact of this proposed rule on endangered and threatened sea turtles and marine mammals. NMFS, in the biological opinion submitted to the Councils concluded that shrimp trawling in the southeastern United States was in compliance with the 1992 Revised Sea Turtle Conservation Regulations and the proposed management actions under the South Atlantic shrimp FMP and Amendment 6 to the Gulf of Mexico shrimp FMP are not likely to jeopardize the continued existence of threatened or endangered species under NMFS jurisdiction. Section 7(b)(4) of the Endangered Species Act (ESA) provides for the issuance of an incidental take statement on the agency action if the biological opinion concludes that the action is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. The incidental take statement is contained in NMFS's biological opinion which is contained in Appendix IX of this document.

17.0 PAPERWORK REDUCTION ACT

The purpose of the Paperwork Reduction Act is to control paperwork requirements imposed on the public by the Federal government. The authority to manage information collection and record keeping requirements is vested with the Director of the Office of Management and Budget. The authority encompasses establishment of guidelines and policies, approval of information collection requests, and reduction of paperwork burdens and duplications.

This plan does not contain any record keeping or collection of information requirements subject to the Paperwork Reduction Act.

18.0 FEDERALISM

No Federalism issues have been identified relative to actions proposed in this plan and associated regulations. Affected states have been closely involved in developing the proposed management measures and the principal state officials for fishery management in their respective states have not expressed Federalism related opposition to adoption of this plan.

19.0 EFFECTS ON SMALL BUISINESSES

Introduction

The purpose of the Regulatory Flexibility Act is to relieve small businesses, small organizations, and small governmental entities from burdensome regulations and record keeping requirements. The category of small entities likely to be affected by the proposed plan is that of commercial shrimp trawlers and fish houses which have a high dependence on locally produced white shrimp. The impacts of the proposed action on these entities have been discussed in the RIR. The following discussion of impacts focuses specifically on the consequences of the proposed action on the mentioned business entities. An Initial Regulatory Flexibility Analysis (IRFA) is conducted primarily to determine whether the proposed action would have a "significant economic impact on a substantial number of small entities." In addition to analyses conducted for the Regulatory Impact Review (RIR), the IRFA provides an estimate of the number of small businesses affected, a description of the small businesses affected, and a discussion of the nature and size of the impacts.

Determination of Significant Economic Impact on a Substantial Number of Small Entities

In general, a "substantial number" of small entities is more than 20 percent of those small entities engaged in the fishery (NMFS 1992). For the 1989/1990 fishing season, the most recent year for which data on numbers of participants are available for all south Atlantic states, there were 5,300 individuals and corporations holding shrimp trawling licenses in south Atlantic states (Table 19). The Small Business Administration (SBA) defines a small business in the commercial fishing activity as a firm with receipts of up to $2.0 million annually. All 5,300 holders of state commercial shrimp trawling licenses readily fall within the definition of small business. Since the proposed action will directly and indirectly affect many of these permittees, the "substantial number" criterion will be met.

Economic impacts on small business entities are considered to be "significant" if the proposed action would result in any of the following: a) reduction in annual gross revenues by more than 5 percent; b) increase in total costs of production by more than 5 percent as a result of an increase in compliance costs; c) compliance costs as a percent of sales for small entities are at least 10 percent higher than compliance costs as a percent of sales for large entities; d) capital costs of compliance represent a significant portion of capital available to small entities, considering internal cash flow and external financing capabilities; or e) as a rule of thumb, 2 percent of small business entities being forced to cease business operations (NMFS 1992). The proposed measure for concurrent closures of EEZ waters potentially meets significance criteria (a) and (e) for a small number of fishing firms and for fish houses (packing and wholesale) which presently deal almost exclusively with local shrimp production. The exact number of fishing firms that will be significantly impacted, as defined above, is not known exactly but is expected to be few in number.

Explanation of Why the Action is Being Considered

Refer to Section 12.0, Management Program and Section 13.0, Regulatory Impact Review.

Objectives and Legal Basis for the Rule

Refer to Section 12.6, Management Objectives. The Magnuson Fishery Conservation and Management Act of 1976 provides the legal basis for the rule.

Demographic Analysis

Refer to Profile of the Panaeid Shrimp Fishery of the South Atlantic (SAFMC 1981), and Sections 8.0, 9.0, 10.0, and 11.0 of this proposed management plan.

Cost Analysis

Refer to the summary Section 13.9 of the RIR and the summary of government costs Section 13.10 within the RIR.

Competitive Effects Analysis

The industry is composed entirely of small businesses (harvesters and fish houses). Since no large businesses are involved, there are no disproportional small versus large business effects.

Identification of Overlapping Regulations

The proposed action does not create overlapping regulations with any state regulations or other Federal laws.

Conclusion

Catch and total revenue from fishing for white shrimp following a winter freeze are expected to be considerably greater with concurrent closures compared to no action. Some shrimp fishing firms in the south Atlantic fleet are presently experiencing poor economic returns (marginal firms). Marginal firms that count on roe white shrimp fishing for a significant portion of their revenues may be impacted such that they cannot meet their financial and business obligations and thus face default. The ability of these firms to find alternative fishing opportunities during closures will ultimately determine whether these firms are able to persevere until fishing for white shrimp begins after the closure. In aggregate, however, closures are expected to increase total revenues compared to no action and stabilize employment in the shrimp fishery by decreasing the variability of shrimp catches over time. A more detailed treatment of these issues can be found in the RIR. In South Carolina and Georgia where closures are more likely to be enacted when freezes occur, fish houses specializing in shrimp normally purchase shrimp from shrimp fishermen and then head and pack the shrimp before selling it to large-scale buyers. These fish houses will forfeit white shrimp sales during closures as well as the sales of support services to vessels that normally would be fishing for roe shrimp if a closure had not been enacted. Increased shrimp catch in the fall will create larger revenues for fish houses compared to no action, but handling and processing costs may also increase if the shortened season stresses the capacity of the processing/distribution sector. A more detailed treatment of these matters can be found in the RIR.

20.0 LOCATION AND DATES OF PUBLIC HEARINGS

December 9, 1991	Cocoa Beach Hilton, 1550 N. Atlantic Ave., Cocoa Beach, FL
December 10, 1991	Holiday Inn-Oceanfront, 1617 N. First St., Jacksonville Beach, FL
December 11, 1991	Glynn Mall Suites Hotel, 500 Mall Blvd., Brunswick, GA
December 11, 1991	Carteret Community College, 3505 Arendell St., Morehead City, NC
December 12, 1991	New Hanover County Courthouse, 320 Chestnut St., Wilmington, NC
December 12, 1991	Best Western Sea Island Inn, 1015 Bay St., Beaufort, SC
December 13, 1991	South Carolina Wildlife and Marine Resources Dept., Ft. Johnson Rd., Charleston, SC
February 26, 1992	Hyatt Regency Savannah; Two W. Bay Street, Savannah, GA
January 4, 1993	South Carolina Wildlife and Marine Resources Dept., Ft. Johnson Rd., Charleston, SC
January 5, 1993	Holiday Inn-Oceanfront, 1617 N. First St., Jacksonville Beach, FL

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22.0 LIST OF FIGURES AND TABLES

Table 1. A summary of monthly growth rates for *P. setiferus*. (Source: SAFMC 1981).

Investigator	Average Growth Per Month	Method
Lindner and Anderson (1956)	30 mm	Tagging 100 mm shrimp
Pearson (1939)	20 mm	Aquarium growth of juveniles
Gunter (1950)	30 mm	Length-frequency studies of field samples, juveniles
Williams (1955)	36 mm	Length-frequency studies of field samples, juveniles
Johnson and Fielding (1956)	57 mm	Pond growth, juveniles
Loesch (1965)	13-27 mm	Length-frequency studies of winter field samples, juveniles
	18-31 mm	Length-frequency studies of summer field samples, juveniles
	65 mm	Length-frequency studies of spring field samples, juveniles
Joyce (1965)	33 mm	Comparison of sizes of largest animals, juveniles.
Harris (1974)	30 mm	Length-frequency studies in July-August field samples, 78 mm
	22 mm	Length-frequency studies of August-September field samples
Gaidry (1974)	14-15 mm	Length-frequency studies of winter field samples, 60-80 mm
Klima (1974)	29 mm	Tagging 117 shrimp
Bishop and Shealy (1977)	25-30 mm	Length-frequency studies of field samples, juveniles
Farmer, et al., (1978)	20 mm	Length-frequency studies of March and April field samples, 95 mm

Table 2. Summary of *P. aztecus* growth rate results for various studies. Growth rates were converted to mm/day if originally reported in other units. (Source: SAFMC 1981).

Investigator	Average Growth Per Day (Total Length)	Method
Williams (1955)	0.8 - 1.54 mm	Length-frequency studies of field samples, 20-120 mm
St. Amant et al., (1966)	0.7 - 1.7 mm	Length-frequency studies (largest and modal) of field samples, 23-125 mm
Loesch (1965)	1.0 - 1.2 mm	Length-frequency studies of field samples, juveniles-subadults
McCoy (1968)	1.0 mm	Mark-recapture, 115+mm
Jacob (1971)	1.32 mm	Length-frequency studies (largest) of field samples, 12-145 mm
Knudsen et al., (1977)	0.53 - 0.87 mm	Mark recapture, 45- 84 mm

Table 3. Length-weight equations for *P. setiferus*, *P. a. azetecus*, and *P. d. dourarum*. W = weight (g), TL = Total Length (mm) CL = Carapace Length (mm). (Source: SAFMC 1981).

Species	Sex	Equation	No. Measured	Source
P. setiferus	male	$W = 2.02 \times 10^{-6} TL^{3.261}$	970	Fontaine and Neal (1971)
	female	$W = 2.32 \times 10^{-6} TL^{3.234}$	1,120	Fontaine and Neal (1971)
	combined	$W = 2.16 \times 10^{-6} TL^{3.247}$	2,090	Fontaine and Neal (1971)
P. a. aztecus[1]	combined	$W = 8.12 \times 10^{-6} TL^{3.02}$	2,104	McCoy (1968)
	male	$W = 11.61 \times 10^{-6} TL^{2.911}$	1,396	Fontaine and Neal (1971)
	female	$W = 9.53 \times 10^{-6} TL^{2.966}$	2,016	Fontaine and Neal (1971)
	combined	$W = 10.52 \times 10^{-6} TL^{2.938}$	3,412	Fontaine and Neal (1971)
	male	$W = 8.19 \times 10^{-6} TL^{2.94}$	259	McCoy (1972)
	female	$W = 1.13 \times 10^{-6} TL^{2.84}$	243	McCoy (1972)
P. d. duorarum[1]	combined	$W = 1.03 \times 10^{-5} TL^{2.98}$	2,641	McCoy (1968)
	male	$W = 10.02 \times 10^{-6} TL^{2.967}$	1,173	Fontaine and Neal (1971)
	female	$W = 5.93 \times 10^{-6} TL^{3.092}$	2,125	Fontaine and Neal (1971)
	combined	$W = 7.71 \times 10^{-6} TL^{3.029}$	3,298	Fontaine and Neal (1971)
	male	$W = 1.48 \times 10^{-3} TL^{2.77}$	297	McCoy (1972)
	female	$W = 2.09 \times 10^{-3} TL^{2.66}$	503	McCoy (1972)

[1] Conversions of CL to TL obtained from North Carolina shrimp (McCoy 1972) are: *P. a. aztecus* male TL = 3.50 = 4.16 CL, female TL = 10.50 + 3.83 CL; *P. d. duorarum* male TL = 12.37 + 3.81 CL, female TL = 21.90 + 3.40 CL.

Table 4. Comparison of instantaneous rate of mortality (in weekly values) for *P. setiferus*, *P. a. azetecus*, and *P. d. dourarum*. (Source: SAFMC 1981).

Species	Natural Mortality	Fishing Mortality	Total Mortality	Source
P. setiferus	0.08	0.06 - 0.19	0.14 - 0.27	Klima and Benigo (1965)
	0.04 -0.12	0.10 - 0.13	0.16 - 0.22	Klima (1974)
	0.21 -0.56	0.02 - 0.25	0.24 - 0.80	Phares (1980)
P. a. aztecus	0.21	0.06	0.27	Klima (1964)
	-	-	0.99, 1.24	McCoy (1968)
	0.36	0.21	0.57	McCoy (1972)
	0.22, 0.33	0.05, 0.11	0.27, 0.43	Purvis and McCoy (1974)
P. d. duorarum	0.55	0.96	0.71 - 1.51	Kutkuhn (1966)
	0.08 - 0.12	0.12 -0.18	0.25	Lindner (1966)
	0.02 - 0.06*	0.16 - 0.23	0.22 - 0.27	Berry (1967)
	0.08 - 0.11*	0.03 -0.07*	0.11 -0.18*	Costello and Allen (1968)
	0.01 - 0.03	0.02 -0.16	0.07 - 0.16	Berry (1972)
	-	-	0.32 -0.35	Purvis and McCoy (1972)
	0.28	0.34	0.61	McCoy (1972)

* Adjusted by Berry (1970)

Table 5. Shrimp landings (heads on) by species for combined South Atlantic states for 1957-91. (Source: Fishery Statistics of the U. S., NMFS, and States).

YEAR	WHITE	BROWN	PINK	ROCK
57	14,712,461	9,740,164	2,157,243	NA
58	11,092,893	9,189,603	823,467	NA
59	12,823,217	9,434,893	2,061,216	NA
60	18,788,016	9,038,236	1,226,496	NA
61	14,033,378	2,495,614	1,747,822	NA
62	12,133,840	11,532,694	2,246,510	NA
63	7,268,926	7,646,291	554,339	NA
64	8,119,217	7,089,616	1,948,048	NA
65	16,304,005	8,126,345	1,687,237	NA
66	9,162,164	11,604,450	531,230	NA
67	10,902,104	7,978,838	1,579,998	NA
68	16,945,887	5,919,510	1,337,930	NA
69	16,914,732	8,570,168	1,698,021	NA
70	12,491,819	7,133,124	860,584	NA
71	18,810,304	9,764,458	1,914,656	NA
72	16,635,560	7,725,422	788,277	NA
73	18,241,500	4,502,900	1,518,395	NA
74	13,375,345	11,088,656	2,118,261	NA
75	15,910,990	6,713,349	2,015,874	NA
76	14,370,316	9,651,432	1,815,048	NA
77	4,961,115	10,605,268	801,227	NA
78	8,913,478	6,601,646	561,297	1,864,033
79	17,014,249	6,643,381	1,775,764	5,853,409
80	14,255,717	13,368,442	1,573,926	3,862,293
81	8,367,526	4,372,667	871,121	3,119,195
82	10,517,276	8,915,451	1,749,785	5,268,093
83	12,404,793	6,711,871	2,699,625	4,878,041
84	4,088,105	7,209,256	1,391,292	6,867,240
85	7,727,811	16,318,704	1,438,953	1,848,595
86	10,968,861	8,702,924	2,101,628	3,441,855
87	13,086,952	3,024,169	3,139,447	5,094,174
88	10,909,691	8,143,448	2,929,585	3,152,395
89	13,851,605	9,231,743	3,393,081	9,183,413
90	12,613,723	8,734,294	1,651,188	8,595,453
91	18,272,539	10,680,481	2,699,144	3,050,103
57-91 AVE	12,771,146	8,405,986	1,697,363	4,719,878 *78-90 ave

box indicates freeze year

Table 6. White Shrimp landings (heads on) by species for combined South Atlantic states for 1957-91. (Source: Fishery Statistics of the U. S., NMFS and States).

YEAR	NC	SC	GA	FLEC	TOTAL
57	648,583	3,900,934	6,576,861	3,586,083	14,712,461
58	78,477	2,249,989	4,727,212	4,037,215	11,092,893
59	112,361	4,095,348	5,216,225	3,399,282	12,823,217
60	359,746	5,158,065	7,573,674	5,696,531	18,788,016
61	156,349	2,769,849	5,706,930	5,400,250	14,033,378
62	50,424	2,861,469	5,523,192	3,698,755	12,133,840
63	0	282,860	3,495,723	3,490,344	7,268,926
64	15,782	794,657	3,913,559	3,395,220	8,119,217
65	871,400	4,292,015	6,646,212	4,494,378	16,304,005
66	409,635	799,911	4,256,283	3,696,334	9,162,164
67	197,085	1,732,120	4,824,792	4,148,107	10,902,104
68	129,066	4,777,083	7,805,991	4,233,748	16,945,887
69	269,987	4,585,000	7,546,430	4,513,315	16,914,732
70	367,820	3,082,664	4,975,150	4,066,185	12,491,819
71	588,271	7,999,371	7,709,590	2,513,072	18,810,304
72	1,571,139	5,837,570	5,553,705	3,673,146	16,635,560
73	1,796,405	6,536,872	7,639,590	2,268,633	18,241,500
74	195,411	5,351,021	5,812,399	2,016,515	13,375,345
75	628,166	6,473,724	6,745,243	2,063,857	15,910,990
76	383,566	5,858,674	5,888,469	2,239,607	14,370,316
77	8,869	669,087	2,991,786	1,291,373	4,961,115
78	40,654	2,561,146	4,359,238	1,952,440	8,913,478
79	236,160	5,235,053	7,920,692	3,622,344	17,014,249
80	567,489	4,395,248	6,222,753	3,070,227	14,255,717
81	11,366	1,593,165	4,018,171	2,744,824	8,367,526
82	172,697	3,397,868	4,904,916	2,041,795	10,517,276
83	450,305	3,585,574	5,962,712	2,406,202	12,404,793
84	97,035	513,667	1,609,312	1,868,091	4,088,105
85	44,666	652,390	4,528,191	2,502,564	7,727,811
86	112,063	3,339,146	5,480,518	2,037,134	10,968,861
87	290,001	4,651,656	5,927,412	2,217,883	13,086,952
88	83,583	2,668,534	5,714,233	2,443,341	10,909,691
89	695,502	5,098,423	5,614,467	2,443,213	13,851,605
90	1,149,207	4,208,303	5,117,243	2,138,971	12,613,723
91	1,410,993	6,837,507	7,165,012	2,859,027	18,272,539
57-91 AVE	405,722	3,681,313	5,590,682	3,093,429	12,771,146

box indicates freeze year

Table 7. Brown Shrimp landings (heads on) by species for combined South Atlantic states for 1957-91. (Source: Fishery Statistics of the U. S., NMFS and States).

YEAR	NC	SC	GA	FLEC	TOTAL
57	4,792,371	2,323,444	1,468,471	1,155,877	9,740,164
58	1,516,393	3,220,750	3,398,517	1,053,943	9,189,603
59	3,920,914	2,919,946	1,824,539	769,495	9,434,893
60	4,128,674	2,303,411	2,051,671	554,479	9,038,236
61	968,285	848,259	559,984	119,087	2,495,614
62	3,509,871	3,612,666	2,958,377	1,451,780	11,532,694
63	2,819,651	1,917,838	1,892,719	1,016,082	7,646,291
64	2,326,357	1,834,302	1,966,591	962,366	7,089,616
65	2,857,557	2,502,629	1,937,440	828,719	8,126,345
66	4,758,268	3,463,488	2,218,237	1,164,457	11,604,450
67	3,142,585	2,356,037	1,813,475	666,741	7,978,838
68	3,162,011	1,550,580	729,433	477,486	5,919,510
69	5,887,227	1,232,014	900,721	550,206	8,570,168
70	3,831,761	1,868,276	1,020,421	412,666	7,133,124
71	5,111,811	2,753,251	1,152,836	746,560	9,764,458
72	3,203,847	2,246,790	1,704,196	570,589	7,725,422
73	1,696,660	1,719,267	608,157	478,816	4,502,900
74	6,132,690	2,077,977	1,414,905	1,463,084	11,088,656
75	2,578,038	2,380,937	1,295,992	458,381	6,713,349
76	4,489,759	2,763,003	1,883,169	515,501	9,651,432
77	4,999,192	3,280,296	1,595,785	729,995	10,605,268
78	2,479,863	2,420,160	1,241,579	460,044	6,601,646
79	3,142,761	1,882,467	1,157,064	461,089	6,643,381
80	7,863,807	2,783,439	1,813,348	907,848	13,368,442
81	1,831,907	1,328,817	692,152	519,791	4,372,667
82	5,263,879	1,874,914	1,186,351	590,307	8,915,451
83	3,030,727	1,776,356	1,301,928	602,860	6,711,871
84	3,662,603	1,815,438	1,193,868	537,347	7,209,256
85	10,377,162	2,693,466	1,999,815	1,248,261	16,318,704
86	4,118,661	2,723,698	1,298,935	561,630	8,702,924
87	1,104,847	1,038,644	479,352	401,326	3,024,169
88	5,315,539	1,626,473	655,454	545,982	8,143,448
89	5,080,971	2,134,401	1,307,806	708,565	9,231,743
90	5,147,228	1,575,974	1,151,699	859,393	8,734,294
91	6,772,056	2,337,335	1,099,599	471,491	10,680,481
57-90 AVE	4,029,312	2,205,336	1,456,417	714,921	8,405,986

box indicates freeze year

Table 8. Pink Shrimp landings (heads on) by species for combined South Atlantic states for 1957-91. (Source: Fishery Statistics of the U. S., NMFS, and States).

YEAR	NC	SC	GA	FLEC	TOTAL
57	2,118,722	9,120	24,770	4,632	2,157,243
58	813,074	0	10,394	0	823,467
59	2,060,976	0	240	0	2,061,216
60	1,226,496	0	0	0	1,226,496
61	1,747,822	0	0	0	1,747,822
62	2,244,342	0	0	2,168	2,246,510
63	554,339	0	0	0	554,339
64	1,936,688	0	11,360	0	1,948,048
65	1,687,237	0	0	0	1,687,237
66	529,392	0	1,838	0	531,230
67	1,579,158	0	0	840	1,579,998
68	1,324,648	6,080	0	7,202	1,337,930
69	1,697,003	0	0	1,018	1,698,021
70	854,776	0	1,240	4,568	860,584
71	1,914,656	0	0	0	1,914,656
72	788,277	0	0	0	788,277
73	1,511,318	0	0	7,077	1,518,395
74	2,112,112	0	0	6,149	2,118,261
75	1,957,416	11,458	0	47,000	2,015,874
76	1,769,419	31,587	0	14,042	1,815,048
77	592,272	47,394	6,714	154,848	801,227
78	440,413	11,877	25,498	83,510	561,297
79	1,558,913	4,438	13,336	199,077	1,775,764
80	1,371,190	9,951	18,128	174,657	1,573,926
81	711,384	13,083	16,141	130,513	871,121
82	1,590,733	17,922	26,931	114,199	1,749,785
83	2,633,067	6,557	9,800	50,201	2,699,625
84	1,277,111	29,001	6,521	78,659	1,391,292
85	1,254,851	39,079	33,821	111,202	1,438,953
86	1,904,050	20,460	43,653	133,465	2,101,628
87	3,018,230	15,106	17,549	88,562	3,139,447
88	2,711,655	40,935	42,147	134,848	2,929,585
89	3,146,334	12,845	23,967	209,935	3,393,081
90	1,502,300	1,034	12,144	135,710	1,651,188
91	2,547,989	3,996	20,867	126,292	2,699,144
57-91 AVE	1,619,668	9,483	10,487	57,725	1,697,363

box indicates freeze year

Table 9. Rock and Royal Red Shrimp landings (heads on) by species for combined South Atlantic states for 1978-91. (Source: NMFS and States).

Rock shrimp landings (lb-head on) by South Atlantic state for 1978-91. (Source: NMFS and States)

YEAR	NC	SC	GA	FLEC	TOTAL
78	0	110,033	44,439	1,709,561	1,864,033
79	0	754,149	621,739	4,477,521	5,853,409
80	5,010	26,127	339,297	3,496,869	3,862,293
81	0	10,686	187,935	2,920,574	3,119,195
82	0	9,504	616,412	4,642,177	5,268,093
83	1,181	9,670	425,549	4,441,641	4,878,041
84	9,414	792,427	655,640	5,409,759	6,867,240
85	6,748	16,240	546,601	1,279,006	1,848,595
86	27,664	9,873	348,217	3,056,101	3,441,855
87	3,558	764	847,886	4,241,966	5,094,174
88	28,413	1,590	442,613	2,679,779	3,152,395
89	125	10,759	867,844	8,304,685	9,183,413
90	40,724	7,827	593,110	7,953,792	8,595,453
91	9,895	0	330,350	2,709,858	3,050,103
78-91 AVE.	9,481	125,689	490,545	4,094,521	4,719,878

box indicates freeze year

Royal red shrimp landings (heads on) for Florida east coast for 1986-91. (Source: FMRI and NMFS

YEAR	NC	SC	GA	FLEC	TOTAL
86				84,698	84,698
87				117,066	117,066
88				138,094	138,094
89				218,455	218,455
90				278,438	278,438
91				205,090	205,090
86-91 AVE	0	0	0	173,640	173,640

Table 10. Estimated wetlands acreage remaining (in thousands of acres), by Atlantic coast state as derived from the National Wetland Inventory Program. (Source: DOC 1987).

State	Salt Marsh	Fresh Marsh	Tidal Flats	Swamp	Total
North Carolina	158.8	92.0	N/A	2,107.5	2,358.3
South Carolina	369.5	64.5	N/A	N/A	434.0
Georgia	374.3	31.5	9.5	286.0	701.3
Florida	95.9	383.4	N/A	259.0	738.3
South Atlantic Total					4,231.9

N/A - not available.

Table 11. Number of proposed projects and acres of habitat by South Atlantic state proposed for dredging, filling, draining, and impounding based on NMFS habitat conservation efforts from 1981-1985. (Source: Mager and Thayer 1986).

State	Number of permit applications	Acreage proposed by applicants	Acreage NMFS did not object to	Acreage potentially conserved	Mitigation recommended by NMFS
FL	1,806	5,879	2,846	3,033	1,241
GA	194	1,106	204	902	247
SC	576	5,610	450	5,160	109
NC	547	3,119	1,673	1,447	576
SA Total	3,123	15,714	5,173	10,542	2,173

Table 12. Coastal wetlands by estuarine drainage area in the south Atlantic. (Source: NOAA 1991a).

	(Acres X 100)				
Estuarine Drainage Area[a]	Salt Marsh[b]	Fresh Marsh[b]	Forested and Scrub[b]	Tidal Flats[b]	Total[b]
1 Albemarle/Pamlico Sounds (8)	1,576 (14)	365 (3)	9,062 (80)	311 (3)	11,314
2 Bogue Sound (65)	211 (22)	11 (1)	616 (64)	118 (12)	956
3 New River (46)	41 (16)	5 (2)	203 (81)	45 (1)	252
4 Cape Fear River (13)	90 (6)	97 (6)	1,291 (86)	20(1)	1,498
5 Winyah Bay (30)	124 (2)	308 (5)	5,472 (93)	6 (0)	5,910
6 North and South Santee Rivers (88)	129 (7)	174 (9)	1,613 (84)	1 (0)	1,916
7 Charleston Harbor (10)	268 (14)	169 (9)	1,540 (78)	8 (0)	1,985
8 St. Helena Sound (100)	916 (21)	321 (7)	3,036 (71)	25 (1)	4,299
10 Savannah Sound (100)	322 (11)	141 (5)	2,428 (84)	9 (0)	2,900
11 Ossabaw Sound (82)	245 (10)	40 (2)	2,282 (89)	4 (0)	2,571
12 St. Catherines/ Sapelo Sounds (29)	352 (40)	46 (5)	461 (53)	13 (2)	872
13 Altamaha River (35)	79 (7)	81 (7)	976 (86)	2 (0)	1,138
14 St. Andrews/ Simmons Sounds (66)	1,134 (20)	157 (3)	4,420 (77)	59 (1)	5,771
15 St Marys R./Cumberland Sound	N/A	N/A	N/A	N/A	N/A
16 St. Johns River (96)	168 (2)	2,646 (25)	7,665 (73)	2 (0)	10,481
17 Indian River (95)	24 (2)	591 (57)	368 (36)	45 (4)	1,028
18 Biscayne Bay (79)	104 (3)	1,556 (41)	2,059 (55)	49 (1)	3,769
South Atlantic Total	66,666 (11)	6,743 (11)	44,615 (76)	747 (1)	58,770

a. Values in parentheses represent the percent of county grid sampled by NOAA. Areas with less than 100 percent coverage may not be completely mapped by the U. S. Fish and Wildlife Service.

b. Values in parentheses represent the percent of total Estaurine Drainage Area wetlands grid sampled by NOAA.

Table 13. Marpol Annex V- Garbage disposal restrictions. (Source: DOC 1988c).

GARBAGE TYPE	ALL VESSELS EXCEPT PLATFORMS AND ASSOCIATED VESSELS		OFFSHORE PLATFORMS AND ASSOCIATED VESSELS
	Outside Special Areas[a]	In Special Areas[b]	
Plastics- including synthetic ropes, fishing nets, and plastic bags	Disposal prohibited	Disposal prohibited	Disposal prohibited
Floating dunnage, lining, and packing materials	Disposal prohibited less than 25 miles from nearest land	Disposal prohibited	Disposal prohibited
Paper, rags, glass, metal bottles, crockery, and similar refuse	Disposal prohibited less than 12 miles from nearest land	Disposal prohibited	Disposal prohibited
Paper, rags, glass, etc., comminuted or ground[c]	Disposal prohibited less than 3 miles from nearest land	Disposal prohibited	Disposal prohibited
Food waste not comminuted or ground	Disposal prohibited less than 12 miles from nearest land	Disposal prohibited less than 12 miles from nearest land	Disposal prohibited
Food waste comminuted or ground[c]	Disposal prohibited less than 3 miles from nearest land	Disposal prohibited less than 12 miles from nearest land	Disposal prohibited
Mixed Refuse	Varies by component[d]	Varies by component[d]	Varies by component[d]

a Includes all fixed or floating platforms engaged in exploration or exploitation and associated offshore processing of seabed mineral resources, and all vessels alongside or within 500 m (1/3 mile) of such platforms.

b The Mediterranean, Baltic, Red and Black seas, and Persian Gulf.

c Must be able to pass through a screen with a mesh size no larger than 25 mm.

d When substances having different disposal or discharge requirements are mixed, the more stringent disposal requirement shall apply.

Table 14. Summary of shrimp management laws and regulations for the Southeastern Atlantic states.

LAWS OR REGULATORY MEASURES	NORTH CAROLINA	SOUTH CAROLINA	GEORGIA	FLORIDA
I. Restrictions on Gear or Method				
A. General	No regulations.	Stop netting illegal.	Stop netting illegal.	Stop netting illegal.
B. Mesh Size, Minimum	Shrimp trawls - 1 1/2" stretched mesh. Channel, float, butterfly nets, and seines 1 1/4" stretched mesh.	Seines - 1" stretched.	Seines under 12' 1" Stretched; up to 100 ft. - 1 1/4" stretched. Bait trawls 1" stretch minimum.	Minimum mesh only pertains to inside COLREGS: Shrimp trawls- 1 1/2" body, 1 1/4" bag in Northeast region for dead production
C. Net Restrictions				
(1) Channel Nets	Legal most areas.	Legal, by permit (80' max. width). Closes Nov. 15 but can be extended to Dec. 15.	Illegal, state waters.	Not allowable gear.
(2) Seines	Legal, all waters open to shrimp trawling.	Legal, all waters year round (40' max. length).	Legal, inside waters; (<12') barrier island beaches (up to 100').	Beach or haul seine no greater than 100 ft in length, for recreational use only; legal in certain areas only
(3) Cast Nets	Legal, all waters open to shrimp trawling. 100 per person per day in closed areas.	Legal, all waters year round. Casting over bait requires a permit and is limited to a 60-day season.	Legal, all waters year round. Baiting illegal.	Legal in most inside waters; no size limit; recreational use only.
(4) Dip or drop nets, bridge nets.	No rules.	Legal all waters year round.	No provisions.	Landing or dip net with an opening no larger than 96 inches around the perimeter; recreational use only.
(5) Butterfly, float nets.	Only in areas open to shrimp trawling.	Legal only in channel net areas and legal trawling areas.	Illegal in state waters.	Legal for live bait, in Volusia County, prohibited between March 1 and June 30, not fished under power; legal for food production in SE Region- no larger than 28 feet around perimeter, no more than two nets per vessel
(6) Shrimp Trawls	Legal in open areas (no restrictions, except mesh size).	Legal in open areas (no size restrictions).	Legal in open areas (size limit on bait trawls 10' headrope recreational and 20' commercial bait.	Legal in open areas, no size limits outside COLREGS; inshore regional configuration restrictions; minimum mesh: 1 1/2" body, 1 1/4" bag.
D. Catch Limits	None.	Recreational fishery limit is 48 qt. (heads on).	Bait shrimp trawling, personal use. 2 qts. per commercial possession.	None for commercial; 5 gal heads on shrimp per person or vessel per day.
II. Trawling Season(s)	Set by Division and based on shrimp size and abundance of juveniles of other species of economic importance.	Offshore - May 15 - Dec. 31. (Commission may open or close any area by discretion). Winyah and N. Santee Bays may be opened by Commission.	Food shrimp: Offshore - on or after June 1 - Dec. 31, provided count is 45 or above. Also may open in Jan., Feb. if count is below 50.	Florida East Coast Shrimp Bed closed to power trawling for food shrimp between April 1 and June.
III. Trawling Areas, Legal	Specified by regulation (legal in off-shore waters, most inside waters). Most tributaries to sounds and rivers closed.	Two bays, offshore waters only.	Nearshore waters only in recent years. Six sounds are infrequently opened on a conditional basis.	Specific areas closed permanently to harvest by gear type and user group.
IV. Shrimp Count Law (Minimum)	No provisions.	No provisions.	45/lb. heads-on (50/lb. Jan., Feb.) (To open).	47 heads on/70 tails per pound- food shrimp only.
V. Bait Shrimp Trawling	Only in areas open to shrimp trawling.	No specific provisions; trawling illegal in restricted areas.	Legal in designated zones. Recreational - 10' trawl (max.). Commercial 20' trawl (max.).	Legal in most open waters, under permit requirements and specific areal gear restrictions. Minimum mesh for live bait shrimp trawls- 1 1/4" body, 1"bag.
VI. Other	Trawling prohibited between one hour after sunset Sat. to one hour before sunset Sun.	Night trawling illegal 1/2 hour after sunset to 1/2 hour before sunrise.	Night trawling illegal, for commercial food shrimping 8 pm to 5 am EST.	Unlawful to catch shrimp by use of trawl nets during night hours except during June, July, and August.

Table 15. Number of North Carolina licensed vessels indicating shrimp trawl use for 1982-1991. (Source: NCDMF).

	CHARTERBOAT		FULL TIME COMMERCIAL		PART TIME COMMERCIAL		PLEASURE		TOTAL
	#	%	#	%	#	%	#	%	
82			1,758	20%	2,931	34%	4,047	46%	8,736
83			1,725	21%	2,634	32%	3,966	48%	8,325
84	2	0.03%	1,694	22%	2,632	34%	3,316	43%	7,644
85	4	0.05%	1,894	23%	2,540	31%	3,656	45%	8,094
86	3	0.04%	2,059	25%	2,510	31%	3,520	43%	8,092
87			1,879	26%	2,274	31%	3,166	43%	7,319
88			1,929	28%	2,005	29%	2,867	42%	6,801
89	2	0.03%	2,003	30%	1,910	28%	2,874	42%	6,789
90	2	0.03%	1,956	30%	1,832	28%	2,786	42%	6,576
91			2,280	32%	2,008	28%	2,812	40%	7,100

Table 16. Number of South Carolina shrimp trawl licenses from 1960-91. (Source: SCWMRD).

FISCAL YEAR (JULY 1-JUNE 30)	RESIDENT	NON-RESIDENT	TOTAL
1960 - 1961	287	134	421
1961 - 1962	281	89	370
1962 - 1963	305	156	461
1963 - 1964	269	97	366
1964 - 1965	221	111	332
1965 - 1966	251	116	367
1966 - 1967	271	97	368
1967 - 1968	294	196	490
1968 - 1969	321	166	487
1969 - 1970	365	251	616
1970 - 1971	368	211	579
1971 - 1972	491	356	847
1972 - 1973	573	305	878
1973 - 1974	667	389	1056
1974 - 1975	624	336	960
1975 - 1976	689	302	991
1976 - 1977	838	291	1129
1977 - 1978	593	196	789
1978 - 1979	693	311	1004
1979 - 1980	944	454	1398
1980 - 1981	1084	418	1502
1981 - 1982	742	312	1054
1982 - 1983	828	393	1221
1983 - 1984	885	465	1350
1984 - 1985	608	206	814
1985 - 1986	644	192	836
1986 - 1987	633	285	918
1987 - 1988	655	323	978
1988 - 1989	630	254	884
1989 - 1990	586	311	897
1990 - 1991	579	378	957

Table 17a. Historic Georgia commercial shrimp trawler license data from 1979-91. (Source: GDNR).

Length Category (feet, loa)	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	*1990	*1991	79-91 AVG
<20	511	458	227	317	345	167	212	171	127	97	93	83	98	224
20 - 29	284	226	114	169	199	104	148	119	91	100	92	54	79	137
30 - 39	64	59	42	42	52	38	45	54	58	57	46	32	29	48
40 - 49	87	85	59	74	69	54	64	79	51	59	56	46	56	65
50 - 59	128	124	93	96	96	73	84	89	80	92	80	68	84	91
60 - 69	219	203	141	153	166	139	154	183	133	147	126	108	126	154
70 - 79	135	155	76	96	107	73	81	101	93	102	106	97	110	102
80 - 89	7	11	6	9	9	5	15	13	11	3	11	4	9	9
90 - 99	0	1	0	0	1	1	0	0	0	0	3	0	0	0
>100	0	0	0	0	0	0	0	0	2	2	1	1	1	1
Unknown	36	38	7	3	2	4	17	10	12	7	5	4	5	12
Total	1471	1360	765	959	1046	658	820	819	658	666	619	497	597	841

Table 17b. Georgia commercial shrimp trawler license summary for 1991-92 license year. (Source: GDNR).

Length Category (feet, loa)	FL	GA	SC	NC	UNK	Commercial Food Total	Live Bait GA	Food & Bait Total
<20'	0	96	2	0	0	98	36	134
20 - 29'	0	77	2	0	0	79	26	105
30 - 39'	3	24	0	2	0	29	0	29
40 - 49'	2	38	4	10	2	56	0	56
50 - 59'	7	64	7	6	0	84	0	84
60 - 69'	16	86	12	11	1	126	0	126
70 - 79'	26	58	14	11	1	110	0	110
80 - 89'	0	5	0	4	0	9	0	9
90 - 99'	0	0	0	0	0	0	0	0
> or = 100'	0	1	0	0	0	1	0	1
Unknown	1	3	1	0	0	5	0	5
						0		
Total	55	452	42	44	4	597	62	659

Table 18. Number of active Florida east coast shrimp trawlers from 1986-90. (Source: FMRI).

	COMMERCIAL			RECREATIONAL
	INDIVIDUAL	VESSEL	TOTAL	TOTAL
1986	107	45	152	
1987	159	98	257	
1988	185	90	275	267
1989	308	143	451	536
1990	214	85	299	647

Active Florida east coast shrimp trawlers in the white shrimp and bait shrimp fishery from 1986-90. (Source: FMRI).

	WHITE SHRIMP		BAIT SHRIMP		
	LICENSES	TRIPS	LICENSES	TRIPS	NUMBER
1986	146	4,056	65	5,382	33,323,500
1987	332	4,054	163	6,010	32,663,000
1988	322	4,413	202	5,725	36,298,600
1989	458	4,556	295	5,278	28,225,500
1990	328	5,279	149	4,125	21,908,100

Table 19. Number of permitted fisherman using shrimp trawls in each south Atlantic state from 1950-1989. (Source: Fishery Statistics of the U.S. [1950-76] and NMFS [1977-89]).

Year	North Carolina	South Carolina	Georgia	Florida (east coast)	Total
1950	2,201	453	613	516	NP
1951	1,942	977	660	418	NP
1952	1,938	694	563	573	NP
1953	2,136	718	502	744	NP
1954	1,963	575	506	587	NP
1955	1,766	730	587	508	NP
1956	1,824	826	713	783	NP
1957	1,817	989	793	907	3,807
1958	1,380	951	1,096	1,080	3,723
1959	1,509	812	1,106	1,034	3,821
1960	1,575	819	953	982	3,667
1961	1,407	702	1,092	1,000	3,534
1962	1,410	740	1,177	889	3,569
1963	1,349	665	1,156	813	3,368
1964	1,361	503	1,104	676	3,119
1965	1,314	489	1,095	661	3,075
1966	1,313	442	1,079	697	3,099
1967	1,241	476	1,076	633	2,904
1968	1,126	633	1,139	612	2,957
1969	1,171	718	1,219	543	3,048
1970	1,326	642	1,003	527	3,004
1971	1,500	874	1,277	559	3,731
1972	1,638	938	1,231	491	2,988
1973	1,856	993	1,218	465	3,811
1974	1,878	1,164	1,406	392	3,283
1975	2,032	1,218	1,530	349	4,340
1976	2,011	1,162	1,562	429	4,456
1977	1,649	921	896	454	3,549
**1978	1,345	1,221	1,105	549	3,389
1979	2,380	1,416	1,427	931	5,125
1980	2,571	1,323	1,282	1,368	5,610
1981	2,876	1,026	884	1,147	5,388
1982	3,182	1,298	999	971	5,684
1983	3,099	1,295	1,199	877	5,780
1984	2,901	785	965	888	5,087
1985	3,333	792	843	895	5,312
1986	3,815	1,089	1,178	750	6,069
1987	3,078	1,240	968	899	5,442
1988	3,327	1,231	1,014	765	5,576
1989	2,980	1,229	841	893	5,300

*includes fishermen from both documented and non-documented vessels

**Florida and, therefore, total South Atlantic figures are estimated

NP = not published

Table 20. **Season comparisons of participation, effort, and catch parameters in the South Carolina recreational white shrimp fishery. (Source: SCWMRD).**

	1987	1988	1989	1990	1991
Permits	NA	5,509	6,644	9,703	12,005
% active permits	NA	92	82	94	89
Assistants/permit	NA	2.50	2.14	2.79	2.24
Participants	21,735	17,749	17,171	34,662	34,821
Season trips/permit	NA	6.99	5.73	7.78	6.56
Effort (trips)	40,101	35,609	31,624	71,153	71,034
Quarts whole shrimp/trip	29	22	27	26	21
Million pounds of whole shrimp	1.80	1.16	1.25	2.75	2.14
Pounds/permit		211	188	283	178
Pounds/participant	83	65	73	79	62
Percent of total fall shrimp harvest	29	32	24	41	29

Table 21. Total South Atlantic white shrimp landings by month from 1978-91 (SOURCE: states and NMFS).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
78	629,066	61,349	22,918	14,547	24,979	6,905	78,506	579,278	1,917,626	2,506,188	2,031,355	1,040,760	8,913,478
79	435,641	108,733	69,715	225,710	746,587	360,997	214,220	544,302	4,209,432	5,188,276	2,955,590	1,955,045	17,014,249
80	819,612	74,028	46,829	95,265	1,062,430	1,175,657	123,671	708,799	3,168,991	2,683,304	2,135,290	2,161,840	14,255,717
81	571,923	44,018	43,933	13,059	38,816	30,771	7,998	253,864	1,372,094	2,251,405	2,093,552	1,646,094	8,367,526
82	266,098	58,541	49,322	151,304	643,903	522,887	67,093	584,128	2,740,930	2,415,436	1,365,357	1,652,278	10,517,276
83	1,248,761	444,792	45,763	29,733	674,261	1,018,695	131,356	346,312	2,227,791	2,370,194	2,228,853	1,638,282	12,404,793
84	681,324	84,403	73,243	21,243	37,388	66,608	35,927	83,073	342,060	769,744	1,207,766	685,326	4,088,105
85	208,983	83,608	35,284	14,639	164,151	60,287	32,768	214,677	1,370,236	1,949,738	1,658,915	1,934,525	7,727,811
86	799,686	92,891	39,545	130,315	667,628	297,695	92,358	662,900	2,121,919	2,288,223	1,876,265	1,899,416	10,968,861
87	1,449,306	182,748	33,088	39,627	881,464	1,163,853	149,537	684,611	3,479,270	2,112,418	1,569,722	1,341,309	13,086,952
88	1,067,116	105,258	36,433	41,484	354,616	348,074	97,252	323,772	2,236,935	2,012,785	2,112,409	2,173,558	10,909,891
89	306,523	40,941	40,050	131,473	1,002,628	1,585,241	176,138	768,547	2,083,084	3,222,278	2,250,781	2,243,921	13,851,605
90	383,278	56,287	46,870	53,583	50,809	226,152	137,246	678,905	2,022,159	4,615,435	2,619,305	1,723,693	12,613,723
91	822,560	322,533	57,622	967,022	2,767,111	982,869	357,670	2,931,820	3,589,607	2,091,823	2,079,670	1,302,233	18,272,539

box indicates freeze month

Table 22. Total South Atlantic brown shrimp landings by month from 1978-91 (SOURCE: states and NMFS).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
*78					9,531	626,130	2,846,995	2,447,897	524,992	115,845	30,257		9,066,414
*79					1,320	968,737	3,398,122	1,906,441	274,421	93,706	634		9,788,696
*80	8,219	3,655	939	113	3,985	1,290,799	6,355,896	4,227,133	898,819	557,662	20,686	536	21,246,284
*81					81	261,809	2,173,273	1,405,162	477,246	51,614	3,482		6,205,742
*82					166	1,105,777	4,385,905	2,588,329	656,444	166,242	10,304	2,285	8,915,451
83				1,840	3,487	345,901	2,966,955	2,458,494	768,542	131,274	34,508	870	6,711,871
84		86			1,890	927,728	3,723,680	1,876,170	475,346	194,792	8,092	1,470	7,209,256
85	24		66		10,114	1,712,883	8,047,156	4,521,800	1,108,445	710,452	200,724	7,040	16,318,704
86	2,443				2,127	2,248,547	3,582,142	1,795,273	778,603	245,130	45,334	3,325	8,702,924
87	37		433		1,798	458,967	1,480,360	702,588	346,363	32,864	385	373	3,024,169
88	3,450		249	48	3,910	228,269	3,117,196	3,100,465	1,444,547	244,181	588	544	8,143,446
89	338	1,225	1,035		13,957	1,180,227	4,638,971	2,737,455	594,001	63,195	1,339		9,231,743
90		847	1,206	555	69,310	2,189,774	3,580,817	1,804,318	928,031	147,988	11,449		8,734,294
91	248	998	3,106	2,756	36,580	2,978,678	5,087,663	1,891,530	581,787	97,135			

*monthly landings for North Carolina are unavailable

Table 23. Total South Atlantic pink shrimp landings by month from 1978-91 (SOURCE: States and NMFS).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
78		1,680	23,690	8,287	65,069	52,753	7,286	44,226	49,248	103,734	127,670	77,654	1,003,112
79	3,198		21,747	121,598	380,011	479,772	111,693	106,412	126,157	185,755	176,309	63,112	3,337,139
80	61,970	51,460	29,491	42,019	214,332	306,491	14,145	15,068	216,181	452,006	140,465	28,278	2,945,246
81	24,563	13,988	5,212	54,308	179,626	263,015	33,123	40,508	101,626	87,692	55,143	12,118	1,584,239
82	23,926	12,955	12,667	54,467	246,914	405,591	54,571	102,632	253,996	362,603	182,596	36,667	1,749,785
83	6,984	4,350	14,049	102,513	419,459	828,495	246,346	131,269	287,724	371,025	254,045	33,366	2,699,625
84	5,011	17,407	14,567	52,702	256,911	335,302	11,341	26,878	175,521	318,259	150,163	27,230	1,391,292
85	17,364	9,065	12,101	52,632	227,287	191,978	1,720	46,934	184,090	292,948	333,019	69,815	1,438,953
86	7,213	11,532	28,452	124,085	455,838	490,513	54,425	97,157	228,617	438,388	116,354	48,654	2,101,628
87	4,711	5,378	8,135	102,279	315,977	1,164,469	378,013	123,180	412,153	420,050	150,529	54,553	3,139,447
88	41,327	26,278	60,466	104,402	268,221	923,245	273,094	50,397	357,490	586,204	193,645	44,816	2,929,565
89	22,052	42,191	58,815	154,701	824,880	1,048,203	222,367	80,223	243,192	371,765	261,262	63,430	3,393,081
90	58,504	22,112	23,502	77,543	123,051	29,787	32,963	211,808	339,507	463,450	221,686	47,274	1,651,188
91	4,284	14,768	27,370	326,280	1,062,011	664,810	38,541	115,832	171,361	163,074	99,710	11,103	2,699,144

*monthly landings for North Carolina 1978-81 are not available

Table 24a. Total South Atlantic rock shrimp landings by month from 1978-91 (SOURCE: states* and NMFS).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
78	75,619	151,631	173,241	94,793	56,763	20,487	8,368	160,180	650,555	392,138	33,321	46,937	1,864,033
79		8,053	60,926	94,232	48,880	76,969	1,336,338	2,570,145	207,458	469,591	417,993	562,825	5,853,409
80	874,600	685,290	583,011	187,665	42,220	33,981	15,161	20,093	110,034	392,730	352,956	569,562	3,867,303
81	759,165	679,945	383,547	132,603	40,950	4,675	12,323	12,172	7,344	616,142	69,262	401,067	3,119,195
82	681,029	625,360	567,107	154,826	21,099	172	101,424	340,055	642,285	696,187	1,075,411	363,138	5,268,093
83	76,765	39,889	38,680	2,517		40,915	900,543	871,269	1,371,099	782,030	486,243	268,092	4,878,041
84	322,029	537,612	221,716	94,473	130,200	203,114	274,040	1,088,625	956,423	1,263,307	1,011,131	764,569	6,867,240
85	216,324	130,755	73,058	34,610	35,478	59,272	43,049	154,709	349,044	514,794	201,176	36,326	1,848,595
86	25,218	43,445	11,989	9,997	33,719	261,771	504,454	348,702	301,370	835,579	746,399	319,211	3,441,855
87	131,517	114,483	46,877	14,684	8,907	103	17,631	94,709	1,327,281	946,819	1,375,625	1,015,537	5,094,174
88	447,991	473,355	313,351	42,730	29,868	153,262	41,948	230,719	220,078	302,066	504,018	393,011	3,152,395
89	422,104	579,936	207,062	66,565	23,499	24,738	28,494	810,758	2,295,030	1,824,435	1,658,975	1,241,816	9,183,413
90	1,191,002	716,841	518,266	194,630	108,156	17,400	67,286	799,078	1,796,511	1,870,390	1,159,436	156,457	8,595,453
91	192,725	108,343	72,870	17,266	1,369	19,860	68,730	558,896	1,098,113	699,147	176,801	35,983	3,050,103

*preliminary

Table 24b. Total royal red shrimp landings* (heads on) for Florida east coast for 1986-91 (Source: 1986-90, FMRI; 1991, NMFS).

Year	TOTAL	TRIPS
86	84,698	9
87	117,066	22
88	138,094	25
89	218,455	43
90	245,272	57
91	205,090	NA

*monthly landings are confidential

Table 25. White shrimp reported commercial landings (lb whole) for known distribution in state and EEZ waters. (Source: NMFS, NCDMF, and GADNR).

YR	ST	UNKNOWN DISTRIBUTION	UNK % OF TOTAL	INSIDE	0-3nm	TOTAL KNOWN STATE	KNOWN EEZ	TOTAL OF KNOWN DISTRIB.	STATE % OF KNOWN TOTAL	EEZ % OF KNOWN TOTAL
78	NC					40,654	0	40,654	100%	0%
79	NC					236,161	0	236,161	100%	0%
80	NC					563,004	4,484	567,488	99%	1%
81	NC					11,367	0	11,367	100%	0%
82	NC					171,330	1,368	172,698	99%	1%
83	NC					450,221	84	450,305	100%	0%
84	NC					91,598	5,437	97,035	94%	6%
85	NC					44,666	0	44,666	100%	0%
86	NC					112,063	0	112,063	100%	0%
87	NC					285,344	4,657	290,001	98%	2%
88	NC					83,489	94	83,583	100%	0%
89	NC					695,502	0	695,502	100%	0%
90	NC					1,149,207	0	1,149,207	100%	0%
90	NC					1,410,994	0	1,410,994	100%	0%
78	SC							NA	NA	NA
79	SC					4,492,905	0	4,492,905	100%	0%
80	SC					4,256,974	11,995	4,268,969	100%	0%
81	SC					1,587,055	7,441	1,594,496	100%	0%
82	SC					3,406,697	2,267	3,408,964	100%	0%
83	SC					3,496,103	89,471	3,585,574	98%	2%
84	SC					500,501	13,166	513,667	97%	3%
85	SC					639,252	13,138	652,390	98%	2%
86	SC					3,291,255	47,891	3,339,146	99%	1%
87	SC					4,475,316	176,340	4,651,656	96%	4%
88	SC					2,663,363	5,171	2,668,534	100%	0%
89	SC					4,447,183	673,733	5,120,916	87%	13%
90	SC					4,206,408	1,895	4,208,303	100%	0%
91	SC					6,684,880	152,626	6,837,506	98%	2%
*78	**GA	598	0%	51,531	2,741,063	2,792,594	1,224,380	4,016,975	70%	30%
79	GA	0	0%	88,533	1,300,629	1,389,162	6,531,531	7,920,693	18%	82%
80	GA	376,070	6%	82,658	2,113,049	2,195,707	3,650,977	5,846,684	38%	62%
81	GA	530,066	13%	68,147	1,889,209	1,957,355	1,530,749	3,488,105	56%	44%
82	GA	856,601	18%	94,012	2,807,462	2,901,474	1,144,842	4,046,316	72%	28%
83	GA	1,024,008	17%	407,279	2,998,195	3,405,474	1,533,393	4,938,868	69%	31%
84	GA	248,682	15%	5,698	747,017	752,715	607,915	1,360,630	55%	45%
85	GA	1,035,206	23%	706,170	2,201,613	2,907,783	585,202	3,492,985	83%	17%
86	GA	3,262,903	60%	340,643	1,504,748	1,845,391	372,224	2,217,615	83%	17%
87	GA	4,788,140	81%	64,121	845,599	909,720	229,552	1,139,272	80%	20%
88	GA	4,594,693	79%	235,625	829,272	1,064,896	177,189	1,242,085	86%	14%
***89	GA	4,033,258	74%	146,699	923,821	1,070,520	324,509	1,395,029	77%	23%
***90	GA	4,695,703	92%	68,823	351,758	420,580	1,337	421,917	100%	0%
***91	GA	4,493,616	95%	68,836	94,902	163,738	77,375	241,113	68%	32%
78	FL							NA	NA	NA
79	FL							NA	NA	NA
80	FL							NA	NA	NA
81	FL					2,651,777	93,098	2,744,875	97%	3%
82	FL					1,527,444	514,408	2,041,852	75%	25%
83	FL					2,257,982	148,270	2,406,252	94%	6%
84	FL					1,793,863	74,275	1,868,138	96%	4%
85	FL					2,437,477	65,133	2,502,610	97%	3%
86	FL					1,845,980	191,205	2,037,185	91%	9%
87	FL					2,015,686	202,243	2,217,929	91%	9%
88	FL					2,424,430	166,126	2,590,556	94%	6%
89	FL					2,213,015	230,244	2,443,259	91%	9%
90	FL					1,656,195	516,219	2,172,414	76%	24%
91	FL					1,891,126	967,901	2,859,027	66%	34%

*May-December only
**Georgia data in fishing season; State and EEZ totals based on percentage of known distribution
***preliminary data

Table 26. Brown shrimp reported commercial landings (lb whole) for known distribution in state and EEZ waters. (Source: NMFS, NCDMF, and GADNR).

YR	ST	UNKNOWN DISTRIBUTION	UNK % OF TOTAL	INSIDE	0-3nm	TOTAL KNOWN STATE	KNOWN EEZ	TOTAL OF KNOWN DISTRIB.	STATE % OF KNOWN TOTAL	EEZ % OF KNOWN TOTAL
78	NC					2,249,717	230,145	2,479,862	91%	9%
79	NC					3,111,979	31,636	3,143,615	99%	1%
80	NC					7,860,722	3,085	7,863,807	100%	0%
81	NC					1,831,908	0	1,831,908	100%	0%
82	NC					5,247,476	0	5,247,476	100%	0%
83	NC					3,010,672	20,055	3,030,727	99%	1%
84	NC					3,575,276	87,327	3,662,603	98%	2%
85	NC					10,284,109	93,053	10,377,162	99%	1%
86	NC					4,082,054	36,607	4,118,661	99%	1%
87	NC					1,102,142	2,705	1,104,847	100%	0%
88	NC					5,297,383	18,156	5,315,539	100%	0%
89	NC					5,080,971	0	5,080,971	100%	0%
90	NC					5,148,317	0	5,148,317	100%	0%
91	NC					6,772,056	0	6,772,056	100%	0%
78	SC							NA	NA	NA
79	SC					1,540,741	0	1,540,741	100%	0%
80	SC					2,688,938	10	2,688,948	100%	0%
81	SC					1,326,814	1,014	1,327,828	100%	0%
82	SC					1,880,532	0	1,880,532	100%	0%
83	SC					1,776,356	0	1,776,356	100%	0%
84	SC					1,811,780	3,658	1,815,438	100%	0%
85	SC					2,676,564	16,902	2,693,466	99%	1%
86	SC					2,719,244	4,454	2,723,698	100%	0%
87	SC					1,033,942	4,702	1,038,644	100%	0%
88	SC					1,625,785	688	1,626,473	100%	0%
89	SC					2,134,725	705	2,135,430	100%	0%
90	SC					1,575,974		1,575,974	100%	0%
91	SC					2,312,563	24,773	2,337,336	99%	1%
**78	*GA	0	0%	0	966,844	966,844	269,839	1,236,683	78%	22%
79	GA	0	0%	0	412,606	412,606	744,458	1,157,064	36%	64%
80	GA	122,874	7%	0	874,462	874,462	816,012	1,690,474	52%	48%
81	GA	81,347	12%	0	527,003	527,003	83,802	610,805	86%	14%
82	GA	208,123	18%	6,762	891,190	897,952	80,276	978,228	92%	8%
83	GA	278,322	21%	100	991,863	991,963	31,643	1,023,606	97%	3%
84	GA	235,310	20%	0	873,757	873,757	84,802	958,559	91%	9%
85	GA	395,944	20%	12,368	1,076,642	1,089,010	514,860	1,603,871	68%	32%
86	GA	550,652	42%	0	693,177	693,177	55,105	748,283	93%	7%
87	GA	352,720	74%	4,592	118,554	123,146	3,486	126,631	97%	3%
88	GA	557,007	85%	4,413	92,778	97,191	1,256	98,447	99%	1%
**89	GA	1,025,242	78%	0	278,916	278,916	2,834	281,750	99%	1%
**90	GA	970,328	84%	0	181,371	181,371	0	181,371	100%	0%
**91	GA	673,143	99%	0	9,719	9,719	44	9,763	100%	0%
78	FLEC							NA	NA	NA
79	FLEC							NA	NA	NA
80	FLEC							NA	NA	NA
81	FLEC					503,481	16,325	519,806	97%	3%
82	FLEC					547,925	42,399	590,324	93%	7%
83	FLEC					583,148	19,724	602,872	97%	3%
84	FLEC					528,998	8,366	537,364	98%	2%
85	FLEC					1,229,485	18,797	1,248,282	98%	2%
86	FLEC					544,146	17,504	561,650	97%	3%
87	FLEC					398,940	2,398	401,338	99%	1%
88	FLEC					545,148	852	546,000	100%	0%
89	FLEC					696,143	12,437	708,580	98%	2%
90	FLEC					556,002	307,466	863,468	64%	36%
91	FLEC					338,753	132,738	471,491	72%	28%

*May-December only
**Georgia data in fishing season; State and EEZ totals based on percentage of known distribution
***preliminary data

Table 27. Pink shrimp reported commercial landings (lb whole) for known distribution in state and EEZ waters. (Source: NMFS, NCDMF, and GADNR).

YR	ST	UNKNOWN DISTRIBUTION	UNK % OF TOTAL	INSIDE	0-3nm	TOTAL KNOWN STATE	KNOWN EEZ	TOTAL OF KNOWN DISTRIB.	STATE % OF KNOWN TOTAL	EEZ % OF KNOWN TOTAL
78	NC					435,624	4,790	440,414	99%	1%
79	NC					1,516,192	42,723	1,558,915	97%	3%
80	NC					1,350,522	20,670	1,371,192	98%	2%
81	NC					711,386	0	711,386	100%	0%
82	NC					1,563,522	21,067	1,584,589	99%	1%
83	NC					2,618,783	14,284	2,633,067	99%	1%
84	NC					1,128,745	148,366	1,277,111	88%	12%
85	NC					1,211,837	43,014	1,254,851	97%	3%
86	NC					1,882,204	21,846	1,904,050	99%	1%
87	NC					2,989,932	28,298	3,018,230	99%	1%
88	NC					2,668,581	43,074	2,711,655	98%	2%
89	NC					3,133,539	12,795	3,146,334	100%	0%
90	NC					1,402,892	101,189	1,504,081	93%	7%
91	NC					2,514,528	33,461	2,547,989	99%	1%
78	SC							NA	NA	NA
79	SC					8,506	0	8,506	100%	0%
80	SC					9,123	43	9,166	100%	0%
81	SC					8,534	4,498	13,032	65%	35%
82	SC					17,862	0	17,862	100%	0%
83	SC					6,501	56	6,557	99%	1%
84	SC					28,623	378	29,001	99%	1%
85	SC					38,696	5,519	44,215	88%	12%
86	SC					16,076	4,384	20,460	79%	21%
87	SC					10,238	4,868	15,106	68%	32%
88	SC					17,041	23,894	40,935	42%	58%
89	SC					11,609	1,256	12,865	90%	10%
90	SC					458	578	1,036	44%	56%
91	SC					3,882	114	3,996	97%	3%
*78	**GA	0	0%	0	286	286	24,571	24,858	1%	99%
79	GA	0	0%	0	1,293	1,293	12,043	13,336	10%	90%
80	GA	0	0%	0	1,570	1,570	23,432	25,002	6%	94%
81	GA	906	6%	0	5,478	5,478	9,757	15,235	36%	64%
82	GA	459	2%	0	6,077	6,077	20,397	26,474	23%	77%
83	GA	947	10%	0	474	474	8,382	8,856	5%	95%
84	GA	0	0%	0	674	674	5,851	6,525	10%	90%
85	GA	2,286	7%	200	0	200	31,336	31,536	1%	99%
86	GA	0	0%	0	184	184	43,472	43,656	0%	100%
87	GA	3,794	22%	0	0	0	13,758	13,758	0%	100%
88	GA	13,114	31%	0	491	491	28,542	29,034	2%	98%
***89	GA	936	3%	0	0	0	29,827	29,827	0%	100%
***90	GA	0	0%	0	0	0	12,144	12,144	0%	100%
***91	GA	5,125	39%	0	0	0	7,917	7,917	0%	100%
78	FLEC							NA	NA	NA
79	FLEC							NA	NA	NA
80	FLEC							NA	NA	NA
81	FLEC					749	129,784	130,533	1%	99%
82	FLEC					0	114,224	114,224	0%	100%
83	FLEC					4,997	45,222	50,219	10%	90%
84	FLEC					21	78,659	78,680	0%	100%
85	FLEC					3,187	108,036	111,223	3%	97%
86	FLEC					1,755	131,737	133,492	1%	99%
87	FLEC					7,365	81,221	88,586	8%	92%
88	FLEC					17,840	117,029	134,869	13%	87%
89	FLEC					2,190	207,766	209,956	1%	99%
90	FLEC					3,005	136,453	139,458	2%	98%
91	FLEC					1,424	124,868	126,292	1%	99%

*May-December only
**Georgia data in fishing season; State and EEZ totals based on percentage of known distribution
***preliminary data

Table 28. Number and race distribution of commercial shrimp fisherman, South Carolina, 1980. (Source: SAFMC 1981).

	Owner Captain		Non-Owner Captain		Total	
	No.	%	No.	%	No.	%
White	929	93.7	395	84.6	1324	90.8
Negro	57	5.8	68	14.6	125	8.6
Others	5	0.5	4	0.8	9	0.6
Total	991	100.0	467	100.0	1458	100.0

Table 29. Number and age distribution of commercial shrimp fisherman, North Carolina, 1980. (Source: SAFMC 1981).

Age	Full-Time Captain		Part-Time Captain		Total	
	No.	%	No.	%	No.	%
<20	2	2.1	0	0.0	2	1.1
21-25	4	4.1	2	2.6	6	3.4
26-30	13	13.4	3	3.8	16	9.1
31-35	10	10.3	5	6.4	15	8.6
36-40	17	17.5	6	7.7	23	13.1
41-45	13	13.4	9	11.5	22	12.6
46-50	14	14.4	8	10.3	22	12.6
51-55	10	10.3	9	11.5	19	10.9
56-60	3	3.1	11	14.1	14	8.0
61-65	6	6.2	10	12.8	16	9.1
66 and over	5	5.2	15	19.3	20	11.5
Total	97	100.0	78	100.0	175	100.0
Average (yrs)	42.6		52.3		46.9	

Table 30. Years of education of commercial fisherman, North Carolina, 1980. (Source: SAFMC 1981).

Education	Full-Time Captain		Part-Time Captain		Total	
	No.	%	No.	%	No.	%
1-5	8	8.2	7	9.1	15	8.6
6-8	25	25.8	13	16.9	38	21.8
9-12	50	51.5	34	44.2	84	48.3
13-16	12	12.4	18	23.4	30	17.2
16-19	2	2.1	5	6.4	7	4.1
Total	97	100.0	77	100.0	174	100.0
Average (yrs)		10.1			10.5	

Table 31. Number and age distribution of commercial shrimp fisherman, South Carolina, 1980. (Source: SAFMC 1981).

Age	Owner-Captain		Non-Owner Captain		Total	
	No.	%	No.	%	No.	%
<20	11	1.1	22	4.7	33	2.2
21-25	66	6.6	82	17.4	148	10.0
26-30	134	13.4	84	17.8	218	14.8
31-35	163	16.3	67	14.2	230	15.6
36-40	172	17.2	55	11.7	227	15.4
41-45	143	14.2	52	11.0	195	13.2
46-50	134	13.4	33	7.0	167	11.3
51-55	83	8.3	36	7.6	119	8.1
56-60	49	4.9	23	4.9	72	4.9
61-65	28	2.8	11	2.3	39	2.6
66 and over	18	1.8	6	1.3	24	1.9
Total	1001	100.0	471	100.0	1472	100.0
Average (yrs)	40.2		36.3		39.0	

Table 32. Number and age distribution of commercial shrimp fisherman, Georgia, 1980. (Source: SAFMC 1981).

Age	No.	%
<21	12	2.9
21-25	41	9.9
26-30	51	12.3
31-35	52	12.6
36-40	84	20.3
41-45	54	13.0
46-50	36	8.7
51-55	40	9.7
56-60	26	6.2
61-65	9	2.2
66 and over	9	2.2
Total	414	100.0
Average (yrs)	39.1	

Table 33. Characteristics of trawler captains by mobility class in South Atlantic states, 1976. (Source: SAFMC 1981).

Characteristics	Mobility Class				
	I n = 176	II n = 91	III n = 29	IV n = 5	All Class n = 301
Age (yrs)	43	42	40	33	42
Years of Formal Education	10	11	11	12	10
Years of Commercial Fishing Experience	19	22	19	14	21
Percent of Captains with Non-Fishing Employment	50	13	21	0	35

Table 34. **Unemployment rates* for coastal counties in South Atlantic states.**

	1970's		1990	
State	Coastal Counties	State Total	Coastal Counties	State Total
N.C.	7.6%	5.9%	6.5%**	4.8%
S.C.	6.2%	5.0%	5.8%	5.6%
Ga.	5.9%	5.1%	5.7%	6.8%
Fl.	5.8%***	6.0%	5.9%***	5.8%

* (Source: 1970's figures calculated from (1) North Carolina Statistical Abstract, Division of State Budget and Management, North Carolina State Government, 1979 (data for 1977); (2) South Carolina Statistical Abstract, 1980, the S.C. Division of Research and Statistical Services. S.C. State Government, 1980 (data for 1979); (3) 1980 Georgia Statistical Abstract College of Business Administration, University of Georgia (data for 1974); (4) 1980 Florida Statistical Abstract, Bureau of Economic and Business Research, University of Florida, 1980 (data for 1979). 1990 data from 1990 Census of Population and Housing Summary; Social, Economic and Housing Characteristics: Georgia, Florida, North Carolina, and South Carolina).

** Excludes N.C. coastal counties from the Albemarle region (Tyrrell, Washington, Bertie, Chowan, Perquimans, Pasquotank, Camden, and Currituck counties) due to lack of shrimping activity in that area.

***Includes only East coast counties.

Table 35. Occupational distribution and length of captain's non-fishery employment, 1976. (Source: SAFMC 1981).

	Mobility Class			
	I	II	III	IV
Number of captains in sample	176	91	29	5
Number of captains with non-fishery employment	88	12	6	0
Professional and technical worker	4	1	0	0
Managers and administrators	5	0	0	0
Blue collar-craftsmen, skilled workers etc.	51	4	5	0
Sales and clerical worker	7	0	0	0
Self-employed	11	4	0	0
Laborers and others	10	3	1	0
Average length of non-fishery employment for those working outside the fishery (months)	8	6	4	0

Table 36. Distribution of primary occupation of commercial fisherman, North Carolina, 1980. (Source: SAFMC 1981).

Primary Occupation	Full-Time Captain		Part-Time Captain		Total	
	No.	%	No.	%	No.	%
Fishing	92	94.9	11	14.9	103	59.9
Boat Building & Repair	2	2.1	1	1.3	3	1.7
Marine Transportation			4	5.4	4	2.3
Other Maritime related			4	5.4	4	2.3
Farmers			3	4.1	3	1.7
Teachers, except College and University			3	4.1	3	1.7
Former members of the Armed Forces			3	4.1	3	1.7
Managers and Administrators			2	2.7	2	1.2
Real Estate brokers & agents			2	2.7	2	1.2
Machinists			2	2.7	2	1.2
Sheetmetal workers & tinsmith			2	2.7	2	1.2
Current member of Armed Forces			2	2.7	2	1.2
All Others	3	3.0	36	49.5	39	22.7
Total	97	100.0	75	100.0	172	100.0

Table 37. Whiting reported commercial landings by month and state for the South Atlantic region from 1978-91 (SOURCE: NMFS).

NORTH CAROLINA

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78	2,870	415	13,459	6,323	4,032	4,556	8,982	13,918	20,733	38,414	34,476	5,776	153,954
79	9,715	22,967	20,615	21,728	6,091	6,342	19,534	20,655	15,509	15,921	34,220	117,206	310,503
80	46,215	20,912	4,837	19,936	16,496	20,565	21,775	31,343	30,506	76,393	40,037	13,590	342,605
81	2,228	*	*	48,766	15,264	2,625	9,054	26,855	23,640	28,552	66,331	30,672	254,651
82	6,857	1,606	5,157	9,109	16,538	14,704	49,605	52,426	51,228	55,121	50,004	48,697	361,052
83	63,503	15,081	5,556	20,915	20,438	24,085	35,648	76,665	45,052	58,727	42,111	34,100	441,881
84	17,204	20,020	13,789	24,142	14,984	27,174	30,697	53,009	31,724	56,160	109,575	65,873	464,351
85	62,462	41,675	33,112	51,463	15,416	20,131	29,645	41,987	42,242	58,142	91,526	144,639	632,440
86	290,912	81,925	45,057	42,353	22,722	24,844	37,724	47,716	62,547	70,945	168,590	98,055	993,390
87	68,527	24,223	25,897	63,404	55,891	25,695	23,283	23,732	28,935	113,279	262,718	244,344	959,928
88	50,284	25,626	22,751	43,917	12,660	19,071	36,211	23,032	29,851	52,880	50,703	136,963	503,949
89	50,216	25,033	16,300	60,255	17,264	8,194	9,604	18,168	8,677	41,186	116,069	191,458	562,424
90	20,480	8,304	50,453	178,394	18,134	13,579	25,863	23,777	32,384	73,044	203,359	90,841	738,612
91	66,913	66,228	61,470	195,384	41,075	9,093	17,302	18,307	20,947	44,167	207,764	118,001	864,651

SOUTH CAROLINA

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78		0	0	0	655	4,131	14,311	19,813	15,839	21,343	14,795	3,133	94,020
79	1,101	0	0	905	2,497	4,060	14,961	14,083	9,019	26,036	13,023	5,199	90,884
80	*	*	0	*	*	7,507	10,631	10,839	11,792	14,636	4,267	2,171	63,906
81	*	*	0	0	0	*	8,757	3,009	2,080	3,489	1,434	0	19,693
82	*	*	0	*	5,958	9,460	12,653	18,260	20,724	24,542	7,765	2,835	102,450
83	*	0	0	*	6,906	8,042	10,266	14,422	19,128	23,747	17,528	3,075	103,939
84	204	*	*	0	1,413	9,771	17,624	14,127	10,214	14,770	17,674	7,159	92,977
85	*	256	*	1,763	1,253	2,715	19,597	10,862	8,760	10,847	4,570	3,305	64,149
86	654	0	*	*	2,331	8,083	13,315	11,479	23,311	20,572	14,831	4,203	99,273
87	1,839	*	*	*	5,673	17,709	11,249	6,992	20,973	21,360	9,361	4,543	107,070
88	1,352	414	*	3,466	5,799	3,159	10,220	10,857	11,383	14,626	9,889	5,957	77,987
89	1,119	*	890	1,343	3,980	12,391	6,325	7,642	11,384	11,202	10,250	3,656	73,060
90	*	*	60	929	*	6,781	5,288	4,889	12,893	17,156	10,366	6,711	65,073
91	1,852	1,008	461	7,680	16,265	4,782	3,782	4,376	7,072	5,943	6,237	3,242	62,700

* confidential

(cont.)

GEORGIA

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78	1,585	61	0	193	4,134	8,997	40,303	37,458	38,874	62,298	63,438	24,390	281,731
79	9,179	3,846	7,832	9,604	18,019	17,728	19,674	15,815	15,688	17,770	22,744	12,906	170,805
80	4,269	900	75	4,635	14,787	11,145	23,825	27,089	36,356	38,601	41,801	31,782	235,265
81	1,054	0	8,600	759	262	1,714	22,222	24,492	36,858	54,640	26,196	25,494	202,291
82	1,751	0	2,600	22,272	133,505	38,665	21,163	18,320	26,822	43,345	42,123	30,485	381,051
83	13,541	8,416	3,316	15,822	91,502	42,033	20,934	21,030	16,055	30,156	44,663	28,212	335,680
84	8,262	8,330	6,753	10,512	17,559	19,486	18,660	25,473	14,736	22,840	40,095	26,498	219,204
85	10,663	3,312	3,547	2,014	14,537	19,190	23,570	31,537	23,033	32,195	19,491	26,625	209,714
86	5,245	2,190	2,407	71,628	53,448	15,940	18,530	20,160	30,413	26,035	32,246	39,458	317,700
87	19,372	1,745	466	15,323	15,789	7,537	7,542	3,697	7,298	14,702	17,904	14,236	125,611
88	11,667	3,189	1,841	17,118	24,166	7,861	11,001	20,068	19,855	21,973	29,902	20,259	188,900
89	2,223	3,700	2,956	11,975	7,990	6,115	8,374	9,086	9,704	14,328	21,521	7,242	105,214
90	1,105	558	201	2,331	1,400	9,372	9,602	10,345	16,987	25,203	20,758	9,964	107,826
91	4,175	2,492	2,199	26,001	25,066	3,933		3,100	8,829	6,603	7,717	10,256	100,371

FLORIDA EAST COAST

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78	32,411	38,654	77,228	90,752	15,122	20,666	53,752	41,605	25,673	54,142	128,965	101,403	680,373
79	50,987	48,797	170,585	111,507	36,475	45,818	123,478	66,267	34,695	71,752	77,983	150,544	988,888
80	64,893	36,092	100,443	200,247	75,331	78,895	84,936	40,656	33,256	44,508	126,938	124,942	1,011,137
81	77,120	41,833	285,315	78,563	23,254	172,223	47,385	21,573	17,212	57,828	186,393	183,818	1,192,517
82	53,894	19,858	81,096	57,411	90,544	127,927	63,591	49,726	35,098	38,413	121,015	145,834	884,407
83	81,889	35,714	105,322	236,285	46,795	84,613	95,639	69,161	42,201	59,447	146,152	101,185	1,104,403
84	88,053	126,588	281,530	60,275	29,679	79,833	62,912	50,059	20,745	40,203	117,537	151,480	1,108,894
85	162,598	89,030	162,432	136,540	89,471	61,709	35,897	39,819	40,124	69,001	98,950	147,667	1,133,238
86	69,276	61,009	125,667	144,504	98,129	99,197	57,018	27,512	31,282	51,061	57,345	99,258	921,258
87	117,423	60,235	52,792	249,781	31,795	99,835	63,812	38,128	19,338	32,311	90,248	154,324	1,010,022
88	44,527	34,936	230,494	123,584	30,200	31,054	60,008	62,506	39,836	60,262	74,968	123,993	916,368
89	77,540	72,932	154,502	157,920	48,837	81,808	101,616	50,632	16,656	57,903	141,225	149,820	1,111,391
90	89,187	95,341	208,597	136,512	124,240	83,713	64,574	52,242	20,367	47,304	116,832	118,427	1,157,336
91	96,154	101,047	250,216	82,060	38,470	16,851	26,423	26,565	22,579	35,146	54,101	107,460	857,072

Table 38. Total South Atlantic whiting landings by month from 1978-91 (SOURCE: NMFS).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78	36,866	39,130	90,687	97,268	23,943	38,350	117,348	112,794	101,119	176,197	241,674	134,702	1,210,078
79	70,982	75,610	199,032	143,744	63,082	73,948	177,647	116,820	74,911	131,479	147,970	285,855	1,561,080
80	116,311	57,954	105,355	224,996	107,515	118,112	141,167	109,927	111,910	174,138	213,043	172,485	1,652,913
81	80,473	42,730	294,430	128,088	38,780	176,667	87,418	75,929	79,790	144,509	280,354	239,984	1,669,152
82	62,652	21,506	88,853	88,853	246,545	190,756	147,012	138,732	133,872	161,421	220,907	227,851	1,728,960
83	159,458	59,211	114,194	273,322	165,641	158,773	162,487	181,278	122,436	172,077	250,454	166,572	1,985,903
84	113,723	154,944	302,087	94,929	63,635	136,264	129,893	142,668	77,419	133,973	284,881	251,010	1,885,426
85	235,888	134,273	199,147	191,780	120,677	103,745	108,709	124,205	114,159	170,185	214,537	322,236	2,039,541
86	366,087	145,124	173,811	258,499	176,630	148,064	126,587	106,867	147,553	168,613	272,812	240,974	2,331,621
87	207,161	86,761	79,162	335,314	109,148	150,776	105,886	72,549	76,544	181,652	380,231	417,447	2,202,631
88	107,830	64,165	255,951	188,085	72,825	61,145	117,440	116,463	100,925	149,741	165,462	287,172	1,687,204
89	131,098	104,543	174,648	231,493	78,071	108,508	125,919	85,528	46,421	124,619	289,065	352,176	1,852,089
90	110,782	104,231	259,311	318,166	143,822	113,445	105,327	91,253	82,631	162,707	351,315	225,943	2,068,933
91	169,094	170,775	314,346	311,125	120,876	34,659	47,507	52,348	59,427	91,859	275,819	236,959	1,884,794

Table 39. Respondent vessel characteristics (1987).

	MEAN	STND. DEV	HIGH	LOW	NUMBER
VESSEL LENGTH (ft)	60	11	80	37	61
HORSE POWER	286	82	450	120	60
YEAR BUILT	1970	10	1985	1941	54
MARKET VALUE(1987$)	$89,000	$49,000	$225,000	$8,000	61
PURCHASE PRICE	$87,000	$56,000	$275,000	$7,500	56

Table 40. Respondent operator/effort characteristics (1987).

	MEAN	STND. DEV	HIGH	LOW	NUMBER
PERCENT HOUSEHOLD INCOME FROM SHRIMPING	75%	28%	100%	20%	51
NUMBER CREW	1.6	0.56	2	0	53
DAYS SHRIMPING IN SOUTH CAROLINA	120	63	250	0	47
DAYS SHRIMPING IN OTHER STATES	75	75	300	0	52
DAYS FISHING FOR OTHER SPECIES	8	30	200	0	51
VESSEL OWNER OPERATED	YES 82%	NO 18%	60 responses		

Table 41. Respondent variable and fixed cost estimates (annual 1987).

	MEAN	STND. DEV	HIGH	LOW	NUMBER
FUEL AND OIL	$11,000	$8,020	$50,000	$2,500	49
ICE	$3,140	$2,815	$15,800	$400	48
ENGINE MAINTENANCE AND REPAIR	$3,620	$4,470	$22,800	$0	50
TRAWLING GEAR REPAIR	$1,365	$1,905	$7,700	$0	51
HULL REPAIRS	$2,960	$3,420	$15,800	$0	50
INSURANCE (annual premium)	$2,480	$3,420	$8,200	$0	51
INTEREST PAYMENTS	$2,540	$3,340	$8,700	$0	49
MISC. SUPPLIES	$3,465	$3,460	$14,900	$500	50
GROCERIES	$1,735	$1,185	$3,500	$200	50
WORK RELATED TRAVEL EXPENSES	$1,080	$1,000	$2,900	$100	49
PACKING AND HEADING EXPENSES	$2,030	$3,270	$12,500	$0	48
MOORING AND DOCKING FEES	$335	$830	$3,100	$0	49
PROFESSIONAL FEES (lawyers, tax prep.)	$590	$980	$4,700	$0	48
OTHER MISC. FEES	$120	$330	$1,400	$0	48
PERMIT FEES	$240	$250	$700	$0	50

Table 42. Respondent landings, price estimates and revenue and net revenue calculations (annual 1987).

	MEAN	STND. DEV	HIGH	LOW	NUMBER
SHRIMP LANDINGS (pounds, heads off)	24,100	14,575	59,100	8,500	32
PRICE PER POUND (average across counts)	\$3.20	\$0.80	\$4.75	\$1.50	40
TOTAL SHRIMPING REVENUE (1987)	\$74,030	\$35,135	\$147,750	\$22,500	29
NON-SHRIMP REVENUE	\$1,450	\$2,075	\$2,800	\$0	34
NET REVENUES (1987) (before taxes to vessel crew and captain)	\$38,750	\$35,900	\$75,200	-\$1,400	29
NET RETURNS TO VESSEL (rents) (1987)	\$11,865	\$10,450	\$30,457	-\$20,850	29

Table 43. White shrimp commercial landings (heads on for closure months for the South Atlantic for 1978-90. (Source: 1978-89, NMFS and 1990, State).

POUNDS Year	NORTH CAROLINA Jan thru May	SOUTH CAROLINA Jan thru May	GEORGIA Mar thru May	FLORIDA Apr thru May	CLOSURE TOTAL SOUTH ATLANTIC	PERCENT OF TOTAL ANNUAL SOUTH ATLANTIC
78	0	4,150	6,493	33,934	44,577	0.50%
79	2,875	124,195	772,644	175,779	1,075,493	6.32%
80	19,604	178,946	823,894	236,415	1,258,859	8.83%
81	0	16,034	5,490	46,765	68,289	0.82%
82	1,112	26,694	595,267	185,079	808,152	7.68%
83	3,323	330,200	473,237	111,973	918,733	7.41%
84	24,612	76,397	15,389	32,906	149,304	3.65%
85	0	4,795	55,164	121,838	181,797	2.35%
86	32	43,631	613,139	180,437	837,239	7.63%
87	1,456	372,984	635,587	155,817	1,165,844	8.91%
88	105	183,687	305,126	95,255	584,173	5.35%
89	0	191,301	772,178	218,508	1,181,986	8.53%
90	0	668	17,014	127,222	144,904	1.10%

DOLLARS Year	NORTH CAROLINA Jan thru May	SOUTH CAROLINA Jan thru May	GEORGIA Mar thru May	FLORIDA Apr thru May	CLOSURE TOTAL SOUTH ATLANTIC	PERCENT OF TOTAL ANNUAL SOUTH ATLANTIC
78	$0	$6,567	$13,076	$558,268	$577,911	2.97%
79	$10,269	$310,817	$2,505,895	$561,346	$3,388,327	7.27%
80	$54,823	$350,086	$1,902,429	$129,779	$2,437,117	7.97%
81	$0	$26,696	$16,181	$641,358	$684,235	3.51%
82	$4,275	$116,091	$2,210,560	$417,647	$2,748,573	7.86%
83	$12,971	$929,558	$1,847,106	$113,128	$2,902,763	7.81%
84	$90,820	$176,675	$57,423	$321,688	$646,606	5.80%
85	$0	$12,942	$150,346	$596,685	$759,973	3.81%
86	$27	$111,649	$2,213,361	$495,443	$2,820,480	8.55%
87	$4,693	$1,060,041	$2,058,865	$333,779	$3,457,378	10.78%
88	$299	$250,715	$1,127,409	$644,236	$2,022,659	6.91%
89	$0	$547,849	$2,362,445	$329,505	$3,239,799	10.61%
90	$0	$1,147	$54,026	$1,497,973	$1,553,146	4.64%

box indicates freeze year

Table 44. Linear specification of regression (dummy variable = landings ≠ freeze year).

	par. est.	std. error	T for Ho
intercept	6,811,607	1,356,125	5.02
dummy	6,832,888	1,472,237	4.64

CONFIDENCE INTERVAL: $x \pm Z_{\alpha/2}\, \sigma/\sqrt{n}$

for

$\mu \leq x+$:

$$6{,}811{,}607 + \frac{1{,}356{,}125\ (1.96)}{\sqrt{32}} + \frac{1{,}472{,}237\ (1.96)}{\sqrt{32}} + 6{,}832{,}888$$

$$= 6{,}811{,}607 + 469{,}873 + 510{,}104 + 6{,}832{,}888$$

$$= 14{,}624{,}472$$

for

$-x \leq \mu$:

$$681{,}607 - \frac{1{,}356{,}125\ (1.96)}{\sqrt{32}} + 6832888 - \frac{1{,}472{,}237\ (1.96)}{\sqrt{32}}$$

$$= 6.341{,}733 + 6{,}322{,}783$$

$$= 12{,}664{,}517$$

CONFIDENCE INTERVAL: $12{,}664{,}517 \leq \mu \leq 14{,}624{,}472$

Table 45. **Spatial distribution and relative abundance of white, brown, and pink shrimp in southeast estuaries. (NOAA 1991b).**

		Southeast Estuaries																				
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
Species/Life Stage		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
Pink shrimp	A		O			●	●		O			O										
	S																					
Penaeus duorarum	J		O			●	●		O			●			●	●		●	●		●	●
	L														●	●		●	●		●	◉
	E																					
White shrimp	A		O			O	O		O			O										
	S																					
Penaeus setiferus	J	O	●		√	●	O		O			O			O	O		O	O	√	O	◉
	L	O	●			●	O					O			O	O		O	O		O	O
	E																					
Brown shrimp	A		O			●	●		●			●										
	S																					
Penaeus aztecus	J	√	O			●	●		●		O	●			●	●		●	◉		●	◉
	L					O	O					O			●	●		●	◉		●	◉
	E																					

T M * T M S T M * T M * T M S T M S T M S
Albemarle Sound | Pamlico Sound | Pamlico/ Pungo Rivers | Neuse River | Bogue Sound | New River | Cape Fear River
Southeast Estuaries

Relative Abundance

● Highly Abundant
◉ Abundant
O Common
√ Rare
Blank Not Present

Salinity Zone

T - Tidal Fresh
M - Mixing
S - Seawater
* - Seawater zone not present.

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

(cont.)
Table 45. **Spatial distribution and relative abundance of white, brown, and pink shrimp in southeast estuaries.**

		Southeast Estuaries																				
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
Species/Life Stage		T	M	S	T	M	•	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Pink shrimp	A		√	O		O			√	√		√	√		O	O		√	√		√	√
	S																					
Penaeus	J		O	O		●			O	O		√	√		O	O		O	O		O	O
duorarum	L		O	O		O			O	O		√	√		O	O			√			√
	E																					
White shrimp	A	√	O	O		●			●	●		●	●		O	O		●	●		●	●
	S								√	√												
Penaeus	J	√	●	●		●			●	●		●	●		●	●		●	●		●	●
setiferus	L		●	●		●			●	●		●	●		●	●		O	O		O	O
	E								√	√												
Brown shrimp	A		●	●		O			●	●		√	√		O	O		O	O		●	●
	S		√	√																		
Penaeus	J		●	●		●			●	●		●	●		●	●		O	O		●	●
aztecus	L		●	●		O			●	●		●	●		●	●						
	E		√	√																		
		T	M	S	T	M	•	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
		Southeast Estuaries																				

Relative Abundance

● Highly Abundant
◉ Abundant
O Common
√ Rare
Blank Not Present

Salinity Zone

T - Tidal Fresh
M - Mixing
S - Seawater
• - Salinity zone not present.

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

(cont.)

Table 45. Spatial distribution and relative abundance of white, brown, and pink shrimp in southeast estuaries.

		Southeast Estuaries																	
		St. Cathe./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	•	M	S	•	M	S
Pink shrimp	A		√	√					√	√					O	O			
	S																		
Penaeus	J		O	O		√	√		O	O	O	O	O		●	●		●	●
duorarum	L			√						√		O	O		●	●		●	●
	E																		
White shrimp	A		●	●		●	●		●	●					√	√		√	√
	S																		
Penaeus	J		●	●		●	●		●	●	●	●	●		O	O		√	√
setiferus	L		O	O		O	O		O	O		●	●		O	O		√	√
	E																		
Brown shrimp	A		◉	◉		O	O		●	●					√	√		√	√
	S																		
Penaeus	J		◉	◉		O	O		●	●	√	●	●		O	O		√	√
aztecus	L											●	●		O	O		√	√
	E																		
		T	M	S	T	M	S	T	M	S	T	M	S	•	M	S	•	M	S
		St. Cath./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
		Southeast Estuaries																	

Relative Abundance

● Highly Abundant
◉ Abundant
O Common
√ Rare
Blank Not Present

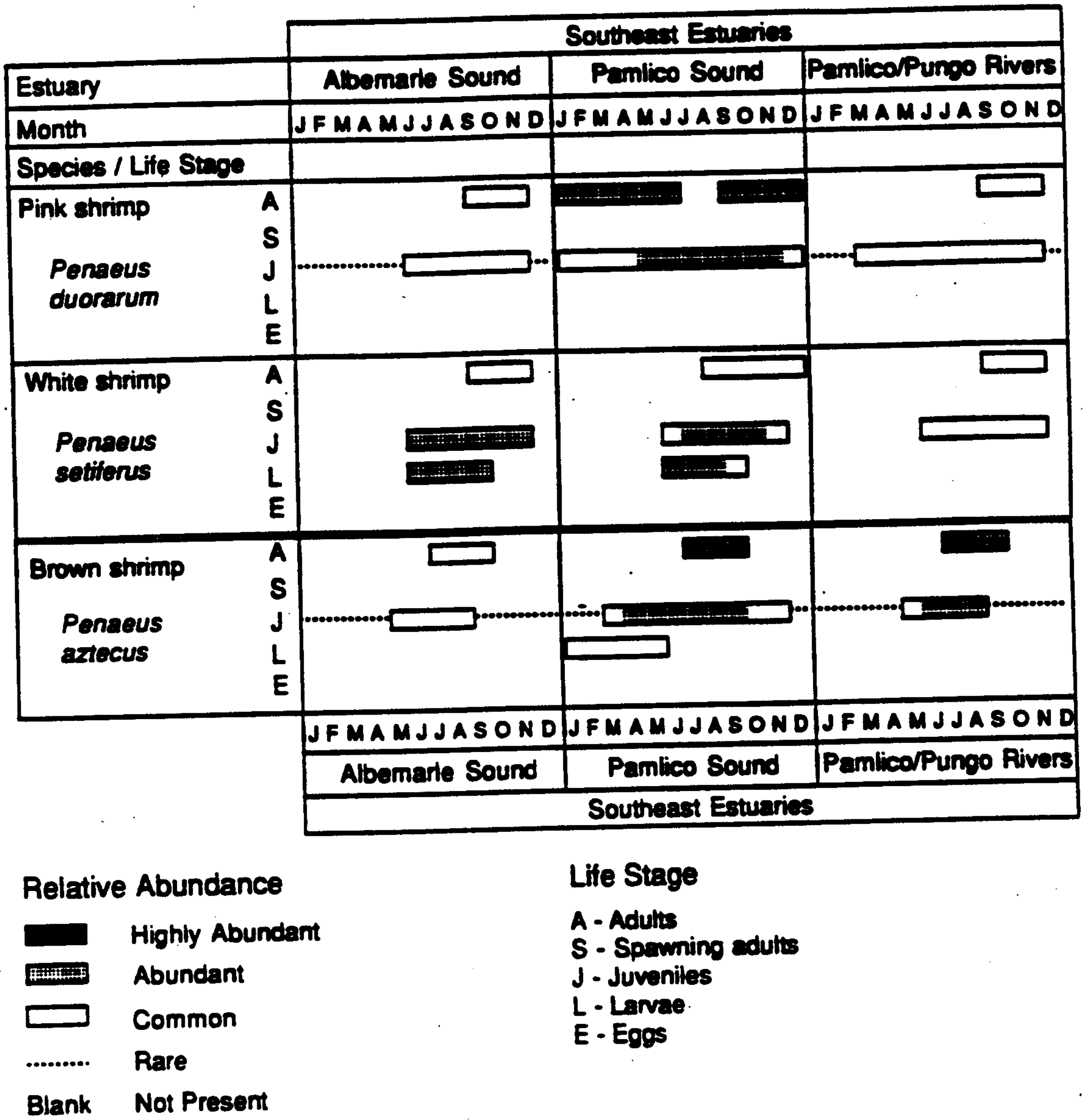
Salinity Zone

T - Tidal Fresh
M - Mixing
S - Seawater
• - Salinity zone not present.

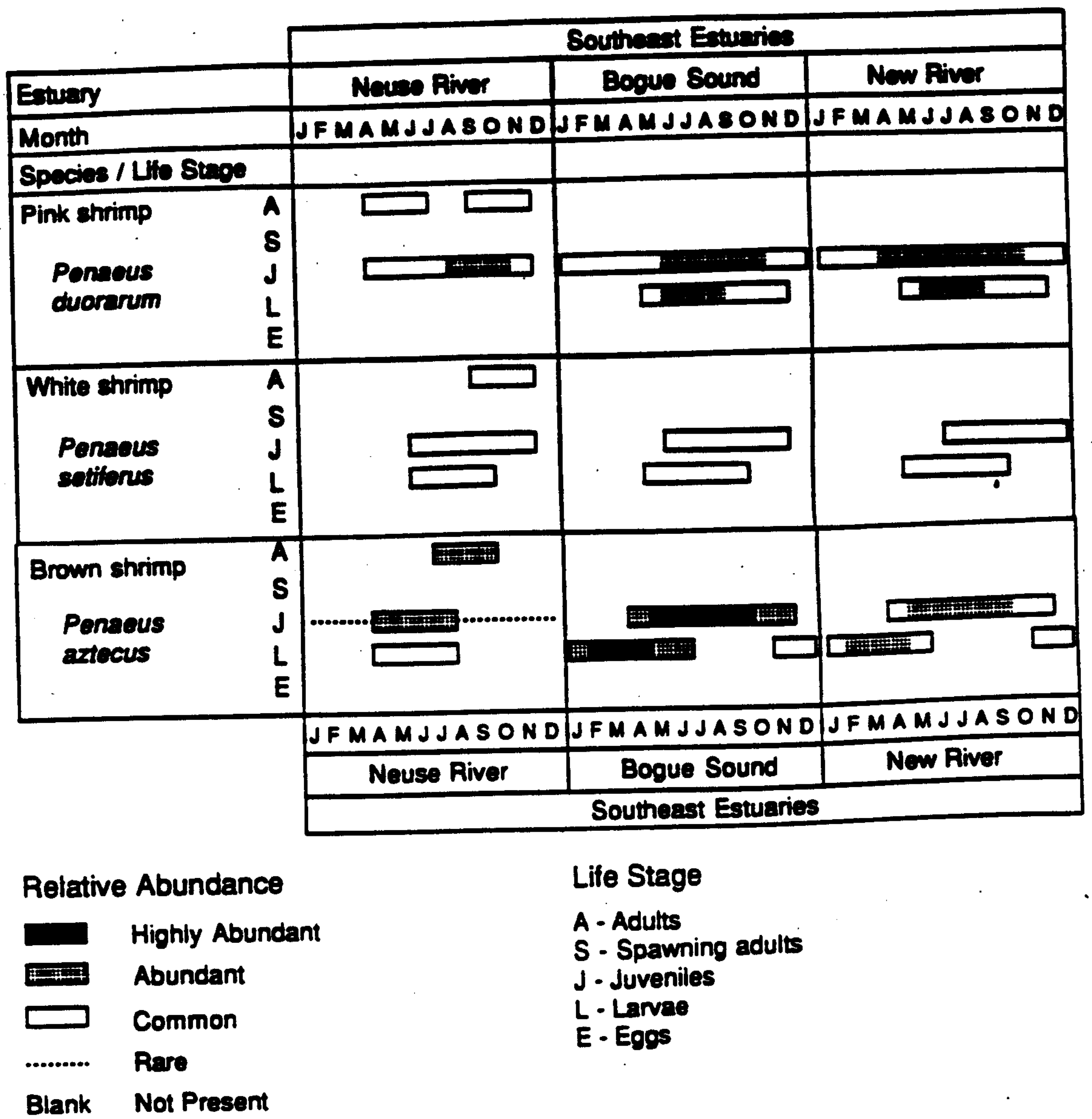
Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

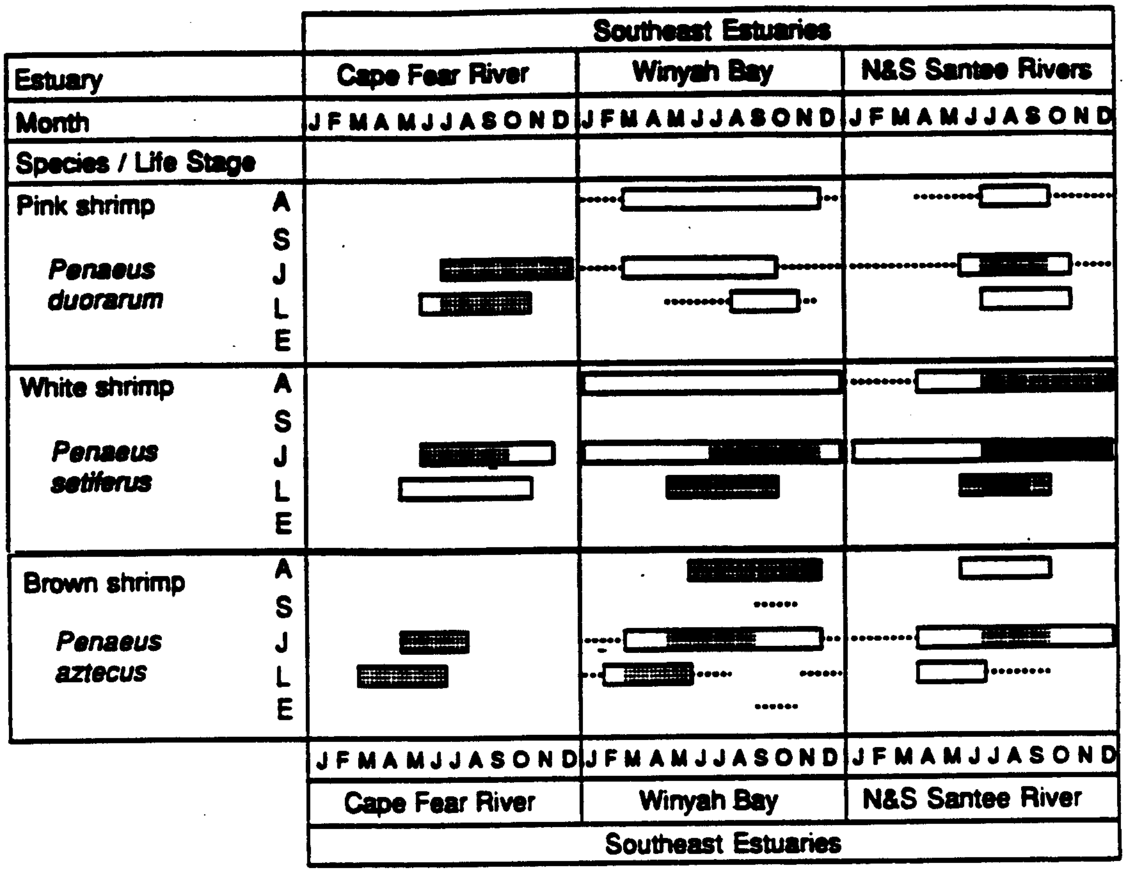
Table 46. Temporal distribution of white, brown, and pink shrimp in southeast estuaries. (NOAA 1991b).



(cont.)
Table 46. Temporal distribution of white, brown, and pink shrimp in southeast estuaries.



(cont.)
Table 46. **Temporal distribution of white, brown, and pink shrimp in southeast estuaries.**



Relative Abundance

Highly Abundant

Abundant

Common

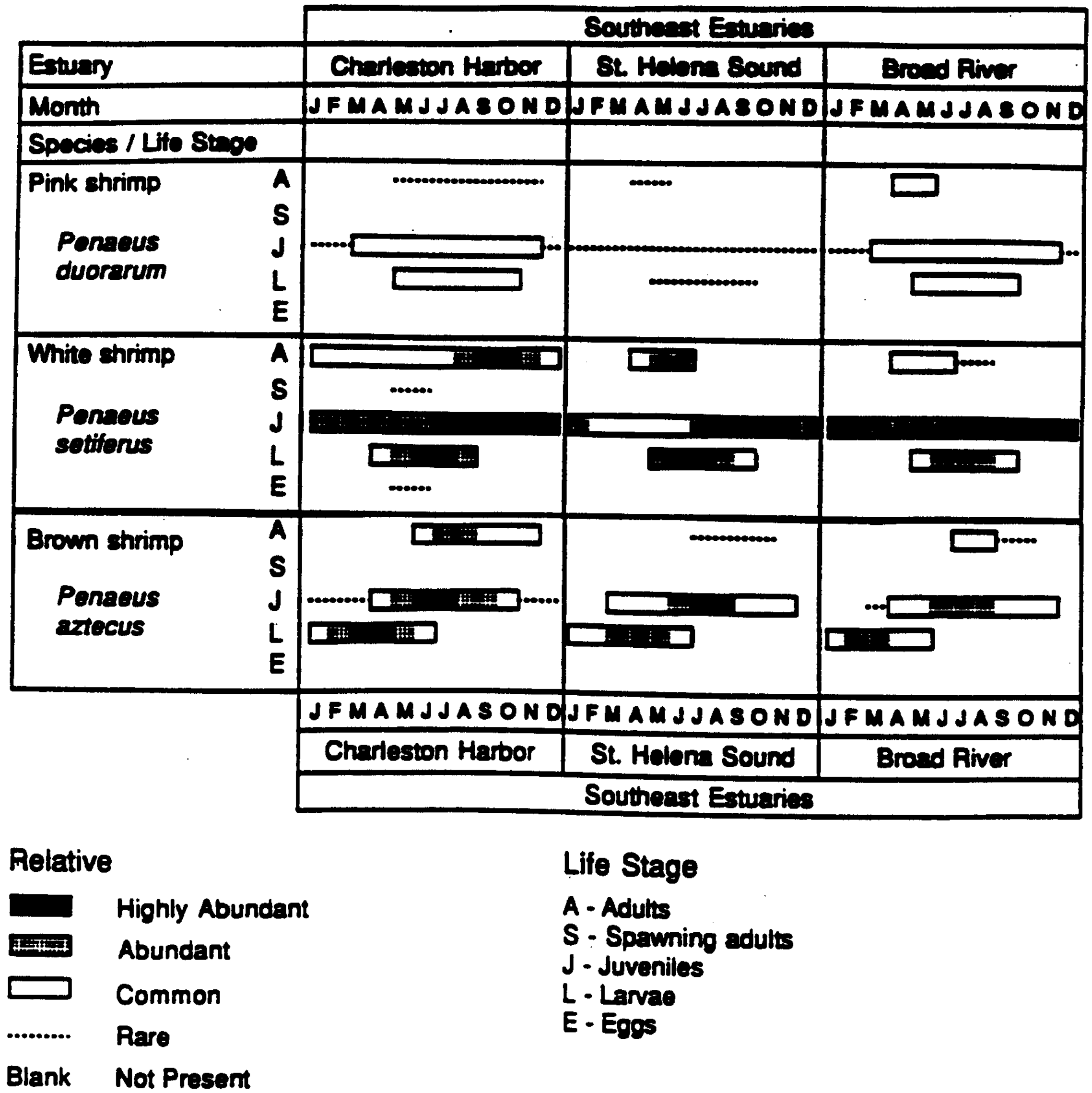
.... Rare

Blank Not Present

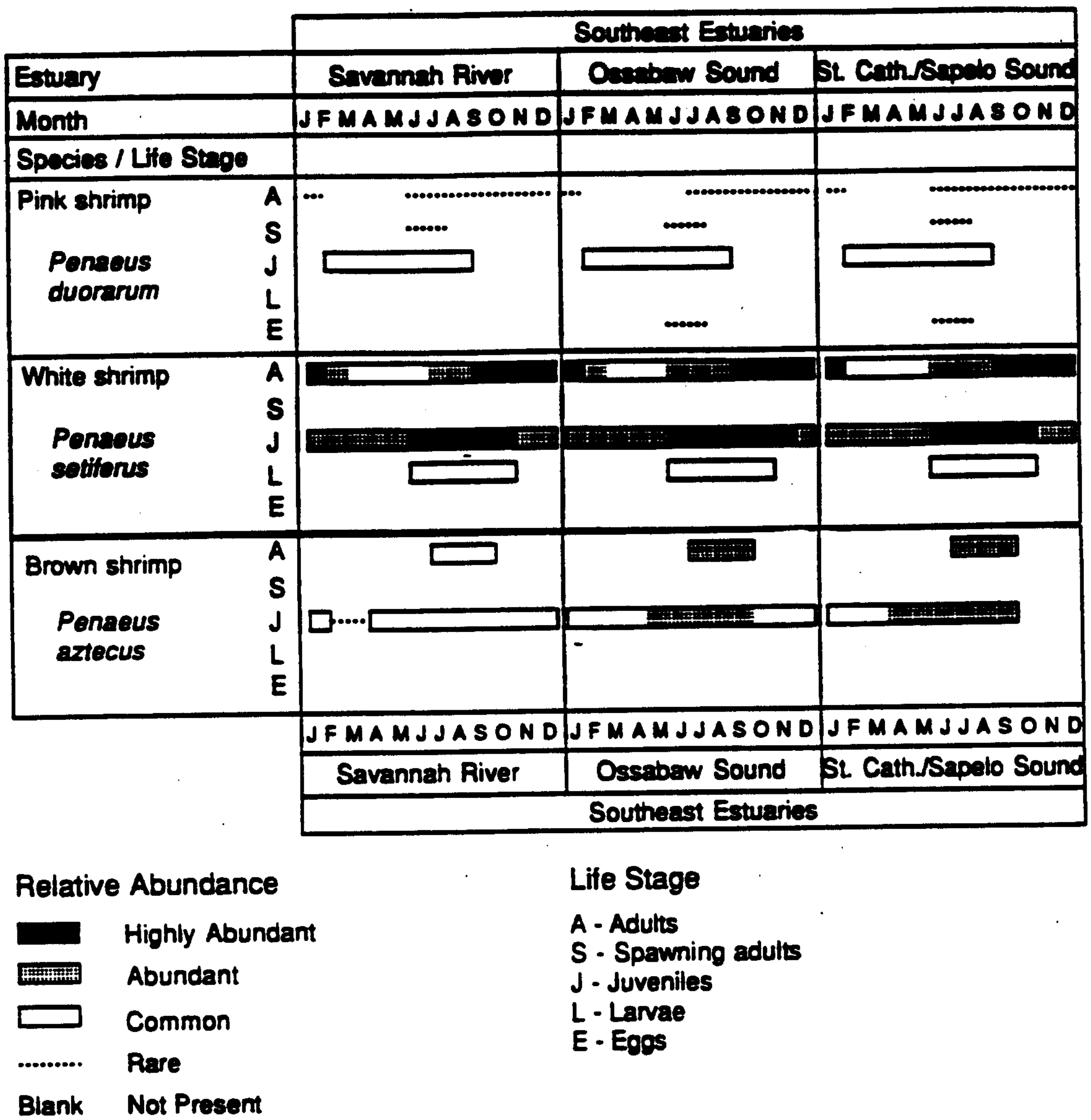
Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

(cont.)
Table 46. **Temporal distribution of white, brown, and pink shrimp in southeast estuaries.**

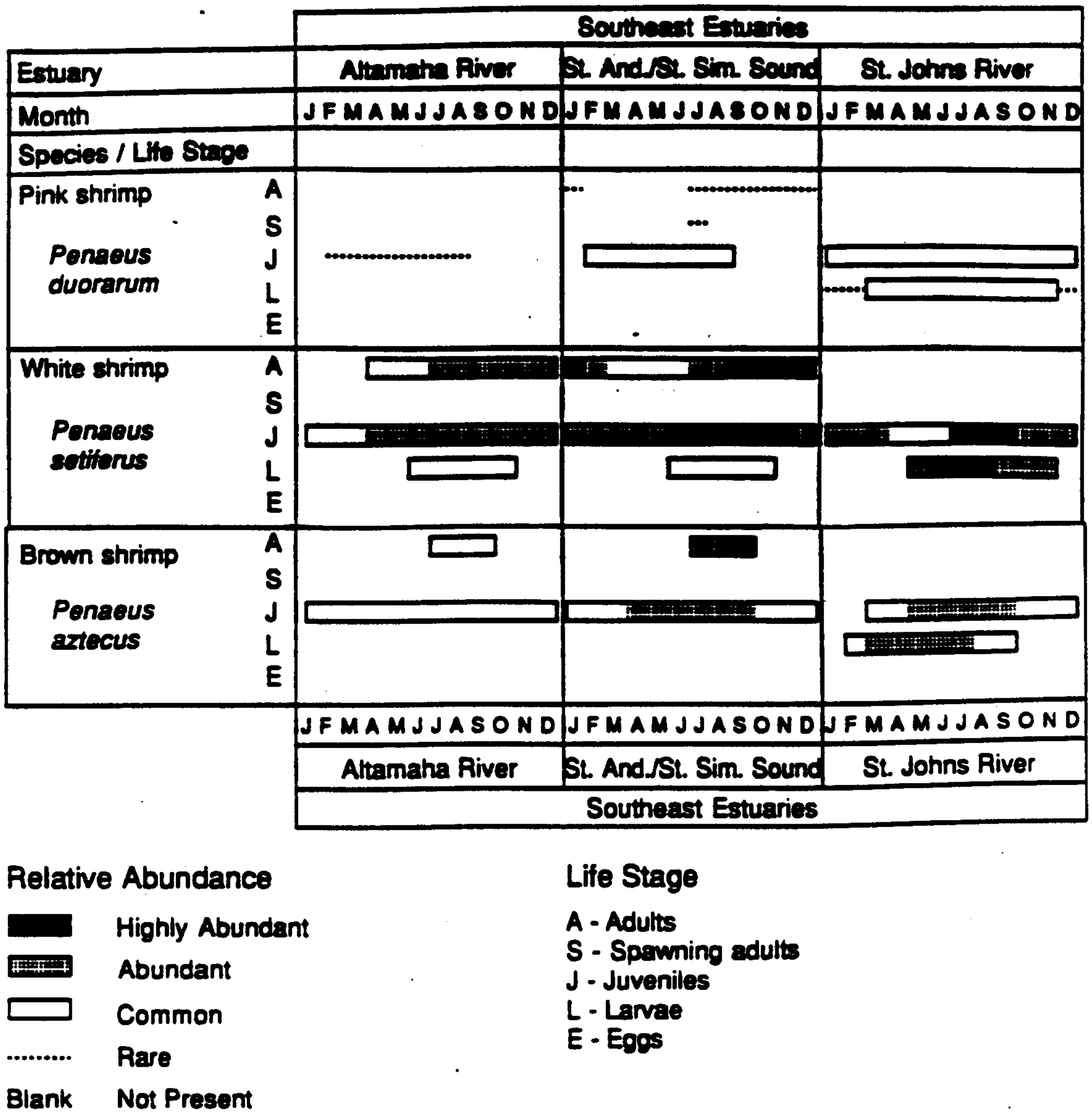


(cont.)
Table 46. **Temporal distribution of white, brown, and pink shrimp in southeast estuaries.**



(cont.)

Table 46. **Temporal distribution of white, brown, and pink shrimp in southeast estuaries.**



(cont.)
Table 46. Temporal distribution of white, brown, and pink shrimp in southeast estuaries.

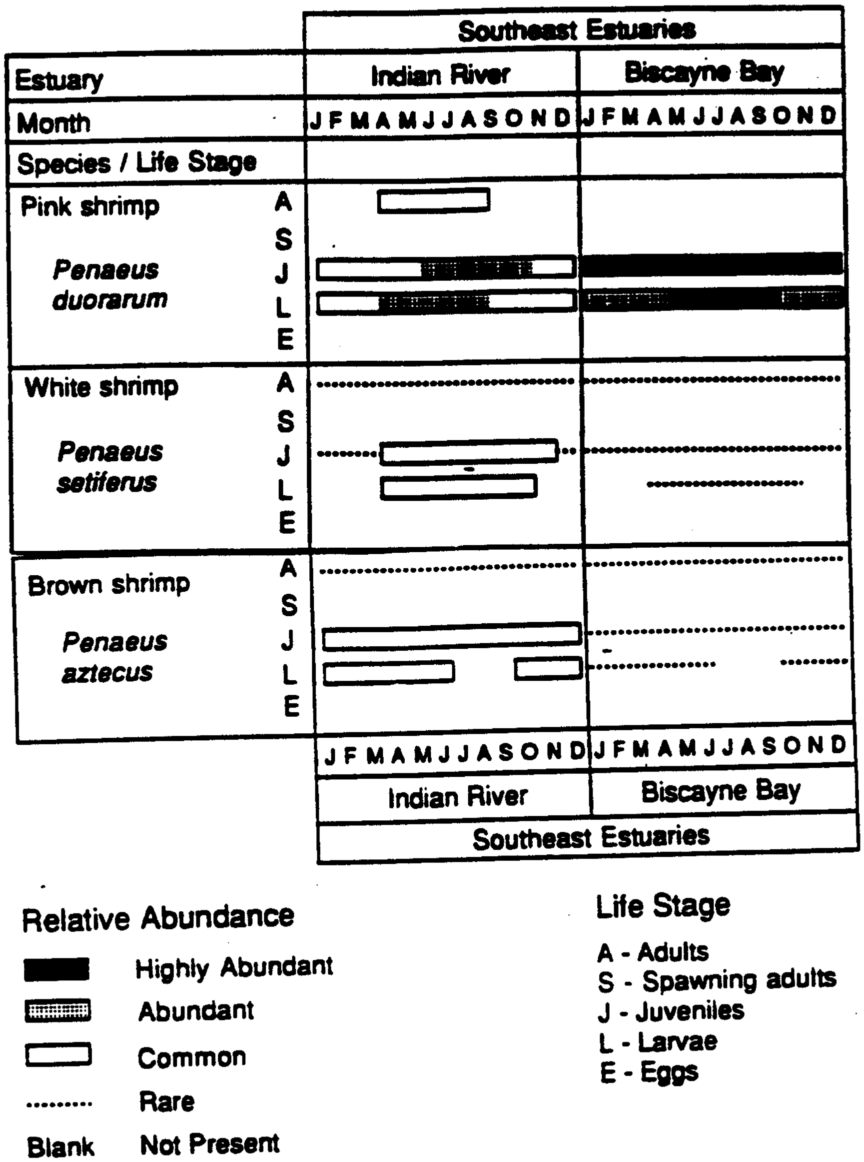


Table 47. Pollutants included in the National Pollutant Discharge Inventory(NOAA 1985).

Pollutants	Definition	Effects
1. Oxygen-Demanding Materials Biochemical Oxygen Demand (BOD)	Measure of organic material in a discharge that can be readily oxidized through microbial decomposition.	Can result in depletion of dissolved oxygen concentration: low concentration can result in death to marine organisms.
2. Particulate Matter Total Suspended Solids	Measure of suspended solid material.	Increases turbidity and bottom deposition: many toxic compounds are bound to, carried by, and deposited with TSS particles.
3. Nutrients a. Total Nitrogen (N)	Measure of all forms of nitrogen, i.e., nitrite, nitrate, ammonia-N, and organic forms.	N and P are major plant nutrients. Excessive amounts in water overstimulate plant growth; resultant oxygen depletion may have lethal effects on marine organisms.
b. Total Phosphorous (P)	Measure of all forms of phosphorus, i.e., ortho and para-compounds.	
4. Heavy Metals a. Arsenic(As) b. Cadmium (Cd) c. Copper (Cu) e. Iron (Fe) f. Lead (Pb) g. Mercury (Mg)	A group of elements present in the environment from natural and anthropogenic sources that can produce toxic effects: determination based on EPA standard methods that measure environmentally available "metals".	Can be toxic to marine organisms and potentially to humans through consumption of contaminated water and organisms.
5. Petroleum Hydrocarbons (Pet HC)	A mixture of hydrocarbons found in petroleum comprised of hundreds of chemical compounds.	Acute lethal and chronic sublethal toxicity to marine organisms; interference with cellular and physiological processes, e.g., feeding and reproduction.
6. Chlorinated Hydrocarbons a. Polychlorinated Biphenyls (PCBs)	A group of aromatic compounds of two fused benzene rings and two or more chlorine atoms: used in heat exchange and insulating fluids.	Toxic to marine organisms; highly persistent; potential human carcinogen through consumption of contaminated water or orgamisms.
b. Chlorinated hydrocarbons other than PCBs (CHP)	Includes the chlorinated pesticides, aromatic, and nonaromatic.	Varying degree of acute and chronic aquatic toxicity, persistence, and human carcinogenicty.
7. Pathogens Fecal coliform bacteria (FCB)	Enteric bacteria which enter water in fecal material of human or animal origin: presence of pathogens.	Main effects are on public health and quality and safety of seafood.
8. Sludges (Slu)	Solids or semi-solid materials generated as a result of potable or industrial water supply treatment, sanitary or industrial wastewater treatment, or flue gas scrubbing using wet processes.	May contain concentrated levels of contaminants found in wastewater, especially pathogens, heavy metals, and toxic organics, contaminants found in flue gases.
9. Wastewater (WW)	Water that has come in contact with pollutants as a result of human activities and is not used in a product, but discharged as a waste stream.	May contain concentrations of various pollutants or be contaminated by heat, or when discharged into marine waters the extra influx of fresh water may affect salinity gradients.

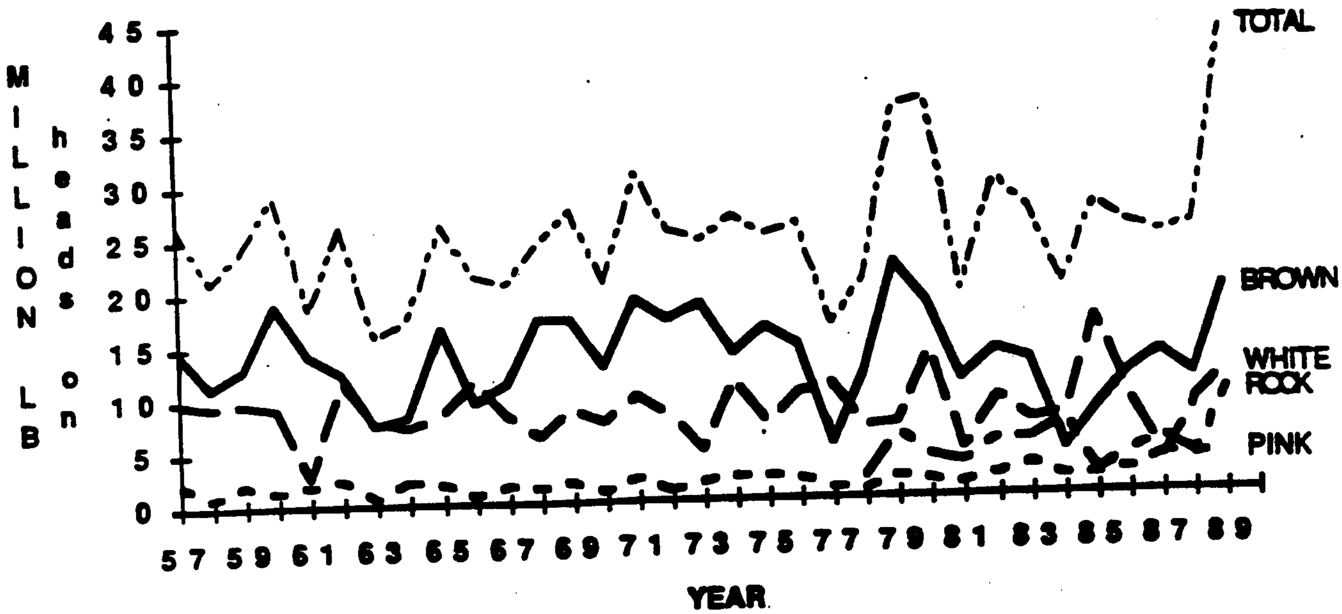
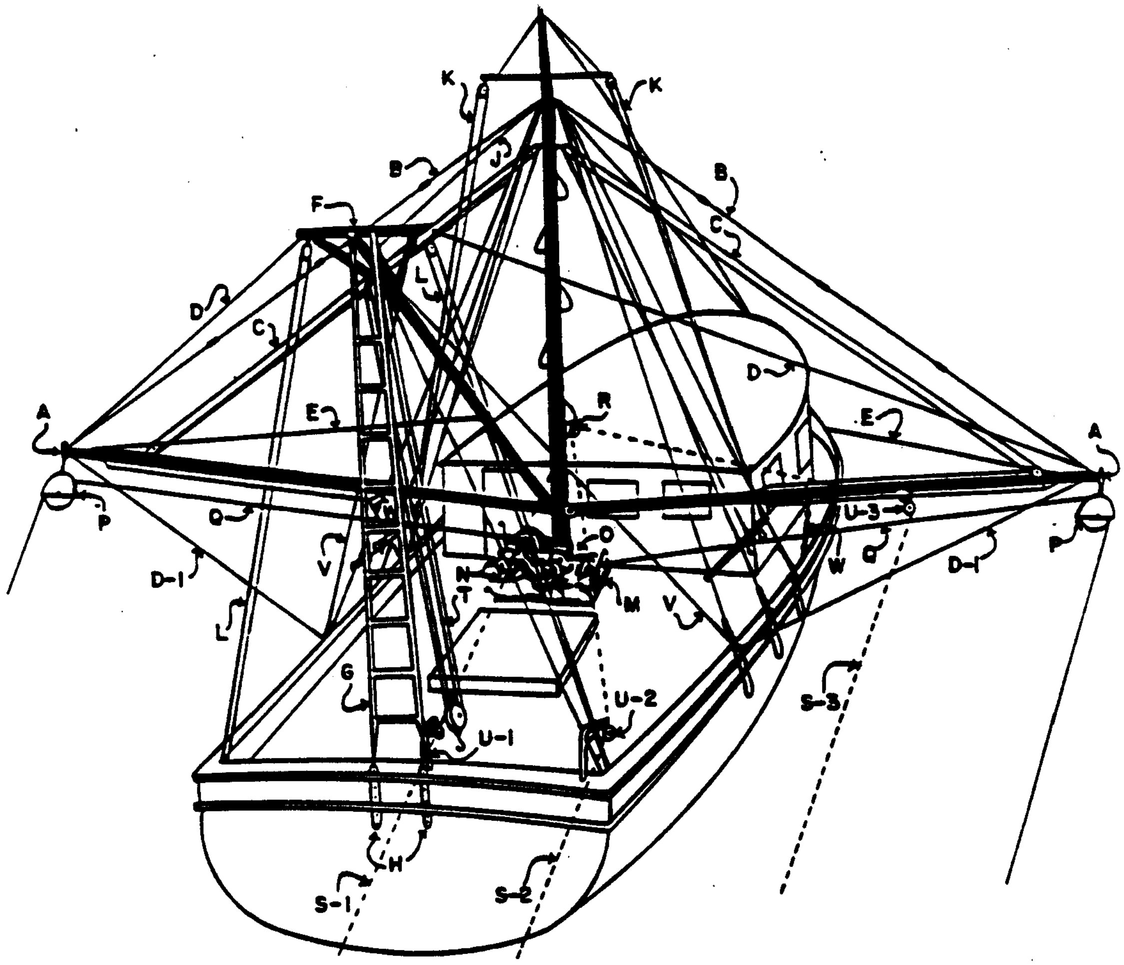


Figure 4. South Atlantic shrimp landings by species for 1957-90.



A- Towing boom or outrigger; B- towing boom topping stay; C- topping lift tackles; D or D-1- towing boom outrigger back stay; E- towing boom outrigger bow stay; F- modified boom; G- boom back stays- ratline structure; H- boom back stay plate on transom; J- boom topping lift stay; K- single block tackle; L- single block tackle; M- trawl winch; N- heads, two on trawl winch; O- center drum for trynet warp; R- leading block for try net; S-1, S-2, S-3- trynet lead block; T- main fish tackle tail block; U-1, U-2, U-3- trynet lead block; any one may be used to accord with selection of S-1, S-2, or S-3; V-boom shrouds; W-chain stoppers for outriggers.

Figure 5. Rigging arrangements for double-rig shrimp trawling (Adapted from Kristjonsson, 1968 In: SAFMC 1981).

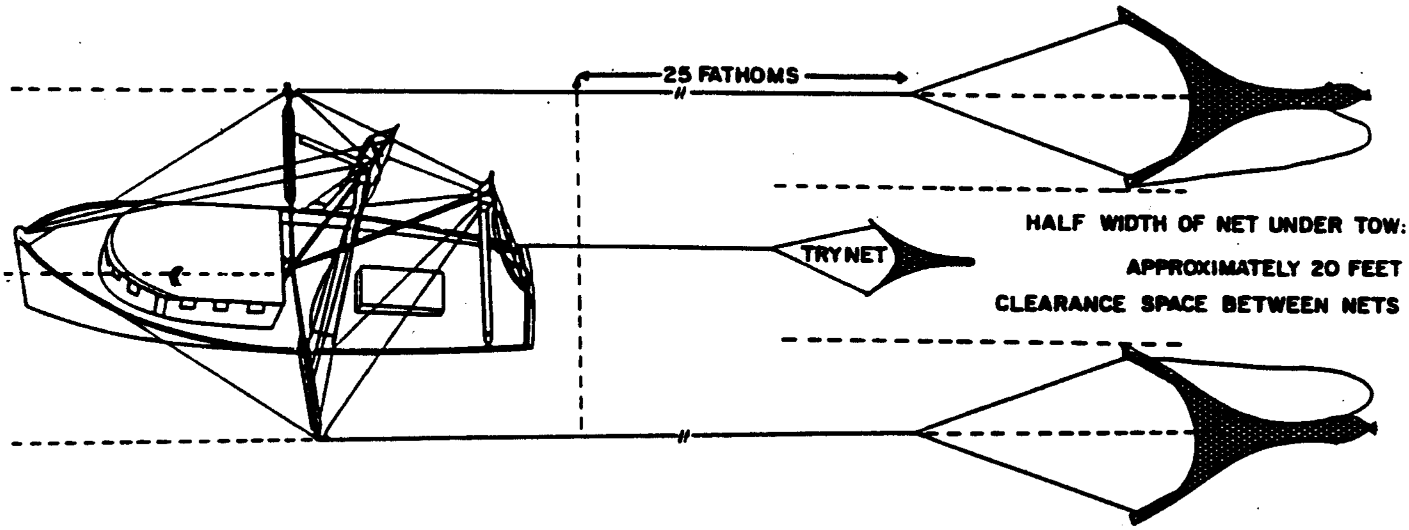


Figure 6. A diagrammatic representation of double-rig shrimp trawling (Adapted from Kristjonsson, 1968 In: SAFMC 1981).

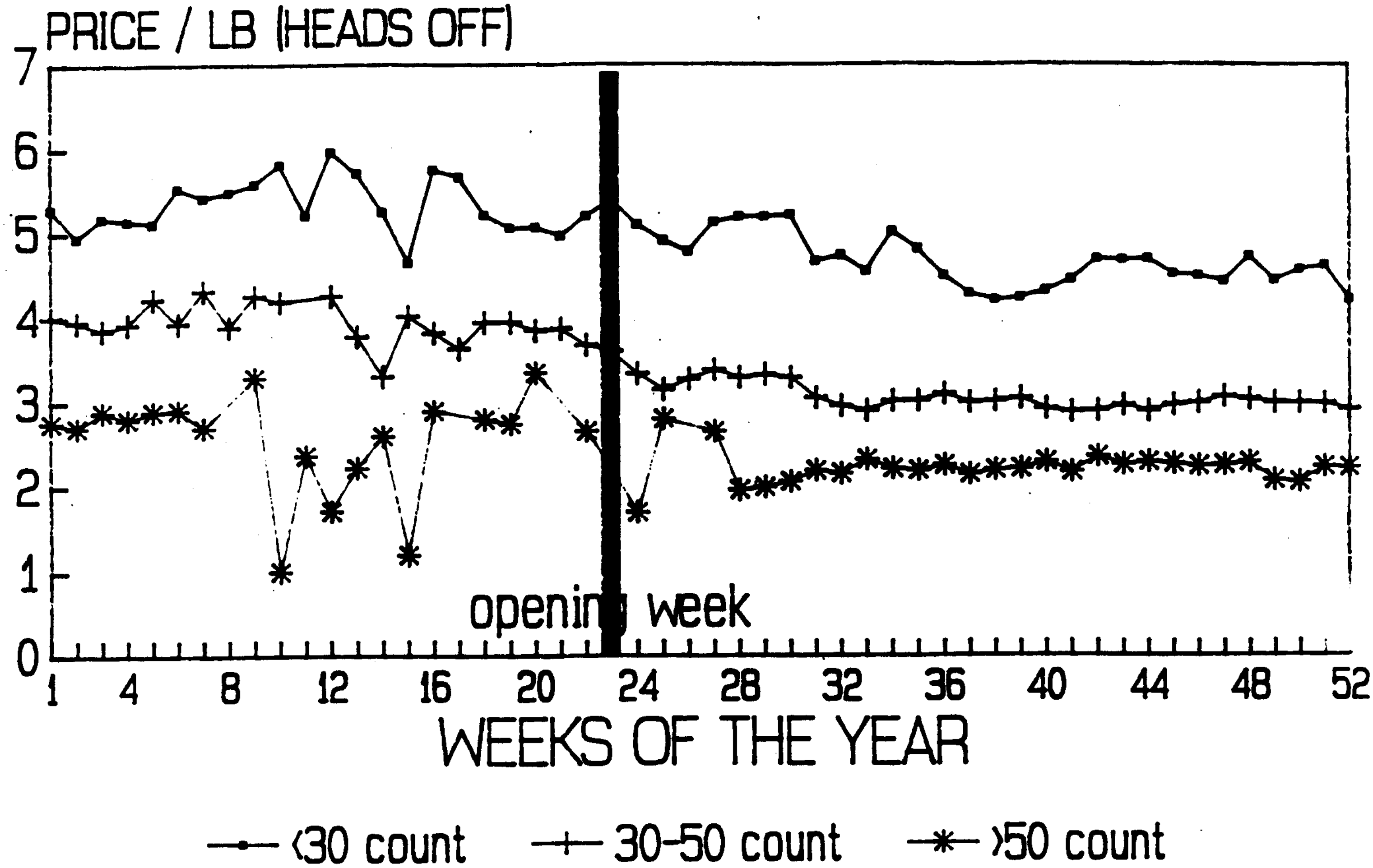


Figure 7. Weekly white shrimp prices, Georgia, 1987 by count.

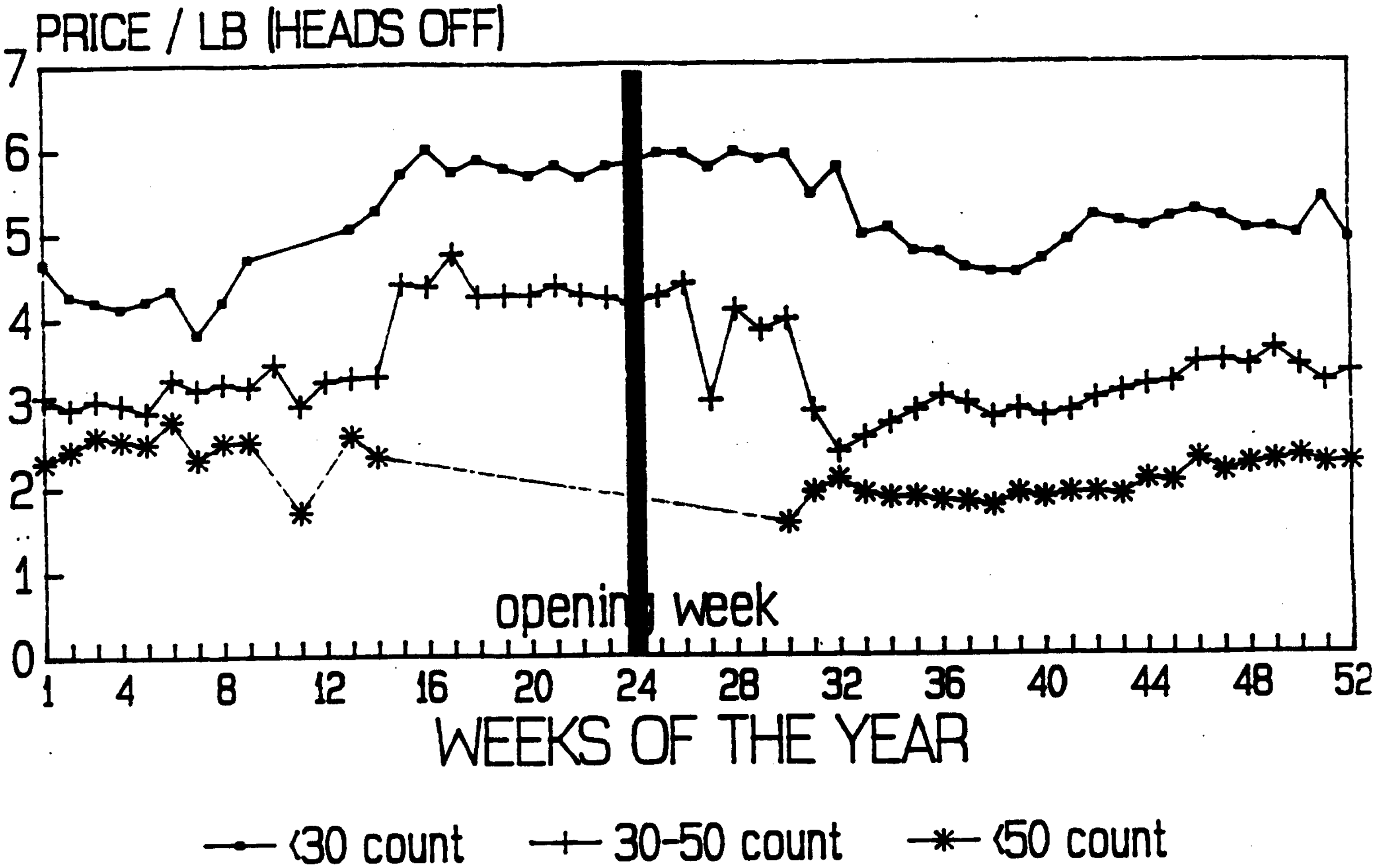


Figure 8. **Weekly white shrimp prices, Georgia, 1988 by count.**

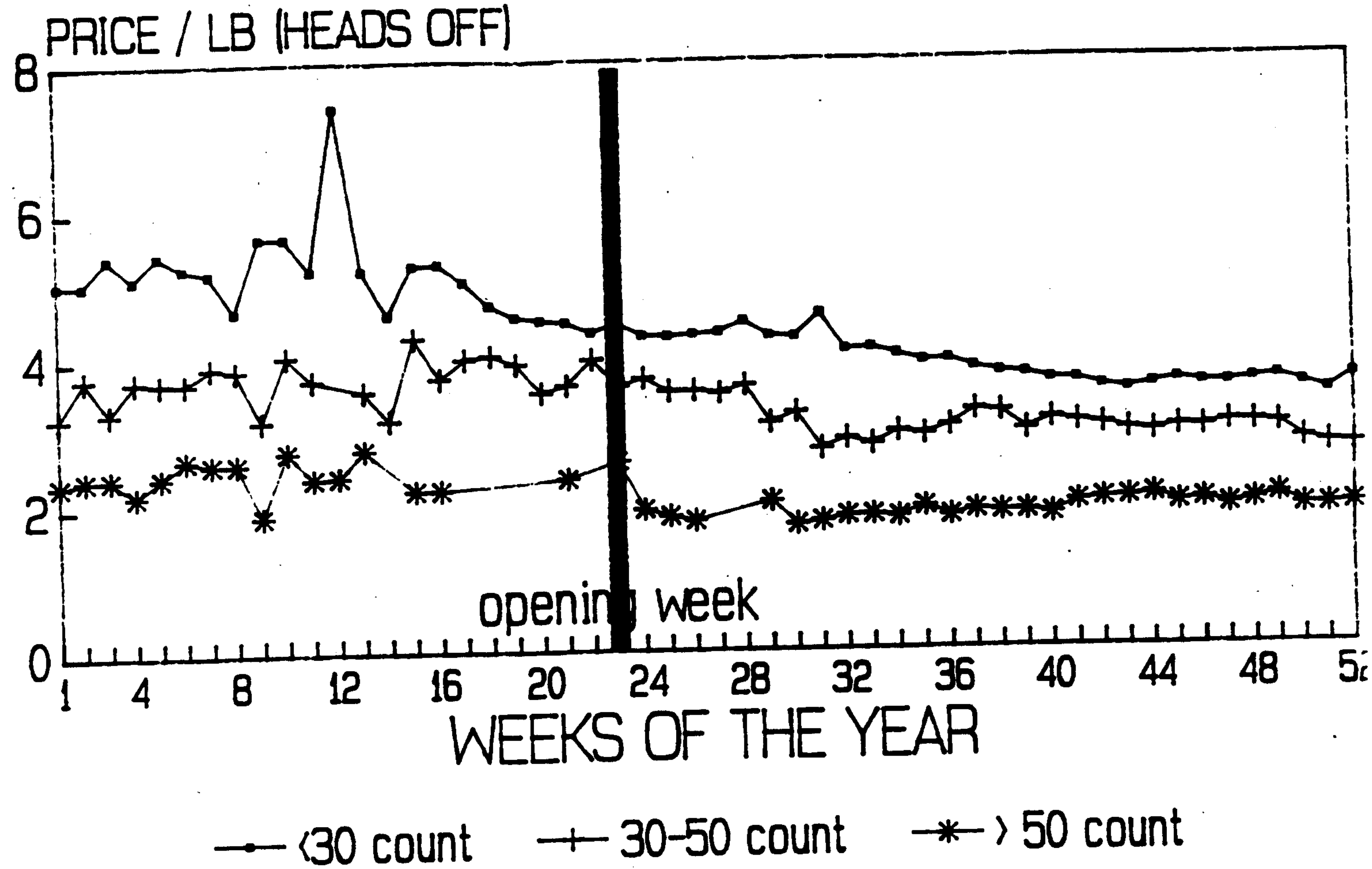


Figure 9. Weekly white shrimp prices, Georgia, 1989 by count.

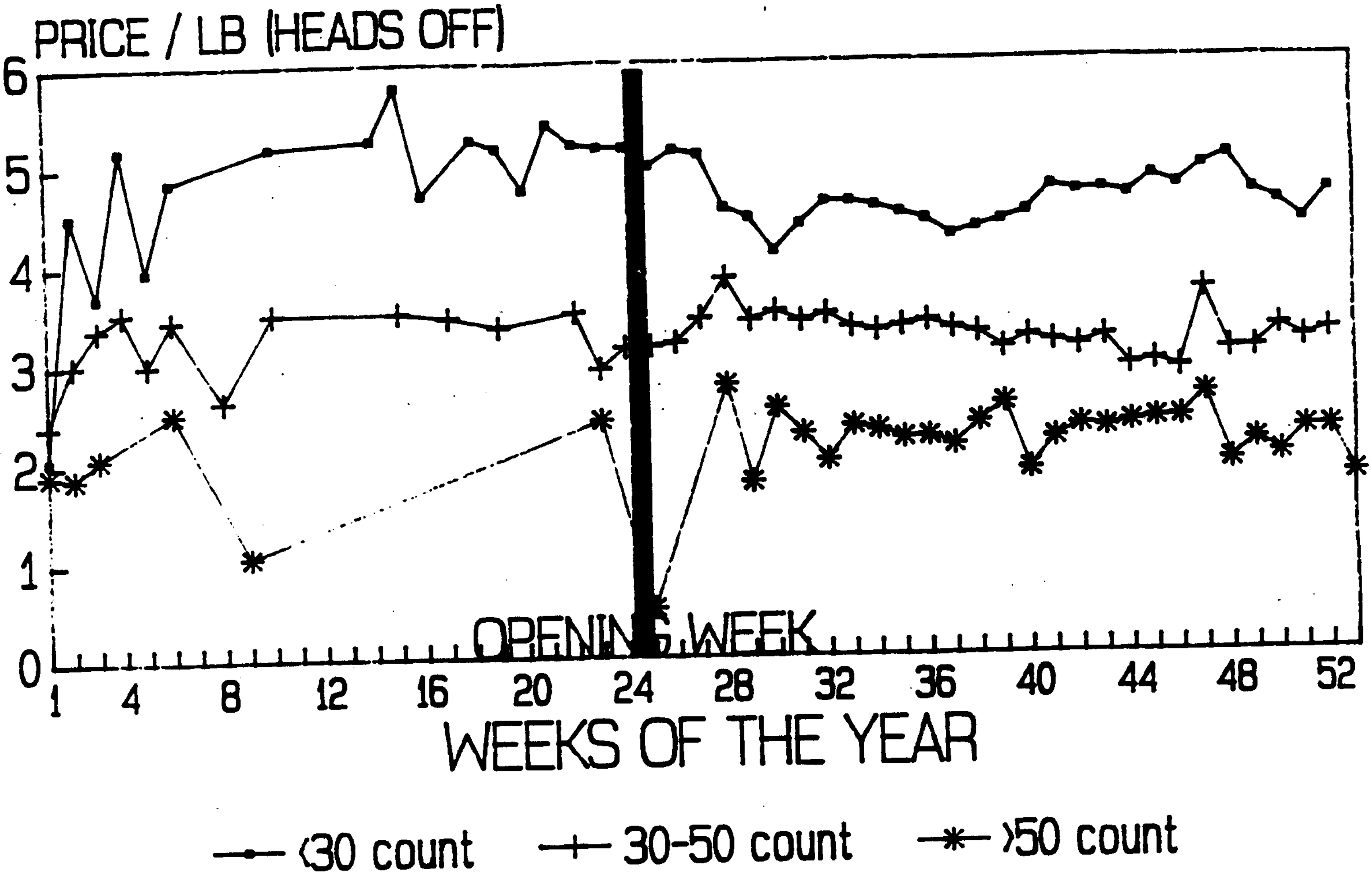


Figure 10. Weekly white shrimp prices, Georgia, 1990 by count.

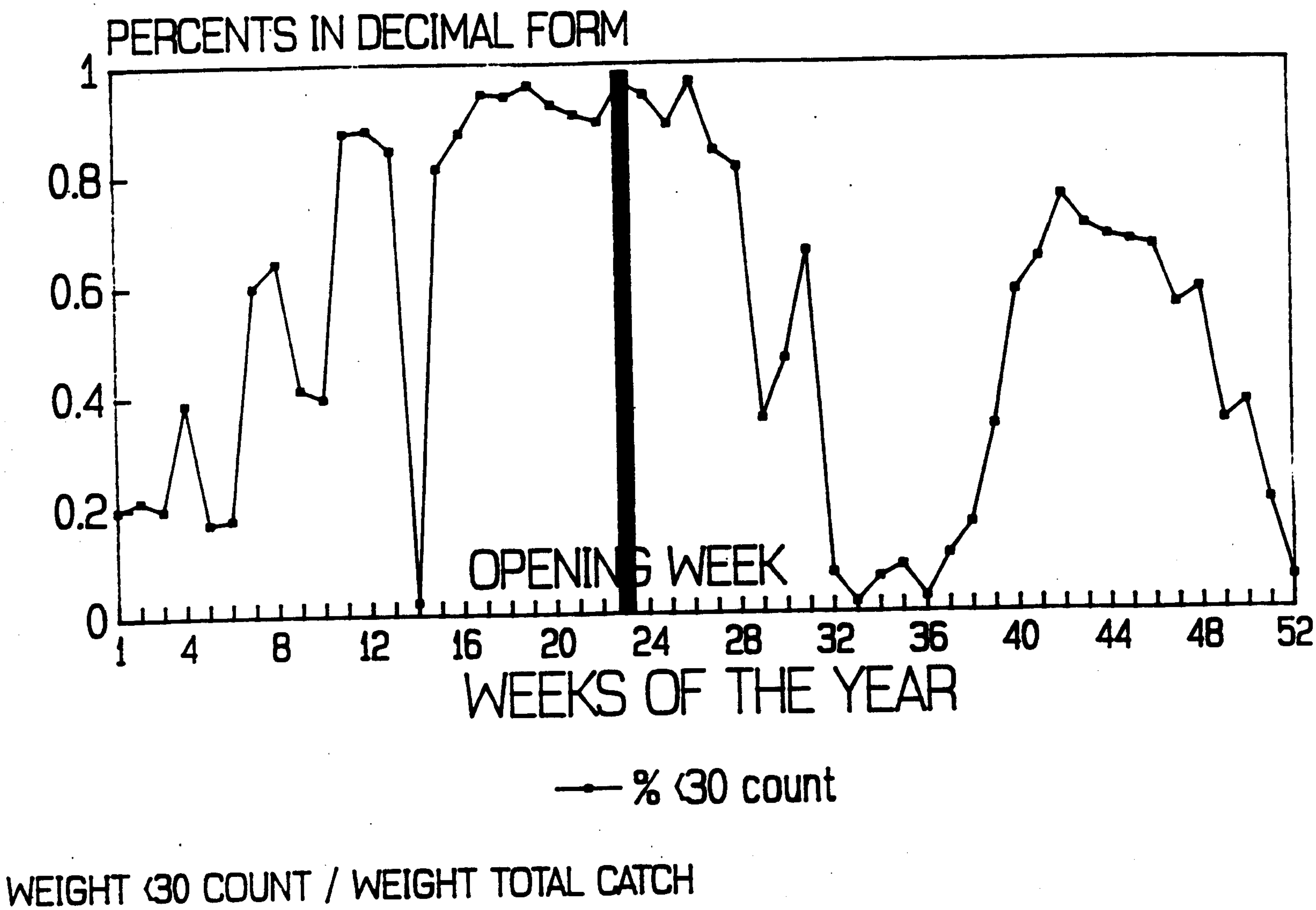


Figure 11. Percentage of catch < 30 count white shrimp in Georgia, 1987 by week.

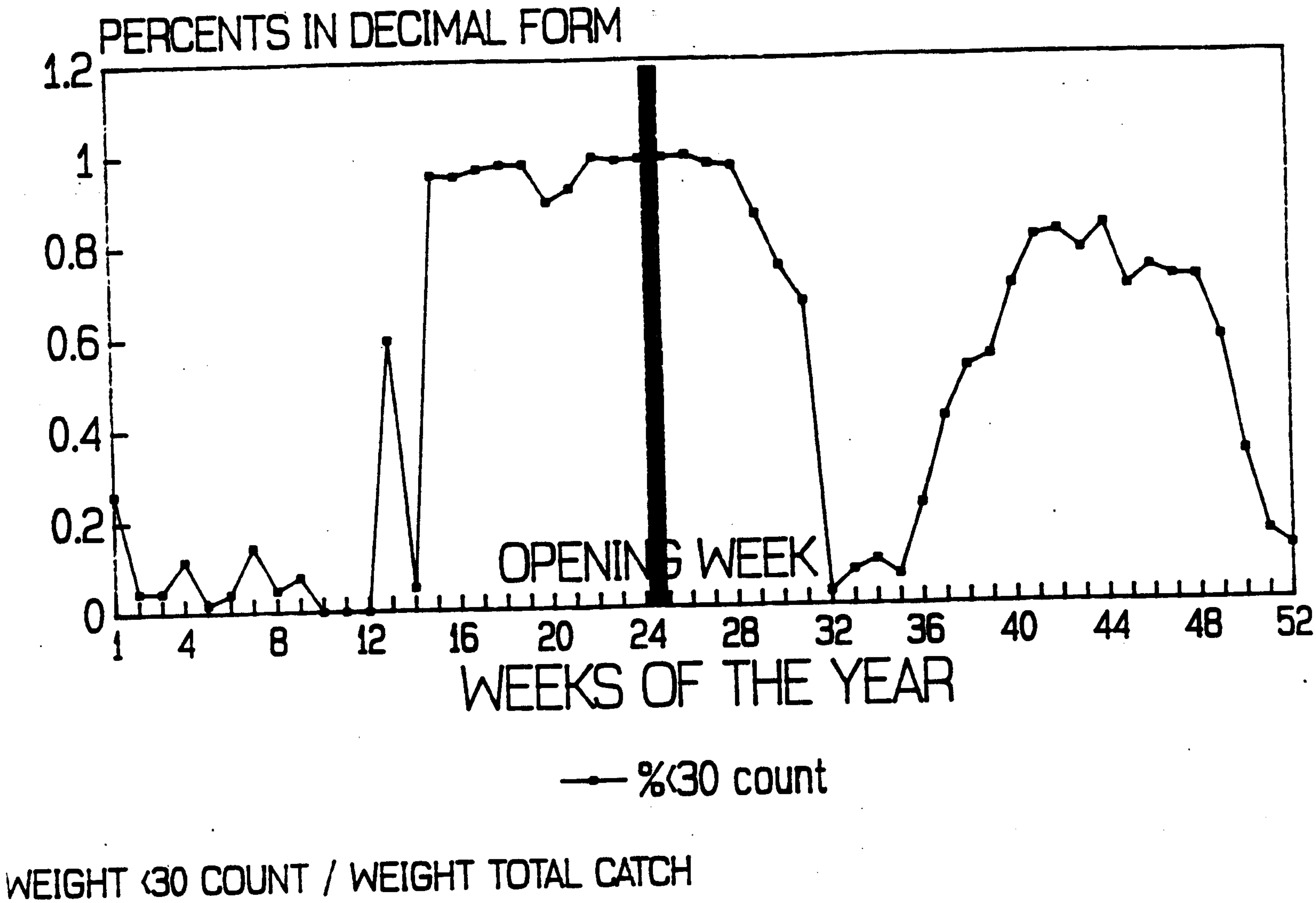
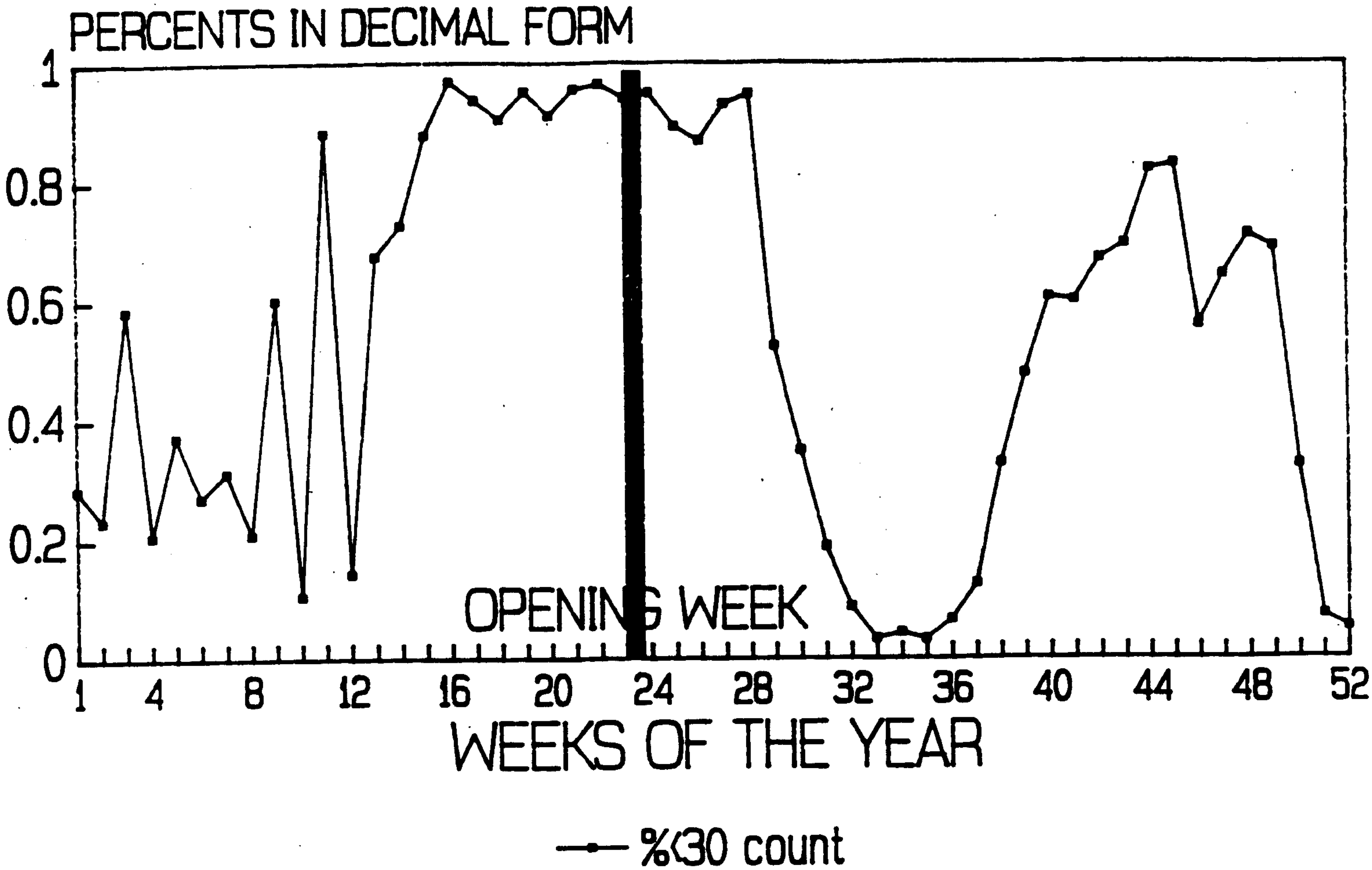


Figure 12. Percentage of catch < 30 count white shrimp in Georgia, 1988 by week.



WEIGHT < 30 COUNT / WEIGHT TOTAL CATCH

Figure 13. Percentage of catch < 30 count white shrimp in Georgia, 1989 by week.

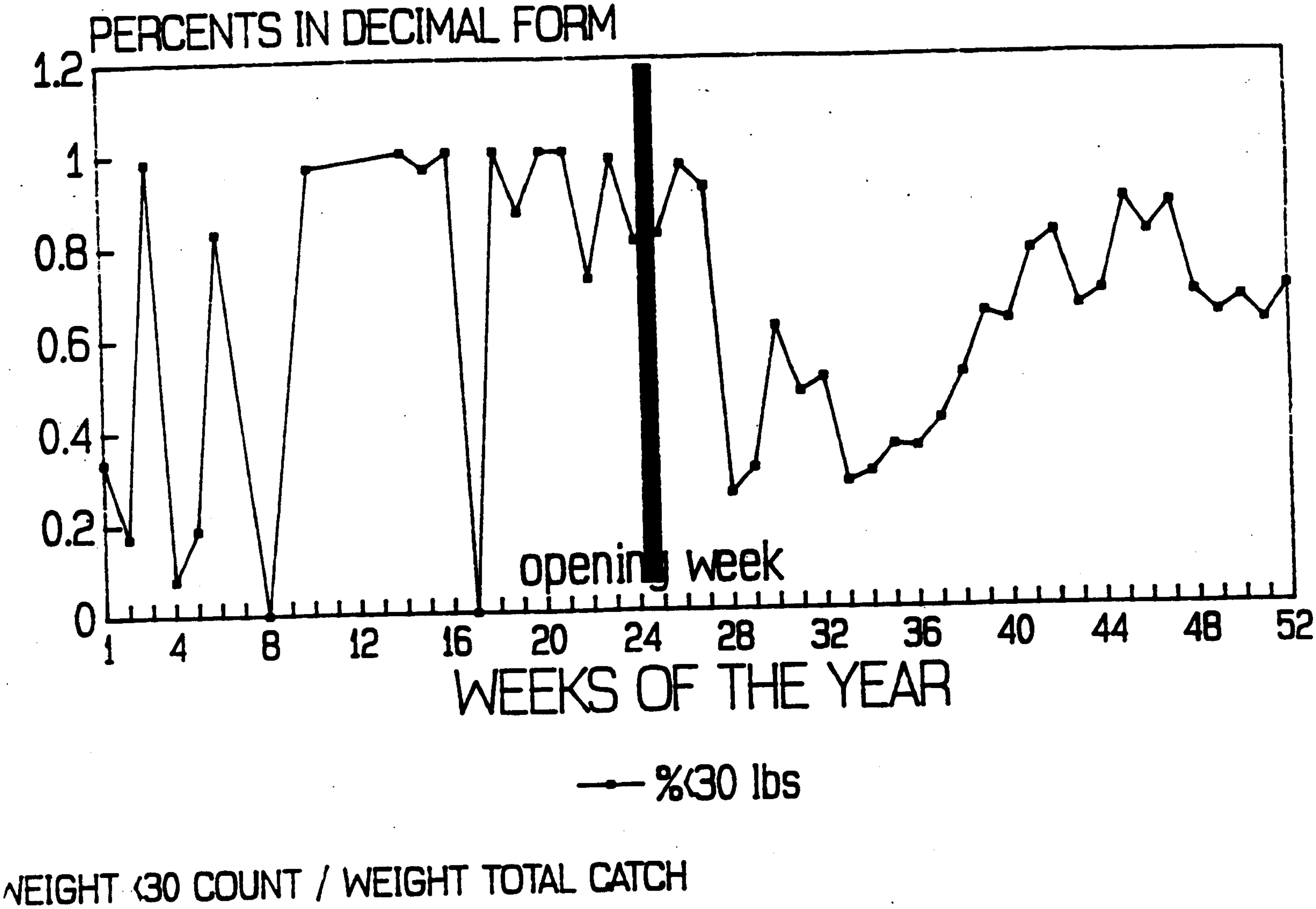


Figure 14. Percentage of catch < 30 count white shrimp in Georgia, 1990 by week.

APPENDIX I

Commercial brown shrimp landings by state by month (1978-1991)

APPENDIX I. Brown shrimp reported commercial landings (heads on) by month for North Carolina for 1978-91 (Source: 1978-82, State and 1983-91, NMFS).

Pounds

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78						52,794	853,102	1,157,984	303,820	81,906	30,257		2,479,863
79				*		191,052	1,540,704	1,051,109	268,279	90,983	*	*	3,142,761
80				*	*	370,958	3,562,553	2,763,874	613,734	534,248	17,902	*	7,863,807
81						86,713	796,882	622,688	274,513	47,632	3,479		1,831,907
82				*	*	195,504	2,474,055	1,896,037	526,881	158,899	10,219	*	5,263,879
83				*	*	23,855	1,039,319	1,315,975	487,795	128,405	34,508	*	3,030,727
84						421,720	2,000,322	1,002,991	202,749	34,154	667		3,662,603
85					956	832,082	5,330,370	2,753,912	613,857	653,278	190,648	2,059	10,377,162
86	*			*	513	481,069	1,752,808	1,137,778	481,681	227,240	33,832	*	4,118,661
87					*	97,676	386,338	327,848	263,200	29,388	*	*	1,104,847
88						132,322	1,912,764	1,986,698	1,075,897	207,858			5,315,539
89					1,572	329,556	2,357,913	1,909,967	417,448	63,195	1,320		5,080,971
90					39,835	662,975	2,243,941	1,273,512	767,666	147,851	11,449		5,147,228
91				*	*	1,055,572	3,497,661	1,574,371	547,179	97,135			6,772,056

Dollars

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78						$57,567	$894,932	$1,682,508	$442,069	$138,923	$46,797		$3,262,796
79				*		$277,783	$2,738,604	$2,419,063	$740,260	$217,663	*	*	$6,397,224
80				*	*	$461,209	$5,526,166	$5,529,041	$1,319,629	$997,937	$34,876	*	$13,869,738
81						$161,873	$1,604,788	$1,405,698	$673,909	$108,113	$8,987		$3,983,368
82				*	*	$359,604	$5,322,464	$4,811,453	$1,640,015	$463,809	$29,112	*	$12,632,468
83				*	*	$41,625	$2,110,813	$3,469,649	$1,511,032	$383,192	$93,759	*	$7,612,327
84						$813,433	$3,874,741	$2,342,180	$536,008	$80,077	$1,871		$7,648,310
85					$1,663	$1,039,592	$8,419,508	$5,918,441	$1,459,994	$1,562,887	$439,284	$3,908	$18,845,277
86	*			*	$638	$678,298	$4,076,210	$3,172,954	$1,473,216	$587,985	$85,556	*	$10,085,043
87					*	$123,414	$706,814	$811,178	$804,236	$95,425	*	*	$2,542,505
88						$178,232	$3,578,449	$4,923,599	$2,736,006	$478,414			$11,894,700
89					$1,516	$394,147	$3,876,605	$3,803,337	$904,756	$122,298	$3,280		$9,105,939
90					$48,985	$1,020,308	$4,631,650	$3,397,498	$1,498,624	$345,260	$23,027		$10,965,352
91				*	*	$1,235,574	$6,162,622	$3,207,279	$1,040,012	$176,706			$11,822,326

* confidential

cont.

Brown shrimp reported commercial landings (heads on) by month for South Carolina for 1978-91 (Source: 1978-82, State and 1982-91, NMFS).

Pounds Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78						304,028	1,175,327	758,022	166,310	16,474			2,420,160
79						431,652	931,523	518,273	1,018				1,882,467
80					3,985	433,293	1,445,390	711,443	163,479	23,414	2,323	111	2,783,439
81						76,473	805,749	381,494	61,116	3,982	3		1,328,817
82					166	399,243	973,957	394,539	101,301	5,624	85		1,874,914
83						•	•	•	•	•			1,776,358
84				•	•	247,647	1,015,260	432,745	95,401	20,715	3,509	•	1,815,438
85	24					313,142	1,227,475	891,804	199,139	49,639	10,076	2,167	2,693,466
86	34				503	1,101,748	963,561	427,311	199,442	17,882	11,502	1,715	2,723,698
87	•			•	357	169,583	611,251	196,219	57,524	3,476	160	•	1,038,644
88	•			•	•	50,995	643,219	638,407	254,377	34,793	588	544	1,626,473
89	•			•	276	419,574	1,124,411	458,756	131,364		•		2,134,401
90				•	•	608,388	634,311	242,973	84,193	137			1,575,974
91	•			•	29,239	1,334,263	797,749	167,730	8,193				2,337,335

Dollars Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78						$396,634	$1,660,895	$1,331,947	$354,244	$37,233			$3,780,953
79						$882,054	$2,388,090	$1,505,000	$2,724				$4,777,868
80					$4,079	$533,550	$2,403,884	$1,495,222	$340,254	$48,863	$5,088	$191	$4,831,131
81						$161,734	$1,594,045	$755,973	$131,566	$9,096	$8		$2,652,422
82					$483	$724,357	$2,270,479	$1,095,367	$314,911	$18,780	$290		$4,424,667
83						•	•	•	•	•			$4,557,080
84				•	•	$444,406	$1,975,026	$987,860	$238,856	$56,557	$9,898	•	$3,713,075
85	$65					$448,425	$1,863,208	$1,647,489	$437,644	$119,120	$21,767	$4,272	$4,541,990
86	$65				$501	$2,323,510	$2,491,680	$1,246,719	$572,133	$51,956	$32,308	$5,127	$6,723,999
87	•			•	$499	$279,504	$1,119,863	$409,692	$121,580	$9,764	$285	•	$1,941,314
88	•			•	•	$85,571	$1,176,085	$1,461,408	$621,086	$88,135	$1,291	$847	$3,439,663
89	•			•	•	•	•	•	•		•		$2,827,986
90				•	•	$1,098,992	$1,335,852	$578,658	$197,211	$347			$3,220,140
91	•			•	$44,551	$1,623,008	$1,126,890	$268,224	$13,911				$3,076,714

• confidential

(cont.)

Brown shrimp reported commercial landings (heads on) by month for Georgia for 1978-91 (Source: 1979-82, 90-91, NMFS and 1978, 1983-89*, State).

Pounds

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
											0		
78					11	173,267	621,843	413,630	32,828				1,241,579
79						216,453	687,240	245,523	5,125	2,723			1,157,064
80	8,219	3,655	939			227,319	1,010,011	513,698	49,047		460		1,813,348
81					81	5,873	363,506	264,074	58,618				692,152
82						329,440	680,842	171,679	4,390				1,186,351
83				1,840	74	78,668	722,423	351,653	147,270				1,301,928
84					48	123,160	489,182	317,273	120,756	139,923	2,170	1,354	1,193,868
85					267	275,597	989,419	534,175	190,061	7,482		2,814	1,999,815
86	279				6	443,792	672,413	132,347	50,090	8			1,298,935
87					50	110,325	309,714	57,651	1,275			336	479,352
88				48	3,007	17,939	323,167	264,293	46,801	198			655,454
89						292,664	854,113	157,941	3,088				1,307,806
90				58	340	625,989	403,121	120,135	2,056				1,151,699
91	248	855	2,821	2,595	2,985	452,682	553,070	84,343					1,099,599

Dollars

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78					$9	$278,787	$1,124,494	$831,861	$73,795				$771,167
79						$517,891	$1,968,532	$669,435	$13,977	$6,088			$718,673
80	$23,571	$10,709	$2,862			$358,630	$1,969,975	$1,108,226	$112,533		$858		$1,126,303
81					$145	$12,712	$765,004	$559,057	$126,368				$429,908
82						$689,005	$1,772,620	$523,241	$16,022				$736,864
83				$6,915	$198	$183,427	$1,913,999	$1,077,207	$467,181				$3,648,927
84					$102	$235,143	$1,079,550	$802,113	$314,074	$405,415	$6,800	$3,815	$2,847,012
85					$452	$457,046	$1,748,628	$1,183,298	$462,606	$21,153		$7,691	$3,880,874
86	$856				$12	$1,074,301	$1,862,020	$402,239	$157,482	$18			$3,496,928
87					$98	$176,167	$612,412	$142,337	$4,279			$715	$936,008
88				$312	$18,976	$43,643	$677,159	$728,614	$119,117	$830			$1,588,651
89						$456,499	$1,551,925	$341,864	$7,457				$2,357,745
90				$22	$575	$1,333,462	$950,861	$300,707	$4,553				$2,590,180
91	$930	$3,449	$10,342	$8,128	$3,631	$719,553	$912,786	$167,380					$1,826,199

*1988-89 data include bait shrimp landings on monthly totals cont.

Brown shrimp reported commercial landings (heads on) by month for Florida east coast for 1978-91 (Source: 1978-91, NMFS).

Pounds Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78					9,520	96,041	196,723	118,261	22,034	17,465			460,044
79					1,320	129,579	238,655	91,535					461,089
80						259,229	337,942	238,118	72,559				907,848
81						92,749	207,137	136,906	82,999				519,791
82						181,590	257,052	126,074	23,872	1,719			590,307
83					3,413	136,162	221,280	231,434	10,441	130			602,860
84		86			1,797	135,201	218,916	123,161	56,440		1,746		537,347
85			66		8,891	292,062	499,892	341,909	105,388	53			1,248,261
86					1,105	221,938	193,360	97,837	47,390				561,630
87			433		1,219	81,383	173,057	120,870	24,364				401,326
88			249		803	27,013	238,046	211,067	67,472	1,332			545,982
89	336	1,225	1,035		12,109	138,433	302,534	210,791	42,102				708,565
90		*	*	*	23,178	292,421	299,444	167,698	74,116				856,857
91		*	*		4,218	136,161	239,183	65,086	26,415				471,491

Dollars Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78					$17,485	$156,432	$326,971	$226,168	$46,860	$39,623			$813,539
79					$1,640	$259,046	$646,028	$268,182					$1,174,896
80						$360,668	$609,632	$516,941	$159,229				$1,646,470
81						$174,519	$471,655	$323,063	$190,150				$1,159,367
82						$336,768	$582,281	$363,504	$80,828	$6,675			$1,370,056
83					$7,649	$233,287	$488,091	$703,347	$34,660	$312			$1,467,286
84		$159			$3,161	$251,055	$420,933	$297,856	$148,905		$6,184		$1,128,253
85			$79		$12,480	$411,067	$814,117	$732,011	$265,635	$135			$2,235,524
86					$1,392	$395,799	$460,622	$285,747	$164,802				$1,308,362
87			$674		$1,989	$118,259	$331,861	$310,064	$61,476				$824,323
88			$369		$1,320	$38,188	$508,946	$554,958	$222,012	$2,047			$1,327,840
89	$313	$2,032	$1,508		$13,096	$174,678	$577,478	$506,487	$103,640				$1,379,232
90		*	*	*	$35,782	$507,591	$657,561	$441,639	$208,946				$1,851,519
91		*	*		$5,034	$211,356	$426,704	$135,985	$65,888				$845,912

* confidential

APPENDIX II

Model for white shrimp landings for South Carolina

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Model for White Shrimp Landings for the Central Coast of South Carolina[1]

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Abstract.—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.

In South Carolina, as in most other coastal states in the southeastern USA, the commercial trawl fishery for penaeid shrimps is composed of two temporally segregated fisheries for the white shrimp *Penaeus setiferus* and the brown shrimp *P. aztecus*. The primary fishery is for white shrimp, which account for an average of about 60% of the annual landings (McKenzie 1981). White shrimp are occasionally caught in large quantities in May and June, the primary spawning season, but the largest landings occur from August to January (hereafter referred to as the fall fishery) when the progeny of the spring spawn are abundant. The majority of the large shrimp (≥120 mm total length), which are not captured by fishermen, move south along the coast and small shrimp remain to overwinter in the estuaries (Lindner and Anderson 1956; Farmer et al. 1978). Annual commercial landings vary considerably; the poorest harvests follow unusually severe winter weather, which results in the nearly total loss of locally overwintering brood stocks (McKenzie 1981).

Shrimp landings have often been related to water temperature. Williams (1969) found a highly significant statistical relationship between the combined shrimp landings of all shrimp species for North Carolina, South Carolina, Georgia, and Texas and heating degree-days (an index of cold weather) for each area. Turner (1977) found an inverse relationship between shrimp yield (kg/hectare) and degrees latitude. Hettler and Chester (1982) noted that a causal relationship of temperature to production (landings) was biologically appropriate and that major variations in pink shrimp *P. duorarum* in North Carolina are probably due to cold induced mortality of overwintering shrimp.

Several researchers have linked rainfall and river discharge to shrimp landings. Hildebrand and Gunter (1953) and Gunter and Hildebrand (1954) showed a relationship between annual harvest of white shrimp in Texas and rainfall of the same year and the two previous years. Barrett and Gillespie (1973, 1975) and Barrett and Ralph (1976, 1977) noted that rainfall and discharge of the Mississippi River, along with water temperature, were important influences on commercial catches of brown shrimp in Louisiana in May. They reasoned that excessive rainfall and river discharge diluted estuarine and nearshore waters below tolerance limits of brown shrimp, thus limiting available optimum nursery habitat. Browder (1985), using multiple-regression analysis, found a strong pos-

[1] Contribution 272 from the South Carolina Marine Resources Center.

itive relationship between quarterly landings of pink shrimp and average water level (an index of freshwater runoff) of the previous quarter (3 months) for three quarters of the year.

Water salinity has been correlated with commercial harvests of shrimp. Hunt et al. (1980) found that salinity and water temperature in April and May are important variables affecting brown shrimp harvests in Pamlico Sound, North Carolina. Production of brown shrimp in Louisiana has been related to estuarine water salinity and temperature (Ford and St. Amant 1971). McFarland and Lee (1963) found that white shrimp and brown shrimp could osmoregulate over a wide range of salinities but that white shrimp seemed more tolerant of low salinities. Pond rearing studies have shown that salinity may be an important factor in growth and survival of postlarval and juvenile white shrimp (Hysmith and Colura 1976). Thus, it is clear that environmental conditions influence shrimp survival and growth and, ultimately, commercial harvests.

Several studies have produced mathematical models to predict shrimp harvest. Walker and Saila (1986) used environmental variables to produce harvest models for brown and white shrimps caught off Texas and Louisiana. They related ocean currents, river discharge, water temperature, and salinity to shrimp landings. Stepwise regression procedure was used to produce a relatively accurate model ($R^2 = 0.84$) for white shrimp landings in Louisiana (GMFMC 1980). This model included May–August river discharge and an estimate of commercial fishing effort. Staples et al (1984) developed catch-prediction models for *Penaeus merguiensis* for the Gulf of Carpentaria, Australia. Their best model, which was based on the sum of summer and autumn rainfall, explained 80% of the catch variation of the fishery. Because only rainfall data available prior to the autumn harvest were of predictive value, the model was not of practical use. A second model was developed, however, based on spring and summer rainfall, and it could predict catch with a standard error of ±19% in a year of average rainfall.

An index of catch rates for postlarval shrimp was used in some prediction models. Sutter and Christmas (1983) produced a model for prediction of the brown shrimp harvest in Mississippi waters with multiple linear regression techniques. Their three-variable model was relatively accurate, accounting for 80% of the variability in brown shrimp landings for several years. However, data from 5 years (1967, 1975, 1977, 1979, and 1980) were not included in the analysis because values for the postlarval index were judged too low to be realistic. This index seriously limits the usefulness of a forecast model in some years and can be very expensive in terms of field and laboratory effort. Berry and Baxter (1969) demonstrated that use of a postlarval index was not effective in predicting harvests of brown shrimp in the northwestern Gulf of Mexico.

We sought to develop a model to predict shrimp landings in South Carolina because harvest forecasts are important to user groups and can be used to alter regulations. Commercial and recreational interest-groups often ask for explanations as to why shrimp stocks fluctuate. Understanding the causes of stock variability allows managers to respond to unsubstantiated claims (e.g., overharvesting by recreational fishermen, overharvesting of spawners, water pollution, nutrient overloading) from user groups that are concerned about periodic declines in stock abundance. A model that can explain major shifts in shrimp abundance would be very useful in forestalling needless regulations and legislation. Additionally, businesses tied to the commercial and recreational fisheries often request forecast information when planning budgets and purchasing supplies for the ensuing fishing season. Although most commercial fishermen will fish regardless of projections of stock size, many will plan their fishing strategies (out-of-state travel, targeting other species, purchase of new gear, etc.) around production predictions.

The most useful model should be one that incorporates easily obtained data. Comparison of postlarval catch rates, which are relatively expensive data to obtain, with commercial landings indicates little correlation, although very low catch rates of white shrimp postlarvae precede poor harvests of white shrimp in South Carolina (J. D. Whitaker, unpublished data). Thus, the use of catch rates of postlarvae in most years is considered impractical in a shrimp model. Environmental data, however, are easily obtained and abiotic factors affect growth and survival of shrimp. In this paper, we present a model based on environmental variables and abundances of spawners to describe August–January landings of white shrimp along the central South Carolina coast.

Study Area

The South Carolina coast can be divided into three distinct areas. The southern district has large barrier islands and large open sounds with relatively small freshwater tributaries. The central district, the area examined in this paper, is bordered on the north by the Santee River and on the south by the Edisto River. Like the southern district, the central district has large barrier islands, but most are separated by relatively small inlets. Charleston Harbor is the only large, deep body of water in the central district that is comparable to the sounds of the southern district. Charleston Harbor, however, typically has a much lower salinity than that of the southern sounds (Ballentine 1972; Tiner 1977; Mathews et al. 1980). The northern district, except for the Winyah Bay–Santee Bay area, has very little freshwater discharge, no large estuaries, and relatively few shrimp. In a first attempt to model shrimp landings for South Carolina, we limited our study to the central coastal area (Figure 1).

Data Sources

Data for water temperature and salinity were obtained largely from the Tides and Water Levels Branch of the National Ocean Survey Office (National Oceanic and Atmospheric Administration, Rockville, Maryland). Temperature was measured with a mercury thermometer and salinity was converted from water density measurements obtained with a hydrometer. These were recorded once daily, without regard to tidal stage, at the U.S. Customs House Wharf on Charleston Harbor. Total number of observations per month usually ranged between 15 and 25. Observations were rarely made on weekends. A few data gaps were filled by including supplemental observations determined with a mercury thermometer and induction salinometer for samples taken at the Marine Resources Center of the South Carolina Wildlife and Marine Resources Department (SCWMRD) at Fort Johnson on James Island. Fort Johnson is about 3.2 km across Charleston Harbor from the primary observation site. Because of relatively large semidiurnal tides averaging 1.6 m in Charleston Harbor (NOAA 1985), water salinity can fluctuate considerably, but temperature varies relatively little during a single tidal cycle. Salinity observations taken daily at the same tidal stage would have provided a better indication of nontidally caused fluctuations, but the month-long averages are adequate as a relative index of overall conditions. Salinities measured in Charleston Harbor were highly correlated with salinities measured in smaller nearby creeks.

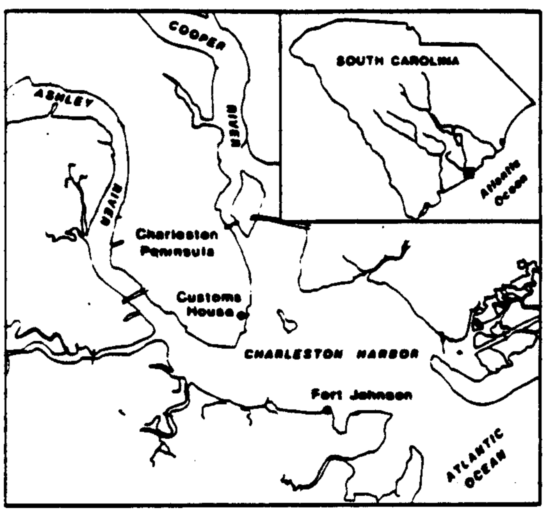

FIGURE 1.—Sampling locations for hydrological conditions in Charleston Harbor. The study area includes the South Carolina coast between the Edisto and Santee rivers.

River discharge data came exclusively from the Cooper River and was measured at the Lake Marion–Lake Moultrie diversion canal near Pineville, South Carolina (USGS 1972–1986). This observation site is about 72 km inland from Charleston Harbor and was the most seaward observation site available for the years included in this study. The average daily flow rate of the Cooper River during the period of the study was 423 m^3/s, the highest discharge of any river in the central district (Bennett et al. 1986). Other rivers within the central district, including the Ashley River, are tidal and drain relatively small coastal areas. The next highest average flow rates occurred in the Santee (96 m^3/s) and Edisto rivers (76 m^3/s); these river mouths are 68 km north and 56 km south, respectively, of Charleston Harbor, at the boundaries of the central coastal district.

Rainfall data were recorded at the downtown Charleston weather station, which is on the Charleston peninsula in Charleston Harbor. Being centrally located in the coastal district, this location should provide an index of coastal rainfall. The Cooper River discharge should reflect the effects of upstate rainfall on estuarine salinity.

Landings data were collected by the Office of Fisheries Statistics of SCWMRD and were limited to those from the central coastal district of South Carolina for the months of August through January of the following year. Occasionally, white shrimp caught elsewhere are landed in the study area. Our observations indicate such landings are unimportant. South Carolina fishermen typically return to port daily and unload shrimp locally. Although some vessels fish in other areas when catch rates are low, a nucleus of vessels remains in the area year-round. Data for fishing effort were not available to calculate catch per unit effort (CPUE) for the entire study period; therefore, landings were used as the dependent variable in our model. Examination of landings, CPUE data for recent years (kilograms per boat per day), and numbers of commercial licenses suggest that fishing effort in South Carolina and total landings are directly related. Examination of recent CPUE data indicates that there is adequate effort to harvest the available resource at or near the level of maximum exploitation every year (A. Applegate, SCWMRD, personal communication). These observations suggest that the fishery is being fully exploited and that landings are a reliable index of stock size. Williams (1969) determined that total landings in North Carolina could serve as a dependent variable as well as his catch–effort index.

TABLE 1.—Mean catch rates of white shrimp during 1976–1977 in double-rigged 6.1-m bottom trawls towed for 30 min at five locations in Charleston Harbor. Weights are for whole white shrimp. Dead shrimp (mean number per sample) had been obviously dead before collection and were in a state of decomposition.

Date	Live shrimp (kg)	Mean number of dead shrimp	Mean bottom temperature (°C)
Dec 1, 2	17.9	0	11.5
7, 10	19.6	0	11.4
15, 16	23.7	0	12.1
21, 22	7.0	0	9.5
29, 30	33.6	0	9.4
Jan 4, 5	5.0	0	8.5
12, 13	2.3	0	7.2
17, 18	0.3	3.4	5.6
26, 27	0	1.8	5.9
Feb 1, 2	0	4.0	6.4
7	0	0	6.7
14, 15	0	0	9.5
23, 24	0	0	10.8

Model Development

There are several well-known linear regression methods: multiple linear regression, all-possible-subsets regression, and stepwise regression. Multiple regression is not suitable in this case because one does not know, a priori, what variables should be included in the model. The all-possible-subset regression procedure was not used because the number of possible variables greatly exceeded the number of cases. We elected to use stepwise regression procedure, which examines the significance of each variable at each step, selects the "best" variable based on *F*-statistics, and deletes any previously selected variable subsequently found to be insignificant (program 7R from BMDP 1983).

Peak immigration of postlarval white shrimp into South Carolina's estuaries occurs from June through August (Bearden 1961). During these months, juvenile shrimp are abundant in the tidal streams, salt marshes, and other shallow estuarine areas, where they grow rapidly (McKenzie 1981). Therefore, we chose to examine environmental data for the months of May through August. Environmental variables considered for spring and summer of 1970–1984 are monthly average water temperature, monthly average salinity, total monthly rainfall in Charleston, monthly average river discharge for the Cooper River, and 2-month averages (May–June, June–July, July–August) of water temperature and salinity.

Severe winter temperatures have been related to high mortalities of overwintering white shrimp in South Carolina and, less frequently, in Georgia (McKenzie 1981; Daigle 1984). Experimental sampling during the severe winter of 1976–1977 showed a decline in weekly catch rates with decreasing water temperature and zero catch rates in the spring (Table 1). Sampling during other unusually cold years has provided similar results. Following severe winters (1976–1977, 1977–1978, 1980–1981, 1983–1984), South Carolina's fall landings were 12–43% of the 1970–1984 average. We believe that severe winters deplete the spring spawning stock and contribute to poor recruitment and low fall landings. Lindner and Anderson (1956) reported that there were few adult white shrimp along the South Carolina and Georgia coasts during spring following the severe winter of 1939–1940. South Carolina's white shrimp landings in 1940 were 46% of the previous 2-year average, a decrease that Lindner and Anderson attributed to cold kill of overwintering shrimp and few returning migrant shrimp. White shrimp that had migrated south in fall and early winter were heavily fished in Florida waters. The intense fishing effort off Florida has continued, and it is thought that few potential spawners survive to migrate northward into South Carolina waters (McKenzie 1981).

Hettler and Chester (1982) also demonstrated a relationship between winter water temperature and subsequent landings of pink shrimp in spring and early summer. Because overwinter conditions affect numbers of spawning shrimp in spring (Lindner and Anderson 1956), we included variables for winter conditions for December through March: monthly average water temperature, 2-month average water temperature (December–January, January–February, February–March), and temperature-days, which is the total number of days in which Charleston Harbor water temperature was 8.5°C or less. To more directly examine spawner abundance, we included indexes of May and June spawners: (1) SCWMRD catch-per-unit-effort data for white shrimp collected in estuarine sampling in April (CPUE), and (2) total landings of white shrimp during May and June in the central district.

Examination of size-frequency data from landings and field sampling clearly showed that small shrimp captured in August were the progeny of the spring spawning stock. Thus, we included August landings in our fall landings (dependent variable). For the period of the study, white shrimp landings for the month of August averaged only 6.6% (SD = 4.3; range = 0.4–12.7) of the August–January totals.

When all of the previously described environmental variables were included in the stepwise regression procedure, water salinity in August and temperature-days were the only significant ($P < 0.05$) variables for estimating landings. The resulting model is ($R^2 = 0.774$)

$$Y = 1642.84 - 53.55S_A - 8.21\mathrm{TD}; \quad (1)$$

Y = fall (August–January) commercial shrimp landings (kg);
S_A = salinity (‰) for August;
TD = temperature-days.

Salinity in August accounted for 60.4% of the variability in fall landings and TD accounted for an additional 17%. The deviations between observed and predicted landings ranged from −567 to 58%. We judged that this model was not adequate for predicting fall landings and explored other methods that included an index of spawner abundance.

Even though the model from the stepwise-regression process did not fit the observed landings well, it identified two of the more important variables: August salinity and the number of days when water temperature falls to or below 8.5°C (temperature-days). Spring landings have a nonlinear and reciprocal (inverse) relationship with temperature-days (Figure 2). Once the number of temperature-days exceeds about 18, further cold weather has little effect because all shrimp are already dead. We believe that fall white shrimp production is related to cold weather of the previous winter only through the quantity of spring spawners that survived the winter. It could be argued that winter conditions may have some other relationship to fall production, such as an effect on

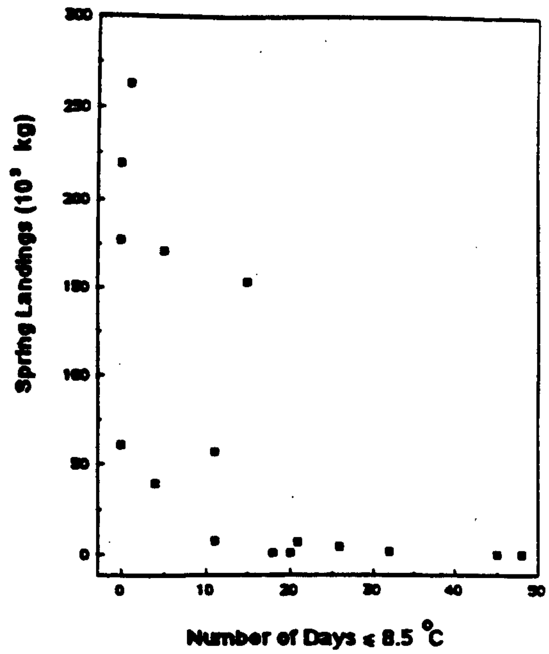

FIGURE 2.—Spring (May and June) white shrimp landings (tonnes, heads off) versus number of days during the preceding winter in which water temperature was 8.5°C or less.

potential predators or prey, or perhaps an effect on nutrient levels. We have no data to support or dispute this.

We investigated the possibility of a spawner-recruit relationship (SRR) using spring landings of white shrimp to represent spawner abundance and fall landings to represent recruitment. The Simplex optimization procedure (Nelder and Mead 1965) was used to estimate the parameters of the nonlinear Beverton–Holt (1957) curve by minimizing the following criterion:

$$\mathrm{SS} = \sum_{I=1970}^{1984} [Y_{cal}(I) - Y_{obs}(I)]^2;$$

SS = sum of squares;
$Y_{obs}(I)$ = fall white shrimp landings of the Ith year;

$$Y_{cal}(I) = \frac{\alpha \mathrm{Sp}(I)}{1 + \beta \mathrm{Sp}(I)}.$$

Y_{cal} is the Beverton–Holt equation; Sp(I) are spring white shrimp landings (spawners) and α and β are constants. The resulting model is

$$Y_{cal} = \frac{272.83\mathrm{Sp}}{1 + 0.3828\mathrm{Sp}}. \quad (2)$$

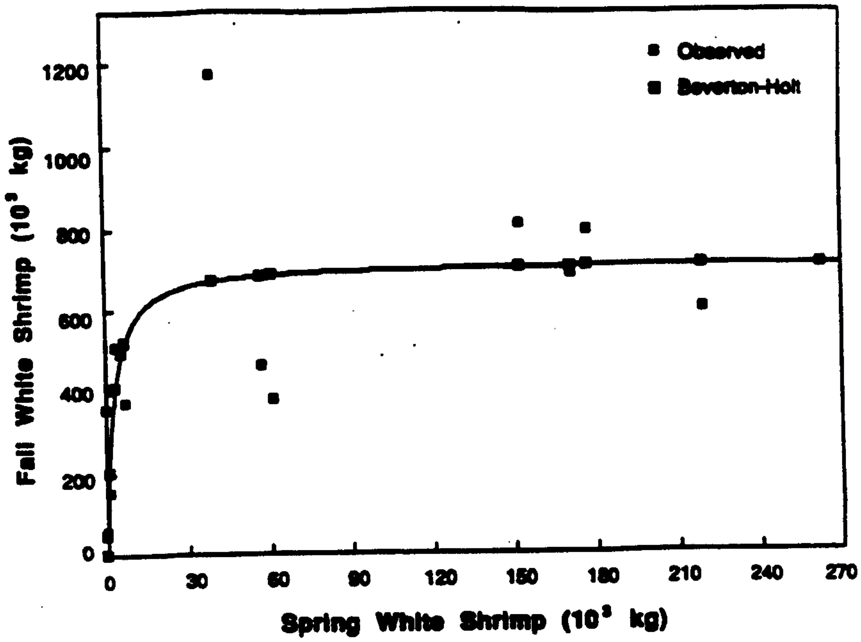

FIGURE 3.—A computer-generated Beverton–Holt curve computed from observations of spring and fall landings (tonnes) of white shrimp.

An SRR curve was created from this model, which accounted for 54.1% of the variability in fall landings (Figure 3). Observed and calculated values were close in only 7 of 15 years examined (Figure 4), and there were unacceptably large discrepancies in several years.

Because August salinity was the first variable selected in the stepwise regression process, it was combined with the Beverton–Holt equation to produce a new model:

$$Y_{cal} = A + BS_A + \frac{\alpha Sp}{1 + \beta Sp}.$$

The parameters A, B, α, and β were estimated with the Simplex nonlinear optimization process, resulting in

$$Y_{cal} = 119.7 - 47.62S_A + \frac{140Sp}{1 + 0.3309Sp}. \quad (3)$$

This model explained 86.8% of the variability in fall landings. Observed and calculated values were relatively close for all years of the study (Figure 5). Values of August salinity for 1970–1984 and 1985 were then used in equation (3) to produce a family of Beverton–Holt spawner–recruit curves (Figure 6).

Discussion

A model developed by Walker and Saila (1986) for white shrimp in the vicinity of the Texas–Louisiana boundary showed that landings were positively correlated with river discharge, and that northwest winds (northeast Ekman transport) during the spring and summer appeared to be correlated with decreased landings. They speculated that a northeasterly transport of larvae during the spawning season would carry these shrimp away from the estuarine nursery areas. The transport conditions for the area were also noted to affect other factors, such as average tidal levels in the marshes, which can influence growth and survival. Zimmerman and Minello (1984) observed that high seasonal tides on the Texas coast facilitated access of shrimp to vegetated habitat in marshes. Because white shrimp spawn relatively close to shore in South Carolina (McKenzie 1981), and perhaps inside some sounds and bays, we believe that the relatively strong tidal currents are usually much more important in transporting larvae and postlarvae than wind-driven currents. Water levels in the marshes are also largely the result of tides and not wind. For these reasons, no wind data were examined in this study.

We find that water salinity is inversely related to white shrimp landings. Barrett and Gillespie (1973) noted that inshore shrimp-fishing grounds in Louisiana included about 809,400 hectares during years of high rainfall and high river discharge but increased to 1,153,400 hectares during

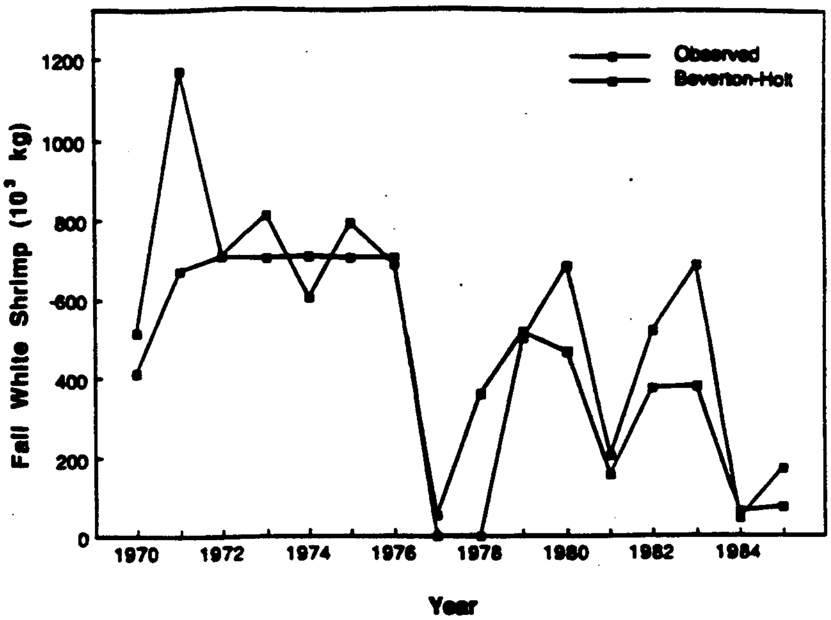

FIGURE 4.—Observed fall landings (tonnes) of white shrimp and calculated landings based on the Beverton–Holt equation.

years of high salinity. Although Louisiana's brown shrimp production is negatively related to rain and discharge, the opposite may be true in South Carolina where, without the presence of a major river system such as the Mississippi River, increased rainfall and river discharge may help reduce salinities to optimal levels and may expand available nursery habitat. Browder (1985) noted that freshwater inflow can have positive or negative effects on young fish and shellfish depending on the characteristics of the particular estuary and the volume of the freshwater inflow. She suggested that changes

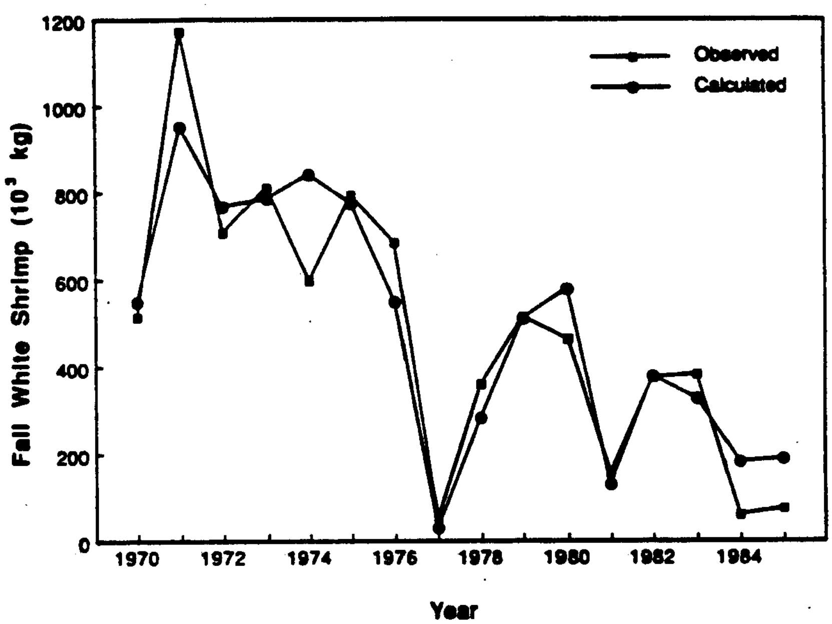

FIGURE 5.—Observed fall landings (tonnes) of white shrimp and calculated landings from the recruitment forecast model (equation 3).

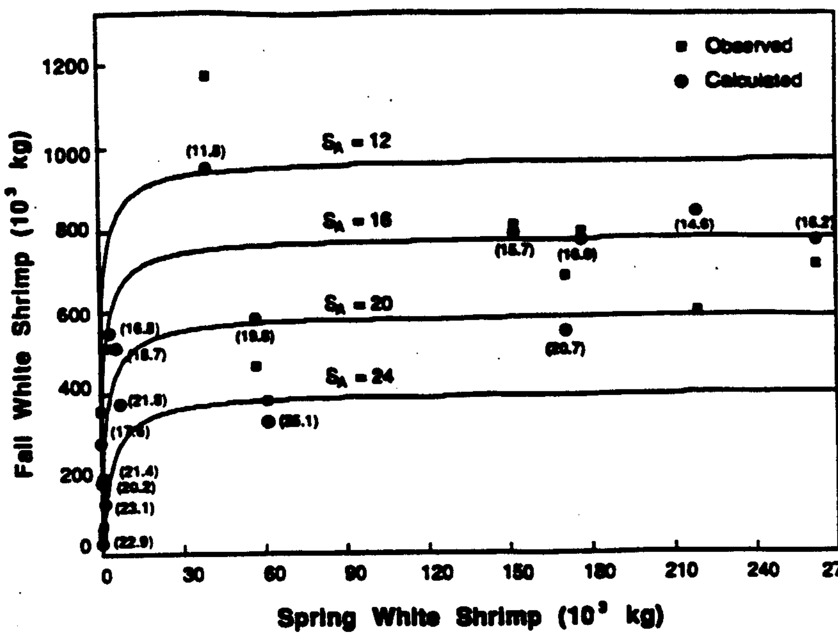

FIGURE 6.—A family of computer-generated Beverton–Holt curves for white shrimp, each curve representing a different salinity (S_A, ‰). Calculated values for fall landings (tonnes) of white shrimp are located directly above or below observed values. The numbers in parentheses are observed August salinity values (‰).

in water-flow patterns may reduce the area of suitable bottom covered by water in which certain salinities or other conditions are favorable to estuarine fauna. Penn and Caputi (1986) developed a model for *Penaeus eculentenus* in Exmouth Gulf, Western Austrlia that included an adjustment for rainfall.

The relationship between salinity per se and white shrimp growth and survival is unclear. Johnson and Fielding (1956) demonstrated good survival in high salinities (34‰). Zein-Eldin (1963) also found that postlarval white shrimp can survive and grow in a wide range of salinities. Subsequent examination of temperature–salinity combinations, however, showed that postlarval white shrimp produced twice as much tissue at intermediate salinities than at salinities of 25 and 35‰ (Zein-Eldin and Griffith 1969). Hysmith and Colura (1976) demonstrated that pond-reared white shrimp had greater growth rates at 15‰ than at 7 and 21‰ in ponds. Several field studies have shown that white shrimp are often more abundant in the lower salinity waters of estuaries (Gunter 1950; Williams 1955; Gunter et al. 1964; Loesch 1965). Our study does not show cause and effect, but it gives strong circumstantial evidence that salinity or some factor governed by or related to salinity is indeed important for growth and survival of white shrimp during their estuarine life phase.

May–August temperature variables did not appear to be important, probably because water temperature is above 20°C by the time postlarvae enter the estuaries (Bearden 1961). Based upon rearing studies of postlarval brown shrimp, Zein-Eldin and Griffith (1966) suggested that temperatures greater than 20°C bring about relatively minor increases in the time required to complete postlarval development. In a laboratory study of growth of postlarval white shrimp, Zein-Eldin and Griffith (1969) found similar growth rates for shrimp reared at temperatures between 25 and 32.5°C. They noted that white shrimp are not abundant in Texas estuaries until water temperatures are well above 25°C and that few enter the estuaries as late as November when temperatures are below 20°C.

We have demonstrated that a spawner–recruit relationship exists for white shrimp in South Carolina. However, a single Beverton–Holt relationship is not adequate to explain the variability of recruitment. On the other hand, a family of curves, each curve representing a different August salinity, explained 86.8% of the variation. Garcia (1984) suggested that a flat relationship of a Beverton–Holt type may exist for shrimp, but that environmental variability masked the relationship. This appears to be the case for white shrimp in South Carolina. Several researchers have proposed that a Beverton–Holt-type relationship would be most likely for shrimp (Garcia 1983, 1984; Penn 1984; Ye 1984) and that a family of curves, each curve corresponding to a given set of environmental conditions, would be better than a single curve (Rothschild and Gulland 1982; Gulland and Rothschild 1984). A previous effort to determine a spawner–recruit relationship for white shrimp in the Gulf of Mexico was unsuccessful (Rothschild and Brunenmeister 1984). In our study when spring landings (spawners) in South Carolina were less than about 10,000 kg, fall recruitment was poor (Figure 6). When landings exceeded this value, low salinity in August improved fall recruitment.

Perhaps for South Carolina, fishermen do not harvest enough brood stock to result in decreased recruitment to the fall fishery, but it is apparent that severe winter weather can reduce stock size at this latitude to the point of being inadequate. Poor fall landings of white shrimp following severe winters have convinced regional managers that mortality of the overwintering brood stock results in very low quantities of spawners and subsequent poor recruitment (McKenzie 1981; Daigle 1984). However, the effects of poor recruitment resulting from severe winters can be offset to a limited extent by favorable environmental conditions during the summer. On the other hand, fewer spawners may be required to produce good fall harvests in years of optimal environmental conditions during late spring and summer.

The present study indicates that spawner abundance, at least in years following severe winters, and environmental conditions can be important for shrimp production in South Carolina. This study also supports South Carolina's existing management strategy of protecting spring spawners to the extent possible after severe winter weather destroys a large percentage of the brood stock. The model developed herein also can be used to predict below-average, average, or above-average landings for the central coast of South Carolina.

Acknowledgments

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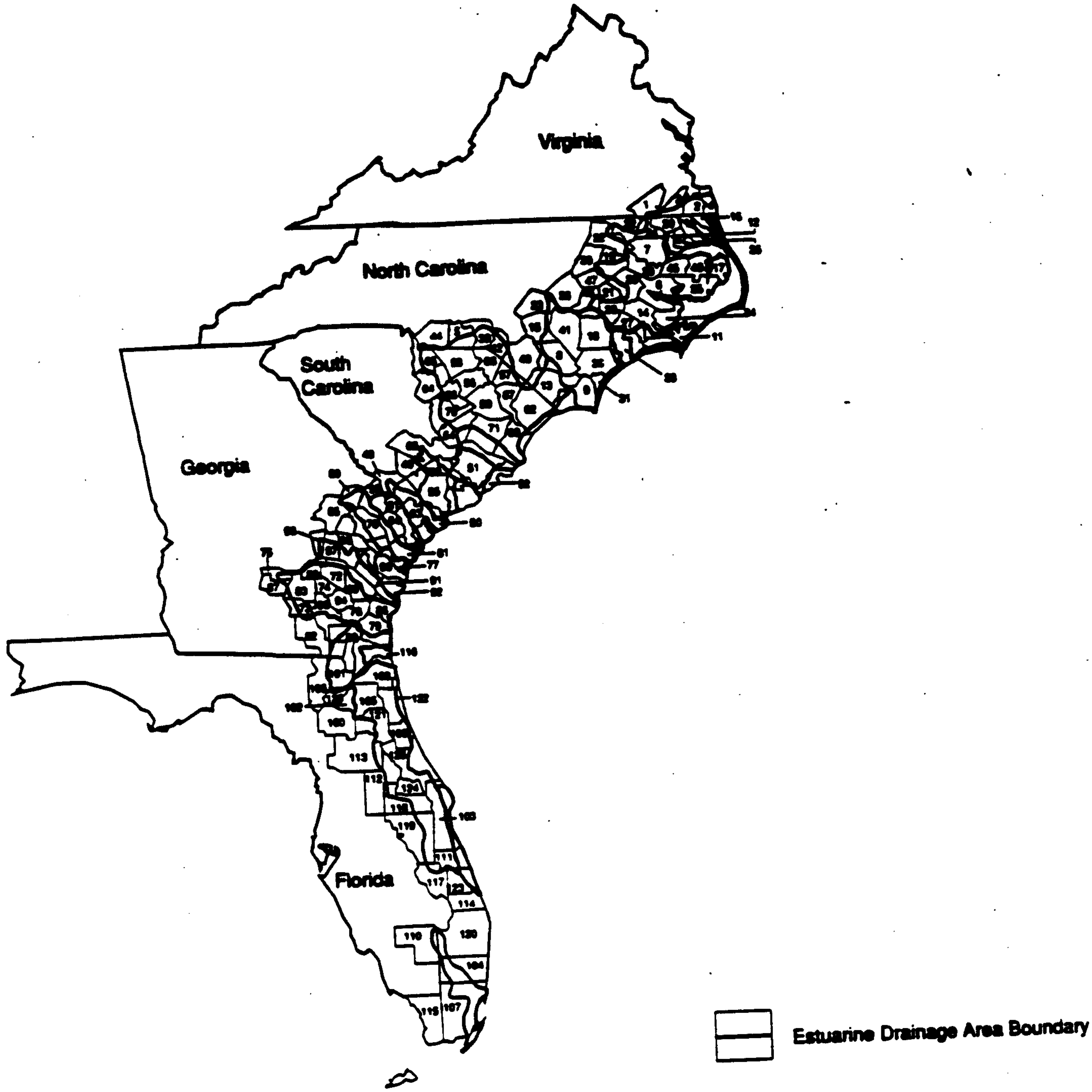
APPENDIX III

Coastal wetland acreage in south Atlantic states (NOAA 1991a)



Virginia
North Carolina
South Carolina
Georgia
Florida
Estuarine Drainage Area Boundary

Coastal wetlands by county (Acres X 100)

State/County[a]	Salt Marsh: Brackish	Salt Marsh: Unsp.	Salt Marsh: Subtotal[b]	Fresh Marsh: Non Tidal	Fresh Marsh: Tidal	Fresh Marsh: Unsp.	Fresh Marsh: Subtotal[b]	Forested and Scrub-Shrub: Est.	Forested and Scrub-Shrub: Fresh (Unsp.)	Forested and Scrub-Shrub: Non Tidal Fresh	Forested and Scrub-Shrub: Tidal Fresh	Forested and Scrub-Shrub: Subtotal[b]	Tidal Flats[a]	Total
VIRGINIA														
1 Southampton (100)	0	0	0 (0)	0	0	0	0 (0)	0	0	162	0	162 (100)	0 (0)	162
2 Chesapeake (100)	0	16	16 (2)	2	0	0	2 (0)	0	0	712	93	805 (98)	1 (0)	824
3 Suffolk (100)	0	39	39 (8)	0	0	0	1 (0)	0	0	449	1	450 (91)	4 (1)	495
4 Virginia Beach (90)	0	98	98 (33)	12	0	0	12 (4)	0	0	60	112	173 (58)	15 (5)	298
Subtotal	0	154	154 (8)	14	0	0	15 (1)	0	0	1,384	206	1,591 (88)	20 (1)	1,779
NORTH CAROLINA														
5 Anson	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6 Beaufort (88)	0	80	80 (8)	27	0	0	27 (3)	14	0	940	0	955 (89)	0 (0)	1,062
7 Bertie (21)	0	0	0 (0)	1	0	0	1 (0)	0	0	351	0	351 (100)	0 (0)	352
8 Bladen	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9 Brunswick (30)	0	108	108 (16)	53	14	2	68 (10)	2	135	340	7	483 (72)	16 (2)	674
10 Camden (16)	0	16	16 (12)	0	0	0	0 (0)	2	0	116	0	118 (88)	0 (0)	134
11 Carteret (88)	169	394	563 (31)	15	2	0	17 (1)	77	0	932	2	1,010 (56)	234 (13)	1,823
12 Chowan (4)	0	0	0 (0)	0	0	0	0 (0)	0	0	0	0	0 (0)	0 (0)	0
13 Columbus (4)	0	0	0 (0)	1	0	0	1 (3)	0	0	43	0	43 (97)	0 (0)	44
14 Craven (50)	1	16	17 (2)	16	0	0	16 (2)	2	0	773	0	775 (96)	4 (0)	811
15 Cumberland	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16 Currituck (57)	0	159	159 (37)	4	0	0	4 (1)	4	0	236	20	259 (61)	5 (1)	426
17 Dare (80)	104	180	284 (14)	172	0	0	172 (8)	132	0	1,453	0	1,585 (76)	36 (2)	2,077
18 Duplin	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19 Edgecombe (12)	0	0	0 (0)	0	0	0	0 (1)	0	0	52	0	52 (99)	0 (0)	52
20 Gates	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21 Greene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22 Halifax	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23 Harnett (1)	0	0	0 (0)	0	0	0	0 (0)	0	0	1	0	1 (100)	0 (0)	1
24 Hertford	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25 Hyde (81)	299	115	415 (18)	61	0	0	61 (3)	26	0	1,782	0	1,808 (78)	46 (2)	2,330
26 Johnston (2)	0	0	0 (0)	0	0	0	0 (0)	0	0	14	0	14 (100)	0 (0)	14
27 Jones (22)	0	0	0 (0)	0	0	0	0 (0)	0	0	138	0	138 (100)	0 (0)	139
28 Lenior	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29 Martin (30)	0	0	0 (0)	0	0	0	0 (0)	0	0	286	0	286 (100)	0 (0)	286
30 Nash (4)	0	0	0 (0)	0	0	0	0 (2)	0	0	26	0	26 (98)	0 (0)	27
31 New Hanover (99)	0	76	76 (17)	21	5	0	27 (6)	5	0	320	5	330 (74)	16 (4)	449
32 Northampton (8)	0	0	0 (0)	0	0	0	0 (0)	0	0	15	0	15 (100)	0 (0)	15
33 Onslow (39)	0	118	118 (25)	6	0	0	6 (1)	13	0	312	0	325 (69)	21 (4)	470
34 Pamlico (89)	17	191	208 (18)	42	0	0	43 (4)	19	0	860	0	879 (75)	47 (4)	1,176
35 Pasquotank	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
36 Pender (29)	0	79	79 (9)	6	0	0	6 (1)	0	0	738	0	738 (88)	16 (2)	839
37 Perquimans (14)	0	0	0 (0)	1	0	0	1 (8)	0	0	10	0	10 (92)	0 (0)	11
38 Pitt (3)	0	0	0 (1)	1	0	0	1 (2)	0	0	59	0	59 (96)	0 (1)	61
39 Richmond	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
40 Robeson	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
41 Sampson	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
42 Scotland	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Abbreviations: Unsp., Unspecified; Est., Estuarine; N/A, Not Available
a Values in parentheses represent the percent of county grid sampled by NOAA. Areas with less than 100 percent coverage may not be completely mapped by the U.S. Fish and Wildlife Service.
b Values in parentheses represent the percent of total county wetlands grid sampled by NOAA.

Coastal wetlands by county (Acres X 100)

State/County*	Salt Marsh: Brackish	Salt Marsh: Unsp.	Salt Marsh: Subtotal[a]	Fresh Marsh: Non Tidal	Fresh Marsh: Tidal	Fresh Marsh: Unsp.	Fresh Marsh: Subtotal[a]	Forested and Scrub-Shrub: Est.	Forested and Scrub-Shrub: Fresh (Unsp.)	Forested and Scrub-Shrub: Non Tidal Fresh	Forested and Scrub-Shrub: Tidal Fresh	Forested and Scrub-Shrub: Subtotal[a]	Tidal Flats[b]	Total
NORTH CAROLINA (cont.)														
43 Tyrrell (81)	0	7	7 (0)	7	0	0	7 (0)	1	0	1,427	0	1,428 (99)	0 (0)	1,441
44 Union	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
45 Washington (99)	0	0	0 (0)	27	0	0	27 (4)	0	0	590	0	590 (96)	0 (0)	618
* Wake (5)	0	0	0 (0)	0	0	0	0 (0)	0	0	20	0	20 (100)	0 (0)	20
46 Wayne (11)	0	0	0 (0)	2	0	0	2 (2)	0	0	95	0	95 (98)	0 (0)	97
47 Wilson (42)	0	0	0 (0)	1	0	0	1 (0)	0	0	182	0	182 (100)	0 (0)	183
Subtotal	599	1,539	2,138 (14)	460	22	3	486 (3)	287	136	[illegible]	35	[illegible]	449 (3)	15,612
SOUTH CAROLINA														
48 Allendale (5)	0	0	0 (0)	0	0	2	2 (3)	0	60	4	0	64 (97)	0 (0)	66
49 Bamberg (30)	0	0	0 (0)	0	0	10	10 (2)	0	376	48	0	424 (98)	0 (0)	434
50 Beaufort (100)	0	1,231	1,231 (72)	37	24	4	65 (4)	9	5	296	27	336 (20)	82 (5)	1,714
51 Berkeley (96)	0	74	74 (3)	82	78	0	160 (8)	0	24	1,803	63	1,891 (89)	0 (0)	2,125
* Calhoun (2)	0	0	0 (0)	0	0	0	0 (3)	0	16	0	0	16 (97)	0 (0)	16
52 Charleston (100)	0	1,302	1,302 (46)	125	18	1	144 (5)	15	0	1,030	41	1,086 (40)	196 (7)	2,728
53 Chesterfield	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
54 Clarendon (10)	0	0	0 (0)	0	0	2	2 (2)	0	51	28	0	79 (98)	0 (0)	80
55 Colleton (94)	0	367	367 (13)	123	112	15	250 (9)	2	504	1,550	69	2,125 (77)	5 (0)	2,747
56 Darlington	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
57 Dillon	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
58 Dorchester (100)	0	10	10 (1)	5	3	24	31 (2)	1	475	990	0	1,466 (97)	0 (0)	1,498
59 Florence (44)	0	0	0 (0)	0	0	3	3 (1)	0	502	0	0	502 (99)	0 (0)	505
60 Georgetown (95)	0	304	304 (15)	112	203	5	320 (16)	1	9	958	480	1,348 (67)	25 (1)	1,997
61 Hampton (74)	0	0	0 (0)	4	0	8	12 (1)	0	640	176	0	816 (99)	0 (0)	828
62 Horry (93)	0	19	19 (1)	46	5	0	51 (2)	1	136	1,958	250	2,344 (97)	6 (0)	2,420
63 Jasper (100)	0	353	353 (18)	23	18	76	116 (6)	5	1,025	417	5	1,452 (75)	5 (0)	1,926
64 Kershaw	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
65 Lancaster	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
66 Lee	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
67 Marion (45)	0	0	0 (0)	2	2	7	11 (2)	0	384	283	68	685 (98)	0 (0)	696
68 Marlboro	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
69 Orangeburg (45)	0	0	0 (0)	3	0	13	16 (1)	0	1,444	3	0	1,447 (99)	0 (0)	1,463
70 Sumter (2)	0	0	0 (0)	0	0	1	1 (2)	0	24	0	0	24 (98)	0 (0)	25
71 Williamsburg (94)	0	0	0 (0)	14	0	20	34 (2)	0	985	416	16	1,417 (98)	0 (0)	1,452
Subtotal	0	[illegible]	[illegible] (16)	575	463	190	1,228 (5)	34	6,531	[illegible]	1,818	17,463 (77)	330 (1)	[illegible]
GEORGIA														
72 Appling	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
73 Atkinson (80)	0	0	0 (0)	7	0	0	7 (2)	0	0	453	0	453 (98)	0 (0)	461
74 Bacon (24)	0	0	0 (0)	5	0	0	5 (4)	0	0	97	0	97 (95)	0 (0)	101
75 Ben Hill (32)	0	0	0 (0)	2	0	0	2 (4)	0	0	62	0	62 (96)	0 (0)	64
76 Brantley (100)	0	1	1 (0)	14	0	0	14 (1)	0	0	1,027	1	1,028 (98)	0 (0)	1,043
77 Bryan (80)	0	34	34 (4)	18	4	0	22 (3)	0	0	748	30	777 (93)	0 (0)	834
78 Bulloch (83)	0	0	0 (0)	14	0	0	14 (1)	0	0	989	0	989 (99)	0 (0)	1,004
* Burke (10)	0	0	0 (0)	2	0	0	2 (2)	0	0	75	0	75 (98)	0 (0)	77

Abbreviations: Unsp., Unspecified; Est., Estuarine; N/A, Not Available
* Non coastal county not within EDA boundaries.
a Values in parentheses represent the percent of county grid sampled by NOAA. Areas with less than 100 percent coverage may not be completely mapped by the U.S. Fish and Wildlife Service.
b Values in parentheses represent the percent of total county wetlands grid sampled by NOAA

Coastal wetlands by county (Acres X 100)

State/County[a]	Salt Marsh: Brackish	Salt Marsh: Unsp.	Salt Marsh: Subtotal[b]	Fresh Marsh: Non Tidal	Fresh Marsh: Tidal	Fresh Marsh: Unsp.	Fresh Marsh: Subtotal[b]	Forested and Scrub-Shrub: Sat.	Forested and Scrub-Shrub: Fresh (Unsp.)	Forested and Scrub-Shrub: Non Tidal Fresh	Forested and Scrub-Shrub: Tidal Fresh	Forested and Scrub-Shrub: Subtotal[b]	Tidal Flats[b]	Total
GEORGIA (cont.)														
79 Camden (100)	30	730	754 (48)	54	16	0	70 (4)	14	0	732	100	846 (88)	38 (1)	1,704
* Candler (10)	0	0	0 (0)	0	0	0	0 (0)	0	0	29	0	29 (100)	0 (0)	29
80 Charlton (25)	0	0	0 (0)	13	0	0	13 (3)	0	0	334	43	377 (97)	0 (0)	391
81 Chatham (7)	0	80	80 (87)	0	0	0	0 (0)	1	2	3	0	6 (6)	7 (7)	104
82 Clinch (23)	0	0	0 (0)	5	0	0	5 (1)	0	0	432	0	432 (88)	0 (0)	437
83 Coffee (36)	0	0	0 (0)	6	0	0	6 (3)	0	0	220	0	220 (97)	0 (0)	236
84 Effingham (100)	0	0	0 (0)	2	0	0	2 (0)	0	342	794	0	1,137 (100)	0 (0)	1,138
85 Emanuel (17)	0	0	0 (0)	1	0	0	1 (1)	0	0	81	0	81 (88)	0 (0)	81
* Evans (59)	0	0	0 (0)	1	0	0	1 (1)	0	0	136	0	136 (88)	0 (0)	136
86 Glynn (99)	43	616	660 (80)	23	22	0	45 (3)	7	0	467	99	573 (44)	33 (3)	1,310
87 Irwin (37)	0	0	0 (0)	8	0	0	8 (8)	0	0	134	0	134 (84)	0 (0)	142
88 Jeff Davis	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
89 Jenkins (93)	0	0	0 (0)	7	0	0	7 (2)	0	0	434	0	434 (88)	0 (0)	441
* Lanier (12)	0	0	0 (0)	1	0	0	1 (3)	0	0	34	0	34 (97)	0 (0)	35
90 Liberty (53)	0	0	0 (0)	8	0	0	8 (1)	0	0	578	0	578 (88)	0 (0)	586
91 Long (10)	0	0	0 (0)	1	0	0	1 (1)	0	0	91	0	91 (88)	0 (0)	92
92 McIntosh (50)	19	383	402 (46)	42	43	0	85 (10)	1	0	187	208	397 (44)	9 (1)	893
93 Montgomery (66)	0	0	0 (0)	6	0	0	6 (3)	0	0	174	0	174 (87)	0 (0)	180
94 Pierce (98)	0	0	0 (0)	21	0	0	21 (3)	0	0	612	0	612 (87)	0 (0)	633
95 Screven (92)	0	0	0 (0)	23	0	2	25 (3)	0	109	796	0	905 (87)	0 (0)	930
96 Tattnall (43)	0	0	0 (0)	8	0	0	8 (3)	0	0	230	0	230 (97)	0 (0)	238
97 Toombs (47)	0	0	0 (0)	5	0	0	5 (5)	0	0	100	0	100 (88)	0 (0)	105
98 Ware (55)	0	0	0 (0)	36	0	0	36 (4)	0	0	1,000	0	1,000 (88)	0 (0)	1,036
99 Wayne (37)	0	0	0 (0)	7	0	0	7 (1)	0	0	621	7	628 (88)	0 (0)	634
* Wheeler (3)	0	0	0 (0)	0	0	0	0 (0)	0	0	32	0	32 (100)	0 (0)	32
Subtotal	83	1,858	1,941 (13)	341	86	4	431 (3)	24	644	11,539	567	12,774 (84)	75 (0)	15,221
FLORIDA														
100 Alachua (8)	0	0	0 (0)	12	0	0	12 (15)	0	0	68	0	68 (85)	0 (0)	80
101 Baker (6)	0	0	0 (0)	0	0	0	0 (0)	0	0	71	0	71 (100)	0 (0)	71
102 Bradford (39)	0	0	0 (0)	8	0	0	8 (5)	0	0	148	0	148 (94)	0 (0)	156
103 Brevard (95)	0	6	6 (0)	1,292	57	0	1,349 (68)	30	0	564	19	613 (31)	22 (1)	1,990
104 Broward (70)	0	0	0 (0)	2,436	0	0	2,436 (73)	19	0	878	0	897 (27)	1 (0)	3,334
105 Clay (71)	0	1	1 (0)	36	0	0	36 (8)	0	0	439	0	440 (92)	0 (0)	477
106 Columbia	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
107 Dade (49)	0	223	223 (8)	1,529	0	0	1,529 (53)	397	0	744	0	1,141 (39)	17 (1)	2,909
108 Duval (87)	0	336	336 (27)	40	0	0	40 (3)	7	0	838	12	857 (69)	12 (1)	1,245
109 Flagler (100)	0	35	35 (3)	98	0	0	98 (9)	6	0	978	2	986 (88)	2 (0)	1,120
110 Hendry	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
111 Indian River (97)	0	3	3 (0)	389	0	0	389 (45)	44	0	401	0	445 (54)	8 (1)	845
112 Lake (36)	0	0	0 (0)	107	0	0	107 (14)	0	0	632	0	632 (86)	0 (0)	739
113 Manon (33)	0	0	0 (0)	75	0	0	75 (22)	0	0	270	0	270 (78)	0 (0)	345
114 Martin (83)	0	0	0 (0)	482	0	0	482 (76)	22	0	138	0	160 (23)	4 (1)	646
115 Monroe (0)	0	0	0 (0)	0	0	0	0 (0)	0	0	0	0	0 (0)	0 (0)	0
116 Nassau (63)	0	249	249 (30)	11	3	0	14 (2)	7	0	469	60	536 (64)	38 (5)	836

Abbreviations: Unsp., Unspecified; Sat., Saturated; N/A, Not Available
* Non coastal county not within EDA boundaries.
a. Values in parentheses represent the percent of county grid sampled by NOAA. Areas with less than 100 percent coverage may not be completely mapped by the U.S. Fish and Wildlife Service.
b. Values in parentheses represent the percent of total county wetlands grid sampled by NOAA.

Coastal wetlands by county (Acres X 100)

State/County[a]	Salt Marsh: Brackish	Salt Marsh: Unsp.	Salt Marsh: Subtotal[b]	Fresh Marsh: Non Tidal	Fresh Marsh: Tidal	Fresh Marsh: Unsp.	Fresh Marsh: Subtotal[b]	Forested and Scrub-Shrub: Est.	Forested and Scrub-Shrub: Fresh (Unsp.)	Forested and Scrub-Shrub: Non Tidal Fresh	Forested and Scrub-Shrub: Tidal Fresh	Forested and Scrub-Shrub: Subtotal[b]	Tidal Flats[b]	Total
FLORIDA (cont.)														
117 Okeechobee (46)	0	0	0 (0)	289	0	0	289 (63)	0	0	170	0	170 (37)	0 (0)	459
118 Orange (76)	0	0	0 (0)	225	0	0	225 (24)	0	0	727	0	727 (76)	0 (0)	952
119 Osceola (56)	0	0	0 (0)	429	0	0	429 (33)	0	0	866	0	866 (67)	0 (0)	1,295
120 Palm Beach (88)	0	0	0 (0)	2,388	0	0	2,388 (62)	5	0	1,461	0	1,466 (38)	6 (0)	3,860
121 Putnam (96)	0	0	0 (0)	108	0	0	108 (10)	0	0	974	0	974 (90)	0 (0)	1,083
122 St. Johns (100)	0	189	189 (12)	89	1	0	90 (6)	12	0	1,138	1	1,140 (80)	27 (2)	1,425
123 St. Lucie (91)	0	11	11 (2)	274	0	0	274 (57)	48	0	137	1	187 (39)	5 (1)	477
124 Seminole (100)	0	0	0 (0)	158	0	0	158 (30)	0	0	376	0	376 (70)	0 (0)	534
125 Union	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
126 Volusia (92)	0	27	27 (1)	413	5	0	418 (18)	72	0	1,808	1-	1,880 (80)	19 (1)	2,344
Subtotal	8	1,889	1,889 (4)	10,888	65	1	10,954 (40)	888	1	14,884	165	15,889 (55)	161 (1)	27,394
South Atlantic Total	672	8,270	8,942 (11)	12,278	637	197	13,116 (18)	1,884	7,310	40,146	1,889	59,432 (72)	1,816 (1)	82,885

Abbreviations: Unsp., Unspecified; Est., Estuarine; N/A, Not Available
a. Values in parentheses represent the percent of county grid sampled by NOAA. Areas with less than 100 percent coverage may not be completely mapped by the U.S. Fish and Wildlife Service.
b. Values in parentheses represent the percent of total county wetlands grid sampled by NOAA.

APPENDIX IV

Commercial white shrimp landings by state by month (1978-1991)

APPENDIX IV. White shrimp reported commercial landings (heads on) by month for North Carolina for 1978-91 (Source: 1978-82, State and 1983-91, NMFS).

Pounds Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78				•	•			254	5,935	17,148	16,855	•	40,654
79					•		2,951	•	•	130,016	48,338	8,368	236,160
80	14,936	2,085		•	•	15,434	•	5,162	174,342	264,598	73,460	14,470	567,489
81									2,225	5,399	3,283	459	11,366
82				•	•		•	14,876	64,916	77,152	13,968	644	172,697
83				596	2,727	5,006	642	7,749	81,287	254,126	94,238	3,934	450,305
84			12,866	11,746			64		24,213	28,874	19,272		97,035
85								3,835	14,656	24,235	1,940		44,666
86				•	•			7,458	48,720	34,145	21,214	•	112,063
87	•	•		•		6,582	3,682	31,784	142,915	75,027	26,158	2,397	290,001
88	•					•	•	•	23,433	47,840	10,759	1,300	83,563
89							1,238	63,975	235,189	223,149	141,789	30,162	695,502
90						2,227		167,040	185,078	640,669	134,068	20,125	1,149,207
91		•			•	1,646	2,116	343,107	341,994	391,741	294,171	27,270	1,410,993

Dollars Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78				•	•			$331	$12,567	$31,544	$37,048	•	$82,450
79					•		•	•	$127,506	$397,531	$138,690	$23,943	$707,357
80	$42,416	$6,470		•	•	$39,486	•	•	$328,328	$583,707	$146,063	$33,498	$1,192,626
81								$4,670	$12,045	$7,282	$1,122		$25,119
82				•	•		•	$32,671	$191,469	$246,896	$38,917	$1,922	$516,439
83				$2,208	$10,763	$18,751	$2,893	$19,582	$198,690	$656,181	$233,486	$6,595	$1,149,151
84			$47,312	$43,508			$235		$57,543	$75,592	$53,477		$277,667
85								$6,896	$26,949	$52,687	$3,833		$90,365
86				•	•			•	$127,220	$84,414	$57,885	•	$286,863
87	•	•		•		$24,965	$9,764	$52,236	$275,053	$191,103	$64,249	$5,763	$627,826
88	•					•	•	•	$51,811	$121,699	$27,733	$3,177	$205,225
89							$3,668	$103,013	$413,822	$476,722	$300,179	$67,572	$1,364,976
90						$8,006		$312,301	$401,985	$1,393,765	$326,553	$58,866	$2,501,476
91		•			•	$5,729	$2,904	$459,597	$687,655	$781,802	$616,522	$60,863	$2,642,425

• confidential

box indicates freeze year

(cont.)

White shrimp reported commercial landings (heads on) by month for South Carolina for 1978-91 (Source: 1978-91, NMFS).

Pounds

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78	4,150							78,229	744,881	1,069,820	487,331	176,735	2,561,146
79	88,023	796	328	1,654	33,393	12,346	14,279	123,995	1,667,059	1,968,564	1,076,138	248,477	5,235,053
80	82,721	598		363	95,264	297,818	74,849	383,853	1,430,039	1,155,559	570,926	303,258	4,395,248
81	16,034					3,576		63,302	487,087	604,114	301,315	117,738	1,593,165
82		385			26,309	27,494	6,439	193,453	1,311,928	1,048,755	416,304	366,802	3,397,868
83	*	*	*		*	*	*	120,621	*	*	*	*	3,585,574
84	76,172	*		*	*	1,816	346	11,606	99,798	158,147	134,696	30,861	513,667
85	2,025	*		*	2,108	1,677	*	25,857	227,203	228,909	118,615	43,152	652,390
86	36,681				6,950	24,970	18,976	228,519	1,021,595	1,028,663	617,618	355,174	3,339,146
87	228,180	10,202	*	*	131,391	334,195	40,836	229,250	1,717,793	978,056	545,372	433,170	4,651,656
88	181,911	*		*	1,681	6,656	7,703	67,081	735,125	651,166	441,449	575,667	2,668,534
89	35,987			2,059	153,255	460,006	45,188	300,163	956,545	1,496,860	717,877	930,486	5,098,423
90	*				*	38,639	16,061	205,786	1,072,453	1,640,313	898,665	335,718	4,208,303
91	94,955	*	*	95,716	896,452	297,506	163,091	1,637,521	1,753,310	671,266	877,865	344,544	6,837,507

Dollars

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78	$6,567							$134,397	$1,637,761	$2,461,364	$1,167,350	$413,472	$5,820,911
79	$195,447	$1,551	$1,150	$5,153	$107,516	$44,261	$49,289	$276,429	$4,454,071	$5,903,960	$2,633,700	$479,233	$14,151,760
80	$123,950	$1,696		$903	$223,537	$732,368	$181,059	$670,343	$2,660,393	$2,417,948	$1,107,133	$494,739	$8,634,069
81	$26,696					$10,333		$109,947	$991,338	$1,443,133	$668,749	$277,047	$3,527,243
82	$17,022	$1,125			$97,944	$1,011,864	$22,488	$453,988	$3,954,010	$3,392,822	$1,215,079	$950,853	$11,117,195
83	*	*	*		*	*	*	$253,627	*	*	*	*	$9,861,004
84	$175,800	*		*	*	$5,536	$889	$27,966	$261,305	$474,661	$394,034	$87,953	$1,429,019
85	$5,349	$1,418		*	$6,175	$4,347	*	$56,424	$547,656	$638,478	$333,509	$124,301	$1 721,650
86	$86,887				$24,762	$96,545	$62,217	$590,638	$2,897,795	$3,200,777	$1,901,761	$990,811	$9,852,193
87	$536,445	$24,293	*	*	$486,998	$1,226,236	$139,838	$388,340	$3,164,735	$2,375,155	$998,829	$611,062	$9,964,236
88	$244,376	*		*	$6,043	$27,260	$31,109	$119,583	$1,838,601	$1,946,164	$1,223,808	$1,373,087	$6,810,327
89	$83,112			$5,942	$458,796	$1,332,502	$104,057	$421,625	$1,674,485	$3,042,609	$1,433,511	$1,302,549	$9,859,185
90	*				*	$122,728	$41,250	$463,720	$2,427,295	$3,948,808	$2,260,791	$754,834	$10,020,570
91	$179,924	*	*	$314,593	$2,793,408	$904,877	$275,740	$2,437,837	$3,279,832	$1,451,511	$1,563,715	$522,918	$13,735,810

* confidential

box indicates freeze year

(cont.)

White shrimp reported commercial landings (heads on) by month for Georgia for 1978-91 (Source: 1979-82, 90-91, NMFS and 1978, 1983-89*, State).

Pounds Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
78	338,980	9,094	901	199	5,393	6,905	12,280	356,605	990,337	1,097,777	1,007,023	533,744
79	347,618	107,937	14,048	178,618	579,978	256,373	35,523	326,711	1,819,821	2,006,089	1,174,775	1,073,201
80	394,238	6,519	824	45,507	777,563	707,530	33,108	275,172	1,303,222	937,433	722,020	1,019,617
81	254,299	847	380	553	4,557	2,624	6,316	165,653	744,425	1,145,641	951,826	741,050
82	74,248	3,400	12,560	101,751	480,956	405,905	33,005	332,247	1,167,017	1,037,952	495,554	760,321
83	855,529	332,503	4,692	9,175	459,370	650,641	62,242	174,011	801,083	919,258	944,077	750,131
84	326,144	1,240	1,635	1,058	12,696	34,487	5,864	32,549	153,900	290,818	528,108	220,813
85	24,851	5,947	320	1,331	53,513	13,316	5,190	126,129	730,519	1,107,907	1,021,675	1,437,493
86	543,585	13,561	2,615	82,988	527,536	155,595	37,236	337,562	817,430	994,318	889,921	1,078,171
87	789,193	58,010	4,916	17,239	613,433	706,232	86,657	370,572	1,442,267	811,982	542,274	484,638
88	698,396	58,973	6,052	21,237	277,838	249,673	66,620	194,581	1,057,726	957,811	1,075,511	1,049,816
89	60,157	10,135	11,898	73,546	686,734	910,921	50,731	373,445	747,436	1,018,182	822,477	848,606
90	15,218	963		2,880	10,665	92,819	96,630	294,185	735,054	2,046,397	1,082,549	739,884
91	419,023	186,526	10,758	687,251	1,478,982	458,792	137,260	664,378	1,239,672	665,143	647,165	570,062

Dollars Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
78	$485,929	$11,644	$1,453	$419	$11,204	$11,277	$16,866	$611,374	$2,171,594	$2,431,165	$2,464,554	$1,251,646
79	$799,764	$254,714	$35,515	$552,746	$1,917,634	$907,281	$124,283	$679,298	$4,672,997	$5,908,482	$3,217,710	$2,489,507
80	$813,087	$16,628	$2,530	$103,761	$1,796,138	$1,765,851	$75,151	$494,588	$2,669,002	$2,133,635	$1,611,550	$2,007,412
81	$433,029	$1,732	$853	$1,277	$14,051	$8,430	$11,260	$287,121	$1,564,719	$2,852,340	$2,287,047	$1,501,759
82	$150,470	$8,928	$36,793	$372,078	$1,801,689	$1,503,691	$82,879	$837,333	$3,770,023	$3,494,603	$1,685,202	$2,439,914
83	$2,246,119	$822,290	$16,641	$32,478	$1,797,987	$2,682,658	$287,805	$481,982	$2,404,105	$2,907,482	$2,932,572	$1,891,823
84	$710,145	$3,495	$5,434	$4,016	$47,973	$98,513	$20,769	$88,417	$421,618	$898,003	$1,425,249	$539,727
85	$67,150	$15,629	$940	$4,244	$145,162	$40,324	$13,128	$242,448	$1,742,515	$3,057,009	$2,704,954	$3,683,735
86	$1,102,029	$33,979	$5,441	$289,599	$1,918,321	$594,415	$124,863	$813,057	$2,206,604	$3,100,200	$3,056,867	$3,391,566
87	$2,016,426	$158,788	$17,270	$62,280	$1,979,315	$2,314,997	$245,101	$658,054	$2,839,303	$2,072,492	$1,404,859	$1,070,617
88	$1,263,627	$120,165	$12,489	$96,428	$1,018,492	$942,609	$232,564	$345,284	$2,517,907	$2,924,744	$3,297,036	$2,452,297
89	$184,629	$46,502	$60,557	$279,354	$2,022,534	$2,598,216	$67,340	$724,856	$1,605,436	$2,271,794	$1,887,529	$1,476,669
90	$29,910	$1,105		$7,513	$33,760	$321,137	$277,002	$751,165	$1,832,741	$5,650,330	$3,193,814	$1,989,310
91	$979,860	$429,898	$26,211	$2,258,523	$4,545,641	$1,426,909	$377,019	$1,198,089	$2,562,977	$1,559,554	$1,514,112	$1,179,219

*1988-90 data include bait shrimp landings on monthly totals

box indicates freeze year

(cont.)

White shrimp reported commercial landings (heads on) by month for Florida east coast for 1978-91 (Source: 1978-91).

Pounds

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
$\boxed{78}$	285,936	52,255	22,017	14,348	19,586		66,226	144,190	176,473	321,444	520,146	329,819	1,952,440
79			55,339	45,438	130,341	92,278	161,467	93,347	679,189	1,083,607	656,339	624,999	3,622,344
80	327,716	64,827	46,005	49,395	187,020	154,876	15,295	44,612	261,388	325,714	768,884	824,495	3,070,227
$\boxed{81}$	301,590	43,171	43,553	12,506	34,259	24,571	1,682	24,909	138,357	496,251	837,128	786,847	2,744,824
82	191,850	54,756	36,762	49,553	135,526	89,488	27,620	43,551	197,070	251,576	439,532	524,511	2,041,795
83	203,256	92,233	41,056	19,962	92,011	143,093	31,239	43,931	237,513	418,890	729,474	353,544	2,406,202
$\boxed{84}$	279,008	83,163	58,742	8,439	24,467	30,305	29,653	38,918	64,149	291,905	525,690	433,652	1,868,091
$\boxed{85}$	182,107	76,999	34,964	13,308	108,530	45,294	25,396	58,856	397,858	586,687	516,685	453,880	2,502,564
86	219,420	79,330	36,930	47,295	133,142	117,130	36,146	89,361	234,174	231,097	347,532	465,577	2,037,134
87	430,766	114,247	28,172	19,177	136,640	116,844	18,362	53,005	176,295	247,353	455,918	421,104	2,217,683
88	186,704	46,279	30,381	20,158	75,097	91,651	22,894	62,093	420,651	355,968	584,690	546,775	2,443,341
89	210,379	30,806	28,152	55,869	162,639	214,315	78,981	30,964	143,915	484,088	568,638	434,467	2,443,213
$\boxed{90}$	367,512	55,325	46,870	50,703	40,025	92,468	24,555	11,895	29,574	288,057	504,022	627,966	2,138,971
91	308,582	128,649	46,094	184,055	385,576	224,925	55,203	286,814	254,631	363,673	260,469	360,357	2,859,027

Dollars

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
$\boxed{78}$	$444,898	$76,413	$37,860	$27,102	$39,096		$90,086	$213,539	$357,533	$700,632	$1,267,639	$842,547	$4,097,345
79			$153,442	$142,433	$415,835	$335,651	$437,773	$213,758	$1,692,622	$3,101,560	$1,916,609	$1,794,301	$10,203,984
80	$884,463	$175,867	$118,895	$121,490	$439,856	$387,917	$39,461	$78,997	$585,451	$767,876	$1,859,368	$1,790,152	$7,249,793
$\boxed{81}$	$595,688	$98,477	$108,840	$33,741	$96,038	$76,173	$2,855	$45,839	$329,302	$1,288,723	$2,293,203	$2,034,204	$7,003,083
82	$473,416	$165,209	$110,913	$168,890	$472,468	$330,323	$91,544	$98,662	$625,719	$844,419	$1,580,150	$2,196,290	$7,158,003
83	$726,766	$312,733	$144,898	$73,325	$344,322	$582,007	$116,995	$63,081	$595,483	$1,369,029	$2,311,195	$989,135	$7,628,969
$\boxed{84}$	$669,260	$248,476	$186,521	$29,443	$83,685	$112,098	$103,538	$99,914	$145,966	$791,811	$1,534,111	$1,181,243	$5,186,066
$\boxed{85}$	$527,752	$229,721	$102,143	$39,930	$281,758	$128,976	$75,325	$125,545	$908,700	$1,495,114	$1,318,082	$1,201,646	$6,431,692
86	$546,184	$226,471	$104,222	$151,673	$445,012	$438,212	$96,678	$162,667	$600,967	$657,549	$1,169,585	$1,602,314	$6,201,534
87	$1,424,742	$383,132	$91,905	$62,430	$433,013	$392,646	$66,367	$105,493	$301,626	$709,159	$1,375,668	$1,301,127	$6,647,308
88	$456,844	$127,407	$108,710	$74,417	$259,362	$339,768	$94,187	$94,978	$841,334	$1,020,907	$1,907,702	$1,701,418	$7,027,034
89	$667,002	$100,797	$95,422	$177,734	$466,502	$666,692	$232,758	$51,839	$283,810	$1,027,723	$1,343,005	$958,180	$6,071,464
$\boxed{90}$	$792,690	$139,832	$129,298	$142,852	$119,744	$295,711	$81,462	$18,056	$61,958	$856,974	$1,619,849	$1,919,968	$6,178,394
91	$950,544	$372,516	$143,113	$589,758	$1,221,803	$679,045	$158,802	$436,527	$480,677	$756,003	$668,223	$934,494	$7,391,505

box indicates freeze year

APPENDIX V

Commercial rock shrimp landings by state by month (1978-1991)

APPENDIX V. Rock shrimp reported commercial landings by month (heads on) for North Carolina for 1978-91 (Source:1978-82, State and 1983-91, NMFS).

Pounds Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78													0
79													0
80	*	*	*										5,010
81													0
82													0
83							*	*		*			1,181
84				2,301	2,677	717			*	*	*		9,414
85				*	*	*					*		6,748
86			*	*	*	*	3,199	1,255	11,737	*			27,664
87		*		*	*		*		*	*			3,558
88			3,088	12,306	9,497	1,416	1,286		820				28,413
89					*				*		*		125
90		6,969	22,009	7,629	2,986			*	*				40,724
91			*	*									9,695

Dollars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot
78													$0
79													$0
80	*	*	*										$1,200
81													$0
82													$0
83							*	*		*			$740
84				$2,218	$2,636	$548			*	*	*		$7,096
85				*	*	*					*		$5,381
86			*	*	*	*	$11,143	$884	$8,361	*			$30,192
87		*		*	*		*		*	*			$2,209
88			$3,062	$12,073	$5,738	$731	$959		$503				$23,066
89					*				*		*		$131
90		$8,346	$26,358	$10,925	$3,260			*	*				$49,566
91			*	*									$7,709

* confidential

(cont.)

Rock shrimp reported commercial landings (heads on) by month for South Carolina for 1978-91 (Source: 1978-91, NMFS).

Pounds

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78	11,708		251	6,129	19,375	10,002		23,631	38,938				110,033
79		8,053	16,974	1,625	396	38,722	162,302	476,192	27,490	4,327	17,834	234	754,149
80			16,650		675	1,643	2,502		222	4,436			26,127
81			10,083			603							10,686
82			67		386	172	2,710	5,528		641			9,504
83							*	*				*	9,670
84						*	*	354,021	243,112	*		*	792,427
85						2,241	*	*	*				16,240
86					*	*	*	*					9,873
87					*	*	*						764
88					*	*	145		*				1,590
89	*	*	*	*		*			*				10,759
90					*		*	*					7,827
91													0

Dollars

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78	$8,764		$150	$3,720	$12,577	$6,136		$15,798	$25,635				$72,780
79		$6,269	$12,705	$1,216	$237	$30,221	$91,635	$296,174	$14,652	$1,818	$12,205	$161	$467,293
80			$12,961		$350	$851	$1,772		$200	$3,984			$20,118
81			$7,548			$584							$8,132
82			$55		$347	$128	$2,570	$5,460		$614			$9,174
83							*	*				*	$5,530
84						*	*	$211,452	$140,810	*		*	$465,032
85						$1,927	*	*	*				$10,742
86					*	*	*	*					$7,500
87					*	*	*						$745
88					*	*	$126		*				$1,333
89	*	*	*	*		*			*				$10,842
90					*		*	*					$7,338
91													$0

* confidential

(cont.)

Rock shrimp reported commercial landings (heads on) by month for Georgia for 1978-91 (Source: 1979-82, 90-91, NMFS and 1978, 1983-89, State).

Pounds Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78			2,747		15	6,929		10,354	19,327	5,067			44,439
79			867	10,940	99	13,408	183,356	289,651	4,988	63,290	55,140		621,739
80	95,952	93,670	35,511	220	72	2,453	942	7,224	473	99,230		3,550	339,297
81	9,739		133,936	36,110					109	8,041			187,935
82	10,835	66,279	28,453	1,733	4,571		259	71,698		54,664	299,747	78,173	616,412
83		23,140	15,857				17,517	1,705	41,429	101,628	125,569	98,705	425,549
84	27,101	50,736	7,368	3,689	27,124	32,468	5,382	53,685	92,733	184,482	43,747	127,124	655,640
85	21,246	16,338			23,475			1,202	193,301	189,166	92,077	9,796	546,601
86	1,027	150			0	3,694	4,836	21,847	33,924	104,163	108,169	70,406	348,217
87	1,219	20,003	33,620	68	2,886		446	0	76,633	192,578	335,032	185,400	847,886
88	26,752		61,381	2,310		1,936	356	31,750	73,518	60,611	71,097	112,904	442,613
89	137,165	74,078	39,581	14,325				105,210	189,891	82,992	134,587	90,015	867,844
90	92,613			25,594	64,798			72,141	24,796	172,908	115,427	24,833	593,110
91	28,165	20,137	11,556	5,927			28,939	89,365	107,920	13,460	24,881		330,350

Dollars Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78			$1,645		$9	$4,396		$6,200	$10,384	$5,390			$28,024
79			$519	$6,794	$53	$6,516	$95,680	$170,624	$3,876	$54,953	$35,933		$374,948
80	$63,663	$55,390	$11,856	$132	$43	$1,617	$564	$5,788	$354	$61,412		$1,940	$202,959
81	$4,293		$96,453	$26,788					$91	$4,756			$132,381
82	$6,488	$34,202	$17,955	$1,222	$4,001		$155	$60,869		$23,175	$152,221	$52,793	$353,081
83		$19,753	$9,495				$8,759	$919	$24,808	$39,556	$44,342	$29,553	$177,185
84	$16,228	$30,381	$4,412	$2,960	$12,908	$16,463	$2,675	$24,126	$41,120	$81,594	$12,004	$38,061	$282,952
85	$6,361	$4,892			$19,680			$1,000	$111,331	$94,092	$45,763	$5,866	$288,985
86	$566	$90				$5,530	$5,184	$12,814	$20,225	$57,383	$59,590	$44,348	$205,730
87	$978	$14,201	$24,890	$57	$2,478		$558		$53,839	$115,149	$200,618	$185,400	$598,168
88	$26,752		$39,695	$1,383		$464	$614	$22,233	$44,466	$36,294	$42,573	$67,607	$282,081
89	$109,302	$74,078	$39,581	$14,325				$73,710	$117,729	$58,135	$134,587	$90,015	$711,462
90	$92,613			$17,931	$51,993			$47,086	$16,184	$112,856	$75,339	$16,208	$430,210
91	$22,657	$19,174	$11,462	$5,739			$28,939	$89,365	$120,754	$15,645	$28,806		$342,341

(cont.)

Rock shrimp reported commercial landings (heads on) by month for Florida east coast for 1978-91 (Source: 1978-91, NMFS).

Pounds

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78	63,911	151,631	170,243	88,664	37,373	3,557	8,368	126,195	592,290	387,071	33,321	46,937	1,709,561
79			43,085	81,667	48,386	24,838	990,680	1,804,301	174,980	401,974	345,019	562,591	4,477,521
80	778,648	586,610	530,850	187,445	41,474	29,884	11,717	12,869	109,339	289,065	352,956	566,012	3,496,869
81	749,426	679,945	239,528	96,493	40,950	4,072	12,323	12,172	7,235	608,101	69,262	401,067	2,920,574
82	670,194	559,081	538,587	153,093	16,142		98,455	262,829	642,285	640,882	775,664	284,965	4,642,177
83	76,765	16,749	22,823	2,517		40,915	882,253	866,360	1,329,670	679,450	360,674	163,465	4,441,641
84	294,928	486,876	214,348	88,483	100,399	110,937	185,175	680,919	619,022	1,024,404	967,157	637,111	5,409,759
85	195,078	114,417	73,058	34,043	9,359	56,719	30,359	152,766	155,175	325,628	105,874	26,530	1,279,006
86	24,191	43,295	11,954	9,954	32,543	253,092	492,439	324,524	255,709	721,365	638,230	248,805	3,056,101
87	130,298	94,201	13,257	12,413	5,508		16,348	94,709	1,250,494	754,008	1,040,593	830,137	4,241,966
88	421,239	473,355	248,882	28,114	20,338	148,810	40,161	198,969	145,428	241,455	432,921	280,107	2,679,779
89	284,490	505,443	162,952	51,906	23,469	24,643	28,494	705,548	2,100,203	1,741,443	1,524,293	1,151,801	8,304,685
90	1,098,389	709,872	496,257	161,407	39,646	17,400	64,180	721,811	1,771,715	1,697,482	1,044,009	131,624	7,953,792
91	164,560	88,206	60,923	•	•	•	39,791	469,531	990,193	685,687	151,920	35,983	2,709,858

Dollars

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78	$34,441	$84,505	$94,665	$52,032	$22,348	$2,130	$4,411	$83,115	$322,582	$218,229	$19,744	$24,464	$962,666
79			$25,525	$86,347	$43,362	$17,194	$503,384	$931,229	$91,629	$300,565	$257,156	$390,820	$2,647,211
80	$435,406	$303,048	$256,747	$103,741	$25,682	$20,279	$6,551	$7,806	$74,046	$181,900	$221,687	$329,674	$1,966,567
81	$432,133	$402,875	$162,529	$72,218	$35,745	$3,500	$9,421	$8,947	$6,538	$318,268	$39,796	$193,076	$1,685,046
82	$301,600	$276,188	$311,253	$90,435	$10,702		$70,953	$164,849	$404,804	$412,659	$511,889	$211,591	$2,766,923
83	$59,119	$14,577	$19,638	$1,944		$35,321	$508,987	$504,890	$736,750	$386,036	$191,829	$107,824	$2,566,915
84	$173,955	$287,264	$136,568	$69,982	$81,981	$84,527	$125,417	$463,165	$359,677	$470,454	$434,788	$323,618	$3,013,396
85	$102,049	$68,643	$50,220	$26,998	$5,708	$33,976	$17,545	$84,186	$76,144	$165,052	$54,547	$15,532	$700,600
86	$12,584	$32,056	$9,882	$7,275	$26,122	$170,177	$285,933	$167,255	$138,568	$387,941	$349,421	$135,636	$1,722,852
87	$80,607	$55,907	$8,657	$6,941	$3,068		$13,415	$70,293	$695,859	$382,667	$576,590	$468,079	$2,362,083
88	$247,396	$288,467	$155,476	$16,309	$12,606	$96,994	$28,220	$135,648	$101,028	$151,889	$230,394	$166,110	$1,630,537
89	$177,282	$313,006	$106,261	$52,045	$26,706	$28,509	$33,897	$394,596	$1,705,374	$984,123	$877,658	$659,173	$5,356,630
90	$604,212	$468,526	$385,705	$144,538	$33,748	$20,491	$58,627	$420,778	$1,163,167	$794,587	$770,395	$65,751	$4,930,525
91	$180,951	$64,694	$63,669	•	•	•	$62,551	$582,956	$1,106,557	$818,983	$206,476	$53,868	$3,175,751

APPENDIX VI

Commercial pink shrimp landings by state by month (1978-1991)

APPENDIX VI. Pink shrimp reported commercial landings (heads on) by month for North Carolina for 1978-91 (Source: 1978-82, State and 1983-91, NMFS).

Pounds Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78	•	•	•	1,390	16,819	28,694	7,264	34,941	43,368	101,899	127,670	77,654	440,413
79	3,198		3,851	97,957	373,771	467,270	89,742	75,016	84,112	178,614	168,222	17,160	1,558,913
80	2,528	•	•	34,184	213,531	298,811	10,030	15,066	210,182	440,350	135,070	•	1,371,190
81		•	•	16,714	171,888	253,264	32,872	31,022	85,566	89,763	50,175	•	711,384
82			1,941	35,458	225,094	396,182	44,528	92,238	242,451	354,472	169,275	29,093	1,590,733
83	4,726	2,990	6,630	101,213	413,549	823,750	243,254	126,147	275,928	359,079	246,135	29,666	2,633,067
84	•	•	•	52,080	253,339	324,458	7,718	25,256	154,167	298,428	136,000	12,872	1,277,111
85	6,206		7,574	42,855	209,861	187,317		28,620	173,025	247,991	290,919	60,483	1,254,851
86			24,706	109,036	434,457	474,652	41,830	84,710	218,550	402,881	90,321	22,907	1,904,050
87	•	•	•	99,868	311,287	1,156,827	372,377	115,995	394,216	405,947	129,797	26,860	3,018,230
88		5,939	18,143	89,164	246,854	895,735	271,945	45,311	345,096	580,488	186,335	26,645	2,711,655
89	•	•	37,390	142,947	818,330	1,037,213	207,632	71,987	240,541	350,625	226,966	•	3,146,334
90		4,509	14,203	70,626	113,562	27,926	30,832	209,002	326,498	448,779	210,230	46,133	1,502,300
91	2,626	4,661	20,317	325,530	1,057,307	657,934	23,781	85,038	133,486	135,213	92,606	9,490	2,547,989

Dollars Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78	•	•	•	$1,760	$23,190	$43,399	$9,418	$39,332	$44,148	$124,198	$155,622	$96,277	$538,200
79	$4,598		$5,249	$149,118	$633,395	$823,665	$173,508	$96,594	$121,223	$303,188	$280,962	$29,553	$2,621,053
80	$4,832	•	•	$109,942	$394,543	$534,872	$18,144	$18,549	$253,677	$576,056	$174,604	•	$2,099,972
81		•	•	$29,333	$310,976	$475,903	$63,577	$57,563	$144,805	$117,378	$81,803	•	$1,281,576
82			$2,912	$63,932	$505,403	$905,704	$97,785	$171,953	$481,857	$698,041	$286,437	$46,540	$3,262,564
83	$8,064	$3,940	$10,757	$178,012	$807,736	$1,665,042	$498,135	$215,817	$429,076	$572,762	$364,499	$46,788	$4,802,628
84	$133	$14,057	$31,152	$126,630	$670,600	$768,383	$15,803	$32,227	$230,207	$426,325	$216,528	$17,643	$2,549,688
85	$10,861		$13,255	$92,917	$509,439	$372,830	$25,980	$202,159	$365,317	$495,076	$101,446		$2,178,419
86			$47,066	$212,015	$872,956	$930,241	$94,968	$118,480	$329,951	$717,299	$164,725	$44,392	$3,532,093
87	$1,760	$698	$7,202	$186,459	$641,670	$1,895,164	$678,087	$182,697	$449,260	$658,763	$232,031	$51,426	$4,985,217
88		$11,889	$41,847	$210,215	$521,429	$1,496,231	$453,356	$94,966	$476,240	$695,822	$332,440	$51,682	$4,386,117
89	•	•	$76,577	$304,725	$1,560,881	$1,621,308	$302,402	$67,926	$328,967	$541,792	$317,986	•	$5,149,390
90		$11,977	$38,869	$249,524	$415,536	$93,386	$42,828	$213,301	$315,096	$580,724	$333,344	$74,052	$2,368,637
91	$5,213	$9,330	$38,788	$651,722	$785,060	$1,071,108	$25,927	$76,817	$161,157	$180,141	$98,213	$10,667	$3,114,143

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(cont.)

Pink shrimp reported commercial landings (heads on) by month for South Carolina for 1978-91 (Source: 1978-91, NMFS).

Pounds

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78					3,842			680	5,520	1,835			11,877
79			232		1,070	2,619	517						4,438
80				10		4,387	2,293	*	1,122	1,998	96	43	9,951
81			182			18	251	4,762	3,678	3,938	254		13,083
82					13,456	3,298		131	994	43			17,922
83					*	*			*				6,557
84					*	*		*	5,410	11,037	3,966	*	29,001
85				*	4,621	*	*	7,320		17,092	6,341	1,793	39,079
86	228				*	1,029	*	2,866	3,601	6,207	2,744	358	20,460
87	*	*			1,034	4,792	435	4,389	3,592	233	59	213	15,106
88				*	6,559	17,583	*	850	9,707	4,086	781	612	40,935
89	*	*	*	*	*	*		*	*	*			12,845
90		*		*				66	214	*			1,034
91					*	*		*					3,996

Dollars

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78					$7,790			$981	$10,192	$3,730			$22,693
79			$544		$3,096	$8,198	$1,777						$13,615
80				$24		$9,031	$4,901	*	$2,290	$3,736	$194	$106	$20,284
81			$507			$48	$452	$8,914	$6,343	$8,180	$496		$24,940
82					$46,255	$10,549		$339	$3,244	$110			$60,497
83					*	*			*				$17,669
84					*	*		*	$10,169	$22,099	$8,074	*	$55,271
85				*	$11,815	*	*	$24,461		$30,743	$10,699	$3,395	$84,883
86	$357				*	$3,371	*	$5,230	$8,739	$17,974	$6,649	$766	$54,236
87	*	*			$2,748	$11,837	$1,290	$11,060	$5,536	$279	$73	$174	$34,200
88				*	$23,494	$45,213	*	$1,201	$16,133	$6,191	$1,136	$944	$96,812
89	*	*	*	*	*	*		*	*	*			$24,423
90		*		*				$149	$383	*			$2,494
91					*	*		*					$5,595

* confidential

(cont.)

Pink shrimp reported commercial landings (heads on) by month for Georgia for 1978-91 (Source: 1979-82, 90-91, NMFS and 1978, 1983-89, State).

Pounds Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78					6,955	9,555	22	8,605	360				25,498
79				11,269					2,067				13,336
80		7,117	416			3,293			5,938	554	811		18,128
81	32		2,227	414	1,104	1,920		4,725	4,054		1,323	341	16,141
82	16	1,465	688	10,907	3,456	246		5,142		710	2,469	1,811	26,931
83		435	606						1,420	2,158	3,836	1,345	9,800
84	728	1,692	140	227	580	232					673	2,249	6,521
85					2,838	574			5,587	10,242	14,580		33,821
86	3,699			8,427	9,437			1,892	2,625	7,289	6,683	3,601	43,653
87	0	1,672	2,466	660	643	102	128		1,433	3,849	2,969	3,627	17,549
88	363	1,165	1,710	5,659	11,979	8,118	301	3,530	842	213	1,029	7,238	42,147
89	5,708	2,952	1,428	1,752				1,544	697	1,862	2,854	5,170	23,967
90	6,107			1,426	4,346			200	66				12,144
91				43	624	69	5,606	7,864	5,509	571	581		20,867

Dollars Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78					$12,848	$18,149	$32	$18,209	$839				$50,077
79		$39,115		$32,738					$6,377				$78,230
80		$21,795	$1,284			$13,924		$181	$11,859	$1,345	$1,927		$52,315
81	$85		$6,437	$1,378	$3,278	$3,843		$8,499	$8,506		$3,566	$739	$36,333
82	$43	$5,104	$2,257	$26,329	$8,690	$646		$19,106		$2,464	$8,625	$7,076	$80,540
83		$1,714	$2,388						$5,032	$6,931	$12,714	$4,769	$33,548
84	$2,389	$5,607	$466	$769	$1,590	$753					$2,231	$6,724	$20,529
85					$5,839	$1,231			$14,506	$30,728	$39,893		$92,197
86	$8,405			$27,722	$29,954			$7,089	$7,933	$25,286	$22,413	$12,418	$141,220
87		$6,002	$8,991	$2,423	$2,601	$405	$500		$3,034	$9,981	$10,752	$13,178	$57,867
88	$1,429	$4,441	$6,918	$21,393	$30,912	$18,137	$1,303	$13,839	$2,658	$838	$3,933	$22,373	$128,174
89	$19,985	$9,346	$4,554	$6,038				$3,891	$1,850	$4,351	$7,474	$14,310	$71,799
90	$16,860			$4,553	$15,591			$638	$209				$37,851
91				$84	$1,300	$108	$14,196	$21,799	$15,785	$1,669	$1,893		$56,834

(cont.)

Pink shrimp reported commercial landings (heads on) by month for Florida east coast for 1978-91 (Source: 1978-89, State and 1990-91, NMFS).

Pounds

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78		1,680	22,976	6,897	37,453	14,504							83,510
79			17,664	12,372	5,170	9,883	21,434	31,396	39,978	7,141	8,087	45,952	199,077
80	59,442	44,343	29,075	7,825	801		1,822		940	9,104	4,508	16,797	174,657
81	24,531	13,988	2,802	37,180	6,634	7,813			8,527	13,991	3,390	11,657	130,513
82	23,910	11,470	10,038	8,102	4,908	5,865	10,043	5,120	10,551	7,377	10,852	5,963	114,199
83	2,258	925	6,813	1,300	2,337	2,004	3,092	5,122	10,133	9,788	4,074	2,355	50,201
84	4,221	11,912	5,499	395	2,722	2,463	3,623	1,616	15,944	8,794	9,524	11,926	78,659
85	11,158	9,065	4,527	9,183	9,967	2,807	1,682	10,994	5,478	17,623	21,179	7,539	111,202
86	3,286	11,532	3,746	6,622	8,536	14,832	12,576	7,689	4,041	22,011	16,606	21,988	133,465
87	4,127	3,194	1,150	1,751	3,013	2,768	5,073	2,796	12,912	10,021	17,704	24,053	88,562
88	40,964	19,174	40,613	9,084	2,829	1,809	586	706	1,845	1,417	5,500	10,321	134,848
89	16,341	27,827	18,426	6,901	5,730	5,213	14,735	6,044	1,736	18,936	31,442	56,604	209,935
90	52,397	17,472	9,299	5,446	5,144	•	•	•	12,730	14,093	11,456	1,141	135,710
91	•	10,107	7,053	•	•	•	•	22,917	32,366	27,290	6,523	•	126,292

Dollars

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
78		$3,106	$41,246	$13,943	$75,369	$30,926							$164,590
79			$39,726	$35,764	$15,531	$25,934	$63,312	$96,700	$85,009	$18,812	$20,581	$139,931	$541,300
80	$178,837	$133,225	$76,729	$19,765	$1,860		$3,698		$2,529	$20,096	$10,761	$41,334	$488,834
81	$61,972	$35,524	$8,177	$24,771	$8,177	$23,888			$19,684	$33,882	$9,097	$32,436	$257,608
82	$69,061	$39,132	$35,141	$25,564	$15,237	$10,313	$21,652	$18,279	$18,754	$24,147	$40,714	$23,160	$341,164
83	$8,708	$3,436	$18,327	$4,101	$34,101	$6,594	$10,746	$16,450	$38,080	$32,971	$14,093	$7,912	$195,519
84	$13,941	$42,723	$18,345	$1,574	$10,057	$6,420	$13,424	$5,248	$29,706	$26,140	$28,269	$33,765	$229,632
85	$35,133	$26,593	$15,995	$26,245	$21,963	$5,122	$3,827	$25,441	$16,779	$48,086	$53,076	$20,021	$300,281
86	$9,947	$37,207	$11,927	$19,828	$28,548	$55,408	$46,854	$27,845	$11,601	$75,198	$57,889	$78,428	$460,680
87	$14,867	$11,742	$4,382	$5,578	$9,838	$3,588	$18,204	$11,180	$28,114	$40,588	$64,678	$81,069	$293,828
88	$97,996	$78,917	$120,175	$17,948	$7,281	$6,809	$1,878	$2,397	$6,730	$4,972	$22,050	$41,202	$408,355
89	$63,174	$111,933	$72,390	$25,594	$20,620	$17,156	$37,403	$18,082	$5,327	$54,010	$87,178	$156,408	$669,275
90	$155,233	$55,730	$29,008	$16,694	$16,093	•	•	•	$43,393	$46,078	$37,258	$3,539	$424,023
91	•	$34,038	$23,179	•	•	•	•	$71,597	$84,954	$79,388	$17,318	•	$369,479

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APPENDIX VII

Joint agency statement to conserve marine, estuarine, and riverine habitat

JOINT STATEMENT TO CONSERVE MARINE, ESTUARINE AND RIVERINE HABITAT

presented at

Atlantic States Marine Fisheries Commission Meeting
Washington, DC

May 16, 1990
Final Revision November 7, 1990

Statement:

The undersigned parties agree to use available mandates and to expand interagency efforts to minimize adverse effects of human activities on marine, estuarine, and riverine species and their habitats. This statement offers general guidance to states, federal agencies and regional bodies that share responsibility for fish habitats through their respective roles in decisions on research, management, and specific human activities. All decisions related to habitat conservation and use must accommodate the ecological needs of living natural resources in marine, estuarine, and riverine systems.

Objectives:

1. To minimize avoidable adverse impacts to fish stocks and their habitat. Our shared intent is to grant these valuable resources an appropriate level of management concern that reflects their tremendous socioeconomic-cultural value to the Nation. Any determination of public interest should balance these values with other uses.

2. To conserve, restore, and enhance fish habitats for the long-term benefit of all users. This applies equally to habitats of existing fish stocks and the historic ranges of stocks covered by a restoration plan. Aggressive action may be warranted to recover lost benefits.

3. To promote innovative programs that will increase our knowledge of management strategies that may reduce habitat loss or augment fish stocks, including:

    a) Beneficial uses of dredged material;

    b) Mitigation techniques for specific habitats accomplished in a manner that does not adversely impact the habitat needs of other important living natural resources.

    c) Restoration measures for specific stocks.

4. To improve our use of existing authorities and adopt new interagency procedures that will improve our habitat management efforts, including:

    a) Policies, guidelines, and/or regulations regarding "no net loss" of wetlands;

b) Recognition, support, and promotion of ecologically responsible wetland enhancement and management techniques that will add benefits for living resources of special concern while maintaining values for other important living resources.

c) Early identification procedures to accord special recognition to deserving habitats; and,

d) Incorporating all agencies into such efforts as fishery management plans (with the Fishery Management Councils established under the Magnuson Fishery Conservation and Management Act and with the Atlantic States Marine Fisheries Commission).

5. To foster greater interagency cooperation and collaboration, including:

a) Shared priority statements, policies and management plans that will improve overall awareness of habitat programs in other agencies;

b) Joint research and management initiatives to address common issues and needs; and,

c) Improved decision-making protocols, including mechanisms to incorporate best-available information into decisions affecting living resources and their habitat in ecological units within meaningful bio-geographic regions rather than administrative or political jurisdictions.

Recommended Actions:

Our shared responsibilities for marine, estuarine, and riverine habitats invite frequent opportunities for collaboration, including:

1) Share general information, recommendations, and decisions for other important living resources that relate to habitats or related resources, e.g., habitat policies or habitat discussions in Fishery Management Plans.

2) Collaborate with other parties on actions that relate to habitat or living resources, e.g., management plans or mitigation protocols.

3) Initiate new agreements to improve our efforts to conserve and manage living resources and their habitat, e.g. development and implementation of strategic multi-objective resource plans to address issues in resource or habitat management.

This statement of intent to conserve and manage marine, estuarine and riverine habitat is endorsed by the following agencies, states, and regional bodies:

RESOLUTION #1

MARINE, ESTUARINE AND RIVERINE HABITAT POLICY

RESOLUTION OF AGREEMENT

WHEREAS, the fishery stocks which inhabit the coastal rivers, estuaries, and shelf waters of the eastern seaboard of the United States represent commercial and recreational resources of enormous economic and social value to the citizens of our country; and,

WHEREAS, management of these resources is the responsibility of the states, the Atlantic States Marine Fisheries Commission, and the federal government acting through the three regional Fishery Management Councils, namely, New England, Mid-Atlantic, and South Atlantic, and,

WHEREAS, the efforts to conserve and manage these fishery resources, the necessary habitat, and water quality are the management responsibilities of the aforementioned organizations; and, further that Fishery Management Plans (FMPs) developed by the Commission and Regional Councils include a detailed Habitat Section dealing with the preservation of the fishery environment and the assessment of the degradation caused by human activities; and,

WHEREAS, the state, interstate, and federal agencies that enforce laws or are designated and authorized by law to monitor, assess, permit and/or regulate human activities that affect the habitat, water quality, and the fish stocks; and, further that these agencies (state agencies, interstate compacts, and NOAA/National Marine Fisheries Service, U.S. Fish and Wildlife Service, U.S. Coast Guard, U.S. Army Corps of Engineers, and U.S. Environmental Protection Agency), share with the Commission and Fishery Management Councils a pressing responsibility to address the impact of their planning and regulatory activities affecting the status of fishery resources which are clearly defined in the provisions of FMPs;

NOW THEREFORE BE IT RESOLVED that the Commission, recognizing the requirement for improved coordination, agrees to actively implement the "unified marine habitat policy statement" presented on May 16, 1990 in Washington, D.C. with final revision dated November 7, 1990 attached hereto and made a part hereof, and calls upon the Regional Councils and federal agencies named above to do so also.

APPENDIX VIII

Final Rule- Sea turtle conservation measures

November 30, 1992. The full text of this Commission decision is available for inspection and copying during normal business hours in the FCC Dockets Branch (room 230), 1919 M Street NW., Washington, DC. The complete text of this decision may also be purchased from the Commission's copy contractors, Downtown Copy Center, 1990 M Street NW., suite 640, Washington, DC 20036, (202) 452–1422.

List of Subjects in 47 CFR Part 73

Radio broadcasting.

PART 73—[AMENDED]

1. The authority citation for part 73 continues to read as follows:

Authority: 47 U.S.C. 154, 303.

§ 73.202 [Amended]

2. Section 73.202(b), the Table of FM Allotments under Missouri, is amended by removing Channel 237A and adding Channel 237C3 at Clinton.

Federal Communications Commission.

Michael C. Ruger,

Chief, Allocations Branch, Policy and Rules Division, Mass Media Bureau.

[FR Doc. 92–29486 Filed 12–3–92; 8:45 am]

BILLING CODE 6712–01–M

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47 CFR Part 73

[MM Docket No. 92–128; RM–8002]

Radio Broadcasting Services; South Hill and Lawrenceville, VA

AGENCY: Federal Communications Commission.

ACTION: Final rule.

SUMMARY: The Commission, at the request of Old Belt Broadcasting Corporation, licensee of Station WSHV–FM, Channel 288A, South Hill, Virginia, exchanges channels between Station WSHV–FM, Channel 288A, South Hill, Virginia, and Station WHFD–FM, Channel 255A, Lawrenceville, Virginia, and modifies the authorizations of both stations. See 57 FR 28167, June 24, 1992. Channel 255A can be allotted to South Hill and Channel 288A can be allotted to Lawrenceville, Virginia, in compliance with the Commission's minimum distance separation requirements and can be used at the transmitter sites specified in Station WSHV–FM's and Station WHFD–FM's authorizations, respectively. The coordinates for Channel 255A at South Hill are 36–44–39 and 78–09–42. The coordinates for Channel 288A at Lawrenceville are 36–45–10 and 77–51–49. With this action, this proceeding is terminated.

EFFECTIVE DATE: January 15, 1993.

FOR FURTHER INFORMATION CONTACT: Pamela Blumenthal, Mass Media Bureau, (202) 634–6530.

SUPPLEMENTARY INFORMATION: This is a synopsis of the Commission's Report and Order, MM Docket No. 92–128, adopted November 12, 1992, and released December 1, 1992. The full text of this Commission decision is available for inspection and copying during normal business hours in the FCC Dockets Branch (room 230), 1919 M Street NW., Washington, DC. The complete text of this decision may also be purchased from the Commission's copy contractor, Downtown Copy Center, (202) 452–1422, 1990 M Street, NW., suite 640, Washington, DC 20036.

List of Subjects in 47 CFR Part 73

Radio broadcasting.

PART 73—[AMENDED]

1. The authority citation for part 73 continues to read as follows:

Authority: 47 U.S.C. 154, 303.

§ 73.202 [Amended]

2. Section 73.202(b), the Table of FM Allotments under Virginia, is amended by removing Channel 288A and adding Channel 255A at South Hill, and by removing Channel 255A and adding Channel 288A at Lawrenceville.

Federal Communications Commission.

Michael C. Ruger,

Chief, Allocations Branch, Policy and Rules Division, Mass Media Bureau.

[FR Doc. 92–29487 Filed 12–3–92; 8:45 am]

BILLING CODE 6712–01–M

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Parts 217 and 227

[Docket No. 910779–2317]

RIN 0648–AE12

Threatened Fish and Wildlife; Threatened Marine Reptiles; Revisions to Enhance and Facilitate Compliance With Sea Turtle Conservation Requirements Applicable to Shrimp Trawlers; Restrictions Applicable to Shrimp Trawlers and Other Fisheries

AGENCY: National Marine Fisheries Service (NMFS), NOAA, Commerce.

ACTION: Final rule.

SUMMARY: NMFS amends the sea turtle conservation measures and the interim final rule currently in effect. As of December 1, 1992, this final rule requires shrimp trawlers to comply with sea turtle conservation measures throughout the year in all areas. Where limited tow-times may be used as an alternative to turtle excluder devices (TEDs), tows must be limited to 55 minutes or less from April 1 though October 31; at other times of the year tows must be limited to no more than 75 minutes. As of January 1, 1993, shrimp trawlers under 25 feet (7.6 meters (m)) in offshore waters can no longer use limited tow-times as an alternative to using turtle excluder devices (TEDs). Also, as of January 1, 1993, all shrimp trawlers in inshore waters must use TEDs, except those equipped with a single net with a headrope length of less than 35 feet (10.7 m) and a footrope length of less than 44 feet (13.4 m), which may use the tow-time alternative under December 1, 1994. This final rule also makes various other technical corrections and minor changes to the sea turtle conservation measures.

EFFECTIVE DATES: This rule is effective on December 1, 1992, except for a registration provision contained in § 227.72(e) (3)(v) and (6)(iv), which requires approval by the Office of Management and Budget (OMB) under the Paperwork Reduction Act (PRA) and which is not yet effective. When OMB approval is received, the effective date of § 227.72(e) (3)(v) and (6)(iv) will be announced in the Federal Register.

ADDRESSES: Dr. Michael F. Tillman, Acting Director, Office of Protected Resources, NMFS, 1335 East-West Highway, Silver Spring, MD 20910. Comments on the collection-of-information requirement subject to the Paperwork Reduction Act should be directed to the Office of Protected Resources, NMFS, 1335 East-West Highway, Silver Spring, MD 20910, Attention: Phil Williams, and to the Office of Information and Regulatory Affairs of OMB; Washington, DC 20503, Attention: Desk Officer for NOAA.

FOR FURTHER INFORMATION CONTACT: Phil Williams, NMFS National Sea Turtle Coordinator, 301–713–2319, or Charles A. Oravetz, Chief, Protected Species Program, NMFS Southeast Regional Office, 813–893–3366.

SUPPLEMENTARY INFORMATION:

Background

All sea turtles that occur in U.S. waters are listed as either endangered or threatened under the Endangered Species Act (ESA). Kemp's ridley, leatherback, and hawksbill turtles are listed as endangered. Loggerhead and green turtles are listed as threatened.

except for breeding populations of green turtles in Florida and on the Pacific coast of Mexico, which are listed as endangered. The incidental take and mortality of these species by shrimp trawlers has been documented in the Gulf of Mexico and along the Atlantic seaboard.

Under the ESA and its implementing regulations, it is prohibited to take sea turtles. The incidental taking of turtles by shrimp trawlers in the Atlantic Ocean off the coast of the southeastern United States and in the Gulf of Mexico is exempted from the prohibition if trawlers employ specified sea turtle conservation measures. Generally, these conservation measures include requiring shrimp trawlers to use TEDs in inshore and offshore waters or, in a few circumstances, to limit the duration of tow-times as an alternative to using TEDs.

Proposed Regulations

NMFS issued regulations amending 50 CFR part 217, 222, and 227 to protect endangered and threatened sea turtles on June 29, 1987 (52 FR 24244). NMFS later determined that there was a need to amend those regulations to conserve and prevent further declines in the populations of listed sea turtles and to enhance and facilitate compliance and enforcement. NMFS published proposed regulations on April 30, 1992 (57 FR 18446) and held public hearings on the regulations in each state where shrimp trawlers would be affected. NMFS extended the comment period on the proposed rule through October 23, 1992.

Interim Final Regulations

On September 8, 1992, (57 FR 40861) NMFS issued an interim final rule, effective September 1, 1992, that implemented some of the provisions of the April 30, 1992, proposed rule. The interim final rule extended the sea turtle conservation requirements in the Atlantic area to year-round, rather than from May 1 through August 31. Beginning November 1, 1992, in all areas where limited tow times could be used as an alternative to the use of TEDs, tow times were reduced from 90 minutes to 75 minutes. The exemption from the TED requirement for rock shrimp in the Atlantic was eliminated and exemptions were provided for vertical barred beam trawls, roller trawls, wing nets, skimmer trawls, pusher-head trawls and bait shrimpers. Procedures were established for restricting shrimp trawling and other types of fishing activities when found necessary to protect sea turtles or when special environmental conditions made trawling with TED-equipped nets impracticable. Definitions were added and prohibitions were revised to clarify sea turtle conservation measures and improve enforcement measures. The sale of non-approved TEDs was prohibited. Generic standards applicable to all hard TEDs were specified. Unnecessary elements concerning the construction requirements for the Morrison "soft" TED were removed. Allowable modifications to approved TEDs were clarified and all other modifications were prohibited. NMFS accepted comments on the interim final regulations until October 16, 1992.

Comments and Responses on the Proposed and Interim Final Regulations

NMFS received over 18,000 comments on the proposed and interim final amendments to the sea turtle conservation regulations, both from participants in the public hearings and by letter. NMFS reviewed all the comments and combined them under general categories provided below. Comments to which responses were provided in the interim final rule are not re-addressed here.

By far the most controversial provision was the proposal to require shrimp trawlers to use TEDs in both inshore and offshore waters throughout the year and to eliminate the tow-time option, except in limited situations. The proposed provisions were strongly supported by the general public and environmental community and were strongly opposed by the commercial shrimp trawl industry. Few offshore shrimp fishermen objected to the requirement to use TEDs all year, but most inshore shrimp fishermen objected to using TEDs instead of restricting tow times in inshore waters. Some of the most commonly voiced comments on this issue follow:

Comment: TEDs will not work in inshore waters because they will become clogged with seagrasses, debris, crab traps and other trash. A large number of commenters from Louisiana, Texas and Mississippi stated that TEDs would not work in areas where they normally shrimp. The biggest complaint concerned abandoned crab traps, which purportedly would become tangled in TEDs and release shrimp through the turtle escape opening. North Carolina inshore shrimp fishermen expressed concerns about clogging of TEDs with seagrasses.

Response: NMFS has received reports of clogging of TEDs with seagrasses and various types of trash. As discussed below, the final rule provides for a phase-in of the requirement to use TEDs in inshore waters. Full implementation of the requirement to use TEDs in inshore waters is delayed until December 1, 1994. Until that time, a shrimp trawler pulling a single net that has a headrope length of less than 35 feet (10.7 m) and a footrope length of less than 44 feet (13.4 m) may restrict tow times instead of using a TED. Furthermore, the option of restricting tow times is available for all shrimp trawlers operating in inshore waters, and small trawlers in offshore waters, until January 1, 1993. During this time, inshore fishermen will have an opportunity to experiment with different TEDs under different conditions to determine what works effectively. At least one approved TED, the Anthony weedless TED, was designed specifically to deal with seagrass and algae problems. Several other approved TEDs also can exclude algae and seagrass. Based on information available, NMFS believes that there are very few historical shrimping areas where seagrass or algal concentrations make it impossible to harvest shrimp economically with a TED installed.

NMFS recognizes that crab traps could potentially lodge in the turtle escape opening, resulting in a loss of shrimp. This is something that NMFS cannot address in these regulations because it is a resource user conflict within state waters, which would be appropriately addressed by state regulation.

Comment: TEDs have not been adequately tested in small nets, and placing full-sized TEDs in small nets will result in a significant loss of shrimp. Many commenters suggested that NMFS was placing an unfair burden on inshore fishermen without adequately testing TEDs in small nets. Many pointed out that years of TED testing were conducted in the offshore fleet before the requirement to use TEDs in offshore waters was implemented.

Response: Based on test results and other information, NMFS believes that all currently approved TEDs will function properly in nets with a headrope length of 35 feet (10.7 m) or longer. A small TED known as the NMFS mini grid TED works well in trawls with nets having a headrope length as small as 25 feet (7.6 m). The Georgia and Matagorda TEDs, based on their construction and configuration, should work in nets with a headrope length of 30 feet (9.1 m). In some situations, especially with respect to smaller and lighter nets used in some inshore areas, there may be problems in adapting and using some types of TEDs. For example, twisting and stretching of lighter nets have been identified as possible problems. These problems are not expected to affect nets with a headrope length of 35 feet (10.7 m) or longer or the heavier type of nets that are usually used offshore.

In this final rule, a shrimp trawler using a single net that has a headrope length of less than 35 feet (10.7 m) and a footrope length of less than 44 feet (13.4 m) may restrict tow times instead of using a TED until December 1, 1994. This will allow additional time for testing of TEDs in smaller nets. When tow-time limits are used, trawlers must restrict their tows to no more than 55 minutes during warm-water months (April 1 through October 31) and to no more than 75 minutes during cold-water months (November 1 through March 31).

Comment: In general, the commercial shrimping industry claims that tow-time limitations are a viable alternative to TEDs and this option should remain in effect in inshore waters. Shrimp fishermen argue that 90-minute tow times have proven successful in protecting sea turtles and that this option is the only thing that will work in inshore waters. Comments from other sectors, which constitute the majority of comments on this issue, favor elimination of restricted tow times as an alternative.

Response: The NMFS decision to eliminate the tow-time option, with the exceptions noted, was based upon several considerations. First, the National Academy of Sciences, in its 1990 report, Decline of the Sea Turtles: Causes and Prevention, concluded that 90-minute tow times are inadequate to provide sea turtle protection comparable to that provided by TED use and recommended 40- and 60-minute tows (actual bottom fishing time) for warm- and cold-water months, respectively. Second, tow-time restrictions do not eliminate stress and trauma to turtles associated with their capture and forced submergence. Physiologists suggest that full recovery from such a capture could require days or even weeks, and that multiple captures of the same turtle could result in death, even when short tows are used. TEDs, on the other hand, minimize stress by releasing the turtle as soon as the TED is encountered. Third, enforcement of tow-time limitations is problematic. An insignificant number of cases involving a violation of the tow-time regulations have been prosecuted, despite the fact that many commenters readily admit to tows in excess of 90 minutes. Information from observers confirms that compliance has been poor. NMFS believes that TEDs are a more effective option to ensure adequate turtle protection. Furthermore, it may be economically advantageous to use TEDs, rather than limiting tow times.

Comment: Existing data do not justify requiring TEDs in all inshore waters or in all places at all times. There are areas and seasons when turtles are not present and TEDs are not needed. A number of commenters thought that the NMFS requirements for TEDs in virtually all shrimp trawls were unnecessary. Other commenters favored this action because it increases the protection of sea turtles.

Response: Even though there is less evidence regarding the distribution of sea turtles in inshore waters than there is regarding their distribution in offshore waters, available information makes clear that sea turtles are present in inshore areas where trawling takes place. They are, therefore, vulnerable to capture and mortality in trawls. While turtles may be present at low abundance levels or even absent in certain areas at certain times of the year, the best available data and information do not allow NMFS to predict accurately when and where this will occur. Consequently, NMFS has determined that protective measures for sea turtles should be implemented throughout the year in all areas (inshore and offshore) off the coast of the southeastern United States in the Atlantic and the Gulf of Mexico. Turtle movements appear to be linked with changing water temperatures, but a number of other factors, including availability of food, probably also play a role in determining distribution and abundance. Further, the numbers of turtles are severely depressed in all areas because of human activities, resulting in their threatened and endangered status, and protections may be necessary to allow turtles to repopulate some areas. NMFS will continue research efforts, and if it is demonstrated that there are areas and times when turtles are never present, NMFS will consider eliminating sea turtle conservation measures in those areas at those times. However, no such areas or times can be delineated at the present time.

Comment: Of the 3,000 additional comments received on the interim final rule, the overwhelming majority of commenters objected to the interim final rule and favored full implementation of the April 30, 1992, proposed rule. The most commonly voiced criticism of the interim rule was that it failed to ensure adequate protection of sea turtles in inshore waters by allowing a tow-line option instead of mandatory TED requirements.

Response: NMFS recognizes that the interim final rule would not provide an adequate long-term solution to the problem of sea turtle mortality in the shrimp fishery. The primary purpose of the interim final rule was to implement immediately turtle protection measures in the Atlantic area, while providing an opportunity for additional public comment on the proposed rule. NMFS agrees that the additional provisions contained in the proposed rule are necessary to ensure that sea turtles are adequately protected as mandated under the ESA.

Comment: Most commenters opposed the use of limited tow times as a substitute for TED requirements under any circumstances, and especially when environmental conditions make TED use impracticable. Most commenters argued that tow times are difficult to enforce and that such an exemption would allow fishermen to circumvent the TED regulations. Many cited past experiences where fishermen ignored tow-time limitations, even with NMFS observers aboard, as evidence of the ineffectiveness of tow times as an alternative to TEDs. Many of the commenters recommended that NMFS further clarify the conditions under which such an exemption would be granted. In general, the commercial shrimp industry favored the use of restricted tow times.

Response: NMFS agrees that in most instances where tow-time limitations were substituted for TED requirements, available evidence indicates that compliance has been poor. For example, poor compliance was documented when shrimpers were allowed to use limited tow times off Louisiana in the aftermath of Hurricane Andrew during September 1992, and when fishermen in the summer flounder fishery off North Carolina were required to use limited tow times from November 1991 through February 1992.

However, NMFS believes that there may be isolated areas and times when adverse environmental conditions (algae, seagrasses, etc.) make it impracticable to trawl with TEDs. Where adequate enforcement is possible, limited tow times may be an appropriate alternative. For example, in a very restricted nearshore area off North Carolina, tow-time limitations have been substituted for TED requirements because of excessive algal concentrations. North Carolina law enforcement personnel have reported one violation. Restricted tow times may be an effective option if fishermen cooperate and a strong law enforcement presence can be maintained. Under most circumstances, however, enforcement is not practicable and at-sea monitoring of tow times is costly, ineffective and requires significant diversion of limited enforcement resources from other areas. In any case, NMFS does not intend to allow compliance with restricted tow times as a permanent alternative to the use of TEDs, except where environmental problems have been well documented and there is a basis for concluding that, in the particular circumstances, sea turtles would be adequately protected.

Other comments: Several commenters provided technical suggestions and recommendations regarding gear descriptions.

Response: NMFS considered these suggestions and incorporated recommended changes where appropriate.

Final Regulations and Changes From the Proposed and Interim Final Rules

As a result of comments and recommendations received, the final amendments differ from the proposed and interim final amendments in several areas. Specific changes are summarized below.

1. Although the interim final rule extended sea turtle conservation measures throughout the year in the Atlantic area, it did not implement year-round protections in the Gulf of Mexico. This final rule extends sea turtle conservation measures throughout the Gulf of Mexico after November 30, 1992, in order to protect sea turtles where protective measures otherwise would not exist. This means that shrimp trawlers 25 feet (7.6 m) or longer in length must use TEDs in all offshore waters throughout the Gulf of Mexico and shrimp trawlers less than 25 feet (7.6 m) in length in offshore waters and all trawlers in inshore waters must use TEDs or abide by restricted tow times. It is essential to take immediate action to avoid a high risk that sea turtles will be injured or killed after November 30, 1992. While fishing effort is expected to decrease somewhat during winter months, fishing effort, nonetheless, is significant and the duration of tows is often long, presenting a substantial risk of injury or mortality to sea turtles. NMFS estimates that unless sea turtle conservation measures are required throughout the Gulf of Mexico during the months of December, January, and February, approximately 700 sea turtles may be killed by shrimp trawlers.

2. Generally, this final rule requires all shrimp trawlers to use TEDs beginning January 1, 1993. At that time, all shrimp trawlers in offshore waters and most inshore shrimp trawlers (with the exception discussed below) will be required to use TEDs in their nets. The proposed rule would have generally eliminated restricted tow times as an alternative to the use of TEDs. The interim final rule did not implement that proposal.

3. The proposed rule did not provide an exemption from the TED requirement for small trawlers or for trawlers equipped with small nets. NMFS has determined that a phase-in of the new requirements is likely to minimize disruptions to the shrimp fishery, while providing adequate protections for sea turtles. Therefore, until December 1, 1994, a shrimp trawler operating in inshore waters and using a single net with a headrope of less than 35 feet (10.7 m) in length and a footrope of less than 44 feet (13.4 m) in length may limit tow times to no more than 55 minutes from April 1 through October 31, and to no more than 75 minutes from November 1 through March 31, as an alternative to using a TED. A single net is required to prevent shrimpers from switching from relatively large single nets to two or more smaller nets to avoid having to use TEDs. Some fishermen, where state regulations allow, may want to use two trawls in inshore waters, especially during the brown shrimp season. NMFS encourages fishermen to experiment with approved TEDs in smaller nets, and will provide such fishermen with technical assistance. Recent gear research has shown that 25-foot (7.6-m) nets can be modified to accommodate grid TEDs. This final rule also specifies a maximum footrope length to discourage attempts to distort nets to evade the requirement to use TEDs.

A headrope length of 35 feet (10.7 m) was selected because virtually all existing TEDs can be accommodated in nets this size or larger. Some types of TEDs can be used in many smaller nets, including most nets with headropes of 30 feet (9.1 m), and many nets with headropes as small as 25 feet (7.6 m). In some cases, additional time, experience, or instruction may be necessary to make TEDs function properly in small inshore nets. Also, NMFS believes that additional testing and evaluation of TEDs, especially soft TEDs, may provide more and better options for shrimp fishermen using small or lightweight nets. The December 1, 1994, date of applicability of this requirement will provide sufficient time for this additional testing and allow fishermen time to gain experience with TEDs.

The headrope length of 35 feet (10.7 m) also is based, in part, on new information on the inshore shrimp fleet and fishery. When the original TED regulations were implemented, NMFS knew relatively little about the gear, vessels or fishing conditions of this inshore fishery. Virtually all vessel observer coverage and most TED research efforts were conducted on offshore trawlers. More recent information indicates there are more variations in the gear, equipment, and boats used in the inshore shrimp fishery, as well as unique fishing conditions in some areas. For example, light twine nets are commonly used inshore. These nets are often constructed of weaker materials than those used offshore. Some of the inshore nets with headropes of less than 35 feet (10.7 m) may stretch and twist when TEDs are installed, or may be more difficult to use in some inshore areas that have special fishing conditions. NMFS gear specialists are investigating existing and new TEDs that could be used in these nets and in these areas, without reducing either fishing efficiency or turtle exclusion capabilities. At this time, NMFS gear specialists are confident that TEDs will work effectively inshore in nets that have a headrope length of 35 feet (10.7 m) or more.

This approach differs from the interim final sea turtle conservation regulations, which exempted shrimp trawlers less than 25 feet (7.6 m) in length from using TEDs in offshore waters. Taking all factors into consideration, NMFS believes that net size is a better criterion than trawler length for determining whether TEDs are required in inshore waters. Offshore trawlers, designed to optimize seaworthiness, are relatively consistent in design from vessel to vessel. Inshore, in protected waters, trawler designs tend to vary greatly. Also, the trawl towing capability of an inshore trawler is more a function of engine power than length. The propulsion system of inshore trawlers is often optimized for towing power as opposed to running speed, because traveling distances are normally not as great, and there may be less need to seek a speedy refuge from an approaching storm.

NMFS recognizes that enforcement of tow-time restrictions is problematic and that using headrope length as the basis for the requirement to use TEDs may present special enforcement problems. These enforcement difficulties will be ameliorated somewhat by allowing only shrimp trawlers with one net rigged for fishing to use the restricted tow-time option. A more concentrated enforcement effort may be necessary in many inshore areas. Nonetheless, if there is widespread noncompliance with the tow-time restrictions in inshore waters, or with other requirements, the interim final rule established new procedures to facilitate a quick response.

This final rule does not extend the limited exemption for trawlers using a single small net to vessels operating offshore because, unlike some trawlers operating with a small net in inshore waters, trawlers operating in offshore waters should be able to equip their nets to operate efficiently with TEDs by January 1, 1993. TEDs have been thoroughly tested and extensively used in offshore waters.

In some cases, small trawlers that normally operate inshore will be required to use TEDs when they are fishing in offshore waters. NMFS expects that most nets used by these trawlers can be equipped with TEDs, using current technology. Additionally, when operating offshore, these smaller trawlers often fish near the coast. Available evidence suggests that mortalities of the critically endangered Kemp's ridley sea turtle often occur when shrimping operations are conducted in these coastal offshore waters. Thus, NMFS has determined that all shrimp trawlers, regardless of length or net size, should be required to use TEDs in offshore waters as soon as practicable to maximize sea turtle protection.

4. This final rule corrects, clarifies, and makes minor amendments to the regulations implemented by the interim rule. For example, technical changes in describing allowable modifications and generic grid TED descriptions are made on the recommendation of NMFS gear specialists. Specifically, the attachment of an accelerator funnel to the TED extension webbing or grid bars opposite the escape opening reduces shrimp loss, and is recommended by gear specialists. This provision in no way hinders turtle release. This specification and others are designed to clarify and explain gear terms and to enhance enforceability of the regulations.

5. This final rule adds registration provisions that may be required for emergency TED exemption programs or temporary sea turtle conservation measures in NMFS-designated restricted areas. The need for the registration of fishermen was identified in the use of the emergency TED exemption provision of the interim final rule in 1992, both off North Carolina and Louisiana. Registration is needed to monitor fishing effort, to monitor incidental capture of turtles, to facilitate placement of observers, and for enforcement purposes. NMFS would be unable to respond to future emergency conditions requiring TED exemptions, temporary observer requirements, and other conservation measures, without the ability to identify and register the participants. While approval for registration of fishermen was granted by OMB in North Carolina and Louisiana, prior OMB approval for registration would allow NMFS to respond more quickly to emergency situations. NMFS has requested comprehensive authorization from OMB to collect registration information through brief telephone interviews, if necessary, to implement several potential emergency actions.

In order to provide continuity and to avoid confusion, many paragraphs amended by the interim final rule that are not changed by this final rule (e.g., many of the definitions in § 217.12) are republished as a part of the regulatory text of this final rule, together with amended text as explained in this preamble.

Classification

The Assistant Administrator for Fisheries, NOAA, (Assistant Administrator) has determined that this rule is consistent with the ESA and other applicable law. NMFS conducted a consultation under section 7 of the ESA for the 1987 sea turtle conservation regulations (52 FR 24244, June 29, 1987). A biological opinion was prepared analyzing those regulations. Additional consultation has been conducted to analyze the effects of the shrimp trawl fishery in the southeastern United States on sea turtles and other species listed under the ESA. The biological opinion prepared for this consultation, issued on August 19, 1992, concludes that operation of the shrimp trawl fishery, upon implementation of specified measures pursuant to the phase-in schedule specified in this final rule, is not likely to jeopardize the continued existence of sea turtles or other listed species. This final rule is consistent with the terms and conditions of the incidental take statement that is included in the biological opinion.

A regulatory impact review/regulatory flexibility analysis (RIR/RFA) was prepared for the 1987 sea turtle conservation regulations. A combination Environmental Assessment (EA) and supplemental RIR was prepared for the proposed amendments that were not already analyzed in the original analysis. An EA/RIR was also prepared on August 19, 1992. The supplemental RIR indicates that this final rule is not a "major rule" for which a regulatory impact analysis is required under E.O. 12291.

An environmental impact statement (EIS) was prepared for the listing of three species of sea turtles: the green loggerhead, and olive ridley. The EIS addressed the development of gear and procedures to reduce the incidental take and mortality of sea turtles in shrimp trawls. An EA that described a voluntary program to encourage the use the TEDs was prepared in 1983. A supplemental EIS covering the mandatory TED and tow-time requirements was prepared in 1987. A combination EA and supplemental RIR was prepared on August 19, 1992. The major provisions of the interim final rule and this final rule were analyzed as the preferred alternative in the EA. This EA concluded that the preferred alternative would not result in an adverse effect on the human environment.

NMFS has determined that this rule will be implemented in a manner that is consistent to the maximum extent practicable with the approved coastal zone management programs of Alabama, Florida, Louisiana, Mississippi, North Carolina, and South Carolina. Georgia and Texas do not participate in the Federal coastal zone management program. These determinations were submitted for review by the responsible state agencies under section 307 of the Coastal Zone Management Act.

Neither this final rule nor the ESA precludes any state from adopting more stringent sea turtle protection measures. This final rule does not contain policies with federalism implications sufficient to warrant preparation of a federalism assessment under E.O. 12612.

This final rule contains a collection-of-information requirement subject to the Paperwork Reduction Act (PRA). Section 227.72(e) (3)(v) and (6)(iv) provides for the registration of fishermen to implement emergency TED exemptions or sea turtle conservation measures. A request to make this collection has been submitted to the Office of Management and Budget (OMB). The public reporting burden for this collection of information is estimated to average 7 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, may be sent to NMFS and OMB (see ADDRESSES).

NMFS has determined that good cause exists to make this final rule effective on December 1, 1992, thereby waiving the 30-day delayed effectiveness date requirement of section 553(d) of the Administrative Procedure Act. Good cause exists because of the need to protect sea turtles in the Gulf of Mexico no later than December 1, 1992. A delay in the implementation of this rule beyond that date may jeopardize the continued existence of endangered and threatened sea turtles and may require the closure of the shrimp fishery. Furthermore, this final rule extends requirements in effect under the interim final rule until January 1, 1993; additional time is not required to comply with the requirements imposed by this final rule since the requirements are substantially similar to those now in effect. Consequently, NMFS has determined that there is good cause to make this final rule effective on December 1, 1992.

List of Subjects

50 CFR Part 217

Endangered and threatened species, Exports, Fish, Imports, Marine mammals, Transportation.

50 CFR Part 227

Endangered and threatened species, Exports, Imports, Marine mammals, Transportation.

Dated: November 30, 1992.

William W. Fox, Jr.,

Assistant Administrator for Fisheries.

For the reasons set forth in the preamble, the interim rule amending 50 CFR parts 217 and 227 that was published at 57 FR 40861 on September 8, 1992, is adopted as a final rule with the following changes:

PART 217—GENERAL PROVISIONS

1. The authority citation for part 217 continues to read as follows:

Authority: 16 U.S.C. 1531–1544; and 16 U.S.C. 742a *et seq.*, unless otherwise noted.

2. In § 217.12, the definitions for "Southwest Florida Area" and "Tow time" are removed; the definitions for "Atlantic Area", "Gulf Area", and "Shrimp" are revised; and the definitions of "Accelerator funnel", "Approved TED", "Authorized officer", "Bait shrimper", "Fishing, or to fish", "Footrope", "Footrope length", "Hard TED", "Headrope", "Headrope length", "Pusher-head trawl (chopsticks)", "Shrimp trawler", "Skimmer trawl", "Soft TED", "Stretched mesh size", "Taut", "TED (turtle excluder device)", "Test net, or try net", and "Wing net (butterfly trawl)" are republished to read as follows:

§ 217.12 Definitions.

Accelerator funnel means a device used to accelerate the flow of water through a shrimp trawl net.

* * * * *

Approved TED means:

(1) A hard TED that complies with the generic design criteria set forth in 50 CFR 227.72(e)(4)(i). (A hard TED may be modified as specifically authorized by 50 CFR 227.72(e)(4)(iii)); or

(2) A soft TED that complies with the provisions of 50 CFR 227.72(e)(4)(ii).

* * * * *

Atlantic Area means all waters of the Atlantic Ocean south of 36°33'00.8" N. latitude (the line of the North Carolina/Virginia border) and adjacent seas, other than waters of the Gulf Area, and all waters shoreward thereof (including ports).

Authorized officer means:

(1) Any commissioned, warrant, or petty officer of the U.S. Coast Guard;

(2) Any special agent or enforcement officer of the National Marine Fisheries Service;

(3) Any officer designated by the head of a Federal or state agency that has entered into an agreement with the Secretary or the Commandant of the Coast Guard to enforce the provisions of the Act; or

(4) Any Coast Guard personnel accompanying and acting under the direction of any person described in paragraph (1) of this definition.

Bait shrimper means a shrimp trawler that fishes for and retains its shrimp catch alive for the purpose of selling it for use as bait.

* * * * *

Fishing, or to fish, means:

(1) The catching, taking, or harvesting of fish or wildlife;

(2) The attempted catching, taking, or harvesting of fish or wildlife;

(3) Any other activity that can reasonably be expected to result in the catching, taking, or harvesting of fish or wildlife; or

(4) Any operations on any waters in support of, or in preparation for, any activity described in paragraphs (1) through (3) of this definition.

* * * * *

Footrope means a weighted rope or cable attached to the lower lip (bottom edge) of the mouth of a trawl net along the forwardmost webbing.

Footrope length means the distance between the points at which the ends of the footrope are attached to the trawl net, measured along the forwardmost webbing.

* * * * *

Gulf Area means all waters of the Gulf of Mexico west of 81° W. longitude (the line at which the Gulf Area meets the Atlantic Area) and all waters shoreward thereof (including ports).

Hard TED means a rigid deflector grid and associated hardware designed to be installed in a trawl net forward of the codend for the purpose of excluding sea turtles from the net.

Headrope means a rope that is attached to the upper lip (top edge) of the mouth of a trawl net along the forwardmost webbing.

Headrope length means the distance between the points at which the ends of the headrope are attached to the trawl net, measured along the forwardmost webbing.

* * * * *

Pusher-head trawl (chopsticks) means a trawl that is spread by poles suspended in a "V" configuration from the bow of the trawler.

* * * * *

Shrimp means any species of marine shrimp (Order Crustacea) found in the Atlantic Area or the Gulf Area, including, but not limited to:

(1) Brown shrimp (*Penaeus aztecus*);

(2) White shrimp (*P. setiferus*);

(3) Pink shrimp (*P. duorarum*);

(4) Rock shrimp (*Sicyonia brevirostris*);

(5) Royal red shrimp (*Hymenopenaeus robustus*); and

(6) Seabob shrimp (*Xiphopenaeus kroyeri*).

Shrimp trawler means any vessel that is equipped with one or more trawl nets and that is capable of, or used for, fishing for shrimp, or whose on-board or landed catch of shrimp is more than 1 percent, by weight, of all fish comprising its on-board or landed catch.

Skimmer trawl means a trawl that extends from the outrigger of a vessel with a cable and a lead weight holding the trawl mouth open.

Soft TED means a panel of polypropylene or polyethylene netting designed to be installed in a trawl net forward of the codend for the purpose of excluding sea turtles from the net.

* * * * *

Stretched mesh size means the distance between the centers of the two opposite knots in the same mesh when pulled taut.

* * * * *

Taut means a condition in which there is no slack in the net webbing.

TED (turtle excluder device) means a device designed to be installed in a trawl net forward of the codend for the purpose of excluding sea turtles from the net.

Test net, or try net, means a net pulled for brief periods of time just before, or during, deployment of the primary net(s) in order to test for shrimp concentrations or determine fishing conditions (e.g., presence or absence of bottom debris, jellyfish, bycatch, seagrasses, etc.).

Wing net (butterfly trawl) means a trawl with a rigid frame, rather than trawl door, holding the trawl mouth open.

PART 227—THREATENED FISH AND WILDLIFE

3. The authority citation for part 227 continues to read as follows:

Authority: 16 U.S.C. 1531 *et seq.*

4. In § 227.71, paragraphs (a) and (b) are revised and paragraph (c) is republished to read as follows:

§ 227.71 Prohibitions.

(a) Except as provided in § 227.72, the prohibitions of section 9 of the Act (16 U.S.C. 1538) relating to endangered species apply to any species of sea turtle enumerated in § 227.4.

(b) Except as provided in § 227.72, it is unlawful for any person subject to the jurisdiction of the United States to do any of the following:

(1) Own, operate, or be on board a vessel, except if that vessel is in compliance with all applicable provisions of § 227.72(e);

(2) Fish for, catch, take, harvest, or possess, fish or wildlife while on board a vessel, except if that vessel is in compliance with all applicable provisions of § 227.72(e);

(3) Fish for, catch, take, harvest, or possess, fish or wildlife contrary to any notice of tow-time or other restriction specified in, or issued under, § 227.72(e)(3) or (6);

(4) Possess fish or wildlife taken in violation of paragraph (b) of this section;

(5) Fail to follow any of the sea turtle handling and resuscitation requirements specified in § 227.72(e)(1);

(6) Possess a sea turtle in any manner contrary to the handling and resuscitation requirements of § 227.72(e)(1);

(7) Fail to comply immediately, in the manner specified at 50 CFR 620.8 (b)-(d), with instructions and signals specified therein issued by an authorized officer, including instructions and signals to haul back a net for inspection;

(8) Refuse to allow an authorized officer to board a vessel, or to enter an area where fish or wildlife may be found, for the purpose of conducting a boarding, search, inspection, seizure, investigation, or arrest in connection with enforcement of this section;

(9) Destroy, stave, damage, or dispose of in any manner, fish or wildlife, gear, cargo, or any other matter after a communication or signal from an authorized officer, or upon the approach of such an officer or of an enforcement vessel or aircraft, before the officer has an opportunity to inspect same, or in contravention of directions from the officer;

(10) Assault, resist, oppose, impede, intimidate, threaten, obstruct, delay, prevent, or interfere with an authorized officer in the conduct of any boarding, search, inspection, seizure, investigation, or arrest in connection with enforcement of this section;

(11) Interfere with, delay, or prevent by any means, the apprehension of another person, knowing that such person committed an act prohibited by this section;

(12) Resist a lawful arrest for an act prohibited by this section;

(13) Make a false statement, oral or written, to an authorized officer or to the agency concerning the fishing for, catching, taking, harvesting, landing, purchasing, selling, or transferring fish or wildlife, or concerning any other matter subject to investigation under this section by such officer, or required to be submitted under this part 227;

(14) Sell, barter, trade or offer to sell, barter, or trade, a TED that is not an approved TED; or

(15) Attempt to do, solicit another to do, or cause to be done, any of the foregoing.

(c) In connection with any action alleging a violation of this section, any person claiming the benefit of any exemption, exception, or permit under this subpart D has the burden of proving that the exemption, exception, or permit is applicable, was granted, and was valid and in force at the time of the alleged violation. Further, any person claiming that a modification made to a TED that is the subject of such an action complies with the requirements of § 227.72(e)(4)(iii) has the burden of proving such claim.

5. In § 227.72, paragraph (e) is revised to read as follows:

§ 227.72 Exceptions to prohibitions.

* * * * *

(e) *Exception for incidental taking*—(1) *General.* The prohibitions against taking in § 227.71(a) do not apply to the incidental take of any member of any species of sea turtle listed in § 227.4 (i.e., a take not directed toward such member) during fishing or scientific research activities to the extent that those involved are in compliance with the requirements of paragraphs (e)(1), (e)(2), (e)(3), and (e)(6) of this section.

(i) Any specimen so taken must be handled with due care to prevent injury to live specimens, observed for activity, and returned to the water according to the following procedures:

(A) Sea turtles that are dead or actively moving must be released over the stern of the boat. In addition, they must be released only when trawls are not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels.

(B) Resuscitation must be attempted on sea turtles that are comatose or inactive but not dead by:

(*1*) Placing the turtle on its back (carapace) and pumping its breastplate (plastron) with hand or foot; or

(*2*) Placing the turtle on its breastplate (plastron) and elevating its hindquarter several inches for a period of 1 up to 24 hours. The amount of the elevation depends on the size of the turtle; greater elevations are needed for larger turtles. Sea turtles being resuscitated must be shaded and kept wet or moist. Those that revive and become active must be released over the stern of the boat only when trawls are not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels. Similarly, sea turtles that fail to move within several hours (up to 24, if possible) must be returned to the water in the same manner.

(ii) Any specimen so taken must not be consumed, sold, landed, offloaded, transshipped, or kept below deck.

(2) *Gear requirements.*—(i) *TED requirement.* Except as provided in paragraph (e)(2)(ii) of this section, any shrimp trawler that is in the Atlantic Area or Gulf Area must have an approved TED (as defined in § 217.12 of this subchapter) installed in each net that is rigged for fishing. A net is rigged for fishing if it is in the water, or if it is shackled, tied, or otherwise connected to any trawl door or board, or to any tow rope, cable, pole or extension, either on board or attached in any manner to the shrimp trawler.

(ii) *Exemptions from the TED requirement.* (A) A shrimp trawler is exempt from the TED requirements of paragraph (e)(2)(i) of this section if it complies with the alternative tow-time restrictions in paragraph (e)(3)(i) of this section and if it:

(*1*) Has on board no power or mechanical-advantage trawl retrieval system (i.e., any device used to haul any part of the net aboard);

(*2*) Is a bait shrimper that retains all live shrimp on board in a container with a circulating seawater system, if it does not possess more than 32 pounds (14.5 kg) of dead shrimp on board, and if it has on board a valid original state bait-shrimp license (if in a state that requires such a license);

(*3*) Has only a pusher-head trawl, skimmer trawl, or wing net rigged for fishing;

(*4*) Is in an area during a period for which tow-time restrictions apply under paragraphs (e)(3)(ii) or (iii) of this section, if it complies with all applicable provisions imposed under those paragraphs;

(*5*) Prior to January 1, 1993, is in inshore waters;

(*6*) Prior to January 1, 1993, is in offshore waters, if it is less than 25 feet (7.6 m) in length; or

(*7*) Prior to December 1, 1994, is in inshore waters, if it has no more than one net rigged for fishing (other than a test (or try) net), if that net has both a headrope length of less than 35 feet (10.7 m) and a footrope length of less than 44 feet (13.4 m).

(B) The following fishing gear or activities are exempted from the TED requirements of paragraph (e)(2)(i) of this section:

(*1*) A single test net (try net) with a headrope length of 20 feet (6.1 m) or less, if it is either pulled immediately in front of another net or is not connected to another net in any way, if no more than one test net is used at a time, and if it is not towed as a primary net;

(*2*) A beam or roller trawl fished without doors, boards, or similar devices, that has a mouth formed by a rigid frame and rigid vertical bars, if none of the spaces between the bars, or between the bars and the frame, exceed 4 inches (10.2 cm); and

(*3*) A shrimp trawler fishing for, or possessing, royal red shrimp, if at least 90 percent (by weight) of all shrimp either found on board, or offloaded from that shrimp trawler, is royal red shrimp.

(3) *Tow-time restrictions.*—(i) *Duration of tows.* If tow-time restrictions are utilized pursuant to paragraphs (e)(2)(ii), (e)(3)(ii), or (e)(3)(iii) of this section, a shrimp trawler must limit tow times to no more than 55 minutes from April 1 through October 31, and to no more than 75 minutes from November 1 through March 31. The tow time is measured from the time that the trawl door enters the water until it is removed from the water. For a trawl net that is not attached to a door, the tow time is measured from the time the codend enters the water until it is removed from the water.

(ii) *Alternative—special environmental conditions.* The Assistant Administrator may allow compliance with tow-time restrictions, as an alternative to the TED requirement of paragraph (e)(2)(i) of this section, if he/she determines that the presence of algae, seaweed, debris or other special environmental conditions in a particular area makes trawling with TED-equipped nets impracticable.

(iii) *Substitute—ineffectiveness of TEDs.* The Assistant Administrator may require compliance with tow-time restrictions, as a substitute for the TED requirement of paragraph (e)(2)(i) of this section, if he/she determines that TEDs are ineffective in protecting sea turtles.

(iv) *Notice; applicability; conditions.* The Assistant Administrator will publish notification concerning any tow-time restriction imposed under paragraphs (e)(3) (ii) or (iii) of this section in the Federal Register and will announce it in summary form on channel 16 of the marine VHF radio. A notification of tow-time restrictions will include findings in support of these restrictions as an alternative to, or as substitute for, the TED requirements of paragraph (e)(2)(i) of this section. The notification will specify the effective dates, the geographic area where tow-time restrictions apply, and any applicable conditions or restrictions that the Assistant Administrator determines are necessary or appropriate to protect sea turtles and ensure compliance, including, but not limited to, a requirement to carry observers, or for all shrimp trawlers in the area to synchronize their tow times so that all trawl gear remains out of the water during certain times. A notification withdrawing tow-time restrictions will include findings in support of that action.

(v) *Registration.* If the Assistant Administrator imposes restrictions under paragraph (e)(3) (ii) or (iii) of this section, he/she may require the owner and operator of a shrimp trawler to register before entering an area where, and during the time when, the restrictions apply. If registration is required, the trawler's owner and operator must submit the following information to the NMFS Regional Office:

(A) The name and official number (or registration number) of the shrimp trawler;

(B) The names, mailing and street addresses, and telephone numbers of the trawler owner and operator;

(C) The permit number or other identification of relevant state or Federal fishing permit(s);

(D) Where and when the trawler intends to fish;

(E) Where and when the trawler will depart on any fishing trip, with sufficient specificity to allow for an observer to embark on the trip; and

(F) Any changes in the information submitted under paragraphs (e)(3)(v) (A) through (E) of this section. Failure to do so immediately will void the registration, which will render unlawful any subsequent entry of the shrimp trawler into the area where and during the time when the restrictions apply.

(vi) *Procedures.* The Assistant Administrator will consult with the appropriate fishery officials (state or Federal) where the affected shrimp fishery is located in issuing a notification concerning tow-time restrictions. An emergency notification can be effective for a period of up to 30 days and may be renewed for additional periods of up to 30 days each if the Assistant Administrator finds that the conditions that necessitated the imposition of tow-time restrictions continue to exist. The Assistant Administrator may invite comments on such an action, and may withdrew or modify the action by following procedures similar to those for implementation. The Assistant Administrator will implement any permanent tow-time restriction through rulemaking.

(4) *Approved TEDs.* Any netting, webbing, or mesh that may be measured to determine compliance with this paragraph (e)(4) is subject to measurement, regardless of whether it is wet or dry. Any such measurement will be of the stretched mesh size.

(i) *Hard TEDs.* Hard TEDs are TEDs with rigid deflector grids and are categorized as "hooped hard TEDs," such as the NMFS and Cameron TEDs (Figures 1 & 2), or "single-grid hard TEDs," such as the Matagorda and Georgia TEDs (Figures 3 & 4). Hard TEDs complying with the following generic design criteria are approved TEDs:

(A) *Construction materials.* A hard TED must be constructed of one or a combination of the following materials, with minimum dimensions as follows:

(*1*) Solid steel rod with a minimum outside diameter of ¼ inch (0.64 cm);

(*2*) Fiberglass or aluminum rod with a minimum outside diameter of ½ inch (1.27 cm); or

(*3*) Steel or aluminum tubing with a maximum inside diameter of ¼ inch (0.64 cm) and a minimum outside diameter of ½ inch (1.27 cm) (schedule 40 tubing).

(B) *Method of attachment.* A hard TED must be sewn into the trawl around the entire circumference of the TED with heavy twine.

(C) *Angle of deflector bars.* The angle of the deflector bars must be between 30° and 50° from the normal, horizontal flow through the interior of the trawl.

(D) *Space between bars.* The space between deflector bars, and between the deflector bars and the frame, must not exceed 4 inches (10.2 cm).

(E) *Direction of bars.* The deflector bars must run from top to bottom of the

TED, as the TED is positioned in the net, except that up to four of the bottom bars and two of the top bars, including the frame, may run from side to side of the TED.

(F) *Position of escape opening*. The entire width of the escape opening from the trawl must be centered on and immediately forward of the frame at either the top or bottom of the net when the net is in its deployed position. The escape opening must be at the top of the net when the slope of the deflector bars from forward to aft is upward, and must be at the bottom when such slope is downward. For a single-grid TED, the escape opening must be cut horizontally along the same plane as the TED, and may not be cut in a fore-and-aft direction.

(G) *Size of escape opening*. (*1*) On a hooped hard TED, the escape opening must not be smaller than 25 inches by 25 inches (63.5 cm by 63.5 cm) in the Gulf Area, or 30 inches by 30 inches (76.2 cm by 76.2 cm) in the Atlantic Area. If a door frame is used over the escape opening, it must open a minimum height of 10 inches (25.4 cm) in the Gulf Area, or 12 inches (30.5 cm) in the Atlantic Area.

(*2*) On a single-grid hard TED, the escape opening in the net webbing must measure at least 32 inches (81.3 cm) in horizontal taut length and, simultaneously, 10 inches (25.4 cm) in vertical taut height in the Gulf Area; or 35 inches (88.9 cm) in horizontal taut length and, simultaneously, 12 inches (30.5 cm) in vertical taut height in the Atlantic Area. The vertical measurement must be taken at the mid-point of the horizontal measurement.

(H) *Size of hoop or grid*. (*1*) *Hooped hard TED*. (*i*) An oval front hoop on a hard TED must have an inside horizontal measurement of at least 32 inches (81.3 cm) and an inside vertical measurement of at least 20 inches (50.8 cm) in the Gulf Area, or an inside horizontal measurement of at least 35 inches (88.9 cm) and an inside vertical measurement of at least 30 inches (76.2 cm) in the Atlantic Area.

(*ii*) A circular front hoop on a hard TED must have an inside diameter of at least 32 inches (81.3 cm) in the Gulf Area or 35 inches (88.9 cm) in the Atlantic Area.

(*2*) *Single-grid hard TED*. A single-grid hard TED must have an inside horizontal and vertical measurement of at least 28 inches (71.1 cm) in the Gulf Area or 30 inches (76.2 cm) in the Atlantic Area. The required inside measurements must be at the mid-point of the deflector grid.

(ii) *Soft TEDS*. Soft TEDs are TEDs with deflector panels made from polypropylene or polyethylene netting. The following soft TEDs are approved TEDs:

(A) *Morrison TED* (Figures 5 & 6). The Morrison TED uses synthetic mesh webbing for its deflector panel(s). The webbing must consist of number 42 (3-mm thick) or larger polypropylene or polyethylene webbing that is heat-set knotted or braided. The stretched mesh size may not exceed 8 inches (20.3 cm). The webbing may be installed either as one main excluder panel or as a main and two side (jib) excluder panels (Figure 6), so long as it forms a complete barrier to large objects inside the trawl net forward of the codend. The base (leading edge) of the excluder panel(s) must be sewn to the bottom body of the trawl net at least 16 feet 8 inches (5.1 m) forward of the point at which the codend is attached to the trawl net. The apex of the excluder panel(s) must be sewn to the center of the top body of the trawl net not more than 20 inches (50.8 cm) forward of the point at which the codend is attached to the trawl net. The meshes of the leading edge of the excluder panel shall be sewn evenly onto the bottom belly of the trawl following the same row of meshes from seam to seam, including the wings (i.e., the sides of the trawl that separate the top from the bottom). The leading edge of the panel cannot be installed on a bias. If a net extension is inserted forward of the codend, the base and apex attachments of the excluder panel(s) must be measured from the forward attachment points of such extension. The horizontal taut length of the stretched main excluder panel may not be less than 15 feet (4.6 m). Each point on the circumference of the webbing must be sewn to the trawl net. The meshes of the webbing must be under tension when the codend is pulled aft, thus forming diamond patterns pointing toward the top of the trawl net. As an escape opening, a slit at least 4 feet 8 inches (1.4 m) in taut length must be cut in a fore-and-aft direction at the top of the trawl net immediately forward of the apex of the panel webbing. The slit may not be covered or closed in any manner.

(B) *Parrish TED* (Figure 7). The Parrish TED consists of an extension and deflector panel made of synthetic mesh and a steel frame. The extension must be a piece of 1¾-inch (4.4-cm) stretched mesh, no. 15 thread, treated nylon, measuring 150 meshes by 100 meshes and installed in the trawl. When installed, the extension must be cylindrically shaped with a circumference of 150 meshes and a depth of 100 meshes. The deflector panel must slope down the inside of the extension and must be a rectangular piece of 8-inch (20.3-cm), stretched mesh, 3-mm diameter, braided polyethylene. The deflector panel must measure eight meshes across its leading and trailing edges and be 15½ meshes deep. The eight meshes at the leading edge of the deflector panel must be sewn into the small (1¾-inch) (4.4-cm) mesh of the extension three meshes down from the top edge of the extension. The eight meshes at the trailing edge must be attached to the top edge of the frame. Each side edge of the deflector panel must be attached at 5⅝-inch (14.3-cm) intervals to a ⅜-inch (1.0-cm) diameter, three-strand polydacron rope, which must be attached to the small mesh of the extension at 5⅝-inch (14.3-cm) intervals. The deflector panel must form a complete barrier to large objects inside the extension forward of the frame. The frame must be a rectangular, ⅜-inch (1.0-cm) diameter, welded galvanized steel rod unit with a 40-inch by 4-inch (101.6-cm by 10.2-cm) opening and small pad eyes at the top corners. The trailing-edge meshes of the deflector panel must be attached to the top of the frame, and 50 lateral meshes of the extension netting (1¾-inch (4.4.-cm) mesh) must be centered and sewn to the bottom and sides of the frame. The escape opening must consist of a lateral slit, measuring 40 meshes, cut from the leading edge at the bottom of the frame. A bungee cord having a 50-inch (127.0-cm) non-stretched length and a ¼-inch (0.64-cm) diameter must be laced through the meshes at the cut. Opposing ends of the bungee cord must be secured to the opposing pad eyes at the top of the frame. One end of a flap measuring 50 meshes across by 30 meshes deep must be attached to the meshes at the cut.

(C) *Andrews TED* (Figures 8a & 8b). The Andrews TED is a funnel constructed of 5-inch (12.7-cm) stretched mesh polyethylene or polypropylene webbing that is sewn inside a shrimp trawl. The leading edge of the funnel must be sewn with heavy twine at all points to the outer trawl beginning on the row of meshes located 20 meshes behind the center of the footrope and continuing around the circumference of the trawl, following the same row of meshes. The webbing must not be laced with rope. The funnel must taper to an escape opening in the bottom of the trawl. The rear edge of the escape opening must be located no more than 20 inches (50.8 cm) ahead of the net extension. The trailing edge on the funnel must be sewn at all points around the circumference of the escape opening. The escape opening must be at least 96 inches (243.8 cm) in circumference. A webbing flap may be used to cover the escape opening if no device holds the webbing flap closed or otherwise restricts the opening, and if such flap is constructed of webbing that has a stretched mesh size no larger than 2-inch (5.1-cm), lies on the outside of the trawl, is attached along its entire forward edge forward of the escape opening, is 50 meshes wide and 15 meshes deep, does not overlap the exit opening more than five meshes on each side (it may be attached along the 15-mesh edge), and maintains an opening of at least 48 inches (121.9 cm) in a taut position.

(iii) *Allowable modifications*. No modifications may be made to an approved soft TED. Only the following modifications may be made to an approved hard TED:

(A) Floats may be attached to the TED, either outside or inside of the net, but not to a flap. Floats attached inside the net must be behind the rear surface at the top of the TED.

(B) An accelerator funnel may be installed in the trawl, if it is made of net webbing material with a stretched mesh size not greater than 1⅝ inches (4.1 cm), if it has an inside horizontal opening of at least 39 inches (99.1 cm) when measured in a taut position, if it is inserted in the net immediately forward of the TED, and if its rear edge does not extend past the bars of the TED. The accelerator funnel may be attached to the TED on the side opposite the escape opening if not more than ⅓ of its circumference is attached, and if the inside horizontal opening of at least 39 inches (99.1 cm) is maintained. In a downward shooting TED, only the top ⅓ of the circumference of the funnel may be attached. In an upward shooting TED, only the bottom ⅓ of the circumference of the funnel may be attached.

(C) A webbing flap may be used to cover the escape opening if no device holds it closed or otherwise restricts the opening, and if it is constructed of webbing with a stretched mesh size no larger than 1⅝-inch (4.1-cm), lies on the outside of the trawl, is attached along its entire forward edge forward of the escape opening, is not attached on the sides more than 6 inches (15.2 cm) beyond the posterior edge of the grid, and does not extend more than 24 inches (61.0 cm) beyond the posterior edge of the grid.

(5) *Revision of generic design criteria and allowable modification of hard TEDs and additional soft TEDs*. (i) The Assistant Administrator may revise the generic design criteria for hard TEDs set forth in paragraph (e)(4)(i) of this section, may approve allowable modifications to hard TEDs in addition to those authorized in paragraph (e)(4)(iii) of this section, or may approve soft TEDs in addition to those listed in paragraph (e)(4)(ii) of this section, by a regulatory amendment if, according to a NMFS-approved scientific protocol, the TEDs demonstrate a sea turtle exclusion rate of 97 percent or greater (or an equivalent exclusion rate). Two such protocols have been published by NMFS (52 FR 24262, June 29, 1987; and 55 FR 41092, October 9, 1990). Testing under the protocol must be conducted under the supervision of the Assistant Administrator, and shall be subject to all such conditions and restrictions as the Assistant Administrator deems appropriate. Any person wishing to participate in such testing should contact the Director, Southeast Fisheries Science Center, NMFS, 75 Virginia Beach Drive, Miami, FL 33149.

(ii) Upon application, the Assistant Administrator may issue permits, subject to such conditions and restrictions as the Assistant Administrator deems appropriate, authorizing public or private experimentation aimed at improving shrimp retention efficiency of existing approved TEDs and at developing additional TEDs, or conducting fishery research, that would otherwise be subject to paragraph (e)(2) of this section. Applications should be addressed to the Director, Southeast Region, NMFS, 9450 Koger Blvd., St. Petersburg, FL 33702.

(6) *Limitations on incidental takings during fishing activities*.—(i) *Limitations*. The exemption for incidental takings of sea turtles in paragraph (e)(1) of this section does not authorize incidental takings during fishing activities if the takings:

(A) Would violate the restrictions, terms, or conditions of an incidental take statement or biological opinion;

(B) Would violate the restrictions, terms, or conditions of an incidental take permit; or

(C) May be likely to jeopardize the continued existence of a species listed under the Act.

(ii) *Determination; restrictions on fishing activities*. The Assistant Administrator may issue a determination that incidental takings during fishing activities are unauthorized. Pursuant thereto, the Assistant Administrator may restrict fishing activities in order to conserve a species listed under the Act, including, but not limited to, restrictions on the fishing activities of vessels subject to paragraph (e)(2)(i) of this section. The Assistant Administrator will take such action if he/she determines that restrictions are necessary to avoid unauthorized takings that may be likely to jeopardize the continued existence of a listed species. The Assistant Administrator may withdraw or modify a determination concerning unauthorized takings or any restriction on fishing activities if the Assistant Administrator determines that such action is warranted.

(iii) *Notice; applicability; conditions*. The Assistant Administrator will publish a notification of a determination concerning unauthorized takings or a notification concerning the restriction of fishing activities in the Federal Register. The Assistant Administrator will provide as much advance notice as possible, consistent with the requirements of the Act, and will announce the notification in summary form on channel 16 of the marine VHF radio. Notification of a determination concerning unauthorized takings will include findings in support of that determination; specify the fishery, including the target species and gear used by the fishery, the area, and the times, for which incidental takings are not authorized; and include such other conditions and restrictions as the Assistant Administrator determines are necessary or appropriate to protect sea turtles and ensure compliance. Notification of restriction of fishing activities will include findings in support of the restriction, will specify the time and area where the restriction is applicable, and will specify any applicable conditions or restrictions that the Assistant Administrator determines are necessary or appropriate to protect sea turtles and ensure compliance. Such conditions and restrictions may include, but are not limited to, limitations on the types of fishing gear that may be used, tow-time restrictions, alteration or extension of the periods of time during which particular tow-time requirements apply, requirements to use TEDs, and requirements to provide observers. Notification of withdrawal or modification will include findings in support of that action.

(iv) *Registration*. If the Assistant Administrator imposes restrictions under paragraph (e)(6)(ii) of this section, he/she may require the owner and operator of a vessel to register before entering an area where, and during the time when, the restrictions apply. If registration is required, the vessel's owner and operator must submit the following information to the NMFS Regional Office:

(A) The name and official number (or registration number) of the vessel;

(B) The names, mailing and street addresses, and telephone numbers of the vessel owner and operator;

(C) The permit number or other identification of relevant state or Federal fishing permit(s);

(D) Where and when the vessel intends to fish; and

(E) Where and when the vessel will depart on any fishing trip, with sufficient specificity to allow for an observer to embark on the trip.

(F) Any changes in the information submitted under paragraphs (e)(6)(iv) (A) through (E) of this section. Failure to do so immediately will void the registration, which will render unlawful any subsequent entry of the fishing vessel into the area where and during the time when the restrictions apply.

(v) *Procedures*. The Assistant Administrator will consult with the appropriate fisheries officials (state or Federal) where the fishing activities are located in issuing notification of a determination concerning unauthorized takings or notification concerning the restriction of fishing activities. An emergency notification will be effective for a period of up to 30 days and may be renewed for additional periods of up to 30 days each. The Assistant Administrator may invite comments on such action, and may withdraw or modify the action by following procedures similar to those for implementation. The Assistant Administrator will implement any permanent determination or restriction through rulemaking.

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APPENDIX IX

ESA Section 7 Consultation- Biological Opinion

Endangered Species Act - Section 7 Consultation

Biological Opinion

Agencies: South Atlantic Fishery Management Council
Gulf of Mexico Fishery Management Council
National Marine Fisheries Service

Activity: Shrimp Trawling, as Proposed by the Councils, in the Southeastern United States from North Carolina through Texas Under the 1992 Revised Sea Turtle Conservation Regulations

Consultation Conducted By: National Marine Fisheries Service

Date Issued: **8-19-92**

A. Background:

On April 9, 1992, Endangered Species Act (ESA) Section 7 consultation was initiated by the South Atlantic Fishery Management Council. This consultation was to address the potential adverse effects to listed species of both the proposed management action (adoption of a Shrimp Fishery Management Plan for the South Atlantic) and the shrimp fishery itself. At about the same time, the Gulf of Mexico Fishery Management Council requested that NMFS initiate consultation on Amendment 6 to the Gulf of Mexico Shrimp Fishery Management Plan (FMP). ESA Section 7 consultation is required prior to implementation of new FMPs or amendments to existing FMPs.

Since both consultations address shrimp fisheries in the southeastern United States, the potential adverse effects of South Atlantic and Gulf of Mexico shrimp fisheries are similar, and because effects to sea turtles must be considered cumulatively in determining whether any species might be jeopardized by this activity, a single consultation has been prepared. Although management actions under shrimp FMPs for the South Atlantic and Gulf of Mexico only apply to Federal waters, this consultation extends beyond political boundaries and applies to all areas where shrimp trawling occurs. In addition to the proposed FMP actions this consultation also considers the fishery as it would be conducted under the 1992 Revised Sea Turtle Conservation Regulations.

A biological opinion on the implementation of the 1987 Sea Turtle Conservation Regulations (52 FR 24244, June 29, 1987) was submitted on September 30, 1987. The 1987 opinion addressed the potential adverse effects to listed species of implementation of the rule, and concluded that the regulations would have a positive impact on sea turtles by substantially reducing positive impact on sea turtles by substantially reducing mortalities. At the time this opinion was issued, the National Marine Fisheries Service (NMFS) policy was to address the potential impacts to listed species of management actions and not to address potential adverse effects of the fishery itself. This policy was changed on October 18, 1990, when the Assistant Administrator for Fisheries advised all Regional Directors that future ESA consultations on FMPs would address both the fishery and proposed management actions.

Incidental capture and mortality of endangered and threatened sea turtles by shrimp trawler has been one of the most controversial issues in the southeast for well over a decade. Because of the economic importance of the shrimp fishery and the number of individuals in the private sector that could be adversely impacted by changes within this fishery, NMFS determined in the late 1970s that resolution of this conflict was of the highest priority. Since that time, considerable resources have been devoted to data collection and analyses related to shrimp fishery/sea turtle interactions.

1. Description of the shrimp fishery in the Gulf of Mexico and southern North Atlantic.

Of all fisheries that occur in the southeastern United States, the shrimp fishery is the most important in terms of value. In 1990, over 277 million pounds of shrimp valued at $454 million were landed in the Gulf of Mexico and southern North Atlantic regions. The southeast shrimp fishery targets shrimp in the family Penaeidae which inhabit the warm, temperate and tropical waters of the world, and are abundant in waters of the U.S. continental shelf, including estuaries, sounds and bays. Catches are dominated by three species; the white shrimp, Penaeus setiferus, the pink shrimp, Penaeus duorarum, and the brown shrimp, Penaeus aztecus. The most commonly employed gear is the otter trawl, but a variety of fishing gears and techniques are used in localized areas.

In providing a general overview of the southeast U.S. shrimp fishery, the offshore commercial fleet was separated from the inshore fleet. Offshore is defined as those waters seaward of the 72 COLREGS demarcation line (International Regulations for Preventing Collisions at Sea, 1972), as depicted or noted on nautical charts published by the National Oceanic and Atmospheric Administration. The offshore fleet consists of larger vessels with larger nets, that operate over wide geographical areas. Offshore vessels may target all three species of penaeid shrimp at different times of the year. Shifts in target species result in varying levels of effort over depths, seasons and areas.

The Gulf of Mexico offshore fleet consists of approximately 5400 vessels, and the offshore southern North Atlantic fleet is composed of about 1500 vessels (NMFS 1987). The majority of the southeast U.S. commercial shrimping effort occurs in the central and western Gulf of Mexico (approximately 4,000,000 trawling hours). The annual southern North Atlantic effort is roughly 550,000 hours. Actual fishing strategies and preferred equipment of the offshore fleet (vessel size, vessel type, number of nets, types of nets, duration of tows, etc.) vary with geographical location, bottom topography, target species, time of the year, and other factors. The level of fishing effort expended in any given area is controlled by seasonal abundance of target species, i.e., the Key West fishery is primarily a winter fishery; the northern Gulf fishery and the Atlantic fishery are primarily summer/fall fisheries.

The inshore commercial shrimping fleet consists of approximately 11,000 boats (less than 25 feet in length). While the otter trawl is the most commonly employed gear, in certain locations butterfly nets, beam trawls, traps, etc. may be used to capture shrimp. In addition to the commercial fleet, approximately 40-50 thousand recreational shrimpers harvest shrimp in inshore waters. Under the existing turtle excluder device (TED) regulations, boats under 25 feet in length are not required to use TEDs, but must restrict their tow times to 90 minutes or less duration in specified areas and during specific seasons.

2. Documented sea turtle/shrimp trawler interactions- the best available information

Some of the earliest records of sea turtle capture by shrimp trawlers were obtained from researchers tagging and releasing adult females on nesting beaches. These early tagging studies were designed to determine distribution and movements of sea turtles away from nesting beaches, and it is noteworthy that most of the tag returns came from shrimp trawlers. While these data did not provide information on the frequency with which turtles were taken in shrimp trawls, they certainly provided evidence that turtles were occasionally caught in trawls.

Another source of direct evidence that turtles were occasionally captured by shrimp trawlers is fisheries landing statistics published annually by NMFS. Through 1975, turtle landings by gear type and species were recorded, and reports of otter trawl captures of sea turtles were common. Here again, turtle landings data do not provide information on the frequency of turtle encounters by shrimp trawlers. These data probably should be viewed as opportunistic rather than as catch rates from directed turtle fisheries.

During the 1960s and 1970s, anecdotal information linking sea turtles to shrimp trawlers abounded. Unfortunately, none of this information was quantifiable, and industry contended that turtle take by shrimp trawlers was such a rare occurrence that impacts to turtle populations were negligible. While a few environmental groups argued otherwise, the problem did not become an issue until the late 1970s.

Perhaps the most obvious link between sea turtles and shrimp trawlers was turtle strandings during times of high nearshore shrimping activity. Strandings data, while extremely weak in terms of demonstrating a cause and effect relationship, got the attention of the general public and led to demands for Federal action. Stranding networks throughout the southeast were organized, and as more beaches were surveyed the number of reported dead turtles increased. Dead turtles on beaches, more than any other evidence of turtle/trawler interactions, prompted Federal actions to further investigate turtle catch and mortality in the shrimp fishery.

The first compelling evidence that sea turtle take by shrimp trawlers might be a major problem came in the late 1970s when NMFS received a report of unprecedented numbers of sea turtles taken in the Canaveral ship channel, Florida. One vessel entered the channel and captured 15 loggerhead turtles in a 20 minute tow while another vessel captured 66 turtles in a 1 hour tow. Trawl surveys were conducted by NMFS during February and March 1978, and the reports of high turtle abundance were corroborated. In late 1978, NMFS initiated a program of monthly trawl surveys of the Canaveral channel to assess turtle distributions and abundance on a seasonal basis. During the next 5 years, over 3,500 turtle captures in otter trawls were recorded in the Canaveral channel alone.

As a result of observed turtle takes in the Canaveral channel and based on a growing body of evidence of a potential ESA problem, NMFS began investigations to assess the magnitude of sea turtle take within the fishery. Data collected by observers aboard commercial shrimp trawlers demonstrated that shrimp trawling in the southeastern United States posed a significant threat to the recovery of sea turtles. Based upon these early studies, turtle mortalities in excess of 11,000 individuals per year were estimated for the southeast shrimp fishery. Subsequent studies by the National Academy of Sciences suggested that this estimate may have underestimated true mortality by a factor of four.

While sea turtle incidental catch and mortality studies were being conducted, NMFS also initiated a program to develop gear that would significantly reduce incidental take of sea turtles in shrimp trawls. The primary objectives of this program were to curtail the take of sea turtles in shrimp nets while achieving a shrimp loss rate of no more than 5 percent. By 1981, these objectives had been met and a TED that reduced turtle take by at least 97 percent was available.

3. The 1987 Sea Turtle conservation Regulations

From 1981 through 1983, NMFS encouraged voluntary use of TEDs in the shrimp fishery. In 1983, NMFS established a formal program which built and delivered TEDs to shrimp fishermen who agreed to use them in commercial shrimp trawling operations. These efforts to introduce TEDs proved ineffective, by 1985 less than 1 percent of the fleet was using these devices. At this time, several environmental groups and the U.S. Fish and Wildlife Service (FWS) began requesting that NMFS and the South Atlantic and Gulf Fishery Management Councils establish regulations requiring the use of TEDs. NMFS continued to pursue the voluntary approach until an August 1986 meeting between environmental interests, the shrimp industry and the National Oceanic and Atmospheric Administration (NOAA), the parent agency of NMFS, was held to discuss the sea turtle problem. The day after this meeting, the Center for Environmental Education (CEE) filed written notice to the Secretary of Commerce that an emergency existed and that the Secretary was violating the ESA by not taking immediate actions to either close the fishery or implement appropriate measures to eliminate take of sea turtles.

In response NOAA and NMFS sponsored a series of mediation meetings in hopes of reaching a compromise acceptable to both the environmental community and the shrimping industry. These negotiations provided the first clear indication that compromise on this issue was unlikely.

Segments of the industry were not willing to accept TEDs under any circumstances and were prepared to fight any Federal actions related to implementation of requirements to use TEDs.

Some of the more common objections to mandatory TED requirements raised by the shrimp industry during these negotiations were: (1) shrimpers do not catch turtles and turtle protection is not needed, (2) TEDs lose shrimp and their required use would result in an extreme economic burden on the fishermen, (3) time would be wasted handling TEDs, (4) TEDs are bulky and dangerous to handle and insurance costs would increase significantly, (5) TEDs cost too much, and (6) TEDs cannot be used in smaller nets in inshore waters. These objections were countered by the environmental community as follows: (1) Commercial shrimp trawlers do incidentally capture and kill sea turtles during normal fishing operations and the proof of this interaction is irrefutable, (2) gear to eliminate 97 percent of this mortality has been developed and is available to the fishery, (3) NMFS is mandated to ensure that the continued existence of endangered and threatened species is not jeopardized, and (4) economic considerations are not a factor under the ESA when a jeopardy situation exists.

When negotiations ended and no agreement was reached, NMFS drafted regulations and published a proposed rule on March 2, 1987, requiring shrimp fishermen in the southeastern U.S. to use TEDs in certain areas and at certain times to reduce the incidental take of endangered and threatened sea turtles. Public hearings were held and NMFS received thousands of comments both favoring or opposing the proposed regulations. On June 29, 1987, NMFS published the final TED regulations which became effective on October 1, 1987. The chronology of events following publication of these regulations are summarized below.

June 29, 1987.	Final TED rules published. They require the use of TEDs on a phase-in basis, the first year from shore out to 15 nautical miles.
October 1, 1987	Rules go into effect at Canaveral, Florida. Shrimp vessels (except rock shrimp) out to 15 nautical miles must use TEDs in NMFS Statistical Zone 28.
October 28, 1987	Louisiana files suit in Federal Court in New Orleans to have the TED rules invalidated.
January 1, 1988	Rules go into effect in S.W. Florida. Shrimp trawlers must use TEDs in Zones 1-4 out to 15 nautical miles. Based on enforcement surveillance, most vessels stayed outside 15 nautical miles.
February 29, 1988	Judge Patrick Carr of the New Orleans Federal Court issues an order upholding the TED regulations.
March 1, 1988	TED rules go into effect in the Gulf. TEDs are required out to 15 nautical miles. Enforcement documents little TED use.
March 21, 1988	Louisiana appeals Judge Carr's decision and requests an injunction of the rules pending appeal.
April 11, 1988	North Carolina challenges the TED rule in Federal-District Court in New Bern, N.C.
April 12, 1988	Judge Carr grants Louisiana's request for an injunction - TED rules are suspended in all areas.
June 28, 1988	South Carolina Wildlife and Marine Resources Commission requires TED use in all state waters beginning on the opening day of shrimp season (June 28). Seven cases made for no use; most boats in compliance.

July 11, 1988	Fifth Circuit Court of Appeals in New Orleans upholds the TED regulations but does not order them back into effect until September 1, 1988.
July 11, 1988	South Carolina State Circuit Judge Brown issues a Temporary Restraining Order suspending the required use of TEDs.
July 25, 1988	South Carolina State Supreme Court Chief Justice George T. Gregory rules that Judge Brown's restraining order has expired and is void; TEDs required again.
August 12, 1988	In a suit brought by the South Carolina Shrimpers Association against the South Carolina Wildlife and Marine Resources Department, Judge Brown again rules against the Department and issues a preliminary injunction; TEDs not required.
August 26, 1988	Full South Carolina Supreme Court issues Supersedes which suspended the preliminary injunction and TEDs are required until regulations automatically expire on August 31.
September 1, 1988	Federal rules do not go into effect - Congress has been working on reauthorization of the Endangered Species Act and passes a stop gap bill that further suspends the regulations except for Canaveral until September 18, 1988.
September 18, 1988	TED rules go back into effect in the Gulf and Southwest Florida areas out to 15 nautical miles (Zones 1-21). They are still in effect at Canaveral.
October 7, 1988	The President signs a bill reauthorizing the Endangered Species Act. The Bill contains a suspension of the TED regulations except Canaveral until May 1, 1989, for offshore waters and May 1, 1990, for inshore waters. TED rules now only in effect at Canaveral. The bill also requires a study by the National Academy of Sciences to "review scientific and technical information pertaining to the conservation of sea turtles and the causes and significance of turtle mortality, including that caused by commercial trawling."
January 24, 1989	The State of Florida adopts an emergency rule requiring the use of 75 minute tow times in Florida Atlantic waters north of Canaveral until February 1, 1989. This is because of large numbers of Kemp's ridley strandings in N.W. Florida and South Georgia in the fall of 1988.
February 1, 1989	Florida adopts a 90-day emergency rule requiring the use of TEDs on all trawls in offshore waters from Canaveral to Georgia (Zone 29 and most of 30).
February 15, 1989	Judge Terrence Boyle of Federal District Court in North Carolina issues an order staying any action on the challenge to the rules by the State of North Carolina because of Congressional delays imposed by amendments to the ESA.
March 1, 1989	The Committee on Sea Turtle Conservation (National Academy of Sciences) was formed and tasked with, among other things, assessing the effectiveness of and need for regulations requiring the use of TEDs by commercial shrimp trawlers.

March 9, 1989	NMFS emergency rules go into effect requiring the use of TEDs on shrimp trawlers in N.E. Florida and South Georgia (Zones 29 and 30). The rule is effective for 240 days.
March 1989	South Carolina legislature passes a bill establishing a permanent TED requirement for state waters. State rule generally follows federal rule. TEDs required June 1 - August 31 each year.
May 1, 1989	Federal rules go back into effect in offshore waters but Secretary of Commerce Mosbacher gives a 60-day grace period on enforcement. There is little, if any, TED use.
June 1, 1989	South Carolina TED rule in effect but a rider to unrelated legislation prevents state enforcement officers from enforcing the rule through August 31, 1989. Nevertheless, most shrimpers still use TEDs.
July 1, 1989	Shrimpers in the Gulf complain that TEDs are clogging with seagrass. NMFS begins to assess the extent of seagrass clogging.
July 10, 1989	At the request of Congressman Bill Tauzin of Louisiana, Admiral Merlin of the 8th Coast Guard District suspends enforcement of the TED regulations in the Gulf to allow NMFS time to study the seagrass problem.
July 12, 1989	Secretary Mosbacher meets with a Gulf Coast Congressional delegation and agrees to ask the Coast Guard to suspend enforcement of the TED regulations and to restudy the situation.
July 20, 1989	NMFS and Coast Guard jointly announce that enforcement of the TED regulations will resume in all waters (no 15 nautical mile limit). NMFS has studied the seagrass clogging problem and found it to be localized and insignificant, but Coast Guard adopts a policy of warnings only.
July 22-23, 1989	Shrimpers blockade ports in Texas and Louisiana disrupting commercial and recreational vessel traffic.
July 24, 1989	Secretary Mosbacher again meets with Gulf Coast Congressmen and agrees to a 45-day cooling off period effectively suspending enforcement of the rules.
July 26, 1989	The National Wildlife Federation, South Carolina Wildlife Federation and the Florida Wildlife Federation file suit in Federal Court in Washington, D.C. to force Secretary Mosbacher to enforce the TED rules.
August 3, 1989	Judge Thomas Hogan of Federal Court in Washington, D.C. declares the rule suspension unlawful and gives the Secretary until August 7 to come-up with a turtle protection program to reduce the take from trawling.
August 8, 1989	Secretary Mosbacher issues an interim rule requiring a 105 minute tow time schedule. The National Wildlife Federation et al., file suit to force the use of TEDs.
August 9, 1989	A Florida emergency rule goes into effect for 90 days requiring the use of TEDs on all shrimp trawls in Florida waters.

August 23, 1989	District Court Judge Stanley Harris, substituting for Judge Hogan, denies the request of the National Wildlife Federation and state affiliates.
September 8, 1989	Because of large scale violations of the 105 minute tow time schedule and overwhelming public comment against the tow time requirement, NOAA reinstitutes the TED requirement but grace periods for TED installation are provided until September 22, 1989, and October 15, 1989. At the request of Gulf Coast Congressmen, President Bush agrees to look into the TED situation and his Chief of Staff Dr. John Sununu becomes personally involved. NMFS conducts extensive reanalysis of data for review by Dr. Sununu. After October 15, TED rules are in effect and being enforced in all Gulf areas (Zones 1-21) and Canaveral (Zone 28).
October 5, 1989	The House Merchant Marine and Fisheries Committee considers an amendment to delay the October 15 deadline for TED installation which is defeated, but the Committee adopts an amendment which ultimately becomes a part of the FY90 Appropriations Bill. This amendment requires the State Department to negotiate with foreign countries on sea turtle conservation programs and requires the President by May 1991 to certify that the foreign country's sea turtle take rate from shrimping is no greater than the U.S.'s, otherwise shrimp imports from that country will be banned.
November 9, 1989	The Florida emergency rule is extended for an additional 90 days
November 21, 1989	Public Law 101-162 was signed by the President. This law embargoes the importation of shrimp into the U.S. by foreign nations that do not adopt sea turtle conservation regulations as stringent as those presently employed in U.S. waters.
November 30, 1989	Federal requirement for Gulf areas Zones 5-21 expires. Florida rule still require TEDs in state waters (9 nautical miles) in Zones 5-9.
February 7, 1990	Florida emergency rule expires. TEDs not required in Gulf, except Zones 1-4 Southwest Florida where they are required year-round.
February 21, 1990	Concerned Shrimpers of America (CSA) file suit in Federal Court in Corpus Christi, Texas, seeking an injunction of the rules and seeking compensation from the government for lost income because of TEDs.
February 28, 1990	Judge Hayden W. Head, of Federal District Court in Texas, denies CSA request for an injunction.
March 1, 1990	TED rules go back into effect in Gulf offshore waters.
March 8, 1990	Judge Head of Texas dismisses CSA claim for compensation.
April 23, 1990	The National Academy of Sciences, study, "Decline of the Sea Turtle, Causes and Prevention" is published. This study focused on sea turtle mortalities in the shrimp fishery where an estimated 5,000 to 50,000 loggerhead and 500 to 5,000 Kemp's ridley turtles were killed annually prior to implementation of turtle conservation regulations. The study supported the need for TED regulations and recommended that TEDs be required in most places at most times.

May 1, 1990 — Federal regulations go into effect in all inshore waters from North Carolina through Texas and in South Atlantic offshore waters. TEDs are required in offshore waters and 90 minute tow times can be used in inshore waters.

June 11, 1990 — Florida permanent state law takes effect which requires TEDs in all trawls (except those less than 35 foot headrope length in inshore waters) in state waters year-round.

November 15, 1990 — Georgia implements state requirements for use of TEDs year-round in all sounds. These regulations also require Georgia trawlers to use TEDs from April through December in state waters south of 31° 21' North latitude.

September 4, 1991 — NMFS issues a rule requiring shrimp trawlers in the southeastern Atlantic coastal states to use TEDs from September 1, 1991 through April 30, 1992. This rule effectively mandated the use of TEDs in offshore waters of North Carolina to Florida throughout the year.

B. Proposed Activities

This consultation addresses the potential adverse effects to listed species of implementation of a shrimp FMP for the South Atlantic and implementation of Amendment 6 to the Gulf of Mexico shrimp FMP. The shrimp FMP for the South Atlantic fishery (1) provides for a definition of overfishing for white, brown, pink, royal red, and rock shrimp; (2) allows states to request closure of the EEZ to shrimp trawling when overwintering populations of white shrimp are reduced by 80 percent or more following severe winter weather; (3) provides for permits for vessels trawling for shrimp in the EEZ; and (4) establishes a control date (effective when published in the Federal Register) that will be a benchmark date for possible future limited entry. Amendment 6 to the Gulf of Mexico shrimp FMP (1) provides for a definition of overfishing for white shrimp; (2) replaces the annual reports and reviews for the Tortugas shrimp sanctuary and seasonal closure to shrimping off Texas with monitoring and an annual assessment; (3) provides for permits for vessels trawling for shrimp in the EEZ; and (4) requires vessels selected by the Center Director to carry an observer for recording catch.

In addition to proposed management actions, this consultation evaluates the potential adverse effects to listed species of shrimp trawl fisheries in the Southeastern United States from North Carolina to Texas as the shrimping activities would be conducted under the 1992 Revised Sea Turtle Conservation Regulations. This analysis applies to all vessels and boats, regardless of size, that employ trawls as the primary fishing gear, and includes both inshore and offshore trawling. The following is a summary of the 1992 Revised Sea Turtle Conservation Regulations:

1. Starting January 1, 1993, turtle excluder devices (TEDs) must be used by shrimp trawlers in all offshore waters. Starting January 1, 1993, TEDs must be used in inshore waters by shrimp trawlers using a headrope length of 35 feet or longer, or that trawl with more than one net. For shrimp trawlers in inshore waters using trawls with a headrope length less than 35 feet, TEDs must be in use by December 1, 1994. In the interim, NMFS will conduct research to develop TEDs suitable for use in these smaller nets.

2. If limited tow times are substituted for TED requirements under any circumstances, tows must be limited to 40 minutes (bottom time) in warm water months (April 1 through October 31) and 60 minutes (bottom time) in cold water months (November 1 through March 31). This translates to 55 minute tows (doors in - doors out) during warm water months and 75 minute tows (doors in - doors out) in cold water months.

3. Episodic take of leatherback turtles by shrimp trawlers during periods of high jellyfish abundance must be eliminated. This may be accomplished by temporary area closures, by requiring an increase in size of TED openings to allow leatherbacks to escape at times when their abundance is high, by limiting tow times, or by implementing some other protective measure. A contingency plan to deal with these periodic events should be developed and implemented.

C. Listed Species and Critical Habitat

Listed species under the jurisdiction of NMFS that may occur in the southeastern United States and which may be affected by shrimp trawling include:

(1) the threatened loggerhead turtle - Caretta caretta
(2) the endangered/threatened green turtle - Chelonia mydas
(3) the endangered Kemp's ridley turtle - Lepidochelys kempi
(4) the endangered leatherback turtle - Dermochelys coriacea
(5) the endangered hawksbill turtle - Eretmochelys imbricata

Green turtles in United States waters are listed as threatened, except for the Florida breeding population which is listed as endangered.

Additional species which are known to occur in marine waters of the southeastern U.S. include:

(1) the finback whale - Balaenotera borealis
(2) the humpback whale - Megaptera novaengliae
(3) the sei whale - Balaenoptera borealis
(4) the sperm whale - Physeter macrocephalus
(5) the right whale - Eubalena glacialis
(6) the shortnose sturgeon - Acipenser brevirostrum

NMFS has determined that these species are unlikely to be adversely affected by shrimp trawling activities.

D. Assessment of Impacts

NMFS believes that shrimp trawling activities in the southeastern United States may adversely affect Kemp's ridley, green, hawksbill, leatherback, and loggerhead turtles. Because of their low population numbers, documented occurrence in areas of known shrimping activity, and their vulnerability to shrimp trawls, Kemp's ridley and green turtles are probably at highest risk of extinction. In terms of number of individuals affected, however, loggerhead turtles are by far the most common species killed in shrimp trawls.

A great deal of information is available on sea turtle distribution, abundance, and movements along the southeastern Atlantic seaboard and in the Gulf of Mexico. Turtle take data from shrimp trawlers, aerial surveys, stranding data, and nesting surveys provide information on seasonality of sea turtle abundance. While these data cannot be used to predict the absolute number of turtles in any given area at any given time, it is clear that turtle encounters are likely in all areas and times where commercial shrimping activities occur.

The take of five species of turtles by shrimp trawlers has been documented in the southeast. Potential impacts of shrimp trawling on each species will be individually assessed because of differences in their abundance, distribution, behavior,. habitat preference, food and habits.

a. Loggerhead turtle (Caretta caretta) - Threatened status

In the western Atlantic Ocean, loggerhead turtles occur from Argentina northward to Nova Scotia including the Gulf of Mexico and the Caribbean Sea (Carr 1952). Sporadic nesting is reported throughout the tropical and warmer temperate range of distribution, but the most important nesting are the Atlantic coast of Florida, Georgia and South Carolina (Carr and Carr 1978). The Florida nesting population of Caretta has been estimated to be the second largest in the world (Ross 1982).

The foraging range of the loggerhead sea turtle extends throughout the warm waters of the United States continental shelf (Rebel 1974). On a seasonal basis, loggerhead turtles are common as far north as the Canadian portions of the Gulf of Maine (Lazell 1980), but during cooler months of the year, distributions shift to the south (Shoop et al., 1981). Loggerheads frequently forage around coral reefs, rocky places and old boat wrecks; they commonly enter bays, lagoons and estuaries (Ernst and Barbour 1972). Aerial surveys of loggerhead turtles at sea indicate that they are most common in waters less than 50 m in depth (Shoop et al.,1981; Fritts et al., 1983), but they occur pelagically as well. Shoop et al., (1981) speculated that loggerhead turtles sighted in deep oceanic water were probably in transit to other areas.

The primary food sources of the loggerhead turtle are benthic invertebrates including molluscs, crustaceans and sponges (Mortimer 1982). Crabs and conchs were identified (Carr 1952) as the most frequently found items in stomachs, although loggerheads often eat fish, clams, oysters, sponges and jellyfish. Ernst and Barbour (1972) included marine grasses and seaweeds, mussels, borers, squid, shrimp, amphipods, crabs, barnacles and sea urchins among the foods of loggerhead turtles. The horseshoe crab (Limulus polyphemus) has been identified as a major food source of loggerheads in Mosquito Lagoon, Florida (Mortimer 1982).

Nesting aggregations of loggerhead sea turtles along the United States Atlantic coast have received considerable attention in recent years, but most studies have been limited to nesting migrations of adult females, development of eggs and behavior of hatchlings (Ernst and Barbour 1972). Little information on the life history of subadults and adult males is available. The work of Mendonca and Ehrhart (1982) suggests that subadult loggerhead turtles may use lagoonal systems as preferred habitats during stages of their life cycles.

Since 1978, loggerhead turtles occurring in the Cape Canaveral area have been studied extensively. Spatial and temporal changes in size and sex composition of loggerhead aggregations, monthly catch rates by trawlers, abundance estimates and movements into and out of the channel have been examined (Henwood 1987; Butler et al., 1987; Henwood and Stuntz 1987). Results of NMFS surveys are summarized in previous NMFS Biological Opinions.

Several sea turtle researchers (Ehrhart 1987; Frazer 1986; Murphy pers. comm.) have suggested that loggerhead turtle nesting populations in the United States are continuing to decline at rates of up to 5 percent annually. A theoretical explanation for these declines was provided by Crouse et al., (1987). Applying a Leftovitch stage-class matrix model of loggerhead populations on Little Cumberland Island, Georgia, these authors showed that loggerhead population stability is more sensitive to changes in the subadult stage of development than in other developmental stages. The significance of these findings with respect to trawling activities should be readily evident; by impacting the most sensitive developmental stages of loggerhead turtles, shrimp trawling may exert a major impact on the recovery of these populations.

Prior to implementation of the current sea turtle conservation regulations (TED regulations), it was estimated that approximately 10,000 loggerhead turtles drowned annually in shrimp trawls in the southeastern United States (Henwood and Stuntz 1987). These estimates applied only to offshore waters and assumed that all comatose turtles that were revived would survive. A reanalysis of these data by the National Academy of Sciences (NAS) concluded that Henwood and Stuntz may have underestimated mortality by a factor of four. The NAS analysis assumed that all comatose turtles died and extrapolated offshore mortality rates to predict mortality for inshore trawling. The most recent analysis of annual turtle mortalities from shrimp trawling (Henwood, Stuntz and Thompson 1992), indicates that approximately 4,000 loggerheads are killed each year by shrimp trawlers despite full implementation of current TED regulations.

b. Green turtle (Chelonia mydas) - Threatened/endangered status

Green turtles are circumglobally distributed mainly in waters between the northern and southern 20 degree C isotherms (Hirth 1971). In the western Atlantic, several major nesting assemblages have been identified and studied (Peters 1954; Carr and Ogren 1960; Duellman 1961; Parsons 1962; Pritchard 1969a; Schulz 1975; Carr et al., 1978). In the continental United States, however, the only known green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart 1979).

While nesting activity is obviously important in determining population distributions, the remaining portion of the green turtle's life is spent on the foraging grounds. Some of the principal feeding pastures in the western Atlantic Ocean include: upper west coast of Florida, northwestern coast of Yucatan peninsula, south coast of Cuba, Mosquito Coast of Nicaragua, Caribbean coast of Panama, scattered areas along Colombia, and scattered areas off the Brazilian coast (Hirth 1971). The preferred food sources in these areas are: Cymodocea, Thalassia, Zostera, Sagittaria and Vallisneria (Babcock 1937; Underwood 1951; Carr 1954; Carr 1952; Neill 1958; Mexico 1966). Although no green turtle feeding pastures or major nesting beaches have been identified on the southeast Atlantic coast, evidence provided by Mendonca and Ehrhart (1982) indicates that immature green turtles may utilize lagoonal systems during periods of their lives. These authors identified a population of young green turtles (carapace length 29.5 - 75.4 cm) believed to be resident in the Mosquito Lagoon, Florida. The Indian River system, of which Mosquito Lagoon is a part, supported a green turtle fishery during the late 1800s (Ehrhart 1983), and these turtles may be remnants of this historical colony.

Information on green turtle distribution and abundance in the southeastern U.S. is sparse. However, juvenile green turtles are known to occur seasonally throughout the southeastern United States, and take by trawlers on all shrimping grounds would not be unexpected. During NMFS surveys in the Cape Canaveral area between 1978 and 1984, a total of twenty-one green turtles were captured; 10 of these turtles were dead and the remaining 11 survived. All of these turtles were subadults ranging in size from 23.6 to 68.1 cm total straight-line carapace length. With the exceptions of August and November, green turtles were captured during all months of the year (Henwood and Ogren 1987).

The most immediate and damaging "trawling effect" on green turtles is injury or death due to drowning. Some question remains about long-term survival of green turtles captured by trawlers even though the animals are released alive. Ingestion of water into the lungs can lead to chronic respiratory problems which may ultimately result in death.

Henwood and Stuntz (1987) estimated that approximately 250 green turtles were killed annually by shrimp trawlers in offshore waters prior to implementation of TED regulations. The most recent analysis (Henwood, Stuntz and Thompson 1992) suggests that full implementation of current TED regulations has resulted in a 67 percent reduction in mortalities for all turtle species. This analysis includes inshore projections of mortality. Unfortunately, even with a 67 percent reduction in mortality, over eighty green turtles still drown each year in shrimp nets. These mortalities could easily be prevented by expansion of current regulations to require TEDs in all places at all times.

c. Kemp's ridley turtle (Lepidochelys kempi - Endangered status

Of the seven extant species of sea turtles of the world, the Kemp's ridley is probably in the greatest danger of extinction. The only major nesting area for this species is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; Hildebrand 1963). Virtually the entire world population of adult females nest annually in this single locality (Pritchard 1969b).

When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the early 1970s, the world population estimate of mature female Kemp's ridleys had been reduced to 2500-5000 individuals. Most recent estimates of the total population of sexually mature female Kemp's ridleys are less than 260 turtles (Byles pers. comm. 1987).

The foraging range of mature Kemp's ridley turtles is restricted to the Gulf of Mexico. Evidence provided by tagging programs (Chavez 1968), suggests that post-nesting females move in comparable numbers to the north (mostly to Louisiana) and to the south (mostly to Campeche) (Pritchard and Marquez 1973). It is assumed that adult male turtles follow similar migratory patterns. Movements of hatchling Kemp's ridley turtles may be determined by current patterns: either the loop current for northward transport or an eddy for southward transport with occasional transportation through the Florida Straits via the Gulf Stream (Hildebrand 1982). Young Kemp's ridley turtles are known to occur in eastern United States coastal waters from Florida to Canadian portions of the Gulf of Maine (Lazell 1980), but also occur throughout the northern and eastern Gulf of Mexico. Pritchard and Marquez (1973) suggest that passive transportation via the Gulf Stream up the eastern coast of the United States may be the usual dispersal pattern of young Kemp's ridley turtles. They speculate that turtles feed and grow rapidly during passive transport, and by the time they reach offshore waters of New England they are large enough for active swimming. At this stage they reverse the direction of travel toward the Gulf of Mexico.

Kemp's ridley turtles feed primarily in shallow coastal waters on bottom-living crustaceans (Hildebrand 1982). Organisms identified from stomachs include crabs (Polyonchus, Hepatus, Callinectus, Panopeus, Mineppe, Ovalipeus, Calappa, Portunus, Arenaeus), fish (Lutjanus, Leiostomus) and mollusca (Noculana, Corbula, Mulinia, Nassarius) (Dobie et al., 1961; Pritchard and Marquez 1973). All of these genera are forms common in the Gulf of Mexico and the eastern coast of the United States.

During trawl surveys in the vicinity of Cape Canaveral from 1978 through 1984, a total of 40 Kemp's ridley turtles were captured. An additional 21 ridley captures occured in Georgia and South Carolina waters (Henwood and Ogren 1987). Interestingly, 93 percent of the Kemp's ridley captures in Canaveral occured during the omnths of December through March, while all ridley captures north of Canaveral occurred during the months of June through November.

From 1986 through 1991, a single shrimp trawling vessel operating in the vicinity of Cape Canaveral captured and released 109 Kemp's ridleys (Jeff Schmid pers. comm.). This vessel was permitted to use a standard net without a TED to provide information on turtle abundance in the area and to collect information of shrimp retention of TEDs. All turtles were captured in tows of less than 90 minutes duration. Size of these turtles ranged from 21 to 65 cm. and the majority of captures occurred in winter and spring. this information supports the need for protection of Kemp's ridleys on the shrimp grounds.

In the Gulf of Mexico, the number of stranded Kemp's ridleys has increased in the last 5 years. This may be due to a variety of factors including better identification of species, a more efficient stranding network, or an increase in mortalities associated with fishing activities, boat collisions, entanglement, pollution, etc. It also could reflect lack of compliance with TED regulations.

Prior to implementation of the TED regulations, Henwood and Stuntz (1987) estimated that over 750 Kemp's ridleys drowned annually in shrimp trawls. Under current regulations assuming 100 percent compliance, this mortality has been reduced by 67 percent. Unfortunately, this still translates into an estimated annual mortality in excess of 250 individuals. Given the fact that the entire nesting population in the world is comprised of less than 500 females, this continuing mortality certainly jeopardizes the recovery of the species.

d. Leatherback turtle (Dermochelys coriacea) - Endangered status

The leatherback turtle is found throughout the waters of the Atlantic, Pacific, Caribbean and the Gulf of Mexico (Ernst and Barbour 1972). It is the most pelagically distributed of the sea turtles feeding primarily on jellyfish (Rebel 1974). Leatherbacks are occasionally taken by shrimp trawlers and longline vessels in Gulf of Mexico offshore waters, but these records are scarce and Hildebrand (1982) speculates that the resultant mortality is small.

In the last two years, high levels of leatherback turtle strandings have been documented off South Carolina (Sally Murphy pers. comm.). Similar stranding events have occurred in Georgia (Charles Maley pers. comm.). These strandings coincide with jellyfish abundance and shrimp trawling activities, and appear to be predictable annual events.

Henwood and Stuntz (1987) estimated that approximately 160 leatherback turtles were drowned annually in shrimp trawls. Most recent estimates suggest that shrimp trawler related sea turtle mortality has been reduced by 67 percent with full implementation of TED regulations. However, this reduction in mortality probably does not apply to leatherback turtles because the openings in most certified TEDs are not of sufficient size to allow this species to escape. Leatherback mortalities remain a problem that must be addressed to avoid jeopardizing the recovery of this species.

e. Hawksbill turtle (Eretmochelys imbricata) - Endangered status

The hawksbill turtle is relatively uncommon in the waters of the continental U.S. The preferred habitat of this species is coral reef, such as is found in the Caribbean and Central America. However, there are accounts of hawksbills in south Florida and a surprising number are encountered in Texas. Most of the Texas records are small turtles, probably in the 1-2 year class range. Many of these captures or strandings are of individuals in an unhealthy or injured condition (Hildebrand 1980; 1982). However, a small (24.7 cm carapace length), healthy hawksbill was captured in National Park Service sampling nets on May 16, 1991 in Port Mansfield Channel, Texas. The lack of sponge-covered reefs and the cold winters in the northern Gulf of Mexico, probably prevent hawksbills from establishing a viable population size in this area.

E. Conclusions

NMFS concludes that shrimp trawling in the southeastern United States is in compliance with the 1992 Revised Sea Turtle Conservation Regulations and the proposed management actions under the South Atlantic shrimp FMP and Amendment 6 to the Gulf of Mexico shrimp FMP are not likely to jeopardize the continued existence of threatened or endangered species under NMFS jurisdiction.

Reinitiation of Consultation:

Reinitiation of formal consultation is required if: (1) the amount or extent of taking specified in the incidental take statement is exceeded, (2) new information reveals effects of the action that may affect listed species or critical habitat (when designated) in a manner or to an extent not previously considered, (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this Biological Opinion (i.e., if the 1992 Sea Turtle Conservation Regulations are not implemented), or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

Incidental Take Statement

Section 7(b)(4) of the Endangered Species Act (ESA) provides for the issuance of an incidental take statement on the agency action if the biological opinion concludes that the action is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. In such a situation, the National Marine Fisheries Service (NMFS) will issue an incidental take statement specifying the impact of any incidental taking of endangered or threatened species, providing for reasonable and prudent measures that are necessary to minimize impacts, and setting forth the terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures. Incidental takings resulting from the agency action, including incidental takings caused by activities authorized by the agency, are authorized under the incidental take statement only if those takings are in compliance with the specified terms and conditions.

NMFS previously considered the effects of the shrimp trawl fishery and other fisheries conducted in the United States as part of an ESA section 7 consultation in conjunction with the implementation of section 114 of the Marine Mammal Protection Act, the Interim Exemption for Commercial Fisheries, Public Law 100-711 (July 5, 1989). The biological opinion resulting from that consultation concluded that bottom trawl fisheries, gill net fisheries, and longline fisheries may have significant adverse impacts on the recovery of listed species. The incidental take level authorized in this opinion for shrimp trawling in the southeastern United States supersedes the take level that could have been utilized by shrimp trawlers in the exemption opinion.

Based on results of past studies of sea turtle/shrimp trawler interactions in the southeastern United States, NMFS anticipates that future trawling activities may result in the injury or mortality of loggerhead, Kemp's ridley, green, leatherback and hawksbill turtles. Therefore, we have established a low level of incidental take and terms and conditions necessary to minimize and monitor this impact. A documented incidental take level of:

four (4) hawksbill turtles,
four (4) leatherback turtles,
ten (10) Kemp's ridley turtles,
ten (10) green turtles, or
three hundred seventy (370) loggerhead turtles

mortalities is set pursuant to section 7(b)(4) of the ESA. This take level represents a total allowable annual take for all shrimp trawling in the southeastern United States. If the incidental take meets or exceeds this level, NMFS must reinitiate consultation.

Our most recent estimates of turtle mortality under a scenario of TEDs everywhere at all times are approximately 400 deaths. These estimates are based on an assumption of 97 percent reduction in mortality; when in fact, we believe that some certified TEDs exceed this exclusion rate and may approach 100 percent reduction in mortality. If this proves true, incidental catch and mortality by shrimp trawlers may ultimately approach zero as TEDs are improved.

The reasonable and prudent measures that NMFS believes are necessary to minimize the impact of shrimp trawling in the southeastern United States have been thoroughly discussed in this opinion. The following terms and conditions are established to implement these measures and to document the incidental take should such take occur:

1. Turtle Excluder Devices (TEDs) must be used as specified in the revised sea turtle conservation regulations. TEDs must be used by all shrimp trawlers in all offshore waters starting January 1, 1993. In all inshore waters, shrimp trawlers towing more than one trawl or towing one trawl with a headrope 35 feet or longer must use TEDs by January 1, 1993, and shrimp trawlers towing one trawl with a headrope shorter than 35 feet must use TEDs by December 1, 1994.

2. If limited tow times are substituted for TED requirements under any circumstances, tows must be limited to 40 minutes (bottom time) in warm water months (April 1 through October 31) and 60 minutes (bottom time) in cold water months (November 1 through March 31). This translates to 55 minute tows (doors in - doors out) during warm water months and 75 minute tows (doors in - doors out) in cold water months.

3. An observer program should be implemented to document capture and mortality of sea turtles whenever tow times are an authorized option to the mandatory use of TEDs. In addition to the shrimp trawl fishery other bottom trawl fisheries should be monitored.

4. Episodic take of leatherback turtles by shrimp trawlers during periods of high jellyfish abundance must be eliminated. This could be accomplished by temporary area closures, by requiring an increase in size of TED openings to allow leatherbacks to escape at times when their abundance is high, by limiting tow times, or by implementing some other protective measure. A contingency plan to deal with these periodic events must be developed and implemented.

5. Resuscitation must be attempted for any captured turtles that are comatose or inactive, but not dead.

6. NMFS should develop a program so that all turtle mortalities are reported to the Southeast Regional Office, NMFS, in person, by phone, or by letter, within 10 days of return from the fishing trip during which the incidental take occurred.

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APPENDIX X

Social Impact Assessment

Social Impact Description

Introduction

Any potential social impacts from regulatory action must be viewed from a total social system perspective. Fish harvesters, processors, dealers, retailers, consumers, related businesses and communities and fishery managers themselves are all part a social system. Changes in the behavior of people in any part of this system may lead to changes in the behavior of others throughout the system.

In the case of the shrimp fishery in the South Atlantic, any regulation-induced changes in the behavior of the fishermen may lead to changes in the behavior of those who interact with those fishermen. Unfortunately, detailed data concerning the fishermen themselves--residence, landing location, crew numbers and residence-- are not readily available from census or license lists. Similarly, data on fish house and fish landing locations, fishery service and supply locations, and other infrastructure elements are not readily available. The bulk of the sociocultural research on shrimp fishermen in the Southeast has been done in the Gulf of Mexico (see Durrenburger, 1988; Dyer and Moberg, 1992; Maril, 1982; Nance et al., 1991; Margavio et al., 1992; White, 1977). Relatively little work has been done with South Atlantic fishermen (Nix and Kim, 1981; Fisch and Maiolo, 1981; Johnson and Orbach, 1990; Liao, 1979; Kitner, 1987; Sabella, et.al., 1979). Accurate data on these elements of the fishery system could only be obtained through further research.

The data characterizations on the sociological and cultural aspects of the South Atlantic shrimp fishery given below are derived from the updated Council profile of the shrimp fishery, and from selected recent studies of various aspects of that fishery in South Atlantic and Gulf areas.

Description of Fishermen

The majority of fishermen involved in the white shrimp fishery are white males. North Carolina had the lowest percentage of black shrimpers (5.2%), while Georgia had the highest (12.0%). The average age of North Carolina shrimpers was 47 in 1980, while shrimpers in both South Carolina and Georgia averaged 39 years old in 1980. The average age of shrimpers in the South Atlantic as a whole was 43. Shrimpers in the South Atlantic averaged to 10 years of formal education in 1979. The average experience in commercial fishing in 1979 was 21 years, of which 10 years were worked as captain and 11 years as crew. Using an example from North Carolina, it appears that crew members average around 27 years of age and have 11 years of formal education. The average number of years of experience in commercial fishing for crew members was 8. The general picture is of a middle-aged group of captains with younger crews, both with relatively low levels of formal education which may limit their occupational alternatives.

Dealer Structure and Function

Seafood dealers are an essential component within the fishing community. They control a good deal of the capital and access to facilities and markets in the shrimp fishery. Most dealers handle more than one species; those that deal shrimp may also deal in species such as clams, oysters, and finfish. Taken from an example in North Carolina, a dealer typically has around four permanent staff and additional seasonal staff hired from married women and school age youths in the community. These temporary employee's wages are directly related to the abundance of shrimp harvested by the fishermen. The more shrimp there is to process, the more opportunities for work they have.

The economic survival of a sea food dealer depends upon his access to commodities to handle and markets to which to sell. Without a steady supply of fish and markets he would be unable to stay in business. In order to maintain this supply of fish dealers often offer services, the most important of which is credit, to fishermen. Once fishermen accept credit from a dealer they are obligated to sell their catch exclusively to that dealer. This symbiotic relationship benefits the shrimper, for whom it is extremely difficult to obtain loans from commercial banks, by giving him a secure form of credit. The arrangement remains productive for the dealer only so long as the fisherman is able to supply a product that he can sell for a profit. Without that supply or the market, the system collapses.

Community Organization and Identity

Little information exists on overall fishing community organization in the South Atlantic shrimp fishery. Although the same kinds of social organization typical among other occupational groups are not prevalent among shrimp fishermen, one should not assume that fishermen pursue their occupation in isolation from one another or from their communities. Complex social networks and informal social groups have been documented among shrimp fishermen in North Carolina. These social networks are the pathways by which new information is introduced and dispersed within the fishing community, and are often important in determining such behavior as fishing patterns and the adoption of technological innovations.

Shrimping serves more than economic functions in coastal fishing communities; for many of the individuals involved it is a way of life. Through long historic participation in the shrimp fishery by fishermen, fish dealers, gear suppliers, etc., shrimping has become a traditional occupation and lifestyle which is a significant part of individual and group identity in many coastal communities.

Dynamics of Shrimping

Shrimping is typically a seasonal activity lasting from spring through fall. In order to stay productive year round, many commercial fishermen participate in other types of fishing while not shrimping. These fisheries can include finfishing, oystering, clamming, crabbing, scallop and whelk trawling, and gill netting. The particular composition of annual rounds varies from state to state throughout the South Atlantic region. Most of these fisheries are seasonal, with fishermen emphasizing one specific fishery during a particular time of year. Various combinations of these seasonal fisheries are used by the shrimpers to round out their yearly cycle of activities. Unfortunately there is little information available that documents the exact structure of these annual cycles for the South Atlantic shrimp fishery. Nor are there data available on the exact home ports, landing locations, crew residence and other variables relevant to an accurate description of these annual cycles.

Migration is an additional solution that fishermen use to adapt to the seasonal nature of the shrimp fishery. Rather than switch over to other fisheries available to them locally, some fishermen choose to migrate to shrimp fisheries in other regions or states. At times, especially for larger vessels, these migrations can last for extended periods of time and take them far up the Atlantic coast or far south to the Gulf of Mexico. Smaller vessels migrate as well, though their search for shrimp frequently takes them only to states adjacent to their home states.

Competition and Conflict

As long as two or more people are attempting independently to obtain benefits from the same limited resource there will be competition. When the activities of one person affect negatively the ability of another to harvest the resource, other than by affecting the amount available for him to harvest, there is conflict. A good example of competition is the relationship between an inshore commercial channel netter and an offshore trawler operator; they affect only the amount of shrimp the other can catch. A good example of conflict can be found in the areas where both stationary crab traps and mobile shrimp trawls are used. In such a situation competition for fishing access often leads to physical conflict such as damage to or loss of gear.

Employment Opportunities and Unemployment Rates

Coastal counties in all of the south Atlantic states except Georgia had a slightly higher unemployment rate in 1990 than the statewide rate. Coastal unemployment rates in North Carolina were 1.7 percent above the state average, in South Carolina they were 0.2 percent higher than the state average, and in Florida's east coast counties they were 0.1 percent higher than the state average. Georgia's coastal counties unemployment rates were 1.1 percent less than the state average.

Data are not available to indicate the extent of unemployment among commercial fishermen in these regions. However, since at least 1980 commercial fishermen have been facing a critical situation caused by rising fuel costs, declining shrimp prices in real dollars, increased regulation, increased competition for shoreside facilities, and other factors. This tends to increase the unemployment rate for commercial fishermen. The employment opportunities for commercial fishermen in non-fishery sectors depends upon the individual fisherman's background and skills either from currently held part-time jobs or alternative jobs held in the past, level of education, age, and capacity to learn new skills.

Proposed Management Measures

12.7.1.1 Concurrent Closures

Preferred Alternative: States may request concurrent closure of the EEZ adjacent to their closed state waters following severe winter cold weather that results in an 80 percent or greater reduction in the population of overwintering white shrimp.

12.7.1.2 Clarification of Management Measure 1

Preferred Alternatives:

1. Exempt royal red and rock shrimp fisheries from any closures of the EEZ for the harvest of white shrimp.

2. Exempt the whiting fishery (*Menticirrhus* sp.) from a closure for white shrimp.

12.7.2 Management Measure 2: Buffer Zone

Preferred Alternative: Establish a buffer zone extending seaward from shore 25 nautical miles, inside of which no trawling would be allowed with a net having less than 4 inch stretch mesh during an EEZ closure. Vessels trawling inside this buffer zone could not have a shrimp net aboard (i.e., a net with less than 4 inch stretch mesh) in the closed portion of the EEZ. Transit of the closed EEZ with less than 4 inch stretch mesh aboard while in possession of *Penaeus* species will be allowed provided that the nets are in an unfishable condition which is defined as stowed below deck. (Stretched mesh size is defined as the distance between the centers of the two opposite knots in the same mesh when pulled taut.)

Discussion of Social Impacts

The proposed management measures have some potential for direct social impact on South Atlantic shrimp fishermen. The actual intensity of this impact is difficult to predict, however, because accurate data on EEZ white shrimp harvests are not available. At this point it appears that during years without winter freezes, little of the annual white shrimp landings originate in the EEZ. In years with winter freezes in which the states close their waters, the relatively small amounts of white shrimp landed in those states are harvested in the EEZ. What few roe white shrimp are present in the EEZ after freeze winters will be available to shrimpers after the shrimp have had time to spawn and the closures are lifted. All of these points imply that concurrent closures of the EEZ in the spring of years with freeze winters would have little effect upon the shrimpers involved. In addition, many of the major social impacts are not direct in the sense of directly altering behavior. Rather, they may affect attitudes, perceptions and other circumstances in the fishery that are important for future relationships among fishery constituents, and among those constituents and fishery managers.

The general suspicion and lack of trust exhibited by fishermen for the regulatory and management structure, for example, has long been noticed. This ranges from lack of understanding or involvement in the regulatory process under the MFCMA (Smith, 1982) to reactions to specific regulatory processes such as those associated with TED requirements (Dyer and Moberg 1992; Kittner, 1987; Margavio et al, 1992). To the extent that these situations can be alleviated, perhaps through more interaction or better communication between fishermen and managers, the social impacts of new regulations may be minimized.

The chief benefit of concurrent closure of the EEZ is the probable increase in fall shrimp harvests after a freeze winter. Continued spring fishing on the already reduced roe shrimp crop following a freeze winter is thought to increase the likelihood of poor recruitment and poor subsequent fall production. The net gain in pounds of white shrimp could be considerable because the roe white shrimp harvest is usually only a fraction of fall white shrimp harvest, both in freeze years and in years where freezes do not occur. Any increase in fall harvest of white shrimp due to regulation of the shrimp fishery would presumably alleviate some of the negative effects of the spring closure, and may even have positive net effects. Additionally, it should be noted that the spring roe white shrimp harvest would not actually be lost, but merely postponed for a few months to allow the shrimp to spawn. When the state and EEZ waters reopen in May or June, the roe white shrimp will still be present (minus natural mortality) and harvestable. This stands to mitigate the impacts of concurrent closures on shrimp fishermen.

Despite this, a number of direct social impacts are possible. Concurrent closures could cause shrimpers to change their annual round of activities. If the white shrimp fishery is unavailable during the spring or any other period due to regulation, fishermen would be forced to switch to other species for their income during that period. If opportunities to fish other species were unavailable, fishermen would have to turn to shore-based work. The fishermen's ability to find employment on shore would depend upon the individual's skills, level of education, age, and capacity to learn new skills. In the worst case fishermen would face unemployment. Such circumstances could force some shrimpers out of fishing permanently. Without the income from shrimping, fishermen may not be able to keep up payments on house mortgages or boat loans, which could force them to sell off their fishing boats and gear. At least closures would reduce the supply of shrimp, with its attendant multiplier effects, in South Atlantic communities.

An alternate fishing opportunity for shrimpers displaced by concurrent closures of the EEZ would be to migrate to waters open to shrimping. This adaption would change the social structure of the communities, and alter the family life of the fishermen. The overall quality of life for the fishermen could suffer by being away from home and community for long periods of time. Additionally, displaced shrimpers could face high levels of competition and conflict with local fishermen in the areas to which they move to shrimp.

Concurrent closures of the EEZ also stand to alter the flow of capital in fishing communities. Fish dealers, and their employees, that regularly depend upon shrimp income from local harvests in areas with closures would be faced with finding other sources of shrimp, typically from imports. Likewise, dealers in areas not subject to closure may have an increase of migratory shrimpers and could actually see an increase in locally-harvested shrimp available to them.

On the other hand, the proposed buffer zone for Royal Red and Rock shrimp fisheries may mitigate any of the potential closure effects described above by creating income-producing opportunities in those fisheries. Similarly, if the regulations produce a net increase in shrimp landings over time, this could increase stability for those fishermen and communities who could adapt to the altered timing of the harvest.

Other Management Measures Considered and Rejected

1. Require annual vessel permit to harvest shrimp in the EEZ.

2. Regional Shrimp permits.

Discussion of Social Impacts

The impact of permits depends on the attitudes of the fishermen with respect to the motives and objectives of the managers. If fishermen perceive the management system to be ultimately supportive of their industry and fishery, they will more likely be supportive of the new requirements. If they perceive the management system to be antagonistic to their industry, they will be more cautious and resentful of the new requirements.

3. Control Date.

Discussion of Social Impacts

The reason for the establishment of a control date would be to set a potential limitation on the granting of initial fishing privileges to those who had been involved in the fishery prior to the control date. The general subject of entry, or access limitation is controversial and would involve 1) a careful definition of objectives, many of which are social and economic, for the shrimp fishery; 2) the collection of a full set of social and economic data on the participants in the fishery; and 3) a process for the development of regulatory alternatives for entry or access limitation which involved broad representation from the concerned constituencies in the fishery.

4. Incorporate TED regulations into the FMP.

5. Finfish bycatch.

6. Implement partial EEZ closures.

Discussion of Social Impacts

The issues of finfish bycatch and of Turtle Excluder Devices (TEDs) in shrimp trawls has generated a tremendous amount of controversy in recent years. The initial industry reaction generated over the issue of TEDs, but now has evolved into a similar reaction to BRDs (Bycatch Reduction Devices). The fishermen cite 1) lack of empirical data showing the relationship between bycatch of particular species and the subsequent adult populations of those species; 2) loss of shrimp due to TEDs/BRDs; 3) problems with clogging of TEDs/BRDs with debris; 4) the additional costs of TEDs/BRDs; and 5) safety concerns resulting from using TEDs/BRDs in sea conditions. (See Dyer and Moberg, 1992; Kittner, 1987; Margavio et al. 1992; Risenhoover, 1990.) Somewhat independent of the "scientific" data, potential social impacts are generated by the fishermen's perceptions of these issues. Additionally, if fishermen perceive concern for bycatch to be motivated by a true, demonstrateable concern for the resource, their reaction will be muted. If, however, they perceive concern for bycatch to be motivated by other factors such as allocation of species or bias against the commercial industry, their reaction will be negative.

Partial closures of 5-12 miles (depending on the state) would probably increase enforcement costs over what they will be under the preferred alternative for concurrent closures while not decreasing the impacts of a closure on legal shrimping activities. For this reason, partial closures will probably not accomplish the benefits of the preferred alternative for closures while necessitating greater expenditures for enforcement.

12.8 Recommendations to the States

12.8.1 Introduction of Exotic Species

The Council requests that states having shrimp mariculture facilities, either research or commercial, institute strict controls and guidelines to minimize the possibility of inadvertently introducing either exotic shrimp species or diseases into the environment. The Council further recommends that states comply with Amendment 1 to the Atlantic States Marine Fisheries Commission's (ASMFC) Procedural Plan to Control Interjurisdictional Transfers and Introductions of Shellfish (Atlantic States Marine Fisheries Commission 1990).

Discussion of Social Impacts

Because of the potential for large social impacts on the shrimp fishery should mariculture of exotic species introduce either species that compete with indigenous species or diseases in indigenous shrimp species, it is important that the councils take all steps available to prevent this from occurring. As evident from the discussion in the introduction to the economic RIR, shrimp harvesters are going through difficult economic and social times, and introduction of competing species or diseases will further aggravate this situation. To the degree that recommendations will help to prevent the introduction of new species or diseases, recommendations are beneficial and involve little cost.

12.8.2 Habitat Alteration and Environmental Degradation

The Council recommends that states minimize or eliminate alteration of shrimp habitat, especially the fragile and highly productive salt marsh and estuarine areas. These areas are considered critical habitat for all species of penaeid shrimp addressed by this FMP.

Discussion of Social Impacts

Habitat alteration or loss is an important factor in the health of the shrimp fishery in the South Atlantic and the social well being of shrimp harvesters. As is evident from the discussion in the introduction to the economic RIR, shrimp harvesters are facing difficult economic conditions, and habitat destruction contributes to this problem. To the degree that recommendations help prevent further habitat damage, recommendations are beneficial and involve little cost.

12.8.3 Recommendations to the States Considered and Rejected

12.8.3.1 Federal Permit to Shrimp in State Waters

The Council considered recommending to the states that they require a Federal permit to fish for shrimp in state waters.

Discussion of Social Impacts

Requiring Federal permits to shrimp in state waters or to obtain a state shrimping permit would make Federal permits a more effective means of identifying the universe of shrimpers. The measure would help management obtain a better estimate of fleet size, and help researchers obtain better biological, economic and social data. In addition, with Federal permits required of all shrimpers, regardless of whether they fish in Federal waters, management would have better information on participation should limited entry be promulgated for the fishery. In this way, requiring Federal permits to shrimp in state waters increases benefits associated from requiring Federal permits far more than the annual cost of renewing permits (between $17 and $34 per year) plus the burden hours cost of filling out applications for permits (no estimate for this is available at this time).

12.8.3.2 Recreational Shrimping

The Council was asked by some members of the commercial industry to recommend to the states that recreational shrimp fishing over bait be curtailed.

Discussion of Social Impacts

Because the economic and social tradeoffs involved with this recommendation are not well understood, this recommendation may not involve promoting the highest value used of the shrimp resource. No rigorous studies of the consumer benefit (consumer surplus) values attributable to recreational shrimping over bait have been undertaken. In addition, no studies are known to exist that look at the producer and consumer benefits associated with the commercial harvest of shrimp at present levels or the increases from allocating the entire white shrimp harvest to the commercial sector. After these studies have been accomplished, management might undertake to allocate the resource differently based comparisons of marginal benefit society derives from the shrimp resource under different allocation schemes.

12.8.3.3 Stock Enhancement

Some members of the commercial industry suggested that the Council recommend to the states that stock enhancement (addition of maricultured shrimp to the natural environment) programs be initiated, especially following cold kills.

Discussion of Social Impacts

Because there is insufficient information to evaluate the biological, economic, or social benefits associated with stock enhancement, it is impossible to develop social rationale for promoting stock enhancement or not promoting it at this time. As information becomes available to evaluate the biological benefits of stock enhancement, then the economic and social merits from recommending that course of action to the states can be developed.

Research Recommendations

The overall lack of current socio-economic data available for South Atlantic shrimpers, processors, dealers and their communities has made any description of the current status of these constituents, or any prediction of impacts on them from the proposed regulations, difficult at best. In hopes of facilitating future research in these areas, and consequentially of aiding to formulate better management, several aspects of the shrimpers and their communities that need further research, as well as why they are significant in socio-economic analysis, are listed below.

1) Current demographic data on those employed in the fishing industry- -This information would provide data essential to the accurate description of shrimp harvesters, their families and industry, and should include data on residence, homeport and fishing locations.

2) Community structure analysis- -Detailed data describing relationships among fishermen, between fishermen and dealers, and between fishermen and other elements of the fishing infrastructure, and between the fishing industry and other elements of their communities would enhance our knowledge of the social structures within which shrimp harvesters live and operate.

3) Education, technical skills, and perceived alternative fishing and non-fishing employment opportunities- -This data would indicate alternatives the fishermen would take as a possible result of regulatory activity.

4) Annual round structure and the significance of white shrimp (as well as other shrimp species) within that structure- -This information would provide researchers and managers with an idea of fishermen's dependence upon shrimp and other fisheries in the South Atlantic. Additionally, the magnitude of socio-economic impacts could be calculated from this information. This data would also indicate other fisheries to which fishing effort might be shifted due to regulatory action.

5) Cost and earnings involved in shrimp harvesting- -Data describing these factors would indicate the current degree of profitability of shrimping to the individuals involved. Declining profitability could indicate a future shift away from shrimping by individuals currently involved in the industry.

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APPENDIX XI

South Carolina's mechanism for declaring a winter kill of white shrimp

Mechanism for Declaring a Winter Kill of White Shrimp in South Carolina

A request to the South Atlantic Fishery Management Council for a closure of the Exclusive Economic Zone (EEZ) off South Carolina will be based upon a minimum of an estimated 80% mortality of the overwintering brood stock. Determination of an 80% mortality of local white shrimp stocks will be made primarily by sampling aboard the Marine Resources Division's research vessel -- which is currently the R/V Carolina Pride.

An estimate of winter mortality can be made by comparing either the total number of shrimp or average number per tow in samples taken prior to the onset of cold weather and those taken immediately after and within two weeks of the winterkill. During December, the Crustacean Management Program usually samples 4 to 7 locations in Charleston Harbor on two or three dates. A cruise covering the estuaries between Charleston Harbor and the Georgia border is also routinely made during the first or second week in December. This cruise is meant to give staff a feel for stock size going into the winter and to aid staff in making a decision about the closing date for the ocean fishery. Staff also sample Charleston Harbor once weekly during January and two or three times during February. After the commercial trawling season closes, some samples are often taken offshore of Charleston if sea conditions are suitable on the scheduled cruise dates. All samples are made with double-rigged, 21-ft. trawls towed for 15 min. Samples are usually taken in the same locations each week, although additional, irregularly sampled locations may be added on any given day. A sample consists of recording total weight and number of shrimp by species. Fifty randomly selected shrimp for each species are measured (total length) and a heads-off count (tails per pound) is determined. Surface and bottom water temperature and salinity are recorded at each sample site.

Should a winter kill occur in December, post-freeze sampling could be compared to Charleston Harbor data and the statewide cruise. Should a freeze occur in January or February, it would probably be improper to compare post-freeze data with the early December cruise. Comparisons at that time would be limited to samples taken in the Charleston area. Historical data has shown us that when a severe winter kill occurs, samples taken in Charleston Harbor are fairly representative of conditions throughout the state and there has been no need to conduct mid-winter, statewide cruises. We prefer to wait until March, because sampling in January would be meaningless should a severe freeze occur in February.

Typically, it takes about two weeks to ascertain if cold temperatures have caused severe damage to the white shrimp stocks. A drop in water temperature makes shrimp congregate in the lower reaches of the estuaries. Continued cold forces some seaward and others die in the deep holes of the estuaries. (A rapid decline in water temperature to very low levels can cause mortalities in the upper parts of the estuaries, before shrimp have a chance to move seaward.) A continued period of cold forces all live shrimp from the estuaries (or kills any that remain) and within a few days all shrimp in the ocean are dead with many washing onto the beaches. We have seen a scattering of shrimp well offshore (> 5-7 miles) following freezes, but if these shrimp survive the cold, they may be lost to predators. It appears that once shrimp are well offshore, they do not move shoreward and do not contribute to the spring spawn. During severe freezes, it is common to see dead shrimp (many in a state of decomposition) in our samples. We have seen dozens of shrimp with their antennae tangled as if they had been rolling along the bottom. Some of these tangled shrimp were live suggesting that they may have been cold narcotized. At the same time, crabbers report shrimp tangled in their crab traps.

Kills usually occur when water temperature reaches about 47°F (8.3°C) and remains there for several days. In the past, we have seen that a drop below 47° for ten to twelve days results in a 99+ % loss of overwintering stock. A period of shorter duration but lower temperatures (down to 43 or 44°F) will have the same effect. Also, low salinities appear to raise the lower lethal temperature limit on shrimp.

Once we have seen all or most of the above, and have determined that South Carolina has lost over 95 percent of the white shrimp stock, we will reccommend to the director of the Division of Marine Resources that he request a closure of the EEZ. Previously, when we have had serious winter kills, we have lost virtually everything (99+%) from border to border. In my opinion, we will rarely ask for a closure if an estimated 10-20 percent of the shrimp survive. The notable exception may occur when a freeze occurs very early in the cold weather season (ie.

Dec. 15 - 30). In that case, we would anticipate that a "normal winter" from that time on would be sufficient to destroy any remaining shrimp and we would probably go ahead and pursue a closure. Should January and February turn out to be milder than normal, then the EEZ could be opened, although it would be highly unlikely that state waters would open before the traditional spring opening.

David Whitaker
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20 December 1991

APPENDIX XII

Georgia's shrimp trawl assessment survey methodology

Georgia's Shrimp Trawl Assessment Survey Methodology

Georgia's assessment trawl sampling survey is conducted each month in Georgia's six commercially important estuarine systems: Wassaw, Ossabaw, Sapelo, St. Simons, St. Andrew and Cumberland. Each estuarine system is divided into three separate sectors: 1) creeks and rivers, 2) open sounds, and 3) nearshore ocean waters or state territorial waters from the beaches to three miles offshore. In each of these primary sectors two fixed or permanent trawl stations have been established, making a total of six stations per estuarine system or 36 total stations for all six systems combined. A list of station locations is attached as Attachment A. Trawl tows are for 15 minutes duration at each station. Trawling time is calculated as bottom time from the moment the winch was "dogged-off" until the bag was retrieved. Trawl sampling is conducted aboard the Department of Natural Resources' larger research vessels ANNA and COBIA. Sampling gear consists of 12.2 m (40 ft) flat otter trawls with 4.8 cm (1-7/8 inch) stretch-mesh webbing for the body and bag.

Trawl assessment monitoring, including station locations, equipment and data gathering criteria are closely aligned with the methodology of previous studies which have served as the historical comparative database (Music, 1979; Shipman, et al., 1983, Music, et al., 1991) so that current analyses can be compared promptly and directly with the long term means. Additional assessment data dates back to 1970, but the sampling regime varied somewhat. Consequently these data are not included in the historical database comparisons at this time.

Sampling schedules are typically conducted on the first neap tides during the first half of the month for standardization where possible.

Some deviation occurs however due to inclement weather, breakdowns and other unforeseen events.

At each station catches are deposited on deck where penaeid shrimp are sorted by species and quantitative measurements taken. A representative sample of 30 shrimp is measured. All lengths are measured in mm and all weights are taken in pounds and ounces and are recorded to the nearest tenth of a pound. If less than 30 individuals are caught, all are measured. Records are maintained for each commercially important penaeid shrimp species on forms providing for sex, total length (mm) from tip of rostrum to tip of telson, stage of ovarian development, the occurrence of diseased individuals, and total weight and number of individuals per pound. Number per pound or "heads-on count size" for each sample is determined by obtaining the average number of whole individuals per pound in a random three-pound subsample. In smaller samples where less than three pounds of a species are collected, number per pound values are calculated by dividing the total number of individuals by the total weight in the sample. In samples where only one specimen is collected or when total weights represent one ounce or less, a length/weight conversion table prepared from previous Commercial Fisheries investigations is used to obtain heads-on counts (Attachment B). Ovarian development is classified and recorded in five distinct stages of maturity (King, 1948): UN = undeveloped; D = developing; Y = yellow; R = ripe; and, S = spent. The presence or absence of spermatophores is also noted.

In addition to regularly scheduled assessment monitoring at established stations, supplemental spot check sampling is also conducted to gain essential population data critical to formulation of management decisions and to keep managers abreast of unusual events. Spot checks are made in the same manner as the normally scheduled assessment trawl sampling described above, but may or may not be made at the established assessment monitoring stations. Therefore, supplemental spot check sampling is not included as part of the regular assessment analyses for historical comparison, but rather as additional information for management purposes. This insures that the historical database is not altered or biased by supplemental samples.

Monthly CPUE values (pounds per hour of trawling) for each 15 minute trawl station are calculated by simply multiplying the total weight of the species collected in each sample by four to obtain a projected pounds per hour (CPUE) value. Means for the two stations of each sector of each estuarine system are calculated as simple arithmetic means by adding the CPUE values of the two individual stations in each sector and dividing by two. Overall or combined CPUE values for each estuarine system are calculated by simply adding the mean CPUE values for the three individual sectors (creeks, sounds and offshore waters) and dividing by three. Cumulative coastwide mean CPUE values for individual sectors as well as individual systems are calculated by adding the six specific means or averages and dividing by six. Examples of these values are attached as Attachments C-E.

Count sizes are reported as weighted means at all levels of reporting. Weighted counts are used to determine anticipated mean count sizes which would result during season openings or extensions.

To compare relative abundance of white shrimp stocks following major winter kills with CPUE values of the long term database, current mean monthly CPUE pounds per hour values are compared with the historical average as relative percentage values. Comparisons are made by individual sector, estuary and for all areas combined. If, following a major freeze with documented freeze related mortalities, the coastwide CPUE value is determined to be 20% or less of the mean long term CPUE average for that month, then stock abundance is considered to be less than 80% of normal and approaching critically low levels. Such depleted stocks of overwintering survivors must be protected to insure maximum spring spawning success and to reduce adverse impacts to the subsequent fall commercial production. Actual calculation of freeze induced mortalities is difficult to determine because the relative number of individuals that emigrate offshore to deeper and more protected waters is unknown. Furthermore, those that succumb to the freeze can not be caught in trawls at the same rate as live specimens. Therefore, the most meaningful analyses are through relative stock abundance comparisons of current monthly mean CPUE values with long term historical mean CPUE values.

Appendix A14. Assessment trawl station locations sampled each month as part of Georgia's Resources Assessment Survey 1987-1990. Latitude and longitude coordinates from NOAA chart.

Estuary	Sector	Station Location	Midpoint Location Latitude/Longitude
	Creek	Halfmoon River	31 58.2'N/80 57.6'W
	Creek	Wilmington River at Sister Island	31 59.8'N/81 00.2'W
Wassaw	Sound	Mouth of Bull River	31 57.0'N/80 56.0'W
	Sound	Wassaw Sound at Saltpond	31 55.6'N/80 58.3'W
	Offshore	North Channel off Little Tybee Isl.	31 54.9'N/80 54.9'W
	Offshore	South Channel off Wassaw Island	31 54.6'N/80 55.0'W
	Creek	Vernon River at Burnside River	31 55.4'N/81 05.5'W
	Creek	Florida Passage at Cane Patch Ck.	31 49.6'N/81 09.5'W
Ossabaw	Sound	North Side of Racoon Key	31 51.7'N/81 04.1'W
	Sound	South Side of Racoon Key	31 50.2'N/81 03.0'W
	Offshore	Channel East of Racoon Key	31 48.1'N/80 59.5'W
	Offshore	Channel East of Ossabaw Island	31 47.4'N/81 00.0'W
	Creek	Wahoo River near mouth	31 35.5'N/81 12.5'W
	Creek	Mud River at Intracoastal Waterway	31 29.0'N/81 18.2'W
Sapelo	Sound	North Side of Dog Hammock	31 31.6'N/81 17.0'W
	Sound	Lower sound north of High Point	31 31.5'N/81 14.8'W
	Offshore	Channel near north end of Blackbeard	31 32.0'N/81 09.5'W
	Offshore	Channel east of Blackbeard Beach	31 31.5'N/81 10.5'W
	Creek	Frederica River at Mackay River	31 11.8'N/81 25.0'W
	Creek	Back River at Little River	31 09.3'N/81 26.8'W
St. Simons	Sound	St. Simons Range Towers at Frederica River	31 08.9'N/81 25.2'W
	Sound	Lower Jekyll Cove at Dubignion	31 06.2'N/81 25.8'W
	Offshore	Offshore of St. Simons Sound entrance	31 06.5'N/81 21.5'W
	Offshore	Channel East of North Jekyll Beach	31 06.0'N/81 20.5'W
	Creek	Jointer Creek near mouth	31 02.8'N/81 28.2'W
	Creek	Floyd Creek near mouth	30 56.3'N/81 26.2'W
St. Andrew	Sound	Satilla River at Todd Creek	30 55.8'N/81 29.3'W
	Sound	Cumberland River at Cumberland Wharf	30 58.4'N/81 30.5'W
	Offshore	Channel North of St. Andrew Sea Buoy	30 59.6'N/81 25.0'W
	Offshore	Channel southwest of north breakers	30 57.0'N/81 19.0'W
	Creek	Brickhill River below Power Cable	30 51.8'N/81 28.3'W
	Creek	Crooked River South Branch	30 49.3'N/81 30.0'W
Cumberland	Sound	Cumberland Sound at Seacamp Dock	30 45.0'N/81 28.6'W
	Sound	Cumberland Sound at Dungeness Dock	30 46.0'N/81 28.4'W
	Offshore	Offshore from mid-Cumberland Beach	30 53.3'N/81 23.0'W
	Offshore	Cumberland Beach (Lake Whitney/ Stafford Shoals)	30 52.7'N/81 23.5'W

Appendix A15

Appendix A15. Total lengths and mean number per pound (heads-on) count size for white shrimp in Georgia. Lengths measured from tip of rostrum to tip of telson.

Length in MM	Heads-On No/Lb	Length in MM	Heads-On No/Lb	Length in MM	Heads-On No/Lb	Length in MM	Heads-On No/Lb	Length in MM	Heads-On No/Lb
		Length versus mean count size for white shrimp							
51	480	71	173	91	81	111	44	134-135	24
52	452	72	166	92	78	112	42	136-137	23
53	426	73	159	93	75	113	41	138-139	22
54	403	74	152	94	73	114	40	140-141	21
55	380	75	146	95	71	115	39	142-144	20
56	360	76	140	96	68	116	38	145-146	19
57	341	77	135	97	66	117	37	147-149	18
58	323	78	130	98	64	118	36	150-152	17
59	306	79	125	99	62	119	35	153-155	16
60	291	80	120	100	60	120	34	156-158	15
61	276	81	115	101	58	121	33	159-162	14
62	263	82	111	102	57	122	33	163-166	13
63	250	83	107	103	55	123	32	167-171	12
64	238	84	103	104	53	124	31	172-176	11
65	227	85	99	105	52	125-126	30	177-182	10
66	217	86	96	106	50	127	29	183-188	9
67	207	87	93	107	49	128	28	189-192	8
68	198	88	89	108	48	129-130	27		
69	189	89	85	109	46	131-132	26		
70	181	90	83	110	45	133	25		

From: Stevens, Stuart A., and Andre Kvaternik. *In preparation*. Length-weight relationships for white shrimp in Georgia waters. 7 pp.

Table 40. Mean pound per hour assessment trawls catches of white shrimp by month, sector and estuary for all estuarine systems from July 1974 through December 1990.

		Calendar Year of Assessment Trawling																
Month	Sector	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Jan.	Creek	*	25.9	17.8	13.0	33.3	40.7	*	*	*	179.7	0.8	16.7	153.7	50.1	26.5	29.4	0.4
	Sound	*	39.3	11.8	21.8	20.0	26.0	*	*	*	118.6	0.5	15.4	98.1	52.6	57.3	26.8	1.0
	Offshore	*	0.1	8.4	0.1	15.8	0.7	*	*	*	9.6	0.6	7.0	11.5	35.9	13.6	1.5	1.3
	Total	*	21.8	12.7	11.6	23.0	22.5	*	*	*	102.6	0.6	13.0	87.7	46.2	33.1	19.2	0.9
Feb.	Creek	*	40.0	76.6	0.1	2.6	25.2	*	0.1	26.7	16.2	*	1.0	82.2	47.9	75.8	3.8	8.0
	Sound	*	132.2	47.5	0.3	0.2	11.9	*	0.2	14.9	17.0	0.2	4.6	44.6	51.3	55.1	9.9	6.7
	Offshore	*	<0.1	0.1	<0.1	0.4	0.4	*	*	1.2	4.1	*	0.5	54.7	11.9	3.6	0.6	0.1
	Total	*	57.4	41.4	0.1	1.1	12.5	*	0.2	14.3	12.4	0.2	2.0	60.5	37.0	44.9	4.8	5.0
Mar.	Creek	*	77.3	52.4	0.5	<0.1	33.3	12.2	*	*	*	0.6	2.7	16.1	62.3	12.1	27.1	7.8
	Sound	*	163.4	31.5	1.1	0.2	23.8	10.6	*	*	*	0.4	1.9	18.6	20.3	13.7	25.5	5.2
	Offshore	*	0.1	<0.1	0.0	<0.1	0.1	0.5	*	*	*	0.1	0.2	0.8	12.6	0.1	6.1	0.5
	Total	*	80.3	28.0	0.5	0.1	19.1	7.8	*	*	*	0.3	1.6	11.8	31.7	8.6	19.6	4.5
Apr.	Creek	*	26.4	38.8	0.5	0.1	104.8	*	2.2	25.4	16.2	1.7	5.8	18.8	61.6	9.8	40.7	17.5
	Sound	*	103.4	41.6	0.3	0.1	113.5	*	0.4	14.1	40.1	3.7	0.8	30.1	75.1	15.5	39.2	12.0
	Offshore	*	1.0	0.1	<0.1	0.1	17.6	*	0.1	2.7	5.3	0.2	0.4	1.4	1.2	2.1	4.7	1.0
	Total	*	43.6	26.8	0.3	0.1	78.6	*	0.9	14.1	20.5	1.8	2.3	16.8	46.0	9.2	28.2	10.2
May	Creek	*	53.5	4.5	0.2	0.1	11.1	15.8	0.4	19.2	15.4	5.6	3.9	17.9	20.7	14.9	20.1	3.7
	Sound	*	87.9	12.8	<0.1	0.1	12.2	27.8	0.1	25.7	18.2	2.0	0.8	12.2	32.3	4.3	13.2	2.2
	Offshore	*	1.6	3.2	0.4	0.2	7.6	1.0	0.4	30.5	5.9	0.9	0.4	4.3	3.1	11.0	6.9	4.2
	Total	*	47.7	6.8	0.2	0.1	10.3	14.9	0.3	25.1	13.2	2.8	1.7	11.5	18.7	10.1	13.4	3.4
June	Creek	*	16.1	1.6	0.0	<0.1	0.3	*	0.0	*	1.3	0.4	0.2	3.6	2.5	2.8	3.2	1.2
	Sound	*	17.8	2.1	0.0	<0.1	1.6	*	0.1	*	2.3	0.4	0.6	1.8	2.7	4.2	10.0	0.4
	Offshore	*	4.9	2.1	0.1	<0.1	1.2	*	1.1	*	4.5	4.4	1.0	3.1	1.7	7.8	3.4	1.7
	Total	*	12.9	1.9	<0.1	<0.1	1.0	*	0.4	*	2.7	2.4	0.6	2.8	2.3	4.9	5.6	1.1
July	Creek	20.3	11.7	22.6	1.1	4.8	1.9	*	*	2.8	*	1.6	0.2	0.5	1.7	0.1	12.3	8.9
	Sound	4.2	77.5	7.9	0.3	1.7	2.2	*	*	0.8	*	0.1	0.2	0.4	0.5	0.1	0.3	2.9
	Offshore	0.2	0.8	0.1	0.1	0.1	0.6	*	*	0.5	*	<0.1	<0.1	0.5	0.2	0.1	0.1	0.2
	Total	8.2	30.0	10.2	0.5	2.2	1.6	*	*	1.4	*	0.6	0.2	0.5	0.9	0.1	4.2	4.0
Aug.	Creek	67.9	148.1	89.9	12.1	29.5	63.3	*	23.7	152.5	53.4	9.2	28.2	24.3	47.1	6.0	18.2	45.1
	Sound	86.7	243.7	104.9	38.1	37.5	40.8	*	14.9	*	47.9	3.7	9.2	14.3	6.2	10.9	26.6	28.3
	Offshore	0.9	0.9	0.7	0.4	0.4	1.0	*	4.8	*	2.2	0.5	1.8	1.8	0.9	0.2	0.4	1.1
	Total	51.8	130.9	65.2	16.9	22.5	35.0	*	14.5	**	34.5	4.5	13.1	13.5	18.0	5.7	15.1	24.8
Sept.	Creek	100.0	84.9	128.1	74.9	81.5	56.7	68.6	*	64.9	70.0	13.4	127.8	137.0	116.4	29.4	43.9	67.6
	Sound	10.7	209.9	180.8	132.5	53.1	103.4	69.1	*	74.4	88.7	27.8	61.3	47.7	89.9	64.9	83.4	48.4
	Offshore	3.9	5.8	0.4	1.9	2.9	3.5	2.5	*	3.1	3.7	4.3	2.3	4.9	5.4	2.5	1.8	2.5
	Total	38.2	100.2	103.1	69.8	45.8	54.5	46.7	*	47.5	54.1	15.2	63.8	59.8	70.5	32.3	43.0	39.5
Oct.	Creek	35.0	54.0	49.4	102.3	85.4	*	*	25.6	*	34.3	35.0	97.7	91.4	69.6	30.4	62.1	22.8
	Sound	51.2	16.9	9.9	51.9	83.7	*	*	29.2	*	47.4	19.0	53.3	112.6	73.5	57.4	74.7	21.6
	Offshore	3.0	4.5	2.4	3.2	6.0	*	*	8.2	*	4.9	2.5	9.2	5.8	3.8	2.0	2.7	2.5
	Total	29.7	25.1	20.7	52.5	58.4	*	*	21.0	*	28.9	18.8	53.4	69.9	49.0	29.9	46.5	15.6
Nov.	Creek	44.6	70.3	68.2	105.1	29.0	*	56.1	21.8	60.3	84.2	37.7	128.3	53.9	64.3	39.5	67.9	19.6
	Sound	7.4	5.0	14.6	128.8	29.3	*	27.7	21.0	51.7	24.2	29.7	130.0	55.2	58.5	55.8	65.7	24.7
	Offshore	1.3	2.3	0.6	5.6	7.4	*	8.9	3.8	5.6	4.5	2.8	4.1	10.3	6.9	3.0	2.2	1.6
	Total	17.8	25.9	27.8	79.8	21.9	*	30.9	15.5	39.2	38.3	22.4	87.5	39.6	43.2	32.7	45.3	15.3
Dec.	Creek	16.9	43.1	94.9	83.0	76.4	56.2	79.2	16.3	63.5	44.1	30.6	106.7	64.8	60.3	51.0	217.7	77.9
	Sound	23.0	8.4	31.8	81.6	99.6	72.3	50.1	40.6	51.9	10.7	28.6	52.1	92.0	170.5	79.0	70.7	85.7
	Offshore	3.8	2.8	1.6	10.5	4.6	9.6	2.0	9.6	9.4	8.3	4.6	18.5	13.4	8.2	2.1	1.6	5.6
	Total	14.6	18.1	42.8	58.4	60.3	46.0	43.8	22.2	41.6	21.0	21.2	59.1	56.7	79.7	44.0	96.6	56.4
All Totals	Creek	**	54.3	53.7	32.7	28.6	**	**	**	**	**	**	43.3	54.5	50.4	25.0	45.5	23.4
	Sound	**	92.1	41.4	38.1	27.1	**	**	**	**	**	9.7	27.5	44.0	52.8	34.8	37.2	19.9
	Offshore	**	2.7	1.7	1.9	3.2	**	**	**	**	**	**	3.8	9.4	7.7	4.0	2.7	1.8
	Total	**	49.5	32.3	24.2	19.6	**	**	**	**	**	**	24.9	35.9	36.9	21.3	28.4	15.0

*No sampling conducted.

**Insufficient sample for calculation.

Table 41. White shrimp assessment catch comparisons by year and by sector for January.

	Means for All Estuaries Combined													
Sector	1978	1979[1]	1980	1981	1982	1983[2]	1984	1985	1986[3]	1987	1988	1989	1990	1991
Mean Pounds/Hour														
Creek	33.3	40.7	*	*	*	179.7	0.8	26.6	150.2	50.1	26.5	29.4	0.4	33.7
Sound	20.0	26.0	*	*	*	118.6	0.5	23.1	98.1	52.9	56.5	26.8	1.0	35.2
Offshore	15.8	0.7	*	*	*	9.6	0.6	8.3	11.4	35.9	13.6	1.5	1.3	3.6
All Sectors	23.0	22.5	*	*	*	102.6	0.2	18.7	86.6	44.5	32.2	19.2	0.9	24.2
Mean Number/Pound (heads-on)														
Creek	46.2	42.8	*	*	*	70.6	52.3	44.0	34.6	51.6	39.8	37.3	54.2	52.1
Sound	39.9	42.9	*	*	*	55.4	55.8	34.4	34.2	48.9	38.3	28.5	51.4	29.8
Offshore	26.7	23.2	*	*	*	25.0	68.6	31.8	27.1	44.5	45.6	26.6	40.2	18.9
All Sectors	37.6	36.3	*	*	*	50.3	32.6	38.1	34.0	48.9	39.8	33.9	46.6	41.0
Mean Salinity (ppt)														
Creek	19.3	24.9	*	*	*	17.1	20.2	25.3	21.4	19.8	29.0	29.0	23.2	26.3
Sound	20.6	22.1	*	*	*	18.0	22.4	28.0	23.7	23.4	30.0	30.3	25.8	27.9
Offshore	25.5	28.0	*	*	*	31.5	27.0	30.7	29.2	27.1	29.9	32.1	30.1	31.0
All Sectors	21.8	25.0	*	*	*	22.2	23.1	28.4	24.8	24.3	29.7	30.4	26.4	28.4
Mean Water Temperature (°C)														
Creek	7.4	10.2	*	*	*	9.6	7.6	12.4	11.8	10.3	8.8	14.7	9.1	14.4
Sound	7.6	10.3	*	*	*	9.6	6.8	11.4	11.3	10.5	8.5	14.5	9.0	14.5
Offshore	9.5	10.0	*	*	*	10.5	7.0	10.1	10.9	10.3	7.7	13.8	9.3	13.5
All Sectors	8.2	10.2	*	*	*	9.9	7.1	11.1	11.3	10.4	8.3	14.3	9.1	14.2

[1] Means calculated for creek stations in St. Simons, St. Andrew and Cumberland, sound stations in Sapelo, St. Simons St. Andrew and Cumberland estuaries; means calculated for offshore sector for St. Simons and St. Andrew estuaries only.

[2] Means calculated for all stations in Wassaw, Sapelo, Altamaha, St. Simons, St. Andrew and Cumberland 1983-1985.

[3] Means calculated ofr all stations in Wassaw, Ossabaw, Sapelo, St. Simons, St. Andrew and Cumberland. In 1986, Ossabaw for substituted for Altamaha as Ossabaw Sound is commercially important.

*Indicates either sampling not conducted or data insufficient for accurate calculation.

Table 42. White shrimp assessment catch comparisons by year and by sector for February.

Means for All Estuaries Combined													
Sector	1978	1979	1980	1981	1982	1983	1984	1985[1]	1986[2]	1987	1988	1989	1990
Mean Pounds/Hour													
Creek	1.7	19.4	*	0.1	26.7	16.2	0.0	1.0	82.2	47.9	75.8	3.8	8.1
Sound	0.1	15.5	*	0.2	14.9	17.0	0.1	4.6	44.6	51.3	55.1	9.9	6.7
Offshore	1.4	2.2	*	*	1.2	3.7	0.0	0.5	54.7	11.9	3.6	0.6	0.1
All Sectors	1.1	12.4	*	0.2	16.4	12.3	<0.1	2.0	60.5	37.0	44.9	4.8	5.0
Mean Number/Pound (heads-on)													
Creek	49.0	36.8	*	51.8	35.1	53.6	*	40.5	39.8	57.5	46.7	29.3	40.5
Sound	59.6	39.6	*	66.0	34.0	42.4	32.6	29.5	28.3	43.4	30.6	28.2	41.9
Offshore	35.8	31.6	*	*	75.7	45.8	*	39.8	22.7	32.8	36.7	22.3	37.7
All Sectors	43.5	37.6	*	58.9	35.5	47.7	32.6	32.1	31.8	48.3	39.8	28.3	41.1
Mean Salinity (ppt)													
Creek	13.7	21.0	*	26.1	20.3	17.0	*	27.8	22.9	17.3	27.0	30.7	19.7
Sound	17.2	20.6	*	29.9	22.8	18.4	15.7	29.9	24.5	19.7	28.7	31.3	23.8
Offshore	25.8	28.0	*	*	25.0	22.2	28.0	31.3	28.8	22.3	31.0	33.2	28.9
All Sectors	18.9	23.0	*	28.0	22.7	19.2	15.0	29.7	25.4	19.8	28.9	31.7	24.2
Mean Water Temperature (°C)													
Creek	6.4	8.9	*	9.9	14.8	9.6	14.0	11.4	14.2	11.3	10.9	15.8	15.9
Sound	6.4	9.2	*	9.2	14.6	10.2	11.3	11.3	14.3	11.3	10.8	15.4	15.5
Offshore	6.1	9.5	*	*	14.4	9.5	8.0	10.5	12.9	11.0	10.3	14.9	15.4
All Sectors	6.3	9.2	*	10.0	14.6	9.8	11.2	11.1	13.8	11.2	10.7	15.4	15.7

[1] Means include Wassaw, Sapelo, Altamaha, St. Simons, St. Andrew and Cumberland for 1978-1985.

[2] Means since 1986 include Wassaw, Ossabaw, Sapelo, St. Simons, St. Andrew and Cumberland estuaries.

*Indicates either sampling not conducted or data insufficient for accurate calculation.

APPENDIX XIII

Coastal Zone Consistency- Letters and Responses

SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

1 SOUTHPARK CIRCLE,SUITE 306 CHARLESTON, SC 29407-4699
TELEPHONE (803)571-4366

Susan Shipman, Chairman
Curtis Bostick, Vice-Chairman

Robert K. Mahood, Executive Director

November 26, 1991

Mr. Dale Twachtmann
Secretary
Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301

Dear Mr. Twachtmann :

This is to advise the State of Florida of proposed federal action and the conclusion of the South Atlantic Council on the consistency of such action with the provisions of Florida's Coastal Management Program. This letter is submitted pursuant to provisions of 15 CFR §930 *et seq*. and §307 of the Coastal Zone Management Act of 1972, as amended.

The proposed federal action is to implement the Shrimp Fishery Management Plan for the south Atlantic region that will enable states to request closure of the adjacent EEZ when the overwintering population of white shrimp is reduced by 80% or more following severe winter weather. This plan also includes a requirement for a federal permit to harvest shrimp in the EEZ and establishes a control date. A copy of the fishery management plan is enclosed.

We have reviewed the proposed action with regard to the provisions of your State's Coastal Management Program and have concluded that it is consistent to the maximum extent practicable with the provisions thereof. In accordance with the provisions of 15 CFR §930.41 we are requesting that you advise us of your agreement or disagreement with our determination. In the event that there is no response from your agency within 45 days of receipt of this letter, we will presume your agency's concurrence with our determination of consistency.

If you have any questions, please do not hesitate to call Steve Berkeley or Bob Mahood at (803) 571-4366 (FAX: (803) 769-4520).

Sincerely,

Robert K. Mahood

Robert K. Mahood
Executive Director

cc: Mr. David Worley w/cpy encl.
Coastal Program Manager
Office of Coastal Management
SAFMC Council Members

SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

1 SOUTHPARK CIRCLE, SUITE 306 CHARLESTON, SC 29407-4699

TELEPHONE (803) 571-4366

Susan Shipman, Chairman
Curtis Bostick, Vice-Chairman

Robert K. Mahood, Executive Director

November 26, 1991

Mr. William W. Cobey, Jr.
Secretary
NC Department of Environment, Health and Natural Resources
P.O. Box 27687
Raleigh, North Carolina 27611-7687

Dear Mr. Cobey:

This is to advise the State of North Carolina of proposed federal action and the conclusion of the South Atlantic Council on the consistency of such action with the provisions of North Carolina's Coastal Management Program. This letter is submitted pursuant to provisions of 15 CFR §930 *et seq*. and §307 of the Coastal Zone Management Act of 1972, as amended.

The proposed federal action is to implement the Shrimp Fishery Management Plan for the south Atlantic region that will enable states to request closure of the adjacent EEZ when the overwintering population of white shrimp is reduced by 80% or more following severe winter weather. This plan also includes a requirement for a federal permit to harvest shrimp in the EEZ and establishes a control date. A copy of the fishery management plan is enclosed.

We have reviewed the proposed action with regard to the provisions of your State's Coastal Management Program and have concluded that it is consistent to the maximum extent practicable with the provisions thereof. In accordance with the provisions of 15 CFR §930.41 we are requesting that you advise us of your agreement or disagreement with our determination. In the event that there is no response from your agency within 45 days of receipt of this letter, we will presume your agency's concurrence with our determination of consistency.

If you have any questions, please do not hesitate to call Steve Berkeley or Bob Mahood at (803) 571-4366 (FAX: (803) 769-4520).

Sincerely,

Robert K. Mahood

Robert K. Mahood
Executive Director

cc: Mr. Roger N. Schecter, Director w/cpy encl.
Office of Coastal Management
SAFMC Council Members

SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

1 SOUTHPARK CIRCLE,SUITE 306 CHARLESTON, SC 29407-4699
TELEPHONE (803)571-4366

Susan Shipman, Chairman
Curtis Bostick, Vice-Chairman
Robert K. Mahood, Executive Director

November 26, 1991

Dr. H. Wayne Beam, Executive Director
South Carolina Coastal Staff
AT&T Capitol Center
1201 Main Street Suite 1520
Columbia, SC 29201

Dear Dr. Beam:

This is to advise the State of South Carolina of proposed federal action and the conclusion of the South Atlantic Council on the consistency of such action with the provisions of South Carolina's Coastal Management Program. This letter is submitted pursuant to provisions of 15 CFR §930 *et seq*. and §307 of the Coastal Zone Management Act of 1972, as amended.

The proposed federal action is to implement the Shrimp Fishery Management Plan for the south Atlantic region that will enable states to request closure of the adjacent EEZ when the overwintering population of white shrimp is reduced by 80% or more following severe winter weather. This plan also includes a requirement for a federal permit to harvest shrimp in the EEZ and establishes a control date. A copy of the fishery management plan is enclosed.

We have reviewed the proposed action with regard to the provisions of your State's Coastal Management Program and have concluded that it is consistent to the maximum extent practicable with the provisions thereof. In accordance with the provisions of 15 CFR §930.41 we are requesting that you advise us of your agreement or disagreement with our determination. In the event that there is no response from your agency within 45 days of receipt of this letter, we will presume your agency's concurrence with our determination of consistency.

If you have any questions, please do not hesitate to call Steve Berkeley or Bob Mahood at (803) 571-4366 (FAX: (803) 769-4520).

Sincerely,

Robert K. Mahood

Robert K. Mahood
Executive Director

cc: Mr. Heyward Robinson, Staff Biologist w/copy encl.
Mr. Steve Snyder, Chief Planner w/cpy encl.
South Carolina Coastal Council
4130 Faber Place Suite 300
N. Charleston, SC 29405
SAFMC Council Members

STATE OF FLORIDA
Office of the Governor
THE CAPITOL
TALLAHASSEE, FLORIDA 32399-0001

LAWTON CHILES
GOVERNOR

FEB ... 92
SOUTH ATLANTIC FISHERY
MANAGEMENT COUNCIL

January 28, 1992

Mr. Robert K. Mahood
Executive Director
South Atlantic Fishery
1 Southpark Circle
Suite 306
Charleston, South Carolina 29407-4699

RE: Public Hearing Draft - Shrimp Fishery Management Plan - South Atlantic Region (Including Environmental Impact Statement and Regulatory Impact Review)

SAI: FL9112100759C

Dear Mr. Mahood:

The Florida State Clearinghouse, pursuant to Presidential Executive Order 12372, Gubernatorial Executive Order 83-150, the Coastal Zone Management Act Reauthorization Amendments of 1990 and the National Environmental Policy Act, has coordinated a review of the above referenced project.

Pursuant to Presidential Executive Order 12372, the project will be in accord with State plans, programs, procedures and objectives when consideration is given to and action taken on the enclosed comments and requirements of our reviewing agencies.

Please refer to the enclosed comments provided by the Department of Natural Resources (DNR) regarding the measurement of "a severe reduction in white shrimp" and the sampling method.

The Marine Fisheries Commission (MFC) recommends a more quantitative approach to the threshold for fishery closures and the overfishing definition. Please refer to the enclosed MFC comments.

The State has reviewed your federal consistency determination for the above referenced project. Based on comments from our reviewing agencies, the State agrees that the proposed project is consistent with the Florida Coastal Management Program.

This letter reflects your compliance with Presidential Executive Order 12372.

Sincerely,

Janice L. Alcott

Janice L. Alcott, Director
State Clearinghouse

JLA/bl

Enclosure(s)

cc: Department of Natural Resources
Marine Fisheries Commission

FLORIDA DEPARTMENT OF NATURAL RESOURCES

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399

Virginia B. Wetherell
Executive Director

January 7, 1992

Ms. Janice L. Alcott, Director
State Clearinghouse
Office of Planning and Budgeting
Executive Office of the Governor
The Capitol
Tallahassee, Florida 32399-0001

SUBJECT: SAI # FL9112100759C, Shrimp Fishery Management Plan

Dear Ms. Alcott:

Our Division of Marine Resources staff has reviewed the subject SAI and would like to offer the following comments which focus on two points, and the reason for the plan: Panaeus setiferus, white shrimp. White shrimp are the dominant species along northwest Florida, Georgia and South Carolina. They occupy shallow estuarine systems and are occassionally subjected to winter freezes sufficient to kill off most of the overwintering adults. There is documentation and legitimate concern that spring shrimp fishing in south Georgia and north Florida will severly deplete an already reduced population during winter kill years. This, in turn, can cause reductions in subsequent years' crops. By not fishing in these winter kill years, fishing will be better in subsequent years. The entire plan is dedicated to finding a method to shut down white shrimp fishing in federal waters (EEZ) after a winter kill has occurred.

The critical issue in this plan is the measurement of "a severe reduction in white shrimp". The plan recommends on page 55 that "overfishing is indicated when the over-wintering shrimp population within a state's waters declines by 80 percent or more following severe winter weather resulting in prolonged cold temperatures". There is no definition of what the 80 percent is measured against i.e., last month's amount, some previous average, a comparable month a year ago? There must be a definition of how to calculate the 80 percent decline clearly spelled out in the plan and not subject to the interpretation of an individual state. It is far too easy to show an 80 percent decline given the variability inherent in the sampling methods used.

Ms. Janice L. Alcott
January 7, 1992
Page Two

The second issue is the sampling method. Georgia and South Carolina currently have reasonably good sample procedures which they have been using for many years. If these are the sampling methods to be used to base a request to close the EEZ then they must be defined in the plan. Otherwise, there may as well be no definition of overfishing; a state would have no obligation to justify with credence a request to close the EEZ.

If need further information, please contact Frank Kennedy with the Florida Marine Research Institute at (813) 896-8626.

Sincerely,

BJWhite

B. J. White
Office of Land Use Planning
and Biological Services

BJW/jp

Marine Fisheries Commission
STATE OF FLORIDA

Executive Director
Russell S. Nelson, Ph.D.

December 20, 1991

DEC 20 1991
STATE CLEARINGHOUSE

Ms. Janice L. Alcott
Director, State Clearinghouse
Executive Office of the Governor-OPB
The Capitol
Tallahassee, FL 32399-0001

Dear Ms. Alcott:

Thank you for offering us the opportunity to review the South Atlantic Fishery Management Council's consistency determination on the Public Hearing Draft Shrimp Fishery Management Plan for the South Atlantic Region (SAI# FL9112100759C).

We concur with the Council's determination and find that the draft plan is consistent with our responsibilities under Florida's coastal management program. The conservation of the white shrimp populations along the Atlantic coast of Florida should benefit from the proposed EEZ closures following severe winter cold kills.

While we support the proposed closures, we believe that the final plan would be greatly strengthened by a more quantitative approach to the threshold for fishery closures and the overfishing definition. Spelling out the specific parent stock densities at which future recruitment is threatened would remove some uncertainty from the management measures, would be more defensible, and would be more easily understood and accepted by the public. Such an approach would also be useful for shaping future management measures which may be needed to control fishing mortality in order to optimize benefits. Both the Georgia Department of Natural Resources and the South Carolina Wildlife and Marine Resources Department have extensive data bases on annual abundance of white shrimp stocks that can be used to assess parent stock thresholds. The South Carolina data base has even been used to calculate and publish a stock-recruitment relationship for white shrimp, and that type of quantitative approach is what is needed to strengthen this FMP.

We strongly concur with the establishment of a control date for use in a future limited entry program and the need for annual vessel permits.

2540 Executive Center Circle West, Suite 106 • Tallahassee, Florida 32301
(904) 487-0554

The latter are essential to any future development of limited entry, especially in Florida. Florida's license and data collection systems probably cannot reliably identify who is fishing in the South Atlantic region since fishing location is a voluntary field on the trip ticket. However, we suggest that the annual vessel permit be coupled with mandatory reporting, e.g., logbooks. Given the possibility of future limited entry, most fishermen will acquire a federal permit, just to have his/her name included on the list of future shareholders in the limited entry system.

Sincerely,

Russell S. Nelson, Ph.D.
Executive Director

cc: Commissioners

RSN/GAC/ROW

SOUTH CAROLINA COASTAL COUNCIL

Ashley Corporate Center
4130 Faber Place
Suite 300
Charleston, S.C. 29405
(803) 744-5838
FAX 744-5847

William W. Jones, Jr.
Chairman

H. Wayne Beam, Ph.D.
Executive Director

December 9, 1991

RECEIVED
DEC 11 91
SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

Mr. Robert K. Mahood
Executive Director
South Atlantic Fishery Management Council
1 SouthPark Circle, Suite 306
Charleston, SC 29407-4699

RE: Shrimp Fishery
Management Plan
Various Counties

Dear Mr. Mahood:

The staff of the S. C. Coastal Council certifies that the above referenced project is consistent with the Coastal Zone Management Program to the maximum extent practicable. This certification shall serve as the final approval by the S. C. Coastal Council.

Sincerely,

H. Stephen Snyder
Director of Planning
and Certification

HR:1228D:jpw

cc: Dr. H. Wayne Beam
Mr. Christopher L. Brooks

State of North Carolina
Department of Environment, Health, and Natural Resources
Division of Coastal Management
225 North McDowell Street • Raleigh, North Carolina 27602

James G. Martin, Governor
William W. Cobey, Jr., Secretary

Roger N. Schecter
Director

12/09/91

Mr. Robert K. Mahood Executive Director
South Atlantic Fishery Mgnt Council
1 Southpark Circle, Suite 306
Charleston, SC 29407

REFERENCE: CD91-32
Implement Shrimp Fishery Management Plan in the EEZ

Dear Mr. Mahood:

The State of North Carolina received your consistency determination dated 11/26/91 concerning a proposed Federal Activity pursuant to 15 CFR 930.30 on 12/06/91. Your determination, which we have assigned the number CD91-32, has been circulated to the appropriate state agency reviewers for comment. We have requested that our reviewers respond by 12/30/91 and, provided no serious problems are identified, will provide the state's position on this proposal on or before 01/20/92.

Should you have any questions concerning our program or the status of the review, please call me at (919)733-2293.

Sincerely,

Stephen B. Benton
Consistency Coordinator

P.O. Box 27687, Raleigh, North Carolina 27611-7687 Telephone 919-733-2293

An Equal Opportunity Affirmative Action Employer

State of North Carolina
Department of Environment, Health, and Natural Resources
Division of Marine Fisheries
P.O. Box 769 • Morehead City, North Carolina 28557-0769

James G. Martin, Governor
William W. Cobey, Jr., Secretary

William T. Hogarth, Director
(919) 726-7021

20 December 1991

Mr. Robert K. Mahood, Executive Director
South Atlantic Fishery Management Council
One Southpark Circle, Suite 306
Charleston, SC 29407-4699

Dear Bob:

The North Carolina Division of Marine Fisheries (DMF) has reviewed the draft "Shrimp Fishery Management Plan for the South Atlantic Region" (FMP) and our comments follow.

The approach taken to specify MSY may lead to future management problems, because species-specific values are given (on page 16). The real MSY is not the long term mean. It is whatever is landed in a given year because penaeid shrimp are annual crops, as stated numerous times in the FMP. Specifying a number could provide a basis for development of limits or quotas which are not appropriate for these species or fisheries.

Section 6.5. - The habitat list for North Carolina needs to be updated. Drainage of freshwater from silviculture should be included. Ocean outfalls may be used for mainland, as well as island, sewage disposal in the future. Future peat mining is unlikely because the main peat area became a part of the Pocosin Lakes National Wildlife Refuge this year.

Section 11.2 - We doubt if "[a]bout 20 percent [of North Carolina's shrimp vessel captains] are 81 years or older." The 4% estimate for this age group is probably high, as well.

Section 12.2 - The management unit is defined as including white, brown, and pink shrimp along the South Atlantic Coast. Yet, the background discussion (12.1) clearly states that the FMP, "is designed to benefit *Penaeus setiferus*, the white shrimp" (page 52). The fisheries for the three species are fairly distinct; thus, there is no need to include, and potentially restrict, brown and pink shrimp in a plan aimed at white shrimp.

Section 12.7.1 - Management Measure 1: Concurrent Closures - The DMF objects to this measure. It is stated at the top of page 60 that "[i]t is the closure of the EEZ off Florida and southern coastal Georgia that is believed to be the critical element of this measure since that is where the greatest number of surviving adults would be." There is no need for, nor benefit to be gained from, the closure of the EEZ off North Carolina to protect roe white shrimp following a severe freeze. These shrimp do not exist off North Carolina following a severe freeze. Prohibition of "the possession aboard a fishing vessel of any species of penaeid shrimp" (page 59) in the EEZ off North Carolina would not benefit white shrimp because the shrimp in possession would be pink shrimp, which survive freezes much better than white shrimp can. There are several areas in the EEZ off North Carolina where shrimpers trawl in the spring for large, very valuable pink shrimp, and this activity would be prohibited during a region-wide closure intended to protect roe white shrimp off Georgia and Florida.

The DMF recommends strongly to the Council that the FMP adhere to the concurrent closure approach in the strict sense: close the EEZ only during the time and off those waters closed by a state or states. If a given state does not close its waters while others do, then the EEZ off that state should not be closed to trawling for white shrimp. The original intent of the plan, as discussed by the Council, was to follow the lead of the individual states regarding closures in order to assist states in protecting depleted white shrimp and enforcing management actions of the states. Closure of the EEZ off four states at the request of two or more states was not the intent of the Council discussions and is not appropriate.

Section 12.7.1.1.3. - The correct American Fisheries Society name for "whiting" should be used. We assume the referenced species is the kingfish group, *Menticirrhus* sp., not the "whiting" or silver hake (*Merluccius bilinearis*) of the middle and northern Atlantic. Trawling for finfish, where and when otherwise legal, should not be restricted by this FMP. North Carolina's winter trawl fishery, using a variety of trawls in state waters and the EEZ, produces millions of dollars worth of products every season, and must not be affected by this plan. This potential effect is another reason for exempting the EEZ off North Carolina from any closure under this FMP.

The DMF agrees with exemption of the rock shrimp and royal red shrimp fisheries from white shrimp closures under this FMP.

The DMF has no comment on federal permits for shrimping in the EEZ or a control date for possible future limited entry.

While there are no shrimp mariculture facilities in coastal North Carolina, the DMF recognizes the potential consequences of accidental introductions. We strongly support the ASMFC "Procedural Plan to Central Interjurisdictional Transfers and Introductions of Shellfish," as amended.

The DMF takes an aggressive position regarding protection of coastal habitat important for shrimp production, and we will continue to do so.

We concur in not recommending the three items included in Section 12.8.3.

Footnotes on a number of the tables in the FMP state that data for North Carolina are not available. I have discussed this issue with Paul Phalen, DMF Data Management Supervisor. He assures me that all the indicated data are available through DMF. The NMFS query programs are sometimes difficult to use in accessing the data files on the NMFS database. We maintain an identical commercial fishery database for North Carolina, and our SAS query system is extremely flexible and easy to use. Please contact Paul for all data needs relative to North Carolina commercial fisheries landings.

There are a number of typos and misspellings throughout the draft which can be located with your word processor's spell check program.

Thank you for the opportunity to comment on the FMP, and we look forward to cooperative development of the final FMP.

Sincerely,

William T Hogarth

William T. Hogarth, Ph.D.
Director

WTH/MWS/dw

APPENDIX XIV

Response to Comments on DEIS

Section I- Comment & Response

Section II- Written Comment

Section I- Comment & Response

1. Comment: SAFMC should recommend to the affected states that they curtail recreational shrimp fishing over bait in state waters during periods of closure to maintain sense of fairness.

   Response: Recreational white shrimp baiting occurs in SC state waters annually during a regulated fall season (generally 60 days). A concurrent closure of the white shrimp fishery in the EEZ, as specified under this FMP, would not occur during the recreational baiting season.

2. Comment: Scientific research on shrimp biology should continue.

   Response: The SAFMC has in the past and continues to make strong recommendations on needed research that will aid in the better management of the shrimp resource.

Section II- Written Comment

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET. N.E.
ATLANTA. GEORGIA 30365

MAY 06 1993

RECEIVED
MAY 10 1993
SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

Mr. David Cottingham, Director
Office of Ecology and Conservation
Room 6222, CS/EC
US Department of Commerce
Washington, DC 20230

RE: Draft Environmental Impact Statement (DEIS) for the Fishery Management Plan for the Shrimp Fishery of the South Atlantic Region

Dear Mr. Cottingham:

The Environmental Protection Agency Region IV (EPA) has reviewed the referenced DEIS and Fishery Management Plan. This review was conducted in accordance with EPA's responsibilities under Section 309 of the Clean Air Act and Section 102(2)(C) of NEPA.

The referenced document discusses alternatives that would provide the States with a mechanism to request closures of the exclusive economic zone (EEZ) adjacent to their waters following severe winter weather that results in an 80 percent reduction in the population of overwintering white shrimp. It also recommends prohibition of trawling with a net with less that 4-inch stretch during a closure, and defines overfishing for white shrimp.

We encourage the South Atlantic Fishery Council to recommend to the States that they curtail recreational shrimp fishing over bait (hereafter referred to as "recreational shrimping") in state jurisdictional waters during periods of closure. As presently proposed, recreational shrimping would not be regulated by the closure action, which in our view gives the recreational shrimpers special treatment and is inconsistent with the objectives of the proposed closure action.

Admittedly, closing the shrimp fishery to recreational shrimpers is based more on a sense of fairness, as perceived by the regulated community, rather than on biological reasons. Most recreational shrimping occurs in the fall before freezing weather is likely to occur, whereas the proposed closures would take effect during spring and early summer when little recreational shrimping occurs. (There is no recreational shrimping in the EEZ offshore at any time of the year because the water is far too deep.)

Since the recreational shrimpers and commercial shrimp fishermen are competing for the same resource, closure policies should be consistent within State and federal waters and apply to all. Although recreational shrimpers are subject to catch limits, and are prohibited from selling their shrimp, abuses are common. Some continue to sell their catches illegally, and blackmarket sales present a continuing problem for law enforcement. It should be noted that in South Carolina (1991 data), recreational shrimpers accounted for 2.14 million pounds of shrimp comprising about 35 percent of the annual total harvest.

That the recreational shrimp fishing closure is an allocation issue within the jurisdiction of the individual states is certainly true; however, we see no reason that the Council should not consider recommending restricting the recreational fishery concomitant with the professional shrimping fishery. If the proposed closure policy is not perceived as being even-handed among those competing for a resource, we would anticipate resentment and subsequent enforcement problems among the regulated community. As you are aware, there is ill-feeling among some of the professional fishing community who believe that recreational shrimping is taking too much of the resource, and that blackmarket sales from recreational shrimpers are affecting dockside prices. We do not know if these allegations have any basis in fact, but they certainly have formed the basis of ill-will. Not having jurisdiction over the State's estuaries and tidal creeks should not preclude the Council's making recommendations on behalf of the fishery. Government policy should protect to the extent possible both the resource and those who harvest.

A more general recommendation - albeit not directly related to the Fishery Management Plan and the DEIS - is that basic scientific research in shrimp biology should continue to receive support. Areas of continued research should focus upon development of disease-resistant stock, and potential impacts to domestic shrimp populations from accidental release of exotic species. The occurrence of asian tiger prawns being found in the nets of local fishermen in the late 1980's was of grave concern. One need only examine the impacts from improvident plant and animal introductions in Florida, and the devastating effects these introductions have had on native habitats and species.

In conclusion, the DEIS document was well-written, informative, and contained one of the better discussions of shrimp biology that we have seen. It was concise, informative and contained practical and constructive means to protect this fishery. The document was readible. The absence of technical fishery jargon, which often can overwhelm the average reader and obfuscate the issues, was refreshing.

Our rating on the DEIS and Fishery Management Plan is EC-1 (Environmental Concerns), indicating that corrective measures might be applied to the preferred alternative. If more information is needed, please call me or John Hamilton at (404) 347-3776.

Sincerely,

Heinz Mueller

Heinz J. Mueller, Chief
Environmental Policy Section

CC: Greg Waugh, Deputy Director
South Atlantic Fishery Management Council
1 Southpark Circle, Suite 306
Charleston, SC 29407