AMENDMENT NUMBER 1

TO THE

REEF FISH FISHERY MANAGEMENT PLAN

(includes Environmental Assessment,
Regulatory Impact Review, and
Regulatory Flexibility Analysis)

AUGUST, 1989

GULF OF MEXICO FISHERY MANAGEMENT COUNCIL
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3. SUMMARY

History of Management Since the Fishery Management Plan

The Gulf of Mexico Fishery Management Council submitted the Reef Fish Fishery Management Plan in August, 1981; it was approved by the Secretary of Commerce in June, 1983, but not implemented until November, 1984. The implementing regulations designed to rebuild declining reef fish stocks included these measures: (1) prohibitions on the use of fish traps, roller trawls, and powerheads within an inshore stressed area; (2) construction requirements, maximum size, and numerical limits for fish traps; (3) permit requirements for fish trap operators; and, (4) a minimum size limit of 13 inches total length for red snapper. The record keeping and reporting requirements specified in the FMP were implemented in July, 1987. The approved reporting requirements include: (1) persons fishing fish traps; (2) commercial vessel owners and operators; (3) dealers and processors; and, (4) commercial vessel, charter vessel, and headboat inventory. Proposed recreational fishermen and charter/headboat interviews have not been implemented.

Problems Requiring Plan Amendment

1. The adult population of red snapper has declined since 1979, and this decline may be greater in the western Gulf. The current snapper fishery is supported primarily by younger fish ages one to three.

2. Habitat loss is negatively affecting reef fish stocks in the Gulf of Mexico.

3. Longline gear has been introduced in the fishery since the FMP was written; this gear needs to be recognized as a segment of the fishery. If longlines are used in areas where other gear have been traditionally used, an increase in the level of mortality and conflicts among user groups may result.

4. The geographic extent of the stressed area requires modification to address fishing mortality and user conflicts under current and potential use patterns.

5. Some reef fish species are growth and recruitment overfished.

6. Management measures specified in the FMP to establish a data base for management have not been successfully implemented. Statistical data for many species have been aggregated into genus or family groups which has made it impossible to assess the condition of specific stocks adequately. Biological profile data are needed throughout the Gulf of Mexico on a

continuing basis; the present system of opportunistic dockside sampling of the commercial catch is not providing a representative characterization.

7. A significant portion of the catch in the reef fish fishery consists of species not in the fishery management unit.

8. Present definition of OY for the reef fish fishery is an overestimate and does not provide adequate protection for the resource due to different vulnerabilities among reef fish species to overfishing.

9. Mortality to juvenile red snapper due to trawl bycatch reduces potential yield.

10. Fishing pressure has increased dramatically in the past decade due to increased number of vessels, greater use of sophisticated electronic equipment, and increased use of more efficient gear by all sectors of the fishery.

11. Definitive research is needed to determine whether artificial reefs contribute more to overfishing or to the rebuilding of the reef fish resource in the various Gulf of Mexico habitats.

12. The user groups utilizing and dependent on the reef fish resources need to be identified and their socio-economic and socio-cultural characteristics delineated to enable analysis of their respective impacts on the resource and the differential impacts alternative management measures may exert on the various user groups.

13. The stock boundaries of reef fish are unknown.

14. Overfishing of the reef fish stocks is the result of directed and nondirected recreational and commercial fishing mortality.

Amendment 1 Management Objectives

The management objectives of this amendment are:

1. The primary objective of the FMP shall be to stabilize long term population levels of all reef fish species by establishing a certain survival rate of biomass into the stock of spawning age to achieve at least 20 percent spawning stock biomass per recruit.

2. To reduce user conflicts and nearshore fishing mortality.

3. To respecify the reporting requirements necessary to establish a database for monitoring the reef fish fishery and evaluating management actions.

4. To revise the definitions of the fishery management unit and fishery to reflect the current species composition of the reef fish fishery.

5. To revise the definition of optimum yield to allow specification at the species level.

6. To encourage research on the effects of artificial reefs.

7. To maximize net economic benefits from the reef fish fishery.

Species in the Management Unit Identified in the FMP

The following species are managed by the Fishery Management Plan:

Snappers - Lutjanidae Family

Queen snapper	*Etelis oculatus*
Mutton snapper	*Lutjanus analis*
Schoolmaster	*Lutjanus apodus*
Blackfin snapper	*Lutjanus buccanella*
Gulf red snapper	*Lutjanus campechanus*
Cubera snapper	*Lutjanus cyanopterus*
Gray [mangrove] snapper	*Lutjanus griseus*
Dog snapper	*Lutjanus jocu*
Mahogany snapper	*Lutjanus mahogoni*
Lane snapper	*Lutjanus synagris*
Silk snapper	*Lutjanus vivanus*
Yellowtail snapper	*Ocyurus chrysurus*
Wenchman	*Pristipomoides aquilonaris*
Vermilion snapper	*Rhomboplites aurorubens*

Groupers - Serranidae Family

Rock hind	*Epinephelus adscensionis*
Speckled hind	*Epinephelus drummondhayi*
Yellowedge grouper	*Epinephelus flavolimbatus*
Red hind	*Epinephelus guttatus*
Jewfish	*Epinephelus itajara*
Red grouper	*Epinephelus morio*
Misty grouper	*Epinephelus mystacinus*
Warsaw grouper	*Epinephelus nigritus*
Snowy grouper	*Epinephelus niveatus*
Nassau grouper	*Epinephelus striatus*
Black grouper	*Mycteroperca bonaci*
Yellowmouth grouper	*Mycteroperca interstitialis*
Gag	*Mycteroperca microlepis*
Scamp	*Mycteroperca phenax*
Yellowfin grouper	*Mycteroperca venenosa*

Sea Basses - Serranidae Family

Black sea bass	Centropristis striata
Bank sea bass	Centropristis ocyurus
Rock sea bass	Centropristis philadelphica

Proposed Additions to the Management Unit

The following species are to be added to the fishery management unit FMP:

Tilefishes - Malacanthidae (Branchiostegidae) Family

Goldface tilefish	Caulolatilus chrysops
Blackline tilefish	Caulolatilus cyanops
Anchor tilefish	Caulolatilus intermedius
Blueline tilefish	Caulolatilus microps
Tilefish	Lopholatilus chamaeleonticeps

Jacks - Carangidae Family

Greater amberjack	Seriola dumerili
Lesser amberjack	Seriola fasciata

Grunts - Pomodasyidae Family

White grunt	Haemulon plumieri

Porgies - Sparidae Family

Red porgy	Pagrus pagrus

Leatherjackets - Balistidae Family

Gray triggerfish	Balistes capriscus

Optiumum Yield

Optimum Yield is any harvest level for each species which maintains, or is expected to maintain, over time a survival rate of biomass into the stock of spawning age to achieve at least a 20 percent spawning stock biomass per recruit (SSBR) population level, relative to the SSBR that would occur with no fishing..

Definition of Overfishing

1. A reef fish stock or stock complex is overfished when it is below the level of 20 percent of the spawning stock biomass per recruit that would occur in the absence of fishing.

2. When a reef fish stock or stock complex is overfished, overfishing is defined as harvesting at a rate that is not consistent with a program that has been established to rebuild the stock or stock complex to the 20 percent spawning stock biomass per recruit level.

3. When a reef fish stock or stock complex is not overfished, overfishing is defined as a harvesting rate that if continued would lead to a state of the stock or stock complex that would not at least allow a harvest of OY on a continuing basis.

Proposed Annual Procedure for Adjusting Management Measures

Optimum Yield can be achieved with annual Total Allowable Catch (TAC) specifications for each species or species group. The Council will establish a framework procedure where, on an annual basis, a scientific working group will establish an Allowable Biological Catch (ABC) range and Council sets annual TAC and prescribes fishing restrictions annually to attain the management goal of OY for implementation by the Regional Director (RD) of NMFS prior to the beginning of a fishing year.

Procedure for Specification of TAC:

1. Prior to April 1 each year, or such other time as agreed upon by the Council and Regional Director, the SEFC will: a) update or complete biological and economic assessments and analyses of the present and future condition of the stocks for red snapper and other reef fish stock or stock complex; b) assess to the extent possible the current SSBR levels for each stock; c) estimate F in relation to F(SSBR); d) estimate annual surplus production, F(max), or other population parameters deemed appropriate; e) summarize statistics on the fishery for each stock or stock complex; f) specify the geographical

variations in stock abundance, mortality, recruitment and age of entry into the fishery for each stock or stock complex; and, g) analyze social and economic impacts of any specification demanding adjustments of allocations, quotas, or bag limits.

2. The Council will convene a scientific stock assessment panel, appointed by the Council, that will, as a working group, review the SEFC assessment(s), current harvest statistics, economic, social, and other relevant data and will prepare a written report to the Council specifying a range of ABC for each stock or stock complex which is in need of catch restrictions for attaining or maintaining OY. The ABC's are catch ranges that will be calculated for those species in the management unit that have been identified by the Council, NMFS, or the working panel as in need of catch restrictions for attaining or maintaining OY. The range of ABC's shall be calculated so as to achieve reef fish population levels at or above the 20 percent SSBR goal by January 1, 2000. For stock or stock complexes where data in the SEFC reports are inadequate to compute an ABC based on the SSBR model, the above working group will use other available information as a guide in providing their best estimate of an ABC range that should result in at least a 20 percent SSBR level. The ABC ranges will be established to prevent an overfished stock from further decline. To the extent possible a risk analysis should be conducted showing the probabilities of attaining or exceeding the stock goal of 20 percent SSBR and the annual transitional yields (i.e., catch streams) calculated for each level of fishing mortality within the ABC range and the economic and social impacts associated with those levels. The working group report will include recommendations on bag limits, size limits, specific gear limits, season closures, and other restrictions required to attain management goal, along with the economic and social impacts of such restrictions, and the research and data collection necessary to improve the assessments. The working group may also recommend additional species for future analyses.

3. The Council will conduct a public hearing on the working group report(s) at, or prior to the time, it is considered by the Council for subsequent action. Other public hearings may be held also. The Council will request review of the report(s) by its Reef Fish Advisory Panel and Standing Scientific and Statistical Committees and may convene these groups to provide advice before taking action.

4. The Council in selecting a TAC level for each stock for which an ABC range has been identified will, in addition to taking into consideration the recommendations provided for in (1), (2), and (3), utilize the following criteria:

   a. Set TAC within or below the ABC range or set a series of TAC's to obtain the ABC level within 3 years or less.

   b. Subdivide the TAC's into commercial and recreational allocations which maximize the net benefits of the fishery to the nation. The allocations will be based on historical percentages harvested by each user group during the base period of 1979-87. If the harvest in any year exceeds the TAC due to either the recreational or commercial user group exceeding its allocation, subsequent allocations pertaining to the respective user group will be adjusted to assure meeting the January 1, 2000 spawning stock biomass per recruit goal.

5. The Council will provide its recommendations to the RD for any specifications in TAC's for each stock or stock complex, the quotas, bag limits, trip limits, size limits, closed seasons, and gear restrictions necessary to attain the TAC, along with the reports, a regulatory impact review and environmental assessment of impacts and the proposed regulations before October 15 or such other time as agreed upon by the Council and RD.

6. Prior to each fishing year or other such time as agreed upon by the RD and Council the RD will review the Council's recommendations and supporting information, and if he concurs that the recommendations are consistent with the objectives of the FMP, the National Standards, and other applicable law he shall forward for publication notice of proposed TAC's and associated harvest restrictions by November 1, or such other time as agreed upon by the Council and RD; providing up to 30 days for additional public comment. The RD will take into consideration all information received and will forward for publication in the Federal Register the notice final rule by December 1, or such other time as agreed upon by the Council and RD.

7. Appropriate regulatory changes that may be implemented by notice include:

   a. The TAC's for each stock or stock complex to achieve a specific level of ABC within the first year or annual levels of TAC designed to achieve the ABC level within three years.

   b. Bag limits, size limits, vessel trip limits, closed seasons or areas, gear restrictions, and quotas designed to achieve the TAC level.

Proposed Management Measures

Size and Catch Limits--Red Snapper

1: Establish a red snapper minimum size limit of 13 inches total length, a recreational bag limit of 7 fish per angler per day, and a commercial quota of 3.1 million pounds that would effect a 20 percent reduction in the 1985-87 average annual recreational and commercial catches, respectively. These limits shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

2: Prohibit the sale of red snapper smaller than the size limit.

3: Delete the allowance for keeping five undersize red snapper.

Size and Catch--Other Reef Fish Species

1: Establish a size limit of 20 inches total length on red, Nassau, yellowfin, black, and gag groupers, a 50-inch limit on jewfish, a five-fish recreational daily possession limit for all grouper, and a commercial grouper quota of 11 million pounds equal to 90 percent of the aggregate 1985-87 grouper landings. The grouper quota is to be subdivided into the following two quotas: 1.8 million pounds for deep water groupers (misty, snowy, warsaw, and yellowedge groupers); 9.2 million pounds for shallow water groupers (includes all grouper species other than those listed above as deep water species). Jewfish is not included in the grouper quotas. These limits shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

2: Establish minimum sizes of 12 inches total length on gray, mutton, and yellowtail snappers and 8 inches total length on lane and vermilion snappers. An overall snapper recreational daily possession limit of 10 fish shall be established, excluding lane, vermilion, and red snappers. There is no bag limit for lane and vermilion snappers and the red snapper limit is separate and distinct from this 10 fish limit. These limits shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

3: Establish a minimum size of 8 inches total length for black sea bass. This limit shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

4: Establish a greater amberjack minimum size limit of 28 inches fork length and a 3 fish per angler per day possession limit for recreational fishermen and a 36 inch fork length minimum size limit for commercial fishermen. These limits shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

5: Prohibit the sale of reef fish smaller than the established size limits. If a larger size limit has been set for commercial fishermen, as with greater amberjack, then no fish smaller than the commercial size limit can be sold.

Multiple-day Possession Limits

1: To allow a maximum of 2 days possession limit for charter vessels and head boats fishing under the bag limits on fishing trips that extend beyond 24 hours duration provided the charter vessel or head boat has two licensed operators aboard as required by the U.S. Coast Guard for multiple-day fishing trips and each passenger can provide a receipt to verify length of fishing trip. All other fishermen fishing under a bag limit are limited to a single day possession limit.

Gear Restrictions--Fish Traps

1: Permitted commercial fishermen may obtain a special fish trap permit (endorsement) to fish up to a maximum of 100 fish traps per permit holder. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

Gear Restrictions--Trawls

1: Trawl vessels must comply with the same size and bag limits that are established for the recreational fishery harvesting reef fish. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

Gear Restrictions--Longlines and Buoys

1: Prohibit the use of longlines and buoy gear for the directed harvest of reef fish inshore of the 50 fathom isobath west of Cape San Blas, Florida (85°30'W) and inshore of the 20 fathom isobath east of Cape San Blas, Florida (85°30'W). The retention of reef fish captured incidentally in other longline operations (e.g., shark) is limited to the recreational bag limit. The restricted area boundary is specified by latitude-longitude coordinates that approximate the depth zones (Table 11.27). Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

Gear Restrictions--Additional

1: Prohibit the use of entangling nets for the directed harvest of reef fish. The retention of reef fish captured in entangling net operations targeting other species is limited to the recreational bag limit. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

Fishing Year

1: Status Quo - The fishing year is from January 1 through December 31.

Stressed Area Boundaries

1: Extend the present boundary of the stressed area to include waters off Texas out to the 30 fathom isobath along the entire coastline of Texas (see Figure 11.8).

2: Extend the present boundary of the stressed area to include waters off Louisiana out to the 10 fathom isobath along the entire coastline of Louisiana (see Figure 11.9).

User Group Conflict Resolution

1: Status Quo - No regulation.

Closed Seasons and Areas

1: Season and area closures for selected reef fish will be considered under the Total Allowable Catch Procedure.

Permits and Gear Identification

1: Require an annual commercial fishing permit for fishing under the commercial quota (exceeding a bag limit) and for the sale of reef fish, with the qualifying condition that more than fifty percent of an individual's (owner or operator) earned income must be derived from commercial or charter (for-hire) fishing. Charter and head boat applicants must submit their Coast Guard Masters license number and commercial applicants must submit their documented vessel number on the permit application. Only those fish caught by a permitted vessel can be sold; where a commercial quota has been established only those fish caught under the commercial quota can be sold. Charter and head boats with permits to fish under the commercial quota are required to fish under the bag limit when under charter or when there are more than 3 persons aboard, including captain and crew. Other fishermen on unpermitted vessels are limited to the established bag limits.

2: Special fish trap permits (endorsements) and trap tags shall be required for all vessels fishing or possessing fish traps in the

EEZ for the harvest of reef fish. The permit and trap tags shall be issued (or reissued) annually and shall be valid until the end of the fishing year for which the permit is issued unless revoked for violation of a fish trap related regulation. A fee shall be charged to recover the direct and indirect costs associated with the issuance of trap permits and tags. Except for the fish trap permit provisions in this paragraph, all other fish trap permit requirements shall remain as specified in Section 641.4 of the current reef fish regulations.

Statistical Reporting Requirements

1: Data will be collected by authorized statistical reporting agents from a statistically valid survey sample of commercial and recreational catch that is of sufficient size to provide representative measures of all major segments of a category of users of a resource and statistically valid estimates for stock assessment analyses and quota monitoring. Any such data collection should rely upon techniques that ensure comparability of data. Those fishermen and dealers selected by the Science and Research Director, or his designee, must make their reef fish (head and fins intact) available at dockside for inspection by those agents.

2: Require head boat operators who are selected by NMFS to maintain a fishery record for each trip and report this information to NMFS on at least a monthly basis.

3: Require charter boat operators who are selected by NMFS to maintain a daily fishing record on forms provided by the Science and Research Director that are to be submitted weekly (as is required in the Coastal Migratory Pelagic FMP). Information to be included in the forms must include, but not be limited to:

(1) Name or official number of vessel.
(2) Operator's Coast Guard license number.
(3) Date of trip.
(4) Number of fishermen on trip.
(5) Area fished.
(6) Fishing methods and type of gear.
(7) Hours fished.
(8) Species targeted.
(9) Number and estimated weight of fish caught by species.

4: The current reporting requirements for fish traps are modified in the following paragraph to implement the Council's intent to strengthen the enforceability of fish trap reporting requirements.

The owner or operator of a fishing vessel or any other person permitted under §641.4 to fish with fish traps must provide the following information regarding all fishing trips on which reef fish are harvested to the Science and Research Director. This information must be submitted within 7 days of completion of each trip:

(1) permit number as provided for in §641.4;
(2) pounds of catch of reef fish by species by gear if gear other than fish traps were also used;
(3) date of trip, depths fished, and fishing locations by statistical area;
(4) number of trap hauls resulting in catch;
(5) duration (days and hours) traps were fished before each haul;
(6) mesh size of traps.

Routine reporting shall be required of all trap permittees. At a minimum, monthly reports shall be required of permittees even if no fishing for reef fish occurred in a particular month. Violation of any of the reporting requirements shall result in revocation of the fish trap permit for one year.

NMFS shall provide quarterly reports concerning compliance with the fish trap regulations.

Rejected Management Measures

Size and Catch Limits -- Red Snapper

1: Status Quo -- An allowance of incidentally harvested red snapper less than 12 inches in fork length is established at five fish per person in possession, and (b) any domestic vessel fishing trawls in the EEZ with the exception of roller trawl vessels fishing in the stressed area is excluded from the possession limit.

2: Immediately reduce fishing mortality by 74 percent to rebuild the spawning stock biomass per recruit to the 20% level (relative to the unfished condition). This reduction would be effected by a 2 fish recreational bag limit and a commercial quota of 1.4 million pounds.

3: Establish larger size limits up to 24 inches total length or smaller bag limits down to a 2, 3 or 5 fish bag limits and quotas down to 1.4, 2.1, or 2.9 million pounds.

4: Establish different catch quotas, bag limits, and minimum sizes by geographical area.

5: Allocate red snapper between recreational and commercial fisheries by allocating to the commercial fishery all red snapper killed by the shrimp and groundfish trawl fisheries and allocate the remaining red snapper to the recreational fishery.

Catch and Size Limits -- Other Reef Fish Species

1: Status Quo -- no regulation.

2: Establish larger size limits or smaller bag limits and quotas for the reef fish species identified in the above proposed options.

3: Establish a recreational bag limit and commercial quota for jewfish to reduce current levels of fishing mortality.

4: Require all reef fish to be landed in accordance with state landing regulations for size and possession when state regulations are more restrictive than those in the EEZ and are consistent with the objectives of the FMP and National Standards.

Multiple-day Possession Limits

1: Make no allowance for multiple-day fishing trips.

2: Allow multiple-day possession limits, up to a maximum of 5 days cumulative bag limit catch, for vessels making multiple-day trips.

Gear Restrictions--Fish Traps

1: FMP regulation -- Require vessels fishing traps in the EEZ be limited to no more than 200 traps.

2: Require trap bottoms to be made of 2 by 4 inch mesh to grade fish during trap retrieval. This measure shall be effective one year after approval by the Secretary.

3: Require at least two sides of a trap to be constructed with 2 by 4 inch mesh to allow escapement of juvenile target fish and small nontarget fish.

4: Require all mesh on fish traps to be 2 by 4 inches or larger.

5: Prohibit the use of fish traps in areas where they are not presently in use.

6: Allow the use of sea bass fish traps for the directed harvest of sea bass, as defined by Florida law, in the EEZ north of 27° north latitude adjacent to Florida's territorial sea. Florida statutes define a black sea bass trap as a fish trap of outer dimensions not to exceed two feet in any dimension. Each trap must have a biodegradable panel and a throat or entrance with the narrowest point of not more than five inches in height and two inches in width. Such traps are also not allowed to be fished south of latitude 27° North.

7: Prohibit the use of fish traps for the directed harvest of reef fish throughout the entire EEZ.

Gear Restrictions -- Shrimp Trawls

1: Status Quo--Any domestic vessel fishing trawls for species other than reef fish in the EEZ with the exception of roller trawl vessels fishing in the stressed area is excluded from the minimum size limit for red snapper. A trawl is assumed to be fishing for species other than reef fish when the total weight of reef fish aboard does not exceed five percent of all other fish (including shrimp) aboard.

2: Trawl vessels must comply with the same size and bag limits that are established for the recreational fishery harvesting red snapper. Bag limits on other reef fish would not apply to trawl vessels.

3: Prohibit shrimp fishing in areas and during periods of substantial red snapper prerecruit bycatch.

4: Require trawls to be designed to reduce finfish bycatch by a minimum percentage compared to trawls not equipped to exclude finfish.

5: Limit shrimp trawling to 90 minutes tow time to increase probability of survival of juvenile red snapper returned to the sea.

6: Delete the red snapper bycatch exclusion for trawl vessels.

7: Exempt trawl vessels from the minimum size limit for red snapper provided the total weight of undersize red snappers does not exceed one percent of all other fish (including invertebrates) landed.

Gear Restrictions -- Longlines

1: Prohibit the use of longlines and buoy gear for the directed harvest of reef fish inshore of the 50 fathom isobath throughout the Gulf EEZ. The retention of reef fish captured incidentally in other longline operations (e.g., shark) is limited to the recreational bag limit.

2: Prohibit use of longlines for directed harvesting of reef fish.

3: Prohibit use of longlines for directed harvesting of reef fish in the stressed area.

4: Status-quo - no regulation on the use of longlines.

Additional Gear Restrictions

1: Establish minimum hook sizes.

2: Only the following gear may be used to take reef fish: hook-and-line, speargun (without powerhead), fish traps, longlines, and runaround nets (including gill and trammel nets).

3: Permit only hook-and-line and spear fishing in the stressed area.

Fishing Year

1: Define the fishing year to begin at another time of the year or set different fishing years for different species groups.

Stressed Area Boundaries

1: Modify the present boundary of stressed area off the West Florida coast from the current stressed area boundary point at latitude 28° 10' North, longitude 83° 14' West to extend east along the same latitude to 83° 5' West and from there to extend north-northwest to a point at 28° 54' North, 83° 15' West and from there to extend northwest to a point 29° 38' North, 83° 44' West and from there to extend due west to longitude 84° 00' West which is an existing point on the stressed area boundary. (See Figure 11.10, map section III).

2: Modify the present boundary of stressed area off the west Florida coast from the current stressed area boundary line along the 20 fathom isobath inshore to the 15 fathom isobath which requires making the following changes to the boundary points: move the boundary point at latitude 26° 26' North, longitude 82° 59' West inshore, along the same latitude to longitude 82° 45' West and the boundary point at latitude 28° 10' North, 83° 45' West inshore along the same latitude to longitude 83° 30' West (Figure 11.10, map section IV).

3: Modify present boundary of stressed area off the southwest Florida coast from the point at latitude 25° 40' North and longitude 82° 39' West to extend shoreward to a point at 25° 40' North and 81° 39' West and from there to extend south-southeast to a point at 25° 03' North and 81° 27' West and then to extend southwest to rejoin the present stressed area boundary at point 6 (24° 48' North, 82° 06.5' West) (Figure 11.10, map section V).

User Group Conflict Resolution

1: Prohibit or restrain specific fishing gear around artificial reefs with the establishment of Special Management Zones (SMZ).

2: Implement a Notice Action procedure for terminating a conflict or preventing a violent confrontation between fishermen fishing different gears.

Closed Seasons and Areas

1: Establish a closed season for selected species or species groups to assure maximum protection of spawning potential.

Permits and Gear Identification

1: Require an annual commercial permit, with no qualifying conditions, for the sale of reef fish.

2: Require an annual commercial fishing permit for the sale of reef fish, with the qualifying condition that ten percent of an individual's (owner or operator) income must be derived from commercial fishing.

3: Require annual permits for charter and head boat vessels.

4: Require annual permits for fish trap possession and their use in the reef fish fishery.

5: Vessels or persons harvesting reef fish in the EEZ for subsequent sale must possess a state permit that allows the sale of reef fish in the state of landing.

6: Establish a moratorium on the issuance of fish trap permits.

Statistical Reporting Requirements

1: Replace the fish trap logbook with a dockside sampling program, designed by NMFS, and patterned after the present state/federal Trip Interview Program.

4. **INTRODUCTION**

4.1. History of Management Since the Fishery Management Plan

The Gulf of Mexico Fishery Management Council submitted the Reef Fish Fishery Management Plan in August, 1981; it was approved by the Secretary of Commerce in June, 1983, but not implemented until November, 1984. The implementing regulations designed to rebuild declining reef fish stocks included these measures: (1) prohibitions on the use of fish traps, roller trawls, and powerheads within an inshore stressed area; (2) construction requirements, maximum size, and numerical limits for fish traps; (3) permit requirements for fish trap operators; and, (4) a minimum size limit of 13 inches total length for red snapper. The record keeping and reporting requirements specified in the FMP were implemented in July, 1987. The approved reporting requirements include: (1) persons fishing fish traps; (2) commercial vessel owners and operators; (3) dealers and processors; and, (4) commercial vessel, charter vessel, and headboat inventory. Proposed recreational fishermen and charter/headboat interviews have not been implemented.

Statement of MSY, OY, EDAH and TALFF (millions of pounds) in FMP

GROUP	MSY	OY	EDAH	TALFF
Snapper and Grouper	51.0	45.0	45.0	0
Sea basses	0.5	0.5	0.5	0

4.2. Problems in the Fishery

4.2.1 Problems Identified in the FMP

1. A substantial decline in reef fish stocks has occurred in some areas under the jurisdiction of the Gulf of Mexico Fishery Management Council. A known factor contributing to this decline is overfishing in many areas of the Gulf of Mexico by directed recreational and commercial users. Other possible factors contributing to the decline are:

    a. Reduction of habitat, both natural and man-made.

    b. A large bycatch in other fisheries.

    c. Major environmental changes (which can be documented for 1973-1975).

2. An insufficient data base exists to pinpoint the causes and magnitude of the decline by exact geographical area.

3. There is expanding competition between users competing for the resource and the space the resource occupies. This expanding competition is in part due to:

   a. Increasing fishing effort and the concentration of that effort in localized areas.

   b. Increasing fishing effort in other fisheries that have a bycatch of reef fish.

   c. Declining catch per unit effort in some areas.

   d. Introduction of new gear.

4.2.2. <u>Problems Requiring Plan Amendment</u>

1. The adult population of red snapper has declined since 1979, and this decline may be greater in the western Gulf. The current snapper fishery is supported primarily by younger fish ages one to three.

2. Habitat loss is negatively affecting reef fish stocks in the Gulf of Mexico.

3. Longline gear has been introduced in the fishery since the FMP was written; this gear needs to be recognized as a segment of the fishery. If longlines are used in areas where other gear have been traditionally used, an increase in the level of mortality and conflicts among user groups may result.

4. The geographic extent of the stressed area requires modification to address fishing mortality and user conflicts under current and potential use patterns.

5. Some reef fish species are growth and recruitment overfished.

6. Measures specified in the FMP to establish a data base for management have not been successfully implemented. Statistical data for many species have been aggregated into genus or family groups which has made it impossible to assess the condition of specific stocks adequately. Biological profile data are needed throughout the Gulf of Mexico on a continuing basis; the present system of opportunistic dockside sampling of the commercial catch is not providing a representative characterization.

7. A significant portion of the catch in the reef fish fishery consists of species not in the fishery management unit.

8. The present definition of OY for the reef fish fishery is an overestimate and does not provide adequate protection for the

resource due to different vulnerabilities among reef fish species to overfishing.

9. Mortality to juvenile red snapper due to trawl bycatch reduces potential yield.

10. Fishing pressure has increased dramatically in the past decade due to increased number of vessels, greater use of sophisticated electronic equipment, and increased use of more efficient gear by all sectors of the fishery.

11. Definitive research is needed to determine whether artificial reefs contribute more to overfishing or to the rebuilding of the reef fish resource in the various Gulf of Mexico habitats.

12. The user groups utilizing and dependent on the reef fish resources need to be identified and their socio-economic and socio-cultural characteristics delineated to enable analysis of their respective impacts on the resource and the differential impacts alternative management measures may exert on the various user groups.

13. The stock boundaries of reef fish are unknown.

14. Overfishing of the reef fish stocks is the result of directed and nondirected recreational and commercial fishing mortality.

4.3. Management Objectives

4.3.1. FMP Management Objectives

Overall Goal: To manage the reef fish fishery of the United States within the waters of the Gulf of Mexico Fishery Management Council jurisdiction to attain the greatest overall benefit to the nation with particular reference to food production and recreational opportunities on the basis of the maximum sustainable yield as modified by relevant ecological, economic, or social factors.

Objectives:

1. To rebuild the declining reef fish stocks wherever they occur within the fishery.

2. To establish a fishery reporting system for monitoring the reef fish fishery.

3. To conserve and increase reef fish habitats in appropriate areas and to provide protection for juveniles while protecting existing and new habitats.

4. To minimize conflicts between user groups of the resource and conflicts for space.

4.3.2. Amendment 1 Management Objectives

Management objectives of this amendment are:

1. The primary objective of the FMP shall be to stabilize long term population levels of all reef fish species by establishing a certain survival rate of biomass into the stock of spawning age to achieve at least 20 percent spawning stock biomass per recruit.

2. To reduce user conflicts and nearshore fishing mortality.

3. To respecify the reporting requirements necessary to establish a database for monitoring the reef fish fishery and evaluating management actions.

4. To revise the definitions of the fishery management unit and fishery to reflect the current species composition of the reef fish fishery.

5. To revise the definition of optimum yield to allow specification at the species level.

6. To encourage research on the effects of artificial reefs.

7. To maximize net economic benefits from the reef fish fishery.

5. FISHERY MANAGEMENT UNIT AND FISHERY

5.1. Areas and Stocks

Reef fishes and the fishery for them have historically been largely conducted within waters shallower than 100 fathoms a depth that approximates the outer edge of the continental shelf. Most reef fish species do not reach commercially exploitable sizes in shallow water. The Exclusive Economic Zone (EEZ) encompasses 263,525 square miles, the continental shelf encompasses 121,204 square miles, using the mean low water depth, excluding bays and estuaries, to a depth of 100 fathoms. Reef fishes are generally confined to reef or reef-like hard bottom areas within the area of the continental shelf. It was calculated that the inhabitable and fishable area available in the Gulf is approximately 15,054 square miles(estimated from Lynch, 1954: U.S. Department of Interior, Bureau of Land Management charts of the outer continental shelf - Visual No. 4 ,OCS base sale No. 41). More recent surveys by the R/V Oregon II indicate the live bottom in the Gulf to be 20,000 square miles within the 55 fathom contour. Offshore sport fishing areas, offshore groups of commercial banks, and reported hard banks were considered as potentially inhabitable areas. These data indicate that approximately 12.4 percent of the Gulf of Mexico shelf within the EEZ is available as habitat for reef fishes but only 5.7 percent is inhabitable within the entire area of the EEZ.

Although there have been no studies published as yet on separate reef fish species stocks within the Gulf of Mexico, several studies conducted on other species indicate that there are separate stocks of many demersal fishes occurring east and west of the Mobile Bay area. Until this suspicion is confirmed each species is treated as its own stock within the Gulf. Because of the lack of data with regard to distribution and recognition of biologically distinct populations, the concept of "unit stock" defined by Cushing (1968) cannot be applied at the present time on the reef fish species of the northern Gulf of Mexico.

The FMP and this amendment manages the reef fish resources in the area of authority of the Gulf of Mexico Fishery Management Council. The area which will be regulated by the federal government under this plan is confined to the waters of the EEZ.

5.2 Species in the Management Unit

5.2.1 Management Unit Identified in the FMP

The following species were identified for management by the FMP:

Snappers - Lutjanidae Family

Queen snapper	*Etelis oculatus*
Mutton snapper	*Lutjanus analis*
Schoolmaster	*Lutjanus apodus*
Blackfin snapper	*Lutjanus buccanella*
Red snapper	*Lutjanus campechanus*
Cubera snapper	*Lutjanus cyanopterus*
Gray [mangrove] snapper	*Lutjanus griseus*
Dog snapper	*Lutjanus jocu*
Mahogany snapper	*Lutjanus mahogoni*
Lane snapper	*Lutjanus synagris*
Silk snapper	*Lutjanus vivanus*
Yellowtail snapper	*Ocyurus chrysurus*
Wenchman	*Pristipomoides aquilonaris*
Vermilion snapper	*Rhomboplites aurorubens*

Groupers - Serranidae Family

Rock hind	*Epinephelus adscensionis*
Speckled hind	*Epinephelus drummondhayi*
Yellowedge grouper	*Epinephelus flavolimbatus*
Red hind	*Epinephelus guttatus*
Jewfish	*Epinephelus itajara*
Red grouper	*Epinephelus morio*
Misty grouper	*Epinephelus mystacinus*
Warsaw grouper	*Epinephelus nigritus*
Snowy grouper	*Epinephelus niveatus*
Nassau grouper	*Epinephelus striatus*
Black grouper	*Mycteroperca bonaci*
Yellowmouth grouper	*Mycteroperca interstitialis*
Gag	*Mycteroperca microlepis*
Scamp	*Mycteroperca phenax*
Yellowfin grouper	*Mycteroperca venenosa*

Sea Basses - Serranidae Family

Black sea bass	*Centropristis striata*
Bank sea bass	*Centropristis ocyurus*
Rock sea bass	*Centropristis philadelphica*

5.2.2 Proposed Additions to the Management Unit

The FMP included the species Pristipomoides macropthalmus which is now recognized as being synonymous with P. aquilonaris, the wenchman (Hoese and Moore, 1977). Also Centropristis melana is now recognized as a subspecies of C. striata and red porgy Pagrus sedecim has been synonymized with P. pagrus (AFS Committee on Names of Fish, 1980).

The Reef Fish Scientific Task Team and Scientific and Statistical Committee report the current definitions of the fishery and management unit do not fully characterize the major species comprising the reef fish fishery. Recommended changes include specification of tilefish and amberjacks by species and their inclusion, along with white grunt, in the fishery management unit. In addition, the scientific committees recommended the queen triggerfish be included in the fishery due to its widespread occurrence in the Gulf of Mexico. Initially, these species were not in the management unit because they were not included in the original calculation of MSY and OY.

The following species are to be added to the fishery management unit FMP:

Tilefishes - Malacanthidae (Branchiostegidae) Family

Goldface tilefish	Caulolatilus chrysops
Blackline tilefish	Caulolatilus cyanops
Anchor tilefish	Caulolatilus intermedius
Blueline tilefish	Caulolatilus microps
Tilefish	Lopholatilus chamaeleonticeps

Jacks - Carangidae Family

Greater amberjack	Seriola dumerili
Lesser amberjack	Seriola fasciata

Grunts - Pomodasyidae Family

White grunt	Haemulon plumieri

Porgies - Sparidae Family

Red porgy	Pagrus pagrus

Triggerfishes - Balistidae Family

Gray triggerfish	Balistes capriscus

5.3. Species Included in the Fishery but not in the Management Unit

5.3.1. Species Identified in the FMP

Tilefishes - Malacanthidae Family

Great northern tilefish	*Lopholatilus chamaeleonticeps*
Tilefish	*Caulolatilus* spp.

Jacks - Carangidae Family

Amberjacks	*Seriola* spp.

Triggerfishes - Balistidae Family

Gray triggerfish	*Balistes capriscus*

Wrasses - Labridae Family

Hogfish	*Lachnolaimus maximus*

Grunts - Pomadasyidae Family

Tomtate	*Haemulon aurolineatum*
White grunt	*Haemulon plumieri*
Pigfish	*Orthopristis chrysoptera*

Porgies - Sparidae Family

Red porgy	*Pagrus pagrus*
Knobbed porgy	*Calamus nodosus*
Jolthead porgy	*Calamus bajonado*
Littlehead porgy	*Calamus proridens*
Pinfish	*Lagodon rhomboides*
Grass porgy	*Calamus arctifrons*

Sand Perches - Serranidae Family

Dwarf sand perch	*Diplectrum bivittatum*
Sand perch	*Diplectrum formosum*

5.3.2 Proposed Additions to the Fishery

Species to be added to the fishery are:

Triggerfishes - Balistidae Family

Queen Triggerfish	*Balistes vetula*

6. HABITAT CONCERNS

6.1. Description of Habitat of the Stocks Comprising the Management Unit

The Gulf of Mexico covers an area of approximately 617 million square miles. Its continental shelf ranges in width from about 12 miles off the Mississippi River to nearly 220 miles off west Florida. Geologic formations in the central and western Gulf of Mexico consist mainly of Mesozoic and Cenozoic strata beneath the coastal plain and adjacent continental shelf. Texas and western Louisiana shelfs are characterized by massive accumulations of silt, clay, and sand deposits between uplifted domes and have no major regional structures. Eastern Louisiana and Mississippi shelfs are transitional in nature and composed of fine grain deposits with occasional surface deposits of sand and shell. Mesozoic and Cenozoic strata of the Florida Platform dominate the eastern Gulf of Mexico. The Florida Platform is fronted by shelf-edge reef complexes of the Cretaceous Era. It is characterized by three regional structures: the Apalachicola Embayment, the Ocala Uplift and the South Florida Basin. Within these structures are better known smaller features such as the Florida Middle Ground, the Tampa Arch, and the Southwest Florida Reef Tract. Corals are most prevalent along southwest Florida while the shelf of upper Florida and Alabama is primarily sand and shell. Within the Gulf of Mexico a minimum of six distinct habitats can be defined as follows:

I. Bottom characteristics between Brownsville and Galveston, Texas are variable, consisting principally of hard sand-silt bottom with little freshwater discharge. Salinities are high throughout the year and temperature shows seasonal variation;

II. Between Galveston and the mouth of the Mississippi River the shelf becomes broader with the bottom changing from hard sand-silt to softer sand-mud to soft mud when approaching the mouth of the river. Considerable freshwater is discharged throughout this area from both the Atchafalaya and the Mississippi Rivers. Salinity and temperature vary seasonally and are somewhat dependent on rates of freshwater discharge. Estuarine areas increase in magnitude.

III. Between the Mississippi River Delta and Mobile Bay, Alabama, the shelf remains fairly broad with the bottom changing from mud to mud-sand and hard sand-shell offshore. Freshwater discharge into this area is somewhat reduced. Salinity is generally higher than west of the Delta;

IV. The area between Mobile Bay and Cape San Blas, Florida, is characterized by a fairly broad shelf outside of 10 fm. There is only a limited amount of estuarine area. A hard sand bottom interspersed with small areas of coral and sponge are found throughout the area. Salinity is quite high and fairly constant. Temperatures vary seasonally. A sharp faunal break is noted east of Mobile Bay were the fauna becomes more tropical;

V. South of Cape San Blas to Tampa, Florida, bottom characteristics are predominantly sand-coral with sponges and marl outcroppings. Offshore salinities remain high throughout the year, but temperatures vary seasonally. Salinity and temperature are variable in the Apalachee Bay because of the Suwannee River discharge. The water also tends to be somewhat turbid; and

VI. South of Tampa to the Tortugas the bottom is composed of sand and shell inshore and coral-sponge farther offshore. Salinity and temperature are high throughout most of the year and are generally higher than in the area north of Tampa.

Reef fish utilize both pelagic and benthic habitats during their life cycle. A planktonic larval stage lives in the water column and feeds on zooplankton and phytoplankton. Juvenile and adult reef fish are typically demersal and usually associated with bottom topographies on the continental shelf (< 100 m) which have high relief; i.e., coral reefs, artificial reefs, rocky hard-bottom substrates, ledges and caves, sloping soft-bottom areas, and limestone outcroppings. More detail on these habitat types is found in the Fishery Management Plan (FMP) for Corals and Coral Reefs (GMFMC and SAFMC, 1982). However, several species are found over sand and soft-bottom substrates. Juvenile red snapper are common on mud bottoms in the northern Gulf. Some juvenile snapper and grouper such as mutton, gray, dog, lane, and yellowtail snappers and jewfish, red, gag and yellowfin groupers have been documented in inshore seagrass beds, mangrove estuaries, lagoons, and larger bay systems (GMFMC, 1981). Habitat ranges, preferences and ranges of depth zones, notes on distribution and migration, as well as information on temperature and salinity preferences are presented in Section 4.1 Life History Features, of the Reef Fish FMP (GMFMC, 1981).

Man-made artificial reefs also were utilized in the Gulf of Mexico to attract fish and increase fish harvests. An artificial reef system of considerable importance is the large number of petroleum platforms and associated structures (approximately 3500) off the shores of Texas and Louisiana (Driessen, 1985a). Their shape, extensive surface area, high and low areas of relief, and hard substrate are very similar to the best Japanese designs of artificial reefs today. Available reef fishes habitat in the Gulf of Mexico may have increased with the construction and emplacement of artificial reefs and oil and gas energy structures. Oil and gas structures include drilling rigs, production platforms, caissons, capped well heads, etc.

Research on man-made reefs including those composed of cars, tires, pipes, etc., is limited. Tennison (1985) discussed the use of offshore oil platforms to develop artificial reefs and enhance fish assemblages. It has been suggested that such platforms support diverse and abundant fish populations not normally found on open sandy bottoms (Hastings et al., 1976; Gallaway and Lewbel, 1982).

Opinions differ as to whether or not artificial structures actually promote an increase of reef fishes or merely concentrate fishes by attracting them from nearby natural areas. Some evidence indicates that artificial reefs actually increase the standing stock of reef fishes (Stone, 1978; Stone et al., 1979). The following excerpt from Bohnsack and Sutherland (1985) adequately portrays the current state of knowledge on artificial reefs:

> "General agreement exists that artificial reefs are effective fish attractants and an important fishery management tool. Most published papers deal with building artificial reefs or are qualitative descriptive studies detailing successional changes and species observed. Conclusions were often based on little or no scientific data. Few studies used quantitative experimental methods and many lacked scientifically valid controls.
>
> Drastically different approaches to artificial reefs in terms of purpose, funding, research, materials, and size have been taken by Japan and the United States. Most marine artificial reefs in the United States are large, low budget, and haphazardly constructed from scrap materials, using volunteer labor. These reefs are usually built in deeper offshore waters for use by recreational fishermen with boats. Japan's artificial reefs, however, are designed and constructed by engineers, built of durable, non-waste, prefabricated materials, placed in scientifically selected sites in shallow and deep water, and are primarily used by commercial fishermen.
>
> In this paper, 29 recommendations are made for future studies. Improved professional publication standards and more carefully controlled studies using an experimental approach are suggested. Greater emphasis should be placed on determining optimal design, size, and placement of artificial reefs to maximize production....Also, reefs designed for increasing larval and juvenile recruitment, survival, and growth should be considered. Improved quantitative assessment techniques are needed to describe artificial reefs, reef communities, and to monitor biotic changes. Artificial reef data bases should be maintained so that the effectiveness of various artificial reefs can be more easily assessed. The importance of fish attraction versus fish production and the relationship between standing crop and fish catch have not been adequately addressed. The economics and social impact of artificial reefs also have not been

carefully examined, especially the benefits from alternative designs and approaches."

Presently, Florida has at least 175 active permitted artificial reef sites (Driessen, 1985a). Artificial reef programs have been underway in Texas, Louisiana, Mississippi, and Alabama, since the 1970's. Alabama has 300-square miles of ocean bottom permitted for artificial reefs.

6.2. Habitat Condition

Offshore areas used by adults appear to be the least affected by nearshore habitat alterations and water quality degradation. Since most of the catch comes from offshore in water deeper than 100 feet, there is an unknown effect of pesticides, herbicides, and other harmful wastes which have been considered as deleterious to many inshore fisheries (Ketchum, 1972; Walsh et al., 1981; Boesch, 1983; Walsh, 1984). Nearshore reefs have been adversely affected to various degrees by man, but overall are in good condition. Some coral reef tracts are protected as marine sanctuaries. These include Dry Tortugas (Ft. Jefferson National Monument) and other parks not located in the Gulf of Mexico.

The estuarine phase of some juvenile reef fishes, if obligatory, may be critical as alterations of the environment coupled with local changes in environmental parameters such as temperature and salinity have occurred to a large extent in estuaries. Natural and man-induced changes have altered freshwater inflow and removed much habitat. Natural wetland losses result from forces such as erosion, sea level rises, subsidence, and accretion. The major man-induced activities that have impacted environmental gradients in the estuarine zone are:

1. construction and maintenance of navigation channels;
2. discharges from wastewater plants and industries;
3. dredge and fill for land use development;
4. agricultural runoff;
5. ditching, draining, or impounding wetlands;
6. oil spills;
7. thermal discharges;
8. mining, particularly for phosphate, and petroleum;
9. entrainment and impingement from electric power plants;
10. dams;
11. marinas;
12. alteration of freshwater inflows to estuaries;
13. saltwater intrusion; and,
14. non-point-source discharges of contaminants.

All of the Gulf's estuaries have been impacted to some degree by one or more of the above activities. The estuaries also have been the most impacted by water quality degradation. Numerous pollution-related reports and publications exist, but there still is no complete list of chemical contaminants, their effects, or concentrations. A comprehensive inventory to assess how seriously the Gulf's estuaries are polluted is also needed. The majority of reef fish spend their entire life cycle offshore where environmental conditions are more stable and man's effect on estuaries is less severe. However, if an obligatory relationship between juvenile reef fish and estuarine habitats is determined, estuaries will have to be managed to the same degree for reef fish as for other estuarine-dependent species such as shrimp and red drum.

Habitats of particular concern (HPC) are those which play an essential role in the life cycle of the species. Specific areas have been identified in the Gulf of Mexico in the Corals and Coral Reefs FMP (GMFMC and SAFMC, 1982). These include the Flower Garden Banks, Dry Tortugas, Florida Middle Ground, and the Gulf of Mexico Topographic Highs. Since these reefs also provide excellent reef fish habitat, they are again identified here as HPCs.

We are unaware of any current habitat condition that affects the ability to harvest and market reef fish resources. The same applies to recreationally caught fish. Stout (1980), however, has found low levels of DDT, PCB, endrin, and dieldrin organochlorines in red and black grouper, gag, and red snapper. If the residue levels of organochlorines or other pesticides ever becomes dangerous to humans, it is likely that the marketability of reef fish could be adversely affected.

6.3. Habitat Threats

Currently, the primary threat to offshore habitat comes from oil and gas development and production, offshore dumping, platform removals, and the discharge of contaminants by river systems, such as the Mississippi River, which empty into the Gulf of Mexico. The destruction of suitable reefs (natural and man-made) or other types of hard bottom areas also may prove deleterious to this fishery as most of the current data indicate an affinity for these habitats by reef fish (Starck, 1968; Bright and Pequegnat, 1974; Shinn, 1974; Gallaway et al., 1981; Gallaway and Lewbel, 1982; Huntsman and Waters, 1987). Natural impacts on reef habitat may arise from severe weather conditions such as hurricanes, red tide, and excessive freshwater discharge resulting from heavy rain. Human impacts on reef habitat result from activities such as pollution, dredging and treasure salvage, boat anchor damage, fishing and diving related perturbations, and petroleum hydrocarbons (Jaap, 1984). Ocean dumping and nutrient overenrichment also may cause local problems. An additional problem occurs in the northern Gulf, mainly off Louisiana, where large areas of oxygen depleted waters have been observed (Stuntz et al., 1982; Boesch, 1983; Renaud, 1986). The effect of this "hypoxia" is unknown.

Nearshore reefs, especially off Florida, may be impacted by coastal pollution such as sewage and non-point-source discharges, urban runoff, herbicides, and pesticides (Jaap, 1984). Residues of the organochlorine pesticides DDT, PCB, dieldrin, and endrin have been found in gag, red grouper, black grouper, and red snapper (Stout, 1980). Heavy metal accumulations in sediment and reef biota near population centers have been noted (Manker, 1975). Disposal of wastes has created local problems. Jaap (1984) reports of batteries and refuse disposed of on the reef flat at Carysfort Lighthouse in Florida. Juvenile snapper and grouper temporarily residing in estuaries may be adversely affected by coastal pollutants and alterations. The habitat section for the amended Red Drum FMP (NMFS, 1986) provides details on the value of estuaries and the impacts to them.

Dredging and salvaging near or on reefs is potentially the most damaging physical human activity. Dredge gear impacts reefs by dislodging corals and other organisms and by creating lesions or scars that lead to infection or mortality. Sedimentation from dredging may seriously damage reefs. Dredged sediments may be anaerobic and bind up available oxygen thereby stressing corals and other sessile reef organisms. If the organisms cannot purge the sediments deposited on them, they generally are killed. Silt generated by dredging may remain in the area for long periods and continue to impact reefs when suspended during storms. Reef habitat also may be removed by dredging for borrow materials and disposal on beaches and by dredging and filling associated with navigation channel construction and maintenance.

Anchor damage is a significant threat to reefs, especially those composed of corals. Anchors, ground tackle, lines, and chains can break hard and soft corals, scar reefs, and open lesions which can become infected. Heavy use of reef areas by boaters can compound the problem. Although anchoring by oil and gas lease operators is prohibited on most of the coral reefs in the Gulf of Mexico, anchoring for other purposes is not restricted. Fishing gear such as bottom trawls, bottom longlines, and traps also may damage reefs. Effects would be similar to anchor damage. Hook-and-line fishing and related losses of line, leaders, hooks, and sinkers also may damage corals. Disposal of garbage by boats has been identified as a problem at Pulaski Shoal near Dry Tortugas (Jaap, 1984).

Recreational spearfishing has damaged corals and may become more of a problem in areas of heavy diver concentration. Divers often illegally overturn corals and cause other damage. Specimen collecting also may result in localized reef damage, especially when chemical collecting agents are improperly used. Collecting corals and the use of chemicals are regulated under the Coral FMP (GMFMC and SAFMC, 1982). Although there are some potential positive aspects of existing operational platforms acting as artificial reefs, unfortunately, these positive aspects are severely compromised due to adverse effects on fish and other biota from the discharge of drilling muds, drill cuttings, and minor petroleum pollution due to wash down activities, effluent discharges, and trash disposal. Malins (1982) reviewed laboratory experiments describing the deleterious effects of petroleum fractions on fish. Grizzle (1981) and Pierce et al., (1980) have documented that wild fish have been injured by petroleum pollutants. Grizzle (1983) suggested that larger liver weights in fish collected in the vicinity of production platforms versus control reefs could have been caused by increased toxicant levels near the platforms. He also suspected that severe gill lamella epithelium hyperplasia and edema in red snapper, vermilion snapper, wenchman, sash flounder, and creole fish were caused by toxicants near the platforms. These types of lesions are consistent with toxicosis and their prevalence and severity increased near drilling platforms. The kinds of effects listed above could result from typical daily activities at platforms. In addition, the possibility of major spills and/or well blowouts exists.

Extensive environmental impact statements were a prerequisite to the installation of offshore platforms. However, prior to 1986 no formal environmental monitoring of structure removals was required. The U.S. Department of Interior, Minerals Management Service (1987), estimates that there were 3,435 platforms in the federal outer continental shelf as of December, 1986 and predicts between 60 and 120 platforms will be removed annually for the next five years. The National Research Council (1985) estimates approximately 1,700 platforms will be removed between 1984 and 2000. The Council predicts about 100 to 130 removals annually between 1990 and 2000. This projection raises questions about the impacts of the potential loss of valuable habitat to a wide variety of marine life. Serious consideration should be given to research projects centered on assessing the importance of platforms to reef fish productivity.

Besides the loss of potential habitat, the removal of a platform often destroys the associated platform ecosystem where one exists. In addition to killing fish at a platform removal site, platform removal will result in dispersal of survivors. This would adversely affect some of the commercial and recreational fishermen that fish near platforms. For example, approximately 112 commercial snapper/grouper boats from Florida fish the platforms off Mississippi and Louisiana on a regular basis (Dimitroff, 1982). The removal of platforms in the Gulf of Mexico may reduce the catches of reef fish. Accordingly, new methodologies for platform removals aside from the standard use of bulk explosives should be devised.

6.4. Habitat Information Needs

The following research needs relative to reef fish habitat are provided so that state, federal, and private research efforts can focus on those areas that would allow the Council to develop measures to better manage reef fish and their habitat:

1. Identify optimum reef fish habitat and environmental and habitat conditions that limit reef fish production;

2. Determine the relationship between juvenile reef fish and estuarine habitat;

3. Quantify the relationships between reef fish production and habitat;

4. Identify areas of particular concern for reef fish;

5. Determine methods for restoring reef fish habitat and/or improving existing environmental conditions (platform environments) that adversely affect reef fish production; and

6. Identify mitigative methods for preserving and/or relocating oil platforms for use as artificial reefs.

7. The 29 recommendations in Bohnsack and Sutherland (1985) for future studies should be followed. Especially the issue whether artificial reefs contribute to population productivity or primarily congregate fish.

8. Determine the impacts of butterfish trawling on reef fish habitats.

6.5. Habitat Protection Programs

State and federal agencies and laws and policies that affect reef fish habitat are found in Section 3.3 of the Reef Fish EIS and FMP (GMFMC, 1981). Specific involvement by other federal agencies are identified below.

Office of Coastal Zone Management, Marine Sanctuaries Program, NOAA: Specifically, this program manages and funds the marine sanctuaries program. On-site management and enforcement are generally delegated to the states through special agreements. Funding for research and management is arranged through grants.

National Marine Fisheries Service: The enactment of the Magnuson Act provides for exclusive management of fisheries seaward of state jurisdiction. This includes both specific fishery stocks and habitat. The process for developing FMPs is highly complex. It includes plan development by various procedures through fisheries management councils. National Marine Fisheries Service implements approved plans. The Coast Guard, National Marine Fisheries Service, and states enforce fishery management plans. Fishery management plans for billfish, corals and coral reefs, coastal migratory pelagics, red drum, reef fish, shrimp, spiny lobster, stone crab, and swordfish are in force in the Gulf of Mexico.

National Park Service: National parks and monuments are under the jurisdiction of National Park Service. Management, enforcement, and research are accomplished in house.

Minerals Management Service: This agency has jurisdiction over mineral and petroleum resources on the continental shelf. Management has included specific lease regulations and mitigation of exploration and production activities in areas where coral resources are known to exist.

Fish and Wildlife Service: Fish and Wildlife Service assists with environmental impact review, develops biological resource evaluations, and administers the endangered species program with the NMFS. In the Keys area the Fish and Wildlife Service manages several national refuges for wildlife.

Geological Survey: In the coral reef areas, the Geological Survey has conducted considerable reef research and assisted or cooperated with other institutions and agencies to facilitate logistics and support of coral reef research.

Coast Guard: The 1978 Waterways Safety Act charges the Coast Guard with marine environmental protection. The Coast Guard is the general enforcement agency for all marine activity in the federal zone. Among the duties are enforcement of sanctuary and fishery management regulations, managing vessel salvage, and coordinating oil spill cleanup operations at sea.

U.S. Army Corps of Engineers: The Corp contracts and regulates coastal engineering projects, particularly harbor dredging and beach renourishment projects. The Corp also reviews and is the permitting agency for coastal development projects, artificial reefs, and offshore structures.

Environmental Protection Agency: This agency has a general responsibility for controlling air and water pollution. Disposal of hazardous wastes and point-source discharge permitting are Environmental Protection Agency functions. Certain mineral and petroleum exploration and production activities are managed by Environmental Protection Agency. Environmental research germane to waste disposal and pollution also are funded.

Federal environmental agencies such as the National Marine Fisheries Service, Mineral Management Service, Fish and Wildlife Service, and the Environmental Protection Agency also analyze projects proposing inshore and offshore alterations for potential impacts on resources under their purview. This is similar to the function of the Gulf Council's Habitat Committee. Recommendations resulting from these analyses are provided to the permitting agencies (the Corp for physical alterations in inshore waters and territorial sea, the Mineral Management Service for physical alterations in the Outer Continental Shelf or the offshore Exclusive Economic Zone (EEZ) and Environmental Protection Agency for chemical alterations). Even though the Corp of Engineers issues permits for oil and gas structures in the EEZ, they only consider navigation and national defense impacts, thus leaving the rest to the Department of Interior, in a nationwide general permit.

In administering the oil and gas resources on the Outer Continental Shelf, the Department of Interior through the Minerals Management Service has not been recognizing the authority of the Fish and Wildlife Coordination Act. Instead they have contended that the Outer Continental Shelf Lands Act, as amended, supersedes the Fish and Wildlife Coordination Act. They also require that the oil and gas lease permit stipulations be more closely coordinated with other Department of Interior bureaus, e.g., Fish and Wildlife Service, as provided in Departmental Manual 655. Coordination with other federal and state agencies is less frequent. For example, coordination between National Marine Fisheries Service and Minerals Management Service results from NOAA participation in the Outer Continental Shelf Advisory Board's Gulf of Mexico Regional Technical Working Group, which usually convenes three times a year, and from authorities under the Endangered Species Act and National Environmental Policy Act. The latter involves the periodic review of environmental statements for proposed lease sales. While review under the Endangered Species Act generally involves exploration and development plans, it is very difficult for agencies like National Marine Fisheries Service to have Minerals Management Service implement less environmentally damaging procedures in oil and gas operations around reefs, etc., if the Fish and Wildlife Service has not already objected to the procedure during the Department of Interior, DM 655 coordination. However, though not required to do so, the Fish and Wildlife Service frequently informally coordinates their proposed actions under DM 655 with National Marine Fisheries Service. None of the fish and wildlife agencies have veto power over Minerals Management Service permitting for oil and gas exploration, development and production on the Outer Continental Shelf, or on essentially the EEZ.

Environmental Protection Agency is the permitting agency for chemical discharges into the Gulf of Mexico, under the National Pollution Discharge Elimination System (NPDES) program of the Clean Water Act for chemicals used or produced in the Gulf (i.e., drilling muds, produced water or biocides) and then released, or under the Ocean Dumping Regulations of the Marine Protection, Research and Sanctuaries Act if the chemicals are transported into the Gulf for the purpose of dumping. When discharge or dumping permits are proposed, federal and state fish and wildlife agencies may comment and advise under the Fish and Wildlife Coordination Act and National Environmental Protection Act. The Gulf Council may do likewise under the Magnuson Act and National Environmental Protection Act. The Gulf Council also protects reef fish habitat under the Corals and Coral Reefs Fishery Management Plan.

6.6. Habitat Recommendations

The reef fish fishery contributes to the food supply, economy, health of the nation, and provides recreational and commercial fishing opportunities. The fishery is dependent upon the survival of reef fish resources, which can only be assured by the wise management of all aspects of reef fish habitat. Increased productivity of reef fish stocks may not be possible without habitat maintenance and regulatory restrictions.

Recognizing that all species are dependent on the quantity and quality of their essential habitats, it is the policy of the Council to protect, restore, and improve habitats upon which commercial and recreational marine fisheries depend, to increase their extent and to improve their productive capacity for the benefit of the present and future generations. This policy shall be supported by three objectives which are to:

1. Maintain the current quantity and productive capacity of habitats supporting important commercial and recreational fisheries, including their food base (This objective may be accomplished through the recommendation of no loss and minimization of environmental degradation of existing habitat);

2. Restore and rehabilitate the productive capacity of habitats which have already been degraded; and

3. Create and develop productive habitats where increased fishery productivity will benefit society.

To achieve these goals the Council has formed a Habitat Committee and Advisory Panels for the Gulf states. The purpose of the Committee is to bring to the Council's attention activities that may affect the habitat of the fisheries under their management. The Council, pursuant to the Magnuson Act, will use its authorities to support state and federal environmental agencies in their habitat conservation efforts and will directly engage the regulatory agencies on significant actions that may affect reef fish habitat. The goal is to ensure that reef fish habitat losses are kept to the minimum and that efforts for appropriate mitigation strategies and applicable research are supported.

7. DESCRIPTION OF THE REEF FISH FISHERY

7.1. Description of Available Data

The primary data source for the recreational harvest of red snapper is the National Marine Fisheries Service (NMFS), Marine Recreational Fishery Statistics Survey (MRFSS) which covers the period 1979-85. This survey did not include boat-mode sampling in Texas during the period 1982-84 or party boats throughout the Gulf in 1986.

Party boat catch estimates for 1986 were obtained from a survey conducted by the NMFS, Beaufort, NC (data courtesy of Gene Huntsman). Estimates for boat-mode catches of red snapper in Texas for 1982-1984 were obtained from Parrack and McClellan (1986) and are based on data collected by the Texas Parks and Wildlife Department. These data were used to adjust the MRFSS data to provide estimates of total numbers of red snapper captured by the recreational fishery in the Gulf of Mexico from 1979-1986.

Data from the Trip Interview Program of the State/Federal Cooperative Statistics Program (TIP) were obtained to characterize the size composition of red snapper landed by different commercial gears. Data were available from 1983 through part of 1987. The records were sorted by gear type and location of capture (statistical area).

Commercial annual landings data were obtained with statistical area location and gear information from the NMFS General Canvas Landings files and monthly data were from the NMFS ALARM reports (Brown et al., 1988) and covered the years 1972-1986 and 1979-1986, respectively. Data from the stock assessment (Goodyear, 1988a; 1988b) were based on the General Canvas Landings files.

7.2. Description of The Reef Fish Fishery

The reef fishes apparently represent the first target fishery of any consequence for demersal fish in the Gulf of Mexico. Throughout the period prior to the late 1970's, the basic fishing gear, hook-and-line, prevailed. However, since the late 1970's both fish trap and longline gear have grown in importance for the commercial fishery.

Users of the reef fish resources can be divided into the two broad user groups of recreational fishermen and commercial fishermen. Recreational users consist of individual sport fishermen and divers. Commercial users consist of "for hire" (charter or head boat) boats and commercial food fishermen. Those fishermen earning their livelihood from the fishery were considered the commercial users.

Recreational fishermen include those fishing from privately owned craft ranging from small outboard powered boats to the more sophisticated charter and "head boat" equipped with modern electronic equipment. Some recreational users combine their sport fishing activities with sport diving. Other divers simply observe the underwater environment but may occasionally do some incidental fishing. Many of these recreational users belong to local, state, national, and even international associations which are active in promoting their interests in the reef fish fishery and the marine environment.

Similarly, commercial fishermen fall into two categories: charter boat or "head boat" operators and commercial fishermen. Through these commercial users, the general public is brought into the overall user group category either as fishermen, providers of services to fishermen, or as consumers.

7.2.1. Review of Landings, Effort and Value in the Commercial and Recreational Fisheries

This section reviews available data pertaining to the economic status of the reef fish fisheries in the Gulf of Mexico. Several sources of data are available, none of which is ideal. For the commercial fishery, aggregated data on landings and value received by fishermen give a general idea about trends in the fishery as a whole. There is limited information about the economic status of individual participants in the fishery. Information about the recreational fishery is limited to estimates of the aggregate catch of reef fish as derived from the Marine Recreational Fishery Statistics Surveys. For both commercial and recreational fisheries, data are available only through 1986.

7.2.1.1. Commercial Fishery

U.S. fishermen have fished for red snappers and groupers since the 1830's and 1840's. Camber (1955), Carpenter (1965), and Allen and Tashiro (1976) have reviewed the history and status of the fishery. Lesser quantities of other species associated with reefs (e.g., other snappers, sea basses, grunts, porgies, tilefishes, triggerfishes, and jacks) are also marketed, principally in Florida. This discussion reviews trends in landings and exvessel value from 1955-1986, with 1986 being the last year for which reasonably complete data are available.

Landings: Total commercial landings of reef fish during the 1980's have been the highest since the 1960's, with landings ranging from 21.9 to 26.2 million pounds per year between 1981 and 1986 (Figure 7.1, Table 7.1). However, the species composition of the catch has changed markedly. Landings of red snapper, once the principal species for the fishery, exhibited an almost uninterrupted decline between 1965 and 1980, from 14.0 million pounds to 4.9 million pounds, then increased for three consecutive years to 7.3 million pounds in 1983, and have since dropped to a low of less than 4.1 million pounds in 1986. Red snapper represented approximately 18% of the total commercial catch of reef fishes in 1986. In contrast, red snapper accounted for 30% of the catch in 1980, 43% in 1970 and 55% in 1960. The decline in landings is due in part to a loss of foreign fishing grounds and a probable decline in the size of the domestic fish population.

Florida ports handled only 25% of the red snapper catch (1.0 million pounds) in 1986, down from an average of 53% from 1955-1983 (Figure 7.2, Table 7.2). Similarly, landings at ports in Alabama and Mississippi handled only 20% of the red snapper catch in 1986 (0.8 million pounds), down from an average of 32% from 1955-1983. While landings in Florida, Alabama, and Mississippi have declined, landings in Louisiana and Texas have increased from a combined total of 0.45 million pounds in 1978 to 2.3 million pounds in 1986. Fish caught in the western gulf that previously would have been landed in Florida are now landed in Louisiana and Texas.

The long run decline in landings of red snapper has been more than offset by the growth of the grouper fishery, primarily due to increased exvessel prices and the use of bottom longlines. Landings of all groupers combined averaged 8.2 million pounds between 1955 and 1980, and 12.9 million pounds between 1981 and 1986 (Figure 7.3, Table 7.1). Landings increased from less than 6.3 million pounds in 1978 (the lowest level since 1958) to a record of 15.3 million pounds in 1982. Groupers have accounted for more than 50% of all reef fish landed at U.S. gulf ports in every year from 1979-1986. Commercial fishermen landed 12.5 million pounds in 1986.

Landings at Florida ports, especially in the central (Charlotte - Levy) counties, dominated the overall catch of groupers. Florida fishermen landed 89-98% of the grouper catch between 1955 and 1986 (Figure 7.3, Tables 7.3, 7.4).

Commercial landings of other (than red) snappers increased to 3.8 million pounds in 1986 (Table 7.1), largely due to increased landings of vermilion snapper (from 0.4 million pounds in 1982 to 1.7 million pounds in 1986), primarily in the northern Gulf (Table 7.5). Yellowtail snapper, gray snapper and lesser quantities of mutton, lane and vermilion snappers are caught in southwest Florida and the Keys. Fishermen landed a record 1.47 million pounds of yellowtail snappers in 1982.

Increasingly significant quantities of other reef fish are also caught, primarily in Florida (Tables 7.1, 7.6). For example, landings of amberjacks have increased from 0.4 million pounds in 1983 to 1.4 million pounds in 1986. Landings of miscellaneous reef fishes, including amberjacks, grunts, hogfish, pigfish, porgies, sea basses, sand perch, tilefishes and triggerfishes, amounted to over 10% of the total catch of all reef fishes in 1985 and 1986

(Table 7.1). However, the exvessel value of the miscellaneous reef fish was less than 5% of total exvessel value.

Historically, the National Marine Fisheries Service has reported landings by county in Florida, with Monroe County considered to be part of the Gulf Coast. However, the current jurisdictional boundary between the South Atlantic and Gulf of Mexico Fishery Management Councils splits Monroe County, with only fish caught from the north and west of Route 1 being under the jurisdiction of the Gulf Council. To maintain a consistent time series of data, Tables 7.1-7.6 have followed the traditional pattern of attributing all landings in Monroe County to the Gulf Council. Technically, however, landings from the Atlantic side of Monroe County should be excluded. Data for 1978-1986 were used to divide Monroe County landings into Atlantic and Gulf sides according to water body codes, with NMFS codes 2.1, 1.2, 600.0, 748.0 and 744.0 assigned to the Atlantic side, code 0 assigned to fish of unknown origin, and all other water body codes assigned to the Gulf side.

Based on the geography of Monroe County, one would expect most reef fish to originate within the jurisdiction of the South Atlantic Council. In fact, between 57% and 74% of all reef fish landed in Monroe County came from the Atlantic side (Table 7.7). At least 70% of the reef fish came from the Atlantic side in each year between 1981 and 1985. Most of the catch for 1986 was of unknown origin; hence valid comparisons for 1986 were not possible.

The boundary between Councils is of minor consequence for management of red snapper because relatively few of them are landed in Monroe County. Only 0.02% to 0.28% of all red snappers originated on the Atlantic side of Monroe County (Tables 7.7, 7.8). But Monroe County accounts for a significant fraction of total catches of other reef fishes, except for vermilion snapper, black sea bass, gray triggerfish, and sand perch (Table 7.8). Approximately 76% of all yellowtail snappers landed from 1978-1985 originated on the Atlantic side of Monroe County. Other percentages include: 54% for lane snapper, 31% for gray snapper, 48% for mutton snapper, and 5.7% for groupers (Table 7.8).

<u>Other Sources of Supply:</u> Ports along the Gulf of Mexico (including all of Monroe County) averaged approximately 85% of the snappers and 83% of the groupers landed in the southeastern United States between 1980 and 1986. The south Atlantic Coast represents the primary alternative source of domestic supplies of reef fish. Historically, there has always been a small fishery for snappers and groupers along the eastern coast of Florida. Then in the mid 1970's, commercial fishing for snappers and, especially, groupers began in earnest along the North and South Carolina coasts. From 1980 to 1986, commercial fishermen along the south Atlantic Coast averaged nearly 1.5 million pounds of snappers and 2.5 million pounds of groupers annually (Table 7.9). Significant quantities of other reef fish, including black sea bass and porgies in the

Carolinas and tilefish in Florida and South Carolina, are also landed in the south Atlantic. There is a growing fishery for reef fish in Hawaii, with 0.6 million pounds landed in 1984 and 0.7 million pounds landed in 1985 (Meyer, 1987).

Despite substantial landings of snappers and groupers in the southeast, domestic production must be supplemented with imports to satisfy increasing quantities demanded in domestic markets. Unofficial data collected from the New Orleans Market News Reports indicates snapper imports have increased over time in both volume and as a percentage of total supplies in the southeast. Snapper imports averaged 9% of total snapper supplies, or 1.2 million pounds on a whole weight basis, from 1960 to 1972, and 38%, or 4.9 million pounds, from 1973 to 1982 (Table 7.10). Imports have increased rapidly since 1982 and now account for more than 50% of total snapper supplies in the southeast (Figure 7.4, Table 7.11).

The Market News Reports indicate that until recently imports have represented a relatively large fraction (30-45%) of total grouper supplies in the southeast (Figure 7.4, Table 7.11). Imports declined during the early 1980's when the domestic fishery expanded. Imports have increased since 1984, however (Table 7.10). There was a curious decline in grouper imports between 1967 and 1971. Imports fell from 7.0 million pounds (live weight) and 41% of total supplies in 1966 to less than 1.0 pounds and 8% of total supplies in 1967. Imports remained approximately constant until 1972 when they jumped to 8.1 million pounds and 46% of total supplies. There was a similar but less noticeable decline in snapper imports between 1967 and 1972. Imports fell from 13% of total snapper supplies in 1966 to 9% in 1967, and then increased from 10% in 1972 to 32% of total supplies in 1973. Keithly and Prochaska (1985) hypothesized that imports declined because Catholics no longer had to observe meatless Fridays after December, 1966. Their hypothesis could explain the sudden decline in imports in 1967, but the sudden increase in imports in 1972 and 1973 suggests that, perhaps, as an unofficial data source, the Market News Reports failed to record significant quantities of imports between 1967 and 1973.

Also, as a regional publication, the New Orleans Market News Reports recorded imports into the southeast only. The New York Market News Report indicates that fresh and frozen snappers and snapper fillets are imported from Central and South America and southeast Asia for sale at the Fulton Fish Market. These data have not been compiled. There is no information about the quantities of snappers and groupers imported into other regions of the country.

Exvessel Value: Exvessel value received by commercial fishermen in the Gulf of Mexico increased throughout the 1955-1986 period to a record $32.4 million (Figure 7.1, Table 7.1). However, much of the increase was due to inflation, as measured by the producer price index (PPI) for all commodities. After adjusting for inflation, total exvessel value remained relatively constant between 1964 and 1980 despite the general decline in landings. Since 1980, increases in total landings resulted in substantial increases in real exvessel value (i.e., after adjusting for inflation). Real exvessel value in 1986 was 80% greater than that received in 1980.

Historically, red snapper has been the most valuable species in the fishery, but its relative importance has declined. In 1986, red snapper contributed 25% to overall value received, whereas it contributed 45% in 1980, 64% in 1970 and 73% in 1960 (Figure 7.1, Table 7.1). Although exvessel prices increased steadily over time (Figure 7.5, Table 7.12), the increases were unable to offset both inflation and the long term decline in landings; consequently real exvessel value for red snapper generally declined from 1964 to 1986, with a brief increase between 1980 and 1983 to disrupt the long term trend (Figure 7.2). Red snapper prices are slightly higher in Florida and Louisiana than in other gulf states, probably because trips are shorter and hence fish are fresher when landed. Florida fishermen received 27% of the exvessel value in 1986 although they landed only 24.5% of the catch (Figure 7.2, Table 7.2). In 1986, exvessel prices averaged $2.44 per pound, gutted weight.

Exvessel value for groupers has increased rapidly since 1978 and in 1981 exceeded for the first time value received from red snapper (Figure 7.1, Table 7.1). In addition to the large quantities of groupers landed, average annual grouper prices have increased in real terms and relative to red snapper prices (Figure 7.5, Table 7.12). Hence, groupers have contributed an increasingly important share of total exvessel value to commercial fishermen, accounting for over 50% of exvessel value in both 1985 and 1986 (Table 7.1).

In 1986, commercial fishermen earned $23.4 million in Florida, $5.1 million in Louisiana, $2.3 million in Texas, $1.2 million in Mississippi and $0.6 million in Alabama.

<u>Demand for Reef Fish:</u> Exvessel demand curves are used to calculate the price flexibility of demand, which is a statistic useful for predicting the direction in which total revenues would change if industry landings were to change. If demand were found to be price inflexible, then a decline in landings would cause prices to increase by a relatively small amount and total revenues would decrease. If demand were price flexible, then a decline in landings would cause a relatively large increase in price and total revenues would increase. If demand were unit flexible, then a decline in landings would cause a proportionately equal increase in price and total revenues would remain the same. It is important for fishery managers, who can reduce industry landings by regulating the fishery, to know if demand is price inflexible, price flexible or unit flexible.

Cato and Prochaska (1976) and Keithly and Prochaska (1985) estimated exvessel demand curves for reef fish in the Gulf of Mexico. Cato and Prochaska (1976) used annual data for 1952-1971 to estimate nominal prices for red snapper in Florida as a function of landings in Florida and total personal income in the U.S. They did not calculate price flexibility; however by using their results, observed landings, and average annual red snapper prices, it can be calculated that exvessel demand became more inflexible over time. Before 1970, demand was price flexible and after 1970 it was price inflexible, apparently because imports have accounted for an increasing share of total red snapper supplies in the southeast. Upon further analysis, Cato and Prochaska concluded that red snapper prices in other gulf states were based on the Florida price. Cato and Prochaska estimated grouper prices in Florida as a function of landings in Florida and total personal income in the U.S. By using their results, it can be found that since 1967 the exvessel demand for groupers also has been price inflexible.

Later, Keithly and Prochaska (1985) used annual data for 1960-1982 and a more sophisticated statistical technique to estimate exvessel demand curves for snappers and groupers. Snapper prices (apparently averaged over all species of snappers) were estimated as a function of snapper landings in the gulf, total disposable income in the U.S., snapper imports and a binary variable to represent a decline in demand after 1967 when Catholics no longer were required to observe meatless Fridays. Grouper prices were estimated as a function of grouper landings in the gulf, total disposable income in the U.S., grouper imports and the binary variable. Both demand curves were found to be price inflexible.

The implication of exvessel demand curves that are price inflexible is that industry revenues to domestic fishermen would increase when landings increase and would decrease when landings decrease. Prices would not increase by enough to offset losses caused by unusually low catches, and they would not fall by enough to offset the benefits of unusually high catches. In addition, regulations that reduce industry catches would cause total revenues to decrease.

Effort: Reef fish are caught and retained primarily with handlines and, since 1980, bottom longlines (Tables 7.13-7.16). Lesser quantities of reef fish are also caught and retained with other gears (e.g., fish and shrimp trawls, lobster traps, gill nets, trammel nets, haul seines, etc.), usually as a bycatch in other fisheries. Increasingly significant quantities of groupers have been caught with fish traps since 1984.

The exact amount of fishing effort expended in the fishery is not known. The NMFS collects data about the number of fishing craft and fishermen by gear type, but not of their intensity of use.

Hence, the number of vessels (i.e., craft > five gross tons) and fishermen using handlines and the number of vessels plus boats (i.e., craft < five gross tons) using reef fish longlines is taken as an approximate measure of effort in the commercial fishery. In 1986, the last year for which the NMFS has reasonably complete data, 852 craft with approximately 2,900 fishermen used handlines and reef fish longlines in the gulf (Table 7.17). These data reflect potential effort in that most of these vessels and fishermen probably were employed in the reef fish fishery for at least part of the year, although the data file does not indicate the species for which these vessels fished.

The number of vessels using handlines was relatively high during the 1978-1986 period, with a peak in 1980 of 779 vessels and 2,586 fishermen (Table 7.17). Participation in the handline fishery declined through 1983, but has since increased to approximately 610 vessels and 1,983 fishermen in 1986 (Table 7.17). Appendix tables 29 and 1 in the FMP for the reef fish fishery (GMFMC 1980) reported that there were approximately 300 to 500 handline vessels and 1,000 to 2,300 fishermen in the fishery between 1957 and 1974, with peak employment occurring during the early 1960's.

Groupers have become relatively more important in the overall catch of reef fish due in part to the increased use of bottom longlines. NMFS records indicate that the number of fishing craft that used bottom longlines rose from 3 in 1979 to a peak of 282 in 1982 and then declined to 242 in 1986 (Table 7.17). Longlines are more labor intensive than handlines. Hence, the total number of fishermen has increased as vessels shifted from handlines to longlines. The gear classification for reef fish longlines was new in 1979; therefore craft that used bottom longlines before 1979 or 1980 were grouped with swordfish vessels that used surface longlines. Prytherch (1982) described the longline fishery in the gulf.

The number of traps fished ranged from approximately 530 to 2,300 between 1978 and 1986 (Table 7.18), the last year for which we have data. The Southeast Regional Office issued 489 permits for 32,217 traps between November 1984, when permits were first required, through June 9, 1988 (Joann Turner, NMFS, SERO, 9450 Koger Blvd., St. Petersburg, FL 33702). Vessels are limited to 200 traps each.

Annual Costs and Revenues: Although economic aggregates such as total exvessel value and total landings describe the overall performance of the fishery, they do not describe the status of individual participants. To fill this void, Cato and Prochaska (1977) and Poffenberger (1985) have described annual costs and revenues of reef fish vessels in the southeast.

Cato and Prochaska (1977) presented income statements for snapper-grouper vessels along the west coast of Florida during 1974 and 1975. They stratified their sample by vessel size (large and small vessels) and geographic region (northern and western coasts of Florida). Their analyses found that the net return to captain and owner was greater for vessels along the northern coast than for vessels along the western coast, regardless of size, because red snappers are primarily caught in the northern gulf and groupers are caught along the western coast. The results for vessel size were mixed. Larger vessels earned more than small vessels in the northern region and less than small vessels along the western coast.

Poffenberger (1985) summarized a 1980 survey of vessels in the reef fish fisheries of the west coast of Florida and the south Atlantic. He classified vessels according to region (south Atlantic versus gulf), mode of ownership (owner operated versus firm owned with a hired captain), and gear type (longlines versus handlines). Data for gulf vessels (Figure 7.6) generally agreed with the earlier results by Cato and Prochaska. Larger vessels earned more than smaller vessels, and vessels in the northern gulf earned more than vessels along the midwestern coast of Florida, other factors (vessel length and gear type) being equal. Gear type was a significant determinant of net revenues. There were 53 handline vessels and 10 longline vessels in the sample. The relatively small number of longline vessels was approximately correct given that longliners comprised only 10% of the total number of vessels in the fishery in 1980 (Table 7.17). On average, longliners landed more fish, received more revenue and incurred higher costs than did vessels using handlines (Figure 7.6). The extra revenues earned by longlining exceeded the extra costs incurred; hence, net revenues to be shared by the vessel owner, captain and crew were greater for longlining than for handlining.

The existence of a higher net return to be shared by owner, captain and crew was required to offset the higher opportunity costs (the amounts that fishermen could earn elsewhere for their capital and labor) of longlining compared to handlining. Longline vessels represented larger investments, and hence, higher opportunity costs of capital for vessel owners. In addition, longline vessels usually carried more crew members; hence the total opportunity costs for the entire crew would be higher than for handline vessels. Also, net returns were higher for longline vessels because longlining was more profitable than handlining. Opportunity costs for captains and for individual crew members were unknown, but given the large differences in net revenues between gear types, it seems likely that longliners earned economic rents (i.e., incomes greater than what they could have earned elsewhere) during 1980.

Productivity: Longlining was more profitable than handlining primarily because longliners had higher catch rates. The economic implication of a profitable longline fishery was that longlining effort would increase until it became no more profitable than traditional handlining. This outcome would most likely occur due to declining catch rates. As competition increases in the fishery, each fisherman would earn a smaller portion of the total available. In addition, greater effort could reduce the population of fish, causing further reductions in catch rates. Apparently, this was exactly what happened. Table 7.17 indicated that the number of vessels using reef fish longlines increased from 1979 to 1982 and then declined through 1986, the last year for which we have data.

The trip interview program (TIP), conducted by the NMFS Southeast Fisheries Center, yielded frequency distributions for productivity in terms of pounds of reef fish caught per trip, pounds per day fished and pounds per man per day fished for commercial reef fish trips in Louisiana (Figures 7.7-7.9) and ports along the west coast of Florida (Figures 7.10-7.12) from 1984-1986. Mean and median catch rates varied for Louisiana fishermen, but with no particular trend either up or down (Table 7.19). For 1984-1986 combined, the median catch of reef fish per trip was 1309 pounds with bandit reels, 1050 pounds with buoys and 2744 pounds with longlines. The median catch per day fished was 363 pounds with bandit reels, 335 pounds with buoys and 558 pounds with longlines. The median catch per man per day fished was 100 pounds with bandit reels, 121 pounds with buoys and 151 pounds with longlines. Along the west coast of Florida, the medians for all three measures of productivity declined between 1984 and 1986 for both handlines and longlines (Table 7.20). The TIP data probably reflect accurately the general trend in productivity along the west coast of Florida. However, substantial differences over time in sampling intensity with respect to gear type and port suggest that data for any given year may not necessarily be representative of the entire west coast fishery.

7.2.1.2. Recreational Fishery

Most of the available information about the recreational fishery comes from the marine recreational fishery statistical surveys (MRFSS) conducted annually since 1979. Data are available for the 1979-1986 period (U.S. National Marine Fisheries Service 1984,1985a,1985b,1986,1987). However, data for 1986 are incomplete in that recreational fishermen in Texas and headboat fishermen throughout the gulf were not sampled by the MRFSS. Another survey conducted in 1981 (Hiett et al. 1983) summarized various socio-economic aspects of marine recreational fishing in the Gulf of Mexico.

This section reviews the recreational catches of snappers, groupers and other reef fish in the management unit. With only eight MRFSS surveys (1979-1986), the time series of information is too short to distinguish between trends and short run variations in the fishery.

The MRFSS categorizes fish as types A, B1 or B2. Catch type A is based on the number of whole fish available for inspection by samplers. Catch type B1 is based on fish that were not available for inspection or not available in whole form, i.e., fish used for bait, discarded dead, filleted, etc. Catch type B2 is based on fish that were caught and released alive. Of these, an unknown percentage (p) survived the stress of being caught and released and successfully reentered the fish population. All fish caught (A+B1+B2) add to fishermen's satisfaction and hence the value of the marine recreational fishery. However, only those fish killed (A+B1+(1-p)B2) reduce the population of fish available to be caught in the future.

Recreational fishermen caught significant numbers of reef fish in the Gulf of Mexico. Except for 1982 and 1986, the total (types A+B1+B2) recreational catch of snappers, groupers, sea basses and other reef fish in the management unit ranged from approximately 26-32 million fish (Table 7.21). As in the commercial fishery, catches peaked in 1982, at 43 million fish. The estimated catch of only 17.8 million fish in 1986 was the lowest total during the 1979-1986 period. However, as noted before, the 1986 estimates are incomplete in that catches by recreational fishermen in Texas and by headboat fishermen throughout the gulf were not included. The headboat catch was estimated in a separate survey to be approximately 2.4 million fish (Gene Huntsman, NMFS, Beaufort Laboratory, Beaufort, N.C. 28516). Information about recreational catches in Texas was unavailable for 1986.

Porgies were the most frequently caught species group, accounting for 30% to 50% of the total catch (Table 7.21). Most of the porgies were pinfish caught in Florida (Table 7.22) from shore or private boats (Table 7.23) in inland or nearshore waters (Table 7.24). And most were released alive (type B2), suggesting that they were too small to be kept or, perhaps, less desirable than the snappers, for example. The data also include red porgy and small numbers of grass and jolthead porgies.

In addition to the porgies, a consistently high proportion of the sea basses (mostly black sea bass, rock sea bass and bank sea bass) and grunts (white grunt, tomtate, pigfish) were released alive. Other species groups have had high release rates on occasion, but not consistently. Overall, approximately 37% to 52% of the reef fish caught in the Gulf of Mexico were released alive.

The snappers were the principal species that were caught and kept by recreational fishermen. Snappers as a group accounted for 43% to 47% of the keepers between 1979 and 1984, but only 24% to 33% of the total catch (Table 7.21). These proportions fell to 16-18% of the total catch and 23% of the keepers in 1985 and 1986. The estimated total number of red snapper caught by recreational fishermen has declined over time, falling from 6.0 million fish in 1979 to 2.0 million fish in 1985. Approximately 1.0 million fish were caught in 1986 (0.65 million from the MRFSS survey and 0.33 million from the independent headboat survey), but this figure excludes catches by fishermen in Texas (except for red snappers caught from headboats). Red snappers were caught throughout the gulf whereas other snappers were caught primarily in Florida. Most snappers were caught in oceanic waters from privately owned boats, charter boats and headboats. A large number of gray snappers were caught from shore.

The release rate for snappers as a group appears to have increased (from 5-10% to 15-25%) since 1982 (Table 7.21). However, the proportion of snappers that were released did not increase noticeably for individual species.

The MRFSS data suggest that, as in the commercial fishery, groupers have become increasingly important recreationally (Table 7.21). The proportion of the total recreational catch of reef fish accounted for by groupers has increased steadily from less than 4% in 1979 and 1980 to approximately 10% in 1984 and 1985. Red grouper, black grouper and gag, the most frequently caught groupers, were caught almost exclusively in Florida (Table 7.22).

The aggregate biomass of fish caught by recreational fishermen is uncertain, partly because the MRFSS estimates catches based on a sample rather than a census. Also, estimates of the biomass of type A fish were reported, but fish in catch types B1 and B2 were not available for weighing by survey interviewers and hence weights were not recorded rather than to depend on the ability of fishermen to recall them. The biomass of type B1 fish can be approximated as the number of B1 fish caught multiplied by the average weight per type A fish, although B1 fish may weigh less on average than A fish if fishermen tend to land and show unusually large fish in whole form. The biomass of fish killed by recreational fishermen is unknown because the survival rate for released fish is unknown.

Recreational fishermen caught and kept approximately the same quantities of red and other snappers as did directed commercial fishermen (Table 8.1). The quantity of red snappers caught and kept ranged from approximately 2 to 10 million pounds, while the catch of other snappers ranged from 2 to 4 million pounds annually. The year 1982 was an exception with the catch of other snappers estimated at 6.5 million pounds for type A fish and nearly 11 million pounds for types A and B1 fish combined. Fishermen caught and kept four to seven million pounds of groupers annually, approximately one-half the quantities that were caught by commercial fishermen. Exceptions occurred in 1982 and 1985 when the recreational quantities were nearly as large as the commercial quantities. Recreational fishermen landed larger quantities of other reef fish than did commercial fishermen. The total quantities of type A and B1 fish accounted for 30% to 40% of the total recreational catch. And because relatively high percentages of other reef fish were released alive, the total kill of other reef fish could have been much higher depending on the survival rate for released fish.

In 1986, recreational fishing effort for all species numbered 17.9 million trips (s.e.=1.2 million), excluding recreational effort in Texas. There were approximately 13.4 million trips in Florida (s.e.=1.1 million), 0.67 million trips in Alabama (s.e.=0.11 million), 0.67 million trips in Mississippi (s.e.=0.18 million), and 3.1 million trips in Louisiana (s.e.=0.4 million) (Table 7.25). There were an additional 0.3 million angler days fished from headboats in 1986. The number of trips on which snappers, groupers and other reef fish were caught is unknown. In fact, 36% of recreational fishermen did not identify a target species (U.S. National Marine Fisheries Service 1987). Red snapper was the primary species of only 1.6% of all fishing trips sampled. Groupers were the primary species of 1.8% of the fishing trips. In addition, most fishermen rated the number of fish caught as the primary determinant of the level of satisfaction of a fishing trip. Other factors, such as species caught and the size of fish, were infrequently mentioned as primary determinants of satisfaction (Hiett et al. 1983).

7.2.2. Description of Commercial Fishing Gear

Since 1982 an average of about 900 vessels (more than five net tons) has operated in the reef fishery (Table 7.26 and Waters 1988). The number of boats (less than 5 net tons) participating in the reef fish fleet is unknown.

Currently Florida vessels account for nearly 85 percent of the total Gulf of Mexico reef fish fleet. Prior to 1984 Texas had the second largest fleet but since then the Louisiana fleet has expanded from 0 to 79 vessels whereas the Texas fleet has declined to about 40 vessels. Most of the growing Louisiana fleet is comprised of fishermen from Florida who had either regularly fished off Louisiana and simply decided to relocate to reduce operating costs or gone to Louisiana due to declining catch rates of reef fish in the eastern Gulf (Ronald Anderson, personal communication). Only about 8 and 122 vessels respectively have fished out of Alabama and Mississippi ports since 1982.

7.2.2.1. Handline and Bandit Fishing

The basic fishing gear, hook-and-line, has prevailed throughout the development and growth of the fishery (see Table 7.27). The original tarred cotton line gave way to hard lay net twine and that in turn to stainless steel. Similarly, the single handline gave way to the hand-driven reels, and eventually the modern power-driven reels that have become prevalent throughout the commercial fishery. Fishing with the hand- and power-driven reels is commonly referred to as bandit fishing. Other methods, such as gill nets, longlines, hoop nets, fish traps and fish trawls had been tried but with only limited success and until the development of a fish trap fishery in south Florida and a longline fishery beginning in 1980 the line and baited hook remained by far the most popular and productive gear both commercially and recreationally.

The typical 'bandit rig', snapper reel, used today may be either manually cranked or powered hydraulically or electrically. A reel may be spooled with either 300-lb test monofilament or small diameter stainless steel cable. A ground rig with 10-15 hooks and a sash weight attached is attached on the end of the reel line; ground gear can be rigged in different ways depending on the fisherman's preference (Horst and Bankston, 1987). In the Louisiana fishing fleet bandit rigged boats are generally the largest being typically greater than 60 feet in length (Russell et al., 1986) and employ a crew of five-seven fishermen. These boats usually target the smaller red snapper, one-four pounds, but have large incidental catches of other reef fish. Vermilion snapper is targeted at night. The bandit boats are usually restricted to shallower shelf waters (25-35 fathom) but have the advantages of being able to fish close to oil rigs and over very rough coral bottoms, both of which are difficult or impossible to fish with longlines and buoys.

7.2.2.2. Fish Traps

Presently the fish trap fishery is conducted primarily in Florida, with two major areas of concentration being the Florida west coast and south Florida. Until the 1980's sea bass had been the primary target of trap fishermen. Catch of sea bass with traps was 300,900 pounds in 1968. Sea bass catch declined steadily after 1968 to a low of 22,200 pounds in 1975. In recent years, groupers and snappers have become the most important component of the fish trap catch (Table 7.28) with grouper predominating.

Studies conducted in south Florida by National Marine Fisheries Service and Florida Department of Natural Resources in the late 1970's resulted in the following estimates of fish trap effort: Dade County - 575 traps, 90 fishermen; Broward County - 665 traps, 18 fishermen; Monroe County - 998 traps, 43 fishermen; Collier County - 250 traps, 8 fishermen (Sutherland and Harper, 1983; Taylor and McMichael, 1983). In the early 1980's an estimated total of 2,488 traps were being fished by 159 fishermen in south Florida. The Reef Fish Fishery Management Plan (FMP) recommended a logbook program for fish trap fishermen that was implemented by NMFS in 1987. In June 1988 475 fish trap permit holders possessed about 34,000 trap tags however, although we have no estimate of the number of traps actually in use, it is likely to be much less than the number of trap tags issued (Angelovic, letter to W. Swingle dated June 29, 1988). The NMFS mailed a questionnaire to the fish trap permittees but only 94 reported they were actively fishing traps; these fishermen were subsequently issued logbooks. Another 164 permittees claimed not to be using fish traps, and 199 did not respond to the questionnaire. By the end of April 1988 only 12 fishermen had submitted 30 logbook trip reports documenting the catch of reef fish using traps (NMFS, ESO, 1988). The majority of fishing activity was off the coasts of Monroe and Collier counties. There appears to be little use of traps elsewhere in the Gulf.

It is commonly believed that traps are highly nonselective and that many species of noncommercial interest are consequently killed in this type of fishing. Noncommercial fish taken incidental to trapping operations are sometimes killed by embolisms when traps are hauled from deep waters. However, the same problem exists for fish that are taken by hook-and-line from deep reefs. In most Caribbean areas, trap catch rates for snappers are relatively low and generally represent an insignificant portion of the total catch (Munro, Reeson and Gaut, 1971). In a study of the Monroe County, Florida trap fishery, Taylor and McMichael (1983) reported that target species in the Monroe County fishery made up 69 percent of the weight and 51 percent of the number of total catch monitored. Groupers composed 71 percent of target weight and 29 percent of target number. In the Collier County fishery target species made up 77 percent by weight and 62 percent by number. Snappers, groupers, grunts, porgies, and hogfish were the most desired target species and made up 55 percent of the catch. Mutton snapper, hogfish, gag grouper, and doctorfish were the principal species taken. The Council's logbook reporting system for fish traps indicates that about 96 percent of the fish caught are listed in either the reef fish management unit or fishery (NMFS ESO Unpublished Report, 1988). Red and black grouper were the predominate species accounting for 53 percent of the total catch; snappers comprised 9 percent and porgies, grunts, and hogfish comprised another 24 percent of the catch. It appears that traps can be fished to target particular species by setting them according to bottom topography (Craig, 1976; Boardman and Weiler, 1980). One way to prevent high losses of incidentally taken fish would be to require a larger minimum mesh size. Because the minimum size limits usually enacted for reef fish (12 inches for snappers and 18 inches for groupers) are larger than the minimum size selected for by the Gulf traps (see Figures 7.13-7.16), which typically use 1x2 inch mesh with 2x2 inch windows, it is likely that larger mesh sizes would be appropriate for the Gulf of Mexico.

A study of the relationship of mesh size in wire fish traps to catch composition and size distribution of reef fish off south Florida was recently completed by NMFS (Bohnsack et al., 1988; Sutherland et al., 1987). Approximately two-thirds of the sampling effort was off Key Biscayne in southeast Florida at depths of 20 to 130 feet along the reef tract and the remainder was off southwest Florida inside and outside the stressed area. The ability of traps to catch fish depends on the availability of fish in the area, the willingness of a fish to enter traps, and the ability of a fish to escape a trap. In addition, both species specific fish size and body shape are important factors in determining retention by a given mesh size. In this particular study total value, total species caught, number of individuals, and mean total weight per haul tended to decline with meshes larger and smaller than the 1.5 hexagonal mesh (Figure 7.17). Mean weight per fish tended to increase with mesh size ranging from a low of 0.4 lbs for a .5x.5 inch mesh to a high of 2.9 lbs for the 4x4 inch mesh; mean weight increased noticeably for meshes 2x3 inches and larger. Mesh size of 2x3 inches or larger should allow snapper and grouper less than 12 inches to escape. The total number of species caught in larger mesh traps was considerably less than with smaller mesh. However larger mesh sizes, caught significantly less weight and value of commercially important species. In general, while the presently specified legal minimum mesh sizes appears to optimize commercial catch and value they do little to reduce bycatch of nontarget species and fish less than the minimum size harvest limits.

Catch composition within traps may change appreciably during the period of submergence, especially if soaktimes are long. Fish traps do not necessarily prevent escapement of fish from the trap although there is large variability among species in ability to escape. Munro (1974 and 1983c) reported escapement rates averaging 12 percent of the daily catch. This suggests that the concern that lost traps will operate as "death traps" or "ghost traps" (see Hipkins, 1974) until their deterioration may be appropriate only for some species.

A two week survey of the trap fishing grounds was conducted off south Florida with a manned submersible in the fall of 1981 (Sutherland, Beardsley, and Jones, 1983). A total of 23 derelict (18) and ghost (5) traps were observed. Though derelict traps (those that fishermen cannot locate and are incapable of catching fish due to structural damage or deterioration) often had no major structural damage, small holes apparently rendered them ineffective as only two fish were observed to be entrapped. The 5 ghost traps (those still capable of catching fish) contained 8 grouper, 14 spiny lobster, 3 cowfish, 1 hogfish, 1 angelfish, and 1 barracuda skull. Although the groupers appeared healthy some had small cuts and abrasions on their snout. All the ghost traps were equipped with zinc anodes whereas none of the derelict traps had intact zinc anodes. The condition of the zinc anodes on four of the ghost traps indicated they had been lost about 4-6 months. In addition to derelict and ghost fish traps, nine actively fished traps were observed in the EEZ. Fifteen species of reef fish were in the traps and all appeared to be in good physical condition. The observed fish traps caused little apparent damage to reef habitats. No information is available on the capture rates of ghost traps or of predation on captured fish.

Traps are fished (soaked) for varying periods depending upon the species sought and their abundance and upon local fishing customs. Soak time is short, averaging 20-40 minutes per trap, for black sea bass. Sea bass are extremely gregarious and are rather quickly attracted to baited traps. Daily catches of 6,300 pounds per boat have been reported (Rivers, 1966). Craig (1976) reported an average catch per unbaited trap haul of 20.4 pounds for trap sets of five days duration off southeast Florida; however his traps were 64 cubit feet in volume--much larger than the size (14-24 cubit feet) of fish traps currently in use (Sutherland and Harper, 1983; Bohnsack et al., 1988). Sutherland and Harper (1983) found the average catch to be 8.6 pounds per trap haul for traps fished for seven days in Broward County, Florida. A similar study conducted in Monroe County, Florida revealed an overall average catch of 11.37 pounds per haul (Taylor and McMichael, 1983). From the 30 logbook trips reported by trap fishermen in 1987 (ESO, 1988), about 20 pounds of fish and shellfish per trap haul were harvested with about 120 trap hauls per fishing trip.

In the Caribbean where the great majority of all fish harvested are taken by traps with few or no regulations on mesh size, several scientists have expressed concern over overfishing of the resources. This gear has provoked considerable reaction by both commercial and recreational fishing groups who claim that it harmful to the resource and bottom habitat, and expansion of this fishery may create social conflicts between fish trappers and other fishermen. The concern is that traps may deplete local reef populations and sports groups fear that the commercial trappers will be expanding their operations to compete on local artificial reefs. However, properly regulated, traps may be a viable component of a fishery. Conversely, if excessive trap fishing is introduced to areas currently fished by hook-and-line, the CPUE of hook-and-line fishermen could be materially reduced and user group conflicts could ensue. A potential but unknown source of fish mortality is by lobster traps which are typically left in the water unattended for 1 to 2 weeks.

An advantage of fish traps over other reef fish gear is the increased potential for greater selectivity of fish traps depending on mesh size. Adjusting mesh size offers a means for regulating and managing the reef fish fishery (Bohnsack et al., 1988).

7.2.2.3. Longline Fishing

Exploratory fishing in the Gulf of Mexico with bottom longlines targeting the deep water species complex of tilefish and groupers was first attempted in the late 1960's by the National Marine Fisheries Service (Nelson and Carpenter, 1968). The golden tilefish and yellowedge grouper were found in potentially commercial concentrations off Texas in 400 to 1200 feet. From 1978 through 1980 the Texas Parks and Wildlife Department conducted explorations off the central Texas coast targeting those species that occur in depths less than 300 feet (Cody et al., 1980 and 1981). The only species caught that occurred in sufficient quantities to support a commercial fishery was sharpnose shark.

Description of the developing fishery: Bottom longline fishing did not develop in the Gulf of Mexico reef fish fishery until the late 1970's (Prytherch, 1983) and by 1981 longline gear was established in the red snapper and grouper fisheries. In the early 1980's three major areas developed for longlines fishing--the eastern Gulf off west central Florida; the northeastern Gulf off the Florida panhandle; and the western Gulf off Texas. In the eastern Gulf the majority of the fishing craft operated out of Pinellas County were longline or bandit rig vessels or a combination of the two. Approximately 45 percent of the fleet were converted shrimp trawlers. Most of the older craft, primarily shrimp trawlers, had wood hulls. The newer, snapper-grouper vessels were constructed of fiberglass. The overall length of 162 longline vessels operating in 1982 was about 40 feet. These boats were crewed by an average of 4 fishermen and made fishing trips of about 9 days average duration. Prior the establishment of longlines in 1981 the predominant fishing gear was 'bandit rigs'. Typically a longline vessel was also equipped with 'bandit rigs'. The fishing grounds were approximately 50 miles offshore, along the 20 fathom isobath, and extended west for another 100 miles to the 140-160 fathom isobaths. These grounds ranged from about 29 degrees North latitude southward to the Dry Tortugas. The predominant species harvested were, in order of importance, red grouper, snowy grouper, yellowedge (called yellowfin by Prytherch) grouper, and black grouper which comprised, respectively, about 34, 29, 22, and 10 percent of the catch. Red snapper accounted for less than 1 percent of the catch.

The northeastern Gulf longline fishery consisted of about 55 boats in 1982. The fleet was quite diverse being comprised of converted shrimp trawlers, snapper-grouper boats, charter boats, and even outboard motorboats. Boat sizes ranged from the 75 foot shrimpers down to 24 foot outboards. Panama City was the major longlining port although some fishing also occurred from Appalachicola, Destin, Niceville, and Pensacola. Commercial bottom longlining may have begun in this area since Prytherch (1983) reports that a small amount of longlining had occurred as early as 1978. By 1982 longline gear was well established in the snapper-grouper fleet. Although some vessels longlined year-round others varied their fishing activity with the season, ranging from charter fishing, shrimp trawling, and surface longlining. The fishing grounds extended from Pensacola south and east to about the northernmost point of the eastern Gulf fishing grounds however the favored area was about 60 miles southwest of Panama City. Fishing depths averaged about 100 fathoms but ranged from 30 to 150 fathoms. Most fishing trips were conducted with a crew of 4 fishermen and lasted on average about 5 days. The principal species harvested were yellowedge grouper and red snapper which accounted for about 82 and 10 percent of the total catch respectively.

The western Gulf longline fishery originally operated primarily out of the Aransas Pass, Brownsville, and Port Isabel. This fleet was composed entirely of commercial shrimp trawlers, which ranged in length from 55 to 85 feet. Closed shrimp seasons and cyclic variations in abundance resulted in approximately 85 vessels converting to longlines which, unlike the eastern longline fisheries, ceased longlining when shrimp were available; in 1982 no vessels longlined from May through December. Texas shrimpers began rigging their vessels to fish longlines during the late 1970's (Prytherch, 1983). The fishing grounds extended about 300 miles along the central and south Texas coast ranging in depth of 50 to 170 fathoms and encompassing the Flower Gardens reef to the north and 'Steamer Rock' to the south. The area most extensively fished in 1982 was southeast of Aransas Pass along the 50 fathom isobath where large concentrations of grouper were found. Most fishing trips were conducted with a crew of about 4-6 fishermen and lasted about 9 days on average. The principal species harvested were yellowedge grouper and red snapper which comprised 18 and 77 percent of the total catch respectively.

By 1983 some of the Florida panhandle and Texas fishermen began fishing the deeper waters of the northern Gulf off Louisiana with longlines (Bankston and Horst, 1984) but landing their catch in their respective home states. In 1984 only three snapper boats were permanently based in Louisiana (Bane et al., 1985). Shortly afterwards however due to fuel and other operating costs associated with fishing so far from port many decided to begin landing in Louisiana to reduce costs. By 1985 the Louisiana reef fish fleet was well established and Louisiana landings increased dramatically (Horst and Bankston, 1987). With them these fishermen brought their fishing techniques including longlines and buoy fishing (to be described below). The boats land at Texas, Alabama, and Florida ports, depending on weather, ex-vessel price, and seasonal proximity to the more productive fishing grounds (Russell et al., 1986). Longline boats in the Louisiana fleet were, in 1985 and 1986, from 30-50 feet long and carried a crew of 3-6 fishermen; typically crewsize was 3-4 but occasionally larger crews of 5-6 were used to fish continuously for 24 hours per day. Trips lasted from 4-8 days. The target species of the longline fishery off Louisiana was red snapper, yellowedge grouper and golden tilefish each species requiring the fishermen to work on different bottom types and at different depths (Horst and Bankston, 1987; Russell et al., 1986).

Today the reef fish longline fleet operates throughout the Gulf of Mexico EEZ landing approximately 8 percent of the red snapper, 34 percent of the grouper, and 24 percent of all reef fish landed commercially (Goodyear, 1988b).

Description of longline gear: Prytherch (1983) also described the type of longline gear and its use at the time the it was being established as a major component of the commercial fishery. Additional descriptions of longline gear are available in Cody et al. (1980), Bankston and Horst (1984), and Horst and Bankston

(1987). Since the FMP did not contain a description of this gear type Prytherch's description will be summarized below.

"Fishing operations were conducted with a crew of 3-4 fishermen, including the captain. The longline was deployed by dropping one end overboard with an anchor, float line, flag staff, radar reflector, and light. The vessel moved forward at about 3-7 knots. While one person was controlling the speed of the line being set two others were attaching prebaited gangions onto the groundline with line snaps (see Figure 7.18). Bait was normally purchased and varied depending on seasonal availability and included mullet, eels, skate, pollock, spanish mackerel, spanish sardines, cigar minnows, or squid. Sometimes when the bait ran out incidental catches of dolphin, sharks, barracuda, amberjack, and tilefish were used. The spacing of the gangions varied; if a good catch was anticipated hooks would be set about 10-12 feet apart but if an unknown area was being sampled the hooks would be set from 20-50 feet apart. Typically tuna circle hooks, sizes 4,6,7, or 8, or Mustad 'sure hold' Japanese hooks were used. The end of the line was equipped identically to the beginning for easy location and retrieval.

"Retrieval of the longline was essentially the reverse of the setting out process. One person controlled the retrieval speed of the groundline while another unsnapped the gangions from the groundline and handed them to the third fisherman who placed hooks with fish on them in one area of the deck and hooks without fish back into the cans or tubs for rebaiting. Vessel speed during retrieval was about 2-3 knots. Most of the bottom longlines were from 1 to 6 miles in length. The groundlines were made up of several shorter sections interconnected with either snaps or brummel hooks. Buoy and anchor lines were also attached with brummel hooks for quick and easy attachment or removal.

"A vessel using a 1 mile longline averaged setting and retrieving it about 5 times a day. Some vessels even set 2 to 3 lines at a time. Longlining is a labor intensive operation with a typical fishing day lasting 18 hours; some vessels even fished for a full 24 hours. Crewmen were constantly busy baiting hooks, unhooking and gutting fish, setting and retrieving lines, etc. Smaller boats stored groundline in tubs or garbage cans while the larger vessels normally used a large spool or drum. Those working out of cans used hydraulic or electric winches or pothaulers to retrieve line. Leaders with baited hooks were stored ready to be snapped onto the outgoing groundline by either hanging them from a tub, line, or 'magazine' (a series of short sections of PVC tubing cut and glued together in rows, staggered like pipes in an organ)."

7.2.2.4. <u>Buoy Fishing</u>

Buoy fishing is the newest form of reef fishing in the Gulf of Mexico usually used in conjunction with longlines. Although this form of fishing, also called vertical longlining, has been known since the early 1970's (Olsen et al., 1974) Prytherch (1983) reported that in the NMFS survey of the developing Gulf of Mexico longline fishery no evidence of buoy fishing was detected. The first description of buoy gear appeared in (Russel et al. 1986), although earlier Bane et al., (1985) reported that in 1984 17 vessels used only buoy gear and another 27 vessels used a combination of bandit, longline or buoy gear.

Buoy boats, which appear to be limited to the Louisiana fleet, come in various sizes with crews of 3-5 fishermen. A buoy consists of a float with an attached radar deflector and a weighted line long enough to reach the bottom with 6-10 baited hooks attached. Each buoy is a separate unit and is deployed individually in sets of about 20 each for one hour. Some boats use two strings, setting one out while picking up the first string set. The advantage of this type of fishing is that a large area of good bottom can be fished, including both smooth mud and rough coral. However, buoys cannot be used in waters greater than 50 fathoms depth or near oil rigs. Buoy boats usually target the larger size classes of red snapper (greater than 4 pounds) and yellowedge grouper.

7.2.2.5. Shrimp Bycatch of Red Snapper

Throughout the Gulf, most of the prerecruit red snapper bycatch is taken from September through November (Bradley and Bryan, 1975; Gutherz and Pellegrin, 1988) and at depths from 11-20 fathoms. Relatively fewer prerecruit red snappers are caught in depths less than 10 fathoms or greater than 30 fathoms. Based on the bycatch estimates in Table 7.29, the maximum impact of commercial shrimping on red snapper appears to be off Texas where 55 percent of the total bycatch occurs; 41 percent occurs off Louisiana, Alabama, and Mississippi, while 4 percent occurs off Florida. However during the warm season, May-November, 76 percent of the bycatch occurred off Alabama through Texas and the average bycatch of red snapper was more evenly distributed by depth. From 1979 through 1986, commercial red snapper catches averaged 5.6 million pounds annually with 14 and 44 percent coming from waters off Texas and Louisiana, respectively (Goodyear, 1988b). Similarly, from 1979 through 1986, recreational red snapper catches averaged three million fish annually with 19 and 41 percent coming from Texas and Louisiana respectively (NMFS MRFSS).

Apparently, the area and season of maximum prerecruit red snapper bycatch coincides with that of maximum brown shrimp production. About 46 and 40 percent of the total annual brown shrimp catch in the U.S. Gulf is taken off Texas (27 million pounds) and Louisiana (16 million pounds) respectively (Figure 3.2 through 4 and Pages 3 though 16 in Shrimp FMP; Nance, et al., 1988). After the Texas closure opens, offshore brown shrimp catch in the Gulf as a whole peaks in July and August at depths of 11-20 fathoms. Generally, there appears to be an offshore migration of brown shrimp of 4-5 fathoms per month, and by December the largest catch comes from 26-30 fathoms.

Best available information indicates that through 1987, red snapper bycatch in shrimp trawls was substantial with averages ranging from about 4 to 12 million fish annually (Gutherz and Pellegrin, In press; Nichols, et al., 1987) (see Table 7.29). The quantity of reef fish other than red snapper caught in trawls is minimal (Bryan, Cody, and Matlock, 1982; Gutherz and Pellegrin, 1985) and probably does not significantly impact the fish populations. Elimination of the red snapper trawl bycatch, most of which consists of prerecruit fish, has the potential to increase yield to the fishery by 10 to 90 percent (Powers, et al., 1987). Goodyear (1988b) presented results indicating the loss in potential red snapper production could range from 0.1 to 12.8 million pounds, depending on population parameters and bycatch estimates selected (Table 8.8).

Shrimp trawls designed to separate shrimp from fish were first developed in Europe in the early 1960's and the development of shrimp separator trawls in the U.S. was initiated in 1968 at the Northwest Fisheries Center for use in the Pacific pandalid fisheries (Watson and Taylor, 1986). These separator designs all used panels of webbing placed in the mouth, throat, or along the wings of the trawl to lead fish toward escape openings, allowing shrimp to pass through relatively large panel meshes into the codends. Mechanical separation of fish and shrimp with webbing panels has been successful in fisheries where the difference between sizes of shrimp and fish is significant. Panel type separator trawls tested in the Gulf of Mexico, however, were not successful in both separating fish while maintaining shrimp catches. The major problem with these trawls is the combined problems of fish and shrimp in the Gulf being of similar size and the substantial abundance of fish in some areas require a more efficient separator design.

The NMFS, SEFC, Mississippi Laboratories began a separator trawl development project in the Gulf in 1974 (Seidel 1975). This work resulted in the development of the "V" design vertical separator panel (Watson and McVea 1977). In 1978 a selective trawl employing electricity to effectively separate shrimp from fish was designed (Seidel and Watson 1978). Although the electric trawl worked effectively, the electronic technology at that time was expensive and not reliable enough to warrant commercial production of electric trawls. Work on separator trawls was discontinued until the Turtle Excluder Device (TED) was developed. The TED was designed to allow turtles to escape from the trawl net through a trap door positioned in the throat of the trawl (Watson and Seidel 1980). During underwater observations of fish and shrimp in the experimental TEDs it was noted behavioral differences between fish and shrimp within the trawl could be used to modify the TED to allow finfish escapement. Design modifications proved to be effective in eliminating finfish, jellyfish, sharks, rays and other bycatch.

The original TED used solely as a turtle excluder was not an effective finfish separator, however the TED modified with accelerator funnels, finfish deflector webbing panels, and openings in the trawl behind the TED do permit fish escapement. The modified TED was effective in reducing finfish catches by as much as 85% during daytime fishing and 54% during nighttime fishing with no significant reduction in shrimp catch rates.

The TED utilizes differences in the behavioral reaction of finfish and shrimp and the better swimming ability of the fish to separate and exclude fish from the catch. A funnel of webbing panels accelerates water flow entering the codend of the trawl which carries the weak swimming shrimp into the codend. Finfish actively swimming in the trawl also pass through the funnel but are stimulated by the crowding of webbing to attempt escape and as they pass through the funnel, they either strike a finfish deflector or enter an area of reduced water flow at the sides of the trawl where they are guided by webbing panels through side exits in the trawl. And, as in an unmodified TED, larger objects or organisms that can not pass through the opening of the main deflector grid are ejected through the hinged door at the top of the TED.

The effectiveness of the modified TED in separating finfish varies with individual species and appears to be related to the swimming ability of the individual species and their behavior. Separation rates thus vary with the species composition of the catch and may also be related to the size of the individual as it relates to their swimming ability.

Prior to implementation of the Turtle Excluder Device (TED) requirements for the Gulf of Mexico shrimp fishery in January, 1988, under the authority of the Endangered Species Act of 1973, no regulations, state or federal, required the use of gear or modifications to gear that reduced finfish bycatch. The Shrimp Fishery Management Plan, implemented in May, 1981, contained a management measure to: "Encourage research on and development of shrimping gear which reduces incidental catch without decreasing the overall efficiency of shrimping or excessively increasing the cost of gear." Independent of government efforts, the shrimp industry has attempted to resolve the bycatch problem on its own by incorporating various gear modifications designed to reduce finfish bycatch (Collins, 1988). Additionally, NMFS has promoted the modified TED to the shrimp fishery as a Trawling Efficiency Device since it substantially reduces finfish bycatch.

A formal NMFS program was initiated in 1978 to encourage shrimp fishermen to use the TED voluntarily. NMFS built and delivered TEDs to shrimp fishermen who agreed to use them in commercial trawling operations. Gear experts worked with shrimp fishermen to demonstrate how to properly install and use TEDs. Sea Grant and a number of industry groups assisted with the transfer of this technology to the shrimp fishing industry. However, despite these efforts, the voluntary program did not result in acceptance of TEDs by the shrimp industry.

The failure of the voluntary TED program prompted the NMFS to implement regulations in 1987 to require TEDs on all offshore shrimp vessels over 25 feet in length. In the Gulf of Mexico, the use of TEDs by shrimp trawlers larger than 25 feet in length will be required in May 1989.

Vessels and boats that are either less than 25 feet or fishing internal waters are not required to use TEDs but are required to restrict their tow time to 90 minutes or less. However, pending the outcome of a court case challenging the TED regulation the TED requirements have been suspended.

The overall effectiveness of TEDs in reducing red snapper bycatch is unknown. To date no research program has been implemented to evaluate the industry-wide effects of TED use on either finfish bycatch reduction or shrimping efficiency. Christian and Harrington (In press) evaluated the effectiveness of the Georgia, Louisiana, modified NMFS, and Texas TEDs off Cape Canaveral, Florida. The NMFS and Texas TEDs reduced bycatch biomass (excluding turtles) by about 44 percent each, whereas the Louisiana and Georgia TEDs achieved an average biomass reduction of 34 and 24 percent, respectively. The percentage shrimp catch change by weight for each TED-equipped net was 3.6 percent gain for Georgia, 4.9 percent loss for NMFS, 9.5 percent loss for Louisiana, and 22.3 percent loss for Texas TEDs. The NMFS TED tested was specifically modified to exclude finfish. The version of the NMFS TED being used in the shrimp fishery to exclude turtles may not be designed to exclude small finfish as well. With any of the TEDs, it is not known if the prerecruit red snapper would be excluded since they comprise less than one percent of the total finfish bycatch (Bryan, et al., 1982) and are smaller and weaker swimmers than the majority of the species caught by trawls. Annual red snapper bycatch estimates (Nichols, et al., 1987) indicate a Gulf-wide average catch rate of about two to three red snapper per hour of shrimping effort which suggests that one red snapper is encountered by a shrimp trawl about every nautical mile of towing (personal communication, Dayton Graham). Therefore, although the present implementation of TEDs will likely effect a reduction in red snapper bycatch, the industry-wide effect is unknown.

The tow time restriction of 90 minutes may effect a decrease in finfish bycatch mortality, but a significant number of prerecruit red snapper may still suffer mortality.

7.2.3. Stressed Area

The Council in the Reef Fish FMP established a stressed area in those waters of the Gulf of Mexico shoreward of the following discontinuous line: (1) From the boundary separating the jurisdiction of Gulf and South Atlantic Councils terminating at 24° 35' North and 83° 0.0' West thence north and east around the Dry Tortugas to a point north of Rebecca Shoal at 82° 35' West the outer boundary shall follow the 100-foot contour;[1] (2) From the point at 82° 35' west thence easterly and northerly to the south end of Sanibel Island (26° 26' North) the outer boundary shall follow the 60-foot contour; (3) From 26° 26' north to a point off Tarpon Springs (28° 10') the outer boundary shall follow the 120-foot contour; (4) From 28° 10' north and west to a point off Cape San Blas (85° 52' and 29° 30.5') the outer boundary shall follow the 60-foot contour; (5) From 85° 52' and 29° 30.5' west to a point off Mobile Bay on the 88° longitude line, the outer boundary shall follow the 150-foot contour. The outer boundary shall then be a line from the point on the 88° longitude north west to the Alabama/ Mississippi state line along the 80-foot contour (88° 23.7' and 30° 01.5'); (6) From 88° 23.7' and 30° 01.5' the outer boundary will be a line running directly west along the 30° 01.5' parallel and terminating at the Chandeleur Islands, Louisiana; (7) From the Texas/Louisiana state line to a point on the 95° longitude line, the outer boundary shall follow the 100-foot contour (Figure 7.19 and Table 7.30).

The stressed area concept provides a mechanism for addressing excessive fishing mortality on predominantly juvenile segments of reef fishes (FMP Problem 1) and user group conflicts (FMP Problem 3 and Amendment Problem 3 and 4) and supports FMP Objectives 3 and 4 as well as Amendment Objective 3 by providing a mechanism for rebuilding inshore reef fish abundance, protecting juveniles, and minimizing user group conflicts, respectively.

The criteria for evaluating the geographic extent of the stressed area include:

(1) The fishery and conditions of the stocks in localized geographic areas.
(2) The amount of fishing pressure applied to the geographic area.
(3) Proximity of the offshore geographical areas to cities of high population.
(4) Coastal access to the reef areas.
(5) Historical fishing practices occurring in the area.
(6) A need for protection of special habitat.

The prohibition of fish traps in the stressed area reduced fishing pressure on nearshore juvenile segments of reef fish populations. This measure also increased protection of shallow water corals which form integral habitat for reef fishes by preventing the placement of fish traps on the inshore coral reef areas of the eastern Gulf of Mexico.

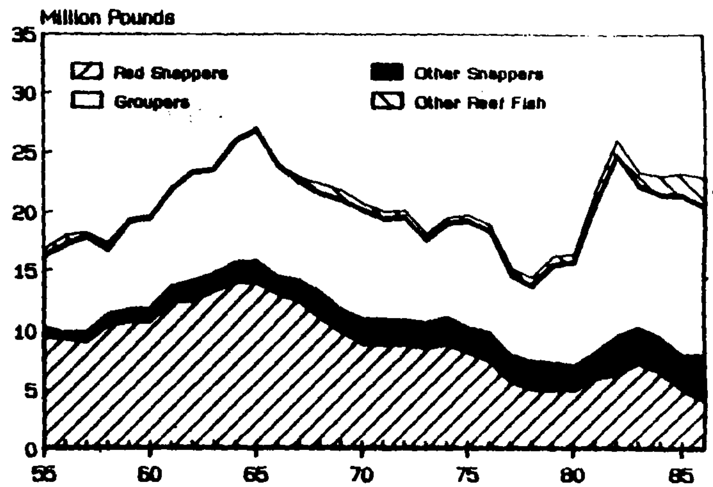
The stressed area also permitted the delineation of areas highly susceptible to growth overfishing and within which restrictions on gear more efficient than hook-and-line were applied. Generally the stressed area concept impacts the biology of the reef fish stocks only indirectly since additional regulations to control fishing mortality must accompany the establishment of the stressed area.

The stressed area impacts the economics of the fishery only in conjunction with gear restrictions. The stressed area creates positive social impacts through increasing the public's awareness about the problems associated with overfishing, gear conflict, and the susceptibility of the nearshore segments of fish populations to overfishing. The establishment of the stressed area provides a mechanism for addressing user group conflicts and reducing fishing mortality on the nearshore fishes.

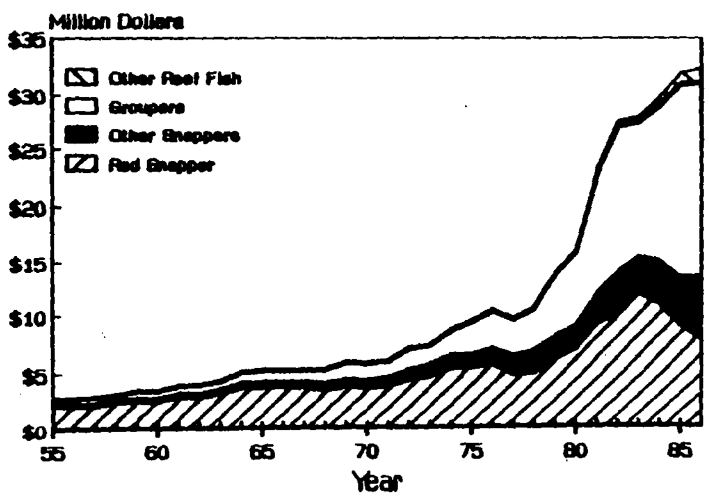
FIGURE 7.1

REEF FISH
COMMERCIAL LANDINGS AND VALUE
AT U.S. GULF OF MEXICO PORTS, 1955-86

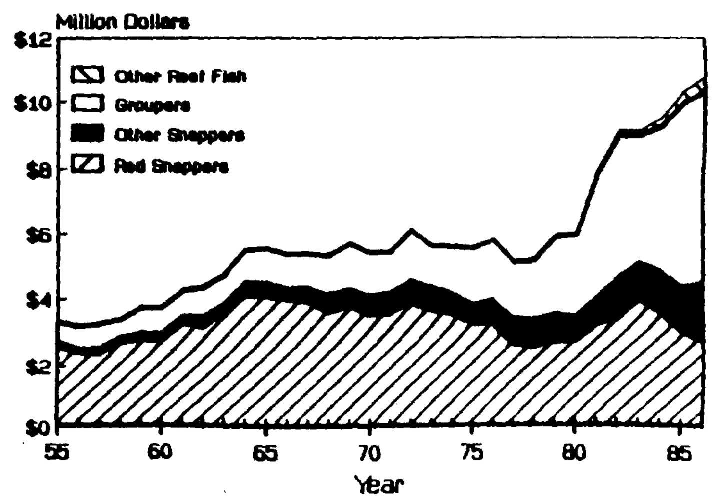
LANDINGS



EXVESSEL VALUE



REAL VALUE

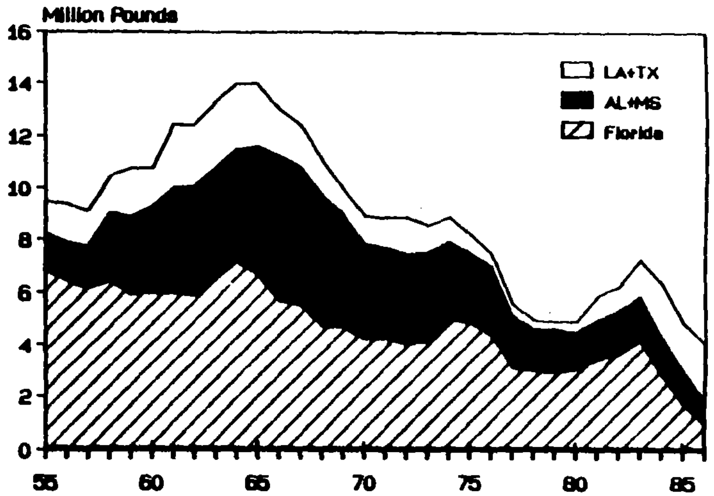


Real Value=Exvessel Value/PPI (1967=100)

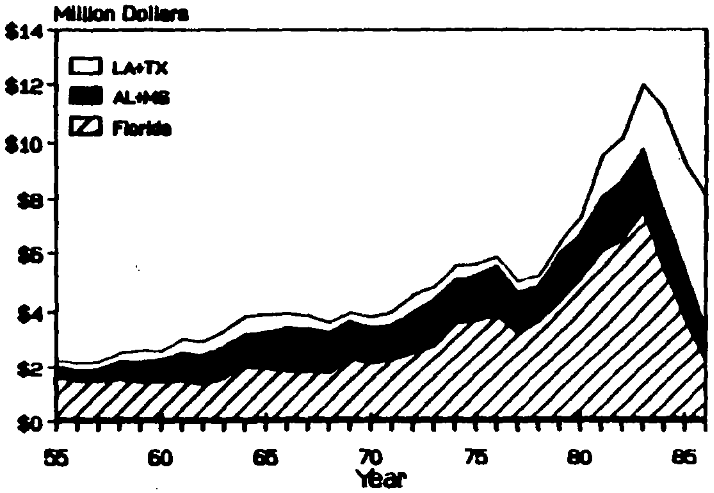
FIGURE 7.2

RED SNAPPER
COMMERCIAL LANDINGS AND VALUE
AT U.S. GULF OF MEXICO PORTS, 1955-86

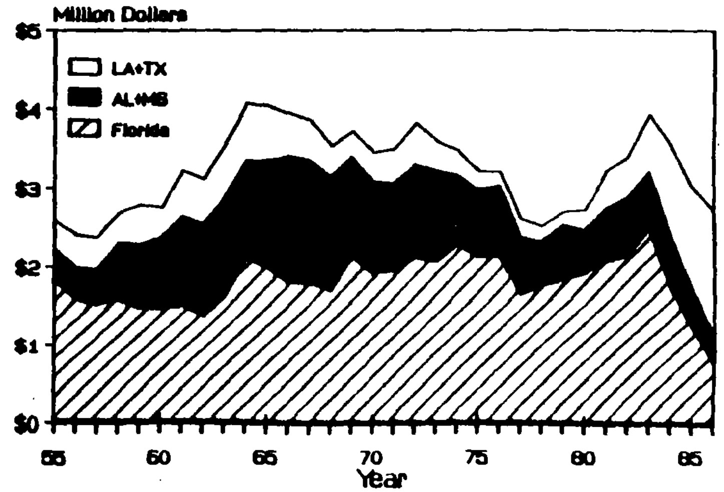
LANDINGS



EXVESSEL VALUE



REAL VALUE

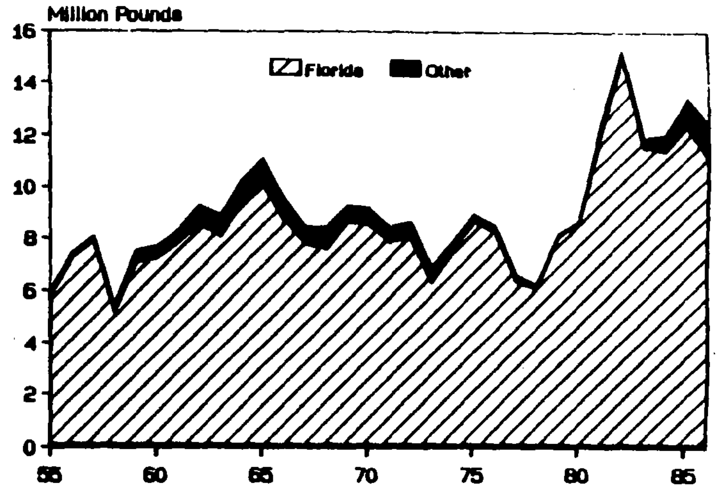


Real Value=Exvessel Value/PPI (1967=100)

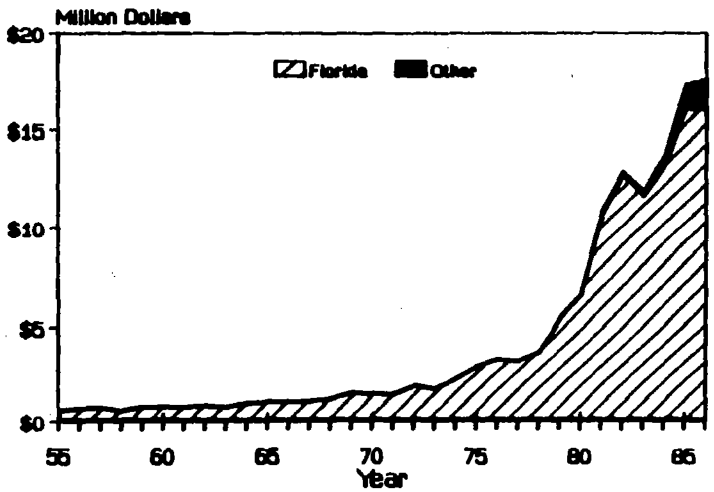
FIGURE 7.3

GROUPERS: LANDINGS AND VALUE AT U.S. GULF OF MEXICO PORTS, 1955-86

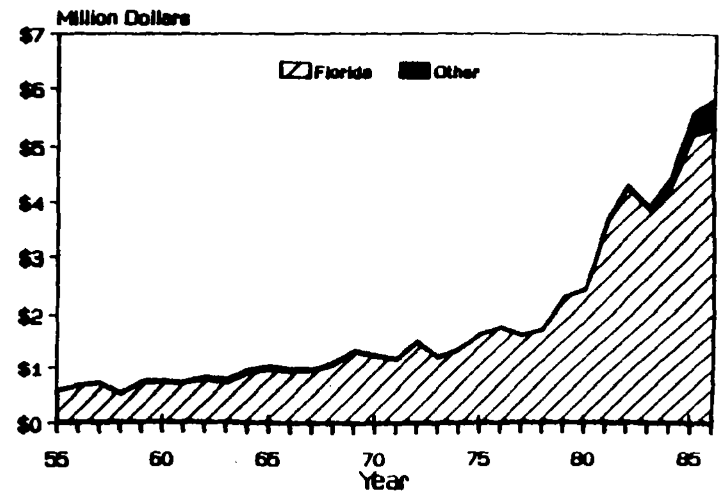
LANDINGS



EXVESSEL VALUE



REAL VALUE



Real Value=Exvessel Value/PPI (1967=100)

FIGURE 7.4

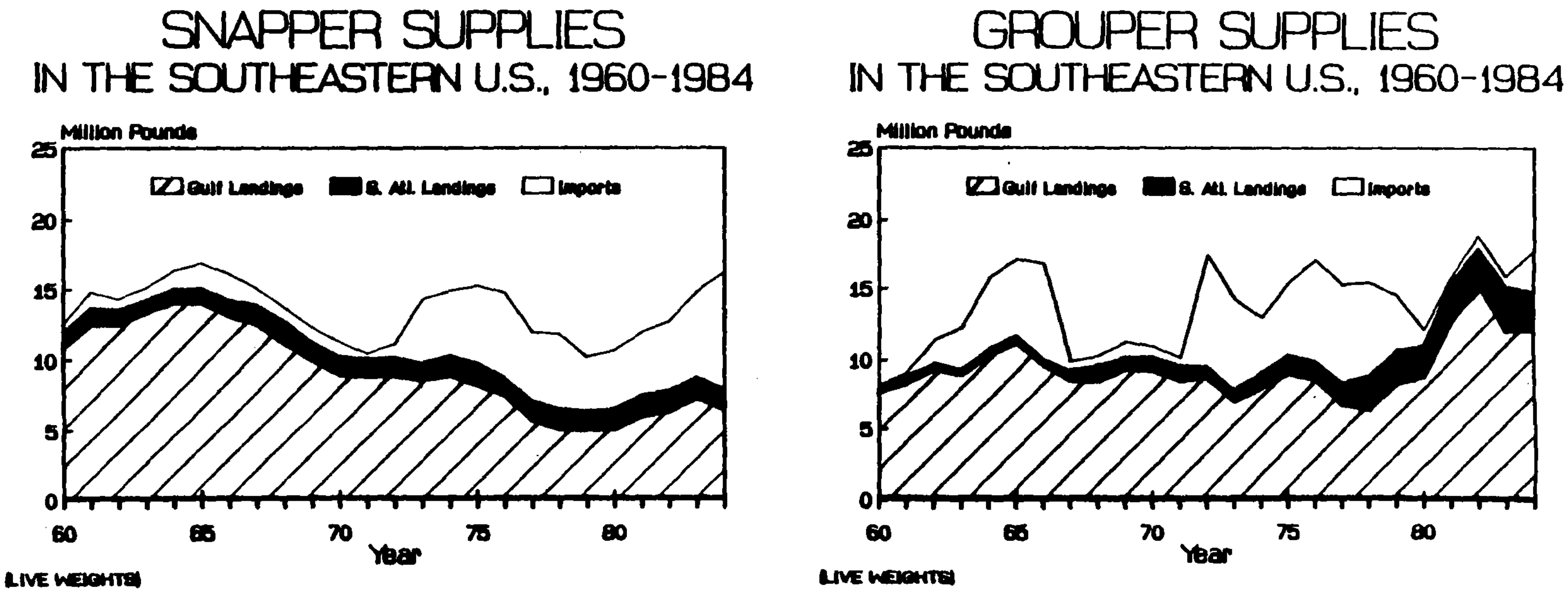
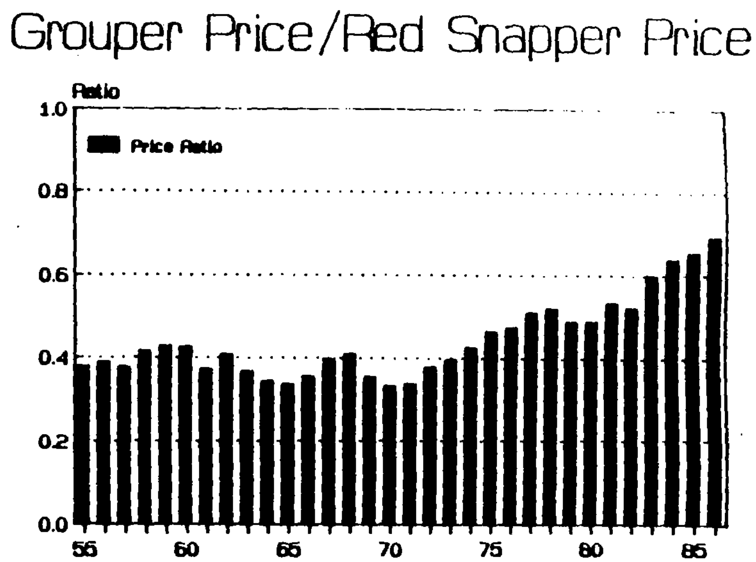
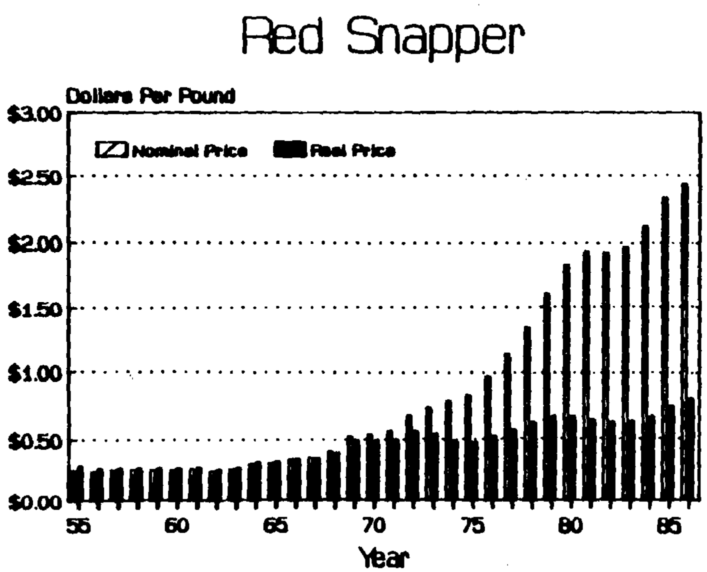

SNAPPER SUPPLIES
IN THE SOUTHEASTERN U.S., 1960-1984
Million Pounds
Gulf Landings
S. Atl. Landings
Imports
25
20
15
10
5
0
60
65
70
75
80
Year
(LIVE WEIGHTS)
GROUPER SUPPLIES
IN THE SOUTHEASTERN U.S., 1960-1984
Million Pounds
Gulf Landings
S. Atl. Landings
Imports
25
20
15
10
5
0
60
65
70
75
80
Year
(LIVE WEIGHTS)

FIGURE 7.5

Average Annual Exvessel Prices
for Red Snappers and Groupers
in Florida, 1955-1986

Nominal Prices=Exvessel Value/Landings
Real Prices=Nominal Prices/PPI (1967=100)





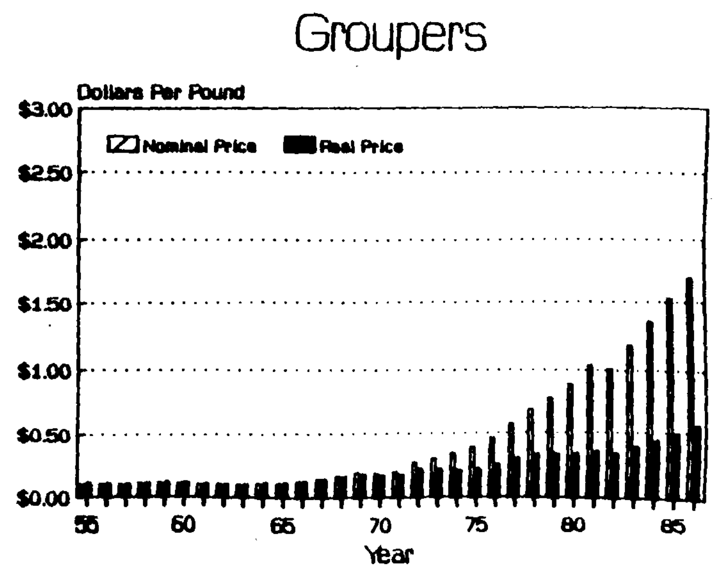
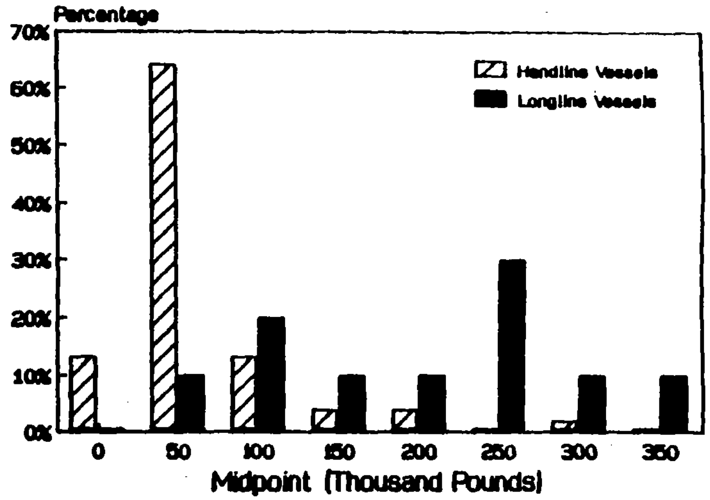


FIGURE 7.6

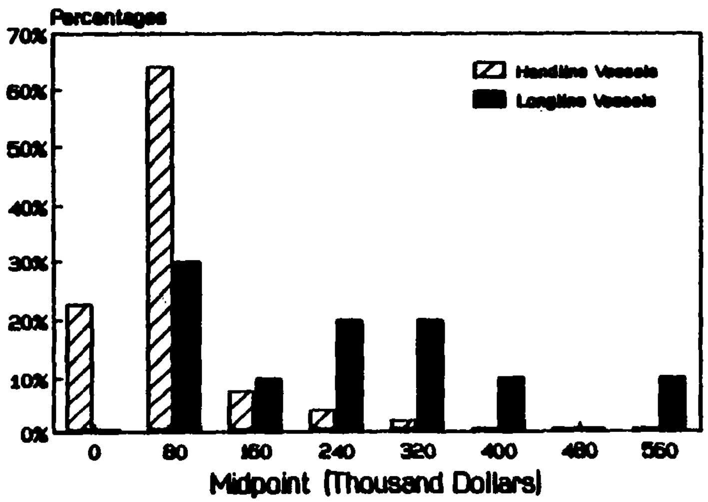
LANDINGS, REVENUES, AND COSTS FOR REEF FISH VESSELS ALONG THE WEST COAST OF FLORIDA, 1980

PERCENTAGES OF VESSELS SAMPLED FOR
N=10 LONGLINE VESSELS
N=53 HANDLINE VESSELS

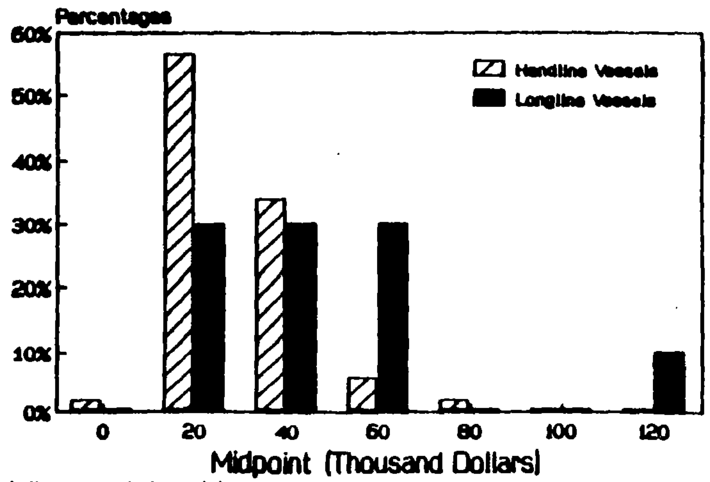
LANDINGS



REVENUES



TOTAL COSTS



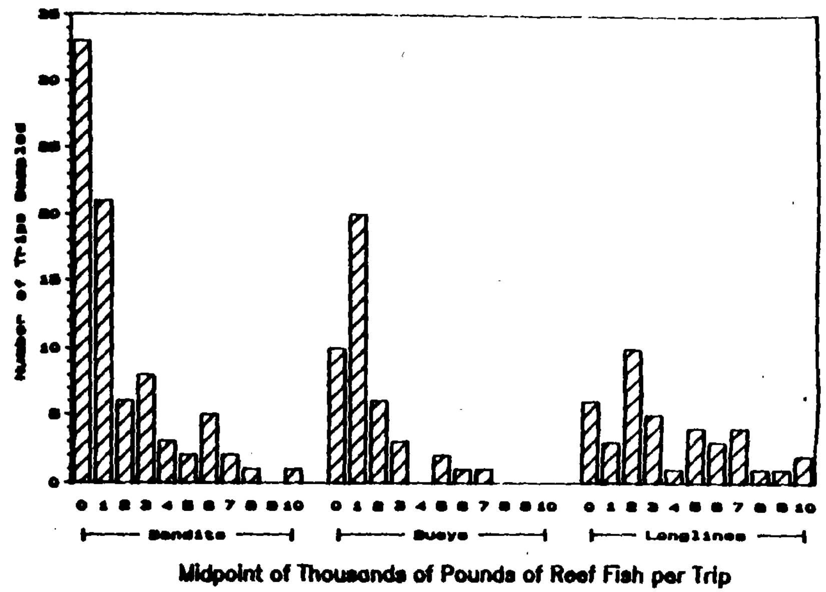
Excluding payments to captain, crew, and vessel owner

FIGURE 7.7

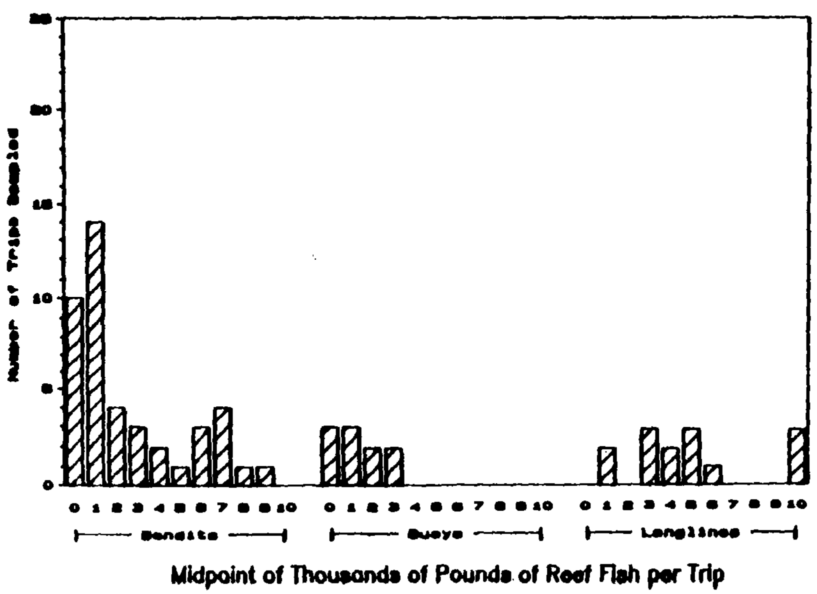
CATCHES OF REEF FISH ON COMMERCIAL REEF FISH TRIPS IN LOUISIANA, 1984–1986

TIP DATA
Summarized on 9-19-88

CATCHES OF REEF FISH PER TRIP, 1985



CATCHES OF REEF FISH PER TRIP, 1984



CATCHES OF REEF FISH PER TRIP, 1986

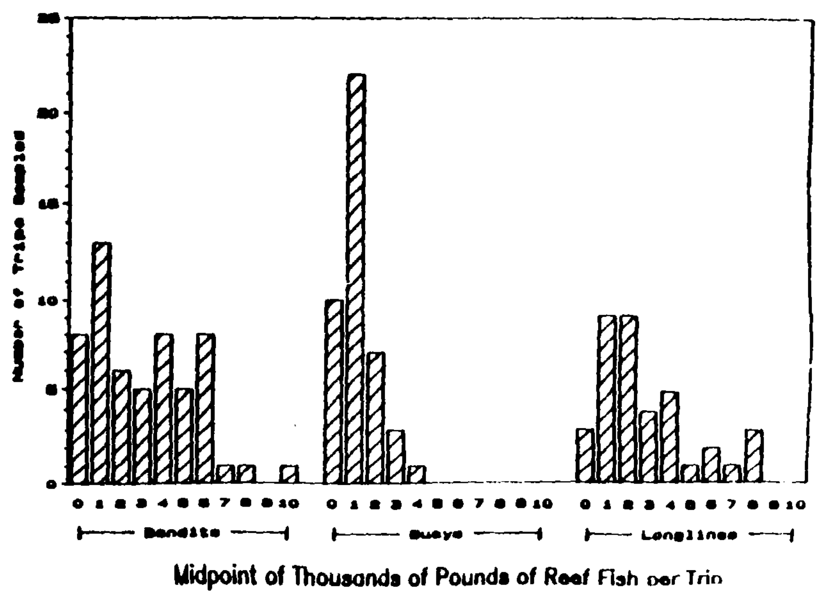
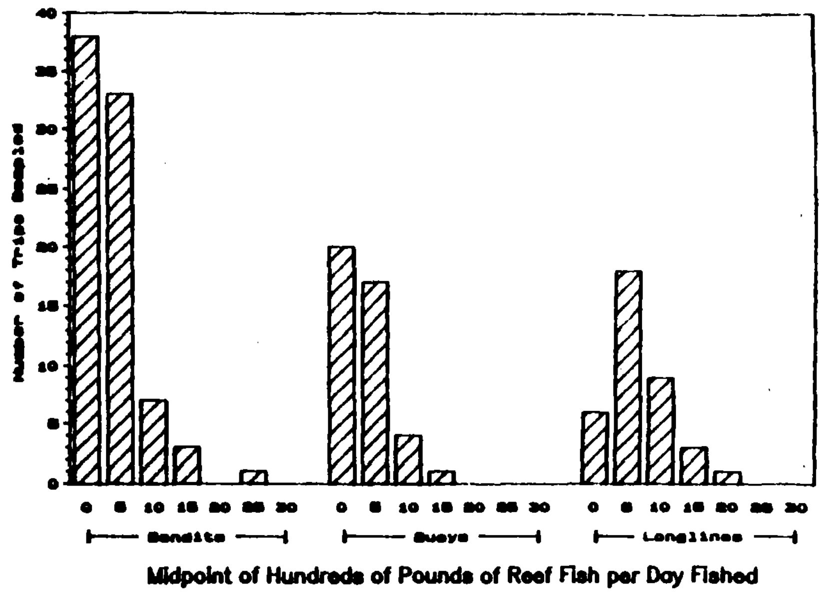


FIGURE 7.8

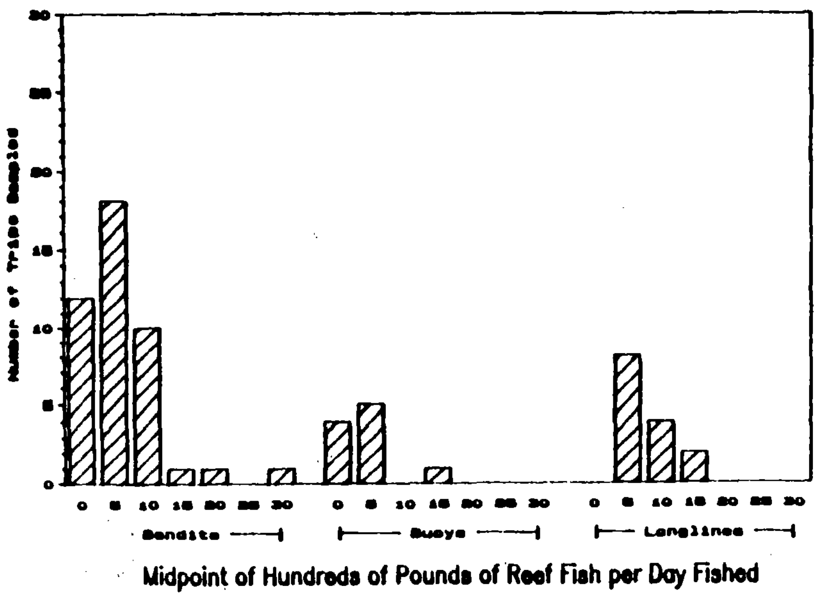
CATCHES OF REEF FISH PER DAY FISHED ON COMMERCIAL REEF FISH TRIPS IN LOUISIANA, 1984–1986

TIP DATA
Summarized on 9–19–88

CATCHES PER DAY FISHED, 1985



CATCHES PER DAY FISHED, 1984



CATCHES PER DAY FISHED, 1986

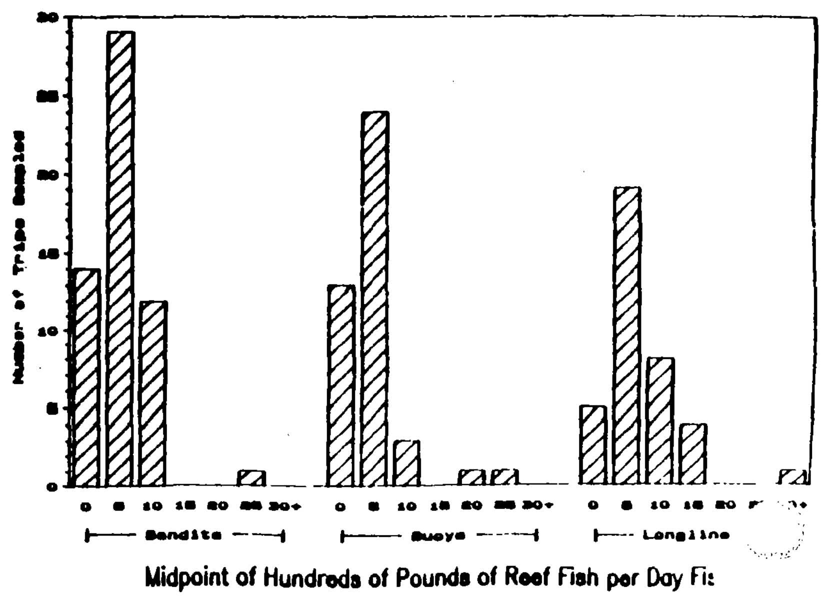
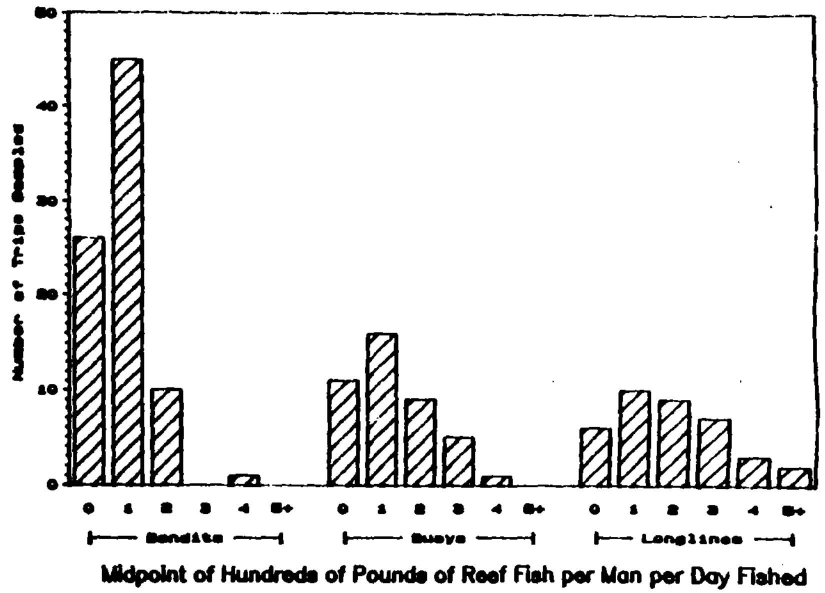


FIGURE 7.9

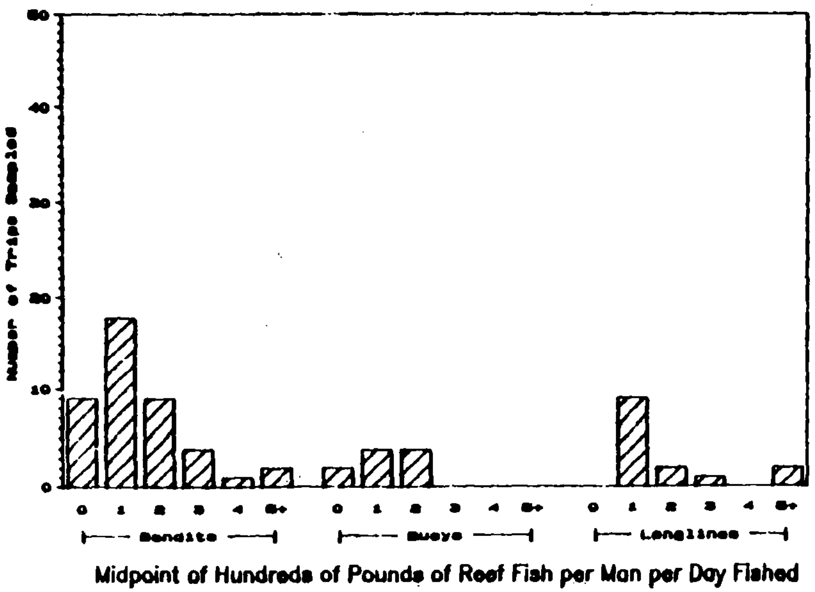
CATCHES OF REEF FISH PER MAN PER DAY FISHED ON COMMERCIAL REEF FISH TRIPS IN LOUISIANA, 1984–1986

TIP DATA
Summarized on 9–19–88

CATCHES PER MAN PER DAY FISHED, 1985



CATCHES PER MAN PER DAY FISHED, 1984



CATCHES PER MAN PER DAY FISHED, 1986

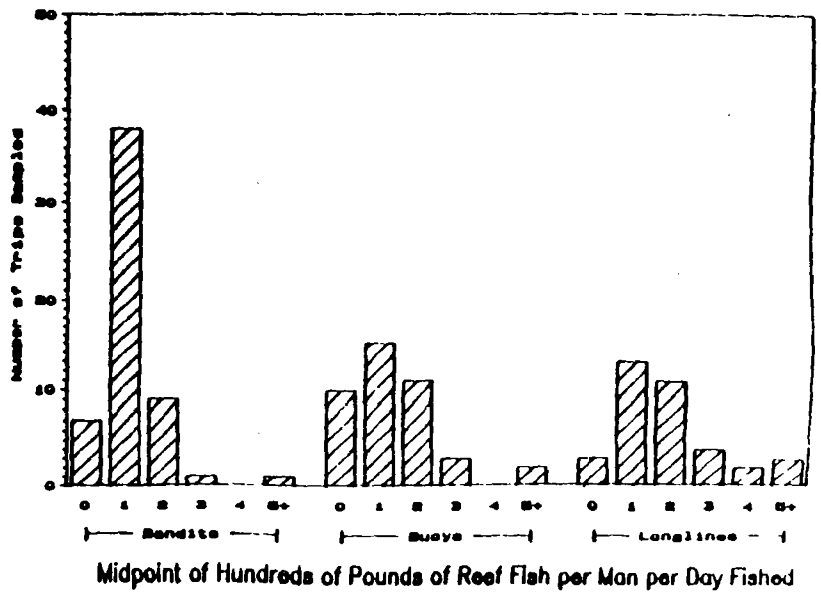
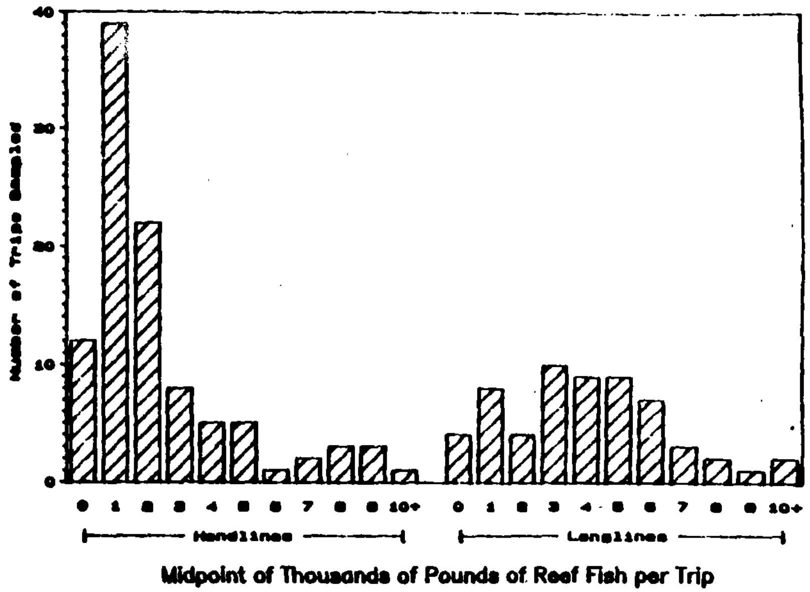


FIGURE 7.10

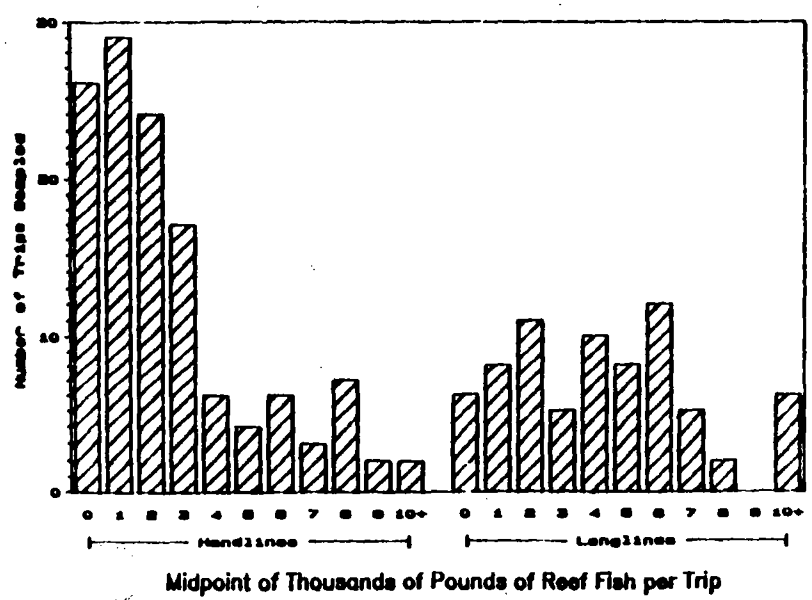
CATCHES OF REEF FISH ON COMMERCIAL REEF FISH TRIPS ALONG THE WEST COAST OF FLORIDA, 1984–86

TIP DATA
Summarized on 9–19–88

CATCHES OF REEF FISH PER TRIP, 1985



CATCHES OF REEF FISH PER TRIP, 1984



CATCHES OF REEF FISH PER TRIP, 1986

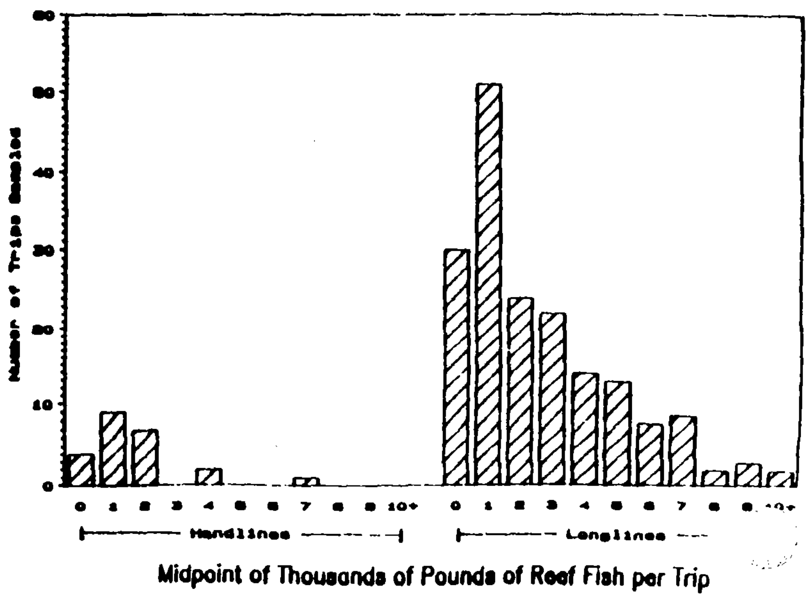
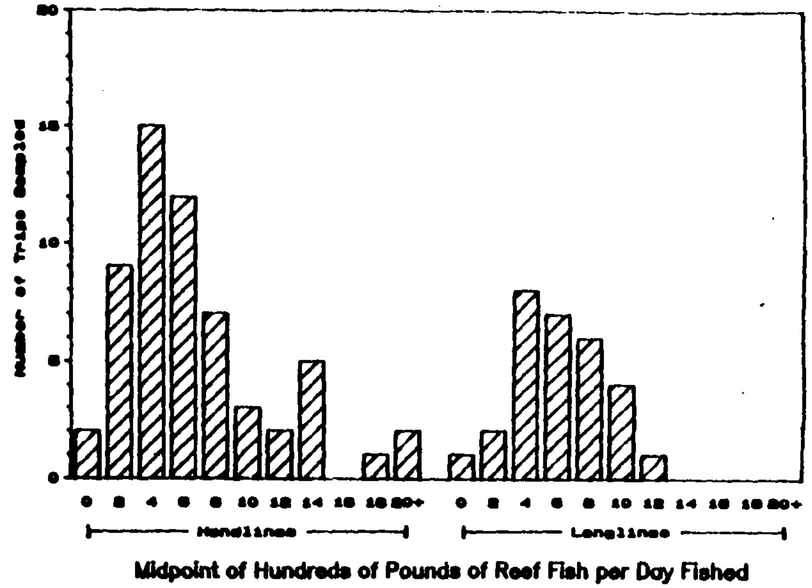


FIGURE 7.11

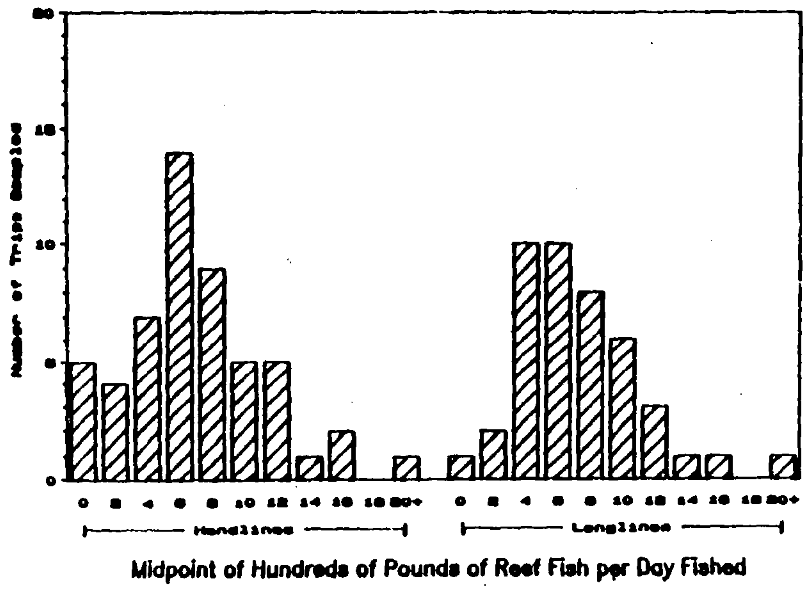
CATCHES OF REEF FISH PER DAY FISHED ON COMMERCIAL REEF FISH TRIPS ALONG THE WEST COAST OF FLORIDA, 1984–86

TIP DATA
Summarized on 9-19-88

CATCHES OF REEF FISH PER DAY FISHED, 1985



CATCHES OF REEF FISH PER DAY FISHED, 1984



CATCHES OF REEF FISH PER DAY FISHED, 1986

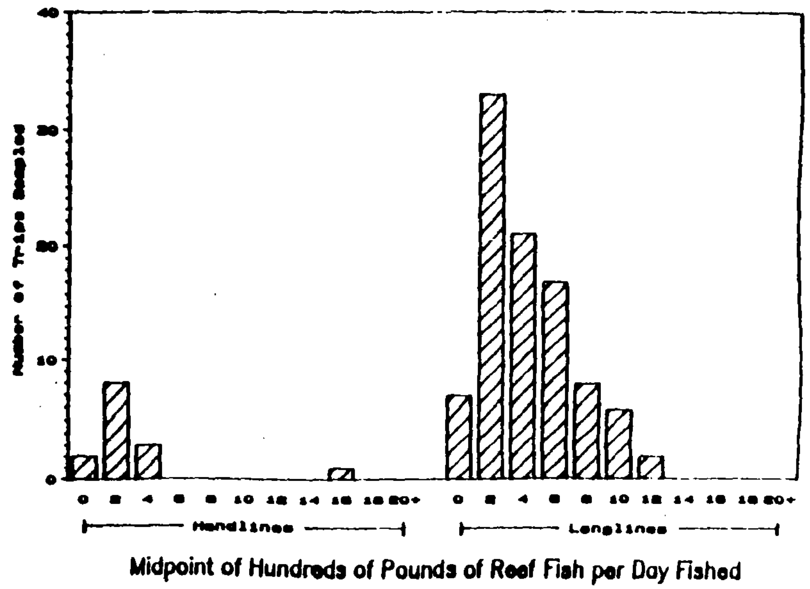
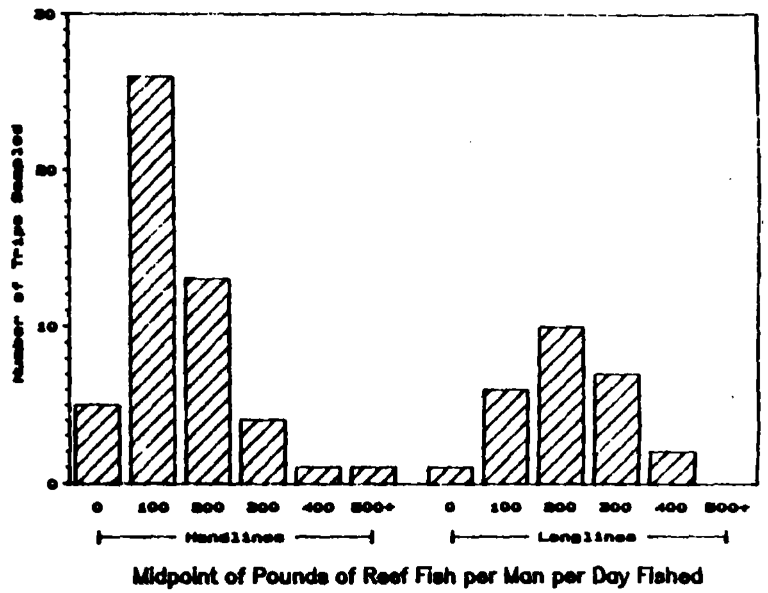


FIGURE 7.12

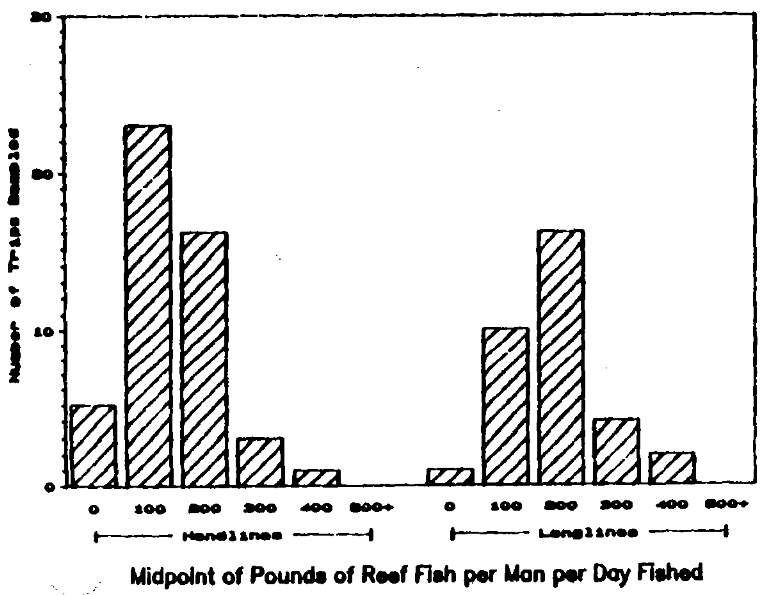
CATCHES OF REEF FISH PER MAN PER DAY FISHED ON COMMERCIAL REEF FISH TRIPS ALONG THE WEST COAST OF FLORIDA, 1984–86

TIP DATA
Summarized on 9–19–88

CATCHES PER MAN PER DAY FISHED, 1985



CATCHES PER MAN PER DAY FISHED, 1984



CATCHES PER MAN PER DAY FISHED, 1986

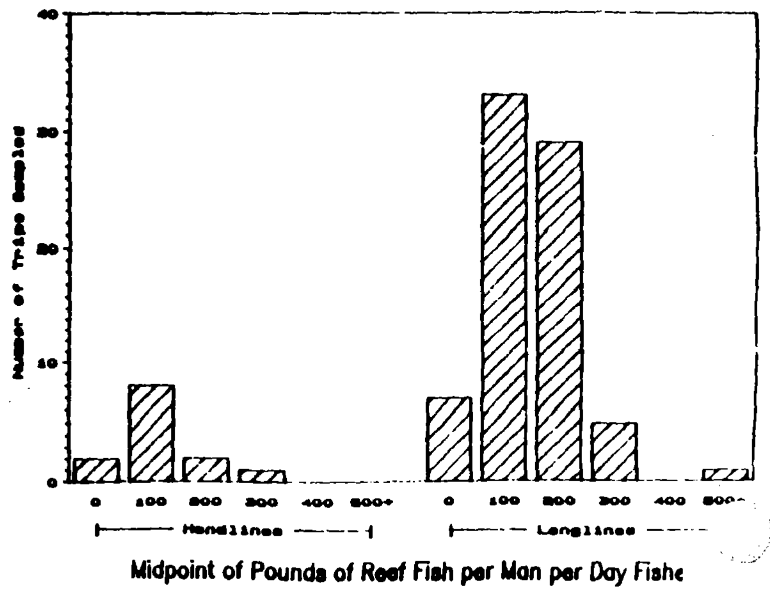
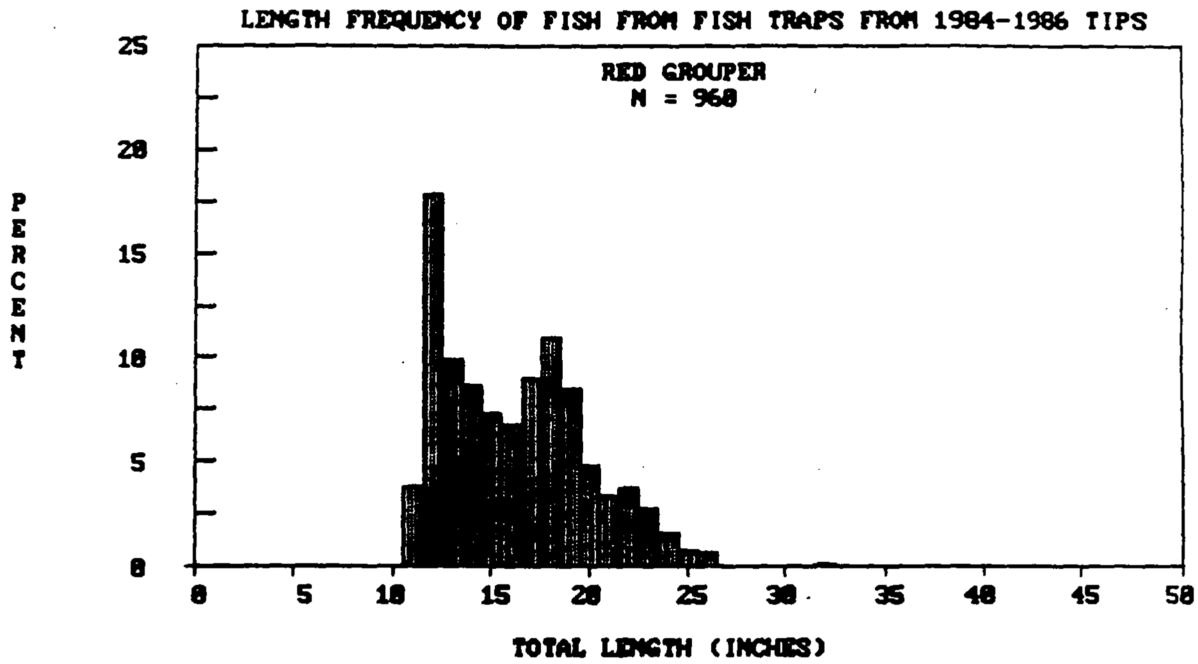
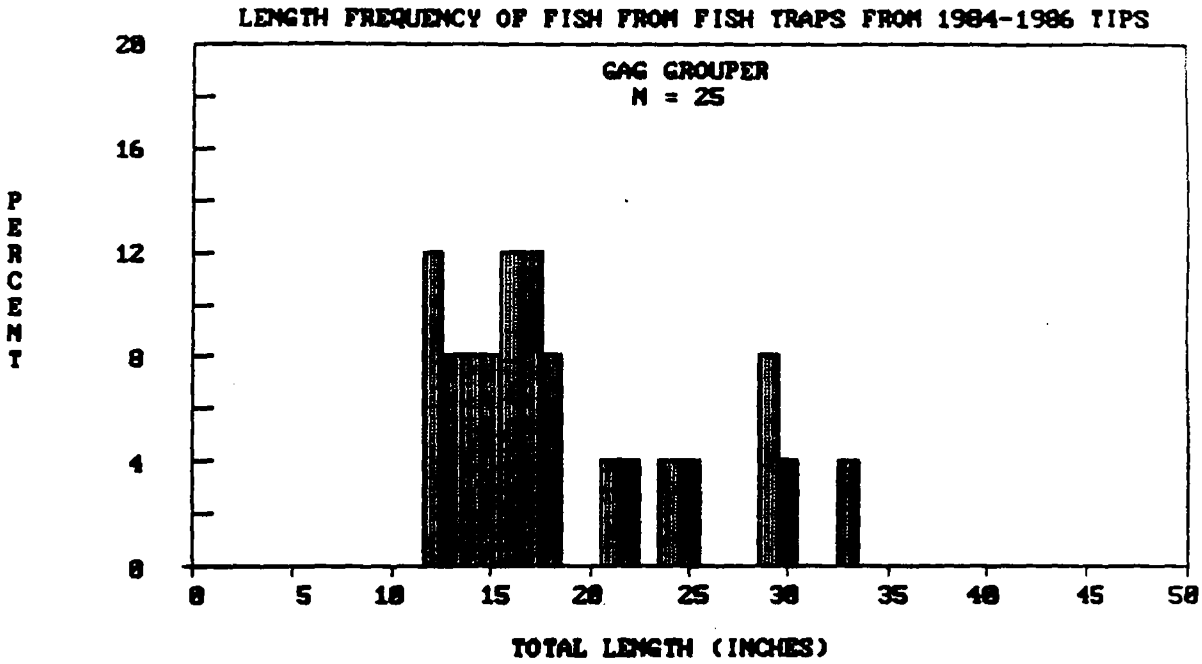


FIGURE 7.13



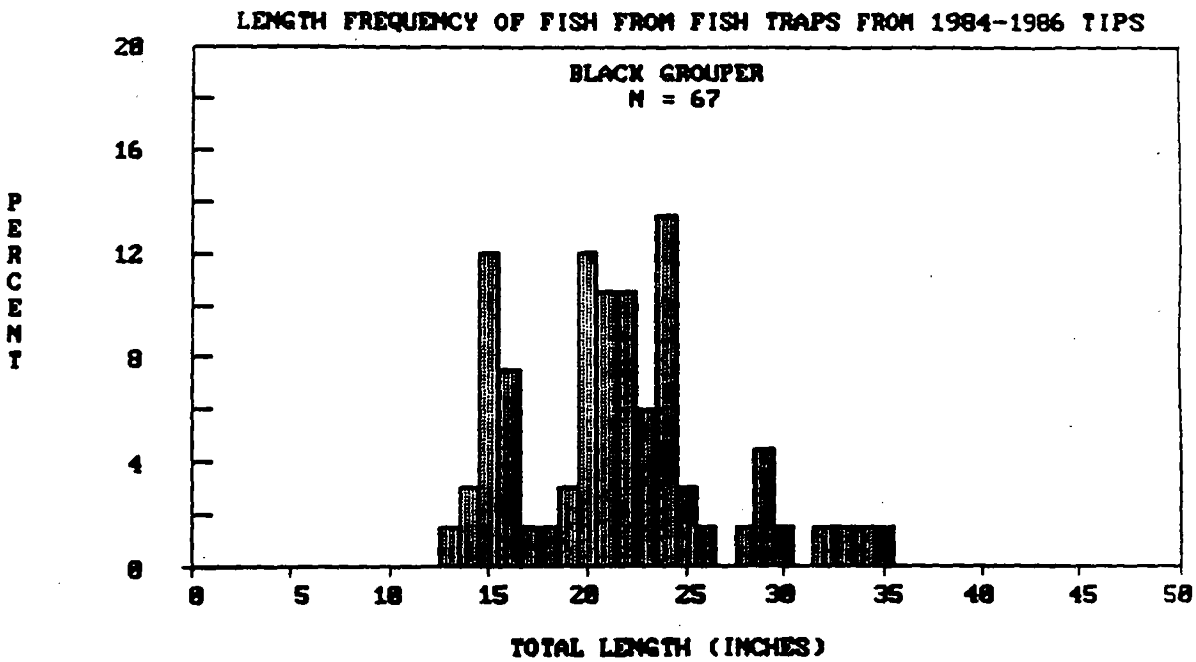
Length frequency of red grouper sampled from fish traps by the State/Federal Cooperative Trip Interview Program (TIP) during the period 1984-1986.

FIGURE 7.14



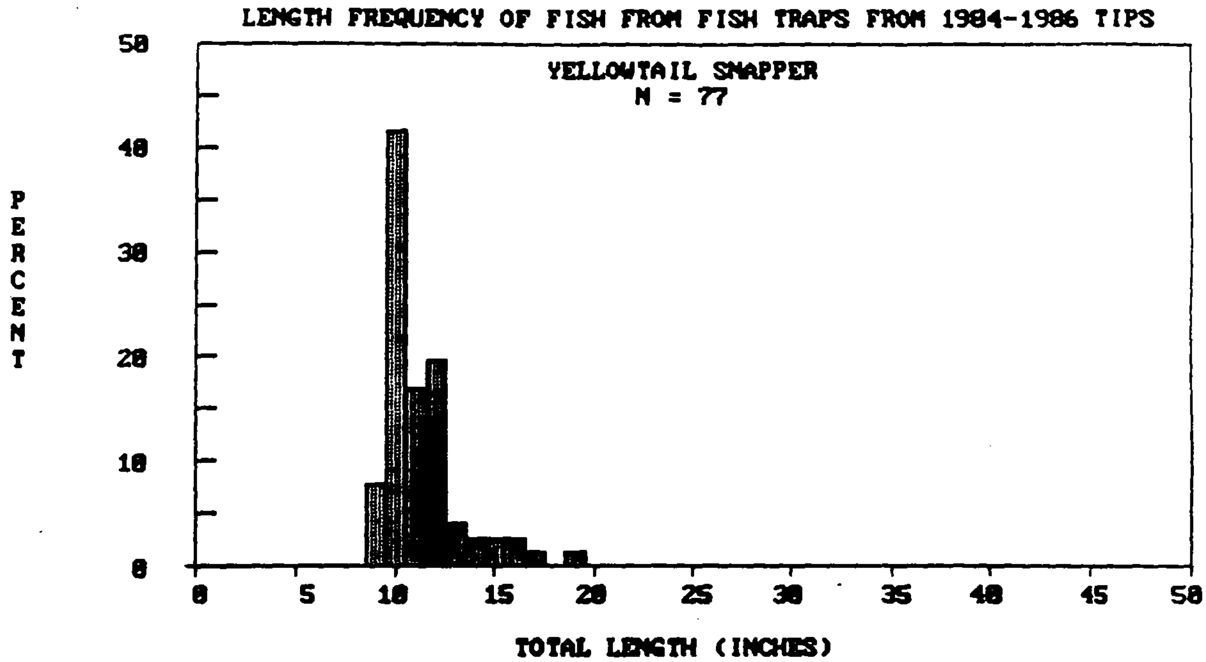
Length frequency of gag grouper sampled from fish traps by the State/Federal Cooperative Trip Interview Program (TIP) during the period 1984-1986.

FIGURE 7.15



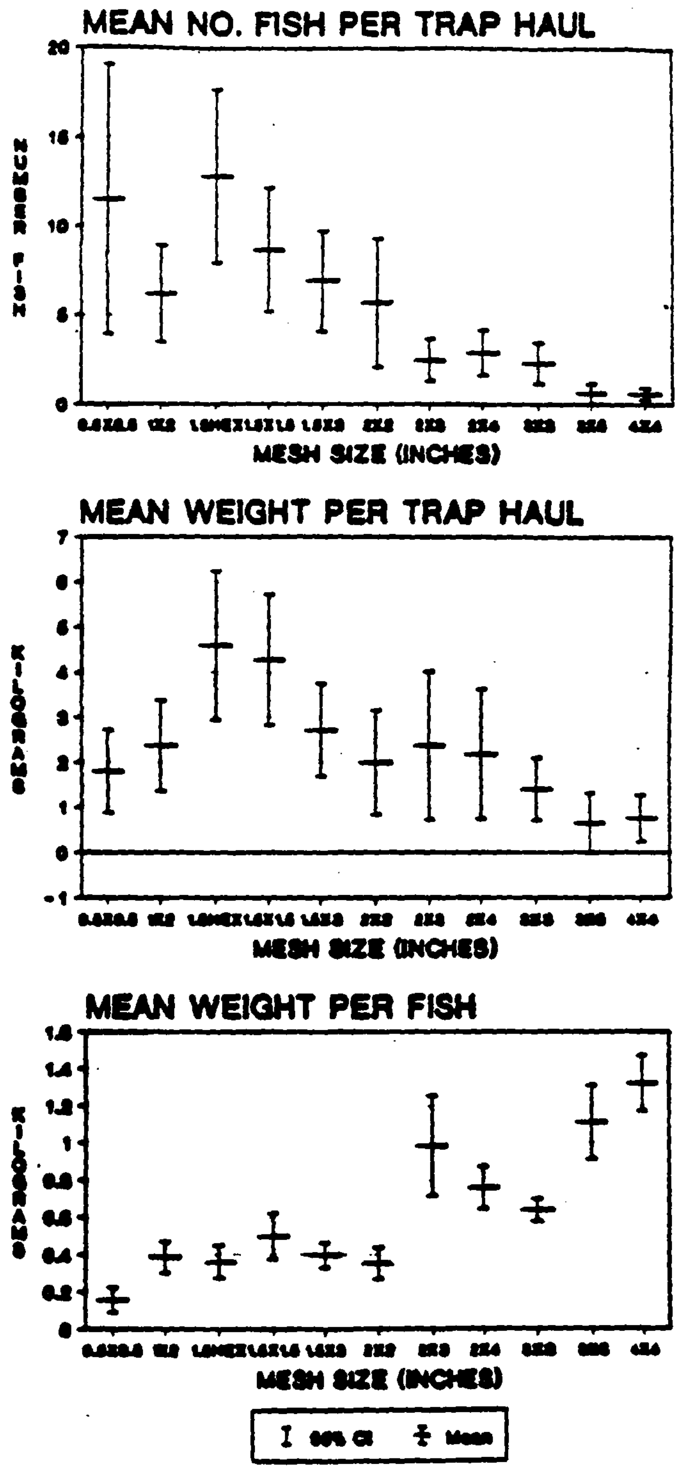
Length frequency of black grouper sampled from fish traps by the State/Federal Cooperative Trip Interview Program (TIP) during the period 1984-1986.

FIGURE 7.16



Length frequency of yellowtail snapper sampled from fish traps by the State/Federal Cooperative Trip Interview Program (TIP) during the period 1984-1986.

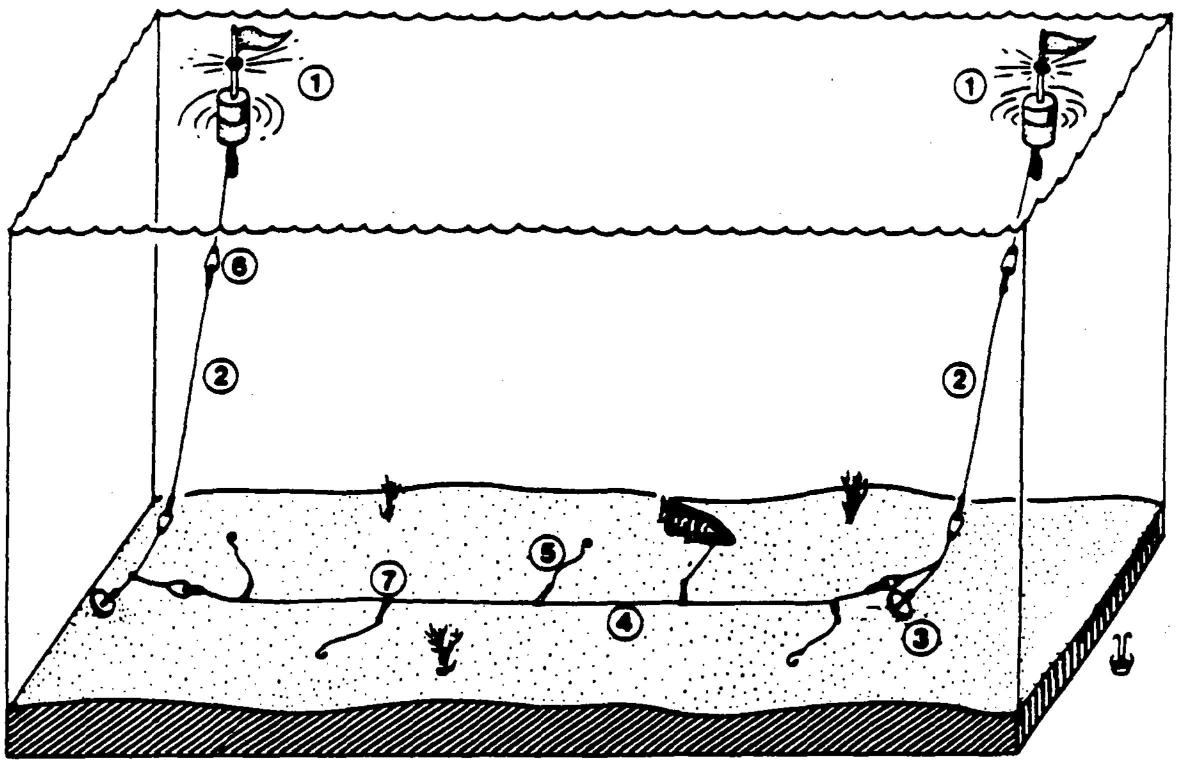
FIGURE 7.17



Effects of mesh size on fish trap catches. Bars show means and 95% confidence intervals.

FIGURE 7.18

A typical bottom longline.



1. MARKER BUOY WITH FLAGS, LIGHT, & RADAR REFLECTOR
2. BUOY LINE- POLYPROPOLENE
3. ANCHOR- MUSHROOM OR OTHER
4. MAINLINE- STEEL, POLYPROPOLENE, OR MONOFILAMENT
5. GANGIONS- MONOFILAMENT, 30" LONG, 10 TO 50 FEET APART, WITH CIRCLE HOOK (INSERT A.)
6. BRUMMEL HOOKS (INSERT B.)
7. LINE SNAPS (INSERT C.)

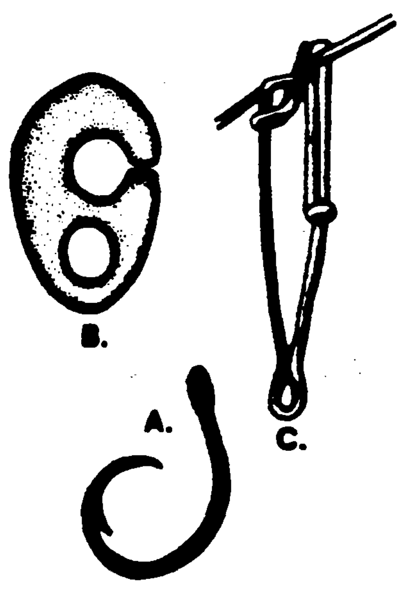
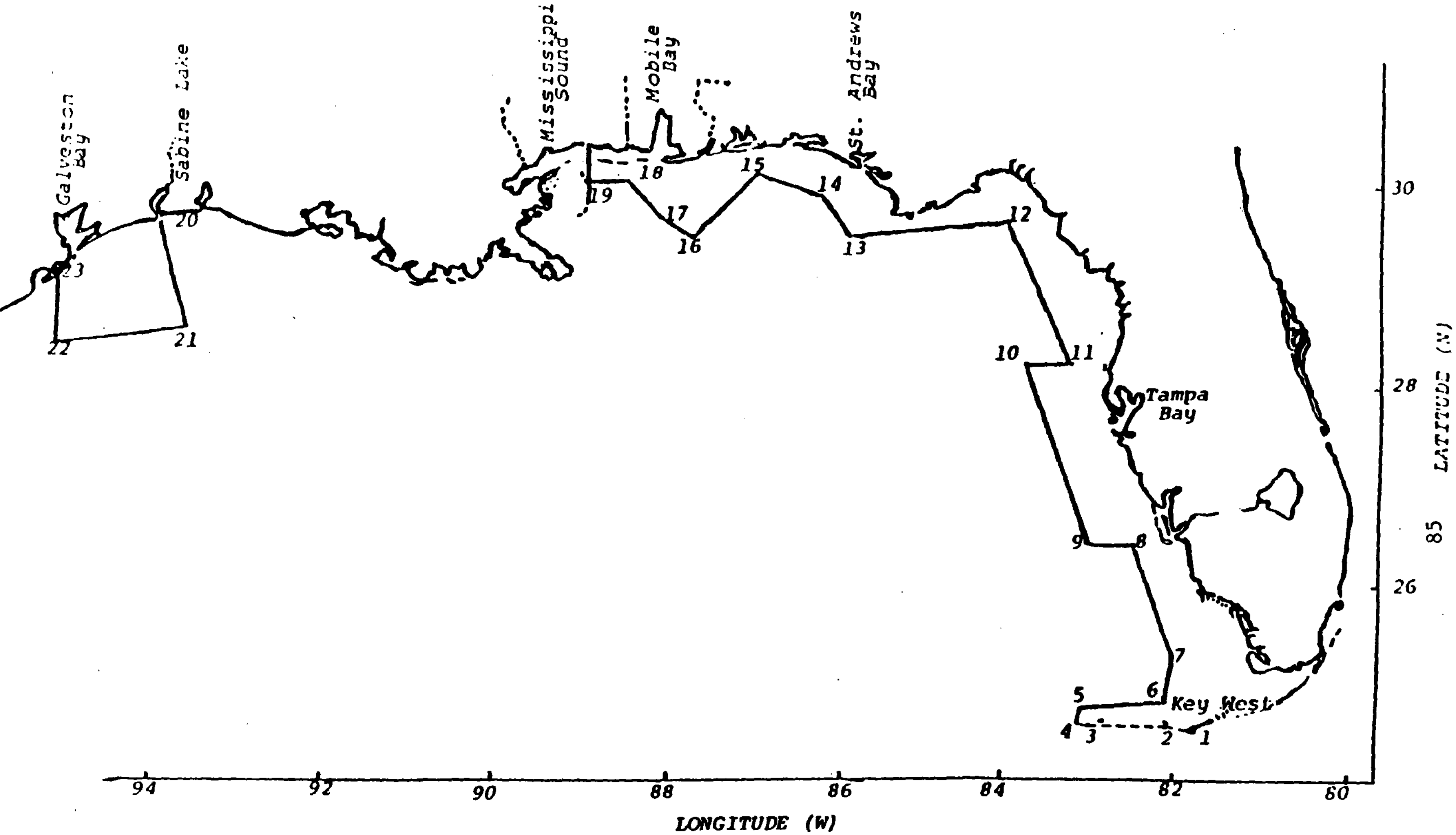


FIGURE 7.19



Map of the stressed area boundaries in the Gulf of Mexico as defined in the Reef Fish FMP (1981).

TABLE 7.1.

COMMERCIAL REEF FISH LANDINGS (1000s) AND VALUE (1000s)
AT U.S. GULF OF MEXICO PORTS, 1955-1986

Year	Red Snapper			Other Snappers			Groupers			Other Reef Fish			Total		
	Pounds	Dollars	Real $	Pounds	Dollars	Real $	Pounds	Dollars	Real $	Pounds	Dollars	Real $	Pounds	Dollars	Real $
1955	9,484	2,265	2,580	624	106	121	6,023	520	592	652	26	30	16,783	2,917	3,322
1956	9,356	2,165	2,387	372	66	73	7,396	619	682	908	28	31	18,032	2,878	3,173
1957	9,100	2,204	2,362	681	121	130	8,066	679	728	425	33	35	18,271	3,037	3,255
1958	10,443	2,532	2,677	782	125	132	5,443	511	540	663	22	23	17,332	3,190	3,372
1959	10,759	2,639	2,784	851	151	159	7,500	732	772	324	22	23	19,434	3,544	3,738
1960	10,760	2,606	2,746	985	185	195	7,679	741	781	260	19	20	19,683	3,551	3,742
1961	12,433	3,061	3,239	1,115	203	215	8,296	716	758	194	14	15	22,037	3,994	4,226
1962	12,417	2,968	3,131	1,574	296	312	9,289	812	857	160	11	12	23,441	4,087	4,311
1963	13,268	3,381	3,578	1,349	242	256	8,902	765	810	174	13	14	23,692	4,401	4,657
1964	13,987	3,864	4,080	1,590	323	341	10,264	952	1,005	165	13	14	26,006	5,152	5,440
1965	13,995	3,912	4,050	1,715	351	363	11,112	1,030	1,066	234	18	19	27,056	5,311	5,498
1966	13,046	3,954	3,962	1,305	298	299	9,551	1,020	1,022	234	19	19	24,135	5,291	5,302
1967	12,447	3,884	3,884	1,585	397	397	8,464	1,015	1,015	461	41	41	22,957	5,337	5,337
1968	11,084	3,643	3,554	1,976	539	526	8,435	1,171	1,142	951	96	94	22,445	5,449	5,316
1969	9,976	3,990	3,746	1,697	533	500	9,293	1,469	1,379	918	102	96	21,885	6,094	5,722
1970	8,923	3,829	3,468	1,975	630	571	9,192	1,419	1,285	689	84	76	20,779	5,962	5,400
1971	8,848	4,008	3,519	2,017	697	612	8,464	1,381	1,212	730	91	80	20,059	6,177	5,423
1972	8,874	4,582	3,850	1,943	765	643	8,654	1,856	1,560	683	92	77	20,154	7,295	6,130
1973	8,564	4,867	3,613	2,039	922	684	6,923	1,676	1,244	595	94	70	18,122	7,559	5,612
1974	8,893	5,586	3,491	2,177	1,016	635	7,916	2,212	1,382	571	98	61	19,557	8,912	5,570
1975	8,218	5,635	3,224	1,979	985	564	8,949	2,913	1,666	624	110	63	19,770	9,643	5,517
1976	7,490	5,895	3,221	2,292	1,272	695	8,519	3,294	1,800	670	128	70	18,971	10,589	5,786
1977	5,646	5,033	2,592	2,278	1,501	773	6,643	3,220	1,658	684	142	73	15,251	9,896	5,096
1978	5,006	5,223	2,495	2,357	1,752	837	6,290	3,684	1,760	788	194	93	14,441	10,853	5,185
1979	4,937	6,313	2,680	2,258	1,937	822	8,198	5,457	2,316	869	259	110	16,262	13,966	5,928
1980	4,945	7,275	2,707	2,000	1,947	725	8,715	6,611	2,460	752	254	95	16,412	16,087	5,987
1981	5,927	9,499	3,238	2,174	2,305	786	12,506	10,911	3,719	1,279	514	175	21,886	23,229	7,917
1982	6,272	10,172	3,399	3,240	3,681	1,230	15,281	13,013	4,348	1,392	580	194	26,185	27,446	9,170
1983	7,289	11,998	3,958	2,938	3,314	1,093	11,926	11,952	3,943	1,255	557	184	23,408	27,821	9,179
1984	6,443	11,123	3,585	2,911	3,757	1,211	12,036	13,843	4,461	1,677	873	281	23,067	29,596	9,538
1985	4,924	9,341	3,026	2,942	4,030	1,305	13,439	17,351	5,621	1,988	1,173	380	23,293	31,895	10,332
1986	4,084	8,106	2,704	3,804	5,302	1,769	12,470	17,597	5,870	2,587	1,441	481	22,945	32,446	10,823

Source: National Marine Fisheries Service

Notes: Real $ is exvessel value adjusted for inflation by dividing by the producer price index for all commodities (1967=100). Florida landings were converted to round weights by multiplying reported landings (assumed to be gutted weights) by the following factors: snappers, 1.1; groupers and sea basses, 1.18; amberjack, grunts, pigfish, hogfish, porgies, and triggerfish, 1.04; sand perch, 1.14; and tilefish, 1.12.

TABLE 7.2.

RED SNAPPER
COMMERCIAL LANDINGS (1000s) AND VALUE (1000s) IN THE GULF OF MEXICO, 1955-1986

Year	Florida		Alabama		Mississippi		Louisiana		Texas		Total		
	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Real $
1955	6,831	1,614	1,173	289	147	35	71	15	1,262	312	9,484	2,265	2,580
1956	6,442	1,457	1,065	261	271	62	44	9	1,534	376	9,356	2,165	2,387
1957	6,146	1,443	933	232	550	143	28	6	1,443	380	9,100	2,204	2,362
1958	6,428	1,520	1,418	349	1,110	274	88	16	1,399	373	10,443	2,532	2,677
1959	5,940	1,420	1,819	452	1,022	255	313	77	1,665	435	10,759	2,639	2,784
1960	5,992	1,416	1,720	426	1,469	367	426	104	1,153	293	10,760	2,606	2,746
1961	5,991	1,449	1,784	470	2,152	537	677	150	1,829	455	12,433	3,061	3,239
1962	5,913	1,328	1,893	495	2,176	544	694	157	1,742	444	12,417	2,968	3,131
1963	6,510	1,562	2,315	663	1,886	471	388	95	2,169	590	13,268	3,381	3,578
1964	7,185	2,009	2,393	685	1,849	461	310	78	2,250	631	13,987	3,864	4,080
1965	6,679	1,931	2,495	707	2,366	589	243	57	2,212	628	13,995	3,912	4,050
1966	5,709	1,809	2,701	803	2,775	771	208	59	1,653	512	13,046	3,954	3,962
1967	5,558	1,804	2,288	690	2,890	850	302	78	1,409	462	12,447	3,884	3,884
1968	4,739	1,757	1,214	328	3,726	1,118	277	73	1,128	367	11,084	3,643	3,554
1969	4,707	2,279	1,246	375	2,968	959	130	35	925	342	9,976	3,990	3,746
1970	4,250	2,122	983	326	2,519	930	255	71	916	380	8,923	3,829	3,468
1971	4,266	2,232	939	341	2,399	886	162	54	1,082	495	8,848	4,008	3,519
1972	4,060	2,526	1,051	443	2,266	944	259	97	1,238	572	8,874	4,582	3,850
1973	4,138	2,790	960	442	2,331	1,089	354	144	781	402	8,564	4,867	3,613
1974	5,073	3,650	891	439	1,900	942	286	139	743	416	8,893	5,586	3,491
1975	4,898	3,720	833	460	1,709	988	151	74	627	393	8,218	5,635	3,224
1976	4,426	3,914	635	388	1,876	1,201	58	39	495	353	7,490	5,895	3,221
1977	3,147	3,246	520	352	1,440	944	99	70	440	421	5,646	5,033	2,592
1978	3,038	3,702	426	315	1,094	755	71	59	377	392	5,006	5,223	2,495
1979	2,954	4,337	535	458	1,057	1,057	176	199	215	262	4,937	6,313	2,679
1980	3,085	5,156	418	423	930	944	201	272	311	481	4,945	7,275	2,708
1981	3,448	6,067	504	654	975	1,205	421	645	578	928	5,927	9,499	3,238
1982	3,652	6,402	581	758	1,041	1,413	468	685	529	915	6,272	10,172	3,399
1983	4,195	7,523	535	651	1,116	1,509	718	1,207	724	1,107	7,289	11,998	3,958
1984	2,863	5,546	340	415	1,029	1,386	1,487	2,480	723	1,296	6,443	11,123	3,585
1985	1,806	3,837	199	261	937	1,272	1,215	2,524	767	1,447	4,924	9,341	3,026
1986	1,003	2,224	146	237	673	896	1,359	3,007	903	1,743	4,084	8,106	2,704

Source: National Marine Fisheries Service

Notes: Real $ is total exvessel value adjusted for inflation by dividing by the producer price index for all commodities (1967=100). Florida landings were converted to round weight by multiplying reported landings (assumed to be gutted weights) by 1.11.

TABLE 7.3.

GROUPERS
COMMERCIAL LANDINGS (1000s) AND VALUE (1000s) IN THE GULF OF MEXICO, 1955-1986
(0 means less than 500 pounds or dollars; . means no observations)

Year	Florida		Alabama		Mississippi		Louisiana		Texas		Total		
	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Real $
1955	5,745	481	152	22	17	3	2	0	107	14	6,023	520	592
1956	7,186	590	157	23	17	3	1	0	35	3	7,396	619	682
1957	7,874	652	117	18	19	3	0	0	56	6	8,066	679	728
1958	5,167	474	179	27	35	4	1	0	61	6	5,443	511	540
1959	7,014	669	249	38	75	11	30	3	132	11	7,500	732	772
1960	7,209	676	240	37	115	17	44	4	71	7	7,679	741	781
1961	7,799	658	246	30	135	16	25	3	91	9	8,296	716	758
1962	8,543	730	253	29	246	28	57	6	190	19	9,289	812	857
1963	8,056	666	336	46	271	30	36	3	203	20	8,902	765	810
1964	9,330	843	423	56	268	29	19	2	224	22	10,264	952	1,005
1965	10,080	923	522	56	322	33	19	2	169	16	11,112	1,030	1,066
1966	8,718	923	483	61	235	24	19	2	96	10	9,551	1,020	1,022
1967	7,793	941	394	45	188	19	4	0	85	10	8,464	1,015	1,015
1968	7,578	1,075	422	47	329	38	6	0	100	11	8,435	1,171	1,142
1969	8,648	1,394	299	35	266	32	7	1	73	7	9,293	1,469	1,379
1970	8,518	1,332	338	41	266	39	11	1	59	6	9,192	1,419	1,285
1971	7,872	1,307	221	27	228	34	5	0	138	13	8,464	1,381	1,212
1972	8,009	1,769	309	41	233	35	5	0	98	11	8,654	1,856	1,560
1973	6,333	1,581	257	40	219	39	14	1	100	15	6,923	1,676	1,244
1974	7,540	2,150	158	26	131	25	2	0	85	11	7,916	2,212	1,382
1975	8,647	2,842	137	34	89	25	5	1	71	11	8,949	2,913	1,666
1976	8,247	3,219	92	27	96	32	15	3	69	13	8,519	3,294	1,800
1977	6,379	3,125	112	45	126	44	4	1	22	5	6,643	3,220	1,658
1978	6,106	3,605	73	33	73	37	2	1	35	8	6,290	3,684	1,760
1979	8,061	5,395	72	31	49	24	2	1	14	7	8,198	5,457	2,316
1980	8,601	6,556	53	25	38	19	2	1	21	9	8,715	6,611	2,460
1981	12,059	10,558	75	43	52	48	5	5	316	257	12,506	10,911	3,719
1982	14,941	12,752	49	32	95	77	34	40	160	112	15,281	13,013	4,348
1983	11,539	11,604	75	58	47	47	21	13	244	230	11,926	11,952	3,943
1984	11,403	13,186	104	127	38	38	270	286	221	206	12,036	13,843	4,461
1985	12,353	16,055	99	107	42	43	563	779	382	367	13,439	17,351	5,621
1986	11,139	15,987	103	144	42	43	949	1,184	237	239	12,470	17,597	5,870

Source: National Marine Fisheries Service
Notes: Real $ is total exvessel value adjusted for inflation by dividing by the producer price index for all commodities (1967=100). Florida landings were converted to round weights by multiplying reported landings (assumed to be gutted weights) by 1.18.

TABLE 7.4.

GROUPERS:
COMMERCIAL LANDINGS (1000s) AND EXVESSEL VALUE (1000s) BY REGION, 1978-1986
(0 means less than 500 pounds or dollars; . means no observations)

Region		1978	1979	1980	1981	1982	1983	1984	1985	1986
Keys	Pounds	1,246	995	620	1,078	1,221	1,033	1,317	897	765
	Dollars	699	666	458	919	972	948	1,383	1,015	1,088
Southwest Florida	Pounds	1,178	1,301	1,613	1,583	1,886	2,101	1,883	2,114	2,635
	Dollars	637	776	1,111	1,251	1,457	1,859	2,075	2,498	3,792
Midwest Florida	Pounds	2,953	4,304	4,666	5,853	8,283	6,428	6,309	6,702	6,702
	Dollars	1,862	3,034	3,744	5,304	7,156	6,767	7,377	8,962	9,639
FL Panhandle	Pounds	730	1,461	1,702	3,544	3,550	1,977	1,895	2,640	1,037
	Dollars	407	919	1,242	3,083	3,168	2,030	2,351	3,580	1,467
Alabama	Pounds	73	72	53	75	49	75	104	99	103
	Dollars	33	31	25	43	32	58	127	107	144
Mississippi	Pounds	73	49	38	52	95	47	38	42	42
	Dollars	37	24	19	48	77	47	38	43	43
Louisiana	Pounds	2	2	2	5	34	21	270	563	949
	Dollars	1	1	1	5	40	13	286	779	1,184
Texas	Pounds	35	14	21	316	160	244	221	382	237
	Dollars	8	7	9	257	112	230	206	367	239
Total	Pounds	6,290	8,199	8,715	12,506	15,281	11,925	12,036	13,439	12,470
	Dollars	3,684	5,457	6,611	10,911	13,014	11,952	13,843	17,351	17,597

Keys = Monroe County, Florida
Southwest Forida = Collier and Lee Counties
Midwest Florida = Charlotte-Levy Counties
FL Panhandle = Dixie-Escambia Counties

TABLE 7.5.

SNAPPERS:
COMMERCIAL LANDINGS (1000s) AND EXVESSEL VALUE (1000s) BY REGION, 1978-1986
(0 means less than 500 pounds or dollars; . means no observations)

Species	Region		1978	1979	1980	1981	1982	1983	1984	1985	1986
Red Snapper	Keys	Pounds	17	11	33	23	18	9	10	5	4
		Dollars	24	16	49	42	32	16	18	10	8
	Southwest Florida	Pounds	210	154	214	254	260	258	83	32	18
		Dollars	260	229	379	464	465	453	155	63	39
	Midwest Florida	Pounds	661	573	407	350	395	483	621	440	168
		Dollars	1,021	996	772	689	780	979	1,276	937	367
	FL Panhandle	Pounds	2,150	2,216	2,431	2,820	2,978	3,442	2,149	1,329	812
		Dollars	2,397	3,097	3,955	4,870	5,122	6,066	4,097	2,827	1,810
	Alabama	Pounds	426	535	418	504	581	535	340	199	146
		Dollars	315	458	423	654	758	651	415	261	237
	Mississippi	Pounds	1,094	1,057	930	975	1,041	1,116	1,029	937	673
		Dollars	755	1,057	944	1,205	1,413	1,509	1,386	1,272	896
	Louisiana	Pounds	71	176	201	421	468	718	1,487	1,215	1,359
		Dollars	59	199	272	645	685	1,207	2,480	2,524	3,007
	Texas	Pounds	377	215	311	578	529	724	723	767	903
		Dollars	392	262	481	928	915	1,107	1,296	1,447	1,743
	Total	Pounds	5,006	4,937	4,945	5,926	6,271	7,285	6,443	4,924	4,084
		Dollars	5,223	6,313	7,275	9,497	10,169	11,989	11,123	9,341	8,106
Lane Snapper	Keys	Pounds	17	35	27	31	58	47	45	30	25
		Dollars	7	24	18	20	39	34	35	26	22
	Southwest Florida	Pounds	0	1	0	2	3	2	16	24	35
		Dollars	0	0	0	1	2	2	12	17	27
	Midwest Florida	Pounds	1	2	1	11	1	3	6	9	1
		Dollars	0	2	1	16	0	3	6	10	1
	FL Panhandle	Pounds	0	.	0	2	1	0	2	8	4
		Dollars	0	.	0	3	1	0	1	8	4
	Louisiana	Pounds	.	.	.	.	.	.	.	.	4
		Dollars	.	.	.	.	.	.	.	.	6
	Total	Pounds	19	38	28	46	63	52	69	71	69
		Dollars	7	27	19	40	43	39	54	60	59

(CONTINUED)

TABLE 7.5. (continued)

Species	Region		1978	1979	1980	1981	1982	1983	1984	1985	1986
Gray Snapper	Keys	Pounds	264	278	307	307	517	586	658	532	458
		Dollars	187	241	297	336	575	615	742	645	565
	Southwest Florida	Pounds	400	367	367	382	353	322	91	35	44
		Dollars	117	127	156	183	213	208	103	37	52
	Midwest Florida	Pounds	59	86	92	59	92	98	93	66	88
		Dollars	41	72	85	66	102	119	132	89	125
	FL Panhandle	Pounds	9	10	11	11	25	20	14	51	7
		Dollars	9	9	10	9	25	22	17	58	9
	Alabama	Pounds	.	.	.	.	.	0	.	.	0
		Dollars	.	.	.	.	.	0	.	.	0
	Louisiana	Pounds	.	.	.	.	.	.	1	2	3
		Dollars	.	.	.	.	.	.	1	3	4
	Total	Pounds	733	741	777	759	987	1,026	857	685	600
		Dollars	354	449	547	594	914	964	996	831	755
Mutton Snapper	Keys	Pounds	177	179	154	160	285	202	166	162	163
		Dollars	133	174	178	200	367	254	227	221	231
	Southwest Florida	Pounds	65	48	55	41	14	66	39	33	22
		Dollars	46	34	48	44	17	80	54	47	37
	Midwest Florida	Pounds	4	13	11	23	19	39	21	28	39
		Dollars	4	11	12	27	21	51	30	38	59
	FL Panhandle	Pounds	.	.	1	0	.	.	.	1	1
		Dollars	.	.	1	0	.	.	.	2	2
	Total	Pounds	246	239	221	225	318	307	227	224	226
		Dollars	183	219	239	272	405	385	311	308	329
Vermilion Snapper	Keys	Pounds	1	2	2	10	5	4	6	3	5
		Dollars	1	2	2	13	5	4	8	3	6
	Southwest Florida	Pounds	0	.	.	.	0	2	0	0	0
		Dollars	0	.	.	.	0	3	1	1	0
	Midwest Florida	Pounds	22	7	2	26	15	31	11	24	5
		Dollars	26	9	3	36	22	60	15	33	6
	FL Panhandle	Pounds	423	427	303	332	379	524	673	802	854
		Dollars	355	369	325	338	400	573	834	1,155	1,140
	Alabama	Pounds	.	.	.	.	.	9	52	129	112
		Dollars	.	.	.	.	.	8	49	133	130
	Mississippi	Pounds	.	.	.	.	.	.	.	0	111
		Dollars	.	.	.	.	.	.	.	0	150
	Louisiana	Pounds	.	.	.	.	.	.	0	85	443
		Dollars	.	.	.	.	.	.	0	131	619
	Texas	Pounds	.	.	.	.	.	.	1	37	128
		Dollars	.	.	.	.	.	.	0	43	194
	Total	Pounds	446	435	307	368	399	569	744	1,079	1,656
		Dollars	382	380	329	386	428	647	907	1,497	2,244

(CONTINUED)

TABLE 7.5. (continued)

Species	Region		1978	1979	1980	1981	1982	1983	1984	1985	1986
Yellowtail Snapper	Keys	Pounds	809	722	589	704	1,384	931	948	838	968
		Dollars	729	779	728	932	1,791	1,214	1,400	1,276	1,545
	Southwest Florida	Pounds	103	81	74	59	55	46	22	15	26
		Dollars	95	81	81	68	68	54	29	23	42
	Midwest Florida	Pounds	1	2	4	1	29	7	33	9	8
		Dollars	1	1	4	1	28	10	52	10	12
	FL Panhandle	Pounds	0	.	.	.	0	.	.	.	0
		Dollars	0	.	.	.	0	.	.	.	0
	Louisiana	Pounds	.	.	.	.	.	.	.	1	0
		Dollars	.	.	.	.	.	.	.	1	0
	Total	Pounds	913	805	667	764	1,468	984	1,003	863	1,002
		Dollars	826	861	813	1,000	1,886	1,278	1,481	1,309	1,599
Other Snappers	Keys	Pounds	.	.	.	.	.	.	.	.	12
		Dollars	.	.	.	.	.	.	.	.	15
	Southwest Florida	Pounds	.	.	.	.	.	.	.	.	5
		Dollars	.	.	.	.	.	.	.	.	6
	Midwest Florida	Pounds	.	.	.	.	.	.	.	.	92
		Dollars	.	.	.	.	.	.	.	.	117
	FL Panhandle	Pounds	.	.	.	.	.	.	.	.	98
		Dollars	.	.	.	.	.	.	.	.	125
	Alabama	Pounds	.	.	0	.	.	.	11	7	4
		Dollars	.	.	0	.	.	.	8	8	2
	Mississippi	Pounds	.	.	.	.	.	.	.	0	.
		Dollars	.	.	.	.	.	.	.	0	.
	Louisiana	Pounds	.	.	.	.	.	.	0	12	32
		Dollars	.	.	.	.	.	.	0	17	42
	Texas	Pounds	.	.	.	.	.	.	.	.	8
		Dollars	.	.	.	.	.	.	.	.	9
	Total	Pounds	.	.	0	.	.	.	11	19	251
		Dollars	.	.	0	.	.	.	8	25	316

Keys = Monroe County, Florida
Southwest Forida = Collier and Lee Counties
Midwest Florida = Charlotte-Levy Counties
FL Panhandle = Dixie-Escambia Counties

TABLE 7.6.

OTHER REEF FISH:
COMMERCIAL LANDINGS (1000s) AND EXVESSEL VALUE (1000s) BY REGION, 1978-1986
(0 means less than 500 pounds or dollars; . means no observations)

Region			1978	1979	1980	1981	1982	1983	1984	1985	1986
Amberjacks	Keys	Pounds	9	26	16	15	97	71	107	60	149
		Dollars	1	3	2	2	14	20	69	35	58
	Southwest Florida	Pounds	2	2	4	0	1	4	7	8	41
		Dollars	0	1	1	0	0	1	3	3	13
	Midwest Florida	Pounds	53	41	47	55	48	47	105	93	210
		Dollars	8	7	8	11	14	13	23	36	94
	FL Panhandle	Pounds	109	125	145	205	193	253	432	532	426
		Dollars	16	26	32	46	58	92	203	273	248
	Alabama	Pounds	.	.	.	.	.	3	19	43	62
		Dollars	.	.	.	.	.	1	9	16	30
	Mississippi	Pounds	.	.	.	.	5	1	9	37	67
		Dollars	.	.	.	.	4	0	7	21	49
	Louisiana	Pounds	.	.	.	.	.	0	0	96	314
		Dollars	.	.	.	.	.	0	0	36	134
	Texas	Pounds	.	.	.	.	.	.	14	51	120
		Dollars	.	.	.	.	.	.	10	29	65
	Total	Pounds	173	194	212	276	345	378	694	920	1,389
		Dollars	25	36	42	59	90	129	325	448	693
Grunts	Keys	Pounds	36	44	41	50	60	41	48	41	82
		Dollars	6	9	8	11	13	8	11	9	23
	Southwest Florida	Pounds	0	0	0	.	0	3	1	6	19
		Dollars	0	0	0	.	0	1	0	2	4
	Midwest Florida	Pounds	110	100	31	10	36	22	45	21	54
		Dollars	19	18	7	2	12	5	15	6	14
	FL Panhandle	Pounds	0	2	0	1	1	3	2	3	3
		Dollars	0	0	0	0	0	1	1	1	1
	Alabama	Pounds	.	.	.	.	.	.	.	.	0
		Dollars	.	.	.	.	.	.	.	.	0
	Total	Pounds	146	146	72	60	98	69	96	71	158
		Dollars	25	27	15	13	25	16	27	18	42

(CONTINUED)

TABLE 7.6. (continued)

Region			1978	1979	1980	1981	1982	1983	1984	1985	1986
Hogfish	Keys	Pounds	36	38	31	41	27	26	35	37	28
		Dollars	17	25	24	31	18	17	28	32	24
	Southwest Florida	Pounds	.	9	16	5	3	6	1	5	3
		Dollars	.	6	12	4	4	2	1	3	4
	Midwest Florida	Pounds	3	2	1	1	1	1	2	2	3
		Dollars	2	1	1	1	1	1	2	3	3
	Total	Pounds	39	50	49	46	31	34	38	44	34
		Dollars	20	32	37	36	23	20	31	38	31
Porgies	Keys	Pounds	12	19	12	14	21	11	11	8	3
		Dollars	2	4	3	3	7	3	5	3	2
	Southwest Florida	Pounds	8	5	6	2	9	13	23	24	26
		Dollars	3	2	3	1	6	7	13	16	19
	Midwest Florida	Pounds	63	71	49	77	43	49	26	51	53
		Dollars	27	32	22	40	23	24	14	31	33
	FL Panhandle	Pounds	97	90	102	117	143	152	175	231	180
		Dollars	32	36	47	49	66	71	91	134	106
	Alabama	Pounds	.	.	.	.	1	3	8	6	15
		Dollars	.	.	.	.	0	1	3	2	7
	Mississippi	Pounds	.	.	.	.	.	.	2	11	15
		Dollars	.	.	.	.	.	.	1	6	13
	Louisiana	Pounds	.	.	.	.	.	.	0	7	21
		Dollars	.	.	.	.	.	.	0	5	14
	Texas	Pounds	.	.	.	.	.	.	1	25	.
		Dollars	.	.	.	.	.	.	0	53	.
	Total	Pounds	179	185	170	209	217	227	247	363	312
		Dollars	63	73	74	93	102	106	129	249	194
Sea Basses	Keys	Pounds	.	.	.	0	.	0	0	0	0
		Dollars	.	.	.	0	.	0	0	0	0
	Southwest Florida	Pounds	10	.	.	4	0	0	.	1	0
		Dollars	4	.	.	0	0	0	.	0	0
	Midwest Florida	Pounds	17	31	10	7	14	9	17	12	20
		Dollars	4	12	3	3	4	4	6	5	10
	FL Panhandle	Pounds	2	13	7	6	17	4	8	6	3
		Dollars	1	4	2	2	5	1	2	2	1
	Alabama	Pounds	.	.	.	2	.	.	.	0	0
		Dollars	.	.	.	0	.	.	.	0	0
	Total	Pounds	29	44	17	19	30	13	25	19	23
		Dollars	8	15	5	6	8	5	9	7	11

(CONTINUED)

TABLE 7.6. (continued)

Region			1978	1979	1980	1981	1982	1983	1984	1985	1986
Tilefishes	Keys	Pounds	45	38	26	64	68	38	42	76	67
		Dollars	16	18	16	39	47	24	30	60	64
	Southwest Florida	Pounds	0	1	2	6	14	7	8	12	7
		Dollars	0	0	1	3	8	5	6	7	6
	Midwest Florida	Pounds	41	44	37	327	71	36	24	16	81
		Dollars	14	19	20	165	33	18	16	10	57
	FL Panhandle	Pounds	4	2	10	53	122	34	210	153	173
		Dollars	1	1	5	30	69	22	168	115	164
	Alabama	Pounds	.	.	.	.	.	1	8	1	1
		Dollars	.	.	.	.	.	0	5	1	1
	Mississippi	Pounds	1	.	.	0	16	.	1	1	0
		Dollars	0	.	.	0	12	.	1	0	0
	Louisiana	Pounds	.	.	.	0	7	.	10	47	94
		Dollars	.	.	.	0	5	.	5	40	83
	Texas	Pounds	.	.	.	.	.	.	79	79	8
		Dollars	.	.	.	.	.	.	62	80	7
	Total	Pounds	92	86	74	450	297	116	382	385	430
		Dollars	31	38	41	237	173	69	294	313	383
Triggerfishes	Keys	Pounds	0	.	0	.	.	1	0	0	0
		Dollars	0	.	0	.	.	0	0	0	0
	Southwest Florida	Pounds	.	.	4	.	0	0	0	0	0
		Dollars	.	.	0	.	0	0	0	0	0
	Midwest Florida	Pounds	6	19	15	13	8	10	10	15	21
		Dollars	1	5	5	5	3	4	4	7	10
	FL Panhandle	Pounds	56	87	81	80	92	63	48	63	48
		Dollars	9	18	20	18	30	23	21	33	29
	Alabama	Pounds	.	.	.	.	.	3	15	12	6
		Dollars	.	.	.	.	.	0	4	3	2
	Mississippi	Pounds	.	.	.	.	.	.	.	0	4
		Dollars	.	.	.	.	.	.	.	0	2
	Louisiana	Pounds	.	.	.	.	.	.	0	5	14
		Dollars	.	.	.	.	.	.	0	2	6
	Texas	Pounds	.	.	.	.	.	.	.	0	1
		Dollars	.	.	.	.	.	.	.	0	0
	Total	Pounds	61	105	100	93	100	77	72	96	95
		Dollars	11	23	25	23	33	27	29	45	49

Keys = Monroe County, Florida
Southwest Forida = Collier and Lee Counties
Midwest Florida = Charlotte-Levy Counties
FL Panhandle = Dixie-Escambia Counties

^Z

TABLE 7.7.

COMMERCIAL LANDINGS (1000s) AND VALUE (1000s) OF REEF FISH BY COUNCIL JURISDICTION IN MONROE COUNTY, FLORIDA, 1978-1986 (0 means less than 500 pounds or dollars; . means no observations).

Species	Council		1978	1979	1980	1981	1982	1983	1984	1985	1986
Red Snapper	Atlantic	Pounds	12	.	14	10	13	7	4	1	0
		Dollars	18	.	22	19	22	13	7	2	0
	Gulf	Pounds	5	11	18	12	5	2	6	4	0
		Dollars	7	16	27	23	10	3	11	8	0
	Unknown	Pounds	.	.	.	.	.	.	.	.	4
		Dollars	.	.	.	.	.	.	.	.	8
	Total	Pounds	17	11	33	23	18	9	10	5	4
		Dollars	24	16	49	42	32	16	18	10	8
Other Snappers	Atlantic	Pounds	788	879	746	939	1,844	1,308	1,294	1,064	34
		Dollars	665	891	848	1,183	2,301	1,587	1,747	1,496	50
	Gulf	Pounds	479	336	333	271	406	461	529	501	238
		Dollars	391	329	374	318	476	533	665	674	368
	Unknown	Pounds	.	.	.	.	.	.	.	.	1,358
		Dollars	.	.	.	.	.	.	.	.	1,965
	Total	Pounds	1,267	1,216	1,079	1,211	2,250	1,769	1,823	1,565	1,630
		Dollars	1,056	1,220	1,222	1,501	2,777	2,121	2,412	2,170	2,383
Groupers	Atlantic	Pounds	641	671	352	635	651	622	972	501	34
		Dollars	358	451	261	543	520	572	1,024	570	49
	Gulf	Pounds	605	324	267	443	571	411	345	396	72
		Dollars	341	215	198	377	451	375	359	445	104
	Unknown	Pounds	.	.	.	.	.	.	.	.	659
		Dollars	.	.	.	.	.	.	.	.	935
	Total	Pounds	1,246	995	620	1,078	1,221	1,033	1,317	897	765
		Dollars	699	666	458	919	972	948	1,383	1,015	1,088
Other Reef Fish	Atlantic	Pounds	97	93	91	166	244	163	235	209	29
		Dollars	33	30	39	79	87	63	139	132	17
	Gulf	Pounds	55	99	35	18	30	24	10	15	10
		Dollars	12	36	14	7	11	9	5	8	6
	Unknown	Pounds	.	0	.	.	.	.	.	.	290
		Dollars	.	0	.	.	.	.	.	.	149
	Total	Pounds	152	192	126	184	273	187	245	223	329
		Dollars	45	66	53	86	99	72	144	140	172
Total	Atlantic	Pounds	1,538	1,643	1,204	1,751	2,751	2,100	2,504	1,775	97
		Dollars	1,074	1,371	1,170	1,824	2,931	2,236	2,916	2,201	117
	Gulf	Pounds	1,144	770	654	745	1,012	898	890	915	320
		Dollars	751	597	613	724	949	921	1,040	1,134	478
	Unknown	Pounds	.	0	.	.	.	.	.	.	2,311
		Dollars	.	0	.	.	.	.	.	.	3,057
	Total	Pounds	2,682	2,414	1,857	2,495	3,763	2,998	3,394	2,690	2,728
		Dollars	1,824	1,968	1,782	2,548	3,879	3,157	3,957	3,335	3,651

TABLE 7.8.

PERCENTAGES OF TOTAL GULF-WIDE LANDINGS OF REEF FISH
THAT ORIGINATED ON THE ATLANTIC SIDE OF MONROE COUNTY, FLORIDA

Species	1978	1979	1980	1981	1982	1983	1984	1985	Average
Red Snapper	0.24	0.0	0.28	0.17	0.21	0.10	0.06	0.02	0.13
Lane Snapper	57.9	50.0	75.0	43.5	60.3	73.1	52.2	33.8	53.6
Gray Snapper	16.9	25.6	25.4	22.5	32.7	34.2	42.1	42.6	30.6
Mutton Snapper	41.5	41.0	44.3	50.2	60.7	46.9	46.3	45.5	47.6
Vermilion Snapper	0.22	0.0	0.33	2.7	1.3	0.70	0.67	0.19	0.64
Yellowtail Snapper	60.2	71.2	64.3	81.8	87.5	78.6	78.5	74.6	75.9
Groupers	10.2	8.2	4.0	5.1	4.3	5.2	8.1	3.7	5.7
Amberjacks	2.9	12.9	6.6	5.4	27.8	18.8	15.4	6.5	12.3
Grunts	12.3	15.1	31.9	66.7	44.9	40.6	45.8	47.9	33.4
Hogfish	69.2	48.0	40.8	76.1	51.6	50.0	78.9	68.2	60.1
Porgies	0.0	6.5	5.3	5.7	9.7	4.4	4.5	2.2	4.6
Black Sea Bass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sand Perch	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tilefishes	48.9	10.5	35.1	14.2	22.9	32.8	11.0	19.7	19.6
Triggerfishes	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.1
Total	10.7	10.1	7.3	8.0	10.5	9.0	10.9	7.6	9.3

TABLE 7.9.

COMMERCIAL LANDINGS AND EXVESSEL VALUE
OF SNAPPERS AND GROUPERS LANDED
ALONG THE U.S. SOUTH ATLANTIC COAST, 1960-1986

	Snappers			Groupers		
Year	Pounds (1000s)	Dollars (1000s)	Real $ (1000s)	Pounds (1000s)	Dollars (1000s)	Real $ (1000s)
1960	974	248	261	329	33	35
1961	1,127	254	269	338	29	31
1962	1,006	245	258	316	28	30
1963	853	212	224	268	23	24
1964	934	269	284	313	31	33
1965	1,005	287	297	435	42	43
1966	1,075	371	372	320	35	35
1967	1,300	412	412	631	78	78
1968	1,539	564	550	1,010	147	143
1969	1,151	548	515	729	127	119
1970	1,196	612	554	878	155	140
1971	1,101	629	552	953	174	153
1972	1,186	749	629	739	182	153
1973	1,076	773	574	754	222	165
1974	1,301	951	594	997	359	224
1975	1,467	1,136	650	1,224	450	257
1976	1,174	1,170	639	1,214	536	293
1977	1,376	1,709	880	1,525	820	422
1978	1,442	2,102	1,004	2,417	1,515	724
1979	1,322	1,988	844	2,276	1,652	701
1980	1,481	2,217	825	2,118	1,713	637
1981	1,478	2,363	805	2,601	2,451	835
1982	1,490	2,406	804	2,487	2,218	741
1983	1,406	2,363	780	3,004	2,984	984
1984	1,388	2,361	761	2,553	3,177	1,024
1985	1,468	2,583	837	2,083	2,919	946
1986	1,634	2,948	983	2,432	3,743	1,249

Real $ is exvessel value adjusted for inflation by dividing by the producer price index for all commodities (1967=100). Florida landings were converted to round weights by multiplying reported landings (assumed to be gutted weights) by 1.1 for snappers and 1.18 for groupers.

TABLE 7.10.

SNAPPER AND GROUPER IMPORTS INTO THE SOUTHEASTERN UNITED STATES, 1960-1987
(THOUSANDS OF POUNDS, PRODUCT AND EQUIVALENT LIVE WEIGHTS)
(. means data were not available)

	Snappers		Groupers	
Year	Product Weight	Live Weight	Product Weight	Live Weight
1960	474	725	62	164
1961	890	1,307	174	457
1962	705	891	710	1,770
1963	796	1,038	1,306	3,104
1964	1,235	1,488	2,175	5,186
1965	1,410	1,986	2,317	5,609
1966	1,392	2,099	2,799	6,970
1967	952	1,365	331	772
1968	621	1,071	331	829
1969	734	1,154	491	1,236
1970	743	1,132	360	867
1971	332	489	338	730
1972	732	1,077	3,141	8,091
1973	2,870	4,617	2,627	6,541
1974	3,155	4,681	1,659	4,018
1975	3,873	5,591	2,369	5,218
1976	3,920	6,097	4,001	7,331
1977	3,713	4,927	3,344	7,051
1978	3,904	5,369	3,049	6,676
1979	3,180	3,962	1,861	3,976
1980	2,201	4,239	573	1,226
1981	3,902	4,517	348	604
1982	4,493	4,921	592	1,070
1983	5,093	6,076	534	869
1984	6,963	8,429	1,984	3,129
1985	10,676	.	3,263	.
1986	11,640	.	6,088	.
1987	10,421	.	6,496	.

Sources: Live weights: data for 1960-1982 were obtained from Walter Keithly (LSU, Center for Wetland Resources, Baton Rouge, LA 70803); data for 1983 and 1984 were obtained from John Vondruska (NMFS, Southeast Regional Office, 9450 Koger Blvd, St. Petersburg, FL 33702.

Product weights: data for 1960-1972 were published in Cato and Prochaska (1976); data for 1973-1977 were obtained from Appendix Tables 39 and 40 in the Reef Fish Management Plan (GMFMC 1980); data for 1978-1987 were obtained from Chuck Adams (Univ. of Florida, 1170 McCarty Hall, Gainesville, FL 32611).

Note: Product weights are the combined weights of imports of all product forms.

TABLE 7.11.

SNAPPER AND GROUPER SUPPLIES IN THE SOUTHEASTERN UNITED STATES, 1960-1986
(THOUSANDS OF POUNDS, LIVE WEIGHT)
(. means that data were not available)

	Snappers					Groupers				
Year	Gulf Landings	S. Atl. Landings	Total Landings	Imports	Total Supplies	Gulf Landings	S. Atl. Landings	Total Landings	Imports	Total Supplies
1960	10,760	974	11,733	725	12,458	7,679	329	8,007	164	8,171
1961	12,433	1,127	13,560	1,307	14,867	8,296	338	8,634	457	9,091
1962	12,417	1,006	13,424	891	14,314	9,289	316	9,605	1,770	11,375
1963	13,268	853	14,121	1,038	15,159	8,902	268	9,170	3,104	12,274
1964	13,987	934	14,921	1,488	16,409	10,264	313	10,577	5,186	15,762
1965	13,995	1,005	15,000	1,986	16,986	11,112	434	11,546	5,609	17,155
1966	13,046	1,075	14,121	2,099	16,219	9,551	320	9,871	6,970	16,841
1967	12,447	1,299	13,747	1,365	15,112	8,464	631	9,095	772	9,866
1968	11,084	1,539	12,623	1,071	13,694	8,435	1,010	9,445	829	10,274
1969	9,976	1,151	11,127	1,154	12,281	9,293	729	10,022	1,236	11,258
1970	8,923	1,196	10,120	1,132	11,252	9,192	878	10,071	867	10,938
1971	8,848	1,101	9,949	489	10,438	8,464	953	9,417	730	10,147
1972	8,874	1,186	10,060	1,077	11,138	8,654	739	9,393	8,091	17,484
1973	8,564	1,076	9,641	4,617	14,258	6,923	754	7,677	6,541	14,218
1974	8,893	1,301	10,194	4,681	14,875	7,916	997	8,913	4,018	12,931
1975	8,218	1,467	9,685	5,591	15,277	8,949	1,224	10,173	5,218	15,391
1976	7,490	1,174	8,664	6,097	14,762	8,519	1,214	9,733	7,331	17,064
1977	5,646	1,375	7,022	4,927	11,949	6,643	1,525	8,168	7,051	15,219
1978	5,006	1,442	6,448	5,369	11,817	6,290	2,417	8,707	6,676	15,383
1979	4,937	1,322	6,259	3,962	10,221	8,198	2,276	10,474	3,976	14,450
1980	4,945	1,481	6,427	4,239	10,666	8,715	2,118	10,834	1,226	12,059
1981	5,927	1,478	7,405	4,517	11,923	12,506	2,601	15,108	604	15,712
1982	6,272	1,490	7,762	4,921	12,683	15,281	2,487	17,768	1,070	18,838
1983	7,289	1,406	8,695	6,076	14,771	11,926	3,004	14,930	869	15,799
1984	6,443	1,388	7,831	8,429	16,260	12,036	2,553	14,589	3,129	17,718
1985	4,924	1,468	6,391	.	.	13,439	2,083	15,522	.	.
1986	4,084	1,634	5,718	.	.	12,470	2,432	14,901	.	.

TABLE 7.12.

AVERAGE ANNUAL EXVESSEL PRICES
FOR RED SNAPPERS AND GROUPERS IN FLORIDA, 1955-1986
Real Price=Nominal Price/PPI (1967=100)

	Red Snapper		Groupers	
Year	Nominal Price ($/lb.)	Real Price ($/lb.)	Nominal Price ($/lb.)	Real Price ($/lb.)
1955	0.26	0.30	0.10	0.11
1956	0.25	0.27	0.10	0.11
1957	0.26	0.28	0.10	0.10
1958	0.26	0.27	0.11	0.11
1959	0.26	0.28	0.11	0.12
1960	0.26	0.27	0.11	0.12
1961	0.27	0.28	0.10	0.11
1962	0.25	0.26	0.10	0.11
1963	0.26	0.28	0.10	0.10
1964	0.31	0.32	0.11	0.11
1965	0.32	0.33	0.11	0.11
1966	0.35	0.35	0.12	0.13
1967	0.36	0.36	0.14	0.14
1968	0.41	0.40	0.17	0.16
1969	0.53	0.50	0.19	0.18
1970	0.55	0.50	0.18	0.17
1971	0.58	0.51	0.20	0.17
1972	0.68	0.58	0.26	0.22
1973	0.74	0.55	0.29	0.22
1974	0.79	0.49	0.34	0.21
1975	0.84	0.48	0.39	0.22
1976	0.97	0.53	0.46	0.25
1977	1.13	0.58	0.58	0.30
1978	1.34	0.64	0.70	0.33
1979	1.62	0.69	0.79	0.34
1980	1.84	0.68	0.90	0.33
1981	1.94	0.66	1.03	0.35
1982	1.93	0.64	1.01	0.34
1983	1.97	0.65	1.19	0.39
1984	2.13	0.69	1.36	0.44
1985	2.34	0.76	1.53	0.50
1986	2.44	0.81	1.69	0.56

Nominal prices were calculated as exvessel value in Florida divided by landings. Prices are in units of dollars per pound, gutted weights.

TABLE 7.13.

RED SNAPPERS:
COMMERCIAL LANDINGS (1000s) AND EXVESSEL VALUE (1000s) BY GEAR, 1978-1986
(0 means less than 500 pounds or dollars; . means no observations)

Gear		1978	1979	1980	1981	1982	1983	1984	1985	1986
Fish Trawls	Pounds	9	4	1	1	1	3	2	1	2
	Dollars	5	2	1	1	1	3	1	1	1
Shrimp Trawls	Pounds	199	126	169	180	155	212	176	78	56
	Dollars	153	102	170	191	158	262	260	120	57
Fish Traps	Pounds	.	.	1	.	.	.	0	.	.
	Dollars	.	.	2	.	.	.	0	.	.
Gill Nets	Pounds	.	.	.	.	.	.	9	.	.
	Dollars	.	.	.	.	.	.	8	.	.
Handlines	Pounds	4,798	4,592	4,325	4,939	5,287	5,807	4,912	3,810	2,007
	Dollars	5,065	5,946	6,384	7,968	8,558	9,586	8,366	7,206	3,851
Longlines	Pounds	.	.	138	227	295	538	621	268	113
	Dollars	.	.	238	410	535	1,031	1,191	567	231
Unknown	Pounds	.	215	311	578	531	724	723	767	1,906
	Dollars	.	262	481	928	918	1,107	1,296	1,447	3,966
Total	Pounds	5,006	4,937	4,945	5,926	6,271	7,285	6,443	4,924	4,084
	Dollars	5,223	6,313	7,275	9,497	10,169	11,989	11,123	9,341	8,106

TABLE 7.14.

GROUPERS
COMMERCIAL LANDINGS (1000s) AND EXVESSEL VALUE (1000s) BY GEAR, 1978-1986
(0 means less than 500 pounds or dollars; . means no observations)

Gear		1978	1979	1980	1981	1982	1983	1984	1985	1986
Fish Trawls	Pounds	.	.	.	.	.	.	.	.	0
	Dollars	.	.	.	.	.	.	.	.	0
Shrimp Trawls	Pounds	33	19	24	28	32	49	19	15	5
	Dollars	7	4	16	22	26	40	19	17	4
Fish Traps	Pounds	315	149	99	106	125	50	675	962	.
	Dollars	180	101	74	91	101	47	714	1,091	.
Gill Nets	Pounds	.	.	.	.	.	0	.	.	.
	Dollars	.	.	.	.	.	0	.	.	.
Handlines	Pounds	5,926	7,908	7,650	7,812	7,118	6,192	6,652	7,654	278
	Dollars	3,490	5,279	5,841	6,748	5,979	6,086	7,682	10,122	322
Longlines	Pounds	.	59	904	4,200	7,797	5,353	4,451	4,374	810
	Dollars	.	37	662	3,761	6,763	5,524	5,210	5,713	1,044
Spears	Pounds	.	.	.	.	0	.	1	17	.
	Dollars	.	.	.	.	0	.	0	8	.
Diving Outfits	Pounds	15	49	16	45	49	36	17	35	.
	Dollars	8	30	8	32	33	25	12	32	.
Unknown	Pounds	.	14	21	316	160	244	221	382	11,377
	Dollars	.	7	9	257	112	230	206	367	16,226
Total	Pounds	6,290	8,199	8,715	12,506	15,281	11,925	12,036	13,439	12,470
	Dollars	3,684	5,457	6,611	10,911	13,014	11,952	13,843	17,351	17,597

TABLE 7.15.

OTHER (THAN RED) SNAPPERS
COMMERCIAL LANDINGS (1000s) AND EXVESSEL VALUE (1000s) BY GEAR, 1978-1986
(0 means less than 500 pounds or dollars; . means no observations)

Gear		1978	1979	1980	1981	1982	1983	1984	1985	1986
Haul Seines	Pounds	30	39	10	4	1	1	.	.	.
	Dollars	12	20	9	3	1	1	.	.	.
Shrimp Trawls	Pounds	.	.	18	14	11	11	5	5	24
	Dollars	.	.	12	9	7	7	7	5	28
Fish Traps	Pounds	82	161	93	72	45	64	55	72	.
	Dollars	57	159	105	84	53	72	66	90	.
Other Traps	Pounds	.	.	.	13	11	2	6	6	.
	Dollars	.	.	.	16	13	3	6	7	.
Gill Nets	Pounds	325	333	124	107	138	140	290	235	.
	Dollars	102	145	83	76	121	125	327	282	.
Trammel Nets	Pounds	42	38	35	37	30	27	6	4	.
	Dollars	13	15	18	22	19	18	7	4	.
Handlines	Pounds	1,864	1,675	1,659	1,787	2,810	2,453	2,381	2,435	662
	Dollars	1,557	1,585	1,670	1,939	3,250	2,805	3,117	3,398	891
Longlines	Pounds	.	.	35	115	181	232	165	148	24
	Dollars	.	.	23	131	204	275	227	199	33
Spears	Pounds	.	.	.	.	.	.	.	1	.
	Dollars	.	.	.	.	.	.	.	2	.
Diving Outfits	Pounds	14	12	26	11	7	7	.	.	.
	Dollars	11	11	28	12	8	7	.	.	.
Unknown	Pounds	.	0	.	.	.	.	1	37	3,095
	Dollars	.	0	.	.	.	.	0	43	4,350
Total	Pounds	2,357	2,258	2,000	2,160	3,235	2,937	2,910	2,942	3,804
	Dollars	1,752	1,937	1,947	2,292	3,676	3,313	3,756	4,030	5,302

TABLE 7.16.

OTHER REEF FISH
COMMERCIAL LANDINGS (1000s) AND EXVESSEL VALUE (1000s) BY GEAR, 1978-1986
(0 means less than 500 pounds or dollars; . means no observations)

Gear		1978	1979	1980	1981	1982	1983	1984	1985	1986
Haul Seines	Pounds	25	31	2	0	.	.	41	20	.
	Dollars	4	8	0	0	.	.	11	10	.
Shrimp Trawls	Pounds	3	3	5	2	.	.	2	6	0
	Dollars	1	1	1	0	.	.	1	3	0
Fish Traps	Pounds	54	37	22	27	15	8	21	25	.
	Dollars	10	10	7	9	5	2	9	15	.
Other Traps	Pounds	.	.	.	.	2	.	1	[illegible]	.
	Dollars	.	.	.	.	1	.	1	3	.
Gill Nets	Pounds	65	44	11	4	5	7	59	60	.
	Dollars	12	9	3	2	2	2	17	34	.
Trammel Nets	Pounds	1	4	0	0	0	0	10	10	.
	Dollars	0	1	0	0	0	0	3	5	.
Handlines	Pounds	631	717	615	942	856	759	1,074	1,223	315
	Dollars	166	219	213	371	330	307	520	649	162
Trolling lines	Pounds	.	.	.	1	.	0	.	7	0
	Dollars	.	.	.	0	.	0	.	2	0
Longlines	Pounds	.	24	37	176	240	139	357	463	299
	Dollars	.	9	16	82	117	60	236	275	180
Spears	Pounds	.	.	.	.	.	.	0	3	.
	Dollars	.	.	.	.	.	.	0	2	.
Diving Outfits	Pounds	1	2	2	6	2	2	4	2	.
	Dollars	0	1	1	4	1	1	3	2	.
Other	Pounds	1	0	.	.	.	.	1	1	0
	Dollars	0	0	.	.	.	.	0	0	0
Unknown	Pounds	.	1	.	.	.	.	94	155	1,954
	Dollars	.	0	.	.	.	.	73	162	1,099
Total	Pounds	780	862	695	1,157	1,121	915	1,662	1,979	2,569
	Dollars	194	259	241	468	456	372	873	1,162	1,441

Table 7.17.

Numbers of Fishing Craft and Fishermen
Using Handlines and Reef Fish Longlines
in the Gulf of Mexico, 1978-1986

	Handlines		Longlines		Total	
Year	Craft	Men	Craft	Men	Craft	Men
1978	529	1806	0	0	529	1806
1979	565	1931	3	3	568	1934
1980	779	2586	85	308	841	2818
1981	700	2298	239	906	853	2922
1982	666	2233	282	1074	862	3019
1983	544	1768	231	878	775	2646
1984	593	1927	251	954	844	2881
1985	572	1859	255	969	827	2828
1986	610	1983	242	920	852	2903

Source for 1978-1982: Vessel Operating Units File, unpublished data from the National Marine Fisheries Service, Southeast Fisheries Center, Office of Economics and Statistics, Beaufort Laboratory, Beaufort, N.C. 28516 (Attn: Kenneth Harris).

Source for 1983-1986: Preliminary data from the National Marine Fisheries Service, Southeast Fisheries Center, Office of Economics and Statistics, 75 Virginia Beach Drive, Miami, Florida 33149 (Attn: Ernest Snell).

Notes: The number of fishing craft using handlines is the number of vessels (craft>5 gross tons) although actual species sought is not known. The number of craft using reef fish longlines is the sum of vessels (craft>5 gross tons) and boats (craft<5 gross tons). Total number of fishing craft excludes duplication of craft that use both gears. The total number of fishermen exclusive of duplication was estimated as the total for handlines and longlines minus the average number of men per handline vessel multiplied by the number of vessels that used both gears.

Table 7.18.

Numbers of Fishing Craft and Fishermen
Using Fish Traps
in the Gulf of Mexico, 1978-1986

Year	Craft	Men	Traps
1978	32	68	2102
1979	38	83	2284
1980	36	68	1434
1981	35	66	1404
1982	13	30	534
1983	18	47	540
1984	43	107	1290
1985	60	150	1800
1986	50	125	1500

Source for 1978-1982: Vessel Operating Units File, unpublished data from the National Marine Fisheries Service, Southeast Fisheries Center, Office of Economics and Statistics, Beaufort Laboratory, Beaufort, N.C. 28516 (Attn: Kenneth Harris).

Source for 1983-1986: Preliminary data from the National Marine Fisheries Service, Southeast Fisheries Center, Office of Economics and Statistics, 75 Virginia Beach Drive, Miami, Florida 33149 (Attn: Ernest Snell).

Notes: Some fishing craft also used handlines and/or longlines. Hence, these data cannot be added to data about handlines and longlines to derive estimates of total employment in the fishery.

TABLE 7.19.

MEASURES OF EFFORT AND PRODUCTIVITY
FOR COMMERCIAL REEF FISH TRIPS IN LOUISIANA, 1984-1986

Variable	Gear Type	Year	Number of Interviews	Minimum Response	Maximum Response	Mean	Standard Deviation	Median
Pounds Per Trip	Bandit Reels	1984	43	40	9098	2441.9	2641.7	1082
		1985	82	13	10270	1796.3	2214.4	795
		1986	56	54	10076	3149.9	2382.6	2974
	Buoys	1984	10	167	3472	1409.8	1076.5	1257
		1985	43	33	7088	1448.0	1602.4	1000
		1986	43	36	4054	1186.6	855.3	1057
	Longlines	1984	14	840	10790	5022.1	3179.2	4418
		1985	40	3	10137	3638.4	2850.7	2624
		1986	37	16	8440	2900.9	2326.7	1968
Calendar Days Fished Per Trip	Bandit Reels	1984	43	1	12	3.9	2.7	3
		1985	82	1	12	4.2	3.0	3
		1986	56	1	14	6.1	3.1	6
	Buoys	1984	10	2	6	3.7	1.3	4
		1985	42	1	11	4.2	3.0	3
		1986	42	1	13	3.7	2.4	3
	Longlines	1984	14	2	13	7.3	3.3	7
		1985	37	1	12	5.7	2.9	6
		1986	37	1	10	4.4	1.9	4
Number of Persons Aboard	Bandit Reels	1984	43	2	7	3.8	1.7	4
		1985	82	1	9	4.0	1.8	4
		1986	56	2	9	4.5	1.8	4
	Buoys	1984	10	2	7	3.7	1.9	3
		1985	42	2	7	3.2	1.2	3
		1986	42	2	6	3.2	1.0	3
	Longlines	1984	14	3	6	4.5	0.9	5
		1985	37	2	8	3.4	1.2	3
		1986	36	2	5	3.3	0.7	3
Pounds Per Day Fished	Bandit Reels	1984	43	14	3033	588.0	577.6	409
		1985	82	1	2285	393.6	394.6	290
		1986	56	11	2519	508.2	386.3	443
	Buoys	1984	10	56	1422	434.1	403.4	363
		1985	42	11	1484	392.4	322.3	294
		1986	42	9	2702	465.1	496.5	371
	Longlines	1984	14	254	1541	721.6	388.9	717
		1985	37	8	1820	648.8	470.2	477
		1986	37	3	4220	728.7	716.5	564
Pounds Per Man Per Day Fished	Bandit Reels	1984	43	7	607	151.4	123.8	128
		1985	82	0	381	90.5	62.9	89
		1986	56	3	630	115.2	88.4	100
	Buoys	1984	10	9	237	120.6	79.4	115
		1985	42	6	371	125.2	97.8	103
		1986	41	2	993	163.5	197.1	130
	Longlines	1984	14	51	514	184.5	148.2	133
		1985	37	3	850	203.7	161.9	154
		1986	36	1	2110	245.2	344.7	154

Source: Unpublished trip interview data as of September 9, 1988, from the National Marine Fisheries Service, Southeast Fisheries Center, Office of Economics and Statistics, 75 Virginia Beach Drive, Miami, Florida 33149.

TABLE 7.20.

MEASURES OF EFFORT AND PRODUCTIVITY
FOR COMMERCIAL REEF FISH TRIPS ALONG THE WEST COAST OF FLORIDA, 1984-1986

Variable	Gear Type	Year	Number of Interviews	Minimum Response	Maximum Response	Mean	Standard Deviation	Median
Pounds Per Trip	Handlines	1984	126	2	11964	2630.1	2620.6	1660
		1985	101	198	11583	2363.5	2345.9	1453
		1986	23	100	6576	1665.3	1512.7	1189
	Longlines	1984	73	21	21084	4617.7	3905.2	4337
		1985	59	189	18286	4172.3	3040.9	3668
		1986	178	21	11355	2648.6	2398.9	1913
Calendar Days Fished Per Trip	Handlines	1984	53	0	13	5.3	3.5	5
		1985	58	1	12	3.3	2.6	3
		1986	14	1	12	7.1	3.0	8
	Longlines	1984	43	2	16	7.7	4.2	7
		1985	29	2	17	7.1	3.1	7
		1986	94	1	15	6.4	3.9	6
Number of Persons Aboard	Handlines	1984	69	1	8	3.9	1.9	4
		1985	52	2	7	4.5	1.4	5
		1986	18	1	6	2.3	1.1	2
	Longlines	1984	41	2	5	3.8	0.8	4
		1985	30	2	5	3.1	0.8	3
		1986	120	1	5	2.8	1.0	3
Pounds Per Day Fished	Handlines	1984	53	19	2117	699.8	431.8	653
		1985	58	44	2267	676.9	484.7	537
		1986	14	89	1644	326.6	396.2	231
	Longlines	1984	43	10	1984	715.8	380.1	683
		1985	29	86	1199	621.8	270.9	606
		1986	94	12	1143	428.3	275.6	351
Pounds Per Man Per Day Fished	Handlines	1984	48	10	423	146.4	76.6	136
		1985	50	15	756	151.1	120.9	121
		1986	13	43	274	122.7	72.7	110
	Longlines	1984	33	41	397	188.8	87.6	186
		1985	26	22	400	215.4	97.4	211
		1986	75	6	550	146.2	88.4	147

Source: Unpublished trip interview data as of September 9, 1988, from the National Marine Fisheries Service, Southeast Fisheries Center, Office of Economics and Statistics, 75 Virginia Beach Drive, Miami, Florida 33149.

TABLE 7.21.
ESTIMATED CATCH BY SPECIES GROUP
NUMBERS OF REEF FISH CAUGHT BY RECREATIONAL FISHERMEN IN THE GULF OF MEXICO, 1979-1986
(0 means less than 500 fish or pounds; . means no observations)
Source: NMFS, Marine Recreational Fishery Statistics Survey (MRFSS)

Species-Group	Year	Est. Total (A+B1+B2 in 1000s)	S.E. Total (1000s)	Est. A (1000s)	S.E. A (1000s)	Est. B1 (1000s)	S.E. B1 (1000s)	Est. B2 (1000s)	S.E. B2 (1000s)	Est. Wgt A (1000 Pounds)
Red Snapper	1979	5,966	974	3,686	718	1,762	524	518	397	3,178
	1980	4,146	428	2,223	229	1,842	361	81	25	5,813
	1981	4,891	1,238	2,783	1,014	2,040	711	67	22	5,503
	1982	3,792	1,464	3,034	1,423	699	342	58	36	4,306
	1983	3,618	973	3,291	964	322	132	4	3	3,537
	1984	1,296	326	623	190	650	264	23	19	963
	1985	1,954	440	1,459	369	217	96	278	220	4,111
	1986	645	189	443	181	178	53	24	8	927
Gray Snapper	1979	2,126	1,340	1,562	1,325	553	199	11	8	1,781
	1980	845	130	459	89	222	85	163	42	489
	1981	718	130	258	82	314	90	145	47	331
	1982	6,490	2,995	1,439	751	2,562	2,075	2,490	2,026	1,237
	1983	2,959	1,051	1,256	568	271	96	1,433	879	1,007
	1984	3,012	736	781	282	1,916	670	315	115	608
	1985	1,657	399	502	173	486	228	669	278	813
	1986	1,561	318	493	145	568	199	500	202	445
Lane Snapper	1979	38	17	38	17	0	0	0	0	19
	1980	109	27	74	20	17	14	18	12	127
	1981	363	149	346	149	17	13	0	0	110
	1982	410	115	247	94	140	67	23	12	208
	1983	336	123	256	114	9	7	70	44	152
	1984	800	516	52	31	721	515	26	21	15
	1985	284	264	284	264	0	0	0	0	105
	1986	174	42	73	25	35	15	66	29	81
Vermilion Snapper	1979	768	382	698	381	27	15	43	24	485
	1980	670	143	340	65	330	128	1	1	134
	1981	219	65	151	52	68	40	0	0	94
	1982	1,202	458	1,185	458	8	8	9	9	1,216
	1983	250	65	138	53	67	34	44	17	99
	1984	420	161	390	161	14	7	16	6	208
	1985	462	179	144	64	292	167	26	13	120
	1986	303	106	95	85	159	59	50	22	152
Yellowtail Snapper	1979	399	397	3	2	0	0	397	397	1
	1980	247	54	90	39	53	22	104	30	62
	1981	1,494	646	1,312	642	91	51	90	43	969
	1982	2,161	837	1,414	787	349	192	398	212	2,033
	1983	930	344	539	294	136	50	255	173	433
	1984	2,119	492	506	255	886	361	727	215	408
	1985	535	252	333	239	107	59	95	51	434
	1986	302	78	100	36	101	62	101	30	163
Other Snappers	1979	252	83	71	16	126	80	55	18	13
	1980	273	52	183	44	48	18	41	20	170
	1981	683	220	264	111	300	182	118	50	200
	1982	882	217	479	174	155	76	248	107	1,805
	1983	329	97	216	88	62	30	51	26	713
	1984	1,212	357	359	135	610	315	243	98	263
	1985	187	47	76	29	60	27	51	24	149
	1986	200	81	30	11	39	14	131	79	88

(Continued)

TABLE 7.21. (continued)

Species-Group	Year	Est. Total (A+B1+B2 in 1000s)	S.E. Total (1000s)	Est. A (1000s)	S.E. A (1000s)	Est. B1 (1000s)	S.E. B1 (1000s)	Est. B2 (1000s)	S.E. B2 (1000s)	Est. Wgt A (1000 Pounds)
Red Grouper	1979	213	119	198	119	10	7	4	4	1,058
	1980	185	32	144	24	33	20	8	4	588
	1981	577	183	208	94	273	154	96	32	933
	1982	627	176	297	118	230	118	101	58	1,489
	1983	727	153	464	136	74	21	189	67	1,700
	1984	1,615	401	360	128	871	354	383	137	1,337
	1985	974	232	200	84	648	213	126	40	997
	1986	1,067	238	225	159	411	127	431	123	738
Gag and Black Groupers	1979	756	373	149	27	136	38	471	370	793
	1980	638	111	393	73	136	65	108	52	1,625
	1981	819	151	248	46	182	58	388	131	1,105
	1982	970	194	420	142	389	123	161	48	2,796
	1983	1,332	403	780	375	100	33	452	145	2,982
	1984	768	211	484	197	137	65	146	43	1,497
	1985	1,278	278	623	173	335	162	320	146	3,762
	1986	904	164	176	51	380	119	348	100	901
Other Groupers	1979	108	57	93	57	9	5	6	3	1,182
	1980	105	14	41	9	43	11	20	3	756
	1981	318	236	233	234	78	25	7	4	921
	1982	638	202	275	110	156	65	208	156	3,160
	1983	154	34	123	32	24	11	8	5	412
	1984	269	124	119	50	101	56	49	99	463
	1985	631	345	376	324	71	42	184	111	1,592
	1986	254	72	109	53	31	15	114	46	890
Sea Basses	1979	3,231	939	1,390	915	428	139	1,413	158	712
	1980	1,182	142	412	96	198	53	571	90	247
	1981	845	197	298	99	194	112	354	128	197
	1982	4,150	1,317	1,329	380	288	99	2,533	1,257	885
	1983	1,930	457	778	282	48	23	1,104	359	345
	1984	1,175	362	304	85	93	49	778	348	267
	1985	7,321	2,149	2,302	1,577	1,283	567	3,735	1,345	1,863
	1986	2,390	329	536	209	688	165	1,166	193	481
White Grunt	1979	2,885	327	747	148	872	225	1,265	184	582
	1980	1,688	344	260	31	197	50	1,232	339	239
	1981	3,162	1,693	2,456	1,684	217	70	489	164	1,106
	1982	3,068	822	631	136	1,206	775	1,231	237	614
	1983	2,782	437	782	205	601	147	1,399	357	333
	1984	3,575	895	1,187	610	716	349	1,672	554	436
	1985	3,973	1,266	1,892	923	1,010	699	1,071	514	1,334
	1986	992	151	314	78	128	49	550	120	191
Other Grunts	1979	468	231	108	71	297	217	63	34	36
	1980	1,939	276	169	24	678	210	1,092	176	54
	1981	1,800	318	510	207	469	130	821	204	344
	1982	2,169	416	754	321	225	70	1,190	256	504
	1983	1,439	266	238	83	228	99	974	232	73
	1984	1,227	413	86	32	244	101	897	399	26
	1985	1,751	302	170	61	234	59	1,346	290	46
	1986	1,039	241	106	47	124	73	809	225	31

(Continued)

TABLE 7.21. (continued)

Species-Group	Year	Est. Total (A+B1+B2 in 1000s)	S.E. Total (1000s)	Est. A (1000s)	S.E. A (1000s)	Est. B1 (1000s)	S.E. B1 (1000s)	Est. B2 (1000s)	S.E. B2 (1000s)	Est. Wgt A (1000 Pounds)
Porgies	1979	11,977	963	1,146	318	2,775	456	8,056	787	261
	1980	13,358	1,184	1,431	163	2,855	396	9,072	1,104	505
	1981	11,128	1,238	1,087	275	2,251	423	7,790	1,130	710
	1982	12,830	1,251	2,552	793	2,840	431	7,438	866	1,569
	1983	11,602	1,967	544	111	2,137	383	8,921	1,927	225
	1984	8,592	1,048	852	207	2,881	529	4,859	881	279
	1985	10,494	1,113	750	213	3,182	545	6,562	947	478
	1986	7,425	882	854	296	2,995	695	3,576	454	220
Tilefishes	1979	5	4	5	4	0	0	0	0	18
	1980	0	0	0	0	0	0	0	0	1
	1981	37	24	34	24	3	3	0	0	126
	1982	305	150	24	22	0	0	281	148	8
Gray Triggerfish	1979	1,037	348	922	347	33	12	81	26	1,292
	1980	716	133	387	65	223	108	106	41	741
	1981	729	228	403	199	179	77	147	81	604
	1982	2,316	1,568	1,943	1,561	242	132	131	62	3,668
	1983	164	31	88	25	42	16	33	11	225
	1984	221	130	55	21	29	13	137	127	137
	1985	203	59	109	49	43	26	51	21	229
	1986	214	69	32	12	127	46	55	50	100
Amberjacks	1979	215	107	102	52	102	93	12	6	1,370
	1980	294	55	121	18	130	50	44	14	4,193
	1981	237	72	187	68	41	25	9	6	1,428
	1982	1,320	781	1,177	779	80	33	64	32	9,201
	1983	320	80	173	57	62	20	84	52	1,791
	1984	154	37	96	32	38	15	21	10	1,124
	1985	275	61	227	55	46	26	1	1	2,111
	1986	320	58	82	27	146	46	92	24	1,266
Total	1979	30,444	6,661	10,918	4,517	7,130	2,010	12,395	2,416	12,781
	1980	26,395	3,125	6,727	989	7,005	1,591	12,661	1,953	15,744
	1981	28,020	6,788	10,778	4,980	6,717	2,164	10,521	2,042	14,681
	1982	43,330	12,963	17,200	8,049	9,569	4,606	16,564	5,522	34,699
	1983	28,872	6,481	9,666	3,387	4,183	1,102	15,021	4,297	14,027
	1984	26,455	6,209	6,254	2,416	9,907	3,663	10,292	3,072	8,031
	1985	31,979	7,386	9,447	4,597	8,014	2,916	14,515	4,001	18,144
	1986	17,790	3,018	3,668	1,415	6,110	1,737	8,013	1,705	6,674

TABLE 7.22.
ESTIMATED TOTAL CATCH (TYPES A+B1+B2) BY STATE AND SPECIES
NUMBERS OF REEF FISH CAUGHT BY RECREATIONAL FISHERMEN IN THE GULF OF MEXICO, 1979-1986
(0 means less than 500 fish; . means no observations)
Source: NMFS, Marine Recreational Fishery Statistics Survey (MRFSS)

Group	Year	Alabama		Florida		Louisiana		Mississippi		Texas		Total	
		Est. Total (1000s)	S.E. Total (1000s)	Est. Total (1000s)	S.E. Total (1000s)	Est. Total (1000s)	S.E. Total (1000s)	Est. Total (1000s)	S.E. Total (1000s)	Est. Total (1000s)	S.E. Total (1000s)	Est. Total (1000s)	S.E. Total (1000s)
Snappers	1979	1,410	158	4,988	1,632	862	273	1	1	2,288	540	9,549	2,604
	1980	104	23	2,904	269	1,598	231	58	20	1,626	316	6,290	859
	1981	1,079	368	3,869	732	2,771	1,048	.	.	647	522	8,366	2,670
	1982	635	322	11,521	3,161	2,752	1,410	29	16	.	.	14,937	4,909
	1983	1,385	675	4,898	1,128	2,066	686	8	8	64	33	8,421	2,530
	1984	893	269	7,214	1,082	711	255	0	0	40	22	8,858	1,628
	1985	453	168	3,331	580	612	243	2	2	682	312	5,080	1,305
	1986	253	128	2,613	350	302	154	17	11	.	.	3,185	643
Groupers	1979	4	1	1,044	395	6	4	.	.	23	19	1,077	419
	1980	.	.	909	116	5	1	2	1	12	1	928	119
	1981	10	4	1,703	334	.	.	.	.	1	1	1,714	339
	1982	23	14	2,184	330	13	5	15	5	.	.	2,235	354
	1983	2	1	2,186	432	26	16	.	.	.	.	2,214	449
	1984	1	1	2,429	432	7	3	0	0	214	185	2,651	621
	1985	26	12	2,849	500	8	6	.	.	.	.	2,883	518
	1986	14	8	2,194	297	13	8	5	7	.	.	2,226	320
Other Reef Fish	1979	503	82	17,954	1,430	75	14	53	11	1,233	223	19,818	1,760
	1980	175	30	14,183	1,087	596	134	469	422	3,753	509	19,176	2,182
	1981	219	68	11,924	1,917	374	109	147	48	5,276	950	17,940	3,092
	1982	179	69	22,277	2,653	522	147	155	33	3,026	417	26,159	3,319
	1983	584	189	14,895	2,022	728	360	165	56	1,864	300	18,236	2,927
	1984	205	54	13,548	1,483	175	35	229	74	787	101	14,944	1,747
	1985	383	85	20,262	2,683	1,031	518	95	32	2,246	288	24,017	3,606
	1986	237	48	11,431	972	396	99	315	136	.	.	12,379	1,255
Total	1979	1,917	241	23,986	3,457	943	291	54	12	3,544	782	30,444	4,783
	1980	279	53	17,996	1,472	2,199	366	529	443	5,391	826	26,394	3,160
	1981	1,308	440	17,496	2,983	3,145	1,157	147	48	5,924	1,473	28,020	6,101
	1982	837	405	35,982	6,144	3,287	1,562	199	54	3,026	417	43,331	8,582
	1983	1,971	865	21,979	3,582	2,820	1,062	173	64	1,928	333	28,871	5,906
	1984	1,099	324	23,191	2,997	893	293	229	74	1,041	308	26,453	3,996
	1985	862	265	26,442	3,763	1,651	767	97	34	2,928	600	31,980	5,429
	1986	504	184	16,238	1,619	711	261	337	154	.	.	17,790	2,218

Notes:

Est. A = the estimated number of type A fish caught (in thousands), based on the number of whole fish available for inspection (catch type A) by MRFSS interviewers.

S.E. A = the standard error of the estimate of catch type A, in thousands of fish.

Est. B1= the estimated number of type B1 fish caught, based on fish that were not available for inspection in whole form (i.e., fish that were filleted, used for bait, discarded dead, etc.).

Est. B2= the estimated number of fish that were caught and released alive (catch type B2).

TABLE 7.23.
ESTIMATED TOTAL CATCH (TYPES A+B1+B2) BY MODE OF FISHING AND SPECIES
NUMBERS OF REEF FISH CAUGHT BY RECREATIONAL FISHERMEN IN THE GULF OF MEXICO, 1979-1986
(0 means less than 500 fish; . means no observations)
Source: NMFS, Marine Recreational Fishery Statistics Survey (MRFSS)

Species-Group	Year	Shore		Charter boat		Party/charter		Private/rental		Total	
		Est. Total (1000s)	S.E. Total (1000s)	Est. Total (1000s)	S.E. Total (1000s)	Est. Total (1000s)	S.E. Total (1000s)	Est. Total (1000s)	S.E. Total (1000s)	Est. Total (1000s)	S.E. Total (1000s)
Snappers	1979	1,419	743	.	.	5,008	1,609	3,122	335	9,549	2,687
	1980	315	58	.	.	2,921	350	3,054	318	6,290	726
	1981	331	71	.	.	3,815	1,086	4,220	926	8,366	2,083
	1982	662	125	.	.	11,287	3,426	2,987	580	14,936	4,131
	1983	2,726	1,065	.	.	3,488	836	2,206	659	8,420	2,560
	1984	881	185	.	.	2,436	456	5,542	1,041	8,859	1,682
	1985	310	83	.	.	1,513	344	3,257	631	5,080	1,058
	1986	875	237	662	152	.	.	1,647	288	3,184	677
Groupers	1979	490	523	.	.	192	125	394	60	1,076	708
	1980	57	19	.	.	307	35	565	109	929	163
	1981	145	47	.	.	1,041	320	528	89	1,714	456
	1982	32	13	.	.	571	164	1,632	287	2,235	464
	1983	77	36	.	.	421	64	1,715	426	2,213	526
	1984	306	189	.	.	602	183	1,743	390	2,651	762
	1985	27	8	.	.	871	188	1,984	464	2,882	660
	1986	87	26	202	31	.	.	1,937	295	2,226	352
Other Reef Fish	1979	7,688	1,265	.	.	1,981	1,001	10,149	540	19,818	2,806
	1980	9,274	1,474	.	.	1,749	201	8,153	638	19,176	2,313
	1981	9,255	1,453	.	.	1,540	324	7,145	1,803	17,940	3,580
	1982	10,035	1,145	.	.	7,323	2,296	8,800	1,096	26,158	4,537
	1983	9,149	2,068	.	.	1,482	250	7,606	826	18,237	3,144
	1984	5,977	870	.	.	953	189	8,013	1,337	14,943	2,396
	1985	7,340	1,162	.	.	1,823	345	14,855	2,600	24,018	4,107
	1986	5,397	812	983	170	.	.	6,000	535	12,380	1,517
Total	1979	9,597	2,531	.	.	7,181	2,735	13,665	935	30,443	6,201
	1980	9,646	1,551	.	.	4,977	586	11,772	1,065	26,395	3,202
	1981	9,731	1,571	.	.	6,396	1,730	11,893	2,818	28,020	6,119
	1982	10,729	1,283	.	.	19,181	5,886	13,419	1,963	43,329	9,132
	1983	11,952	3,169	.	.	5,391	1,150	11,527	1,911	28,870	6,230
	1984	7,164	1,244	.	.	3,991	828	15,298	2,768	26,453	4,840
	1985	7,677	1,253	.	.	4,207	877	20,096	3,695	31,980	5,825
	1986	6,359	1,075	1,847	353	.	.	9,584	1,118	17,790	2,546

Notes:

Est. A = the estimated number of type A fish caught (in thousands), based on the number of whole fish available for inspection (catch type A) by MRFSS interviewers.

S.E. A = the standard error of the estimate of catch type A, in thousands of fish.

Est. B1= the estimated number of type B1 fish caught, based on fish that were not available for inspection in whole form (i.e., fish that were filleted, used for bait, discarded dead, etc.).

Est. B2= the estimated number of fish that were caught and released alive (catch type B2).

TABLE 7.24.

ESTIMATED TOTAL CATCH (TYPES A+B1+B2) BY DISTANCE FROM SHORE AND SPECIES
NUMBERS OF REEF FISH CAUGHT BY RECREATIONAL FISHERMEN IN THE GULF OF MEXICO, 1979-1986
(0 means less than 500 fish; . means no observations)
Source: NMFS, Marine Recreational Fishery Statistics Survey (MRFSS)

Group	Year	Ocean (<=3 mi)		Ocean (> 3 mi)		Ocean (<=10mi)		Ocean (>10 mi)		Inland		Unknown		Total	
		Est. Total 1000s	S.E. Total 1000s	Est. Total 1000s	S.E. Total 1000s	Est. Total 1000s	S.E. Total 1000s	Est. Total 1000s	S.E. Total 1000s	Est. Total 1000s	S.E. Total 1000s	Est. Total 1000s	S.E. Total 1000s	Est. Total 1000s	S.E. Total 1000s
Snappers	1979	1,393	596	4,302	621	.	.	.	.	2,269	1,379	1,585	643	9,549	3,239
	1980	173	47	3,007	386	742	143	1,634	198	397	107	337	67	6,290	948
	1981	975	191	5,372	1,263	453	486	812	241	89	54	665	335	8,366	2,570
	1982	6,598	2,919	4,540	1,640	945	278	2,636	888	138	65	80	53	14,937	5,843
	1983	3,178	1,041	2,010	685	147	125	860	269	122	42	2,103	746	8,420	2,908
	1984	3,272	589	1,488	367	2,255	708	1,482	565	199	74	163	57	8,859	2,360
	1985	19	9	990	291	2,533	539	1,401	377	85	33	53	44	5,081	1,293
	1986	32	19	544	200	2,029	335	444	84	134	51	.	.	3,183	689
Groupers	1979	519	371	207	50	.	.	.	.	351	129	.	.	1,077	550
	1980	35	7	147	45	224	83	331	41	162	53	29	11	928	240
	1981	223	52	124	35	68	27	1,151	228	19	7	129	234	1,714	583
	1982	781	191	369	167	142	45	819	194	115	73	10	5	2,236	675
	1983	736	173	26	16	209	84	1,084	384	73	35	86	28	2,214	720
	1984	963	234	4	2	592	186	1,015	345	51	53	25	97	2,650	917
	1985	4	2	29	13	860	239	1,882	431	107	82	.	.	2,882	767
	1986	2	2	43	17	641	70	1,521	289	19	11	.	.	2,226	389
Other Reef Fish	1979	2,534	328	3,777	419	.	.	.	.	13,396	1,338	111	171	19,818	2,256
	1980	1,135	502	991	156	2,105	367	1,448	220	8,652	656	4,846	865	19,177	2,766
	1981	7,544	1,005	3,265	1,705	691	182	1,509	341	3,185	438	1,746	584	17,940	4,255
	1982	12,277	992	1,766	810	1,825	533	5,913	2,236	3,671	522	707	199	26,159	5,292
	1983	10,979	1,728	451	250	1,382	310	2,083	433	2,647	980	694	232	18,236	3,933
	1984	10,200	1,222	92	29	1,580	294	1,086	400	1,342	282	643	632	14,943	2,859
	1985	1,085	171	169	45	12,535	1,677	7,212	2,086	2,981	602	34	26	24,016	4,607
	1986	271	70	93	29	6,800	622	2,132	336	3,083	685	.	.	12,379	1,742
Total	1979	4,446	1,295	8,286	1,090	.	.	.	.	16,016	2,846	1,696	814	30,444	6,045
	1980	1,343	556	4,145	587	3,071	593	3,413	459	9,211	816	5,212	943	26,395	3,954
	1981	8,742	1,248	8,761	3,003	1,212	695	3,472	810	3,293	499	2,540	1,153	28,020	7,408
	1982	19,656	4,102	6,675	2,617	2,912	856	9,368	3,318	3,924	660	797	257	43,332	11,810
	1983	14,893	2,942	2,487	951	1,738	519	4,027	1,086	2,842	1,057	2,883	1,006	28,870	7,561
	1984	14,435	2,045	1,584	398	4,427	1,188	3,583	1,310	1,592	409	831	786	26,452	6,136
	1985	1,108	182	1,188	349	15,928	2,455	10,495	2,894	3,173	717	87	70	31,979	6,667
	1986	305	91	680	246	9,470	1,027	4,097	709	3,236	747	.	.	17,788	2,820

Notes:

Est. A = the estimated number of type A fish caught (in thousands), based on the number of whole fish available for inspection (catch type A) by MRFSS interviewers.

S.E. A = the standard error of the estimate of catch type A, in thousands of fish.

Est. B1= the estimated number of type B1 fish caught, based on fish that were not available for inspection in whole form (i.e., fish that were filleted, used for bait, discarded dead, etc.).

Est. B2= the estimated number of fish that were caught and released alive (catch type B2).

Table 7.25.

Marine Recreational Fishing Effort Estimated by the Marine Recreational Fishery Statistics Survey (MRFSS)

		Number of Fishing Trips (Thousands)							
		1979	1980	1981	1982	1983	1984	1985	1986
Florida	Trips	10,750	11,904	9,217	12,103	10,224	11,451	13,372	13,436
	s.e.	846	995	2,124	2,989	1,482	911	1,325	1,070
Alabama	Trips	1,012	989	523	962	1,139	521	603	675
	s.e.	187	267	105	225	295	78	91	109
Mississippi	Trips	655	1,319	581	576	909	546	536	672
	s.e.	87	306	136	104	163	97	67	178
Louisiana	Trips	3,170	2,994	1,611	2,167	2,862	1,434	2,446	3,114
	s.e.	405	351	203	285	315	163	495	425
Texas	Trips	5,685	7,265	7,157	4,712	5,365	2,445	7,270	-
	s.e.	467	655	838	435	426	244	692	-
Total	Trips	21,273	24,471	19,089	20,520	20,500	16,397	24,227	17,897*
	s.e.	1,067	1,306	2,299	3,044	1,609	965	1,578	1,170*

* The estimates for 1986 exclude fishing trips in Texas and trips on headboats elsewhere in the gulf.

TABLE 7.26.

Distribution of reef fish vessels by state and gear type fishing in the Gulf of Mexico, 1982 - 1986. *

Year	State	Number of vessels: Traps	Stabnet	Handline	Longline	Totals
1982	FL	10	0	603	205	818
	AL	0	0	7	0	7
	MS	0	0	12	0	12
	LA	0	0	0	0	0
	TX	0	0	67	36	103
	Totals	10	0	689	241	940
1983	FL	18	17	497	192	724
	AL	0	0	7	0	7
	MS	0	0	12	0	12
	LA	0	0	0	0	0
	TX	0	0	28	0	28
	Totals	18	17	544	192	771
1984	FL	43	35	502	202	782
	AL	0	0	7	1	8
	MS	0	0	12	0	12
	LA	0	0	46	3	49
	TX	0	0	26	45	71
	Totals	43	35	593	251	922
1985	FL	60	33	481	224	798
	AL	0	0	7	1	8
	MS	0	0	12	0	12
	LA	0	0	54	4	58
	TX	0	0	18	26	44
	Totals	60	33	572	255	920
1986	FL	50	20	506	207	783
	AL	0	0	7	1	8
	MS	0	0	12	0	12
	LA	0	0	70	9	79
	TX	0	0	15	25	40
	Totals	50	20	610	242	922

*** Personal communication from Ernie Snell, NMFS, December, 1987. There may be some duplication between gears and states due to the flexibility and mobility of reef fish vessels.**

TABLE 7.27

COMMERCIAL LANDINGS OF ALL REEF FISH (EXCLUDING FOREIGN CATCH) BY PERCENT OF CATCH FOR EACH GEAR TYPE FROM 1972-1986.
Data from NMFS Stock Assessment (Goodyear, 1988b).

	Year														
GEAR TYPE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Totals
Hand/Power Lines	0.88	0.89	0.91	0.93	0.96	0.91	0.92	0.92	0.88	0.71	0.62	0.66	0.65	0.65	0.80
Longlines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.08	0.26	0.36	0.31	0.28	0.25	0.13
Fish Traps	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.02	0.01	0.01	0.01	0.00	0.02	0.04	0.01
Shrimp Trawls	0.02	0.04	0.03	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.00	0.02
Fish Trawls	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Misc. Gears	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.01	0.01	0.00	0.01	0.02	0.01	0.01
Unclassified	0.07	0.05	0.04	0.04	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.04	0.02
Totals	18311	16994	18492	19168	17743	14800	13805	15710	15782	20876	25103	22637	22022	22399	263842

Note: 1986 Florida landings by gear type are not presently available.

TABLE 7.28

Gulf of Mexico Reef fish trap catch (pounds) for 1975 - 1985 by major species groups. Only Florida has reported fish trap catch of reef fish.

	Groupers	Grunts	Sea Bass	Snappers
1975	14,600	61,100	22,200	1,400
1976	40,200	3,500	27,900	8,600
1977	154,300	23,000	-	55,700
1978	319,200	31,100	4,000	72,000
1979	126,600	8,500	12,600	146,000
1980	84,116	8,203	6,511	86,054
1981	89,411	14,281	4,096	65,371
1982	106,117	8,901	2,192	41,199
1983	42,650	3,139	2,437	58,290
1984	572,172	11,658	1,449	50,600
1985	815,475	7,945	744	65,242

Data from NMFS General Canvas Landings Data.

TABLE 7.29

AVERAGE BYCATCH OF RED SNAPPER (NUMBERS OF FISH) AND SHRIMP PRODUCTION (POUNDS, HEADS OFF), 1972-1985 (Seasons: warm=May-November; cool=December-April. Zones: west=TX; central=LA-AL; east=W FL.)

SEASON	ZONE	DEPTH	RED SNAPPER	SHRIMP
WARM	WEST	<10 FM	1872528	14574025
		>10 FM	3691828	25935253
	CENTRAL	<10 FM	2254612	17363783
		>10 FM	1876045	7530073
	EAST	<10 FM	191970	1395459
		>10 FM	185610	1155929
COOL	WEST	<10 FM	470443	2762595
		>10 FM	971757	4169932
	CENTRAL	<10 FM	501328	3377172
		>10 FM	511449	2718742
	EAST	<10 FM	66344	793649
		>10 FM	70843	540234
GRAND TOTAL			12664757	82316846

Data from Nichols, personal communication to Gregory, 1988.

TABLE 7.30

Coordinates of stressed area

Point No.	Reference Location[1]	Latitude (North)	Longitude (West)	Loran C Coordinates[2] W	X	Y	Z
1	Key West	24° 33.0'	81° 48.7'	13927.8	30238.2	43654.2	62655.1
2	Marquesas Key	24° 35.0	82° 06.2'	13894.5	30189.2	43748.8	62726.6
3	Gulf/South Atlantic Boundary	24° 35.0'	83° 00.0'	13768.5	29992.2	44049.2	62941.1
4	Tortugas Bank South	24° 36.0'	83° 06.0'	13753.4		44084.4	62965.5
5	Tortugas Bank North	24° 44.0'	83° 04.0'	13772.3		44087.4	62960.3
6	West of Smith Shoal	24° 48.0'	82° 06.5'	13915.1		43760.2	62727.7
7	Off Cape Sable	25° 15.0	82° 02.0'	13974.7		43759.8	62704.9
8	Off Sanibel Island	26° 26.0'	82° 29.0'	14060.3		43117.4	62824.3
9	Off Sanibel Island	26° 26.0'	82° 59.0'	13990.0		43347.6	62970.7
10	Off Anclote Keys	28° 10.0'	83° 45.0'	14145.8		45328.0	63266.8
11	Off Anclote Keys	28° 10.0'	83° 14.0'	14224.3		45092.0	63086.4
12	Off Deadman Bay	29° 38.0'	84° 00.0'	14412.4		45167.7	63442.2
13	SW of Cape San Blas	29° 30.5'	85° 52.0'	13873.2		46702.0	63976.2
14	Off St. Andrews Bay	29° 53.0'	86° 10.0'	13816.5		46922.3	64050.8
15	Desoto Canyon	30° 06.0'	86° 55.0'	13434.6	30600.6	47045.8	
16	Alabama/Florida line	29° 34.5'	87° 38.0'	12971.5	30023.4	46886.0	
17	Off Mobile Bay	29° 41.0'	88° 00.0'	12766.5	29841.2	46930.9	
18	Mississippi/Alabama line	30° 01.5'	88° 23.7'	12537.6	29697.7	47029.3	
19	Chandeleur Islands	30° 01.5'	88° 51.0'	12262.0	29422.2	47028.6	
20	Sabine Pass	29° 39.0'	93° 49.5'	11027.8	26367.1	46966.6	
21	Texas/Louisiana line, south	28° 38.0'	93° 32.0'	11139.4	26220.7	46815.1	
22	Off Galveston Island	28° 28.0'	95° 00.0'	11086.2	25308.9	46817.0	
23	Off Galveston Island	29° 09.5'	95° 00.0'	11036.9	25551.4	46909.0	

1 Nearest identifiable landfall, boundary, navigation aid or submarine area.

2 Loran coordinates are provided to aid the fishermen affected by the measures and are subject to local variations due to atmospheric conditions, therefore, are not used as part of the legal description of the stressed area.

8. STATUS OF THE REEF FISH STOCKS

8.1. Red Snapper

8.1.1. Harvest Trends

Commercial harvest. The bulk of the commercial catch of red snapper is from the northern Gulf of Mexico between Panama City, Florida, and Galveston, Texas, with a decided peak in grids 13 and 14 off Louisiana (Figures 8.1a and 1b; Table 8.2). A significant proportion of the snapper landed in Florida, Alabama, and Mississippi was harvested from areas west of the Mississippi River. Louisiana and Texas landings of red snapper are dominated by fish caught off each respective state (Goodyear 1988a).

Reported commercial landings in 1987 were the lowest since 1972 (Tables 8.1 and 8.2). The landings of red snapper taken in fish trawls, shrimp trawls, and fish traps were much less than those attributable to handlines and bandit rigs (power reels) (Table 8.2). Red snapper longline landings increased in the early 1980's to a peak in 1983 but have subsequently declined.

Recreational harvest. About 70% of the estimated number of red snapper caught by recreational fishermen in 1986 was from Louisiana and Texas. These data indicate a substantial decline in the numbers and weight of red snapper landed by recreational fishermen since 1979 (Tables 8.1 and 8.3).

Combined catch. The combined landings of red snapper by all components of the fishery declined since 1979 and 1980 (Tables 8.1-8.3). Both the commercial and recreational components were lower in 1987 than in any previous year.

8.1.2. Trends in Recruitment

Indices of juvenile abundance were obtained from the Fall Groundfish Survey conducted by the NMFS Mississippi Laboratories, Pascagoula, MS (data courtesy of Scott Nichols). This survey is conducted using bottom trawls. For each set, the number of snapper caught, their total weight and the trawl duration are known. This information provides an index of numerical abundance (i.e., the number captured per trawl hour). It also provides information on the mean size of the red snapper that are caught.

Data are available from 1972 to 1988. Mean size ranged from 0.08 to 0.29 lb during the period, indicating that most of the fish caught are very small. Thus, annual variations in the number caught per hour would be expected to largely reflect variations in the abundance of juvenile (pre-recruit) red snapper. These data then provide a time series of juvenile abundance estimates beginning in 1972, and suggest that recruitment was lower in each of the last 6 years than in any of the previous years (Figure 8.2).

The total annual harvest of 10 and 11 inch red snapper by recreational fishermen was derived as a product of the sampled length frequency and estimated total numbers harvested (Table 8.5). The estimated harvest of these fish by the recreational fishery was significantly correlated with the juvenile abundance index the previous year (Figure 8.3). The strength of the relation is exceptional given all the known potential sources of error (R^2=0.97; p<0.001). Nonetheless, it argues that the decline in landings in recent years is in part explained by reduced recruitment.

8.1.3. Meristics and Growth

Data sources. Meristic and growth characteristics were evaluated using a composite of length and other measurements of Gulf of Mexico red snapper that have been collected by investigators throughout the years. A description of the data and sources are given in Parrack (1986a and 1986b) and Parrack and McClellan (1986), who obtained and maintained computer files of the various data sets. The data in these files constitute the base of information upon which the present meristic and growth analyses were developed. The present analysis converted all length data to inches (see Goodyear, 1988a).

Length conversions. The relation between fork (FL, in), standard (SL, in), and total lengths (TL, in) is

$$TL = 0.038 + 1.275 * SL \qquad (r^2 = 0.99,\ n = 1285),\ \text{and}$$
$$TL = 0.120 + 1.070 * FL \qquad (r^2 = 0.99,\ n = 265).$$

Length to weight conversions. The length (TL, in) - weight (W, lb) relation is

$$W = 0.000414 * TL^{3.07} \qquad (r^2 = 0.97,\ n = 4143).$$

Growth. The previous assessment used separate growth models for the eastern and western Gulf based on the fact that the parameter values fitted to a von Bertalanffy growth equation were significantly different between the two areas. However, the predicted lengths at age from the two models are very similar over the range of the data to which they were fitted (Figure 8.5), suggesting that growth could be characterized by a single equation.

A von Bertalanffy model was fitted to the back-calculated lengths by least squares. The resulting fit is plotted along with a scattergram of the observed lengths at age and the mean of backcalculated lengths in Figure 8.6. Actual age at capture for these fish was determined by adding to the integer of the age, the fraction of a year which had elapsed from the previous June 15 when the fish was captured (i.e., annulus formation on June 15).

The predicted lengths from the von Bertalanffy equation were compared with mean observed length at capture by age class. Mean length at age was simply the mean of lengths of fish in an age class, and mean age was the mean of the estimated actual ages. There was generally good agreement between the mean back-calculated lengths, mean lengths at capture, and the predicted length. A least squares fit of the inverted von Bertalanffy equation was performed for estimating age as a function of length (Figure 8.7).

8.1.4. Size Composition of the Harvest

The age composition of the Gulf of Mexico red snapper stock by year was estimated by assigning ages to sampled length distributions by year using the inverted von Bertalanffy equation of Figure 8.7. It is apparent from the length frequencies of Figures 8.8 that there are large differences in the sizes of fish captured by various gears. In particular, the hydraulic and electric powered reels (bandit rigs) catch larger fish than hand lines, bottom longlines catch even larger fish, and buoys catch a different size composition than of the other gears.

The commercial landings data are categorized by gear of capture; however, there is no distinction in the landings data between hand lines and hydraulic/electric (bandit) lines, and there is no category for red snapper landed through the use of buoys. As a result, the commercial landings were stratified into fish caught via longlines and those caught by all other gears combined. Unknowns were assigned to the latter category. Recreational landings and lengths were pooled across fishing modes by year.

This convention provided three strata for which annual length frequencies and landings estimates were required - the catch by recreational fishermen, longlines, and by all other gears combined. The required length samples could not be constructed for all combinations of gear and year. Length measurements were inadequate for describing lengths of the harvests in 1980, 1981, 1982, and 1983 for commercial gear other than longlines and in 1980, 1981, and 1983 for bottom longlines. In contrast to the small numbers of length measurements for the commercial fishery components in some years, large numbers of red snapper have been measured from the recreational fishery for each year for which catches were estimated. The combined length and age frequencies from the three harvesting strata are presented in Tables 8.6 and 8.7 for 1979 and 1984-1986.

Commercial harvest. Red snapper measured from unknown gear, trawls, trolling lines, and hand lines were predominately less than 17 inches (Goodyear 1988a, Figure 8.8). In contrast, the sample of fish taken on electric and hydraulic reels tended to be larger, with the majority between 17 and 24 inches. However, the sample of fish caught with this gear was dominated by observations from the Eastern Gulf, and those from the West were of lengths similar to the hand lines.

Fish sampled from the bottom longline catches tended to be even larger than those captured by hydraulic and electric reels but represented a broad range of sizes. The distribution was bimodal with those sampled from the Western Gulf responsible for the mode with the largest fish. Fish sampled from the buoy catch represented a broad size range from the Western Gulf.

It would appear from these data that red snapper have been commercially harvested from about 9 inches to about 40 inches for the period 1983-1987. The harvest in the Western Gulf represents a broader size distribution than those to the east, primarily as a result of the inclusion of larger numbers of smaller fish.

Recreational harvest. Intercept data from MRFSS provide length measurements for samples of fish encountered during the interviews. These data permit characterization of the length frequencies of landings by fishing mode and are available since 1979. Similar data were gathered in the 1986 headboat survey.

The length frequency from the MRFSS samples from party boats for 1979-1985 range from 6 inches to about 35 inches with a peak at 11 inches (Figure 8.9). Fish above 20 inches are rare. Data from the 1986 headboat survey are similar with a peak at 11 inches (Figure 8.10). The same pattern is repeated for charter boats and private/rental boats. The length frequencies of all modes sampled by MRFSS are similar and suggests that the red snapper are fully vulnerable to the recreational fishery by 11 inches.

The 1986 headboat survey provided length samples for seven areas of the Gulf. Those from the western Gulf locations differed from areas to the east in that the decline in relative abundance with increasing size fell more rapidly from the peak of about 11 inches (Goodyear 1988a). As a result, snapper in the 15 to 17 inch range are less represented in the Texas samples. A similar trend was evident with length frequencies from the 1979-1987 MRFSS intercept data. This difference may be the effect of the nature of the fisheries, or the result of the larger samples from Texas.

These data are consistent with a higher mortality rate on the newly recruited fish in the Western Gulf which would cause a more rapid decline of these incoming year classes. Such a higher mortality rate is also consistent with the previous observation that the commercial fishery in the Western Gulf begins harvesting red snapper at a smaller size than is typical in the Eastern Gulf.

8.1.5. Mortality Estimates

Goodyear (1988a) estimated mortalities with two different methods however only the results based on the catch curve analysis are presented here. A comparison of the catch curves for 1979 and 1984-1986 suggests a relative change in the shape of the curve between the two periods (Figure 8.11). The change, if real, could be interpreted as an increase in the mortality rate after 1979. However, the apparent difference is not very persuasive and may simply reflect the effect of the strength of the 1972 year class on the estimated age distribution. Estimates of total mortality rates (Z) from these catch curves are: 1979 - Z = 0.63 (R^2 = 0.95); 1984 - Z = 0.47 (R^2 = 0.97); 1985 - Z = 0.54 (R^2 = 0.96); 1986 - Z = 0.53 (R^2 = 0.93). The estimated mean from this approach would be 0.54 which, if the natural mortality rate (M) is a constant 0.2, would imply an average fishing mortality rate (F) of 0.34 for all ages.

Catch curve estimates for each gear type based on data from all years combined (Figure 8.12) produced a range of Z (F) estimates from 0.38 (0.18) to 0.81 (0.51) with an overall estimate of 0.53 (0.33). These estimates are intermediate of fishing mortality rates ranges of 0.58-0.74 for Louisiana and 0.23-0.25 for West Florida estimated by Nelson and Manooch (1982). The present analysis is directed at the Gulf of Mexico stock as a whole, and might be expected to produce mortality estimates intermediate between those observed from the two localities by Nelson and Manooch (1982). However given that the bulk of both the recreational and commercial fishery is to the west of Florida, their Louisiana estimates may be more comparable to the results of this study. In any event, their results do not appear to be inconsistent with the current estimates. For purposes of further analysis F will be assumed to be constant at F=0.34 (constant F).

8.1.6. Fecundity and Maturity

Fecundity. The relation between length and ovarian weight (Figure 8.4; Goodyear, 1988a) is expressed by

$$\text{Gonad Weight} = 1.018 * 10^{-7} + TL^{5.87} \qquad (r^2 = 0.72,\ n = 148).$$

Fecundity (Fec) in number of eggs produced has also be estimated by Collins et al. (unpublished manuscript) relative to fork length (FL, mm) and total fish weight (W, grams) as

$$Fec = 5.146 * 10^{-8} + FL^{3.79} \qquad (r^2 = 0.53,\ n = 51), \text{ and}$$

$$Fec = 5.463 * 10^{-2} + W^{1.24} \qquad (r^2 = 0.60,\ n = 51).$$

As typical of other species, gonad weight increases more rapidly with length than does the total weight of the fish.

Seasonality. Spawning occurs from spring through fall for red snapper with peak activity in the late summer. Nelson (1988) observed female red snapper with ripe ovaries only during the summer months in the Flower Gardens. Camber (1955) reported spawning activity from July through September but with a peak of activity in July and August. Futch and Bruger (1976) observed spawning in the eastern Gulf from July through October with peak activity in August and September. Similarly Collins et al. (unpublished manuscript) reported the spawning season to extend from May through September.

Maturity. Red snapper appear to first obtain sexual maturity sometime in ages 2 and 3 (Futch and Bruger, 1976) or after 286 mm (11 in) FL (Nelson, 1988). Camber (1955) also reported maturity to be from 300 to 320 mm (12-13 in) FL. However, Collins et al. (unpublished manuscript) based on a more extensive analysis of maturation at size concluded that most males and females did not mature until 425 mm (17 in) and 375 mm (15 in) respectively.

8.1.7. Yield and Spawning Stock Biomass per Recruit

Yield computations. Yield-per-recruit calculations (Goodyear, 1988a) utilized the Beverton and Holt yield model (Ricker 1975), modified to reflect the mortality suffered by undersized fish that are released upon capture (Waters and Huntsman 1986). Based on the observed length frequencies in the existing red snapper directed fishery, the fish were assumed to be fully vulnerable to the fishery at 10 inches TL. Growth parameters were from Figure 8.6 with the maximum weight (W_∞) estimated from L_∞ using the length-weight relation described earlier. Natural mortality (M) was assumed to be 0.20 (Nelson and Manooch 1982). The results are presented as curves of constant yield over the range of minimum size and fishing mortality examined. Curves were plotted for 25%, 50%, 75%, 90%, 95%, and 99% of the maximum obtainable within the parameter space examined (Figures 8.13 and 8.14).

Spawning stock biomass computations. Spawning stock biomass per recruit (SSBR) was evaluated as the average lifetime production of eggs per recruit at equilibrium population densities, plus those eggs that would have been produced under conditions of optimum growth and natural mortality (see Goodyear 1988a). The SSBR was evaluated as the ratio (percentage) of the fished to the unfished level for each combination of minimum size and fishing mortality examined in the yield per recruit analyses (Figures 8.13 and 8.14).

Results. In the absence of release mortality, biomass yield would be maximized by delaying harvest until the fish reach about 27 inches TL and then subjecting them to high fishing mortality (Figure 8.13). As the release mortality increased, the optimum minimum size and fishing mortality fell (Goodyear, 1988a). At a release mortality of 33%, the maximum yield would occur at a minimum size of about 20 inches at F = 0.2. These results suggest that management for maximum yield per recruit through minimum size regulations must account for existing fishing mortality in setting size limits or somehow control the fishing mortality rate.

Given the current sizes harvested the SSBR ratio was estimated to be about 20% at an fishing mortality rate of 0.08 (Figure 8.14). However, it is clear that the protection afforded the spawning stock by minimum size regulations diminishes as the mortality of released fish rises.

8.1.8. Shrimp Bycatch

The shrimp industry's bycatch of age 0 (young-of-the-year) red snapper, as estimated in Nichols et. al. (1987) suggests that the impact of the shrimp bycatch could easily exceed a million pounds annually (Table 8.8; Goodyear, 1988a). Depending on the true survival rates the loss could be as great as the existing catch. The strong correlation between the juvenile index and subsequent recreational catch is indicative of remarkably constant and high survival of juveniles between the period they are exposed to bycatch mortality and the time they enter the directed fishery.

These estimates compare favorably with those derived by Powers et. al. (1987) who estimated that the elimination of the bycatch could increase recruitment to the fishery and long term yield by 10% to 90% for the Nichols et. al. (1987).

8.1.9. Spawning Stock Status

The current status of the spawning stock was evaluated using the SSBR methods described above. The analysis was performed for constant F as defined above. The SSBR ratio was estimated to be 0.048, considerably below the 0.20 guideline established by the Council as an indicator of overfishing.

Presently the commercial handline fishery is having the most dramatic impact on spawning stock followed, in order of decreasing impact, by the recreational, bottom longline, and shrimp trawl fisheries (Table 8.9). The relative impacts of each fishery on the spawning stock was derived by examining the impact of a particular fishery given that it was the only source of mortality on the red snapper population. However, all the above fisheries are impacting the red snapper population; the shrimp trawl, handline and recreational fisheries are harvesting or killing too many juveniles to allow replenishment of the spawning stock and longlines are depressing the abundance of older larger spawning fish.

At the current rate of fishing both the landings and spawning stock size are predicted to decline from the present levels (Figure 8.15). Clearly the red snapper population is severely overfished, and the combination of a 5 percent level of spawning stock biomass and six consecutive years of depressed recruitment indicates that red snapper in the Gulf of Mexico will experience a stock collapse if something is not done to reverse the current trend.

8.2. Vermilion Snapper

8.2.1. Harvest Trends

Commercial harvest. The major proportion of the commercial catch of vermilion snapper is from the northeastern Gulf between Panama City and the Mississippi River (Figures 8.16 and 8.1b) and until 1984 essentially all landings were made in Florida (Table 8.10); particularly in the Florida panhandle area (Brown et al., 1988).

Commercial landings remained relatively steady during the 1970's but have been increasing each year since 1980 (Table 8.10), reaching an all time high of 1.66 million pounds in 1986 (Tables 8.1 and 8.10). Hand and power lines (bandit rigs) have consistently taken over 90 percent of the catch (Table 8.10) and only since 1982 have vermilion been caught by longline gear but it has not accounted for more than 6 percent of the total annual catch.

Recreational harvest. The recreational harvest of vermilion occurs primarily off Florida and Alabama whose anglers together have harvested from 85 to 90 percent of the gulfwide annual recreational catch and most of the harvest was from the Exclusive Economic Zone (EEZ) (Table 8.11). The major proportion of recreational harvest has been by party and charter boat anglers (Table 8.12). The recreational catch peaked in 1982 at a little over one million pounds but has since averaged about 200 thousand pounds (Tables 8.1 and 8.11).

Combined harvest. The combined landings of all segments of the fishery exhibited a peak harvest of 1.6 million pounds in 1982, but was followed by a dramatic decline in 1983 and 1984 (Table 8.1). In the last two years, for which data are available, total vermilion landings averaged 1.6 million pounds with the commercial sector comprising between 80 and 90 percent of the total.

8.2.2. Meristics and Growth

Length conversions. The available data are from Grimes (1978) for vermilion snappers from the South Atlantic area. Total length (TL, mm), standard length (SL, mm), and fork length (FL, mm) were highly correlated. The conversion equations are:

$$TL = 2.348 + 1.105 * FL ,$$

$$SL = -3.869 + 0.780 * TL , \text{ and}$$

$$SL = -2.037 + 0.863 * FL.$$

Length to weight conversions. Two vermilion length-weight (L, mm; W, g) equations are available. Grimes (1978) developed one from 1,804 fish ranging 52-618 mm (2.0-24.3 in) taken in the South

Atlantic and Nelson (1988) developed another from 906 fish ranging 168-510 mm (6.6-20.1 in) taken in the western Gulf Flower Garden Reef.

$$W = 0.00001722 * TL^{2.946} \qquad \text{South Atlantic}$$

$$W = 0.0000314 * FL^{2.8816} \qquad \text{Flower Gardens}$$

Growth. Grimes (1978) fit the von Bertalanffy growth model to back-calculated total lengths and derived the equation

$$L_t = 626.5 * [\ 1 - e^{-0.198 * (t - 0.128)}\ ].$$

Nelson (1988) fit the von Bertalanffy growth model to fish (L, mm, FL) from the Flower Gardens and obtained

$$L_t = 500 * [\ 1-e^{-0.22 * (t - 0.30)}\ ].$$

Nelson concluded his estimate of the growth parameters were consistent with that of Grimes above; the observed differences were due to the use of different length measures--Grimes used total length whereas Nelson used fork length.

The growth of males and females does not differ until age 8, when females are larger (Grimes, 1978). Vermilion from the Flower Gardens grow approximately 148 mm (5.8 in) FL during their first year with annual increments of 23-57 mm/yr (0.9-2.2 in/yr) through the seventh year of life (Nelson, 1988). In the South Atlantic annual incremental growth decreased from a high of 91 mm (3.6 in) at age 1 to about 70 mm (2.8 in) at ages 3 and 4 and 10-20 mm (0.4-0.8 in) after age 8.

8.2.3. Size Composition of the Harvest

Vermilion measured from the commercial fishery were generally greater than 10 inches FL whereas the predominant recreational catch was less than 10 inches (Figures 8.17 and 8.18). Few fish larger than 12 inches were caught by recreational anglers. Fish up to 16 inches were common in the commercial fishery. Vermilion snapper are harvested over a size range of 7 to 17 inches.

8.2.4. Mortality Estimates

Goodyear (1988b) made catch curve estimates for each gear type based on NMFS Trip Interview Program data from all years combined (1979-1986 for recreational and 1984-1987 for commercial samples) produced a range of total mortality estimates (Z) from 0.56 to 1.00 with an overall estimate of 0.73. Nelson (1988) estimated total mortality in the western Gulf to be about 0.85. Natural mortality (M) has been estimated to be 0.20 (Goodyear, 1988b), 0.25-0.5 (Huntsman et al., 1983), and 0.22-0.50 (Nelson, 1988).

8.2.5. Fecundity and Maturity

South Atlantic. The proportion of females in the population increases as the cohort ages (Grimes, 1979). Some vermilion are sexually mature at three years of age and nearly all are mature at age four. Fecundity (Fec) estimates for individual females varied from about 100,000 to 1.8 million ova. Fish weight (W, g) (Grimes, 1979) and fish length (TL, mm) were used as predictors of fecundity than length (Grimes and Huntsman, 1980).

$$Fec = e^{10.2183 + 0.0019 * W}, \quad (r^2=.86, n=?).$$

$$Fec = e^{7.065 + 0.013 * TL}, \quad (r^2=.86, n=41).$$

Males and females with ripe-appearing gonads were collected from April through September (Grimes and Huntsman, 1980). Gonad index values also indicated spawning from late spring through early fall.

Huntsman and Grimes (1980) found that most fish attain sexual maturity during their third or fourth years of life (186-324 mm or 7.3-12.7 in TL). Also, fish age 4-9 (> 12.7 in TL) ripen earlier and remain in reproductive condition longer than younger spawning fish. In contrast, a more thorough study on the relationship between size and maturity demonstrated that female vermilion snapper attain maturity at about 160 mm (6.3 in) TL with males attaining maturity at about 6 in.

Flower Gardens. Nelson (1988) examined 881 vermilion snapper for reproductive condition. Males were more abundant than females accounting for 55 percent of the sampled fish. A protracted spawning season was evident extending April-September. Throughout that period male and female vermilion were collected in imminent spawning condition at night from depths of 61 to 112 meters.

The smallest female and male with mature gonads was 209 mm (8.2 in) and 260 mm (10.2 in) in length, respectively. Nelson concluded that females begin to mature in the second year and males in their third year of age.

Estimates of fecundity ranged from 62,000 to 392,000 eggs per fish. The relationship between fish body size (L, mm, FL) and fecundity (Fec) was modeled by the linear regression equation

$$Fec = 2425.66 * L - 490405 \quad (r^2=0.59, n=21).$$

The estimates of fecundity from this study was generally greater than those derived by Grimes and Huntsman (1980). A 450 mm (17.7 in) TL vermilion snapper from the Carolinas would contain an estimated 410,000 eggs whereas the same sized fish from the Flower Gardens would contain 601,000 eggs.

8.3. Gray (Mangrove) Snapper

8.3.1. Harvest Trends

Commercial harvest. Over 99 percent of the gray or mangrove snapper is harvested in waters adjacent the state of Florida. Since 1979, 86 percent of all commercial landings have come from southwest Florida and the Florida Keys (Brown et al., 1988). In addition, 31 percent of the Gulf of Mexico commercial landings is taken from the South Atlantic Council's area of jurisdiction in the Florida Keys (Table 8.13; Waters, 1988).

During the 1970's annual commercial gray snapper landings averaged 655 thousand pounds. The peak commercial harvest occurred in 1983 with 1.014 million pounds being landed, but subsequent landings have declined to the 1987 value of 631,000 pounds (Table 8.13).

Recreational harvest. The recreational harvest of gray snapper occurs almost exclusively off Florida (Table 8.3) with about 80 percent being taken in the state waters (Table 8.11). The recreational harvest is about equally divided among anglers fishing from shore, private boats, and charter/party boats (Table 8.12).

Combined harvest. The combined commercial and recreational harvests peaked in 1982 at 4.4 million pounds with the recreational sector harvesting 79 percent (Table 8.1). Since 1979 the recreational sector has typically harvested the majority of gray snapper annual landings.

8.3.2. Meristics and Growth

Length conversions. Manooch and Matheson (1981) sampled 95 fish from the South Atlantic headboat fishery to develop the following fork length (FL, mm), standard length (SL, mm), and total length (TL, mm) equations.

$$FL = 3.6474 + 0.9359 * TL \qquad (r^2=0.99).$$

$$SL = 2.7381 + 0.7781 * TL \qquad (r^2=0.99).$$

Length to weight conversions. Croker (1962) developed the following weight (W, g)-length (FL, cm) equation from 168 gray snapper caught by recreational fishermen in the Everglades National Park.

$$W = 0.2453 * FL^{2.7261} \qquad (r^2=?).$$

Croker cautioned that the above equation was most appropriate for fish weighing under 2 pounds.

Manooch and Matheson (1981) also developed a length-weight equation from 119 fish sampled from headboat catches in the South Atlantic. The length (TL, mm) - weight (W, kg) equation for gray snapper was

$$W = 0.000000024 * TL^{2.9122} \qquad (r^2=0.99).$$

The equation developed by Manooch and Matheson was used in the yield and spawning stock biomass calculations discussed below.

Growth. In the Everglades National Park during 1959 and 1960 (Croker, 1962), the Florida Keys a decade later (Starck and Schroeder, 1971), and the South Atlantic headboat fishery (Manooch and Matheson, 1981) the estimated size in total length (mm) at age distribution was:

Age	South Atlantic	Florida Keys	Everglades
1	95	84	83
2	198	155	188
3	276	216	254
4	335	278	311
5	381	320	372
6	424	365	457
7	465	413	483
8	503	474	
9	536	520	

Manooch and Matheson (1981) also fitted the following von Bertalanffy growth equation to 568 fish ranging 80-775 mm (3.1-30.5 in) TL.

$$L_t = 890 * [\ 1 - e^{-0.1009 * (t-0.3161)}\ ].$$

In the South Atlantic study growth increments for the first 2 years were about 100 mm (3.9 in). Gray snapper continue to grow at a relatively fast rate for the next two years but afterwards annual growth slows and generally declines to an annual increment of about 20 mm (0.8 in) after age 12.

8.3.3. Size Composition of the Harvest

Gray snapper caught by the commercial fishery were generally larger than 12 inches TL (Figures 8.19). The recreationally caught fish exhibited a wider size distribution ranging from 7 inches to 20 inches fork length. The majority of the fish harvest by the recreational sector occurring between 7 and 12 inches in length.

8.3.4. Mortality Estimates

Goodyear (1988b) made catch curve estimates for each gear type based on NMFS Trip Interview Program data from all years combined (1979-1986 for recreational and 1984-1987 for commercial samples) produced a range of total mortality estimates (Z) from 0.39 to 1.01 with an overall estimate of 0.42. Total mortality estimates for gray snapper in the South Atlantic was 0.60 for south Florida and 0.39 for north Florida (Manooch and Matheson, 1981). The overall estimate calculated here for the Gulf fish is between those of the South Atlantic and therefore seems reasonable..

Natural mortality (M) was assumed to be 0.22 by Manooch and Matheson (1981) and subsequently used by Goodyear (1988b). Current fishing mortality (F) then is estimated to be equal to 0.20.

8. 5. Fecundity and Maturity

As in the other snappers the sexes are separate and females predominate in the shallower waters whereas males are found more frequently offshore (Reef Fish FMP, 1981). Females mature at about 195 mm (7.7 in) in standard length and males mature at 185 mm (7.3 in). Females also attain a larger size than males. Multiple spawning apparently occurs offshore at dusk and may have peak spawning periods that follow a lunar cycle during the spawning season which lasts form June to August (Starck, 1971).

Females produce about 12,000 eggs per gram of ovary. The only fecundity equations for gray snapper was reported in Bortone and Williams (1986) and was based on data from Venezuela (Guerra-Campos and Bashirullah, 1975). The two equations, relating fecundity (Fec) to total length (TL, mm) and weight (W, g) are as follows.

$$Fec = 0.00299 * TL^{3.26}.$$

$$Fec = 1478.82 * W^{0.973}.$$

8.4. Lane Snapper

8.4.1. Harvest Trends

Commercial harvest. The commercial harvest of lane snapper is small averaging about 40,000 pounds per year since 1972 and never exceeding 70,000 in any year (Table 8.13). Over 99 percent of the lane snapper is harvested in waters adjacent to the state of Florida. Since 1979 approximately 77 percent of all commercial landings have come from southwest Florida and the Florida Keys (Brown et al., 1988). In addition, 54 percent of the Gulf of Mexico commercial landings is taken from the South Atlantic Council's area of jurisdiction in the Florida Keys (Table 8.13; Waters, 1988).

During the 1970's annual commercial lane snapper landings averaged 27,000 pounds. Commercial harvest since 1980 has been increasing somewhat and in 1987, 76,000 pounds were landed (Table 8.13).

Recreational harvest. The recreational harvest of lane snapper occurs almost exclusively off Florida (Table 8.3) with approximately 64 percent being taken in the state waters (Table 8.11). The major proportion of the recreational harvest is taken by anglers either fishing from private boats (Table 8.12).

Combined harvest. The combined commercial and recreational harvests peaked in 1982 at 355,000 pounds with the recreational sector harvesting 83 percent of the total (Table 8.1). Since 1979 the recreational sector has typically harvested the majority of lane snapper accounting for 75 percent of the harvest since 1979.

8.4.2. Meristics and Growth

Length conversions. Manooch and Mason (1984) developed the following fork length (FL, mm) to total length (TL, mm) conversion from 100 lane snapper sampled from South Atlantic headboat catches.

$$TL = -2.6252 + 1.0891 * FL \qquad (r^2=0.99).$$

Thompson and Munro (1983c) developed length conversions for 23 fish sampled in Jamaica waters (lengths in cm and SL = standard length):

$$SL = -0.2 + 0.86 * FL;$$

$$TL = 1.087 * FL.$$

Length to weight conversions. Manooch and Mason (1984) developed the following weight-length equation from 101 fish (W, g; TL, mm).

$$W = 0.000102 * TL^{2.6524} \qquad (r^2=0.96).$$

Thompson and Munro (1983c) developed the following equation from 224 fish from Jamaica ranging from 17-35 cm fork length (W, g; FL, cm).

$$W = 0.0189 * FL^{2.943}.$$

Growth. Lane snapper sampled (n=320) from the South Atlantic headboat fishery were aged and observed average sizes (TL, mm) at age were as follows (Manooch and Mason (1984).

Age	Number	Mean TL	Standard Error
0	1	168	-
1	2	194	4.5
2	29	219	2.2
3	33	243	3.7
4	69	274	3.9
5	69	296	4.9
6	57	305	6.7
7	35	346	9.7
8	18	376	15.0
9	5	428	24.9
10	2	461	51.0

The Bertalanffy growth equation fitted back-calculated ages was

$$L_t = 501 * [1 - e^{-0.1337 * (t + 1.49)}].$$

8.4.3. Size Composition of the Harvest

No information is available on the size composition of the harvest.

8.4.4. Mortality Estimates

Mortality rates for lane snapper in the Gulf of Mexico have not been calculated. Total mortality rate was estimated for the South Atlantic to be 0.678 from 1977 to 1982 (Manooch and Mason, 1984).

8.4.5. Fecundity and Maturity

No information on fecundity and maturity of lane snapper is available from the U.S. fishery. In Cuba lane snapper spawn from March through September, with spawning peaks in July and August, however in Puerto Rico and Jamaica peak spawning appears to occur in the spring (Bortone and Williams, 1986). Age at maturity is unknown. Thompson and Munro (1983c) reported the smallest fish with indications of maturity was 18 centimeters (7 inches) fork length. Fecundity studies in the Gulf are nonexistent, but lane snappers from 225-335 mm (8.9-13.2 in) FL have been reported to produce from 347,000 to 995,000 eggs (Pino, 1962; as quoted by Bortone and Williams 1986).

8.5. Mutton Snapper

8.5.1. Harvest Trends

Commercial harvest. Over 98 percent of the mutton snapper is harvested in waters adjacent the state of Florida. Since 1979 approximately 88 percent of all commercial landings have come from southwest Florida and the Florida Keys (Brown et al., 1988). In addition, 48 percent of the Gulf of Mexico commercial landings is taken from the South Atlantic Council's area of jurisdiction in the Florida Keys (Waters, 1988). Handline catches account for most of the commercial harvest (Table 8.15).

During the 1970's annual commercial mutton snapper landings averaged 260,000 pounds (Table 8.15). The peak commercial harvest of 330,000 pounds occurred in 1987.

Recreational harvest. The recreational harvest of mutton snapper occurs almost exclusively off Florida (Table 8.3) with about 48 percent being taken in state waters (Table 8.11). About 90 percent of the recreational harvest is taken equally by anglers either fishing from private and party/charter boats (Table 8.12).

Combined harvest. The combined commercial and recreational harvests peaked in 1982 at 2 million pounds with the recreational sector harvesting 86 percent of the total (Table 8.1). On average, since 1979 the commercial sector has harvested only 43 percent of the mutton snapper but 63 percent since 1985.

8.5.2. Meristics and Growth

Length conversions. The only available length conversion equations for mutton snapper are from fish taken in Jamaican waters (Thompson and Munro, 1983c). Thirteen fish from 22-45 cm fork length were measured to develop the following equations in fork length (FL, cm), standard length (SL, cm), and total length (TL, cn).

$$SL = -0.2 + 0.85 * FL.$$

$$TL = 0.7 + 1.09 * FL.$$

Length to weight conversions. Mason and Manooch (1985) developed length-weight equations for 140 mutton snapper sampled from the South Atlantic headboat survey and reported similar equations developed by Pozo (1979) for mutton snapper in Cuba. For the South Atlantic the total length (TL, mm)-weight (W, kg) equation was

$$W = 1.0 * 10^{-8} * TL^{3.0449} \quad (r^2=0.98).$$

For Cuban fish the length (FL, cm)-weight (W, grams) equation was

$$W = 0.1138 * FL^{2.53} \quad \text{for males} \quad (r^2=0.96), \text{ and}$$

$$W = 0.0912 * FL^{2.59} \quad \text{for females} \quad (r^2=0.96).$$

The mutton snapper sampled in Cuba were smaller than those sampled in the South Atlantic and not as representative of the full size range of fish (Mason and Manooch, 1985).

Growth. Mutton snapper sampled (n=1005) from the South Atlantic headboat fishery were aged and observed average sizes (TL, mm) at age were as follows (Mason and Manooch, 1985).

Age	Number	Mean TL	Standard Error
1	4	318	5.6
2	113	364	2.4
3	238	407	1.6
4	147	450	1.9
5	120	493	2.2
6	109	546	3.6
7	111	588	3.8
8	75	635	4.5
9	34	681	5.2
10	25	718	5.9
11	13	757	5.6
12	7	770	7.7
13	6	772	6.5
14	3	808	8.0

The growth equation fitted to back-calculated ages was

$$L_t = 861.5 * [1 - e^{-0.1534 * (t + 0.5788)}].$$

8.5.3. Size Composition of the Harvest

No information was available on the size composition of the mutton snapper harvest.

8.5.4. Mortality Estimates

Mortality rates for mutton snapper in the Gulf of Mexico have not been calculated. Total mortality rates estimated for the South Atlantic ranged 0.29-0.37 for 1977-1981 (Mason and Manooch, 1985).

8.5.5. Fecundity and Maturity

No information on fecundity and maturity of mutton snapper is available from the U.S. fishery. Age at maturity is unknown. Fecundity studies in the Gulf are also nonexistent however a mutton snapper in Cuba (Rojas, 1960; cited by Bortone and Williams, 1986) a 20.2 in FL mutton snapper had approximately 1.4 million eggs.

8.6. Yellowtail Snapper

8.6.1. Harvest Trends

Commercial harvest. Over 99 percent of the yellowtail snapper is harvested in waters adjacent the state of Florida. Since 1979 98 percent of all commercial landings have come from southwest Florida and the Florida Keys (Brown et al., 1988). In addition, 76 percent of the Gulf of Mexico commercial landings is taken from the South Atlantic Council's area of jurisdiction in the Florida Keys (Table 8.16; Waters, 1988). Yellowtail snapper constitute about 35 percent of the total snapper landings (Table 8.13).

Yellowtail snapper landings since 1972 have fluctuated but have exhibited no long term increasing or decreasing trend. During the 1970's annual commercial yellowtail snapper landings averaged 910,000 pounds. The peak commercial harvest occurred in 1982 with 1.289 million pounds being landed but since then landings have somewhat declined and ranged from about 800,000 to 1.3 million pounds annually (Table 8.16).

Recreational harvest. The recreational harvest of yellowtail snapper occurs almost exclusively off Florida (Table 8.3) with approximately 50 percent being taken in the Territorial Sea. The major proportion of the recreational harvest is taken by anglers either fishing from private boats (Table 8.12).

Combined harvest. The combined commercial and recreational harvests peaked in 1982 at 3.8 million pounds with the recreational sector harvesting 66 percent of the total in that year (Table 8.1). Since 1985 the commercial sector has landed about 67 percent of the yellowtail snapper harvest.

8.6.2. Meristics and Growth

Length conversions. Johnson (1983) developed the following equation from yellowtail snappers sampled in the Florida Keys for converting total length (TL, mm) to fork length (FL, mm).

$$FL = 17.7 + 0.78 * FL \qquad (r^2=0.97).$$

Similar equations developed for fish from Jamaica (Thompson and Munro, 1983c) were

$$SL = 0.3 + 0.828 * FL, \qquad \text{and}$$

$$TL = -0.8 + 1.266 * FL,$$

where fish lengths ranged 8-52 cm fork length (n=23).

Length to weight conversions. Johnson (1983) also measured 517 fish ranging 100-500 mm (3.9-19.7 in) fork length to determine the length (FL, mm) - weight (W, g) relationship as follows:

$$W = 0.0000613 * FL^{2.76} \qquad (r^2=0.97).$$

Thompson and Munro (1983c) measured 393 yellowtail snapper (15-49 cm) from Jamaica and developed the following length (FL, cm) - weight (W, g) relationship:

$$W = 0.0145 * FL^{3.032}.$$

Piedra (1969), in Cuba, measured 5,823 yellowtail snapper ranging 100-515 mm (3.9-20.3 in) FL and 30 to 2265 grams and developed the following length (FL, mm) - weight (W, g) relationship:

$$W = 0.00007327 * FL^{2.73927}.$$

Johnson (1983) concluded the above length - weight equations predicted similar weights within the sampled size ranges.

Growth. Yellowtail snapper sampled (n=1005) from the Florida Keys commercial fishery were aged and observed average sizes (FL, mm) at age were as follows (Johnson, 1983).

Age	Number	Size	Standard Error
1	77	222	4.3
2	243	256	1.9
3	190	292	2.4
4	133	334	3.5
5	92	355	4.7
6	30	386	4.9
7	10	373	29.4
8	12	445	2.9
9	10	453	10.8
10	5	458	30.9
11	2	496	24.0
12	2	518	49.5
13	0	-	-
14	1	443	-

The growth equation fitted to back-calculated ages was

$$L_t = 450.9 * [\ 1 - e^{-0.279 * (t + 0.355)}\ ].$$

Thompson and Munro (1983c) estimated, from modal progression analysis, the coefficient of growth, K, to be about 0.25; this compares favorably with the estimate of 0.279 by Johnson (1983). Piedra (1969) reported an average annual growth of 30 mm (1.2 in) fork length from 1 to 8 years of age.

8.6.3. Size Composition of the Harvest

Yellowtail snapper caught by the commercial fishery were generally larger than 11 inches fork length (Figures 8.20). With the exception of fish traps all commercial gears caught relatively large fish; fish trap caught fish 10 inches fork length or smaller.

The recreationally caught fish ranged primarily from 7 to 14 inches fork length but were predominantly less than 12 inches fork length.

8.6.4. Mortality Estimates

Goodyear (1988b) made catch curve estimates for each gear type based on NMFS Trip Interview Program data from all years combined (1979-1986 for recreational and 1984-1987 for commercial samples) produced a range of total mortality estimates (Z) from 0.21 to 0.45 with an overall estimate of 0.36.

Natural mortality (M) was assumed to be 0.2 by Goodyear (1988b). Current fishing mortality (F) then, using the overall total mortality estimate above, was estimated to equal 0.16.

8.6.5. Fecundity and Maturity.

Piedra (1969) examined over 6000 fish for maturation and found that yellowtail mature at about 130-140 mm (5.1-5.5 in) FL and reproduced between March and September. The fecundity of yellowtail snapper in Cuba was determined from 4 individuals as follows (sizes,mm FL - number of eggs in ovary): 292 - 176,660; 302 - 99,666; 305 - 1,472,594; 382 - 618,742.

Thompson and Munro (1983c) reported maturity of yellowtail snapper in Jamaica occurred at about 26 cm fork length for males and 29 to 31 cm for females. The main spawning periods in Jamaica were in the spring, February-April and fall, September-October although some reproducing fish were taken throughout the year. No estimates of fecundity are available from the Jamaican study.

Collins and Finucane (Manuscript in preparation) evaluated the reproductive biology of 1,621 yellowtail snapper taken in the recreational and commercial hook and line fisheries in the Florida Keys. Length at maturity was estimated at 200 mm (7.9 in) FL for both females and males. Spawning occurred during April-August but with maximum reproduction, as evidenced by ripe ovaries, occurring in June and July. Fecundity (Fec) was significantly correlated with fish size (FL, mm) and was expressed by the following equation:

$$Fec = 0.04575 * FL^{2.627} \qquad (r^2=0.658;\ n=44).$$

Fecundity estimates ranged from 11,000 to 1,391,000 eggs from 44 fish that ranged in size from 200 to 480 mm (7.9 to 18.9 in) FL.

8.7. Groupers

8.7.1. Harvest Trends

Since commercial landings of groupers have not been segregated by species, this section will contain a description of the harvest trends for all groupers combined. Individual species trends will be discussed where data exist for a species or species group.

Commercial harvest. The major proportion of the commercial catch of groupers is from the eastern Gulf between Panama City and the Florida Keys. (Figures 8.21 and 8.1b). Since 1979 51 percent of the total gulfwide commercial grouper harvest has come from the west coast of Florida, and more specifically from ports in and around the Tampa Bay area (Brown et al., 1988). The geographic distribution of the remaining landings by area was 24 percent Florida Keys and southwest Florida, 19 percent in the Florida panhandle, and 6 percent in the other Gulf states.

Commercial landings remained relatively steady during the 1970's averaging about 7 million pounds per year but, with the introduction of bottom longlines grouper production increased until 1982 when landings peaked at 15 million pounds (Table 8.17). Since 1982 annual landings have averaged about 12 million pounds. Prior to 1980 hand and power lines (bandit reels) consistently took over 95 percent of the catch (Table 8.17) but since 1981 longline gear has accounted for 36 to 52 percent of the annual catch.

Recreational harvest. The recreational harvest of groupers is taken primarily by Florida anglers who have harvested consistently over 95 percent of the gulfwide annual recreational catch (Table 8.3). About two-thirds of the recreational harvest was from the Exclusive Economic Zone (EEZ) (Table 8.11). The major proportion of recreational harvest has been by private boat anglers (Table 8.12). Since 1979 grouper recreational catch has averaged about 1.8 million pounds annually (Table 8.1). Although the highest annual harvest was in 1985, with 11 million pounds, annual harvests have fluctuated and with no discernable trend.

Combined harvest. The combined landings of all segments of the grouper fishery exhibited a peak harvest of 25.3 million pounds in 1982 but was followed by a dramatic decline in 1983 and 1984 (Table 8.1). In the last two years for which data are available total grouper landings have averaged about 18 million pounds with the commercial sector taking about two-thirds of the total harvest.

8.7.2. Red Grouper

8.7.2.1. Meristics and Growth

Length conversions. Moe (1969) measured red grouper taken from the recreational and commercial fishery operating in the Gulf of Mexico off central west Florida, and developed the following relationship between standard (SL, mm) and total lengths (TL, mm):

$$TL = 12 + 1.16 * SL \qquad (n=215).$$

Length to weight conversions. The only available information for converting lengths to weight is from Moe (1969) but the equation he presents on page 68 is apparently in error. However, using the average observe lengths (in) and weights (lb) given in his Table 12, the following length-weight conversion formula was developed:

$$W = 0.001265 * TL^{2.923} \qquad (r^2=0.99,\ n=12).$$

Growth. Red grouper sampled (n=202) from the Florida commercial fishery were aged and back-calculated average sizes (TL, mm) at age were as follows (Moe, 1969:Table 4).

Age	Average size mm	(inches)
1	164	(6.5)
2	260	(10.2)
3	327	(12.9)
4	373	(14.7)
5	413	(16.3)
6	449	(17.7)
7	484	(19.1)
8	513	(20.2)
9	539	(21.2)
10	565	(22.2)
11	586	(23.1)
12	601	(23.7)
13	613	(24.1)
14	629	(24.8)
15	634	(25.0)

The growth equation fitted to back-calculated age values was

$$L_t = 672 * [\ 1 - e^{-0.179 * (t + 0.449)}\ ].$$

The oldest fish examined was 26 years and measured 700-710 mm (27.6-28.0 in) TL.

8.7.2.2. Size Composition of the Harvest

Red grouper measured from all segments of the fishery were generally greater than 12 inches TL (Figures 8.22). However, commercial electric reels tended to capture fish greater than 18 inches in length, and the recreational sector did not target fish less than 14 inches TL. Samples of catch from the NMFS headboat survey indicate that red grouper of 14 inches and larger comprised most of the catch (Figure 8.23).

8.7.2.3. Mortality Estimates

Catch curve estimates for each gear type based on data from all years combined (1979-1986 for recreational and 1984-1987 for commercial samples) produced a range of total mortality estimates (Z) from 0.23 to 0.58 with an overall estimate of 0.28 (Figure 8.24). Due to the expansion of the grouper longline fishery in the past 8 years, and that the historical fishery had been prosecuted by handlines it was assumed that the mortality estimate provided by the traps and handline category was most indicative of the true mortality rate. It was reasoned that lengths of fish caught by handline gear were more consistent, over time, because the same geographic areas were fished, whereas the length frequency from electric reels and longlines represented fish that were caught during the exploitation of new fishing areas; however, there is no supporting data to verify the above argument. Conversely, it is possible that the handline segment of the fishery is targeting only on the smaller fish that tend to occur in shallower water. If the latter scenario were true then the estimates of total mortality and consequently fishing mortality that are used here in assessing the condition of the stock would be overestimates. Moe (1969) estimated that total mortality in the fishery during the mid 1960's was 0.322 therefore the above assumption of using the estimate of 0.541 for total mortality for the entire fishery during the past few years, is not unreasonable.

Natural mortality (M) was assumed to equal 0.15 due to the life history characteristics of grouper whereby they first mature as females and later transform into males (Goodyear, personal communication). Consequently, the estimated present fishing mortality rate is 0.431.

8.7.2.4. Fecundity and Maturity.

The only information available on the reproduction of red grouper is from Moe (1969), who determined, from a sample of about 800 fish, that red grouper females matured at 400-425 mm standard length (18.7-19.9 in TL). Red groupers, as probably are most groupers, are born females and after a period of egg production transform into males. Consequently, the larger individuals in a population are usually males. The consequence of this life history strategy on fisheries management is unclear; we do not know if grouper are more prone or more resistent to overfishing than species in which the sexes are separate. Grouper typically are managed similar to other species where the sexes are separate. Moe (1969) found that transition from female to male usually occurs before age 10 between 425 and 650 mm standard length (19.9-30.2 in TL). Active reproduction occurred from January through May with peak activity in April and May.

Moe (1969) examined 14 gonads for fecundity determination of fish ranging in size from 495 to 667 mm (23.1-30.9 in TL) standard length (ages 8-28; 3 fish were not aged). The range of eggs estimated ranged from 196,000 eggs (29.5 in TL, age 11) to 5,735,000 eggs (29.3 in TL, no age). The average number of eggs per fish was 1,469,000 eggs. No fecundity equation was developed.

8.7.2.5. Yield and Spawning Stock Biomass per Recruit

Yield computations. Yield-per-recruit calculations utilized the Beverton and Holt yield model for F = 0.01 to F = 0.5 as a function of minimum size at recruitment to the fishery (Ricker 1975), modified to reflect the mortality suffered by undersized fish that are released upon capture (Waters and Huntsman 1986). The rate of capture of the undersized fish was assumed to be the same as the rate of capture of fully recruited fish in the analysis. Based on the observed length frequencies in the existing red grouper fishery, the fish were assumed to be fully vulnerable to the fishery at 12 inches TL. Growth parameters were from Moe (1969). Natural mortality (M) was assumed to be 0.15. The results are presented as curves of constant yield over the range of minimum size and fishing mortality examined. Curves were plotted for 25%, 50%, 75%, 90%, 95%, and 99% of the maximum obtainable within the parameter space examined (Figures 8.25 and 8.26).

Spawning stock biomass computations. Spawning stock biomass per recruit (SSBR) was evaluated as the average adult biomass at equilibrium population densities. The SSBR was evaluated as the ratio of the fished to the unfished level for each combination of minimum size and fishing mortality examined in the yield per recruit analyses. The curves corresponding to SSBR ratios of 20% of the unfished level were determined for undersize release mortalities of zero and thirty percent (Figures 8.25 and 8.26).

Results. In the absence of release mortality, yield would be maximized by delaying harvest until the fish reach about 22 inches TL and then subjecting them to high fishing mortality (Figure 8.25). As the release mortality increased, the optimum minimum size and fishing mortality fell (Goodyear, 1988c). At a release mortality of 33%, the maximum yield would occur at a minimum size of about 17 inches at F = 0.18 (Figure 8.26). Given the current sizes harvested and an assumed 33 percent undersize release mortality the SSBR ratio was estimated to be about 20% at a fishing mortality rate of 0.28 (Figure 8.26).

8.7.3. Gag Grouper

8.7.3.1. Meristics and Growth

Length conversions. The only information available on length conversions is from a study that sampled about 2,400 gag groupers from the recreational and commercial hook-and-line grouper landings on the west coast of Florida (Schlieder, Unpublished manuscript). Total length (TL, mm) and fork length (FL, mm) were related to standard length (SL, mm) by the following equations.

$$TL = 30.323 + 1.147 * SL \qquad (r^2=0.99).$$

$$FL = 32.309 + 1.107 * SL \qquad (r^2=0.99).$$

McErlean (1963) provided graphs of the relationship between total and standard length but no equation.

Length to weight conversions. Schlieder also weighed 804 fish and developed the following weight (W, g) - length (SL, mm) equation.

$$W = 0.0000269 * SL^{2.96} \qquad (r^2=0.99).$$

Manooch and Haimovici (1978) measured 252 gag from the headboat fishery operating in the South Atlantic area to develop the following length (TL, mm) - weight (W, kg) equation.

$$W = 1.2 * 10^{-8} * TL^{2.996} \qquad (r^2=0.99).$$

McErlean (1963) provided graphs of the relationship between total and standard length for Gulf gag grouper but no equation.

Growth. Manooch and Haimovici (1978) examined over 1,000 gag grouper sampled from the South Atlantic headboat fishery during 1972-1976. Growth rates were determined for 136 fish by examining growth rings on otoliths. The growth rate was rapid the first 2 years, declined somewhat for ages 3 to 4, and then leveled off.

Age	Number of fish Observed	Weighted Mean back-calculated total length
1	13	269
2	23	417
3	18	525
4	16	612
5	17	686
6	12	753
7	3	806
8	8	857
9	6	902
10	7	948
11	7	988
12	4	1014
13	2	1080

The growth equation fitted to back-calculated age values was

$$L_t = 1290 * [1 - e^{-0.12154 * (t + 1.127)}].$$

Schlieder (Unpublished manuscript) aged 761 gag grouper sampled from the eastern Gulf fishery from 1977 to 1980.

Age	Number of fish Observed	Weighted Mean back-calculated standard length
1	15	269
2	28	367
3	50	446
4	104	523
5	118	589
6	131	643
7	90	696
8	63	739
9	56	777
10	34	809
11	32	837
12	15	856
13	6	877
14	9	893
15	8	903
16	2	930

The growth equation fitted to back-calculated age values was

$$L_t = 1014 * [1 - e^{-0.156 * (t + 1.402)}].$$

8.7.3.2. <u>Size Composition of the Harvest</u>

Gag grouper measured from all segments of the commercial fishery were generally larger than 25 inches TL and 4 years of age (Figures 8.27). However, commercial fish traps and the recreational sector tended to capture fish less than 25 inches in length. The other commercial gear types exhibited remarkably similar length frequency distributions with modes occurring between 28 and 30 inches TL.

8.7.3.3. <u>Mortality Estimates</u>

Schlieder (Unpublished manuscript) estimated, from the age distribution of 882 fish, total mortality of gag grouper in the eastern Gulf to be 0.37. Goodyear (1988b) evaluated catch curves based on length frequencies of each gear type collected by the NMFS Trip Interview Program that were aged by the von Bertalanffy equation of Manooch and Haimovici (1978); total mortality values from 0.301 to 0.476 were obtained.

8.7.3.4. <u>Fecundity and Maturity</u>

McErlean (1963) first reported on reproduction of gag grouper, however, his observations were limited to macroscopic identification of those females with eggs present in the ovaries. Only 17 of 35 females examined with eggs could be accurately aged. The age distribution of females with eggs indicated that females probably do not mature until age five. Later, McErlean and Smith (1964) examined histologically the gonads of 32 fish and concluded that gag grouper first mature as females at 5 or 6 years of age and transform to males at 10 or 11 years of age. Schlieder (Unpublished manuscript) examined, histologically, 877 fish and concluded that although some females as young as age 1 (18.1 in TL) may mature, but the majority (over 50 percent of an age (size) class) was not mature until age 5 (29.4 in TL). Similarly, males as young as age 5 (36.2 in TL) were observed but males were not numerous until age 9 when they accounted for 21 percent of an age class. About 63 percent of all males were larger than 875 mm SL (40.7 in TL). All fish greater than age 15 were male. Also, males were generally larger than females

McErlean (1963) suggested than spawning probably occurred between January and March. Schlieder (Unpublished manuscript), based on data collected from 1977 to 1980, concluded that spawning occurred from late December through April, with peaks in February and March.

McErlean (1963) examined 3 fish ranging in size from 787 to 795 mm SL (36.7-37.1 in TL; ages 7-8) and obtained fecundity estimates from 529 thousand to 1.5 million eggs. No fecundity equation is available for gag grouper.

8.7.4. Black Grouper

8.7.4.1. Meristics and Growth

Length conversions. No length conversion equations for black grouper are available.

Length to weight conversions. Manooch and Mason (1987) derived the following weight (W, g)-length (TL, mm) relationship for black grouper from fish sampled from the South Atlantic headboat fishery.

$$W = 0.000005548 * TL^{3.141} \qquad (n=108,\ r^2=0.98).$$

Growth. The only growth information is from Manooch and Mason (1987) who aged about 150 black grouper sampled from the South Atlantic headboat fishery from 1972 to 1985. Growth was most rapid for the first three to four years of age, but then gradually declined throughout the remaining years of life (see table below).

Age	Number of fish Observed	Weighted mean back-calculated total length
1	146	260
2	144	397
3	130	504
4	118	591
5	98	664
6	74	734
7	51	806
8	25	873
9	14	925
10	8	975
11	5	1010
12	3	1054
13	2	1077
14	1	1110

The von Bertalanffy growth equation fitted to back-calculated age values was

$$L_t = 1352 * [\ 1 - e^{-0.1156 * (t + 0.927)}\ ].$$

The oldest black grouper observed was 14 years of age and measured 1110 mm (43.7 in) TL.

8.7.4.2. Size Composition of the Harvest

Black grouper measured from all segments of the commercial fishery were generally larger than 15 inches TL (Figures 8.28). The recreational sector tended to capture fish less than 20 inches in length. The buoy and longline commercial gear harvested a wider size range of fish taking fish that were larger than 30 inches TL.

8.7.4.3. Mortality Estimates

Black grouper in the South Atlantic headboat fishery were not fully recruited until ages 5 to 7 (Manooch and Mason, 1987), after which total mortality rate (Z) equals 0.49-0.53. Catch curves based on length frequencies of each gear type sampled from the Gulf recreational and commercial fishery, aged by inverting the von Bertalanffy equation of Manooch and Mason (1987) (Figure 8.60), produced a range of total mortality values from 0.178 to 0.557 (Goodyear, 1988b). An overall total mortality rate of 0.303 was estimated from the combined data from all gear types.

8.7.4.4. Fecundity and Maturity

No information is available on the fecundity and maturation of black grouper.

8.7.5. Nassau and Yellowfin Groupers

8.7.5.1. Meristics and Growth

Length conversions. Thompson and Munro (1983a) developed the following standard length (SL, cm) to total length (TL, cm) conversion equation for Nassau grouper in Jamaica ranging in size from 43 to 75 cm TL.

$$TL = 3.0 + 1.09 * SL \qquad (n=26).$$

Thompson and Munro (1983a) also developed the following standard length (SL, cm) to total length (TL, cm) conversion equation for yellowfin grouper in Jamaica ranging in size from 26 to 77 cm TL.

$$TL = 1.0 + 1.16 * SL \qquad (n=36).$$

Length to weight conversions. Olsen and LaPlace (1978) estimated the weight (W, g)-length (SL, cm) equation of Nassau grouper between 18 and 76 cm standard length to be:

$$W = 0.0097 * SL^{3.233} \qquad (n=241, r^2=0.93).$$

No information is available on lengths and weights of yellowfin groupers.

Growth. Olsen and LaPlace (1978) developed the following von Bertalanffy growth equation for Nassau grouper in the Virgin Islands (length measures in cm).

$$L_t = 97.4 * [1 - e^{-0.183 * (t + 0.488)}].$$

Thompson and Munro (1983a) analyzed Randall's (1962, 1963) tagging data on Nassau grouper and concluded the growth rate, as expressed by the growth coefficient (K), ranged from 0.05 to 0.13 and averaged 0.09. Maximum size (L_∞) was assumed to be about 90 cm TL.

A period of about 4 years is required for yellowfin to reach a size of 46-57 cm TL and 10 years to reach a size of about 70 cm TL (Thompson and Munro, 1983a). Overall, yellowfin grouper in Jamaica grow about 3 cm a year. The growth coefficient (K) and asymptotic length (L_∞) for yellowfin grouper were estimated to be 0.1 and 86 cm TL, respectively.

8.7.5.2. Size Composition of the Harvest

Available information on Nassau and yellowfin groupers is too sparse to be useful.

8.7.5.3. Mortality Estimates

No information is available on Nassau or yellowfin grouper.

8.7.5.4. Fecundity and Maturity

Thompson and Munro (1978; as cited by Shapiro, 1987) determined, macroscopically, that Nassau grouper mature at about 480 mm (18.9 in) TL, and that yellowfin grouper mature at about 510 mm (20.0 in) TL. The spawning season, in Jamaica, is January-May for Nassau and April-May for yellowfin (Munro et al., 1973; as cited by Shapiro, 1987; Thompson and Munro, 1983a).

Olsen and LaPlace (1978) estimated average fecundity of Nassau grouper from 42 females with ripe ovaries to be 4.8 million eggs. No information on the fecundity of yellowfin grouper is available.

8.8. Jewfish

8.8.1. Harvest Trends

Commercial harvest. Commercial landings of jewfish averaged about 240,000 pounds from 1971 to 1983 (Table 8.18). Since 1983 annual landings have steadily declined to about 100,000 pounds in 1987.

Recreational harvest. Data on the recreational harvest is available only since 1979. Jewfish are harvested recreationally primarily in Florida, with some harvest also occurring in Louisiana (Table 8.3). About equal numbers of fish are taken in state and federal waters (Table 8.11), primarily by private boat anglers (Table 8.12).

Combined harvest. The combined commercial and recreational harvest is available since 1979. Peak harvest of 1.4 million pounds occurred in 1982 (Table 8.1), with harvests fluctuating afterwards (220,000-1983; 338,000-1984; 410,000-1985; 145,000-1986; 293,000-1987).

8.8.2. Meristics and Growth

Length conversions. No information is available.

Length to weight conversions. No information is available.

Growth. No detailed information is available on growth of jewfish, however, Steidinger (1988 letter to Roy Williams) reported the oldest jewfish of 324 collected by Florida Department of Natural Resources was 37 years of age and 75 inches TL.

8.8.3. Size Composition of the Harvest

No information is available.

8.8.4. Mortality Estimates

No information is available.

8.8.5. Fecundity and Maturity

No detailed information is available on the fecundity and maturity jewfish, however, Steidinger (1988 letter to Roy Williams) reported that jewfish, similar to other groupers, were born as females and later transformed into males. Approximately 60 males and females each were examined for reproductive activity. The smallest mature female was 47 inches TL but some females were still immature at 53 inches TL. The youngest mature female was 10 years old. The smallest mature male was 43 inches TL.

8.9. Black Sea Bass

8.9.1. Harvest Trends

Commercial harvest. All species of sea basses have been combined in the NMFS landings, therefore, identification of landings of individual species was not possible. Sea basses have not constituted a significant fishery since the mid 1970's (Table 8.19). The reported commercial landings declined from a peak of 143,000 pounds in 1972 to a minimum of 13,000 pounds in 1983.

Recreational harvest. Data on the recreational harvest of black sea bass is available for 1979 through 1986. Annual average harvests have averaged about 700 thousand pounds (Table 8.1), however annual landings have fluctuated widely exhibiting no discernable trend.

Combined harvest. The combined annual commercial and recreational harvest of sea bass has fluctuated being dominated by the recreational harvest which since 1979 has accounted for 97 percent of the total (Table 8.1).

8.9.2. Meristics and Growth

Data sources. Meristic and growth information is available only from studies on the Atlantic populations of black sea bass.

Length conversions. The relationship of standard length (SL, mm) to total length (TL, mm) of black sea bass in the South Atlantic was (Waltz et al., 1979):

$$SL = 8.179 + 0.7387 * TL \qquad (r^2 = 0.94, n = 1903).$$

Length to weight conversions. The relationship of length to weight (W, g) in the South Atlantic was (Waltz et al., 1979):

Both sexes: $W = 0.01130 * SL^{2.987}$ $(r^2 = 0.98, n = 1771)$,

$W = 0.01004 * TL^{2.897}$ $(r^2 = 0.96, n = 1773)$,

Females: $W = 0.01231 * SL^{2.951}$ $(r^2 = 0.96, n = 693)$,

$W = 0.01058 * TL^{2.878}$ $(r^2 = 0.94, n = 683)$,

Males: $W = 0.01279 * SL^{2.934}$ $(r^2 = 0.94, n = 568)$,

$W = 0.01213 * TL^{2.817}$ $(r^2 = 0.90, n = 564)$.

Growth. Observed average lengths and weights at age for black sea bass in the South Atlantic was as follows (Waltz et al., 1979).

	Females			Males		
Age	SL	TL	W	SL	TL	W
1	4.6	5.9	0.12	4.5	5.7	0.10
2	6.4	8.2	0.30	6.6	8.5	0.34
3	7.4	9.6	0.46	8.3	10.9	0.67
4	7.9	10.2	0.56	9.2	12.1	0.87
5	9.1	11.7	0.86	10.6	13.9	1.28
6	10.6	13.7	1.33	11.0	14.5	1.39
7	11.1	14.1	1.42	11.5	15.2	1.67
8	10.3	13.2	1.13	12.0	15.5	1.85
9	--	--	--	11.7	16.0	1.38
10	13.0	16.7	--	13.4	17.6	2.10

Kendall (1977) provided a Bertalanffy growth equation for measures in standard length (mm) and weight. The equation, in length, is:

$$L_t = 625 * (1 - e^{-0.088 * (t + 1.33)}).$$

8.9.3. Size Composition of the Harvest

No data are available on the size composition of the black sea bass commercial harvest. A description of the fishery, as it existed in the late 1960's can be found in Godcharles (1970). The recreational fishery harvests primarily fish between 9 and 13 inches fork length (Table 11.21).

8.9.4. Mortality Estimates

No mortality estimates are available for black sea bass in the Gulf of Mexico.

8.9.5. Fecundity and Maturity

Black seas bass are protogynous hermaphrodites with the males dominating the larger sizes (> 8.7 in SL) and older ages (> 4 yrs). Sex reversal takes place over a large size and age range; however transitional fish are most commonly age 3. Mature males and females were found in all age groups in the South Atlantic (Waltz, et al., 1979).

Estimates of fecundity (Fec) of fish from South Carolina were derived from (Cupka et al., 1973 as cited by Kendall, 1977):

$$Fec = 2.0344 * SL^{1.973} \qquad (r^2 = 0.45).$$

Observed fecundities of fish, ages 1-5, ranged from about 30,000 to 122,000 eggs.

8.10. Greater Amberjack

8.10.1. Harvest Trends

Commercial harvest. Greater amberjack historically has been a relatively minor component of the reef fish fishery with annual commercial harvests below 100,000 pounds prior to 1975 (Berry and Burch, 1979), and less than 300,000 pounds until 1983 (Table 8.20). Since 1983 amberjack landings have grown, increasing to an all time high of 1.4 million pounds in 1986. Most of the commercial harvest is taken east of the Mississippi River (Figure 8.29) with 60 and 22 percent being landed in Florida and Louisiana, respectively (Table 8.20). A minimum of 66 percent of the commercial harvest is taken by hand and power lines and about 13 percent by longlines.

Recreational harvest. Annual recreational landings since 1979, the first year of record, have fluctuated from a low of 1.7 million pounds in 1984 to a high of 9.6 million pounds in 1982 (Table 8.1). Annual recreational landings have averaged about 4 million pounds. Approximately 80 and 15 percent of the recreational harvest has been taken by Florida and Louisiana anglers, respectively (Table 8.3). Most (83%) of the amberjack harvest comes from the EEZ (Table 8.11) and is taken principally by anglers fishing from charter and party boats (Table 8.12).

Combined harvest. Total combined harvest trends have mirrored those of the recreational fishery. Recreational anglers have taken about 90 percent of the total amberjack harvest since 1979 (Table 8.1), however the recreational component has declined from over 95 percent prior 1982 to about 66 percent in 1987.

8.10.2. Meristics and Growth

Length conversions. No length conversions are available for greater amberjack.

Length to weight conversions. Burch (1979) provides the only length (FL, cm)-weight (W, lb) conversion equations available.

$$W_{♂} = 0.0000886 * FL^{2.773} \quad (r^2=0.87,\ n=270,\ \text{range } 61\text{-}141\ \text{cm}).$$

$$W_{♀} = 0.0000528 * FL^{2.888} \quad (r^2=0.90,\ n=187,\ \text{range } 50\text{-}156\ \text{cm}).$$

$$W_{♂+♀} = 0.0000640 * FL^{2.842} \quad (r^2=0.91,\ n=?,\ \text{range } 39\text{-}156\ \text{cm}).$$

Females were heavier at a given length, but the rate of weight gain with increasing weight was the same for both sexes.

Growth. The only growth information is from Burch (1979) who aged, with scales, 160 male and 183 female greater amberjack sampled from the charterboat fishery off southeast Florida. Observed average size at age is given below. (Note: the category labeled "both sexes" includes the above 343 fish plus an additional 89 fish that could not be classified as either male or female.)

Age	Average observed fork length (cm) Males	Females	Both sexes
1	41	41	42
2	63	63	63
3	80	81	80
4	90	94	91
5	97	104	102
6	103	112	110
7	108	121	117
8	124	130	127
9	-	136	134
10	-	140	140

The growth equations Burch (1979) fitted to greater amberjack data were:

$$L_{t(♂)} = 146.3 * (1 - e^{-0.193 * (t + 0.798)}) \text{ for males,}$$

$$L_{t(♀)} = 159.7 * (1 - e^{-0.194 * (t + 0.490)}) \text{ for females, and}$$

$$L_{t(♂+♀)} = 164.3 * (1 - e^{-0.174 * (t + 0.653)}) \text{ for both sexes.}$$

8.10.3. Size Composition of the Harvest

Greater amberjack measured from all segments of the commercial fishery were generally larger than 25 inches fork length (Figure 8.30). The recreational sector tended to capture fish less than 25 inches in length (Figures 8.30 and 8.31). The headboat anglers harvest fish predominantly smaller than 25 inches but also harvest significant quantities of fish up to about 40 inches in length.

8.10.4. Mortality Estimates

Catch curves based on length frequencies of each gear type (Figure 8.71) aged by inverting the von Bertalanffy equation of Burch (1979--both sexes combined) produced a range of total mortality values from 0.544 to 0.958. Total mortality with all gear types combined was estimated to be 0.599 which compares favorably with an independent estimate of 0.61 made with headboat data (Figures 8.32 and 8.33). Thus assuming a natural mortality rate of 0.2 we used the estimate of 0.399 for fishing mortality in subsequent analyses.

8.10.5. Fecundity and Maturity

Burch (1979) reported the smallest reproductively active female and male observed was 81 and 83 cm (32 inches) fork lengths, respectively. Spawning apparently occurs from March through June, with peak activity in April and May. No fecundity information is available for greater amberjack.

8.10.6. Yield and Spawning Stock Biomass per Recruit

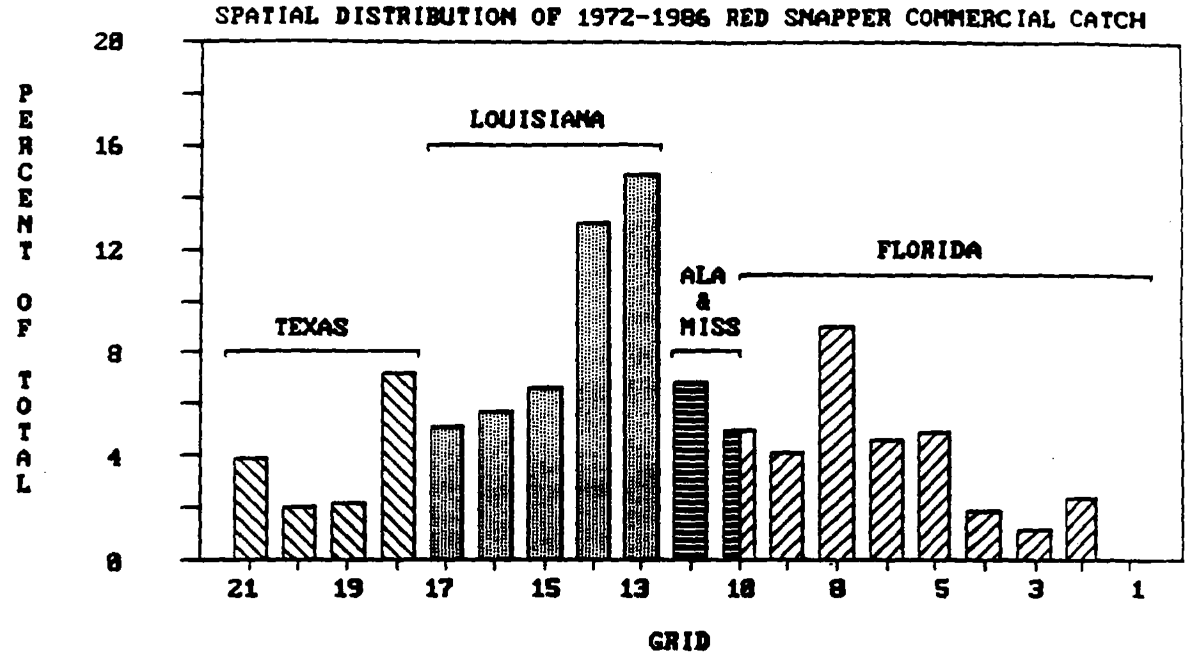
Yield computations. The rate of capture of the undersized fish was assumed to be the same as the rate of capture of fully recruited fish in the analysis. Based on the observed length frequencies in the existing greater amberjack fishery, the fish were vulnerable to the recreational fishery somewhere between 10 and 15 inches fork length and to the commercial fishery between 25 and 30 inches fork length. Growth parameters were from Burch (1979). Natural mortality (M) was assumed to be 0.2. The results are presented as curves of constant yield over the range of minimum size and fishing mortality examined. Curves were plotted for 25%, 50%, 75%, 90%, 95%, and 99% of the maximum obtainable within the parameter space examined (Figures 8.34 and 8.35).

Spawning stock biomass computations. Spawning stock biomass per recruit (SSBR) was evaluated as the average adult biomass at equilibrium population densities. The SSBR was evaluated as the ratio of the fished to the unfished level for each combination of minimum size and fishing mortality examined in the yield per recruit analyses. The curves corresponding to SSBR ratios of 20% of the unfished level were determined for undersize release mortalities of zero and thirty percent (Figures 8.34 and 8.35).

Results. In the absence of release mortality, biomass yield would be maximized by delaying harvest until the fish reach about 45 inches fork length and then subjecting them to high fishing mortality (Figure 8.34). As the release mortality increased, the optimum minimum size and fishing mortality fell (Goodyear, 1988c). At a release mortality of 33%, the maximum yield would occur at a minimum size of about 32 inches at F = 0.20 (Figure 8.35). These results suggest that management for maximum yield per recruit through minimum size regulations must account for existing fishing mortality in setting size limits or somehow control the underlying fishing mortality rate. However, it is clear that the protection afforded the spawning stock by minimum size regulations rapidly disappears as the mortality of released fish rises.

Given the current sizes harvested and an assumed 33 percent undersize release mortality, the SSBR ratio was estimated to be about 20% at a fishing mortality rate of 0.20 (Figure 8.35).

FIGURE 8.1a



Spatial distribution of the commercial catch of red snapper in the Gulf of Mexico regardless of the location where they were landed. The grids correspond to the NMFS shrimp grid designations. Catch from grid 7 was divided equally between grids 6 and 8 and that from grid 12 was divided equally between grids 11 and 13.

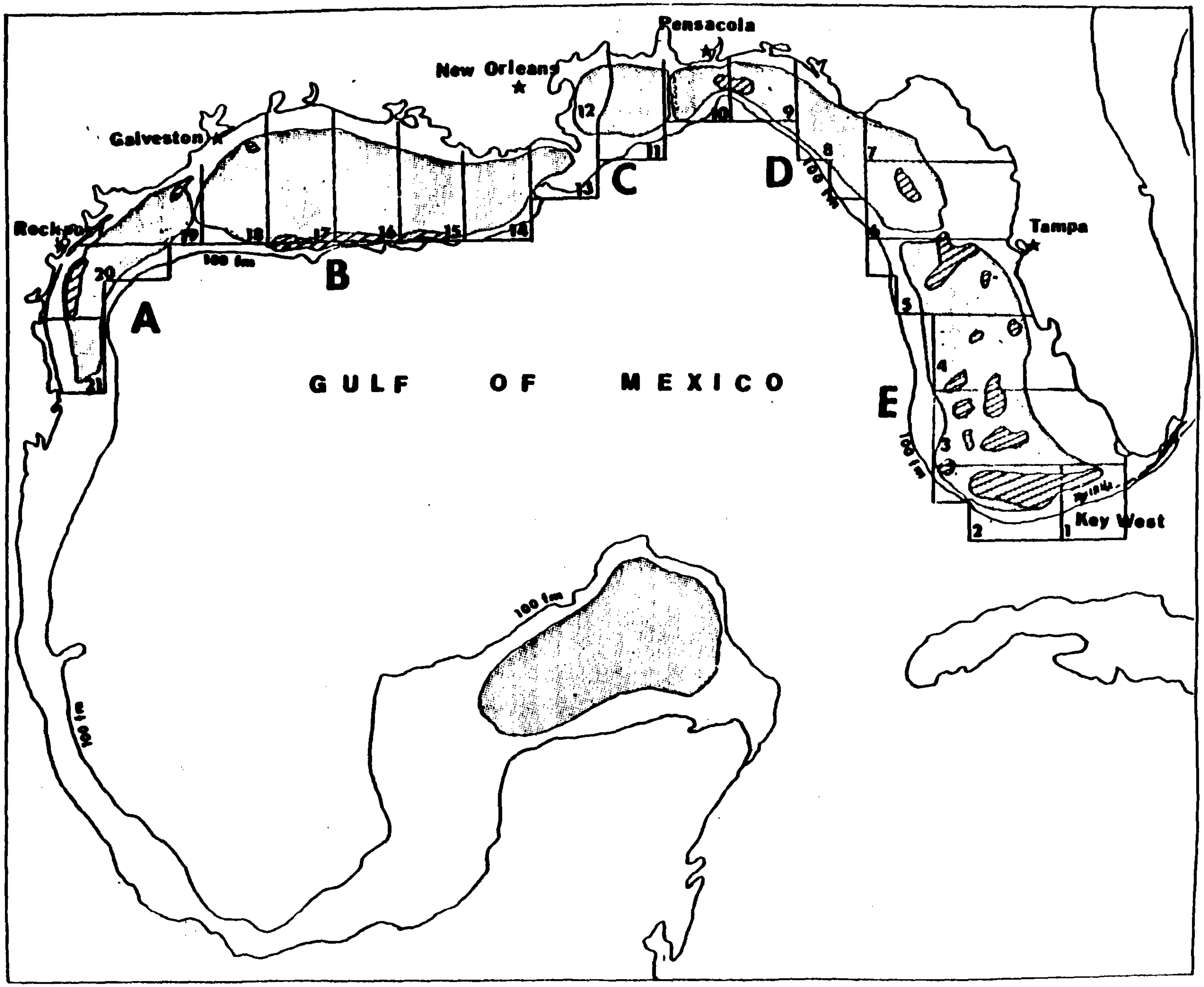
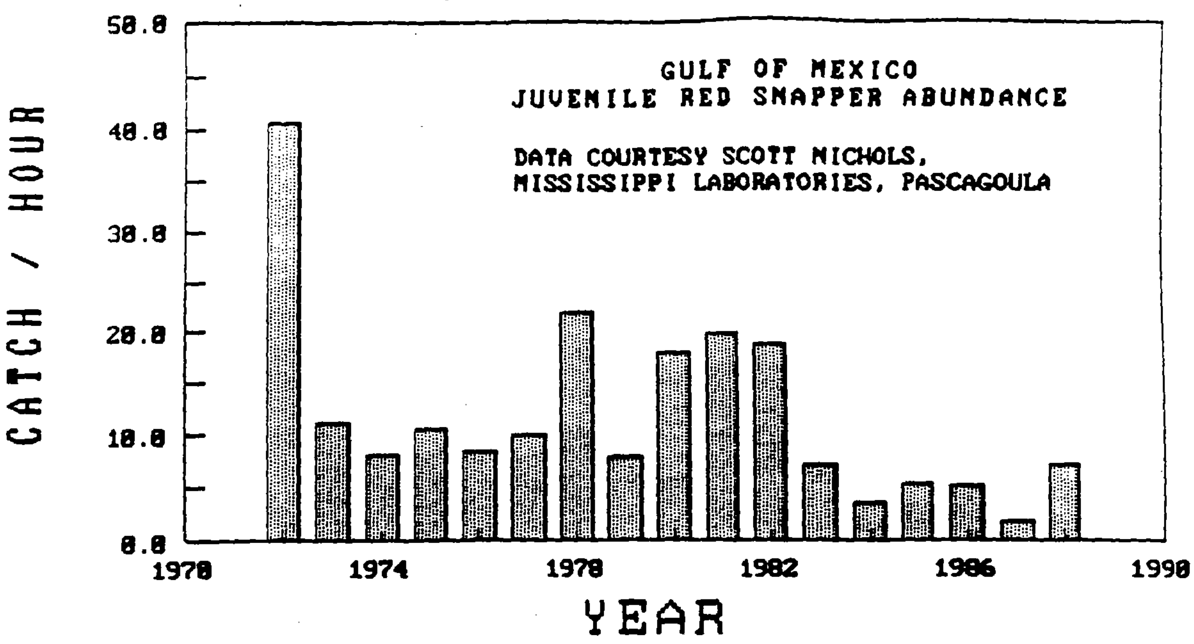


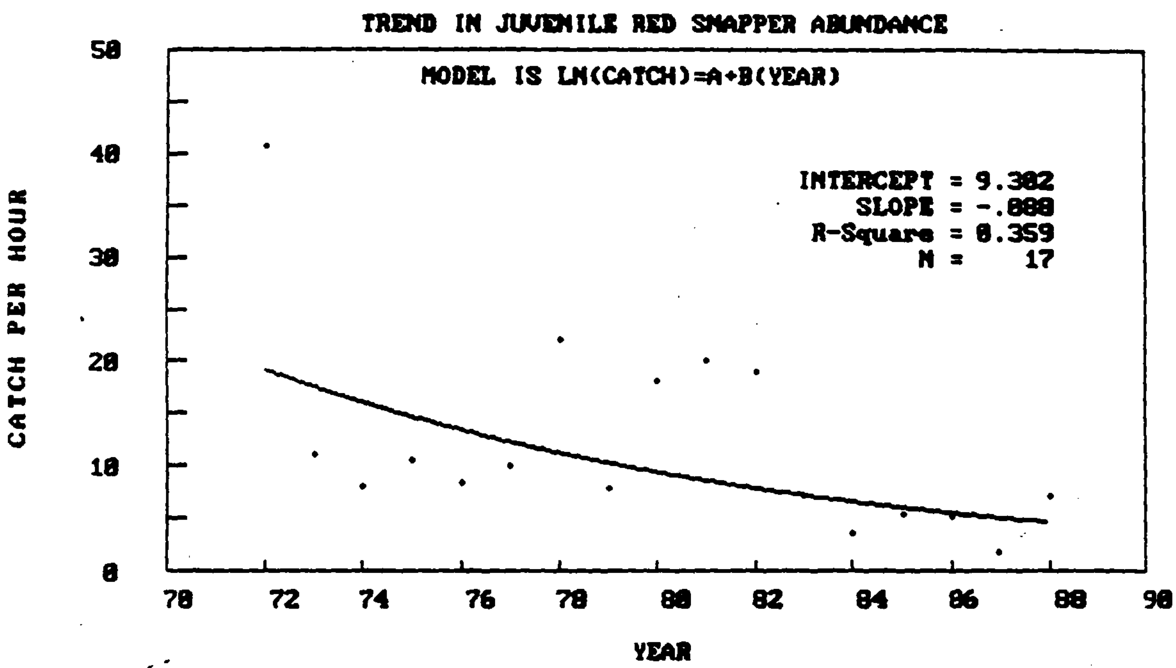
FIGURE 8.1b

Chart of Gulf of Mexico historical red snapper fishing grounds and statistical reporting zones (A = Western zone

FIGURE 8.2

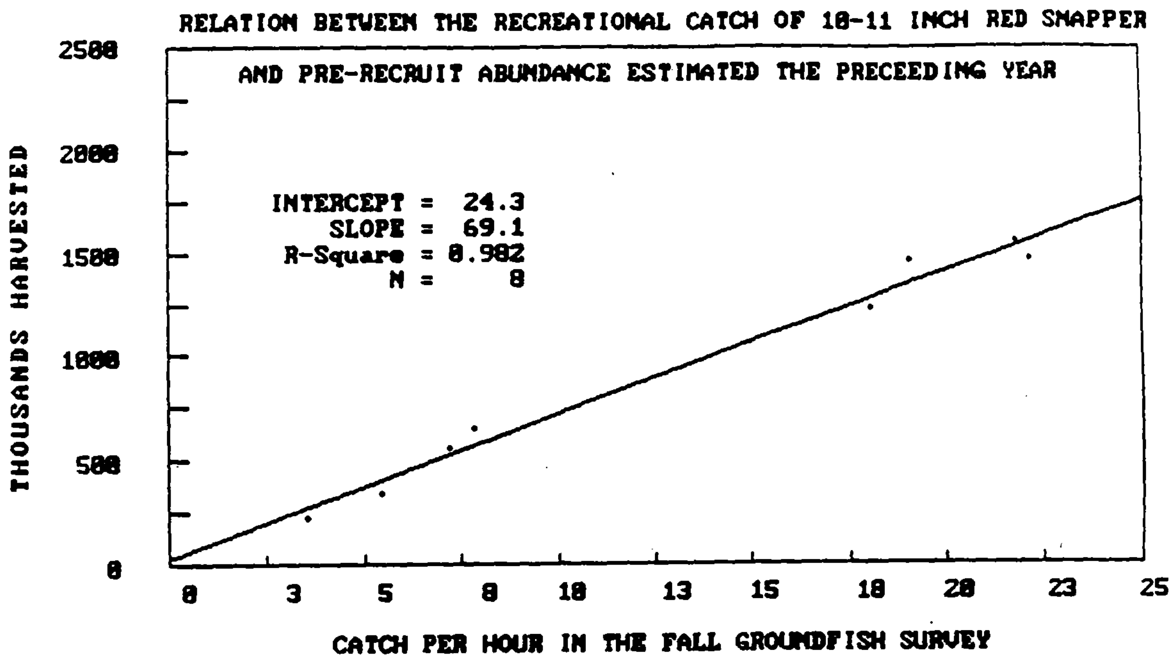


Abundance estimates for juvenile red snapper from the NMFS Fall Groundfish Survey from 1972-1988.



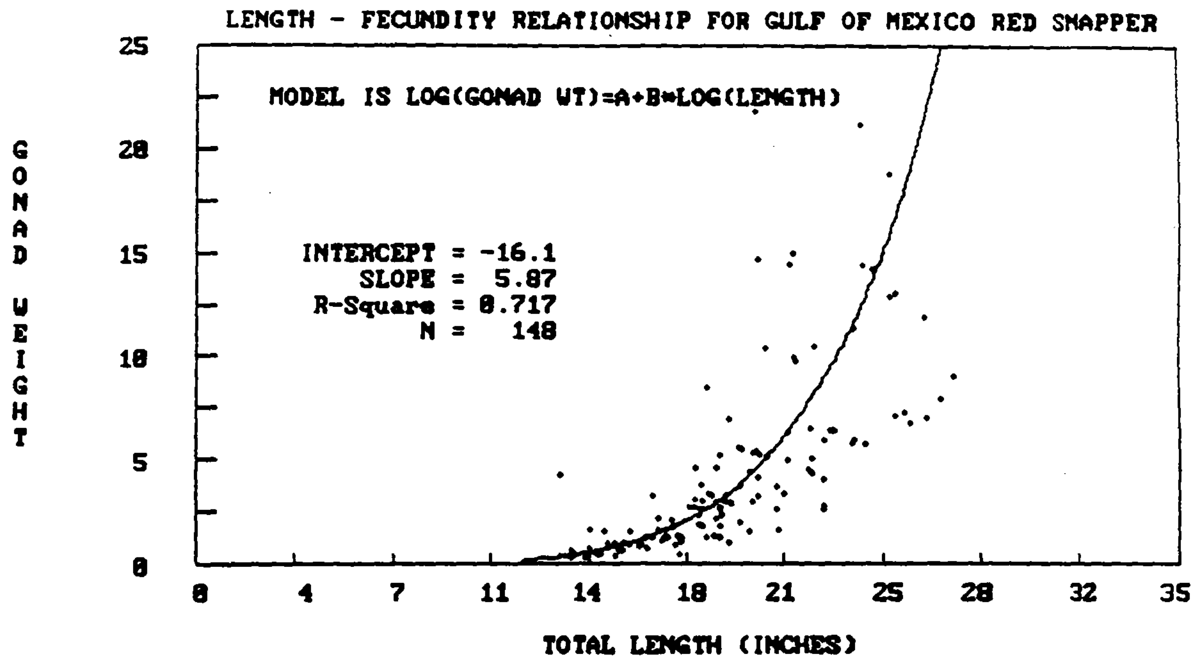
Trend line of juvenile red snapper abundance by year from 1972 through 1988.

FIGURE 8.3



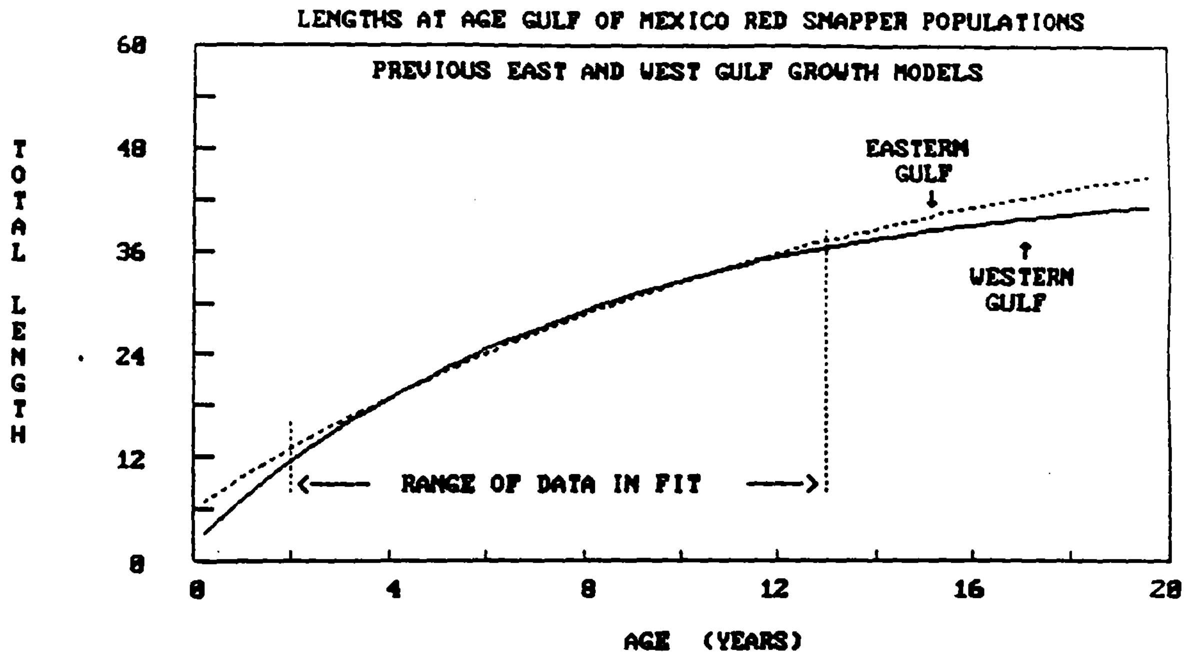
Relationship of the juvenile abundance estimates from the NMFS Fall Ground-fish Survey and the estimated total catch of 10 and 11 inch (TL) red snapper by recreational fishermen the following year. The recreational catch estimates are the sum of The type A and B1 catch from the NMFS Marine Recreational Survey for all years, plus estimates of the party boat catch for 1986, and Texas boat mode catches for 1982-1984 and 1986. The number of 10-11 inch fish was estimated as the product of the annual estimate of the number of fish harvested and the annual proportion of the harvest in these length classes (updated 4/18/88).

FIGURE 8.4



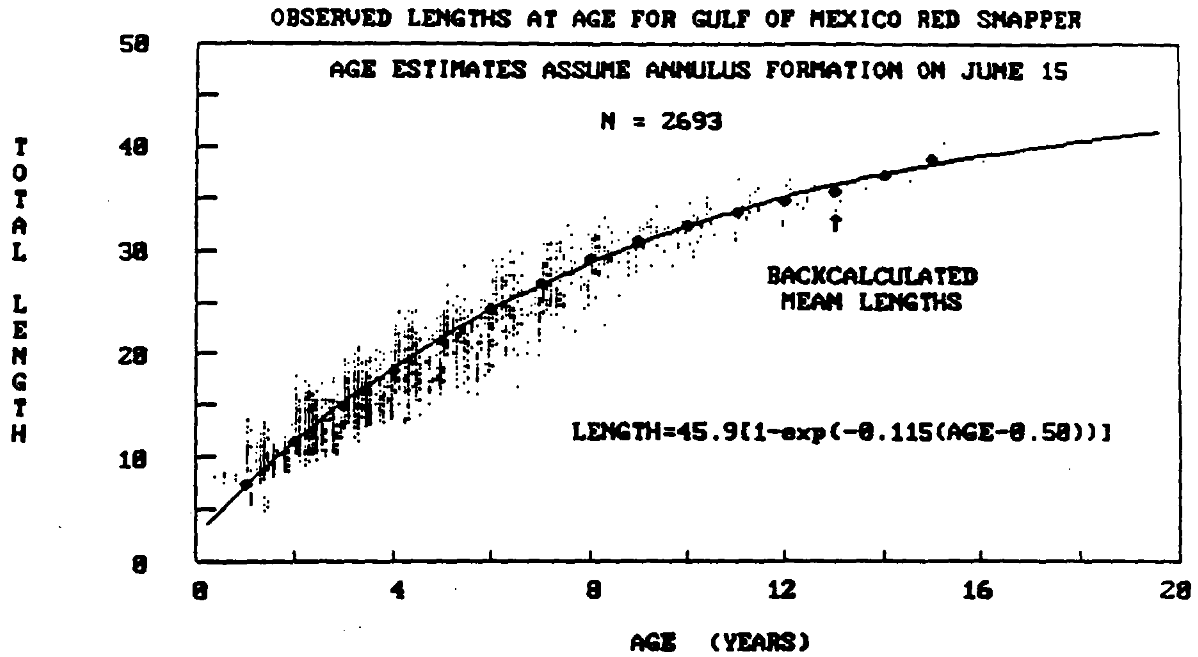
Relation between gonad weight (grams) and total length for red snapper. The fitted relationship includes data pairs with gonad weights well above the plotted range.

FIGURE 8.5



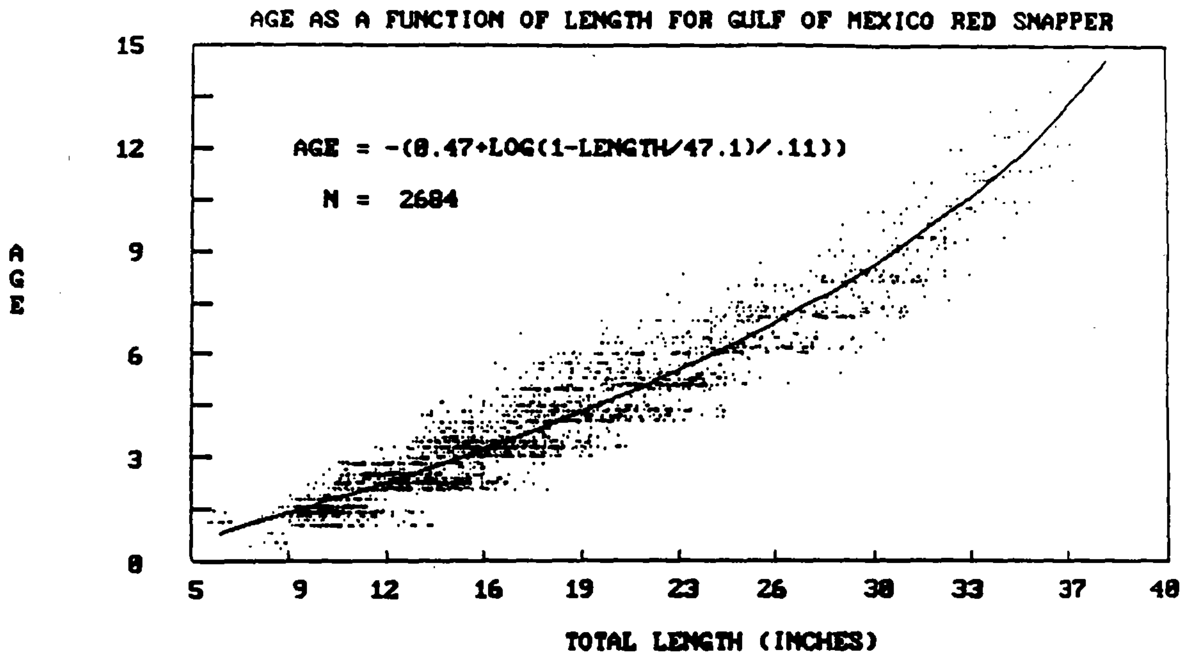
Comparison of the two growth models used to separate Gulf of Mexico red snapper into "eastern" and "western" stocks. Note that although there were significant differences in the parameter estimates, the predicted lengths at age are very similar over the range of data employed in the estimates.

FIGURE 8.6



Observed and mean back-calculated lengths of red snapper plotted against age and compared with a von-Bertalanffy equation fitted to the back-calculated lengths at age.

FIGURE 8.7



Von-Bertalanffy relation predicting age as a function of length. The data were pooled from the several sources described in Parrack (1986b).

FIGURE 8.8

Length frequency of red snapper harvested by commercial and recreational anglers. The data were obtained from the NMFS TIp data files, 1983-1987 and the MRFSS data files, 1979-1986.

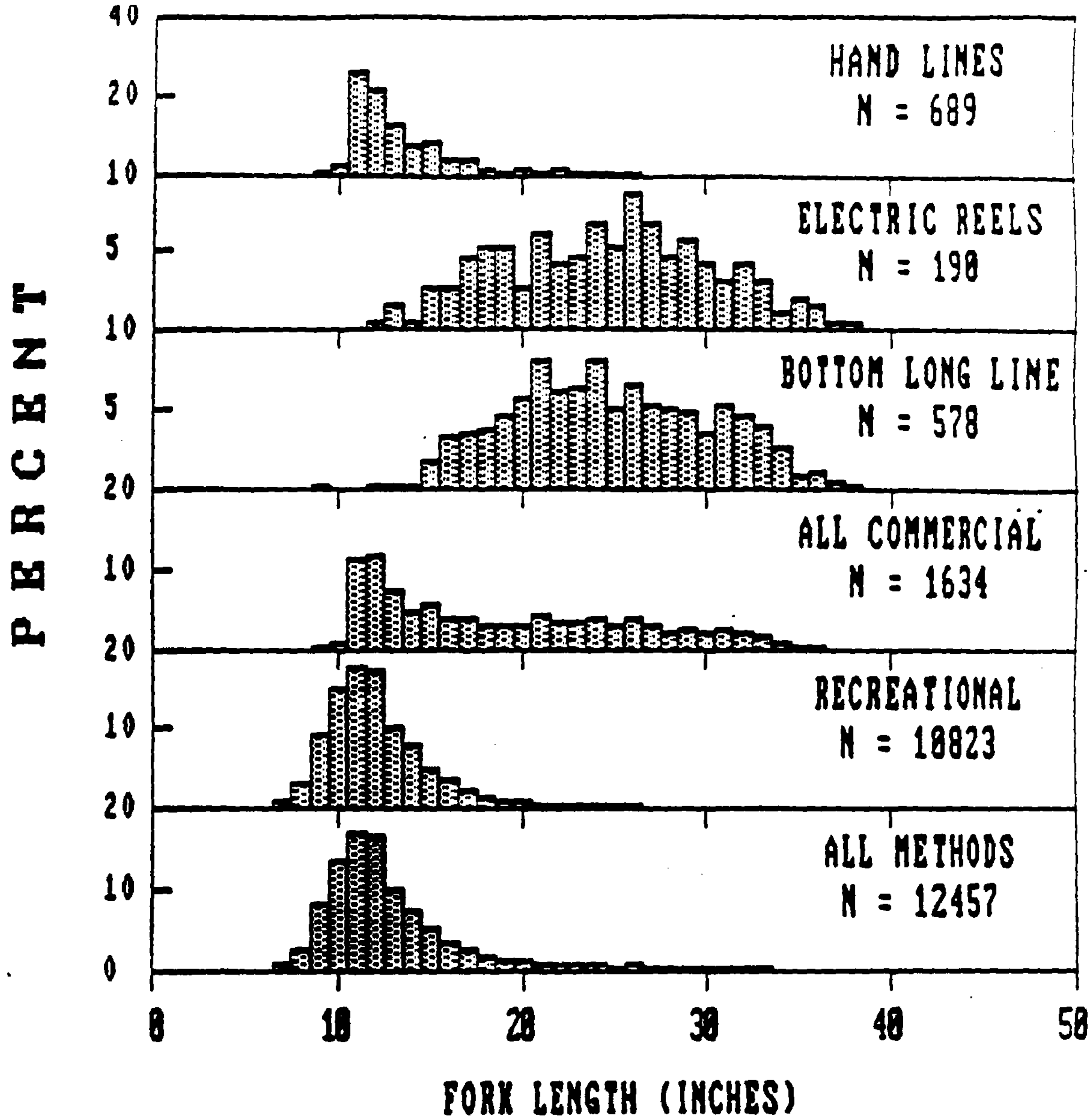
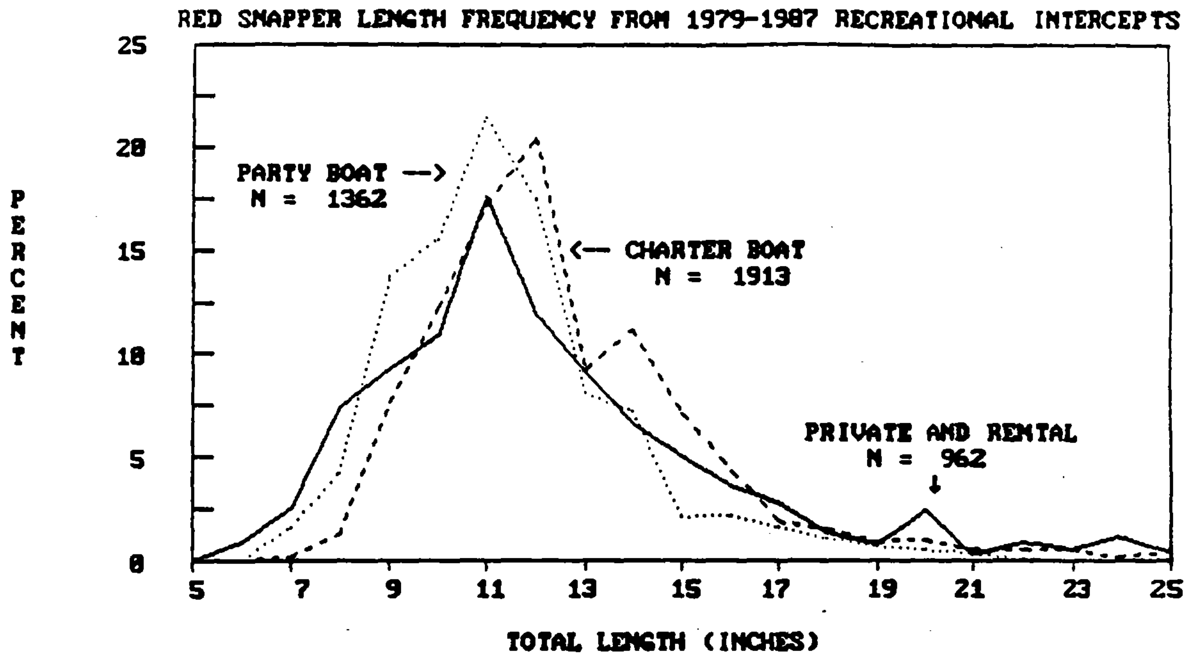
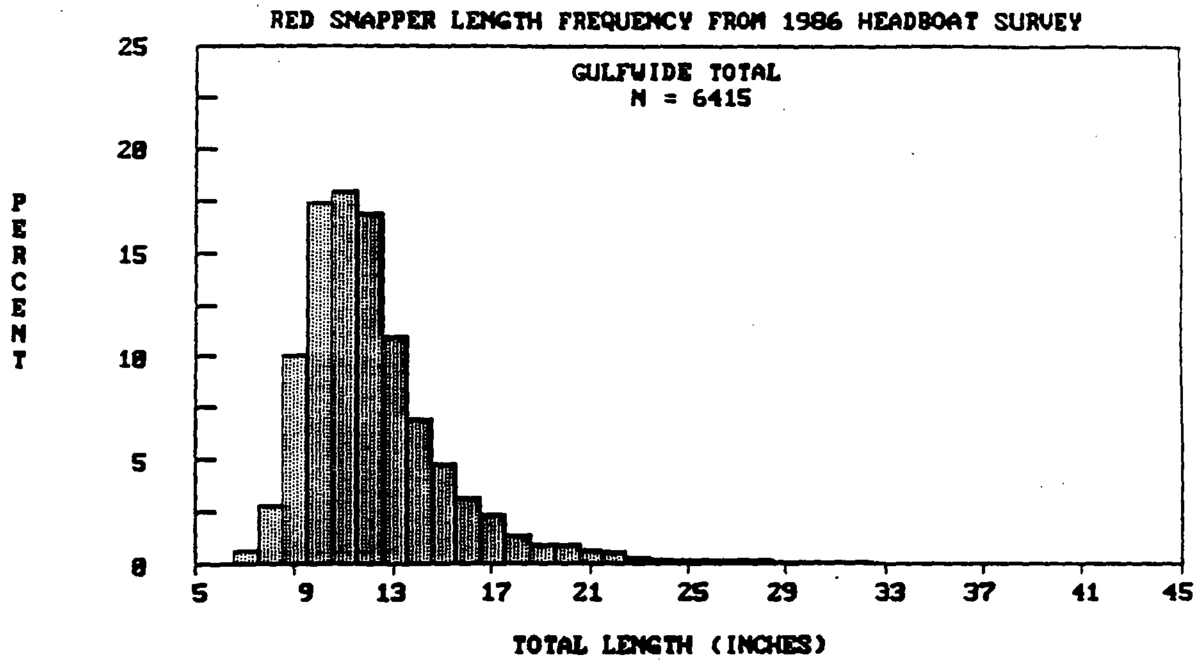


FIGURE 8.9



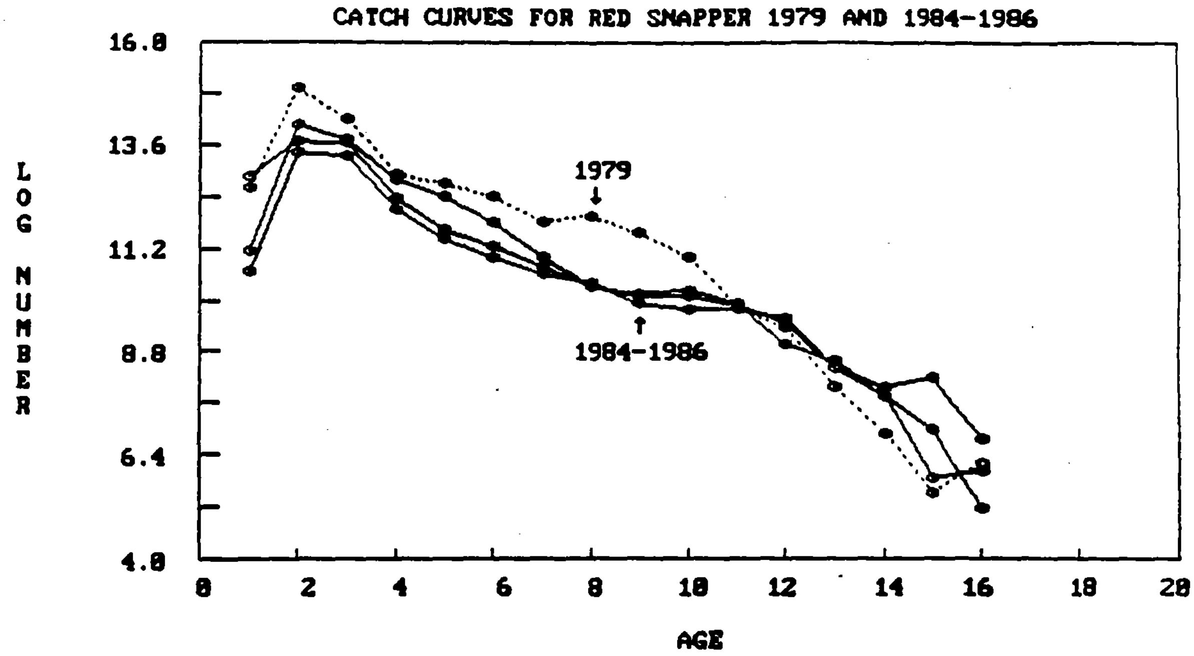
Comparrison of the length frequencies of red snappers captured by party, charter and private/rental boats as sampled by the NMFS Marine Recreational Fisheries Survey during the period 1979-1987.

FIGURE 8.10



Length frequency of red snapper captured from party boats and sampled by the NMFS Headboat sampling program in 1986. Data courtesy Gene Huntsman, NMFS, Beaufort NC.

FIGURE 8.11



Catch curves for Gulf of Mexico red snapper for 1979, and 1984-1986. Numbers at age were estimated from the length frequencies of red snapper by mode of capture (weighted by estimated total landings by mode of capture).

FIGURE 8.12

Total mortality estimates of red snapper harvested by commercial and recreational anglers. The estimates were derived from lengths from the NMFS TIp data files, 1983-1987 and the MRFSS data files, 1979-1986.

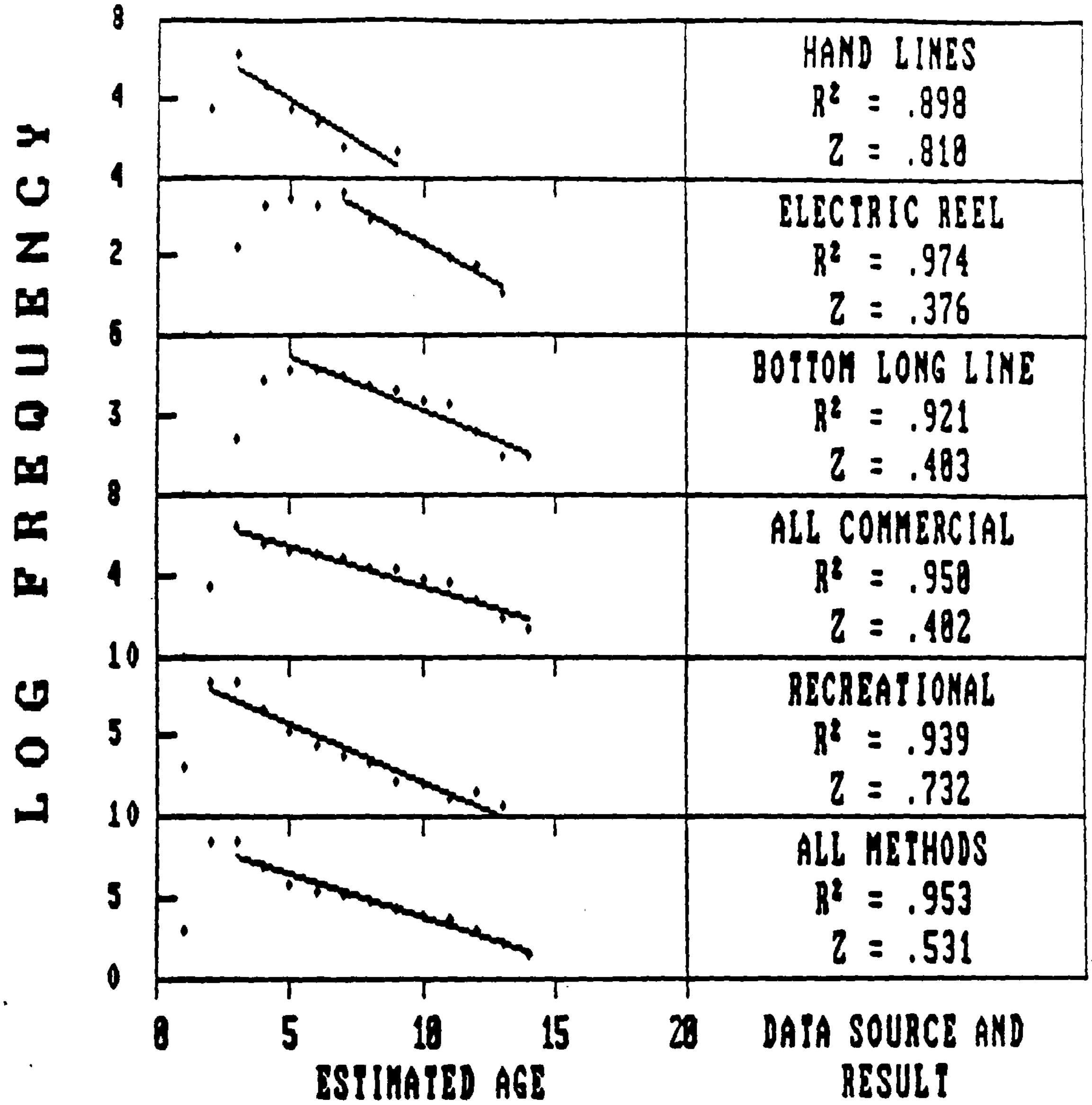
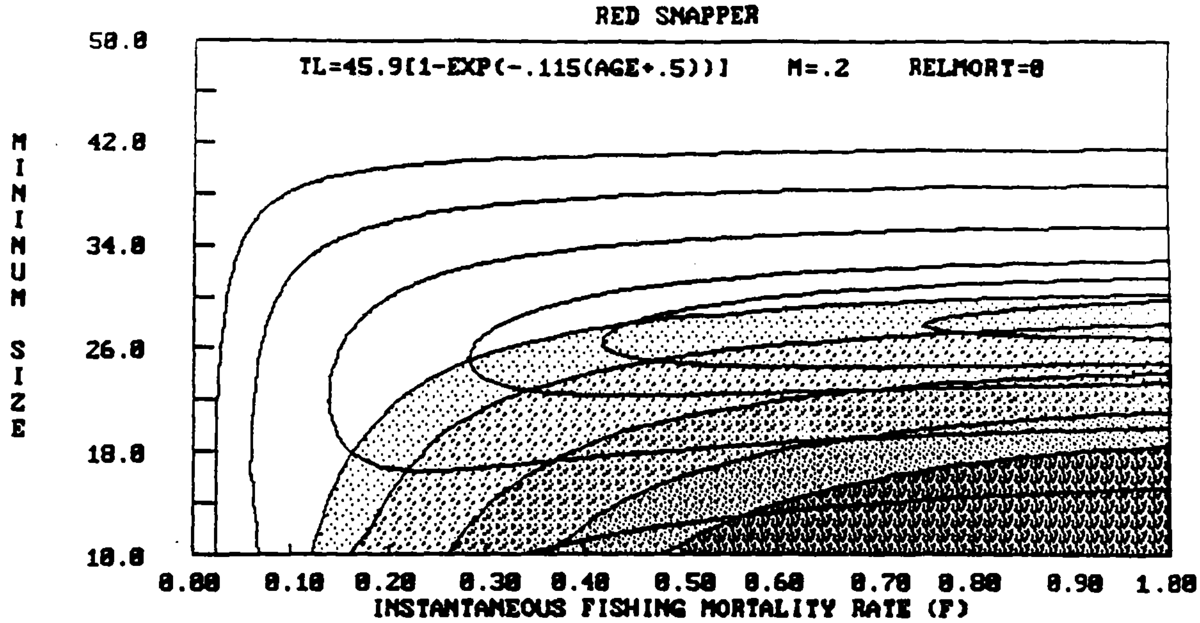
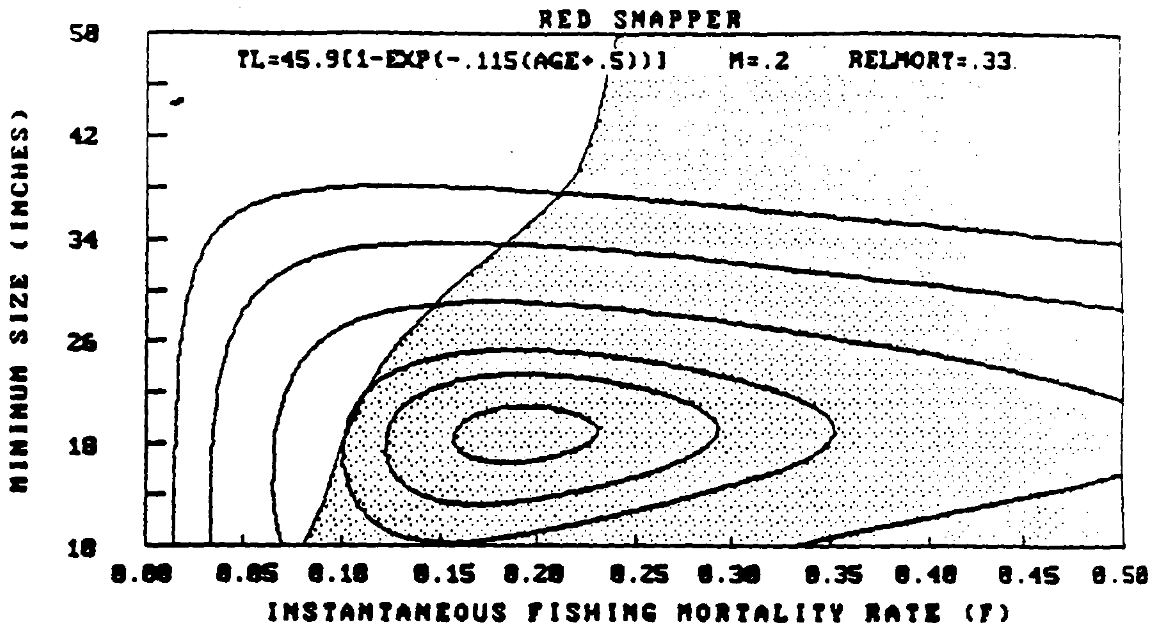


FIGURE 8.13



Yield and spawning stock biomass per recruit for red snapper as a function of minimum length in inches and the instantaneous rate of fishing mortality (F). The shaded regions represent areas where fishing has reduced spawning stock biomass per recruit to levels below 2.5% (lower right), 5%, 10%, 20%, and 30% (upper left) of the unfished level. Each yield isopleth traces a contour where the combination of length at recruitment and fishing mortality produce a constant biomass yield. The contours are for yields that are 25%, 50%, 75%, 90%, 95% and 99% of the maximum obtainable within the parameter space. The growth and mortality estimates are taken from this study and Nelson and Manooch (1982). M is the natural mortality rate employed in the calculations, and RELMORT is the fraction of released sublegal fish that die as a result of capture.

FIGURE 8.14



Yield in pounds for each isopleth

25%	0.534	50%	1.067	75%	1.601
90%	1.921	95%	2.028	99%	2.114

Yield and spawning stock biomass per recruit (SSBR) for red snapper as a function of minimum length in inches and the instantaneous rate of fishing mortality (F). The boundry of the shaded region is the isopleth for 20% of the unfished SSBR. Parameter combinations within the shaded area cause SSBR to be reduced below 20%. Each yield isopleth traces a contour where the combination of length at recruitment and fishing mortality produce a constant biomass yield. The contours are for yields that are 25%, 50%, 75%, 90%, 95% and 99% of the maximum obtainable within the parameter space. The growth and mortality estimates are taken from this study and Nelson and Manooch (1982). M is the natural mortality rate employed in the calculations, and RELMORT is the fraction of released sublegal fish that die as a result of capture. A shrimp trawl bycatch mortality of 50% is assumed in the SSBR estimates.

FIGURE 8.15

Projections of future landings and spawning stock size of red snapper that would occur with no change in present regulations.

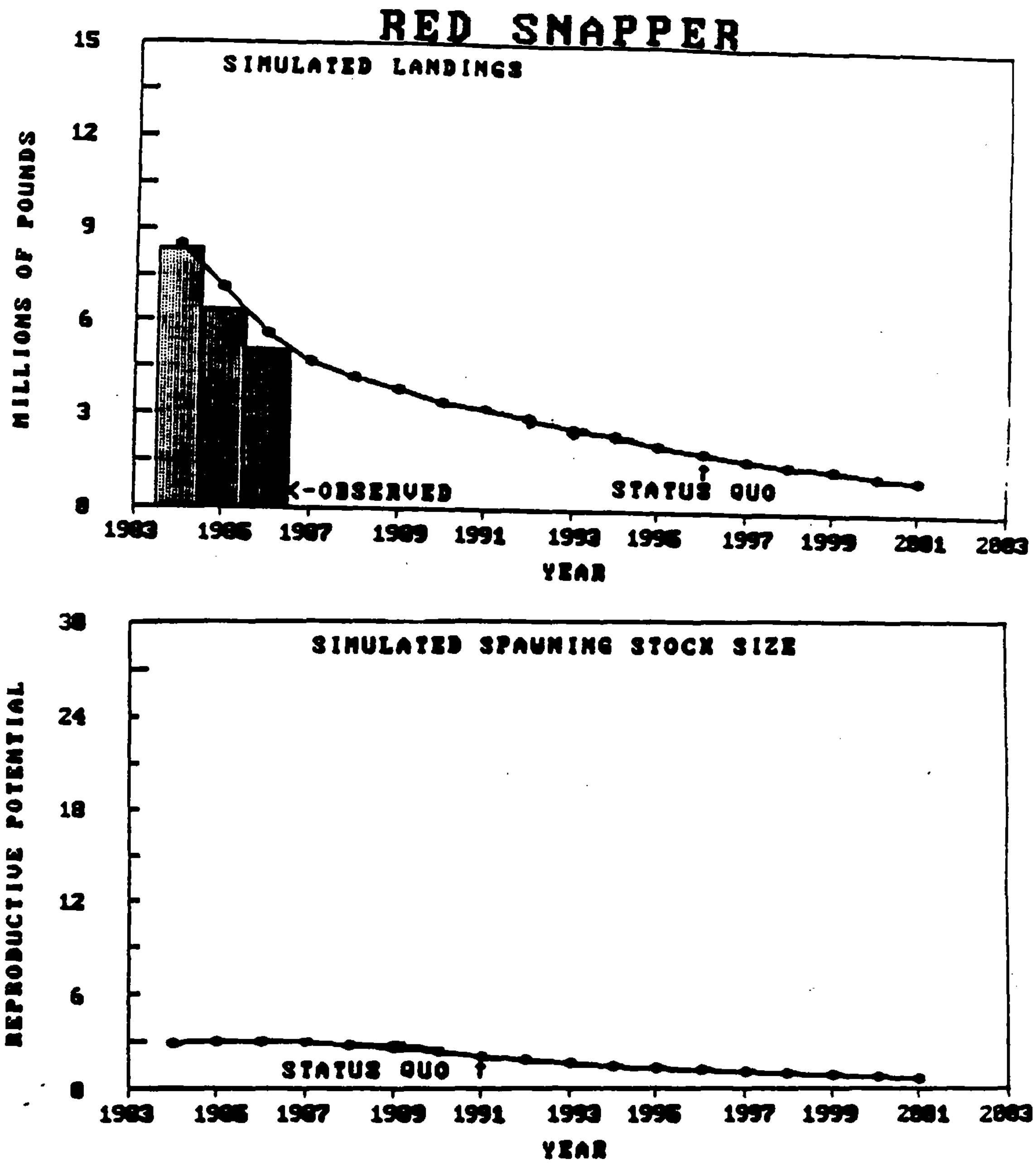
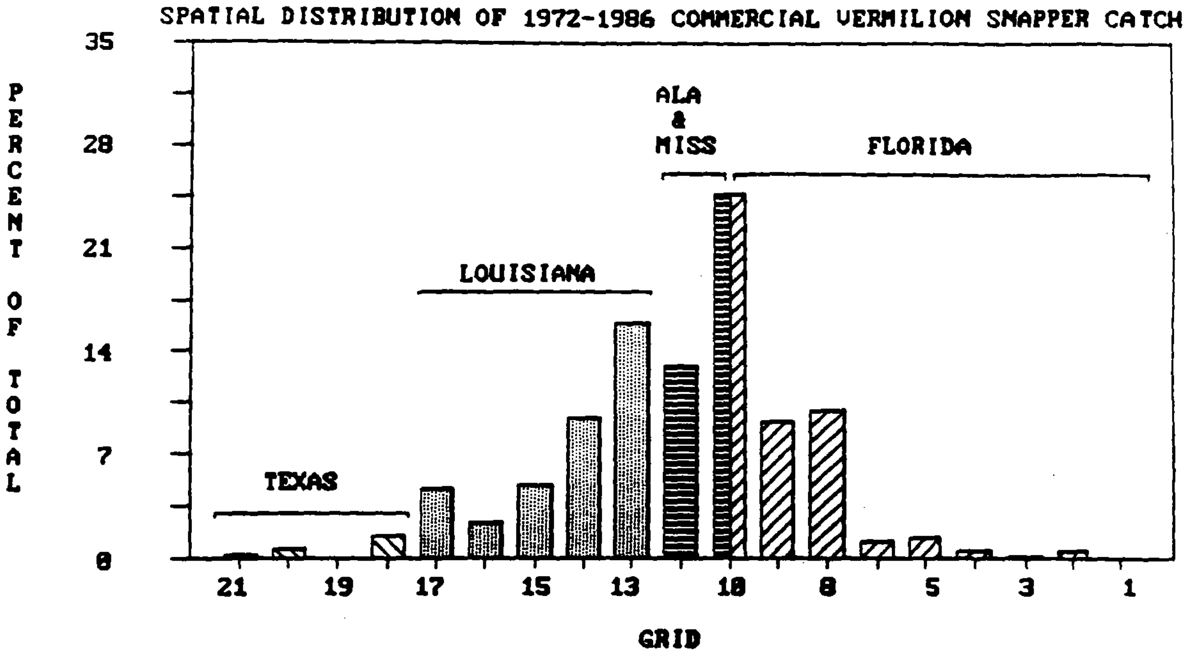


FIGURE 8.16



Spatial distribution of the 1972-1986 commercial catch of vermilion snapper regardless of where they were landed. The grid designations are from the NMFS shrimp grid system. Landings from grid 7 are equally divided between grids 6 and 8, and landings from grid 12 are equally divided between grids 11 and 13 for presentation.

FIGURE 8.17

Length frequency of vermilion snapper harvested by commercial and recreational anglers. The data were obtained from the NMFS TIp data files, 1983-1987 and the MRFSS data files, 1979-1986.

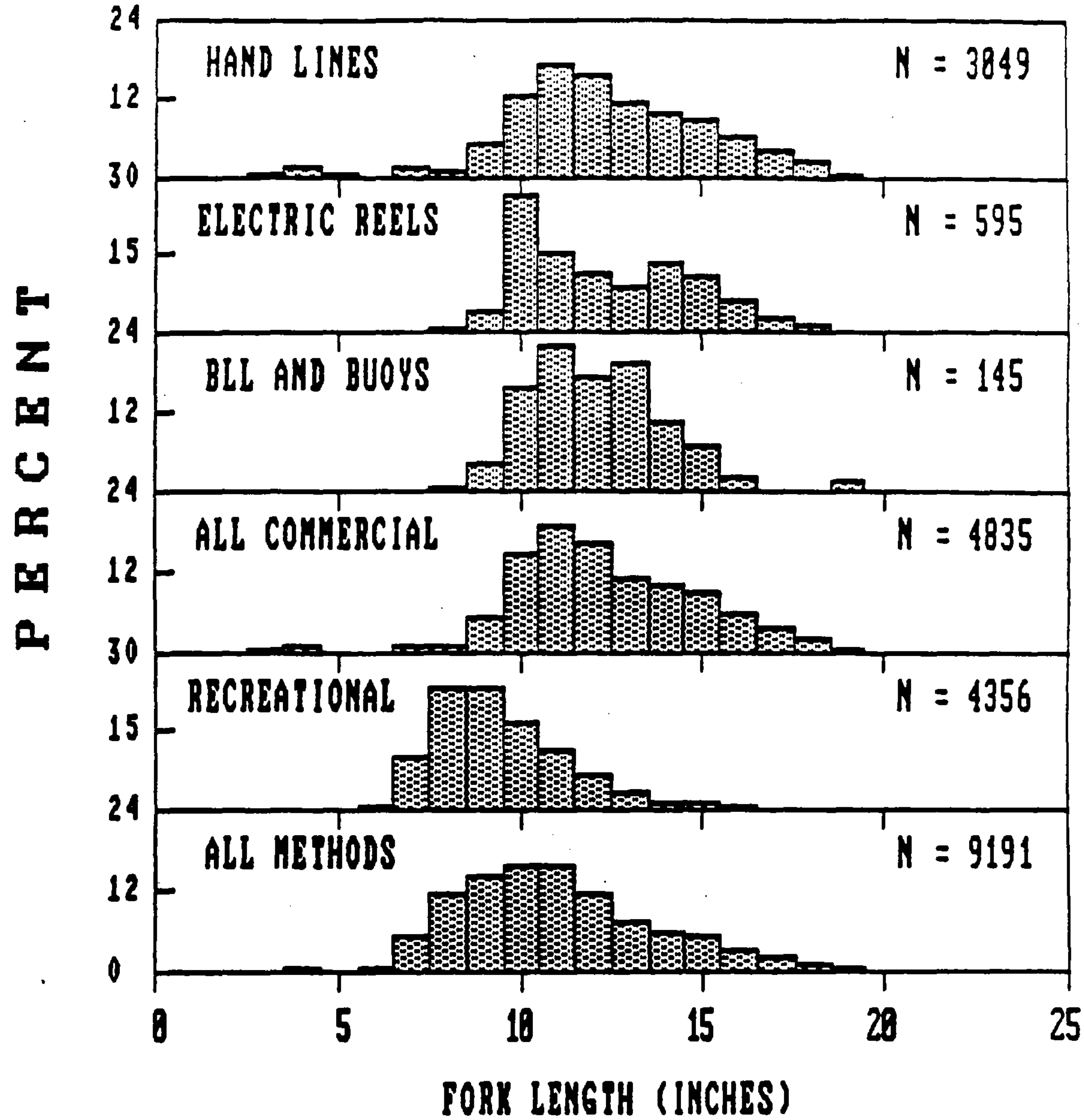
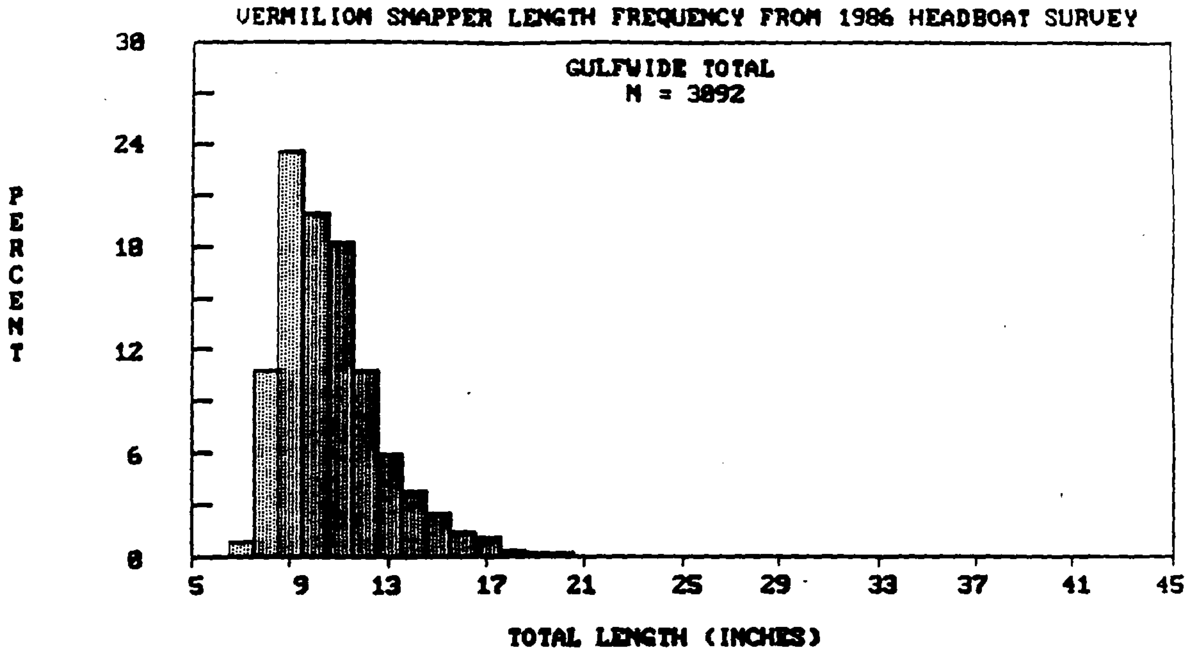


FIGURE 8.18



Length frequency of vermilion snapper sampled from the Headboat fishery throughout the Gulf of Mexico in 1986. Data courtesy Gene Huntsman, NMFS, Beaufort, NC.

FIGURE 8.19

Length frequency of gray (mangrove) snapper harvested by commercial and recreational anglers. The data were obtained from the NMFS TIp data files, 1983-1987 and the MRFSS data files, 1979-1986.

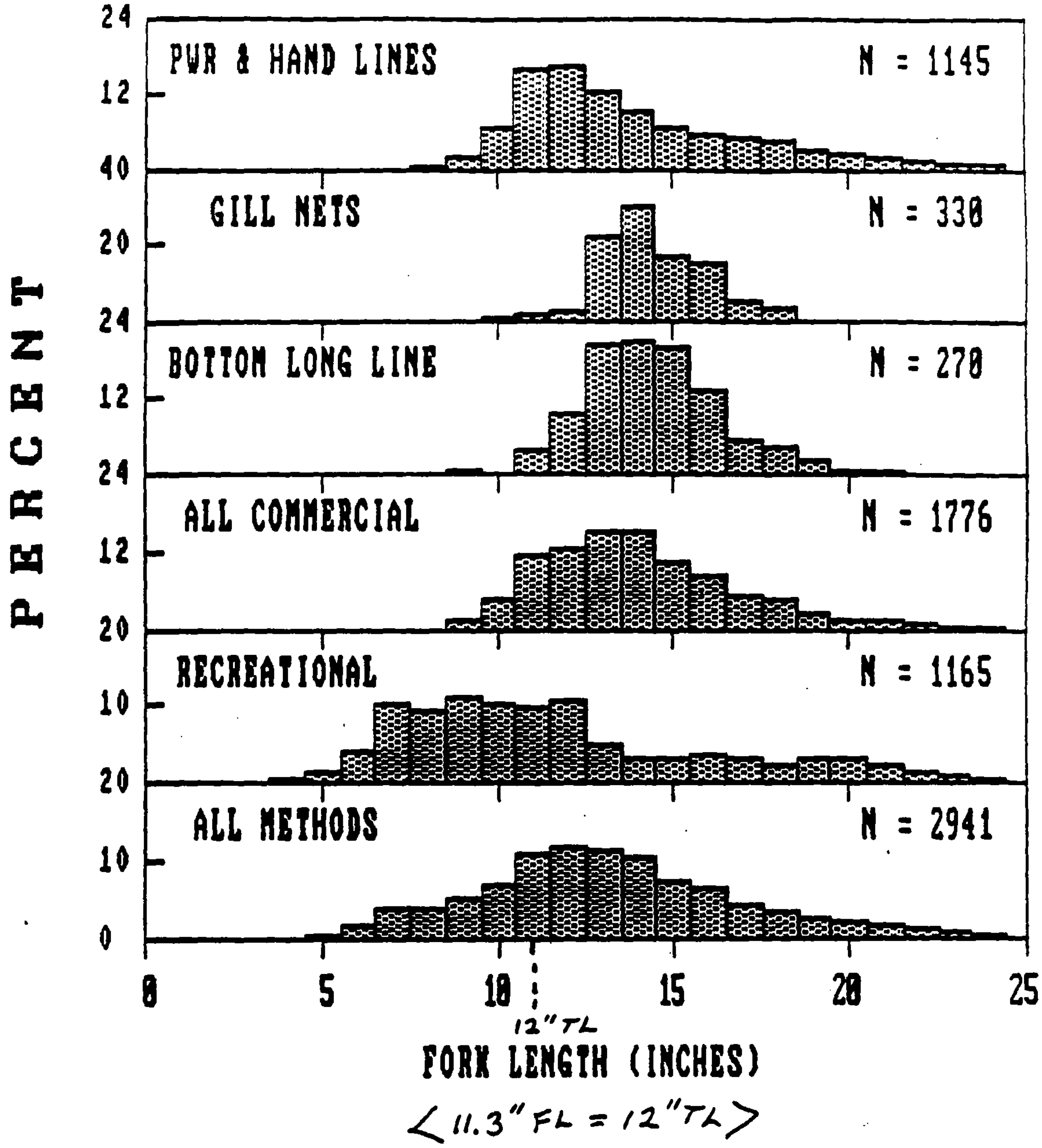


FIGURE 8.20

Length frequency of yellowtail snapper harvested by commercial and recreational anglers. The data were obtained from the NMFS TIp data files, 1983-1987 and the MRFSS data files, 1979-1986.

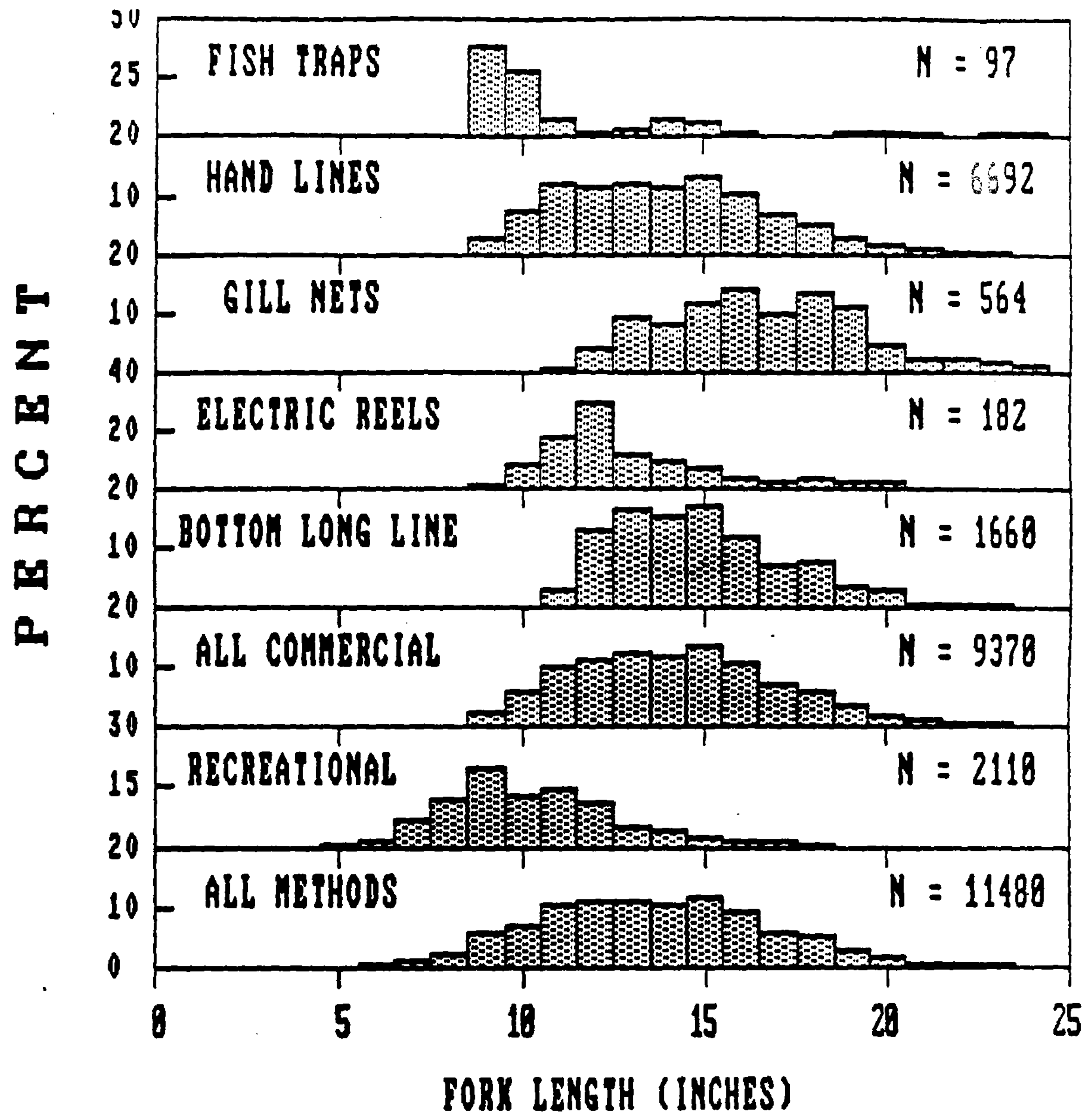
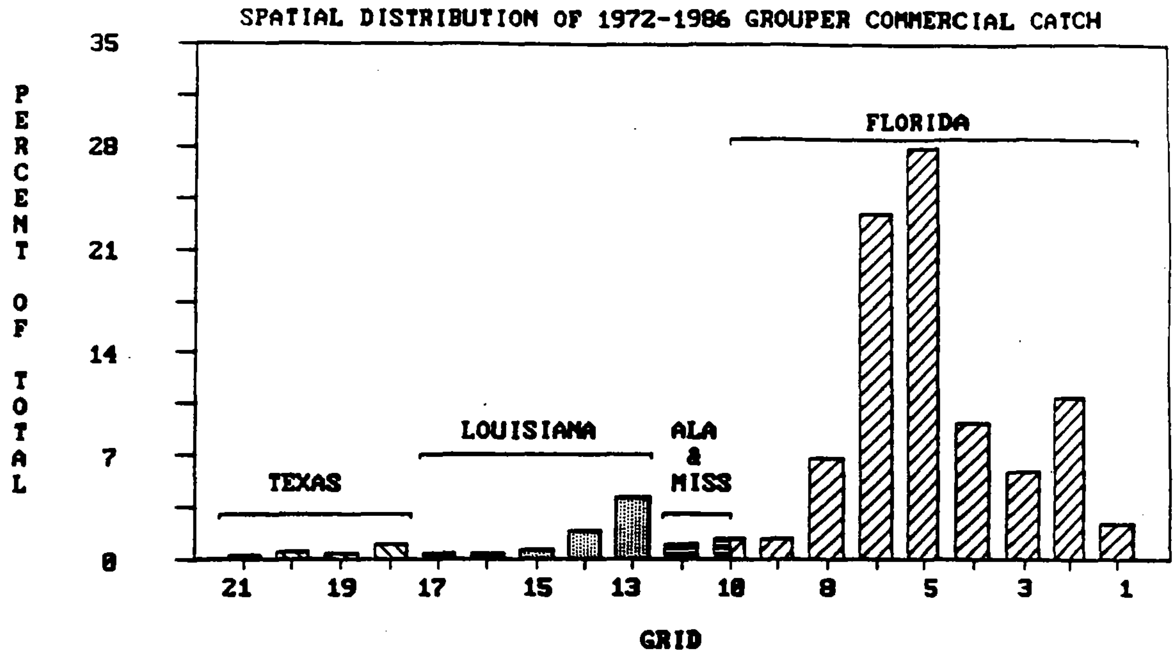


FIGURE 8.21



Spatial distribution of the 1972-1986 commercial catch of grouper and scamp regardless of where they were landed. The grid designations are from the NMFS shrimp grid system. Landings from grid 7 are equally divided between grids 6 and 8, and landings from grid 12 are equally divided between grids 11 and 13 for presentation.

FIGURE 8.22

Length frequency of red grouper harvested by commercial and recreational anglers. The data were obtained from the NMFS TIp data files, 1983-1987 and the MRFSS data files, 1979-1986.

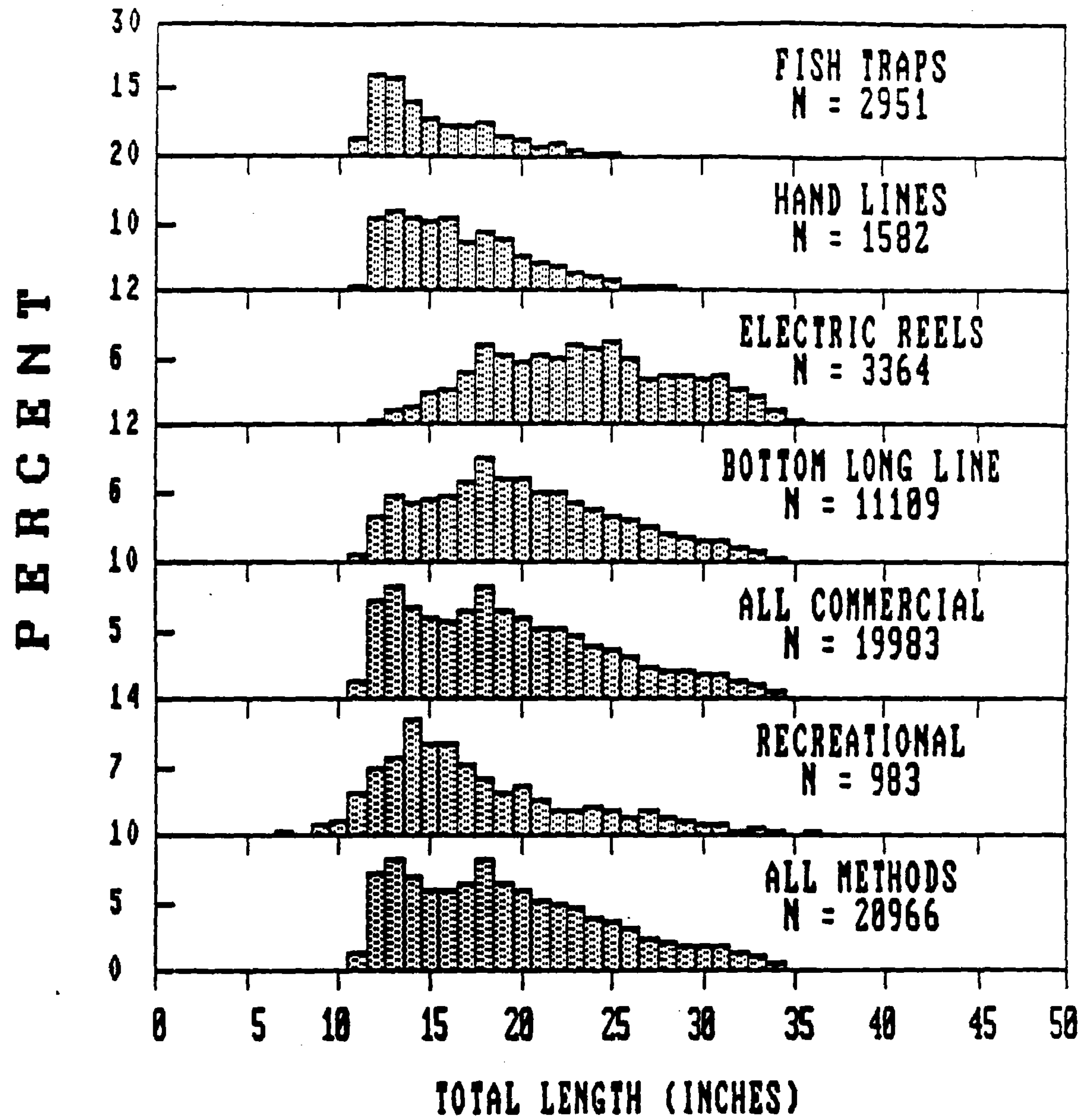
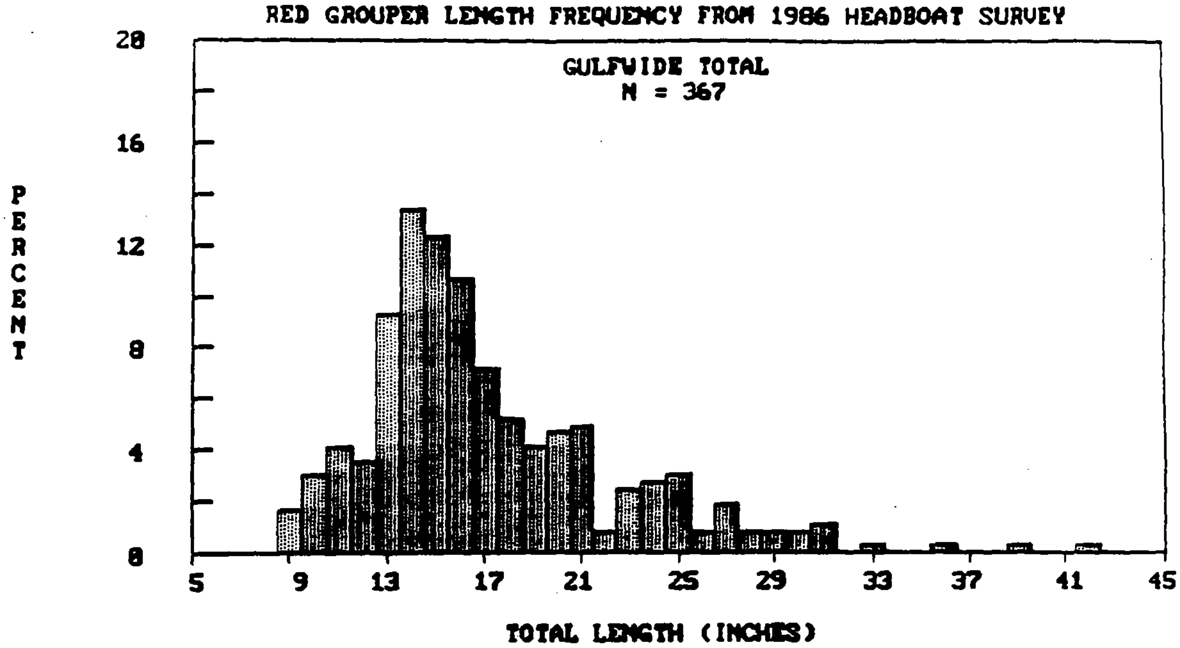


FIGURE 8.23



Length frequency of red grouper sampled from the Headboat fishery throughout the Gulf of Mexico in 1986. Data courtesy Gene Huntsman, NMFS, Beaufort, NC.

FIGURE 8.24

Total mortality estimates of red grouper harvested by commercial and recreational anglers. The estimates were derived from lengths from the NMFS TIp data files, 1983-1987 and the MRFSS data files, 1979-1986.

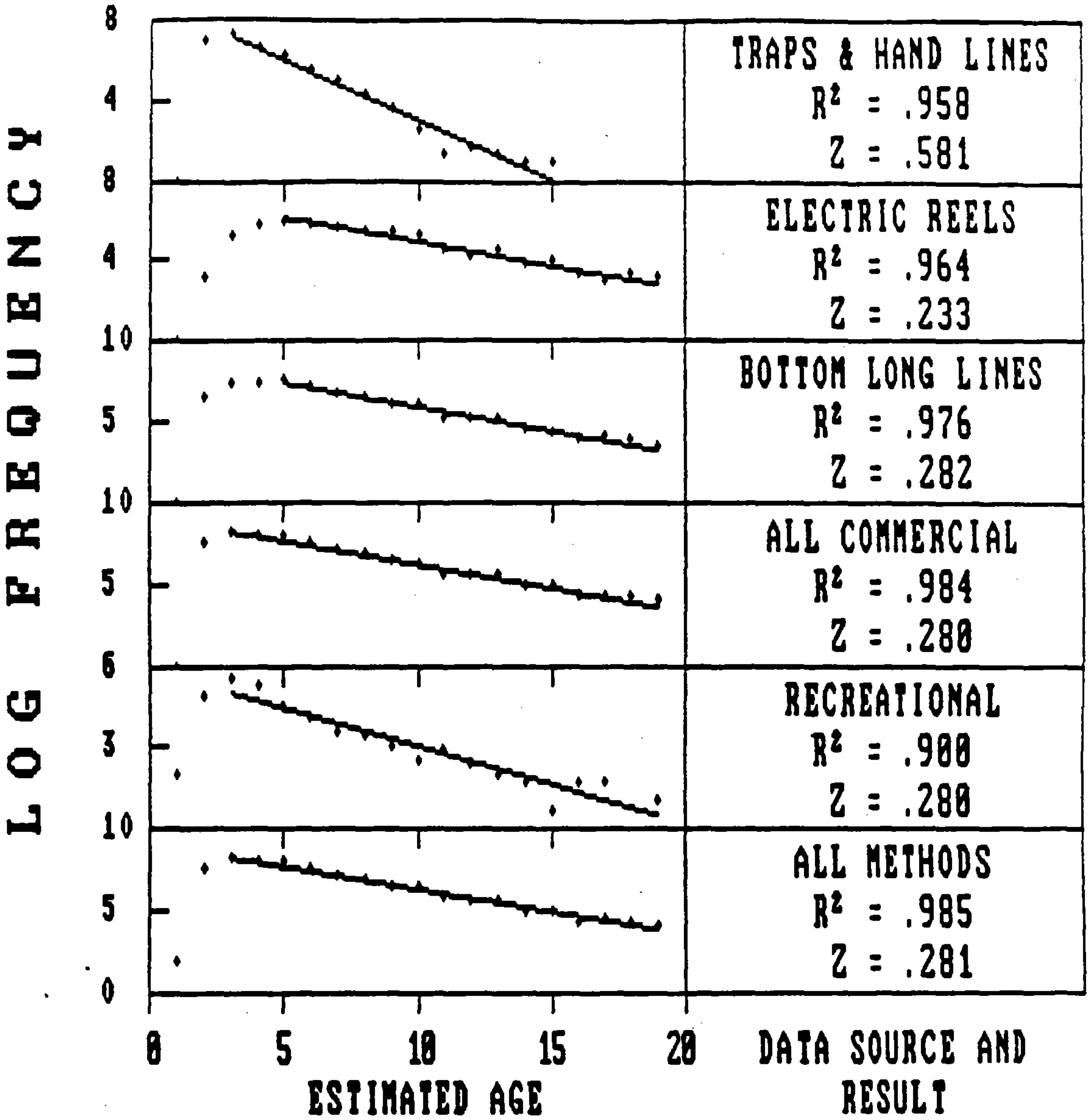
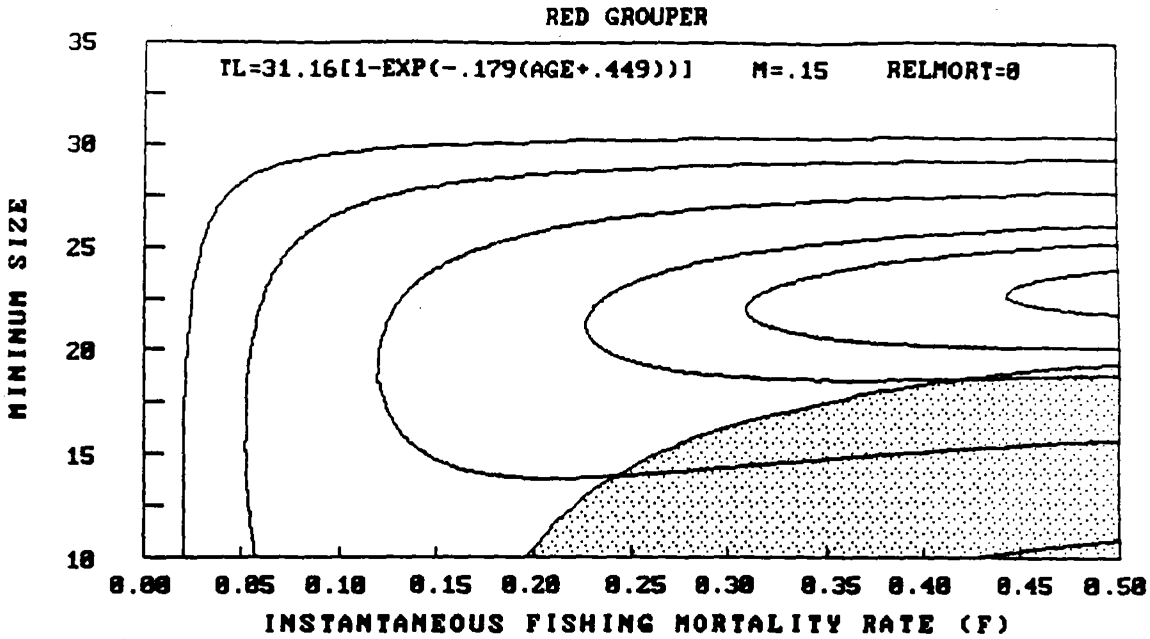


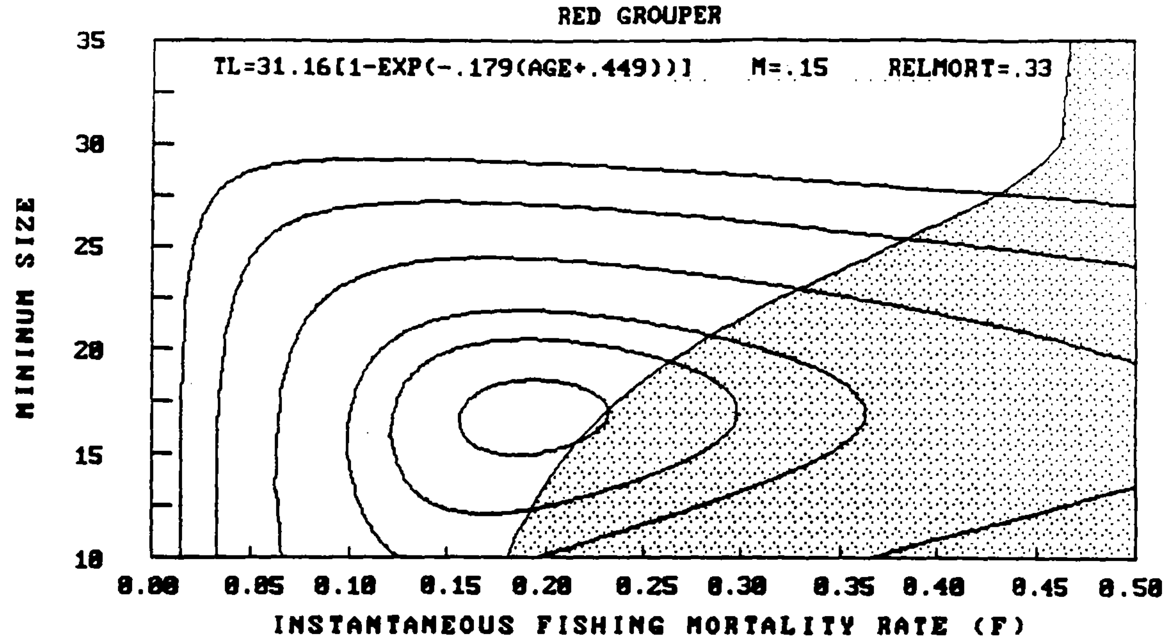
FIGURE 8.25



Yield in pounds for each isopleth					
25%	0.780	50%	1.560	75%	2.339
90%	2.807	95%	2.963	99%	3.088

Yield and spawning stock biomass per recruit (SSBR) for red grouper as a function of minimum length in inches and the instantaneous rate of fishing mortality (F). The boundry of the shaded region is the isopleth for 20% of the unfished SSBR. Parameter combinations within the shaded area cause SSBR to be reduced below 20%. Each yield isopleth traces a contour where the combination of length at recruitment and fishing mortality produce a constant biomass yield. The contours are for yields that are 25%, 50%, 75%, 90%, 95% and 99% of the maximum obtainable within the parameter space. The growth and mortality estimates are derived from Moe (1969). M is the natural mortality rate employed in the calculations, and RELMORT is the fraction of released sublegal fish that die as a result of capture.

FIGURE 8.26



Yield in pounds for each isopleth

25%	0.559	50%	1.117	75%	1.676
90%	2.011	95%	2.123	99%	2.212

Yield and spawning stock biomass per recruit (SSBR) for red grouper as a function of minimum length in inches and the instantaneous rate of fishing mortality (F). The boundry of the shaded region is the isopleth for 20% of the unfished SSBR. Parameter combinations within the shaded area cause SSBR to be reduced below 20%. Each yield isopleth traces a contour where the combination of length at recruitment and fishing mortality produce a constant biomass yield. The contours are for yields that are 25%, 50%, 75%, 90%, 95% and 99% of the maximum obtainable within the parameter space. The growth and mortality estimates are derived from Moe (1969). M is the natural mortality rate employed in the calculations, and RELMORT is the fraction of released sublegal fish that die as a result of capture.

FIGURE 8.27

Length frequency of gag grouper harvested by commercial and recreational anglers. The data were obtained from the NMFS TIp data files, 1983-1987 and the MRFSS data files, 1979-1986.

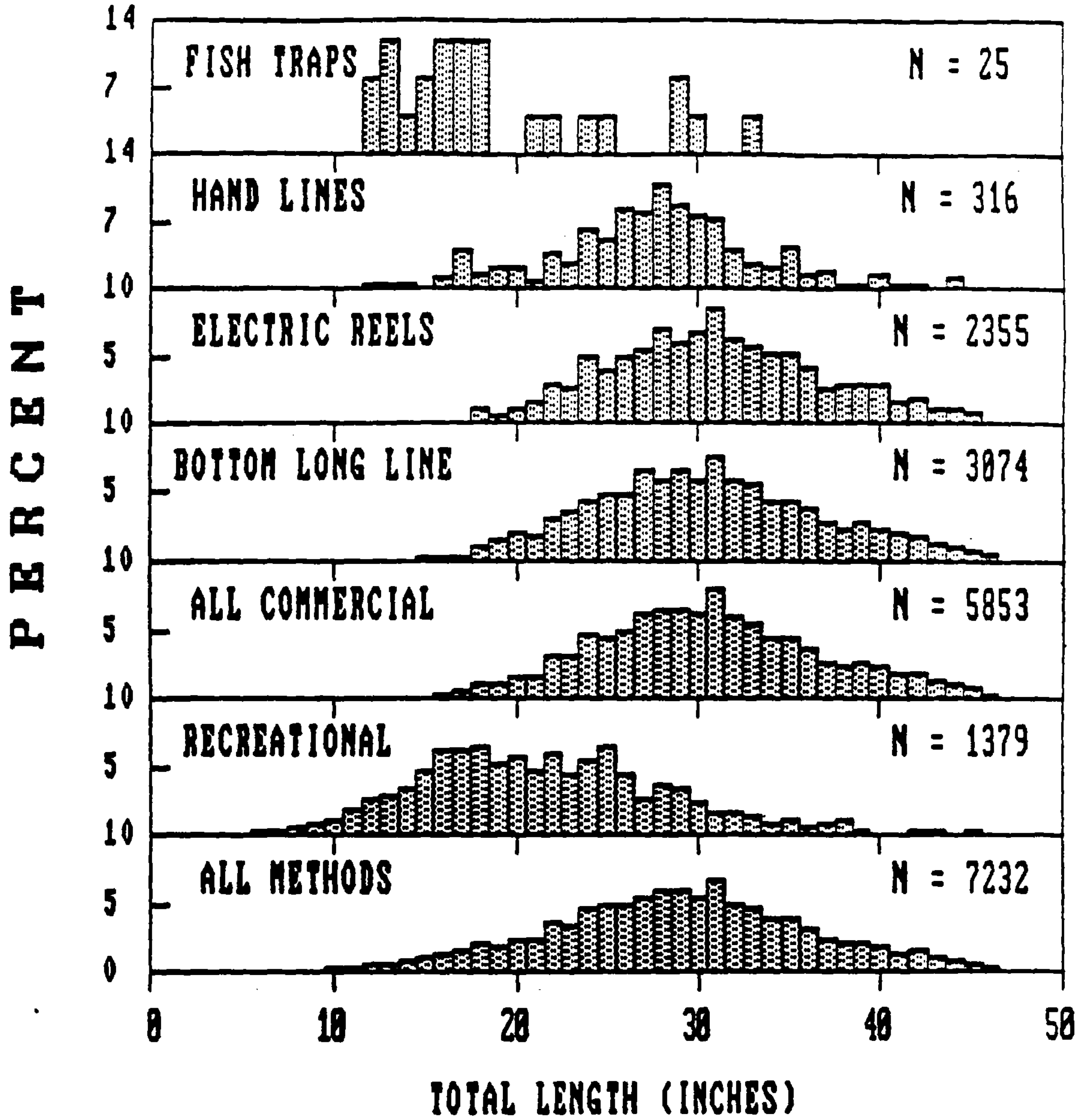


FIGURE 8.28

Length frequency of black grouper harvested by commercial and recreational anglers. The data were obtained from the NMFS TIp data files, 1983-1987 and the MRFSS data files, 1979-1986.

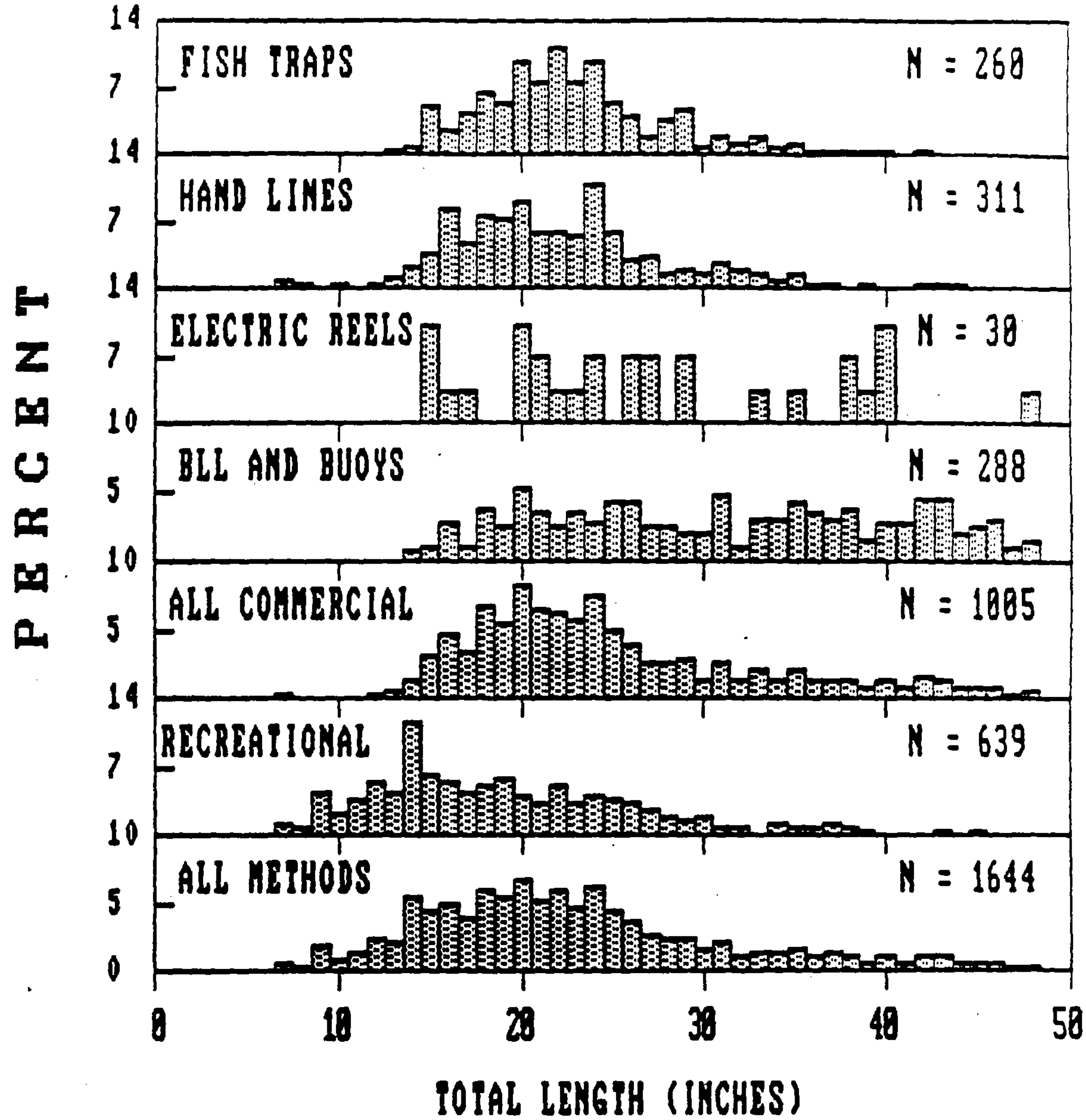
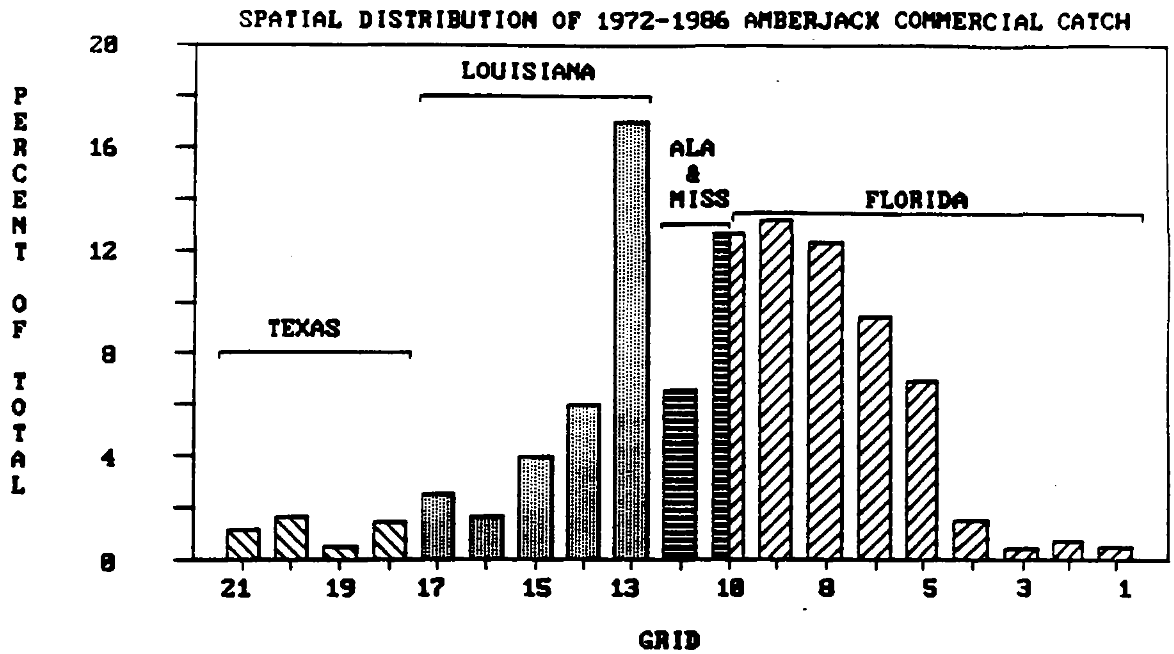


FIGURE 8.29



Spatial distribution of the 1972-1986 commercial catch of amberjack regardless of where they were landed. The grid designations are from the NMFS shrimp grid system. Landings from grid 7 are equally divided between grids 6 and 8, and landings from grid 12 are equally divided between grids 11 and 13 for presentation.

FIGURE 8.30

Length frequency of greater amberjack harvested by commercial and recreational anglers. The data were obtained from the NMFS TIp data files, 1983-1987 and the MRFSS data files, 1979-1986.

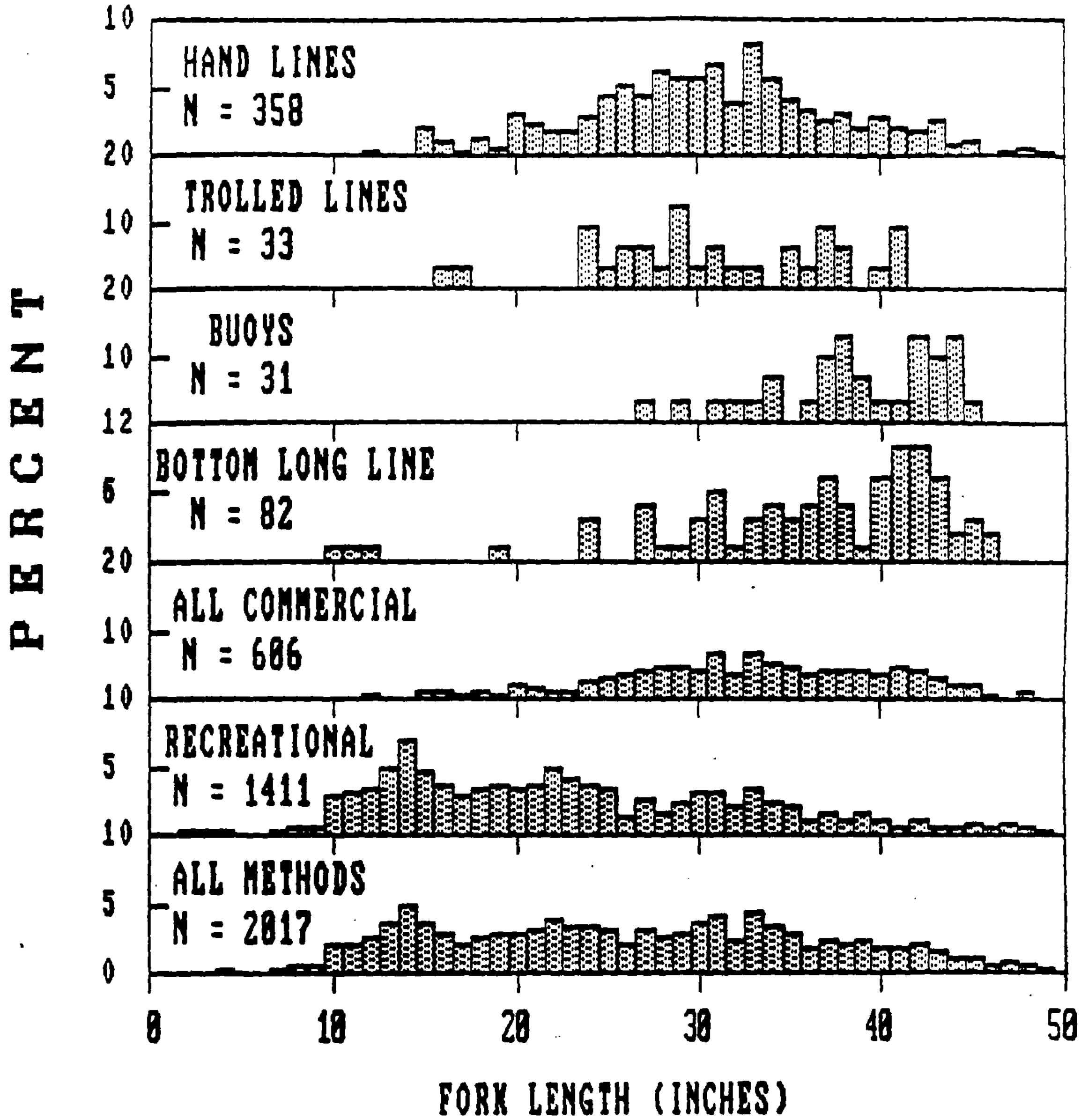
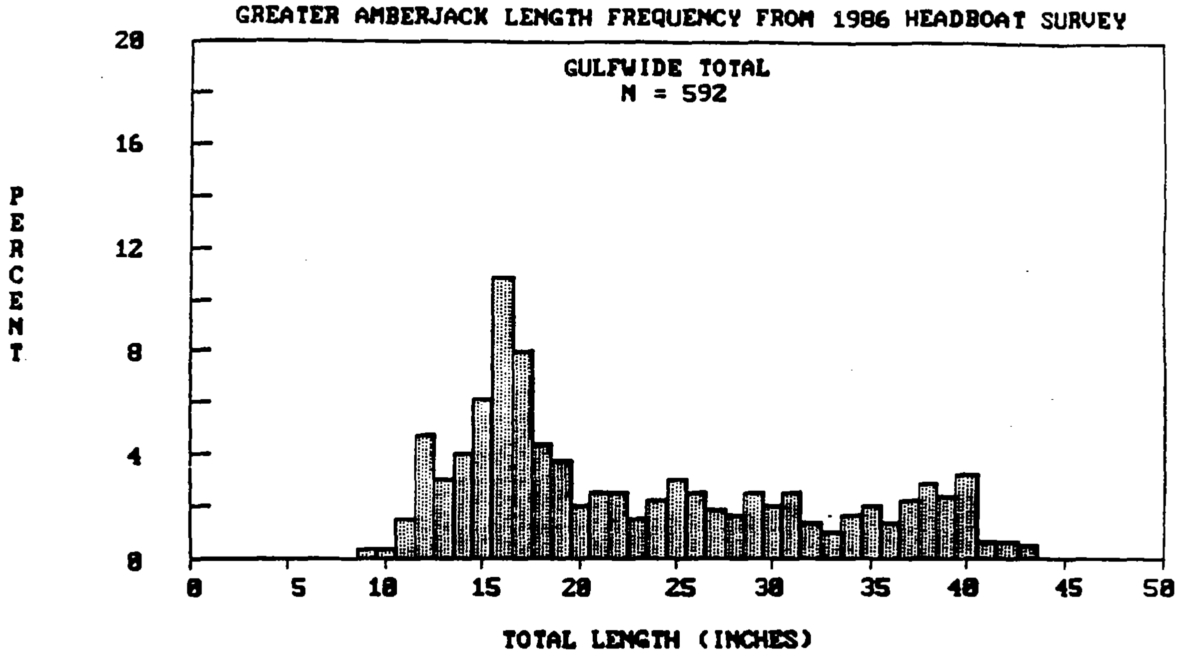


FIGURE 8.31



Length frequency of greater amberjack sampled during the 1986 Headboat survey from the Gulf of Mexico (Data courtesy Gene Huntsman, NMFS, Beaufort, NC).

FIGURE 8.32

Total mortality estimates of greater amberjack harvested by commercial and recreational anglers. The estimates were derived from lengths from the NMFS TIp data files, 1983-1987 and the MRFSS data files, 1979-1986.

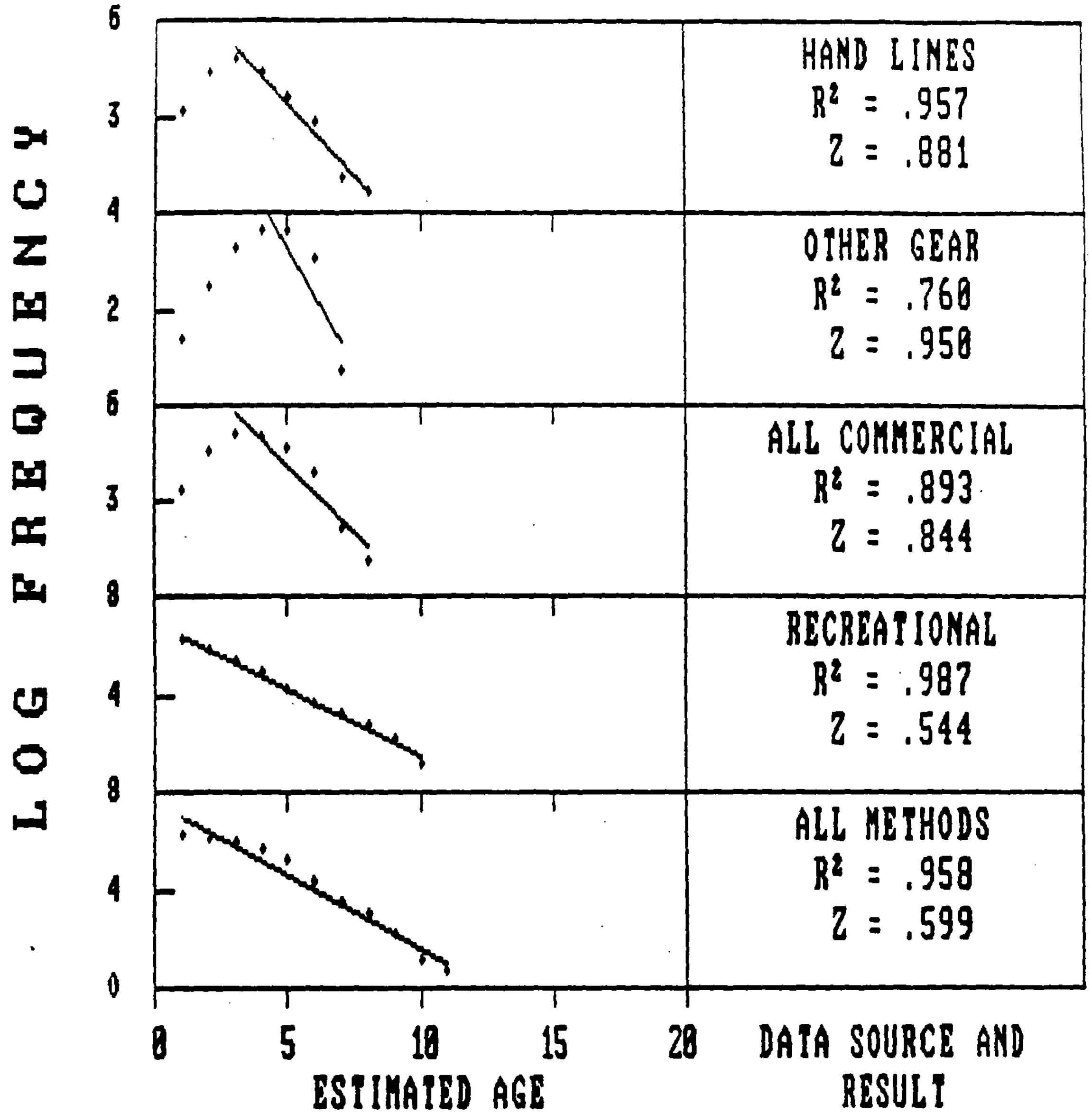
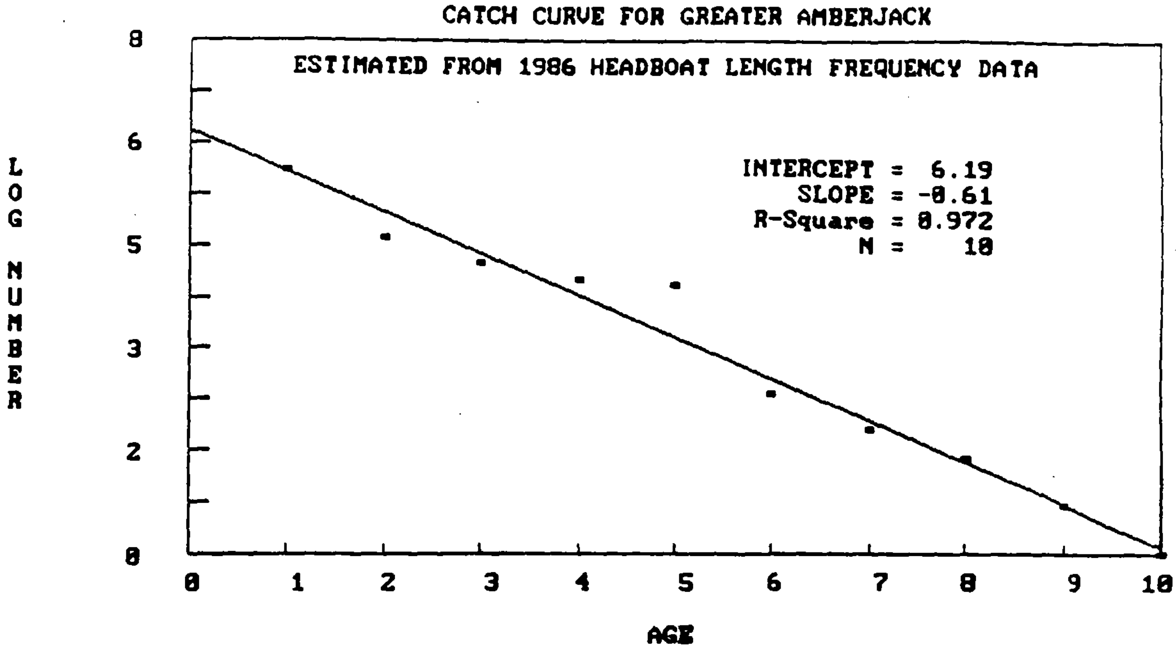
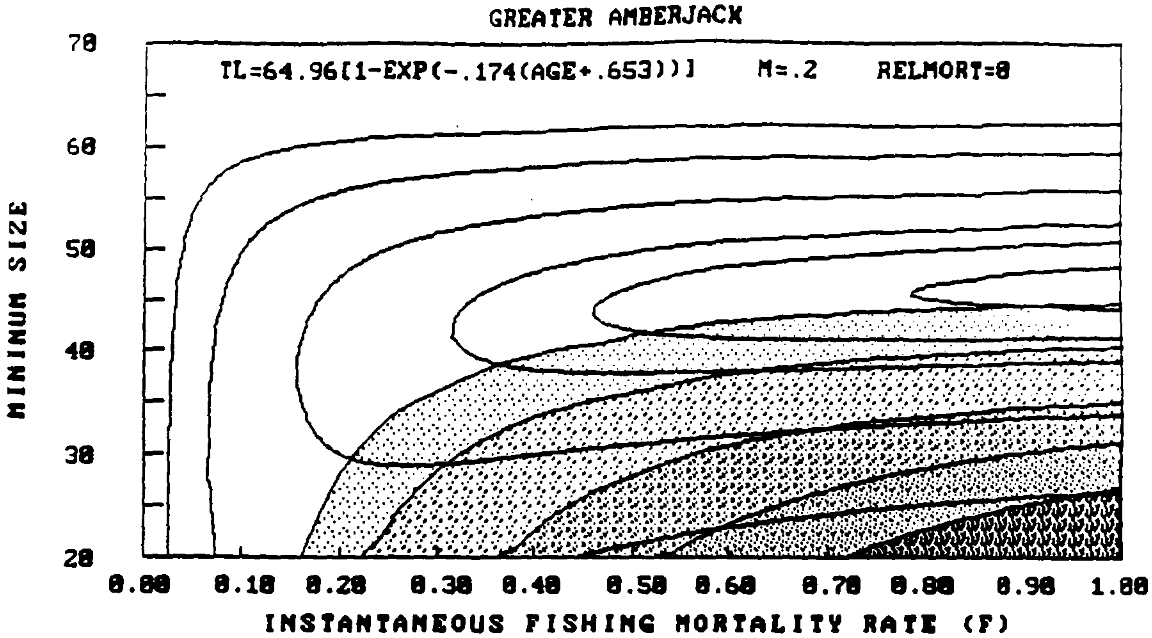


FIGURE 8.33



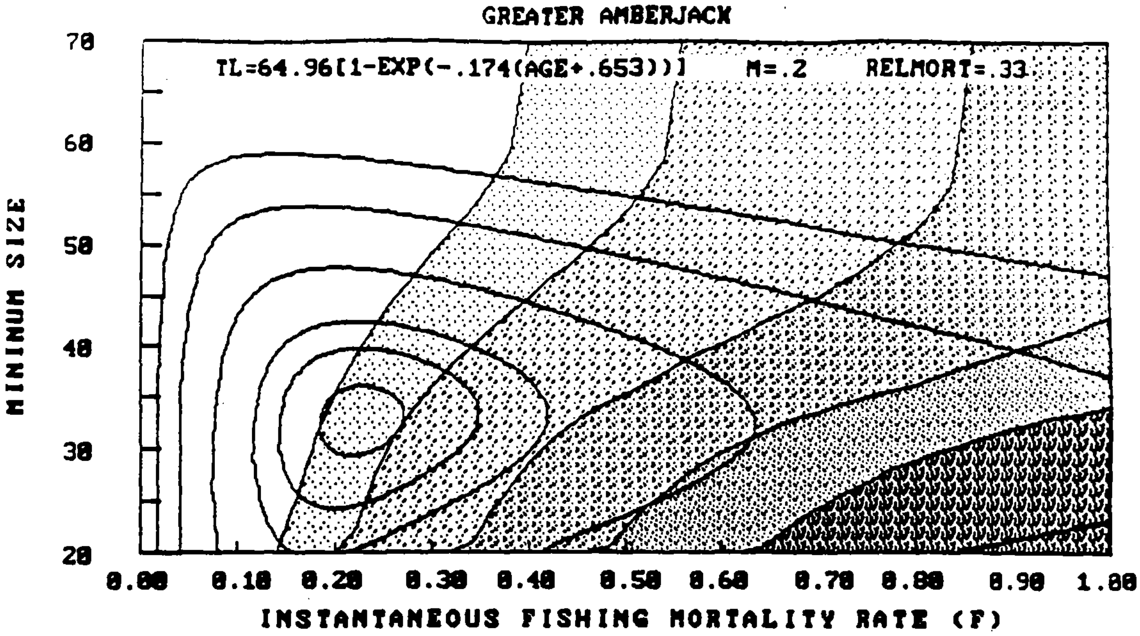
Catch curve for greater amberjack based on the length frequency observed in the 1986 headboat survey in the Gulf of Mexico. Ages were estimated from lengths based on the von Bertalanffy growth equation. The slope of the regression (-0.61) is an estimate of total mortality (Z). If the headboat catch is a random sample of the Gulf of Mexico population of amberjack and natural mortality is 0.2, fishing mortality would be estimated to about 0.40 from this approach.

FIGURE 8.34



Yield and spawning stock biomass per recruit for amberjack as a function of minimum length in inches and the instantaneous rate of fishing mortality (F). The shaded regions represent areas where fishing has reduced spawning stock biomass per recruit to levels below 2.5% (lower right), 5%, 10%, 20% and 30% (upper left) of the unfished levels. Each yield isopleth traces a contour where the combination of length at recruitment and fishing mortality produce a constant biomass yield. The contours are for yields that are 25%, 50%, 75%, 90%, 95% and 99% of the maximum obtainable within the parameter space. The growth and mortality estimates are from D. Gregory (personal communication). M is the natural mortality rate employed in the calculations, and RELMORT is the fraction of released sublegal fish that die as a result of capture.

FIGURE 8.35



Yield and spawning stock biomass per recruit for amberjack as a function of minimum length in inches and the instantaneous rate of fishing mortality (F). The shaded regions represent areas where fishing has reduced spawning stock biomass per recruit to levels below 2.5% (lower right), 5%, 10%, 20% and 30% (upper left) of the unfished levels. Each yield isopleth traces a contour where the combination of length at recruitment and fishing mortality produce a constant biomass yield. The contours are for yields that are 25%, 50%, 75%, 90%, 95% and 99% of the maximum obtainable within the parameter space. The growth and mortality estimates are from D. Gregory (personal communication). M is the natural mortality rate employed in the calculations, and RELMORT is the fraction of released sublegal fish that die as a result of capture.

TABLE 8.1

TOTAL ANNUAL LANDINGS, IN THOUSAND POUNDS, PERCENT CONTRIBUTION OF THE COMMERCIAL AND RECREATIONAL SECTORS OF SELECTED REEF FISH FOR THE GULF OF MEXICO, 1979-1987. Commercial data includes only domestic catches. Data from NMFS data files (General Canvas and MRFSS).

	1979					1980					1981				
SPECIES	Commercial		Recreatioanl		Total	Commercial		Recreatioanl		Total	Commercial		Recreatioanl		Total
Snappers - total	6788	47%	7632	53%	14420	6462	35%	11963	65%	18425	7450	39%	11617	61%	19067
Gray	747	24%	2411	76%	3158	784	52%	725	48%	1509	731	50%	734	50%	1465
Mutton	242	100%	0	0%	242	223	72%	87	28%	310	173	75%	58	25%	231
Red	4510	49%	4697	51%	9207	4445	29%	10631	71%	15076	5435	36%	9536	64%	14971
Vermillion	439	47%	504	53%	943	309	54%	264	46%	573	362	73%	137	27%	499
Yellowtail	812	100%	1	0%	813	673	87%	98	13%	771	708	41%	1037	59%	1745
Lane	38	67%	19	33%	57	28	15%	158	85%	186	41	26%	115	74%	156
Grt. Amberjack	194	6%	2863	94%	3057	212	3%	7272	97%	7484	263	13%	1744	87%	2007
Groupers	7969	67%	3837	33%	11806	8433	72%	3252	28%	11685	12133	72%	4752	28%	16885
Jewfish	191	51%	187	49%	378	240	27%	663	73%	903	219	100%	0	0%	219
Sea basses	44	4%	988	96%	1032	17	4%	377	96%	394	19	5%	335	95%	354
Totals	15186	49%	15507	51%	30693	15364	40%	23527	60%	38891	20084	52%	18448	48%	38532

	1982					1983					1984				
SPECIES	Commercial		Recreatioanl		Total	Commercial		Recreatioanl		Total	Commercial		Recreatioanl		Total
Snappers - total	9100	38%	14544	62%	23644	10075	62%	6202	38%	16277	8861	60%	5929	40%	14790
Gray	932	21%	3439	79%	4371	1014	45%	1224	55%	2238	838	29%	2099	71%	2937
Mutton	278	14%	1721	86%	1999	277	53%	248	47%	525	180	38%	295	62%	475
Red	6143	54%	5299	46%	11442	7210	65%	3883	35%	11093	6091	76%	1969	24%	8060
Vermillion	398	25%	1224	75%	1622	570	79%	147	21%	717	746	78%	216	22%	962
Yellowtail	1289	34%	2535	66%	3824	955	64%	543	36%	1498	943	46%	1124	54%	2067
Lane	60	16%	326	84%	386	49	24%	157	76%	206	63	22%	226	78%	289
Grt. Amberjack	251	3%	9581	97%	9832	307	11%	2493	89%	2800	593	26%	1654	74%	2247
Groupers	14933	59%	10360	41%	25293	11545	67%	5783	33%	17328	11212	62%	6807	38%	18019
Jewfish	199	14%	1174	86%	1373	220	100%	0	0%	220	112	33%	226	67%	338
Sea basses	30	3%	1092	97%	1122	13	3%	366	97%	379	25	7%	341	93%	366
Totals	24513	40%	36751	60%	61264	22160	60%	14844	40%	37004	20803	58%	14957	42%	35760

<< Continued >>

TABLE 8.1 (cont'd)

TOTAL ANNUAL LANDINGS, IN THOUSAND POUNDS, PERCENT CONTRIBUTION OF THE COMMERCIAL AND RECREATIONAL SECTORS OF SELECTED REEF FISH FOR THE GULF OF MEXICO, 1979-1987. Commercial data includes only domestic catches. Data from NMFS data files (General Canvas and MRFSS).

SPECIES	1985 Commercial		1985 Recreatioanl		1985 Total	1986 Commercial		1986 Recreatioanl		1986 Total	1987 Commercial		1987 Recreatioanl		1987 Total
Snappers - total	7372	50%	7493	50%	14865	7301	69%	3240	31%	10541	6988	67%	3520	33%	10508
Gray	668	29%	1600	71%	2268	590	38%	956	62%	1546	631	33%	1286	67%	1917
Mutton	195	60%	132	40%	327	218	63%	128	37%	346	330	65%	175	35%	505
Red	4565	49%	4722	51%	9287	3838	75%	1301	25%	5139	3111	76%	997	24%	4108
Vermillion	1086	75%	361	25%	1447	1661	80%	408	20%	2069	1565	85%	266	15%	1831
Yellowtail	790	58%	573	42%	1363	924	74%	327	26%	1251	1275	69%	566	31%	1841
Lane	68	39%	105	61%	173	70	37%	120	63%	190	76	25%	230	75%	306
Grt. Amberjack	829	25%	2542	75%	3371	1331	29%	3220	71%	4551	1843	34%	3627	66%	5470
Groupers	13146	55%	10960	45%	24106	12569	68%	5916	32%	18485	12608	76%	3923	24%	16531
Jewfish	133	32%	277	68%	410	109	74%	38	26%	147	101	34%	192	66%	293
Sea basses	19	1%	2827	99%	2846	24	2%	1076	98%	1100	37	5%	673	95%	710
Totals	21499	47%	24099	53%	45598	21334	61%	13490	39%	34824	21577	64%	11935	36%	33512

SPECIES	1979-87 Commercial		1979-87 Recreatioanl		1979-87 Total	1985-87 Commercial		1985-87 Recreatioanl		1985-87 Total
Snappers - total	70397	49%	72140	51%	142537	21661	60%	14253	40%	35914
Gray	6935	32%	14474	68%	21409	1889	33%	3842	67%	5731
Mutton	2116	43%	2844	57%	4960	743	63%	435	37%	1178
Red	45348	51%	43035	49%	88383	11514	62%	7020	38%	18534
Vermillion	7136	67%	3527	33%	10663	4312	81%	1035	19%	5347
Yellowtail	8369	55%	6804	45%	15173	2989	67%	1466	33%	4455
Lane	493	25%	1456	75%	1949	214	32%	455	68%	669
Grt. Amberjack	5823	14%	34996	86%	40819	4003	30%	9389	70%	13392
Groupers	104548	65%	55590	35%	160138	38323	65%	20799	35%	59122
Jewfish	1524	36%	2757	64%	4281	343	40%	507	60%	850
Sea basses	228	3%	8075	97%	8303	80	2%	4576	98%	4656
Totals	182520	51%	173558	49%	356078	64410	57%	49524	43%	113934

TABLE 8.2

RED SNAPPER COMMERCIAL LANDINGS (IN THOUSANDS OF POUNDS, EXCLUDING FOREIGN CATCH) FOR EACH GULF STATE AND PERCENT OF OF CATCH BY GEAR TYPE. FOR 1972-1987. Data from the NMFS Stock Assessment for red snapper (Goodyear, 1988a and 1988b)and NMFS, ESO, General Canvas Landings Files.

	Year															
STATE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Florida	3749	4017	4967	4841	4393	3143	2966	2981	3113	3473	3676	4228	2885	1822	1034	713
Alabama	733	728	693	723	534	343	276	248	164	346	514	443	340	199	146	139
Mississippi	1537	1837	1615	1325	1332	1275	1003	891	736	674	958	1096	926	565	396	265
Louisiana	259	354	286	151	58	99	71	176	201	421	464	718	1487	1215	1359	1285
Texas	1238	781	743	627	341	440	227	215	231	521	530	724	452	764	903	709

GEAR TYPE	Percentage Contribution															
Entangling Nets	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Handlines/Bandit	78%	82%	86%	88%	95%	89%	95%	92%	91%	84%	86%	81%	79%	76%	67%	65%
Longlines/Buoys	0%	0%	0%	0%	0%	0%	0%	0%	5%	11%	11%	15%	10%	9%	10%	13%
Fish Traps	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Shrimp Trawls	6%	7%	5%	4%	5%	3%	4%	3%	4%	4%	3%	4%	3%	2%	1%	2%
Fish Trawls	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Misc./Unk. Gear	16%	10%	9%	8%	0%	8%	0%	5%	0%	0%	0%	0%	7%	14%	22%	21%
TOTAL LANDINGS	7516	7717	8304	7667	6658	5300	4543	4511	4445	5435	6142	7209	6090	4565	3838	3111

TABLE 8.3

Percentage distribution, in numbers of fish, of recreational reef fish landed (A+B1) by species, state, and year in the Gulf of Mexico, 1979-1987. The Texas data do not include charter/party or private/rental boat modes in 1982-1984 nor any modes for 1986-1987. The party boat mode is not included for any state during 1986-1987. Data are from the NMFS Marine Recreational Fishery Statistics Survey.

		Recreational harvest (A+B1), 1979-1987									
SPECIES	STATE	79	80	81	82	83	84	85	86	87	79-87
Red grouper	Alabama	0.0	0	0	0	0	0.0	0	0	0	0.0
	Florida	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Louisiana	0	0	0	0	0	0	0	0	0	0
	Mississippi	0	0	0	0	0	0	0	0	0	0
	Texas	0	0	0	0	0	0	0	0	0	0
	Number	208696	177167	480741	526361	537863	1231794	847884	636604	429854	5076964
Warsaw grouper	Alabama	9.4	0	0	0.8	0	0	0.2	0	7.5	0.7
	Florida	0	17.8	85.3	99.2	53.7	50.5	99.8	100.0	78.6	91.7
	Louisiana	0	50.4	0	0	46.3	0	0	0.0	0	2.5
	Mississippi	0	31.9	0	0	0	0	0	0	13.9	0.3
	Texas	90.6	0	14.7	0	0	49.5	0	0	0	4.8
	Number	24784	5430	7213	190743	31419	18602	392280	11861	3248	685580
Nassau grouper	Alabama	0	0	0	0	0	0	0	0	0	0
	Florida	100.0	99.4	100.0	91.7	100.0	96.2	44.4	99.6	100.0	98.1
	Louisiana	0	0	0	8.3	0	2.1	55.6	0.4	0	1.4
	Mississippi	0	0	0	0	0	0.1	0	0	0	0.0
	Texas	0	0.6	0	0	0	1.6	0	0	0	0.5
	Number	48964	67365	65823	32466	30328	133548	2851	93801	43854	519000
Gag grouper	Alabama	0	0	1.7	0	0	0	0	3.3	0.1	0.3
	Florida	100.0	100.0	98.3	100.0	100.0	57.9	98.4	90.1	97.4	91.0
	Louisiana	0	0	0	0	0	0.0	1.6	1.1	0	0.3
	Mississippi	0	0	0	0	0	0	0	5.5	2.5	0.4
	Texas	0	0	0	0	0	42.1	0	0	0	8.0
	Number	126630	106745	249893	466633	310583	437241	374456	91037	145506	2308724
Black grouper	Alabama	0.5	0	2.9	0	0.3	0	4.4	1.9	0.1	1.3
	Florida	96.0	100.0	97.1	98.6	99.4	99.9	95.6	97.9	98.5	98.1
	Louisiana	3.6	0	0	0.8	0.3	0.1	0	0.3	1.4	0.5
	Mississippi	0	0	0	0.6	0	0	0	0	0	0.1
	Texas	0	0	0	0	0	0	0	0	0	0
	Number	158068	422442	180816	342679	569774	184599	583113	464971	284043	3190505
Scamp	Alabama	0	0	0.5	23.7	0.3	0	0	0	0	6.2
	Florida	100.0	100.0	99.5	71.7	99.7	100.0	100.0	100.0	100.0	92.6
	Louisiana	0	0	0	0.0	0	0	0	0	0	0.0
	Mississippi	0	0	0	4.6	0	0	0	0	0	1.2
	Texas	0	0	0	0	0	0	0	0	0	0
	Number	1278	9055	133981	90995	40606	29892	33288	13601	5975	358671
Jewfish	Alabama	0	0	0	0	0	0.0	0	0	0	0.0
	Florida	77.9	90.4	100.0	86.3	0	0	100.0	10.9	97.8	80.5
	Louisiana	0	9.6	0	13.7	0	100.0	0	89.1	2.2	18.2
	Mississippi	0	0	0	0	0	0	0	0	0	0
	Texas	22.1	0	0	0	0	0.0	0	0	0	1.2
	Number	3823	16904	14330	10175	0	2456	10651	7963	3039	69341
Sea basses	Alabama	0	0	0	0.5	0	0	0	0.1	0.2	0.1
	Florida	100.0	100.0	100.0	99.4	94.0	100.0	100.0	99.9	99.7	99.4
	Louisiana	0	0	0	0.1	0	0	0	0.0	0.1	0.0
	Mississippi	0	0	0	0.0	0	0	0	0	0	0.0
	Texas	0.0	0	0	0	6.0	0	0	0	0	0.4
	Number	1818303	610512	491209	1617044	825839	396963	3585243	1223975	743645	1.131E7

<Continued>

TABLE 8.3 (cont'd)

Percentage distribution, in numbers of fish, of recreational reef fish landed (A+B1) by species, state, and year in the Gulf of Mexico, 1979-1987. The Texas data do not include charter/party or private/rental boat modes in 1982-1984 nor any modes for 1986-1987. The party boat mode is not included for any state during 1986-1987. Data are from the NMFS Marine Recreational Fishery Statistics Survey.

SPECIES	STATE	Recreational harvest (A+B1), 1979-1987									
		79	80	81	82	83	84	85	86	87	79-87
Greater Amberjack	Alabama	2.1	5.4	29.1	0.3	0	0	0	5.1	5.2	3.9
	Florida	81.8	55.6	56.5	92.1	65.4	35.7	71.0	92.2	87.0	80.2
	Louisiana	9.2	32.9	14.0	7.6	34.6	64.3	29.0	2.6	7.8	15.0
	Mississippi	0	0	0	0	0	0	0	0	0	0
	Texas	7.0	6.2	0.5	0	0	0.0	0	0	0	0.9
	Number	192320	196873	228357	12[illegible]5311	196655	102788	230407	208550	397187	2968448
Gray snapper	Alabama	0.3	0.4	2.6	0.0	0.0	0	0	0	0.6	0.2
	Florida	99.7	98.7	97.4	100.0	97.6	100.0	100.0	99.4	98.6	99.4
	Louisiana	0	0.9	0	0	0.3	0	0	0.2	0.0	0.1
	Mississippi	0	0	0	0	0	0	0	0.5	0.8	0.1
	Texas	0	0	0	0	2.1	0	0	0	0	0.2
	Number	2115331	681312	572207	4000094	1526526	2696796	987969	1060992	1246967	1.489E7
Mutton snapper	Alabama	0	0	0	0	0	0	0	0	0	0
	Florida	0	96.0	100.0	100.0	100.0	96.0	100.0	100.0	100.0	98.6
	Louisiana	0	4.0	0	0	0	0	0	0	0	0.1
	Mississippi	0	0	0	0	0	0	0	0	0	0
	Texas	0	0	0	0	0	4.0	0	0	0	1.3
	Number	0	20356	199030	284626	102973	368802	29174	43407	89165	1137533
Red snapper	Alabama	23.9	1.9	20.2	16.4	37.3	36.1	27.0	24.8	32.8	21[illegible]
	Florida	24.5	20.8	10.9	20.9	9.1	7.2	16.6	29.5	37.8	17[illegible]
	Louisiana	15.1	38.4	55.8	62.0	53.2	55.0	29.0	45.5	19.4	42.[illegible]
	Mississippi	0.0	1.3	0	0.7	0.2	0.0	0.1	0.2	10.0	0.5
	Texas	36.5	37.6	13.1	0	0.1	1.6	27.3	0	0	18.0
	Number	5448019	4065227	4823718	3733637	3613444	1273516	1676449	621071	523091	2.578E7
Lane snapper	Alabama	85.0	2.8	0	0	0	0	0	0.2	1.7	1.5
	Florida	0	75.6	99.7	70.4	79.3	98.2	99.5	93.4	93.4	89.6
	Louisiana	0	14.5	0	29.6	20.7	1.3	0	6.4	3.1	8.0
	Mississippi	0	4.9	0	0	0	0	0	0	1.7	0.4
	Texas	15.0	2.1	0.3	0	0	0.5	0.5	0	0	0.5
	Number	37705	91321	363001	387014	265565	773402	284479	107801	317738	2628026
Yellowtail snapper	Alabama	0	0	0.0	0	0	0	0	0	0	0.0
	Florida	0.0	100.0	100.0	100.0	97.0	100.0	99.5	100.0	100.0	99.6
	Louisiana	100.0	0	0	0	0	0	0.5	0.0	0	0.1
	Mississippi	0	0	0	0	0	0	0	0	0	0
	Texas	0	0	0	0	3.0	0	0	0	0	0.3
	Number	2623	142596	1403265	1762780	675670	1391566	440086	201364	412131	6432081
Vermilion snapper	Alabama	6.3	0.8	25.5	1.7	16.5	85.3	0	36.3	14.7	14.5
	Florida	89.9	97.9	67.1	83.7	73.9	14.7	89.7	62.6	85.2	78.8
	Louisiana	0	0.1	6.9	14.6	9.6	0.0	10.3	1.2	0.2	5.9
	Mississippi	0	0	0	0	0	0	0	0	0	0
	Texas	3.8	1.1	0.5	0	0	0	0	0	0	0.8
	Number	725554	669610	218532	1193753	205269	403659	436436	253689	310922	4417424

TABLE 8.4

Estimates of the numbers of red snapper caught in the Gulf of Mexico headboat fishery in 1986. (data courtesy G. Huntsman, NMFS, Beaufort, NC).

Location	Number	Pounds	Mean Weight
Dry Tortugas	9	23	2.5
Southwest Florida	509	1282	2.5
Florida Middle Grounds	943	2330	2.5
NW Florida & Alabama	14903	34133	2.3
Louisiana	14247	27796	2.0
Northeast Texas	220703	219003	1.0
Port Aransas, Texas	24049	32235	1.3
Port Isabel, Texas	57091	92828	1.6
Total	332454	409630	1.2

TABLE 8.5

Estimated total recreational harvest of red snapper in numbers 1979-1986. The estimates are derived from the Marine Recreational Fishery Statistics Survey adjusted for missing strata (4/18/88).

Year	MRFSS	Adjustments A	Adjustments B	Adjustments C	Total
1979	5448000				5448000
1980	4065000				4065000
1981	4824000	206000			5030000
1982	3734000		489667		4224000
1983	3613000		463555		4077000
1984	1274000		348975		1623000
1985	1676000				1676000
1986	621000			364175	985000

A. Adjustment for missing first wave of program based on proportion of total annual landings that occurred in the first wave of other years.

B. Adjustment for years in which Texas boat mode was not estimated by MRFSS. See Parrack (1986a) for the derivation of these estimates.

C. Adjustment to include party boat catch which was not sampled by MFRSS in 1986 (N = 332454) and Texas boat modes (N = 31721). The data are from the NMFS Headboat survey, courtesy G. Huntsman, NMFS, Beaufort, NC, and from Texas Parks and Wildlife Department computer printouts of recreational catch estimates.

TABLE 8.6

Estimated total numbers of red snapper landed by commercial and recreational fishermen by length and year for 1979 and 1983-1986 (4/18/88).

	YEAR			
leng	1979	1984	1985	1986
5	0	1070	3886	283
6	6896	357	11657	425
7	45515	8200	84189	5807
8	182546	39134	213709	26636
9	486622	127841	139848	96308
10	625241	268919	51560	167133
11	900739	417255	188399	174546
12	910565	468587	547222	249314
13	665317	345844	311611	224333
14	485995	248325	251037	205534
15	289336	213648	163603	138776
16	190451	179688	157012	89610
17	166453	121450	72886	60035
18	100486	102859	62270	52474
19	84007	94807	49325	42737
20	123169	98626	45602	33128
21	103617	68509	30663	27010
22	118775	72571	29930	27494
23	99644	62563	34761	27854
24	76453	43929	28185	18587
25	77682	31740	21218	20252
26	48811	25940	22686	18377
27	68928	18330	17386	16921
28	74845	10654	12732	13758
29	54800	14443	13062	11590
30	57965	13347	14259	10989
31	45066	11398	15333	10399
32	33646	17404	16485	11058
33	13371	11957	12067	11556
34	11920	11866	11700	12801
35	4131	8792	5172	9071
36	2351	4464	4459	3261
37	972	1636	1779	1948
38	243	3597	1066	351
39	486	873	259	703
40	0	0	259	78
41	0	0	0	39
42	0	246	0	0
43	0	0	0	0
SUM	6157046	3170870	2647279	1821178

TABLE 8.7

Estimated total numbers of red snapper landed by commercial and recreational fishermen by age and year for 1979 and 1983-1986 (4/18/88).

	YEAR			
age	1979	1984	1985	1986
0	0	0	0	0
1	296129	69330	376906	43915
2	2968675	1296328	865941	687603
3	1462038	902676	828077	616118
4	401735	355150	228015	178841
5	321071	237912	108792	89395
6	235291	131041	74380	57719
7	130059	57975	47587	39136
8	150984	29637	29266	31372
9	100116	23837	24859	20060
10	57473	23552	26695	17210
11	17831	18708	20014	17728
12	11106	12807	7680	14159
13	2837	4377	5165	4433
14	972	2823	2320	2319
15	243	3597	1066	351
16	486	873	173	410
17	0	0	259	371
18	0	0	86	39
19	0	0	0	0
20	0	246	0	0
SUM	6157045	3170870	2647279	1821178

TABLE 8.8

Estimated loss in numbers and weight of potential red snapper in the combined commercial and recreational catch as a consequence of the bycatch of juvenile snappers in the shrimp fishery. Fishing mortality is assumed to be either constant at 0.34 or to be a decreasing function of age (see text). S is the assumed survival between the bycatch age and recruitment to the fishery. M is assumed to be constant 0.2.

		Estimated shrimp trawl bycatch			
		12 million		4.4 million	
Fishing mortality	S	number 1000s	pounds 1000s	number 1000s	pounds 1000s
F constant	1.00	7556	12769	2770	4682
F constant	0.80	6044	10215	2216	3745
F constant	0.60	3627	6129	1330	2247
F constant	0.40	1451	2452	532	899
F constant	0.20	290	490	106	180
F variable	1.00	8899	7904	3263	2898
F variable	0.80	7119	6323	2610	2319
F variable	0.60	4272	3794	1566	1391
F variable	0.40	1709	1518	627	556
F variable	0.20	342	304	125	111

TABLE 8.9

Estimated gear specific fishing mortality rates and spawning stock ratios (SSR) for Gulf of Mexico red snapper.

	SHRIMP BYCATCH				BOTTOM LONG LINE				COMMERCIAL HANDLINE				RECREATIONAL				COMBINED		
AGE	100'S	PROP	F1	F2	100'S	PROP	F1	F2	100'S	PROP	F1	F2	100'S	PROP	F1	F2	100'S	F1	F2
0	120000	1.000	1.040	0.940	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.000	0.000	0.000	120000	1.040	0.940
1	0	0.000	0.000	0.000	0	0.000	0.000	0.000	5	0.003	0.000	0.000	1629	0.997	0.129	0.058	1634	0.129	0.058
2	0	0.000	0.000	0.000	4	0.000	0.000	0.000	1579	0.166	0.125	0.057	7917	0.833	0.625	0.283	9500	0.750	0.340
3	0	0.000	0.000	0.000	21	0.003	0.002	0.001	4084	0.522	0.339	0.178	3718	0.475	0.309	0.162	7823	0.650	0.340
4	0	0.000	0.000	0.000	45	0.018	0.010	0.006	1820	0.717	0.394	0.244	675	0.266	0.146	0.090	2540	0.550	0.340
5	0	0.000	0.000	0.000	90	0.062	0.028	0.021	1184	0.815	0.367	0.277	179	0.123	0.056	0.042	1454	0.450	0.340
6	0	0.000	0.000	0.000	91	0.104	0.042	0.035	709	0.808	0.323	0.275	77	0.088	0.035	0.030	877	0.400	0.340
7	0	0.000	0.000	0.000	59	0.122	0.043	0.041	392	0.813	0.285	0.277	31	0.065	0.023	0.022	482	0.350	0.340
8	0	0.000	0.000	0.000	37	0.122	0.037	0.042	243	0.807	0.242	0.274	21	0.071	0.021	0.024	301	0.300	0.340
9	0	0.000	0.000	0.000	38	0.164	0.049	0.056	180	0.785	0.236	0.267	12	0.051	0.015	0.017	229	0.300	0.340
10	0	0.000	0.000	0.000	49	0.218	0.065	0.074	168	0.748	0.224	0.254	8	0.035	0.010	0.012	225	0.300	0.340
11	0	0.000	0.000	0.000	42	0.221	0.066	0.075	144	0.765	0.230	0.260	3	0.014	0.004	0.005	188	0.300	0.340
12	0	0.000	0.000	0.000	24	0.207	0.062	0.071	90	0.776	0.233	0.264	2	0.016	0.005	0.006	115	0.300	0.340
13	0	0.000	0.000	0.000	14	0.298	0.089	0.101	33	0.702	0.211	0.239	0	0.000	0.000	0.000	47	0.300	0.340
14	0	0.000	0.000	0.000	5	0.208	0.063	0.071	18	0.735	0.220	0.250	1	0.057	0.017	0.019	25	0.300	0.340
15	0	0.000	0.000	0.000	3	0.206	0.062	0.070	7	0.438	0.131	0.149	6	0.356	0.107	0.121	17	0.300	0.340
16	0	0.000	0.000	0.000	2	0.385	0.115	0.131	2	0.370	0.111	0.126	1	0.245	0.074	0.083	5	0.300	0.340
17	0	0.000	0.000	0.000	1	0.535	0.160	0.182	1	0.465	0.140	0.158	0	0.000	0.000	0.000	2	0.300	0.340
18	0	0.000	0.000	0.000	0	1.000	0.300	0.340	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.300	0.340
19	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.000	0.000	0.000	0	0.300	0.340
20	0	0.000	0.000	0.000	0	0.000	0.000	0.000	1	1.000	0.300	0.340	0	0.000	0.000	0.000	1	0.300	0.340
SSR			0.353	0.391			0.716	0.711			0.104	0.161			0.252	0.471		0.009	0.027

Column definitions:

100's = estimated 1984-1986 mean catch by age in hundreds of fish.

PROP = proportion of total catch in that age class that were captured in the specified gear.

F1 = estimated gear specific partial F assuming the variable F vector.

F2 = estimated gear specific partial F assuming the constant F vector.

TABLE 8.10

VERMILION SNAPPER COMMERCIAL LANDINGS (IN THOUSANDS OF POUNDS, EXCLUDING FOREIGN CATCH) FOR EACH GULF STATE AND PERCENT OF OF CATCH BY GEAR TYPE FOR 1972-1987. Data from the NMFS Stock Assessment for red snapper (Goodyear, 1988b) and NMFS,ESO, General Canvas Landings Data.

	Year															
STATE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Florida	127	191	197	392	310	532	450	439	309	362	398	562	694	836	874	703
Alabama	0	0	0	0	0	0	0	0	0	0	0	9	52	129	112	61
Mississippi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	111	149
Louisiana	0	0	0	0	0	0	0	0	0	0	0	0	0	85	443	610
Texas	0	0	0	0	0	0	0	0	0	0	0	0	0	37	121	42
GEAR TYPE	Percentage Contribution															
Entangling Nets	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Handlines/Bandit	100%	100%	100%	100%	100%	100%	100%	100%	100%	96%	97%	95%	95%	94%	91%	95%
Longlines/Buoys	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	3%	5%	4%	6%	5%	3%
Fish Traps	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Shrimp Trawls	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	1%	0%
Fish Trawls	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Misc./Unk. Gear	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	2%
ANNUAL TOTALS	127	191	197	392	310	532	450	439	309	362	398	571	746	1087	1661	1565

TABLE 8.11

Percentage distribution, in numbers of fish, of recreational reef fish landed (A+B1) by species, area fished, and year in the Gulf of Mexico, 1979-1987 (TS = Territorial Sea, EEZ = Exclusive Economic Zone).The Texas data do not include charter/party or private/rental boat modes in 1982-1984 nor any modes for 1986-1987. The party boat mode is not included for any state during 1986-1987. Data are from the NMFS Marine Recreational Fishery Statistics Survey.

		Recreational harvest (A+B1), 1979-1987									
SPECIES	AREA FISHED	79	80	81	82	83	84	85	86	87	79-87
Red grouper	TS	58.3	23.4	6.5	39.1	49.4	51.6	25.1	22.7	36.9	35.8
	EEZ	41.7	76.6	91.4	60.9	48.3	48.1	74.9	77.3	63.1	63.7
	Unknown	0	0.0	2.1	0	2.3	0.2	0	0	0	0.5
	Number	208696	177167	480741	526361	537863	1231794	847884	636604	429854	5076964
Warsaw grouper	TS	25.8	0	22.5	26.1	34.1	98.5	6.0	0	74.6	16.5
	EEZ	74.2	100.0	77.5	73.9	65.9	1.5	94.0	100.0	25.4	83.5
	Unknown	0	0	0	0	0	0	0	0	0	0
	Number	24784	5430	7213	190743	31419	18602	392280	11861	3248	685580
Nassau grouper	TS	100.0	80.8	52.5	26.4	54.5	97.8	44.4	22.5	82.2	67.9
	EEZ	0	7.3	40.2	73.6	15.6	2.2	55.6	77.5	17.8	27.9
	Unknown	0	11.9	7.3	0	29.8	0	0	0	0	4.2
	Number	48964	67365	65823	32466	30328	133548	2851	93801	43854	519000
Gag grouper	TS	61.6	49.6	4.6	32.2	15.7	66.3	2.7	42.1	23.4	30.9
	EEZ	38.4	50.4	90.6	67.8	83.1	33.7	97.3	57.9	76.6	68.4
	Unknown	0	0	4.8	0	1.2	0	0	0	0	0.7
	Number	126630	106745	249893	466633	310583	437241	374456	91037	145506	2308724
Black grouper	TS	69.5	41.1	26.4	80.0	24.9	76.1	52.1	32.2	35.9	45.[illegible]
	EEZ	30.5	57.2	65.7	20.0	72.3	23.9	47.9	67.8	64.1	53.[illegible]
	Unknown	0	1.7	7.9	0	2.8	0	0	0	0	1.2
	Number	158068	422442	180816	342679	569774	184599	583113	464971	284043	3190505
Scamp	TS	100.0	37.9	6.6	32.8	3.0	0	46.1	6.8	12.5	17.2
	EEZ	0	62.1	54.4	64.2	97.0	100.0	53.9	93.2	87.5	67.5
	Unknown	0	0	38.9	2.9	0	0	0	0	0	15.3
	Number	1278	9055	133981	90995	40606	29892	33288	13601	5975	358671
Jewfish	TS	100.0	44.2	100.0	93.1	0	0.0	0.0	0	37.5	52.3
	EEZ	0	45.1	0	6.9	0	0	100.0	100.0	62.5	41.6
	Unknown	0	10.7	0	0	0	100.0	0	0	0	6.2
	Number	3823	16904	14330	10175	0	2456	10651	7963	3039	69341
Sea basses	TS	69.8	47.7	18.8	65.8	76.4	65.6	39.1	41.2	55.1	52.4
	EEZ	30.2	51.8	73.7	33.9	23.2	32.5	60.9	58.8	44.9	47.1
	Unknown	0	0.4	7.4	0.3	0.5	1.8	0	0	0	0.5
	Number	1818303	610512	491209	1617044	825839	396963	3585243	1223975	743645	1.131E7

<Continued>

TABLE 8.11 (cont'd)

Percentage distribution, in numbers of fish, of recreational reef fish landed (A+B1) by species, area fished, and year in the Gulf of Mexico, 1979-1987 (TS = Territorial Sea, EEZ = Exclusive Economic Zone).The Texas data do not include charter/party or private/rental boat modes in 1982-1984 nor any modes for 1986-1987. The party boat mode is not included for any state during 1986-1987. Data are from the NMFS Marine Recreational Fishery Statistics Survey.

		Recreational harvest (A+B1), 1979-1987									
SPECIES	AREA FISHED	79	80	81	82	83	84	85	86	87	79-87
Gray snapper	TS	94.2	49.2	50.6	72.7	74.3	92.3	80.1	89.2	84.4	80.2
	EEZ	5.8	26.2	44.4	26.4	22.0	6.1	17.9	10.8	15.6	17.5
	Unknown	0	24.6	5.0	0.9	3.7	1.6	2.1	0	0	2.4
	Number	2115331	681312	572207	4000094	1526526	2696796	987969	1060992	1246967	1.489E7
Mutton snapper	TS	0	75.1	84.9	5.2	74.2	44.9	54.4	72.0	61.2	47.7
	EEZ	0	17.8	15.1	94.3	3.9	55.1	45.6	28.0	38.8	50.1
	Unknown	0	7.1	0	0.5	21.9	0.0	0	0	0	2.2
	Number	0	20356	199030	284626	102973	368802	29174	43407	89165	1137533
Red snapper	TS	1.4	11.0	6.6	27.2	2.3	10.1	4.1	18.6	29.5	9.4
	EEZ	71.2	86.7	81.6	72.3	60.2	86.3	94.0	81.4	70.5	76.7
	Unknown	27.3	2.2	11.8	0.5	37.5	3.6	1.9	0	0	14.0
	Number	5448019	4065227	4823718	3733637	3613444	1273516	1676449	621071	523091	2.578E7
Lane snapper	TS	15.0	32.8	66.8	49.5	74.3	49.9	98.6	70.1	86.7	64.1
	EEZ	85.0	60.4	33.2	50.2	25.2	50.1	1.4	29.9	13.3	35.6
	Unknown	0	6.8	0	0.3	0.4	0.0	0	0	0	0.3
	Number	37705	91321	363001	387014	265565	773402	284479	107801	317738	2628026
Yellowtail snapper	TS	100.0	42.5	17.2	42.3	42.2	73.3	96.8	81.7	64.2	49.9
	EEZ	0	50.6	82.8	57.6	3.5	26.3	3.2	18.3	35.8	44.1
	Unknown	0	6.9	0.0	0.1	54.2	0.3	0	0	0	6.0
	Number	2623	142596	1403265	1762780	675670	1391566	440086	201364	412131	6432081
Vermilion snapper	TS	89.9	5.2	1.2	14.2	15.9	5.1	40.9	22.3	43.0	29.0
	EEZ	10.1	94.7	90.4	84.2	66.1	94.9	59.1	77.7	57.0	69.3
	Unknown	0	0.1	8.4	1.7	18.0	0	0	0	0	1.7
	Number	725554	669610	218532	1193753	205269	403659	436436	253689	310922	4417424
Greater amberjack	TS	77.0	21.6	24.6	4.4	2.0	17.2	12.1	12.9	17.0	15.0
	EEZ	23.0	70.4	73.7	95.4	97.0	52.7	87.9	87.1	83.0	83.2
	Unknown	0	8.1	1.7	0.2	1.1	30.1	0	0	0	1.8
	Number	192320	196873	228357	1215311	196655	102788	230407	208550	397187	2968448

TABLE 8.12

Percentage distribution, in numbers of fish, of recreational reef fish landed (A+B1) by species, fishing mo. and year in the Gulf of Mexico, 1979-1987. The Texas data do not include charter/party or private/rental boa. modes in 1982-1984 nor any modes for 1986-1987. The party boat mode is not included for any state during 1986-1987. Data are from the NMFS Marine Recreational Fishery Statistics Survey.

		Recreational harvest (A+B1), 1979-1987									
SPECIES	FISHING MODE	79	80	81	82	83	84	85	86	87	79-87
Red grouper	Shore	0.0	0.0	2.5	0.8	2.9	3.1	0.0	1.1	2.5	1.7
	Party/charter	46.9	42.6	78.8	28.3	17.3	26.3	33.6	5.2	12.1	29.3
	Private/rental	53.1	57.4	18.7	70.9	79.8	70.6	66.4	93.7	85.4	69.0
	Number	208696	177167	480741	526361	537863	1231794	847884	636604	429854	5076964
Warsaw grouper	Shore	0	0	0	0	0	49.5	0	0	0	1.3
	Party/charter	4.8	28.0	62.9	74.1	20.5	2.7	0.3	1.6	18.5	23.0
	Private/rental	95.2	72.0	37.1	25.9	79.5	47.8	99.7	98.4	81.5	75.7
	Number	24784	5430	7213	190743	31419	18602	392280	11861	3248	685580
Nassau grouper	Shore	0	12.5	51.1	0	41.8	1.6	14.9	6.3	24.3	14.2
	Party/charter	100.0	4.8	15.6	0	3.8	1.1	54.7	0	0.8	12.9
	Private/rental	0	82.7	33.4	100.0	54.4	97.3	30.4	93.7	74.9	72.9
	Number	48964	67365	65823	32466	30328	133548	2851	93801	43854	519000
Gag grouper	Shore	0.8	0	1.3	0.7	0	43.7	0.0	16.9	0	9.3
	Party/charter	2.4	30.2	79.4	28.3	59.7	22.4	67.3	33.7	11.7	41.1
	Private/rental	96.8	69.8	19.3	71.1	40.3	34.0	32.7	49.4	88.3	49.7
	Number	126630	106745	249893	466633	310583	437241	374456	91037	145506	2308724
Black grouper	Shore	34.4	5.6	4.1	2.4	7.8	8.7	1.4	4.2	0.0	5
	Party/charter	24.7	38.8	33.9	10.1	0.8	12.0	31.0	14.8	5.9	18
	Private/rental	40.9	55.6	62.0	87.5	91.4	79.4	67.5	81.0	94.1	75.6
	Number	158068	422442	180816	342679	569774	184599	583113	464971	284043	3190505
Scamp	Shore	0	0	3.0	8.1	0	0	0	0	0	3.2
	Party/charter	100.0	67.5	89.2	62.7	81.8	100.0	21.9	34.0	32.8	72.8
	Private/rental	0	32.5	7.8	29.2	18.2	0	78.1	66.0	67.2	24.1
	Number	1278	9055	133981	90995	40606	29892	33288	13601	5975	358671
Jewfish	Shore	22.1	0	0	0	0	0.0	0	0	0	1.2
	Party/charter	0	35.4	0	0	0	100.0	0	0.0	39.7	13.9
	Private/rental	77.9	64.6	100.0	100.0	0	0.0	100.0	100.0	60.3	84.9
	Number	3823	16904	14330	10175	0	2456	10651	7963	3039	69341
Sea basses	Shore	1.0	1.9	0.8	1.5	13.8	8.4	1.8	2.4	0.0	2.6
	Party/charter	41.7	34.7	29.9	31.4	15.5	10.2	8.9	18.4	3.6	20.9
	Private/rental	57.3	63.5	69.2	67.2	70.7	81.4	89.3	79.2	96.4	76.5
	Number	1818303	610512	491209	1617044	825839	396963	3585243	1223975	743645	1.131E7

<Continued>

TABLE 8.12 (cont'd)

Percentage distribution, in numbers of fish, of recreational reef fish landed (A+B1) by species, fishing mode and year in the Gulf of Mexico, 1979-1987. The Texas data do not include charter/party or private/rental boat modes in 1982-1984 nor any modes for 1986-1987. The party boat mode is not included for any state during 1986-1987. Data are from the NMFS Marine Recreational Fishery Statistics Survey.

		Recreational harvest (A+B1), 1979-1987									
SPECIES	FISHING MODE	79	80	81	82	83	84	85	86	87	79-87
Greater Amberjack	Shore	48.5	6.0	0.0	0.7	0	2.7	0	0	1.0	4.0
	Party/charter	29.2	59.9	66.9	88.7	73.3	93.0	82.3	59.1	41.6	71.5
	Private/rental	22.3	34.1	33.1	10.7	26.7	4.3	17.7	40.9	57.4	24.5
	Number	192320	196873	228357	1215311	196655	102788	230407	208550	397187	2968448
Gray snapper	Shore	21.7	25.3	19.9	7.8	64.7	16.0	13.7	59.6	55.8	26.5
	Party/charter	71.5	35.9	23.7	79.8	24.5	5.6	10.6	6.4	1.7	39.0
	Private/rental	6.7	38.8	56.4	12.3	10.8	78.4	75.7	33.9	42.5	34.5
	Number	2115331	681312	572207	4000094	1526526	2696796	987969	1060992	1246967	1.489E7
Mutton snapper	Shore	0	7.1	1.4	0.3	72.7	5.8	7.8	17.7	23.9	11.6
	Party/charter	0	80.2	1.1	73.5	20.4	63.1	92.2	13.5	8.4	45.9
	Private/rental	0	12.7	97.5	26.2	6.9	31.1	0	68.7	67.7	42.5
	Number	0	20356	199030	284626	102973	368802	29174	43407	89165	1137533
Red snapper	Shore	1.2	0	0	0	0.3	1.6	0.9	0.0	0.4	0.4
	Party/charter	53.1	50.3	67.8	84.7	57.2	82.7	64.5	54.3	49.1	62.7
	Private/rental	45.7	49.7	32.2	15.3	42.5	15.6	34.6	45.7	50.5	36.9
	Number	5448019	4065227	4823718	3733637	3613444	1273516	1676449	621071	523091	2.578E7
Lane snapper	Shore	15.0	6.7	0.5	8.1	0.3	1.9	0	7.1	22.3	5.3
	Party/charter	64.0	8.1	5.4	52.2	7.7	3.9	2.0	6.1	4.7	12.6
	Private/rental	21.0	85.1	94.1	39.7	92.1	94.2	98.0	86.7	73.0	82.1
	Number	37705	91321	363001	387014	265565	773402	284479	107801	317738	2628026
Yellowtail snapper	Shore	100.0	8.5	6.4	7.7	17.5	5.9	6.6	11.5	3.5	7.9
	Party/charter	0	43.5	9.4	33.8	70.1	25.4	13.3	5.4	8.2	26.7
	Private/rental	0	48.1	84.2	58.5	12.4	68.7	80.1	83.1	88.3	65.4
	Number	2623	142596	1403265	1762780	675670	1391566	440086	201364	412131	6432081
Vermilion snapper	Shore	0	0	0	0	0	0	0.2	0	0	0.0
	Party/charter	73.8	67.4	71.2	99.3	90.4	95.5	28.8	74.2	43.7	75.8
	Private/rental	26.2	32.6	28.8	0.7	9.6	4.5	71.0	25.8	56.3	24.2
	Number	725554	669610	218532	1193753	205269	403659	436436	253689	310922	4417424

TABLE 8.13

GRAY SNAPPER COMMERCIAL LANDINGS (IN THOUSANDS OF POUNDS, EXCLUDING FOREIGN CATCH) FOR EACH GEAR TYPE FROM 1972 TO 1987.
Data from the NMFS Stock Assessment for red snapper (Goodyear, 1988b) and NMFS,ESO, General Canvas Landings Data.

	Year															
GEAR TYPE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Entangling nets	140	188	216	252	131	335	400	412	171	145	163	164	289	234	162	125
Handlines/Bandit	447	429	436	285	525	298	259	298	554	524	690	721	495	392	379	281
Longlines/Buoys	0	0	0	0	0	0	0	0	22	22	52	95	52	38	41	44
Traps	0	0	0	2	8	61	80	31	16	20	11	18	2	2	6	11
Trawls	0	0	0	0	0	0	0	0	11	12	11	10	1	2	1	1
Misc./Unk. Gear	0	0	0	0	0	0	0	7	11	8	5	6	0	1	1	169
ANNUAL TOTALS	587	617	652	539	664	694	739	748	785	731	932	1014	839	669	590	631

NOTE: Over 98 percent of the gray snapper commercial landings in each year were landed in Florida.
Thirty-one percent of the gray snapper landings were taken from the South Atlantic Council's area of jurisdiction in the Florida Keys (Waters, 1988; Table 8).

TABLE 8.14

LANE SNAPPER COMMERCIAL LANDINGS (IN THOUSANDS OF POUNDS, EXCLUDING FOREIGN CATCH) FOR EACH GEAR TYPE FROM 1972 TO 1987.
Data from the NMFS Stock Assessment for red snapper (Goodyear, 1988b) and NMFS,ESO, General Canvas Landings Data.

	Year															
GEAR TYPE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Entangling nets	0	0	0	0	0	0	0	2	0	2	2	0	8	6	3	4
Handlines/Bandit	16	22	20	28	51	16	16	29	19	27	52	38	34	34	36	33
Longlines/Buoys	0	0	0	0	0	0	0	0	0	5	1	1	3	7	3	4
Traps	0	0	0	0	2	1	2	8	9	6	4	10	18	22	28	33
Trawls	0	5	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Misc./Unk. Gear	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
ANNUAL TOTALS	16	27	20	28	53	17	18	39	28	40	60	49	63	69	71	76

NOTE: Over 98 percent of the lane snapper commercial landings in each year were landed in Florida.
Fifty-four percent of the lane snapper landings were taken from the South Atlantic Council's area of jurisdiction in the Florida Keys (Waters, 1988; Table 8).

TABLE 8.15

MUTTON SNAPPER COMMERCIAL LANDINGS (IN THOUSANDS OF POUNDS, EXCLUDING FOREIGN CATCH) FOR EACH GEAR TYPE FROM 1972 TO 1987.
Data from the NMFS Stock Assessment for red snapper (Goodyear, 1988b) and NMFS,ESO, General Canvas Landings Data.

	Year															
GEAR TYPE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Entangling nets	0	0	0	0	0	0	0	0	0	1	2	4	2	2	4	4
Handlines/Bandit	263	287	286	288	251	199	234	196	186	101	147	159	106	121	125	214
Longlines/Buoys	0	0	0	0	0	0	0	0	6	48	99	93	56	60	63	94
Traps	0	0	0	0	0	0	0	40	14	21	30	20	15	10	25	16
Trawls	0	0	0	0	0	0	0	0	3	2	0	0	1	1	1	0
Misc./Unk. Gear	0	0	0	0	12	11	14	6	16	0	0	0	0	1	1	2
ANNUAL TOTALS	263	287	286	288	263	210	248	242	225	173	278	276	180	195	219	330

NOTE: Over 98 percent of the mutton snapper commercial landings in each year were landed in Florida.
Forty-eight percent of the mutton snapper landings were taken from the South Atlantic Council's area of jurisdiction in the Florida Keys (Waters, 1988; Table 8).

TABLE 8.16

YELLOWTAIL SNAPPER COMMERCIAL LANDINGS (IN THOUSANDS OF POUNDS, EXCLUDING FOREIGN CATCH) FOR EACH GEAR TYPE FROM 1972 TO 1987.
Data from the NMFS Stock Assessment for red snapper (Goodyear, 1988b) and NMFS,ESO, General Canvas Landings Data.

	Year															
GEAR TYPE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Entangling nets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Handlines/Bandit	961	927	1041	750	1024	846	923	729	607	681	1276	938	901	746	888	1261
Longlines/Buoys	0	0	0	0	0	0	0	0	7	4	13	7	23	8	11	5
Traps	0	0	0	0	0	0	0	83	55	23	0	9	19	36	25	0
Trawls	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	1
Misc./Unk. Gear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
ANNUAL TOTALS	961	927	1041	750	1024	846	923	812	674	708	1289	954	943	790	924	1275

NOTE: Over 98 percent of the yellowtail snapper commercial landings in each year were landed in Florida.
Seventy-six percent of the yellowtail snapper landings were taken from the South Atlantic Council's area of jurisdiction in the Florida Keys (Waters, 1988; Table 8).

TABLE 8.17

GROUPER, EXCLUDING JEWFISH, COMMERCIAL LANDINGS (IN THOUSANDS OF POUNDS, EXCLUDING FOREIGN CATCH) FOR EACH GULF STATE AND PERCENT OF CATCH BY GEAR TYPE FROM 1972-1987. Data from the NMFS Stock Assessment (Goodyear, 1988c) and NMFS, ESO, General Canvas Data Files.

STATE	Year															
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Florida	7534	5985	6941	8420	7707	6097	5818	7873	8363	11722	14616	11172	10776	12082	11248	11489
Alabama	164	143	86	91	65	64	55	35	17	46	31	61	96	86	102	60
Mississippi	178	187	121	80	71	119	69	45	32	46	91	47	37	32	33	18
Louisiana	5	8	2	5	14	4	2	2	2	5	34	20	270	563	948	663
Texas	98	100	85	71	39	22	29	14	20	314	161	245	33	383	237	379
GEAR TYPE	**Percentage Contribution**															
Entangling Nets	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Handlines/Bandit	99%	98%	99%	99%	99%	96%	94%	97%	88%	62%	46%	51%	56%	57%	50%	40%
Longlines/Buoy	0%	0%	0%	0%	0%	0%	0%	1%	11%	37%	52%	48%	39%	34%	41%	51%
Fish Traps	0%	0%	0%	0%	1%	3%	5%	2%	1%	1%	1%	0%	4%	7%	7%	5%
Shrimp Trawls	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fish Trawls	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Misc./Unk. Gear	1%	2%	1%	1%	0%	1%	0%	1%	0%	0%	0%	0%	0%	2%	2%	4%
TOTAL LANDINGS	7979	6423	7235	8667	7896	6306	5973	7969	8434	12133	14933	11545	11212	13146	12568	12609

TABLE 8.18

JEWFISH COMMERCIAL LANDINGS (IN THOUSANDS OF POUNDS, EXCLUDING FOREIGN CATCH) FOR EACH GULF STATE AND PERCENT OF CATCH BY GEAR TYPE FROM 1972-1987. Data from the NMFS Stock Assessment (Goodyear, 1988b) and NMFS, ESO, General Canvas Data Files.

	Year															
STATE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Florida	178	191	190	219	218	236	227	189	238	213	185	206	105	120	108	100
Alabama	57	48	25	19	14	17	4	3	2	6	13	14	7	13	1	0
Mississippi	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Louisiana	0	6	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Texas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

GEAR TYPE	Percentage Contribution															
Entangling Nets	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Handlines/Bandit	97%	89%	93%	85%	92%	93%	92%	87%	88%	81%	71%	66%	69%	46%	40%	40%
Longlines/Buoy	0%	0%	0%	0%	0%	0%	0%	0%	7%	11%	20%	25%	19%	28%	20%	14%
Fish Traps	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Shrimp Trawls	3%	11%	7%	15%	7%	6%	6%	7%	1%	1%	1%	1%	1%	0%	3%	2%
Fish Trawls	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Misc./Unk. Gear	0%	0%	0%	0%	0%	1%	1%	5%	4%	6%	8%	8%	11%	26%	37%	45%
Total Landings	235	245	215	238	232	253	231	192	240	219	199	221	112	133	109	101

TABLE 8.19

SEA BASS COMMERCIAL LANDINGS (IN THOUSANDS OF POUNDS, EXCLUDING FOREIGN CATCH) FOR EACH GEAR TYPE FROM 1972 TO 1987.
Data from the NMFS Stock Assessment for red snapper (Goodyear, 1988b) and NMFS,ESO, General Canvas Landings Data Files.

	Year															
GEAR TYPE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Entangling nets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Handlines/Bandit	28	44	20	14	25	39	22	26	9	11	21	6	18	13	16	30
Longlines/Buoys	0	0	0	0	0	0	0	0	0	1	7	4	6	5	4	3
Traps	115	89	40	26	33	0	5	15	8	5	3	3	2	1	3	3
Trawls	0	0	0	5	0	0	3	3	0	2	0	0	0	0	0	0
Misc./Unk. Gear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
ANNUAL TOTALS	143	133	60	45	58	39	30	44	17	19	31	13	26	19	24	36

NOTE: Over 99 percent of the sea bass commercial landings in each year were landed in Florida.

TABLE 8.20

AMBERJACK COMMERCIAL LANDINGS (IN THOUSANDS OF POUNDS, EXCLUDING FOREIGN CATCH) FOR EACH GULF STATE AND PERCENT OF CATCH BY GEAR TYPE FROM 1972-87. Data from the NMFS Stock Assessment (Goodyear, 1988b) and NMFS, ESO, General Canvas Data Files.

	Year															
STATE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Florida	46	40	60	95	99	136	173	194	212	263	246	303	550	603	768	1279
Alabama	0	0	0	0	0	0	0	0	0	0	0	3	19	43	62	31
Mississippi	0	0	0	0	0	0	0	0	0	0	5	1	9	37	67	46
Louisiana	0	0	0	0	0	0	0	0	0	0	0	0	0	96	314	381
Texas	0	0	0	0	0	0	0	0	0	0	0	0	14	50	120	105

GEAR TYPE	Percentage Contribution															
Entangling Nets	22%	0%	0%	0%	2%	7%	1%	3%	2%	0%	0%	0%	0%	0%	0%	0%
Handlines/Bandit	78%	100%	100%	100%	98%	93%	99%	96%	95%	90%	82%	83%	87%	75%	68%	76%
Longlines/Buoy	0%	0%	0%	0%	0%	0%	0%	2%	2%	10%	17%	17%	11%	21%	24%	14%
Fish Traps	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Shrimp Trawls	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fish Trawls	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Misc./Unk. Gear	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	3%	8%	10%
Total Landings	46	40	60	95	99	136	173	194	212	263	251	307	592	829	1331	1842

9. OPTIMUM YIELD, OVERFISHING, AND TOTAL ALLOWABLE CATCH PROCEDURE

Optimum yield (OY) from a fishery is considered to be that amount of fish which will provide the greatest overall benefit to the nation, with particular reference to food production and recreational opportunities, and which is prescribed as such on the basis of the maximum sustainable yield from that fishery, as modified by any relevant ecological, economic, or social factor (P.L. 94-265).

The Council considered the following goals in choosing an OY:

(a) To provide the greatest benefit to the nation - harvesters, processors, and consumers.

(b) To assure the conservation and management of the stocks.

(c) To provide mechanisms for preventing overfishing and rebuilding of declining stocks.

(d) To provide a reporting system for more precisely assessing the status of the individual stocks.

The Council's reef fish scientific advisory committees recommend the definition of optimum yield in the FMP be changed to reflect species specific levels of optimum yield because the current aggregate definition does not protect the resource from overfishing. It was also recommended that when supporting data are available, optimum yield should be specified quantitatively.

9.1. Optimum Yield as a Long-Term Goal.

Proposed Option: Optimum Yield is any harvest level for each species which maintains, or is expected to maintain, over time a survival rate of biomass into the stock of spawning age to achieve at least a 20 percent spawning stock biomass per recruit (SSBR) population level, relative to the SSBR that would occur with no fishing.

a. Ecological impacts

This alternative potentially can provide for more stable population structures through improved reproduction and the harvest of larger fish. The principal impact will be to maintain the spawning stocks at a level that assures, relative to the quality of available data, recruitment overfishing will not occur.

This measure directly addresses the need to protect the reproductive potential of a population. Ideally, the relative percent SSBR chosen as the management goal would be based on an analysis of actual estimates of spawning stock biomass and subsequent recruitment, but with reef fishes the data simply are not available for evaluating alternative levels of SSBR. Based on the work done on Northwest Atlantic groundfish by the NMFS NEFC (see Gabriel, 1987), the 20 percent SSBR was chosen as a reasonably conservative starting point. The NMFS SEFC should initiate monitoring programs that would measure stock size and recruitment levels for reef fish with the goal being determination of the appropriate SSBR level for each stock or stock complex.

b. Socioeconomic impacts

In the long-term a more stable fishery would develop and management can exercise greater flexibility in maintaining optimum yield through a combination of size limits, quotas, bag limits, or closed seasons and areas. The value of the commercial fishery will be increased through the harvest of larger, more valuable fish and the recreational fishery would improve due to greater abundance of fish once the 20 percent SSBR level is reached. In the short-term the inshore recreational and commercial fisheries will experience a decline in harvestable fish due to the implementation of more restrictive management measures designed to allow the fishery to recover to OY. However, since mortality rates will decrease, an increase in the recreational catch rates will occur immediately due to the increased abundance of fish, primarily undersize fish.

c. Rationale

The Council proposed this option because it provides the most appropriate management goal for the mixed recreational and commercial reef fish fishery and explicitly defines overfishing relative to reproductive potential (see Section 9.2 below). This option provides for direct protection against recruitment overfishing. The Council has determined this definition of OY will produce the greatest overall benefit to the Nation.

Rejected Option 1: Status Quo -- An OY of 45.5 million pounds for snapper/grouper and 0.5 for sea bass.

a. Ecological impacts

An overall OY for all snapper and grouper species does not protect any one species from overfishing. Thus, the reef fish resource is vulnerable under status quo because each species can be selectively overfished without exceeding OY. Also, not all species respond equally to similar fishing pressures. This OY estimate is based on a MSY which is an overestimate for the reef fish complex (Goodyear 1988a). Best available data on the reef fish fishery are insufficient for calculation of MSY in the traditional sense.

b. Socioeconomic impacts

If the resource becomes overfished the economic benefits projected in the FMP will not be realized. This can happen if the market value of a particular species increases and that species is overharvested without exceeding OY with the consequence that the economics of the overall fishery will be negatively impacted. Overfishing of any one of the major reef fish species would have negative impacts on landings, employment, and recreation.

Rejected Option 2: Specify OY as the combination of a fishing mortality level and optimum size limit that maximizes YPR for those species for which yield-per-recruit (YPR) models can be developed. For those species in need of management but for which YPR values cannot be calculated, OY can be expressed nonquantitatively as all fish that can be taken in accordance with provisions in this plan.

a. Ecological impacts

Relative to the status quo this alternative will significantly increase yield (at optimum size) and will provide for improved control of fishing mortality on individual species, and consequently result in more stable population structures through improved reproduction and the harvest of larger fish since the optimum size of a species usually coincides with size at maturity. The use of size limits that maximize's yield would result in rebuilding the stocks. However, an F(max) management goal such as this option implies is not as conservative as the F(0.1) goal which has been widely applied in recent years, nor does this goal directly address protection of the reproductive potential of a population. In some cases an F(max) management strategy may provide for adequate reproduction, but it is not assured.

b. Socioeconomic impacts

This measure, by attempting to maximize yield implies that absolute production alone is important; relative economic efficiency, differences in user group goals, and population productivity are not addressed as explicit goals. Clearly in a recreational or mixed commercial/recreational fishery, maximization of total yield may not be the optimal goal.

In the long-term a more stable fishery would develop. The value of the commercial fishery would be increased through the harvest of larger, more valuable fish, and the recreational fishery would improve due to greater abundance of fish. In the short-term the inshore recreational and commercial fisheries would experience a decline in harvestable fish due to the required release of undersize fish; the recreational fishermen would see an increase in their catch rates due to the increased survival of undersize fish. If fish sizes are immediately increased to the size that maximizes yield rather than gradually over several years, then inshore fisheries may be completely displaced for several years. Adaption of comparable size limits by the Gulf States and a prohibition on the possession and sale of undersize fish is necessary for effective shoreside enforcement.

Rejected Option 3: OY shall be equivalent to the yield available from each species when fished at a fishing mortality rate of F(0.1). For those species in need of management but for which F(0.1) values cannot be calculated OY can be expressed nonquantitatively as all fish that can be taken in accordance with provisions in this plan.

a. Ecological impacts

The ecological impacts are similar to those described under Option 2, however an F(0.1) management strategy implies that economic efficiency and not maximum yield is the primary management goals. Reproductive productivity is better protected by this measure than an F(max) strategy.

b. Socioeconomic impacts

The F(0.1) concept was first developed in the early 1970s (ICNAF 1972, Gulland and Borema 1973) and has an explicit economic basis. Essentially, F(0.1) is the fishing mortality level at which, for a given size of entry into a fishery, the marginal yield is 10 percent of the marginal yield per recruit in a lightly exploited fishery. (Marginal yield is the increase in total yield that would be achieved by adding one extra unit of fishing effort.) The F(0.1) level was chosen arbitrarily--F(0.2) or other levels could have also been chosen--but it had immediate appeal to both economists and biologists. The initial argument to adopt this management strategy was threefold:

1) At some levels of fish size at entry into a fishery F(max) does not exist but rises to an asymptote; however a unique F(0.1) always exists.

2) As a fishery develops and begins to reach F(max) the increase in yield is disproportionately small relative to the increase in effort required to take that yield. Consequently, as a fishery approaches F(max), economic efficiency suffers.

3) Biologically F(0.1) is more conservative than F(max), not only providing better protection of reproductive potential but also serving as a buffer to prevent a fishery from exceeding F(max).

9.2. <u>Definition of Overfishing</u>

The NMFS has recently published amended proposed guidelines (CFR Part 602.11) for the National Standards related to optimum yield and overfishing. In general, the guidelines, provided below, specify that OY and associated management measures must prevent overfishing.

> "Overfishing is a level or rate of fishing mortality that jeopardizes the long-term capacity of a stock or stock complex to produce MSY on a continuing basis. Each FMP must specify, to the maximum extent possible, an objective and measurable definition of overfishing for each stock or stock complex covered by that FMP, and provide an analysis of how the definition was determined and how it relates to reproductive potential" (CFR Part 620.11 (c)(1)).
>
> "The definition of overfishing for a stock or stock complex may be developed or expressed in terms of a minimum level of spawning stock biomass ("threshold"); maximum level or rate of fishing mortality; formula, model, or other measurable standard designed to ensure the maintenance of the stock's productive capacity. Overfishing must be defined in a way to enable the Council and the Secretary to monitor and evaluate the condition of the stock or stock complex relative to the definition" (CFR Part 620.11 (c)(2)).
>
> "Overfishing definitions must be based on the best scientific information available. Councils must build into the definition appropriate consideration of risk, taking into account uncertainties in estimating domestic harvest, stock conditions, or the effects of environmental factors. In cases where scientific data are severely limited, the Councils' informed judgment must be used and effort should be directed to identifying and gathering the needed data" (CFR Part 620.11 (c)(4)).
>
> "Secretarial approval or disapproval of the overfishing definition will be based on consideration of whether the proposal:
>
> (i) has sufficient scientific merit;
>
> (ii) is likely to result in effective Council action to prevent the stock from closely approaching or reaching an overfished status;
>
> (iii) provides a basis for objective measurement of the status of the stock against the definition; and
>
> (iv) is operationally feasible" (CFR Part 620.11 (c)(5))

"An FMP must contain management measures necessary to prevent overfishing.

(i) If overfishing is defined in terms of a threshold biomass level, the Council must ensure that fishing effort does not cause spawning stock biomass to fall and remain below that threshold.

(ii) If overfishing is defined in terms of a maximum fishing mortality rate, the Council must ensure that fishing effort on that stock does not cause the maximum rate to be exceeded.

(iii) If data indicate that an overfished condition exists, a program must be established for rebuilding the stock over a period of time specified by the Council and acceptable to the Secretary.

(iv) If data indicate that a stock or stock complex is approaching an overfished condition, the Council should identify actions or combination of actions to be undertaken in reponse.

(v) Depending on the objectives of a particular FMP and the specific definition of overfishing established for the stock or stock complex under management, a Council may recommend measures to prevent or permit pulse, localized, or growth overfishing" (CFR Part 620.11 (c)(6)).

"Significant adverse alterations in the environment/habitat conditions increase the possibility that fishing effort will contribute to a stock collapse. Care should be taken to identify the cause of any downward trends in spawning stock sizes or average annual recruitment.

(i) Whether these trends are caused by environmental changes or by fishing effort, the only direct control provided for by the Act is to reduce fishing mortality.

(ii) Unless the Council asserts, as supported by appropriate evidence, that reduced fishing effort would not alleviate the problem, the FMP must include measures to reduce fishing mortality regardless of the cause of the low population level.

(iii) If man-made environmental changes are contributing to the downward trends, in addition to controlling effort Councils should recommend restoration of habitat and other ameliorative programs, to the extent possible, and consider whether to take action under section 302(i) of the Act" (CFR Part 620.11 (c)(7)).

"There are certain limited exceptions to the requirement of preventing overfishing. Harvesting the major component of a mixed fishery at its optimum level may result in the overfishing of a minor stock component in the fishery. A Council may decide to permit this type of overfishing if it is demonstrated by analysis that it will result in net benefits to the Nation, and if the Council's action will not cause any stock to require protection under the Endangered Species Act" (CFR Part 620.11 (c)(8)).

The alternative OY options presented above define OY such that overfishing occurs whenever OY is exceeded, therefore the Council has adopted the following definitions (conditions) for overfishing and an overfished stock that satisfy the above NMFS guidelines.

1. A reef fish stock or stock complex is <u>overfished</u> when it is below the level of 20 percent of the spawning stock biomass per recruit that would occur in the absence of fishing.

2. When a reef fish stock or stock complex is overfished, <u>overfishing</u> is defined as harvesting at a rate that is not consistent with a program that has been established to rebuild the stock or stock complex to the 20 percent spawning stock biomass per recruit level.

3. When a reef fish stock or stock complex is not overfished, <u>overfishing</u> is defined as a harvesting rate that if continued would lead to a state of the stock or stock complex that would not at least allow a harvest of OY on a continuing basis.

Rationale: Spawning stock biomass per recruit (SSBR) is recommended as the model for defining overfishing to prevent recruitment overfishing directly (see OY discussion below). The SSBR (reproductive potential) is determined by integrating or summing the multiple, for each age, of relative number of fish alive times the fraction mature times the weight of fish. The two models used to determine SSBR, both variants of yield per recruit models, are the Beverton-Holt continuous model or the Ricker discrete model. The total contribution of an cohort to the spawning stock biommass over its lifetime is found by summing the cohort's contribution at each age, which is then scaled to a per recruit basis to derive a theoretical measure of SSBR. The SSBR measure can be used to evaluate alternative fishing mortality scenarios without knowing actual levels of recruitment or spawning stock. Maximum SSBR is obtained by setting fishing mortality to zero.

These definitions satisfy the NMFS guidelines in that they have sufficient scientific merit; are likely to result in effective Council action to prevent the stock from closely approaching or reaching an overfished status; provide a basis for objective measurement of the status of the stock against the definition; and, are operationally feasible.

9.3. Annual Total Allowable Catch (TAC) Designed to Achieve OY Goal.

Proposed Option: Optimum Yield can be achieved with annual Total Allowable Catch (TAC) specifications for each species or species group. The Council will establish a framework procedure where, on an annual basis, a scientific working group will establish an Allowable Biological Catch (ABC) range and Council sets annual TAC and prescribes fishing restrictions annually to attain the management goal of OY for implementation by the Regional Director (RD) of NMFS prior to the beginning of a fishing year.

Procedure for Specification of TAC:

1. Prior to April 1 each year, or such other time as agreed upon by the Council and Regional Director, the SEFC will: a) update or complete biological and economic assessments and analyses of the present and future condition of the stocks for red snapper and other reef fish stock or stock complex; b) assess to the extent possible the current SSBR levels for each stock; c) estimate F in relation to F(SSBR); d) estimate annual surplus production, F(max), or other population parameters deemed appropriate; e) summarize statistics on the fishery for each stock or stock complex; f) specify the geographical variations in stock abundance, mortality, recruitment and age of entry into the fishery for each stock or stock complex; and, g) analyze social and economic impacts of any specification demanding adjustments of allocations, quotas, or bag limits.

2. The Council will convene a scientific stock assessment panel, appointed by the Council, that will, as a working group, review the SEFC assessment(s), current harvest statistics, economic, social, and other relevant data and will prepare a written report to the Council specifying a range of ABC for each stock or stock complex which is in need of catch restrictions for attaining or maintaining OY. The ABC's are catch ranges that will be calculated for those species in the management unit that have been identified by the Council, NMFS, or the working panel as in need of catch restrictions for attaining or maintaining OY. The range of ABC's shall be calculated so as to achieve reef fish population levels at or above the 20 percent SSBR goal by January 1, 2000. For stock or stock complexes where data in the SEFC reports are inadequate to compute an ABC based on the SSBR model, the above working group will use other available information as a guide in providing their best estimate of an ABC range that should result in at least a 20 percent SSBR level. The ABC ranges will be established to prevent an overfished stock from further decline. To the extent possible a risk analysis should be conducted showing the probabilities of attaining or exceeding the stock goal of 20 percent SSBR and the annual

transitional yields (i.e., catch streams) calculated for each level of fishing mortality within the ABC range and the economic and social impacts associated with those levels. The working group report will include recommendations on bag limits, size limits, specific gear limits, season closures, and other restrictions required to attain management goal, along with the economic and social impacts of such restrictions, and the research and data collection necessary to improve the assessments. The working group may also recommend additional species for future analyses.

3. The Council will conduct a public hearing on the working group report(s) at, or prior to the time, it is considered by the Council for subsequent action. Other public hearings may be held also. The Council will request review of the report(s) by its Reef Fish Advisory Panel and Standing Scientific and Statistical Committees and may convene these groups to provide advice before taking action.

4. The Council in selecting a TAC level for each stock or stock complex for which an ABC range has been identified will, in addition to taking into consideration the recommendations provided for in (1), (2), and (3), utilize the following criteria:

   a. Set TAC within or below the ABC range or set a series of annual TAC's to obtain the ABC level within three years or less.

   b. Subdivide the TAC's into commercial and recreational allocations which maximize the net benefits of the fishery to the nation. The allocations will be based on historical percentages harvested by each user group during the base period of 1979-87. However, if the harvest in any year exceeds the TAC due to either the recreational or commercial user group exceeding its allocation, subsequent allocations pertaining to the respective user group will be adjusted to assure meeting the January 1, 2000 spawning stock biomass per recruit goal.

5. The Council will provide its recommendations to the RD for any specifications in TAC's for each stock or stock complex, the quotas, bag limits, trip limits, size limits, closed seasons, and gear restrictions necessary to attain the TAC, along with the reports, a regulatory impact review and environmental assessment of impacts and the proposed regulations before October 15 or such other time as agreed upon by the Council and RD.

6. Prior to each fishing year or other such time as agreed upon by the RD and Council the RD will review the Council's

recommendations and supporting information, and if he concurs that the recommendations are consistent with the objectives of the FMP, the National Standards, and other applicable law he shall forward for publication notice of proposed TAC's and associated harvest restrictions by November 1, or such other time as agreed upon by the Council and RD; providing up to 30 days for additional public comment. The RD will take into consideration all information received and will forward for publication in the Federal Register the notice final rule by December 1, or such other time as agreed upon by the Council and RD.

7. **Appropriate regulatory changes that may be implemented by notice include:**

   a. **The TAC's for each stock or stock complex that are designed to achieve a specific level of ABC within the first year or annual levels of TAC designed to achieve the ABC level within three years.**

   b. **Bag limits, size limits, vessel trip limits, closed seasons or areas, gear restrictions, and quotas designed to achieve the TAC level.**

a. Ecological impacts

Direct catch controls through the establishment of TAC's can most effectively limit catch at predetermined levels and more effectively attain the long-term OY goal. However, with the exception of red snapper, the available database may be insufficient to quantitatively evaluate the impacts of a TAC on reef fish populations and future probable conditions under TAC management. Reducing catch through TAC's for other species stocks or stock complexes, using the SSBR model as a guide, may alleviate the necessity to institute more stringent restrictions for these species in the future when data to assess their condition becomes available. This would also provide better protection against overfishing.

b. Socioeconomic impacts

The determination of short-term socioeconomic impacts are likely to be negative and directly related to the level of TAC established relative to present total catch. Long-term impacts will invariably be positive in that a more stable fishery will result from improved population abundance and stability.

Preseason and inseason adjustments provide by this TAC Procedure will provide for the more timely management of the reef fish fishery needed due to the overfished status of some of the stocks and the dynamic nature of the fishing fleets that has the ability to pulse fish one species after another. The proposed procedure provides for public input to both the Council and NMFS prior to implementation of management changes. Recreational harvests are regulated by bag limits only, without an overall quota, because recreational harvest data are not available in a timely fashion. If the recreational sector should exceed its allocation (e.g., due to increased fishing effort, availability of fish, etc.) in a particular year then adjustments, such as in bag limits, will be made in the following years to ensure the Council's goal of attaining 20% SSBR by January 1, 2000 will not be jeopardized.

The proposed allocation based on the historical percentage harvested by each user group during 1979-87 provides the best available basis for allocating reef resources because it represents the longest time period of documented commercial and recreational annual harvests. It is the goal of the Council to allocate reef resources so that the net benefits to the nation are maximized. Therefore alternative allocation procedures will be regularly reviewed relative to the goal to maximize net benefits. Other allocation methods may be developed in subsequent years based on other periods or criteria, but since they may involve significant impacts on the respective user groups, the Council intends that such allocation changes be made only by plan amendment, thus affording the fullest possible public review.

c. Rationale

The Council proposed this option because it provides for continuing assessment of the reef fish resources, management flexibility and, most importantly, timeliness in management. Plan amendments are not sufficiently timely for making preseason or inseason adjustments of management measures on the reef fish stocks which need to be maintained at or restored to the 20 percent SSBR level. The reef fish fishery is dynamic and diversified and can shift fishing effort among species dramatically from one year to the next. This proposed TAC procedure which utilizes a regulatory amendment approach with time-certain constraints is the only practical means for making effective timely preseason management adjustments. The Council, recognizing the potential for the assessment panel to recommend an ABC range that would significantly impact the fishery, established a three year period during which management measures may effect a less than desired biological recovery to allow for a transitional period during which the industry can adjust to the modified, or in some cases new, management regime. The three year period is intended to be in effect only at the initiation of management of a stock or stock complex under the TAC procedure because it was recognized that probably some fisheries have been overfished for a number of years but have gone undetected simply due to the lack of information on the status of the stock. It was felt that the provision for a three year transition period would reduce negative impacts and burdens on the industry without jeopardizing the long-term conservation of a fishery resource.

Rejected Option 1: Specify TAC for each species to be the yield that results from the recommended minimum size which can be changed by regulatory amendment to the size that optimizes YPR. This option implies the only harvest limitations needed are the minimum size limit and the rate at which the size limit will increase.

a. Ecological impacts

The ecological impacts are summarized under the proposed option above. Size limits that gradually increase to the size that maximizes yield will greatly increase the poundage available from the resource. The increase in yield gained is a function of the time period utilized to reach that size.

b. Socioeconomic impacts

The socioeconomic impacts are summarized under the proposed option above. A gradual (yearly or biennial) increase in size limits would reduce the short-term impact on users (especially recreational fishermen) who would be unable to harvest most of the fish they are currently harvesting for several years if the size limit was initially set to maximize yield. A rapid increase in size limits would likely result in vessels fishing further offshore at greater expense and may in some instances, because of the distances involved, completely deny harvest to some fishermen until the fish have reached the larger size.

Rejected Option 2: Reduce annual TAC by 10 percent each year until fishing mortality is at the level that would rebuild SSBR to a 20 percent level.

a. Ecological impacts

The risk with this approach is that the stocks may decline faster than the TAC is reduced.

b. Socioeconomic impacts

Approximately 38 million pounds (M) of reef fish were landed in 1986, of which 11.0 M were snappers, 18.0 M groupers, and 5.0 M of amberjacks and red snapper each. (See Table 8.1 of combined recreational/commercial catches annual landings (1979-1987) for each species or species group). Short-term losses would be 10 percent of landings per year to the rebuilding level, and the cumulative annual loss until stocks are rebuilt. At that time, landings could increase to the level consistent with maintaining a 20 percent SSBR. This level of landings would, presumably, be higher than current landings and represent a long-term gain.

10. PROPOSED MANAGEMENT MEASURES

Size and Catch Limits

--Red Snapper

1: Establish a red snapper minimum size limit of 13 inches total length, a recreational bag limit of 7 fish per angler per day, and a commercial quota of 3.1 million pounds that would effect a 20 percent reduction in the 1985-87 average annual recreational and commercial catches, respectively. These limits shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

2: Prohibit the sale of red snapper smaller than the size limit.

3: Delete the allowance for keeping five undersize red snapper.

--Other Reef Fish Species

1: Establish a size limit of 20 inches total length on red, Nassau, yellowfin, black, and gag groupers, a 50-inch limit on jewfish, a five-fish recreational daily possession limit for all grouper, and a commercial grouper quota of 11 million pounds equal to 90 percent of the aggregate 1985-87 grouper landings. The grouper quota is to be subdivided into the following two quotas: 1.8 million pounds for deep water groupers (misty, snowy, warsaw, and yellowedge groupers); 9.2 million pounds for shallow water groupers (includes all grouper species other than those listed above as deep water species). Jewfish is not included in the grouper quotas. These limits shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

2: Establish minimum sizes of 12 inches total length on gray, mutton, and yellowtail snappers and 8 inches total length on lane and vermilion snappers. An overall snapper recreational daily possession limit of 10 fish shall be established, excluding lane, vermilion, and red snappers. There is no bag limit for lane and vermilion snappers and the red snapper limit is separate and distinct from this 10 fish limit. These limits shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

3: Establish a minimum size of 8 inches total length for black sea bass. This limit shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

4: Establish a greater amberjack minimum size limit of 28 inches fork length and a 3 fish per angler per day possession limit for recreational fishermen and a 36 inch fork length minimum size limit for commercial fishermen. These limits shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

5: Prohibit the sale of reef fish smaller than the established size limits. If a larger size limit has been set for commercial fishermen, as with greater amberjack, then no fish smaller than the commercial size limit can be sold.

Multiple-Day Possession Limits

1: To allow a maximum of 2 days possession limit for charter vessels and head boats fishing under the bag limits on fishing trips that extend beyond 24 hours duration provided the charter vessel or head boat has two licensed operatores aboard as required by the U.S. Coast Guard for multiple-day fishing trips and each passenger can provide a receipt to verify length of fishing trip. All other fishermen fishing under a bag limit are limited to a single day possession limit.

Gear Restrictions

1: Permitted commercial fishermen may obtain a special fish trap permit (endorsement) to fish up to a maximum of 100 fish traps per permit holder. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

2: Trawl vessels must comply with the same size and bag limits that are established for the recreational fishery harvesting reef fish. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

3: Prohibit the use of longlines and buoy gear for the directed harvest of reef fish inshore of the 50 fathom isobath west of Cape San Blas, Florida (85°30'W) and inshore of the 20 fathom isobath east of Cape San Blas, Florida (85°30'W). The retention of reef fish captured incidentally in other longline operations (e.g., shark) is limited to the recreational bag limit. The restricted area boundary is specified by latitude-longitude coordinates that approximate the depth zones (Table 11.27). Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

4: Prohibit the use of entangling nets for the directed harvest of reef fish. The retention of reef fish captured in other entangling net operations targeting other species is limited to the recreational bag limit. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

Fishing Year

1: Status Quo - The fishing year is from January 1 through December 31.

Stressed Area Boundaries

1: Extend the present boundary of the stressed area to include waters off Texas out to the 30 fathom isobath along the entire coastline of Texas.

2: Extend the present boundary of the stressed area to include waters off Louisiana out to the 10 fathom isobath along the entire coastline of Louisiana.

User Group Conflict Resolution

1: Status Quo - No regulation.

Closed Seasons and Areas

1: Season and area closures for selected reef fish will be considered under the Total Allowable Catch Procedure.

Permits and Gear Identification

1: Require an annual commercial fishing permit for fishing under the commercial quota (exceeding a bag limit) and for the sale of reef fish, with the qualifying condition that more than fifty percent of an individual's (owner or operator) earned income must be derived from commercial or charter (for-hire) fishing. Charter and head boat applicants must submit their Coast Guard Masters license number and commercial applicants must submit their documented vessel number on the permit application. Only those fish caught by a permitted vessel can be sold; where a commercial quota has been established only those fish caught under the commercial quota can be sold. Charter and head boats with permits to fish under the commercial quota are required to fish under the bag limit when under charter or when there are more than 3 persons aboard, including captain and crew. Other fishermen on unpermitted vessels are limited to the established bag limits.

2: Special fish trap permits (endorsements) and trap tags shall be required for all vessels fishing or possessing fish traps in the EEZ for the harvest of reef fish. The permit and trap tags shall be issued (or reissued) annually and shall be valid until the end of the fishing year for which the permit is issued unless revoked for violation of a fish trap related regulation. A fee shall be charged to recover the direct and indirect costs associated with the issuance of trap permits and tags. Except for the fish trap permit provisions in this paragraph, all other fish trap permit requirements shall remain as specified in Section 641.4 of the current reef fish regulations.

Statistical Reporting Requirements

1: Data will be collected by authorized statistical reporting agents from a statistically valid survey sample of commercial and recreational catch that is of sufficient size to provide representative measures of all major segments of a category of users of a resource and statistically valid estimates for stock assessment analyses and quota monitoring. Any such data collection should rely upon techniques that ensure comparability of data. Those fishermen and dealers selected by the Science and Research Director, or his designee, must make their reef fish (head and fins intact) available at dockside for inspection by those agents.

2: Require head boat operators who are selected by NMFS to maintain a fishery record for each trip and report this information to NMFS on at least a monthly basis.

3: Require charter boat operators who are selected by NMFS to maintain a daily fishing record on forms provided by the Science and Research Director that are to be submitted weekly (as is required in the Coastal Migratory Pelagic FMP). Information to be included in the forms must include, but not be limited to:

(1) Name or official number of vessel.
(2) Operator's Coast Guard license number.
(3) Date of trip.
(4) Number of fishermen on trip.
(5) Area fished.
(6) Fishing methods and type of gear.
(7) Hours fished.
(8) Species targeted.
(9) Number and estimated weight of fish caught by species.

4: The current reporting requirements for fish traps are modified in the following paragraph to implement the Council's intent to strengthen the enforcability of fish trap reporting requirements.

The owner or operator of a fishing vessel or any other person permitted under §641.4 to fish with fish traps must provide the following information regarding all fishing trips on which reef fish are harvested to the Science and Research Director. This information must be submitted within 7 days of completion of each trip:

(1) permit number as provided for in §641.4;

(2) pounds of catch of reef fish by species by gear if gear other than fish traps were also used;
(3) date of trip, depths fished, and fishing locations by statistical area;
(4) number of trap hauls resulting in catch;
(5) duration (days and hours) traps were fished before each haul;
(6) mesh size of traps.

Routine reporting shall be required of all trap permittees. At a minimum, monthly reports shall be required of permittees even if no fishing for reef fish occurred in a particular month. Violation of any of the reporting requirements shall result in revocation of the fish trap permit for one year.

NMFS shall provide quarterly reports concerning compliance with the fish trap regulations.

11. ANALYSIS OF ADOPTED AND ALTERNATIVE MANAGEMENT MEASURES

11.1. Size and Catch Limits

11.1.1. Red Snapper

Adopted Management Measures:

1: Establish a red snapper minimum size limit of 13 inches total length, a recreational bag limit of 7 fish per angler per day, and a commercial quota of 3.1 million pounds that would effect a 20 percent reduction in the 1985-87 average annual recreational and commercial catches, respectively. These limits shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

a. Ecological impacts

This measure would reduce fishing mortality on juveniles and less so on adults since most recreational and commercial fishermen fish primarily on juveniles and young adults. The potential mortality associated with the release of recreationally caught undersize fish will be less with this combined bag and size limit than with the existing size limit alone since some fishermen will probably curtail fishing once the bag limit is reached. It is anticipated that this measure, based on 1985-87 average catches, will reduce recreational and commercial catches--and to a similar extent fishing mortality--by approximately 20 percent in the first year of implementation (Tables 8.1 and 11.3). Without a limit on total recreational effort or catch the bag limit may effect less than the desired reduction in recreational fishing mortality and therefore should be closely monitored. This measure, in conjunction with other proposed measures (TAC Procedure and longline and stressed area geographic restrictions) will have both short- and long-term positive impacts on the red snapper resource.

The size limit is the same that was originally implemented in the FMP and will have no additional ecological impacts. Size limits alone will not effectively restore spawning stock levels if undersize release mortality is significant (see Figures 11.1-11.3). The Council, based upon scientific results (Gitschlag and Renaud 1987) and public testimony, has concluded that size limits for red snapper should be established based on an undersize release mortality of 33 percent. The 13-inch size limit in conjunction with an initial 20 percent catch reduction will virtually halt the decline of the red snapper stock (see Figure 11.4) and provide an adequate basis for future evaluation by the stock assessment panel and Council as established in the TAC Procedure of Section 9.2.

It is not anticipated that this measure will create any negative impacts on red snapper habitat or on the bycatch of "endangered" or "threatened" species.

b. Socioeconomic impacts

In the short-term this measure would effect about a 20 percent reduction in both recreational and commercial catch (see Tables 8.1 and 11.3). Although this proposed measure would have a significant negative impact it would be substantially less than the impact that would occur if the Council chose to rebuild the stock as quickly as the Scientific and Statistical Committee recommended (see Rejected Measure 2 below). However, without highly restrictive measures the stock is expected to decline further resulting in even more significant negative long-term impacts.

The size limit is the same as that specified in the FMP except that only the total length will be used to determine a legal size fish. Use of total length only reduces confusion on the part of the fishing public and eases enforcement of the size limit. Catch and size limits on red snapper will affect fishermen primarily in the northern Gulf, from Alabama through Texas (Figure 8.1, Table 8.3). Red snapper is the primary reef fish harvested in the northern Gulf. The Texas headboat fishery is dependent on red snapper for 90 percent of their catch (Table 11.6).

This measure does not directly impact vessel or crew safety since it is anticipated that the commercial fishing season will remain open throughout most of the year. The recreational fishing season will not be affected by this measure.

c. Rationale

The Council reviewed a number of catch limit combinations to reach the SSBR goals needed to restore the red snapper population (see Rejected Measures 1-4) and has proposed this option to reduce fishing mortality sufficient to significantly slow the decline in the spawning stock without imposing an undue burden on the fishing public. The Council, sensitive to the concerns expressed by the public about such drastic restrictions, deliberated extensively about the most appropriate size and catch limit combinations required for restoring the population without overly restricting the fishing public. However, even this proposed measure will be difficult for the public to accept since it will require a substantial change in their present fishing operations. Future modifications, as recommended by the assessment panel, will be needed but for now the Council believes this option is most appropriate because in conjunction with the TAC Procedure in Section 9.2 it provides a time period for arresting overfishing of this valuable resource--in conformance with the NMFS FMP Operational Guidelines 602.11(c)--which will lead to increased future landings (Figure 11.4) and stability of the fishery.

2: Prohibit the sale of red snapper smaller than the size limit.

a. Ecological impacts

Ecological impacts would be positive relative to the reduction in harvest of undersize fish effected by prohibiting their sale. Effectiveness of the proposed size limit is dependent on this measure. No direct impacts will occur on habitats or protected species due to this measure.

b. Socioeconomic impacts

This measure would have minimal socioeconomic impacts since no directed harvest of undersize fish would be allowed anyway. Enforcement would be greatly enhanced since it would allow shoreside enforcement and be regulated by dealers purchasing reef fish. Enforcement would be more effective if each state adopted similar sizes and prohibitions on sale. To avoid problems with imported fish, enforcement would be at the fisherman/primary dealer level rather than at the secondary processing marketing level.

c. Rationale

The Council proposed this option to strengthen the minimum size requirement and to further protect the resource. Without this measure the effectiveness of the size limit would be seriously weakened.

3: Delete the allowance for keeping five undersize red snapper.

a. Ecological impacts

This measure should result in increased survival of undersize snappers with resultant increases in juvenile and adult abundance (see Table 11.4). No direct impacts will occur on habitats or protected species due to this measure.

b. Socioeconomic impacts

Removing this allowance may negatively impact some charter and head boats that depend on the catch of undersize snappers as a bag limit to attract paying customers. A negative perception of wasting fish may be developed by the public relative to the numbers of released fish that die or are moribund before release. A long-term positive impact will occur as more larger snappers are captured.

c. Rationale

The Council proposed this option to strengthen the minimum size requirement and to further protect the resource. Without this measure the effectiveness of the size limit would be seriously weakened.

Rejected Management Measures:

1: Status Quo -- An allowance of incidentally harvested red snapper less than 12 inches in fork length is established at five fish per person in possession, and (b) any domestic vessel fishing trawls in the EEZ with the exception of roller trawl vessels fishing in the stressed area is excluded from the possession limit.

a. Ecological impacts

New information provided by the 1988 stock assessment (Goodyear, 1988a) demonstrates that present management measures do not adequately protect the red snapper population from overfishing.

Red snapper first mature at a size range of 10-13 inches fork length (Grimes, 1987); however, the size at which 50 percent of the female population matures--the single most important measure of maturity relative to evaluating the effects of size limits--is unknown but presumably is larger than 13 inches fork length. Based on an analysis of fecundity by age Goodyear (personal communication) recommends use of a maturity size equivalent to one-half the size of maximum length as an index of maturity, as determined from the von Bertalanffy growth equation; thus red snapper, for the SSBR analyses, are assumed to be fully mature at 23 inches total length. The FMP (1981) projected that a 13-inch total length minimum size alone would potentially increase overall yield to the fishery by 18 to 25 percent, provided hook-and-release mortality was not excessive. However, the retention of five undersize snapper largely negated the potential benefits of the minimum size limit (see Tables 11.4 and 11.5, Goodyear, 1988c).

The continued decline in red snapper is indicative the measures implemented with the FMP are not adequate to rebuild the resource. Indeed, a size limit alone will not adequately protect the resource if the undersize release mortality is as significant as claimed by the industry--assumed to equal about 33 percent--therefore additional measures are needed to reduce fishing mortality.

b. Socioeconomic impacts

The minimum size limit was expected to have a long-term positive economic impact as yield from the fishery increased. In the short term, the economic impact on the commercial fishery was minimally negative since most commercial fishing activity focused on larger fish in deeper waters. The head boat and inshore handline fisheries in northern Texas and west Louisiana were impacted more negatively since the broad continental shelf off west Louisiana and north Texas restricted head boats and handliners to relatively shallow water where juvenile red snappers are known to occur in abundance.

In the long-term, the minimum size limit was expected to provide positive social benefits as population size and average fish size increased. The short-term impacts were negative due to the perception of the fishing public toward having to release undersize fish in varying states of stress that would appear to lead ultimately to the death of released fish. The five undersize fish allowance provided for short-term benefits in that the fishing public was allowed to selectively keep those undersize fish, up to five for anglers, that under current stock conditions in the fishery may be the only size class available in certain areas, i.e., the allowance for undersize fish is really acting as a bag limit. However, the long-term impacts are negative because new evidence indicates present management measures do not provide for either sustained levels of yield or population stability.

2: Immediately reduce fishing mortality by 74 percent to rebuild the spawning stock biomass per recruit to the 20% level (relative to the unfished condition). This reduction would be effected by a 2 fish recreational bag limit and a commercial quota of 1.4 million pounds.

a. Ecological impacts

Given that 33 percent undersize mortality occurs this would be the most effective measure, short of a complete closure, for rebuilding the stock to 20% SSBR as quickly as possible (Figures 11.2-11.4, Table 11.2). Such a reduction in fishing mortality (F) would rebuild the stock to 20% SSBR in about ten years. A more gradual incremental reduction in F would delay rebuilding but a too gradual reduction in F would involve the risk that the stock will continue to decline and eventually require complete closure of the fishery to effect a recovery of the resource.

b. Socioeconomic impacts

The socioeconomic impacts of this option would be significantly negative. The 2 fish bag limit would severely impact the charter and headboat fishing fleets of the northern Gulf and probably discourage many private anglers. The commercial quota would result in an very short season forcing most fishermen to either go out of business or to operate during the winter months, since the fishing year begins January 1, thus potentially creating a vessel safety problem.

3: Establish larger size limits up to 24 inches total length or smaller bag limits down to a 2, 3, or 5 fish bag limits and quotas down to 1.4, 2.1, or 2.9 million pounds.

a. Ecological impacts

Larger size limits would provide increased benefits to the spawning stock if undersize release mortality is not too significant. Smaller bag limits (and quotas) would be beneficial in rebuilding the spawning stock if total recreational (and commercial) fishing effort did not increase significantly. The ecological impacts of smaller bag limits from 2 to 7 fish and quotas from 1.4 to 3.1 million pounds would be similar but less than those stated above for Rejected Measures 2.

b. Socioeconomic impacts

Larger size limits would severely impact the catches of recreational and commercial fishermen (Figures 8.8-8.10, Tables 11.4 and 11.5). The Council considered larger size limits but decided they did not provide optimal benefits because of the minimal impacts to the resource due to undersize release mortality (Figure 11.1) and the significant short-term impact larger size limits would have on catches. Smaller bag limits and quotas than those proposed above was deemed to have an unacceptable negative socioeconomic impact. The Council considered specific proposals of 12, 15, and 16 inch size limits, 2-15 fish bag limits, and commercial quotas as low as 1.4 million pounds during its review of the draft amendment but concluded that theses measures, although appropriate long-term goals, would unnecessarily disrupt the red snapper fishery. The Council decided to implement restrictions on the fishery over a three year period, following the TAC Procedure which assures that adequate measures will be taken to rebuild the resource over time.

4: Establish different catch quotas, bag limits, and minimum sizes by geographical area.

a. Ecological impacts

Different geographic catch and size limits for red snapper would have minimal positive impacts on the resource and potentially negative impacts because there is no clear delineation of differences in population characteristics in the northern Gulf. Red snapper primarily occur in the northern Gulf with its population center occurring off Louisiana and east Texas. There is no biological evidence that red snapper comprise more than a single population. Differing limits by geographic area may actually result in greater overfishing than overall limits due to the difficulty in determining geographic differences and the cumulative effects of separate limits.

b. Socioeconomic impacts

The socioeconomic impacts on those areas with the least restrictive limits may be positive if the commercial and for-hire fishing fleets do not move their base of operation from the more restrictive areas to the less restrictive areas. The long-term impacts are dependent on the dynamics of the fishery.

5: Allocate red snapper between recreational and commercial fisheries by allocating to the commercial fishery all red snapper killed by the shrimp and groundfish trawl fisheries and allocate the remaining red snapper to the recreational fishery.

a. Ecological impacts

This measure, by eliminating the traditional commercial red snapper fishery, would provide immediate protection to the older fish inhabiting the deeper continental shelf waters that are beyond the reach of the recreational angler. It would be expected that adult biomass would accumulate slowly due to the relatively slow growth and longevity of the species, and then only if additional measures are taken to reduce the mortality of juvenile fish.

b. Socioeconomic impacts

The commercial reef fish fishery would be completely closed with a loss of about 5 million pounds of production annually. However, the recreational fishery would eventually realize benefits in increased abundance of juveniles and young adults. This measure was rejected due to the substantial negative impact that would be imposed on the commercial fishery.

11.1.2. Other Reef Fish Species

Adopted Management Measures:

1: Establish a size limit of 20 inches total length on red, Nassau, yellowfin, black, and gag groupers, a 50-inch limit on jewfish, a five-fish recreational daily possession limit for all grouper, and a commercial grouper quota of 11 million pounds equal to about 90 percent of the aggregate 1985-87 grouper landings. The grouper quota is to be subdivided into the following two quotas: 1.8 million pounds for deep water groupers (misty, snowy, warsaw, and yellowedge groupers) and 9.2 million pounds for shallow water groupers (includes all grouper species other than those listed above as deep water species). Jewfish is not included in the grouper quotas. These limits shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

a. Ecological impacts

The size limits proposed by this measure would significantly reduce growth overfishing and mortality on juvenile groupers and jewfish. Female maturity first occurs at approximately 10, 19, and 20 inches for red, Nassau, and yellowfin groupers, respectively (Shapiro, 1987). However the size of 50 percent maturity for red grouper in US waters is about 19 inches total length (Moe, 1969). Jewfish mature at a size of about 50 inches total length (see Section 8.8). Gag grouper mature at 29 inches total length (see Section 8.7.3.4). No information is available on black grouper. Nassau and yellowfin grouper mature at about 19 and 20 inches total length, respectively (Section 8.7.5.4). The Council has chosen to use the red grouper assessment information as an index for the other shallow water groupers listed above. The proposed 20-inch size limit and 10 percent reduction in harvest should begin rebuilding the spawning stock and increasing overall yield (Table 11.7 and Figure 11.5).

It is not anticipated that this measure will create any negative impacts on red snapper habitat or on the bycatch of "endangered" or "threatened" species.

b. Socioeconomic impacts

Over 90 percent of the harvest of these species are landed in Florida ports (Goodyear, 1988b). Florida has established an 18-inch size limit on the above groupers (see Table 11.1).

The proposed size limits would impact primarily the recreational and inshore handline commercial fisheries (Figures 8.22, 8.27, and 8.28). Short-term recreational catches, using 1986 and 1987 as an index, would be reduced by about 75-90 percent for red (Tables 11.8

and 11.9), 30-50 percent for gag groupers (Tables 11.10 and 11.11), and 40 percent for black (Table 11.12). No data are available on the length distribution of catches of the other species. A long-term increase in yield would accrue to the commercial fishery which harvests the larger fish further offshore. The recreational fishery would be expected to benefit in the long-term because larger fish would occur inshore as well. The present absence of larger fish inshore is probably as much the result of present high fishing mortality as that due to emigration into deeper water.

The recreational bag limit and commercial quota should effect, in the short-term, a 10-20 percent reduction in total grouper harvest (Tables 8.1 and 11.13). The long-term impacts are dependent on a variety of presently unknown factors. However, as with any quota where effort is not similarly constrained, the commercial fishing season will not be expected to extend the full year with the fishing season becoming shorter as the stocks recover and effort increases--these are generally recognized characteristics of open access fisheries where only output controls are implemented. The long-term impacts of the size and bag limits on recreational fishermen can only be guessed. The large fish that presently do not frequent inshore waters will return as population levels increase. Recreational catch rates should increase with a greater proportion of the catch consisting of larger legal-size fish.

This measure should not negatively impact vessel or crew safety, in the short-term, since the quotas are only 10 percent less than reported landings and the season should extend for most of the fishing year. However, a number of fishermen have reported that grouper landings are substantially under-reported and that the proposed quota will have a greater negative impact that anticipated. There is no means for evaluating the magnitude of such under-reporting which in recent years has probably been in violation of Florida state law which requires documentation of all saltwater product sales purchased by licensed wholesale seafood dealers.

c. Rationale

The Council adopted this option because it initiates the rebuilding of the spawning stock of groupers without unduly restricting harvest levels. Future management action will be based on the annual TAC Procedure described in Section 9.2. The short-term negative impacts resulting from the size limit are unavoidable and will result in spawning stock increases and improved future commercial and recreational catches.

2: Establish minimum sizes of 12 inches total length on gray, mutton, and yellowtail snappers and 8 inches total length on lane and vermilion snappers. An overall snapper recreational daily possession limit of 10 fish shall be established, excluding lane, vermilion, and red snappers. There is no bag limit for lane and vermilion snappers and the red snapper limit is separate and distinct from this 10 fish limit. These limits shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

a. Ecological impacts

Gray snapper first exhibit indications of sexual maturity at about 9-10 inches total length in the Florida Keys (Grimes, 1987). However, due to the absence of data relating to full maturity, it was assumed that full maturity occurred at about 17 inches total length (one-half the size of theoretical maximum length--Goodyear, personal communication). Total mortality was estimated to equal 0.42 (Goodyear, 1988b) which, with an assumed natural mortality rate of 0.20, provides a fishing mortality rate of 0.22. Adults do not migrate long distances (Beaumariage, 1969) and are reported to spawn in groups during a prolonged summer spawning season with peak spawning occurring in July and August (Bortone and Williams, 1986). The characteristic of congregating around reef structures for spawning (Grimes, 1988) makes gray snapper more vulnerable to fishing during the spawning season. The proposed size and catch limits would protect gray snapper from overfishing.

Lane snapper, in Jamaica, first exhibit indications of sexual maturity at about eight inches total length (Thompson and Munro, 1983c); no data are available from U.S. waters. No estimates of fishing mortality for the Gulf fishery are available. Lane snapper, in Cuba, spawn from March through September with peak spawning occurring in July and August (Bortone and Williams, 1986). Aggregate spawning is also reported for this species. The proposed 8-inch size limit would protect lane snapper from overfishing since recruitment and maturity occur at this size.

Mutton snapper are reported, in Cuba, to first exhibit indications of sexual maturity at about 17 inches total length (Grimes, 1987; Thompson and Munro, 1983c). No estimates of mortality are available for mutton snapper in the Gulf. Adults do not migrate long distances (Beaumariage, 1969) and are reported to spawn in groups during a prolonged summer spawning season (Bortone and Williams, 1986). The proposed size and catch limits together would provide protection against overfishing.

Yellowtail snapper mature at about nine inches total length in the Florida Keys (Grimes, 1987) and 13 inches total length in Jamaica (Thompson and Munro, 1983c). Yellowtail grow faster than most other reef fishes (Johnson, 1983). Yellowtail, in Cuba, spawn from March to September with peak activity during April-May, however, in Jamaica Thompson and Munro (1983c) found spawning to occur year-round with peak activity in the spring and fall. Yellowtail do not migrate long distances (Beaumariage, 1969). Juveniles occur over shallow grass flats and reefs, whereas adults are found on deeper reefs (Thompson and Munro, 1983c). Yellowtail frequently form schools and are easily captured at these times. The proposed size and catch limits will prevent overfishing of yellowtail snapper.

Most vermilion snapper mature from 6 to 8 inches total length (Grimes and Huntsman, 1980). The spawning season extends from April to September (Grimes and Huntsman, 1980; Collins and Pinckney, 1988). The proposed size and catch limits would protect vermilion snapper from overfishing.

Using gray snapper as an index, the proposed size and catch limits will rebuild the populations of these species at levels equal to or greater than the 20 percent SSBR goal (Figure 11.6).

b. Socioeconomic impacts

Gray snapper landings peaked in 1982 at 4.4 million pounds but have declined to the 1987 level of 1.9 million pounds (Table 8.1). Since 1979, 86 percent of all commercial landings have come from southwest Florida and the Florida Keys, and less than one percent of both recreational and commercial landings have come from the other Gulf states (Brown et al, 1988; Goodyear, 1988b). Approximately 80 percent of the gray snapper harvested recreationally are taken in state waters (Table 8.11). Also, 31 percent of the Gulf commercial harvest is taken from the South Atlantic Council's area of jurisdiction in the Florida Keys (Table 8.13, Waters, 1988). This proposed measure would have a substantial impact on recreational fishermen if Florida adopts a similar size limit (Table 11.15). Commercial fishermen would be affected minimally (Figure 8.19). In the long term, this measure would provide for increased availability of larger fish to all users and a more stable fishery.

Lane snapper landings are a minor component of the fishery comprising about four and one percent of the Gulf recreational and commercial catches respectively (Goodyear, 1988b; Brown et al, 1988). Since 1979, recreational landings have increased from 37 to 300 thousand fish (Table 8.3), and the commercial landings have increased from 38 to 76 thousand pounds (Table 8.14). About 90 percent of recreational landings are taken off Florida, and over 64 percent are taken in state waters. Similarly, 99 percent of the commercial harvest is landed in Florida (54 percent of the total is taken from the South Atlantic Council's area of jurisdiction). Only 6 percent of the current recreational catch is less than 8 inches total length (Table 11.17), This proposed measure will have minimal impact on the fishery.

Mutton snapper recreational and commercial landings peaked in 1982 at 1.9 million pounds (Table 8.1) but have since declined to 500 thousand pounds in 1987. Since 1979, approximately 99 percent of both commercial and recreational harvest has been landed in Florida (Brown et al, 1988; Tables 8.3 and 8.15). Also, 48 percent of the Gulf commercial landings are taken from the South Atlantic Council's area of jurisdiction (Waters, 1988). Only 25 percent of the present harvest is less than the proposed size limit (Table 11.18) and approximately 98 percent of the recreational harvest is taken in state waters (Table 8.11). Therefore, this measure will have a minimal impact on the EEZ fishery.

Yellowtail commercial and recreational landings peaked in 1982 at 3.8 million pounds respectively (Table 8.1) but have declined to 1.9 million pounds in 1987. Virtually all yellowtail harvest is landed in Florida (Brown et al, 1988; Tables 8.3 and 8.15). Although about 20 percent of the recreational catch is less than the proposed size limit (Table 11.19) the majority of recreational catches are taken from state waters, and about 76 percent of the commercial Gulf landings are taken from the South Atlantic Council's area of jurisdiction in the Florida Keys (Waters, 1988). Consequently, the proposed size limit will have a minimal impact on the fishery, since few fish are harvested within the Gulf EEZ.

Recreational vermilion snapper landings peaked in 1982 at 1.2 million pounds but have since declined to about 600 thousand pounds (Table 8.1). Commercial landings have exhibited a steady increase since 1979 from a low of 400 thousand pounds to the 1986 high of 1.6 million pounds (Table 8.10). Over 96 percent of the commercial harvest is taken in the northeastern Gulf of Mexico (Brown, et al., 1988, Figure 8.16) with the panhandle area of Florida representing 70 percent of the total. Recreational harvests come predominantly from the EEZ (Table 8.11). The proposed 8 inch size limit would impact only about 3 percent of the recreational harvest (Table 11.20) and a minimal impact on commercial harvest (Figure 8.17).

The size and catch limits proposed here should protect the above snapper species from overfishing. Florida presently provides daily possession limits of 10 snapper per person for any combination of snapper, excluding lane and vermilion, with an off-the-water possession limit of 20 snapper. Florida also has a 12-inch size limit for mutton and yellowtail snappers, and the South Atlantic Council has 12-inch limits on vermilion and yellowtail.

c. Rationale

The Council adopted this measure to prevent overfishing on these predominantly inshore species and to be more compatible with both the State of Florida and South Atlantic reef fish limits to provide for regulatory consistency.

3: Establish a minimum size of 8 inches total length for black sea bass. This limit shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

a. Ecological impacts

The proposed minimum size would have a minimal positive impact since in 1986 and 1987 less than 5 percent of the recreational catch was below eight inches (Tables 11.21). Most undersize black sea bass occur in shallow waters and can be easily released with minimal injury.

b. Socioeconomic impacts

The impacts of this measure would be minimal since the fishery apparently already complies with Florida's minimum size limit of 8 inches (see Table 11.21), and the fishery for sea bass is largely limited to Florida's coast. Both Florida and the South Atlantic Council have implemented an eight-inch size limit on black sea bass. Landings for all sea bass have been minimal since 1980 (Table 8.1), averaging less than one million pounds per year.

c. Rationale

The Council adopted this measure not only to extend the protection currently provided by Florida's size limit into the EEZ, but also to become more compatible with the state to provide for regulatory consistency.

4: Establish a greater amberjack minimum size limit of 28 inches fork length and a 3 fish per angler per day possession limit for recreational fishermen and a 36 inch fork length minimum size limit for commercial fishermen. These limits shall be established during the first fishing year or for the remaining portion of the fishing year in which the amendment is implemented. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

a. Ecological impacts

Greater amberjack first exhibit indications of maturity at 32 inches fork length (Burch, 1979). Spawning may occur year round. Total mortality rate was 0.599 (Figure 8.32) which, with a natural mortality of 0.2, provides a fishing mortality of 0.399. Greater amberjack apparently do not migrate great distances (Burch, 1979); consequently the Gulf fish probably constitute separate stock(s) from those found in the Atlantic. The proposed 28-inch size and 3 fish bag limits for recreational fishermen and 36-inch size limit for commercial fishery, should allow stocks to recover to the 20 percent SSBR goal established in section 9.2 (Table 11.22). The proposed three-fish possession limit would effect about a 45 percent reduction in the 1985-87 average recreational catch (Table 11.24). The proposed commercial size limit should effect a similar reduction in the commercial harvest (Figure 8.30).

b. Socioeconomic impacts

Amberjack landings peaked in 1982 at 9.8 million pounds but have averaged 3.4 million pounds from 1983 through 1986 (Table 8.1). Both commercial and recreational harvests are primarily from the northeastern Gulf, including Louisiana, Alabama, and the Florida panhandle (Figure 8.29, Table 8.3), with the recreational catch predominantly taken in the EEZ (Table 8.11). The proposed size limits would significantly impact recreational and commercial fishermen (Figure 8.30, Table 11.23). Since 1979, the recreational sector has taken about 86 percent of the total harvest; however the proportional commercial harvest has increased from less than 5 percent prior in 1982 to 34 percent in 1987.

c. Rationale

The Council proposed this option to protect amberjack from overfishing. As the other reef fish decline in abundance, anglers are turning more to species such as amberjack to compensate for reduced catches. Consequently, amberjack has been a target species only in the past few years and the Council is concerned that continued unregulated harvest would result in overfishing.

5: Prohibit the sale of reef fish smaller than the established size limits. If a larger size limit has been set for commercial fishermen, as with greater amberjack, then no fish smaller than the commercial size limit can be sold.

a. Ecological impacts

The impacts of this measure would be positive relative to the reduction in harvest of undersize fish effected by prohibiting their sale.

b. Socioeconomic impacts

Socioeconomic impacts would be minimal since no directed harvest of undersize fish would be allowed anyway. Enforcement would be difficult since only Florida and the South Atlantic Council have implemented similar size limits.

c. Rationale

The Council proposed this option to strengthen the minimum size requirements and to protect the resource.

Rejected Management Measures:

1: Status Quo -- no regulation.

a. Ecological impacts

Continued growth overfishing and possibility of recruitment overfishing would occur. Virtually all the above species for which management is proposed are fully utilized.

b. Socioeconomic impacts

Loss of yield through growth overfishing and the potential for recruitment overfishing would occur. The quality of recreational experience and the relative size of the commercial fishery would be expected to decline in proportion to expected future losses in yield.

2: Establish larger size limits or smaller bag limits and quotas for the reef fish species identified in the above proposed options.

a. Ecological impacts

Size limits up to the estimated size of full maturity for the above reef fish would have reduced benefits to the spawning stock if undersize release mortality is as significant as that reported by fishermen. Smaller bag limits and quotas would be beneficial in rebuilding the spawning stock if total fishing effort did not increase significantly.

b. Socioeconomic impacts

Larger size limits would severely impact the catches of recreational and commercial fishermen. The Council considered larger size limits but decided they were inappropriate because of the unknown and possibly improbable benefit to the resource and the significant impact larger size limits would have on catches. Smaller bag limits and quotas than those proposed above would have an unacceptable negative impact on the fishery.

3: Establish a recreational bag limit and commercial quota for jewfish to reduce current levels of fishing mortality.

a. Ecological impacts

No scientific studies exist on jewfish (see Section 8.8), however, given that jewfish are long lived slow growing fish that are easily harvested -- they bite a hook readily and do not try to evade spearfishermen (Mark Godcharles, personal communication) they can be very susceptible to overfishing. Jewfish first mature at about 50 inches total length. Uncontrolled fishing mortality, even with the proposed 50 inch size limit, would negatively impact the jewfish resource in the long-term. The main difficulty with establishing a quota for jewfish is that there is no stock assessment from which to objectively evaluate the effect of a particular quota.

b. Socioeconomic impacts

The short-term socioeconomic impacts would be negative relative to the quota level established. Commercial landings in 1986 were about 100,000 pounds and have averaged about 178 thousand pounds per year since 1979 (Tables 8.1 and 8.18). Recreational harvest has averaged about 300 thousand pounds since 1979.

4: Require all reef fish to be landed in accordance with state landing regulations for size and possession when state regulations are more restrictive than those in the EEZ and are consistent with the objectives of the FMP and National Standards.

a. Ecological impacts

This measure would result in greater conservation of and yield from the resource in those areas where state regulations are more restrictive.

b. Socioeconomic impacts

This measure would enhance enforcement of state rules and simplify public understanding of fishery regulations where a state is more restrictive. Regulatory consistency problems would still exist in those instances where a state is less restrictive. A state could set possession limits that would preclude commercial vessels from landing, but that would only result in the fish being landed in other states since the fleet is generally a mobile distant water fleet. For areas where states have smaller size limits, the effective limit for prohibition of sale would become that of the state. Enforcement would be more effective if each state adopted similar sizes and prohibitions on sale. To avoid problems with imported fish, enforcement would be necessary at the fisherman/primary dealer level rather than at the secondary marketing level.

11.1.3. Multiple-day Possession Limits

Adopted Management Measures:

1: To allow a maximum of 2 days possession limit for charter vessels and head boats fishing under the bag limits on fishing trips that extend beyond 24 hours duration, provided the charter vessel or head boat has two licensed operators aboard as required by the U.S. Coast Guard for multiple-day fishing trips, and each passenger can provide a receipt to verify length of fishing trip. All other fishermen fishing under a bag limit are limited to a single day possession limit.

a. Ecological impacts

This measure will have no direct ecological impacts. Indirectly it will facilitate compliance with the proposed bag limits and thus aid in restoring the reef fish resources. This measure will have no negative impacts on reef fish habitats or protected species.

b. Socioeconomic impacts

The measure will have positive impacts because allowance of a cumulative two-day limit would permit those charter vessels and head boats away from port for more than one day to retain cumulative daily bag limits and provide for greater flexibility in their operations.

The head and charter vessels in this category make primarily weekend two-day trips. The requirements for these vessels desiring to possess multiple-day limits are minimal and are not designed to be burdensome but are to provide a minimum level of documentation to prevent the multi-day allowance from being used to circumvent the proposed bag limits. A potentially negative impact is that recreational anglers fishing from private vessels on multiple-day trips will not be allowed to possess more than a single day's bag limit; however it is believed this category of anglers is very small. A private angler multiple-day allowances would create a loophole and negate the effectiveness of the adopted bag limits. This measure should not result in any negative impacts on vessel or crew safety.

c. Rationale

This measure was adopted because it reinforces the proposed bag limits without unduly restricting those charter vessels and head boats limited by a bag limit which make multiple-day fishing trips.

Rejected Management Measures:

1: Make no allowance for multiple-day fishing trips.

a. Ecological impacts

No direct ecological impacts would result from this measure.

b. Socioeconomic impacts

The socioeconomic impacts of not allowing cumulative bag limits for vessels making multiple-day fishing trips would be negative. This measure would result in significant loss of business for those head and charter vessels that depend on the overnight fishermen for business. Similarly, this measure would restrict the bycatch of those commercial vessels that will be limited by the bag limit.

2: Allow multiple-day possession limits, up to a maximum of 5 days cumulative bag limit catch, for those vessels that make multiple-day fishing trips.

a. Ecological impacts

The ecological impacts would be minimal if the multiple-day limit was fully complied with. If allowance of multiple-day possession limits provide a loophole (see discussion below under Socioeconomic impacts) that can be used by anglers to circumvent the daily bag limit requirement then this measure would have negative ecological impacts by retarding or preventing the recovery of the stock.

b. Socioeconomic impacts

Allowance of multiple-day limits would permit those vessels that are away from port for more than one day to retain cumulative daily bag limits and provide for greater flexibility in their operations. At present those vessels most in need for multiple-day limits are the charter and head boats that advertise multiple-day trips to distant fishing grounds and the shrimp vessels that typically are at sea for 5 or more days. The major difficulty with this measure is in determining those operators that qualify for multiple-day possession limits. If everyone is allowed multiple-day limits, then this cumulative limit would effectively become the daily bag limit since it would be impossible for enforcement agents to determine actual trip length.

11.2. Gear Restrictions

11.2.1. Fish Traps

Adopted Management Measures:

1: Permitted commercial fishermen may obtain a special fish trap permit (endorsement) to fish up to a maximum of 100 fish traps per permit holder. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

a. Ecological impacts

This measure will have no short-term impacts but its long-term impacts will be positive because it will prevent an excessive deployment of traps that when lost could both damage reef fish habitat and increase ghost fishing mortality similar to problems now being experienced the spiny lobster fishery. Due to the potential fishing power of fish traps, this measure will further protect the reef fish resources from overfishing.

b. Socioeconomic impacts

The proposed limitation will not affect the present activity of trap fishermen in the Gulf because few or no trap fishermen deploy more than 100 traps at a time and most deploy less. As of June, 1988, NMFS had issued 475 fish trap permits for the Gulf fishery and 32,786 trap tags, for an average of 69 trap tags per permittee. In July, 1987, only 94 permittees reported to NMFS they were actively fishing traps during the past year; 72 percent were fishing fewer than 50 traps and about half fished traps for 6 months or less. About 120 permittees did not respond to the questionnaire (ESO, 1988). Apparently, the number of fish traps typically fished is less than the proposed 100-trap limit. The trap fishery off southwest Florida is prosecuted on a trip basis where the traps are taken to sea on the boat and returned to shore at the end of the fishing trip; therefore, the number of traps fished are restricted by relative size of the vessel. Those fishermen working the Tortugas area typically leave their traps in the water for extended lengths of time, from one fishing trip to the next, but most of their traps are typically fished in the South Atlantic. In the long-term this measure may limit the total fishing effort of each fishermen.

The fish trap permit or endorsement should not create a significant paperwork or cost burden on the government since it will be a part of the commercial fishing permit. The issuance of trap tags will cost about $.70 per tag and will be paid by the permittee who requests them.

c. Rationale

The Council proposed this measure because of concern that unrestricted fish trap use would negatively impact the reef fish resource and habitat, as has occurred throughout the Caribbean. This measure will allow continued development of the fish trap fishery while decreasing the potential for overfishing of the resource by uncontrolled expansion of an efficient, relatively new gear (fish traps were not routinely used commercially until the late 1970's). The potential for user group conflicts will also be averted. The long-term benefits of this measure are expected to be positive through reducing possibility of overfishing by fish traps and by preventing, or at least delaying, overcapitalization in the trap fishery.

Rejected Management Measures:

1: FMP regulation -- Require vessels fishing traps in the EEZ be limited to no more than 200 such traps.

a. Ecological impacts

The ecological impacts of this measure would be minimal in the short-term (see discussion under adopted measure above), but in the long-term may contribute to overfishing of the reef fish stocks and habitat destruction.

b. Socioeconomic impacts

The restriction of 200 traps per vessel prevented, or at least delayed, gear overcapitalization in the trap fishery. The trap fishery, concentrated in Collier and Monroe Counties, is conducted primarily during the spiny lobster and stone crab closed seasons of April 1-July 25 and May 15-October 15, respectively. A few fishermen fishing the Tortugas area do use fish traps year-round.

2: Require trap bottoms to be made of 2 by 4 inch mesh to grade fish during trap retrieval. This measure shall be effective one year after approval by the Secretary.

a. Ecological impacts

Mortality on juvenile fish and small nontarget species would be reduced due to escapement through the larger mesh as the trap is pulled. The overall effectiveness of this measure is unknown, but underwater observations of fish traps being hauled indicate that fish are forced against the bottom of the trap and thus some opportunity exists for escapement of small fish. Fish would have greater difficulty escaping from lost (ghost) traps and from predation in the trap than under Option 4 below.

b. Socioeconomic impacts

Trap costs would change minimally since the required mesh size can be provided by cutting sections of the smaller sized mesh typically used, or only the bottom mesh would need to be replaced. Long-term catches of larger, more valuable fish would result.

3: Require at least two sides of a trap to be constructed with 2 by 4 inch mesh to allow escapement of juvenile target fish and small nontarget fish.

a. Ecological impacts

This measure would allow small fish to escape both while the trap is actively fishing on the sea floor and while it is being hauled. Recent work by NMFS indicates that the selectivity of traps can be modified by enlarging only the mesh on the top of the trap (Bohnsack, et al., 1988). By requiring that at least two sides be of a particular mesh size the trap will always have at least one exposed side with the required mesh. Harvest of undersize fish could be controlled better with this measure.

A 2x4" mesh would select for gray snapper and white grunt larger than 15, and 12 inches fork length, and red grouper greater than 14 inches total length (Sutherland et al., 1987).

b. Socioeconomic impacts

Rectangular mesh sizes of 2x3" and 2x4" retains larger fish than a 1x2" mesh. The 2x4" mesh was equally productive to .5x.5" and 1x2" meshes; only the 1.5" square and hexagonal meshes produced a more valuable catch (Bohnsack, 1988). The hexagonal mesh produced about $5.50 per haul, whereas 2x4" mesh produced $4.75 per haul; no statistical analyses were provided to determine if these differences are statistically supported. In Bermuda, the 1.5 inch, 2 inch, and 3.25 inch hexagonal mesh caught 10, 9, and 4 pounds per haul respectively (Ward, In press).

This measure would allow fishermen to use smaller mesh on the other sides so the trap will continue to attract fish; traps constructed entirely of large mesh may fail to attract fish in sufficient quantity to make the operation profitable (Luckhurst and Ward, In press). Also, smaller meshes tend to add strength to the trap. Trap costs should change minimally since the required mesh size can be provided by cutting sections of the smaller sized rectangular mesh typically used. Traps constructed with hexagonal mesh may require complete replacement of two sides with the larger mesh.

4: Require all mesh on fish traps to be 2 by 4 inches or larger.

a. Ecological impacts

This measure would have the same ecological impacts as those described under Option 4 above.

b. Socioeconomic impacts

In the ongoing NMFS study, rectangular mesh sizes of 2x3" and 2x4" retained larger fish. The 2x4" mesh was equally productive to .5x.5" and 1x2" meshes; only the 1.5" square and hexagonal meshes produced a more valuable catch (Bohnsack, 1988). The hexagonal mesh produced about $5.50 per haul, whereas 2x4" mesh produced $4.75 per haul; no statistical analyses were provided to determine if these differences are statistically supported. In Bermuda, the 1.5 inch, 2 inch, and 3.25 inch hexagonal mesh caught 10, 9, and 4 pounds per haul respectively (Ward, In press).

Traps constructed entirely of mesh of sufficient size to release juvenile groupers and snappers may result in reduced catches if the trap does not offer enough of an attraction to fish (Luckhurst and Ward, In press). Although most traps are baited, fish enter traps due to curiosity or conspecific behavior as much as they do to search for food.

5: Prohibit the use of fish traps in areas where they are not presently in use.

a. Ecological impacts

Restriction of fish traps geographically will have no short-term ecological impacts; however, over the long term, this measure would prevent the expansion of this gear to other areas where reef fish are already overfished.

b. Socioeconomic impacts

Approximately 475 fish trap permits have been issued to date with 452 in Florida, 13 in Texas, 10 in Louisiana, and one in North Carolina. Florida permits are geographically distributed as 15 percent on the east coast, 65 percent on southwest coast, 17 percent on west coast, and 3 percent on the northwest coast (panhandle). Clearly the majority (76 percent) of fish trap permittees live in south Florida.

6: Allow the use of sea bass fish traps for the directed harvest of sea bass, as defined by Florida law, in the EEZ north of 27° north latitude adjacent to Florida's territorial sea. Florida statutes define a black sea bass trap as a fish trap of outer dimensions not to exceed 2 feet in any dimension. Each trap must have a biodegradable panel and a throat or entrance with the narrowest point of not more than five inches in height and two inches in width. Such traps are also not allowed to be fished south of latitude 27° North.

a. Ecological impacts

The sea bass fishery is localized being prosecuted only along the northern part of the west Florida coast. The extent of bycatch of other reef fish in sea bass traps is unknown but due to the required dimensions any bycatch would probably be minimal and consist of commercially valuable juvenile fish or of small, nontarget fish and invertebrates.

b. Socioeconomic impacts

Allowance of sea bass traps in the EEZ would have a positive impact on the fishery because it would result in an expansion of their current fishery into the EEZ, which is now closed due to the establishment of the stressed area.

7: Prohibit the use of fish traps for the directed harvest of reef fish throughout the entire EEZ.

a. Ecological impacts

This measure would result in a decrease in fishing mortality on reef fish species that occur in areas where traps are used extensively, primarily southwest Florida. Currently fish traps account for approximately five percent (1.0 million pounds in 1985) of total reef fish landings in the Gulf (Goodyear, 1988b). The benefits gained by this measure would be related to the extent that increases in effort with other gear by fishermen currently using traps in an attempt to maintain production will not increase fishing mortality on species and sizes now harvested by fish traps. Some southwest Florida fishermen have indicated that this measure would force them to turn to bottom longlining. Long-term benefits of this measure would be positive on major target species, relative to the effected reduction in juvenile mortality, and may be positive for nontarget species which represent integral components of the reef community and are not easily caught by other gear. Fish traps are a passive efficient gear that are capable of capturing substantial numbers of nontarget species (Craig, 1986; Dammann, 1980; Stevenson and Stuart-Sharkey, 1980). Fish traps in other regions of the western central Atlantic, where management is minimal, have severely depopulated the reef fish communities (Stevenson and Stuart-Sharkey, 1980). Logbook reports to date indicate that the bycatch of nontarget species is less than five percent (ESO, 1988). Taylor and McMichael (1983) found, during their 1979-80 study, that target fishes comprised 91 percent of total weight and 73 percent of total number of fish caught in fish traps off Collier County; similarly off Monroe County, target fishes made up 69 percent of the total weight and 51 percent of the total number of fish trap catches.

b. Socioeconomic impacts

In general, gear restrictions do not solve the problem of excessive fishing mortality, they only postpone the problem until additional, more inefficient gear accumulate to the point where fishing mortality again reaches current levels. Economic theory predicts that within a commercial fishery, gear restrictions actually increase the costs of harvesting fish and consequently the price of fish, which results in a reduction in quantity produced due to decreased demand for the product. However, given the high esteem placed on the recreational fishing experience where one attempts to catch the largest fish on the lightest tackle, the desire to restrict more efficient gear is a logical extension of this sports philosophy.

This measure would result in complete closure of the commercial trap fishery with a loss of up to 1.0 million pounds in total production from the commercial fishery. Economically this measure would only marginally affect the total reef fish fishery but would have significant impacts on southwest Florida (Collier and Monroe Counties); approximately 76 percent of the fish trap permits have been issued to individuals living in south Florida. Trap fishermen will likely be switch to less efficient single line and longline gear, which would increase operating costs since fishermen would have to refit their vessels. The fish currently caught by fish traps probably would be redistributed to fishermen using other gear.

11.2.2. Trawls

Adopted Management Measures:

1: Trawl vessels must comply with the same size and bag limits that are established for the recreational fishery harvesting reef fish. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

a. Ecological impacts

Since 1972 trawl vessels harvested an average of 221,000 pounds of reef fish, representing only two percent of the total commercial reef fish harvest (Table 7.27). Consequently this measure will have minimal effect in reducing the fishing mortality on reef fish.

b. Socioeconomic impacts

The trawl industry will be minimally affected by this measure since reef fish typically comprise a minor component of their harvest. Anecdotal information indicates that reef fish caught in shrimp trawls are usually sold by the boat's crew independent of the main catch. A potential enforcement problem and burden on groundfish trawl fishermen may occur in that this measure would require all reef fish on groundfish vessels be separated from the catch to be sold which may be difficult to do. This measure would prevent trawl vessels from diversifying into the reef fish fishery to harvest those species which are regulated by bag limits. In the South Florida area up to 50 vessels fish for reef fish which sometimes accounts for 60-70 percent of the vessel's monthly income when shrimping is relatively nonproductive (see Key West Public Hearing Minutes).

c. Rationale

The Council proposed this option to discourage reef fish harvest by trawl vessels because the reef fish stocks are in a state of overfishing and directed fishing effort, in conjunction with unavoidable trawl bycatch mortality, is more than sufficient for taking available optimum yield.

Rejected Management Measures:

1: Status Quo--Any domestic vessel fishing trawls for species other than reef fish in the EEZ with the exception of roller trawl vessels fishing in the stressed area is excluded from the minimum size limit for red snapper. A trawl is assumed to be fishing for species other than reef fish when the total weight of reef fish aboard does not exceed five percent of all other fish (including shrimp) aboard.

a. Ecological Impact

The shrimp trawl bycatch of red snapper may potentially be taking from 4 to 12 million fish per year which may be depriving the directed fishery of 600,000 to 10 million pounds per year of future production (Table 8.8); this assumes a range of 40 to 80 percent survival rates of fish between their exposure to shrimp mortality and entry into the directed fishery.

b. Socioeconomic impact

The status quo could potentially result in loss of 10 million pounds of red snapper valued (using 1987 commercial exvessel value) at $21 million. Recreational value is not available but 7.1 million fish would equate to 2.4 million 3-fish bag limits. This compares to the exvessel value (1987 prices) of 1972-85 average landings of shrimp for the Gulf of Mexico of nearly $250 million.

The bycatch representing the loss of potential for one additional red snapper, is associated with 11 pounds of shrimp catch worth $32 (Table 11.25). Each pound of potential snapper foregone corresponds to shrimp catch of 12 pounds. Put a different way, avoiding enough bycatch to produce additional commercial snapper catch worth one dollar would cost $17 in shrimp.

2: Trawl vessels must comply with the same size and bag limits that are established for the recreational fishery harvesting red snapper. Bag limits on other reef fish would not apply to trawl vessels.

a. Ecological impacts

Since 1976 trawl vessels harvested less than 5 percent of the total commercial red snapper harvest; and 2 percent or less since 1985 (Table 8.2). Consequently this measure would have minimal effect in reducing the fishing mortality on red snapper.

b. Socioeconomic impacts

The trawl industry will be minimally affected by this measure since red snapper typically comprise a minor component of their harvest.

Anecdotal information indicates that red snapper caught in shrimp trawls are usually sold by the boat's crew independent of the main catch. This measure would prevent trawl vessels in the northern and western Gulf from diversifying into the red snapper fishery to harvest those species which are regulated by bag limits. A potential enforcement problem and burden on groundfish trawl fishermen may occur in that this measure would require all red snapper on groundfish vessels be separated from the catch to be sold which may be difficult to do.

3: Prohibit shrimp fishing in areas and during periods of substantial red snapper prerecruit bycatch.

a. Ecological impact

A decrease in red snapper bycatch in the shrimp fishery would result in increased production in the commercial and recreational red snapper fishery (Table 8.8). The loss in pounds of shrimp that would be incurred to gain an additional red snapper and an additional pound of red snapper, in various time-area windows of the Gulf of Mexico was evaluated (Table 11.25). The largest addition to potential red snapper catch could be obtained by prohibiting trawling off Texas in over 10 fathoms of water during May through November, but at a relatively high cost of foregone shrimp catch (Table 7.29).

b. Socioeconomic impact

The lowest ratios of shrimp catch to potential red snapper catch occur May to November in greater than 10 fathoms off Louisiana, and from December to April in greater than 10 fathoms off Texas (Table 11.25). Even in these time-area windows, to gain an additional snapper would require foregoing $24-$26 worth of shrimp. That is an additional dollar of red snapper in the commercial catch would cost $13-$14 in shrimp.

4: Require trawls to be designed to reduce finfish bycatch by a minimum percentage compared to trawls not equipped to exclude finfish.

a. Ecological impact

The increase in potential red snapper catch and reduction in shrimp catch would depend on the characteristics of the trawl developed.

b. Socioeconomic impact

Complete elimination of reef fish bycatch may not be possible; trawl gear is not currently available to reduce finfish bycatch with the possible exception of the NMFS TED specifically modified for finfish exclusion. The Groundfish FMP specified that an acceptable gear should reduce the finfish bycatch by at least 50 percent. However, the Groundfish FMP also specified that the gear should not reduce the shrimp catch by more than three percent nor increase the overall cost of the gear by more than 10 percent.

5: Limit shrimp trawling to 90 minutes tow time to increase probability of survival of juvenile red snapper returned to the sea.

a. Ecological impacts

This measure would reduce mortality over that which existed in the fishery before TEDs were required. The extent of possible reductions are unknown, but may be limited to fish caught in the last 15-30 minutes and by exposure on deck. TEDs may be more effective in reducing mortality than reduced tow time.

b. Socioeconomic impacts

This measure would adversely impact the efficiency of shrimp vessel harvest operation over that for the normal 3-4 hour tow by the increased trawling time and costs, and lost fishing time. This measure is largely unenforceable unless engine RPM recorders are required.

6: Delete the red snapper bycatch exclusion for trawl vessels.

a. Ecological impacts

This measure would improve survival of undersize red snapper relative to the directed fishing activity on undersize fish that is curtailed. The survival rate of fish released after capture in a trawl, as bycatch, is unknown but not expected to be significant.

b. Socioeconomic impacts

This measure would have a minimal negative on the trawl fisheries, as only about 100,000 to 200,000 pounds of red snapper of all sizes have been landed annually between 1972 and 1985 by trawl vessels (Table 7.27). However, as the red snapper population increases, the expected trawl bycatch would also increase.

7: Exempt trawl vessels from the minimum size limit for red snapper provided the total weight of undersize red snappers does not exceed one percent of all other fish (including invertebrates) landed.

a. Ecological impacts

Positive relative to amount of undersize red snapper harvest eliminated by preventing the sale of large quantities of undersize fish that are presently "claimed" to be part of the trawl bycatch.

b. Socioeconomic impacts

Minimal since this measure would affect only the illegal harvesting practices currently used to circumvent the minimum size limit. If a directed reef fish trawl fishery develops, this measure will not unnecessarily restrict such vessels if undersize fish are incidentally harvested but will discourage such directed effort on undersize red snapper. Socioeconomic impacts would be positive since this measure supports the present minimum size limit and affects only purposeful illegal fishing activity.

A potential enforcement problem and burden on trawl fishermen is that this measure, in conjunction with the no sale provision would require that all undersize red snapper on groundfish vessels be separated from the catch to be sold. The difficulty of doing this on all trawl vessels is unknown but perceived to be a problem for groundfish vessels.

11.2.3. Longlines and Buoys

Adopted Management Measures:

1: Prohibit the use of longlines and buoy gear for the directed harvest of reef fish inshore of the 50 fathom isobath west of Cape San Blas, Florida (85°30'W) and inshore of the 20 fathom isobath east of Cape San Blas, Florida (85°30'W). The retention of reef fish captured incidentally in other longline operations (e.g., shark) is limited to the recreational bag limit. The restricted area boundary is specified by latitude-longitude coordinates that approximate the depth zones Table 11.27. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

a. Ecological impacts

Restriction of longline and buoy gear to waters deeper than 50 fathoms west of Cape San Blas, Florida would concentrate this effort on the deep water reef fish complex (tilefish, and snowy, misty, and yellowedge groupers) which due to the relatively lower productivity of their environment may be susceptible to overfishing (Moore and Labisky, 1984). This measure should reduce red snapper harvests by longlines by a significant amount; from 11 to 73 percent of the annual red snapper catch by longlines has been taken at depths less than 50 fathoms (Table 11.26).

The prohibition of longline and buoy gear inshore of the 20 fathom isobath in the eastern Gulf will still allow the continued operation of the Florida grouper longline fleet without significant disruption as less than 10 percent of the red grouper is taken at depths less than 20 fathoms (Table 11.26).

This measure would reduce inshore fishing mortality by an unknown but substantial amount in the short-term but in the long-term the use of other gear such as handlines and bandit rigs may expand with a corresponding increase in fishing mortality.

b. Socioeconomic impacts

Gear restrictions, in general, only solves the problem of excessive fishing mortality only in the short-term since they simply postpone the problem until additional, more inefficient gear accumulate where fishing mortality again reaches current levels. Economic theory predicts that within a commercial fishery, gear restrictions actually increase the costs of harvesting fish and consequently the price of fish, which results in a reduction in quantity produced due to decreased demand for the product. However, given the high esteem placed on the recreational fishing experience where one attempts to catch the largest fish on the lightest tackle, the desire to restrict more efficient gear is a logical extension of this sports philosophy.

This measure would have a negative, but unquantifiable, immediate impact on the longline fishery which has developed during the last decade. The long-term impact is unknown; the longline fishery in the western Gulf may be able to adapt and maintain a somewhat lower level of production. The longline fishery in the eastern Gulf should be only minimally affected since less than 10 percent of the red grouper catch is from depths less than 20 fathoms.

In the northern Gulf many fishing vessels have begun to target different species and use multiple gears to harvest these species (Ronald Anderson, personal communication). This measure will effectively preclude the use of longlines and buoy gear because a vessel with multiple gears, (e.g., bandit rigs in addition to a longline) will be prevented from fishing inside 50 fathoms on a given trip simply because longline or buoy gear is on board. Although the type of gear used on a particular fishing trip currently is not determined prior to leaving port, it will have to be determined in advance of leaving port to avoid inadvertent violation of this proposed area longline prohibition.

c. Rationale

The Council proposed this option to protect the spawning component of the reef fish resources. About 50-60 percent of the present longline red snapper harvest is taken inshore of 50 fathoms (Table 11.26). This measure would restrict the continued use of a relatively new gear (first used in 1979-1980 in the reef fish fishery) which has targeted the adult fish in the Gulf. If longlines, being more efficient than other gears used in the fishery, are not restricted they have a greater potential to prevent rebuilding of the spawning stock. Although the longline industry has grown substantially since 1980, it is not a historical component of the fishery. Because the reef fish resources have declined since the introduction of longlines and it is believed longlines have disproportionately impacted the resource, the Council believes this measure is appropriate.

Rejected Management Measures:

1: Prohibit the use of longlines and buoy gear for the directed harvest of reef fish inshore of the 50 fathom isobath throughout the Gulf EEZ. The retention of reef fish captured incidentally in other longline operations (e.g., shark) is limited to the recreational bag limit.

a. Ecological impacts

The ecological impacts on red snapper would be the same as those above in the proposed option but for the shallow water groupers the ecological impacts would be more significant since 70 to 80 percent of all red grouper are harvested in depths less than 50 fathoms.

b. Socioeconomic impacts

About 50 percent of the longline reef fish catch is taken in waters deeper than 50 fathoms (Table 11.26). This option while providing protection to red snapper would have a significant negative impact on the eastern Gulf grouper longline fishery.

2: Prohibit use of longlines for directed harvesting of reef fish.

a. Ecological impacts

A 20 to 50 percent decrease in fishing mortality would occur immediately on red snapper ages 9 and older (Table 8.9) captured by longline gear. The expected impacts of this measure is that the red snapper percentage SSBR would increase from the present level of 0.9-2.7 percent to 1.3-3.8 percent (calculated as 1.3 = .009/.716 from Table 8.9). The positive impacts expected on groupers would be greater since they are the major target species for longline gear. In the long term, fishing mortality by other gear will increase to present levels if an overall limit on catch or effort is not established as well.

Deep water species such as misty, snowy, and yellowedge groupers the tilefishes are most efficiently harvested by longline gear. Effort would likely be redirected with other, less effective gear, such as handlines. Some reef fish will still be captured as incidental species in the shark longline fishery.

b. Socioeconomic impacts

Prohibiting longlines would result in a complete closure of the commercial longline fishery with loss of up to about 5.6 million pounds in total production (based on 1985 landings--see Table 7.27) from the commercial fishery worth $6.6 million at 1986 prices, and significant loss in capital equipment required in refitting vessels or purchase of other vessels. Longline vessels are relatively more efficient than the traditional bandit rigged vessels (based on catch per unit effort, costs per trip, and costs per pound of catch - see Poffenberger, 1985), especially for species or areas with low fish densities. Consequently, effort for reef fish would likely be redirected with less efficient gear and production would be partly maintained although at a higher cost. Longlining vessels, if not refitted, would likely be redirected to the tuna, swordfish, or shark fisheries (thereby increasing bycatch mortality of billfishes). Disruption of the commercial longline fishery would require significant restructuring of the fishery activities of about 300 firms.

The non-longline commercial fishery should experience short-term increased income through increases in catch resulting from decreased competition from longliners. To the extent that recreational fishermen fish the areas vacated by longliners, there could be potential enhancement of the recreational reef fish fishery. Recreational anglers would experience increased satisfaction in the short-term, until effort increased, reducing catch rates to their former levels. Non-longline commercial effort would be expected to increase also in response, dissipating the short-term income increase.

3: Prohibit use of longlines for directed harvesting of reef fish in the stressed area.

a. Ecological impacts

This measure would provide for increased short-term protection of nearshore reef fish through a reduction in fishing mortality by eliminating the use of the efficient longline gear. However, some reef fish will still be captured as incidental species in the shark longline fisheries. In the long term, without limits on total fishing mortality, as the use of other gear increases the short-term protection against overfishing will be dissipated by the increased fishing mortality by other gear.

b. Socioeconomic impacts

A negative unquantifiable impact would occur on longline fishermen who have been operating within the stressed area; the proportion of longline fishing activity presently conducted in the stressed area is unknown. Longlining is already prohibited in State waters. A potentially positive impact on the recreational fishery would result from increased catch rates and greater participation could occur. However, since most longlining occurs offshore of the recreational fishery, this effect is likely to be minor. As long as the recreational and commercial handline fishery does not expand its fishing effort to fill the void left by exclusion of longlines, the increased catch rates will be maintained.

4: Status-quo - no regulation on the use of longlines.

a. Ecological impacts

The status quo option would have no direct short-term ecological impacts. In the long-term unregulated longlines, being the most efficient gear used in the fishery, would negatively impact the reef fish resources.

b. Socioeconomic impacts

The status quo option would have no short-term socioeconomic impacts. In the long-term longlines, being the most efficient gear used in the fishery, would create user conflicts if unregulated. With a quota system the more efficient gear such as longlines may, over time, dominate the fishery displacing the less efficient gear.

11.2.4. Additional Gear Restrictions

Adopted Management Measures:

1: Prohibit the use of entangling nets for the directed harvest of reef fish. The retention of reef fish captured in entangling net operations targeting other species is limited to the recreational bag limit. Subsequent changes are to be made by following the TAC procedure described in Section 9.2.

a. Ecological impacts

From 1978 through 1985 vessels fishing entangling nets (drift and runaround gillnets, sink, and trammel nets) harvested an average of only 1 percent of the total commercial reef fish harvest (Table 7.27). This measure will have minimal effect in reducing the short-term total fishing mortality on reef fish but may have significant positive impacts in the long-term by preventing the development of a larger fishery based on these gears which have the potential for ghost fishing and killing of nontarget species, including protected species such as turtles.

b. Socioeconomic impacts

The impact of this measure will be minimal on the commercial reef fish industry but may have some significant local impacts. The fish currently caught by entangling nets would be redistributed to fishermen using other gear.

c. Rationale

The Council proposed this option to prohibit directed reef fish harvest by entangling nets because many of the reef fish stocks are overfished and entangling nets have the potential for ghost fishing and killing nontarget and protected species. The potential problems with a growing entanglement net fishery outweigh the benefits that would accrue to those few fishermen using these nets.

Rejected Management Measures:

1: Establish minimum hook sizes.

a. Ecological impacts

This measure, if effective, would reduce fishing mortality on juveniles and those species that take smaller prey. The Advisory Panel reports that a range of hook sizes catch similar size fish and this measure would not be effective.

b. Socioeconomic impacts

This measure would likely reduce efficiency by an unknown amount. Higher costs of fishing as well as at-sea enforcement costs would offset possible long-term benefits of reduced growth overfishing. This measure is essentially unenforceable and so would require an effective educational program. This measure would be most appealing if all fish caught could be kept as it would be the least restrictive on fishing activity.

2: Only the following gear may be used to take reef fish: hook-and-line, speargun (without powerhead), fish traps, longlines, and runaround nets (including gill and trammel nets).

a. Ecological impacts

As these gear already occur in the fishery, the short-term ecological impacts would be minimal. However as more species become regulated through size limits some gear such as spearguns may he harmful in that the mortality of undersize fish captured would be great since it is not always possible to accurately determine the size of fish while underwater (a similar argument led to the banning spearguns in the spiny lobster fishery).

b. Socioeconomic impacts

Short-term impacts would be minimal, however, the long-term development of new commercial gear would be prevented.

3: Permit only hook-and-line and spear fishing in the stressed area.

a. Ecological impacts

This measure would provide increased protection to nearshore reef fish through a reduction in fishing mortality by eliminating the use of gear more efficient than hook-and-lines. Longlines are the primary gear affected immediately, however, introduction of new gear would also be prevented. Some reef fish will still be captured incidentally in the trawl and shark longline fisheries. Without limits on total fishing mortality, as the use of permitted gear increases the short-term protection against overfishing will be dissipated by the increased fishing mortality by other gear.

b. Socioeconomic impacts

A potentially negative but unknown impact will occur on longline and net fishermen that have been operating within the stressed area. A potentially positive impact on the recreational fishery will result from increased catch rates possibly leading to greater recreational participation. Potential enhancement of the recreational fishery will occur through increased satisfaction for anglers and increased CPUE, thus, business for charter and head boat operators, at least until effort increases to the point that catch rates return to former levels. This measure will also effect a wider distribution of limited resources among more users.

11.3. Fishing Year

Adopted Management Measures:

1: Status Quo - The fishing year is from January 1 through December 31.

a. Ecological impacts

The ecological impacts of this measure will be minimal.

b. Socioeconomic impacts

The socioeconomic impacts of this measure will be negligible on the recreational fishery but for the commercial fishery the impacts will be directly related to the relative differences in the length of the commercial fishing seasons.

c. Rationale

The Council adopted this measure because the first half of the year provides the better prices and, except for the first months, better fishing weather. The proposed quotas are sufficiently large relative to past years landings that fishing should continue throughout most of the year.

Rejected Management Measures:

1: Define the fishing year to begin at another time of the year or set different fishing years for different species groups.

a. Ecological impacts

The direct ecological impacts of this measure would be minimal unless the fishing year can be selected so that it begins just after the main period of spawning activity. This would be particularly beneficial for those species managed by quotas that are filled before the end of the fishing year thus providing a closure during the spawning season.

b. Socioeconomic impacts

The socioeconomic impacts of this measure would be negligible on the recreational fishery but for the commercial fishery the impacts would be directly related to the relative differences in the length of the commercial fishing seasons. An enforcement problem would occur with different seasons for because oftentimes harvest activity can not be directed at a single species group and the release mortality of the bycatch, for which the season may be closed, would result in wastage of fish.

11.4. Stressed Area Boundaries

Adopted Management Measures:

1: Extend the present boundary of the stressed area to include waters off Texas out to the 30 fathom isobath along the entire coastline of Texas (Figure 11.8, map section I; Table 11.28).

a. Ecological impacts

This measure would decrease fishing mortality on nearshore reef fishes in the short-term if prohibited gear types are currently fished within these waters. The relative impacts of this measure on reef fish stocks and reduction in fishing effort effected are not known.

b. Socioeconomic impacts

This measure would displace those fishermen currently using prohibited gear--fish traps, powerhead spear guns, and roller trawls--inshore the 30 fathom isobath. There would be a potential dislocation of commercial trap and recreational powerhead fishermen. A potential reduction in user group conflicts would result, as well as potential increased recreational satisfaction if catch rates increase. Fish traps currently are not a significant fishing gear in this area. However since fish traps are relatively efficient gear at low abundance levels (as a result of reef fish aggregating around any object projecting above the bottom) the prohibition would prevent them from competing with hook and line for the available resource. The only roller trawls known to be in use in the Gulf are those used by butterfish vessels fishing off the central and western Gulf. These vessels are currently fishing much further offshore but could potentially use this gear to harvest reef fish. The proposed stressed area would prohibit their use in nearshore areas.

c. Rationale

The Council proposed this option to extend protection to the nearshore reef fish populations to the waters off Texas. The condition of the red snapper stock off Texas is severely overfished and in need of stringent protection. Red snapper is also the principal species targeted by charter vessels, head (party) boats, and private recreational fishermen in the nearshore areas which are, thereby, subject to much more intensive fishing pressure as a result of being close to shore. The Council, therefore, proposed this extension of the stressed area to eliminate the potential use of more efficient gear on these already stressed local aggregations of reef fish. As a result of coastal access and fishing pressure off Texas the Council proposed a 30-fathom boundary for the entire Texas coast, whereas under the FMP rule the stressed area was only off east Texas. Because of the configuration of the continental shelf off Texas the proposed boundary is much further offshore in the highly populated east Texas area.

This measure also carries a strong educational message to the public that the reef fish resources in the nearshore areas are overfished and that conservation attitudes among the fishing public need to be encouraged.

2: Extend the present boundary of the stressed area to include waters off Louisiana out to the 10 fathom isobath along the entire coastline of Louisiana (Figure 11.9, map section II; Table 11.28).

a. Ecological impacts

In the short term, this alternative will decrease fishing mortality on nearshore reef fishes if prohibited gear types are currently fished within these waters. The relative impacts of this measure on reef fish stocks and reduction in fishing effort effected are unknown. The extent of reef fish abundance at depths less than 10 fathoms is also unknown.

b. Socioeconomic impacts

This measure would displace those fishermen currently using prohibited gear within the 10 fathom isobath. A potential reduction in or prevention of user group conflicts would result. Fish traps are not a significant fishing gear in this area. However since fish traps are relatively efficient gear at low abundance levels (as a result of reef fish aggregating around any object projecting above the bottom) the prohibition would prevent them from competing with hook-and-line for the available resource. The only roller trawls known to be in use in the Gulf are those used by butterfish vessels fishing off the central and western Gulf. These vessels are currently fishing much further offshore but could potentially use this gear to harvest reef fish. The proposed stressed area would prohibit their use in nearshore areas.

c. Rationale

The Council proposed this option to extend protection to the nearshore reef fish populations to the waters off Louisiana. The condition of the red snapper stock off Louisiana, which is the principal reef fish found, is severely overfished and in need of stringent protection. Red snapper is also the principal species targeted by charter vessels, head (party) boats, and private recreational fishermen in the nearshore areas which are, thereby, subject to much more intensive fishing pressure as a result of being close to shore. The Council, therefore, proposed this extension of the stressed area to eliminate the potential use of more efficient gear on these already stressed local aggregations of reef fish. As a result of coastal access and fishing pressure off Louisiana the Council proposed a 10-fathom boundary for the whole Louisiana coast, whereas under the FMP rule there was no stressed area off Louisiana. The 10-fathom boundary was proposed rather than one further offshore, as in Texas, because access to coastal areas of Louisiana is limited.

This measure also carries a strong educational message to the public that the reef fish resources in the nearshore areas are overfished and that conservation attitudes among the fishing public need to be encouraged.

Rejected Management Measures:

1: Modify the present boundary of stressed area off the West Florida coast from the current stressed area boundary point at latitude 28° 10' North, longitude 83° 14' West to extend east along the same latitude to 83° 5' West and from there to extend north-northwest to a point at 28° 54' North, 83° 15' West and from there to extend northwest to a point 29° 38' North, 83° 44' West and from there to extend due west to longitude 84° 00' West which is an existing point on the stressed area boundary. (See Figure 11.10, map section III).

a. Ecological impacts

This measure would allow an increase in fishing mortality on nearshore reef fishes off west Florida, most particularly on sea basses which would be the primary target species. Florida's minimum size limits and those implemented by this amendment may prevent harvest of juvenile fishes for which minimum sizes exist. Reportedly, specialized sea bass traps are pulled at regular intervals during the day, thus facilitating the live release of captured juvenile fish for which size limits exist and non-target species. The condition of the stocks and fishing effort within this area are unknown. The area that would be excluded by this measure encompasses depths from 45 to 60 feet in the southern half and depths from 30 to 60 feet in the northern half.

b. Socioeconomic impacts

Concern has been expressed by fishermen that the sea bass trap fishery in the west central Florida area is unduly restricted by the present stressed area boundaries because sea bass traps are legal under Florida state law but are prohibited within the stressed area. This measure would allow expansion of the commercial trap fishery off west Florida into an area that is not extensively used by recreational fishermen due to the remoteness from local human population centers. Principal users will be vessels from the stone crab fishery fishing during the closed crab season. If the proposed excluded area does not result in increased user group conflicts, then social impacts will be positive. The

Levy County Chapter of Organized Fishermen of Florida which represents the shrimpers in the area reports fish trap use would not interfere with present shrimping operations. The proposed change will permit existing trap fishing boats to operate in the shallower waters and reduces the dangers the small 40-foot crab boats endure when attempting to fish outside the present boundary. At-sea enforcement will be required to ensure positive impacts occur.

2: Modify the present boundary of stressed area off the west Florida coast from the current stressed area boundary line along the 20 fathom isobath inshore to the 15 fathom isobath which requires making the following changes to the boundary points: move the boundary point at latitude 26° 26' North, longitude 82° 59' West inshore, along the same latitude to longitude 82° 45' West and the boundary point at latitude 28° 10' North, 83° 45' West inshore along the same latitude to longitude 83° 30' West (Figure 11.10, map section IV).

a. Ecological impacts

If moving the boundary does not result in more fishermen harvesting from the area between 15 and 20 fathoms the ecological impacts would be minimal. If more fishermen participate in the newly opened area, the impact may be negative due to increased fishing mortality.

b. Socioeconomic impacts

This change would have minimal impact if few trap and powerhead fishermen operate in this area.

3: Modify present boundary of stressed area off the southwest Florida coast from the point at latitude 25° 40' North and longitude 82° 39' West to extend shoreward to a point at 25° 40' North and 81° 39' West and from there to extend south-southeast to a point at 25° 03' North and 81° 27' West and then to extend southwest to rejoin the present stressed area boundary at point 6 (24° 48' North, 82° 06.5' West) (Figure 11.10, map section V).

a. Ecological impacts

This measure would allow an increase in fishing mortality on nearshore reef fishes off southwest Florida. The area both inside and outside the present boundary apparently serves as a nursery area for red grouper because fishermen report a greater preponderance of small fish off southwest Florida than off other areas of west Florida. However, the Florida minimum size limit and size limits implemented with this amendment may prevent the harvest of juvenile fishes for which minimum sizes exist, thus reducing harvest mortality.

b. Socioeconomic impacts

Fishermen contend that the present boundary of the stressed area off Florida, due to the distances offshore that the stressed area encompasses, may be unnecessarily preventing the development of a shallow water trap fishery where potential user group conflict is minimal. This measure would allow expansion of the commercial trap fishery off southwest Florida into an area not extensively utilized by recreational fishermen due to the remoteness from local human population centers. Principal users would be vessels from the crab and lobster fisheries, during periods when those fisheries are closed. If the proposed excluded area does not result in increased user group conflicts, then social impacts will be positive. This measure would permit existing trap fishing boats to operate in the shallower waters and reduces the dangers the small 40-foot boats endure when attempting to fish outside the present boundary (AP-June 15, 1987).

11.5. <u>User Group Conflict Resolution</u>

Adopted Management Measures:

1: Status Quo - No regulation.

a. Ecological impacts

Status quo will provide minimal impacts in addition to the protection already afforded by the stressed area in reducing user conflicts.

b. Socioeconomic impacts

This measure will provide minimal impacts since it requires no regulation. However, impacts may be somewhat negative in that builders of an artificial reef may perceive that they are denied the full benefit of their efforts and not acquire an equitable share of the reef fish resources associated with their reef, if no explicit protective mechanisms exist.

c. Rationale

The Council proposed this option because the gear that causes the conflicts with recreational and commercial handline fishermen are fish traps and longlines, and since these gear are proposed to be prohibited or restricted to offshore waters specific procedures are not necessary. Other conflicts among fishermen at sea can be adequately handled by the state and federal enforcement agencies.

Rejected Management Measures:

1: Prohibit or restrain specific fishing gear around artificial reefs with the establishment of Special Management Zones (SMZ).

Upon request to Council, by the permittee (possessor of a Corps of Engineers permit) for any artificial reef or fish attraction device (or other modification of habitat for the purpose of fishing) the modified area and an appropriate surrounding area may be designated as a Special Management Zone (SMZ) that prohibits or restrains the use of specific types of fishing gear which are not compatible with the intent of the permittee for the artificial reef or fish attraction device. Pertinent information the permittee should provide includes, but is not limited to, location and depth of permitted reef, adjacent habitats, historical users of the area and expected primary users, target species and the status of their stocks, susceptibility of the reef to overfishing, reasons for particular gear restrictions, and whether the purpose of the SMZ designation is to prevent overfishing or to prevent gear conflicts. The following procedures (adopted from the South Atlantic Council's Snapper-Grouper FMP) will be followed:

1. The Reef Fish Operations Unit will evaluate the request and provide a written report considering the following criteria:

a. Fairness and equity.
b. Promote conservation.
c. Excessive shares.
d. Historical users.
e. Location.

2. At the request of the Management Committee, the Council Chairman may schedule meetings of the Advisory Panel or Scientific and Statistical Committee to review the report and associated documents and to advise the Council.

3. The Council, following review of the Team's report, supporting data, public comments, and other relevant information, may recommend to the Regional Director that a SMZ be approved. Such a recommendation would be accompanied by all relevant background data.

4. The Regional Director will review the Council's recommendation, and if he concurs in the recommendation, will prepare a regulatory amendment in accordance with the recommendations. If the Council's recommendation is rejected or modified, the Regional Director must provide written reasons and supporting analysis for the rejection or modification.

a. Ecological impacts

Within the localized area of the SMZ, the ecological impacts would be positive in that gear restrictions would reduce fishing mortality but only in the short-term. Long-term impacts would be minimal as angler pressure increased.

b. Socioeconomic impacts

The objective of this measure is to vest rights to use of an artificial reef in the user group that constructed the reef. Positive impacts would occur for the user groups not excluded. This measure would encourage the construction of additional reefs, however, the excluded user groups would be affected negatively relative to area of fishing grounds excluded. A significant long-term negative impact would occur if an accumulation of SM7 effectively excluded a particular user group from fishing prim fishing grounds.

At-sea enforcement would be required unless enforcement co effected by private citizens filing of affidavits aga particular user who had violated the conditions of a SMZ.

2: Implement a Notice Action procedure for terminating a conflict or preventing a violent confrontation between fishermen fishing different gears.

1. If the Secretary determines a conflict exists between user groups in the reef fish fishery, one or more of the following actions may be taken by notice in the Federal Register:

   a. Immediately prohibit fishing in the area for five to ten days while a fact-finding meeting is held.

   b. Divide the area into fishing zones for each gear type.

   c. Specify on an equitable basis the days of the week or a month that a specific gear may be utilized in the area.

2. The following procedures will be used to determine whether a conflict exists for which a notice is appropriate:

   a. When the Secretary is advised by any person that a conflict exists, he will confirm the existence of such a conflict through information supplied by NMFS, the U.S. Coast Guard, other appropriate law enforcement agencies, or personnel of the appropriate State agency.

   b. The Secretary shall confer with the Chairman of the Gulf of Mexico Fishery Management Council (Council), the State agency with marine fishery management responsibility, and such other persons as the Secretary deems appropriate.

3. Restrictions on Federal Register notices are as follows:

   a. No action may result in exclusive access of any user group or gear type to the fishery during the time the notice is in effect.

   b. No notice may be effective for more than 10 days, except under the conditions set forth in paragraph 4(e).

   c. The area affected shall be the minimum required to resolve the conflict.

   d. When the notice is submitted, a fact-finding meeting shall be arranged in the area of the conflict, to be convened no later than 72 hours from the time of implementation of the notice.

   The following persons will be advised of such a meeting:

   1) The Chairman of the Council.

   2) The State agency with fishery management responsibility.

3) Local media.

4) Such user group representatives or organizations as may be appropriate and practicable.

5) Other persons as deemed appropriate by the Secretary or as requested by the Chairman of the Council or the State agency.

4. The fact-finding meeting will be held for the purpose of evaluating the following:

a. The existence of a conflict needing resolution by notice and the area affected.

b. The appropriate term of the notice, i.e., either greater or less than five days.

c. Other possible solutions to the conflict besides Federal intervention.

d. Other relevant matters.

e. If the Secretary determines that the term of the notice should exceed 10 days, he may, after consultation with the Chairman of the Council and the State agency, extend such notice for a period not to exceed 30 days from the date of initial implementation. If the Secretary determines that it is necessary or appropriate for the term of such notice to extend beyond 30 days, he may extend it a second time, after consulting with the Chairman of the Council, for such period of time as necessary to resolve the conflict.

f. The Secretary may rescind a notice if he finds, through application of the same procedures set forth in section (2), that the conflict no longer exists.

a. Ecological impacts

No direct ecological impacts would be expected.

b. Socioeconomic impacts

Positive social impacts would result from alleviating or resolving serious user confrontations. Minimal negative economic impacts would result from localized restriction of fishing which may be offset by avoidance of gear damage.

11.6. Closed Seasons and Areas

Adopted Management Measures:

1: Season and area closures for selected reef fish will be considered under the Total Allowable Catch Procedure.

a. Ecological impacts

Ecological impacts would be positive and relative to the extent spawning potential is protected through reduced fishing mortality. Many reef fish either form spawning aggregations or migrate to specific locations to spawn (Grimes 1987, Shapiro 1987) and consequently they become more susceptible to harvest during this time; most fishermen know the habits of their target fish and use this knowledge to increase their harvest.

b. Socioeconomic impacts

The extent of socioeconomic impacts will be dependent on the length and timing of closures. Most reef fish spawn from the late spring to early fall (May-September) with the spawning season probably more restricted to the summer months in the northern Gulf which also coincides with the peak fishing season.

c. Rationale

The Council proposed this option at the request of both recreational and commercial fishermen who feel that spawning season closures would provide substantial protection to the reef fish resources.

Rejected Management Measures:

1: Establish a closed season for selected species or species groups to assure maximum protection of spawning potential.

a. Ecological impacts

The impacts of spawning season closures would be positive since some reef fish may be more susceptible to harvesting during the spawning season. The data are not available to determine the quantitative benefits of this measure.

b. Socioeconomic impacts

The socioeconomic impacts can be calculated for the short-term reduction in catch that would occur with a closure by examining monthly catches. The long-term gains or losses at present cannot be quantified.

11.7. Permits and Gear Identification

Adopted Management Measures:

Status Quo--Permit and gear identifications specified in FMP

Permits shall be required for vessels or persons fishing fish traps in the EEZ.

All fish traps used in the fishery within the EEZ shall be identified by a number, and trap buoys be identified by a color code. Further, each trap or string of traps must be marked by a floating buoy or by buoys designed to be submerged and automatically released within a certain time period; each string of traps shall be marked with a buoy at opposite ends of the string. Each boat, vessel, or structure fishing traps shall be clearly marked with the same number and color code to allow identification from aerial and water patrol craft.

Each vessel permitted shall be issued identification tags that must be permanently affixed to each trap. Such tags shall have the permit number of the vessel and shall be numbered consecutively. Replacement tags for traps lost may be obtained.

As a condition of obtaining a permit to fish traps, the permittee must allow federal officers reasonable access to his property (vessel or dock) to inventory traps for compliance with the measures of this plan.

Each applicant for a permit must specify the number, dimensions and estimated cubic volume of the traps that will be fished under the permit.

1: Require an annual commercial fishing permit for fishing under the commercial quota (exceeding a bag limit) and for the sale of reef fish, with the qualifying condition that more than fifty percent of an individual's (owner or operator) earned income must be derived from commercial or charter/head boat fishing. Charter and head boat applicants must submit their Coast Guard Masters license number and commercial applicants must submit their documented vessel number on the permit application. Only those fish caught by a permitted vessel can be sold; where a commercial quota has been established only those fish caught under the commercial quota can be sold. Charter and head boats with permits to fish under the commercial quota are required to fish under the bag limit when under charter or when there are more than 3 persons aboard, including captain and crew. Other fishermen on unpermitted vessels are limited to the established bag limits.

a. Ecological impacts

This measure is the same as the permitting requirements proposed in Amendment 4 to the Coastal Migratory Pelagics FMP. The ecological impacts will be positive because this measure should significantly reduce commercial fishing effort on the resource in the EEZ. However unless the states adopt similar requirements, this effort may be relocated to state waters in some areas (e.g., off Florida and Texas).

b. Socioeconomic impacts

Some negative impacts would occur to part-time commercial and recreational fishermen who sell their catch but do not meet the qualifying condition. Positive impacts on full-time commercial fishermen would occur due to an increase in CPUE and by reduced competition for fishing areas. This measure would allow effective enforcement of the commercial quotas and recreational bag limits.

c. Rationale

The Council adopted this measure as a means of achieving an equitable reduction in catch of both commercial and recreational fishermen. The for-hire income is included due to the dependence of this user group on the commercial sale of reef fish during a part of the year. The Council believes requiring permits of boats fishing a commercial quota that is likely to be reached during a fishing season is the procedure which imposes the least regulation and imposition while still maintaining the catch within established quotas.

2: Special fish trap permits (endorsement) and trap tags shall be required for all vessels fishing or possessing fish traps in the EEZ for the harvest of reef fish. The permit and trap tags shall be issued (or reissued) annually and shall be valid until the end of the fishing year for which the permit is issued unless revoked for violation of a fish trap related regulation. A fee shall be charged to recover the direct and indirect costs associated with the issuance of trap permits and tags. Except for the fish trap permit provisions in this paragraph, all other fish trap permit requirements shall remain as specified in Section 641.4 of the current reef fish regulations.

a. Ecological impacts

Impacts would be minimal and indirectly positive as this alternative should help to improve supporting data required for stock assessments which should ultimately lead to improved population productivity through improved management.

b. Socioeconomic impacts

Long-term impacts would be indirectly positive due to improved stock assessments and management. The present implementation of the trap permit does not provide adequate data for management purposes. Over 400 permits have been issued to date, but only 94 permittees are reportedly active (ESO, 1988). The permit system does not provide an appropriate level of information on the universe of fish trap fishermen.

This measure would allow management to track the dynamics of the trap fishery and facilitate the deployment of logbooks. Presently, 475 permittees are on file as of June, 1987. To date, only 12 fishermen have turned in logbooks. Currently, we have no information as to the number of active trap fishermen. Without this modification to the permitting system, the utility of requiring permits for the purpose of monitoring the fish trap fishery is questionable. Our information needs are as great today as they were when the FMP was written in 1981. The permitting system, when corrected, should provide improved identification of the commercial fish trap user group and evaluation of relative impacts of management measures. This measure has the support of the advisory panel and would result in only a minimal burden on fishermen.

This measure will result in improved identification of the commercial fish trap user group and evaluation of relative impacts of management measures, and be a minimal burden on fishermen. It is estimated by the NMFS, SERO that a permit will cost $17.00 and each trap tag $.70. Total costs involved in issuing annual permits and trap tags will be borne by the permit applicant.

c. Rationale

This measure implements changes to the current fish trap permit system that will provide usable information on the dynamics of the fishery and will reduce costs to the government since the pemittees will now pay for the cost of the permit and trap tags. Without the modifications included in this measure the permitting of fish traps serves a limited, even counterproductive purpose.

Rejected Management Measures:

1: Require an annual commercial permit, with no qualifying conditions, for the sale of reef fish.

a. Ecological impacts

Ecological impacts would be minimal and indirectly positive as this alternative should help to improve supporting data required for stock assessments which should ultimately lead to improved population productivity through improved management.

b. Socioeconomic impacts

Socioeconomic impacts would be minimally negative relative to administrative costs and reporting burden. Positive impacts would result from improved identification of commercial and recreational user groups and improved estimates of the impact of the commercial fishery on the resource. Improved identification of size of commercial user group and evaluation of relative impacts of management measures would be a positive impact also.

2: Require an annual commercial fishing permit for the sale of reef fish, with the qualifying condition that ten percent of an individual's (owner or operator) income must be derived from commercial fishing.

a. Ecological impacts

Impacts would be minimal and indirectly positive as this alternative should help to improve supporting data required for stock assessments which should ultimately lead to improved population productivity through improved management.

b. Socioeconomic impacts

This measure is the same as the permitting requirements now in place for coastal migratory pelagics. Somewhat negative impacts may occur relative to administrative costs and reporting burden, but these are expected to be minor. Positive impacts will result from improved identification of commercial and recreational user groups and improved estimates of the impact of the commercial fishery on the resource. Part-time fishermen and recreational fishermen that sell their catch would be negatively impacted. This measure would lead to improved identification of commercial user group and evaluation of relative impacts of management measures.

3: Require annual permits for charter and head boat vessels.

a. Ecological impacts

Impacts would be minimal and indirectly positive as this alternative should improve supporting data required for stock assessments of both reef fish and mackerels which should ultimately lead to improved population productivity and management.

b. Socioeconomic impacts

A similar measure is already in place through the Coastal Migratory Pelagics FMP. Minimally negative impacts would occur relative to marginal administrative costs and reporting burden over that imposed by the mackerel permit requirements since most party boats harvest both mackerels and reef fish. Positive impacts will result from improved identification of the for-hire user group and improved estimates of their impact on the resource. Improved uniformity in reporting burden for party boats will reduce problems with confusion and compliance associated with present party boat permit requirements implemented by Coastal Migratory Pelagics FMP.

4: Vessels or persons harvesting reef fish in the EEZ for subsequent sale must possess a state permit that allows the sale of reef fish in the state of landing.

a. Ecological impacts.

The ecological impacts of this measure would be minimal.

b. Socioeconomic impacts.

These permits typically cost from one to five dollars so many permittees will be recreational fishermen--if 51 percent criterion is selected then this requirement should be in addition to the 51 percent requirement. If Option 7 of Section 4.3 is selected, requiring conformance with state law, this measure would be redundant and could be included in the regulations. Positive results would occur relative to the support this measure provides to existing state law requiring permits for the sale of reef fish--presently fishermen may circumvent current state law by claiming fish were harvested in the EEZ and not subject to state permitting requirements. It is unknown whether the state permitting requirements will fulfill management needs in identifying user groups or regulating catch on a Gulf-wide basis since not all state systems similarly identify reef fish fishermen.

5: Establish a moratorium on the issuance of fish trap permits.

a. Ecological impacts

Ecological impacts would be positive in that the number of permittees has been increasing rapidly and most live or operate in south Florida. Other measures such as a 51 percent income requirement may reduce effort more significantly and make this measure unnecessary.

b. Socioeconomic impacts

This approaches the creation of a limited entry system where only existing permit holders are included in the fishery and there is no opportunity for entry either through the marketplace or the permitting agency. The Magnuson Act requirements are more stringent for such systems, and from a policy standpoint OMB appears reluctant to approve completely closed systems. From a sociological perspective what is likely to occur is that when the concept is presented to the public, permit requests will increase significantly before it can be implemented.

11.8. Statistical Reporting Requirements

Adopted Management Measures:

1: Data will be collected by authorized statistical reporting agents from a statistically valid survey sample of commercial and recreational catch that is of sufficient size to provide representative measures of all major segments of a category of users of a resource and statistically valid estimates for stock assessment analyses and quota monitoring. Any such data collection should rely upon techniques that ensure comparability of data. Those fishermen and dealers selected by the Science and Research Director, or his designee, must make their reef fish (head and fins intact) available at dockside for inspection by those agents.

a. Ecological impacts

Ecological impacts would be indirectly positive relative to improvements in stock assessments resulting from improved data.

b. Socioeconomic impacts

The impacts would be indirectly positive relative to improvements in management resulting from improved data collection. Presently, fishermen are not required to land reef fish with head and fins intact. Without such a measure dockside data collection will be potentially hindered. The FMP implementing regulations required that all red snappers be landed with head and fins intact--this measure would extend that requirement to all reef fish. Costs involved would be minimal since this measure would not change present data collection efforts. Only if non-compliance became a significant problem would enforcement actually be required. Reporting burden would be minimal since reporting by the commercial and head boat sectors of the fishery is already required.

c. Rationale

The Council adopted this measure because the current recreational and commercial data collection programs are inadequate to provide the data needed to assess the status of the reef fish populations or the dynamics of the fisheries harvesting these resources. It is the intent that all data collection programs instituted in support of the Reef Fish FMP be done on a mandatory basis; while the NMFS has the authority to selectively sample a segment of the fishery those persons selected shall be required to report the information requested. The population analyses required for characterization of the fishery and the status of its supporting resources depend on parameters such as standardized CPUE's and age-length keys that are not available for the reef fish. Without an improved database it will be difficult, if not impossible, to evaluate the effectiveness of management.

2: Require head boat operators who are selected by NMFS to maintain a fishery record for each trip and report this information to NMFS on at least a monthly basis.

a. Ecological impacts

Ecological impacts would be indirectly positive, as data collection would be improved resulting in improved stock assessments and better informed decision base for management.

b. Socioeconomic impacts

Socioeconomic impacts and reporting burdens required by this measure are negligible. The NMFS head boat survey has been collecting data on a monthly basis since its inception in the early 1970's. When NMFS implemented the FMP reporting requirements for head boats in 1987, the frequency of reporting was changed to quarterly. If the industry adopts a quarterly reporting schedule, the quality and timeliness of the data will seriously deteriorate.

c. Rationale

The Council adopted this measure to ensure the integrity and timeliness of the headboat data collection program, which is vital for monitoring the health of the reef fish stocks and regulatory impacts of implemented measures.

3: Require charter boat operators who are selected by NMFS to maintain a daily fishing record on forms provided by the Science and Research Director that are to be submitted weekly (as is required in the Coastal Migratory Pelagic FMP). Information to be included in the forms must include, but not be limited to:

(1) Name or official number of vessel.
(2) Operator's Coast Guard license number.
(3) Date of trip.
(4) Number of fishermen on trip.
(5) Area fished.
(6) Fishing methods and type of gear.
(7) Hours fished.
(8) Species targeted.
(9) Number and estimated weight of fish caught by species.

a. Ecological impacts

Ecological impacts would be indirectly positive, as data collection would be improved resulting in improved stock assessments and better informed decision base for management.

b. Socioeconomic impacts

The additional reporting burden this measure would put on the charter boat industry is minimal because they are already required to provide similar data for coastal pelagics. The collection of these data were proposed in the FMP but not implemented by NMFS due to perceived duplication of data collection between the charterboat and MRFSS. However, as long as the coastal pelagics requirements are in place, the absence of the above requirements creates confusion with respondents and results in voluntarily provided reef fish data that is of such inconsistent quality that NMFS scientists believe the data to be inadequate for stock assessment purposes.

c. Rationale

The Council adopted this measure to ensure the integrity and timeliness of the charter boat data collection program which is vital for monitoring the health of the reef fish stocks and regulatory impacts of implemented measures.

4: The current reporting requirements for fish traps are modified in the following paragraph to implement the Council's intent to strengthen the enforcability of fish trap reporting requirements.

The owner or operator of a fishing vessel or any other person permitted under §641.4 to fish with fish traps must provide the following information regarding all fishing trips on which reef fish are harvested to the Science and Research Director. This information must be submitted within 7 days of completion of each trip:

(1) permit number as provided for in §641.4;
(2) pounds of catch of reef fish by species by gear if gear other than fish traps were also used;
(3) date of trip, depths fished, and fishing locations by statistical area;
(4) number of trap hauls resulting in catch;
(5) duration (days and hours) traps were fished before each haul; and
(6) mesh size of traps.

Routine reporting shall be required of all trap permittees. At a minimum, monthly reports shall be required even if no fishing for reef fish occurred in a particular month. Violation of any of the reporting requirements shall result in revocation of the fish trap permit for one year. NMFS shall provide quarterly reports concerning compliance with the fish trap regulations.

a. Ecological impacts

Ecological impacts would be indirectly positive, as this measure would result in better information for managing the resource.

b. Socioeconomic impacts

The permitting and reporting requirements established in the FMP were to provide information on the growing fish trap fishery.

Little was, and still is, known about the catch characteristics of fish traps in the Gulf of Mexico; these requirements were to provide information on the dynamics of a segment of the fishery whose potential impact on the reef fish resource was unknown but potentially deleterious. The permit and vessel and gear identification requirements serve as a useful enforcement tool. The permit was initially designed to track participation in the fishery but, as implemented, serves only an enforcement purpose because permits are issued for indefinite periods of time. The reporting requirements, implemented as a logbook program, were to provide biological information on the impacts of fish traps on the resource. However, it has been concluded that logbooks can be required only of those fishermen who have used fish traps to harvest reef fish. Therefore, of 428 permits issued to trap fishermen in the Gulf since implementation of the FMP in 1984, only 94 logbooks have been issued to trap fishermen since the reporting requirements were implemented in July, 1987. Consequently, to date, the permitting and reporting requirements have not served the purpose for which they were initially designed.

The initial letter of July, 1987, sent to permittees by NMFS introducing the logbook program indicated that logbook records must be kept of all fishing trips, and if no fish trap fishing occurred during a particular month a monthly negative report would be required. Subsequently, NOAA General Counsel advised NMFS that monthly negative reporting cannot be required because the regulations did not specifically address negative reporting. This measure would close that loophole and improve the capability of the logbook program to document the dynamics of the fishery and its impact on the resource.

Participants in the fishery have generally refused to comply with the reporting requirements indicating a social rejection of this new requirement or a lack of understanding of the importance of the data. In that the fishery is either fully or over exploited, some fishermen fear the data will be utilized in formulating more restrictions on their activities. The economic impact would be in burden hours for either the fisherman or, more likely, the dealer purchasing the fish. Permit revocation would result in a significant impact on fishermen who would have to seek alternative employment.

Overall, this measure may increase the reporting burden on the fishing public somewhat, the resulting improvements in communication between government and industry and, in our knowledge of the fish trap fishery, should offset any concern over the potential increase of reporting burden. The present system does not provide adequate information on the fish trap fishery which has the potential to exert far reaching impacts on the reef resources.

c. Rationale

The modifications in this measure to the current reporting requirements are necessary to obtain more reliable information on the trap fishery. This measure will strengthen the enforceability of the logbook requirements with a minimum of addition burden on the fishermen or cost to the government over current requirements.

Rejected Management Measures:

1: Replace the fish trap logbook with a dockside sampling program, designed by NMFS, and patterned after the present state/federal Trip Interview Program.

a. Ecological impacts

Ecological impacts would be positive in that better data will be collected, particularly size composition information. Total landings by gear type is collected by dealers under FMP rules and Florida Trip Ticket System.

b. Socioeconomic impacts

This option would reduce the reporting burden on the fishery and facilitate the collection of more accurate data. Logbook programs, to be successful, require substantial government resources to enforce and validate the data that is submitted by fishermen. Presently, the Trip Interview Program (TIP) does not include the fish trap fishery officially. Although NMFS and Florida port samplers attempt to obtain fish trap information, it is collected sporadically because of the remote location of fish trap fishermen in southwest Florida. A dockside sampling approach, if appropriately designed, would provide more accurate information on catch and effort than the present logbook program. The government costs involved may be greater for the collection of data, but it would require no enforcement or validation and may actually be less expensive to government overall. However, this measure was considered too costly relative to the benefits of the logbook program already in existence.

Presently, the Florida Trip Ticket System does not require fishermen to report the type of gear used or its soak time. Fishermen are not volunteering the gear information in sufficient frequency or detail to be of management use. This gear information is very important in determining its impact on the resource and in evaluating the status of the fishery.

FIGURE 11.1

Projections of RED SNAPPER yield-per-recruit and spawning-stock-biomass-per-recruit effects of only minimum sizes ranging from 10 to 18 inches total length with a 33 percent undersize release mortality. (Goodyear, personal communication, 1988).

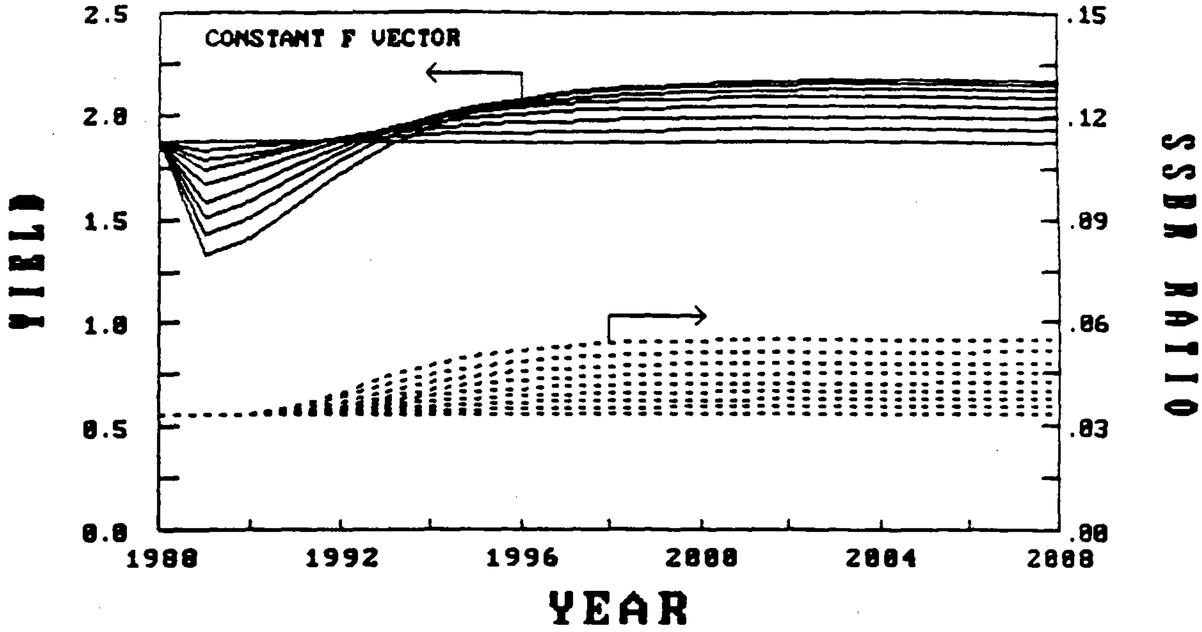


FIGURE 11.2

Projections of RED SNAPPER yield-per-recruit and spawning-stock-biomass-per-recruit effects of only reductions in fishing mortality (0%, 25%, 50%, 75%). (Goodyear, personal communication, 1988).

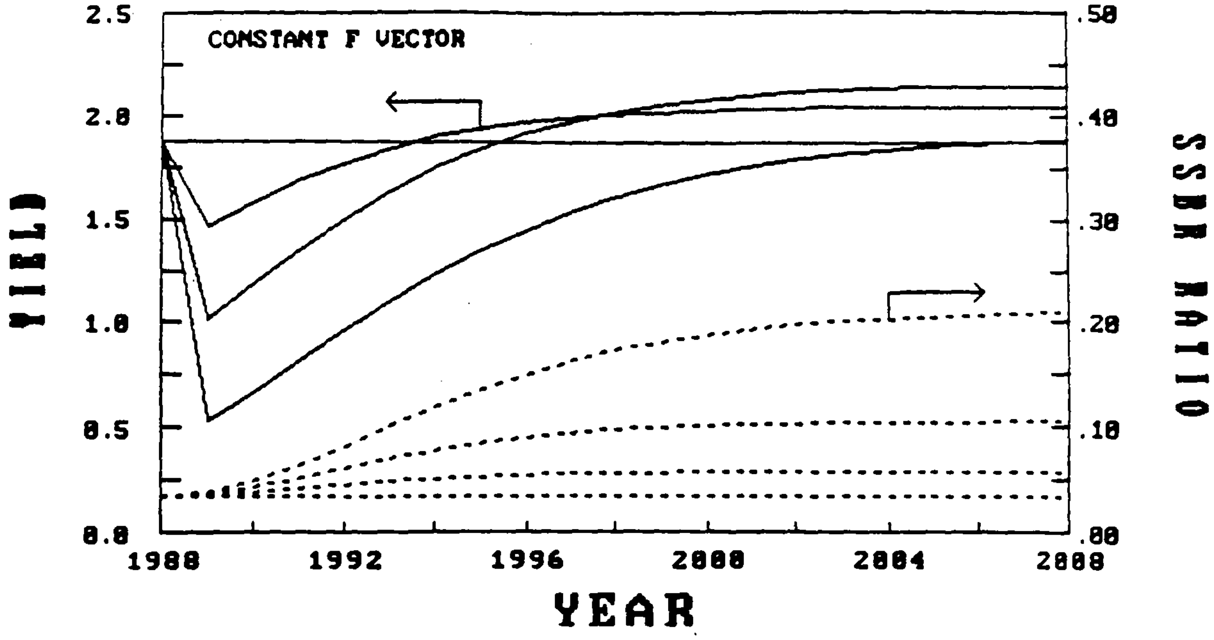


FIGURE 11.3

Projections of RED SNAPPER yield-per-recruit and spawning-stock-biomass-per-recruit effects of a 75% reduction in fishing mortality in combination with minimum sizes of 12, 14, 16, and 18 inches total length with a 33 percent undersize release mortality. (Goodyear, personal communication, 1988).

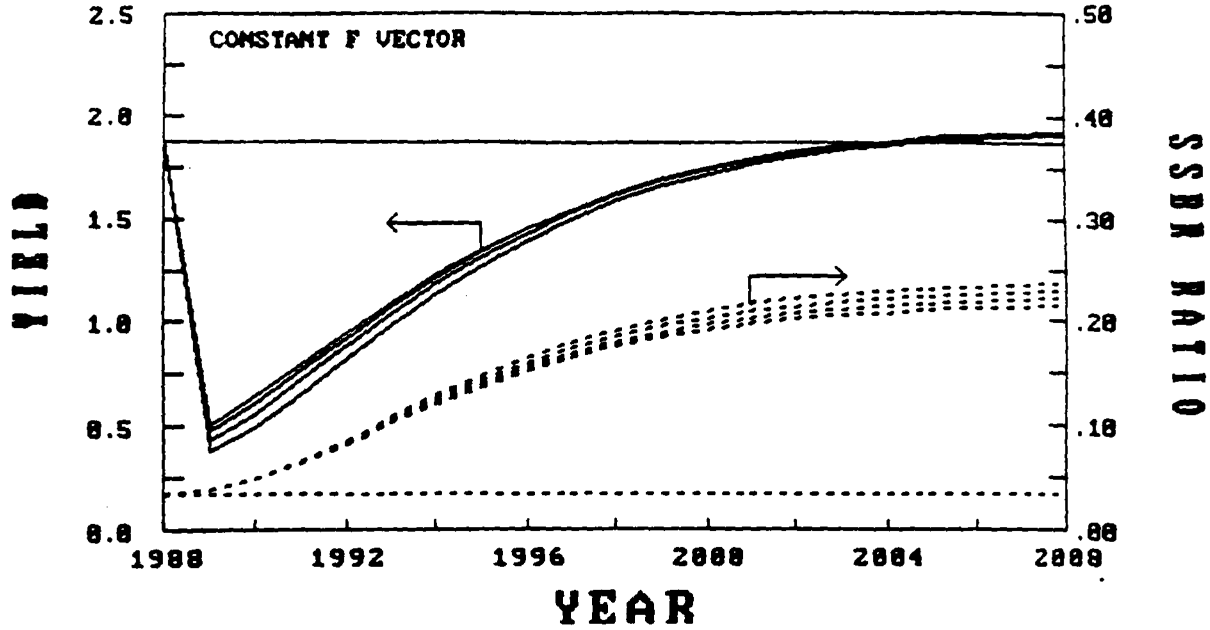
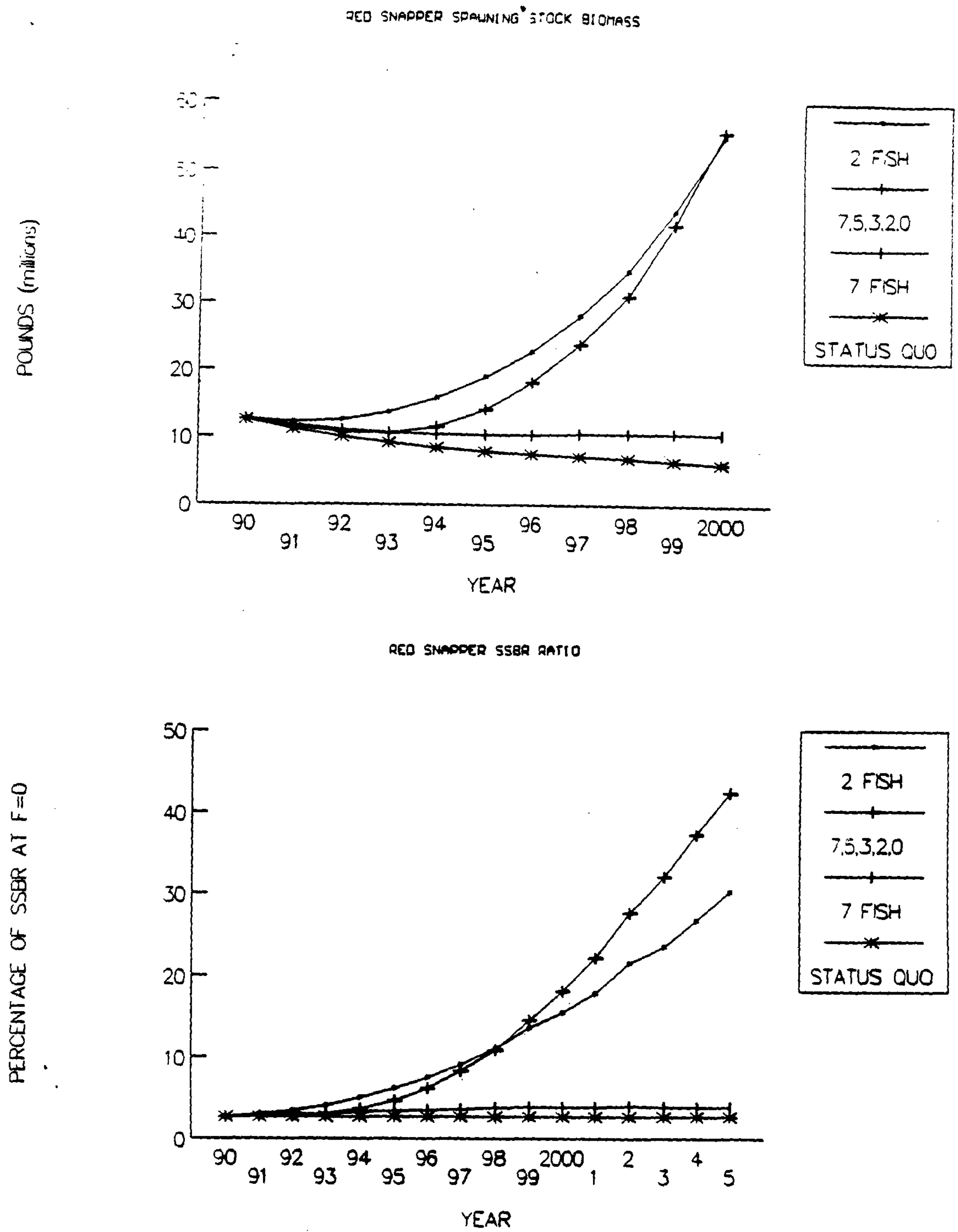


Figure 11.4



Projections of future spawning stock biomass and the spawning stock biomass per recruit ratio, in percentage, for red snapper effected by 4 harvest scenarios: **1)** 2 fish recreational bag limit and 1.4 million pound (MP) commercial quota; **2)** 7, 5, 3, 2, 0 fish bag limits and 3.1, 2.7, 2.1, 1.4, and 0.0 MP quotas phased in over a 5 year period; **3)** 7 fish bag limit and 3.1 MP quota; and **4)** status quo. All projections were made based on initial implementation January, 1990. Data from LSIM - A length-based fish population simulation model, developed and available from C. Philip Goodyear, Miami Laboratory, Southeast Fisheries Center, National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, Florida 33149.

FIGURE 11.5

Projections of RED GROUPER yield per recruit and spawning stock biomass per recruit effects of minimum sizes ranging from 10 to 18 inches total length with an undersize release mortality of 20 percent (Goodyear, personal communication, 1988).

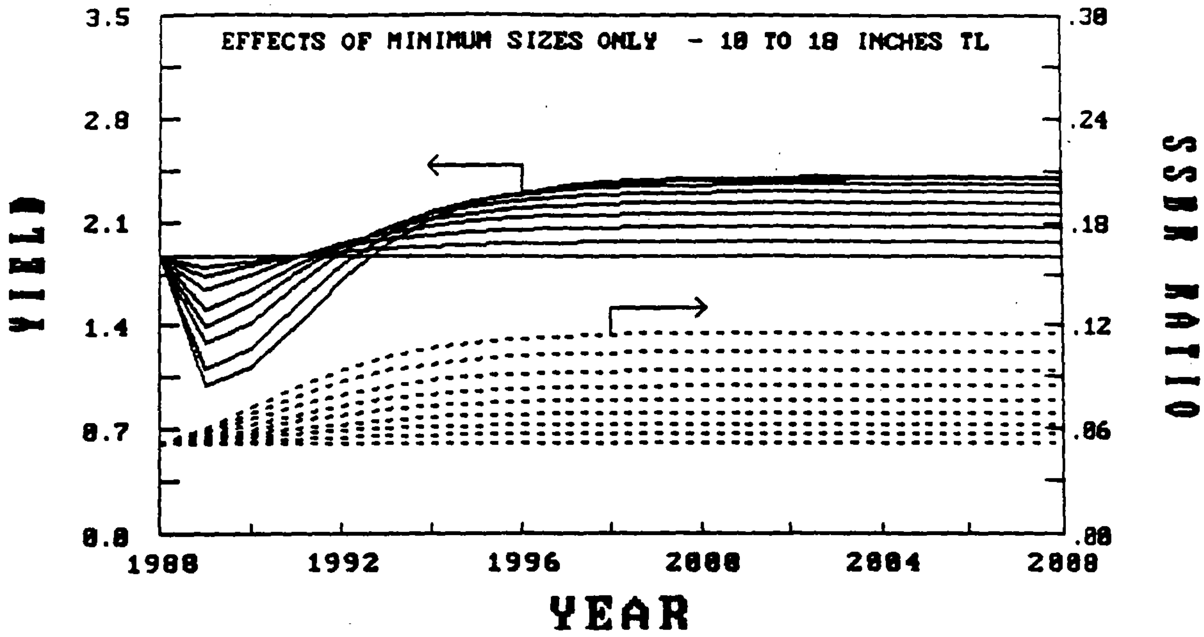


FIGURE 11.6

Projections of GRAY SNAPPER yield per recruit and spawning stock biomass per recruit effects of minimum sizes ranging from 10 to 14 inches total length with an undersize release mortality of 33 percent (Goodyear, personal communication, 1988).

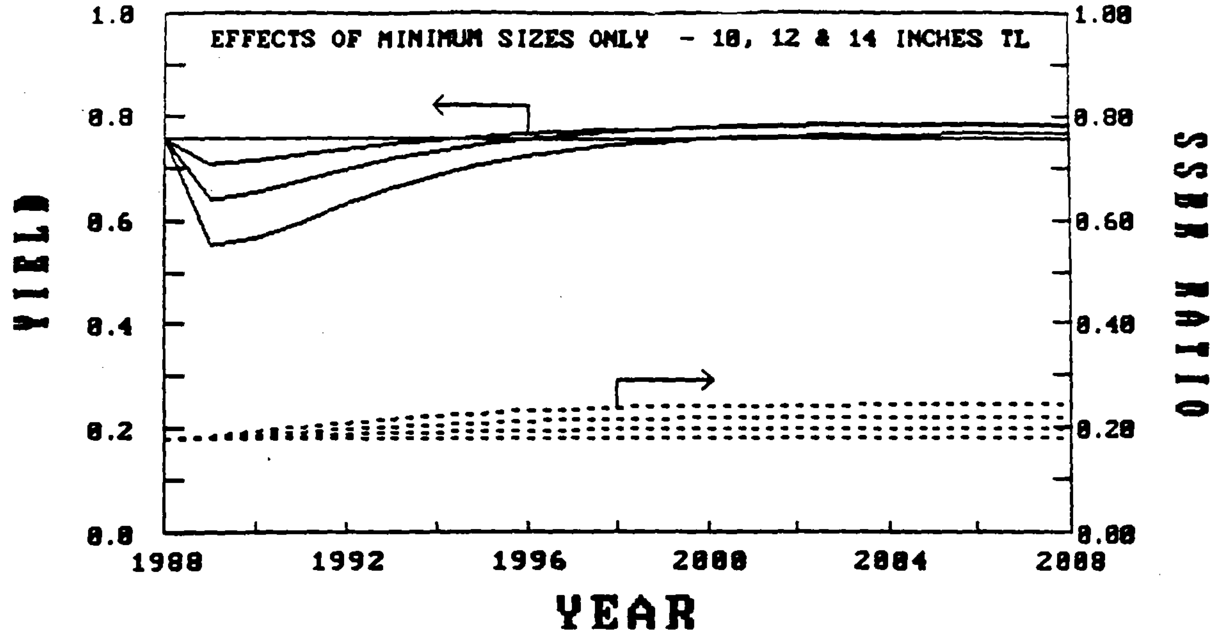


FIGURE 11.7

Projections of GREATER AMBERJACK yield-per-recruit and spawning-stock-biomass-per-recruit effects of only minimum sizes ranging from 24 to 36 inches total length. (Goodyear, personal communication, 1988).

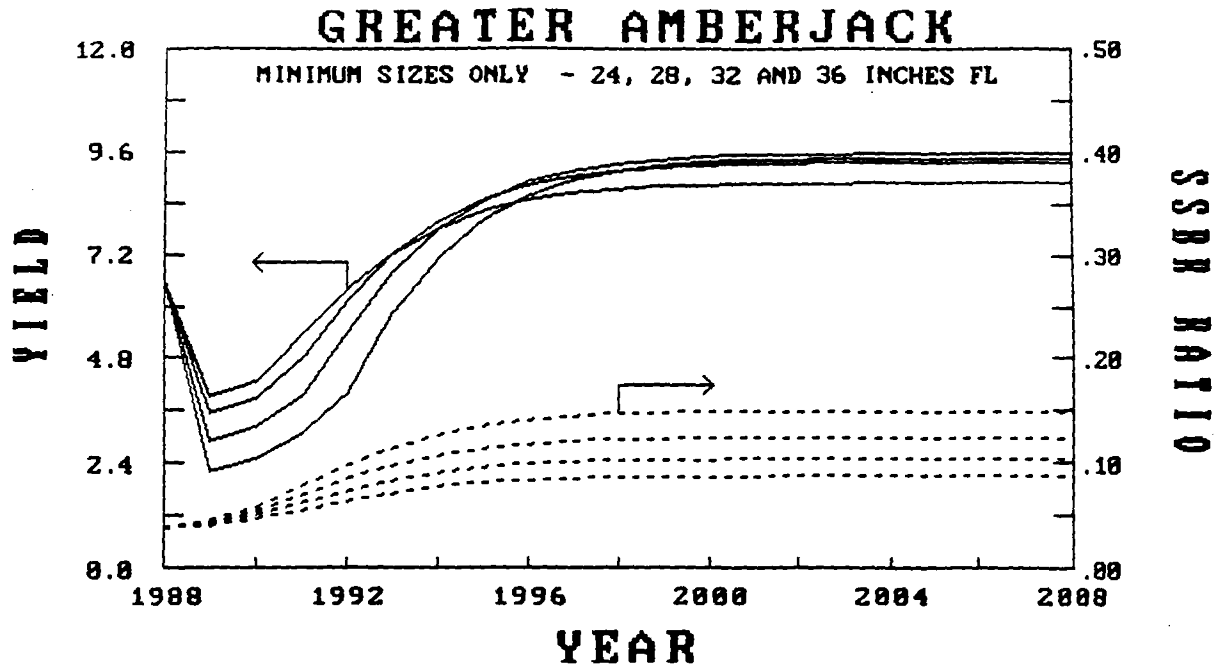
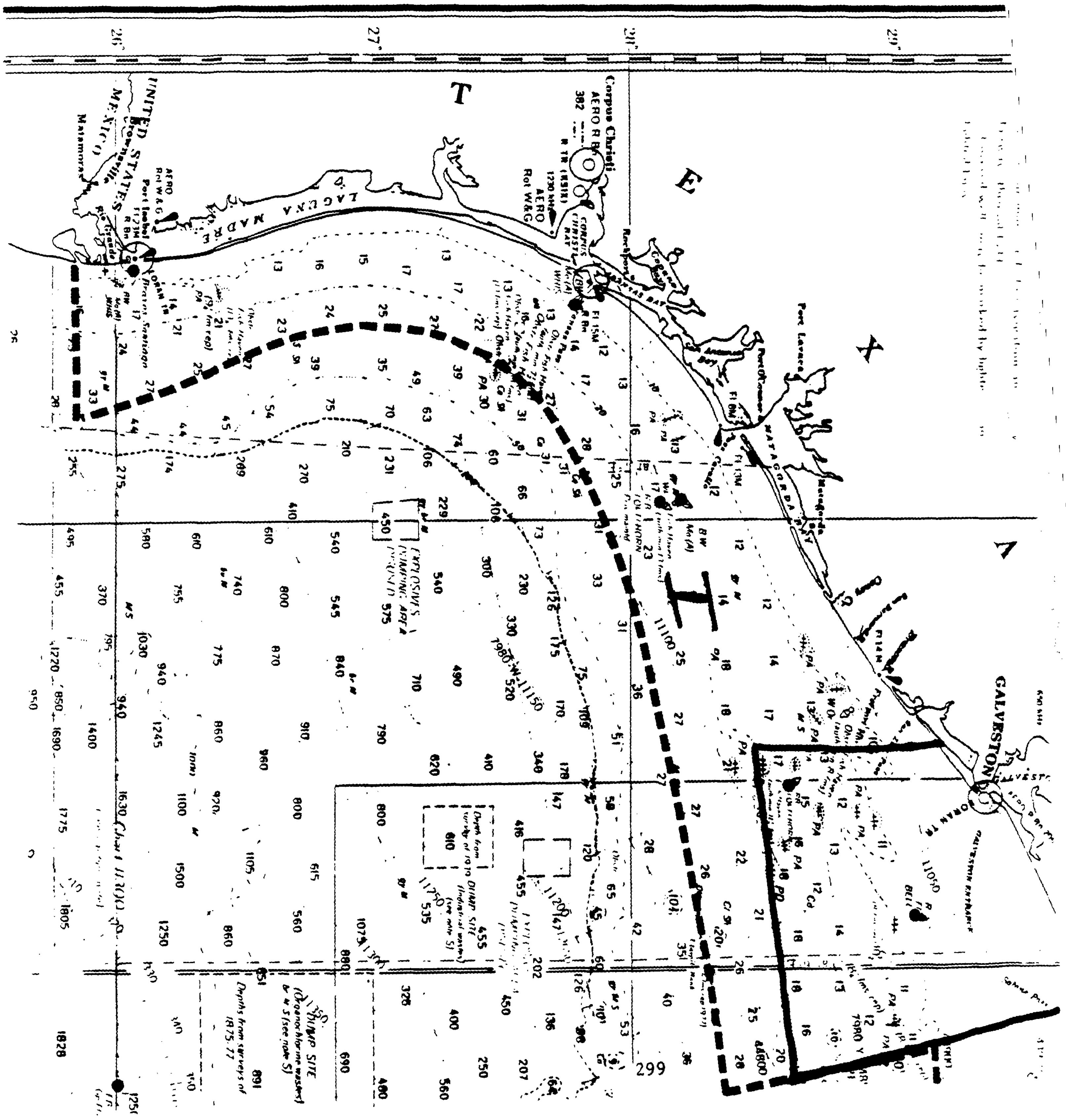


FIGURE 11.8

Map of western Gulf of Mexico stressed area boundary (solid line) and proposed addition (dashed line) along the 30 fathom isobath offshore the Texas coast. The area proposed to be included in the stressed area is marked with a V.



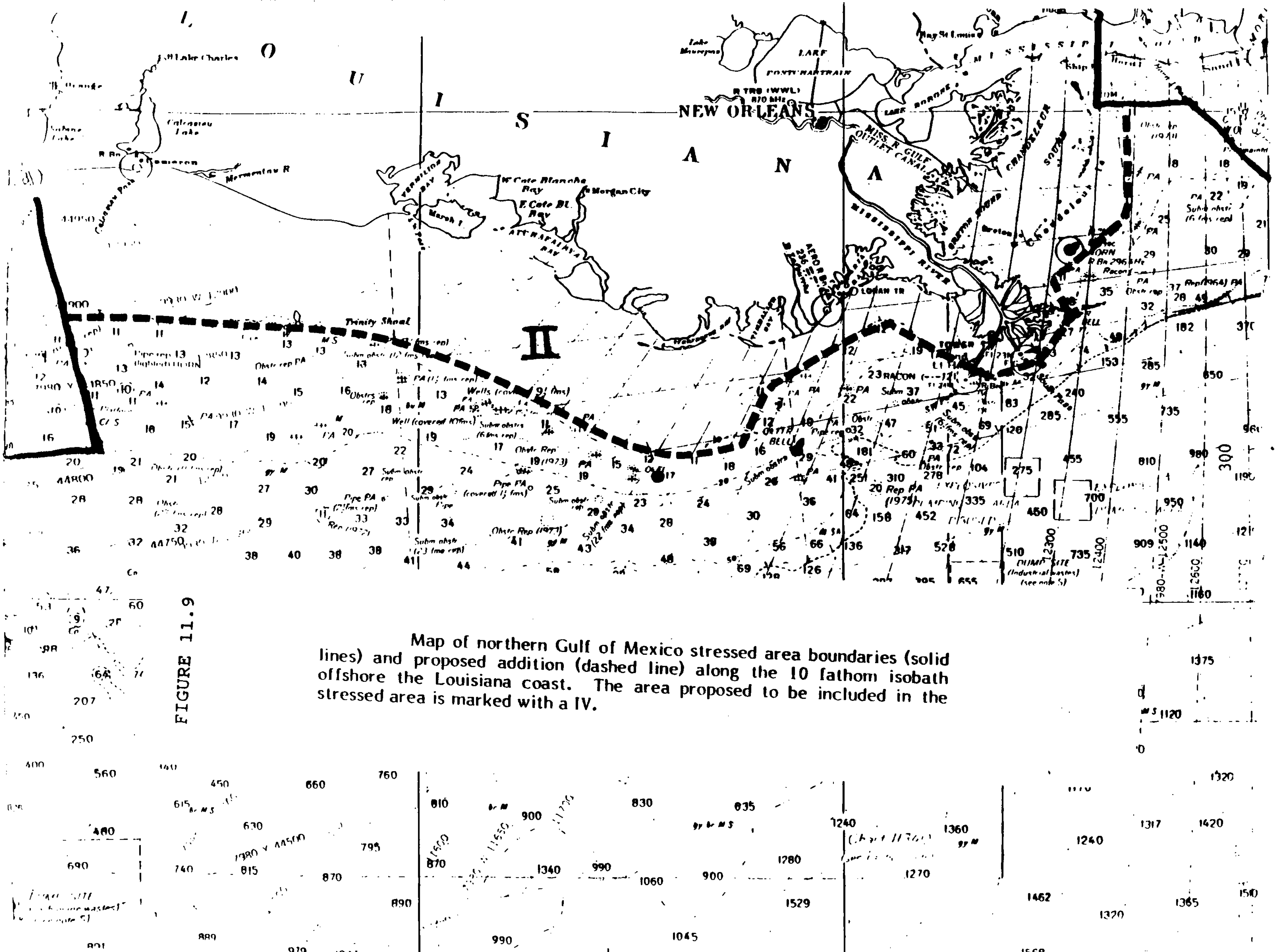
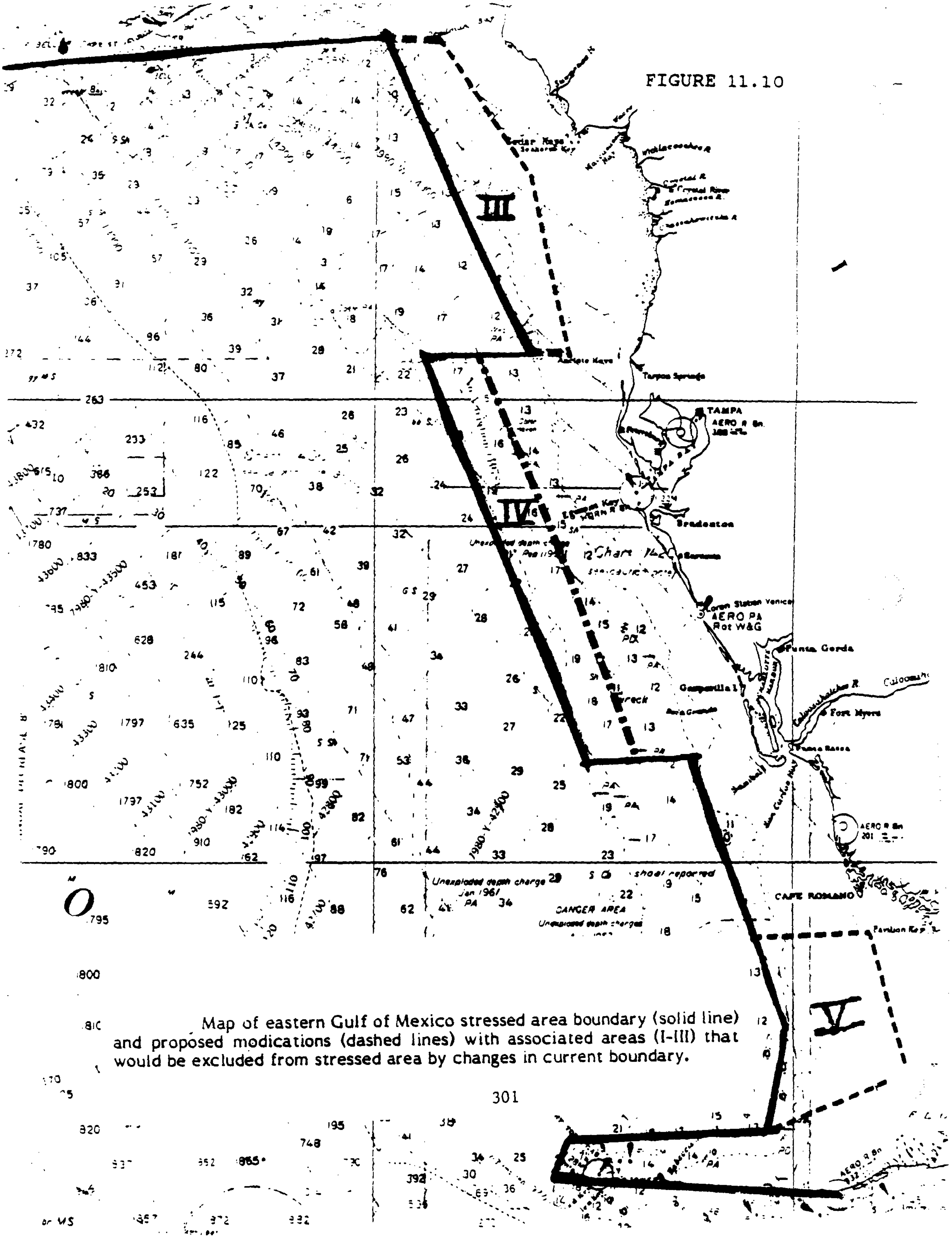


FIGURE 11.9

Map of northern Gulf of Mexico stressed area boundaries (solid lines) and proposed addition (dashed line) along the 10 fathom isobath offshore the Louisiana coast. The area proposed to be included in the stressed area is marked with a IV.

FIGURE 11.10



Map of eastern Gulf of Mexico stressed area boundary (solid line) and proposed modications (dashed lines) with associated areas (I-III) that would be excluded from stressed area by changes in current boundary.

TABLE 11.1

Current minimum size limits for reef fish in jurisdictions adjacent to the Gulf of Mexico EEZ listed by management authority. The sizes are in inches total length.

	Current Minimum Size					
Species	SAFMC	FL	AL	MS	LA	TX
Amberjack	-	-	-	-	-	-
Red snapper	12	12	12	13	-	13
Vermilion snapper	12	-	-	-	-	-
Mutton snapper	-	12	-	-	-	-
Yellowtail snapper	12	12	-	-	-	-
Black sea bass	8	8	-	-	-	-
Red grouper	12	18	-	-	-	-
Nassau grouper	12	18	-	-	-	-
Yellowfin grouper	-	18	-	-	-	-
Black grouper	-	18	-	-	-	-
Gag grouper	-	18	-	-	-	-
Jewfish	-	18	-	-	-	-

TABLE 11.2

Red snapper--percentage reduction in fishing mortality required to achieve 20 percent SSBR given different combinations of minimum size limits (inches total length) and percent undersize release mortality.*

Size	Lbs	Age	Percent Release Mortality 0	10	20	30	40	50
10	.49	1.6	76	76	76	76	76	76
11	.65	1.9	74	74	74	74	74	74
12	.85	2.1	74	74	74	74	74	74
13	1.09	2.4	74	74	74	74	74	74
14	1.37	2.7	71	74	74	74	74	74
15	1.69	2.9	71	71	71	74	74	74
16	2.06	3.2	71	71	71	71	74	74
17	2.48	3.5	68	71	71	71	71	74
18	2.96	3.8	68	68	68	71	71	71
19	3.49	4.1	65	68	68	68	71	71
20	4.08	4.5	62	65	68	68	71	71
21	4.74	4.8	62	62	65	68	68	71
22	5.47	5.2	56	62	62	65	68	68
23	6.27	5.5	53	59	62	65	65	68
24	7.15	5.9	47	53	59	62	65	68

*These estimates are based on the Beverton-Holt yield per recruit model and, as such, reprsent long-term equilibrium values. The von Bertalanffy growth parameters were t_0=-0.5, K=0.115, and Lmax=45.9 inches total length. Other parameters included: natural mortality=0.2, fishing mortality exerted by shrimp trawls=0.69 for snapper sizes 4-10 inches total length, directed fishing mortality rate=0.331, size of entry into the directed fishery=10 inches total length, and size at maturity=22.9 inches total length (Goodyear 1988 and pers. comm.).

TABLE 11.3

Estimates of percentage reduction in recreational catches of red snapper during 1979-1987 for 1-10 fish bag limits (derived from MRFSS intercept data).

	Years										
Bag Limit	79	80	81	82	83	84	85	86	87	79-87	85-87
1	87	88	88	81	81	81	84	76	77	82	78
2	77	79	79	68	69	66	71	57	59	69	61
3	68	71	72	57	59	54	60	43	44	58	47
4	60	64	65	48	51	46	50	32	34	49	37
5	53	58	59	40	44	39	42	24	27	42	29
6	47	53	53	35	38	34	35	19	22	36	24
7	41	49	49	30	33	29	29	15	18	32	19
8	37	46	45	25	28	25	24	13	15	28	16
9	32	42	41	21	24	21	20	11	13	24	14
10	28	39	38	18	21	18	16	10	11	22	11
N*	2,892	3,937	1,744	1,649	3,907	2,382	2,117	4,010	3,742	26,380	9,869

*N = number of harvested fish (types A and B1) by anglers interviewed by the MRFSS intercept survey.

TABLE 11.4

Cumulative length frequency by percentage of RED SNAPPER landed by recreational anglers in the Gulf of Mexico for the years 1979-1987. Fish size is in total length. Data from the MRFSS Intercept Survey. See Reef Fish Amendment 1 text for fork length to total length conversion equation.

Length (inches)	YEAR									
	79	80	81	82	83	84	85	86	87	Total
< 10	13.12	16.13	3.58	10.81	5.35	5.24	4.55	2.38	1.12	6.32
< 11	31.81	22.15	10.75	16.42	10.17	7.07	8.82	8.16	6.48	12.71
< 12	49.90	35.91	27.69	34.72	34.94	14.40	21.12	23.47	17.32	29.30
< 13	66.80	53.33	35.83	51.56	46.71	25.39	31.02	33.50	26.26	41.45
< 14	78.33	65.16	49.51	63.20	63.84	31.41	41.44	48.98	35.64	54.12
< 15	86.08	74.84	63.52	72.14	76.76	38.74	57.49	67.35	52.74	67.09
< 16	90.06	83.23	73.94	77.55	83.64	52.88	66.04	74.66	65.25	75.54
< 17	93.64	90.32	82.41	81.29	90.67	69.37	74.87	83.84	75.42	83.61
< 18	94.23	91.83	86.64	84.41	93.50	79.06	81.55	86.90	80.34	87.37
< 19	95.43	93.12	91.21	89.81	95.34	81.15	85.83	90.48	84.25	90.31
< 20	95.63	94.41	93.81	92.10	96.56	86.39	90.64	92.01	86.93	92.44
< 21	95.83	94.41	95.11	92.93	97.32	88.74	93.58	93.71	89.83	93.85
< 22	97.02	95.27	96.42	95.01	98.17	90.05	94.65	94.73	92.51	95.25
< 23	97.81	95.91	97.39	96.26	98.32	92.67	96.26	95.41	94.41	96.29
< 24	98.41	96.34	97.39	96.88	98.39	93.72	96.26	96.09	95.87	96.85
< 25	98.81	96.77	97.39	97.71	98.93	93.98	97.06	96.43	97.09	97.45
< 26	99.20	97.42	97.72	98.13	99.01	95.55	98.13	96.94	97.77	97.98
< 27	99.40	97.85	98.37	98.54	99.16	95.81	98.40	97.28	97.99	98.27
< 28	99.60	98.28	98.70	98.75	99.16	95.81	98.40	98.13	98.32	98.51
< 29	99.60	98.71	99.35	99.58	99.16	96.34	98.66	98.47	99.11	98.89
< 30	99.60	98.92	99.35	99.58	99.24	97.12	98.93	98.47	99.22	99.02
< 31	99.60	98.92	99.67	99.79	99.46	97.64	99.20	98.81	99.78	99.30
< 32	99.60	98.92	99.67	99.79	99.46	97.64	99.73	98.81	99.78	99.34
< 33	99.60	98.92	100.00	99.79	99.54	97.64	99.73	99.49	99.89	99.47
< 34	99.60	98.92	100.00	99.79	99.69	97.91	99.73	100.00	99.89	99.59
< 35	99.60	99.57	100.00	100.00	99.77	97.91	99.73	100.00	99.89	99.68
< 36	99.60	99.78	100.00	100.00	99.77	98.17	99.73	100.00	100.00	99.74
< 37	99.60	99.78	100.00	100.00	99.85	98.17	99.73	100.00	100.00	99.75
< 38	100.00	99.78	100.00	100.00	99.92	98.17	99.73	100.00	100.00	99.81
< 39	100.00	100.00	100.00	100.00	99.92	98.17	99.73	100.00	100.00	99.83
< 42	100.00	100.00	100.00	100.00	99.92	99.48	100.00	100.00	100.00	99.94
< 43	100.00	100.00	100.00	100.00	99.92	99.74	100.00	100.00	100.00	99.96
< 46	100.00	100.00	100.00	100.00	100.00	99.74	100.00	100.00	100.00	99.98
< 51	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Number of fish measured	503	465	307	481	1308	382	374	588	895	5303

TABLE 11.5

Percentage cumulative length frequency of RED SNAPPER harvested on headboats in the Gulf of Mexico during 1986. Data from NMFS Headboat Survey (Gene Huntsman, pers. comm.)

Size (inches)	Florida	Louisiana	Texas	All States
< 11	2.4	2.1	14.3	13.5
11	6.0	15.2	32.3	31.0
12	18.1	37.6	50.1	48.8
13	31.3	48.5	67.3	65.7
14	44.6	57.0	78.3	76.7
15	51.8	67.5	85.1	83.6
16	62.7	78.5	89.5	88.4
17	71.1	84.8	92.3	91.5
18	80.7	90.3	94.3	93.8
19	85.5	92.4	95.5	95.1
20	89.2	93.7	96.3	96.1
21	92.2	95.4	97.2	97.0
22	92.8	96.2	97.8	97.6
23	-	97.0	98.4	98.2
24	95.2	-	98.6	98.4
> 24	100.0	100.0	100.0	100.0
N*	166	237	6,015	6,418

*N = number of fish measured by NMFS samplers.

TABLE 11.6

Percentage distribution of 1986 Gulf of Mexico head boat catches in numbers and pounds for selected reef fish species by area.

Species		Percentage				Totals
		S&W FL	NW FL &AL	LA	TX	
Red Snapper	No.	0.4	4.5	4.3	91.0	332,454
	Wt.	0.9	8.3	6.8	84.0	409,630
Vermillion Snapper	No.	5.0	85.6	0.1	9.2	570,993
	Wt.	6.8	80.8	0.6	11.8	298,117
Gray Snapper	No.	97.6	2.2	<0.1	0.2	55,222
	Wt.	96.7	2.8	<0.1	0.4	151,412
Red Grouper	No.	96.3	3.7	0.0	<0.1	32,913
	Wt.	92.8	7.1	0.0	<0.1	118,083
Gag Grouper	No.	66.8	31.1	0.9	1.2	42,495
	Wt.	66.1	33.1	0.3	0.5	323,291
Greater Amberjack	No.	64.0	24.1	0.9	11.0	86,024
	Wt.	75.6	15.0	0.6	8.8	749,066
All Reef Fish Species	No.	33.8	47.7	0.8	17.7	2,270,899
	Wt.	50.6	30.3	1.4	17.7	2,893,266

TABLE 11.7

Red grouper--percentage reduction in fishing mortality required to achieve 20 percent SSBR given different combinations of minimum size limits (inches total length) and percent undersize mortality.*

			Percent Release Mortality					
Size	Lbs	Age	0	10	20	30	40	50
10	1.06	1.7	54	54	54	54	54	54
12	1.81	2.3	50	50	50	51	52	0
14	2.83	2.9	43	44	46	47	48	49
16	4.19	3.6	32	35	38	41	44	46
18	5.91	4.4	11	20	27	33	37	41
20	8.04	5.3	0	0	10	22	30	36
22	10.62	6.4	0	0	0	7	20	30
24	13.69	7.8	0	0	0	0	10	23
26	17.30	9.6	0	0	0	0	0	17

* These estimates are based on the Beverton-Holt yield-per-recruit model and, as such represent long-term equilibrium values. The von Bertalanffy growth parameters were: t_0=-.0449, K=0.179, and Lmax=31.16 inches total length (Moe 1969). Other parameters included: natural mortality rate=0.15, current fishing mortality rate=0.431, size of entry in fishery=10 inches total length, and maturity=15.5 inches total length (Goodyear pers. comm.).

TABLE 11.8

Cumulative length frequency by percentage of RED GROUPER landed by recreational anglers in the Gulf of Mexico for the years 1979-1987. Fish size is in total length. Data from the MRFSS Intercept Survey.

Length (inches)	YEAR									
	79	80	81	82	83	84	85	86	87	79-87
< 10	0.00	0.00	3.28	3.81	0.88	0.79	2.38	0.00	3.31	1.83
< 11	0.00	0.00	6.56	4.76	0.88	1.59	2.38	0.00	6.62	3.00
< 12	0.00	1.61	9.84	10.48	7.89	3.97	4.76	6.85	12.58	7.56
< 13	6.06	17.74	13.11	25.71	17.54	11.11	4.76	13.70	24.50	17.08
< 14	6.06	25.81	22.95	33.33	28.07	15.08	9.52	20.55	36.42	25.03
< 15	9.09	40.32	34.43	44.76	38.60	26.19	14.29	34.25	43.71	35.20
< 16	15.15	46.77	45.90	49.52	44.74	31.75	23.81	47.95	50.99	42.63
< 17	15.15	59.68	59.02	55.24	52.63	38.10	28.57	64.38	60.26	51.37
< 18	15.15	72.58	63.93	63.81	56.14	43.65	42.86	72.60	66.89	58.28
< 19	18.18	79.03	67.21	72.38	62.28	49.21	52.38	78.08	73.51	64.54
< 20	24.24	83.87	67.21	73.33	64.91	55.56	57.14	87.67	80.13	69.23
< 21	30.30	90.32	77.05	75.24	66.67	60.32	69.05	94.52	86.09	74.58
< 22	42.42	91.94	80.33	76.19	68.42	65.08	73.81	95.89	90.73	77.97
< 23	54.55	91.94	86.89	80.00	69.30	70.63	76.19	98.63	92.05	81.23
< 24	54.55	93.55	88.52	82.86	71.05	74.60	78.57	100.00	92.72	83.18
< 25	60.61	96.77	91.80	84.76	71.93	80.95	80.95	100.00	95.36	86.05
< 26	63.64	98.39	93.44	86.67	74.56	83.33	85.71	100.00	96.69	88.01
< 27	63.64	98.39	93.44	90.48	78.95	84.92	90.48	100.00	97.35	89.83
< 28	66.67	98.39	95.08	92.38	84.21	88.10	95.24	100.00	98.01	92.05
< 29	72.73	100.00	95.08	94.29	87.72	90.48	97.62	100.00	98.68	93.87
< 30	72.73	100.00	96.72	96.19	90.35	94.44	97.62	100.00	99.34	95.44
< 31	78.79	100.00	98.36	96.19	92.98	95.24	97.62	100.00	99.34	96.35
< 32	84.85	100.00	98.36	97.14	94.74	97.62	97.62	100.00	100.00	97.52
< 33	84.85	100.00	98.36	99.05	97.37	97.62	97.62	100.00	100.00	98.17
< 34	87.88	100.00	98.36	99.05	99.12	99.21	97.62	100.00	100.00	98.83
< 35	90.91	100.00	100.00	100.00	99.12	100.00	100.00	100.00	100.00	99.48
< 36	93.94	100.00	100.00	100.00	99.12	100.00	100.00	100.00	100.00	99.61
< 37	96.97	100.00	100.00	100.00	99.12	100.00	100.00	100.00	100.00	99.74
< 38	100.00	100.00	100.00	100.00	99.12	100.00	100.00	100.00	100.00	99.87
< 39	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Number of fish measured	33	62	61	105	114	126	42	73	151	767

TABLE 11.9

Percentage cumulative length frequency of RED GROUPER harvested on headboats in the Gulf of Mexico during 1986. Data from NMFS Headboat Survey (Gene Huntsman, pers. comm.)

Size (inches)	Florida	Louisiana	Texas	All States
< 11	1.4	-	100	1.7
11	4.5	-	-	4.7
12	8.6	-	-	8.9
13	12.3	-	-	12.5
14	21.7	-	-	21.9
15	35.4	-	-	35.6
16	47.9	-	-	48.1
17	58.2	-	-	58.3
18	65.5	-	-	65.6
19	70.8	-	-	70.8
20	74.9	-	-	75.0
21	79.4	-	-	79.4
22	84.4	-	-	84.4
23	85.2	-	-	85.3
24	87.7	-	-	87.8
> 24	100.0	-	-	100.0
N*	359	0	1	360

*N = number of fish measured by NMFS samplers.

TABLE 11.10

Cumulative length frequency by percentage of GAG GROUPER landed by recreational anglers in the Gulf of Mexico for the years 1979-1987. Fish size is in total length. Data from the MRFSS Intercept Survey.

Length (inches)	YEAR									
	79	80	81	82	83	84	85	86	87	79-87
< 10	6.90	20.59	5.88	0.00	0.00	12.50	0.00	0.00	0.98	2.61
< 11	6.90	23.53	9.80	5.32	1.65	13.75	0.00	0.00	0.98	3.80
< 12	13.79	35.29	13.73	17.02	1.65	16.25	0.00	0.58	2.44	6.52
< 13	20.69	44.12	15.69	24.47	4.13	17.50	0.00	4.09	3.90	9.35
< 14	24.14	47.06	19.61	30.85	9.09	23.75	0.74	5.26	4.88	12.17
< 15	24.14	55.88	33.33	34.04	14.05	26.25	1.48	8.19	5.37	15.22
< 16	37.93	61.76	41.18	38.30	19.01	27.50	3.70	11.11	6.83	18.70
< 17	41.38	67.65	47.06	45.74	24.79	30.00	10.37	16.96	10.24	23.91
< 18	44.83	70.59	49.02	53.19	29.75	31.25	12.59	25.73	13.66	28.48
< 19	48.28	70.59	52.94	56.38	34.71	33.75	15.56	41.52	24.39	35.76
< 20	58.62	73.53	54.90	60.64	40.50	35.00	20.00	49.12	33.17	41.63
< 21	62.07	79.41	60.78	68.09	45.45	38.75	25.19	55.56	42.93	48.15
< 22	65.52	82.35	70.59	68.09	52.07	42.50	29.63	59.65	49.27	52.93
< 23	68.97	82.35	80.39	70.21	54.55	51.25	38.52	69.01	54.63	59.13
< 24	68.97	88.24	84.31	71.28	57.85	57.50	43.70	71.35	59.02	62.83
< 25	82.76	91.18	84.31	75.53	61.98	63.75	57.04	77.19	66.34	69.57
< 26	89.66	94.12	86.27	77.66	68.60	67.50	63.70	83.04	71.22	74.57
< 27	89.66	94.12	86.27	79.79	70.25	72.50	69.63	88.30	76.10	78.37
< 28	93.10	94.12	86.27	81.91	75.21	76.25	74.81	90.64	80.98	81.96
< 29	93.10	94.12	90.20	81.91	79.34	78.75	82.22	95.32	86.34	86.09
< 30	96.55	97.06	92.16	81.91	82.64	83.75	86.67	97.08	92.68	89.67
< 31	96.55	97.06	96.08	81.91	84.30	87.50	88.15	98.83	93.66	91.20
< 32	100.00	97.06	96.08	82.98	85.95	92.50	91.11	99.42	96.10	93.15
< 33	100.00	100.00	96.08	84.04	88.43	92.50	92.59	99.42	96.59	94.02
< 34	100.00	100.00	98.04	86.17	90.91	96.25	93.33	100.00	97.56	95.43
< 35	100.00	100.00	98.04	88.30	91.74	97.50	94.81	100.00	97.56	96.09
< 36	100.00	100.00	98.04	90.43	93.39	97.50	94.81	100.00	97.56	96.52
< 37	100.00	100.00	98.04	91.49	94.21	97.50	95.56	100.00	98.54	97.07
< 38	100.00	100.00	98.04	93.62	96.69	98.75	97.04	100.00	99.02	98.04
< 39	100.00	100.00	100.00	96.81	99.17	100.00	97.78	100.00	99.02	99.02
< 40	100.00	100.00	100.00	98.94	99.17	100.00	97.78	100.00	99.51	99.35
< 41	100.00	100.00	100.00	98.94	99.17	100.00	97.78	100.00	99.51	99.35
< 42	100.00	100.00	100.00	98.94	99.17	100.00	97.78	100.00	99.51	99.35
< 43	100.00	100.00	100.00	98.94	100.00	100.00	99.26	100.00	99.51	99.67
< 44	100.00	100.00	100.00	100.00	100.00	100.00	99.26	100.00	100.00	99.89
< 45	100.00	100.00	100.00	100.00	100.00	100.00	99.26	100.00	100.00	99.89
< 46	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Number of fish measured	29	34	51	94	121	80	135	171	205	920

TABLE 11.11

Percentage cumulative length frequency of GAG GROUPER harvested on headboats in the Gulf of Mexico during 1986. Data from NMFS Headboat Survey (Gene Huntsman, pers. comm.)

Size (inches)	Florida	Louisiana	Texas	All States
< 11	-	-	3.2	0.2
11	0.3	-	-	0.5
12	0.8	-	6.5	1.1
13	1.9	8.3	16.1	2.7
14	4.3	16.7	-	5.1
15	7.2	25.0	-	8.0
16	11.7	41.7	25.8	12.9
17	18.0	50.0	41.9	19.7
18	25.5	58.3	51.6	27.3
19	31.9	-	61.3	33.8
20	37.4	66.7	67.7	39.3
21	42.5	75.0	80.6	44.9
22	47.7	83.3	83.9	50.0
23	53.6	-	-	55.6
24	58.7	-	90.3	60.7
> 24	100.0	100.0	100.0	100.0
N*	623	12	31	666

*N = number of fish measured by NMFS samplers.

TABLE 11.12

Cumulative length frequency by percentage of BLACK GROUPER landed by recreational anglers in the Gulf of Mexico for the years 1979-1987. Fish size is in total length. Data from the MRFSS Intercept Survey.

Length (inches)	YEAR 79	80	81	82	83	84	85	86	87	79-87
< 10	0.00	6.25	16.47	5.26	9.52	8.06	1.41	0.73	2.55	5.30
< 11	16.67	6.25	17.65	9.21	9.52	8.06	2.82	2.19	3.18	6.94
< 12	16.67	9.82	23.53	17.11	9.52	16.13	2.82	3.65	5.10	10.09
< 13	20.00	14.29	28.24	32.89	9.52	22.58	4.23	8.76	7.01	14.75
< 14	20.00	22.32	34.12	34.21	12.70	32.26	5.63	10.22	7.64	18.16
< 15	23.33	50.00	38.82	35.53	25.40	50.00	21.13	16.79	8.92	27.99
< 16	26.67	55.36	42.35	39.47	33.33	59.68	33.80	19.71	12.74	33.42
< 17	40.00	58.93	50.59	42.11	36.51	66.13	38.03	24.82	16.56	38.34
< 18	43.33	64.29	57.65	46.05	44.44	67.74	43.66	26.28	23.57	43.25
< 19	50.00	66.07	62.35	47.37	49.21	72.58	54.93	33.58	30.57	48.80
< 20	53.33	67.86	68.24	50.00	53.97	75.81	66.20	43.07	36.31	54.48
< 21	53.33	72.32	70.59	53.95	57.14	79.03	77.46	45.26	43.31	59.02
< 22	53.33	74.11	75.29	55.26	61.90	82.26	84.51	47.45	47.13	62.30
< 23	56.67	76.79	81.18	63.16	76.19	83.87	85.92	52.55	55.41	68.10
< 24	63.33	78.57	83.53	65.79	80.95	85.48	87.32	57.66	61.15	71.75
< 25	73.33	79.46	88.24	72.37	87.30	87.10	90.14	62.77	66.24	76.17
< 26	73.33	83.93	89.41	75.00	92.06	88.71	91.55	68.61	72.61	80.08
< 27	73.33	85.71	95.29	80.26	92.06	88.71	91.55	75.18	73.25	82.72
< 28	73.33	87.50	95.29	80.26	93.65	90.32	95.77	81.75	81.53	86.38
< 29	73.33	88.39	95.29	81.58	95.24	91.94	98.59	86.13	87.26	89.03
< 30	80.00	88.39	95.29	85.53	95.24	95.16	98.59	89.05	92.36	91.42
< 31	83.33	91.07	95.29	86.84	96.83	95.16	98.59	91.97	96.18	93.44
< 32	83.33	91.96	95.29	88.16	98.41	95.16	100.00	92.70	96.82	94.20
< 33	83.33	91.96	96.47	90.79	98.41	95.16	100.00	94.16	96.82	94.83
< 34	83.33	91.96	96.47	90.79	98.41	95.16	100.00	94.89	96.82	94.96
< 35	86.67	92.86	96.47	92.11	98.41	96.77	100.00	96.35	97.45	95.84
< 36	86.67	93.75	96.47	93.42	98.41	96.77	100.00	97.81	97.45	96.34
< 37	86.67	93.75	97.65	96.05	98.41	96.77	100.00	98.54	97.45	96.85
< 38	90.00	96.43	98.82	96.05	98.41	98.39	100.00	99.27	97.45	97.73
< 39	93.33	96.43	100.00	98.68	98.41	98.39	100.00	99.27	97.45	98.23
< 40	93.33	96.43	100.00	100.00	98.41	98.39	100.00	100.00	97.45	98.49
< 41	96.67	96.43	100.00	100.00	98.41	98.39	100.00	100.00	97.45	98.61
< 42	96.67	96.43	100.00	100.00	98.41	98.39	100.00	100.00	97.45	98.61
< 43	96.67	96.43	100.00	100.00	100.00	98.39	100.00	100.00	98.73	98.99
< 44	96.67	97.32	100.00	100.00	100.00	100.00	100.00	100.00	98.73	99.24
< 45	96.67	100.00	100.00	100.00	100.00	100.00	100.00	100.00	98.73	99.62
< 46	96.67	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.36	99.75
< 47	96.67	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.36	99.75
< 48	96.67	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.87
< 49	96.67	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.87
< 50	96.67	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.87
< 51	96.67	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.87
< 52	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Number of fish measured	30	112	85	76	63	62	71	137	157	793

TABLE 11.13

Estimates of percentage reduction in recreational catches of groupers during 1979-87 for 1-10 fish bag limits (derived from MRFSS intercept data).

	Years										
Bag Limit	79	80	81	82	83	84	85	86	87	79-87	85-87
1	40	43	58	54	41	62	62	64	47	56	58
2	22	27	43	36	21	47	47	47	27	39	41
3	12	18	36	25	12	39	36	35	16	29	30
4	8	15	32	18	7	33	29	27	10	22	23
5	5	12	29	13	4	28	24	22	7	18	18
6	4	10	27	9	2	24	21	18	5	15	15
7	3	9	25	6	1	20	18	16	4	13	13
8	2	8	24	4	1	17	16	14	3	11	11
9	1	7	23	3	0	15	14	13	2	10	10
10	1	7	22	2	0	14	13	12	2	9	9
N*	156	338	607	717	559	849	1,040	1,939	1,187	7,392	4,166

*N = number of harvested fish (types A and B1) by anglers interviewed by the MRFSS intercept survey.

TABLE 11.14

Gray snapper-- percentage reduction in fishing mortality required to achieve 20 percent SSBR given different combinations* of minimum size limits (inches total length) and percent undersize release mortality.

			Percent Release Mortality					
Size	Lbs	Age	0	10	20	30	40	50
10	0.5	3.0	18	18	18	18	18	18
11	0.7	3.4	13	14	14	15	15	16
12	0.9	3.8	8	9	10	11	12	13
13	1.1	4.3	1	3	5	7	9	10
14	1.4	4.7	0	0	0	2	4	7

* These estimates are based on the Beverton-Holt yield per recruit model and, as such, represent long-term equilibrium values. The von Bertalanffy growth parameters were: t_0=-0.3161, K=0.1009, and Lmax=35.04 inches total length (Manooch and Matheson 1981). Other parameters included: natural mortality=0.2, current fishing mortality rate=0.22, size of entry in fishery=10 inches total length, and size of maturity=17.5 inches total length (Goodyear pers. comm.).

TABLE 11.15

Cumulative length frequency by percentage of GRAY SNAPPER landed by recreational anglers in the Gulf of Mexico for the years 1979-1987. Fish size is in total length. Data from the MRFSS Intercept Survey. See Reef Fish Amendment 1 text for fork length to total length conversion equation.

Length (inches)	YEAR									
	79	80	81	82	83	84	85	86	87	79-87
< 6	0.00	0.63	4.32	2.12	0.58	0.00	0.00	3.85	1.28	1.62
< 7	0.00	3.16	17.90	11.86	2.31	2.13	0.00	5.77	1.60	5.62
< 8	2.82	7.59	38.89	30.51	7.51	5.67	1.47	8.97	4.81	13.54
< 9	26.76	15.19	41.36	44.49	19.08	9.22	5.88	19.23	8.97	21.87
< 10	35.21	29.75	50.00	58.05	32.95	19.86	19.12	24.36	17.31	32.50
< 11	57.75	42.41	61.11	69.07	45.09	32.62	27.94	29.49	32.05	44.62
< 12	67.61	54.43	66.67	75.00	53.76	41.84	42.65	39.74	43.27	53.96
< 13	90.14	78.48	74.07	82.63	59.54	51.06	50.00	46.79	53.53	64.45
< 14	92.96	87.34	75.93	84.75	61.85	56.03	55.88	58.97	61.22	70.01
< 15	94.37	91.77	78.40	87.29	64.16	68.79	57.35	62.82	66.03	74.20
< 16	97.18	91.77	79.63	88.14	65.90	71.63	64.71	67.31	72.12	77.18
< 17	97.18	96.20	81.48	91.53	69.94	78.01	70.59	69.23	76.92	80.97
< 18	98.59	98.10	82.72	93.22	75.72	83.69	73.53	71.79	82.69	84.50
< 19	98.59	98.10	83.95	93.64	82.08	88.65	79.41	73.72	85.58	87.00
< 20	100.00	98.73	88.27	95.76	84.97	90.07	83.82	80.13	89.10	90.05
< 21	100.00	98.73	95.06	97.03	88.44	92.91	89.71	86.54	91.99	93.23
< 22	100.00	98.73	98.15	98.31	91.33	94.33	89.71	92.95	92.95	95.13
< 23	100.00	98.73	98.77	98.73	94.22	97.16	94.12	95.51	93.59	96.48
< 24	100.00	98.73	99.38	99.58	95.38	99.29	95.59	97.44	94.87	97.56
< 25	100.00	98.73	99.38	100.00	96.53	100.00	97.06	98.08	97.12	98.44
< 26	100.00	98.73	100.00	100.00	97.69	100.00	98.53	98.72	98.08	98.98
< 27	100.00	98.73	100.00	100.00	98.84	100.00	100.00	98.72	98.40	99.26
< 28	100.00	98.73	100.00	100.00	99.42	100.00	100.00	98.72	99.36	99.53
< 29	100.00	99.37	100.00	100.00	99.42	100.00	100.00	99.36	100.00	99.80
< 30	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.36	100.00	99.93
< 31	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Number of fish measured	71	158	162	236	173	141	68	156	312	1477

TABLE 11.16

Percentage cumulative length frequency of GRAY SNAPPER harvested on headboats in the Gulf of Mexico during 1986. Data from NMFS Headboat Survey (Gene Huntsman, pers. comm.)

Size (inches)	Florida	Louisiana	Texas	All States
< 11	0.8	5.0	-	1.0
11	6.6	25.0	-	7.2
12	14.4	35.0	-	14.9
13	26.0	55.0	-	26.6
14	34.0	75.0	-	34.9
15	43.5	80.0	18.2	44.4
16	53.6	-	-	53.9
17	62.7	85.0	-	62.6
18	68.2	90.0	27.3	68.2
19	76.7	-	-	76.2
20	81.9	-	36.4	81.2
21	86.6	95.0	-	85.9
22	90.5	-	-	89.5
23	92.4	-	45.5	91.5
24	94.6	-	72.7	94.2
> 24	100.0	100.0	100.0	100.0
N*	485	20	11	516

*N = number of fish measured by NMFS samplers.

TABLE 11.17

Cumulative length frequency by percentage of LANE SNAPPER landed by recreational anglers in the Gulf of Mexico for the years 1979-1987. Fish size is in total length. Data from the MRFSS Intercept Survey. See Reef Fish Amendment 1 text for fork length to total length conversion equation.

Length (inches)	YEAR									
	79	80	81	82	83	84	85	86	87	Total
< 7	0.00	0.00	0.00	1.92	0.00	0.00	0.00	0.00	0.55	0.34
< 8	4.00	0.00	6.38	11.54	0.00	4.17	0.00	0.00	6.08	3.96
< 9	8.00	2.70	46.81	46.15	10.96	8.33	15.00	0.00	16.57	16.18
< 10	24.00	8.11	76.60	71.15	28.77	10.42	25.00	0.00	29.28	28.57
< 11	48.00	27.03	85.11	76.92	41.10	14.58	40.00	4.08	40.33	38.55
< 12	68.00	43.24	89.36	80.77	65.75	54.17	60.00	6.12	51.38	51.98
< 13	96.00	56.76	93.62	84.62	78.08	79.17	80.00	18.37	61.33	64.20
< 14	100.00	62.16	97.87	88.46	90.41	100.00	85.00	25.51	71.27	73.15
< 15	100.00	70.27	100.00	88.46	95.89	100.00	95.00	52.04	83.98	83.30
< 16	100.00	70.27	100.00	96.15	95.89	100.00	95.00	66.33	91.71	88.81
< 17	100.00	72.97	100.00	98.08	98.63	100.00	100.00	78.57	95.03	92.77
< 18	100.00	81.08	100.00	100.00	100.00	100.00	100.00	91.84	95.03	95.87
< 19	100.00	83.78	100.00	100.00	100.00	100.00	100.00	92.86	97.79	97.07
< 20	100.00	89.19	100.00	100.00	100.00	100.00	100.00	95.92	98.90	98.28
< 21	100.00	91.89	100.00	100.00	100.00	100.00	100.00	97.96	100.00	99.14
< 22	100.00	94.59	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.66
< 27	100.00	97.30	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.83
< 30	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Number of fish measured	25	37	47	52	73	48	20	98	181	581

TABLE 11.18

Cumulative length frequency by percentage of MUTTON SNAPPER landed by recreational anglers in the Gulf of Mexico for the years 1979-1987. Fish size is in total length. Data from the MRFSS Intercept Survey. See Reef Fish Amendment 1 text for fork length to total length conversion equation.

Length (inches)	YEAR 79	80	81	82	83	84	85	86	87	Total
< 10	.	0.00	22.22	5.88	5.00	0.00	0.00	0.00	0.00	3.95
< 11	.	0.00	33.33	8.82	5.00	13.79	6.67	0.00	6.06	9.60
< 12	.	0.00	33.33	14.71	5.00	20.69	6.67	4.55	6.06	12.43
< 13	.	16.67	38.89	23.53	10.00	24.14	33.33	9.09	12.12	20.34
< 14	.	16.67	44.44	23.53	15.00	34.48	40.00	18.18	12.12	24.86
< 15	.	16.67	50.00	26.47	15.00	48.28	40.00	27.27	21.21	31.07
< 16	.	16.67	66.67	29.41	30.00	58.62	60.00	27.27	27.27	39.55
< 17	.	16.67	72.22	29.41	30.00	62.07	60.00	31.82	36.36	42.94
< 18	.	16.67	88.89	29.41	30.00	68.97	66.67	40.91	48.48	49.72
< 19	.	16.67	88.89	38.24	35.00	72.41	66.67	40.91	57.58	54.24
< 20	.	16.67	94.44	38.24	35.00	72.41	66.67	40.91	66.67	56.50
< 21	.	50.00	94.44	41.18	35.00	75.86	73.33	40.91	72.73	60.45
< 22	.	50.00	100.00	44.12	35.00	75.86	73.33	54.55	78.79	64.41
< 23	.	83.33	100.00	50.00	35.00	86.21	73.33	59.09	78.79	68.93
< 24	.	83.33	100.00	52.94	40.00	86.21	80.00	59.09	78.79	70.62
< 25	.	83.33	100.00	52.94	50.00	86.21	80.00	68.18	81.82	73.45
< 26	.	83.33	100.00	55.88	50.00	86.21	80.00	72.73	87.88	75.71
< 27	.	83.33	100.00	67.65	65.00	93.10	80.00	77.27	93.94	82.49
< 28	.	83.33	100.00	73.53	65.00	93.10	86.67	77.27	93.94	84.18
< 29	.	100.00	100.00	79.41	70.00	93.10	86.67	81.82	93.94	87.01
< 30	.	100.00	100.00	85.29	75.00	96.55	86.67	86.36	96.97	90.40
< 31	.	100.00	100.00	91.18	75.00	96.55	93.33	86.36	96.97	92.09
< 32	.	100.00	100.00	94.12	75.00	96.55	100.00	95.45	100.00	94.92
< 33	.	100.00	100.00	97.06	80.00	96.55	100.00	100.00	100.00	96.61
< 34	.	100.00	100.00	97.06	85.00	100.00	100.00	100.00	100.00	97.74
< 35	.	100.00	100.00	100.00	85.00	100.00	100.00	100.00	100.00	98.31
< 36	.	100.00	100.00	100.00	90.00	100.00	100.00	100.00	100.00	98.87
< 37	.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Number of fish measured	0	6	18	34	20	29	15	22	33	177

TABLE 11.19

Cumulative length frequency by percentage of YELLOWTAIL SNAPPER landed by recreational anglers in the Gulf of Mexico for the years 1979-1987. Fish size is in total length. Data from the MRFSS Intercept Survey. See Reef Fish Amendment 1 text for fork length to total length conversion equation.

Length (inches)	YEAR									
	79	80	81	82	83	84	85	86	87	Total
< 10	50.00	36.11	12.96	10.73	3.72	12.50	7.27	2.27	1.71	8.74
< 11	100.00	38.89	29.01	12.20	7.02	20.31	10.91	4.55	5.13	14.24
< 12	100.00	41.67	41.36	17.07	16.94	31.25	12.73	9.09	9.40	21.79
< 13	100.00	44.44	53.70	24.88	30.17	42.19	16.36	11.36	14.53	30.96
< 14	100.00	44.44	58.64	34.15	50.00	45.31	21.82	13.64	29.06	41.53
< 15	100.00	47.22	64.81	42.44	63.22	62.50	30.91	13.64	44.44	51.67
< 16	100.00	58.33	75.93	48.29	75.21	68.75	43.64	25.00	55.56	61.60
< 17	100.00	69.44	83.33	59.02	84.71	75.00	49.09	52.27	65.81	71.52
< 18	100.00	72.22	87.65	66.83	90.08	76.56	60.00	52.27	75.21	77.45
< 19	100.00	86.11	89.51	78.54	96.28	79.69	70.91	52.27	83.76	84.47
< 20	100.00	91.67	91.36	84.88	98.35	82.81	76.36	52.27	86.32	87.81
< 21	100.00	97.22	93.83	90.24	99.17	92.19	85.45	56.82	[illegible]8.03	91.48
< 22	100.00	100.00	95.06	93.66	99.17	95.31	89.09	70.45	[illegible]2.31	94.17
< 23	100.00	100.00	96.30	98.05	99.17	98.44	94.55	79.55	94.87	96.66
< 24	100.00	100.00	98.77	99.51	99.59	100.00	100.00	90.91	97.44	98.81
< 25	100.00	100.00	99.38	100.00	100.00	100.00	100.00	93.18	98.29	99.35
< 26	100.00	100.00	99.38	100.00	100.00	100.00	100.00	100.00	100.00	99.89
< 27	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Number of fish measured	2	36	162	205	242	64	55	44	117	927

TABLE 11.20

Cumulative length frequency by percentage of VERMILION SNAPPER landed by recreational anglers in the Gulf of Mexico for the years 1979-1987. Fish size is in total length. Data from the MRFSS Intercept Survey. See Reef Fish Amendment 1 text for fork length to total length conversion equation.

Length (inches)	YEAR 79	80	81	82	83	84	85	86	87	Total
< 7	0.00	0.00	0.00	0.26	3.39	0.00	0.00	0.00	0.00	0.67
< 8	3.18	3.85	1.05	2.88	9.15	0.00	1.41	0.00	0.52	2.99
< 9	10.19	13.46	5.26	11.26	15.25	10.53	5.63	0.00	1.29	8.49
< 10	21.02	40.38	27.37	25.13	28.14	42.86	12.68	7.81	7.99	22.05
< 11	61.15	69.23	52.63	51.57	50.85	71.43	22.54	15.63	24.23	45.45
< 12	75.16	84.62	70.53	70.94	65.08	84.21	39.44	21.87	44.85	62.31
< 13	82.17	90.38	82.11	84.29	77.97	90.23	60.56	39.06	67.01	76.60
< 14	90.45	92.31	94.74	98.69	89.83	98.50	78.87	48.44	80.93	88.82
< 15	98.09	98.08	98.95	99.21	95.59	100.00	81.69	67.19	91.24	94.56
< 16	99.36	100.00	98.95	99.21	97.29	100.00	94.37	79.69	96.39	97.31
< 17	100.00	100.00	98.95	99.74	98.31	100.00	98.59	84.37	98.45	98.53
< 18	100.00	100.00	100.00	100.00	98.64	100.00	100.00	92.19	99.74	99.39
< 19	100.00	100.00	100.00	100.00	99.32	100.00	100.00	93.75	100.00	99.63
< 20	100.00	100.00	100.00	100.00	99.32	100.00	100.00	100.00	100.00	99.88
< 21	100.00	100.00	100.00	100.00	99.66	100.00	100.00	100.00	100.00	99.94
< 22	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Number of fish measured	157	52	95	382	295	133	71	64	388	1637

TABLE 11.21

Cumulative length frequency by percentage of BLACK SEA BASS landed by recreational anglers in the Gulf of Mexico for the years 1979-1987. Fish size is in total length. Data from the MRFSS Intercept Survey.

Length (inches)	YEAR 79	80	81	82	83	84	85	86	87	Total
< 5	0.00	0.00	0.00	0.49	0.00	2.67	0.00	0.00	0.00	0.25
< 6	0.78	0.56	0.00	4.88	0.00	4.00	0.78	0.00	0.00	1.36
< 7	5.47	0.56	7.14	12.20	0.00	9.33	3.10	0.00	0.00	3.82
< 8	16.41	3.89	14.29	24.39	3.51	28.00	17.83	0.00	3.27	11.12
< 9	29.69	8.89	21.43	31.22	10.53	46.67	25.58	0.84	7.19	17.66
< 10	50.00	26.67	28.57	46.34	31.58	65.33	48.84	10.97	20.26	33.79
< 11	68.75	44.44	28.57	59.02	56.14	74.67	64.34	32.49	39.22	51.02
< 12	83.59	81.67	42.86	71.71	77.19	80.00	79.07	58.65	64.05	72.16
< 13	95.31	93.89	64.29	87.32	92.98	81.33	89.15	84.81	79.74	87.52
< 14	98.44	97.78	71.43	96.10	96.49	82.67	97.67	93.67	90.85	94.48
< 15	100.00	100.00	92.86	98.54	100.00	85.33	100.00	97.05	96.73	97.71
< 16	100.00	100.00	92.86	100.00	100.00	89.33	100.00	100.00	98.69	99.07
< 17	100.00	100.00	100.00	100.00	100.00	92.00	100.00	100.00	98.69	99.32
< 18	100.00	100.00	100.00	100.00	100.00	94.67	100.00	100.00	98.69	99.49
< 19	100.00	100.00	100.00	100.00	100.00	96.00	100.00	100.00	99.35	99.66
< 20	100.00	100.00	100.00	100.00	100.00	97.33	100.00	100.00	100.00	99.83
< 21	100.00	100.00	100.00	100.00	100.00	97.33	100.00	100.00	100.00	99.83
< 22	100.00	100.00	100.00	100.00	100.00	98.67	100.00	100.00	100.00	99.92
< 23	100.00	100.00	100.00	100.00	100.00	98.67	100.00	100.00	100.00	99.92
< 24	100.00	100.00	100.00	100.00	100.00	98.67	100.00	100.00	100.00	99.92
< 25	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Number of fish measured	128	180	14	205	57	75	129	237	153	1178

TABLE 11.22

Greater amberjack -- percentage reduction in fishing mortality required to achieve 20 percent SSBR given different combinations of minimum size limits (inches fork length) and percent undersize release mortality.*

			Percent Release Mortality					
Size	Lbs	Age	0	10	20	30	40	50
24	7.6	2.0	36	38	40	42	43	45
26	9.5	2.3	31	34	37	40	42	44
28	11.7	2.6	26	30	34	37	40	42
30	14.2	2.9	19	25	30	34	37	40
32	17.2	3.3	10	18	25	30	35	38
34	20.4	3.6	0	9	19	26	31	36
36	24.0	4.0	0	0	10	20	28	34
38	28.0	4.4	0	0	4	17	26	33
40	32.3	4.8	0	0	1	12	23	31
42	37.1	5.3	0	0	1	3	17	27
44	42.4	5.8	0	0	1	1	15	26
46	48.1	6.4	0	0	1	1	8	21
48	54.3	7.1	0	0	1	1	1	17
50	61.0	7.8	0	0	1	1	1	17

* These estimates are based on the Beverton-Holt yield-per-recruit model and, as such, represent long-term equilibrium values. The von Bertalanffy growth parameters were: t_0=-0.653, K=0.174, and Lmax=64.96 inches fork length (Burch 1979). Other parameters included: natural mortality=0.2, present fishing mortality=0.399, size of entry (tc)=10 inches, and size of maturity=32.5 inches (Goodyear pers. comm.).

TABLE 11.23

Cumulative length frequency by percentage of GREATER AMBERJACK landed by recreational anglers in the Gulf of Mexico for the years 1979-1987. Fish size is in fork length. Data from the MRFSS Intercept Survey.

Length (inches)	YEAR 79	80	81	82	83	84	85	86	87	Total
< 15	0.00	26.32	31.34	16.91	5.48	1.74	14.81	15.57	11.71	12.95
< 16	0.00	28.95	38.81	21.32	6.85	3.48	20.37	17.62	15.44	16.28
< 17	0.00	35.53	46.27	25.00	8.22	3.48	22.22	20.08	21.92	20.88
< 18	0.00	42.11	47.76	26.47	10.27	5.22	24.07	24.18	27.77	25.18
< 19	0.00	51.32	53.73	27.94	11.64	5.22	24.07	28.28	36.86	31.11
< 20	0.00	52.63	56.72	31.62	15.07	14.78	27.78	32.38	44.08	36.80
< 21	9.09	52.63	59.70	36.76	17.12	18.26	33.33	37.70	54.67	43.95
< 22	9.09	52.63	64.18	42.65	19.18	21.74	37.04	43.85	58.78	48.06
< 23	9.09	52.63	73.13	52.94	27.40	26.96	38.89	48.36	65.26	54.24
< 24	9.09	52.63	77.61	61.03	28.77	37.39	38.89	54.10	70.73	59.44
< 25	9.09	52.63	82.09	66.91	32.19	50.43	38.89	58.61	76.59	64.83
< 26	9.09	56.58	83.58	67.65	36.99	53.91	38.89	60.66	80.82	68.16
< 27	18.18	56.58	85.07	68.38	40.41	53.91	40.74	61.48	83.44	70.10
< 28	18.18	57.89	86.57	72.06	45.89	55.65	42.59	61.89	85.68	72.34
< 29	18.18	57.89	86.57	72.79	49.32	60.00	46.30	63.52	88.04	74.52
< 30	18.18	59.21	88.06	76.47	54.11	62.61	50.00	64.75	89.41	76.51
< 31	18.18	59.21	88.06	79.41	65.75	66.09	53.70	66.80	90.29	78.87
< 32	18.18	61.84	88.06	83.82	73.29	69.57	55.56	68.85	90.91	80.93
< 33	18.18	63.16	88.06	85.29	74.66	71.30	62.96	70.08	91.66	82.14
< 34	18.18	65.79	88.06	87.50	77.40	75.65	66.67	75.41	93.03	84.56
< 35	18.18	67.11	88.06	89.71	79.45	77.39	68.52	79.10	93.52	85.96
< 36	27.27	67.11	88.06	90.44	84.25	78.26	75.93	81.15	93.77	87.23
< 37	45.45	67.11	88.06	92.65	86.30	79.13	77.78	81.97	93.90	88.01
< 38	54.55	67.11	88.06	94.85	86.30	79.13	85.19	84.43	93.90	88.86
< 39	63.64	69.74	88.06	94.85	88.36	80.87	87.04	85.66	94.15	89.71
< 40	63.64	69.74	88.06	94.85	90.41	81.74	90.74	88.52	94.40	90.62
< 41	63.64	69.74	88.06	94.85	93.15	83.48	92.59	90.16	94.52	91.34
< 42	72.73	71.05	89.55	95.59	93.15	84.35	92.59	91.80	94.89	92.07
< 43	72.73	73.68	89.55	95.59	94.52	84.35	94.44	92.62	95.27	92.68
< 44	81.82	75.00	91.04	95.59	95.21	87.83	94.44	93.03	95.89	93.52
< 45	81.82	77.63	91.04	95.59	95.89	89.57	94.44	93.85	96.39	94.19
< 46	81.82	78.95	94.03	95.59	96.58	90.43	94.44	95.90	97.14	95.16
< 47	81.82	80.26	94.03	96.32	97.26	91.30	94.44	96.31	97.76	95.76
< 48	81.82	81.58	95.52	97.79	97.95	93.04	94.44	97.95	98.13	96.61
< 49	90.91	82.89	95.52	97.79	99.32	94.78	94.44	97.95	98.75	97.28
< 50	90.91	85.53	97.01	97.79	99.32	95.65	96.30	97.95	99.00	97.70
< 51	90.91	89.47	98.51	97.79	99.32	97.39	98.15	98.36	99.50	98.43
< 52	100.00	90.79	100.00	99.26	100.00	98.26	98.15	99.18	99.75	99.09
< 53	100.00	92.11	100.00	99.26	100.00	98.26	98.15	99.59	100.00	99.33
< 54	100.00	93.42	100.00	100.00	100.00	98.26	100.00	100.00	100.00	99.58
< 55	100.00	96.05	100.00	100.00	100.00	98.26	100.00	100.00	100.00	99.70
< 58	100.00	97.37	100.00	100.00	100.00	99.13	100.00	100.00	100.00	99.82
< 60	100.00	98.68	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.94
< 61	100.00	98.68	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.94
< 63	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Number of fish measured	11	76	67	136	146	115	54	244	803	1652

TABLE 11.24

Estimates of percentage reduction in recreational catches of amberjacks during 1979-87 for 1-10 fish bag limits (derived from MRFSS intercept data).

Bag Limit	79	80	81	82	83	84	85	86	87	79-87	85-87
	Years										
1	64	62	61	66	57	54	56	75	73	69	73
2	57	46	41	48	38	27	41	63	54	51	56
3	51	37	27	34	28	10	33	53	41	40	45
4	49	28	17	25	20	6	27	46	33	32	37
5	47	20	11	19	16	4	22	39	26	26	30
6	45	16	6	14	14	4	18	33	21	21	25
7	43	14	3	11	11	3	14	28	17	17	20
8	42	12	1	9	10	3	10	23	13	14	17
9	40	11	0	8	8	3	6	20	10	12	13
10	38	10	0	6	6	3	3	16	8	9	10
N*	53	218	128	381	497	386	240	1,364	2,345	5,612	3,949

*N = number of fish harvested (types A and B1) by anglers interviewed by the MRFSS intercept survey.

TABLE 11.25

SHRIMP CATCH ASSOCIATED WITH AMOUNT RED SNAPPER BYCATCH WOULD HAVE TO BE REDUCED TO PRODUCE AN EXTRA UNIT OF RED SNAPPER IN THE COMBINED COMMERCIAL AND RECREATIONAL CATCH.

SEASON	ZONE	DEPTH	LBS/FISH	LBS/LB	$/FISH	$/S
WARM	WEST	<10 FM	13.12	14.77	30.84	16.61
		>10 FM	11.85	13.33	42.65	22.96
	CENTRAL	<10 FM	12.99	14.61	30.52	16.43
		>10 FM	6.77	7.62	24.37	13.12
	EAST	<10 FM	12.26	13.79	28.81	15.51
		>10 FM	10.50	11.82	37.81	20.36
COOL	WEST	<10 FM	9.90	11.14	23.27	12.53
		>10 FM	7.24	8.14	26.05	14.03
	CENTRAL	<10 FM	11.36	12.78	26.70	14.37
		>10 FM	8.96	10.09	32.27	17.37
	EAST	<10 FM	20.17	22.70	47.41	25.52
		>10 FM	12.86	14.47	46.29	24.92
GRAND TOTAL			10.96	12.33	31.57	17.00

SEASONS: WARM=MAY-NOVEMBER; COOL=DECEMBER-APRIL.
ZONES: WEST=TX; CENTRAL=LA-AL; EAST=W FL.)
PRICES: SHRIMP <3MI = SHRIMP <10FM = $2.35/LB HEAD OFF
SHRIMP >3MI = SHRIMP >10FM = $3.60/LB HEAD OFF
SHRIMP TOTAL = $2.88/LB HEAD OFF
RED SNAPPER = $2.09/LB WHOLE

VALUES SHOWN ARE EXPRESSED AS RATIOS OF SHRIMP CATCH (HEADS OFF POUNDS OR VALUE BASED ON 1972-1985 AVERAGE LANDINGS AND 1987 PRICES) TO UNITS OF RED SNAPPER CATCH (ONE FISH, POUND OR $ COMMERCIAL VALUE IN 1987 PRICES). BYCATCH ASSOCIATED WITH UNITS OF POTENTIAL CATCH IN THE SNAPPER FISHERY CALCULATED AFTER GOODYEAR USING THE VARIABLE F VECTOR AND SURVIVAL PROBABILITY FROM BYCATCH PERIOD TO RECRUITMENT OF 0.8.

DATA FROM GOODYEAR, CRD 87/88-16; NICHOLS, PERSONAL COMMUNICATION TO GREGORY, 1988; AND NMFS 1987 CATCH BY DISTANCE FROM SHORE PRINTOUTS.

TABLE 11.26

Percentage distribution of longline catches of selected species by depth in fathoms. No. trips represents the number of fishing trips sampled and Pounds the pounds, in hundreds, caught by the sampled trips. Data from NMFS Trip Interview Program.

RED SNAPPER

Depth (fathoms)	1984	1985	1986	1987
<20	0%	0%	0%	0%
<30	10%	2%	3%	2%
<40	1%	2%	21%	34%
<50	62%	7%	22%	26%
>50	27%	89%	54%	38%
Pounds (x100)	203	297	126	50
No. trips	40	66	96	39

RED GROUPER

Depth (fathoms)	1984	1985	1986	1987
<20	6%	0%	6%	9%
<30	63%	40%	34%	15%
<40	9%	18%	25%	17%
<50	9%	17%	17%	27%
>50	13%	25%	19%	32%
Pounds (x100)	728	1580	3100	1558
No. trips	32	81	191	77

YELLOWEDGE GROUPER

Depth (fathoms)	1984	1985	1986	1987
<20	0%	0%	0%	0%
<30	0%	0%	0%	0%
<40	0%	0%	0%	0%
<50	0%	1%	1%	0%
>50	100%	99%	98%	100%
Pounds (x100)	936	558	919	335
No. trips	19	20	55	24

ALL REEF FISH

Depth (fathoms)	1984	1985	1986	1987
<20	1%	0%	5%	6%
<30	16%	22%	22%	11%
<40	4%	12%	21%	15%
<50	18%	18%	15%	25%
>50	60%	49%	38%	42%
Pounds (x100)	3363	3255	5171	2358
No. trips	235	442	869	355

TABLE 11.27

Seaward coordinates of reef fish longline restricted area.

Point No.	Reference Location[1]	North Latitude	West Longitude
1	Seaward limit of Florida's waters North of Dry Tortugas	24°48.0'	82°48.0'
2	North of Rebecca Light	25°07.5'	82°34.0'
3	Off Sanibel Island	26°26.0'	82°59.0'
4	West of Egmont Key	27°30.0'	83°21.5'
5	West of Anclote Keys	28°10.0'	83°45.0'
6	Southeast corner of Florida Middle Ground protected area	28°11.0'	84°00.0'
7	Southwest corner of Florida Middle Ground protected area	28°11.0'	84°07.0'
8	West corner of Florida Middle Ground protected area	28°26.6'	84°24.8'
9	Northwest corner of Florida Middle Ground protected area	28°42.5'	84°24.8'
10	South of Carrabelle	29°05.0'	84°47.0'
11	South of Cape St. George	29°02.5'	85°09.0'
12	South of Cape San Blas bell buoy - 20 fathom contour	29°21.0'	85°30.0'
13	South of Cape San Blas bell buoy - 50 fathom contour	28°58.7'	85°30.0'
14	Southeast of Pensacola (Desota Canyon)	30°06.0'	86°55.0'
15	South of Pensacola	29°46.0'	87°19.0'
16	South of Perdido Bay	29°29.0'	87°27.5'
17	East of Mississippi River - North Pass	29°14.5'	88°28.0'
18	South of Mississippi River - Southwest Pass	28°46.5'	89°26.0'
19	Northwest tip of Mississippi Canyon	28°38.5'	90°08.5'
20	West side of Mississippi Canyon	28°34.5'	89°59.5'
21	South of Timbalier Bay	28°22.5'	90°02.5'
22	South of Terrebonne Bay	28°10.5'	90°31.5'
23	South of Freeport	27°58.0'	95°00.0'
24	Off Matagorda Island	27°43.0'	96°02.0'
25	Off of Aransas Pass	27°30.0'	96°23.5'
26	Northeast of Port Mansfield	27°00.0'	96°39.0'
27	East of Port Mansfield	26°44.0'	96°37.5'
28	Northeast of Port Isabel	26°22.0'	96°21.0'
29	U.S./Mexico EEZ boundary	26°00.5'	96°24.5'
	Then westerly along U.S./Mexico EEZ boundary to the seaward limit of Texas' waters.		

[1] Nearest identifiable landfall, boundary, navigation aid or submarine area.

TABLE 11.28

Seaward coordinates of reef fish stressed area boundary.

Point No.	Reference Location[1]	North Latitude	West Longitude
1	Seaward limit of Florida's waters Northeast of Dry Tortugas	24°45.5'	82°41.5'
2	North of Marquesas Keys	24°48.0'	82°06.5'
3	Off Cape Sable	25°15.0'	82°02.0'
4	Off Sanibel Island - Inshore	26°26.0'	82°29.0'
5	Off Sanibel Island - Offshore	26°26.0'	82°59.0'
6	West of Egmont Key	27°30.0'	83°21.5'
7	Off Anclote Keys - Offshore	28°10.0'	83°45.0'
8	Off Anclote Keys - Inshore	28°10.0'	83°14.0'
9	Off Deadman Bay	29°38.0'	84°00.0'
10	Seaward limit of Florida's waters, East of Cape St. George	29°35.5'	84°38.6'
	Then westerly along the seaward limit of Florida's waters to		
11	Seaward limit of Florida's waters, South of Cape San Blas	29°32.2'	85°27.1'
12	Southwest of Cape San Blas	29°30.5'	85°52.0'
13	Off St. Andrews Bay	29°53.0'	86°10.0'
14	Desoto Canyon	30°06.0'	86°55.0'
15	Alabama/Florida line	29°34.5'	87°38.0'
16	Off Mobile Bay	29°41.0'	88°00.0'
17	Mississippi/Alabama line	30°01.5'	88°23.7'
18	Horn/Chandeleur Islands	30°01.5'	88°40.5'
19	Chandeleur Islands	29°35.5'	88°37.0'
20	Seaward limit of Louisiana's waters off Mississippi River North Pass	29°16.3'	89°00.0'
	Then southerly and westerly along the seaward limit of Louisiana's waters to		
21	Seaward limit of Louisiana's waters off Mississippi River Southwest Pass	28°57.3'	89°28.2'
22	Southeast of Grand Isle	29°09.0'	89°47.0'
23	Quick flashing horn buoy south of Isles Dernieres	28°32.5'	90°42.0'
24	Southeast of Calcasieu Pass	29°10.0'	92°37.0'
25	South of Sabine Pass on 10 fathom contour	29°09.0'	93°41.0'
26	South of Sabine Pass on 30 fathom contour	28°21.5'	93°28.0'
27	East of Aransas Pass	27°49.0'	96°19.5'
28	East of Baffin Bay	27°12.0'	96°51.0'
29	Northeast of Port Mansfield	26°46.5'	96°52.0'
30	Northeast of Port Isabel	26°21.5'	96°35.0'
31	U.S./Mexico EEZ boundary	26°00.5'	96°36.0'
	Then westerly along U.S./Mexico EEZ boundary to the seaward limit of Texas' waters.		

[1] Nearest identifiable landfall, boundary, navigation aid or submarine area.

12. RESEARCH RECOMMENDATIONS

12.1. Research Recommendations Identified in the FMP

Recommendations To the Secretary of Commerce

1. Initiate research designed to evaluate the need for protection of juvenile reef fish and habitat in specific locations from damage or excessive mortality by gear such as traps or other gear taking reef fish. (Research underway by SEFC).

2. Encourage immediate development of escape panels or devices on trawls for use in areas where bycatch of juvenile snapper and grouper are high. (Research underway by SEFC on TED modifications to release fish bycatch).

3. Encourage and support the construction of permitted artificial reef habitats.

4. Initiate research to determine the optimum minimum mesh size for traps which will allow escapement of juvenile reef fish. (Research completed by SEFC).

5. Develop information on sizes of reef fish that should be released by fishermen in the stressed area. (YPR analyses was conducted in 1988 stock assessment).

6. Initiate research to determine the impact of fish traps on reef fish populations and the reef ecosystem. (This should include catches of targeted species and bycatch of other species as well as information on other relevant parameters.) (Research underway by SEFC).

7. The development of self-destruct panels on fish traps. (No research planned).

8. Since there is a question on the use of artificial reefs to increase fish stocks, the need exists for a five-year program to be immediately initiated to determine the level of reef effectiveness. Research should be directed toward the following areas:

   (a) Recruitment to reefs.

   (b) Contribution of reef fauna to support the food requirement of resident reef fish.

   (c) Determination of whether reef fish forage in areas adjoining the reefs for their primary food sources.

(d) The effectiveness of artificial reefs as habitat. (Research being conducted by SEFC in South Atlantic).

9. Provide information on optimum mesh size of fish traps or initiate research to provide this information. (Limited research has been completed by SEFC and FDNR).

10. NMFS is to provide information on the procedure for puncturing the air bladder of reef fish so that Council staff can prepare information and education brochure on this procedure for distribution to the public. (No activity planned).

11. That NMFS SEFC place observers on longline vessels fishing for reef fish in the Gulf, provided the vessel owners agree to such an arrangement. (An observer study was completed by SEFC in 1983).

12.2. Research Recommendations Identified in this Amendment

Recommendations To the Secretary of Commerce

1. Greater emphasis must be placed on the collection of bioprofile and catch-effort statistics from all user groups by geographic area.

2. The spawning stock biomass and recruitment levels of reef fish populations need to be monitored on a continuing basis by geographic area.

3. Better growth, mortality, maturity, and fecundity information is needed for species in the fishery management unit.

4. The effectiveness of the different trawl designs (including TEDs) used within the shrimp fishery in reducing the bycatch of reef fish, especially prerecruit reef fish needs to be evaluated. Catch rates of all bycatch species need to be determined for various trawl designs fished in different regions of the Gulf for both day and night trawling.

5. The socio-economic and socio-cultural aspects of the reef fish fishery needs to be evaluated with the purpose of examining the potential utility of a limited entry management strategy and for purposes of allocations.

Recommendations To the States

The Council recommends that the states implement the management measures proposed in this Amendment within their territorial jurisdiction, where applicable. The Council further encourages the states to assist the Secretary in addressing and supporting the research and other special recommendations.

13. RELATED FEDERAL LAWS AND REQUIREMENTS

13.1. Vessel Safety Concerns

Amendment by P.L. 99-659 to the Magnuson Act requires that a fishery manangement plan or amendment must consider, and may provide for, temporary adjustments (after consultation with the Coast Guard and persons utilizing the fishery) regarding access to the fishery for vessels otherwise prevented from harvesting because of weather or othe ocean conditions affecting the safety of the vessels.

No vessel will be forced to participate in the fishery under adverse weather or ocean conditions as a result of the imposition of the management regulations set forth in this fishery management plan. Therefore, no management adjustments for fishery access will be provided.

13.1.1. Fishery access and weather-related vessel safety.

There are no fishery conditions or management measures or regulations contained in this amendment that would result in the loss of harvesting opportunity because of the crew and vessel safety effects of adverse weather or ocean conditions. Concern was expressed by grouper longline fishermen that the prohibition of longlines within 50 fathoms in the Eastern Gulf of Mexico would create vessel safety problems, particularly during the winter, because many of the Florida longline boats were ill equipped for long distance fishing (see minutes of September, 1988 Council Meeting). The Council subsequently modified the proposal to allow longlining in the Eastern Gulf into 20 fathoms thus significantly reducing the potential vessel safety problem. No other concerns have been raised by the Coast Guard or by people engaged in the fishery that other aspects of the proposed management measures directly or indirectly pose a hazard to crew or vessel safety under adverse weather or ocean conditions. Therefore, there are no procedures for making management adjustments in the amendment due to vessel safety problems because no person will be precluded from a fair or equitable harvesting opportunity by the management measures set forth.

13.1.2. Coast Guard Evaluation

No vessel safety issues, whether pertinent to fishery access and weather related vessel safety or to other significant or relevant safety issues have been identified by the Coast Guard.

13.1.3. Procedures

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

13.1.4. Other Safety Issues

There have been no significant and releveant safety issues raised by fishery users, other public or the Coast Guard.

13.2. 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. This authority encompasses establishment of guidelines and policies, approval of information collection requests, and reduction of paperwork burdens and duplications.

13.2.1. Proposed Data Collection Program

The Councils propose through this amendment to establish a permit system to 1) define commercial and recreational user groups, 2) establish a vehicle for permit sanction against repeat fishery violators, and 3) prevent recreational fishermen from circumventing the possession limit.

13.2.2. Estimate of Reporting Burden and Cost

Approximately 1200 permit applications are expected to be received with about 780 meeting the income requirements (M. Justen, NMFS, SERO). The administrative costs of application form production, mailing, and review for eligibility determination is expected to be $23.36 per permit and $0.70 for each trap tag cost about. The overall permit costs will be $18,221.00. It is estimatedd that about 200 fishermen will also request trap tag that will cost an additional $140.00. All administrative costs will be paid by the permitee. The reporting burden on the public is expected to be about 170 hours for completing and filing permit applications at an approximate cost of $1000.00 for the time required and mailing costs.

13.3. Federalism

No Federalism issues have been identified relative to the actions proposed in this amendment and associated regulations. The affected States have been closely involved in developing the proposed management measures and the principal State officials responsible for fisheries management in their respective States have not expressed federalism related opposition to adoption of this amendment.

13.4. Endangered Species Act and Marine Mammal Act

The proposed actions have no anticipated impact on threatened or endangered species or on marine mammals. A Section 7 consultation was conducted for the original FMP and it was determined the FMP was not likely to jeopardize the continued existence of threatened or endangered animals or result in the destruction or adverse modification of habitat that may be critical to those species; this amendment proposes no changes to the FMP relative to species included in the Endangered Species Act or the Marine Mammal Act.

13.5. Coastal Zone Management Act

Section 307(c)(1) of the Federal Coastal Zone Management Act of 1972 requires that all federal activities which directly affect the coastal zone be consistent with approved State coastal zone management programs to the maximum extent practicable. The proposed changes in Federal regulations governing reef fish in the EEZ of the Gulf of Mexico will not necessarily make federal regulations more consistent with either existing or proposed State regulations but the proposed regulations are necessary to maintain the health of the Gulf of Mexico reef fish resource.

While it is the goal of the Councils and the State to have complementary management measures, Federal and State administrative procedures vary and amendments are unlikely to be fully instituted at the same time. Based upon the assessment of this amendment's impacts in previous sections, the Councils have concluded that this amendment is an improvement to the Federal management measures for the reef fish fishery.

This amendment is consistent with the Coastal Zone Management Program of the States of Alabama, Florida, Louisiana, and Mississippi to the maximum extent possible.

This determination has been submitted to the responsible State agencies under Section 307 of the Coastal Zone Management Act administering approved Coastal Zone Management Programs in the States of Alabama, Florida, Mississippi, and Louisiana. The State of Texas does not have an approved Coastal Zone Management Programs.

13.6. National Environmental Policy Act -- Environmental Assessment.

The discussion of the need for this amendment, proposed actions and alternatives and their environmental impacts are contained in Section 11 of this amendment.

The proposed amendment is not a major action having significant impact on the quality of the marine or human environment of the Gulf of Mexico. The proposed action is an adjustment of the original regulations of the FMP to improve enforceability and fishery yield. The proposed action should not result in impacts significantly different in context or intensity from those described in the Environmental Impact Statement (EIS) published with the initial regulations implementing the approved FMP. The preparation of a formal EIS is not required for this amendment by Section 102(2)(c)(c) of the National Environmental Policy Act or its implementation regulations. For a discussion of the need for this Reef Fish FMP Amendment please refer to Section 11.

Mitigating measures related to proposed actions are unnecessary. No unavoidable adverse impacts on protected species, wetlands or the marine environment are expected to result from the proposed management measures in this amendment (see Section 11).

Both the short- and long-term benefits of more compatible regulations, reductions in reef fish mortality and fishing effort and documentation of resource users and their impacts on the resource will help to improve fishery production, to achieve the objectives of the FMP, and to lessen the environmental impacts of the fishery. Overall, the benefits to the nations resulting from implementation of this amendment is greater than management costs incurred.

Findings of No Significant Environmental Impact

Having reviewed the environmental assessment and the available information relating to the proposed actions, I have determined that there will be no significant environmental impact resulting from the proposed actions.

Approved: ____

Assisstant Administrator for Fisheries   Date

RESPONSIBLE AGENCIES:

Gulf of Mexico Fishery Management Council
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LIST OF AGENCIES AND PERSONS CONSULTED

In addition to extensive comments received during the development of this amendment and thirteen public hearings (minutes and list of persons attending are available upon request) comments were solicited of the following governmental bodies.

Gulf of Mexico Fishery Management Council
- Reef Fish Advisory Panel
- Reef Fish Special Scientific and Statistical Committee
- Standing Scientific and Statistical Committee
- Reef Fish Assessment Panel
- Law Enforcement Advisory Panel

Alabama Coastal Zone Management Program
Florida Coastal Zone Management Program
Louisiana Coastal Zone Management Program
Mississippi Coastal Zone Management Program

Alabama Department of Conservation and Natural Resources
Florida Marine Fisheries Commission
Florida Department of Natural Resources
Louisiana Department of Wildlife and Fisheries
Mississippi Department of Wildlife Conservation
Texas Parks and Wildlife Department

National Marine Fisheries Service
- Southeast Fisheries Center
- Southeast Regional Office

United States Coast Guard

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Wayne E. Swingle, Gulf of Mexico Fishery Management Council
James R. Waters, NMFS, SEFC, Beaufort Laboratory

LOCATION AND DATES OF PUBLIC HEARINGS

March 6, 1989	Key West, Florida
March 7, 1989	Naples, Florida
March 8, 1989	Madeira Beach, Florida
March 9, 1989	Panama City, Florida
March 27, 1989	Port Isabel, Texas
March 28, 1989	Port Aransas, Texas
March 29, 1989	Freeport, Texas
April 3, 1989	Lake Charles, Louisiana
April 4, 1989	Thibodaux, Louisiana
April 5, 1989	Biloxi, Mississippi
April 6, 1989	Fairhope, Alabama
April 27, 1989	Tampa, Florida
July 12, 1989	Key West, Florida

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