FISHERY MANAGEMENT PLAN

for the

REEF FISH FISHERY

of the

GULF OF MEXICO

AUGUST, 1981

GULF OF MEXICO FISHERY MANAGEMENT COUNCIL
LINCOLN CENTER, SUITE 881
5401 WEST KENNEDY BOULEVARD
TAMPA, FLORIDA

FISHERY MANAGEMENT PLAN

for the

REEF FISH FISHERY

of the

GULF OF MEXICO

AUGUST, 1981

GULF OF MEXICO FISHERY MANAGEMENT COUNCIL
LINCOLN CENTER, SUITE 881
5401 WEST KENNEDY BOULEVARD
TAMPA, FLORIDA

1.0 CONTENTS

1.0 TABLE OF CONTENTS 1-1

2.0 SUMMARY 2-1

2.1 Fishery 2-1

2.2 Management Area 2-1

2.3 Species 2-1

2.3.1 Species in the Management Unit 2-1

2.3.2 Species Included in the Fishery but Not in the Management Unit . 2-2

2.3.3 Species Not Addressed 2-3

2.4 Statement of MSY, OY, EDAH and TALFF 2-3

2.5. Problems in the Fishery 2-3

2.6 Goals and Objectives for Management Plan 2-3

2.7 Domestic Management Measures 2-4

2.7.1 Stressed Area (Area Subject to Special Management) 2-4

2.7.2 Fishing Gear 2-4

2.7.3 Bag and Size Limits 2-5

2.7.4 Permits and Gear Identification 2-5

2.7.5 Statistical Reporting System 2-6

2.8 Procedures for Inseason and Corrective Adjustments to Management Measures, MSY and OY 2-6

2.9 Special Recommendations to the Secretary on Research and Development Requirements 2-6

2.10 Special Recommendations to the States 2-7

3.0 DESCRIPTION OF THE FISHERY 3-1

3.1 Areas and Stocks 3-1

3.1.1 Species in the Management Unit 3-1

3.1.2 Species Included in the Fishery but Not in the Management Unit . . 3-2

3.2 History of Exploitation 3-3

3.2.1 Domestic Fishery 3-3

3.2.1.1 Description of User Groups 3-5

3.2.1.2 General Description of Commercial Fishing Effort 3-6

3.2.1.3 Commercial Catch Trends and Value of Catch 3-7

3.2.1.4 Description of Commercial Vessels and Gear Employed 3-10

3.2.1.4.1 Fish Traps 3-11

3.2.2 History of Foreign Fleet Exploitation 3-19
3.2.2.1 Description of User Groups 3-19
3.2.2.2 U.S. Commercial Fishery in the Mexican Economic Zone 3-21
3.2.2.3 Descriptions of Foreign Commercial Vessels and Gear Employed . . 3-21
3.3 History of Management 3-22
3.3.1 Management Institutions, Policies, Jurisdiction 3-22
3.3.1.1 Regulatory Measures Employed to Regulate Fishery 3-22
3.3.1.2 Purpose of Regulatory Measures 3-29
3.3.2 Management of Foreign Fisheries 3-29
3.3.2.1 Regulatory Measures Employed to Regulate Fishery 3-29
3.3.2.2 Purpose of Measures Governing International Fishery Agreements . 3-29
3.3.3 Effectiveness of Management Measures (Foreign and Domestic) . . . 3-29
3.4 History of Biological Research 3-29
3.5 Socioeconomic Characteristics 3-30
3.5.1 Output of Subject Domestic Commercial Fishery 3-30
3.5.1.1 Value of Catch (Exvessel) 3-30
3.5.1.2 Description and Value of Wholesale Product 3-30
3.5.1.3 Domestic and Export Markets 3-31
3.5.2 Domestic Commercial Fleet Characteristics 3-32
3.5.2.1 Total Gross Income of Fleet 3-32
3.5.2.2 Investment in Vessels and Gear 3-34
3.5.2.3 Annual Commercial Fishing Participation 3-35
3.5.2.4 Total Manpower Employed 3-35
3.5.3 Domestic Commercial Processing Characteristics 3-35
3.5.3.1 Gross Income of Area Processors 3-35
3.5.3.2 Investment in Plant and Equipment 3-38
3.5.3.3 Total Employment and Labor Income 3-38
3.5.3.4 Economic Viability 3-39
3.5.4 Recreational Fishing Characteristics 3-39
3.5.5 Subsistence Fishing Characteristics 3-46
3.5.6 Indian Treaty Fishing Characteristics 3-46
3.5.7 Other Activities Directly Related to Fishing 3-47
3.5.8 Area Community Characteristics 3-47
3.6 Interaction Between and Among User Groups 3-55

4.0 BIOLOGICAL DESCRIPTORS 4-1
4.1 Life History Features 4-1
4.2 Stock Units 4-15
4.3 Catch Effort Data for Snappers and Groupers 4-15
4.3.1 Commercial Landings Per Unit Effort 4-15
4.3.2 Commercial and Recreational Catch Per Unit Effort 4-16
4.4 Survey and Sampling Data 4-19
4.5 Other Relevant Data on Habitat, Habitat Concerns, and Habitat Protection Programs 4-19
4.6 Quality of Data 4-25
4.7 Current Status of Stocks 4-25
4.7.1 Maximum Sustainable Yield (MSY) 4-25
4.7.1.1 MSY for Snapper and Grouper 4-25
4.7.1.2 MSY for Sea Bass 4-26
4.7.1.3 Present Condition of the Stocks 4-32
5.0 CATCH AND CAPACITY DESCRIPTORS 5-1
5.1 Data and Analytical Approaches 5-1
5.1.1 Domestic (Commercial) 5-1
5.1.2 Domestic (Recreational) 5-1
5.1.3 Foreign Capacity 5-2
5.2 Domestic Annual Harvesting and Processing Capacity (DAC) 5-2
5.3 Expected Domestic Annual Harvest (DAH) 5-3
5.4 Expected Domestic Annual Processing (DAP) 5-4
6.0 OPTIMUM YIELD CONCEPT 6-1
6.1 Departure From MSY to ABC for Biological Reasons 6-1
6.2 Departure From ABC for Socioeconomic Reasons 6-1
6.3 Optimum Yield (OY) 6-1
6.4 Probable Future Condition of the Fishery 6-2
7.0 TOTAL ALLOWABLE LEVEL OF FOREIGN FISHERY (TALFF) 7-1
8.0 MANGEMENT REGIME 8-1
8.1 Problems and Objectives 8-1
8.1.1 Problems in the Fishery 8-1
8.1.2 Specific Management Objectives 8-2
8.1.3 Objectives Considered and Rejected 8-3
8.2 Areas, Fisheries and Stocks Involved 8-3

8.3 Management Measures and Rationale 8-3
8.3.1 Domestic Management Measures 8-4
8.3.1.1 Stressed Area (Area Subject to Special Management) 8-4
8.3.1.2 Fishing Gear 8-10
8.3.1.3 Bag and Size Limits 8-21
8.3.1.4 Permits and Gear Identification 8-23
8.3.1.5 Statistical Reporting System 8-24
8.3.1.6 Procedures for Adjustment When OY is Exceeded 8-25
8.3.2 Other Measures Considered and Rejected 8-27
8.3.3 Relationship of the Recommended Measures to Existing Applicable Laws and Policies 8-32
8.3.3.1 Other Fishery Management Plans Prepared by a Council or the Secretary 8-32
8.3.3.2 Federal Laws and Policies 8-32
8.3.3.3 State Laws and Policies 8-32
8.3.3.4 Other 8-32
8.4 Enforcement Requirements (inspection, surveillance) 8-33
8.5 Reporting Requirements (foreign, domestic, processors) 8-33
8.5.1 Data Standards 8-33
8.5.2 Time and Place of Reporting 8-33
8.6 Special Recommendations to the Secretary on Research and Development Requirements 8-33
8.7 Special Recommendations to the States 8-33
8.8 Financing Requirements 8-35
8.8.1 Management and Enforcement Costs 8-35
8.8.2 Expected State and Federal Revenues, Taxes, Fees 8-35
9.0 COUNCIL REVIEW AND MONITORING OF THE PLAN 9-1
10.0 REFERENCES 10-1
11.0 APPENDICES (Available from Gulf Council upon Request)

LIST OF TABLES

Number		Page
1.	Total commercial reef fish landings in the Gulf of Mexico, 1957-1976	3-8
2.	Total commercial landings of Gulf of Mexico reef fish by gear type, 1972-1974 average	3-11
3.	Number of fish traps, fishermen using fish traps, and catch of fish by fish traps on the Florida west coast, 1957-1976	3-17
4.	Domestic marketing of grouper and snapper by Gulf of Mexico commercial fish dealers, 1977	3-33
5.	Estimated wholesale value of Gulf of Mexico commercial reef fish, 1976	3-37
6.	Percentage of total number of reef fish caught by method of fishing in the west and east Gulf of Mexico, 1970	3-40
7.	Estimated number of private recreational boats that fished in salt water over a 12-month period by region and size class, Gulf of Mexico, 1973	3-44
8.	Number of commercial sportfishing boats owned and/or operated per boat captain in the Gulf of Mexico, 1977	3-44
9.	Principal port production, population and sales impact characteristics	3-49
10.	Catch data used to generate MSY by the Graham-Schaefer equilibrium model for the U.S. Gulf reef fish fishery	4-17
11.	Effort used to calculate MSY for all reef fish (snapper and grouper) in handline days	4-18
12.	Coordinates of stressed area	8-7

LIST OF FIGURES

Number		Page
1.	Historical fishing grounds	3-4
2.	Recorded Cuban fishing areas	3-20
3.	Port areas and general fishing areas for red snapper-grouper vessels	3-36
4.	Socioeconomic impact of yield limitations; The Gulf reef fishing communities	3-48
5.	U.S. commercial catch of snapper and grouper for the Gulf of Mexico FCZ, 1965-1974	4-20
6.	U.S. recreational catch of snapper and grouper for the Gulf of Mexico FCZ, 1965-1974	4-21
7.	Cuban grouper catch for the Gulf of Mexico FCZ, 1965-1974	4-22
8.	Snapper and grouper catch for the Gulf of Mexico FCZ, 1965-1974 (includes commercial, recreational and Cuban catch)	4-23
9.	Fishing effort (adjusted to standard hardline days) expended in the Gulf of Mexico reef fish fishery, 1965-1974	4-24
10.	Graham-Schaefer yield model for snapper and grouper in the Gulf of Mexico FCZ, 1965-1974 (includes commercial, recreational and Cuban catch)	4-27
11.	Map of the Stressed Area	8-6

2.0 SUMMARY

2.1 Fishery

The reef fish fishery includes the marine and estuarine waters within the authority of the Gulf of Mexico Fishery Management Council shoreward of the outer boundary of the fishery conservation zone (FCZ). The fishery year is from January 1 to December 31.

2.2 Management Area (Unit)

This Plan is for the management of reef fish resources in the area of authority of the Gulf of Mexico Fishery Management Council. The Plan considers the resource throughout its range from Florida through Texas. The area which will be regulated under this Plan is confined to the waters of the FCZ.

2.3 Species

2.3.1 Species in the Management Unit

The following species are managed by this 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
Voraz	Pristipomoides macrophthalmus
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

Southern sea bass	*Centropristis melana*
Bank sea bass	*Centropristis ocyurus*
Rock sea bass	*Centropristis philadelphica*

2.3.2 Species Included in the Fishery but Not in the Management Unit

The following species are included in the fishery for the purposes of data collection. These species are not normally target species and are normally taken incidentally to the directed fishery for species in the management unit. There is insufficient data to compute a maximum sustainable yield (MSY) for these species and no measures are proposed for management of these species in the Plan. If regulation becomes necessary, the MSY and Optimum Yield (OY) will be calculated and the appropriate species will be incorporated into the management unit through the plan amendment process.

Tilefishes - Branchiostegidae 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 sedecim*
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

2.3.3 Species Not Addressed

The tropical reef fishes such as damselfishes (Pomacentridae), angel fishes and butterfly fishes (Chaetodontidae) are not included in this Plan. They will be addressed in a separate Tropical Aquarium Fish Plan after development of a decision profile is prepared by the Council. All grunts and porgies not included in this Plan will be addressed in either the Tropical Aquarium Fish Plan or the Groundfish Plan.

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

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

2.5 Problems in the Fishery

1. Data presented in this Plan reflects that the overall problem in this fishery is a substantial decline in reef fish stocks 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.

2.6 Goals and Objectives for Management Plan

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 economic, social or ecological factors.

Objectives:

(i) To rebuild the declining reef fish stocks wherever they occur within the fishery.

(ii) To establish a fishery reporting system for monitoring the reef fish fishery.

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

(iv) To minimize conflicts between user groups of the resource and conflicts for space.

2.7 Domestic Management Measures

Management measures affecting the domestic fishery are as follows:

2.7.1 Stressed Area (Area Subject to Special Management)

Establish 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' and 83° 0.0' northward and eastward around the Dry Tortugas to a point north of Rebecca Shoal at 82° 35' the outer boundary shall be the 100-foot contour;[1] (2) From the point at 82° 35' eastward and northerly to the south end of Sanibel Island (26° 26') the outer boundary shall be the 60-foot contour;[1] (3) From 26° 26' northward to a point off Tarpon Springs (28° 10') the outer boundary shall be the 120-foot contour;[1] (4) From 28° 10' northward and westward to a point off Cape San Blas (85° 52' and 29° 30.5') the outer boundary shall be the 60-foot contour;[1] (5) From 85° 52' and 29° 30.5' westward to a point off Mobile Bay on the 88° longitude line, the outer boundary shall be at the 150-foot contour[1]. The outer boundary shall then be a line from the point on the 88° longitude north westward to the Alabama/Mississippi state line at the 80-foot contour (38° 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 be at the 100-foot contour[1] (Figure 11 and Table 12).

2.7.2 Fishing Gear

(1) Prohibit the use of power heads[2] for the taking of reef fish within the stressed area.

(2) Prohibit the use of roller trawls in the stressed area.

(3) Prohibit the use of fish traps in the stressed area. Further, provide for seizure of such gear illegally deployed in the stressed area.

---

[1] The contour lines described shall be generic lines consisting of a series of straight lines closely following the actual contours. Turning points on the series of straight lines will be defined by latitude and longitude as well as by loran C coordinates.

[2] Power heads are metal devices with an explosive charge and usually a projectile that fires on contact. It is usually attached to a speargun, spear, pole or stick.

(4) Require degradable or other self-destructing panels or access door hinging devices on fish traps which are constructed as follows:

(4.1) Require the opening covered by the panel (or the access door) be 144 square inches or larger with one dimension of the area equal to or larger than the largest interior axis of the throat (funnel).

(4.2) Require that one panel or access door be located opposite each of the sides that has a funnel.

(4.3) Require that one year after the implementation of this Plan, all fish traps within the FCZ be constructed of material with mesh size of 1 x 2 inches or larger, and there shall be a minimum of two 2 x 2 inch escape windows on each of two sides of the trap.

(4.4) All fish traps fished shoreward of the 300-foot contour within the FCZ shall be 33 cubic feet or smaller in volume.

(5) Require that each vessel fishing traps in the FCZ be limited to no more than 200 such traps.

(6) Prohibit the use of poisons and explosives for the taking of reef fish.

(7) Prohibit the willful pulling of another person's traps and the pulling or harvesting of traps after sundown or before sunrise.

2.7.3 Bag and Size Limits

(1) Prohibit the possession of red snapper (Lutjanus campechanus) less than 12 inches in fork length subject to the following exceptions and conditions: (A) 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 FCZ with the exception of roller trawl vessels fishing in the stressed area is excluded from the possession limit.

2.7.4 Permits and Gear Identification

(1) Require permits for all boats and vessels fishing fish traps in the FCZ (for identification and reporting purposes). Such permits shall be obtained from the Regional Director of NMFS or his designee.

(2) Allow the use of fish traps in the FCZ only from permitted boats and vessels or by persons fishing fish traps from fixed or movable structures who have first obtained a permit from the Regional Director of NMFS or his designee.

(3) Require that all fish traps used in the fishery within the FCZ be identified by a number and all fish trap buoys be identified by a color code issued through the Regional Director of NMFS or his designee, to each boat, vessel or person desiring to use fish traps in the FCZ. Further, require that each trap or string of traps be marked by a floating buoy or by buoys designed to be submerged and automatically released in a certain time; each string of traps shall be marked with a buoy at opposite ends of the string. Further, require that each boat, vessel or structure fishing traps be clearly marked with the same number and color code to allow identification from aerial and water patrol craft. Further, provide for seizure of all deployed gear not properly identified.

(4) Each vessel so permitted shall be issued metal or plastic 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 from the Regional Director or his designee, upon request. Traps fished or aboard vessels in the FCZ which have no such tag attached are illegal gear and may be confiscated by federal officers.

(5) 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.

(6) Each applicant for a permit must specify the number, dimensions and estimated cubic volume of the traps that will be fished under the permit.

2.7.5 Statistical Reporting System

(1) Based on vessel enumeration, it is expected that those vessels fishing for reef fish will be identified.

The Plan shall require a mandatory reporting system, with participation limited to random samples sufficient for fishery management needs from i) charter, guide and party boats; ii) not-for-hire recreational boats; iii) commercial fishing boats and vessels (with the exception of trap fishing boats and vessels); and iv) processors and wholesalers or others purchasing reef fish.

NMFS is requested to develop a data collection and analysis system designed to provide usable data on: levels and frequency of participation in the reef fish fishery; levels of reef fish catch, by species; size composition of the catch; catch per unit of effort; incidental catches of other species; and indicators of the economic value of the fishery.

(2) Require that all boats or vessels fishing with traps be required to report the following information on a periodic basis: (1) size of vessel or boat, (2) total number of traps, (3) size of traps, (4) mesh size of traps, (5) composition of catch by weight and species by trip, (6) water depth, (7) number of traps harvested by trip, (8) location of traps by NMFS statistical grid, and (9) number of trap hauls per trip.

2.8 Procedures for Inseason and Corrective Adjustments to Management Measures, MSY and OY

This plan contains a number of procedures for implementing measures by the regulatory amendment process and by field order.

Procedures contained in the plan for modifying the management measures are as follows:

(1) Procedures for adjustment of mesh size of fish traps (FMP Section 8.3.1.2(8), Part A).

(2) Procedures for limitation on gear use in the fishery (FMP Section 8.3.1.2(8), Part B).

(3) Procedures for catch adjustment when OY is exceeded (FMP Section 8.3.1.6)

2.9 Special Recommendations to the Secretary on Research and Development Requirements

(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.

(2) Encourage immediate development of escape panels or devices on trawls for use in areas where bycatch of juvenile snapper and grouper are high.

(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.

(5) Develop information on sizes of reef fish that should be released by fishermen in the stressed area.

(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.)

(7) The development of self-destruct panels on fish traps is an immediate research need which must be developed and implemented by 1981.

(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.

(9) Modify current NMFS/FDNR study to provide information on the optimum mesh sizes of trap material or initiate research to provide this information.

(10) NMFS to provide Council with information on the correct 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.

(11) That NMFS SEFC place observers on vessels fishing with longlines for reef fish in the Gulf, provided the vessel owners agree to such an arrangement.

2.10 Special Recommendations to the States

The Council recommends that the states implement the management measures proposed in this Plan 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.

3.0 DESCRIPTION OF THE FISHERY

3.1 Areas and Stocks

Reef fishes and the fishery for them have historically been largely conducted within waters shallower than 100 fathoms (183 m). In the Gulf of Mexico this depth approximates the outer edge of the continental shelf. Most reef fish species do not reach commercially exploitable size in shallow water. In this consideration the management area involved (the Gulf/South Atlantic Council boundary on the southwest coast of Florida to the Texas-Mexico boundary) was calculated from maps using a dot planimeter on an equal area projection of the Gulf of Mexico. The fishery conservation zone encompasses 6.82×10^5 km^2 (263,525 square miles), the continental shelf encompasses 3.14×10^5 km^2 (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 0.39×10^5 km^2 (15,054 square miles). This was 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 Oregon II indicate the live bottom in the Gulf to be 0.51×10^5 km^2 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 FCZ is available as habitat for reef fishes but only 5.7 percent is inhabitable within the entire area of the FCZ. Two studies currently in progress by Texas A&M University and the Bureau of Land Management may provide more precise estimates of suitable habitat.

This Plan is for the management of reef fish resources in the area of authority of the Gulf of Mexico Fishery Management Council. The Plan considers the resource throughout its range from Florida through Texas. The area which will be regulated by the federal government under this Plan is confined to the waters of the FCZ.

3.1.1 Species in the Management Unit

The following species are managed by this 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*
Voraz	*Pristipomoides macrophthalmus*
Vermilion snapper	*Rhomboplites aurorubens*

Note: 1 fathom = 6 feet; 1 kilometer = 0.621 miles; 1 meter = 39.37 inches.

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

Southern sea bass	*Centropristis melana*
Bank sea bass	*Centropristis ocyurus*
Rock sea bass	*Centropristis philadelphica*

3.1.2 Species Included in the Fishery but Not in the Management Unit

The following species are included in the fishery for the purposes of data collection. These species are not normally target species and are normally taken incidentally to the directed fishery for species in the management unit. There is insufficient data to compute a MSY for these species and no measures are proposed for management of these species in the Plan. If regulation becomes necessary, the MSY and OY will be calculated and the appropriate species will be incorporated into the management unit through the plan amendment process.

Tilefishes - Branchiostegidae Family

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

Jacks - Carangidae Family

Amberjacks	*Seriola* spp.

Triggerfishes - Ballistidae 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 sedecim
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

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. In the analysis of catch and effort the data were examined both east and west of Mobile Bay (88° meridian) and combined. 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.

While several other reef fishes are caught incidental to the directed fishery for species included in this management unit, they were not included in the MSY calculations. However, as incidental catch items they do contribute to the economics of the directed fishing fleets and must be acknowledged as members of the overall reef fish populations from a biological standpoint.

3.2 History of Exploitation

3.2.1 Domestic Fishery

The reef fishes apparently represent the first target fishery of any consequence for demersal fish in the Gulf of Mexico. While the original settlers undoubtedly relied heavily upon the intertidal and estuarine fish and shellfish for their daily subsistence it was the search for the red snapper particularly, that led to the development of offshore fishing craft and an offshore fishery in the Gulf. Much of this section was taken from personal knowledge, informal interviews and Futch and Torpey (1966).

These settlers, basically centered in the Florida Panhandle in the early 1850's, used small craft equipped with live wells to make their catches. These 40-50 foot craft usually carried three to seven men, but seldom ventured beyond the 40 fathom curve between Mobile Bay and Cape St. George, Florida, for their 500-3,000 pound catches. By the mid-1800's the size had steadily increased to 50-100 foot smacks with crews of eight to 12 men, and trips of two to four weeks to more distant waters became more commonplace. Even by then the traditional grounds were showing signs of this increased fishing pressure, and the vessels were soon venturing southeast of Pensacola to grounds off Tampa and the Dry Tortugas and as far as the western portion of the coast of Texas (Figure 1).

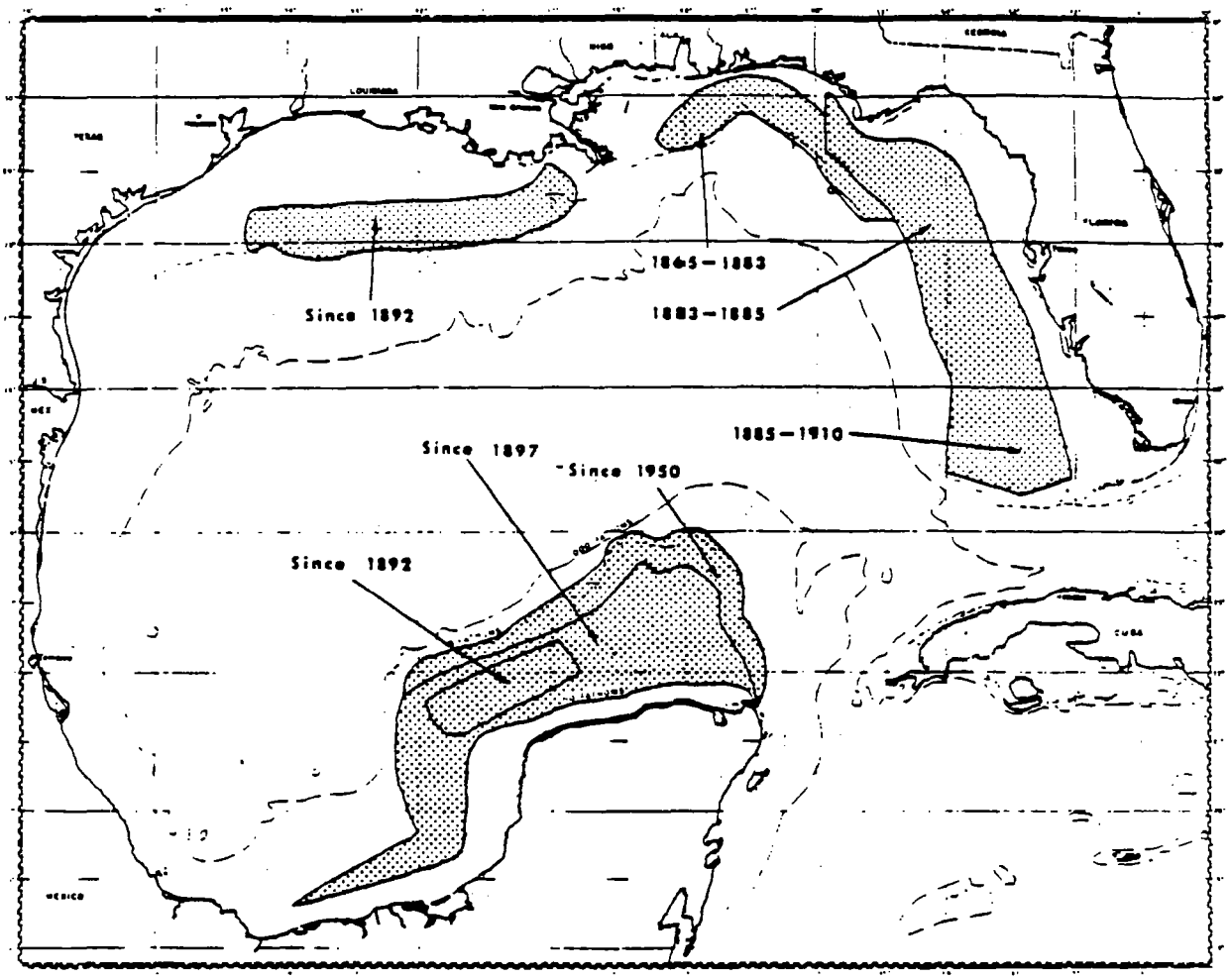


Figure 1 - Historical Fishing Grounds
Source: Carpenter (1965)

The growing influx of new settlers, particularly those from New England, fostered the introduction of the traditional North Atlantic Grand Bank two-masted schooner. Live-well preservation soon gave way to ice since by that time ice making facilities had been established on the Gulf Coast. By the turn of the century, the sail-rigged smacks and schooners were being equipped with auxiliary gasoline engines, and by the mid-1920's, diesel engines provided even additional boosts. These innovations, almost synergistically coupled with increased consumer demand, soon resulted in larger craft, longer trips, bigger loads, and extension of fishing efforts into south Texas and even the Campeche and Yucatan (Mexican) waters. By the early 1900's the reputation of this fine flavored and delicately textured fish had spread to distant consumer areas and "Gulf red snapper" soon became a delicacy featured on gourmet menus from New York to San Francisco. Catches, however, were highly selective and it was the red snapper, Lutjanus campechanus, and closely related Lutjanidae, that were the fishermen's primary target.

Throughout this entire period, the basic fishing gear, hook and line, has prevailed. However, 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. Other methods, such as gill nets, longlines (or trawl lines), hoop nets, fish traps and fish trawls have been tried but with only limited success and the line and baited hook remains by far the most popular and productive gear both commercially and recreationally. (Refer to Sections 3.2.1.4 and 3.2.2.3).

As a result of these technological combinations, the commercial fishery now spans the entire Gulf and since World War II, has been augmented by a mosquito fleet of recreational fishermen using craft that range from small outboard rigs to sophisticated "head boats", whose catch exceeds that of the commercial fleet.

Unlike the snapper, the grouper fishery has been largely confined to Florida waters and until the mid-1950's and early 1960's, it really offered no competition to the snapper in the marketplace. The emphasis centered on snapper, and grouper catches generally were treated as a byproduct and sold at a much lower price. However, these trends have markedly changed and by the mid- and late 1960's, particularly as a result of the leveling off of snapper catches and a growing consumer recognition of grouper as a delectable item, the groupers and snappers became generally interchangeable in the marketplace and on the menus. Certain fleets, particularly along the mid-west coast of Florida, subsist almost entirely upon grouper catches and their snapper catch is generally considered secondary.

The yellowtail snapper fishery has traditionally been confined to the lower Florida Keys and the type and range of the fleet has remained nearly stable throughout the years.

As these fisheries extended geographically and particularly with the advent of the sizeable recreational fishery, so did the composition of the catch, and today the overall directed and incidental reef fish catch includes snappers, groupers, and other reef species. While these differ substantially morphologically and in range, habitat, behavior, and stock, these species are all caught by similar methods and can be logically considered as one single fishery for management purposes.

3.2.1.1 Description of User Groups

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 sophisticated charter and "head boat" equipped with the most 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.[2]

Similarly, commercial fishermen fall into two categories: charter boat or "head boat" operators and commercial fishermen, both of whom are discussed in greater detail in later sections. 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. Of course, those purchasing from, or selling goods to fishermen are indirectly members of this commercial user group.

3.2.1.2 General Description of Commercial Fishing Effort

The number of fishermen fishing for reef fish is estimated as the number of handline fishermen operating on vessels[3]. This estimation procedure appears reasonable since nearly all reef fish are landed by handlines, and by restricting fishermen-count to those operating only on vessels most of the inshore handline fishermen can be eliminated. This restriction, however, does result in a count of less than one-half of the reported handline fishermen as reef fish fishermen. In some areas such as the Florida Keys, handline boats are able to land reef fish during the off season for the primary species such as spiny lobster and stone crabs. These are generally one or two day trips. This, however, is not the general case throughout the Gulf of Mexico in the commercial fishery. In contrast to one or two day trips made by recreational boats, commercial vessels need the capacity to fish from one to three weeks per trip to be profitable.

In 1974, 1,705 fishermen were estimated to be participating in the Gulf of Mexico reef fish fishery (Appendix Table 1). The trend in number of fishermen was upward from 1957 through 1964 when a maximum of 2,302 fishermen were estimated (Appendix Table 1).

The number of fishermen then declined consistently until 1970 when 1,303 were reported. Since 1970, the number of reef fishermen has increased each year.

Currently Florida fishermen account for nearly 68 percent of the total Gulf of Mexico reef fish fishermen (Appendix Table 1). This represents an increase from the mid-1950's when Florida accounted for 55 percent of the Gulf reef fish fishermen. The maximum number of Florida fishermen occurred in 1964 when 1,370 was estimated. In the 18-year time period from 1957 through 1974, three statistically significant trends occurred; increasing until the late 1950's, decreasing to 1970, and again increasing after 1970 (Appendix Tables 1 and 2). (Appendix Figure 1).

Texas accounts for the second largest number of fishermen (Appendix Table 1). During the 1972-1974 period, Texas fishermen accounted for 13 percent of the total reef fish fishermen operating in the Gulf of Mexico. Statistically, the number of Texas fishermen has declined overall by an average of 21 per year since 1972.

Both Alabama and Louisiana fishermen increased in numbers during the early years of the 1957-1970 period but have decreased significantly in recent years (Appendix Tables 1 and 2). The number of Louisiana fishermen peaked in 1962 with a total of 200, while Alabama fishermen peaked in 1966 with 219 fishermen. Mississippi fishermen showed an overall increase through 1970 after which time some decline has been noted.

---

2 All recreational effort data are reported in Section 3.5.4.

3 Vessels are described as craft of five net tons carrying capacity or more.

3.2.1.3 (also 3.5.1.1) Commercial Catch Trends and Value of Catch

Total reef fish landings in the Gulf of Mexico from 1957 to 1976 (Table 1 and Appendix Figure 2) peaked at 24.7 million pounds. They then declined steadily until 1973 when landings amounted to 16.5 million pounds. Landings since then have ranged from 17.0 to 17.8 million pounds. Direction of change patterns for management unit species are presented in Appendix Table 4.

Three significant trends have occurred in the years 1957-1976: landings for all reef fish increased until the mid-1960's, declined rapidly until the early 1970's, and since have begun to stabilize (Appendix Table 3). The value of landings has followed a pattern of steady increases over the past twenty years with a maximum overall value of $10.6 million reported in 1976 (Appendix Figure 3). The 1972-1976 average landings and value of these landings for commercially caught reef fish are shown in Appendix Table 62. Value in terms of real dollars has remained fairly constant for all reef fish as a group since 1964.

Direction of change patterns for all reef fish, red snapper, grouper, and scamp, for each state are shown in Appendix Table 5. After initial increases in all reef fish landings from the five-year period 1957-1961 to the five year period 1962-1966, the direction of change became negative in three states, with landings in the 1972-1976 period less than in the 1957-1961 period for Alabama, Louisiana, and Texas. The overall average for the Gulf of Mexico was positive for this same period. Red snapper landings showed only one increase from the previous period after the initial increases in all states from 1957-1961 and for the five-year period 1972-1976. Grouper and scamp landings demonstrated much the same pattern during the middle periods. However, total Gulf of Mexico landings and Mississippi, Texas and Florida west coast landings for grouper and scamp were greater in the 1972 1976 period than in the 1957-1961 period. The quantity and value of all reef fish, red snapper and grouper, are shown in Appendix Tables 6, 7, and 8, respectively.

The value of Gulf of Mexico reef fish landings has steadily increased since 1957 with a high of $10.6 million reported in 1976 (Appendix Figure 3). While this same pattern for the Florida west coast and Mississippi has maintained itself, total values in Texas, Alabama, and Louisiana have declined during recent years. Alabama's values were highest in 1966, Texas in 1964, and Louisiana in 1962.

Red snapper and grouper dominate the landings and value of landings of Gulf of Mexico reef fish (Appendix Table 62). These species are also the most valuable, accounting for approximately 87 percent of the total value of all reef fish landings in the Gulf. Values for individual states by species for 1975 and 1976 are shown in Appendix Table 9.

Red snapper landings in the Gulf of Mexico reached a peak in 1965, amounting to 13.4 million pounds (Appendix Table 7 and Appendix Figure 4). Since that time landings have declined steadily to a low of 7.1 million pounds in 1976. The same pattern holds true in all five Gulf states. The Florida west coast peaked in 1964, Alabama in 1966, Mississippi in 1968, and Texas in 1964. Recent increases in the mid-1970's have occurred on the Florida west coast after the very low years in the early 1970's, but landings have never reached the earlier peaks. The value of total red snapper landings has also increased substantially to a high of $5.9 million in 1976 (Appendix Table 7 and Appendix Figure 5). The Florida west coast value peaked in 1976.

Grouper (including scamp) landings in the Gulf of Mexico reached a peak in 1965 (Appendix Table 8 and Appendix Figure 6). Landings prior to that time had been on a steadily increasing trend but since that peak, have declined. Almost all grouper landings are concentrated in Florida on the basis of the 20-year time series of data reported in this study. Total value of grouper landings have also increased with the largest value reported in 1976 at $3.2 million (Appendix Table 8 and Appendix Figure 7).

Table 1. Total commercial reef fish landings in the Gulf of Mexico 1957-1976. [b]

Year	Pounds (thousands)	Current dollars (thousands)	Real dollars [a] (thousands)
1957	16,392	3,137	3,255
1958	15,881	3,193	3,374
1959	17,705	3,666	3,735
1960	17,321	3,548	3,739
1961	20,155	3,988	4,220
1962	21,432	4,084	4,308
1963	21,719	4,398	4,654
1964	23,745	5,148	5,436
1965	24,706	5,307	5,494
1966	22,116	5,287	5,298
1967	21,055	5,333	5,333
1968	20,504	5,440	5,307
1969	19,852	6,087	5,716
1970	18,810	5,954	5,393
1971	18,208	6,171	5,418
1972	18,302	7,288	6,119
1973	16,526	7,554	5,608
1974	17,693	8,906	5,563
1975	17,771	9,637	5,510
1976	17,046	10,582	5,731

[a] Deflated by wholesale price index, all commodities, 1967=100. The wholesale price index for all commodities was used because (1) the data are available over the total study period and (2) these real dollar estimates give an indication of the well-being of the industry relative to all other industries rather than some more narrowly defined group. Other of the numerous available indicies could have been used to make other comparisons.

[b] Includes directed catch for those species in the management unit and catch for species caught incidental to the management unit as outlined in Section 2.3.2.

Calculated from: (1) U.S. National Marine Fisheries Service, Current Fisheries Statistics, Landings for Selected States.

(2) U.S. National Marine Fisheries Service, Fishery Statistics of the United States.

Note: Unless otherwise indicated, all data are for U.S. fishermen and U.S. ports.

Landings and values of all other species in the reef fish category are shown in Appendix Tables 10-22. Where available, the landings and values are delineated by state.

In terms of commercial reported dockside prices, red snapper are about twice as valuable as grouper. The average Gulfwide price for red snapper was 83.2 cents per pound in 1976 while that for grouper was 46.7 cents per pound (Appendix Table 23). Since 1964, dockside prices for red snapper landed in Florida generally have been higher than those reported in other states (Appendix Figure 8).

Florida prices began to increase more rapidly than prices in other states beginning in 1964, (Appendix Table 24, Appendix Figure 8), with Alabama and Mississippi prices remaining relatively stable, but by 1973 they were 29 cents per pound lower than Florida prices, and Texas prices were 24 cents per pound lower. These price differentials between states can be attributed both to different market outlets and to quality differences. Some buyers in Florida markets indicated that fish caught in distant waters which have been iced for longer periods of time sometimes bring lower market prices.

Dockside prices actually paid to individual captains or boat owners vary substantially from those reported in the annual statistics (Cato and Prochaska, 1976). The actual price paid depends on the type of agreement between captains or boat owners and buyers. Buyers or fish house owners frequently pay higher prices to independent boats than to company boats with the latter frequently reflecting "accounting prices" resulting from internal recordkeeping procedures. Generally the company-owned boat is paid a price slightly more than one-half the common dockside value because of the record-keeping procedures and slightly different crew's-share agreement. Whereas the independent boat owner must pay all his costs including insurance, depreciation, and fixed costs from the price received from his catch, the company-owned boats account for costs differently and can cover their costs from the lower price. The average prices reported herein measure the weighted average of these two kinds of prices and the accuracy of the reported price would depend upon the particular mix of independent and company-owned boats in each state (Cato and Prochaska, 1976).

Red snapper dockside prices in Florida during late 1977 and early 1978 were as high as $1.97 per pound with vermilion snapper prices at about the same rate. Grouper prices were reported as high as $.95 per pound.

Eight of the eleven ports that landed over 300 thousand pounds of reef fish are located in Florida (Appendix Table 25). The leading port was Pascagoula, Mississippi, followed closely by Panama City, Florida, and Madeira Beach, Florida. The leading snapper port was Pascagoula and the leading grouper port was Madeira Beach.

Some data are available which show the landings of red snapper and groupers by area of catch. Large volumes of red snapper have historically been caught on the high seas off foreign coasts with the highest landings of 6.4 million pounds reported in 1966 (Figure 1 and Appendix Table 26). The percentage of total U.S. red snapper landings coming from waters off foreign coasts was 54.2 percent in 1966. U.S. landings from waters off foreign coasts have since declined both in volume and percentage contribution to total U.S. landings. Landings from waters off foreign coasts have been 1.1 million pounds or less since 1973 and have comprised less than 13 percent of total U.S. landings.

U.S. grouper landings from waters off foreign coasts have shown the same declining pattern as red snappers. A total of 1.2 million pounds were reported in 1963 and 1964 (Appendix Table 27). This represented 18.8 and 15.2 percent of total U.S. landings in these two years, respectively. Landings since 1970 from waters off foreign coasts have been below one-half million pounds each year with the exception of 1974. This level of landings represented between 6.7 and 2.2 percent of total U.S. grouper landings from 1970 to 1977.

Landings of grouper, red snapper, other snappers, porgies and warsaw caught by specified distance from U.S. shores are shown in Appendix Table 28. Between 70.7 and 81.2 percent of all groupers caught [illegible]

tween 1971 and 1976 were caught between 12 and 200 miles from U.S. shores. Red snapper landings from this geographical area ranged from 68.5 to 81.6 percent of total grouper landings for these years. Similar data are given for other snapper, porgies and warsaw in Appendix Table 28.

3.2.1.4 Description of Commercial Vessels and Gear Employed

The number of vessels fishing the Gulf of Mexico reef fish resource is estimated to be the number of vessels fishing with hook and line. With the exception of 1959, the trend in number of U.S. vessels in the total Gulf increased consistently from the late 1950's through 1965 when a maximum of 519 vessels were fishing (Appendix Table 29 and Appendix Figure 9). After 1965 the number of vessels decreased to a low of 316 in 1970. Since then, the number of vessels again increased to 435 in 1974.

The 353 Florida vessels in 1974 made up 81 percent of the total Gulf reef fish vessels (Appendix Table 29). With the exception of the unexplained increases in 1959, 1964 and 1965, the trend in number of Florida vessels has been gradually upward from 108 in 1957 to 353 vessels in 1974. Statistical analysis shows a significant positive trend of 8.8 additional vessels per year (Appendix Table 30). These trends show patterns of growth over time but do not propose to explain reasons for growth.

Alabama vessels increased significantly through 1966 but since then have declined to levels of the mid-1950's (Appendix Tables 29 and 30). The number of Louisiana vessels followed the same trend but peaked in 1962 at 36 vessels. Mississippi vessels increased at an average rate of nearly one vessel per year for the 1957-1974 period. The number of Texas vessels decreased at an average rate of seven vessels per year.

The average size vessel measured in gross tonnage was nearly 35 tons in 1974 (Appendix Table 31). The average size vessel in the Gulf of Mexico reef fish fishery has not changed significantly (Appendix Table 32). This, however, is due to the predominance of Florida vessels which have not shown a significant change in average size (Appendix Tables 31 and 32). Florida vessels on the average are less than one-half the size of those in Alabama, Mississippi and Louisiana and two-thirds the size of Texas vessels. Average size of vessels in all Gulf states except Florida has increased significantly over the past 18 years (Appendix Table 32). Average vessel size in Mississippi increased at an average rate of 3.2 tons per year followed by Louisiana with an average increase of 2.3 tons per year.

Vessels are basically constructed from wood, steel or fiberglass (Cato and Prochaska, 1976). The exact percentage of Gulf of Mexico vessels made of each material is not known. Field observations indicate wooden vessels are still most numerous in the fishery. Fiberglass vessels tend to be concentrated on the lower west coast of Florida and tend to be below average size for the Gulf. The largest vessels, over 60 feet in length, are often of steel construction.

Principal gear used to catch reef fish is handlines (Table 2). This gear type accounted for 94 percent of all reef fish taken during the 1972-1974 period. The number of handlines used from 1957-1974 is approximately equal to the number of fishermen reported in Section 3.2.1.2. Statistics for Louisiana are the exception for the 1958-1966 period when handlines per fishermen varied from 2.9 to 29.6 per fisherman. (In this case, the data are suspect). As many as twelve hooks are used per handline. Generally two types of reels are used. One is a reel powered manually by a large crank (sometimes called a one-arm bandit). The second type of reel is powered by a small electric motor.

The other gear type of importance is shrimp otter trawls (Table 2). The shrimp otter trawl catch bycatch of the shrimp fishery. All other gear types catch less than one percent of the reef fish (Table 2). Type of gear used varies by state and species (Appendix Tables 33, 34, and 35).

Table 2. Total commercial landings of Gulf of Mexico reef fish by gear type, 1972-1974 Average.

Gear Type	Pounds of Gulf Reef Fish Caught by Gear Type ----------000----------	Percent of Total Gulf Reef Fish Landings
Haul Seines, Common	20.4	.1
Otter Trawls, Shrimp	678.0	3.9
Otter Trawls, Fish	3.4	(a)
Pots and Traps, Spiny Lobster	1.8	(a)
Pots and Traps, Fish	148.4	.9
Gill nets, Runaround	163.8	.9
Trammel Nets	31.9	.2
Handlines	16,446.2	94.0

(a) Less than .05

Source: Computed from Appendix Table 33

3.2.1.4.1 Fish Traps

A diversity of portable fish traps are used throughout the world, but the fundamental concept is the same in most areas. Basically, fish enter these traps via one or several entrance funnels, the innermost end of which is directed downward or is constricted. The configuration of the trap varies but frequently may be rectangular, hexagonal, chevron-shaped, conical, semi-cylindrical, heart-shaped or circular.

Traps are commonly employed in various western North Atlantic fisheries. Rivers (1966) described trap fishing for black sea bass, Centropristis striata, off the Carolinas; in this fishery the Chesapeake Bay crab trap is the principal gear used. A local, fairly insignificant trap fishery for sea bass also exists in the northeastern Gulf of Mexico (Godcharles, 1970). Traps are the primary fishing gear used throughout most of the Caribbean, accounting for some 65 percent of the total neritic fish production (Munro, 1974c). In the Virgin Islands, more than 80 percent of the fishermen utilize traps in their operations (Olsen, Dammann and LaPlace, 1978). These traps, commonly known as Antillean traps, are fabricated of galvanized wire surrounding a mangrove pole frame (described by Munro, Reeson and Gaut, 1970). There is a certain amount of geographic variation in their construction, largely reflecting local availability of materials used and preferred trap design.

Puerto Rican and Virgin Island fishermen frequently use chevron or "arrowhead" traps with a single entrance funnel (Munro, 1974b) and these are remarkably similar to those used in Singapore (Burdon, 1954) and Madeira (Hornell, 1950). Jamaican fishermen typically use double chevron or Z-shaped traps with two entrances (Munro, 1974b). Various S-shaped traps, apparently originating in Haiti, are employed in Cuban and Jamaican fisheries (see Buesa Mas, 1962). The University of the West Indies Laboratory has used some experimental metal-framed, stackable traps (Munro, 1973, 1974b). Plan configurations of these basic trap types are diagrammed in Munro (1974b). Recently, Craig (1976) reported good success at capturing snappers with traps slightly modified from Munro's (1973) design.

Munro (1974a) tested various trap types in Jamaica and concluded that the S-shaped traps yielded slightly higher catches than Z-shaped Jamaican traps of comparable size. Z-traps, in turn, collected more fishes than single-funnelled arrowhead (chevron) traps. S-traps also have the distinct advantage of relatively lower (by about 20 percent) construction costs. Moreover, they realize a longer working life due to increased structural rigidity imparted by the curved sides (Munro, 1974a).

Fish traps are used in waters of less than 1.0 m to about 100 fathoms (183 m), though the normal fishing depth is between five and 45 m (Sylvester and Dammann, 1972; Munro, 1974a). Handling of gear is complicated at depths greater than 45 m and generally hook and lining replaces trapping as the usual mode of fishing deeper (i.e., 45-300 m) waters.

Trap location relative to bottom irregularities (e.g., ledges, coral heads, rock piles) may be critical; distances as little as five feet from reefal biotopes have shown surprising differences in catch rates of tropical, coral reef associated species (Sylvester and Dammann, 1972). However, some reports suggest that the relationship of trap location to catch composition may vary geographically, by species, and by depth (Boardman and Weiler, in Press). For example, Craig (1976) found the highest catch weights were obtained in traps set over open sandy bottoms, but High and Ellis (1973) reported the greatest catch rates when traps are positioned on sandy bottoms peripheral to reefs. Traps placed on the reef's surface caught fewer fish than those positioned alongside (High and Ellis, 1973). However, Craig's catch was predominantly snapper (70 percent) whereas High and Ellis reported on tropical reef fish catches. Off southeast Florida, traps positioned on high-relief (to 5 m) reefs produced many unwanted fishes, e.g., angelfishes, surgeonfishes and parrotfishes (Craig, 1976). However, recent studies conducted in south Florida have shown that fish trap fishermen normally place their traps adjacent to the desirable relief areas rather than directly on them. (Sutherland and Harper, in prep.; Taylor and McMichael, in prep.). Summarizing, it seems as though successful trapping techniques may vary widely for differing ichthyofaunas and for dissimilar environmental settings.

Fish traps may be baited or not (Sylvester and Dammann, 1972). High and Ellis (1973) suggested that there was little difference in catch rates between baited and unbaited traps. Conversely, black sea bass fishermen believe that bait is absolutely essential to successful fishing operations (Rivers, 1966).

Most traps in use in the Florida fishery are baited, except in Broward County (Sutherland and Harper, in prep.; Taylor and McMichael, in prep.), whereas most of the traps in the Caribbean fishery (Swingle, Dammann and Yntema, 1970) are apparently not baited and which is a practice recommended by some researchers (Munro, Reeson and Gaut, 1971). However, Wolf and Chislett (1974) found baited traps to be much more effective in taking snapper from deeper waters. Craig (1976) reported an average catch per unbaited trap haul of 20.4 pounds (9.26 kg) for trap sets of five days duration from south Florida. During a six-month period he harvested 9,188 pounds of snapper and approximately 3,000 pounds of other reef fish utilizing 20 traps. Wolf and Rathjen (1974) reported catch rates of 40 pounds per baited trap haul in areas where the catch was predominantly snapper.

Swingle, Dammann and Yntema (1970) reported on a fishing technique in use in the Virgin Islands which was locally called "fundering". This consisted of lowering a thoroughly baited fish trap (usually baited on the outside as well as the inside, to induce a feeding frenzy) to depths of 600 feet or more. After a short interval the trap was hauled. Catches of up to 200 pounds per set were reported. This method was primarily used to harvest snapper (Swingle, Gulf Council, personal communication).

Biological personnel of the Alabama Department of Conservation and Natural Resources utilized this method to collect red snapper for tagging studies. Bill Wade (Department of Conservation and Natural Resources, personal communication) reported an average catch of approximately 100 red snapper averaging about 0.75 pounds for each 10 to 15 minute set on a relatively unfished reef in 35 feet of water utilizing traps of 27 cubic feet in volume. He feels that the technique, if commonly used, could result in overfishing reefs substantially reducing hook and line fishing success.

Research conducted by the various scientists cited in this section suggests that traps set for several days duration are likely just as effective if unbaited. However, traps which are set in relatively unfished areas appear to be much more effective if baited, but must be pulled during the same day and usually within a few hours after setting. Discussions of fish escapement from traps, thigmotrophic associations and behavior which follow support this observation.

Baits, when used, range from materials of nonmarine origin (e.g., animal skins, fruits, cactuses, bread) to fish (commonly sprat, Harengula) and shellfish (e.g., conch). Sea bass fishermen may use punctured cans of cat food to lure fish into traps. Some West Indian fishermen feel that traps should be "preconditioned" or "aged" in the marine environment until algae foul the structure (Swingle, Dammann and Yntema, 1970). In Florida, however, Craig (1976) discovered that new (unfouled) traps caught more fish than older traps.

Fish Behavior and Response to Traps

High and Beardsley (1970) contend that fish enter traps for reasons other than pursuit of bait. Random movements, use of traps as shelter, curiosity, intraspecific social behavior, thigmotrophic associations and predator escapement are probably all important factors contributing to the success of fish traps.

Certain fishes enter traps individually (e.g., groupers) others enter traps as groups (e.g., goatfishes and young jacks) or as pairs (butterfly fishes and angelfishes). Conspecific attraction in schooling species certainly plays an important role in trapping fishes. For example, when a few grunts are trapped within a cage, other grunts outside the enclosure try to join them. Catch composition within traps may actually change appreciably during the period of submergence. Frequently, traps will contain certain species almost to the exclusion of others resulting in considerable intertrap variation in composition (Craig, 1976).

Fish traps do not necessarily prevent escapement of fish from the trap although there is much interspecific variability in ability to escape. Many territorial reef fish have been observed to swim freely in and out of pots (Dammann, 1969). Munro (1974b and 1974a) also reported high escapement rates, averaging almost 12 percent of the daily catch and suggested that the installation of nonreturn devices in funnels would markedly improve the catch. Craig (1976) also believed that fish, for the most part, are not actually trapped within the cages but utilize them for shelter and living quarters. This suggests that the fear that lost pots will operate as "death traps" or "ghost traps" (see Hipkins, 1974) until their deterioration is not well-grounded in fact. This is not to say, however, that certain fishes or groups of fishes do not die in traps. In fish trapping studies conducted by Billings and Munro (1974), four percent of the white grunts entering traps within a two-week interval had died. A recent study in south Florida (Sutherland and Harper, in prep.) revealed an overall, average mortality of 2.6 percent within fish traps. Moreover, certain grouper species may die from

the "stress" associated with capture. Thompson and Munro (1974b) reported that only three of 32 red hind were alive when traps were hauled from 40 m depths after a three-day soak. Craig (1976) commented upon the possibility of installing high-corrosion rate panels in traps to eliminate any chance that fish would be wasted if traps should accidentally become lost in the environment.

Daytime catches in traps are generally greater than nighttime catches for the dominant species groups, i.e., the groupers, squirrelfishes and parrotfishes. In the Bahamas, where grunts dominate trap catches, nocturnal trapping is quite successful (Munro, et al., 1971). Daytime catches may be higher for some species that utilize the traps as habitat and leave via the funnel to forage at night. Catch rates undoubtedly vary according to moon phase, corresponding to tidal pattern, and are generally greatest at the time of spring tides (Munro, et al., 1971; Munro, 1974b). Off southeast Florida, Craig (1976) found that greatest catches were usually associated with rough sea conditions, turbid water and strong bottom currents.

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). In the Caribbean, traps are usually soaked from one to several days. Munro (1974b) reported that cumulative catch in a trap reaches a maximum at seven to ten days. After that, escapement equilibrates with ingress. Escapement reaches about 50 percent in about seven to ten days. Large numbers of fish within a trap may discourage others from entering, thereby further contributing to this 'saturation effect' (Sylvester and Dammann, 1972). Unlike the temperate sea bass fishery, Caribbean pots catch an average of less than 5.5 pounds per trap per three-day period (Olsen, 1978). At relatively unexploited oceanic banks, demersal fish production for traps is 10 to 12 times this figure (Juhl, 1969). Off southeast Florida, Craig (1976) reported an average catch of about 20.4 pounds (of which 15.8 pounds was snappers) in traps soaked for 108 hours. Sutherland and Harper (in prep.) 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, in prep.). Boardman and Weiler (in Press) reported an average catch rate of 9.0 pounds per trap lift of which 86 percent consisted of snapper by number off Puerto Rico. This catch rate was reduced over previous samples, possibly due to increased fishing pressure.

It is commonly believed that traps are highly nonselective and that many species of noncommercial interest are consequently wasted in this type of fishing. A review of the facts resulting from scientific studies and testimony presented at public hearings suggest that this may not be the case. Munro (1974b) reported that nine species of fish and spiny lobster made up about 50 percent (by weight) of the trap catch in the Port Royal area; the remaining catch was divided amongst another 100 species. Olsen, Dammann and LaPlace (1978) reported that of 1,559 individual fish caught in West Indian traps, lane snapper and vermilion snapper together with tomtate (a grunt), accounted for 90 percent by number. Munro (1974b) mentioned that white grunt is clearly the most abundant fish at Port Royal reefs, but only comprises eight percent of the total trap catch. All of this evidence suggests that traps are generally selective and can be set so they are highly selective (Craig, 1976; Boardman and Weiler, in Press). As shown in a series of reports by Thompson and Munro (1974a-c), length-frequency distributions for trap catches do not differ significantly from those for hook and line catches.

Unbaited traps or traps set (soaked) for several days duration are probably less efficient than hook and lines at high stock densities; however, baited traps pulled after soaks of short duration (before mass escapement) would be highly efficient. Munro (1974a) believed that deep trap fishing in the Caribbean might be an economically viable alternative to exploiting reef fishes in areas where hook and lining yielded unacceptable catch rates. Huntsman (in Press) felt traps were especially appropriate to reef fisheries. In the Gulf of Mexico, most grouper and snapper are taken from

relatively few reef complexes where they are concentrated enough to make hook and lining feasible. However, grouper (particularly the red grouper) and the red snapper are also widely distributed in low densities over vast expanses of flat, low relief rock and hard bottoms (Smith, 1976). Trap fishing might be successful in such areas (the Cubans extensively fished such habitats a few years ago with bottom longlines). Trap fishing would also seem well suited for use in highly exploited areas (e.g., Florida Keys) where population densities of groupers and snappers are comparatively low. In some trapping experiments off southeast Florida, Craig (1976) reported a drop in average trap catches from 9 kg per 108 hour soaks to about 7 kg for snappers at the end of only six months (620 trapping events, 101 trap months). However, this may have been related to seasonality.

Catch Composition

Munro (1974b) found the dominant fishes in traps around Port Royal (Jamaica) to be white grunt, surgeonfishes, parrotfishes, red hind, gray angelfish, and bar jack. Other fishes commonly included in Caribbean trap catches include gray and queen triggerfishes, wrasses and boxfishes (Juhl, 1969).

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). Three species (schoolmaster, lane snapper, and yellowtail snapper) largely dominate snapper catches. In contrast to Caribbean snapper catches, Craig (1976) found snappers to be readily caught by traps off southeast Florida where they (almost wholly lane snapper) comprised about 70 percent by weight of the total catch. Snappers comprised only four percent of the catches by weight in the Jamaican study by Munro, Reeson and Gaut (1971). However, Boardman and Weiler (in Press) fished from 40 to 150 fathoms off Puerto Rico and caught primarily blackfin and vermilion snapper between 41 and 60 fathoms and primarily silk snapper from 61 to 90 fathoms.

Jacks enter traps, with the most important species being bar jack and yellow jack. Interestingly, these two species are never taken on baited lines (Thompson and Munro, 1974a). Horse-eye jack, on the other hand, is the most important species in the Caribbean hook and line fishery but rarely enter traps. Grunts are frequently taken in traps. Their schooling behavior is important; when a few individuals enter traps, conspecific attraction induces ingress of other individuals (Billings and Munro, 1974). Grunts comprised nearly 12 percent of Jamaican trap catches analyzed by Munro, Reeson and Gaut (1971). Groupers are readily trapped; red hind and coney dominate West Indian catches (Thompson and Munro, 1974b). The grouper family made up about eight percent by weight of the Jamaican fish trap catch (Munro, Reeson and Gaut, 1971). Lyons (1965) reported the second most important species (by number) in lobster pots at Grand Cayman Island to be the Nassau grouper. Craig (1976) compared composition (by weight) of trap catches off southeast Florida with those of Munro, Reeson and Gaut's (1971) from Jamaica. The three most important families off southeast Florida were snappers (70 percent), jacks (12 percent) and grunts (10 percent). The most important groups in the Jamaican fishery were parrotfishes (16 percent), surgeonfishes (15 percent), grunts (12 percent), groupers (eight percent), snappers (four percent) and jacks (3.5 percent). In a recent study of the Monroe County, Florida trap fishery, Taylor and McMichael (in prep.) reported the following trap composition (by weight): grouper (57.32 percent), grunts (8.21 percent) and snapper (4.61 percent).

However, these data on catches must be viewed in relation to species composition of the areas fished. For example, during 1968 the Virgin Islands Ecological Research Station (Dammann, Swingle and Yntema, 1969) studied the fish population composition and density and the effects of trapping on a typical fringing coral reef. The reef was completely surrounded by a 1/4 inch mesh net to prevent fish from leaving or entering the reef complex. Standard Caribbean fish traps were used to harvest fish from inside the enclosure and eventually all the remaining fish were killed with emulsifiable rotenone and collected. During a 67-day period, three traps were pulled six times and removed 38 percent of the total poundage of reef fish from the reef. This catch was equivalent to 280 pounds of fish per acre of reef with a constant trap density of 30 traps per acre.

The percentage by weight of snapper and grouper taken by traps during this study was 9.62 percent of the total catch. The percentage of snapper and grouper in the reef population was 8.13 percent by weight as determined by collecting and weighing all fish from the reef. Therefore, in this study the catch of snapper and grouper species was in direct relation to their abundance in the reef population.

In general, the Caribbean studies on catch composition were conducted on the fringing reef areas of the shelf where the fish density was generally lower and where the ichthyofauna differs considerably from the Florida and Gulf waters. In general, grouper and particularly snapper make up a smaller percentage of the biomass in the Caribbean than the Gulf area; therefore, percentages of these species in the catches would be lower for the Caribbean.

Craig (1976) believed catch composition could be regulated somewhat by placing traps in different habitats. For example, setting traps on high-relief (to 5 m) rocky bottoms produced a preponderance of "unwanted" species such as surgeonfishes, parrotfishes, and angelfishes. However, when traps were positioned over open sandy bottoms, snappers largely dominated catches.

Status and Regulation of the Fishery

Presently the fish trap fishery is conducted primarily in Florida, with two major areas of concentration being the Florida west coast and south Florida. All trap catch data shown in Table 3 are for the Florida west coast. Between 1957 and 1963 the total number of traps reported on the Florida west coast was maximum at 216 in 1961. None were reported from 1964 to 1967. A total of 800 were reported in 1968, with the number declining to between 100 and 80 from 1971 through 1975. The total increased to 400 in 1976, the last year recorded data are available. The number of fishermen using traps was maximum in 1968 at 38.

Sea bass has 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. No sea bass catch by traps was reported in 1976 (Table 3). The other major species caught by fish traps has been grunts. Maximum catch was 101,600 pounds in 1971. The Florida west coast fish trap fishery has been centered primarily off St. Petersburg northward to New Port Richey (Ernie Snell, NMFS, personal communication).

The last two years of recorded data indicate a shift in the directed catch by traps. In 1975 and 1976, groupers, mangrove snapper, and lane snapper have become a more important component of the catch. Grouper was the most important species in 1976. This probably reflects a change in the area in which traps are fished.

Total catch per trap has varied substantially among the years for which data are available. Variation has ranged from 187 pounds per trap per year during 1976 when grouper was the primary catch, to as high as 2,000 pounds per trap per year when "trash" fish was the primary target. Extreme care should be used in extrapolating these catch rates because of the low numbers of traps reported and small catch areas reflected by the data.

Recent studies conducted in south Florida by National Marine Fisheries Service and Florida Department of Natural Resources have 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, in prep.; Taylor and McMichael, in prep.). This amounts to an estimated total of 2,488 traps being fished by 159 fishermen in south Florida. There appears to be very little use of traps elsewhere in the Gulf. Insufficient current catch data are available to measure their impact on the reef fish resources but observation confirms substantial catches of red grouper, mutton snapper and some yellowtail and other snappers. Many south Florida spiny lobster fishermen are diversifying to this fishery. This gear has provoked considerable

Table 3. Number of fish traps, fishermen using fish traps, and catch of fish by fish traps on the Florida west coast, 1957-1976 [a]

	Number of traps	Number of fishermen using traps		Catch by traps									Total catch per trap
		Full-time	Part-time	Sea Bass	Grunts	Pigfish	Groupers	Mangrove snapper	Unclassified for food	Lane snapper	Trash[e]	Total	
				(pounds)									
1957	200	10	0									c	c
1958	d	d	d									c	c
1959	90	3	0									c	c
1960	90	3	0									c	c
1961	216	6	0								15,500	15,500	72
1962	6	2	0								12,000	12,000	2,000
1963	25	2	0				3,000				10,500	12,500	500
1964	0	0	0									0	--
1965	0	0	0									0	--
1966	0	0	0									0	--
1967	0	0	0									0	--
1968	800	38	0	300,900								300,900	376
1969	634	29	0	218,700								218,700	345
1970	283	15	0	128,900	22,600							151,500	535
1971	100	9	0	85,600	101,600	3,600						190,800	1,908
1972	90	8	0	97,400	61,300							158,700	1,763
1973	95	1	4	75,300	85,200							160,500	1,689
1974	95	1	4	33,700	92,400							126,100	1,327
1975	80	0	5	22,200	61,100		14,600	1,400	21,600			120,900	1,511
1976[b]	400	12	3		3,500		40,200	7,200	21,200	1,400	1,200	74,700	187

[a] Louisiana and Alabama report fish traps in some years but the catch is limited to catfish and bullheads.

[b] Personal communication, Ernie Snell, NMFS. Total of nine boats.

[c] No fish reported other than catfish and eels.

[d] Not recorded

[e] Blue runner and bullheads

Source: U.S. National Marine Fisheries Service, Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual Issues, 1957-1975.

reaction by both commercial and recreational fishing groups who claim that it interferes with their customary fishing activities, and expansion of this fishery may evolve into a major social issue. The claim is also made 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.

Although trap sizes vary greatly in south Florida, the most common size is 2 x 3 x 4 feet. These traps are normally fished at depths ranging from 25 to 150 feet (Taylor and McMichael, in prep.). The number of traps generally runs from 20 to 100 per fisherman.

Currently, the most common material used in fish trap construction in south Florida is vinyl-covered welded wire mesh usually of the size one by two inches or larger. This material is generally favored over the more traditional hexagonal poultry wire. For trap fisheries in the Caribbean, Stevenson (1978) recommended a minimum mesh size of 1.8 inches (4.6 cm) for protection of the red hind stocks of Puerto Rico, and Wolf and Chislett (1974) suggested a two-inch mesh size for protection of silk snapper. Olsen, Dammann and LaPlace (1977) recommended a minimum size of 1.5 by 1.5 inches as near optimum ecologically and economically for the Virgin Islands since it releases small fish while larger mesh sizes would release marketable fish.

Many noncommercial fish taken incidental to trapping operations are killed by embolisms when traps are hauled surfaceward from deep waters. However, the same problem exists for fish that are taken by hook and line from deep reefs. One way to prevent high losses of incidentally taken fish (such as colorful tropical fishes utilized by the aquarium trade) would be to require a larger minimum mesh size. By utilizing the Beverton & Holt yield equation, Munro (1974a) predicted that increasing mesh size above 1.25 inches would increase the total catch value. Because the minimum marketable size is larger in the U.S., it is likely that larger mesh size would be appropriate for the management area. Research should be conducted to determine minimum mesh size that is optimum for the Gulf reef fish fishery and the effect of larger mesh sizes on the fishing effectiveness of the traps, i.e., smaller fish may serve as attractants for the larger fish.

If the use of fish traps becomes a significant fishing method for harvesting reef fish in the Gulf of Mexico, there is a possibility of seriously overfishing the stocks of reef fish particularly in the nearshore waters unless effort by other gear is reduced (see Section 4). Further, the widespread use of this gear could seriously reduce the fishing success (CPUE) of recreational and commercial hook and line fishermen by reducing population abundance in the more accessible areas. Presently, the use of fish traps is largely confined to south Florida.

In the Caribbean where the great majority of all fish harvested are taken by traps, several scientists have expressed concern over overfishing of the resources.

Munro, Reeson and Gaut (1971) report the following:

> "In Jamaica, where the intensity of fishing on the nearshore reefs appears to be higher than any other island in the Caribbean, the abundance of fishes on the reefs is remarkably low. We are working on the hypothesis that the low density of fishes is a direct consequence of exploitation with small mesh traps; that is, that the largest reef fishes and thus usually those which mature at a relatively larger size are subjected to severe biological overfishing, while the smaller reef fishes which mature before recruitment to the traps, are subject to intense exploitation with corresponding low stock density, but are not biologically overfished."

Reporting on another area where the predominant fishing gear used is fish traps, Olsen, Dammann and LaPlace (1975) make the following statement:

> "Our efforts are somewhat tempered by the evidence that the Puerto Rico-Virgin Islands shelf is overfished."

However, during 1979, Dammann (In Press) reported as follows:

> "There was never any consideration of making traps illegal; only in making them responsive to the needs of the fish populations and people of the area."

Fish traps are an efficient (Huntsman, In Press), low cost fishing gear for reef fishes. The use of this gear in various localities in the Gulf of Mexico should be clearly examined through research (Murray, In Press). Current research (largely conducted in other areas) indicates that traps are unlikely to biologically decimate the stocks. 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. Because of the current status of the Gulf reef fish stocks in the nearshore waters and the harvesting potential of traps, some restrictions should be placed on the use of traps in the Gulf fishery. These restrictions may include imposing a reasonable limit on the number of traps per vessel, limiting the number of traps in a given area, prohibiting traps in certain "overfished" areas, regulating size or fishing power of the traps, regulating mesh sizes to allow escapement of juvenile fish, requiring degradable hinging devices and requiring buoy identification by color and number. The number of traps in use in the Gulf and their catch should be determined annually by a statistical system.

3.2.2 History of Foreign Fleet Exploitation

3.2.2.1 Description of User Groups

The best source of data on Cuban fishing ventures in the fishery conservation zone is that of Tashiro and Coleman, (1977). According to their accounts, Cuban vessels of various types have fished waters off Florida and Mexico for mullet, groupers, snappers and other fishes since Spanish colonial times. First efforts were sailing vessels during the 1850's, using live wells. Ice was evidently not used until the late 1940's when many of these sailing vessels were converted. However, as many as 40 of these vessels were still in use in the late 1950's. In 1959, the Cuban government began to nationalize and expand the traditional artisanal fishing industry with one of its main thrusts being the development of a proficient Gulf of Mexico fishery. In 1936, a centralized state fishing administration, the "Institutes Nacional de la Pesca, INP" (National Fishing Institute), was established to coordinate activities and modernize this expanding industry.

Prior to enactment of P.L. 94-265, the fishing grounds utilized by Cuba pertinent to the U.S. snapper and grouper fishery, were off the west coast of Florida, extending from the Dry Tortugas to Cape San Blas with vessels usually fishing 20-80 nautical miles offshore. Figure 2 shows those areas off Florida.

The Cuban fishing effort was directed toward the red grouper, which according to Abascal, 1968, as reported by Tashiro and Coleman, 1977, constituted about 90 percent of the total catch. The average size of the catch was reported at about ten pounds. The remainder of the catch was composed mainly of other groupers, snappers, king and Spanish mackerels, grunts, sharks and porgies.

Catch data on the Cuban fishing effort on the Florida shelf are limited in availability. Tashiro and Coleman, 1977, obtained estimates from the Law Enforcement and Marine Mammal Protection Division of National Marine Fisheries Service, indicating that Cuban catch on the west Florida shelf of groupers and snappers ranged from 3.5 to 5.0 million pounds between 1971 and 1975 with an average of 4.2 million pounds. The U.S. catch for the same area in 1974 was 13 million pounds of snappers and groupers.

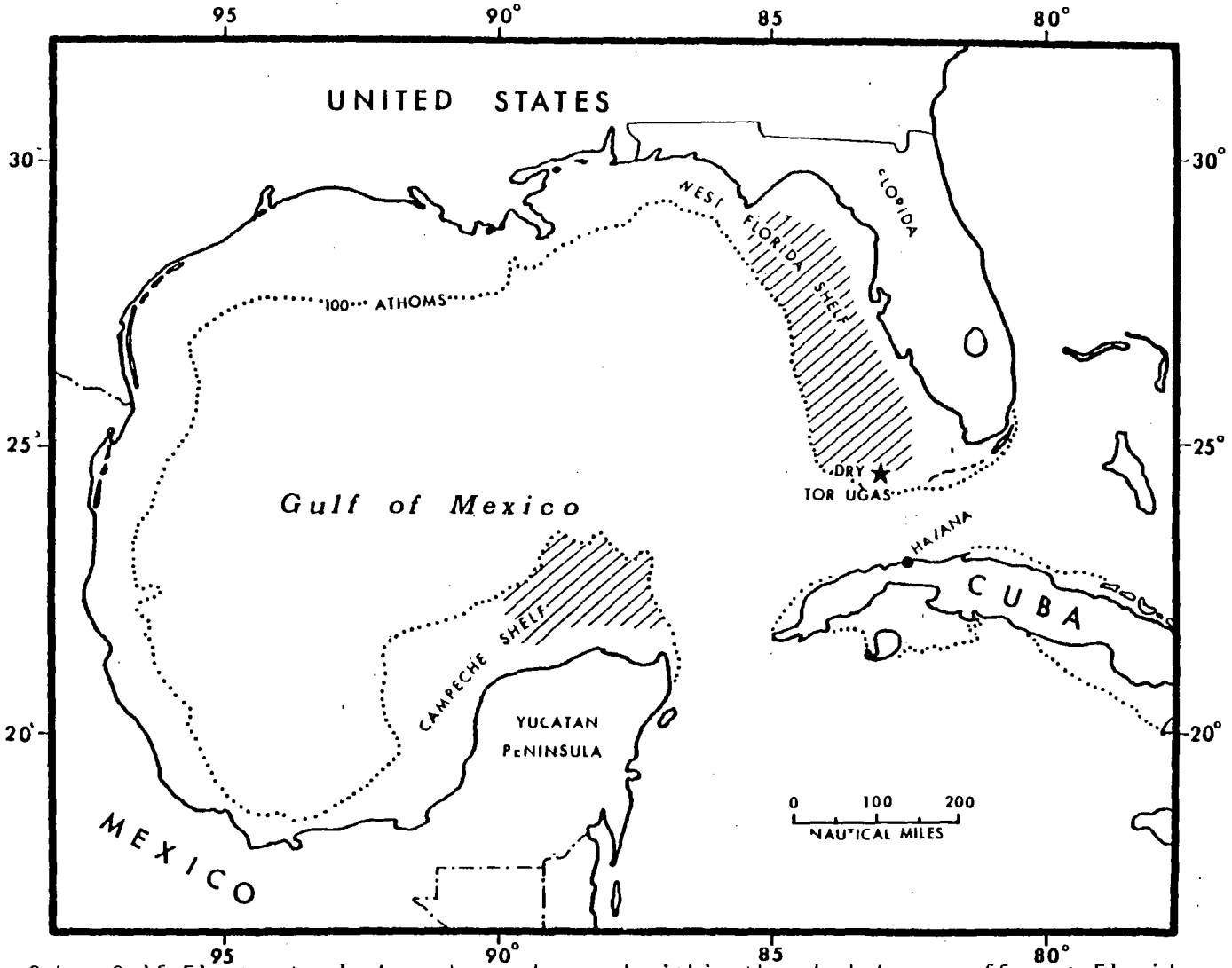


Figure 2 - The Cuban Gulf Fleet vessels have been observed within the shaded area off west Florida. The Campeche Shelf fishing area is also shaded. Sources: Law Enforcement and Marine Mammal Protection Division, NMFS, NOAA, St. Petersburg, Florida 33702; Monthly Report of Foreign Fishing Activities off the Southern U. S. Coast (and other unpublished reports), 1972-76. Carles Martin and Liubimova, 1967; Zupanovic and Gonzalez, 1975. Tashiro, Joseph E. and Susan E. Coleman, The Cuban Grouper and Snapper Fishery in the Gulf of Mexico, U. S. National Marine Fisheries Service, NOAA, MFR, Paper 1265, Miami: October 1977.

One other source of data on the catch of groupers and snappers by the Cuban fleet off the Florida we. coast became available in May, 1977. These data were presented to Dr. Edward Klima[4] by Cuban fishery officials and show the catch of groupers by Cuban fishermen on the Florida west coast and effort in terms of launch days fished. Catch per launch day fished was highest at 930 pounds in 1951 with much lower levels shown beginning with the early 1960's (Appendix Figure 10). Total catch followed much the same pattern.

These data should be used with caution since data given in Tashiro and Coleman, 1977, are estimates and validity of the data presented to Klima is not known. Also, the exact area fished for which the data are reported, is not known. For example, Appendix Table 37 compares data for 1971 to 1975 from the two sources. The range in the data and lack of understanding of its real meaning makes interpretation difficult.

3.2.2.2 U.S. Commercial Fishery in the Mexican Economic Zone

U.S. fishermen participated in snapper and grouper fishing within the economic zone of Mexico in accordance with terms spelled out in the Governing International Fishery Agreement (GIFA) between the United States of America and Mexico signed on November 24, 1976. Conditions in the Agreement for the snapper and grouper fishery were:

a. The annual volume of authorized harvest of snapper and grouper shall be an amount up to 450 metric tons. For this fishery, the government of Mexico will not issue permits for more than 52 fishing vessels of the United States.

b. For snapper and grouper, the permit fees will be $800.00 U.S. dollars, for each vessel. The total of the charges for the amounts of agreed capture will be five percent of the official price of $1,000.00 U.S. dollars per ton, for each vessel of less than 150 tons of net registered tonnage. The annual charge for each vessel will be the total of the charges divided by the number of authorized vessels. For an authorized harvest of 450 metric tons, this charge will be $433.00 U.S. dollars, if the maximum number of authorized vessels apply to fish. If less than that number of vessels apply to fish, at the request of the government of the United States of America, less than 450 metric tons shall be authorized for capture by United States vessels, so that the annual charge per vessel will not exceed $433.00 U.S. dollars.

c. The authorized harvest will take place in the economic zone in the Gulf of Mexico outside 12 nautical miles.

d. Fishing for snapper and grouper and incidentally caught fishes will be restricted to the use of hook and line gear.

U.S. vessels must fill out forms identifying individual crew members for each trip as well as a trip report showing a daily log of catch and fishing effort by zone. During 1977-1978, a total of 26 snapper-grouper vessels were authorized to fish in Mexican waters. This Agreement is still in effect.

3.2.2.3 Description of Foreign Commercial Vessels and Gear Employed

The traditional handline is still used to some degree by the Cuban fleet, although the "palangre de fondo," bottom longline (Appendix Figure 11), came into general use about 1965 and is the principal fishing gear (Tashiro and Coleman, 1977). The bottom longline is 3,280 to 4,921 feet (1,000-1,500 meters) in length, buoyed at each end and weighted in between to keep the longline near the bottom.

---

[4] Director, Galveston, Texas, Laboratory, National Marine Fisheries Service.

As many as 250-330 branch lines, each with a baited hook, are spaced about 10-20 feet (3-6 m) apart on the fishing portion of the longline. The bottom longline is set and retrieved manually from launches.

In recent years, the Cuban Gulf fleet was composed mainly of "Lambdas," 75-foot (23 m) diesel powered, wooden hulled vessels, capable of speeds of about ten knots. The fish hold capacity is about 33 tons. Each Lambda has a complement of 11-20 men. There were 1,082 men in the Gulf fleet in 1975. Most of the crew are trainees and students between 16 and 25 years of age. There appears to have been about 65 vessels in the fleet in 1963 with an increase to about 140 in 1967. The number appears to have declined to about 55 in 1975.

Each Lambda serves as a mother vessel and usually has six 16-foot fiberglass longlining launches on board. During a day's fishing, the longline is set and traversed by the launch six to eight times per day. The fishing trip cycle is about 40 days: ten days in port, 27 days fishing, and three days in transit. Each vessel averages nine trips annually. Beginning in 1971, the vessels began to operate in flotillas of from two to four Lambdas each. One Lambda returns to Cuba during the midpoint of each trip with the total catch of the flotilla and returns with supplies.

3.3 History of Management

3.3.1 Management Institutions, Policies, Jurisdiction

3.3.1.1 Regulatory Measures Employed to Regulate Fishery

This FMP represents the first attempt to directly manage the reef fish fishery. Most reef fish occur offshore. Consequently, only a limited number of state laws have attempted to directly manage the fishery. Other state and federal laws affect the reef fish fishery indirectly. This limited amount of management is reviewed in the following sections.

A. State:

1. Alabama - (all citations to code of Alabama)

a. Marine fishery resources in state waters are owned by the State of Alabama. Such resources are under the exclusive control of the Department of Conservation and Natural Resources of the State of Alabama.

b. In the event a license fee is to be assessed for any given fishery activity, that fee is to be doubled for a non-resident (9-12-80).

c. Miscellaneous statutory provisions having potential impact upon the grouper-snapper fishery as follows:

1) License fees for packing, canning or processing of seafood, $50 (9-12-88).

2) Size of mesh of seines, nets or trawls used for taking saltwater fish, baits, etc., to be prescribed by Department of Conservation and Natural Resources (9-12-110).

3) Length of lead lines of seines, nets, etc., used for taking of saltwater fish, etc.: maximum 500 fathoms except purse seines (1-12-111).

4) Licenses for use of nets and seines: $1.00 commercial hook and line license (9-12-113).

5) Licenses for wholesale and retail dealers of fresh saltwater fish. Wholesale: $25 per year; Retail: $5 per year (9-12-114).

6) Limit of 25 snapper per day with two-day possession limit on persons fishing in Alabama waters or landing fish at Alabama ports; red snapper must be eight inches or larger (78-MR-10).

d. Alabama is a participant in the Gulf States Marine Fisheries Compact (9-12-180). Participation in the Compact is discretionary with the members, and the Compact has no regulatory authority.

2. Florida - (all citations are to West's Florida Statutes Annotated Sections)

a. The Department of Natural Resources is the regulatory agency for natural resources (370.013) with regulation of the marine resources being the responsibility of the Division of Marine Resources of such Department (370.02). Those responsibilities include: regulation of fishermen and vessels; fishing; issuance of licenses; maintaining statistical records of catch, gear, etc. (370.02).

b. Ownership of all saltwater fish in waters within state jurisdiction (Gulf of Mexico) is vested in the State (370.02).

c. State license requirements:

1) Purse seines - $25 per year (370.06).

2) Alien and nonresident commercial fishermen (saltwater), except for personal use - $25 per year (370.06).

3) Resident wholesale seafood dealer - $100 per year (370.07).

4) Nonresident wholesale seafood dealer - $150 per year (370.07).

5) Alien wholesale seafood dealer - $500 per year (370.07).

6) Resident retail seafood dealer - $10 per year (370.07).

7) Nonresident retail seafood dealer - $50 per year for each county in which they do business for each business in that county (370.07).

d. Regulation of fishermen or equipment:

1) Use of purse seines, purse gill nets, and pound nets for catching food fish prohibited (370.08).

2) Caught fish not retained must be immediately returned to the water alive (370.08).

3) Use of explosives or poisons prohibited (370.08).

4) Use and possession of fish traps and landing of fish taken by fish trap are prohibited effective October 1, 1980, (S.B. 46, Chapter 80-63). This plan allows use of fish traps outside of state territorial waters in the FCZ and assumes this state act will not impinge on this fishing privilege within the FCZ.

e. Size limitations of fish caught:

Grouper of the following species of less length than 12 inches from tip of nose to rear center edge of tail may not be taken: (370.11)

Red grouper (Epinephelus morio)
Jewfish (E. itajara)
Nassau grouper (E. striatus)
Black grouper (Mycteroperca bonaci)
Gag (M. microlepis)

f. Spearfishing:

Spearfishing is prohibited within the boundaries of the John Pennekamp Coral Reef State Park and in the area of Monroe County known as the Upper Keys (includes all salt waters under the jurisdiction of the Department of Natural Resources beginning at the county line between Dade and Monroe counties and running south, including all of the Keys down to and including Long Key) (370.172).

g. Gulf States Marine Fisheries Compact - Florida is a participant (370.20).

h. County regulations:

1) Citrus - (Chapter 63-1220, Special Acts 1963): Spearfishing prohibited in county waters - includes salt waters.

Groupers less than 12 inches tip to tip may not be taken in county waters. (Chapter 63-1218).

2) Collier - Spearfishing prohibited in county waters - includes salt waters. (Chapter 30665, Special Acts 1965).

Restrictions on the usage of nets or seines in county waters (Chapter 69-1097, Special Acts of 1969).

3) Hernando - Spearfishing prohibited in county waters (Chapter 65-1622, Special Acts 1965).

4) Lee - Restrictions on the usage of nets or seines in county waters (Chapter 23951, Special Acts of 1947).

5) Levy - May not fish with any nets less than one and three-eights inch mesh (Chapter 21355, Special Acts 1941). May not use nets longer than 100 yards or set closer than 500 yards to another net (Chapter 77-595, Special Acts 1976).

6) Monroe - Use of traps prohibited except for taking of crawfish during season; provided, however, each commercial fishing boat may have one wire trap five feet long, two feet high and two feet wide (Chapter 29299, Special Acts 1953).

7) Pinellas - Restrictions on the usage of nets or seines in county waters (Chapter 29432, Special Acts 1953).

8) Santa Rosa - Prohibition against the use of seines of one and one-quarter inch bar, measured from knot to knot, or a stretched mesh of two and one-half inches length measured from knot to knot (Chapter 7584, Special Acts 1917).

9) Sarasota - Restrictions on the usage of nets or seines in county waters (Chapter 57-1844, Special Acts 1963).

10) Taylor - Taking of fish with haul seines or drag nets in county waters prohibited (Chapter 6311, Special Acts 1911).

11) Walton - May not use seine of less than one and one-quarter inch bar or mesh of less than two and one-half inches length (Chapter 7613, Special Acts 1917).

12) Dixie - Prohibition against use of net 1,000 yards or longer and against the setting of net within 500 yards of another net in county waters (Chapter 77-541, Special Acts 1976).

3. Louisiana - (All citations to Louisiana Revised Statutes Annotated Title 56)

a. Ownership of fish in state waters is in state and as such subject of state regulation and control (Title 56, Section 312). The marine fishery resources of the state are under the management and conservation jurisdiction of the Department of Wildlife and Fisheries (Louisiana Constitution Article IX, Section 7); The Louisiana Wildlife and Fisheries Commission is the agency vested with enforcement authority under the Department of Wildlife and Fisheries (Title 36, Section 601).

b. Control of fisheries - Control of fish having sport or game value is vested in Wildlife and Fisheries Commission (Section 313).

c. Closed seasons - Closed seasons or restricted fishing zones may be imposed (Section 317).

d. Methods of taking saltwater fish:

1) Commercial fish may be taken only with pole or line or yo-yo or handline or trotline (hooks not less than 24 inches apart) or with legal seines or net (Section 320).

2) Illegal to use explosives, poisons, etc. (Section 320).

3) Elevated trotlines are prohibited (Section 321).

e. May not conduct fishing operations in such a manner as to destroy nets or natural hiding places of young fish (Section 328).

f. Fishing licenses:

1) Resident - $2 per year unless below age 16 or over age 60 (Section 333, 643).

2) Nonresident - $6 per year (or $3 for seven days) (Section 334).

3) Commercial - resident - $5 per year; resident net fisher - $5 per year per 300 feet of net; nonresident $1,000 per year (Section 337).

g. Dealer licenses.

h. Louisiana is a participant in Gulf States Marine Fisheries Compact.

i. Local regulations - none provided after request to Louisiana Department of Wildlife and Fisheries. Assumed there are none; just state regulation.

4. Mississippi - (All citations are to Sections of Mississippi Code Annotated).

a. Marine fishery resources in state waters are owned by the state (Section 49-15-5). Such resources are under the regulatory control of the Mississippi Bureau of Marine Resources (Section 49-15-11).

b. Licenses:

1) Fishing vessels: All vessels used in catching or transporting fish for commercial purposes shall pay fees as follows: $1 per year for commercial hook and line; $7.50 per year on boats using trammel nets, gill nets or seines of not more than 200 fathoms in length; $15 per year on boats using seines or other nets over 200 but less than 300 fathoms in length; $25 per year on boats using seines or other nets over 300 but less than 400 fathoms in length; $50 per year on boats using seines or other nets over 400 but less than 500 fathoms in length (49-15-29).

2) Factories: All factories canning fish - $100 per year privilege tax (49-15-29).

3) Wholesale dealers - $20 per year (49-15-29).

c. Mississippi is a participant in the Gulf States Marine Fisheries Compact.

d. Local - (none provided after request to Mississippi Bureau of Marine Resources; assumed there are none).

e. Note: Letter received from Richard L. Leard, Director, Bureau of Marine Resources stated:

"The waters under our state's jurisdiction do not contain significant reef fish fisheries and at present we have no regulations concerning these fishes. We have only a small recreational fishery in our waters, mostly in the vicinity of several artificial reefs..."

5. Texas - (All citations to Vernon's Texas Code Annotated Sections)

a. Marine fishery resources in state waters are in the ownership of the state and are subject to the regulatory control of the Parks and Wildlife Department (Section 1.011 Parks and Wildlife).

b. Licenses:

1) Fishing, resident: $4.50 per year (Section 46.004) excepting persons under 17 or over 65 (Section 46.0011).

2) Fishing, nonresident: alien: $10.50 per year (Section 46.004). Temporary license for five-day period for $4.50 (Section 46.0051).

3) Commercial fishing - $10 per year (Section 47.002).

4) Fishing boat - $6 per year (Section 47.005).

5) Wholesale dealers - $250 per year per place of business (Section 47.009).

6) Wholesale truck dealers - $125 per year per truck (Section 47.010).

7) Retail fish dealer:

a) $6 for each place of business in a city or town with population less than 7,500 (Section 47.011).

b) $15 for each place of business in a city or town of population between 7,500 and 40,000 (Section 47.011).

c) $20 for each place of business in city or town of population greater than 40,000 (Section 47.011).

8) Seine or net license (if used for catching aquatic life for pay or sale) $1 per 100 feet or portion thereof. Maximum length -1,800 feet; minimum mesh - one and one-half inches from knot to knot (Section 47.015).

c. County regulations:

None impacting (letter from Texas Parks and Wildlife Department, April 6, 1973).

d. Note - Letter received from C. E. Bryan, Texas Parks and Wildlife Department stated:

"I can think of no state or local regulations that impact upon the grouper and snapper fisheries in Texas. Most of the fishery for these species exists in the FCZ and therefore does not come under State jurisdiction. Snappers and groupers are caught in State waters, but there are no regulations pertaining to their management."

e. Texas is a participant in the Gulf States Marine Fisheries Compact.

B. Federal:

1. Coastal Zone Management Act of 1972 (16 U.S.C. 1451 et seq.) Regulations promulgated by the National Oceanic and Atmospheric Administration regarding the content of fishery management plans mandate that those plans be consistent with state coastal zone management plans approved in accordance with the CZMA. This Act provides a framework for federal support for state programs directed at coastal zone management in accordance with standards established by the federal government. To date Alabama, Louisiana and Mississippi of the constituent states of the Gulf of Mexico region have adopted approved coastal zone management programs.

2. Marine Protection, Research and Sancturies Act of 1972 (16 U.S.C. 1451 et seq.) Under this Act the Secretary of Commerce is vested with the authority to designate as marine sanctuaries those areas of ocean waters within U.S. jurisdiction and superjacent to the continental shelf of the United States which are determined to be necessary for the preservation and restoration of such areas for purposes of conservation, recreation, ecological or esthetic value. The designation is made with the agreement of the Governor of

any affected state to the extent of state water involvement. Key Largo Coral Reef Marine Sanctuary is the only designated sanctuary of concern herein, although Looe Key in Florida and the Flower Garden Banks off Texas are under consideration as sanctuaries.

3. Submerged Lands Act (43 U.S.C. 1301 et seq.) This Act granted to the states title to and ownership of the natural resources (including fish) in the lands beneath the navigable waters in the territorial sea.

4. Reef fish communities inhabit reef and other hard bottom areas. Protection of the bottom communities they occupy is of vital importance. Therefore, federal legislation pertaining to the protection and management of marine coral communities has an impact on reef fish management. Under authority of Sec. 5, Outer Continental Shelf Lands Act (67 Stat. 462; 43 U.S.C. 1334), the Bureau of Land Management (U.S. Department of the Interior) has issued regulations relating to the protection and management of viable coral communities located on the Outer Continental Shelf. These regulations, published in the Federal Register, September 16, 1976 (Vol, 41, No. 181) state that "no person shall engage in any operation which directly causes damage or injury to a viable coral community that is located on the Outer Continental Shelf ..." The federal district court in New Orleans has ruled that BLM authority under this act applies only to coral communities associated with oil and gas leasing practices; therefore, these provisions only apply to reefs in tracts leased for oil and gas development.

5. Other federal laws of tangential impact:

   a. National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) requires the preparation of a detailed Environmental Impact Statement for any major federal action significantly affecting the environment. An EIS is required for a federal fishery management plan.

   b. Estuarine Areas Act (16 U.S.C. 1221 et seq.) supports coordination with states for purpose of conservation, protection, and restoration of resources of estuarine areas.

   c. Fish Restoration and Management Projects (16 U.S.C. 777) provides federal support for state fish restoration and management projects.

   d. State Commercial Fisheries Research and Development Projects (16 U.S.C. 778) provides for cooperation and funding by Secretary of Commerce for research and development projects by states regarding commercial fisheries.

   e. Reefs for Marine Life Conservation (16 U.S.C. 1220) provides for state acquisition of Liberty ships to sink for offshore artificial reefs.

   f. Deepwater Ports Act of 1974 (33 U.S.C. 1501 et seq.) establishes procedures for the location, construction, and operation of deepwater ports off United States coasts.

   g. Rivers and Harbors Act of 1899 (33 U.S.C. 407 et seq.) prohibits the alteration of any navigable water within U.S. jurisdiction unless authorized by Corps of Engineers, and also requires permits for construction of artifical reefs.

   h. Fish and Wildlife Act of 1956 (16 U.S.C. 741 et seq.) declares that fish resources of the United States constitute a material contribution to the health, recreation and well being of the United States and authorizes programs and investigation required for the development, management, conservation and protection of the fishery resources of the United States.

i. The Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.) is for the conservation of endangered and threatened species. Because of the possibility that sea turtles may become entangled in fish trap gear, the Gulf of Mexico Fishery Management Council has held a Section 7 threshold consultation with the Fish and Wildlife Service and the National Marine Fisheries Service. The resulting biological opinion considered all aspects of the fishery on threatened and endangered species. No adverse impacts on threatened or endangered species are anticipated from implementation of the Plan.

j. Marine Mammal Protection Act of 1972 (16 U.S.C. 1361 et seq.) is for the conservation and protection of marine mammals. There are no records of marine mammals having been adversely affected by activities of the reef fish fishery.

C. Indian Treaties:

There are no impacting Indian treaties.

3.3.1.2 Purpose of Regulatory Measures

The generally acknowledged and codified purpose for fishery management regulations set forth herein is to provide for effective and responsive fishery management in a manner consistent with the best interests of the populace of the given state and directed to the preservation and maintenance of the fishery.

3.3.2 Management of Foreign Fisheries

3.3.2.1 Regulatory Measures Employed to Regulate Fishery

Subsequent to the adoption of the Fishery Conservation and Management Act of 1976, the only foreign agreements and/or treaties of impact upon the reef fish fishery of the Gulf of Mexico are the Governing International Fishery Agreements with Cuba, Mexico and Japan.

3.3.2.2 Purpose of Measures Governing International Fishery Agreements

These Agreements spell out the basic guidelines within which foreign countries may undertake to fish within U.S. waters.

3.3.3 Effectiveness of Management Measures (Foreign and Domestic)

The effectiveness of any given regulatory measure is difficult to ascertain. It is a subjective determination and as such any analysis is purely speculative. It must be assumed that they are sufficiently effective in light of the goals for which they were enacted; otherwise it would seem logical that they would have been abolished.

3.4 History of Biological Research

In preparing this Plan more than 1,000 published and unpublished literature references were examined which pertain to the families Serranidae, Lutjanidae, Branchiostegidae, Carangidae, and Balistidae. Of these, approximately 350 have direct application of life history information upon which the biological and fishery data in this Plan are compiled. Of the 350 literatures examined, 89 pertain to the biology of the reef fishes off the coastal U.S. (excluding the Gulf of Mexico), and 111 deal strictly with reef fish studies conducted outside the Gulf of Mexico. Within the Gulf, 130 of the literatures are concerned specifically with the reef species occurring over the U.S. continental shelf. There are an additional 31 references which deal with reef fishes in the Gulf but outside the U.S. continental shelf area.

Seventy-one percent of all 350 references surveyed were published in the last 20 years (since 1958), 17 percent were published between 1928 and 1958, and the remaining 12 percent were published the previous 50 years (between 1928 and 1979).

The history of research on the reef fish species comprising the fishery shows that most of the interest has been by American researchers within the U.S. Gulf of Mexico and most of this is relatively recent information. It is important to indicate that there has been much information published on these same reef species within the Gulf by Brazilian, Cuban, Russian, and Mexican researchers. All of these have been published since 1955, and a goodly number have been published within the last ten years.

3.5 Socioeconomic Characteristics

3.5.1 Output of Subject Domestic Commercial Fishery

Reported as landings under Section 3.2.1.3.

3.5.1.1 Value of Catch (Exvessel)

Reported under Section 3.2.1.3.

3.5.1.2 Description and Value of Wholesale Product

Several levels in the marketing system can be considered as wholesale levels. The commercial dockside values discussed in Section 3.2.1.2 are exvessel values paid to fishermen. (Fish at this market level are fresh fish in the round.) In 1976, the current value of all reef fish to the fishermen in the Gulf was $10.6 million.

The total market value of reef fish depends on quantity and prices. Prices received per pound are a function of seasonal supply and demand factors such as personal incomes of consumers (Cato and Prochaska, 1976). Demand analyses at the dockside level are available only for red snapper and grouper of all species in the reef fish complex.

Price response equations for red snapper prices in Florida, Texas, Alabama and Mississippi demonstrate the importance of the Florida industry in influencing annual dockside prices. The quantity of red snapper landed in Florida was statistically significant in influencing Florida prices (Appendix Table 63, Equation 1). Total personal income in the United States was used to measure increase in demand, resulting from higher personal income and greater population. The income coefficient was significant. The estimated Florida price equation shows that a one million pound increase/decrease in red snapper landings would result in a 5.5 cent decrease/increase in average dockside price paid at Florida ports.[5] Similar equations estimated for Texas, Alabama, and Mississippi, however, did not result in significant price-quantity relationships. In addition to the nonsignificance, statistical estimation problems for these three equations also made them unacceptable. Further examination, and the fact that Florida dockside prices are much higher than dockside prices in the other three states, suggests the Florida industry may be a price leader for the United States. Since Florida lands a large portion of the total commercial catch, pays a higher price, and is able to influence the total market, the less dominant states in the industry may pay prices based on Florida prices and, in turn, accept the remainder of the total market share.

---

[5] Current dollars were used in these equations. This may have contributed to the strong and highly significant relationship between price and income. However, given the exceptionally high significance levels, use of real dollars probably would have still resulted in significant coefficients.

To test this hypothesis, regressions were estimated relating other state prices to Florida prices. Prices paid in Florida were extremely important in influencing prices in each of the other three states (Appendix Table 63, Equations 2, 3, and 4). A one-cent increase in Florida price resulted in price increases in Texas, Alabama, and Mississippi of 0.54, 0.27, and 0.36 of one cent respectively.

Landings of red snapper in each of these states were not statistically important in influencing prices in that state. Both total personal income and quantity landed were important in influencing dockside price for the total U.S. industry (Appendix Table 63, Equation 5).

Total personal income and quantity landed were both important in determining annual grouper prices (Appendix Table 64). A one million pound increase in the quantity of groupers landed in Florida would cause a 1.3 cent decline in dockside prices (Appendix Table 64, Equation 1). In the industry as a whole, the same landings increase would cause a one-cent decrease in U.S. prices (Appendix Table 64, Equation 2). As with red snapper, grouper prices in the other Gulf states appear to be more responsive to grouper landings in Florida than to grouper landings within those states.

Changes in quantities landed and personal incomes of consumers affect exvessel fish prices and thus the value of wholesale fishery products throughout all market levels. In addition, at market levels above dockside, costs of such items as marketing services and processing activities impact on the value of the wholesale product. These costs, including net returns to marketing agents, are reflected in marketing margins between the various levels in the marketing systems. Unfortunately, price statistics are very limited and questionable at the various levels in the marketing system above the dockside level.

It is estimated that at least 30 percent of Florida landings of reef fish are shipped to the New York Fulton Fish Market, and the prices at that market generally affect the local dockside price paid to the fishermen. It is estimated that if all Gulf of Mexico reef fish were shipped to the New York market, the wholesale value of Gulf red snappers would be $12.3 million, grouper would be $5.7 million, and the total of all reef fish from the Gulf would amount to $22.7 million (Appendix Table 65).

Several points must be considered in the evaluation of the difference in wholesale value between the New York market level and the fisherman level: (1) The difference in the dockside and New York value represents two or three levels of market agents, the local fish house dealer, in some cases assemblers between local dealers and the New York market, and dealers or brokers operating at the New York market. The spread thus represents costs and profits for several agents in the market system. (2) The above estimate assumes all of the product is sold through the New York market. Perhaps as much as two-thirds of the product is shipped to areas outside of the northeast. A transportation differential of approximately $3.68 per box is estimated for fish consumed within the southeast. Secondary market prices thus would be lower to reflect this difference. If two thirds of the reef fish are consumed in the southeast, then the estimated total value at comparable market levels would be $22.3 million. This lower estimate reflects the lower transportation cost of shipping to markets located closer to the production area.

3.5.1.3 Domestic and Export Markets

Published research and statistics describing markets for Gulf of Mexico reef fish are not available. A telephone survey was taken from 30 percent of the dealers classified as handling reef fish species to develop this portion of the Plan. Thirty-nine dealers were listed as reef fish dealers in 1977 by the National Marine Fisheries Service. Respondents were selected from each of the states in the Gulf. Over 90 percent of snappers and 30 percent of groupers landed in 1977 were accounted for in the survey. The smaller percentage of total grouper landings represented by the survey is due to wider distribution of grouper landings and thus more dealers handling groupers.

This survey indicated that over 77 percent of the groupers handled by Gulf of Mexico fish dealers are shipped to buyers within the southeast (Table 4). Only 15 percent of the groupers are shipped to buyers in northeastern markets such as New York and Chicago, indicating a southern preference for groupers compared to red snappers. More than 58 percent of red snappers are shipped to buyers in the northeast.

The majority of groupers are shipped in fresh gutted form on ice while nearly all (93.7 percent) red snappers are shipped in this form (Table 4). Very often red snapper are filleted while over 16 percent of the grouper are filleted. The larger proportion of groupers being filleted is perhaps due to the relatively larger proportion (36 percent) shipped directly to fish markets and restaurants as compared to a relatively small percent (8.8) of the red snapper being sold directly to this type of market. From 50 to 60 percent of both species are sold to other wholesalers with the remaining 11.9 and 32.3 percent of groupers and snappers, respectively, being sold through New York market agents.

Dealers interviewed indicated substantially less than one percent of groupers and snappers were exported. Published U.S. statistics do not identify snapper and grouper as specific export items. Therefore, it has to be concluded that the reef fish fishery of the Gulf of Mexico does not contribute significantly to the export market. This conclusion is further supported by the amount of groupers and snappers imported into the United States.

Existing import data (Appendix Tables 38-41) on both snappers and groupers are of inadequate quality to allow trend and econometric analyses. Data have not been continuously recorded over time at each port and publication of relevant import statistics has been discontinued since 1972. In addition, the numerous product forms imported makes comparable measurements of total pounds on imported snapper and grouper difficult. Published information on forms of snapper imports for the period 1953-1972 recorded at customs offices show such items as snapper, snapper fillets, red snapper, red snapper fillets, red snapper throats and flanks, and dressed. Imports of snapper by product form were very consistent on an annual basis from 1952 to 1962 after which a gradual decline is indicated. Although published data have not been available since 1972, some unpublished data from the National Marine Fisheries Service (Appendix Table 39) show a sudden and marked increase that has extended through 1977. Several factors, could account for this sudden upswing: new countries of origin; changes in reporting techniques or labeling; different ports of entry; etc.

In contrast, the import data for grouper appear to be more reliable probably because Mexico is the principal source of foreign grouper and because most imports come through six principal ports: Port Isabel, Brownsville, and Houston, Texas; New Orleans and Morgan City, Louisiana; and Miami and Tampa, Florida. Import classifications for grouper include grouper, grouper fillets, steaks, chunks, chips, throats, fingers, heads, and breasts (Appendix Table 40). After a decline through the years 1966-1971, grouper imports increased to the levels reported in the earlier 1960's.

Some twenty countries are reported as having shipped grouper and snapper into the United States in 1977 (Appendix Table 41). Mexico is the leading exporter for both snapper and grouper followed by Nicaragua, French Guiana, and Venezuela.

3.5.2 Domestic Commercial Fleet Characteristics

(Refer to 3.2.1.4)

3.5.2.1 Total Gross Income of Fleet

During 1974 and 1975 the average Florida-based vessel in the red snapper and grouper fishery sold $56,484 of red snapper (68.5 percent), grouper (22.8 percent), and other fish (8.7 percent). Sales of the average vessel were determined by a survey of sales of 20 vessels typical of Gulf of Mexico red

Table 4. Domestic marketing of grouper and snapper by Gulf of Mexico commercial fish dealers, 1977

Item	Grouper	Red snapper
	Percent of Volume	
Market location:		
Northeast[a]	15.0	58.4
Southeast[b]	77.1	24.1
Mid South[c]	6.5	11.0
Rest of U.S.	1.4	6.5
Product form:		
Fresh iced	81.6	93.7
Frozen whole	2.3	4.4
Fillets	16.1	1.9
Type of Buyer:		
Retail market or restaurant	36.3	8.8
Other wholesaler	51.8	58.9
New York market agent	11.9	32.3

[a] Includes New York, Illinois, Michigan, Maryland, Pennsylvania and Ohio.

[b] Includes South Carolina, Georgia and Florida.

[c] Includes Texas, Oklahoma, Louisiana, Mississippi and Alabama.

Source: Telephone survey, Cato and Prochaska, 1977.

snapper and grouper fishing, (Morris, 1977). These vessels accounted for ten percent of all reef fish and 9.5 percent of all grouper and red snapper landed in the Gulf of Mexico in 1975. Area fished in the survey ranged from Texas to the west Florida shelf and the Campeche shelf. Crew shares generated on the average vessel amounted to $11,680, with a net return to the captain and owner of $22,752, for a total dollar income of $34,430, or 60.96 percent of total sales. The remainder of total fish sales was consumed through fixed costs and variable boat expenses.

Total value or gross income of Gulf of Mexico reef fish landings in 1975 was $9,637,000 (Table 1). Parts of the catch of other fish by the average vessel are not reef fish, but this composition is not known from the data, therefore, it is not possible to separate incomes generated due solely to reef fish. Assuming that all sales of reef fish generated incomes to the crew, captain, and owners according to the ration of 60.96 percent of total sales, incomes generated at the fishermen level in the Gulf of Mexico reef fish industry would have amounted to a maximum of $5,874,715 in 1975.

The total number of reef fish (handline) vessels in the Gulf of Mexico reef fish fishery was estimated at 435 in 1974 (Section 3.2.1.4), while the number of fishermen was estimated at 1,705 (Section 3.2.1.2). Although these data are for 1974, an approximation of income generated per vessel using 1975 sales, is $13,505, while average income generated per fisherman is $3,446.

The primary economic impact during 1975 for the Florida red snapper-grouper fishery including estimates of expenditures, sales and income, was estimated by Morris, 1977. Major expenditures in the red snapper-grouper fishery were for repairs and maintenance, groceries, bait, and fuel and oil. Repairs and maintenance were $1.3 million which was more than twice as large as any other expenditure item and represented over 25 percent of total expenditures.

For each $100 of fish sales in the red snapper-grouper fishery, other industries claimed $47.33 of items such as fuel and oil, ice, fishing craft, engines, fishing gear, etc. These sales of fish also generated $52.67 of wages, crew shares, captains' salaries, profits, etc. Sales of $100 by this fishery resulted in an estimated primary economic impact of $147.33 in 1975.

Florida red snapper-grouper fishermen in 1975 sold approximately $8.5 million of fish, which then generated over $4 million for industries supplying inputs to this fishery. This generated $4.5 million of incomes. The primary economic impact of the red snapper-grouper fishery in Florida in 1975 was estimated at approximately $12.5 million.

The average number of trips per year and days fished per year was similar for the two small vessels groups surveyed at 19.0 (199 days) and 20.5 (203 days) as shown by Cato and Prochaska (1977). In contrast, the large northern Gulf vessels averaged only 11.3 trips per year (193 days), while the large southeastern vessels averaged 16.3 trips (185 days).

The twenty boats in this survey made a total of 332 trips per year and landed a total of 1,707,218 pounds for an overall average of 5,142 pounds per trip. Total pounds of reef fish landed in the Gulf of Mexico during 1975, was 17,771,000 pounds. Using the estimate of 5,142 pounds per trip, an estimated 40,712 vessel-days were fished in the overall Gulf reef fish fishery.

3.5.2.2 Investment in Vessels and Gear

Average investment in Florida based on Gulf of Mexico red snapper and grouper vessels ranged from $26,526 to $67,267 in 1974 and 1975 (Cato and Prochaska, 1977). The ten sampled vessels ranging in length from 38 to 47 feet, had an average investment of $31,111. The ten ranging in size from 56 to 69 feet had an average value of $62,860. Total investment for the twenty boats was $939,710 with an average value for all twenty vessels of $46,986. This amounted to an investment of 55.04 cents per pound of fish caught.

Total landings of reef fish during 1975 in the Gulf of Mexico were 17,771,000 pounds (Table 1). Total investment in the Gulf of Mexico reef fishery, using 55.04 cents per pound of fish caught, would amount to $9,781,158. Using the 1974 estimate of handline vessels at 435 and number of handline fishermen at 1,705 (Sections 3.2.1.2 and 3.2.1.4) it can be computed that for vessels and fishermen that caught at least some reef fish, there was an average value per vessel of $22,485 and average investment per fisherman of $5,737.

3.5.2.3 Annual Commercial Fishing Participation

Fishing operations for vessels surveyed in the grouper-snapper fishery, (Cato and Prochaska, 1977), range as far west as Texas in the western Gulf of Mexico, the Campeche Shelf in the southern Gulf of Mexico, and the West Florida Shelf (Figure 3). Some vessels from the northern Gulf have fished in Caribbean areas in past years, but this practice does not now appear to be common. (Quantitative treatment of annual fishing participation is presented in Section 3.0.)

3.5.2.4 Total Manpower Employed

Crew sizes on vessels in the Gulf of Mexico reef fish fishery show a considerable fluctuation during the 1957-1974 period. Whereas the general trend has been upward until 1966 (5.07 crewmen per vessel) the average has declined to a 1974 estimate of 3.92 persons. In comparison, the 20 vessels sampled in the Florida survey (Cato and Prochaska, 1977), showed a downward trend in crew size to an average of 3.1 (Appendix Table 43). Florida vessels have traditionally carried smaller crews than vessels operating out of other Gulf states. For instance, the average crew size in Alabama ranges from 7.0 to 9.95, from 5.43 to 10.0 in Mississippi, from 3.16 to 6.16 in Texas, and from 3.0 to 7.0 in Louisiana. However, since the bulk of the vessels are in Florida, the Gulfwide average more nearly approximates that of the Florida crew size than for any other Gulf state (Appendix Figure 12).

Using the reported 1,705 total crewmen on handline vessels in the Gulf of Mexico in 1974 (Section 3.2.1.2) and the average number of days fished by a vessel (Cato and Prochaska, 1977) as 195.6, a total of 333,498 man-days employed in the fishery in 1974 is determined. This does not include time spent working on shore.

Average crewmen's wages (Section 3.5.2.1), were approximated at $3,446 per year in 1975. Using this as an approximation of crew shares or wages, and using the estimated number of crewmen in 1974 at 1,705, gives an approximation of $5,875,430 in crewshares generated in the Gulf of Mexico handline reef fishery.

3.5.3 Domestic Commercial Processing Characteristics

3.5.3.1 Gross Income of Area Processors

Gross income from processing reef fish is the value of processed products. These would include fillets, steaks, and some "fingers". Only a minimal amount of Gulf of Mexico reef fish are actually processed since the survey (Section 3.5.1.3) indicates that 82 percent of grouper and 94 percent of snapper were gutted only and then shipped as fresh iced products. Only groupers and snappers from the total reef fish species are reported separately as processed products.

With the exception of three years for Alabama, (1957, 1966 and 1967), Florida is the only state reporting processed grouper and snapper products (Appendix Tables 44 and 45). The data for the west coast of Florida should be interpreted as low estimates since some products are reported as unclassified. Reported data indicate processed snapper products were at a high of 565,350 pounds valued at $449,377 in 1958. Since 1964, the trend in volume of processed snapper products has been downward with 107,077 pounds reported in 1974. However, this downward trend in quantity is not

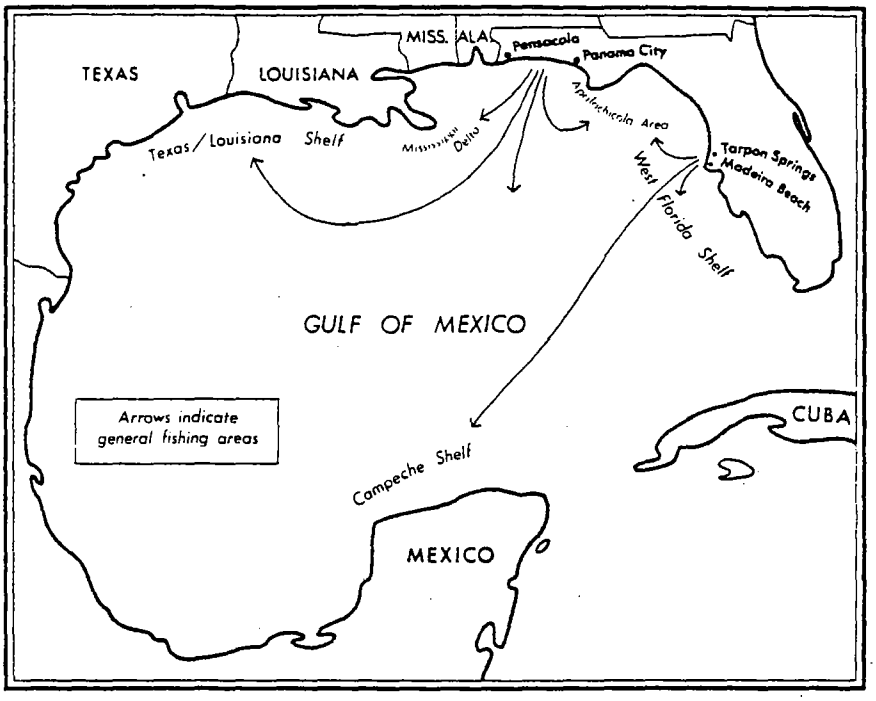


Figure 3 - Port areas and general fishing areas for red snapper - grouper vessels.

Source: Cato, James C. and Fred J. Prochaska, 1977.

evident in terms of value of processed snapper products because of increasing prices. There has been no overall trend in value of processed snapper product since 1964. In 1974, the value of processed snapper products was reported at $181,165.

Processed grouper products showed the same erratic variation from year to year. Record production of processed grouper products occurred in 1973 when 1,769 thousand pounds were processed at a value of $1,155,074. Again, essentially all processing occurs in Florida (west coast data only).

Gross income from processing of reef fish is relatively small. Only 39, or 5.4 percent of the 723 wholesale dealers and processors reported for the Gulf of Mexico were listed as primary reef fish dealers or handlers. However, when gross income generated by both wholesale dealers and processors is considered the estimate is sizeable.

A study of Florida fish dealers handling fresh fish determined the marketing margin for shipping fresh iced fish to the New York market (Prochaska and Cato, 1977, and Moore, 1978). This estimate was adjusted for transportation differences for products shipped within state, within the southeast region and to northeastern markets. The resulting estimated margins are $21.62, $19.24, and $16.64 per 100 pounds shipped to northeastern, southeastern and in-state markets, respectively (Table 5).

Table 5. Estimated wholesale value of Gulf of Mexico commercial reef fish, 1976.

Market Region[a]	Marketing margin per 100 pounds	Pounds shipped[b]	Value Added[c]	Total wholesale value[d]
	(dollars)		(dollars)	(dollars)
In State	16.64	6,982,706	1,161,922	5,041,234
Southeast	19.24	6,982,706	1,343,473	5,222,785
Northeast	21.62	4,267,891	922,718	3,611,955
Total			3,428,113	13,875,974

[a] Refers to location of buyers purchasing reef fish from Gulf of Mexico dealers.

[b] Pounds shipped is based on 1976 landings of 18,687,000 pounds minus an estimated 453,697 pounds processed.

[c] Marketing margin times pounds shipped.

[d] Dockside value plus value added.

Source: Prochaska and Cato, 1977.

In order to estimate the gross income generated in the marketing sector an estimate of the volume of reef fish moving through the system was necessary. In 1976 a total of 17,046,000 pounds were landed in the Gulf region (Table 1). The latest reported volume of processed products from Gulf reef fish is for 1974 at 482,383 pounds. In 1974, processed grouper-snapper products were 3.24 percent of grouper-snapper landings. Assuming this percent to hold for the 1976 grouper-snapper landings, it is estimated that 555,290 pounds were processed. Therefore, the remaining 16,493,710 pounds of all reef fish will move through the fresh fish marketing system.

The market survey reported in Section 3.5.3.1 (Table 5) suggests approximately 20 percent of the product is shipped to northeastern markets and the remaining 80 percent is split equally between in-state and southeastern markets. Using the estimates of the market distribution and the respective marketing margins presented above, it is estimated that total value added by wholesale marketing system is $3,428,113. The total wholesale value of reef fish can therefore be established as $13,875,974 which represents the gross income to Gulf of Mexico wholesalers from reef fish sales.

Past research (Morris, 1977) estimates value added of $60.87 per $100 of processed fish products sold. Thus the 555,290 pounds of estimated processed reef fish products for 1976 will generate $473,207 in value added using projected prices for 1976 processed grouper and snapper products. The total wholesale value of processed reef fish processed by Gulf of Mexico processors is $776,215. When this is added to gross income at the wholesale level, total income to Gulf processors and wholesalers is estimated to be $14,628,320 in 1976.

3.5.3.2 Investment in Plant and Equipment

The number of processing and wholesaling plants in the Gulf of Mexico has only been reported separately since 1970. The number of processing plants has declined from 434 in 1970 to 350 in 1975 (Appendix Table 47). The number of wholesaling plants (fish houses) has remained relatively constant at between 373 and 383 plants. Total number of plants peaked in 1965 when 847 wholesaling and processing plants were reported.

No information is available on investment in plants and equipment. Overall, there does not appear to be growth in the industry. The number of firms has decreased and the size of firms, measured in terms of employees per firm, has remained relatively constant in the past ten years. Growth may have occurred through more mechanical processing. This, however, does not appear likely due to the small amount of processing required for reef fish and the current state of available technology.

All plants do not wholesale or process reef fish products; but, of the number reported, 39 plants handle appreciable volumes of reef fish (Appendix Table 48). These plants employ 274 persons. Thus, only 5.4 percent of the Gulf of Mexico plants actually handle or specialize in handling reef fish and account for only 2.5 percent of total employment in fish wholesaling and processing establishments in the region.

3.5.3.3 Total Employment and Labor Income

Total employment in wholesaling and processing increased to a maximum in 1971 when 13,456 persons were employed (Appendix Table 47). Since that time, employment has dropped to 11,034. Only 274 of these employees are employed by the 39 plants handling reef fish. Net income generated from handling reef fish is estimated to be $1,302,547. This is based on an estimate of $24.59 per $100 sales of processed products (Morris, 1977) and $6.74 per 100 pounds of fish handled by wholesale fish dealers (Morris, 1977). Average income generated per employee is then $4,754. This results in gross output per employee of $50,555.

3.5.3.4 Economic Viability

In addition to the general economic parameters about the commercial fishery presented throughout this Plan, several key factors point out that this is an economically viable fishery. The high rate of return on investment to both small and large Gulf of Mexico snapper and grouper vessels is obvious when comparing the net return to captain and owner (Cato and Prochaska, 1976) and levels of investment (Cato and Prochaska, 1977). Price and total value for red snapper and grouper have increased substantially with very little seasonal variation (Appendix Table 23).

3.5.4 Recreational Fishing Characteristics

General effort description and catch trends

Data on the number of fishermen participating in the recreational reef fishery of the Gulf of Mexico are available on a Gulfwide basis only for the years 1960, 1965, and 1970 (Clark, 1960; Deuel and Clark, 1965; Deuel, 1973).[6] Published data on number and weight of finfish are available for 1960, 1965, and 1970. During 1960, an estimated total of 27,531,000 reef fish were reported as caught in the Gulf of Mexico with a total weight of 122,640,000 pounds (Appendix Table 49). This includes only those species of fish included in Appendix Table 49 and not all are included in the management unit. Some are incidental catch species to those in the management unit. Groupers, jacks, porgies, and snappers constituted 93 percent of the individual fish caught and 99 percent of the weight.

The number of fishermen in 1960 reporting a catch of at least one fish in each reporting category ranged from a high of 317,000 catching porgies to a low of 3,000 catching yellowtail snapper. A total of 78 percent of the catch was caught from boats.

The total number of fish reported in 1965 was 24,511,000 with an estimated weight of 70,925,000 pounds. Both of these were below 1960 estimated levels. A total of 75 percent was reported caught from boats.

Estimates for 1970 gave 47,572,000 fish caught for a total weight of 76,755,000 pounds. This apparent large increase in fish caught did not increase total weight appreciably. Boat fishing accounted for 69 percent. A different method was used to determine fish weights, however, in 1965 and 1970, than was done in the 1960 study (see catch-effort section).

For 1975, a total of 14,534,000 fish were reported caught with an estimated weight of 39,505,000 pounds (Appendix Tables 50 and 51). A slightly different set of species were used for these estimates than was used for estimates for the earlier years.

Catch by method of fishing reported in 1970 is shown in Table 6. Most red snappers were reported caught by party, charter, private, or rental boat. Grunts were reported caught primarily by private or rental boats or from bridges, piers, and jettys. Groupers were reported caught by a number of methods depending on the area of the Gulf.

---

[6] Many people involved in fisheries research have often questioned the accuracy of these data due to suspected bias in the sampling procedure and data collection methods. All data were collected by mail questionnaires and through interviews and were based on recall. Catch weight was estimated in the 1960 survey from average weight data supplied by state agencies, other organizations and individuals. Weight data in the 1965 and 1970 surveys was obtained from such interviews. Data for 1975 were never published due to inaccuracies in sampling design.

Table 6. Percentage of total number of reef fish caught by method of fishing in the west and east Gulf of Mexico, 1970[1].

Species	Private or Rental Boat		Party or Charter Boat		Bridge, Pier or Jetty		Beach or Bank	
	West	East	West	East	West	East	West	East
	percent							
Sea bass	.1	6.8	-	-	-	-	-	-
Groupers	.8	12.7	-	23.5	7.9	2.2	34.7	-
Grunts	85.3	31.4	-	5.0	31.3	38.4	-	13.8
Jacks	.8	1.9	.7	b	1.4	7.2	2.8	4.2
Porgy	8.2	36.0	29.3	5.0	26.1	49.2	62.6	71.6
Snappers	3.9	-	70.0	b	33.4	1.2	-	-
Snapper, red	.9	9.2	-	64.0	-	1.8	-	1.8
Snapper, yellowtail	-	1.9	-	1.7	-	-	-	8.6

[1] West Gulf of Mexico includes the Gulf coast from the Mississippi River Delta to the Mexico border. East Gulf of Mexico includes the Gulf coast from the Florida Keys to and including the Mississippi River Delta.

Source: Deuel, D. G., 1973.

Other data on recreational catch of reef fish are available only from isolated studies done in various states. Typical landings from charter boat, private boat, pier and shoreline fishing in Alabama for 1975, for example, are reported by Wade (1977). That study revealed total landings for 22 charter boats to be 349,951 pounds in 1975 of which 55.7 percent were reef fish consisting of amberjack, groupers and snapper. These did not include catches that entered the commercial market. Total reef fish landings from the private boat fishery were 89,716 pounds which was only 1.3 percent of the total catch. Reef fish accounted for .3 percent of the total catch from piers.

Red snapper and grouper landings from party boats on the northwest coast for 1974 were estimated by Prochaska and Cato (1975). Total catch was estimated at 6.4 million pounds for the eight northernmost Florida coastal counties. Red snapper (2.4 million pounds) and grouper (2.3 million pounds) were the most prominent catches.

The most current information on recreational charter and party boat fishing along the Florida west coast is currently being analyzed by the University of Miami on a contract with the National Marine Fisheries Service, Miami, Florida. This analysis represents the results of a mail survey conducted during 1977. Tentative results of this survey are discussed in the following paragraphs. The discussion centers around offshore charter, inshore/offshore charter and offshore head boat fishing in the Florida Panhandle, west coast and Florida Keys and points out the level of dependence on various species. The discussion contains the entire analysis to enable placing of importance on the reef fish species.

Offshore Charter

Panhandle

The spring, summer and fall are the principal seasons for fishing activity in the Florida Panhandle. The species of greatest importance to offshore charter boat operations during all of these seasons is king mackerel. Bottomfishes, particularly snapper and grouper, are second in importance. Cobia is next in importance during the spring. Amberjack and bluewater fish, particularly billfish, are important during the summer and fall. Winter fishing is heavily dependent on snapper and grouper. Redfish, flounder, and other species are relatively important during the winter. Some king mackerel also are taken during the season. See Appendix Table 66 for percent dependence on the various species during each season.

West Coast

The most important species to the offshore charter boat industry on the Florida west coast are bottomfishes, principally snapper and grouper. From 66 to 77 percent of total effort is expended on these species during the summer, fall, and winter. They also are important during the spring, (31.2 percent of effort); however, more effort (49 percent of effort) is expended on king mackerel during this season. Some fishing effort is expended on amberjack during the spring, summer and fall, and on tarpon during the spring.

Florida Keys

The offshore charter boat fishery in the Florida Keys expends the greatest percent of its effort on bluewater species such as dolphin and billfish. Bluewater species account for from 49.5 and 86.4 percent of fishing effort, depending on the season. Emphasis is on dolphin during the spring (39.2 percent) and summer (49.3 percent) and on billfish during the fall (39.3 percent) and winter (41.8 percent). King mackerel are important to the fishery during the winter (34.3 percent). Bottomfish, particularly snapper and grouper, have some importance, particularly during the spring and fall.

Although major dependence is on only a few species, the offshore charter boat fishery has more target species in the Keys than in any other part of the study area. Others of these are sharks, barracuda, bluefin tuna, amberjack, tilefish, and wahoo.

Inshore/Offshore Charter

Florida West Coast

Bottomfishes and tarpon are the species of major importance to the inshore/offshore charter operations of the Florida west coast. Areas of principal tarpon activity are Boca Grande and Tampa. Tarpon activity is concentrated into the spring (32.6 percent of effort) and summer (21.4 percent of effort) months. Percent of effort on bottomfish ranges from 35 percent in the spring to 52.2 percent in the winter. Other offshore species are king and Spanish mackerel and sharks. Other inshore species are snook, redfish, trout, and sheepshead.

Florida Keys

Bluewater species and bottomfish receive an approximately equal amount of interest and together account for about 50 percent of fishing effort by the inshore/offshore fishery in the Florida Keys during all four seasons. Fishing effort for billfish ranges from 10.8 percent in spring to 31.7 percent in summer. Emphasis is on common dolphin in the spring (8.3 percent) and summer (29.2 percent) and on billfish during the fall (18.3 percent) and winter (30.8 percent). Snapper are more important than grouper during the spring and summer, and effort is approximately evenly divided between the two groups during the fall and winter.

The inshore/offshore fishery in the Keys is different from that on the west coast in that a larger proportion of effort is expended on offshore species. Percent of effort expended on offshore species ranges from 55.7 percent in spring to 84.1 percent in winter. Inshore species receiving attention from this fishery are permit, tarpon, and bonefish. The most important of these is tarpon.

Barracuda and cobia are two wide-ranging species that are somewhat important to the inshore/offshore fishery in the Keys. Amberjack, king mackerel and Spanish mackerel are other species sought by this fishery.

Offshore Head boats

Reliance on bottomfish by the offshore head boat industry is consistent in all three areas, accounting for 80 and 95 percent of effort.

Florida Panhandle

In the Panhandle, grouper is the leading fish group sought, (40-45 percent, depending on the season); snappers are next in importance (20 percent), followed by a mix of triggerfish and other bottom species (20 percent). Amberjack (five percent) is another species important to the industry in this area. Percent of effort is approximately the same each season.

Florida West Coast

Snapper and grouper account for 65 to 70 percent of effort by this fishery. Grunts and seabass are secondarily important bottomfish. Approximately five to ten percent of effort of this fishery is expended on mackerel (probably king mackerel). Greatest effort on mackerel is during the spring and summer.

Florida Keys

From 88.8 percent to 95 percent of total effort of the head boat industry in the Florida Keys is directed toward grouper and snapper. Effort towards snapper predominates, particularly in the fall. King mackerel, common dolphin, and sharks are other target species of the offshore head boat industry in the Florida Keys.

Recreational Customers

The University of Miami and National Marine Fisheries Service survey also provided information describing paying passenger fleet customers. Details of customer characteristics outlined by the study are presented under the same categories discussed above. Only the overall general conclusions are presented.

The average customer was in his mid-40's, ranging in average age from 41.4 years for head boat customers to 46.4 years for inshore/offshore customers. Fishing trips tend to be a group activity.

In all categories, families made up the largest class of individuals ranging from 36.4 percent of charter boat customers to 41.4 percent of the head boat customers. Business groups were the second most important class. Business associates ranged from 22.4 percent of the head boat customers to 38.6 percent of the inshore/offshore boat customers. Groups of friends were the third most important class of customers. For all three types of operations the individual customer was only a small percentage of the total customers, with a range of four percent on inshore/offshore to eleven percent on head boats.

Out-of-state customers were the most important group of customers by place of residence. Out-of-state customers ranged from 65.4 percent on head boats to 74.6 percent on inshore/offshore boats. Approximately 30 percent or more of all customers were obtained because of previous trips they had made. Between 15 percent (inshore/offshore) to 30 percent (charter) of the customers were due to on-site contacts. Personal references were the next most important reason. Very few customers participated in the fishery due to hotel references, advertisement, etc.

Description of Recreational Fishing Vessels and Gear

The following data and estimates on the number of boats specializing in the recreational fisheries for snappers and groupers, as well as for all fisheries in the Gulf of Mexico, have been delineated into both private and commercial boat categories.

Private

Bromberg (1973) estimated a total number of 348,595 private recreational boats in salt water in the Gulf of Mexico[7] in 1973 (Table 7). Texas boats accounted for 138,195 of this total, Florida had 95,996 with the remainder in the other three states. A total of 14.0 percent of all fishing trips sought snappers and 14.1 percent sought groupers. Bromberg (1973) shows that 185,327 of these boats fished in the open ocean. These same data are summarized in an article by Ridgely, 1975.

Commercial

Bromberg (1973) also estimated that 437 commercial sportfishing vessels fished in the open ocean in 1973. Of all trips made, 53.8 percent of the trips sought snappers and 36.3 percent of the trips sought groupers.

Another study by Fraser, et al., 1977, estimated a total of 579 vessels carrying sport fishermen for hire as of May, 1977, in the Gulf of Mexico. No information is given in this study as to percent of boats or trips that were focused on the reef fishery. A total of 77.3 percent of all boat captains on commercial boats owned and operated one boat while another 13.6 percent were involved with two or more boats (Table 8). Gulf of Mexico boats averaged 47.2 feet in length with average capacity of 21 passengers. A total of 67 boats used loran while another 29 percent were planning to purchase loran within the next three years. This would make a total of 96 percent who expect to have the capability of "exact spot" fishing on good reef fish areas.

Total Fleet Income

Estimated total annual gross revenue of commercial saltwater sport fishing was $16,854,682 in 1973 as estimated by Bromberg (1973). The majority of this income came from boats 65 feet or longer in length. Bromberg estimated 53.8 and 36.3 percent of all trips were specifically seeking snappers and groupers, respectively. However, since part of these trips regardless of ultimate catch, probably

---

[7] The Gulf of Mexico was defined as all states from Texas to Florida including the Florida Atlantic Coast.

Table 7. Estimated number of private recreational boats that fished in salt water over a 12-month period by region and size class, Gulf of Mexico, 1973[1].

Region	Number of private recreational boats	Size Class		
		Less than 16 feet	16 feet but less than 26 feet	26 + feet
Alabama	52,318	28,478	21,193	2,647
Florida [2]	95,996	52,253	38,886	4,857
Louisiana	46,267	25,184	18,742	2,341
Mississippi	15,819	8,611	6,408	800
Texas	138,195	75,222	55,980	6,993
TOTAL GULF	348,595	189,748	141,209	17,638

[1] All private recreational boats that fish in salt water includes those fishing in salt water portions of rivers, sounds, and bays in addition to those fishing in the open ocean.

[2] Includes Florida Atlantic coast.

Source: Bromberg, K. M., 1973.

Table 8. Number of commercial sportfishing boats owned and/or operated per boat captain in the Gulf of Mexico, 1977[1].

Number of boats owned/operated	Percent owning/operating the designated number of boats
1	77.3
2	13.6
3	4.5
4	0.0
5	4.5

[1] Includes all vessels that carry sport fishermen for hire

Source: Fraser, Michael B., James A. Henderson, and John F. McManus, 1977.

sought groupers and snappers as the primary species, it is not possible to delineate the total gross revenue in this study to that part just due to reef fish.

According to Fraser, et al. (1977), a total of 73 percent of commercial sportfishing captains in the Gulf chartered for their sole support. Wade (1977) estimated that the average Alabama charter boat grossed $147.50 for each charter in 1975 and made 183 trips per season for an average annual gross revenue per boat of $26,992. On that basis, seasonal totals for the 22 charter boats amounted to $593,835 with 57 percent of the catch on these boats being reef fish.

In contrast, Prochaska and Cato (1975) estimated that the average party boat on the Florida northwest coast had a gross revenue of $142,529. Based on the number of fishermen trips and a total of 48 boats operating in the region at the time, total gross revenue for this fleet would have amounted to $6.8 million. A total of 74 percent of the catch was reported to be grouper and red snapper.

Ditton, et al. (1977) estimated that charter fishing fee expenditures along the Texas coast amounted to $1.3 million in 1976. This estimate included both bay and Gulf fishing. That portion of expenditures for Gulf fishing amounted to slightly less than $1.1 million. Estimated total spending for fees as well as noncharter fee expenditures for both bay and Gulf fishing amounted to $4.2 million. Ditton estimated that 83 percent of charter boat operators acted as single proprietors. The average Gulf boat had a gross revenue of $14,351 with an average investment in the boat of $25,554.

Total fleet income for both private and commercial recreational fisheries are available only in the combined form of total economic estimates in terms of sales, value-added, wages, employment and annual capital expenditures for recreational reef fishing in the eastern and western Gulf of Mexico for 1975. Total sales in the eastern Gulf of Mexico associated with the reef fishery were $119,262,000 and included sales of fishing tackle, boats, motors, trailers, marinas, commercial vessels, food, lodging, travel, insurance, bait and other expenditures (Appendix Table 52). A similar value for the western Gulf was $26,968,000 (Appendix Table 53). Data on value added, wages and salaries, employment and annual capital expenditures for the two regions are also shown in Appendix Tables 52 and 53.

Of the national economic impacts associated with the marine recreational fishery, it is estimated that approximately 35 percent are due to fishing activities in the Gulf of Mexico. It is also estimated that approximately 23 percent of Gulf recreational fishing economic impact results from reef fishing activities. Thus, Gulf of Mexico recreational reef fishing accounts for approximately eight percent of the total national economic impact associated with marine recreational fishing.

Investment in Vessels and Gear

Data on investment in recreational vessels and gear are available from various sources. Prochaska and Cato (1975) estimated the average value of commercial party boats along the Florida northwest coast in 1974 at approximately $155,643. The Florida commercial party boats were the larger party or head boat type sometimes as large as 85 feet in length; and in contrast, the average value of the smaller Texas charter boats that fished the Gulf was estimated at $25,554 in 1976 by Ditton (1977).

Value estimates for the entire recreational fleet are available from Centaur (1977). Annual capital expenditures at the manufacturing, wholesale and retail trade levels for tackle, boats, motors, trailers, and commercial vessels totaled $1,225,000 in the eastern Gulf (Appendix Table 52) and $241,000 in the western Gulf (Appendix Table 53). This would not be total current value of the vessels and associated gear, but that capital added each year in the form of new equipment and to replace depreciated equipment.

Annual participation

Participation in terms of trips and days spent fishing for the Gulf of Mexico are estimated by Bromberg (1973). The number of fishing trips in the open ocean by all private recreational boats in 1973 was estimated at 2,592,956 and for commercial sportfishing boats at 59,066 (Appendix Table 54). The number of days were estimated at 2,839,222 and 60,521 respectively. Participation rates are given by state and boat size for private boats and commercial recreational boats in Bromberg (1973).

The percentage of trips and days seeking the various species of reef fish is also shown in Appendix Table 54. Red snappers and groupers were the most sought-after species accounting for about 14 percent of all trips in the private boats and between 36 and 54 percent of all trips in commercial sportfishing boats.

Wade (1977) estimated a total of 161,040 hours fished from 20,130 fishermen trips for the Alabama charter boat fleet in 1975. The average boat made 183 trips per season. Prochaska and Cato (1975) estimated an average of 6,714 fishermen fished per party boat along northwest Florida in 1974. This amounted to a total number of fishermen trips of 322,272 during that year. Ditton, et al. (1977) estimated that Texas boats fishing in the Gulf only made an average of 68 trips per year with no details available on number of fishermen.

Total Manpower Employed

Centaur (1977) estimated employment resulting from all activities associated with the marine recreational fishing industry. These data were disaggregated to the reef fish sector and show a total of 3,250 person-years employment in the east Gulf and 732 person-years in the west Gulf associated with the reef fish marine recreational sector (Appendix Tables 52 and 53).

Catch-Effort Data

Accurate catch-effort data for both the private and commercial recreational reef fishery are very limited. Almost all data are from random studies done for various states and in different years. Analysis of the data given by Clark (1960), Deuel and Clark (1965), and Deuel (1970) points out few consistent trends. Methods used to estimate average weights for 1960 in contrast to the 1965 and 1970 studies also make comparison difficult. Some species were also reported in different categories in different years (snappers vs. red snappers). The data are delineated in average size, number of fish per fishermen and pounds per fishermen in Appendix Table 55. The extremely wide variations in these data point out the limits in their usefulness. Wade, et al. (1977) reported some limited catch-effort data for 22 Alabama charter boats. Catch reported for 1975 was in pounds per man-hour for amberjack (.83), grouper (.02), and snapper (.36). Snapper included red, gray, lane, and vermilion snappers.

Prochaska and Cato (1975) reported an average annual catch per boat for northwest Florida party boats in 1974 of 134,286 pounds of red snapper, grouper and other fish. This amounted to a catch per fisherman for snapper (7.5 pounds), grouper (7.3 pounds) and other fish (5.2 pounds) for a total of 20.1 pounds. Catch per fisherman-hour was not recorded. Ditton (1977) did not include catch data in his Texas charter boat study.

3.5.5 Subsistence Fishing Characteristics

None occurs in this fishery.

3.5.6 Indian Treaty Fishing Characteristics

None exist in this fishery.

3.5.7 Other Activities Directly Related to Fishing

No activities other than those covered are considered important.

3.5.8 Area Community Characteristics

(3.5.8.1., 3.5.8.2. and 3.5.8.3. are all combined under this general heading).

The estimate of impact of the MSY/OY recommendations on each major reef fish landing point and its surrounding area have been developed with three objectives in mind: (1) to determine the extent of the reef fishing industry at the local level; (2) to determine if locational differences exist in the socioeconomic characteristics of the reef fishermen, and (3) to construct socioeconomic profiles of each major landing point and its surrounding area.

Data searches were made of: (1) previous research (which is generally sample survey data), (2) published data such as the Census of Population, and Fishery Statistics of the U.S.; and (3) unpublished data such as current unemployment rate and employment profiles which are tabulated by state employment security agencies. These three data sources, however, did not yield sufficient information about the reef fishermen to develop any reliable profile so they were supplemented with a brief sample survey of "expert" reef fishermen at state, county and local community levels.

Unfortunately, these survey data do not support concrete deductions. The data from previous sample surveys indicate some general socioeconomic characteristics of reef fishermen. Since these studies were completed by various researchers and conducted at varying scales of investigation (i.e., local community, region, state, etc.), there is little comparability among the findings. The Census, on the other hand, has tabulated some characteristics of fishermen which are comparable from location to location. These data, however, are for commercial fishermen in general, rather than reef fishermen. Moreover, the Census tabulates this data only for state and metropolitan statistical areas with populations greater than 250,000. Another severe shortcoming of the data is that the employment characteristics, age, and income group tabulations are totaled for those employed in forestry as well as fishing.

The Commercial Reef Fishing Industry by Local Area

The Gulf reef fishing industry covers five states and is concentrated in 17 major landing points: Bon Secour and Mobile in Alabama; Panama City, Pensacola, Carrabelle, Tampa, Ft. Myers, Bradenton, Key West, Niceville, Madeira Beach and Nokomis in Florida; Golden Meadow in Louisiana; Pascagoula in Mississippi; and Port Isabel, Galveston, and Aransas Pass in Texas (Figure 4).

The majority of the Gulf reef fish are landed in Florida (Table 9). Florida counties with high percentages of the total Gulf landings include: Pinellas (17.8 percent), Monroe (15.6 percent), Bay (13.5 percent), and Lee (11.4 percent). Of the remaining 15.0 percent, Jackson County, Mississippi, accounted for 9.0 percent, Alabama for 3.6 percent and Texas 2.1 percent. La Fourche Parish, Louisiana, accounted for less than one percent of the total.

By computing the percentage of the total county landings that were reef fish (Table 9, column 4), an indication of the opportunity for other types of employment in the fishing industry can be obtained. Florida's highest county, with a high of 60.6 percent was Pinellas County. Lee County was lowest at 19.2 percent. In Baldwin and Mobile counties, Alabama, reef fish were 12.5 and 11.2 percent respectively, of total landings in those counties. For the three Texas landing points, reef fish accounted for less than 9.0 percent of all fish landed. In both Louisiana and Mississippi, the reef fish industry appears insignificant with less than one percent of their total catch in reef fish.

Figure 4 - Socioeconomic Impact of Yield Limitations: The Gulf Reef Fishing Communities

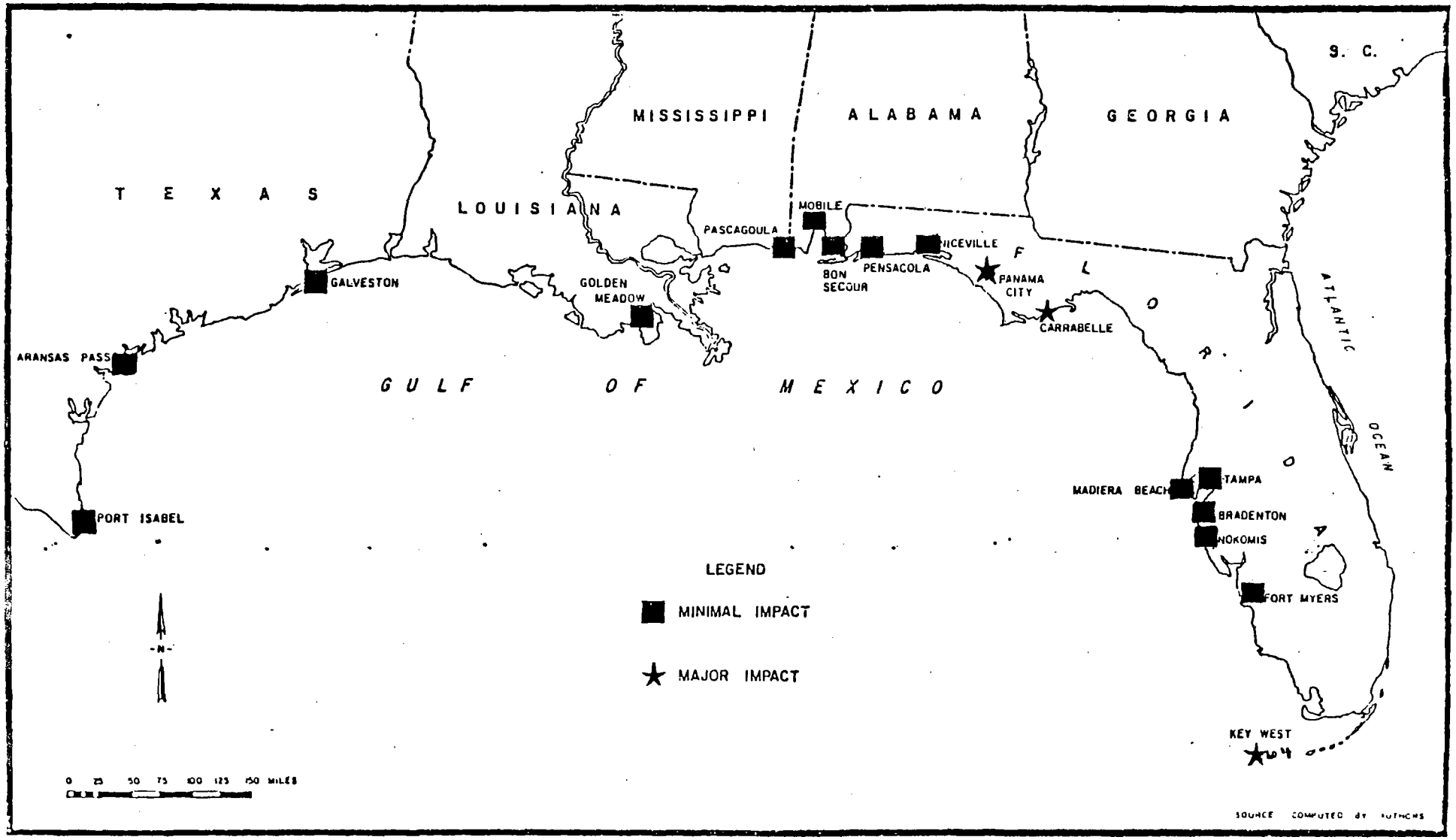


Table 9. Principal Port Production, Population and Sales Impact Characteristics.

State/County	(1) Reef Fish Landings (thousands of pounds)	(2) Percent of Total Gulf Landings	(3) Total Landings (thousands of pounds)	(4) Reef Fish as a Percent of Total Landings	(5) Population	(6) Reef Fish Sales Impact Per Capita (dollars)
Alabama						
Baldwin	179	1.0	1,438	12.5	70,962	1.44
Mobile	452	2.6	4,124	11.2	341,034	0.76
Florida						
Bay	2,342	13.5	7,051	33.2	92,884	15.63
Escambia	816	4.7	2,684	30.4	59,507	8.50
Franklin	369	2.1	1,472	25.1	7,943	28.80
Hillsborough	155	0.9	544	28.5	600,715	0.16
Lee	1,977	11.4	10,260	19.2	163,978	7.48
Manatee	1,122	6.5	4,511	24.9	126,160	5.51
Monroe	2,720	15.6	11,922	22.8	53,886	31.30
Okaloosa	472	2.7	2,026	20.3	164,356	1.78
Pinellas	3,099	17.8	5,115	60.6	673,604	2.85
Sarasota	97	0.6	311	31.2	165,054	0.36
Louisiana						
La Fourche	52	0.3	389,983	1.0	74,987	0.40
Mississippi						
Jackson	1,561	9.0	244,340	1.0	122,650	8.01
Texas						
Cameron	201	1.2	3,235	6.2	169,300	0.77
Galveston	85	0.5	981	8.6	182,000	0.30
Aransas Pass	71	0.4	1,251	5.7	102,633	0.45

Sources: (by column)

(1) and (3) National Marine Fisheries Service; NOAA; Washington, D.C. (Florida data from 1976 Annual Summary. Other states for 1975.)

(2) and (4) Computed by research team

(5) 1975 Population Estimates from State Employment Security Agencies

(6) Column (1) multiplied by average value of all reef fish per pound in each state divded by Column (5).

An index of the impact of the industry for each local area has been computed to better evaluate the relative importance of the industry in each local area. This was derived by multiplying the total pounds of reef fish landed in each area by the average state price of all reef fish per pound to obtain the approximate annual value of reef fish. This figure divided by the population for each area, provides a fairly reliable per capita impact figure for each local area (Table 9).

The impact figures vary widely from a high of $31.30 per capita for Monroe County, Florida, to a low of $0.16 for Hillsborough County, Florida.

Socioeconomic Characteristics of Reef Fishermen of Local Areas

Detailed descriptions of locational differences in the median age, education, income, etc., of reef fishermen appear in Appendix Tables 58-60. Where these differences are relevant to the impact of yield limitations, they are noted in the following section.

Socioeconomic Characteristics of Local Areas

This assessment of the relative socioeconomic well-being of the Gulf reef fishing communities (Figure 4) is based on selected social and demographic variables obtained from the U.S. Bureau of the Census, 1970, (median education, median family income, median age, net migration, percent below the poverty level, percent foreign born, and total population (see Appendix Table 67). Census data are not sub-divided adequately to delineate employment in these regions for the fishery sector. Consequently, more general employment categories are discussed. A combination of three leading economic indicators (the unemployment rate, the percent of male workers employed less than 26 weeks per year, and the percent of total employment in manufacturing) helps to gauge the relative economic strength of the local economies and the impact of possible yield limitations on those economies. The unemployment rate and the percent of total employment in manufacturing were obtained from each community's state employment security agency. The percent of male workers employed less than 26 weeks was obtained from the 1970 Census of Population (see Appendix Table 68).

Each of the counties was ranked on these three economic indicators to determine the level of economic and social impact on the county should reef fishing be restricted or limitations imposed. Those counties that performed consistently well were designated as "minimal impact" areas. Those counties with a poor performance on all three economic indicators were designated as areas of "major impact". Finally, those counties with mixed results on the economic indicators were grouped in either the minimal or major impact categories depending on reef fish sales per capita (Table 9, Column 6). Similarly, for a few counties the degree of impact could not be determined solely on the basis of the economic indicators because the counties did not perform consistently on all three indicators. In these cases, the county's social and demographic indicators and reef fish sales per capita were used to determine the appropriate "impact" designation. These instances are noted in each county's description that follows.

Areas of Minimal Impact

Escambia County - Pensacola, Florida

The social and demographic picture in Pensacola and Escambia County is promising. The county has experienced some out-migration, but the city is growing well and income and educational levels are high for both the county and the city. Based on the social and demographic variables, Pensacola could withstand yield limitations without significant impact.

The same strength is evident for the economic variables. Opportunities for employment in the area are good. The county had the lowest unemployment rate (4.0 percent; final quarter, 1977) for all the

counties studied. The strong showing for manufacturing in the county also suggests that the county capable of withstanding yield limitations without significant impact.

Galveston County - Galveston, Texas

The net migration figure for the city of Galveston indicates that an exodus into richer and better educated Galveston County has begun. The situation for the city, however, is not so serious compared to the other landing points in the study. Income levels are relatively high in the city, although the median educational level is below high school completion. Given the size of the region, however, yield limitations should not have a significant impact on the social structure of the community. Both the county and the city are stronger on the basis of the social and demographic variables than the rest of the Texas landing sites studied.

Galveston County places in the top third for the economic variables. Manufacturing in the county is relatively strong and is expected to improve as is the situation for oil and gas production. If yield limitations are necessary in Texas, Galveston would be the area of least impact.

Hillsborough County - Tampa, Florida

Hillsborough County and Tampa are capable of withstanding significant yield limitations. Both rate relatively well on the social and demographic variables. The city and the county have fairly high median educational levels and quite high median income levels. Unfortunately, the county's high growth rate appears to come at the expense of Tampa, which grew only one percent during the 1960-1970 period. Nevertheless, the overall community's showing is strong. Coupled with the fact that the county's median age is low (28.8 years), the area appears quite stable.

Hillsborough County does well on the economic variables to place it in the top third on the combination of economic indicators. The unemployment rate in the county was third lowest for all the counties studied, (4.8 percent in November, 1977). Compared to the other Florida counties, the area has a high concentration of manufacturing.

Jackson County - Pascagoula, Mississippi

Jackson County and the major landing point, Pascagoula, place at the top of the list for the production areas with minimal impact if yield limitations are necessary. The strength of the community is evident in both the social/demographic and economic variables studied.

Both the county and the city have the strongest showing for the social and demographic variables for all the landing points studied. Pascagoula ranks first, second, and third for the variables median income, median education, and percent above poverty level, respectively. The net migration rate for Pascagoula (5.9 percent increase per year) indicates that the city experienced an unusually high growth rate for the period 1960-1970. Coupled with the fact that the county's growth rate is lower than the city's (3.4 percent increase per year), it appears that Pascagoula is not experiencing an exodus to the county suburbs, a common experience for cities its size.

The economic strength of the county also suggests that yield limitations would not have a serious impact on the area. The county ranked in first place on the combination of important economic indicators. The county has an extremely high concentration of employment in the manufacturing sector. Most of these persons are involved in shipbuilding. The industry's unemployment rate is low, and the future outlook is promising.

On the basis of the social and demographic characteristics, Pascagoula could well withstand the impact of yield limitations without seriously affecting the community's social structure.

La Fourche Parish - Golden Meadow, Louisiana

La Fourche Parish and Golden Meadow differ from most of the the other counties and cities in the study. While many of the Florida counties and cities had low income levels and high educational levels, both La Fourche Parish and Golden Meadow have relatively high income levels and low educational levels. The parish and the city also differ from the Florida sites in that they have a low median age and a high rate of out-migration. Golden Meadow had a high percent of the population above the poverty level, yet the town had a 1970 population of only 2,681. The extremely low educational level for Golden Meadow, only 7.2 years, would normally be the decisive factor in protecting the community from yield limitations. However, the economic picture for the county is favorable. The county ranks third (behind Jackson and Escambia counties) for the combination of factors.

The paradox was resolved when it was determined that the 52,000 pounds of grouper and snapper caught in 1977 in the central district of Louisiana was primarily incidental catch, and that no commercial reef fishermen live in the area. Based on this information, supplied by a local Sea Grant marine agent, and coupled with the strong economic situation, the area appears capable of withstanding yield limitations.

Baldwin County - Bon Secour, Alabama

Social and demographic statistics for the town of Bon Secour are unavailable although a recent population estimate for the town is 850. The county has experienced good growth rates in recent years, probably at the expense of neighboring Mobile County. The median educational level and median family income level are lower than the average for the remainder of the counties.

The combination of economic indicators places Baldwin County in the middle third for all the counties in the study. The county generally appears to be similar to Mobile County in terms of the economic variables. Bon Secour, however, is not as capable of withstanding yield limitations.

Mobile County - Mobile, Alabama

The social and demographic situation is similar for both the county and city of Mobile. Both have relatively low educational levels and relatively high income levels. The city does fare slightly better for the net migration rate, income level, and educational level when compared to the county. In general, the high concentration of people in the area suggests that the yield limitations could be tolerated in the area, although in terms of these social and demographic variables, other areas should be considered.

The economic situation in Mobile is fairly good. The county ranks in the upper third for the combination of economic indicators. Opportunities for employment, however, are primarily for the technical and professional occupations. Work surpluses do exist in the unskilled and semi-skilled trades. However, this combination of factors suggests that the county is an area of minimal impact if yield limitations were initiated.

Lee County - Ft. Myers, Florida

Lee County and Ft. Myers show a good deal of strength for the selected social and demographic variables. The city has experienced high growth rates in recent years and it ranks third in positive net migration for all the landing points studied. Median income, percent above poverty level, and median educational levels are well above average in the city. The county fares well also, especially in the rate of growth variable. On the basis of the social and demographic variables, the Ft. Myers area is the strongest of all the reef fishing communities located on Florida's west coast south of Tampa.

The strength demonstrated by the social and demographic variables, however, is not reflected in the economic variables. Lee County was in the middle third for the combination of economic indicators. Although the local unemployment rate was only 4.9 percent in July, 1977, the percent employed in manufacturing was low. This suggests that the likelihood of obtaining other employment is not good. It appears, therefore, that the county would experience a moderate impact if yield limitations were initiated.

Manatee County - Bradenton, Florida

Manatee County and Bradenton demonstrated a situation similar to that in the neighboring county, Sarasota. Median education and growth rates are high, yet the income levels for both the county and the city are low. This probably is a result of the large number of older residents in the county and city, many of whom are living on fixed incomes. This situation is worse than in the rest of the Florida cities. Bradenton ranks the second lowest of all the landing points in median income.

In addition, the county ranks in the middle third for the combination of economic indicators. Unemployment is relatively high (8.6 percent in 1976) and opportunities for employment are scarce.

Okaloosa County - Niceville, Florida

The social and demographic picture is much better for Okaloosa County than for Niceville. Growth rates in the county are high, and the educational level, 12.4 years, puts the county in a tie for first place with Sarasota County. However, Ft. Walton, located in the county, significantly affects these figures.

The county places in the middle third for the combination of economic indicators. The economic indicators offer conflicting evidence. The low percentage of workers working less than 26 weeks suggests a stable employment picture, however, the low percentage of employment involved in manufacturing is unfavorable. The unemployment rate, 7.2 percent in November, 1977, is about average for all the counties studied.

Pinellas County - Madeira Beach, Florida

The character of Madeira Beach, as evidenced in the social and demographic variables, is typical of many of the Florida communities studied. Educational levels are high, but income levels are lower because of the high median age in the county. For the city, however, the low median income levels are not reflected in high poverty levels. Many of the people in this community have low incomes, but few are below the poverty level. This is also a reflection of the older population.

Although the county shows some indications of strength, the county ranks in the middle third for the combination of economic indicators. The economic situation in Pinellas County indicates that the reef fish fishing community may suffer moderately with yield limitations.

Sarasota County - Nokomis, Florida

Both Sarasota County and Nokomis have high rates of growth and high educational levels. However, both median income and percentage above poverty level are low for the city and county. The discrepancy can be explained by the large number of retirees in the county as evidenced by the median age, 49.4 years. These people could be expected to raise the educational levels, but most of them are living on fixed incomes.

The situation is even worse considering the economic variables. The unemployment rate is relatively low but the percent employed in manufacturing is low. This puts the county at the bottom of the list

for the combination of economic indicators and there might be moderate impact because of any restriction.

Aransas, Nueces, and San Patricio Counties - Aransas Pass, Texas

Aransas Pass lies on the border of three counties. San Patricio and Nueces are urban, and losing population, while Aransas County is at the 50 percent urban level and gaining population. The educational levels for all three counties are below the high school completion rate, but Nueces County, which contains the city of Corpus Christi, has the third highest median income level of all the counties studied.

The data for Aransas Pass indicate a situation much like that in Port Isabel. It has the fourth lowest median income level of all the landing points, the second lowest percent above the poverty level, and the third lowest educational level. The town also lost 16 percent of its population during 1960-1970.

The economic situation is mixed. Nueces County ranks in the upper third, San Patricio County in the middle third, and Aransas County was excluded from the combination of economic indicators because of insufficient data. It appears the impact on the city of Aransas Pass could be major due to limitations.

Cameron County - Port Isabel, Texas

Cameron County and Port Isabel are consistently the most distressed areas in the study. The county ranks last in net migration and median education, and second to last in median income. Port Isabel is also experiencing high levels of out-migration, as well as the lowest rank of median income. A full 36 percent of the community was below the poverty level in 1970. The median educational level was only 8.0 years. The county has the most significant level of foreign-born population for the counties in the study (one-third of the county is of Mexican origin).

The economic picture in Cameron County is not promising. The county has the highest unemployment rate (11.3 percent in February, 1978) for all the counties studied. The percentage of males working less than 26 weeks per year is the highest for all counties. Furthermore, a large proportion of employment in the county is in seafood processing and net production. Thus, yield limitations would impact the community considerably. However, reef fish only represent 6.2 percent of total fish landings.

Areas of Major Impact

Monroe County - Key West, Florida

The social and demographic situation in Monroe County and Key West is not conducive to yield limitations. The city experienced the highest rate of negative net migration (-1.9 percent per year in 1960-1970) for all the landing points studied. The city fared well down the list for such variables as percent above the poverty level, median income and median education. The same is true for Monroe County except for the median education variable which is slightly higher than that of the city.

The economic picture in Monroe County is also not amenable to yield limitations. The unemployment rate in the county is the second highest (9.6 percent in 1977) for all the counties studied. The percent employed in manufacturing in the county is the lowest for all the counties. The county's dependence on fishing ($31 of reef fish per capita in 1977) suggest that yield limitations would be felt throughout the local economy.

Bay County - Panama City, Florida

Panama City and Bay County are generally in the mean area for the social and demographic variables. Both the county and the city have average levels of income, education, and net migration. The economic situation in Bay County is also unfavorable. The county places at the bottom of the middle third for the combination of economic indicators. Opportunities for other employment in the county are limited.

The county and city's growth rate dropped to the negative migration level during 1960-1970. Although the trend can be reversed as more people migrate to Florida's less populated Panhandle counties, the other social and demographic variables suggest that the area would suffer moderate impact with yield limitations of any significance.

Franklin County - Carabelle, Florida

Franklin County exhibits the poorest economic indicators among all the areas and the demographic indicators point to a small rural county also losing population. Reef fish sales impact per capita is the second highest, reinforcing the conclusion that this area would experience a major impact from MSY limitations. Most fishing operations in this area are smaller with respect to employees, total sales, and size of vessel.

3.6 Interaction Between and Among User Groups

The only known foreign fishing for reef fish is that historically done by Cuba on the west Florida shelf. Details on this activity are reported in Section 3.2.2. Since the fishery appears fully exploited (Sections 4.0, 5.0, and 7.0) the impact of foreign fishing would be detrimental.

Some individual industry members and recreational fishermen and divers have expressed concern about the use of roller trawls and traps in the reef fish fishery and the impact of juvenile reef fish bycatch by shrimp trawlers. These are discussed in Sections 4.5 and 3.2.1.4.

4.0 BIOLOGICAL DESCRIPTORS

4.1 Life History Features

In many instances available life history features are incomplete or nonexistent; therefore many specific references will reflect this condition. Sources are listed at the end of each species section. Life history features have been provided only for those species in the management unit (Section 3.1.1). Less information is available for those species in the fishery (Section 3.1.2) and only a general discussion is provided. While the literature lists ranges of some species to extend into the New England area, the realistic northern limit is about Cape Hatteras.

Etelis oculatus, queen snapper

Distribution: This species is widely distributed throughout the tropical areas of the world as it is thought to be conspecific with the Indo-Pacific species *E. carbunculus*. It is only rarely seen in the Gulf of Mexico.

Habitat: This is basically a slope dwelling fish which is occasionally found associated with soft bottom at depths of 165-275 m.

Age and Growth: No data are available.

Reproduction: No data are available.

Feeding: No data are available.

Anderson, 1967; Brownell and Rainey, 1971; Camber, 1955; Thompson and Munro, 1974.

Lutjanus analis, mutton snapper

Distribution: This species occurs from New England southward to southeastern Brazil in the western Atlantic. It is also known from the Bahamas, the Gulf of Mexico, and has been introduced in Bermuda.

Habitat: There is considerable contradiction in the literature regarding the preferred habitat of this species. Several references indicate the species prefers shallow water areas near mangroves, canals, grass beds, soft bottom areas, and sandy areas between reefs. Another group of papers indicates the species is often found over mud or sand bottom in deeper parts of the shelf at 100-183 m in depth.

Reproduction: Individuals are reported to spawn in July and August. They probably attain sexual maturity at 40 cm fork length and one female has produced 1,365,975 eggs.

Feeding: The mutton snapper feeds principally on crustaceans, fishes, and some gastropods. The dominance of either fish and/or crustaceans in the diet is probably dictated by local relative abundance of prey and competition with other carnivores.

Beebe and Tee-Van, 1928; Bohlke and Chaplin, 1968; Brownell and Rainey, 1971; Jordan and Evermann, 1923; Moe, 1963; Randall, 1962; 1968; Starck, 1971; Struhsaker, 1969; Thompson and Munro, 1974.

Lutjanus apodus, schoolmaster

Distribution: This species occurs on both sides of the Atlantic Ocean. In the western Atlantic it is known from Massachusetts southward to Brazil. It occurs in the Caribbean, Gulf of Mexico, Bermuda, and the Bahamas.

Habitat: This species has been described as the most common snapper on the West Indies reefs. It shows a preference for elk horn coral but does occasionally occur over grass flats and reef-like areas. It apparently is the shallowest dwelling snapper reported on herein. The schoolmaster does occasionally live in fresh water. An individual apparently does not migrate very much during its life.

Age and Growth: Some large individuals may weigh as much as 3.6 kg. The maximum length of schoolmaster snappers is 60 cm total length (TL). Growth is apparently slow, being about 1.5 to 1.7 mm per month in tagged specimens.

Reproduction: As only spent individuals have been taken, spawning may take place offshore, away from the normal inshore reef habitat of the species. The spawning period cannot be discerned at present although it may occur during the winter.

Feeding: They tend to feed at dusk and basically eat crabs, shrimp and fishes.

Beebe and Tee-Van, 1928; Bohlke and Chaplin, 1968; Hoese and Moore, 1977; Longley and Hildebrand, 1941; Munro, et al., 1973; Randall, 1962, 1968; Rivas, 1949; Starck, 1971; Thompson and Munro, 1974.

Lutjanus campechanus, Gulf red snapper

Distribution: This species which may be a synonym of the Caribbean red snapper, Lutjanus purpureus, is widely distributed in the western Atlantic. The red snapper occurs northward to Massachusetts and southward to Brazil. It is also found in the Gulf of Mexico, where it is perhaps most abundant, as well as the West Indies and Caribbean.

Habitat: Generally the species prefers deeper offshore reefs or hard bottom areas as an adult. It is often found associated with coral reefs or limestone outcroppings in the northern Gulf of Mexico. The depth preference for adults is broad but in general they tend to be found in deeper areas in the winter, 30-65 m (although depth records indicate a potential range of 10-256 m). There is considerable evidence that during the warm summer months there is movement from offshore reefs to inshore reefs (20-30 m) except during the period of spawning when the adults tend to move offshore. During this movement individuals may be captured over open sand or on softer substrates. Juveniles are most often collected inshore in sandy or mud bottom shallow areas (10-35 m) in the shrimp ground area east, west, and south of the Mississippi Delta. It is presumed that this constitutes a nursery area as large numbers of specimens are taken off these grounds as incidental catch by shrimpers and industrial fish trawlers. There is evidence also that there is a reciprocal offshore migration during the fall of the year by adults. A single tagged specimen had moved only 148 km after six years of freedom. Temperature preference of the species is between 14-30° C. The lower lethal temperature is 12.7° C and the optimal activity temperature is 18° C.

Age and growth: Individuals initially show a rather rapid growth rate, attaining 14-25 cm (fork length) in the first year of life. Individuals which are four years of age may be between 37-56 cm long. Specimens may reach a maximum age of at least 20 years, a maximum length of 90 cm total length and a maximum weight of 18 kg. Large variation in growth rate plus a prolonged spawning period make it difficult to use length-frequency data for age-group analysis and otoliths appear to be a reliable way of aging specimens. However, there is some question if the first annulus mark is valid for age-group one. Most specimens which comprise the fishery are apparently two years old and about 21-23 cm long in fork length.

Reproduction: Sexes are separate. Spawning occurs at inshore areas on the shelf between June and October. There is apparently an offshore migration during warmer months, presumably for spawning purposes. Larger individuals spawn earlier in the season than smaller individuals. Individuals may reach sexual maturity after age two.

Feeding: The red snapper is basically carnivorous, feeding mainly on squid and fish. Although this species is presumed a bottom feeder, the presence of squid and gastropod larvae in the stomachs indicates a tendency to feed off the bottom in the water column at times. Most other invertebrates consumed by the red snapper are not obligate reef or rock dwellers and therefore the inference can be made that the species feeds away from these areas. Juveniles often have shrimp in their guts and these snapper are also taken by shrimp trawlers in the shrimp grounds. After attaining age-group I the fish change feeding habits to become more piscivorous.

Beebe and Tee-Van, 1928; Bradley and Bryan, 1973; Camber, 1955; Futch and Bruger, 1976; Hoese and Moore, 1977; Moe, Beaumariage and Topp, 1970; Moore, 1976; Mosely, 1966; Sal'nikov, 1969.

Lutjanus cyanopterus, cubera snapper

Distribution: This species is not frequently captured anywhere within its range. Presently this range includes the western Atlantic from New England southward to Recife, Brazil. It is also known from the Bahamas and the Gulf of Mexico.

Habitat: The cubera snapper is a reef-associated species found around patch reefs and offshore coral reefs as well as wrecks. It is found at depths of 30-36 m but juveniles have been taken among seagrass areas off Cuba.

Age and Growth: This species grows to at least 45 kg and 150 cm and is therefore one of the largest snapper species in the Gulf.

Reproduction: No data are available.

Feeding: The species is piscivorous. Starck (1971) examined the stomach contents of seven fish and noted the presence of snapper, grunt, parrotfish and porcupine fish.

Bohlke and Chaplin, 1968; Hoese and Moore, 1977; Starck, 1971.

Lutjanus griseus, gray (mangrove) snapper

Distribution: This species occurs on both sides of the Atlantic. In the western Atlantic it occurs from New England to southeastern Brazil. It is also known from Bermuda, the Bahamas, Caribbean, West Indies, and Gulf of Mexico.

Habitat: The gray snapper is common to a wide variety of habitats and environmental situations. It is found at offshore reefs to a depth of 75 m. It is also common to inshore areas, mangroves in tidal creeks and lagoons, estuaries and grass beds of Thalassia, Ruppia, Holophila, Diaplanthera. It can also be found in the wide range of salinities from 0-35°/oo. Concomitantly it tolerates a wide temperature range (13.4 to 32.5° C).

Age and Growth: The largest specimen reported to date is 90 cm in total length (perhaps this was a cubera snapper) although a specimen of 45 cm fork length has been examined by Thompson and Munro (1974). Fish may weigh as much as 14 kg but specimens larger than 3.6 kg are rare. Otolith annuli are formed in the fall off Florida. These specimens indicate that the overall growth rate is 3.1 to 4.5 mm per month. Fish 50 cm in length may be as old as nine years. Because of its affinity for shallow water, its growth rate is greatly affected by seasonal water temperatures.

Reproduction: The sexes are separate and females predominate at the inshore sites while males are more frequently found offshore. Females mature at about 19.5 cm in standard length and males mature at 18.5 cm. Females also tend to attain a greater size than males. Multiple spawning apparently

occurs offshore at dusk during the spawning season which lasts from June to August. Females produce about 12,000 eggs per gram of ovary (about 273,500 eggs per ovary).

Feeding: Juveniles at inshore localities feed primarily on small crustaceans such as shrimp, copepods, and amphipods, as well as larval fishes. Larger juveniles feed primarily on larger crustaceans. At inshore areas adults feed predominantly on crustaceans, particularly portunid crabs, as well as benthic fishes. At offshore reefs, the diet of adults is primarily fishes and secondarily crustaceans. Larger fish tend to eat proportionately more fish. Juveniles are primarily diurnal feeders while larger fish are nocturnal feeders.

Anderson, 1967; Bashirullah, 1975; Bohlke and Chaplin, 1968; Erdman, 1956; Randall, 1961, 1968; Smith, 1976; Springer and Woodburn, 1960; Starck, 1971; Thompson and Munro, 1974.

Lutjanus jocu, dog snapper

Distribution: The species has been introduced to Bermuda but naturally occurs in the western Atlantic from Massachusetts to Recife, Brazil. It is found in the Gulf of Mexico and throughout the Caribbean.

Habitat: Juveniles apparently prefer inshore localities in brackish water of estuaries. Larger fish are found over hard, rock and coral bottoms. The largest individuals have been taken at the deepest localities. Depth range preferred is variable. Smaller fish may be in water only 1 m deep but larger fish have been taken as deep as 83 m.

Age and Growth: Largest specimens are about 72 cm in fork length and maximum weight is between 9-14 kg. Average length of fish comprising the fishery is about 30 cm fork length. In 11 months one tagged fish grew only 2 mm.

Reproduction: The smallest ripe female observed is 32.3 cm fork length. Ripe females have been collected in both the early spring and late fall months.

Feeding: The dog snapper eats primarily reef fishes, these comprising about 61 percent of the diet, with crustaceans and mollusks making up the remaining portion of its food. The dog snapper apparently feeds night and day.

Beebe and Tee-Van, 1928; Hoese and Moore, 1977; Randall, 1962, 1968; Starck, 1971; Thompson and Munro, 1974.

Lutjanus mahogoni, mahogany snapper

Distribution: This snapper is found in the Caribbean northward in the western Atlantic to the Carolinas. It is found in the eastern Gulf of Mexico and in the Bahamas.

Habitat: The mahogany snapper prefers a wide variety of habitats: from sandy, grass bottom areas in shallow water to rocky, coral substrate areas. It is often captured from Acropora coral areas.

Age and Growth: The largest known specimen of the mahogany snapper is 37.5 cm in total length.

Reproduction: No data are available.

Feeding: Starck (1971) examined the stomach contents of 32 individuals and noted the diet was predominantly reef fishes with shrimp, crabs and octopus also present.

Bohlke and Chaplin, 1968; Randall, 1968; Starck, 1971; Thompson and Munro, 1974.

Lutjanus synagris, lane snapper

Description: The lane snapper is restricted to the warm temperate and tropical areas of the western Atlantic. It is known from the Carolinas to southeastern Brazil as well as the Gulf of Mexico, the Bahamas, Bermuda, and the western Caribbean.

Habitat: This species is found in a wide variety of habitats and depths. Juveniles are often taken inshore in grass flats and back reefs. Often juveniles are taken off soft bottom shrimp grounds where L. campechanus juveniles are also common. Adults tend to be found at deeper reef areas but may also be taken over sandy bottom areas away from reefs. Depth range of the species is extreme from 9.1 m to 395 m. Individuals are usually found in higher salinities (35°/oo) but are occasionally taken in water with lower salinity (22°/oo). The temperature preference has not been established but individuals have been taken in water from 15.0 to 30° C.

Age and Growth: The largest specimen recorded is about 45 cm in total length but most fish which comprise the fishery are between 18 and 38 cm total length. One scale annulus was observed on each of five fish examined by Thompson and Munro (1974) and the size range was 21-29 cm total length, implying a rather rapid first year growth rate as the size at first annulus formed was 20.5 cm (total length).

Reproduction: Juveniles are often observed at inshore localities in the late summer or fall of the year, suggesting a midsummer spawning period. Studies on the gonads indicate that individuals off Cuba may spawn from March to September, with peak reproduction periods in April-May and June-August. Egg production is reasonably high as individuals may produce 347,000 to 995,000 eggs at a time. Specimens attain sexual maturity above 14 cm in length.

Feeding: Juveniles feed on copepods, grass shrimp and other small invertebrates. Adults tend to feed diurnally on fishes, crustaceans, annelids and mollusks.

Beebe and Tee-Van, 1928; Bohlke and Chaplin, 1968; Druzhinin, 1970; Hoese and Moore, 1977; Moe and Martin, 1965; Randall, 1968; Springer and Woodburn, 1960; Starck, 1971; Thompson and Munro, 1974.

Lutjanus vivanus, silk snapper

Distribution: The silk snapper is found in the western Atlantic from the Carolinas southward to the northern coast of South America and in the Gulf of Mexico. It is very common around the Virgin Islands.

Habitat: This is a predominantly deep dwelling snapper normally found at a depth of 157-234 m at or off the shelf edge on deep reefs (although it has been collected in water as shallow as 25 m and as deep as 387 m). Some individuals may be found over softer substrate particularly in the shallow parts of its depth range.

Age and Growth: Most specimens which comprise the fishery are between 19-74 cm with the largest specimen reported being 79 cm total length. The length-weight relationship is represented by

$$\text{Log } W = -3.47088 \quad 2.41350 \text{ Log } L.$$

Reproduction: Individuals mature above a size of 24-27 cm in fork length. Spawning may take place year round with potential spawning peaks in March, September, and November.

Feeding: Fish comprise about 50 percent of the species diet; shrimp 17 percent, crabs 11 percent, isopods four percent with ophiuroids, squid, octopus, and stomatopods also present. Tunicates have been reported as a common food item in shelf dwelling individuals.

Bohlke and Chaplin, 1968; Brownell and Rainey, 1971; Munro, et al., 1973; Sylvester, 1974; Sylvester and Dammann, 1973; Thompson and Munro, 1974.

Ocyurus chrysurus, yellowtail snapper

Distribution: The yellowtail snapper occurs in the western Atlantic from Massachusetts to southeastern Brazil. The species is known from Bermuda, the Bahamas, the West Indies, and the Gulf of Mexico.

Habitat: Adults are normally found over reefs and sandy areas near reefs. These adults also form schools which swim a few to several meters above these substrates. Juveniles are more commonly seen at inshore areas among turtle grass. Depth distribution is from very shallow water to water less than 183 m. Maximum temperature tolerated by the species is 34° C and the lower temperature limit is 18° C for juveniles. The preferred temperature range is 24 to 30° C for juveniles.

Age and Growth: The range of individuals caught by the commercial fishery is 16-27 cm in fork length with the mean being about 22 cm and three years of age. Females generally are larger than males. Maximum age is about eight years and maximum size of individuals is about 76 cm total length. There is little evidence of sexual difference in growth rates. Growth rates are between 5.3 and 6.6 mm per month.

Reproduction: Individuals are reproductively active from February to October although there are possibly two peaks which occur in February-April and September-October. Females produce between 100,000 and 1,473,000 eggs at a time and they attain sexual maturity at about 11-12 cm standard length. Spawning probably takes place away from inshore areas.

Feeding: Juveniles are generally planktivorous. Adults feed predominantly on benthic and pelagic reef fishes and to a lesser extent on crustaceans and mollusks. Algae in the diet is apparently incidental.

Beebe and Tee-Van, 1928; Bohlke and Chaplin, 1968; Bright and Cashman, 1974; Druzhinin, 1970; Hoese and Moore, 1977; Munro, et al., 1973; Piedra, 1969; Starck, 1971; Struhsaker, 1969; Thompson and Munro, 1974; Wallace, 1977.

Pristipomoides aquilonaris, wenchman

Distribution: The species is distributed from North Carolina in the north to French Guiana in the south. It is particularly common off the Greater Antilles, the western Caribbean and the Gulf of Mexico.

Habitat: The wenchman prefers hard bottom from the middle to outer edge of the shelf. The depth range of individuals is from 24-366 m with most specimens taken from water of 183 m at the shelf edge.

Age and Growth: No data are available.

Reproduction: No data are available.

Feeding: No data are available.

Anderson, 1966.

Pristipomoides macrophthalmus, voraz

Distribution: The voraz is a western Atlantic species which occurs in the Greater Antilles, West

Indies, Bahamas, southward to the mouth of the Orinoco off Venezuela, and northward to Florida and the Gulf of Mexico.

Habitat: This is a rather deep dwelling species known from a depth range of 60-549 m but most often taken off the shelf edge in water about 230-400 m deep. The substrate preferred is apparently coral rubble, rock, sand and occasionally mud. The species may favor areas with a steep drop off at the shelf edge.

Age and Growth: Most fish which comprise the fishery are 30-39 cm in length. The largest specimens are 44 cm long and the smallest fish captured by the fishery are 10-19 cm long.

Reproduction: Females mature at a size larger than 18 cm in fork length. Ripe individuals have been collected in October.

Feeding: The voraz apparently prefers a diet of shrimp.

Anderson, 1966; Brownell and Rainey, 1971; Sylvester, 1974; Thompson and Munro, 1974.

Rhomboplites aurorubens, vermilion snapper

Distribution: The vermilion snapper occurs from southeastern Brazil northward to the Carolinas in the western Atlantic. It is not often taken in the more tropical areas such as the Bahamas but is common in the Gulf of Mexico.

Habitat: The species is normally caught at the edge of reefs in deeper water ranging from 30 to 183 m, being most commonly found at reefs deeper than 64 m. Both juveniles and adults are found on these reefs which may be coral or limestone. The species is often found in the same areas as red snapper but it is presumed that the vermilion snapper is not as closely associated with the substrate as is the red snapper. The lower lethal temperature of the species is 12.5° C and it has an activity temperature preferential of 27.5° C.

Age and Growth: The species attains a maximum size of 60 cm total length and a weight of 2.8 kg. Sexes are separate and they grow at about the same rate until age eight. Females continue to grow to age ten but males have not been seen older than eight. Growth is slow, as one-year old fish are 9.9 cm; two-year old, 18 cm; three-year old, 26 cm; four-year old, 32 cm; five-year old 39 cm; six-year old, 44 cm; seven-year old 49 cm; etc, with the ten-year old fish being about 53 cm.

Reproduction: Spawning takes place from April through September. Females mature at year four and, occasionally, three. Fecundity ranges from 8,168 to 1,789,998 eggs per fish and they tend to spawn in depths of 30-90 m.

Feeding: The species basically forages in the water column. Pelagic organisms such as ostracods, copepods, stomatopods, amphipods, euphausids, etc., constitute 30 percent of their diet by volume. Squid account for 37 percent of their diet while pteropods, heteropods, and other opisthobranchs constitute 11 percent. Fish make up eight percent of the diet. They are probably nocturnal feeders. The vermilion snapper probably feeds about 3-5 m off the bottom.

Bohlke and Chaplin, 1968; Grimes, 1976, Hildebrand, 1955; Moore, 1973.

Epinephelus adscensionis, rock hind

Distribution: The species is rather broadly distributed. It is known from the eastern Atlantic, from the Azores, Canary Islands, Ascension Islands, and along the southwestern African coast to the Cape of

Good Hope. The species also occurs commonly along the western Atlantic coast from Massachusetts along the southeastern coast of the United States, throughout the Gulf of Mexico. It has additionally been recorded from localities in Bermuda, the Bahamas, Cuba, Belize, and Panama. It may be more generally stated that the species occurs in the littoral areas of the tropical Atlantic.

Habitat: The rock hind is generally found at inshore localities over hard rocky bottom such as rock jetties, coral reefs, and rubble piles, particularly in the warmer parts of its range. It prefers rather shallow water having been recorded commonly at 3–4 m and having been taken in water only as deep as 45 m.

Age and Growth: Few data are available on these life history parameters but they probably attain a maximum size (total length) of 60 cm. One study indicated the species attains a maximum weight of 2.3 to 3.6 kg.

Reproduction: No data are available but the species is probably a protogynous hermaphrodite (reproduces first as a female, later changing sex to reproduce as a male) as are other members of the genus Epinephelus.

Feeding habits: No data are available but the species may most probably be classed as an euryphagic carnivore (i.e., feeds on a wide variety of invertebrates and fishes).

Bohlke and Chaplin, 1968; Hoese and Moore, 1977; Smith, 1961; Smith; 1971; Springer and Woodburn, 1960.

Epinephelus drummondhayi, speckled hind

Distribution: The speckled hind is distributed within the Gulf of Mexico, along the Florida east coast to North Carolina, and in Bermuda. Within the Gulf it has been reported only east of the Mississippi Delta and is apparently infrequently collected in the eastern part of the Gulf.

Habitat: Although rare and apparently restricted to the eastern portion within its Gulf range, the species is found at more offshore localities in deeper water of 30–185 m. No preferred substrate data are available.

Age and Growth: Age data on the speckled hind are not currently available. The maximum size of the species is reported as 29 kg in weight. Most individuals are somewhat smaller, however, reaching 46 cm in total length.

Reproduction: Data on reproduction are not presently available. The species is probably a protogynous hermaphrodite.

Feeding: The speckled hind is probably an euryphagic carnivore based on information available for other groupers.

Gunter, 1935; Hoese and Moore, 1977; Smith, 1958; Smith, 1961; Smith, 1971; Smith, 1976; Smith, et al., 1975.

Epinephelus flavolimbatus, yellowedge grouper

Distribution: The species is a more tropical and reef associated species than some other groupers. It has been recorded throughout the Gulf of Mexico but is also known from Cuba, the West Indies and the northern coast of South America.

Habitat: Nelson and Carpenter (1968) reported that the yellowedge grouper is often taken in the Gulf off Texas over areas of flat bottom as well as irregular substrates. Others have found it to occur more often at the shelf edge on mud, sand or sand-shell bottom. Although juvenile specimens have been recorded from shallow water (35 m) it is most frequently taken from deeper water at the shelf edge (180-275 m).

Age and Growth: The yellowedge grouper attains a maximum size of 16 kg with most fish being caught weighing about 4.5 kg.

Reproduction: Brownell and Rainey (1971) reported the presence of a ripe female, 88 cm long and weighing 9 kg from the Virgin Islands. The report of a female near maximum size is cause to question the presence of protogynous hermaphroditism as the reproductive mode in this species.

Feeding: No feeding data are presently available except the report of squids in the stomach of E. flavolimbatus from the West Indies.

Bullis and Thompson, 1965; Brownell and Rainey, 1971; Nelson and Carpenter, 1968; Smith, 1971; Walls, 1975.

Epinephelus guttatus, red hind

Distribution: The species is known from Bermuda, along the Atlantic coast from North Carolina to Brazil. It is also known to occur throughout the Gulf of Mexico, the Bahamas, and Caribbean.

Habitat: The species is very common in the deeper reefs off Bermuda. Throughout other parts of its range it generally is common in clear water, deep reef areas and is only rarely reported from murky estuarine, soft bottom regions. The species apparently prefers reefs associated with continental areas as opposed to insular localities. Although it has been reported from shallow water, its normal depth preference appears to be between 6 and 10 m for smaller specimens and generally between 30-110 m for larger adults. Even though the species is tropical in its distribution, some authors have suggested its preference for cooler, deep water as is found off Bermuda. In the Gulf of Mexico it is found at the west Florida shelf and off Texas.

Age and Growth: Maximum size attained by the species is 76 cm in the northern Gulf of Mexico but most larger specimens are generally only between 25-45 cm in total length. Maximum weight is unknown but estimates can be made from the length-weight equation of Thompson and Munro (1974: Log W = -1.754 + 2.960 Log L). Most large specimens average about 2 kg. Burnett-Herkes (1975) also reports that 30 cm long specimens have about 10 annular otolith rings.

Reproduction: The species is definitely a protogynous hermaphrodite. Individuals mature first as females at or before 25 cm in length. Burnett-Herkes (1975) indicated that females range from 19 cm to 41 cm (average 34) and males range from 23 cm to 41 cm (average 39). The ratio of males to females varies with local populations with reported ranges as 1:1.7 to 1:35. Spawning generally takes place from January to July. They tend to be sexually active at water temperatures above 20° C. Available evidence indicates that individuals come together at shallow (5-15 m) coral reefs and remain for a month during the spawning season. Fecundity estimates are variable: 89,671 to 3,364,902 eggs from individuals ranging from 25-46 cm.

Feeding: Individuals feed rapidly on a variety of reef or near reef fishes and invertebrates such as Mithrax and Callapa crabs, Scyllarid lobsters, Alphid shrimp, wrasses, parrotfish and grunts. Crabs are apparently the most important food item, making up approximately 40 percent of the diet by volume, while stomatopods (17 percent), shrimp (10 percent), fish (21 percent), octopods (seven percent), and echiuroids (two percent) also contribute to the food of the species. Red hinds are apparently diurnally active, reef dwelling organisms.

Bardach and Mowbray, 1955; Bohlke and Chaplin, 1968; Bullis and Thompson, 1965; Burnett-Herkes, 1975; Collette and Talbot, 1972; Hoese and Moore, 1977; Menzel, 1960; Munro, et al., 1973; Randall, 1962, 1968; Smith, 1958; Smith, 1971; Smith, 1976; Smith, et al., 1975; Thompson and Munro, 1974.

Epinephelus itajara, jewfish

Distribution: This is one of the grouper species in the Atlantic that has a conspecific population in the eastern Pacific Ocean as well. In the present study, however, the discussion will be confined to the Atlantic populations only. The general Atlantic distribution is from Florida to Brazil, throughout the West Indies, Bahamas, Bermuda and the Gulf of Mexico.

Habitat: The species generally is found in areas of cover around ledges, caves, sunken wrecks, docks, bridges, reef outcroppings, etc. Juveniles have been taken commonly in lagoons and mangrove areas which presumably have a somewhat softer substrate. Depth preference data are few. The species is known from a depth of 12-36 m in the eastern Gulf of Mexico.

Age and Growth: This is the largest of the Atlantic American groupers, reaching a maximum size of 182 cm and a weight of 320 kg. Large specimens of 225 kg are common throughout its range.

Reproduction: There is evidence that the species is protogynously hermaphroditic.

Feeding: Food of the jewfish is diverse. There are records of it eating items such as fish, hawksbill turtles, crabs, and slipper lobsters. Most references indicate that it feeds on spiny lobsters.

Anderson, 1966; Beebe and Tee-Van, 1928; Bohlke and Chaplin, 1968; Erdman, 1956; Hoese and Moore, 1977; Longley and Hildebrand, 1940; Randall, 1967, 1968; Smith, 1958; Smith, 1971; Smith, 1976; Springer and Woodburn, 1960; Thompson and Munro, 1974.

Epinephelus morio, red grouper

Distribution: This species is widely distributed along the coastal western Atlantic from Massachusetts southward to Florida, Bermuda, the Bahamas, the Gulf of Mexico, West Indies, Venezuela, and Brazil. It is also known from the west coast of Africa.

Habitat: Generally the red grouper is found on rocky, hard bottom areas near reefs. The favorite habitat is apparently near crevices, ledges and caverns. Struhsaker (1969) however reported large catches of red grouper from soft, mud bottom off the southeastern coast of the U.S. Small adults and juveniles are frequently found inshore among turtle grass or sandy holes. The species prefers a moderate depth of about 30-120 m, but as stated previously, is occasionally found inshore in water less than 3 m and adults are rarely found in water less than 15 m deep.

Age and Growth: The species attains a maximum total length of 85 cm and a maximum weight of about 23 kg. Individuals attain a size of about 40 cm after five years. Some may attain at least 30 years of age. Instantaneous mortality rates have been calculated at 0.322, annual survival rate is 0.724, and the annual mortality rate is 0.226.

Reproduction: Sex reversal (female to male) may occur in fish larger than 38 cm standard length and most often between 45-65 cm standard length. A broad size range of sexual transition is apparently the norm for the species. Sexual maturity is attained at four to six years for females and the maximum fecundity is at ages eight to twelve. Males reach reproductive importance at age ten and older. Peak spawning is probably between April and May but individuals may be reproductively active January through November. A female may produce 1,500,000 eggs.

Feeding: This diurnally active species apparently feeds on a wide variety of organisms such as fish, octopods, shrimp, crabs, stomatopods, and lobster. Specifically, they eat portunid and Callapa crabs and palinurid and scyllarid lobsters. Generally they appear to feed on a wide variety of crustaceans and fishes, with larger individuals consuming more fishes.

Bohlke and Chaplin, 1968; Moe, 1969; Smith, 1971; Smith, 1976; Struhsaker, 1969.

Epinephelus mystacinus, misty grouper

Distribution: This species has an amphi-American distribution, being reported from Bermuda, the Bahamas, eastern Florida, the southwestern Gulf of Mexico, Cuba, Puerto Rico, the West Indies, and as far south as Brazil, and from the Galapagos in the Pacific.

Habitat: This solitary species is found over both hard and soft bottom in water deeper than most groupers prefer (100-300 m). Smith (1958) reports specimens taken as deep as 490 m off the Florida Straits.

Age and Growth: Maximum weight reported is generally about 120 kg.

Reproduction: Spawning may occur at least from July through August. Although protogynous hermaphroditism is the suspected mode of reproduction in the species, the largest specimens known (100 cm fork length) were females.

Feeding: Food studies have not yet been conducted on this species, however, fish and squid have been found in stomachs.

Bohlke and Chaplin, 1968; Brownell and Rainey, 1971; Munro, et al., 1973; Robins, 1967; Smith, 1958; Smith, 1971.

Epinephelus nigritus, Warsaw grouper

Distribution: The species is common in the northern Gulf of Mexico but also occurs from Massachusetts to Florida, and has been reported from Trinidad and Brazil. Smith (1971) also reported the species from the eastern Pacific Ocean from Mexico to Panama.

Habitat: Occasionally they are captured as juveniles at shallow inshore localities but they are most often captured from reef areas at a depth of 37-457 m.

Age and Growth: Specimens may reach 136 kg in weight and up to 150 cm in length. Five to six kg individuals are common in the Gulf.

Reproduction: The Warsaw grouper is probably a protogynous hermaphrodite.

Feeding: No data on feeding are available.

Bradley and Bryan, 1973; Hoese and Moore, 1977; Nelson and Carpenter, 1968; Smith, 1971.

Epinephelus niveatus, snowy grouper

Distribution: The species is found in the western Atlantic Ocean from Massachusetts to Florida, the Gulf of Mexico, the Bahamas, and Cuba. The species apparently does not occur in the West Indies except for Cuba. The snowy grouper also is known from Brazil in the western Atlantic and from Baja, California, to Panama in the eastern Pacific.

Habitat: Little is known of the habits of this fish except that it has been recorded from shoreline to depths of 395 m.

Age and Growth: Maximum size attained by this species is 122 cm.

Reproduction: The snowy grouper is probably a protogynous hermaphrodite.

Feeding: No data are available on its feeding habits.

Bohlke and Chaplin, 1968; Smith, 1971.

Epinephelus striatus, Nassau grouper

Distribution: The species has been recorded from off North Carolina and Bermuda in the western Atlantic, southward along the coastal U.S. and throughout the Gulf of Mexico. It is also known from the Caribbean and occurs as far south as Recife, Brazil, in the south Atlantic.

Habitat: Adults tend to prefer a reef-type habitat while juveniles are often found in shallower sea grass areas. Smith (1971) has noted the presence of two distinct populations: one which occurs in deeper water and migrates inshore to spawn and another group which remains at inshore reef areas. The species has been reported as deep as 95 m but most fish are caught from coral reefs in the 26-30 m depth range.

Age and Growth: Specimens have been reported weighing as much as 25 kg but the average weight of specimens comprising the fishery is 2.3 to 7 kg. Although Brownell and Rainey (1971) reported that most specimens were 2.3 kg or less, the maximum length may be 130 cm.

Reproduction: The Nassau grouper is protogynously hermaphroditic and the transformation from female to male takes place at 30-80 cm in length. The spawning season is from May to August off Bermuda and from November to February off the Virgin Islands. This species has been reported to spawn in dense aggregations off the Virgin Islands.

Feeding: Specimens from Puerto Rico and the Virgin Islands ate fish (55 percent), crabs (22.5 percent), and lesser amounts of other crustaceans, cephalopods, pelecypods, and gastropods. Off Venezuela, Cervigon (1966) found that crustaceans formed the major portion of the diet of this species.

Bohlke and Chaplin, 1968; Brownell and Rainey, 1971; Cervigon, 1966; Hoese and Moore, 1977; Manday and Fernandez, 1966; Munro, et al., 1973; Randall, 1968; Smith, 1958; Smith, 1971; Olsen and La Place, 1978.

Mycteroperca bonaci, black grouper

Distribution: The species occurs as far south as Brazil and Venezuela, and in the West Indies. It is also known from the Bahamas, Bermuda, Florida and northward to Massachusetts as well as the eastern Gulf of Mexico and off the Yucatan.

Habitat: This species is often confused with the gag, Mycteroperca microlepis, owing to the preferred common name of the black grouper for M. microlepis by Gulf of Mexico fishermen; therefore much of the colloquial reports of "common to the Gulf of Mexico" do not refer to M. bonaci.

Age and Growth: Most reports indicate that the black grouper attains a weight of 23 kg but there are several reports of large specimens reaching 100 cm in length and weighing 82 kg.

Reproduction: The species is probably also a protogynous hermaphrodite as the largest individuals tend to be males and all the smaller individuals are females. In Bermuda, Smith (1971) indicated that spawning takes place from May to August while Erdman (1956) stated that a ripe male was captured in February off Puerto Rico.

Feeding: Bohlke and Chaplin (1968) reported that the species feeds on small fishes and crabs.

Bohlke and Chaplin, 1968; Cervigon, 1966; Erdman, 1956; Hoese and Moore, 1977; Randall, 1968; Smith, 1958; Smith, 1971.

Mycteroperca interstitialis, yellowmouth grouper

Distribution: The species is recorded from the tropical western Atlantic. It is abundant off Bermuda and also occurs in the Bahamas, Antilles, and Caribbean. Along the continental shelf it is known from New England to Recife, Brazil. Several authors have indicated a systematic problem in recognizing M. interstitialis in the Gulf of Mexico. It is apparently absent from the Gulf but small species of scamp, M. phenax, apparently have characters similar to M. interstitialis adults. The matter is not yet resolved.

Habitat: The species has been taken from both coral and sand substrate within its range. There is also no apparent depth preference as specimens have been captured from 4 to 150 m.

Age and Growth: The yellowmouth is one of the smallest grouper. The largest reported size is 70 cm and the maximum weight recorded is 3.6 kg.

Reproduction: Protogynous hermaphroditism is apparently the reproductive mode. Gonads are in a ripe condition from May to August.

Feeding: Randall (1967) examined the stomach contents from eight specimens from inshore areas and indicated the species was piscivorous.

Bohlke and Chaplin, 1968; Bright and Cashman, 1974; Brownell and Rainey, 1971; Bullis and Thompson, 1965; Randall, 1967, 1968; Smith, 1971; Smith, et al., 1975.

Mycteroperca microlepis, gag

Distribution: The gag is restricted to the western Atlantic from Massachusetts to Rio de Janeiro, Brazil. It occurs abundantly through the Gulf of Mexico where it is often called the "black grouper". It is also known from Bermuda but is apparently absent from the West Indies.

Habitat: Adults are normally captured in depths ranging from 20-80 m. Juveniles are often found inshore in water less than a meter deep. Adults prefer offshore reefs or reef-like structures and areas of depression in the shelf east of the Mississippi River. Juveniles are often taken in estuaries, bays and grass flats.

Age and Growth: McErlean (1963) conducted a life history study of the gag off St. Petersburg, Florida. He found that specimens attained a probable maximum size of 95 cm standard length (approximately 110 cm in total length) and a maximum weight of 16 kg. Manooch and Huntsman (pers. comm.) have reported specimens greater than 25 kg. Most specimens which comprise the fishery weigh only about 2.5 kg. Growth is relatively rapid. The oldest and largest specimens examined were determined to be 8-15 years of age. A specimen tagged, released and recaptured, indicates that in 6.3 years of freedom it had moved 3.2 km and had grown at 4 mm per month.

Reproduction: McErlean and Smith (1964) found that females were one to eleven years old in the population. Females transformed into mature males as males represented only the largest and oldest specimens (age 13-15 years; 86 cm in standard length). Spawning time is short and occurs in the early spring. Females produce a large number of eggs (526,000 to 1,500,000) and the eggs are apparently demersal and the larvae pelagic.

Feeding: The species feeding habits have not been adequately studied.

Hoese and Moore, 1977; McErlean, 1963; McErlean and Smith, 1964; Moe, Beaumariage and Topp, 1970; Smith, 1971; Springer and Woodburn, 1960; Wells, 1975.

Mycteroperca phenax, scamp

Distribution: The species is essentially restricted to the western north Atlantic. It is common throughout the Gulf of Mexico and has also been recorded along the east coast of the U.S. as far north as Massachusetts. It may also occur in the southern Caribbean Sea. Some records of this species perhaps should be attributed to M. interstitialis.

Habitat: The scamp is often found on the "snapper banks" in the Gulf. The species generally favors hard bottom areas and its depth range is 20-90 m.

Age and Growth: The scamp may attain a size as long as 91 cm and some specimens are said to weigh up to 9 kg.

Reproduction: This grouper is also probably a protogynous hermaphrodite. The only literature reference to spawning is the report of a ripe female in March.

Feeding: No data are available.

Bradley and Bryan, 1973; Hoese and Moore, 1977; Randall, 1968; Smith, 1971; Smith, 1976.

Mycteroperca venenosa, yellowfin grouper

Distribution: Although found in the Gulf of Mexico, the yellowfin grouper is also found in the tropical western Atlantic from Bermuda, south Florida, the Bahamas, the Antilles, and Brazil.

Habitat: Apparently the species prefers irregular, hard coral bottom but there is some evidence it can be found over mud bottom as well. Juveniles have also been taken in shallow grass beds. Depth records range from 2 to 145 m but most specimens have been taken at 35-120 m.

Age and Growth: Thompson and Munro (1974) found that in the Antilles the species attained a maximum length of 86 cm although there are other reports of specimens attaining 90 cm in length. After four years of life M. venenosa reaches 46-57 cm in length and grows at approximately 3 cm per year. The average size of specimens collected from the fishery is 65 cm.

Reproduction: Fish mature first as females at about 51 cm. Larger specimens are apparently males. Peak spawning takes place as early as December and as late as May.

Feeding: No data are available. It has been recorded as having toxic flesh due to ciguatera. This may indicate a piscivorous feeding habit.

Bholke and Chaplin, 1968; Brownell and Rainey, 1971; Bullis and Thompson, 1965; Randall, 1968; Smith, 1971; Thompson and Munro, 1974.

Centropristis spp., sea basses

Distribution: Several species occur in the Gulf of Mexico. Centropristis melana, the southern sea bass, which was previously considered as a subspecies of C. striata is the dominant species in the fishery which is located off the Florida west coast. This species is rare west of Cape San Blas and has not been documented from the western Gulf. C. ocyura, the bank sea bass, is less common in the eastern Gulf and occupies deeper water than the other species. It ranges from North Carolina to Florida and throughout the Gulf. C. philadelphica, the rock sea bass, is very common in the shallow northwestern Gulf. C. striata, the black sea bass, (previously C. striata striata) occurs principally off the eastern Atlantic coast and is rare in the Florida Keys area.

Habitat: As a group the sea basses tend to have a preference for rocky or rough hard bottoms. C. philadelphica, however, is more frequently found over sandy or muddy bottoms between 22 and 110 m and rarely occurs in the bays and sounds. Both C. philadelphica and C. melana are found closer to shore than C. ocyura which has a more pronounced preference for hard (rocky) bottoms. C. melana is taken from the highly saline bays of Florida.

Age, Growth and Reproduction: No information is available for sea basses from the Gulf. C. striata in the south Atlantic reaches sexual maturity at age three for males and at age two for females. In this area a three to four year old fish is approximately 23 cm and 142 g. The females of C. philadelphica and probably the other species predominate in the earlier years and some transform into males as they get larger.

Feeding: No information is available for the Gulf.

Hoese and Moore, 1977; Smith, et al., 1975; Smith, 1975.

Other Species in the Fishery

Other species included in the fishery but not the mangement unit include tilefishes, amberjacks, triggerfish and some of the wrasses, grunts, porgies and sand perch which are associated with the directed fishery for species in the management unit. Tilefish are deepwater species occurring from 20 to 600 m. Triggerfish are reef dwellers commonly associated with red snapper in the northern and northwestern Gulf. They also occur, though less abundantly, in the eastern Gulf. The hogfish, grunts, porgies and sand perch are largely associated with rough bottom in the eastern Gulf but range in deeper waters (25 to 100 m) across the Gulf. Amberjacks are schooling fish (particularly during their early life) which frequently occupy the water column above the reef apparently attracted by the bait fishes associated with the reefs. Larger specimens may become reef dwellers. They range throughout the western Atlantic from Massachusetts to Brazil.

4.2 Stock Units

This section covered under 3.1.

4.3 Catch Effort Data for Snappers and Groupers

The following discussion under this section and under Section 4.7.1.1 pertains to the snapper and grouper in the management unit. "All reef fish" is used to designate the species of the snapper/grouper complex. Sea basses are discussed separately under Section 4.7.1.2.

4.3.1 Commercial Landings Per Unit Effort

Three types of effort data are consistently reported in published statistics which may be used to measure effort and catch per unit of effort. These effort variables are number of handline vessels,

number of handline fishermen on vessels and number of handlines. However, these three reduce to two because the number of handlines used from 1957-1974 is approximately the same as the number of handline fishermen during these years. (The exception is that the number of handlines used per fishermen in Louisiana ranged from 2.9 to 29.6 between 1958-1966. These data are suspect for these years. Since 1966, the Louisiana data are consistent with that from other states which indicate approximately one handline per fisherman.)

Total reef fish landed per commercial handline vessel in the Gulf of Mexico in the 1970's is significantly below landings in the late 1950's. In 1973 and 1974, vessels averaged about 40,000 pounds compared to over 66,400 in 1957 and 1958 (Appendix Table 56). Three statistically distinct trends occurred since 1957. Landings per vessel declined until the early 1960's, then increased until 1969 and since then have trended downward to current levels (Appendix Figure 13). Landings per vessel show the most pronounced downward trend in Florida where the average declined from over 123,000 pounds in 1957 to slightly less than 40,000 currently. Landings per vessel have also trended downward in Alabama and Mississippi while an upward trend is reported in Texas. No apparent trend exists in Louisiana.

4.3.2 Commercial and Recreational Catch and Effort Data

Catch data (Table 10) was compiled from several sources:

(1) U.S. commercial catch data were supplied by the National Marine Fisheries Service. It is our understanding that these data reflect "catch" (i.e., actually captured from a specific area) and not "landings" (i.e., landed in a port regardless of where caught) as these figures will be different.

(2) Cuban commercial catch consists only of grouper catches from the west Florida shelf as presented by Zuboy, 1978.

(3) Recreational catch is the interpolated and extrapolated catch presented in this report for the years 1960, 1965, and 1970.

Total catch as considered herein, represents the sum of the U.S. commercial, Cuban, and U.S. recreational catches for all species treated as part of the reef fish management unit. When snapper were considered, catch for all species were combined. Grouper catch similarly is a summation for all grouper for which catch data were available.

The U.S. commercial effort (Table 11) for the reef fish fishery in the FCZ was compiled from the National Marine Fisheries Service (Fisheries Statistics of the United States, 1965-1974). The unit of effort used in this examination was the number of handline fishermen in the Gulf of Mexico reef fish handline fishery. This was corrected to the number of handline fishermen days by multiplying the number of handline fishermen times the average number of days they fish (considered to be 200 days).

Cuban commercial effort (Table 11) was estimated as a proportion of the combined effort of the Cuban and U.S. commercial catch for which U.S. commercial handline fishermen-day data were available. This calculation is based on the equation presented by Gulland (1969:53) for use when more than one group of vessels is exploiting a stock:

$$\text{Total Effort} = \text{Effort of Fleet (A)} \times \frac{\text{Total Catch}}{\text{Catch of Fleet (A)}} = \frac{\text{Total Catch}}{\text{Catch per unit effort of Fleet (A)}}$$

Table 10. Catch data used to generate MSY by the Graham-Schaefer equilibrium model for the U.S. Gulf reef fish fishery. [1]

	U.S. Commercial (tons)		U.S. Recreational (tons)		Cuban (tons)	Total Gulf FCZ (tons)		
	Grouper[2]	Snapper[3]	Grouper	Snapper	Grouper	Grouper	Snapper	S&G Combined
1965	3,530	3,410	7,220	11,410	870	11,620	14,820	26,440
1966	3,170	2,810	6,750	10,750	1,190	11,110	13,560	24,670
1967	2,620	3,300	6,750	9,900	1,540	10,910	13,200	24,110
1968	2,880	3,700	7,000	8,750	1,510	11,390	12,450	23,840
1969	3,250	3,150	7,250	7,600	1,460	11,960	10,750	22,710
1970	3,210	3,360	7,640	6,480	2,580	13,430	9,840	23,270
1971	2,990	3,680	7,700	5,250	1,480	12,170	8,930	21,110
1972	3,130	3,910	7,750	4,500	2,220	13,100	8,410	21,510
1973	2,410	3,710	7,800	4,000	2,000	12,210	7,710	19,920
1974	2,660	3,980	7,850	3,750	1,900	12,410	7,730	20,140

1) Data are in metric tons.

2) U.S. Commercial grouper catch includes Warsaw and Jewfish.

3) U.S. Commercial snapper catch composed of red, lane, mangrove, mutton, vermillion, and yellowtail snappers

Source: U.S. Commercial catch data are from NMFS General Canvass data for the Gulf FCZ; Cuban data are from Zuboy (Ms.); Recreational data are based on national recreational fishing surveys by Clark, 1960, Deuel and Clark, 1965, and Deuel, 1973.

Table 11. Effort used to calculate MSY for all reef fish (snapper and grouper) in handline days.

Year	U.S. Commercial	Proportional Cuban	Maximum Recreational (x 1 day)	Total
1965	440,400	81,400	58,800	580,600
1966	395,200	114,400	61,200	570,800
1967	368,600	162,200	63,700	594,500
1968	315,200	127,000	65,000	507,200
1969	300,000	105,200	66,500	471,700
1970	260,600	155,600	68,700	484,900
1971	297,800	185,600	71,200	554,600
1972	317,400	166,000	72,000	555,400
1973	324,800	197,000	73,500	595,300
1974	341,000	158,200	75,000	574,200

U.S. recreational effort data (Table 11) were much more difficult to estimate because of several uncertainties and lack of data. Proportional catch-effort estimates as were used for the Cuban fishery would prove unreliable. The recreational catch has been on a continual decline while the number of people participating in this fishery has increased during the 1965-1975 period. Several adjustments were made using the "number of fishermen" data for the recreational fishery presented in this report. These adjustments were made for several reasons. Unadjusted data did not permit use of the Graham-Schaefer model since the high number of recreational fishermen would not allow solution of a maximum equilibrium value. Also, the unadjusted recreational fishing effort was so high that the effort by commercial fishing became unimportant to the solution of the Graham-Schaefer model. Adjustments were made in several ways. It was determined that a reasonable range of estimates could be obtained by varying the adjustment parameters instead of presenting a statistically invalid set of derivations. The number of recreational fishermen represented the estimated number of fishermen who fished in a given year during each of the 1960, 1965, and 1970 surveys.

The maximum effort and minimum effort in terms of the number of handline fishermen were obtained for 1965 and 1970 and interpolated. Data were then extrapolated to 1974. As the number of recreational handline fishermen were counted only once regardless of how many times they went fishing, the data were translated into the number of handline fishermen-day units by making the following changes and assumptions: (1) multiply the estimated number of handline fishermen by two to represent the average number of days fished per fishermen, (2) multiply the average number of fishermen by four, (3) make no adjustment and assume each recreational fisherman fished only once. This adjustment put all the data

into the number of recreational handline fishermen-days. However, this estimate was much too high as it still negated the effect of effort from any other fishery due to its inordinate size. The assumption was made that the effective fishing effort of a recreational fisherman is not equivalent to a commercial fisherman. A recreational fisherman does not fish an equivalent amount of time in a fishing "day" as compared to a commercial fisherman because: (1) search time is greater, (2) length of fishing day is shorter, (3) number of hooks per line are fewer, and (4) experience is less. All these factors led to the further assumption that the recreational handline fishermen-day should be divided by ten in order to equate the effort of the commercial to the recreational fishery. Fishing effort is presented in the following manner using number of handline fishermen-day units in the U.S. commercial plus Cuban commercial plus recreational fishery. Several effort levels were examined for the recreational fishery. These were: maximum number of handline fishermen multiplied by one day; maximum number of fishermen multiplied by two or four days; minimum number of fishermen multiplied by two or four days. Maximum fishermen times one day was selected as the most appropriate measure after analysis.

The catch data from Table 10 are displayed in Figures 5 through 9. The "standardized" effort data covering the same time period are shown in Figure 10. Note that while total effort (Figure 10) has remained relatively constant, i.e., no sustained increasing or decreasing trend, total catch has steadily declined (Figure 9). The explanation for this is found by closer examination of the catch data by fishery component. Figure 5 shows the U.S. commercial catch of snapper increasing while the grouper catch is decreasing slightly over time. The Cuban catch of grouper (Figure 7) was relatively stable around 2,000 metric tons in 1970-74. The U.S. Recreational catch of grouper (Figure 6) is also relatively stable, however, the snapper catch has declined steadily and significantly. In fact, the apparent decrease of 7,000 metric tons in the U.S. Recreational snapper catch is the driving variable in the catch and effort analysis. As noted earlier, the recreational catch and effort data are the weakest link in the analysis. This tremendous decline in the recreational catch of snapper, while the commercial catch has generally risen, must be viewed with great suspicion. The production model analysis which follows is based entirely on these, really inadequate, data and thus should be considered only a pro forma estimate of the potential yield of reef fish in the Gulf of Mexico FCZ.

4.4 Survey and Sampling Data

Referred to throughout the body of the Plan.

4.5 Other Relevant Data on Habitat, Habitat Concerns, and Habitat Protection Programs

Of prime interest in the Gulf reef fishery is the importance of changes in the habitat. The destruction of suitable reef or other types of hard bottom areas would obviously prove disastrous to this fishery as most of the current data indicate this habitat affinity for most of the fishery groups. Since most of the catch comes from offshore in water deeper than 30 m, there seems to be, at present, an apparently indiscernible effect of coastal pesticides, pollutants, and other harmful wastes which have been considered as deleterious to many inshore fisheries. Literature sources indicate the importance of offshore shrimp grounds for the snapper species, particularly the Gulf red snapper. In data made available by the Southeast Fisheries Center of the National Marine Fisheries Service (March 1977) the red snapper landed by the shrimp trawlers, particularly in the vicinity of the Mississippi River Delta are either too small and are discarded or, if large enough, are retained for sale. The industrial groundfish fishery utilizes some of these small snapper for processing. The Gulf commercial foodfish landings of marketable red snapper caught by shrimp and fish trawlers in 1972-1974 was reported to total 632,200 pounds (Appendix Table 33).

The National Marine Fisheries Service in Pascagoula has estimated that there is an average bycatch of 15 snapper per trawl hour. Data presented in the Shrimp Fishery Management Plan indicate that 4,600 boats trawled 1.9 million hours annually and an additional 3,700 vessels trawled 3.3 million hours

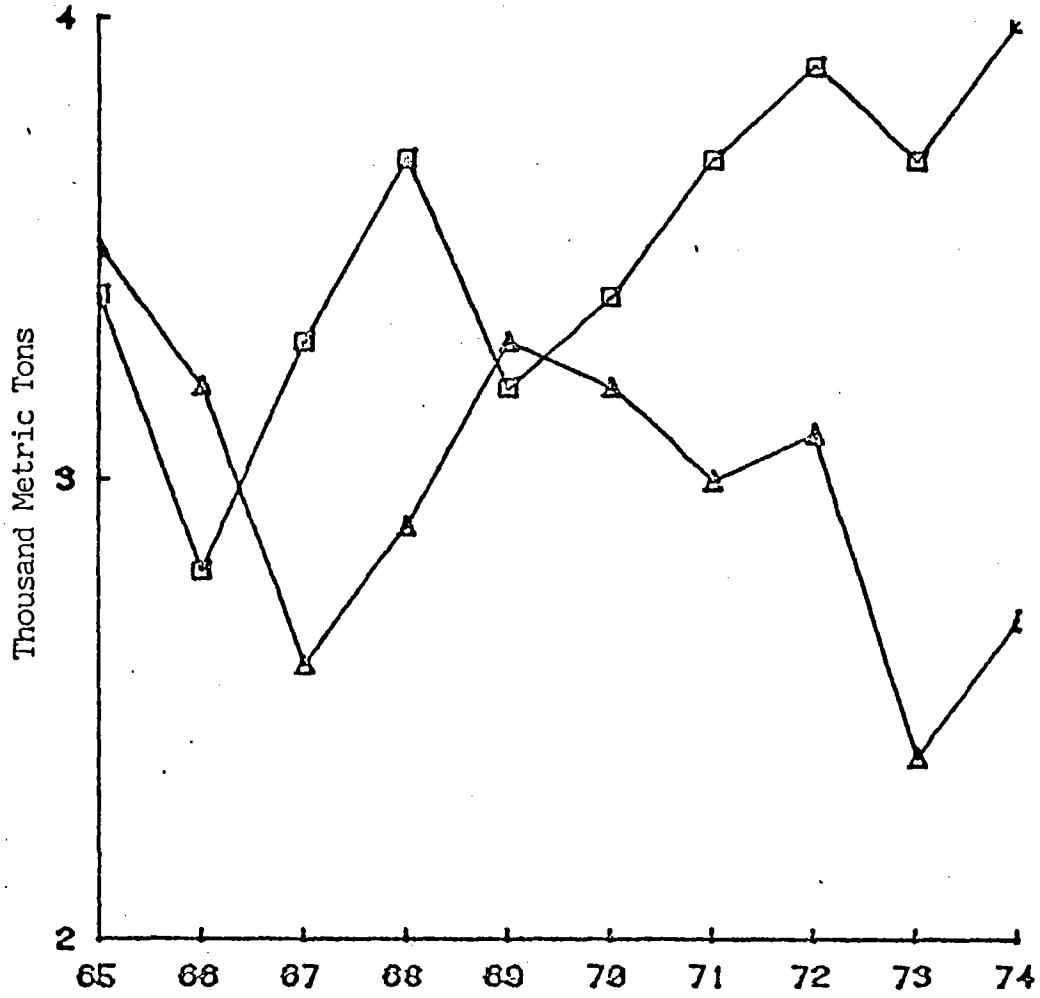


Figure 5. U.S. Commercial catch of snapper and grouper for the Gulf of Mexico FCZ, 1965-74.

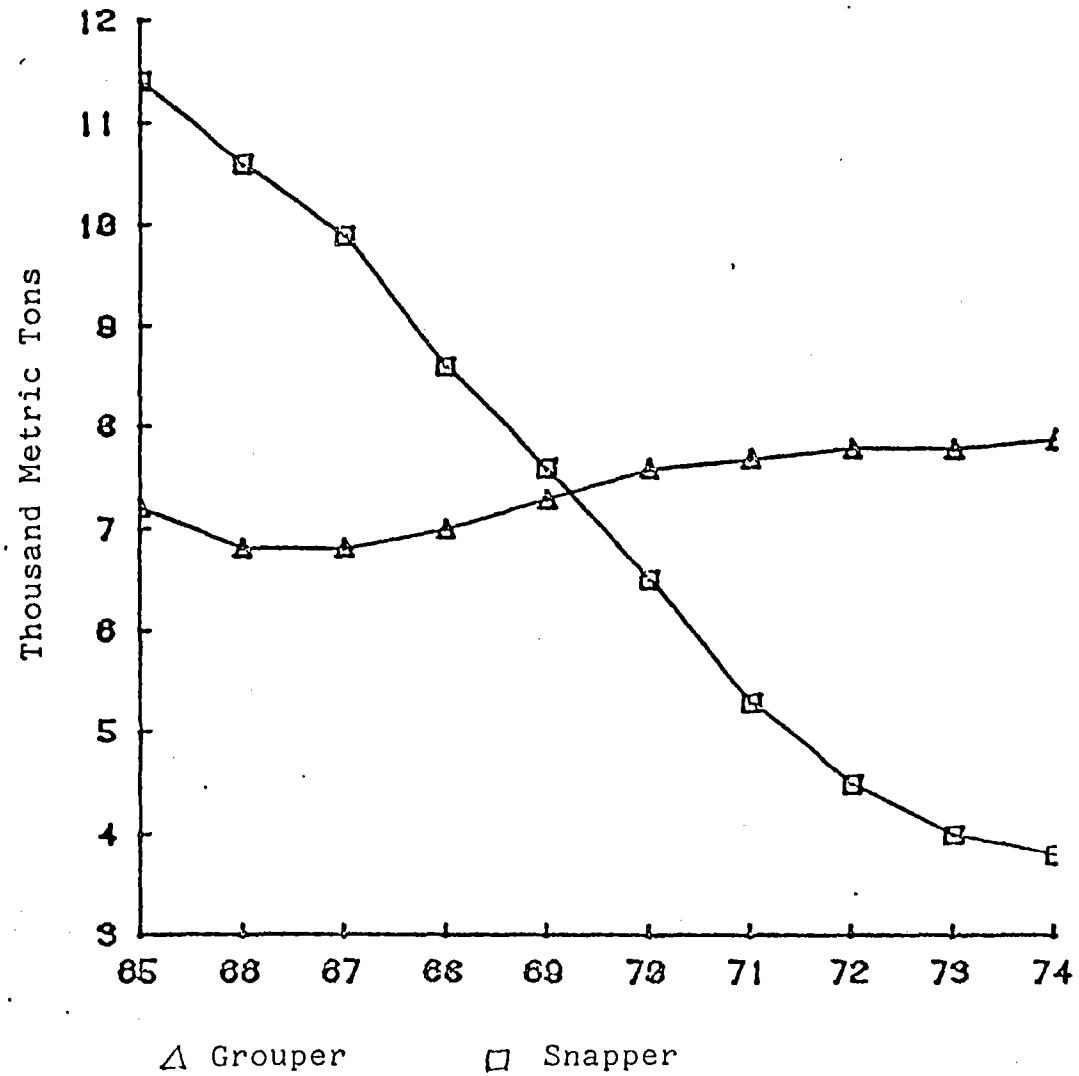


Figure 6 . U.S. Recreational catch of snapper and grouper for the Gulf of Mexico FCZ, 1965-74.

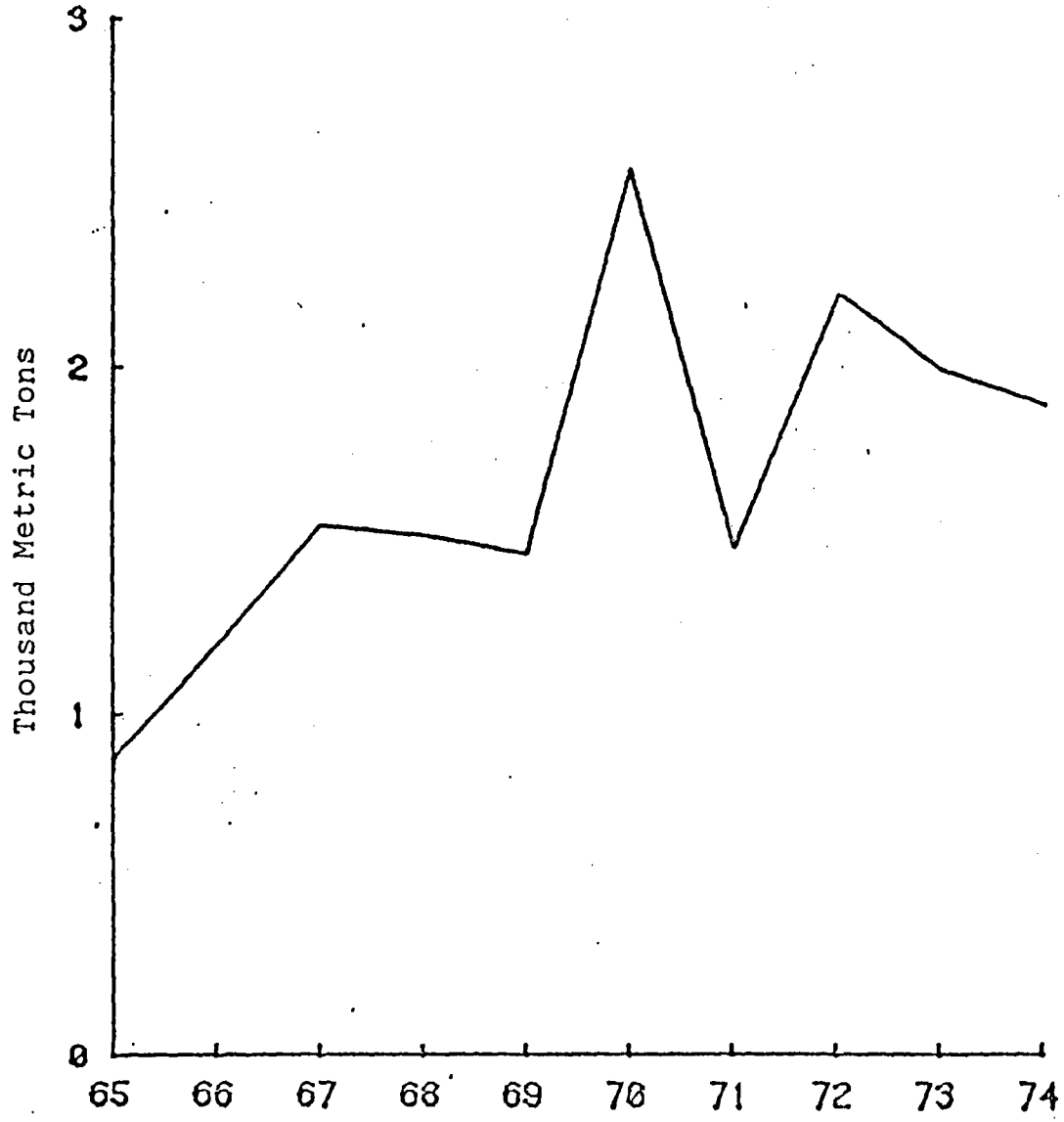


Figure 7. Cuban grouper catch for the Gulf of Mexico [illegible], 1965-74.

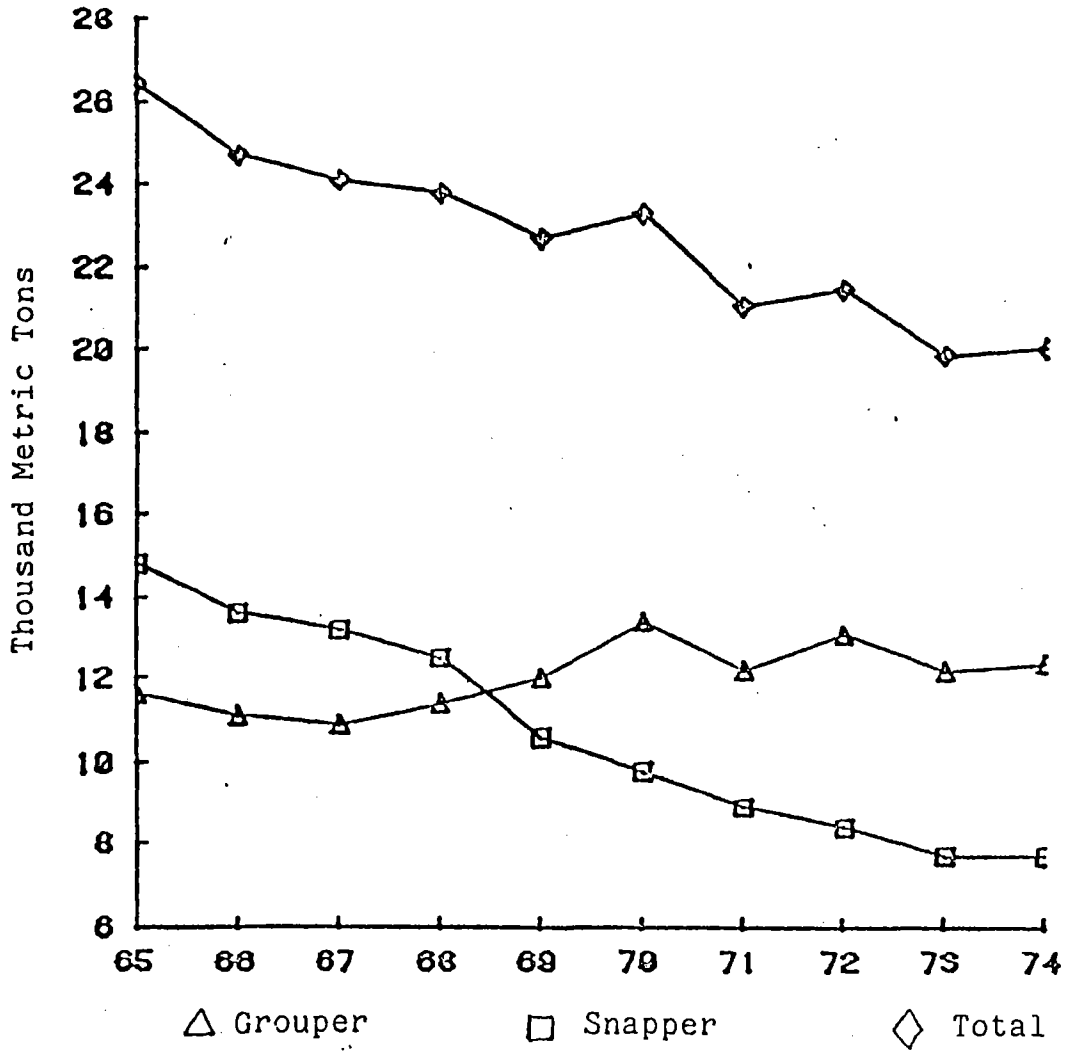


Figure 8. Snapper and grouper catch for the Gulf of Mexico FCZ, 1965-74. (Includes commercial, recreational, and Cuban catch.)

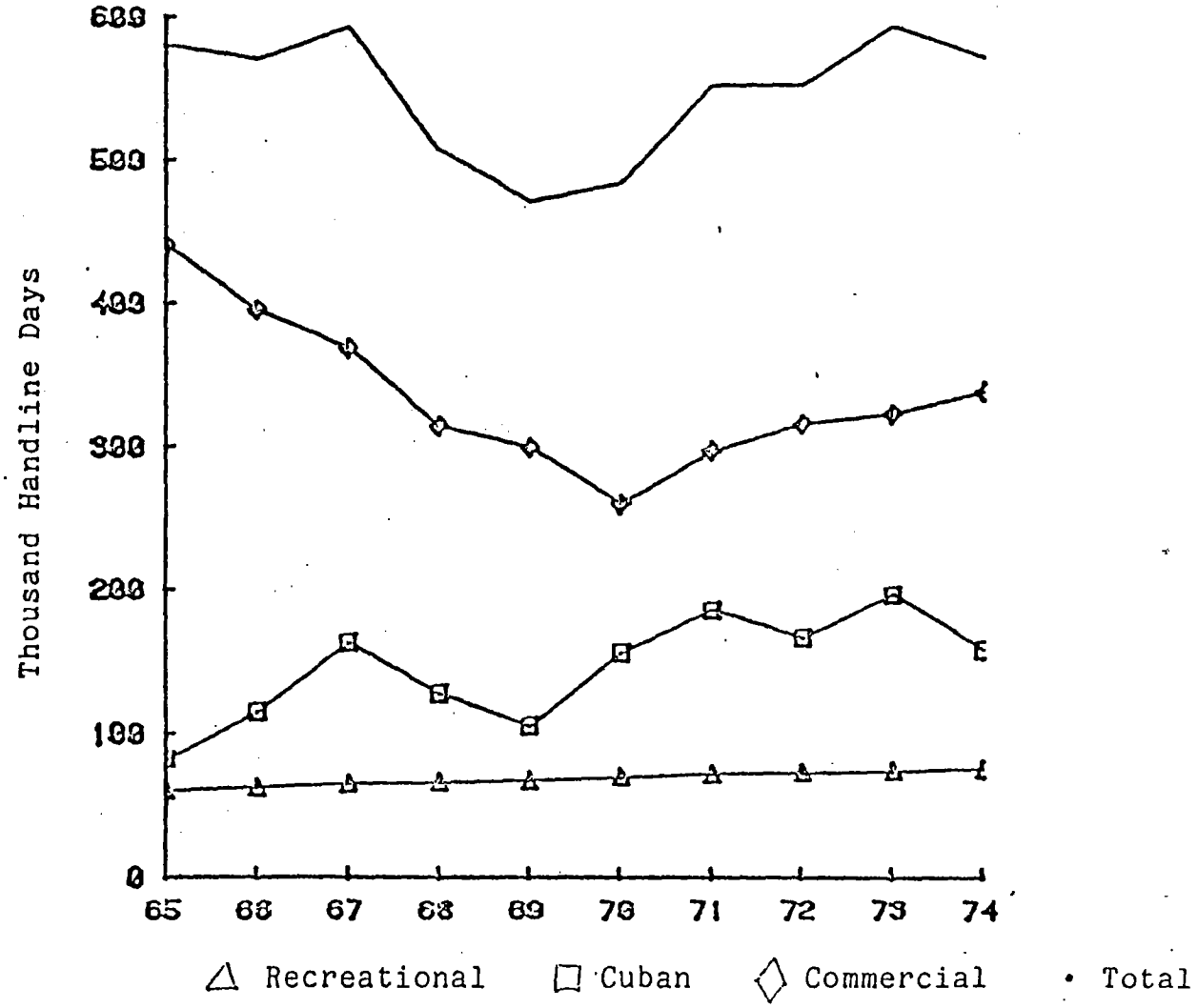


Figure 9. Fishing effort (adjusted to standard handline days) expended in the Gulf of Mexico reef fish fishery, 1965-74.

annually. Assuming that each of these vessel groups caught an average of 15 snapper per trawl hour it is estimated that 78 million snapper of all sizes, juveniles to adults, are caught by the Gulf shrimp fleet annually. This should be considered a maximum estimate. It must also be noted that the size of these fish range from 38 to 252 mm in length. Generally, the fish larger than 200 mm in length are sold and are reported as landings. The great majority are too small to market and are discarded. Although the estimate appears high, a better assessment of the impact of this estimate is difficult without having hard evidence of the natural mortality, total population size, migration and growth of these juveniles.

There has been an increase (although insignificant on a percentage basis) in available habitat to the reef fishes in the Gulf with the construction or placement of artificial reefs and oil structures. Opinions differ as to whether or not these artificial structures actually result in an increase of reef fishes or merely concentrate fishes and attract them from other natural reef areas. Some recent evidence indicates that these reefs actually do increase the standing stock of reef fishes (Stone, 1978). The Council's Habitat and Environmental Protection Committee reviews permit applications for construction of artificial reefs and encourages approval of those which will not adversely impact other fisheries.

4.6 Quality of Data

Life history data, in general, are poor. Only a few species, notably the gag, red grouper, vermilion snapper, and gray snapper have reasonably adequate data to even begin dynamic modelling and fishery analysis. Much of the data on life histories are either incomplete, as they pertain to specific attributes (fecundity, for example), or they are inadequate and outdated by more modern methodology.

With regard to the catch and effort data there is ample evidence of misidentification of species, inadequate reporting of catch and inapplicable or unavailable effort statistics. In general, the fishery data currently compiled needs scrutiny. There is evidence that species may be reported in several categories. This is due to the use of common names for species which are not universally accepted by fishermen (e.g., the black snapper, the black grouper, etc.) The problem of catch (where caught) and landings (where landed) is a serious one and may totally invalidate intra-Gulf comparisons. There are few effort data specific enough to allow estimates of fishing mortality. Similarly, the effort being applied individually to each of the reef fishes of the fishery is unknown.

4.7 Current Status of Stocks

4.7.1 Maximum Sustainable Yield (MSY)

4.7.1.1 MSY for Snapper and Grouper

MSY was calculated for the entire reef species complex considered in this report. MSY estimates include the range of the species which include, in some cases, both territorial waters of the state and the FCZ. However, the catch is predominately in the FCZ. The model chosen for calculation of MSY was the Graham-Schaefer model as presented by Ricker (1975). The justification for this method of analysis is based on the assumption that the Graham-Schaefer model closely approximates MSY for a multi-species fishery as long as effort is applied nonselectively to all species. Although this assumption is questionable, there is no way, at present, to separate effort as it pertains to each species. Therefore, separate estimates of MSY for individual species are not additive since the same effort data are used for each species. It is also assumed that a fishery is at MSY when it is at or near maximum equilibrium with regard to catch and effort data. Additionally, the assumption is made that the data available are accurate or at least proportionately accurate relative to each other. These data were the best scientific data available.

Catch and effort data used to generate MSY using the Graham-Schaefer model are presented in Tables 10 and 11. Adjustments to and sources of data have been described previously.

The best estimate of MSY for snapper and grouper is approximately 51 million pounds. The fishery in any case is operating in the area of the peak of the yield curve and a further increase in effort is not likely to result in a corresponding increase in catch (Figure 10).

Although previous drafts of this Plan presented separate MSYs for snapper and for grouper, these MSYs are technically incorrect and are omitted here. The single MSY for the snapper/grouper compex (Figure 10) which was developed by Southeast Fisheries Center and approved by the Scientific and Statistical Committee is technically correct and is the specification of MSY for this Plan. Other MSYs were calculated to aid in data analyses but were technically incorrect because the effort parameter could not be disaggregated into effort for grouper and effort for snapper.

4.7.1.2 MSY for Sea Bass[8]

This section provides an estimate, within the limits imposed by the supporting data of the MSY for sea bass in the Gulf of Mexico. The sea bass resource is defined to include not only the southern sea bass, Centropristis melana; but also Centropristis philadelphica, the rock sea bass; and Centropristis ocyurus, the bank sea bass. Separate statistics are not kept for the latter two species, and catches of these are both relatively and absolutely small. Consequently, yield estimates are for the aggregate of all three species.

Data Assembly

Recognizing that the quality and accuracy of catch data were poor, assembled catch information from as many sources as possible was used to obtain information, not only on the magnitude of catches, but also on their geographical distribution and on relative contributions of recreational and commercial fisheries. The principal data sources were:

Source	Information
Fishery Statistics of the U.S., 1955-1975	Commercial catches by gear type and amount of gear
1965 Saltwater angling survey - Deuel and Clark	Recreational catches
1970 Saltwater angling survey - Deuel	Recreational catches
1975 Survey of saltwater angling catches in Southeastern U.S. - unpublished	Recreational catches
A survey of offshore sportfishing in Florida - Moe, 1963	Recreational catch distribution
A fishing survey of Choctowatchee Bay and adjacent Gulf of Mexico waters - Irby, 1974	Recreational catch magnitude

[8] Analyses by Manooch, Schaaf and Huntsman, NMFS, Beaufort.

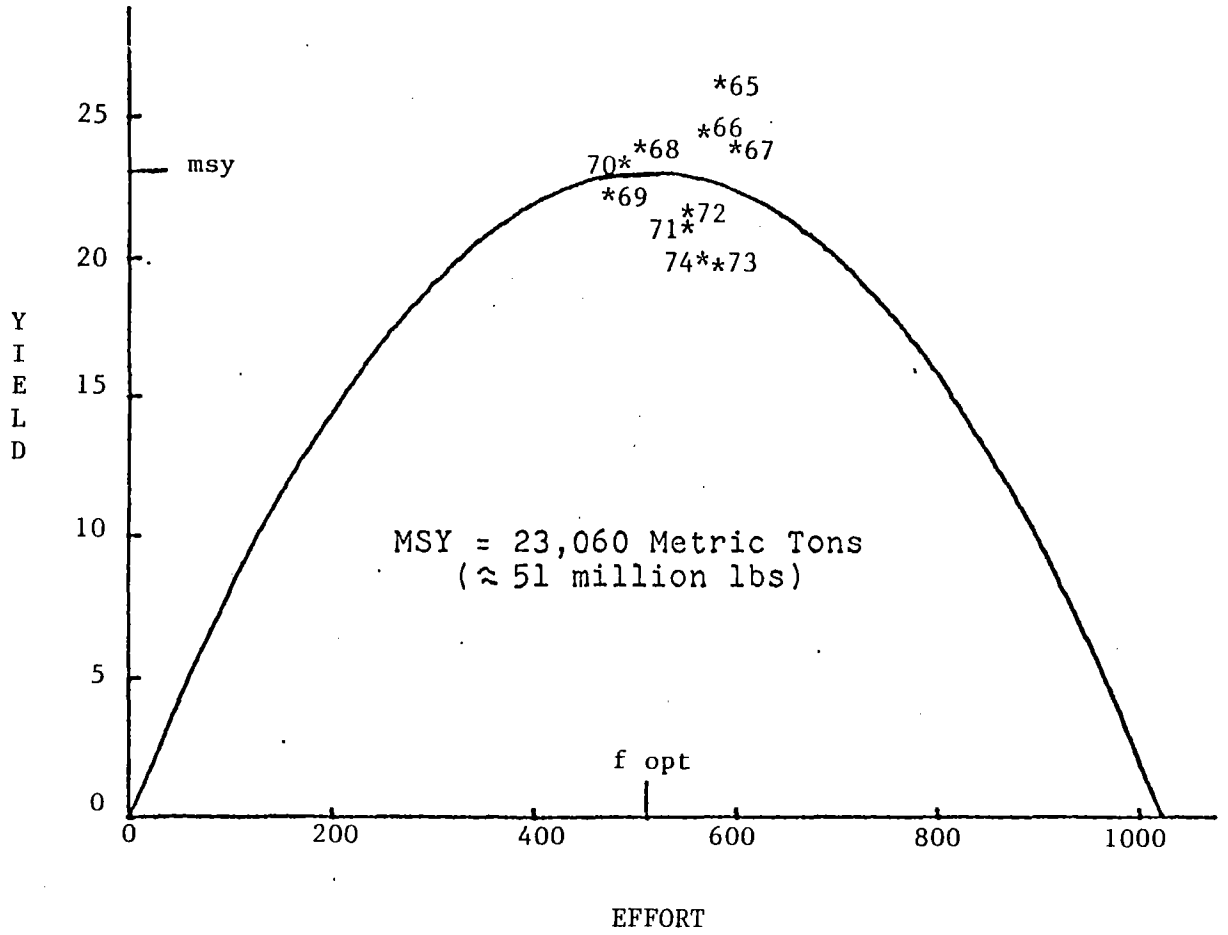


Figure 10. Graham-Schaefer yield model for snapper and grouper in the Gulf of Mexico FCZ, 1965-74. (Includes commercial, recreational, and Cuban catch.)

Source	Information
Survey of head boats in Tampa Bay area - conducted by NMFS, October, 1979	History and magnitude of headboat catches
Personal communications - Herb Allen, Tampa Tribune, Tampa, Florida	Recreational catches
Roger Anderson, Gulf and South Atlantic Fishery Development Foundation, Tampa, Florida	Recreational catches
Ormond Farley, NMFS, Galveston, Texas	Commercial and recreational catches in western Gulf of Mexico
Mark Godcharles, Florida Dept. Natural Resources, St. Petersburg, Florida	History of bass fishery, recreational and commercial catches
C. Hatcher, Hatcher Seafoods, New Port Richey, Florida	History and status of commercial fishery
William Link, University of North Carolina Institute of Marine Science, Morehead City, North Carolina	Sea bass taxonomy and distribution
Martin Moe, Marathon, Florida	History and commercial and recreational fisheries
W. Raprosa, Wallace Seafoods, Tarpon Springs, Florida	History and status of commercial fishery
Carl Saloman, NMFS, Panama City, Florida	Western Florida and central Gulf commercial and recreational catches
Ernie Snell, NMFS, Miami, Florida	Commercial and recreational catch history
O.B. Stander, Pinellas Marine Institute, Tampa, Florida	West coast Florida small boat catch

Review of Commercial Landings

Commercial catch and effort data for sea bass landed in the Gulf of Mexico were reviewed for the years 1955-1978 (Fishery Statistics of the United States, 1955-1975; personal communication, Ernie Snell, NMFS, Miami). No catches were reported prior to 1968, and all landings in the Gulf were made along Florida's west coast.

Landings were greatest in 1969 (305,300 pounds) and in 1968 (302,700 pounds) and then generally declined every year to a low of 25,000 pounds in 1978.

Black sea bass were caught by fish pots (traps), handlines, otter trawls, and run around gill nets (Appendix Table 61). In the late sixties and early seventies, most were landed by fish pots. Percentages of the total caught in pots ranged from a high of 99.4 percent in 1968 to a low of 0.0 percent in 1978. Catch data and comments by Florida seafood buyers reveal a changeover in gear from pots to hook and lin In fact, in 1976, 1977, and 1978 virtually all of the commercial catch in Florida was attributable to recreational anglers who sold their catches to fish dealers (personal communication, E. Snell).

Production Function Analysis

The commercial catch and effort data for black sea bass is quite limited. There was apparently no fishery prior to 1968. Appendix Table 61 shows the commercial catch for 1968-1978, with a pronounced fishery prior to 1968. Appendix Table 61 shows the commercial catch for 1968-1978, with a pronounced downward trend in landings. The principal gear has traditionally been traps, though in recent years an ever-increasing proportion of the catch has been by hook and line. In fact, the last three years has probably been all hook and line catch. Hook and line effort data, and its associated catch of sea bass, is considered to be not amenable to analysis because sea bass catches are probably incidental to other target species. There is perhaps a similar problem with trap-effort data in that the grounds fished or trap characteristics could be changed to concentrate on other species. Table 4 shows an increase in trap-caught grunts concomitantly to the continuing decline of sea bass catches, beginning in about 1972. Based on the catch and effort data only from 1968-1972, when trap effort may have been directed principally to sea bass, a Schaefer yield model was used. This model indicates an MSY of 263,000 pounds with 550 traps fished. The correlation coefficient for these data is -0.84, high though not significant at the five percent level, with only three degrees of freedom. Fitting the model to all the data does not significantly alter the estimated MSY (255,000 pounds) though the correlation coefficient drops to only -0.46. A Schaefer-type production function fit to these data is not a valid approach because of the assumption that the fishery is in equilibrium with the stock. The catch trend seems typical of an emerging pattern for reef fishes, of practically zero catches suddenly shooting to quite high levels and as rapidly declining to quite moderate, or relatively low levels. The calculated MSY may be biased considerably by the 1968 and 1969 catches which were two times greater than the next largest catch. Potentially, the data reflect a situation of the sudden inception of an intensive commercial fishery harvesting the standing stock of larger, older fish, i.e., fishing down the capital. The fishery seems to be shifting from a commercial trap fishery on large fish to a recreational hook and line fishery on smaller fish. From these considerations, it was concluded that the traditional production function analysis based only upon commercial fishery data is probably not a reliable method of determining MSY.

To estimate recreational catch three procedures were used, each based on a different data set to furnish values for comparison.

Method 1 -- Based on Deuel

The 1975 Saltwater Angling Survey states that the eastern Gulf of Mexico recreational catch of sea bass was 1,762,000 pounds.

Comparison of Deuel's estimates of reef fish catches off North and South Carolina with those reported by Huntsman (1976) suggest that Deuel's estimate may be four times the true value.

Therefore, we propose one estimate of the Gulf of Mexico black sea bass catch as 447,000 pounds, 25 percent of the Deuel estimate.

Method 2 -- Based on commercial landings

Recorded commercial landings for sea bass on Florida's west coast were 50,000 pounds in 1976, 27,000 pounds in 1977, and 25,000 pounds in 1978 and averaged 34,000 pounds. Snell and fish house operators suggest that virtually all of the commercial landings reported in recent years are recreational catches that are sold. Hypothesizing that from five to ten percent of the recreational catch is sold, it was calculated that the recreational catch may have been from 340,000 to 680,000 pounds with an average of 510,000 pounds.

Method 3 -- Based on Creel Census by Florida Marine Institute

The Florida Marine Institute creel census for the west coast of Florida indicates a mean catch rate of 0.3 sea bass per angler-hour based on observations of 2,150 angler-hours. The 1974 survey of saltwater fishing in the southeastern U.S. (unpublished) indicates 998,000 fishing trips were made on the Florida west coast. Personal experience suggests a mean fishing trip duration of five hours, and estimates of 4,990,000 angler-hours expended and 1,497,000 sea bass caught. Several of the cited sources stated that most west Florida sea bass taken were nine inches total length. South Atlantic head boat samples indicate nine-inch sea bass weigh 0.33 pounds. The estimate of recreational sea bass poundage is 494,000 pounds.

Summary of Estimates

Three estimates based on completely independent data sources suggest the recent Florida west coast, and virtually the Gulf of Mexico, recreational sea bass catch to be about 480,000 pounds.

Trends in the Recreational Catch

Interviews with twelve head boat operators in the Tampa Bay area and with Florida recreational fishermen do not suggest major trends in magnitude of catch or the size of fish caught in recent years.

Conclusion: Yield Estimate and Analysis of the Fishery

An overview of the sea bass fishery on Florida's west coast shows a quick-blooming commercial fishery in the late 1960's of about 300,000 pounds and a recreational fishery of unknown magnitude. Based on general trends of tourism and development in Florida and in the popularity of marine angling, the recreational catch was probably on the order of 100,000 to 200,000 pounds and the total fishery was 400,000 to 500,000 pounds.

Commercial yields quickly dropped to 100,000 pounds and then to even lower levels, but sources suggest that no such dramatic trend has occurred in the recreational fishery. Today there is apparently a recreational fishery of about 500,000 pounds and virtually no commercial fishery. This suggests the conclusion that total yields have varied little over time, but the harvest has shifted from the commercial to the recreational sector.

No information on fish size is available for the late 1960's but likely the mean size then must have been greater than the nine-inch norm of today for commercial interest to have been so high.

4.7.1.3 Present Condition of the Stocks

The MSY discussion under Section 4.7.1.2 adequately describes the current condition of the stocks of sea bass. Figure 6 depicts a decline in the recreational catch of snapper, whereas the grouper catch is stable to increasing. Figure 5 shows a gradual increase in commercial catch of snapper and a stable to slightly declining grouper catch. Red snapper constitute the great preponderance of the snapper catches (60 percent or greater) for both recreational and commercial fishermen (Appendix Tables 7, 49, and 51). Appendix Table 55 shows a decline in average size of red snapper taken by recreational fishermen. Figure 12 shows the fishery to be in approximate equilibrium with MSY.

More detailed analyses of MSY and the condition of the stocks were included in the draft FMP and in the preliminary drafts of the Plan. A summary of these analyses presented in the draft FMP* is as follows:

---

* Table numbers in the quotation refer to tables in the draft EIS/FMP/RA dated February, 1980.

It was determined in the course of this analysis that the commercial fishery is operating at or below its maximum equilibrium. This was resolved in Graham-Schaefer models presented for the total reef fish (snappers and groupers) U.S. commercial catch (Figures 34, 35 and 36). In using all data for the U.S. commercial fishery, Cuban fishery, and estimated recreational fishery, a different picture is indicated with regard to position on the equilibrium model, especially with regard to the MSY for snapper catch. Figure 36 indicates that the U.S. commercial fishery is underfishing its portion of the snapper stocks. The fact that the exponential coefficient estimated for the effort variable in this model is greater than one, is not the basic point of concern in this model. The basic point of theoretical importance is that catch and effort are positively related, which indicates that increased effort does not bring about decreased yields per unit of effort which would indicate a situation of overfishing. Figure 33 indicates that snapper are definitely being overfished when recreational effort and catch are added into the model. The overall overfishing for snapper seems to be a direct result of the increasing effort in the recreational fishery. Table 18 shows a nearly equal snapper catch by the U.S. commercial fishery between 1965 and 1974. During the same period, the total snapper catch has declined and the effort has increased for the recreational fishery (Tables 18 and 19). It can be concluded from this analysis that the overfished condition for snapper is due to an increased effort by recreational fishermen and not to the U.S. commercial fishermen's effort, as this has been constant during same period (Table 19).

The scientific inference from all these data and analyses is that the grouper stocks are below or at an equilibrium point near MSY and presently are not overfished. This is further substantiated by the fact that the Cuban harvest of grouper (Section 3.2.2.1) has ceased, reducing some of the fishing pressure on the stocks.

These data and analyses indicated that snapper (and particularly red snapper) are slightly overfished by the recreational sector in the nearshore waters creating a growth overfishing situation. Because of the inadequacy of the data in which red snapper are recorded simply as "snapper" for some areas and some years, it was surmised that the major impact was on red snapper rather than other snapper species. This is supported by the fact that, with the exception of south Florida, red snapper is the species targeted by recreational fishermen and other snapper species are taken incidentally. Because of the increased fishing pressure, other species of snapper and grouper may be slightly overfished in some localized geographical areas; however, this cannot be documented and the plan focuses on correcting the growth overfishing for red snapper and secondarily provides a mechanism for reducing fishing pressure on other species as this becomes necessary.

5.0 CATCH AND CAPACITY DESCRIPTORS

5.1 Data and Analytical Approaches

5.1.1 Domestic (Commercial)

Catch and capacity descriptors are considered in order to determine annual domestic harvest and allowable level of foreign catch. Capacity is generally considered strictly as a physical concept. It represents the maximum volume which can be harvested given existing physical constraints of the fleet. The rate of utilization of the physical capacity is the important point to consider when making projections for the near future. The rate at which capacity is utilized depends on economic and biological factors. Thus, expected catch considers physical, economic and biological constraints encountered in fishing. Expected catch may be estimated using several approaches. The method employed here is to estimate the following general relationship: $c = (k)(e)(t)$ where:

c = total catch,
k = catch per unit of effort,
e = number or amount of physical effort units,
t = intensity at which effort units are employed in the fishery.

The nature or description of effort units, (e), depends on the type of fishery being analyzed. In the Gulf reef fish fishery, (e) may be represented by the number of vessels, number of fishermen, number of fishing gear units or some combination of these. How frequently, or intensely, the effort units are used to produce fish determines the "effective" units of effort. For example, days fished per season or per year times the number of vessels would give the effective units of effort in terms of vessel days fished per season or per year. In the Gulf reef fish fishery, days fished has been estimated in previous research. Catch per unit of effort, (k), may be estimated in a variety of ways to estimate total catch. Catch per vessel and catch per fisherman are available from published statistics and past research (Cato and Prochaska, 1977).

Several capacity descriptors are presented in this FMP. Average catch per commercial vessel in the Gulf of Mexico FCZ during the 1972-1974 period was 38,333 pounds (Section 4.3). During this period, average annual total catch in the fishery was 14,500,000 pounds per year (Section 3.2.1.3). The average number of vessels used in the fishery during the 1972-1974 period was 415 (Section 3.2.1.4). The remaining variable necessary for analysis, days fished, is not reported annually. A survey of Florida vessels showed an average annual rate of 195 days fished per year with a range for individual boats of 126 to 240 days (Section 3.5.2.3). These Florida vessels averaged 83,119 pounds per year, almost twice the average catch for all Gulf vessels.

5.1.2 Domestic (Recreational)

Conceptually, capacity and capacity descriptors for the recreational fishery are vaguely defined. However, refinement of definition and concepts for the development of the present Plan is not justified given the quality of recreational statistics to be analyzed. Available recreational statistics are reported in Section 3.5.4 of this Plan.

Average catch (1972-74) of total reef fish by recreational fishermen is estimated to be 26,500,000 pounds; i.e., 26 million pounds of snapper and grouper (Table 10) and 0.5 million pounds of sea bass (Section 4.7.1.2). There are approximately 1,000,000 recreational fishermen-days per year in the fishery. Average catch per recreational fisherman-day then is approximately 26.5 pounds. Thus, the capacity or rate of use can be concluded to produce at least 26.5 pounds per fisherman per day.

5.1.3 Foreign Capacity

The only information available is that presented in Section 3.2.2 for the Cuban fishery. Catch per launch-day fished and number of launch-days is one approach to estimating capacity. During 1975 and 1976, average launch-days were 18,680 days. Catch per launch-day averaged 278 pounds. Thus, average catch capacity at these rates would be 5,193,040 pounds annually. This represents a minimum estimate of the capacity of the Cuban fleet since these catches were actually achieved. However, the Cuban fleet no longer participates in the reef fish fishery.

5.2 Domestic Annual Harvesting and Processing Capacity (DAC)

Commercial:

As was noted in Section 5.1, capacity refers to the physical limit of the fleet to harvest reef fish. The most recent estimate of the number of handline vessels fishing in the Gulf of Mexico is 415. The exact capacity of these vessels to harvest reef fish is not known. However, an estimate is possible with the limited available information and a set of assumptions. If it is assumed each handline vessel was fished full time at the rate of the Florida vessels reported in Section 5.1, an estimate of capacity would be 34,494,385 pounds annually. This is based on the equation

$$34,494,385 = (83,119)(415)$$

where:

83,119 = pounds landed by full-time Florida vessels on an annual basis (Section 5.1.1)
415 = number of handline vessels in the Gulf.

If the set of vessels in the Florida sample represent those throughout the Gulf of Mexico and if they are fished full time, then the capacity of the Gulf fleet is approximately 34.5 million pounds annually.

The estimate of 34.5 million pounds may be conservative for several reasons. First, the average vessel size measured in gross tonnage per vessel is considerably less in Florida than the remaining states in the Gulf of Mexico. It is, therefore, expected that the physical capacity of the nonFlorida vessels may be greater. A second reason why this estimate may be conservative is because other harvesting methods, which account for some small amount of reef fish landings, such as trawls and handline boats, were not included.

Estimates of capacity presented in this section indicate the capacity of the fleet, if vessels are fished full time. They do not indicate whether or not the stock is available for harvest.

Section 3.5.3.1 reports that 94 percent of snapper landings and 82 percent of grouper landings are shipped fresh in ice to market outlets. Thus, the vast majority of reef fish enter the fresh product markets. Therefore, processing capacity is concluded to be sufficient to handle the capacity of the fishing fleet fishing for reef fish. In addition, approximately five percent of the fish houses currently receive reef fish (Section 3.5.3.2). There appears to be substantial facilities for handling additional landings of reef fish, since reef fish command relatively higher prices than fish handled by the remaining 95 percent of the fish houses along the Gulf of Mexico. Therefore, the domestic processing capacity may greatly exceed the domestic harvesting capacity.

Recreational:

The recreational harvesting and processing capacity is assumed to be equal to the catch. This is estimated to be 26.5 million pounds.

5.3 Expected Domestic Annual Harvest (DAH)

Commercial:

Expected domestic commercial harvest differs from the concept of physical capacity in that DAH is a function of the rate at which capacity is utilized and the stock of fish to which effort is employed. The rate at which capacity is utilized is dependent on economic factors such as price, cost and output per unit of effort. These functional relationships have not been determined.

The catch equation formulated in Section 5.1 provides a framework for discussing DAH. Based on 1972-1974 average data and past research, the catch equation for the latest published data is:

$$14{,}500{,}000 = (174.7)(415)(200)$$

where:

14,500,000 = 1972-1974 average annual catch of reef fish (Table 10)
415 = 1972-1974 average number of handline vessels
200 = estimated number of days fished
174.7 = calculated catch per vessel per day

The catch per vessel per day was calculated with the above equation given the remaining variables. Annual catch (Table 10) and number of handline vessels (Appendix Table 29) are the best available statistical data. The 200 fishing days per year was based on the Florida study. This figure (200 days) may be slightly high for some vessels in the western Gulf. However, 200 days are assumed in this analysis. Florida vessels represent approximately 80 percent of the total Gulf handline vessels fishing for reef fish and, therefore, the 200 days is reasonable.

Current projections of annual domestic commercial handline harvest are 14.5 million pounds given that the parameters k, e, and t in the above equations remain the same in the near future. The number of vessels varied considerably during the 1957-1974 period. However, since 1962, the number of vessels employed in the fishery has been within ten percent of the current average of 415 vessels (Appendix Table 29). The number of fishermen has been relatively stable in the last decade as well as the catch per fisherman (Table 1 and Appendix Table 1). If these parameters remain relatively constant in the near future, the expected annual commercial handline harvest will be around 14.5 million pounds. Although there has been a gradual decline in catch per vessel, this may be due to a decline in number of days fished, a trend which may be reversed because of increased prices currently offered for reef fish species.

The above analysis, with given assumptions, concludes that the handline fishery is expected to harvest 14.5 million pounds annually, if average days fished is 200 with an average daily catch of 174.7 pounds for each of the 415 vessels. For additional insight into potential catch by other gear, further discussion is warranted.

Current studies of the wire trap fishery in Monroe and Collier Counties (Florida) are being conducted by the Florida Department of Natural Resources (Taylor and McMichael in prep.). These data provide the most reasonable basis for estimating the yield from the fish trap fishery within the Gulf of Mexico because:

1. The fish trap fishery is conducted primarily in southern Florida.
2. These are the most recent data available.
3. The study is based upon a reasonably large sample size, i.e., 454 traps.

Taylor and McMichael (in prep.) reported that approximately 998 traps are fished in Monroe County, with 407 being fished full-time, 398 part-time, and 193 summer only. In addition, approximately 250 traps are fished during summer only in Collier County. The study revealed that traps in the Keys and Tortugas are generally soaked for one to two days with an overall "yield per haul" of 11.37 pounds. On the average, grouper and snapper comprised approximately 62 percent of the catch. Using these figures (and assuming a six-month season for part-time fishermen), the yield for this south Florida fishery would equal approximately 1,480,000 pounds of snapper/grouper. Adding in the 1974 snapper/grouper catches from the west coast of Florida (Table 4), would bring the total yield of snapper/grouper from the Gulf of Mexico fish trap fishery to approximately 1.5 million pounds per year. Combining this figure with the domestic commercial handline harvest of 14.5 million pounds, would provide a total, expected domestic annual commercial harvest of 16 million pounds.

However, the commercial catch figures represent a very conservative estimate and should actually be adjusted upward to account for the following:

1. Underreporting of commercial catch,
2. increasing fish trap effort in offshore waters,
3. relocation of domestic hook and liners from foreign waters back to domestic waters, and
4. increasing effort by domestic bottom longliners.

This combination of factors would support an estimated additional 19 percent increase in the expected commercial domestic annual harvest, bringing the total commercial expected domestic annual harvest to 19 million pounds.

Recreational:

A conservative estimate of domestic annual harvest by recreational fishermen is 26,500,000 pounds (Section 5.1.2). There have been indications of a gradual increase in number of fishermen, but at the same time a decrease in catch per fisherman. Therefore, the estimate of approximately 26.5 million pounds seems reasonable for the near future.

Total:

Together the estimate of domestic annual harvest is 45.5 million pounds (19 million for commercial and 26.5 million pounds for recreational). Therefore, the expected domestic annual harvest of snapper/grouper and sea bass will be approximately 45.5 million pounds as below:

	EDAH($\times 10^6$)
Snapper/Grouper	45.0
Sea bass	0.5

5.4 Expected Domestic Annual Processing (DAP)

The majority of reef fishes (snapper, 94 percent and grouper, 82 percent) entering domestic markets are shipped fresh in ice. The balance of the commercial harvest is processed by the domestic industry. The market and capacity exists to accommodate far in excess of current processing levels. Probably all sea bass enter the market in fresh iced form, since processed products are reported only for snappers and groupers in the total reef fish complex. The domestic industry is expected to process the entire amount available on an annual basis.

6.0 OPTIMUM YIELD CONCEPT

6.1 Departure From MSY to ABC for Biological Reasons

Normally in this fishery there is no biological reason for a difference between allowable biological catch (ABC) and MSY; however, under present circumstances the fishery is subject to growth overfishing of red snapper (a predominant species) in the nearshore waters. Therefore, Optimum Yield (OY) was adjusted downward from MSY to help alleviate this situation. ABC becomes equivalent to OY. (See Section 6.3)

6.2 Departure from ABC for Socioeconomic Reasons

The socioeconomic factors were considerations in setting OY in addition to the biological conditions. See Section 6.3 below and 4.0 of the EIS. No further departure from ABC = OY was warranted.

6.3 Optimum Yield (OY)

Optimum Yield 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 economic, social, or ecological factor (P.L. 94-265).

In determining a fair and equitable OY for the reef fish fishery within the FCZ of the Gulf of Mexico, the Council was influenced by the following considerations:

(i) to provide the greatest benefit to the Nation - harvestors, processors and consumers.

(ii) to assure the conservation and management of the stocks.

(iii) to provide mechanisms for preventing overfishing and rebuilding of declining stocks.

(iv) to provide a reporting system for more precisely assessing the status of the individual stocks.

Three alternative levels of OY were considered for the snapper/grouper fishery are as follows:

Alternative I - Set OY = 45 million pounds

An OY of 45 million pounds is approximately equal to the current catch level, but is below the calculated MSY of 51 million pounds. Setting OY less than MSY will aid in rebuilding the stocks, which are stressed in the nearshore waters, a goal consistent with objective one of the FMP. This approach will also help maintain an acceptable CPUE, which is desirable from the standpoint of recreational fishermen and essential to both the commercial and recreational-for-hire fleets, particularly in view of rising fuel costs. An OY initially set less than MSY will provide future opportunity for a moderate expansion of the domestic offshore fishery. Management measures in the plan are designed to rebuild stocks and eventually bring the fishery into equilibrium at MSY. This will enable OY to be set at MSY within the foreseeable future, thereby optimizing benefits to the nation.

Alternative II - Set OY = MSY

The nearshore stocks of reef fish are stressed at the current levels of catch and effort. Setting OY = MSY would provide the potential for further increased effort and would contribute to growth overfishing and reduced CPUE, particularly in nearshore waters. Declines in CPUE would adversely affect

both the commercial and recreational fisheries and particularly the recreational for-hire fleet. The ultimate effect would be a reduction in tourism and loss of revenue to the coastal communities.

Alternative III - Set OY higher than MSY

Setting OY higher than MSY would merely intensify the adverse effects, which would result from setting OY = MSY.

Recommendation: The Council has recommended the adoption of an OY = 45 million pounds (Alternative I) as representing the measure that will provide the greatest benefit to the nation and provide the greatest protection to the resource.

Accordingly, the Council has recommended the following:

(i) An optimum yield of 45 million pounds for snapper/grouper and 0.5 for sea bass for Plan Implementation.

(ii) An OY which will be harvested by the domestic fishermen and, therefore, does not provide for a TALFF (total allowable level of foreign fishing).

(iii) The actual MSY and OY may vary annually and OY will be reevaluated following each fishing season.

(iv) An OY of 45.5 million pounds with the following safeguards to prevent overfishing

(a) Management measures to prevent overfishing.

(b) The definition of stressed area for more strict management areas where growth overfishing of some species appears to be a problem.

(c) Implementation of a monitoring system that will allow assessment of the landings to insure that more reliable catch and effort data are collected in the future.

There is additional discussion of the proposed OY in FEIS Section 3.2.1 which discusses its impacts on the stocks.

6.4 Probable Future Condition of the Fishery

The growth overfishing situation documented in Section 4.7.1.3 for red snapper is expected to be corrected by the management measures of Section 8.0. The management measures should also prevent a growth overfishing situation from occurring for other species. Recruitment overfishing is not currently a problem in the fishery and will not become a problem in the future under the provisions of the plan. It is expected that through implementation of the management regime that the future condition of the stocks within the fishery will be improved.

7.0 TOTAL ALLOWABLE LEVEL OF FOREIGN FISHING (TALFF)

Allowable level of foreign catch is defined as the difference between OY and expected domestic catch. Expected domestic annual harvest was conservatively estimated at 45.5 million pounds for snapper/grouper and sea bass (Section 5.3). Establishment of OY = 45.5 million pounds provides for no allowable foreign catch in this reef fish fishery.

Stocks in the nearshore waters are overfished, particularly red snapper. Since common gear is used to catch all species in the reef fish complex, it would be difficult to selectively fish for only those species that showed some small surplus.

8.0 MANAGEMENT REGIME

In considering the management measures as well as optimum yield for the fishery, the Council and its advisory bodies delineated the problems in the fishery and set specific objectives for the Plan which address these problems.

8.1 Problems and Objectives

8.1.1 Problems in the Fishery

The principal problems affecting this fishery are summarized as follows:

1. Data presented in this Plan reflects that the overall problem in this fishery is a substantial decline in reef fish stocks 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.

Analysis of data presented in Sections 4.7.1 and 6.3 which describe MSY and OY indicate the likelihood of overfishing in some areas of the Gulf, particularly the nearshore waters. Specific data for catches and effort by specific area and by distance from shore is not available. However, analysis of available data on catch for both the recreational sector and the commercial sector, separately and combined, indicate that the snapper catches by the recreational sector have declined significantly (Figure 6). This trend was not evident for the commercial catch data treated alone (Figure 5). Therefore, the scientific inference was that the overfishing effort was due to the recreational sector and likely confined to the nearshore waters which are more accessible to the recreational sector (also see Appendix Table 55).

---

* Unless otherwise specified, the term overfishing in this section refers to growth overfishing rather than recruitment overfishing. Growth overfishing results in a decrease in the average size of fish in the population and a slight reduction in the overall biomass available for harvest.

This scientific inference has generally been confirmed by the Council's advisors, state scientific personnel and the general public. The Council thus concluded that declining stocks and associated growth overfishing in some areas of the Gulf was a major problem and that overfishing was a known factor contributing to this decline.

Other factors contributing to the decline are not as readily supportable by documented scientific evidence. Among these other possible factors is the destruction of habitat. In general, the reef fish are not estuarine dependent so they are not greatly affected by the destruction of habitat caused by shoreline development projects. However, reef fish in general are dependent on habitats consisting of reefs or irregularities in bottom profile, such as rocky outcroppings and debris or structures placed through man's activities. Therefore, any reduction in this type of bottom habitat affects the reef fish populations. For a number of years oil and gas exploration and development probably resulted in a net increase in habitat. Because of the waning production of these fields and the short life of the structures, man-made habitat is probably declining. Natural habitat is also likely declining through the activities of man and natural phenomena such as hurricanes.

Another possible factor contributing to this decline is the bycatch of reef fish by other fisheries in the Gulf (Section 4.5). As documented in the Shrimp and Groundfish Fishery Management Plans for the Gulf, trawling effort has increased over the years. Juvenile reef fish, and particularly snapper, are taken by these fisheries as a bycatch in significant numbers (Section 4.5). Because of the lack of data on natural mortality for these species by size class, no scientific evaluation of the affect of this bycatch on the reef fish populations is possible. The bycatch of juveniles may not contribute significantly to the population abundance of adults, or it may. Research is needed to answer this question. Major environmental changes such as pronounced flooding for successive years by the Mississippi and other rivers may also be a factor causing temporary declines or fluctuations.

Another major problem is the insufficient data base available to assess the causes and magnitude of the decline. Available data on recreational catches is extremely poor and probably unreliable. Sample designs for this data will not permit detailed analysis by specific geographical area or by species. Commercial data is similarly unreliable when assessing catch and effort by specific area.

The third major problem in the fishery is the expanding competition among user groups for the resource with the potential for personal and political conflicts over the resource. Fishing effort, particularly in the recreational segment, has continued to expand as has trawling effort which takes a bycatch of reef fish. The potential for the introduction of new gear such as fish traps into the nearshore fishery also poses a potential problem for harvesters utilizing less efficient traditional harvesting gear.

8.1.2 Specific Management Objectives

The following specific management objectives have been developed for the reef fish fishery in the Gulf of Mexico to address the problems in the fishery and reflect the biological, economic, social and ecological considerations influencing the resource and users and managers of the resource and are listed in priority order:

(I) To rebuild the declining reef fish stocks wherever they occur within the fishery.

(II) To conserve reef fish habitats and increase reef fish habitats in appropriate areas and to provide protection for juveniles.

(III) To minimize conflicts between user groups of the resource and conflicts for space.

(IV) To establish a fishery reporting system for monitoring the reef fish fishery.

8.1.3 Objectives Considered and Rejected

Other objectives, as follow, were considered but were rejected as not being within the specific provisions of Sections 300 and 303 of P.L. 94-265, or as being unattainable:

(i) To provide the consumer with adequate supplies of reef fish.

(ii) To encourage the harvest and marketing of certain less utilized species, e.g., tilefish. (This resource utilization recommendation will be forwarded separately to the Secretary of Commerce for consideration as a program priority for National Marine Fisheries Service.)

8.2 Fisheries and Stocks Involved

The management unit presently includes only species of grouper, snapper, and sea bass. Other species that are included in the fishery, but not in the current management unit, are certain tilefishes, jacks, triggerfishes, wrasses, grunts, porgies and sand perches. As additional data become available, other species in the fishery may be incorporated into the management unit as deemed necessary.

For species in the management unit, OY has been set below MSY. MSY has been computed for the snapper/grouper complex consisting of many species. This approach was taken because insufficient data were available for calculation of separate MSY's for the species. The effort data could not be segregated by species or by species groups. Data will eventually be available for separate MSY computations for, at least, the principal species.

MSY for sea bass is a very gross estimate which can be improved with a better data base. Both MSY's in the plan are based on very poor data for the recreational segment. Current NMFS statistical surveys will improve the reliability of the data base for the computations.

The commercial fishing effort in the snapper/grouper complex is concentrated on the most readily marketable species with incidental landings of more poorly marketable species. If the effort shifts or expands to include major effort on these less desirable species, the MSY for the entire complex will have to be reassessed.

Any proposed alterations of the MSY(s) will require reassessment of the OY(s). Better information on the current status of abundance and condition of the stocks will also require a reassessment of the OY(s).

8.3 Management Measures and Rationale

Objective analysis of the descriptive data contained in Sections 3.0 through 7.0 of this Plan indicate that the Gulf of Mexico reef fish resource, as a multi-species resource, is in approximate equilibrium near MSY (Figure 10). The grouper resource is also in approximate equilibrium. That is, taken as a whole in the Gulf of Mexico, these groups are not overfished based on the data analyzed through 1980 (Section 5.0) and can sustain themselves at approximately 1970 to 1974 levels of fishing effort which were higher than more recent levels. However, since they are in equilibrium and the analyzed catch is near estimated MSY, increased levels of fishing effort much beyond those levels employed until 1974 would probably cause growth overfishing to occur with resulting decreases in average size.

The snapper resource (principally red snapper) is also at an equilibrium near MSY. The relationship between catch and effort indicates levels beyond optimum effort to take MSY for 1965 through 1974 (Figure 10). This analysis indicates that groupers and snappers taken as a whole should not be harvested at levels much greater than that of mid-1970's level.

Section 4.7.1.2 indicates that domestic harvest of sea bass is approximately equal to OY. Computations of MSY and domestic harvest for this group must be considered gross estimates and were computed by the "American Assembly Plan" approach.

Disaggregation of effort and yield data shows that most of the growth overfishing problem (particularly in snappers) may be zonal in nature (Section 4.7.1.3). Total catch and catch per unit of effort by recreational fishermen has declined in recent years, possibly indicating some overfishing (Appendix Table 55). Equilibrium models for snapper based solely on commercial effort indicate no overfishing has occurred. This difference may be mainly due to the commercial fishery taking place outside of the normal reach of recreational vessels and the fact that private recreational vessels, charter boats, and party boats fish the same location more often due to time, distance, and weather constraints. Based on this analysis, and the examination of capacity in the commercial and recreational fishery, the expected domestic annual harvest is sufficient to take the OY for reef fishes in the Gulf of Mexico (see Section 5.0).

Based on this analysis of the best available data the most appropriate management measures for this fishery at this time appear to be those which would hold total harvest of snapper at levels near those of the mid-1970's, or to reduce the catches of subadults. Management measures of this nature will protect the equilibrium state of the fishery. Holding total fishing effort at current levels could be accomplished while allowing some sectors of the fishery to expand while reducing others, and through zonal fishing limitations.

In setting optimum yield, the Council recognized the impossibility of obtaining recreational statistics rapidly enough to implement management restrictions which would prevent exceeding the OY amount in any one year. Recreational catch estimates from the National Recreational Survey can be produced within three to six months following the close of the year. Preliminary estimates can be made sooner. This provides a valid basis for management restrictions in the following year. A procedure for reducing the OY amount and restricting the fishery in the following year was developed. Through this procedure the long-term average catch will closely approximate the OY amount resulting in a real achievement of optimum yield.

The OY amount may be slightly exceeded in some years. Such short-term overharvests are not expected to cause overfishing either of the growth or recruitment types. These species are long-lived and relatively slow growing. Annual fluctuations in catch have little effect on them. So long as the long-term average catch is maintained at the OY level, growth overfishing will not occur. At the stock levels which will result from average catches near the OY amount, recruitment overfishing is extremely unlikely.

The many management options considered by the Council evolved from these sources: recommendations by the plan drafting team (contract to Florida Sea Grant College), evaluation of comments received by the drafting team through a mail and personal interview survey of representative commercial and recreational groups and state and federal fishery administrators in the five Gulf states, the Advisory Panel and the Scientific and Statistical Committee appointed by the Gulf of Mexico Fishery Management Council, and from public hearings held on the first draft of the Plan. From this group the Gulf Council recommends the following specific management actions.

8.3.1 Domestic Management Measures

Management measures affecting the domestic fishery are as follows:

8.3.1.1 Stressed Area (Area Subject to Special Management)

ESTABLISH A STRESSED AREA IN THOSE WATERS OF THE GULF OF MEXICO SHOREWARD OF THE FOLLOWING DISCONTINUOUS LINE: (1) From the boundary separting the jurisdiction of Gulf and South Atlantic

Councils terminating at 24° 35' and 83° 0.0' northward and eastward around the Dry Tortugas to a point north of Rebecca Shoal at 82° 35' the outer boundary shall be the 100-foot contour;[9] (2) From the point at 82° 35' eastward and northerly to the south end of Sanibel Island (26° 26') the outer boundary shall be the 60-foot contour;[9] (3) From 26° 26' northward to a point off Tarpon Springs (28° 10') the outer boundary shall be the 120-foot contour;[9] (4) From 28° 10' northward and westward to a point off Cape San Blas (85° 52' and 29° 30.5') the outer boundary shall be the 60-foot contour;[9] (5) From 85° 52' and 29° 30.5' westward to a point off Mobile Bay on the 88° longitude line, the outer boundary shall be at the 150-foot contour[9]. The outer boundary shall then be a line from the point on the 88° longitude north westward to the Alabama/Mississippi state line at the 80-foot contour (88° 23.7' and 30° 01.5'); (5) 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 be at the 100-foot contour[9] (Figure 11 and Table 12).

Rationale: Analysis in Sections 4.7.1 and 6.3 indicates that total catch and catch per unit effort by recreational fishermen has declined in recent years, suggesting possible overfishing in areas where recreational fishermen participate. The relationship between commercial catch and commercial effort suggests that stocks in the commercial fishery may be underfished. The commercial fishery normally occurs in offshore waters beyond the normal recreational fishing area. The recreational fishermen are generally restricted to inshore waters due to (1) limited capacity of their boats to travel great distances and withstand sea conditions and (2) available time to make individual fishing trips.

These conclusions led to the identification of a stressed area in which specific management measures are deemed necessary. This area is characterized by excessive fishing pressure resulting in reduced catches of certain species, reduced catch per unit effort, and decreased average size of certain species. The stressed area was delineated through a consensus of fishery experts from various states, the Council members, the Advisory Panel, and the public hearing process.

Factors considered in delineating the stressed area included local knowledge of: (1) the fishery and conditions of the stocks in localized geographical areas, (2) the amount of fishing pressure applied to the geographical 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, and (6) a need for protection of special habitat.

At one point in Plan development, a single stressed area zone was proposed extending seaward to the 100-foot contour completely around the perimeter of the U.S. Gulf of Mexico. In subsequent dialogue with state officials and scientific personnel, recreational and commercial advisors, scientific committee members and NMFS personnel, it became obvious that the stressed area varied geographically and that in some localities the stocks were not stressed. The Council redefined the stressed area based on a scientific evaluation from these sources.

Portions of the Florida reef tract are encompassed by points 1 through 3 (Table 12, Figure 11). The reef tract supports large assemblages of reef fish. Key West is a major attraction to tourists and support a relatively large fleet of recreation-for-hire vessels which target reef fishes. The Keys also support a relatively large commercial fleet which targets reef fish, at least during some times of the year when other fisheries are closed. The importance of this commercial effort to the local

---

[9] The contour lines described shall be generic lines consisting of a series of straight lines closely following the actual contours. Turning points on the series of straight lines will be defined by latitude and longitude as well as by loran C coordinates.

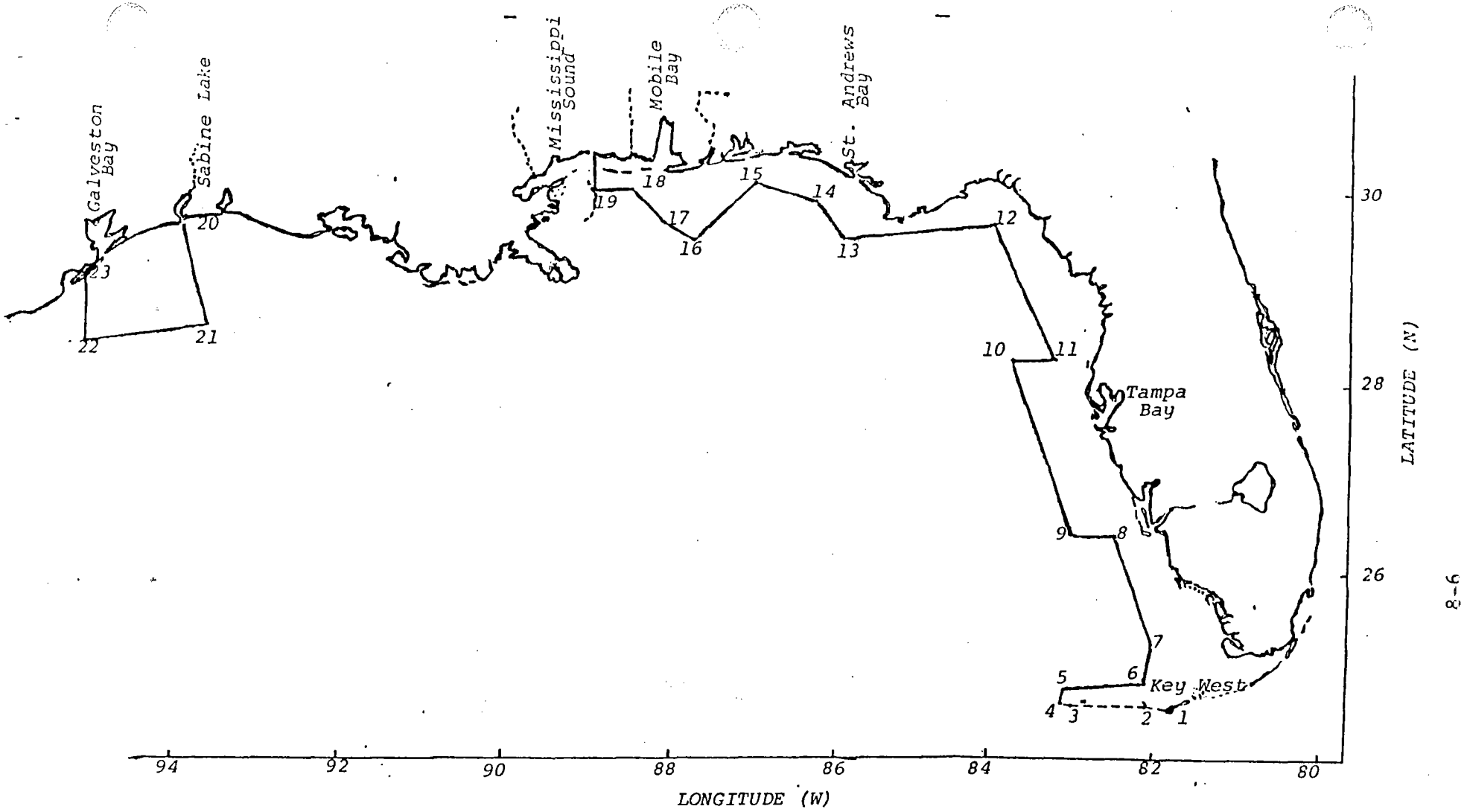


FIGURE 11. MAP OF THE STRESSED AREA.

Table 12. 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.

economy is documented in Section 3.5.8 and Table 9. Because of this high fishing effort, this area around the Dry Tortugas was included in the stressed area. The outer boundary of this portion of the stressed area was set at the 100-foot contour upon advice of Florida Department of Natural Resources scientists and fishermen advising the Council. The boundary was set based on the stressed condition of the fishery and fish stocks rather than on the outermost limit of the coral formations.

The area encompassed by points 4 through 8 (Table 12, Figure 11) is characterized by a large relatively shallow expanse of bottom which has scattered low profile reefs and rough bottom supporting reef fish. The shore line is characterized by small fishing ports of low population density such as Everglades City and Naples. The majority of tourists bypass this area and take other routes to south Florida; therefore, the recreation-for-hire fleet is rather limited in size and the total effort applied to the reef fish fishery is reduced. Consequently, the outer boundary of the stressed area was set at the 60-foot contour. It should also be noted that the continental shelf is very broad and gently sloping in this area and the boundary varies from 29 to 56 nautical miles offshore from the fishing ports.

Between points 8 and 11 are the large metropolitan areas of Fort Myers, Sarasota, Bradenton, St. Petersburg, Tampa, Clearwater, and Tarpon Springs with combined populations exceeding two million persons. Because of this large population density and because this area attracts large numbers of tourists, fishing pressure by private and recreation-for-hire vessels is extremely high on the reef fish stocks. The area is also characterized by scattered extensive tracts of low profile reefs and rough bottom extending from shore in a northwesterly direction out more than 100 nautical miles and includes the Florida Middle Grounds reef tract in the outermost extremity. Because of these considerations the outer boundary of the stressed area was set at the 120-foot contour, which is approximately 45 nautical miles off Tampa Bay.

Between points 11 and 13 there are no major cities of consequence with large populations. There are very few lodging accommodations for tourists and virtually no recreation-for-hire vessels. The outer limit or boundary of the stressed area was set at the 60-foot contour for this low population density area.

The area between points 13 and 17 (Table 12, Figure 11) includes the 'Gold Coast' of Florida and the relatively high population centers between Pensacola, Florida and Mobile, Alabama (500,000+). The entire area is characterized by a very large recreation-for-hire fleet catering to tourists. Also the density and frequency of natural reef tracts declines markedly in this area. The fishing pressure is very high considering the amount of reef tracts. The boundary of the stressed area was set at the 150-foot contour and encompasses virtually all the reefs in the offshore areas. Commercial fishing from ports in this area and in Mississippi is a distant water operation.

Between points 17 and 19, there are no natural reefs of consequence and the outer boundary of the stressed area encompasses the artificial reefs placed offshore by the States of Alabama and Mississippi.

The Louisiana coast is distinctly different from the coastal areas of the other Gulf states being characterized by an extensive marsh complex. This results in cities with high populations being much further inland and access to the Gulf waters being much more limited. Tourist accommodations in the coastal areas are severely limited as are the number of recreation-for-hire vessels (about 30). The distance from the major metropolitan area of New Orleans to the major recreational port of Grand Isle is in excess of 90 miles by highway.

The offshore area of Louisiana is also characterized by extensive oil and gas exploration and production. These structures contribute significantly to the available reef fish habitat resulting in increased population size. Because of the limited access, the limited amount of participation in the

fishery, the relatively large amount of habitat (as compared to other central Gulf states), and the scientific evaluation by Louisiana Wildlife and Fisheries Department biologists, the area off Louisiana did not demonstrate the characteristics common to the stressed area and, therefore, was not included in the stressed area.

Between points 20 and 23 the continental shelf again becomes a broad, gradually sloping expanse. The area also contains the large metropolitan complex of Houston-Galveston, Texas with a population exceeding 1.5 million. Fishing effort on the available natural reefs and oil structures is very high. Texas biologists cited the result of a recent tagging study in which 50 percent of the tagged individual red snapper were taken within a short period, indicating extremely heavy fishing pressure. For this area off Texas, the boundary of the stressed area was set at the 100-foot contour.

The reef fish population off the remainder of the Texas Coast was judged to be unstressed primarily because the reefs were at water depths of 40 fathoms or deeper, which is out of the range of most recreational reef fish fishermen.

Once the stressed area was delineated, the Council then proceeded to determine means of reducing fishing pressure on stocks within the stressed area as well as measures to rebuild the stocks. In terms of reducing fishing pressure, the first order was to delineate user groups and to address each user group's activities within the stressed area. This approach was deemed necessary in order to establish management measures that would be equitable to all users and to assure that management measures proposed are in compliance with the seven National Standards. The following user groups were considered in terms of management measures that might be applied to them:

1. Commercial hook and line fishermen
2. Recreational hook and line fishermen
3. Divers
4. Commercial fish trap fishermen
5. Commercial "roller-rig" trawlers

Following is a brief summary of Council conclusions with respect to management measures that might be applied to each user group within the stressed area. A more detailed rationale is provided under specific management measures that were adopted as well as for those rejected.

1. Commercial hook and line fishermen. Virtually all commercial hook and line fishermen fish offshore of the stressed area; therefore, this user group is essentially not involved in contributing to overfishing in the stressed area and is unaffected by the management measures proposed for the stressed area.

2. Recreational hook and line fishermen. This user group is the primary contributor to overfishing in the stressed area; however, it is difficult to develop enforceable management measures that reduce effort by this group. For example, bag limits were considered for the stressed area, but it was determined that this would not be enforceable unless they applied to the entire management area. For this reason, bag and size limits are proposed for all user groups for red snapper throughout the management area.

3. Divers. Again, management measures relating to bag and/or size limits apply to divers. Other management measures include restrictions on power heads.

4. Commercial fish trap fishermen. Management measures that follow prohibit the use of fish traps within the stressed area. These measures will eliminate catch by this user group within the stressed area. Prohibiting fish traps in the stressed area will have a minimal adverse economic impact on fish trap fishermen in that it will involve traveling an extra few miles to allowable fishing grounds.

5. Commercial "roller-rig" trawlers. This potential user group is prohibited from fishing for reef fish within the stressed area in order to preclude future increased effort and catch. Again, the adverse economic impacts are negligible for two reasons: First, currently this type of gear is not used to take reef fish in the stressed area. Second, this type of trawling is permissable outside of the stressed area and, as in the case of fish trappers, only a few extra mile's travel will be required to reach permissable fishing grounds. And, in the case of both trawlers and trappers, the fishing grounds are generally more productive outside of the stressed area. During 1981, fishermen began experimenting with the user of roller trawls for taking reef fish in the offshore waters of the Gulf. Without some restrictions on their use this practice would likely be extended to the stressed area with detrimental effects on the nearshore stocks of fish.

In summation, establishing the stressed area is the principal means by which this plan addresses the problem of overfishing in nearshore waters. The Council evaluated management measures that could be applied to each user group to reduce catch within the stressed area while simultaneously considering the adverse economic impacts resulting from management considerations. In addition, the Council evaluated the enforceability of management measures considered. Those adopted are considered to be enforceable, effective in addressing the basic problem of overfishing, and do not result in a severe adverse economic impact on any user group. The user group that might appear to be impacted the most is commercial fish trappers. However, this is not the case as fish trappers can very easily fish outside of the stressed area because of the short additional "running time" involved. At public hearings, commercial fish trappers supported the proposed management measures as being fair and equitable.

8.3.1.2 Fishing Gear

(1) PROHIBIT THE USE OF POWER HEADS[10] FOR THE TAKING OF REEF FISH WITHIN THE STRESSED AREA.

(2) PROHIBIT THE USE OF ROLLER TRAWLS IN THE STRESSED AREA.

(3) PROHIBIT THE USE OF FISH TRAPS IN THE STRESSED AREA. FURTHER, PROVIDE FOR SEIZURE OF SUCH GEAR ILLEGALLY DEPLOYED IN THE STRESSED AREA.

Rationale: The purpose of including these measures is to help achieve specific management objectives (i), (iii) and (iv) of Section 8.1.2. On establishment of the stressed area or areas subject to special management, it became obvious that measures were needed to reduce fishing pressure within these areas. The Council, during its deliberations, considered measures that would reduce effort by each user group fishing the resource within these areas.

Measures (1), (2) and (3) were proposed by the Council to reduce fishing effort by other users within the stressed area and to reduce conflicts and the potential for conflicts. Measure (1) prohibiting the use of power heads for taking reef fish in the stressed area results in a slight reduction of harvest by fishermen utilizing SCUBA gear within the stressed area.

---

[10] Power head means a metal device with an explosive charge and usually a projectile that fires on contact. It is usually attached to a speargun, spear, pole or stick.

Although other restrictions on fishermen using SCUBA gear were discussed, they were never seriously considered since no data supported more severe restrictions. SCUBA fishermen are also subject to the size limit restrictions of 8.3.1.3.

Power heads are prohibited in Florida waters and possibly could be construed as being illegal within the the territorial waters of the other Gulf states (Section 3.3.1). Persons armed with power heads can selectively harvest the largest spawning individuals of many species, whereas through the use of traditional hook and line gear, it is difficult to dislodge these specimens from their refuges in the reef complexes. These large seditary specimens do not constitute a significant portion of the harvest, but because fecundity increases with size the large individuals contribute relatively more to the spawning capacity of the stocks. No prohibition is proposed on the use of power heads as a protection device against sharks and other predators; however, their use in taking reef fish in the stressed area will be prohibited.

Whereas most full-time commercial fishermen fish more distant, offshore waters outside the stressed area, two types of gear would allow them to economically fish the less productive waters of the stressed area. If the use of roller trawls and fish traps become common methods of harvest, they have the potential to adversely affect the more heavily exploited reef fish populations in the stressed area. By restricting the use of this gear for taking reef fish, fishing pressure by this segment of the commercial industry will be reduced in the stressed area.

Roller trawls (which are otter trawls equipped with very large rollers allowing operation over rough bottoms) when used in conjunction with side scanning sonar, have the potential to be highly effective for taking reef fish. Further, this gear is nonselective and its use would inflict additional mortality on species which are currently overfished. Therefore, their use for taking reef fish will be prohibited in the stressed area. This gear also has the potential to damage coral reef habitat. The use of this efficient gear outside the stressed area is not restricted.

Fish traps are discussed in Section 3.2.1.4.1. This gear, if permitted in the stressed area, could seriously reduce the catch per unit effort for persons using the traditional fishing gear and aggravate existing resource competition. Since the Plan indicates that the offshore stocks of reef fish are not stressed, this gear is allowed outside the stressed area with some restrictions.

The prohibition of fish traps and roller trawls for harvesting reef fish in the stressed area would prevent the imposition of a new fishery with more efficient gear on stressed stocks of the nearshore waters. It would also provide for conserving and protecting the reef fish habitats. The measures would help in rebuilding declining stocks only marginally except in some areas such as off south Florida; however, the restrictions would prevent further decline in most of the overfished areas. With the exception of fish traps in south Florida, none of the gear prohibited for taking reef fish in the stressed area is commonly used in the fishery. The Plan does not prohibit the use of this more efficient gear outside of the stressed area.

(4) REQUIRE DEGRADABLE OR OTHER SELF-DESTRUCTING PANELS OR ACCESS DOOR HINGING DEVICES ON FISH TRAPS AND WHICH ARE CONSTRUCTED AS FOLLOWS:

(4.1) REQUIRE THAT THE OPENING COVERED BY THE PANEL (OR ACCESS DOOR) BE AT LEAST 144 SQUARE INCHES OR LARGER WITH ONE DIMENSION OF THE AREA EQUAL TO OR LARGER THAN THE LARGEST INTERIOR AXIS OF THE THROAT (FUNNEL).

(4.2) REQUIRE THAT ONE PANEL OR ACCESS DOOR BE LOCATED OPPOSITE EACH OF THE SIDES THAT HAS A FUNNEL.

(4.3) REQUIRE THAT ONE YEAR AFTER THE IMPLEMENTATION OF THIS PLAN, ALL FISH TRAPS WITHIN THE FCZ BE CONSTRUCTED OF MATERIAL WITH MESH SIZE OF 1 x 2 INCHES OR LARGER AND THERE BE A MINIMUM OF TWO 2 x 2 INCH ESCAPE WINDOWS ON EACH OF TWO SIDES OF THE TRAP.

(4.4) REQUIRE THAT ALL FISH TRAPS FISHED WITHIN THE 300-FOOT CONTOUR OF THE FCZ BE 33 CUBIC FEET OR SMALLER IN VOLUME. THERE IS NO LIMITATION ON TRAP SIZE OUTSIDE THE 300-FOOT CONTOUR.

(5) REQUIRE THAT EACH VESSEL FISHING IN THE FCZ BE LIMITED TO A MAXIMUM OF 200 TRAPS.

(6) PROHIBIT THE WILLFUL PULLING OF ANOTHER PERSON'S TRAPS AND THE PULLING OR HARVESTING OF TRAPS AFTER SUNDOWN OR BEFORE SUNRISE.

(7) PROHIBIT THE USE OF POISON OR EXPLOSIVES FOR THE TAKING OF REEF FISH.

Rationale: The purpose of the measures relating to degradable panels or hinging devices is to prevent lost traps from continuing to capture reef fish. Two studies of the south Florida wire fish trap fishery (Taylor and McMichael, in press; Sutherland and Harper, in press) indicated substantial losses of traps for two groups of fishermen fishing Gulf waters. Fishermen operating from the port of Miami reported losses averaging 100 percent per year and Florida Keys fishermen reported losses averaging 63 percent per year, while west coast fishermen reported losses of less than five percent per year but constantly attended their traps. While Section 3.2.1.4.1 indicates that many species can and will freely leave the trap by the funnel, data supporting this behavior for most Gulf reef fish species is not available. Although Munro (1974b) reported that escapement reaches about a level of 50 percent in about seven to ten days, Munro, et al. (1971) reported that almost all fishes confined for two weeks show obvious signs of physical deterioration and often have fungal infections. They speculated that mortality increased greatly for periods of confinement of somewhat less than a month due to starvation and predation. This observation was confirmed by Taylor and McMichael (in press) in their study of the Florida Keys fishery. They reported on the catch of 55 traps which had been soaked (fished) for 20 days. Fifty-three percent of the angelfishes, 32 percent of the groupers and 40 percent of the snappers confined to these traps were either dead or injured. This information demonstrates the need for degradable panels or access door fasteners which will be constructed of material specified by regulation. Regulations governing the fish trap fishery in Bermuda specify that the door must be secured by string yarn or other perishable material. The Caribbean Council specified an assortment of materials which deteriorate within 90 days (Dammann, in press). Kumpf (in press) tested deterioration rates for several materials. Both jute and sisal twines deteriorated within 42 days. Lost cages, with large openings as proposed in Measure 4.1, would allow full access for most fishes and would become useable habitat.

Both Taylor and McMichael (in press) and Sutherland and Harper (in press) reported that the access doors of traps fished in the Gulf were located on the side opposite the funnel. In some trap designs the funnel occupied one entire side. Nearly all the traps fished in the Gulf were rectangular. Only two "Z" shaped traps and a few cylindrical and heart-shaped traps were reported in the fishery. If the lost trap with one funnel should land on the side with the access door, the funnel would be on top. The trap would not be very effective in fishing as evidenced by the limited catch of fish by other traps with funnels on the top such as lobster and stone crab traps. Traps with two funnels would have two access doors or degradable panels so that one funnel and one access door would be in the vertical plane regardless of how the trap landed.

Measure 4.3 will provide for escapement of juvenile fish confined to traps and from traps pulled from water depths that may cause death by embolism. Although several researchers (Munro, 1974a; Stevenson, 1978; Wolf and Chislett, 1974; and Olsen, et al., 1977) have suggested optimum mesh sizes for various species and areas, Taylor and McMichael (in press) found no significant differences in the sizes of five grouper species confined to traps of 1 x 2 inch and 2 x 2 inch meshes in the south Florida

fishery. Most traps in this fishery were constructed of 1 x 2 inch mesh. The optimum mesh size for Gulf species is not presently known; however, research is being carried out in an effort to establish optimum sizes and Measure 8A provides a procedure for implementation of mesh size modifications. However, Measure 4.3 provides for 2 x 2 inch windows which are slightly larger than optimum mesh sizes reported in the scientific literature for the Caribbean and which will serve as an interim conservation measure until research delineates the optimum mesh size for the Gulf fishery.

Both Measures 4.4 and 5.0 are conservation measures which are designed to provide for a regulated growth of the trap fishery so that this segment of the fishery does not adversely impact the stocks or other user groups. Studies of the south Florida trap fishery (Taylor and McMichael, in press; Sutherland and Harper, in press) indicate that the participants in this segment of the fishery are primarily new entrants into the reef fish fishery. Almost all of these fishermen were previously employed in the spiny lobster and stone crab fisheries. Many of these fishermen were displaced from fisheries in Bahamian waters where U.S. fishermen were denied access to those waters and began entering the U.S. trap fishery in about 1976 (Table 3). Approximately 80 percent of the trap fishermen are part-time fishermen who still participate in the stone crab and spiny lobster fisheries during part of each year.

The purpose of Measures 4.4 and 5.0 is to place a reasonable upper limit on the fishing power of an individual without reducing the efficiency of his operation. This limitation is beneficial both to competing users of the resource utilizing other gear and also to the trap fishermen.

Fishing power is a measure of the catch of a particular gear or a particular vessel using standardized units of gear and is related to the size (or volume) of the gear, the length of time deployed, and the catch taken by the gear from the available stocks (Gulland, 1977). Rothschild (1977) described the fishing power of crab traps and demonstrated its relation to trap size. Limitations on fishing power by regulating size and units of gear are common methods used in managing fisheries. Often limits on fishing power are utilized to standardize the effort among participants (vessels) in highly exploited fisheries to provide for equal access to the stocks by the fishermen, e.g., trawl size limitations in state waters. Almost always these management restrictions specify a maximum number of units or maximum size of gear and fishermen are free to utilize less or smaller units of gear. Usually, as the rate of exploitation increases, the number or size of the units of gear is reduced by the regulatory agency in order to control effort. Limitation on fishing power does not completely limit effort since it does not control increases in participation (vessels). However, limitation of fishing power does provide an effective interim method of control of fishing effort prior to the more sociologically disruptive control of limiting vessels in a fishery. It is more equitable than catch quotas since each fisherman controls his effort and success within the restrictions on fishing power imposed by the regulatory agency to conserve the resource.

Both Measures 4.4 and 5.0 provide such limitations on fishing power which the Council felt were equitable to the participants and necessary for conservation of the resource. These measures do not provide for an absolute control on fishing effort, such as limitations on participants, as this was deemed as unnecessary at this time. A limitation on vessels could be accomplished under the procedure of Measure 8.0, Part B, if it should become necessary in the future.

Measure 5.0, which provides for a restriction on the number of traps per vessel, is a conservation measure designed to place a reasonable limitation on the fishing power of these new participants in the fishery. The proposed limitation will effect primarily the full-time trap fishermen. This group presently constitutes 20 percent of the participants and takes the greatest portion of the catch. Some of these fishermen fishing in the Gulf are presently using up to 100 traps per vessel (Oleson, 1981). The highest number of traps in use by one vessel was reported to be 200 but that vessel did not presently fish Gulf waters. Therefore, the measure will provide an effective limitation without adversely impacting the present participants.

In addition, the restriction on the number of traps per vessel is a reasonable conservation measure since it provides some limitation on effort and catch by trap fishermen so that they do not adversely affect the CPUE for hook and line fishermen. Although other provisions of the Plan [8.3.1.2(3)] restrict trap fishing from areas where the most intensive effort by hook and line fishermen occurs, both commercial and recreational fishermen do fish beyond the stressed area utilizing hook and line gear. The fixed gear utilized by trappers will have an effect locally on depressing the CPUE of hook and line gear. Because of the limited nature of the resource, the efficiency of this gear and the small number of trap fishermen, unrestricted growth of the trap fishery would redistribute the present catch and associated value from many hook and line participants to the few trap fishermen. The measure, therefore, also benefits the traditional hook and line fishery of the Gulf by placing modest restrictions on traps. The Council concluded that a reasonable limitation of 200 traps per permitted vessel is warranted at this time. Stevenson (in press) indicated the maximum number of traps fished per fisherman in Puerto Rico may range up to 200 traps. Because excessive numbers of traps obstruct navigation and interfere with other fishing operations, the State of Louisiana limits crab fishermen to 200 traps.

In the long-term prospective, the measure will greatly benefit the trap fishermen by preventing or greatly delaying technical overcapitalization of his fishery. Overcapitalization (technical and economic) is characteristic of other open-access, fixed-gear fisheries for stone crab and spiny lobster which exist in the same locality. Overcapitalization results in adverse economic impacts on the fishermen and society.

The limitation of 200 traps per vessel is a completely reasonable restriction for several reasons. First, a fishing vessel normally uses less than this number of traps (Section 3.2.1.4.1). As cited in this section an average of 1,248 traps are currently utilized by 51 vessels during the season, or an average of 25 traps per vessel. However, during the peak period of participation by part-time fishermen an average of 39 traps per vessel were utilized (Taylor and McMichael, in press; Sutherland and Harper, in press). Full-time fishermen use more traps than the averages cited above and are the persons who will be primarily affected by the limitation. In public testimony on the plan one trap fisherman indicated he was utilizing 200 traps and another was using 160 traps. Neither was presently fishing the Gulf. All individual testimony supported a limitation of 200 or less traps as did the testimony by the fisheries associations representing trap fishermen.

To illustrate the reasonableness of this proposed restriction an analysis of the estimated economic return for the 1979-1980 fishing season is provided as follows: In Section 5.3.0AH for the trap fishery is computed to be approximately 1.5 million pounds of grouper and snapper. This is based on average catch per trap and estimated effort for the first year. Assuming an exvessel value of $1.00 per pound ($0.90 for grouper species and $1.20 for snapper species) the total gross revenue is approximately $1.5 million. This is equivalent to an average annual gross income of $29,411 per vessel or per fisherman. It is also equivalent to an annual gross income of $1,202 per trap. Since full-time fishermen fish considerably more traps than the average for all fishermen, their gross income would be higher, possibly approaching four times this amount.

The average catch and return per trap will decline as participants or traps increase in the fishery. Without some limitation, the fishery will become technically overcapitalized as in the case for the spiny lobster and stone crab fisheries. To illustrate the potential for such overcapitalization, fisheries statistics (Fishery Statistics of U.S.) for 1964 and 1976 are cited below:

In the stone crab fishery in 1964 there were 20,974 traps being utilized. By 1976 the number of traps had increased to 224,351, an increase of 1,069 percent, whereas the number of fishermen increased only by 416 percent during the same time period. Although catch increased by 326 percent, catch per trap for 1976 declined to 30.4 percent of the CPUE for 1964 and the gross income per trap declined by 12 percent despite a 289 percent increase in exvessel value. Gross income per trap actually declined by an additional 34 percent when inflation at the producer level is considered.

In the spiny lobster fishery in 1969 there were 96,955 traps being utilized. By 1978 the number of traps had increased to 529,200, an increase of 546 percent, whereas the number of fishermen increased only 187 percent. During this period, the catch remained stable whereas catch per trap declined to 19 percent of the CPUE for 1969 and the gross income per trap declined by 42 percent despite a 307 percent increase in exvessel price. Gross income per trap actually declined by an additional 13 percent when inflation at the producer level is considered.

The changes in the number of traps per vessel in the fisheries were as follows: In the stone crab fishery in 1964 there was an average of 262 traps per vessel which had increased to an average of 707 traps per vessel by 1974. In 1964 the number of traps per vessel in the spiny lobster fishery was 333 which increased to 632 traps per vessel by 1975. In both fisheries some full-time fishermen use 3,000 to 4,000 traps per vessel.

Both of these examples demonstrate the potential for over-expansion in an open access fishery. They demonstrate that fishermen may not gain in the long run with more effort and that society has misallocated its resource. Both also demonstrate that units of gear (which are relatively inexpensive) proliferate much faster than number of participants, be they vessels or fishermen. By limiting the number of traps per vessel the potential rate of overcapitalization is slowed, since entry into the fishery requires investment in additional vessels (which are very expensive) rather than just additional traps. In the long-term, limiting effort is beneficial to all the participants in the fishery. The limitation proposed is a reasonable one which provides for moderate expansion of the existing trap fishery by full-time fishermen and it allows the potential for a very reasonable return. Most trap fishermen operate only part-time in the reef fish fishery.

Overcapitalization caused by excess units of gear should be avoided in the reef fish fishery for biological as well as economic reasons. The biological consequences of excess effort are much more serious for reef fish than for crustaceans such as lobster or stone crab. For those crustacean stocks, natural mortality and fecundity are very high, maturity occurs at or before entry into the fishery, the exploited population is essentially an annual crop, and there does not appear to be any relation between spawning stocks abundance and recruitment, even at very high rates of exploitation. Trap gear is designed to catch only one species. In such fisheries, if regulated by size limit, fishing effort in excess of that needed to harvest the maximum yield have little adverse impact on yield per recruit and no apparent impact on recruitment. For most reef fish stocks, exploitation normally begins before age at maturity, fecundity is lower than crustaceans, natural mortality is very low, the catch is made up of many year classes, and it is much more likely that substantial decreases in spawning stock abundance would reduce recruitment. Because fish trap gear is designed to harvest many species of various sizes, size limit management is much less effective than in crustacean trap fisheries. If trap fishing for reef fish becomes as intense as in the lobster or stone crab fisheries, it is probable a very large decline in average size and spawning stock abundance will result. Yield per recruit would decline and recruitment would probably be reduced.

Because of these economic and biological concerns over unregulated expansion of the trap fishery and its affect on conservation of the stocks, it appeared better to establish these limitations on fishing power early in development of the trap fishery, rather than to impose the restriction after the expansion of the fishery. This serves two purposes, first, it prevents investments in excess units of gear or very large vessels by the trap fishermen, and secondly, provides for regulated expansion of the fishery to alleviate the adverse biological and economic consequences of such an expansion on the stocks and other user groups.

The enforcement of this proposed measure may be conducted largely at shoreside. The two studies of the south Florida trap fishery indicated that 80 percent of all fish trap fishermen participated in the spiny lobster and stone crab fisheries during part of the year; therefore, these traps would be stacked ashore during part of the year. These studies also indicated that more than half of the

fishermen always returned their traps to shore on the vessel at the conclusion of each trip. These studies also reported that all traps fished in the Gulf were individually buoyed allowing aerial counts. Only on the east coast of Florida were "trawls" of traps used. The numbering and color code provisions of Section 8.3.1.4 are structured to enhance enforcement.

Measure 4.4 would provide for a maximum volume which is somewhat larger than most traps currently in use (Section 3.2.1.4.1). In baited traps, the volume is directly related to the potential catch. In studies under FAO, Wolf and Chislet (1971, 1974) demonstrated that the catch rate of snapper was almost directly proportional to the trap volume for two sizes of traps. Traps which were 167 percent larger caught 161 percent higher poundages of fish. All the traps fished in the Gulf fishery are baited (Taylor and McMichael, in press). Juhl and Suarez-Caabro (1971) also commented on the ability of larger traps to yield greater catches.

Personal observations of the catches of a 384-cubic foot trap reported in the preliminary draft of this plan indicated that the daily catch averaged as high as 1,200 pounds per trap during part of the year. Therefore, any proposed measure which is designed to impose an upper limitation on the fishing power of each individual participant must consider a limitation to the volume of the traps as well as a limitation on the number of traps (Measure 5.0).

Throughout the early deliberations on the plan, a maximum volume of 50-54 cubic feet was considered since this was reported as the typical size in early drafts of the plan. However, this represents a maximum size which is more than twice the volume of traps utilized in the fishery (Taylor and McMichael, in press). They reported the most common size to be 24 cubic feet. Almost all other traps described in their study were smaller in volume. The average size of traps used by fishermen from the port of Miami who fished the Gulf was 18.6 cubic feet. Only one vessel was reported as using traps exceeding 33 cubic feet (Sutherland and Harper, in press).

Fishermen testifying on the plan reported the use of traps varying in size between 24 and 15 cubic feet. However, the majority of trap fishermen testifying supported a maximum limitation of at least 54 cubic feet as did the representatives of the fisheries associations affected. Their rationale for this increase in trap size over the sizes used in the fishery was speculation that larger traps may be necessary to fish for deepwater species such as tilefish.

The Gulf Council while always supporting a limitation on maximum size recognized the importance of special allowances for developing fisheries for deepwater species. In fact, the Council encouraged the harvest of the less utilized species, such as tilefish (Section 8.1.3), hoping that an industry initiative for harvest of these species would develop. This would reduce fishing effort on some of the snapper and grouper species. Therefore, the Council adopted a compromise position of limiting trap size to 33 cubic feet inshore of the 300-foot contour, but allowing unrestricted size offshore of the 300-foot contour.

This is a very reasonable conservation measure in that few trap fishermen would be adversely impacted by the measure as most traps were smaller than 33 cubic feet. In fact, this limitation on size is about 38 percent larger than traps commonly used in the fishery. Bermuda, for instance, limits all fish traps to 13.5 cubic feet. The measure is reasonable in that the size limitation is restricted to the area adjacent to the stressed area while allowing larger traps in the more distant and deeper waters. It should be recognized that the trap fishery is a new fishery and has the potential to yield a very good fiscal return (see rationale for Measure 5 of this subsection). Therefore, it is likely that more participants will enter the fishery, but it should also be recognized that the increased catch by trap fishermen will be to the detriment of other user groups because the resource is limited. This will decrease the CPUE of the traditional hook and line fishermen in localized areas and transfer the benefits accruing to them to the trap fishermen. Therefore, the proposed limit on size is a reasonable measure which will aid in reducing the affect on persons utilizing traditional fishing practices while also allowing the new fishing methodology (traps) to be pursued at a reasonable level.

Although enforceability of this proposed measure appears difficult, in reality it is expected that initially very few fishermen will choose to utilize traps larger than 33 cubic feet regardless of where they fish. This observation is supported by the historical developments in the trap fishery of the Caribbean. Those persons fishing larger traps will be known through the permitting requirement of the plan. These vessels can easily be identified by the color code requirements for vessels and buoys (Section 8.3.1.4) and periodic enforcement overflights should indicate intent to violate the measure, particularly as all traps currently used in this fishery are individually buoyed. Also the species composition of catches landed by these vessels would indicate to a great extent the depths of water they are fishing (Taylor and McMichael, in press). This should aid enforcement officers in identifying, from those vessels which are fishing large traps, those which may be violating the restriction on depth. Since 80 percent of the fishermen participate in other fisheries during part of the year and since the majority bring their traps back aboard the vessels, most of the enforcement could be done at shoreside.

Although both Measures 4.4 and 5.0 provide for restrictions on fishing power they do allow a moderate increase in fishing power of trap fishermen which should partially offset the higher operating cost of being excluded from the stressed area. Measure 6 would reduce conflicts and theft, discourage illegal trap fishing in the stressed area and promote enforceability. Measure 7 would prevent the destruction and waste of reef fish resources and living habitat.

(8) PROCEDURES FOR MODIFICATION OF FISHING GEAR MEASURES

Part A. Adjustment of Mesh Size of Traps

The concern of the Council is that it may be necessary to specify the allowable mesh size for fish traps in order to reduce excessive mortality of juvenile reef fish and incidental species. Mortality could occur through extended confinement, predation in traps and embolism. The Council desires to prevent excessive mortality but presently does not have the information to: (1) assess whether mortality is excessive, (2) assess the optimum mesh sizes, (3) assess whether larger meshes are necessary, (4) assess whether escape windows or panels would be as effective as larger mesh, or (5) assess the effects of larger mesh on fishing effectiveness of the traps. To prevent avoidable and unnecessary mortality, information will be collected and analyzed on the selectiveness of and mortality associated with various mesh sizes of traps as it relates to species in the Gulf fishery. This information will include statistical information collected through implementation of the plan, other studies and research.

If these data analyses are inadequate for the Gulf fishery, NMFS will be requested to complete research specific in the fishery which will provide information on the optimum mesh size for traps used in the Gulf. Included in the factors that will be considered by the study are the following:

(a) Species and size composition of catches of traps.

(b) Mortality rates of the various species and size classes of fish confined to traps.

(c) Escapement of the various species from traps via the funnel or escape windows.

(d) Sizes of mesh that would allow escapement of unutilized fishes and undersized fishes.

(e) Effects of mesh size on fishing effectiveness of the traps.

SEFC* and the Operations Unit** will continuously review and assess the information which pertains to the selectiveness of and mortality associated with various mesh sizes of traps and as it relates to species in the Gulf fishery.

Point of Concern Option 1: In the course of the continuous review, a Point of Concern occurs when the information demonstrates a level of mortality occurring in traps as a result of mesh size which may adversely effect recruitment to the adult populations of those species affected.

Point of Concern Option 2: In the course of the continuous review, a Point of Concern occurs when one or more of the following is found:

(a) When the information demonstrates a level of mortality among juveniles or adults of species taken incidentally to the directed fishery for reef fish that may adversely limit the abundance of these species in localized areas, particularly when these species are important to other fisheries (aquarium trade, for example) or are important to continued survival of the reef ecosystem;

(b) When the information demonstrates that fishing effectiveness of traps is not adversely affected by larger meshes and such larger meshes allow escapement of fishes of a size not desirable for the market;

(c) When the information demonstrates excessive mortality of juvenile fish confined in ghost (lost) traps and when there is evidence of significant violation of the requirement for degradable panels or hinges and when the number of lost traps exceeds those in the fishery.

Once a Point of Concern is identified by SEFC and the Operations Unit under Options 1 or 2:

(1) They will evaluate current data to determine if the total mortality occurring as a result of inadequate mesh size adversely impacts any stock, local aggregation of species or any portion thereof or whether such mortality is inconsequential in comparison to natural mortality for that species and size of fish.

(2) They will evaluate whether an increased mesh size will adversely impact fishing effectiveness of the traps or have no such adverse impact.

(3) They will evaluate the optimum mesh size for traps considering all the biological and economic factors characteristic of each mesh size.

(4) If SEFC and the Operations Unit concludes that there is evidence of excessive mortality or that fishing effectiveness is not changed or is enhanced by larger mesh sizes, they will make findings regarding which one or more of the following management measures will alleviate the conditions cited above, while at the same time achieving the objectives of the Plan:

a. Require the use of the optimum mesh size wire for construction of traps.

b. Require the bottoms of traps to be constructed of certain mesh size that excludes undesirable fish from the catch.

---

* SEFC = Southeast Fisheries Center of NMFS

** Operations Unit = Multidiscipline technical team comprised of Council staff and NMFS Management Division personnel

c. Require panels of the optimum mesh on two or more sides of the trap.

d. Require four or more escape windows of an optimum size be cut in the mesh of each side.

(5) Procedures (5) through (9) of Part B of this section will be followed in implementing the measures under this Part, except that the regulation(s) promulgated will become effective one year after publication in order to minimize economic impact on trap fishermen.

Part B. Limitations on Gear

The concern of the Council is that major influxes of new and more efficient gear may occur into the fishery which would result in biological stress on the stocks, growth or recruitment overfishing, and displacement of traditional users of the resource. Because of economic difficulties encountered in some fisheries (the shrimp fishery, for example) it is no longer profitable to pursue these other fisheries on a continuous basis. Other fisheries (spiny lobster and stone crab, for example) are seasonal. In all of these other fisheries the participants are seeking alternative fishing activities for the slack or closed periods in their fishery. Sea Grant institutions and other agencies are instructing fishermen in the use of alternative types of gear and fishing methodology. Because of the high value of reef fish much of this activity is directed toward that fishery and includes fishing techniques utilizing fish traps, longlines, roller trawls, buoyed drop lines, etc.

Because the fishery is being harvested at levels approaching OY; because OY was set at a level below MSY to provide for rebuilding of stocks and to account for an anticipated equilibrium yield currently below MSY; because fishing pressure from traditional users continues to increase, the Council is very concerned that major influxes of new participants and new, more efficient gear will occur to the detriment of the existing fishery. To prevent avoidable and undesirably high catches of individual species or species complexes, each species or species complex will be subject to continuous assessment and monitored throughout the calendar year for signs of biological stress, with particular emphasis on catch by gear type. SEFC and the Operations Unit will monitor statistical information collected through implementation of the plan and that provided from other surveys and research to assess the effects of each type of specific gear on the reef fish stocks or elements thereof. As new gear is introduced into the fishery, the Council may request special NMFS surveys to assess the effects of the gear on the stocks.

Point of Concern Option 1: In the course of the continuous review, a Point of Concern occurs when the catch is expected to reach OY before the end of the calendar year.

Point of Concern Option 2: In the course of the continuous review, a Point of Concern occurs when any one or more of the following is found:

(a) The use of any gear or combination of gear is resulting in an increase in growth overfishing or which may lead to recruitment overfishing of the stocks or any portion thereof in any locality;

(b) The use of any gear or combination of gear is resulting in displacement of historical users of the resource from the fishery or is seriously affecting the catch per unit effort of historical users of the resource;

(c) The use of any gear or combination of gear is resulting in persistent or prolonged conflicts between user groups;

(d) The use of any gear or combination of gear is resulting in excessive mortality of reef fish or species taken incidentally to the fishing effort;

(e) The use of any gear or combination of gear is resulting in major destruction of reef fish habitat.

Once a Point of Concern is identified by SEFC and the Operations Unit under Options 1 or 2:

(1) They will evaluate current data to determine if the species or stock shows legitimate signs of biological stress or is merely demonstrating aberrant tendencies which have no potential for biological stress or overfishing;

(2) They will evaluate the current data to determine if historical participants in the fishery are being displaced or are changing fishing methodology and gear. They will evaluate the current data to determine the impact of the gear on the catch per unit effort of remaining historical participants;

(3) They will evaluate the current data to determine if the gear is resulting in excessive mortality or damage to reef fish habitats;

(4) If SEFC and the Operations Unit concludes that there is evidence of stress, evidence of overfishing, evidence of excessive mortality or habitat destruction or prolonged conflict which are related to a specific type of gear or combination of gear, they will make findings regarding which of one or more of the following management measures will relieve the conditions cited above, while at the same time achieving the objectives of the Plan:

a. Prohibit or reduce the use of the gear in areas where the stocks or habitat are adversely affected;

b. Require a modification in the construction characteristics or use of the gear to alleviate the adverse effects;

c. Limit the size and number of units of gear that may be utilized by vessels in the FCZ or portions thereof;

d. Require permits and more detailed statistical information from participants using gear with adverse effects on stocks or habitat; and

e. Permanently prohibit the use of the gear from the stressed area or other localities as necessary.

(5) The Operations Unit with assistance from SEFC will prepare a report containing rationale and all evidence documenting the extent and impacts of the adverse conditions listed in (4) above, along with a recommendation and supporting rationale indicating which management measure(s) should be employed to alleviate the adverse condition consistent with the objectives of the Plan. The report will also contain reasons why other measures were not recommended. An environmental assessment of the proposed action and alternatives will also be prepared by the Operations Unit and will accompany the report. A supplemental environmental impact statement and/or regulatory impact review will be prepared, if necessary.

(6) At the request of the Management Committee, the Council Chairman may schedule meetings of the Advisory Subpanel (AP) and/or Scientific and Statistical Committee (SSC) or portions thereof concurrently with the Council meeting to review the report and associated documents and to advise the Council. The Council Chairman will also schedule a public hearing before the Council at this meeting or may, at the request of the Management Committee, schedule several hearings in appropriate locations prior to the Council meeting.

(7) The Council, following review of the report, supporting data, public comment, SSC and AP advice and other relevant information, will recommend management measure(s) to the Southeast Regional Director of National Marine Fisheries Service (RD), accompanied by all background data, information and public comment. The recommendation will explain the urgency in implementation of the measure(s), if any, and reasons therefor.

(8) The RD will review the Council's recommendation, supporting rationale, public comments and other relevant information, and, if he concurs in the recommendation, will propose regulations in accordance with the recommendations. He may also reject the recommendation, providing written reasons for rejection.

(9) If the RD concurs in the Council's recommendations, he shall publish proposed regulations in the Federal Register and shall afford a reasonable period for public comment which is consistent with the urgency (if any) of the need to implement the management measure(s).

Nothing in this section shall be interpreted to derogate from the authority of the Secretary of Commerce to take emergency action under Section 305(e) of the FCMA.

Rationale: The procedures under Measure 8.0 provide for changes in the regulations implementing the Plan while at the same time assuring review of any proposed major changes by the public, the fishermen and the scientific community. Procedures under Part A of this measure provide for modification of the mesh sizes of fish traps. Scientific research is presently being carried out to attempt to determine the optimum mesh sizes of the Gulf species. The alternative actions proposed in this procedure provide a reasonable statement of the changes that may need to be implemented in the future. Because the changes may have a considerable economic impact on the trap fishermen, implementation is delayed for one year after publication of regulations to allow replacement of lost gear with new units having the required mesh size. Overall for the fishery, more than one-half of all traps are lost each year.

Procedures under Part B provide for regulatory controls on the introduction of new gear which may have detrimental impacts on the stocks. As pointed out in the expression of Council concern within the procedures, the commercial industry is experimenting with several types of new gear. The Council certainly does not want to limit the development and use of better, more efficient gear, but it also does not want such gear to adversely impact the stocks, especially as the stocks are being harvested near maximum allowable exploitation. The implementation procedure provides for a report summarizing the conditions in the fishery, effects of the gear, recommended regulatory changes and analysis of impacts of the alternatives. Such a report would be subject to comment from the fishery Advisory Panels, Scientific and Statistical Committee, the public and Council before recommendations were made to the Regional Director for implementation. Thus all the safeguards for full consideration of the merits of the proposed change are maintained and still the procedure allows more timely action to protect the stocks than is possible under plan amendment.

8.3.1.3 Bag and Size Limits

(1) PROHIBIT THE POSSESSION OF RED SNAPPER (LUTJANUS CAMPECHANUS) LESS THAN 12 INCHES IN FORK LENGTH SUBJECT TO THE FOLLOWING EXCEPTIONS AND CONDITIONS: (A) 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 FCZ, WITH THE EXCEPTION OF ROLLER TRAWL VESSELS FISHING IN THE STRESSED AREA, IS EXCLUDED FROM THE POSSESSION LIMIT.

Rationale: Yield per recruit estimates[11] indicate that an increase in minimum size will increase total yield from the stock of red snapper. Several alternative sizes were considered. Present age and size at recruitment is established to be approximately one year and eight inches fork length. Increases in yield per recruit are possible with increasing minimum sizes up to a maximum of fifteen inches.

Fork length at recruitment	Weight (lbs)	Yield per recruit (Y/R^1) given present fishing effort (grams)	Percent of Maximum Y/R given present fishing effort	Increase in Yield
8" (present)	0.3	342 - 370	65 - 77%	0
12"	1.0	458 - 470	90 - 95%	18 - 25%
14"	1.6	474 - 499	96 - 99%	22 - 31%
15"	2.0	480 - 513	98 - 100%	23 - 33%

Parameters

$M = .3$
$F = .5 - .6$ (assumed based on results of surplus production model)
$L_{oo} = 692$
$W_{oo} = 4488g$
$t_o = .324$
$t_r = 1.0$
$K = .333$

A minimum size of 12 inches fork length is recommended as optimum. This size will result in an estimated 18 to 25 percent increase in potential yield provided mortality from embolism and hooking is not excessive. The resultant yield will be within 90 to 95 percent of the theoretical maximum at present levels of effort. Some red snapper of this size will have reached sexual maturity and spawned before entering the fishery. Larger minimum sizes were rejected because the potential additional gains are small, only five to eleven percent. This would be further reduced by increased mortality of released fish as more fish would be caught and released. Additionally, the data available, while adequate to indicate that a moderate increase in size was desirable, was not considered reliable to guarantee an increased yield from large increases in minimum size.

The Plan documents in Section 4.7.1.3 that the major stressed species is the red snapper, the predominant snapper in the fishery. Institution of this measure would address the first specific management objective of "rebuilding declining stocks where they occur." This measure would be instituted throughout the FCZ and recommended to the states for implementation. By instituting the measure throughout the Gulf rather than in the stressed area, enforcement will be much easier and the benefit to the stocks would be greater. Also, most of the smaller red snapper occur in the nearshore waters and individuals generally become progressively larger as they move farther offshore. This occurrence in shallower waters assures a reasonable survival rate of released undersized fish, whereas release of all fish exceeding a numerical bag limit would result in a relatively low survival rate for fish which were released from deeper waters. Therefore, a size limit appeared more beneficial than a bag limit.

The exception allowing a possession limitation of five undersized red snapper is to provide for retention and prevent waste of fish that are dead or probably will die. Since fishermen who infrequently fish a specific reef have no information whether the population is comprised of large individuals or undersized individuals, it allows the fisherman to test fish the reef and retain a limited number while at the same time discouraging them from fishing reefs with predominantly undersized fish.

---

11 Analysis performed by Gulf Council staff using parameters supplied by Dr. Charles Manooch, Beaufort Laboratory, NMFS.

The exception for trawl fisheries for other species takes into consideration the following factors: (a) virtually all the vessels in the fishery are not directed toward capture of reef fish, but takes them incidentally, (b) the reef fish are all usually dead when taken by trawl and return to the water does not promote conservation, (c) some vessels (e.g., groundfish vessels) do not sort their catch at sea and may be in technical violation of a possession limit when landing the catch, (d) because of the small size of the majority of specimens taken as bycatch, they are not acceptable as human food, and (e) the Council hopes to reduce this bycatch problem by development of separator trawls or other similar gear (see discussion under Sections 8.1.1 and 8.6).

While this size limit was applied to the entire management unit area (FCZ) to improve enforceability, it is expected to have the greatest impact and beneficial effect on the stressed area since the great majority of the juvenile (undersized) red snapper are taken from more shallow, nearshore waters. Juvenile snapper can also be released from these nearshore waters with a minimum amount of embolism mortality. Thus, this measure, in effect, results in a reduction of fishing mortality of juvenile red snapper by hook and line fishermen primarily in the stressed area.

8.3.1.4 Permits and Gear Identification

(1) REQUIRE PERMITS FOR ALL BOATS AND VESSELS FISHING FISH TRAPS IN THE FCZ (FOR IDENTIFICATION AND REPORTING PURPOSES). SUCH PERMITS SHALL BE OBTAINED FROM THE REGIONAL DIRECTOR OF NMFS OR HIS DESIGNEE.

(2) ALLOW THE USE OF FISH TRAPS IN THE FCZ ONLY FROM PERMITTED BOATS AND VESSELS OR BY PERSONS FISHING FISH TRAPS FROM FIXED OR MOVABLE STRUCTURES WHO HAVE FIRST OBTAINED A PERMIT FROM THE REGIONAL DIRECTOR OF NMFS OR HIS DESIGNEE.

(3) REQUIRE THAT ALL FISH TRAPS USED IN THE FISHERY WITHIN THE FCZ BE IDENTIFIED BY A NUMBER AND ALL FISH TRAP BUOYS BE IDENTIFIED BY A COLOR CODE ISSUED THROUGH THE REGIONAL DIRECTOR OF NMFS OR HIS DESIGNEE, TO EACH BOAT, VESSEL OR PERSON DESIRING TO USE FISH TRAPS IN THE FCZ. FURTHER, REQUIRE THAT EACH TRAP OR STRING OF TRAPS BE MARKED BY A FLOATING BUOY OR BY BUOYS DESIGNED TO BE SUBMERGED AND AUTOMATICALLY RELEASED IN A CERTAIN TIME; REQUIRE EACH STRING OF TRAPS TO BE MARKED WITH A BUOY AT OPPOSITE ENDS OF THE STRING. FURTHER, REQUIRE THAT EACH BOAT, VESSEL OR STRUCTURE FISHING TRAPS BE CLEARLY MARKED WITH THE SAME NUMBER AND COLOR CODE TO ALLOW IDENTIFICATION FROM AERIAL AND WATER PATROL CRAFT. FURTHER, PROVIDE FOR SEIZURE OF ALL DEPLOYED GEAR NOT PROPERLY IDENTIFIED.

(4) EACH VESSEL SO PERMITTED SHALL BE ISSUED METAL OR PLASTIC 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 FROM THE REGIONAL DIRECTOR OR HIS DESIGNEE, UPON REQUEST. TRAPS FISHED OR ABOARD VESSELS IN THE FCZ WHICH HAVE NO SUCH TAG ATTACHED ARE ILLEGAL GEAR AND MAY BE CONFISCATED BY FEDERAL OFFICERS.

(5) 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.

(6) EACH APPLICANT FOR A PERMIT MUST SPECIFY THE NUMBER, DIMENSIONS AND ESTIMATED CUBIC VOLUME OF THE TRAPS THAT WILL BE FISHED UNDER THE PERMIT.

Rationale: Because the trap fishing method is a new element which has the potential to displace participants using historical methods and because the gear is highly efficient (Section 3.2.1.4.1), and as no information is available on the potential impact on the stocks by a rapid expansion of the trap fishery, the Council is proposing the permitting of all vessels engaged in the trap fishery to

provide for the collection of information on the fishery and more closely follow the development of the fishery. The purpose of the color code and numbering system for vessels, traps and buoys is to provide for identification of traps and vessels to assure compliance with the measures proposed under Sections 8.3.1.2 and 8.3.1.5.

The management measure prohibiting the use of fish traps within the stressed area will result in fish traps being used initially just outside the stressed area, i.e., between the concentrated recreational fishery nearshore and the offshore commercial hook and line fishery. The potential exists for rapid expansion of this fishery and, therefore, needs to be closely monitored to measure impacts on the stocks. As opposed to a voluntary reporting system, establishment of a permit system will ensure that data will be collected as fish trap fishermen will necessarily contact the permitting agency for their permits. In the development of this Plan, it has been extremely difficult to acquire accurate information on this fishery; catch statistics ranged from eight pounds to 60 pounds per trap per pull. Additional research was necessary to acquire accurate information. With respect to the number of traps in the fishery, data available from NMFS has ranged from 2,400 traps to as many as 8,000 traps. Obviously, this type of information is too imprecise to adequately monitor this developing method of harvesting. A permitting system offers the only means of acquiring the necessary information.

Measures 4 through 6 are designed to improve the enforceability and reduce the cost of enforcement of trap restrictions on number and size.

8.3.1.5 Statistical Reporting

(1) BASED ON VESSEL ENUMERATION,[12] IT IS EXPECTED THAT THOSE VESSELS FISHING FOR REEF FISH WILL BE IDENTIFIED.

THE PLAN SHALL REQUIRE A MANDATORY REPORTING SYSTEM, WITH PARTICIPATION LIMITED TO RANDOM SAMPLES SUFFICIENT FOR FISHERY MANAGEMENT NEEDS FROM (I) CHARTER, GUIDE AND PARTY BOATS; (II) NOT-FOR-HIRE RECREATIONAL BOATS; (III) COMMERCIAL FISHING BOATS AND VESSELS (WITH THE EXCEPTION OF TRAP FISHING BOATS AND VESSELS); AND (IV) PROCESSORS AND WHOLESALERS OR OTHERS PURCHASING REEF FISH.

NMFS IS REQUESTED TO DEVELOP A DATA COLLECTION AND ANALYSIS SYSTEM DESIGNED TO PROVIDE USABLE DATA ON: LEVELS AND FREQUENCY OF PARTICIPATION IN THE REEF FISH FISHERY; LEVELS OF REEF FISH CATCH BY SPECIES; SIZE COMPOSITION OF THE CATCH; CATCH PER UNIT OF EFFORT; INCIDENTAL CATCHES OF OTHER SPECIES; AND INDICATORS OF THE ECONOMIC VALUE OF THE FISHERY.

(2) REQUIRE THAT ALL BOATS OR VESSELS OR PERSONS FISHING WITH TRAPS REPORT THE FOLLOWING INFORMATION ON A PERIODIC BASIS: (I) SIZE OF VESSEL OR BOAT, (II) TOTAL NUMBER OF TRAPS, (III) SIZE OF TRAPS, (IV) MESH SIZE OF TRAPS, (V) COMPOSITION OF CATCH BY WEIGHT AND SPECIES BY TRIP, (VI) WATER DEPTH, (VII) NUMBER OF TRAPS HARVESTED BY TRIP, (VIII) LOCATION OF TRAPS BY NMFS STATISTICAL GRID, AND (IX) THE NUMBER OF TRAPS HAULS PER TRIP.

Rationale: Measure 1 will provide for collection of the statistical information needed to manage the fishery in the most cost effective manner and with the least impact on the users. Those persons randomly selected to report will be required to do so under this measure. The percentage of each group required to report under Measure 1 will be a function of the number of participants in each category, i.e., the greater the number of participants, the smaller the percentage required for a valid statistical sampling design. Details of reporting requirements are presented in the regulations.

---

[12] The vessel enumeration system utilizes the state boat registration system and the U.S. Coast Guard vessel documentation system to identify vessels fishing in marine waters.

Measure 2 specifies the data that will be required to assess the effects of the trap fishery on the resource without great expense to the federal government. Historical data are available in more detail for other segments of the fishery and they are harvesting the resource very near the OY available. Slightly more detailed information is needed to assess the effects and expansion of the trap fishery.

8.3.1.6 Procedures for Adjustment When OY is Exceeded

NMFS and the Operations Unit will monitor statistical information on fisheries catches by recreational and commercial fishermen. As soon as possible after the end of the fishing year, they will provide the Regional Director and the Council with their assessment.

If catches during the year exceed OY for the fishery, the Regional Director, after consultation with the Council, shall take one or more of the following actions by Field Order:

a. If OY was exceeded by less than ten percent, the Regional Director shall implement size limits by Field Order as follows:

   (i) The optimum size limit which shall result in a significant increase in yield per recruit for the principal species in the fishery or for those species which were overfished. SEFC will be requested to derive the optimum size limits for principal species; and

   (ii) Increase the minimum allowable size of those species with size limits specified in the Plan or subsequent amendments thereof, e.g., increase red snapper from a 12 to 15-inch size limit.

b. If OY was exceeded by more than ten percent but less than 20 percent, the Regional Director, after consultation with the Council, shall take the following actions by Field Order:

   (i) Incorporate size limits as in "a" above; and

   (ii) Place bag and harvest limits on the take of the principal species overfished. SEFC will provide information on the bag and harvest limits necessary to rebuild the stocks.

c. If OY was exceeded by more than 20 percent, the Regional Director, after consultation with the Council, shall take one or more of the following actions by Field Order:

   (i) Close the entire fishery at a date projected from the previous year's data at which OY will be reached (including the catch exceeding OY from the previous year). For example, if OY was exceeded by eight million pounds, the fishery would be closed when it was projected to reach 45.5 million pounds (8 + 37.5 = 45.5); or

   (ii) Close geographic areas where overfishing was documented from statistical data for periods projected to allow the rebuilding of the stocks as determined by SEFC; or

   (iii) Impose the size and bag limits under "a" and "b" above as well as the closures under "c" (i) and (ii).

Rationale: These procedures allow the Regional Director of NMFS to take corrective regulatory action to conserve the stocks if fishing exploitation results in catches exceeding OY in any one year. The action would be taken in the following year. The procedures provide for corrective action based upon the degree by which OY was exceeded. Upon OY being exceeded by less than ten percent, size limits

will be set upon harvest of the principal species which are overexploited. As evidenced by the discussion of the size limit for red snapper (Section 8.3.1.3) this type of restriction can provide significant increases in stock size and likely would alleviate the overfishing problem. The SEFC would provide yield per recruit relationships for these species which would allow selection of a size limitation which should alleviate the overfishing problem without major impact on the activities of the fishermen. Such size limits should remain in effect for the time required to correct the problem which will probably be several years. During that time they should be re-evaluated to determine if they should become a permanent regulation or should be modified.

Upon OY being exceeded by less than 20 percent but more than ten percent, both size limits and bag and harvest limits will be set on the principal species overfished. Statistical information gathered by implementation of the Plan will provide data by which the bag and harvest limits may be set to obtain the desired reduction in catch. Such data is presently unavailable except for the commercial sector of the fishery. Bag limits are not as effective as size limits since the size limits provide for an increase in biomass, whereas bag limits simply limit catch. Bag (recreational) and harvest (commercial) limits would remain in effect for the remainder of the fishing year in which they were implemented.

In this fishery OY may be exceeded by 13.3 percent and MSY will not be exceeded. Exceeding OY by up to 20 percent is not anticipated to result in any long-term adverse impacts on the stocks as a whole, but may impact on certain species. The measures proposed under (a) and (b) of this procedure would alleviate the species-specific adverse impacts.

Upon OY being exceeded by 20 percent or more, the entire Gulf fishery could be closed at a date during the following fishing year at which it would be projected that OY would be exceeded. That portion of the catch in excess of OY would be subtracted from OY to provide the allowable level of catch for the following year.

The Regional Director could also take action to close a portion of the fishery by closing only the geographical area where overfishing is documented. The information collected through the statistical system could well demonstrate that the overfishing had occurred only off Florida, for example. Any closure would have a major economic impact on the user groups, and it would certainly be unjust to close the entire fishery for a coast line of 1,200 miles if it could be documented that the overfishing causing the catch to exceed OY by 20 percent occurred in certain geographical areas, particularly as the fish do not migrate throughout the region. Either of these closures, if implemented, should remain in effect only for the remainder of the fishing year in which they were implemented.

All actions taken under these procedures would be taken in the year following that in which the catch exceeded OY. This is necessary since the statistical system will not provide information rapidly enough to institute in-season adjustments. Whereas statistical catch data from the commercial sector may be timely enough for this purpose, the data for recreational catches is not expected to be available until the following year. This is due to the large number of participants in the recreational fishery (400,000 plus), statistical designs necessary for collection of recreational data and the seasonality of the recreational fishery.

Likely OY will be adjusted upward as the stocks are increased through implementation of the measures of the Plan which are designed to achieve objective (1) of rebuilding the stocks. If this occurs, this procedure and its provisions for activating action should remain unchanged. Even though OY will more closely approach MSY, the recruitment potential stocks will not be seriously impacted by catches exceeding OY by less than 20 percent and corrective action can be taken in the following year.

8.3.2 Other Measures Considered and Rejected (Measures considered and rejected are discussed in more detail in Section 4 of the EIS and in the RA.)

(1) Alternative of taking no action in the development of a plan or instituting management measures.

Rationale: This option was rejected for the following reasons: (a) of all the fishery management units in the Gulf area, the reef fish resource appeared to be the one with the greatest need for management. Data developed subsequently in the Plan indicated overfishing of some species in certain geographical localities in the nearshore waters. The states were constrained from adopting management regimes because the fishery is largely in the FCZ; and, (b) a major foreign fishery had historically harvested approximately twenty percent of the commercial catch of domestic stocks, whereas, the domestic fishery was unable to satisfy domestic demand and had the capacity to take this portion of the stocks. Domestic imports of reef fish exceeded six million pounds; (c) recreational fishermen indicated declining size, catches and catch per unit effort for certain species in highly fished areas. Because of the high domestic demand for reef fish, prices were high and many recreational fishermen were apparently taking more fish than needed for home consumption and selling them locally, thereby increasing pressure on the nearshore stocks.

(2) Require vessel permits for each boat or vessel in the fishery.

(3) Mandatory reporting by all vessels.

(4) Require a permit to sell fish.

Rationale: These measures were rejected as unnecessary and expensive. Adequate data for management could be collected in a more cost effective manner and with less impact on the users and government by randomly sampling participants identified by the vessel enumeration system which uses Coast Guard documentation records and state boat registrations.

(5) Prohibit commercial fishing on artificial reefs.

Rationale: This measure would be discriminatory and unenforceable as recreational fishermen are not prohibited from selling their catch, therefore, there is no way to separate commercial and recreational fishermen. The size limit and measures implemented for the stressed area were considered better solutions.

(6) Prohibit trawling at times of peak abundance of juvenile snapper and grouper in critical areas of concern.

Rationale: This measure was rejected because there is no data to indicate that the bycatch of juvenile snapper and grouper adversely affected the population abundance of adult snapper and grouper (see discussion under Section 8.3.1.3 (1)). Research is planned to answer this question.

(7) Discourage oil and gas drilling activity on coral reefs.

Rationale: This measure was rejected as being an option which should be considered in the Coral Fishery Management Plan.

(8) Artificial propagation and stocking.

Rationale: This measure was rejected because it is impractical. The natural populations are highly fecund and produce more spawn than is necessary to sustain the population. The problem is the fishery is one of growth overfishing which reduces the individual size of fish available and the total biomass

available. Recruitment overfishing which might result in collapse of the stocks is apparently not a problem in this fishery and it appears doubtful considering the economics of the fishery that the population could be reduced to a point where this would occur.

(9) Areas that will be closed to that segment or segments of the user group that are overfishing local geographical portions of any stock.

Rationale: Areal closures were rejected in lieu of implementing the stressed area in which special management measures would apply. The Council provided framework measures through which other measures could be implemented as improved information dictated the need for the additional measures. The difficulties with simple closures of areas are as follows: (a) would cause a major impact on some segment of the user group, (b) difficulty in assessing and identifying the areas that would benefit the stocks through closure, (c) the fishery is a multispecies fishery and some species are not stressed. A closure would prevent access to these less heavily exploited species.

(10) Closed seasons for specific localities or zones for short durations to prevent overfishing of one or more local geographical portion of any stock.

Rationale: This measure was rejected. Because the fishery occurs entirely in the ocean, natural weather conditions cause frequent cessation of fishing effort. If a closed period were implemented, weather conditions may have prohibited fishing during most of the open period causing drastic impacts on the users. The problems of assessing and identifying the localities to be closed are the same as discussed under Rejected Measure 9. The size limit on the stressed species and other measures provided a more useful and effective system. Data available in the future may provide information supporting such closures.

(11) Provide annual allocations to recreational and commercial users.

Rationale: This measure was rejected as completely unworkable and of doubtful benefit to the resource. A large number of recreational fishermen sell their catch and there is no way to separate the two groups. Recreational catch data are of doubtful validity and allocations based on these data would be incorrect and may allow additional overharvest. Commercial vessels fish waters off foreign nations in Central America and the Caribbean as well as the FCZ and assessing domestic catches from the FCZ would be difficult or impossible.

(12) Require the use of only one hook or lure per line for recreational fishermen fishing in the FCZ including those of private boats and recreational-for-hire boats (charter and party boats).

Rationale: The FMP indicated that it may become necessary to reduce the effort of the recreational fishery especially on red snapper. The implementation of this measure would lower the effort and efficiency of the recreational fishery. Generally, recreational fishermen use two or three hooks per line. The maximum net effect could potentially reduce the recreational effort by 50 to 66 percent although this has not been verified. Enforcement costs would have been extremely high for this measure.

(13) Prohibit the use of "power" reels by recreational fishermen except by physically handicapped persons.

Rationale: The implementation of this measure may have little or no effect on reducing the overall effort of the recreational sector as was its intent. Indications are that few recreational fishermen make use of "power" reels at present. Additionally, there is one study which implies that there is little or no difference in effective fishing effort between "power" and manually operated reef fish fishing gear (Kawaguchi, 1974).

(14) Prohibit the use of power heads for harvest of reef fish.

Rationale: Prohibiting the use of these devices in all waters of the FCZ was deemed unnecessary. Power heads are used almost exclusively by divers whose depth range does not generally exceed the depths within the boundary of the stressed area.

(15) Reporting system: an alternative statistical system as presented below was considered and rejected.

A. Required of fishermen selling catch:

- o Catch by species, pounds, and landed price by month, area and gear type
- o Number, size and species composition of catch
- o Effort

Rationale: This measure would require complete statistical coverage of all commercial fishermen. It would require a great increase in personnel to collect the information and greater demands on commercial fishermen's time. Costs of this measure would amount to $135,330 for collection and $6,000 for forms.

B. Required of persons purchasing catch for resale:

- o Sales by species, pounds and price by month and marketing level
- o Location of wholesalers, processors and middlemen and number of employees

Rationale: This measure would require reporting by all processors on a mandatory basis. The same type of information is already collected by existing reporting systems on a voluntary basis.

C. Collected by vessel enumeration system and statistical survey from commercial and recreational fishermen.

- o Number of boats and vessels classified by length, tonnage and motor size
- o Catch by species and pounds landed by area and gear type
- o Number, size and species
- o Number of gear units
- o Number of fishermen (full time and part time)
- o Home port, fishing area and landing location
- o Fishermen characteristics

Rationale: This measure would provide statistics, most of which are already available through several present reporting methods. With this system, reporting would be mandatory for all. The cost for commercial fishermen is estimated to be $5,000 annually, based on a $25,000 survey every five years. Total costs for data from recreational fishermen have not been quantified but they appear to be quite prohibitive due to the magnitude of recreational craft in the management area.

Management information about the recreational catch would become available through this measure. Catch data would be collected on a quarterly basis from a large portion of all recreational users. This measure is not proposed because of its cost ($270,000) and proposed measures collect the same information with a more cost effective sampling method.

(16) Size limits for all species.

Rationale: Protection of all reef fish species would be furthered by this measure. It would not limit economic activity or participation in the fishery like the measure above, but enforcement may be just as burdensome. This measure is not proposed because of a lack of clear scientific evidence that all species of reef fish throughout the FCZ are overfished or otherwise stressed.

(17) Prohibition of commercial fishing inshore of waters ten fathoms and less.

Rationale: This measure was proposed to reduce fishing pressures in areas where the depth was ten fathoms or less. The measure is discriminatory, however, by only prohibiting commercial fishing. The effect of this measure would not significantly reduce fishing pressure and relieve pressure on stressed stocks; most commercial fishing takes place in deeper waters.

(18) Harvest Practices

- o Institute a bag limit of ten red snapper (Lutjanus campechanus) per person per day for all persons fishing the stressed area with the following exceptions: (No limit on other species.)
- o All persons aboard vessels involved in the directed shrimp fishery within the stressed area are subject to the same bag limit of ten red snapper per person per day, except that red snapper included in the bycatch and which are discarded shall not be included in said limitation.
- o Vessels in the directed groundfish fishery shall be allowed a one percent bycatch by weight of red snapper per trip in the stressed area.

Rationale: This measure was rejected because it would be ineffective in rebuilding stocks of red snapper in the stressed area. Data in the Plan indicate commercial fishermen concentrate their efforts in deeper waters than the stressed area and the average recreational fisherman catches far less red snapper than that proposed. Also, it was concluded that the measure, since it applied to the stressed area only, was unenforceable.

(19) Institute a bag limit of 25 reef fish in aggregate per person per day from the stressed area.

Rationale: Available data was insufficient to determine either the positive impact on stocks or the adverse impact on user groups if such a measure were to be implemented. Also, the measure would be unenforceable inasmuch as it could not be determined what was caught inside and outside of the stressed area. Also there was no evidence of growth overfishing for most of the species.

(20) Include the Texas Flower Garden Banks and a portion of the Florida Middle Grounds in the stressed area.

Rationale: Incorporating the Flower Gardens and Florida Middle Grounds does not fit the criteria established in defining the stressed area. Both of these areas are substantially outside the fishing range of most recreational fishermen. Both of these areas will be addressed as potential Habitat Areas of Particular Concern (HAPC) in the Coral Plan.

(21) Require all traps to be constructed of mesh of 1 x 2 inches or larger, one year after implementation of the plan.

Rationale: This measure was rejected in favor of the management measure that provides that each trap must have at least two openings on at least two sides of 2 x 2 inches or larger to allow escapement of smaller fish.

(22) Require all traps to be constructed of mesh of 2 x 2 inches or larger.

Rationale: This proposed measure was deemed to have too severe of an adverse economic impact on fish trap fishermen and there currently is no data to support this measure. A framework procedure is provided to enable adjustment of required mesh sizes when scientific evidence supports a need to change the current measure.

(23) Require all traps to be constructed with a volume of 54 cubic feet or smaller.

Rationale: This measure was rejected in favor of a requirement of 33 cubic feet or smaller in depths of 300 feet or less and no size restrictions in waters 300 feet or deeper. Most fish traps currently in use are 24 cubic feet or smaller. The adopted measure, therefore, (1) is consistant with current fishing practices, (2) allows development of an offshore fishery where stocks are underutilized, and (3) alleviates potential overfishing in nearshore waters bordering the stressed area.

(24) Require one panel or access door be located on each of the sides of the trap that has a funnel.

Rationale: This measure was originally proposed to prevent entrapment of fish in lost traps which are laying on the escape panel. However, recent studies completed which document the fishery (Taylor and McMichael, in press) indicate that nearly all traps have the access door located opposite of the funnel. For most traps this is necessary since the funnel structure takes up most or all of one side. Such a requirement is both impractical and would create a severe economic hardship on the fishermen who would have to redesign each trap. The elimination of excessive mortality from lost traps is adequately handled in the revision of the measure.

(25) Alternative procedures for adjustment when OY is exceeded:

A. Option 1 (complete closure)

NMFS and the Operations Unit will monitor statistical data on fisheries catches by recreational and commercial fishermen during each fishery year. Upon the catches reaching a level of 80 percent of OY, they will provide projections on the data by which OY will be reached and when it will be exceeded by ten percent. They will begin monitoring the catches more frequently and provide biweekly projections of the dates OY will be exceeded and exceed by ten percent. This information will be provided to the Regional Director of NMFS and the Council as it is derived.

Upon the catches reaching 90 percent of OY, the Regional Director, after consultation with the Council, shall issue a Field Order to close the reef fish fishery for snapper, grouper and/or sea bass in the FCZ of the Gulf on either:

a. the projected date for reaching/exceeding OY, or

b. the projected date for exceeding OY by ten percent.

B. Option 2 (decrease effort prior to reaching OY)

NMFS and the Operations Unit will monitor the statistical data on fisheries catch by recreational and commercial fishermen during each year. Upon the catches reaching 50 percent of OY, they will begin making biweekly projections of the date that the catches will reach 80 percent of OY.

Upon the catches reaching 70 percent of OY, the Regional Director, after consultation with the Council, shall take the following actions by Field Order on the date that the catch is projected to reach 80 percent of OY:

a. Institute the size limits as described in 8.3.1.6, and

b. Institute the bag and harvest limits as described above in 8.3.1.6.

All subsequent adjustments will be made in the following year.

Rationale: Due to the inherent time lag involved in data collection, in-season adjustments are not feasible; therefore, both Options 1 and 2 were rejected in favor of making adjustments in the following fishing season, but allowing the Regional Director to make in-season adjustments should the data become available.

8.3.3 Relationship of the Recommended Measures to Existing Applicable Laws and Policies

8.3.3.1 Other Fishery Management Plans Prepared by a Council or the Secretary

(i) Other Gulf of Mexico Fishery Management Council sponsored or cosponsored management plans which may impact on the reef fish fishery are those for shark (direct), shrimp (direct), coral (direct), groundfish (indirect) and coastal migratory pelagic fish (indirect).

(ii) The Snapper/Grouper Plan sponsored by the South Atlantic Fishery Management Council borders on this Plan at its southernmost extremity.

8.3.3.2 Federal Laws and Policies

Those federal laws and policies which may have an impact upon the Gulf of Mexico reef fish fishery are discussed in Section 3.3.1. The management recommendations are consistent with those laws and policies and are supported by the appropriate provisions of the Fishery Conservation and Management Act of 1976, found in Section 303(b).

8.3.3.3 State Laws and Policies

Those applicable state and local laws and policies are discussed in Section 3.3.1. There are no conflicts between the recommended measures and those laws.

This Management Plan was compared with existing Coastal Zone Management (CZM) plans in Alabama, Mississippi and Louisiana. There are no conflicts between the recommended measures and those programs. Copies of the plan were provided to each state's CZM office for their review for consistency. The plan was judged to be consistent with the CZM programs.

8.3.3.4 Other

The recommended measures are consistent with existing Governing International Fishery Agreements.

8.4 Enforcement Requirements (inspection, surveillance)

Appropriate enforcement measures were determined by the U.S. Coast Guard and the National Marine Fisheries Service. Enforcement costs are discussed in the EIS and RA and amount to $903,600.

8.5 Reporting Requirements (foreign, domestic, processors)

The National Marine Fisheries Service and Bureau of Customs have responsibility for developing, collecting, compiling and publishing applicable statistics on domestic catches, landings, processing and imports of reef fish and processed reef fish products. The U.S. Bureau of the Census has responsibility for collection and availability of employment data. Reporting requirements for this Plan are cited in Section 8.3.1.5.

8.5.1 Data Standards

These will be prescribed by appropriate data collecting agencies and are appended in the proposed regulations section.

8.5.2 Time and Place of Reporting

These will be determined by appropriate data collecting agencies.

8.6 Special Recommendations to the Secretary on Research and Development Requirements

(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.

(2) Encourage immediate development of escape panels or devices on trawls for use in areas where bycatch of juvenile snapper and grouper are high.

(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.

(5) Develop information on sizes of reef fish that should be released by fishermen in the stressed area.

(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.)

(7) The development of self-destruct panels on fish traps is an immediate research need which must be developed and implemented by 1981.

(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.

(9) Modify current NMFS/FDNR study to provide information on the optimum mesh sizes of trap material or initiate research to provide this information.

(10) NMFS to provide Council with information on the correct 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.

(11) That NMFS SEFC place observers on vessels fishing with longlines for reef fish in the Gulf, provided the vessel owners agree to such an arrangement.

8.7 Special Recommendations to the States

The Council recommends that the states implement the management measures proposed in this Plan 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]

1. Specific management measures that should be considered for implementation by all the Gulf States include the following:

1) Measures pertaining to fishing gear under Section 8.3.1.2 number (4) through (4.4) which regulate the construction characteristics of fish traps. Measure (7) of Section 8.3.1.2 which prohibits the use of poisons or explosives for taking reef fish.

2) The size and possession limit for red snapper proposed under Section 8.3.1.3 which limits the legal size to 12 inches (fork length) and possession of undersized fish to five per person.

3) Measures pertaining to permits and gear identification under Section 8.3.1.4 numbers (1) and (3) which require permits for vessels fishing traps and require a numerical and color code identification system for traps, buoys and vessels.

4) Measures allowing the collection of statistical information from vessel owners (Section 8.3.1.5). State statutes allowing state agents to collect statistical information on catches directly from vessel owners or captains will greatly strengthen the statistical system upon which management is based.

5) Procedures for adjusting the management measures of the plan are contained in Sections 8.2, 8.3.1.1, 8.3.1.2, 8.3.1.3 and 8.3.1.6. If measures are implemented in the future under these procedures, some will require state implementation to be effective.

---

13 The Council procedure for notifying the states of measures that they should consider for implementation is as follows: (1) Informative letters and a copy of the plan are sent to each governor with copies to legislative leaders and other appropriate state officials. These letters inform the states of the measures that will affect their states and are mailed when the final plan is submitted to the Secretary, (2) On implementation of the plan by the Secretary, letters are sent to the governor, legislative leaders, and appropriate state officials requesting implementation of certain measures in state waters, (3) The Operations Unit confers with the states on implementation schedules and advises the Council on progress of implementation.

II. Specific management measures which should be considered by the states of Alabama, Mississippi, Florida and Texas for implementation include the following:

1) Measures pertaining to fishing gear under Section 8.3.1.2 numbers (1) through (3). These measures would prohibit the use of power heads, roller trawls and fish traps for taking reef fish in the territorial sea of Florida, Alabama and Mississippi and that portion of the territorial sea of Texas as described in Section 8.3.1.1.

III. Specific management measures which should be considered by the states of Louisiana and Texas for implementation include the following:

1) Measures pertaining to fishing gear under Section 8.3.1.2 numbers (5) and (6). These measures would limit each vessel to no more than 200 fish traps and would prohibit pulling of another's traps and harvesting of traps at night.

8.8 Financing Requirements

8.8.1 Management and Enforcement Costs

These costs will be apportioned among the various fishery management plans being enforced throughout the Gulf region by the appropriate enforcement authorities and are discussed in the EIS and Regulatory Impact Review (RIR).

8.8.2 Expected State and Federal Revenues, Taxes, Fees

No revenue will result from implementation of the Plan.

9.0 COUNCIL REVIEW AND MONITORING OF THE PLAN

The Gulf of Mexico Fishery Management Council, will, after approval and implementation of this Plan by the Secretary, maintain a continuing review of the fishery managed under this Plan by the following methods:

9.1.1 Maintain close liaison with the management and enforcement agencies involved to assess the condition of the stocks and the effectiveness of the regulations and compliance by the fishermen with the regulations. National Marine Fisheries Service and the U.S. Coast Guard are the primary agencies with which close liaison will be established for Plan monitoring.

9.1.2 Liaison will be maintained with members of the Reef Fish Subpanel of the Council's Fishery Advisory Panel to assess the effectiveness of regulations and the need for implementation of other measures or revisions of existing measures.

9.1.3 Promote research to increase the knowledge of the fishery and resource by the following methods:

9.1.3.1 Identify the research required for better management of the fishery and resource. Emphasis will be placed on juvenile and habitat protection.

9.1.3.2 Request National Marine Fisheries Serice (NMFS) consider these research needs and identify those which it can immediately address and those which will require efforts by other agencies or groups.

9.1.3.3 Request state and university participation in research under their own programs to fill thes data needs.

9.1.3.4 Provide Council funding for research that cannot be addressed by NMFS, state and university entities.

9.1.3.5 Assess the effectiveness of the statistical reporting system in comparison to needs as specified in this Plan and recommend changes to NMFS or fund specific one-time surveys for data collection where data gaps exist.

9.1.4 Conduct public hearings at appropriate times and locations in the areas where the fishing effort is concentrated to hear testimony on the effectiveness of all aspects of this Plan and from time to time during the life of this Plan to determine the changes needed.

9.1.5 Consideration will be given by the Council and its advisory groups to all information gained from the first four activities listed above, and if necessary, prepare amendments to the Plan. Hold public hearings on the amendments prior to sending them to the Secretary.

10.0 REFERENCES

Abascal, J. 1968. Cuba y La Pesca: 10 anos de revolucion. Mar Pesca 38/39: 8-15

Alabama State Code. Title IX: Secs. 9-128, 9-12-88, 9-12-110, 9-12-111, 9-12-113, 9-12-114 and 78-MR-10.

Alabama State Employment Service, Department of Industrial Relations. February, 1978. Labor Market News: Mobile and Baldwin Counties.

Alexander, L.M. 1977. Regional Arrangements in the Ocean. Am. Journal of International Law 71:84.

Allen, D.M. and J.E. Tashiro. 1976. Status of the U.S. Commercial Snapper-Grouper Fishery. In H.R. Bullis, Jr., and A.C. Jones (Editors), Proceedings: Colloquium on Snapper-Grouper Fishery Resources of the Western Central Atlantic Ocean, Florida Sea Grant Report No. 17, pp. 41-76.

Alverson, D.L. 1977. The Role of Conservation and Fishery Science Under the Fishery Conservation and Management Act of 1976. Washington Law Review 52:723.

Anderson, L.G. 1977. A Classification of Fishery Management Problems to Aid in the Analysis and Proper Formulation of Management Problems. Ocean Development and International Law 4:113.

Anderson, R.C. and J.A. Wilson. 1977. Economic Dimensions of Fees and Access Control Under the Fishery Conservation and Management Act of 1976. Washington Law Review.

Anderson, W.D., Jr. 1966. A New Species of Pristipomoides (Pisces: Lutjanidae) from the Tropical Western Atlantic. Bull. Mar. Sci. 16(4):814-826.

1967. Field Guide to the Snappers (Lutjanidae) of the Western Atlantic. U.S. Fish. Wildl. Serv., Circ. No. 252. 14 pp.

Bardach, J.E. and L. Mowbray. 1955. Bermuda Fisheries Research Program, Progress Report No. 2, Bermuda Government. Publ., Bermuda Trade Development Board, Hamilton, Bermuda. 96 pp.

Bashirullah, A.K.M. 1975. Biology of Lutjanus griseus (L.) of the Cubagua Island, Venezuela. I. Length-Weight, Body Length-Gut Length Relationships and Condition Factors. Bol. Inst. Oceanogr. Univ. Oriente Cumana. 14(1):101-107.

Beebe, W. and J. Tee-Van. 1928. The Fishes of Port-au-Prince Bay, Haiti, With a Summary of the Known Species of Marine Fish of the Island of Haiti and Santo Domingo. Zoologica, N.Y., 10(1): 1-279.

Billings, V. and J. Munro. 1974. The Biology, Ecology and Bionomics of Caribbean Reef Fishes Ve. Pomadasyidae (Grunts). Sci. Rep. ODA/UWI Fish. No. 3, Res. Rep. Zool. Dep., Univ. West Indies. 128 pp.

Boardman, C. and D. Weiler. In Press. Aspects of the Life History of Three Deepwater Snapper Around Puerto Rico. Proc. Gulf Caribb. Fish. Inst. 32:

Bohlke, J.E. and C.C.G. Chaplin. 1968. Fishes of the Bahamas and Adjacent Tropical Waters. Academy of Natural Sciences, Philadelphia, Livingston Publ. Co., Wynnewood, Pa. 771 pp.

Bradley, E., and C.E. Bryan. 1973. Northwestern Gulf of Mexico Marine Fisheries Investigations Study No. 2, 1970-1973. Project No. 2, 109-R, U.S. Dept. of Commerce, NOAA, NMFS, St. Petersburg, Florida, 134 pp.

Bright, T.J. and C.W. Cashman. 1974. Fishes: In Biota of the West Flower Garden Bank. T.J. Bright and L.H. Pequegnant, ed. Gulf Publ. Co., Houston, Texas: 340-409.

Bromberg, K.M. 1973. Determination of the Number of Commercial and Noncommercial Recreational Boats in the United States, Their Use and Selected Characteristics. Final Report, NMFS Contract No. 3-35490 to Information Concepts, Inc. Distributed by NTIS, U.S. Department of Commerce, Washington, D.C.

Browder, J.A. 1977. The Fishery Act of 1976. A Summary; the Management Councils: A Description. Univ. of Miami Sea Grant Special Report No. 12.

Brownell, W.N. and W.E. Rainey. 1971. Research and Development of Deepwater Commercial and Sport Fisheries Around the Virgin Islands Plateau. Contr. Virgin Is. Ecol. Res. Sta., Carib. Rest. Inst., No. 3. 88 pp.

Buesa Mas, R.J. 1962. La nasa Antilliana. Contr. Cent. Invest. Pesq. Habana (15):5-26.

Bullis, H.R. and A.C. Jones (Editors). 1976. Proceedings: Colloquium on Snapper-Grouper Fishery Resources of the Western Central Atlantic Ocean. Sea Grant Rept. No. 17. 333 pp.

Bullis, H.R., Jr. and J.R. Thompson. 1965. Collections by the Exploratory Fishing Vessels OREGON, SILVER BAY, COMBAT and PELICAN Made During 1956 to 1960 in the Southwestern North Atlantic. U.S. Fish and Wildl. Serv., Spec. Sci. Rep. Fish. 510, 130 pp.

Burdon, T.W. 1954. Fishing Methods of Singapore. J. Malay Brch. R. Asiat. Soc. 27:24-30.

Burke, W.T. 1977. Recapture of Economic Rent under the FCMA: Sections 303-304 on Permits and Fees. Washington Law Review 52:681.

Burnett-Herkes, J. 1975. Contribution to the Biology of the Red Hind, Epinephelus guttatus, a Commercially Important Serranid Fish from the Tropical Western Atlantic. Ph.D. Dissertation. Univ. Miami. 166 pp.

Camber, C.I. 1955. A Survey of the Red Snapper Fishery of the Gulf of Mexico with Special Reference to the Campeche Banks. Fla. State Bd. Conser., Tech. Ser. 12:64 pp.

Carpenter, J.S. 1965. A Review of the Gulf of Mexico Red Snapper Fishery. U.S. Fish and Wildlife Service Circular 208. 35 pp.

Cato, J.C. and F.J. Prochaska. 1976. The Gulf of Mexico Commercial and Recreational Red Snapper-Grouper Fisheries: An Economic Analysis of Production, Marketing, and Prices. Proceedings: Colloquium on Snapper-Grouper Fishery Resources of the Western Central Atlantic Ocean. Florida Sea Grant Report No. 17. pp. 95-128.

1977. A Statistical and Budgetary Economic Analysis of Florida-based Gulf of Mexico Red Snapper-Grouper Vessels by Size and Location, 1974 and 1975. Marine Fisheries Review. 39(11):6-14.

Centaur Management Consultants, Inc. and U.S. National Marine Fisheries Service. 1977. Economic Activity Associated with Marine Recreational Fishing. Washington: U.S. Government Printing Office, June 1977.

Cervigon, F. 1966. Los Peces Marinos de Venezuela. Fundacion La Salle de Ciencias Naturales, Monografia 11, Tome 1. 436 pp.

Christy, F.T., Jr. 1977. The Fishery Conservation and Management Act of 1976: Management Objectives and the Distribution of Benefits and Costs. Washington Law Review 52:657.

Clark, J.R. 1963. The 1960 Salt-Water Angling Survey. U.S. Department of Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Circular 153.

Clingan, T.A., Jr. 1972. A Second Look at United States Fisheries Management, San Diego Law Review 9:432.

Collette, B.B., and R.H. Talbot. 1972. Activity Patterns of Coral Reef Fishes with Emphasis on Nocturnal-Diurnal Changeover. Los Angeles Mus. Sci. Bull. 14:98-124.

Comment - Legal Dimensions of Entry Fishery Management. William and Mary Law Review. 1976.

Comment - Judicial Review of Fishery Management Regulations Under the Fishery Conservation and Management Act of 1976. Washington Law Review 52:599, 1977.

Comment - Shellfish regulation: Conservation and Discrimination. 29 Maine Law Review 360.

Comment - Constitutionality of State Fishing Zones in the High Seas: The Oregon Fisheries Conservation Zone Act. Oregon Law Review 55:121, 1976.

Comment - The Effects of the 200-Mile U.S. Fishing Zone. Louisiana Law Review. 37:853, 1976-77.

Comment - The Fishery Conservation and Management Act of 1976: Structure and Function of a Contiguous Economic Zone. Texas International Law Journal. 12:331, 1977.

Craig, K. 1976. Trapping Experiments with Snappers in South Florida. Proceedings: Colloquium on Snapper-Grouper Fishery Resources of the Western Central Atlantic Ocean. Florida Sea Grant Program, 17:222-236.

Cushing, D.H. 1978. Fisheries Biology. University of Wisconsin Press, Madison, Wisconsin. 200 pp.

Dammann, A.E. In press. Caribbean Reef Fish, Fish Traps and Management. Proc. Gulf. Carib. Fish. Inst. 32:

Dammann, A.E., W.E. Swingle and J.A. Yntema. 1969. Study of the Fisheries Potential of the Virgin Islands. Special Report: Contribution Virgin Island Ecological Research Station. (1):1-197.

Deuel, D.G. 1973. 1970 Salt-Water Angling Survey. U.S. Department of Commerce, National Marine Fisheries Service. Washington: U.S. Government Printing Office, April 1973.

Deuel, D.G. and J.R. Clark. 1968. The 1965 Salt-Water Angling Survey. U.S. Department of Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Washington.

Ditton, R.B., R.N. Jarman, T.J. Martens, M.P. Schuartz, and S.A. Woods. 1977. Charter Fishing on the Texas Gulf Coast. Texas Agricultural Experiment Station (Recreation and Parks), Texas A&M University, College Station, Texas.

Dooley, J.K. 1978. Systematics and Biology of the Tilefishes (Perciformes: Branchiostegidae and Malacanthidae), With Descriptions of Two New Species. NOAA Technical Report, NMFS Circular, 411:1-78.

Druzhinin, A.D. 1970. The Range and Biology of Snappers (Fam. Lutjanidae). J. Ichthyol. 10(6):717-736.

Eisenbud, R. 1971. Understanding the International Fisheries Debate. Natural Resource Lawyer 4:19.

Erdman, D.S. 1956. Recent Fish Records from Puerto Rico. Bull. Mar. Sci. Gulf and Carib. 6(4):315-340.

Fidell, E.R. 1977. Enforcement of the Fishery Conservation and Management Act of 1976: The Policeman's Lot. Washington Law Review 52:513.

Florida Department of Commerce, Division of Economic Development. 1975. Florida Community Data.

Florida Department of Commerce, Division of Employment Security, Bureau of Research and Statistics. 1978. Basic Labor Market Information. February, 1978.

Florida Department of Commerce, Division of Employment Security. 1977. Labor Market Trends. December, 1977.

Florida, Special Acts. 1911. Ch. 6311; 1917, Ch. 7584 and 7613; 1947, Ch. 23951; 1953, Ch. 29299 and 29432; 1963, Ch. 57-1844, 63-1220 and 63-1228; 1965, Ch. 65-1622 and 30665; 1969, Ch. 69-1097; 1976, Ch. 77-541 and 77-595.

Fraser, M.B., J.A. Henderson, and J.F. McManus. 1977. Survey of Commercial Sports Fishing Boats in the Coastal United States. Oregon State University Sea Grant College Program. Publication No. ORESU-T-77-009. Corvallis, Oregon.

Futch, R.B. and G.E. Bruger. 1976. Age, Growth, and Reproduction of Red Snapper in Florida Waters. Pages 65-184 In H.R. Bullis and A.C. Jones (Editors). Proceedings: Colloquium on Snapper-Grouper Fishery Resources of the Western Central Atlantic Ocean. Florida Sea Grant, Rep. 17:65-184.

Futch, C.R. and J.M. Torpey. The Red Snapper - A Valuable Marine Resource. Salt-Water Fish Leaflet No. 4. Florida Department of Conservation, St. Petersburg, Florida.

Godcharles, M.F. 1970. Exploratory Fishing for Southern Sea Bass, Centropristis striata melana, in the Northeastern Gulf of Mexico. Fla. Dept. Nat. Resour. Mar. Res. Lab., Tech. Ser. No. 63. 26 pp.

Grimes, C.B. 1976. Certain Aspects of the Life History of the Vermilion Snapper Rhomboplites aurorubens (Cuvier) from North and South Carolina Waters. Ph.D. Dissertation, Univ. North Carolina (Chapel Hill). 251 pp.

Gulland, J.A. 1969. Manual of Methods for Fish Stock Assessment, Part 1. Fish Population Analysis. FAO Manual in Fish. Sci. 4(FRs/M4). 154 pp.

1977. The Management of Marine Fisheries. Univ. Washington Press. Seattle. 198 pp.

Gunter, G. 1935. Records of Fishes Rarely Caught in Shrimp Trawls in Louisiana. Copeia 1935(1):39-40.

High, W.L. and I.E. Ellis. 1973. Underwater Observations of Fish Behavior in Trapps. Helgol. Wiss. Meeresunters, 24:341-347.

High, W.L. and A.J. Beardsley. 1970. Fish Behavior from an Undersea Habitat. Comm. Fish. Rev. 32(10):31-37.

Hildebrand, H.H. 1955. A Study of the Fauna of the Pink Shrimp Grounds in the Gulf of Campeche. Publ. Inst. Mar. Sci., Univ. of Texas 4:171-232.

Hipkins, F.W. 1974. A Trapping System for Harvesting Sablefish, Anoplopoma fimbria. U.S. Dep. Comm., NOAA, NMFS, Fish. Facts 7. 20 pp.

Hoese, H.D. and R.H. Moore. 1977. Fishes of the Gulf of Mexico, Texas, Louisiana, and Adjacent Waters. Texas A&M University Press, College Station, Texas. 327 pp.

Hornell, J. 1950. Fishing in Many Waters. Cambridge University Press. Cambridge. 210 pp.

Hunt, F. 1972. Campeche Days. Thirty Years of American Neptune. Edited by Ernest S. Dodge. Harvard University Press, Cambridge, Massachusetts.

Huntsman, G.R. In press. The Biological Bases of Reef Fish Production. Proc. Gulf Caribb. Fish. Inst. 32:

Jacobson, J.L. and D.G. Cameron. 1977. Potential Conflicts Between a Future Law of the Sea Treaty and the Fishery Conservation and Management Act of 1976. Washington Law Review 52:451.

Job, T.J. and V.R. Pantula. 1953. Fish Trapping in India. J. Asiatic. Soc., Calcutta 19:175-196.

Jordan, D.S. and B.W. Evermann. 1923. American Food and Game Fishes. Doubleday, Page and Co., Inc., N.Y. 574 pp.

Juhl, R. 1969. Exploratory Fishing Survey and Gear Tests in Puerto Rico. Contr. Agr. and Fish. 1(1):1-40.

Juhl, R. and J.D. Suarez-Caabro. 1973. Fish Pot Fisheries in Puerto Rico. Contr. Agr. y Pesq. 5(4):1-18.

1973. Fish pot fisheries in Puerto Rico. Cont. Serv. Aux. Oper. No. 4. Dep. Agriculture, San Juan, Puerto Rico. 19 pp.

Kawaguchi, K. 1974. Handline and Longline Fishing Exploration for Snapper and Related Species in the Caribbean and Adjacent Waters. Marine Fisheries Review. 36(9):8-31.

Kelly, J.E. 1978. The Fishery Conservation and Management Act of 1976: Organizational Structure and Conceptual Framework. Marine Policy, Jan. 1978:30.

Klima, E.F. 1976. Snapper and Grouper Resources of the Western Central Atlantic Ocean. Florida Sea Grant Report No. 17:5-18.

1977. Commercial Catch and Effort of Cuban Grouper Fishermen on the West Coast of Florida (this information presented to Dr. Klima by Cuban officials during May, 1977). U.S. National Marine Fisheries Service.

Knight, H.G. 1978. Management Procedures in the U.S. Fishery Conservation Zone. Marine Policy, Jan. 1978:22.

Kumpf, H.E. In press. Practical Considerations and Testing of Escape Material in Fish Traps. Proc. Gulf Carib. Fish. Inst. 32:

Kury, C.R. 1974. Application of a Market Theory to the Regulation of International Fisheries. Ocean Development and International Law 1:355.

Lalo, D.S. and J.B. Stevens. 1975. Oregon's Commercial Fishermen: Characteristics, Profits and Incomes in 1972. Oregon State University Sea Grant College Program: Pub. No. ORESY-T1-75-001.

Longley, W.H. and S.F. Hildebrand. 1941. Systematic Catalogue of the Fishes of Tortugas, Florida, with Observations on Color, Habits and Local Distribution. Pap. Tortugas Lab. 34; Carnegie Inst. Wash., Pub. 535. 331 pp.

Louisiana Department of Labor, Office of Employment Security. 1978. Telephone Conversation, April, 1978.

Louisiana Revised Statutes Annotated (West). Title 36, Sec. 601; Title 56, Secs. 313, 317, 320, 321, 328, 333, 334, 337 and 643.

Lynch, S.A. 1954. Geology of the Gulf of Mexico. In P.S. Galtsoff (ed.) Gulf of Mexico, Its Origin, Waters, and Marine Life. Fish. Bull. 55:67-86.

Lyons, W. 1965. Exploratory Fishing in Grand Cayman. (Mineogr. Rep. to Fla. Dep. Nat. Resour. Mar. Res. Lab.)

Magnuson, W.G. 1977. The Fishery Conservation and Management Act of 1976: First Step Toward Improved Management of Marine Fisheries. Washington Law Review 52:427.

Manday, D.G. and M.J. Fernandez. 1966. Desarrolo Embrionario y Primeros Estados Larvales de la Cherno Criolla, Epinephelus striatus (Bloch) (Perciformes: Serranidae). Est. Inst. Oceanog. Habana, 1:35-45.

McErlean, A.J. 1963. A Study of the Age and Growth of the Gag, Mycteroperca microlepis Goode and Bean (Pisces: Serranidae) on the West Coast of Florida. Fla. State Bd. Conser., Tech. Ser. 41. 29 pp.

McErlean, A.J. and C.L. Smith. 1964. The Age of Sexual Succession in the Protogynous Hermaphrodite, Mycteroperca microlepis. Trans. Amer. Fish. Soc. 93(3):301-302.

Menzel, D.W. 1960. Utilization of Food by a Bermuda Reef Fish, Epinephelus guttatus. J. Cons. Int. Explor. Mer. 25(2)216-222.

Mississippi Code Annotated: Secs. 49-15-5 and 49-15-29.

Mississippi Employment Security Commission. 1977. Pascagoula-Moss Point SMSA Labor Area Summary. Dec. 1977.

Mississippi Employment Security Commission, Department of Research and Statistics. 1978. Annual Planning Information for Fiscal Year 1979: Pascagoula-Moss Point SMSA.

Moe, M.A. 1963. A Survey of Offshore Fishing in Florida. Fla. State Bd. Conser., Tech. Ser. 49:44 pp.

1969. Biology of the Red Grouper, Epinephelus morio (Valenciennes) From the Eastern Gulf of Mexico. Florida Dep. Nat. Res., Prof. Pap. Ser. 10:95 pp.

Moe, M.A., Jr., D.S. Beaumariage and R.W. Topp. 1970. Return of a Tagged Gag, Mycteroperca microlepis and Caribbean Red Snapper, Lutjanus campechanus, After Six Years of Freedom. Trans. Amer. Fish. Soc. 99:428-429.

Moe, M.A., Jr., and G.T. Martin. 1965. Fishes Taken in Monthly Trawl Samples Offshore of Pinellas County, Florida, with New Additions to the Fish Fauna of the Tampa Bay Area. Tulane Stud. Zool. 12(4):129-151.

Moore, J.M. 1977. Foreign Policy and Fidelity to Law: The Anatomy of a Treaty Violation. Amer. Journal of International Law 70:802.

Moore, L.M. 1978. An Economic Analysis of the Florida East Coast Finfish Subsector. Unpublished M.S. Thesis, Food and Resource Economics Department, Univ. of Florida, Gainesville. June 1978.

Moore, R.H. 1973. The Effect of Temperature and Swimming Speed on the Oxygen Consumption of Two Snappers, Lutjanus campechanus (Poey) and Rhomboplites aurorubens (Cuvier). Contrib. in Marine Sci. 17:53-61.

Morris, R.A. 1977. Primary Economic Impact of Florida's Commercial Fishing Industry. Unpublished M.S. Thesis, Food and Resource Economics Department, Univ. of Florida, Gainesville. 181 pp.

Moseley, F. 1965. Biology of the Red Snapper, Lutjanus aya Bloch, of the Northwestern Gulf of Mexico. Publ. Inst. Mar. Sci., Univ. of Texas 11:90-101.

Munro, J. 1973. Large Volume Stackable Fish Traps for Offshore Fishing. Proc. Gulf Carib. Fish. Inst. 25:121-128.

1974a. The Biology, Ecology, Exploitation and Management of Caribbean Reef Fishes. VI. Summary of the Potential Productivity of Jamaican Fisheries. Sool. Dep. Univ. West Indies 5(3):1-82.

1974b. The Mode of Operation of Antillean Fish Traps and the Relationship Between Ingress, Escapement, Catch and Soak. J. Cons. Int. Explor. Mer. 35(3):337-350.

1974c. The Biology, Ecology, Exploitation and Management of Caribbean Reef Fishes III. The Composition and Magnitude of Line Catches in Jamaican Waters. Zool. Dep. Univ. West Indies, Res. Rep. 3. 28 pp.

Munro, J.L., V.C. Gaut, R. Thompson and P.H. Reeson. 1973. The Spawning Seasons of Caribbean Reef Fishes. J. Fish Biol. 5:69-84.

Munro, J.L., P.H. Reeson and V.C. Gaut. 1971. Dynamic Factors Affecting the Performance of the Antillean Fish Trap. Proceedings Gulf and Carib. Fish. Inst. 23:184-194.

Munro, J.L. and R. Thompson. 1973. The Biology, Exploitation and Management of Caribbean Reef Fishes II. Jamaican Fishing Industry. The Area Investigated and the Objectives and Methodology of the ODA/UWI Fisheries Ecology Research Project. Zool. Dep. Univ. West Indies, Res. Rep. No. 3. 44 pp.

Murray, T.J. In press. Fish Traps: Reef Fish Boom or Bust. Proc. Gulf & Carib. Fish. Inst. 32:

Nelson, W.R. and J.S. Carpenter. 1968. Bottom Longline Explorations in the Gulf of Mexico. A Report on OREGON II's First Cruise. Commer. Fish. Rev. 30(10):57-62.

Note - 1974. The Constitutionality of a Program Restricting the Number of Commercial Fishermen in the Coastal Waters of the United States. Louisiana Law Review. 34:801.

Note - 1977. Congressional Authorization and Oversight of International Fishery Agreements Under the Fishery Conservation and Management Act of 1976. Washington Law Review.

Note - 1977. Fisheries Jurisdiction - United States. Harvard International Law Journal. 18:177.

O'Connor, C.R. 1978. The Fishery Conservation and Management Act of 1976: The Need for State and Federal Cooperation. Univ. of Miami Sea Grant Special Report No. 16 (in press).

1978. The Fishery Conservation and Management Act of 1976: The Regulatory Framework for Gulf of Mexico Fishery Management. Univ. of Miami Sea Grant Special Report No. 16 (in press).

Oleson, R. 1979. A Florida Trap Fisherman Defends His Method. National Fishermen. 60(8):15, 78.

1981. Trap Fishing in Florida is Bruised by Outcry of Misinformed Public. National Fisherman. 62(5):20.

Olsen, D.A. 1978. Virgin Islands Fisheries Remain Primitive. National Fisherman 58(13):164-165.

Olsen, D.A., A.E. Dammann and J.A. LaPlace. 1975. Modernization of Virgin Islands Small Boat Fishing Techniques. Completion Report, Project 2-239-R-1, U.S. Department of Commerce, NOAA, NMFS, St. Petersburg, Florida.

1977. Mesh Selectivity of West Indian Fish Traps. Completion Report Job IV, Project 2-239-R-3. U.S. Department of Commerce, NOAA, NMFS, St. Petersburg, Florida. 10 pp.

Olsen, D.A. and J.A. LaPlace. In press. A Study of a Virgin Island Grouper Fishery Based on a Breeding Aggregation. Proc. Gulf Carib. Fish. Ins. 31:130-144.

Peidra, G. 1969. Materials on the Biology of the Yellowtail Snapper (Ocyurus chrysurus, Bloch). Pages 251-269 In A.S. Bogdanov, Ed. Soviet-Cuban Fishery Research. All-Union Sci. Res. Inst. of Marine Fishery and Oceanography, Fishery Res. Center Nat. Pisciculturel Inst. Rep. of Cuba. (Transl. from Russian.) Israel Program for Scientific Translations, Jerusalem, 1969. Keter Press, Jerusalem.

Pontecorvo, G. 1977. Fishery Management and the General Welfare: Implications of the New Structure. Washington Law Review 52:641.

Prabhu, M.S. 1954. Fishing Methods of Kelantan and Tregganu. Indian J. Fish. 1:91-129.

Proceedings of the 21st Annual Session Gulf and Caribbean Fisheries Institute of Marine Sciences, Univ. of Miami, Coral Gables, Florida, June, 1969. Higman, James B., Editor.

Prochaska, F.J. and J.C. Cato. 1975. Northwest Florida Gulf Coast Red Snapper-Grouper Party Boat Operations, an Economic Analysis, 1974. Florida Cooperative Extension Service, Marine Advisory Program, SUSFSG-75-007. Gainesville, Florida. December, 1975.

1977. Economic Analysis of Production and Marketing of Florida East Coast King and Spanish Mackerel. Mackerel Systems Workshop. Univ. Miami Sea Grant Spec. Rep. 14. 23 pp.

1977. An Economic Profile of Florida Commercial Fishing Firms: Fishermen, Commercial Activities and Financial Considerations. Florida Sea Grant Program, February, 1977, 19:1-22.

Randall, J.E. 1961. Ciguetera: Tropical Fish Poisoning. Sea Frontiers: 7(3):130-139.

1962. Additional Recoveries of Tagged Reef Fish from the Virgin Islands. Proc. Gulf Carib. Fish. Inst. 15:155-157.

1962. Food Habitats of Reef Fishes of the West Indies. Stud. in Trop. Oceanog. 5:665-847.

1963. Methods of Collecting Small Fishes. Underwater Naturalist 1(2):6-11.

1968. Caribbean Reef Fishes. T.F.H. Publications, Neptune City, N.J. 318 pp.

Ricker, W.E. 1975. Computation and Interpretation of Biological Statistics of Fish Populations. Bull. Fish. Res. Bd. Canada 191. 382 pp.

Ridgely, J. 1975. Selected Information on Recreational Boats in the United States. Marine Fisheries Review 37(2).

Rivas, L.R. 1949. A Record of Lutjanid Fish (Lutjanus cyanopterus) for the Atlantic Coast of the United States with Note on Related Species of the Genus. Copeia 1949(2):150-152.

Rivers, J.V. 1966. Gear and Techniques of the Sea Bass Trap Fishery in the Carolinas. Comm. Fish. Rev. 28(4):15-20.

Robins, C.R. 1967. The Juvenile of the Serranid Fish Epinephelus mystacinus and Its Status in Florida Waters. Copeia 1967(4):838-839.

Rothschild, B.J. 1978. Fishing Effort. Fish Population Dynamics. John Wiley & Sons, New York. 371 pp.

Salnsbury, J.C. 1971. Commercial Fishing Methods; an Introduction to Vessels and Gears. Fishing News Ltd., London.

Salmon, G.C. 1958. Report on the Fisheries Industry in the Countries Served by the Caribbean Commission. Rep. FAO/ETAP (781). 86 pp.

Sal'nikov, N.E. 1969. Fishery Research in the Gulf of Mexico and the Caribbean Sea. Pages 78-171, In Soviet-Cuban Fishery Research. All-Union Sci. Res. Inst. of Marine Fishery and Oceanography, Fishery Res. Center, Nat. Pisciculturai Inst. Rep. of Cuba. (Transl. from Russian.) Israel Program for Scientific Translations, Jerusalem, 1969. Keter Press, Jerusalem.

Saxeno, R.K. 1964. The Fishing Nets and Traps in a Section of the Middle Reaches of the Ganga River System of India. Proc. Indo-Pacific Fish. Cobn. 2(2):250-271.

Smith, C.L. 1958. The Groupers of Bermuda. In Bermuda Fisheries Research Program. Final Report, August 1958. J.E. Bardach, D.L. Smith and D.W. Menzel (Editors). Appendix: 37-59. Bermuda Trade Development Board, Hamilton.

1961. Synopsis of Biological Data on Groupers (Epinephelus and Allied Genera) of the Western North Atlantic. FAO Fish. Biol. Synop. 23(1):1-12.

1971. A Revision of the American Groupers: Epinephelus and Allied Genera. Bull. Amer. Mus. Nat. Hist. 146(2):67-242.

1974. Fishing Success in a Regulated Commons. Ocean Dev. and Inter. Law 1:369.

Smith, G.B. 1976. Ecology and Distribution of Eastern Gulf of Mexico Reef Fishes. Fla. Dep. Nat. Res., Fla. Mar. Res. Publ. 19. 78 pp.

Smith, G.B., H.M. Austin, S.A. Bortone, R.W. Hastings and L.H. Ogren. 1975. Fishes of the Florida Middle Grounds with Comments on Ecology and Zoogeography. Fla. Dep. Nat. Res., Fla. Mar. Res. Publ. 9. 14 pp.

Snell, J.E. Unpublished Data About Wholesale Dealers and Processors of Gulf of Mexico Reef Fish. NMFS, Miami: April, 1978.

Snow, R. 1977. Lobster Fishery Licensing: Injustice and Muddling Through? 4 Dalhousie Law Journal 119.

Springer, V.G. and K.D. Woodburn. 1960. An Ecological Study of the Fishes of Tampa Bay Area. Fla. State Bd. Conserv., Prof. Pap. Ser. 1. 104 pp.

Starck, W.A., II. 1971. Biology of the Gray Snapper, Lutjanus griseus (Linnaeus), in the Florida Keys. Pages 1-150. In W.A. Starck, II and R.E. Schroeder. Investigations on the Gray Snapper, Lutjanus griseus, Stud. Trop. Oceanogr. Miami. 10:224 pp.

Stevenson, D.K. 1978. Management of Tropical Fish Pot Fishery for Maximum Sustainable Yield. Proc. 30th Ann. Meet. Gulf Carib. Fish. Inst., 95-115.

Stone, R.B. 1978. Artificial Reefs and Management. Fisheries 3(1):2-9.

Strushaker, P. 1969. Demersal Fish Resources: Composition, Distribution and Commercial Potential of the Continental Shelf Stocks off Southeastern United States. Fish. Indust. Res. 4:261-300.

Sutherland, D.L. and D.E. Harper. In press. The Wire Fish Trap Fishery of Dade and Broward Counties, Florida, December, 1979 - September, 1980. NOAA Tech. Memo. NMFS-SEFC-75. 42 pp.

Swingle, W.E., A.E. Dammann, and J.A. Yntema. 1970. Survey of the Commercial Fishery of the Virgin Islands of the United States. Proc. 22nd Ann. Meet. Gulf Carib. Fish. Inst.: 110-121.

Sylvester, J.R. 1974. A Preliminary Study of the Length Composition, Distribution and Relative Abundance of Three Species of Deep Water Snapper from the Virgin Islands. J. Fish. Biol. 6(1):43-49.

Sylvester, J.R. and A.E. Dammann. 1972. Pot Fishing in the Virgin Islands. Mar. Fish. Rev. 34 (9-10):33-35.

1973. Contribution to the Biology of the Silk Snapper Lutjanus vivanus from the Virgin Islands. Trans. Amer. Fish. Soc. 102:843-845.

Tashiro, J.E. and S.E. Coleman. 1977. The Cuban Grouper and Snapper Fishery in the Gulf of Mexico. Mar. Fish Rev. 39(10):1-5.

Taylor, R.G. and R.H. McMichael, Jr. In press. The Wire Fish Trap Fishery in Monroe and Collier Counties, Florida. NOAA Tech. Memo. NMFS-SEFC-75. 54 pp.

Texas Employment Commission. 1978. Labor Market Review for Selected Texas Counties. March, 1978.

Texas Parks and Wildlife Code Annotated (Vernon). Title IX: Secs. 1.011, 46.0011, 46.0051, 47.002, 47.005, 47.009, 47.010, 47.011 and 47.015.

Thompson, R. and J. Munro. 1974a. The Biology, Ecology, Exploitation and Management of Caribbean Reef Fishes V. The Biology, Ecology and Bionomics of Caribbean Reef Fishes Vc. Carangidae (Jacks). Zool. Dep. Univ. West Indies Res. Rep. 3(5):43 pp.

1974b. The Biology, Ecology, Exploitation and Management of Caribbean Reef Fishes V. The Biology, Ecology and Bionomics of Caribbean Reef Fishes Vb. Serranidae (Hinds and Groupers). Zool. Dep. Univ. West Indies. Res. Rep. 3(5):78 pp.

1974c. The Biology, Ecology, Exploitation and Management of Caribbean Reef Fishes. Scientific Report of the O.D.A. U.W.I. Fisheries Ecology Research Project 1969-1973. Part V. The Biology, Ecology and Bionomics of Caribbean Reef Fishes: V. Lutjanidae (Snappers). Research Report from the Zool. Dep. Univ. West Indies, No. 3. 19 pp.

Tunstall, J. 1968. Fish: An Antiquated Industry. Fabian Society, London.

U.S. Bureau of the Census, 1970. Census of Population. Washington: U.S. Government Printing Office.

U.S. National Marine Fisheries Service. 1975-1976. Current Fishery Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual Issues.

1962-1977. Fisheries of the United States. Washington: U.S. Government Printing Office. Annual Issues.

1957-1974. (Formerly U.S. Bureau of Commercial Fisheries.) Fishery Statistics of the United States. Washington: U.S. Government Printing Office. Annual Issues.

1972. Production of Fishery Products in Selected Areas of Florida, Alabama, Mississippi, Louisiana, Texas. Market News Annual Summary, Gulf Fisheries. New Orleans.

1974-1975. Unpublished Data Based on Southeastern Regional Survey of Saltwater Fishermen.

1978. Unpublished Data About Imports of Snapper and Grouper and Associated Products into Gulf of Mexico Ports, 1973-1977. New Orleans: March, 1978.

U.S. State Department. Document "Governing International Fisheries Agreement Between the United States of America and Mexico." Washington, D.C.

Vidaeus, L. 1970. An Inventory of the Jamaican Fishing Industry. UNDP/FAO Caribbean Fishery Development Project, Rep SF/CAR/REG 180M9. 47 pp.

Wade, W.C. 1977. Survey of the Alabama Marine Recreational Fishery, Alabama Marine Resources Bulletin. Alabama Resource Division, Dauphin Island: December, 1977.

Wallace, R.K., Jr. 1977. Thermal Acclimation, Upper Temperature Tolerance, and Preferred Temperature of Juvenile Yellowtail Snappers, Ocyurus chrysurus (Bloch) (Pisces: Lutjanidae). Bull. Mar. Sci. 27(2):292-298.

Walls, J.G. 1975. Fishes of the Northern Gulf of Mexico. T.F.H. Publ. Inc., Ltd., Hong Kong.

Wolf, R.J. and G.R. Chislett. 1971. Trap Fishing Explorations for Snappers and Related Species in the Caribbean and Adjacent Waters. UNDP/FAO Carib. Fish. Develop. Proj. Rep. SF/CAR/REG 189F6. 36 pp.

1974. Trap Fishing Explorations for Snappers and Related Species in the Caribbean and Adjacent Waters. Mar. Fish. Rev. 36(9):49-61.

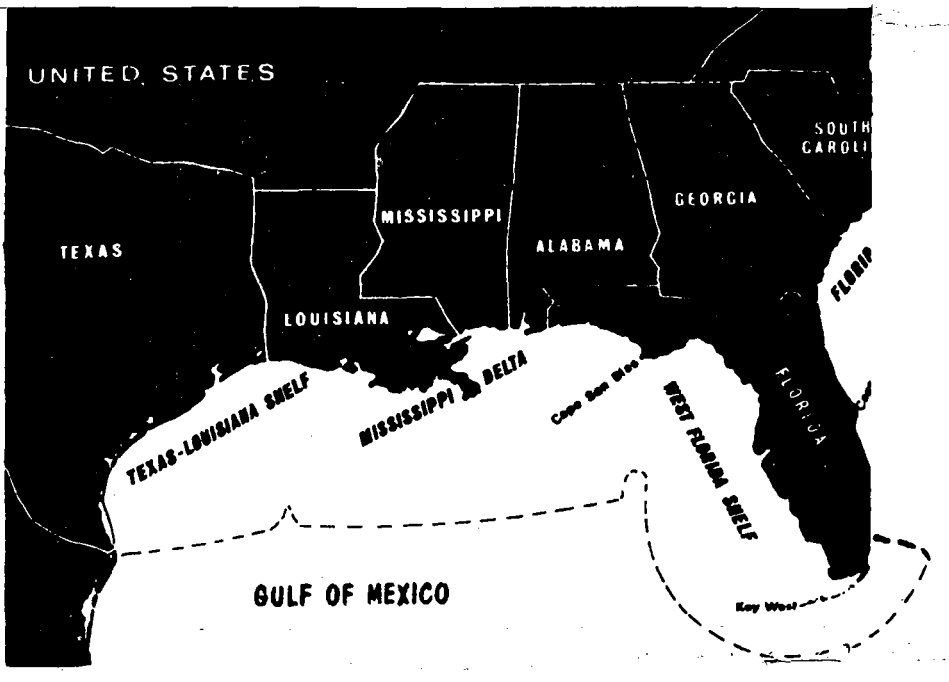
APPENDIX TO THE

ENVIRONMENTAL IMPACT STATEMENT
and
FISHERY MANAGEMENT PLAN

for

REEF FISH RESOURCES
of the
GULF OF MEXICO

Gulf of Mexico Fishery Management Council
Tampa, Florida



Prepared by Florida Sea Grant College
Gainesville, Florida 32611

REVISED BY GULF COUNCIL
JULY 1980

APPENDIX

TABLE OF CONTENTS

List of Tables . . . . . A-i

List of Figures . . . . . A-v

APPENDIX
LIST OF TABLES

NUMBER		PAGE
1	Number of commercial fishermen in the Gulf of Mexico reef fish handline fisheries, 1957-1974	A-1
2	Trend equations for total commercial fishermen in Gulf of Mexico snapper-grouper fishery, 1957-1974	A-2
3	Trend equations for commercial landings for Gulf of Mexico reef fish, red snapper and grouper	A-3
4	Direction of change in commercial landings of individual reef fish species in the reef fish management unit using five-year averages for the Gulf of Mexico	A-4
5	Direction of change in commercial landings of all reef fish, red snapper and grouper and scamp by state using five-year averages in the Gulf of Mexico	A-5
6	Quantity and value of commercial reef fish landings in the Gulf of Mexico by state, 1957-1976	A-6
7	Quantity and value of commercial red snapper landings in the Gulf of Mexico, 1957-1976	A-8
8	Quantity and value of commercial grouper landings in the Gulf of Mexico, 1957-1976	A-10
9	Quantity and value of Gulf of Mexico commercial reef fish landings by state and species, 1975 and 1976	A-12
10	Quantity and value of commercial amberjack landings in the Gulf of Mexico, 1957-1976	A-14
11	Quantity and value of commercial sea bass landings in the Gulf of Mexico, 1957-1976	A-15
12	Quantity and value of commercial grunt landings in the Gulf of Mexico, 1957-1976	A-16
13	Quantity and value of commercial jewfish landings in the Gulf of Mexico, 1957-1976	A-17
14	Quantity and value of commercial porgy (scup) landings in the Gulf of Mexico, 1957-1976	A-19
15	Quantity and value of commercial gray snapper (mangrove snapper) landings in the Gulf of Mexico, 1957-1976	A-20
16	Quantity and value of commercial lane snapper landings in the Gulf of Mexico, 1957-1976	A-21

NUMBER PAGE

17 Quantity and value of commercial mutton snapper landings in the Gulf of Mexico, 1957-1976 . . . . . A-22

18 Quantity and value of commercial vermilion snapper landings in the Gulf of Mexico, 1957-1976 . . . . . A-23

19 Quantity and value of commercial yellowtail snapper landings in the Gulf of Mexico, 1957-1976 . . . . . A-24

20 Quantity and value of commercial tilefish landings in the Gulf of Mexico, 1957-1976 . . . . . A-25

21 Quantity and value of commercial triggerfish landings in the Gulf of Mexico, 1957-1976 . . . . . A-26

22 Quantity and value of commercial warsaw grouper landings in the Gulf of Mexico, 1957-1976 . . . . . A-27

23 Average dockside price in dollars per pound for Gulf of Mexico commercially landed reef fish, 1957-1976 . . . . . A-28

24 Dockside prices of Gulf of Mexico commercial reef fish by state, 1975-1976 . . . A-31

25 Commercial U.S. snapper-grouper fishery, port areas ranked by quantity landed, 1973 . . . . . A-33

26 U.S. commercial landings of red snapper caught off U.S. shores and caught in international waters off foreign shores, 1962-1977 . . . . . A-34

27 U.S. commercial landings of groupers caught off U.S. shores and caught in internationl waters off foreign shores, 1962-1977 . . . . . A-35

28 U.S. commercial landings of reef fish by U.S. fishery craft by distance caught off U.S. shores and caught in international waters off foreign shores, and Gulf of Mexico landings, 1971-1977 . . . . . A-36

29 Number of commercial vessels in the Gulf of Mexico reef fish handline fishery, 1957-1974 . . . . . A-39

30 Trend equations for total commercial vessels in Gulf of Mexico snapper-grouper fishery A-40

31 Average commercial vessel size in gross tons in the Gulf of Mexico reef fish handline fishery, 1957-1974 . . . . . A-41

32 Trend equations for Gulf of Mexico snapper-grouper commercial vessel size, 1957-1974 . . . . . A-42

33 Commercial landings of Gulf of Mexico reef fish by gear type and state, 1972-1974 average A-43

NUMBER PAGE

34 U.S. commercial landings of Gulf of Mexico red snappers by gear type and state, 1957-1974 . . . . . A-46

35 Commercial landings of Gulf of Mexico groupers by gear type and state, 1957-1974 . . . . . A-49

36 Commercial catch and effort of Cuban grouper fishermen on the west coast of Florida, 1940-1976 . . . . . A-52

37 Comparison of data on Cuban commercial fish catches in Florida for 1971-1975 . . A-53

38 Recorded commercial imports of snapper into Gulf states, 1952-1972 . . . . . A-54

39 Commercial imports of snapper, snapper fillets, and other snapper products into the Gulf of Mexico ports, 1973-1977 . . . . . A-55

40 Recorded commercial imports of grouper into Gulf coast states, 1952-1972 . . . . A-56

41 Recorded commercial imports of grouper and snapper into Gulf of Mexico ports, 1977 . . . . . A-57

42 Average crew size for commercial vessels in the Gulf of Mexico handline fishery A-58

43 Trend equations for average crew size in the Gulf of Mexico commercial handline fishery A-59

44 Processed commercial snapper products in the Gulf of Mexico by state, 1957-1974 . . . . . A-60

45 Processed commercial grouper products in the Gulf of Mexico by state, 1957-1974 . . . . . A-61

46 Gulf of Mexico processing and wholesaling plants and employment, 1970-1975 . . . A-62

47 Gulf of Mexico total number of processing and wholesaling plants and employment, 1957-1975 . . . . . A-63

48 Wholesale dealers and processors of Gulf of Mexico reef fish by state, 1976 . . . A-64

49 Estimated catch and effort in the recreational fisheries for reef fish in the Gulf of Mexico A-65

50 Estimated number of finfish caught by marine recreational fishermen by species group and state of catch, Gulf region, 1975 . . . . . A-68

51 Estimated weight of finfish caught by marine recreational fishermen by species group and state of catch, Gulf region, 1975 . . . . . A-69

52 Economic information about marine recreational reef fishing in the east Gulf of Mexico, 1975 . . . . . A-70

NUMBER PAGE

53 Economic information about marine recreational reef fishing in the west Gulf of Mexico, 1975 . . . . . A-71

54 Annual participation, private and commercial recreational boats, 1973 . . . . . A-72

55 Estimated catch and effort in reef fish recreational fishing in the Gulf of Mexico A-73

56 Quantity of reef fish landed per commercial handline vessel in the Gulf of Mexico, 1957-1974 . . . . . A-75

57 Quantity of reef fish landed per commercial handline fisherman in the Gulf of Mexico, 1957-1974 . . . . . A-76

58 Summary of ages of Gulf of Mexico reef fish fishermen by state from various sources A-77

59 Summary of income of Gulf of Mexico reef fish fishermen by state from various sources A-78

60 Summary of education levels of Gulf reef fish fishermen by state from various sources A-79

61 Catch and catch per unit effort for sea bass in the Gulf of Mexico, 1967-1975 . . . . . A-80

62 Average landings and value of landings for Gulf of Mexico commercially caught reef fish by species from 1972-1976 . . . . . A-81

63 Price response equations for annual dockside red snapper prices in Florida, Texas, Alabama, Mississippi, and the United States, 1952-1971 . . . . . A-82

64 Price response equations for dockside grouper prices in Florida and the United States, 1952-1971 . . . . . A-83

65 Dockside and New York wholesale values of principal reef fish, 1976 . . . . . A-84

66 Percent effort on different species in the offshore charter boat fisheries by coastal area A-85

67 Selected demographic characteristics of the reef fishing community A-86

68 Economic indicators of the reef fishing communities A-87

APPENDIX
LIST OF FIGURES

Number		Page
1.	Number of Gulf of Mexico commercial reef fish fishermen, 1957-1974	A-88
2.	Quantity of Gulf of Mexico commercial reef fish landings, 1957-1976	A-89
3.	Value of Gulf of Mexico commercial reef fish landings, 1957-1976	A-90
4.	Quantity of Gulf of Mexico commercial red snapper landings, 1975-1976	A-91
5.	Value of Gulf of Mexico commercial red snapper landings, 1957-1976	A-92
6.	Quantity of Gulf of Mexico commercial grouper landings, 1957-1976	A-93
7.	Value of Gulf of Mexico commercial grouper landings, 1957-1976	A-94
8.	Texas, Alabama, and Mississippi commercial red snapper dockside prices expressed as differentials from Florida prices, 1952-1973	A-95
9.	Number of Gulf of Mexico commercial reef fish handline vessels, 1957-1974 . . .	A-96
10.	Grouper catch and catch per launch day fished by Cuban commercial fishermen on the west coast of Florida, 1940-1976	A-97
11.	A diagram of a typical bottom longline; Cuban Gulf fleet	A-98
12.	Average crew size in the Gulf of Mexico reef fish handline fisheries, 1957-1974	A-99
13.	Quantity of Gulf of Mexico reef fish landed per commercial handline vessel, 1957-1974	A-100
14.	Quantity of Gulf of Mexico reef fish landed per commercial handline fisherman, 1957-1974	A-101

Appendix Table 1. Number of commercial fishermen in the Gulf of Mexico reef fish handline fisheries, 1957-1974[a]

Year	Florida West Coast	Alabama	Mississippi	Louisiana	Texas	Total Gulf
1957	478	86	29	14	436	1,043
1958	617	86	38	31	358	1,130
1959	1,138	95	47	76	499	1,855
1960	901	95	80	66	429	1,571
1961	1,046	119	94	130	522	1,911
1962	1,056	137	107	200	555	2,055
1963	1,218	201	117	172	545	2,253
1964	1,370	193	126	117	496	2,302
1965	1,334	184	137	104	443	2,202
1966	1,141	219	163	59	394	1,976
1967	1,084	181	202	18	358	1,843
1968	1,014	108	201	15	238	1,576
1969	975	108	190	15	212	1,500
1970	930	78	175	22	98	1,303
1971	1,043	78	184	25	159	1,489
1972	1,038	86	192	39	232	1,587
1973	1,115	77	174	45	213	1,624
1974	1,214	80	163	47	201	1,705

[a]The above data were taken from a table listing number of vessels by gear type. These numbers represent the number of vessels using handlines. Most reef fish are landed by handline vessels. However, a relatively small quantity of other species are also landed by handline vessels. The ratio of reef fish to other species landed by handline vessels may differ among states in some years.

Source: U.S. National Marine Fisheries Service (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1957-1974.

Appendix Table 2. Trend equations for total commercial fishermen in Gulf of Mexico snapper-grouper fishery, 1957-1974

DEPENDENT VARIABLE	Time[a] CONSTANT	T	T^2	T^3	R^2	F Statistic	Durbin Watson Statistic	Mean	Std. Dev.
Florida fishermen	123.1 (.939)	361.42 (6.219)	-37.410 (-5.338)	1.1488 (4.730)	.79	17.362	2.04	103.9	212.92
Alabama fishermen	42.69 (1.608)	27.058 (4.205)	-1.5099 (-4.589)	-	.60	11.102	.82	122.83	48.095
Mississippi fishermen	42.91 (3.246)	9.6295 (7.884)	- -	-	.80	62.162	.35	134.39	56.021
Louisiana fishermen	48.26 (1.173)	12.226 (1.226)	-8.3656 (-1.641)	-	.25	2.559	.47	66.389	54.304
Texas fishermen	559.1 (12.165)	-21.492 (-5.062)	-	-	.62	25.625	.61	354.89	142.11

[a]Numbers in parenthesis are t-values.

Source: Calculated by authors.

Appendix Table 3. Trend equations for commercial landings for Gulf of Mexico reef fish, red snapper and grouper

Dependent Variable Landings	Time[a]								
	Constant	T	T^2	T^3,	R^2	F Stastic	Durbin Watson Statistic	Mean	Std. Dev.
Reef Fish	11545	3010.5 (8.36)	-261.7 (5.42)	6.2 (3.27)	.79	19.58	1.18	19346	1265
Red Snapper	8714	738.22 (4.205)	-43.779 (-5.391)	-	.74	23.957	.40	10183	1938
Grouper	5256	426.87 (3.130)	-19.083 (-3.025)	-	.37	4.901	1.54	7000	968

[a] Numbers in parentheses are t-values.

Data are in thousands of pounds.

Source: Calculated by authors.

Appendix Table 4. Direction of change in commercial landings of individual reef fish species in the reef fish management unit using five-year averages for the Gulf of Mexico

Reporting Category[a]	Direction of Change: 1957-61 Average to 1962-66 Average	1962-66 Average to 1967-71 Average	1967-71 Average to 1972-76 Average	1972-76 average in relation to 1957-61 Average
Red snapper	+	-	-	-
Grouper and scamp	+	-	-	+
Sea bass	-	+	-	+
Yellowtail snapper	+	+	-	+
Gray snapper (mangrove)	+	+	+	+
Mutton snapper	+	+	+	+
Vermilion snapper	+	+	+	+
Jewfish	+	+	+	+
Warsaw grouper	+	-	-	-
Lane Snapper	+	+	+	+
Total reef fish	+	-	-	-

[a] Listed in order of landings based on the 1972-1976 average from highest to lowest.

Source: Calculated from U.S. National Marine Fisheries Service, Fishery Statistics of the U.S., Washington: 1957-1974.

Appendix Table 6. Quantity and value of commercial reef fish landings[b] in the Gulf of Mexico by state, 1957-1976.

Year	Florida, West Coast			Alabama			Mississippi		
	Pounds	Current dollars	Real dollars	Pounds	Current dollars	Real dollars	Pounds	Current dollars	Real dollars
	(Thousands of pounds and thousands of dollars)								
1957	13,246	2,349	2,410.51	1,050	250	267.95	569	146	156.48
1958	11,176	2,140	2,261.28	1,597	376	397.46	1,145	278	293.87
1959	12,398	2,259	2,382.91	2,068	490	516.88	1,097	266	280.59
1960	12,680	2,293	2,416.23	1,960	463	487.88	1,584	384	404.64
1961	13,216	2,318	2,452.91	2,030	500	529.10	2,287	553	585.19
1962	14,181	2,362	2,491.56	2,146	524	552.74	2,422	572	603.38
1963	14,115	2,480	2,624.34	2,651	709	750.26	2,157	501	530.16
1964	16,009	3,184	3,362.19	2,816	741	782.47	2,117	490	517.42
1965	16,358	3,219	3,332.30	3,017	763	789.86	2,688	622	643.89
1966	13,946	3,045	3,051.10	3,184	864	865.73	3,010	795	796.60
1967	13,495	3,179	3,179.00	2,682	735	735.00	3,078	869	869.00
1968	13,301	3,458	3,373.62	1,636	375	365.85	4,055	1,156	1,127.80
1969	13,937	4,301	4,038.64	1,545	410	384.98	3,234	991	930.52
1970	13,463	4,160	3,768.12	1,321	367	332.43	2,785	969	877.72
1971	13,034	4,321	3,793.84	1,160	368	323.09	2,627	920	807.73
1972	12,843	5,145	4,319.73	1,360	484	406.38	2,499	979	822.00
1973	11,510	5,382	3,995.60	1,217	482	357.83	2,550	1,128	837.42
1974	13,497	6,908	4,314.74	1,049	465	290.44	2,031	967	604.00
1975	14,148	7,652	4,375.42	970	494	282.45	1,798	1,013	579.19
1976	13,708	8,526	4,606.48	727	415	226.90	1,972	1,233	674.14

Appendix Table 6. Quantity and value of commercial reef fish landings in the Gulf of Mexico by state, 1957-1976 (contd.)

Year	Louisiana			Texas		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	----------Thousands of pounds and thousands of dollars----------					
1957	28	6	6.43	1,499	386	413.72
1958	503	20	21.14	1,460	379	400.63
1959	345	80	84.39	1,797	446	470.46
1960	473	108	113.80	1,224	300	316.12
1961	702	153	161.90	1,920	464	491.01
1962	751	163	171.94	1,932	463	488.40
1963	424	98	103.70	2,372	610	645.50
1964	329	80	84.48	2,474	653	689.55
1965	262	59	61.08	2,381	644	666.67
1966	227	61	61.12	1,749	522	523.05
1967	306	78	78.00	1,494	472	472.00
1968	284	73	71.22	1,228	378	368.78
1969	138	36	33.80	998	349	327.70
1970	266	72	65.22	975	386	349.64
1971	167	54	47.41	1,220	508	446.01
1972	264	97	81.44	1,336	583	489.50
1973	368	145	107.65	881	417	309.58
1974	288	139	86.82	828	427	266.71
1975	157	74	42.31	698	404	230.99
1976	72	41	22.42	567	367	200.66

[a]Wholesale price index, all commodities, 1967 = 100.

[b]Include both reef fish in the management unit, and those caught incidental to the directed fishery as identified in Section 2.3.2.

Compiled from: (1) U.S. National Marine Fisheries Services, Current Fishery Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-76.
(2) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries), Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1957-74.

Appendix Table 7. Quantity and value of commercial red snapper landings in the Gulf of Mexico, 1957-1976

Year	Florida West Coast			Alabama			Mississippi		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of pounds and thousands of dollars								
1957	5,587	1,443	1,546.62	933	232	248.66	550	143	153.27
1958	5,844	1,520	1,606.77	1,418	349	368.92	1,110	274	289.64
1959	5,400	1,420	1,497.89	1,819	452	476.79	1,022	255	268.99
1960	5,447	1,416	1,492.10	1,720	426	448.89	1,469	367	386.72
1961	5,446	1,449	1,533.33	1,784	470	497.35	2,152	537	568.25
1962	5,375	1,328	1,400.84	1,893	495	522.15	2,176	544	573.84
1963	5,918	1,562	1,652.91	2,315	663	701.59	1,886	471	498.41
1964	6,532	2,009	2,121.44	2,393	685	723.34	1,849	461	486.80
1965	6,072	1,931	1,998.96	2,495	707	731.88	2,366	589	609.73
1966	5,190	1,809	1,812.63	2,701	803	804.61	2,775	771	772.55
1967	5,053	1,804	1,804.00	2,288	690	690.00	2,890	850	850.00
1968	4,308	1,757	1,714.15	1,214	328	320.00	3,726	1,118	1,090.73
1969	4,279	2,279	2,139.91	1,246	375	352.11	2,968	959	900.47
1970	3,864	2,122	1,922.10	983	326	295.29	2,519	930	842.39
1971	3,878	2,232	1,956.61	939	341	299.39	2,399	886	777.88
1972	3,691	2,526	2,120.91	1,051	443	371.96	2,266	944	792.61
1973	3,762	2,790	2,071.27	960	442	328.14	2,331	1,089	808.46
1974	4,612	3,650	2,279.83	891	439	274.20	1,900	942	588.38
1975	4,453	3,720	2,126.93	833	460	263.01	1,709	988	564.89
1976	4,024	3,914	2,139.97	635	388	212.14	1,875	1,201	656.64

Appendix Table 7. Quantity and value of commercial red snapper landings in the Gulf of Mexico, 1957-1976(contd)

Year	Louisiana			Texas			Total Gulf		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of pounds and thousands of dollars								
1957	28	6	6.43	1,443	380	407.29	8,541	2,204	2,362.27
1958	88	16	16.91	1,399	373	394.29	9,859	2,532	2,676.53
1959	313	77	81.22	1,665	435	458.86	10,219	2,639	2,783.76
1960	426	104	109.59	1,153	293	308.75	10,215	2,606	2,746.05
1961	677	150	158.73	1,829	455	481.48	11,888	3,061	3,239.15
1962	694	157	165.61	1,742	444	468.35	11,880	2,968	3,310.80
1963	388	95	100.53	2,169	590	624.34	12,676	3,381	3,557.78
1964	310	78	82.37	2,250	631	666.31	13,334	3,864	4,080.25
1965	243	57	59.01	2,212	628	650.10	13,388	3,912	4,049.69
1966	208	59	59.12	1,653	512	513.03	12,527	3,954	3,961.92
1967	302	78	78.00	1,409	462	462.00	11,942	3,884	3,884.00
1968	277	73	71.22	1,128	367	358.05	10,653	3,643	3,554.15
1969	130	35	32.86	925	342	321.13	9,548	3,990	3,746.48
1970	255	71	64.31	916	380	344.20	8,537	3,829	3,468.30
1971	162	54	47.41	1,082	495	434.59	8,460	4,008	3,518.88
1972	259	97	81.44	1,238	572	480.27	8,505	4,582	3,847.19
1973	354	144	106.90	781	402	298.44	8,188	4,867	3,613.21
1974	286	139	86.82	743	416	259.84	8,432	5,586	3,489.07
1975	151	74	42.31	627	393	224.70	7,773	5,635	3,221.84
1976	58	38	20.78	495	353	193.00	7,087	5,894	3,222.53

[a]Wholesale price index, 1967 = 100.

Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1957-1974.

(2) U.S. National Marine Fisheries Service, Current Fishery Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 8. Quantity and value of commercial grouper landings in the Gulf of Mexico, 1957-1976

Year	Florida West Coast			Alabama			Mississippi		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of pounds and thousands of dollars								
1957	6,483	639	684.89	111	17	18.22	19	3	3.22
1958	4,155	457	483.09	172	26	27.48	35	4	4.23
1959	5,750	656	691.98	231	35	36.92	75	11	11.60
1960	5,923	663	698.63	236	36	37.93	115	17	17.91
1961	6,370	643	680.42	221	28	29.63	135	16	16.93
1962	6,977	712	751.05	237	28	19.54	246	28	29.54
1963	6,579	651	688.89	295	42	44.44	271	30	31.75
1964	7,662	823	869.06	305	44	46.46	268	29	30.62
1965	8,217	900	931.68	388	43	44.51	322	33	34.16
1966	7,169	905	906.81	383	51	51.10	235	24	24.05
1967	6,407	924	924.00	318	38	38.00	188	19	19.00
1968	6,176	1,051	1,025.37	306	36	35.12	329	38	37.07
1969	7,072	1,367	1,283.57	249	30	28.17	266	32	30.05
1970	6,902	1,298	1,175.72	265	33	29.89	266	39	35.33
1971	6,356	1,273	1,117.65	180	23	20.19	228	34	29.85
1972	6,479	1,732	1,454.24	229	32	26.87	233	35	29.39
1973	5,086	1,544	1,146.25	198	33	24.50	219	39	28.95
1974	6,111	2,107	1,316.05	129	22	13.74	131	25	15.62
1975	7,007	2,787	1,593.48	114	30	17.15	89	25	17.29
1976	6,657	3,157	1,726.08	76	24	13.12	97	32	17.50

Appendix Table 8. Quantity and value of commercial grouper landings in the Gulf of Mexico, 1957-1976 (contd.)

Year	Louisiana			Texas			Total Gulf		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of pounds and thousands of dollars								
1957	(b)	(b)	-	48	5	5.36	6,661	664	711.68
1958	-	-	-	31	3	3.17	4,393	490	517.97
1959	12	1	1.05	112	9	9.49	6,180	712	751.05
1960	24	2	2.11	43	4	4.21	6,341	722	760.80
1961	16	2	2.12	56	5	5.29	6,798	694	734.39
1962	53	6	6.33	114	11	11.60	7,627	785	828.06
1963	23	2	2.12	156	15	15.87	7,324	740	783.07
1964	13	1	1.06	191	19	20.06	8,439	916	967.27
1965	13	1	1.04	135	13	13.46	9,075	990	1,024.84
1966	16	2	2.00	89	9	9.02	7,892	991	992.99
1967	3	(b)	.94	76	9	9.00	6,992	990	990.00
1968	6	(b)	-	93	10	9.76	6,910	1,135	1,107.32
1969	4	1	-	53	5	4.69	7,644	1,435	1,347.42
1970	5	(b)	-	59	6	5.43	7,497	1,376	1,219.20
1971	3	(b)	-	138	13	11.41	6,905	1,343	1,179.10
1972	5	(b)	-	98	11	9.24	7,044	1,810	1,519.73
1973	8	1	.74	100	15	11.14	5,611	1,632	1,211.58
1974	2	(b)	-	85	11	6.87	6,458	2,165	1,352.28
1975	5	(b)	-	71	11	6.29	7,286	2,853	1,631.22
1976	14	3	1.64	72	14	7.65	6,916	3,230	1,765.99

[a]Wholesale price index, 1967 = 100.
[b]Less than 500 pounds or 500 dollars.
Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishert Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1957-1974.
(2) U.S. National Marine Fisheries Service, Current Fishery Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1957-1976.

Appendix Table 9. Quantity and value of Gulf of Mexico commercial reef fish landings by state and species, 1975 and 1976

Species	1975									
	Florida West Coast		Alabama		Mississippi		Louisiana		Texas	
	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars
Amberjack[d]	90,875	10,586								
Sea bass	39,020	6,622								
Grouper and Scamp	7,006,577	2,787,250	114,079	30,370	89,100	24,736	5,264	748	71,488	11,212
Grunts[d]	220,856	43,070								
Jewfish	185,402	22,162	22,861	4,210						
Porgies[a,d]	108,414	24,846								
Gray snapper[b]	484,537	167,142								
Lane snapper	25,582	11,560								
Mutton snapper	259,575	134,053								
Red snapper	4,452,777	3,719,815	832,950	460,025	1,709,100	987,895	150,756	74,286	627,449	393,442
Vermilion snapper	352,816	215,696								
Yellowtail snapper	675,398	456,254								
Tilefish[d]	32,422	9,170								
Triggerfish[d]	78,090	8,861								
Warsaw grouper	135,026	33,517								
TOTAL[c]	14,147,367	7,650,604	969,890	494,605	1,798,200	1,012,631	156,020	75,034	698,937	404,654

Appendix Table 9. Quantity and value of Gulf of Mexico commercial reef fish landings by state and species, 1975 and 1976

	1976									
	Florida West Coast		Alabama		Mississippi		Louisiana		Texas	
Species	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars
Amberjack[d]	95,545	9,860								
Sea bass	49,617	10,200								
Grouper and Scamp	6,657,339	3,156,619	76,282	23,949	96,500	31,850	14,443	3,434	71,653	14,394
Grunts[d]	207,419	40,974								
Jewfish	184,800	22,894	15,893	3,262						
Porgies[a,d]	120,340	31,926								
Gray snapper[b]	598,120	209,651								
Lane snapper	47,506	20,663								
Mutton snapper	236,689	143,336								
Red snapper	4,023,809	3,914,063	634,855	387,670	1,875,400	1,200,885	57,877	38,488	495,092	353,157
Vermilion snapper	280,480	193,544								
Yellowtail snapper	922,321	704,120								
Tilefish[d]	53,275	15,839								
Triggerfish[d]	84,434	11,599								
Warsaw grouper	147,050	38,982								
TOTAL[c]	13,708,804	8,514,093	727,030	414,881	1,971,900	1,232,735	72,320	41,922	566,745	367,551

[a] Listed as scup in the landings data.

[b] Listed as mangrove snapper in the landings data.

[c] Totals may differ slightly from those shown in other tables. This is because other tables are in thousands and when less than 500 units were designated, a (1) was used, resulting in no number to add into the total of these other tables. Consequently, if several (1)'s appeared on these other tables, where values were actually 400 then the total would be slightly larger than shown. The above table takes this into account, so some of the above totals may be slightly larger than on the other tables.

[d] Not reef fish species in the management unit but included in table for informational purposes since caught incidental to the directed fishery.

Source: U.S. National Marine Fisheries Service, Current Fishery Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 10. Quantity and value of commercial amberjack landings in the Gulf of Mexico, 1957-1976

Year	Florida West Coast			Other Gulf			Total Gulf		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of pounds and thousands of dollars								
1957	57	3	3.22	0	0	0	57	3	3.22
1958	33	1	1.06				33	1	1.06
1959	12	(1)	-	(1)	(1)	(1)	12	(1)	-
1960	16	(1)	-	0	0	0	16	(1)	-
1961	7	(1)	-	"	"	"	7	(1)	-
1962	10	(1)	-	"	"	"	10	(1)	-
1963	14	1	-	"	"	"	14	1	-
1964	10	(1)	-	"	"	"	10	(1)	-
1965	8	(1)	-	"	"	"	8	(1)	-
1966	9	(1)	-	"	"	"	9	(1)	-
1967	34	2	2.00	"	"	"	34	2	2.00
1968	14	1	0.98	"	"	"	14	1	0.98
1969	80	5	4.69	"	"	"	80	5	4.69
1970	20	2	1.81	"	"	"	20	2	1.81
1971	45	4	3.51	"	"	"	45	4	3.51
1972	44	2	1.68	"	"	"	44	2	1.68
1973	39	3	2.23	"	"	"	39	3	2.23
1974	58	4	2.50	"	"	"	58	4	2.50
1975	91	11	6.29	"	"	"	91	11	6.29
1976	96	10	5.47	0	0	0	96	10	5.47

[a]Wholesale price index, 1967 = 100.
(1) Less than 500 pounds or 500 dollars.
Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office. Annual issues, 1957-1974.
(2) U.S. National Marine Fisheries Service, Current Fishery Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-76.

Appendix Table 11. Quantity and value of commercial sea bass landings in the Gulf of Mexico, 1957-1976.

Year	Florida, West Coast			Other Gulf			Total Gulf		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of pounds and thousands of dollars								
1957	2	(1)	-	0	0	0	2	(1)	-
1958	7	1	1.06	0	0	0	7	1	-
1959	1	(1)	-	0	0	0	1	(1)	-
1960	(1)	(1)	-	0	0	0	(1)	(1)	-
1961	0	0	-	0	0	0	0	0	-
1962	0	0	-	0	0	0	0	0	-
1963	0	0	-	0	0	0	0	0	-
1964	0	0	-	0	0	0	0	0	-
1965	0	0	-	0	0	0	0	0	-
1966	0	0	-	0	0	0	0	0	-
1967	(1)	(1)	-	0	0	0	(1)	(1)	-
1968	303	35	34.15	0	0	0	303	35	-
1969	305	39	36.62	0	0	0	305	39	-
1970	149	17	15.40	0	0	0	149	17	-
1971	106	11	9.66	0	0	0	106	11	-
1972	121	16	13.43	0	0	0	121	16	-
1973	112	18	13.36	0	0	0	112	18	-
1974	51	7	4.37	0	0	0	51	7	-
1975	39	7	4.00	0	0	0	39	7	-
1976[b]	50	10	5.46	0	0	0	50	10	-

[a] Wholesale price index, 1967 = 100.

[b] Preliminary.

(1) Less than 500 pounds or 500 dollars.

Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office. Annual issues, 1957-1974.

(2) U.S. National Marine Fisheries Service, Current Fishery Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 12. Quantity and value of commercial grunt landings in the Gulf of Mexico, 1957-1976

Year	Florida West Coast			Other Gulf			Total Gulf		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of pounds and thousands of dollars								
1957	238	18	19.29	0	0	0	238	18	19.29
1958	95	7	7.40	"	"	"	95	7	7.40
1959	201	14	14.77	"	"	"	201	14	14.77
1960	134	10	10.54	"	"	"	134	10	10.54
1961	85	5	5.29	"	"	"	85	5	5.29
1962	63	4	4.22	"	"	"	63	4	4.22
1963	60	4	4.23	"	"	"	60	4	4.23
1964	37	3	3.17	"	"	"	37	3	3.17
1965	78	6	6.21	"	"	"	78	6	6.21
1966	120	10	10.02	"	"	"	120	10	10.02
1967	279	27	27.00	"	"	"	279	27	27.00
1968	383	42	40.98	"	"	"	383	42	40.98
1969	310	40	37.56	"	"	"	310	40	37.56
1970	315	44	39.86	"	"	"	315	44	39.86
1971	357	51	44.78	"	"	"	357	51	44.78
1972	277	45	37.78	"	"	"	277	45	37.78
1973	239	44	32.67	"	"	"	239	44	32.67
1974	258	53	33.10	"	"	"	258	53	33.10
1975	221	43	24.59	"	"	"	221	43	24.59
1976	207	41	22.42	0	0	0	207	41	22.42

[a]Wholesale price index, 1967 = 100.

Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1957-1974.

(2) U.S. National Marine Fisheries Service, Current Fishery Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 13. Quantity and value of commercial jewfish landings in the Gulf of Mexico, 1957-1976

Year	Florida West Coast			Alabama			Other Gulf		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of pounds and thousands of dollars								
1957	27	2	2.14	6	1	1.07	1	(1)	-
1958	52	4	4.23	7	1	1.06	31	3	3.17
1959	65	4	4.22	18	3	3.16	38	4	4.22
1960	67	5	5.27	4	1	1.05	33	3	3.16
1961	51	4	4.23	25	2	2.12	9	1	1.06
1962	48	4	4.22	16	1	1.05	4	(1)	-
1963	65	4	4.23	41	4	4.23	16	2	2.12
1964	86	8	8.45	118	12	12.67	5	(1)	-
1965	61	5	5.18	134	13	13.46	1	(1)	-
1966	42	3	3.01	100	10	10.02	2	(1)	-
1967	67	5	5.00	76	7	7.00	(1)	(1)	-
1968	99	7	6.83	116	11	10.73	(1)	(1)	-
1969	102	7	6.57	50	5	4.69	3	(1)	-
1970	130	10	9.06	73	8	7.25	6	1	0.91
1971	149	13	11.41	41	4	3.51	2	(1)	
1972	151	13	10.92	80	9	7.56	231	(1)	-
1973	161	16	11.88	59	7	5.20	6	(1)	-
1974	161	18	11.24	29	4	2.50	(1)	(1)	-
1975	185	22	12.58	23	4	2.29	0	0	-
1976	185	23	12.58	16	3	1.64	0	0	-

Appendix Table 13. Quantity and value of commercial jewfish landings in the Gulf of Mexico, 1957-1976 (contd.)

Year	Total Gulf		
	Pounds	Current dollars	Real[a] dollars
	Thousands of pounds and thousands of dollars		
1957	34	3	3.22
1958	90	8	8.46
1959	121	11	11.60
1960	104	9	9.48
1961	85	7	7.41
1962	68	5	5.27
1963	122	10	10.58
1964	209	20	21.12
1965	196	18	18.63
1966	144	13	13.03
1967	143	12	12.00
1968	215	18	17.56
1969	155	12	11.27
1970	209	19	17.21
1971	192	17	14.93
1972	231	22	18.47
1973	226	23	17.07
1974	190	22	13.74
1975	208	26	14.87
1976	201	26	14.22

[a]Wholesale price index, 1967 = 100.

(1) Less than 500 pounds or 500 collars.

Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1957-1974.

(2) U.S. National Marine Fisheries Service, Current Fishery Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 14. Quantity and value of commercial porgy (scup) landings in the Gulf of Mexico, 1957-1976

Year	Florida West Coast			Other Gulf[a]			Total Gulf		
	Pounds	Current dollars	Real[b] dollars	Pounds	Current dollars	Real[b] dollars	Pounds	Current dollars	Real[b] dollars
	Thousands of pounds and thousands of dollars								
1957	-	-	-	-	-	-	-	-	-
1958	48	4	4.23	414	4	4.23	462	8	8.46
1959	54	4	4.22	2	(1)	-	56	4	4.22
1960	69	5	5.27	1	(1)	-	70	5	5.27
1961	48	3	3.17	0	0	0	48	3	3.17
1962	52	4	4.22	0	0	0	52	4	4.22
1963	55	4	4.23	0	0	0	55	4	4.23
1964	54	5	5.28	0	0	0	54	5	5.28
1965	47	4	4.14	0	0	0	47	4	4.14
1966	30	3	3.01	0	0	0	30	3	3.01
1967	53	6	6.00	0	0	0	53	6	6.00
1968	57	7	6.83	0	0	0	57	7	6.83
1969	68	9	8.45	0	0	0	68	9	8.45
1970	72	10	9.06	0	0	0	72	10	9.06
1971	89	13	11.41	0	0	0	89	13	11.41
1972	84	14	11.75	0	0	0	84	14	11.75
1973	71	14	10.39	0	0	0	71	14	10.39
1974	80	17	10.62	0	0	0	80	17	10.62
1975	108	25	14.29	0	0	0	108	25	14.29
1976	120	32	17.50	0	0	0	120	32	17.50

[a]All landings appearing in this category were from Louisiana.

[b]Wholesale price index, all commodities, 1967 = 100.

(1) Less than 500 dollars or 500 pounds.

Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office. Annual issues, 1957-1974.

(2) U.S National Marine Fisheries Service, Current Fishery Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 15. Quantity and value of commercial gray snapper (mangrove snapper) landings in the Gulf of Mexico, 1957-1976

Year	Florida West Coast			Other Gulf[a]			Total Gulf		
	Pounds	Current dollars	Real[b] dollars	Pounds	Current dollars	Real[b] dollars	Pounds	Current dollars	Real[b] dollars
	Thousands of Pounds and thousands of dollars								
1957	322	52	55.73	0	0	0	322	52	55.73
1958	446	67	70.82	0	0	0	446	67	70.82
1959	288	45	47.47	(1)	(1)	-	288	45	47.47
1960	263	42	44.26	2	(1)	-	265	42	44.26
1961	262	40	42.33	0	0	0	262	40	42.33
1962	338	54	56.96	0	0	0	338	54	56.96
1963	311	53	56.08	0	0	0	311	53	56.08
1964	325	58	61.25	0	0	0	325	58	61.25
1965	407	77	79.71	0	0	0	407	77	79.71
1966	312	63	63.13	0	0	0	312	63	63.13
1967	373	83	83.00	0	0	0	373	83	83.00
1968	471	106	103.41	0	0	0	471	106	103.41
1969	480	123	115.49	0	0	0	480	123	115.49
1970	442	112	101.45	0	0	0	442	112	101.45
1971	469	131	115.01	0	0	0	469	131	115.01
1972	530	164	137.70	0	0	0	530	164	137.70
1973	557	185	137.34	0	0	0	557	185	137.34
1974	587	206	128.67	0	0	0	587	206	128.67
1975	485	167	95.48	0	0	0	485	167	95.48
1976	598	210	114.82	0	0	0	598	210	114.82

a All landings appearing in this category were from Louisiana

b Wholesale price index, all commodities, 1967 = 100

(1) Less than 500 pounds or 500 dollars

Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1957-1974.

(2) U.S. National Marine Fisheries Service, Current Fisheries Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 16. Quantity and value of commercial lane snapper landings in the Gulf of Mexico, 1957-1976

Year	Florida West Coast			Other Gulf			Total Gulf		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of Pounds and thousands of dollars								
1957	-	-	-	0	0	0	-	-	-
1958	-	-	-	0	0	0	-	-	-
1959	-	-	-	0	0	0	-	-	-
1960	-	-	-	0	0	0	-	-	-
1961	-	-	-	0	0	0	-	-	-
1962	-	-	-	0	0	0	-	-	-
1963	-	-	-	0	0	0	-	-	-
1964	-	-	-	0	0	0	-	-	-
1965	28	3	3.11	0	0	0	28	3	3.11
1966	11	2	2.00	0	0	0	11	2	2.00
1967	18	3	3.00	0	0	0	18	3	3.00
1968	10	2	1.95	0	0	0	10	2	1.95
1969	12	2	1.88	0	0	0	12	2	1.88
1970	14	3	2.72	0	0	0	14	3	2.72
1971	16	4	3.51	0	0	0	16	4	3.51
1972	15	4	3.36	0	0	0	15	4	3.36
1973	25	8	5.94	0	0	0	25	8	5.94
1974	19	7	4.37	0	0	0	25	7	4.37
1975	26	12	6.86	0	0	0	19	12	6.86
1976	48	21	11.48	0	0	0	48	21	11.48

[a] Wholesale price index, 1967 = 100

Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1957-1974.

(2) U.S. National Marine Fisheries Service, Current Fisheries Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 17. Quantity and value of commercial mutton snapper landings in the Gulf of Mexico, 1957-1976

Year	Florida West Coast			Other Gulf			Total Gulf		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of pounds and thousands of dollars								
1957	53	11	11.79	0	0	0	53	11	11.79
1958	40	8	8.46	"	"	"	40	8	8.46
1959	78	16	16.88	"	"	"	78	16	16.88
1960	94	20	21.07	"	"	"	94	20	21.07
1961	90	18	19.05	"	"	"	90	18	19.05
1962	142	30	31.65	"	"	"	142	30	31.65
1963	118	25	26.46	"	"	"	118	25	26.46
1864	134	30	31.68	"	"	"	134	30	31.68
1965	110	26	26.92	"	"	"	110	26	26.92
1966	82	20	20.04	"	"	"	82	20	20.04
1967	148	39	39.00	"	"	"	148	39	39.00
1968	166	48	46.83	"	"	"	166	48	46.83
1969	135	45	42.25	"	"	"	135	45	42.25
1970	234	85	76.99	"	"	"	234	85	76.99
1971	274	101	88.67	"	"	"	274	101	88.67
1972	238	101	84.80	"	"	"	238	101	84.80
1973	259	117	86.86	"	"	"	259	117	86.86
1974	257	119	74.33	"	"	"	257	119	74.33
1975	260	134	76.62	"	"	"	260	134	76.62
1976	237	143	78.18	0	0	0	237	143	78.18

[a]Wholesale price index, 1967 = 100.

Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1957-1974.
(2) U.S. National Marine Fisheries Service, Current Fishery Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 18. Quantity and value of commercial vermilion snapper landings in the Gulf of Mexico, 1957-1976

Year	Florida West Coast			Other Gulf			Total Gulf		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of pounds and thousands of dollars								
1957	1	(1)		0	0	0	1	(1)	
1958	4	1	1.06	"	"	"	4	1	1.06
1959	2	1	1.05	"	"	"	2	1	1.05
1960	8	2	2.11	"	"	"	8	2	2.11
1961	22	4	4.23	"	"	"	22	4	4.23
1962	41	6	6.33	"	"	"	41	6	6.33
1963	68	11	11.64	"	"	"	68	11	11.64
1964	90	15	15.84	"	"	"	90	15	15.84
1965	72	14	14.49	"	"	"	72	14	14.49
1966	28	7	7.01	"	"	"	28	7	7.01
1967	52	14	14.00	"	"	"	52	14	14.00
1968	124	39	38.05	"	"	"	124	39	38.05
1969	108	42	39.44	"	"	"	108	42	39.44
1970	118	46	41.67	"	"	"	118	46	41.67
1971	126	53	46.53	"	"	"	126	53	46.53
1972	117	53	44.50	"	"	"	117	53	44.50
1973	177	104	77.21	"	"	"	177	104	77.21
1974	178	107	66.83	"	"	"	178	107	66.83
1975	353	216	123.50	"	"	"	353	216	123.50
1976	280	194	106.07	"	"	"	280	194	106.07

[a]Wholesale price index, 1967 = 100.
(1) Less than 500 pounds or 500 dollars.
Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1957-1974.
(2) U.S. National Marine Fisheries Service, Current Fishery Statistics, Landings for Selected States. Washington: U.S. Government Printing Office, Annual issues, 1975-1976.

Appendix Table 19. Quantity and value of commercial yellowtail snapper landings in the Gulf of Mexico, 1957-1976

Year	Florida West Coast			Other Gulf			Total Gulf		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of pounds and thousands of dollars								
1957	296	69	73.95	0	0	0	296	69	73.95
1958	261	57	60.25	"	"	"	261	57	60.25
1959	406	89	93.88	"	"	"	406	89	93.88
1960	528	121	127.50	"	"	"	528	121	127.50
1961	640	141	149.21	"	"	"	640	141	149.21
1962	910	206	217.30	"	"	"	910	206	217.30
1963	729	153	161.90	"	"	"	729	153	161.90
1964	896	220	232.31	"	"	"	896	220	232.31
1965	942	231	239.13	"	"	"	942	231	239.13
1966	753	206	206.41	"	"	"	753	206	206.41
1967	850	258	258.00	"	"	"	850	258	258.00
1968	1,025	344	335.61	"	"	"	1,025	344	335.61
1969	808	321	301.41	"	"	"	808	321	301.41
1970	987	384	347.83	"	"	"	987	384	347.83
1971	949	408	358.21	"	"	"	949	408	358.21
1972	866	443	371.96	"	"	"	866	443	371.96
1973	836	508	377.13	"	"	"	836	508	377.13
1974	938	577	360.40	"	"	"	938	577	360.40
1975	675	456	260.72	"	"	"	675	456	260.72
1976	922	704	384.91	0	0	0	922	704	384.91

[a]Wholesale price index, 1967 = 100.

Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1957-1974.
(2) U.S. National Marine Fisheries Services, Current Fishery Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 20. Quantity and value of commercial tilefish landings in the Gulf of Mexico, 1957-1976

Year	Florida West Coast			Other Gulf			Total Gulf		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of Pounds and thousands of dollars								
1957	-	-	-	0	0	0	-	-	-
1958	4	(1)	-	0	0	0	4	(1)	-
1959	2	(1)	-	0	0	0	2	(1)	-
1960	(1)	(1)	-	0	0	0	(1)	(1)	-
1961	1	(1)	-	0	0	0	1	(1)	-
1962	4	(1)	-	0	0	0	4	(1)	-
1963	3	(1)	-	0	0	0	3	(1)	-
1964	(1)	(1)	-	0	0	0	(1)	(1)	-
1965	26	3	3.11	0	0	0	26	3	3.11
1966	9	1	1.00	0	0	0	9	1	1.00
1967	14	1	1.00	0	0	0	14	1	1.00
1968	6	1	0.98	0	0	0	6	1	0.98
1969	1	(1)	-	0	0	0	1	(1)	
1970	5	1	0.91	0	0	0	5	1	0.91
1971	14	2	1.76	0	0	0	14	2	1.76
1972	10	2	1.68	0	0	0	10	2	1.68
1973	13	4	2.97	0	0	0	13	4	2.97
1974	15	5	3.12	0	0	0	15	5	3.12
1975	32	9	5.15	0	0	0	32	9	5.15
1976	53	16	8.75	0	0	0	53	16	8.75

[a] Wholesale price index, 1967 = 100

(1) Less than 500 pounds or 500 dollars

Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1957-1974.

(2) U.S. National Marine Fisheries Service, Current Fisheries Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 21. Quantity and value of commercial triggerfish landings in the Gulf of Mexico, 1957-1976

Year	Florida West Coast			Other Gulf			Total Gulf		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of Pounds and thousands of dollars								
1957	17	1	1.07	0	0	0	17	1	1.07
1958	15	1	1.06	0	0	0	15	1	1.06
1959	10	1	1.05	0	0	0	10	1	1.05
1960	12	(1)	1.05	0	0	0	12	1	1.05
1961	6	(1)	-	0	0	0	6	(1)	-
1962	6	(1)	-	0	0	0	6	(1)	-
1963	12	1	1.06	0	0	0	12	1	1.06
1964	24	1	1.06	0	0	0	24	1	1.06
1965	26	1	1.04	0	0	0	26	1	1.04
1966	14	1	1.00	0	0	0	14	1	1.00
1967	17	1	1.00	0	0	0	17	1	1.00
1968	12	1	0.98	0	0	0	12	1	0.98
1969	22	2	1.88	0	0	0	22	2	1.88
1970	24	2	1.81	0	0	0	24	2	1.81
1971	40	4	3.51	0	0	0	40	4	3.51
1972	63	6	5.04	0	0	0	63	6	5.04
1973	53	6	4.45	0	0	0	53	6	4.45
1974	54	6	3.75	0	0	0	54	6	3.75
1975	78	9	5.15	0	0	0	78	9	5.15
1976	84	12	6.56	0	0	0	84	12	6.56

[a] Wholesale price index, 1967 = 100

(1) Less than 500 pounds or 500 dollars

Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1957-1974.

(2) U.S. National Marine Fisheries Service, Current Fisheries Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 22. Quantity and value of commercial warsaw grouper landings in the Gulf of Mexico, 1957-1976

Year	Florida West Coast			Other Gulf			Total Gulf		
	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars	Pounds	Current dollars	Real[a] dollars
	Thousands of Pounds and thousands of dollars								
1957	163	11	11.79	7	1	1.07	170	12	12.86
1958	172	13	13.74	0	0	0	172	13	13.74
1959	129	9	9.49	0	0	0	129	9	9.49
1960	119	8	8.43	15	2	2.11	134	10	10.54
1961	188	11	11.64	35	4	4.23	223	15	15.87
1962	215	14	14.77	76	8	8.44	291	22	23.21
1963	183	11	11.64	44	4	4.23	227	15	15.87
1964	159	12	12.67	34	4	4.22	193	16	16.90
1965	264	18	18.63	39	4	4.14	303	22	22.77
1966	177	15	15.03	8	1	1.00	185	16	16.03
1967	130	12	12.00	10	1	1.00	140	13	13.00
1968	147	17	16.59	8	1	0.98	154	18	17.56
1969	155	20	18.78	20	2	1.89	176	22	20.66
1970	187	24	21.74	0	0	0	187	24	21.74
1971	166	21	18.44	0	0	0	166	21	18.44
1972	157	24	20.15	0	0	0	157	24	20.15
1973	120	21	15.59	0	0	0	120	21	15.59
1974	118	25	15.62	0	0	0	118	25	15.62
1975	135	34	19.44	0	0	0	135	34	19.44
1976	147	39	21.32	0	0	0	147	39	21.32

[a] Wholesale price index, 1967 = 100

Source: (1) U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1957-1974.

(2) U.S. National Marine Fisheries Service, Current Fisheries Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 24. Average dockside price in dollars per pound for Gulf of Mexico commercially landed reef fish, 1957-1976

Year	Triggerfish		Jewfish		Warsaw grouper		Amberjack		Sea Bass	
	Actual price	Deflated[a] price	Actual price	Deflated[a] price	Actual price	Deflated[a] price	Actual price	Deflated[a] price	Actual price	Deflated[a] price
1957	.059	.063	.088	.094	.071	.076	.053	.057	--	--
1958	.067	.071	.089	.094	.076	.080	.030	.032	.143	.151
1959	.100	.105	.091	.096	.070	.074	--	--	--	--
1960	.083	.087	.087	.092	.075	.079	--	--	--	--
1961	--	--	.082	.087	.067	.071	--	--	--	--
1962	--	--	.074	.078	.076	.080	--	--	--	--
1963	.083	.088	.082	.087	.066	.070	.071	.075	--	--
1964	.042	.044	.096	.101	.083	.088	--		--	--
1965	.038	.039	.092	.095	.073	.076	--		--	--
1966	.071	.071	.090	.090	.086	.086	--		--	--
1967	.059	.059	.084	.084	.093	.093	.059	.059	--	--
1968	.083	.081	.084	.082	.117	.114	.071	.069	.116	.113
1969	.091	.085	.077	.072	.126	.118	.063	.059	.128	.120
1970	.083	.075	.091	.082	.128	.116	.100	.091	.114	.103
1971	.100	.088	.089	.078	.127	.112	.089	.078	.104	.091
1972	.095	.078	.095	.078	.153	.128	.045	.038	.132	.111
1973	.113	.084	.102	.076	.175	.130	.077	.057	.161	.119
1974	.111	.069	.116	.072	.212	.132	.069	.043	.137	.086
1975	.115	.066	.125	.071	.252	.144	.121	.069	.180	.103
1976	.143	.078	.129	.071	.265	.145	.104	.057	.200	.109

Appendix Table 24. Average dockside price in dollars per pound for Gulf of Mexico commercially landed reef fish, 1957-1976 (contd.)

Year	Grunts		Lane Snapper		Mutton Snapper		Tilefish		Vermilion Snapper	
	Actual price	Deflated[a] price	Actual price	Deflated[a] price	Actual price	Deflated[a] price	Actual price	Deflated[a] price	Actual price	Deflated[a] price
1957	.076	.081	--	--	.208	.223	--		--	
1958	.074	.078	--	--	.200	.211	--		.250	.264
1959	.070	.074	--	--	.205	.216	--		.500	.527
1960	.075	.079	--	--	.213	.224	--		.250	.263
1961	.059	.062	--	--	.200	.212	--		.182	.193
1962	.063	.066	--	--	.211	.223	--		.146	.154
1963	.067	.071	--	--	.212	.224	--		.162	.171
1964	.081	.086	--	--	.224	.237	--		.167	.176
1965	.077	.078	.107	.111	.236	.244	.115	.119	.194	.201
1966	.083	.083	.182	.182	.244	.244	.111	.111	.250	.251
1967	.097	.097	.167	.167	.264	.264	.071	.071	.269	.269
1968	.110	.107	.200	.195	.289	.282	.167	.163	.315	.307
1969	.129	.121	.167	.157	.333	.313	--		.389	.365
1970	.140	.127	.214	.194	.363	.329	.200	.181	.390	.353
1971	.143	.126	.250	.219	.369	.324	.143	.126	.421	.370
1972	.162	.136	.267	.224	.424	.356	.200	.168	.453	.380
1973	.184	.137	.320	.238	.452	.336	.308	.229	.588	.437
1974	.205	.128	.368	.230	.463	.289	.333	.208	.601	.375
1975	.195	.111	.462	.264	.515	.294	.281	.161	.612	.350
1976	.198	.108	.438	.239	.603	.330	.302	.165	.693	.379

Appendix Table 23. Average dockside price in dollars per pound for Gulf of Mexico commercially landed reef fish, 1957-1976 (continued)

Year	Yellowtail Snapper		Red Snapper		Grouper		Gray Snapper		Porgy (Scup)	
	Actual price	Deflated[a] price	Actual price	Deflated[a] price	Actual price	Deflated[a] price	Actual price	Deflated[a] price	Actual price	Deflated[a] price
1957	.233	.250	.258	.277	.100	.107	.161	.173	-	-
1958	.218	.230	.257	.272	.112	.118	.150	.159	.017	.018
1959	.219	.231	.258	.272	.115	.121	.156	.165	.071	.075
1960	.229	.241	.255	.269	.114	.120	.158	.166	.071	.075
1961	.189	.200	.257	.272	.102	.108	.153	.162	.063	.067
1962	.226	.238	.250	.264	.103	.109	.160	.169	.077	.081
1963	.210	.222	.267	.283	.101	.107	.170	.180	.073	.077
1964	.246	.260	.290	.306	.109	.115	.178	.188	.093	.098
1965	.245	.254	.292	.302	.109	.113	.189	.196	.085	.088
1966	.274	.275	.316	.317	.126	.126	.202	.202	.100	.100
1967	.304	.304	.325	.325	.142	.142	.223	.223	.113	.113
1968	.336	.328	.342	.334	.164	.160	.225	.220	.123	.120
1969	.397	.373	.418	.392	.188	.177	.256	.240	.132	.124
1970	.389	.352	.449	.407	.184	.167	.253	.229	.139	.126
1971	.430	.378	.474	.416	.194	.170	.279	.245	.146	.128
1972	.512	.430	.539	.453	.257	.216	.309	.259	.167	.140
1973	.608	.451	.594	.441	.291	.216	.332	.246	.197	.146
1974	.615	.384	.662	.413	.335	.209	.351	.219	.213	.133
1975	.676	.387	.725	.415	.392	.224	.344	.197	.231	.132
1976	.764	.418	.832	.455	.467	.255	.351	.192	.267	.146

[a] Wholesale price indexes were used, 1967 = 100.

Derived from: (1) U.S. National Marine Fisheries Service, Current Fishery Statistics, Landings for Selected States, 1975-1976.

(2) U.S. National Marine Fisheries Service, Current Fishery Statistics, Landings for Selected States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 24. Dockside prices of Gulf of Mexico commercial reef fish by state, 1975-76

Species	1975				
	Florida, West Coast	Alabama	Mississippi	Louisiana	Texas
	dollars				
Amberjack	.121				
Sea bass	.180				
Grouper	.398	.263	.281		.155
Grunts	.195				
Jewfish	.119	.174			
Lane Snapper	.462				
Mutton Snapper	.515				
Red Snapper	.835	.552	.578	.490	.627
Tilefish	.281				
Triggerfish	.115				
Vermilion Snapper	.612				
Warsaw grouper	.252				
Yellowtail Snapper	.676				
Gray Snapper (Mangrove Snapper)	.344				
Porgy (Scup)	.231				

Appendix Table 24. Dockside prices for Gulf of Mexico commercial reef fish by state, 1975-76 (contd.)

Species	1976				
	Florida, West Coast	Alabama	Mississippi	Louisiana	Texas
	dollars				
Amberjack	.104				
Sea bass	.200				
Grouper	.474	.316	.330	.214	.194
Grunts	.198				
Jewfish	.124	.188			
Lane Snapper	.438				
Mutton Snapper	.603				
Red Snapper	.973	.611	.641	.655	.713
Tilefish	.302				
Triggerfish	.143				
Vermilion Snapper	.693				
Warsaw grouper	.265				
Yellowtail Snapper	.764				
Gray Snapper (Mangrove Snapper)	.351				
Porgy (Scup)	.267				

Appendix Table 26. U.S. commercial landings of red snapper caught off U.S. shores and caught in international waters off foreign shores, 1962-1977

Year	Waters off U.S. coasts	High seas off foreign coasts	Total
	----------Million Pounds (percent)----------		
1962	7.4 (63.8)	4.2 (36.2)	11.6
1963	6.7 (53.2)	5.9 (46.8)	12.6
1964	7.2 (54.5)	6.0 (45.5)	13.2
1965	7.3 (56.2)	5.7 (43.8)	13.0
1966	5.4 (45.8)	6.4 (54.2)	11.8
1967	7.1 (56.8)	5.4 (43.2)	12.5
1968	6.9 (66.3)	3.5 (33.7)	10.4
1969	5.7 (66.3)	2.9 (33.7)	8.6
1970	7.5 (79.8)	1.9 (20.2)	9.4
1971	7.3 (83.0)	1.5 (17.0)	8.8
1972	6.8 (80.0)	1.7 (20.0)	8.5
1973	7.8 (87.6)	1.1 (12.4)	8.9
1974	7.4 (90.2)	0.8 (9.8)	8.2
1975	7.6 (90.5)	0.8 (9.5)	8.4
1976	8.3 (89.2)	1.0 (10.8)	9.3
1977	5.9 (92.2)	0.5 (7.8)	6.4

Source: U.S. National Marine Fisheries Service. Fisheries of the United States. Washington: U.S. Government Printing Office. Annual issues, 1962-1977.

Appendix Table 27. U.S. commercial landings of groupers caught off U.S. shores and caught in international waters off foreign shores, 1962-1977

Year	Waters off U.S. coasts	High seas off foreign coasts	Total
	----------Million Pounds (percent)----------		
1962	5.6 (84.8)	1.0 (15.2)	6.6
1963	5.2 (81.3)	1.2 (18.8)	6.4
1964	6.7 (84.8)	1.2 (15.2)	7.9
1965	8.0 (87.9)	1.1 (12.1)	9.1
1966	6.5 (87.8)	0.9 (12.2)	7.4
1967	5.7 (83.8)	1.1 (16.2)	6.8
1968	6.4 (92.8)	0.5 (7.2)	6.9
1969	6.1 (91.0)	0.6 (9.0)	6.7
1970	6.5 (94.7)	0.4 (5.8)	6.9
1971	7.1 (94.7)	0.4 (5.3)	7.5
1972	7.2 (94.7)	0.4 (5.3)	7.6
1973	6.7 (95.7)	0.3 (4.3)	7.0
1974	7.0 (93.3)	0.5 (6.7)	7.5
1975	6.7 (95.7)	0.3 (4.3)	7.0
1976	9.1 (97.8)	0.2 (2.2)	9.3
1977	6.5 (95.6)	0.3 (4.4)	6.8

Source: U.S. National Marine Fisheries Service. Fisheries of the United States. Washington: U.S. Government Printing Office. Annual issues, 1962-1977.

Appendix Table 25. Commercial U.S. snapper-grouper fishery, port areas ranked by quantity landed, 1973 a/, b/

	Snappers c/, d/		Groupers c/, d/		Snappers & Groupers (Combined) f/	
Rank	Thousand Pounds	Principal Port by Port Area	Thousand Pounds	Principal Port by Port Area	Thousand Pounds	Principal Port by Port Area
1	2,327	Pascagoula, Miss.	1,951	Madeira Beach, Fla.	2,546	Pascagoula, Miss.
2	2,048	Panama City, Fla.	825	Ft. Myers Beach, Fla.	2,333	Panama City, Fla.
3	1,220	Key West, Fla.	691	Bradenton, Fla.	2,207	Madeira Beach, Fla.
4	738	Mobile, Ala.	535	Key West, Fla.	1,755	Key West, Fla.
5	688	Pensacola, Fla.	384	Carabelle, Fla.	1,443	Ft. Myers Beach, Fla.
6	618	Ft. Myers Beach, Fla.	285	Panama City, Fla.	961	Mobile, Ala.
7	382	Port Isabel, Tex.	223	Mobile, Ala.	937	Bradenton, Fla.
8	363	Niceville, Fla.	219	Pascagoula, Miss.	808	Pensacola, Fla.
9	298	Golden Meadow, La.	120	Pensacola, Fla.	384	Carabelle, Fla.
10	264	Miami, Fla.	119	Tampa, Fla.	382	Port Isabel, Tex.
11	256	Madeira Beach, Fla.	101	Nokomis, Fla.	363	Niceville, Fla.
12	246	Bradenton, Fla.				
13	222	Bon Secour, Ala.				
14	197	Mayport, Fla.				
15	196	Aransas pass, Tex.				
16	177	Riviera Beach, Fla.				
17	104	Galveston, Tex.				

a/ Landings are available by port area (county, parish, or district); for simplicity, the principal ports are used to designate these areas.
b/ Listed in descending order by pounds landed (primarily gutted weight).
c/ Includes only those port areas with snapper or grouper landings that exceeded 100 thousand pounds.
d/ Gulf red snapper is the predominant snapper landed at most of the ports listed. The exceptions are yellowtail snapper at Key West and Miami, Fla. and mutton snapper at Riviera Beach, Fla.
e/ Red grouper is the predominant grouper landed at the ports listed.
f/ Includes only those port areas with snapper and grouper landings (combined) that exceeded 360 thousand pounds.
Source: Landings compiled from U.S. Department of Commerce (1973-75).
Source: Allen and Tashiro, 1976.

Appendix Table 28. U.S. commercial landings of reef fish by U.S. fishery craft by distance caught off U.S. shores and caught in international waters off foreign shores, and Gulf of Mexico landings, 1971-1977

Species	Distance caught off U.S. shores			Caught in international waters off foreign shores	Total	Percent of total U.S. landings caught in the Gulf of Mexico
	0-3 Miles	3-12 Miles	12-200 Miles			
	Thousand Pounds (percent)					
Grouper						
1971	524 (7.0)	1,264 (16.8)	5,339[a] (71.1)	381 (5.1)	7,508	92.0
1972	277 (3.6)	1,285 (16.8)	5,649[a] (74.0)	423 (5.5)	7,634	92.3
1973	425 (6.1)	1,172 (16.9)	5,063 (72.9)	287 (4.1)	6,947	80.8
1974	501 (6.7)	1,212 (16.2)	5,303 (70.7)	484 (6.5)	7,500	86.1
1975	515 (7.4)	1,109 (15.9)	5,071 (72.7)	279 (4.0)	6,974	100.0[c]
1976	275 (3.0)	1,305 (14.1)	7,507 (81.2)	155 (1.7)	9,242	74.8
1977	251 (3.7)	6,270[b] (91.5)		335 (4.9)	6,856	
Red Snapper						
1971	83 (0.9)	503 (5.7)	6,723[a] (76.5)	1,476 (16.8)	8,785	96.3
1972	143 (1.7)	823 (9.6)	5,872[a] (68.5)	1,734 (20.2)	8,572	99.2
1973	109 (1.2)	579 (6.5)	7,073 (79.7)	1,118 (12.6)	8,879	92.2
1974	70 (0.9)	681 (8.3)	6,677 (81.4)	778 (9.5)	8,206	100.0[c]
1975	61 (0.7)	667 (7.9)	6,911 (81.6)	829 (9.8)	8,468	91.8
1976	124 (1.3)	632 (6.9)	7,505 (81.4)	955 (10.4)	9,216	76.9
1977	197 (3.1)	5,748[b] (89.7)		466 (7.3)	6,411	

Continued

Appendix Table 28. U.S. commercial landings of reef fish by U.S. fishery craft by distance caught off U.S. shores and caught in international waters off foreign shores, and Gulf of Mexico landings, 1971-1977 (continued)

Species	Distance caught off U.S. shores			Caught in international waters off foreign shores	Total	Percent of total U.S. landings caught in the Gulf of Mexico
	0-3 Miles	3-12 Miles	12-200 Miles			
	Thousand Pounds (percent)					
Other Snapper						
1971	158 (7.4)	1,119 (52.7)	846[a] (39.8)		2,123	86.4
1972	140 (5.3)	1,368 (51.8)	1,064[a] (40.3)	67 (2.5)	2,639	66.9
1973	844 (33.2)	653 (25.7)	979 (38.5)	66 (2.6)	2,542	72.9
1974	832 (31.8)	597 (22.8)	1,049 (40.1)	139 (5.3)	2,617	75.9
1975	1,037 (38.7)	593 (22.1)	868 (32.4)	180 (6.7)	2,678	66.9
1976	365 (14.7)	864 (34.8)	1,187 (47.7)	70 (2.8)	2,486	83.9
1977	314 (17.7)	1,303[b] (73.3)		160 (9.0)	1,777	
Scup (Porgy)						
1971	2,851 (31.9)	1,397 (15.6)	4,690[a] (52.5)	-	8,938	1.0
1972	1,086 (13.3)	1,186 (14.5)	5,915[a] (72.2)	-	8,187	1.0
1973	4,965 (46.2)	1,482 (13.8)	4,311 (40.1)	-	10,758	0.7
1974	6,735 (44.0)	1,216 (7.9)	7,371 (48.1)	-	15,322	0.5
1975	7,667 (45.7)	797 (4.8)	8,302 (49.5)	-	16,766	0.6
1976	6,142 (38.4)	1,310 (8.2)	8,546 (53.4)	-	15,998	0.8
1977	9,157 (47.9)	9,955[b] (52.1)			19,112	

Continued

Appendix Table 28. U.S. commercial landings of reef fish by U.S. fishery craft by distance caught off U.S. shores and caught in international waters off foreign shores, and Gulf of Mexico landings, 1971-1977 (continued)

Species	Distance caught off U.S. shores			Caught in international waters off foreign shores	Total	Percent of total U.S. landings caught in the Gulf of Mexico
	0-3 Miles	3-12 Miles	12-200 Miles			
	Thousand Pounds (percent)					
Warsaw Grouper						
1971	-	31 (13.0)	187[a] (78.2)	21 (8.8)	239	69.5
1972	-	16 (8.4)	145[a] (76.3)	29 (15.3)	190	82.6
1973	-	25 (14.3)	150 (85.7)	-	175	68.6
1974	-	28 (15.4)	144 (79.1)	10 (5.5)	182	64.8
1975	-	25 (14.7)	143 (84.1)	2 (1.2)	170	79.4
1976	-	25 (13.2)	165 (86.8)	-	190	77.4
1977	25 (10.6)	210[b] (89.4)		-	235	

[a] Greater than 12 miles.

[b] Three to 200 miles.

[c] Apparently there are data discrepancies.

Sources:

(1) U.S. National Marine Fisheries Service. Fisheries of the United States. Washington: U.S. Government Printing Office. Annual issues, 1971-1977.

(2) U.S. National Marine Fisheries Service. Fishery Statistics of the United States. Washington: U.S. Government Printing Office. Annual issues, 1971-1974.

(3) U.S. National Marine Fisheries Service, Current Fisheries Statistics, Landings for the Gulf States. Washington: U.S. Government Printing Office. Annual issues, 1975-1976.

Appendix Table 29. Number of commercial vessels in the Gulf of Mexico reef fish handline fishery, 1957-1974[a]

Year	Florida	Alabama	Mississippi	Louisiana	Texas	Total Gulf
1957	108	11	5	2	129	255
1958	120	11	7	5	89	232
1959	300	12	8	12	158	490
1960	179	12	11	13	118	333
1961	219	13	12	30	151	425
1962	232	15	12	36	152	447
1963	280	22	13	30	118	464
1964	334	22	14	23	93	486
1965	377	20	14	23	85	519
1966	274	22	17	13	64	390
1967	267	19	20	6	66	378
1968	256	12	21	5	50	344
1969	242	12	20	5	46	325
1970	257	11	19	6	23	316
1971	282	11	20	7	30	350
1972	306	12	21	11	45	395
1973	331	11	19	13	41	415
1974	353	11	18	13	40	435

[a]The above data were taken from a table listing number of vessels by gear type. These numbers represent the number of vessels using handlines. Most reef fish are landed by handline vessels. However, a relatively small quantity of other species are also landed by handline vessels. The ratio of reef fish to other species landed by handline vessels may differ among states in some years.

Source: U.S. National Marine Fisheries Service (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues, 1952-1974.

Appendix Table 31. Trend equations for total commercial vessels in Gulf of Mexico snapper-grouper fishery

DEPENDENT VARIABLE	Time[a]				R^2	F Statistic	Durbin Watson Statistic	Mean	Std. Dev.
	CONSTANT	T	T^2	T^3					
Florida vessels	175.8 (6.808)	8.8431 (3.706)	-	-	.46	13.737	1.32	259.83	67.502
Alabama vessels	7.456 (2.911)	2.2842 (3.680)	-0.23603 (-3.971)	-	.52	8.167	.76	14.389	4.2575
Mississippi vessels	6.732 (6.408)	.87616 (9.028)	-	-	.84	81.503	.48	15.056	4.9718
Louisiana vessels	8.007 (1.041)	2.5610 (1.374)	-.15602 (-1.637)	-	.19	1.760	.44	14.056	9.8289
Texas vessels	152.0	-7.2353	-	-	.74	45.109	1.34	83.278	43.691

[a]Numbers in parenthesis are T-values.

Source: Calculated by authors.

Appendix Table 31. Average commercial vessel size in gross tons in the Gulf of Mexico reef fish handline fishery, 1957-1974

Year	Florida West Coast	Alabama	Mississippi	Louisiana	Texas	Total Gulf
1957[a]	27.19	43.64	20.80	17.00	39.57	33.96
1958[a]	25.05	47.55	27.71	20.40	40.21	31.91
1959[a]	28.59	51.08	32.75	22.75	40.14	32.79
1960	18.44	51.08	37.64	38.92	50.49	32.41
1961	20.93	46.92	38.00	42.93	49.74	33.99
1962	21.97	49.27	40.42	41.81	49.11	34.20
1963	24.63	52.45	41.08	40.77	41.51	31.78
1964	25.27	52.32	42.64	49.57	44.49	31.83
1965	22.08	55.75	52.14	52.52	44.61	29.23
1966	23.82	57.50	58.00	59.54	45.25	31.92
1967	24.64	57.63	66.75	63.17	47.30	33.10
1968	24.83	58.50	65.76	66.40	52.72	33.16
1969	26.82	58.50	66.65	66.40	52.72	34.71
1970	27.37	60.64	68.32	59.67	52.26	33.42
1971	27.39	60.82	70.05	53.29	53.93	33.67
1972	24.67	63.08	70.81	50.00	50.44	31.93
1973	24.35	64.73	71.79	54.85	45.17	30.61
1974	29.38	68.91	73.00	59.46	44.75	34.49

[a]Data reported in net tons and converted to gross tons based on statistical procedure yielding conversion factor of 1.5249.

Derived from: U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office. Annual issues, 1957-1974.

Appendix Table 32. Trend equations for Gulf of Mexico snapper-grouper commercial vessel size, 1957-74

DEPENDENT VARIABLE	Time[a]				R^2	F Statistic	Durbin Watson Statistic	Mean	Std. Dev.
	CONSTANT	T	T^2	T^3					
Average Gulf of Mexico vessel size	33.39 (28.282)	-0.20757 (-0.725)	0.0111 (0.762)	-	.19	.751	1.56	32.728	1.3843
Florida vessel size	23.46 (18.108)	0.16446 (1.374)	-	-	.11	1.888	1.58	25.019	2.6260
Alabama vessel size	43.95 (49.582)	1.2240 (14.947)	-	-	.93	223.418	1.34	55.577	6.5736
Mississippi vessel size	22.42 (10.826)	3.1604 (16.521)	-	-	.94	272.929	.55	52.442	16.870
Louisiana vessel size	25.46 (5.652)	2.3258 (5.550)	-	-	.66	30.807	.36	47.733	14.874
Texas vessel size	42.53 (20.830)	0.46155 (2.447)	-	-	.27	5.988	.91	46.912	4.5886

[a]Numbers in parenthesis are T-values.

Source: Calculated by authors.

Appendix Table 33. Commercial landings of Gulf of Mexico reef fish by gear type and state, 1972-1974 average

Gear Type	Amberjack	Grouper	Grunts
	----------Thousand Pounds----------		
Florida			
Haul seines, common	0.1		4.4
Purse seines and lampara nets			
Otter trawls, shrimp			
Pots & traps, spiny lobster		1.7	
Pots & traps, fish			79.6
Gill nets, runaround	3.2		41.9
Trammel nets			0.3
Hand lines	43.5	5,890.3	131.7
Troll lines			
Albama			
Otter trawls, shrimp		10.6	
Hand lines		174.6	
Mississippi			
Otter trawls, shrimp		3.7	
Otter trawls, fish			
Pots & traps, spiny lobster			
Hand lines		190.2	
Louisiana			
Otter trawls, shrimp		5.0	
Hand lines		0.1	
Texas			
Otter trawls, shrimp		17.0	
Hand lines		77.3	

Appendix Table 33. Commercial landings of Gulf of Mexico reef fish by gear type and state, 1972-1974 average, (contd.)

Gear Type	Sea bass	Jewfish	Scup (Porgies)	Mangrove snapper (Gray snapper)
	----------Thousand Pounds----------			
Florida				
Haul seines, common		2.9		13.0
Purse seines and lampara nets				
Otter trawls, shrimp		3.7	0.1	
Pots & traps, spiny lobster				
Pots & traps, fish	68.8			
Gill nets, runaround				118.7
Trammel nets				31.6
Hand lines	14.8	151.0	77.9	394.6
Troll lines				
Alabama				
Otter trawls, shrimp		5.7		
Hand lines		50.5		
Mississippi				
Otter trawls, shrimp				
Otter trawls, fish				
Pots & traps spiny lobster				
Hand lines				
Louisiana				
Otter trawls, shrimp		1.8		
Hand lines		0.1		
Texas				
Otter trawls, shrimp				
Hand lines				

Appendix Table 33. Commercial landings of Gulf of Mexico reef fish by gear type and state, 1972-1974 average, (contd.)

Gear Type	Lane Snapper	Red Snapper	Total Caught	State Total Reef Fish	Percent Caught By Gear Type
	----------	----------	Thousand Pounds	----------	----------
Florida				12,603.8	
Haul seines, common			20.4		0.2
Otter trawls, shrimp	1.6	21.1	26.5		0.2
Pots & traps, spiny lobster			1.7		(b)
Pots & traps, fish			148.4		1.2
Gill nets, runaround			163.8		1.3
Trammel nets			31.9		0.3
Hand lines	17.9	4,000.4	12,211.1[a]		96.9
Alabama				1,208.7	
Otter trawls, shrimp		282.4	298.7		24.7
Hand lines		684.9	910.0		75.3
Mississippi				2,360.0	
Otter trawls, shrimp		17.4	21.1		0.9
Otter trawls, fish		3.4	3.4		0.1
Pots & traps, spiny lobster		0.1	0.1		(b)
Hand lines		2,144.7	2,334.9		98.9
Louisiana				306.7	
Otter trawls, shrimp		161.8	168.6		55.0
Hand lines		138.0	138.2		45.1
Texas				1,015.0	
Otter trawls, shrimp		146.1	163.1		16.1
Hand lines		774.7	852.0		83.9

[a]This total does not equal the sum of the individual figures because it also includes 1,488,999 pounds of mutton snapper, vermilion snapper, yellowtail snapper, tilefish, triggerfish, and warsaw grouper caught by handlines.

(b) Less than .05

Source: U.S. National Marine Fisheries Service, Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual Issues, 1957-1974.

Appendix Table 34. U.S. commercial landings of Gulf of Mexico red snappers by gear-type and state, 1957-1974

Year	Florida West Coast					Alabama		
	Hand Lines	Otter trawls, Shrimp	Otter trawls, Fish	Long or Set Lines	Otter Trawls	Otter trawls, Shrimp	Hand Lines	Otter Trawls
	Thousand Pounds							
1957	5,586.9						916.8	16.1
1958	5,844.3						1,365.3	52.6
1959	5,399.8						1,791.2	27.9
1960	5,447.0						1,683.0	37.1
1961	5,445.6				0.3		1,761.2	23.0
1962	5,375.0						1,857.4	36.0
1963	5,916.3			1.5			2,303.0	11.9
1964	6,455.5		76.7			18.7	2,374.2	
1965	6,071.6					60.8	2,434.3	
1966	5,185.1	5.0				109.2	2,592.1	
1967	5,047.3	6.0				161.0	2,127.4	
1968	4,306.3	1.6				313.2	900.6	
1969	4,278.8	0.3				214.0	1,031.9	
1970	3,864.2					228.6	754.6	
1971	3,877.5					181.6	757.6	
1972	3,691.3					223.7	826.9	
1973	3,698.3	63.3				309.1	651.3	
1974	4,611.5					314.5	576.4	

Continued

Appendix Table 34. Commercial landings of Gulf of Mexico red snappers by gear-type and state, 1957-1974, (contd.)

Year	Mississippi					Louisiana			
	Otter Trawls, Fish	Otter Trawls, Shrimp	Hand Lines	Pots & Traps, Spiny Lobster	Otter Trawls	Otter Trawls, Shrimp	Hand Lines	Otter Trawls, Fish	Otter Trawls
	Thousand Pounds								
1957			544.5		5.1		12.8		15.4
1958			1,066.0		43.9		26.9		60.9
1959			1,017.0		4.7		251.2		61.8
1960			1,467.0		1.5		372.7		53.3
1961			2,149.0		2.7		427.0		250.2
1962			2,175.8		0.1		522.7		171.2
1963			1,881.8		4.0		309.1		78.8
1964	0.2	10.1	1,838.9			63.9	246.0		
1965	2.2	12.4	2,350.9			93.0	149.8		
1966	0.7	7.0	2,767.2			119.3	88.4		
1967		20.3	2,870.8 [1]			183.2	118.6		
1968	2.5	71.8	3,651.4			133.2	143.7		
1969	5.0	25.2	2,937.7			69.6	60.0		
1970	5.9	28.5	2,484.6			226.1	28.7		
1971	6.1	11.6	2,381.3			133.7	23.9	4.0	
1972	2.6	14.1	2,249.1			196.6	62.4		
1973	2.9	19.9	2,308.2	0.2		176.1	117.8		
1974	4.6	18.3	1,876.9			12.6	173.8		

Continued

Appendix Table 34 Commercial landings of Gulf of Mexico red snappers by gear-type and state, 1957-1974, (continued)

Year	Texas		
	Otter Trawls, Shrimp	Hand Lines	Otter Trawls
	Thousand Pounds		
1957		1,404.3	38.7
1958		1,341.9	57.1
1959		1,630.5	34.6
1960		1,140.7	11.9
1961		1,799.1	29.8
1962		1,708.6	33.7
1963		2,115.5	53.2
1964	116.3	2,133.5	
1965	84.1	2,127.7	
1966	86.7	1,566.4	
1967	111.3	1,297.3	
1968	81.5	1,046.0	
1969	148.0	776.7	
1970	139.7	776.7	
1971	157.1	925.3	
1972	197.6	1,040.4	
1973	126.2	655.2	
1974	114.4	628.5	

Source: U.S. National Marine Fisheries Service, Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual Issues, 1957-1974.

Appendix Table 35. Commercial landings of Gulf of Mexico groupers by gear type and state, 1957-1974

Year	Alabama				Mississippi				
	Otter Trawls, Shrimp	Hand Lines	Trammel Nets	Otter Trawls	Otter Trawls, Shrimp	Hand Lines	Pots & Traps Spiny lobster	Otter Trawls, Fish	Otter Trawls
	Thousand Pounds								
1957		109.0		2.3		19.0			
1958		169.2		2.8		34.0			1.4
1959		229.1		2.3		73.5			2.0
1960		235.1		0.8		114.0			1.2
1961		220.1		1.2		135.4			
1962		233.5		3.9		246.1			
1963		294.5		1.0		271.4			
1964	0.6	303.9			1.2	267.2			
1965	1.7	386.8			0.6	321.1		0.4	
1966	3.5	379.2	0.1			235.3			
1967	10.6	307.6			5.4	182.6			
1968	15.1	290.9			4.8	324.0			
1969	10.6	238.2			2.8	263.7			
1970	10.8	254.7			1.2	264.4			
1971	6.9	172.9			1.4	226.6		0.2	
1972	7.0	221.8			6.4	225.0	1.1		
1973	13.8	183.9			4.0	215.0	0.4		
1974	11.0	118.0			0.6	130.4			

(continued)

Appendix Table 35. Commercial landings of Gulf of Mexico groupers by gear type and state, 1957-1974 (continued)

Year	Louisiana			Texas		
	Otter Trawls, Shrimp	Hand Lines	Otter Trawls	Otter Trawls, Shrimp	Hand Lines	Otter Trawls
	----------Thousand Pounds----------					
1957			0.3		47.6	0.7
1958					30.4	0.3
1959		11.9			110.7	1.0
1960		21.4	2.8		43.2	
1961		13.5	2.3		53.9	2.2
1962		45.4	7.3		109.1	4.7
1963		18.6	4.8		151.5	4.1
1964	3.9	8.8		4.8	186.7	
1965	2.0	11.3		5.4	129.4	
1966	3.5	12.3		4.3	84.8	
1967	1.0	2.2		6.6	69.5	
1968	3.5	2.7		8.5	84.5	
1969	2.4	1.2		8.5	44.1	
1970	4.5	0.3		9.0	50.3	
1971	2.9			16.3	121.3	
1972	5.0			30.6	66.9	
1973	7.9	0.1		13.8	86.5	
1974	2.1	0.3		6.5	78.5	

(continued)

Appendix Table 35. Commercial landings of Gulf of Mexico grouper by gear type and state, 1957-1974 (continued)

Year	Florida West Coast						
	Otter Trawls, Shrimp	Pots & Traps, Spiny Lobster	Hand Lines	Otter Trawls, Fish	Pots & Traps	Long or Set Lines	Haul Seines
	----------Thousand Pounds----------						
1957			6,482.6				
1958			4,154.8				
1959			5,750.3				
1960			5,922.5				0.2
1961			6,370.5				
1962			6,976.7				
1963			6,552.3		2.0	24.4	
1964		10.0	7,634.5	17.7			
1965		10.5	8,206.4				
1966	2.1	12.0	7,154.9				
1967	29.0	13.0	6,364.6				
1968	6.2	40.0	6,130.3				
1969	4.0	30.9	7,036.6				
1970		49.0	6,852.5				
1971		47.3	6,308.9				
1972		5.1	6,473.7				
1973			5,086.4				
1974			6,110.8				

Source: U.S. National Marine Fisheries Service, Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual Issues, 1957-1974.

Appendix Table 36. Commercial catch and effort of Cuban grouper fishermen on the west coast of Florida, 1940-1976.

Year	Catch		Launch days fished	Catch per launch day fished	
	metric tons	thousand pounds		kilograms	pounds
1940	1,508	3,325	5,010	301	664
1941	1,537	3,388	4,892	314	692
1942	1,914	4,220	5,842	328	723
1943	1,742	3,840	5,423	321	708
1944	2,592	5,714	7,062	367	809
1945	2,914	6,424	7,866	376	829
1946	3,701	8,159	8,897	416	917
1947	4,326	9,537	10,859	398	877
1948	4,740	10,450	11,599	409	902
1949	4,658	12,474	11,797	395	871
1950	4,713	10,390	11,438	412	908
1951	5,033	11,096	11,927	422	930
1952	4,477	9,870	11,892	411	906
1953	4,968	10,952	14,263	348	767
1954	5,722	12,615	15,029	381	840
1955	6,050	13,338	19,182	315	694
1956	4,880	10,758	12,140	403	886
1957	5,301	11,687	12,867	412	908
1958	4,939	10,889	15,748	313	690
1959	3,468	7,646	13,983	248	547
1960	2,708	5,970	13,021	208	459
1961	1,453	3,203	7,940	183	403
1962	930	2,050	4,604	202	445
1963	994	2,191	5,231	190	419
1964	417	919	2,452	170	375
1965	869	1,916	5,715	152	335
1966	1,188	2,619	9,337	127	280
1967	1,542	3,399	8,602	179	395
1968[a]	1,514	3,338	9,462	160	353
1969	1,458	3,214	9,467	154	340
1970	2,581	5,690	14,478	178	392
1971	1,482	3,267	11,202	132	291
1972[b]	2,224	4,903	12,708	175	386
1973	2,004	4,418	11,206	179	394
1974	1,905	4,200	14,767	129	284
1975	2,207	4,866	18,090	188	269
1976	2,505	5,533	19,269	130	287

[a] Best data from 1968 - present standard lambda vessels comprise whole fleet.

[b] Greater efficiency - fishing flotillas, better electronics gear, etc. 1972 to present.

Source: Klima, Edward. Commercial catch and effort of Cuban grouper fishermen on the west coast of Florida (this information presented to Dr. Klima by Cuban officials during May 1977). U.S. National Marine Fisheries Service, SEFC, May 1977.

Appendix Table 37. Comparison of data on Cuban commercial fish catches in Florida for 1971-1975.

Year	Grouper and snapper catch from Tashiro and Coleman, (1977)	Catch of Cuban grouper fishermen [a]
	Thousand pounds	
1971	3,960	3,267
1972	3,780	4,903
1973	4,960	4,418
1974	3,520	4,200
1975	4,880	4,866

[a] From Appendix Table 39.

Appendix Table 38. Recorded commercial imports of snapper into Gulf states, 1952-1972[1]

Year	Product form				
	Snapper	Snapper filets	Red snapper	Red snapper filets	Other[2]
	----------Thousand Pounds----------				
1952			713.6		
1953			759.5		
1954			768.8		
1955			724.7		
1956			730.9	0.6	
1957			589.6	24.4	
1958			587.6	12.8	
1959		202.0	314.9	12.9	
1960			243.8	230.7	
1961		376.4	513.4		
1962		60.4	563.8	80.5	
1963		25.9	576.1	168.5	25.2
1964		73.8	1,063.7	93.7	3.6
1965		142.5	719.7	360.8	9.9
1966		163.1	566.2	484.0	25.2
1967		94.0	566.2	272.2	19.3
1968		435.1	185.7		
1969	2.0	392.4	339.1		0.7
1970	20.6	358.4	363.9		
1971	5.3	142.0	183.4		1.2
1972	141.1	12.2	208.7	299.3	71.0

[1]Ports included and recording imports were: Port Isabel-Brownsville, New Orleans, Morgan City, Miami, Houston (started collecting data in 1963) and Tampa (started collecting data in 1967). Ports included but recording no imports were: Mobile, Freeport, Port Arthur-Orange.

[2]Includes red snapper steaks, throats and flanks, and dressed.

Source: U.S. National Marine Fisheries Service. "Production of Fishery Products in Selected Areas of Florida, Alabama, Mississippi, Louisiana, Texas." Market News Annual Summary, Gulf Fisheries. New Orleans: 1972.

Appendix Table 39. Commercial Imports of snapper, snapper filets, and other snapper products into Gulf of Mexico ports, 1973-1977.

Years	Snapper	Filets	Other[a]
	(Thousands of Pounds)		
1973	1,095.9	1,649.8	124.2
1974	1,700.2	1,384.1	70.7
1975	2,283.2	1,531.3	58.3
1976	1,844.0	2,025.5	50.8
1977	2,699.3	997.4	15.9

[a]Includes steaks, heads, throats, tails, flanks, slabs, portions, and dressed.

Source: U. S. National Marine Fisheries Service. Unpublished data about imports of snapper and grouper and associated products into Gulf of Mexico ports, 1973-1977. New Orleans: March 1978.

Appendix Table 40. Recorded commercial imports of grouper into Gulf Coast states, 1952-1972[1]

Year[2]	Product form			
	Grouper	Grouper filets	Steaks	Other[3]
	----------Thousand pounds----------			
1953		4.0		
1955		1.7		
1959		237.0		
1960		62.3		
1961		173.9		
1962	33.9	644.0	32.2	0.1
1963	24.0	1,082.9	199.0	
1964	70.6	1,812.1	292.7	
1965	143.8	1,989.7	182.9	0.5
1966	54.8	2,535.0	207.3	1.5
1967	60.4	264.0	7.1	
1968		302.9		27.8
1969	20.6	453.3		17.6
1970	54.1	305.9		
1971		230.9		106.7
1972	17.7	3,026.3		97.2
1973	221.4	2,378.5		26.9
1974	191.3	1,425.4		42.7
1975	184.5	1,684.3		500.6
1976	248.8	1,844.7	25.2	1,882.4
1977	539.0	2,166.3		638.5

[1]Ports included and recording imports were: Port Isabel-Brownsville, New Orleans, Morgan City, Miami, Tampa (started collecting data in 1967). Ports included but recording no imports were: Mobile, Houston, Freeport, and Port Arthur-Orange.

[2]No imports recorded for 1952, 1954, 1956-1958.

[3]Includes grouper chunks, chips, throats, fingers, heads, and breasts, dressed, and portions.

Source: U.S. National Marine Fisheries Service. "Production of Fishery Products in Selected Areas of Florida, Alabama, Mississippi, Louisiana, Texas." Market News Annual Summary, Gulf Fisheries. New Orleans: 1972.

Appendix Table 41. Recorded commercial imports of grouper and snapper into Gulf of Mexico ports, 1977

Exporting Country	Snapper	Grouper
	----------Pounds----------	
Bahamas	5,400	
Belize	32,200	47,500
Bermuda		2,500
Brazil	10,000	
BWI	800	7,900
Canada	400	
Columbia	49,700	17,300
Costa Rica	100,400	103,700
Ecuador	66,400	24,600
French Guiana	117,200	
Guatemala	79,700	900
Honduras	39,300	10,100
Mexico	1,717,000	3,094,400
Nicaragua	1,196,100	36,850
Panama	32,800	
Peru	4,000	
South Africa		10,900
Taiwan	97,500	
Thailand	5,200	
Venezuela	116,300	
Total	3,670,500	3,356,650

Source: U. S. National Marine Fisheries Service. Unpublished data about imports of snappers and grouper and associated products into Gulf of Mexico ports, 1973-1977. New Orleans: March 1978.

Appendix Table 42. Average crew size for commercial vessels in the Gulf of Mexico handline fishery.

Year	Florida	Alabama	Mississippi	Louisiana	Texas	Weighted Total Gulf Average
1957	4.43	7.82	5.80	7.00	3.38	4.09
1958	5.14	7.82	5.43	6.20	4.02	4.87
1959	3.79	7.92	5.88	6.33	3.16	3.79
1960	5.03	7.92	7.27	5.08	3.64	4.72
1961	4.78	9.15	7.83	4.33	3.46	4.50
1962	4.55	9.13	8.92	5.56	3.65	4.60
1963	4.35	9.14	9.00	5.73	4.58	4.86
1964	4.10	8.77	9.00	5.09	5.33	4.74
1965	3.96	9.20	9.79	4.52	5.21	4.24
1966	4.16	9.95	9.59	4.54	6.16	5.07
1967	4.06	9.53	10.00	3.00	5.42	4.88
1968	3.96	9.00	9.57	3.00	4.76	4.58
1969	4.03	9.00	9.50	3.00	4.61	4.62
1970	3.62	7.09	9.21	3.67	4.26	4.12
1971	3.70	7.09	9.20	3.57	5.30	4.25
1972	3.39	7.17	9.14	3.55	5.16	4.02
1973	3.37	7.00	9.16	3.46	5.20	3.91
1974	3.44	7.27	9.06	3.62	5.03	3.92

Derived from: U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States, Washington: U.S. Government Printing Office. Annual issues.

Appendix Table 43. Trend equations for average crew size in the Gulf of Mexico commercial handline fishery.

DEPENDENT VARIABLE	CONSTANT	Time (T) [a]		R^2	F STATISTIC	Durbin Watson Statistic	MEAN	STD. DEV.
		T	T^2					
Florida crew size	4.880 (31.798)	-.081749 (-5.766)	-	.68	33.244	2.82	4.1035	.51620
Alabama crew size	6.989 (15.258)	.51257 (4.618)	-.038183 (-5.303)	.70	16.624	1.28	8.3316	.94492
Mississippi crew size	6.589 (13.477)	.20372 (4.510)	-	.56	20.342	.28	8.5244	1.4127
Louisiana crew size	6.427 (19.410)	-.20146 (-6.586)	-	.73	43.371	1.00	4.5133	1.2229
Texas crew size	3.535 (11.086)	.10927 (3.079)	-	.46	13.760	.88	4.5731	.83375
Gulf of Mexico crew size	4.025	.16575 (2.869)	.00997 (-3.373)	.49	7.187	2.98	4.4322	.3838

[a]Numbers in parenthesis are t-values.

Source: Calculated by authors.

Appendix Table 44. Processed commercial snapper products in the Gulf of Mexico by state, 1957-1974[a]

Year	Florida, West Coast		Alabama		Mississippi		Louisiana		Texas	
	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars
1957	53,322	44,253	16,300	10,590						
1958	565,350	949,377	(b)	(b)						
1959	55,575	38,361	(b)	(b)						
1960	37,003	27,425	(b)	(b)					(b)	(b)
1961	23,763	20,123	(b)	(b)						
1962	56,808	43,123	(b)	(b)			(b)	(b)	(b)	(b)
1963	150,006	130,515	(b)	(b)			(b)	(b)	(b)	(b)
1964	230,581	47,316	(b)	(b)						
1965	198,097	172,082	(b)	(b)						
1966	130,475	127,300	46,600	39,960						
1967	137,882	158,570	41,200	33,446						
1968	90,029	91,052	(b)	(b)						
1969	(b)	(b)	(b)	(b)			(b)	(b)		
1970	(b)	(b)	(b)	(b)						
1971	117,104	208,555	(b)	(b)						
1972	(b)	(b)	(b)	(b)						
1973	(b)	(b)	(b)	(b)						
1974	107,077	181,165								

[a]Processed snapper products consist of fresh and frozen filets, frozen stuffed specialities, steaks, etc.

(b) Included in a category labeled unclassified.

Source: U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues.

Appendix Table 45. Processed commercial grouper products in the Gulf of Mexico by state, 1957-1974[a]

	Florida, West Coast		Alabama		Mississippi		Louisiana		Texas	
Year	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars
1957	263,326	106,119	55,000	26,000						
1958	412,846	182,263	(b)	(b)						
1959	283,714	117,947								
1960	246,346	104,146	(b)	(b)						
1961	195,703	85,360	(b)	(b)						
1962	305,101	128,842	(b)	(b)			(b)	(b)		
1963	573,728	236,727	(b)	(b)	(b)	(b)				
1964	1,007,620	448,229	(b)	(b)	(b)	(b)				
1965	1,197,436	499,225	(b)	(b)	(b)	(b)				
1966	401,985	206,200	(b)	(b)	(b)	(b)				
1967	347,803	196,043	(b)	(b)	(b)	(b)				
1968	179,787	117,845	(b)	(b)	(b)	(b)				
1969	(b)	(b)	(b)	(b)	(b)	(b)				
1970	(b)	(b)	(b)	(b)						
1971	356,042	277,909	(b)	(b)						
1972	472,362	550,902	(b)	(b)						
1973[c]	1,769,719	1,155,074								
1974	375,306	325,337								

[a]Processed grouper products consist of fresh and frozen filets raw & breaded and steaks.

(b) Included in a category labeled unclassified.

[c]Source data incorrect for 1973 lising processed grouper as flounder.

Source: U.S. National Marine Fisheries Service, (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual issues.

Appendix Table 46. Gulf of Mexico processing and wholesaling plants and employment, 1970-1975.

Year	Processing			Wholesaling		
	Employees	Plants	Employees per Plant	Employees	Plants	Employees per Plant
1970	11,527	434	26.6	1,900	383	5.0
1971	11,488	428	26.7	1,968	333	5.9
1972	11,477	417	27.5	1,840	379	4.9
1973	11,405	407	28.0	1,771	378	4.7
1974	9,316	360	25.9	1,785	382	4.7
1975	9,058	350	25.9	1,976	373	5.3

Source: U.S. National Marine Fisheries Service. Fisheries of the United States. Washington: U.S. Government Printing Office. Annual issues.

Appendix Table 47. Gulf of Mexico total number of processing and wholesaling plants and employment, 1957-1975

Year	Employees	Plants	Employees per plant
1957	8,898	749	11.88
1958	9,795	727	13.47
1959	10,373	737	14.08
1960	11,259	743	15.15
1961	10,438	768	13.59
1962	10,082	820	12.30
1963	10,446	809	12.91
1964	11,804	780	15.13
1965	12,645	847	14.93
1966	12,822	839	15.28
1967	12,665	835	15.17
1968	12,767	831	15.36
1969	12,721	825	15.42
1970	13,427	817	16.43
1971	13,456	761	17.68
1972	13,317	796	16.73
1973	13,176	785	16.78
1974	11,101	742	14.96
1975	11,034	723	15.26

Sources: 1) U.S. National Marine Fisheries Service. Fisheries of the United States. Washington: U.S. Government Printing Office, Annual issues.

2) U.S. National Marine Fisheries Service (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office. Annual issues.

Appendix Table 48. Wholesale dealers and processors of Gulf of Mexico reef fish by state, 1976

State	Number of Plants	Employment
Florida	35	221
Alabama	1	11
Mississippi	1	16
Louisiana	0	0
Texas	2	26
Total	39	274

Source: Snell, James Ernest; Unplublished data about wholesale dealers and processors of Gulf of Mexico reef fish. NMFS, Miami: April 1978.

Appendix Table 49. Estimated catch and effort in the recreational fisheries for reef fish in the Gulf of Mexico

Species group	1960						
				Number caught by fishing method		Number caught by fishing area	
	Number of fish	Pounds of fish	Number of fishermen	Boat fishing	Shore fishing	Ocean	Sounds, Rivers, and Bays
	----------Thousands----------						
Groupers	9,346	74,770	238	8,747	599	-	-
Grunts	1,877	1,310	106	1,588	289	-	-
Jacks	4,324	24,200	183	1,764	2,560	-	-
Porgies	8,550	12,770	317	6,185	2,365	-	-
Snappers	3,414	9,560	183	3,152	262	-	-
Snapper, red	a	a	a	a	a	-	-
Snapper, yellowtail	20[b]	30	3	-	20	-	-
Total	27,531	122,640	c	21,436	6,095	-	-

Appendix Table 49. Estimated catch and effort in the recreational fisheries for reef fish in the Gulf of Mexico (continued)

Species group	1965						
				Number caught by fishing method		Number caught by fishing area	
	Number of fish	Pounds of fish	Number of fishermen	Boat fishing	Shore fishing	Ocean	Sounds, Rivers, and Bays
	Thousands						
Groupers	2,153	15,913	222	1,918	235	1,300	853
Grunts	2,440	1,502	110	400	2,040	665	1,775
Jacks	314	724	29	256	58	45	269
Porgies	9,360	9,197	550	5,822	3,538	2,055	7,305
Snappers	5,675	25,166	156	5,594	81	3,761	1,914
Snapper, red	4,434	18,288	205	4,411	23	4,184	250
Snapper, yellowtail	135	135	34	65	70	55	80
Total	24,511	70,925	c	18,466	6,045	12,065	12,446

Appendix Table 49. Estimated catch and effort in the recreational fisheries for reef fish in the Gulf of Mexico (continued)

Species group	1970						
				Number caught by fishing method		Number caught by fishing area	
	Number of fish	Pounds of fish	Number of fishermen	Boat fishing	Shore fishing	Ocean	Sounds, Rivers, and Bays
	Thousands						
Groupers	3,576	16,856	301	3,043	533	2,682	894
Grunts	20,645	11,430	203	16,425	4,220	13,934	6,711
Jacks	1,291	4,592	183	470	821	871	420
Porgies	15,202	26,995	706	7,977	7,225	1,375	13,827
Sea bass	1,260	1,786	28	1,260	-	-	1,260
Snappers	1,341	2,644	71	938	403	1,058	283
Snapper, red	3,676	11,638	315	3,463	213	2,365	1,311
Snapper, yellowtail	581	814	51	347	234	294	287
Total	47,572	76,755	c	32,691	13,649	22,579	22,473

Note: East and West Gulf are combined in this table because they were not separated in the 1960 saltwater angling survey.

[a] Not listed separately in the 1960 survey. Probably included under "snappers".

[b] Yellowtail snapper in the amount of 3,251,000 fish were listed separately as "yellowtail" by interviewees who did not realize this species should have been included in the "snappers" group. It is believed that this represents only part of the catch.

[c] The number of anglers is not additive because of duplication of anglers among species groups.

[d] May also include jack crevalle.

Sources: (1) Clark, J.R. The 1960 Salt-Water Angling Survey. U.S. Department of Interior, Fish and Wildlife.

(2) Duel, D.G. 1970 Salt-Water Angling Survey. U.S. Department of Commerce, National Marine Fisheries Service. Washington: U.S. Government Printing Office, April, 1973.

(3) Duel D.G. and J.R. Clark. The 1965 Salt-Water Angling Survey. U. S. Department of Interior, Fish Wildlife Service. Washington: U.S. Government Printing Office, 1968.

Appendix Table 50. Estimated number of finfish caught by marine recreational fishermen by species group and state of catch, Gulf region, 1975

Species	Florida West Coast	Alabama	Mississippi	Louisiana	Texas
		(Number of fish)			
Groupers	2,364	(1)	(1)	(1)	(1)
Grunts	2,663	(1)	(1)	(1)	(1)
Jacks	1,408	52	(1)	83	73
Porgies	1,824	100	(1)	(1)	(1)
Red Snapper	2,122	154	(1)	848	206
Sea bass	(1)	-	(1)	(1)	-
Snappers	2,637	(1)	(1)	(1)	(1)
Triggerfish	(1)	(1)	-	(1)	(1)

(1) Represents a species group reported caught on less than 10 questionnaires in a state.

Note: Severe methodological problems caused the standard error of estimates to exceed normal reporting limits. The data above should be used with caution.

Source: U. S. National Marine Fisheries Service. Unpublished data based on Southeastern Regional Survey of Saltwater Fishermen, 1974-75.

Appendix Table 51. Estimated weight of finfish caught by marine recreational fishermen by species group and state of catch, Gulf region, 1975

Species	Florida West Coast	Alabama	Mississippi	Louisiana	Texas
	(Thousands of pounds)				
Groupers	17,435	(1)	(1)	(1)	(1)
Grunts	1,994	(1)	(1)	(1)	(1)
Jacks[2]	3,704	272	(1)	1,774	1,029
Porgies	587	47	(1)	(1)	(1)
Red Snapper	4,048	343	(1)	3,129	477
Sea bass	(1)	-	(1)	(1)	-
Snappers	4,666	(1)	(1)	(1)	(1)
Triggerfish	(1)	(1)		(1)	(1)

(1) Represents a species group reported caught on less than 10 questionnaires in a state.

(2) May include jack crevalle.

Note: Severe methodological problems caused the standard error of estimates to exceed normal reporting limits. The data above should be used with caution.

Source: U. S. National Marine Fisheries Service. Unpublished data based on Southeastern Regional Survey of Saltwater Fishermen, 1974-75.

Appendix Table 52. Economic information about marine recreational reef fishing in the east Gulf of Mexico, 1975[a]

	Sales ($1,000)	Value-added ($1,000)	Wages & Salaries ($1,000)	Employment (person-years)	Annual capital expenditures ($1,000)
Fishing Tackle					
Manufacturing	3,219	2,032	885	141	141
Wholesale trade	3,612	337	264	28	22
Retail trade	7,677	2,935	891	129	219
Boats					
Manufacturing	12,172	5,341	2,583	360	149
Retail trade	18,212	2,890	1,366	177	104
Motors					
Manufacturing	1,993	905	337	22	59
Retail trade	2,718	422	205	28	17
Trailers					
Manufacturing	1,313	613	219	25	45
Retail trade	1,577	261	124	17	8
Marinas	21,015	8,405	5,675	571	422
Commercial Sport-fishing vessels	6,623	3,964	1,923	264	461
Fuel					
Manufacturing	4,290	700	79	6	194
Wholesale trade	6,392	613	132	14	96
Retail trade	7,531	1,226	430	93	62
Food	13,330	4,804	3,067	647	363
Lodging	4,053	2,122	1,074	222	110
Travel					
Manufacturing	6,828	1,181	160	11	304
Wholesale trade	10,162	975	247	25	155
Retail trade	11,961	1,386	871	152	98
Boat Insurance	4,902	1,138	430	37	-
Bait	12,453	2,479	1,020	155	76
Other	7,210	1,442	866	126	143
Total	119,262	46,171	22,848	3,250	3,248

[a] Includes Gulf Coast from the Florida Keys to and including the Mississippi River delta.

Note: The East Gulf reef fish recreational fishery was disaggregated into the following species: barracudas, groupers, grunts, jacks, porgies, snappers, red snapper, and yellowtail snapper.

Derived from: Centaur Management Consultants, Inc. and U.S. National Marine Fisheries Service Economic Activity Associated With Marine Recreational Fishing. Washington: U.S. Government Printing Office, June 1977.

Appendix Table 53. Economic information about marine recreational reef fishing in the west Gulf of Mexico, 1975[a]

	Sales ($1,000)	Value-added ($1,000)	Wages & Salaries ($1,000)	Employment (person-years)	Annual capital expenditures ($1,000)
Fishing Tackle					
Manufacturing	830	524	229	36	37
Wholesale trade	932	87	69	7	6
Retail trade	1,979	757	230	33	57
Boats					
Manufacturing	2,489	1,093	528	74	31
Retail trade	3,725	591	279	37	21
Motors					
Manufacturing	408	186	69	5	12
Retail trade	556	86	42	5	4
Trailers					
Manufacturing	269	125	44	5	9
Retail trade	322	54	25	4	1
Marinas	4,298	1,719	1,160	117	86
Commercial Sport-fishing vessels	906	542	263	37	63
Fuel					
Manufacturing	876	144	16	1	39
Wholesale trade	1,308	125	27	2	20
Retail trade	1,540	251	87	18	12
Food	3,440	1,239	791	167	93
Lodging	1,046	548	277	58	28
Travel					
Manufacturing	1,760	305	41	2	79
Wholesale trade	2,620	252	64	6	39
Retail trade	3,085	358	225	39	25
Boat Insurance	999	232	87	7	-
Bait	3,213	639	263	39	20
Other	1,859	372	224	33	37
Total	26,968	10,229	5,040	732	719

[a] Includes Gulf Coast from the Mississippi River delta to the Mexican border.

Note: The west Gulf reef fish recreational fishery was disaggregated into the following species: barracudas, groupers, grunts, jacks, porgies, snappers, red snapper, and yellowtail snapper.

Derived from: Centaur Management Consultants, Inc. and U.S. National Marine Fisheries Service Economic Activity Associated With Marine Recreational Fishing. Washington: U.S. Government Printing Office, June 1977.

Appendix Table 54. Annual participation, private and commercial recreational boats, 1973

		Private recreational boats	Commercial sportfishing boats
Total number of boats fishing in salt water[a]		348,595	437
Number of boats fishing in open ocean[a]		185,327	437
Number of fishing trips in open ocean[a]		2,592,956	59,066
Number of fishing days in open ocean[a]		2,839,222	60,521
Percentage of trips seeking:[b]			
	Groupers	14.1	36.3[c]
	Jacks	-	6.2[c]
	Grunts	2.7	-
	Porgies	0.8	-
	Snappers	-	36.4[c]
	Snapper, red	14.0	53.8[c]
	Snapper, yellowtail	-	15.1
Number of trips seeking:[b]			
	Groupers	365,607	21,441[c]
	Jacks	-	3,662[c]
	Grunts	70,010	-
	Porgies	20,744	-
	Snappers	-	21,500[c]
	Snapper, red	363,014	21,778[c]
	Snapper, yellowtail	-	8,919
Number of days seeking:[d]			
	Groupers	400,330	21,969[c]
	Jacks	-	3,752[c]
	Grunts	76,659	-
	Porgies	22,714	-
	Snappers	-	22,030[c]
	Snapper, red	397,491	32,560[c]
	Snapper, yellowtail	-	9,139

[a]Total for all species sought.

[b]For open ocean only. Does not include data for sounds, rivers, and bays.

[c]This species was named as being sought after by one or more respondents who refused to disclose the related number of fishing trips. As a result, the percentage (when compiled from the remaining respondent sample) associated with a particular species should be treated as a minimum estimate.

[d]Based on percentage of trips.

[e]May include jack crevalle.

Taken and Estimated From: Bromberg, K.M. Determination of the number of commercial and non-commercial recreational boats in the United States, their use, and selected characteristics. Final Report, NMFS Contract No. 3-35490 to Information Concepts, Incorporated. Distributed by NTIS, U.S. Department of Commerce, Washington, D.C., 1973.

Appendix Table 55. Estimated catch and effort in reef fish recreational fishing in the Gulf of Mexico

Species	Number of fish	Pounds of fish	Average size	Number of fishermen	Number of fish per fisherman	Pounds per fishermen
	-------- 1,000 --------		Pounds	--- 1,000 ---		
Sea bass						
1960	0	0	0	0	0	0
1965	0	0	0	0	0	0
1970	1,260	1,786	1.42	28	45.00	63.79
Groupers						
1960	9,346	74,770	.80	238	39.27	214.16
1965	2,153	15,913	7.39	222	9.70	71.68
1970	3,576	16,856	4.71	301	11.88	56.00
Grunts						
1960	1,877	1,310	.70	106	17.71	12.36
1965	2,440	1,502	.62	110	22.18	13.65
1970	20,645	11,430	.55	203	101.70	56.31
Jacks[d]						
1960	4,324	24,200	5.60	183	23.63	132.24
1965	314	724	2.31	29	10.83	24.97
1970	1,291	4,592	3.56	183	7.05	25.09
Porgies						
1960	8,550	12,770	1.45	317	26.97	40.28
1965	9,360	9,197	.98	550	17.02	16.72
1970	15,202	26,995	1.78	706	21.53	38.24
Snappers						
1960	2,414	9,560	2.00	183	18.66	52.24
1965	5,675	25,166	4.43	156	36.38	161.32
1970	1,341	2,644	1.97	71	18.89	37.24

Appendix Table 55. Estimated catch and effort in reef fish recreational fishing in the Gulf of Mexico (cont.)

Species	Number of fish	Pounds of fish	Average size	Number of fishermen	Number of fish per fisherman	Pounds per fishermen
	-------- 1,000 --------		Pounds	--- 1,000 ---		
Red Snapper						
1960	a	a	-	a	-	-
1965	4,434	18,288	4.12	205	21.63	89.21
1970	3,676	11,638	3.09	315	11.67	36.95
Yellowtail snapper						
1960	20[b]	30	1.50	3	6.67	10.00
1965	135	135	1.00	34	3.97	3.97
1970	581	814	1.40	51	11.39	15.96
Total reef fish						
1960	27,557	122,900	4.46	c	-	-
1965	24,626	71,562	2.91	c	-	-
1970	46,316	75,081	1.62	c	-	-

Note: East and West Gulf are combined in this table because they were not separated in the 1960 saltwater angling survey.

[a] Not listed separately in the 1960 survey. Probably included under "snappers".

[b] Yellowtail snapper in the amount of 3,251,000 fish were listed separately as "yellowtail" by interviewees who did not realize this species should have been included in the "snappers" group. It is believed that this represents only part of the catch.

[c] The number of anglers is not additive because of duplication of anglers among species groups.

[d] May include jack crevalle.

Sources: (1) Clark, J.R., The 1960 Salt-Water Angling Survey. U.S. Department of Interior, Fish Wildlife.

(2) Deuel, D.G., 1970 Salt-Water Angling Survey. U.S. Department of Commerce, National Marine Fisheries Service. Washington: U.S. Government Printing Office, April, 1973.

(3) Deuel, D.G. and J.R. Clark. The 1976 Salt-Water Angling Survey. U.S. Department of Interior, Fish Wildlife Service. Washington: U.S. Government Printing Office, 1968.

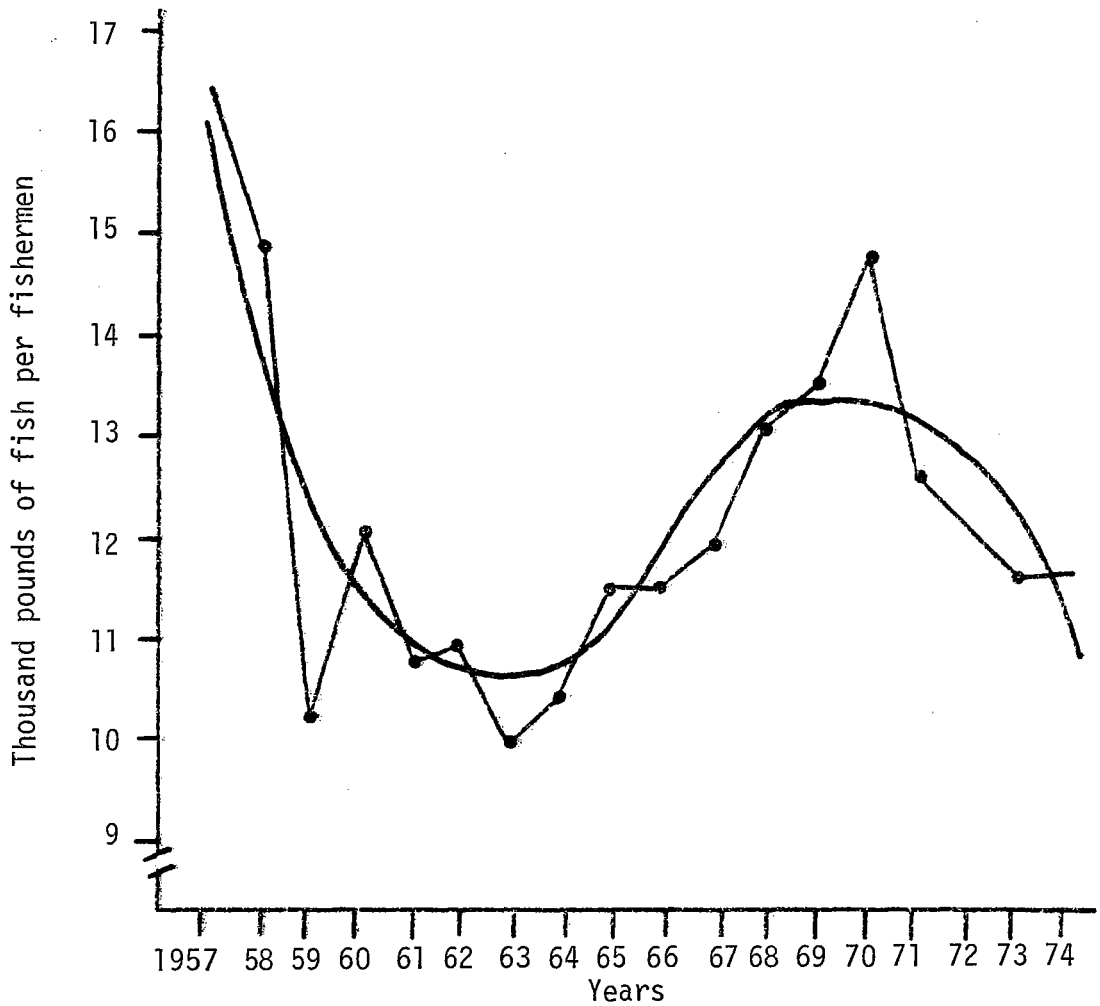


Figure 14. Quantity of Gulf of Mexico reef fish landed per commercial handline fisherman, 1957-1974.

Source: Derived from National Marine Fisheries Service data.

Appendix Table 56. Quantity of reef fish landed per commercial handline vessel in the Gulf of Mexico, 1957-1974[a]

Year	Florida West Coast	Alabama	Mississippi	Louisiana	Texas	Total Gulf
	(Thousands of pounds)					
1957	122.7	95.5	113.8	14.0	11.6	64.3
1958	93.3	145.2	163.6	100.6	16.4	68.5
1959	41.3	172.3	137.1	28.8	11.4	36.1
1960	70.8	163.3	121.9	36.4	10.4	52.0
1961	60.4	156.2	190.6	23.4	12.7	47.4
1962	61.1	143.1	201.8	20.9	12.7	48.0
1963	50.4	120.5	165.9	14.1	19.9	46.8
1964	47.9	128.0	151.2	14.3	26.6	48.9
1965	43.4	150.9	192.0	11.4	28.0	47.6
1966	50.9	144.7	177.1	17.5	27.3	56.7
1967	50.5	141.2	153.9	51.0	22.6	55.7
1968	52.0	136.3	193.1	56.8	24.6	59.6
1969	57.6	128.8	161.7	27.6	21.7	61.1
1970	52.4	120.1	146.6	44.3	42.4	59.5
1971	46.2	105.5	131.4	23.9	40.7	52.0
1972	42.0	113.3	119.0	24.0	29.7	46.3
1973	34.8	110.6	134.2	28.3	21.5	39.8
1974	38.2	95.4	112.8	22.2	20.7	40.7

[a] The above data were derived from a table listing number of vessels by gear type. These numbers represent the number of vessels using handlines. Most reef fish are landed by handline vessels. However, a relatively small quantity of other species are also landed by handline vessels. The ratio of reef fish to other species landed by handline vessels may differ among states in some years. This does not include sea bass since they are predominantly caught by traps.

Estimated from: U.S. National Marine Fisheries Service (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual Issues.

Appendix Table 57. Quantity of reef fish landed per commercial handline fisherman in the Gulf of Mexico, 1957-1974[a]

Year	Florida West Coast	Alabama	Mississippi	Louisiana	Texas	Total Gulf
	(Thousands of pounds)					
1957	27.7	12.2	19.6	2.0	3.4	15.7
1958	18.1	18.6	30.1	16.2	4.1	14.1
1959	10.9	21.8	23.3	4.5	3.6	9.5
1960	14.1	20.6	19.8	7.2	2.9	11.0
1961	12.6	17.1	24.3	5.4	3.7	10.6
1962	13.4	15.7	22.6	3.8	3.5	10.4
1963	11.6	13.2	18.4	2.5	4.4	9.6
1964	11.7	14.6	16.8	2.8	5.0	10.3
1965	12.3	16.4	19.6	2.5	5.4	11.2
1966	12.2	14.5	18.5	3.8	4.4	11.2
1967	12.5	14.8	15.2	17.0	4.2	11.4
1968	13.1	15.1	20.2	18.9	5.2	13.0
1969	14.3	14.3	17.0	9.2	4.7	13.2
1970	14.5	16.9	15.9	12.1	9.9	14.4
1971	12.5	14.9	14.3	6.7	7.7	12.2
1972	12.4	15.8	13.0	6.8	5.8	11.5
1973	10.3	15.8	14.7	8.2	4.1	10.2
1974	11.1	13.1	12.5	6.1	4.1	10.4

[a] The above data were derived from a table listing number of vessels by gear type. These numbers represent the number of vessels using handlines. Most reef fish are landed by handline vessels. However, a relatively small quantity of other species are also landed by handline vessels. The ratio of reef fish to other species landed by handline vessels may differ among states in some years. This does not include sea bass since they are predominantly caught by traps.

Estimated from: U.S. National Marine Fisheries Service (formerly U.S. Bureau of Commercial Fisheries). Fishery Statistics of the United States. Washington: U.S. Government Printing Office, Annual Issues.

Appendix Table 58. Summary of ages of Gulf of Mexico reef fish fishermen by state from various sources

	Alabama	Florida	Louisiana	Mississippi	Texas
Source 1	N/A	Range 16-65 Mean 48 Majority between 41-60 years	N/A	N/A	N/A
Source 2	N/A	N/A	N/A	N/A	N/A
Source 3	18-over 65 range 46.2 mean crew, 18-30 range recreational	10-over 65 range 47.2 mean crew, 18-60 range	N/A	45.0 mean crew, 18-60 range	N/A
Source 4	N/A	47.4 mean	N/A	N/A	N/A

Sources:

(1) Prochaska, F.J. and J.C. Cato, 1977.

(2) Ditton, et al., 1977

(3) Information supplied by members of Industry Advisory Panel, Gulf of Mexico Fishery Management Council.

(4) Cato, J.C. and F.J. Prochaska, 1977.

N/A: Information not available.

Appendix Table 59. Summary of income of Gulf of Mexico reef fish fishermen by state from various sources

	Alabama	Florida	Louisiana	Mississippi	Texas
Source 1	11,000 mean - owner 15,000 mean - owner captain 13,000 mean - captain	10,000 owner 16,000 owner captain 15,000 captain 3,500 crew	N/A	10,000 owner per boat 20,000 owner captain 15,000 captain 6,000 crew	N/A
Source 2	4,000 mean - crew				33,000 mean - all Texas charter 21% with incomes over 50,000

Sources:
(1) Information supplied by members of Industry Advisory Panel, Gulf of Mexico Fishery Management Council.

(2) Ditton, et al., 1977

N/A: Information not available.

Appendix Table 60. Summary of education levels of Gulf reef fish fishermen by state from various sources

	Alabama	Florida	Louisiana	Mississippi	Texas
Source 1	N/A	1-18 years range 11.3 mean	N/A	N/A	N/A
Source 2	18-over 65 range 12.1 mean Crew, less than high school, mostly temporary	18-65 range 12.2 mean	N/A	12.0 mean	N/A
Source 3	N/A	12.2 mean	N/A	N/A	N/A

Sources:

(1) Prochaska, F.J. and J.C. Cato, 1977.

(2) Information supplied by members of Industry Advisory Panel, Gulf of Mexico Fishery Management Council.

(3) Cato, J.C., and F.J. Prochaska, 1977.

N/A: Information not available.

Appendix Table 61. Catch and catch per unit effort for sea bass in the Gulf of Mexico, 1967-1975.

		Pots, Fish			Hook and Line			Trawl, otter			Gill net, run around		
Year	Pounds	Gear	lbs.	CPUE	Gear	lbs.	CPUE	Gear	lbs.	CPUE	Gear	lbs.	CPUE
1967	--	--	--	--					100				
1968	302,700	800	300,900	376.0	2,124	1,700	0.80				877	100	
1969	305,300	634	218,700	345.0	2,176	86,600	39.80						
1970	149,000	283	128,900	455.0	2,224	20,100	9.04						
1971	105,500	100	85,600	856.0	2,293	19,900	8.68						
1972	121,200	90	97,400	1,082.0	2,574	23,800	9.25						
1973	112,300	95	75,300	792.6	2,902	37,000	12.75						
1974	50,600	95	33,700	354.7	2,936	16,900	5.76						
1975	39,000	80	22,200	277.5	3,275	12,200	3.73	33	4,600				
1976	50,000					50,000							
1977	27,000					27,000							
1978	25,000					25,000							

Appendix Table 62. Average landings and value of landings for Gulf of Mexico commercially caught reef fish by species from 1972-1976.

Species	Pounds	Percent	Dollars	Percent
	(Thousands)		(Thousands)	
Directed Catch [a]				
Red snapper	7,997	45.8	5,312	60.4
Grouper and Scamp	6,663	38.1	2,338	26.6
Yellowtail snapper	847	4.8	538	6.1
Gray snapper (mangrove)	551	3.2	186	2.1
Mutton snapper	250	1.4	123	1.4
Vermilion snapper	221	1.3	135	1.5
Jewfish	211	1.2	24	.3
Warsaw	135	.8	29	.3
Lane snapper	26	.2	10	.1
Sea bass	75	.4	12	.1
Incidental Catch [b]				
Grunt	240	1.4	45	.6
Porgy (scup)	93	.5	20	.2
Triggerfish	66	.4	8	.1
Amberjack	65	.4	6	.1
Tilefish	25	.1	7	.1
Total [c]	17,465	100.0	8,793	100.0

[a] Species in the management unit.

[b] Incidental catch to the directed fishery. These are considered part of the fishery but not part of the management unit.

[c] Totals may not add exactly to other tables due to rounding.

Appendix Table 63. Price response equations for annual dockside red snapper prices in Florida, Texas, Alabama, Mississippi, and the United States, 1952-1971.[1]

Equation	Region	Dependent Variable[2]	Constant	Independent Variables[3] Q_t	Independent Variables[3] $P^{Fla.}_t$	Independent Variables[3] I_t	R^2	Durbin-Watson Statistic
1	Florida	$P^{Fla.}_t$	0.4549	-0.05546 (4.16)	--	0.00004 (8.20)	0.94	1.27
2	Texas	P^{Tex}_t	0.1024	0.00724 (0.70)	0.54243 (14.44)	--	0.94	1.70
3	Alabama	$P^{Ala.}_t$	0.1605	0.01619 (2.10)	0.27158 (6.97)	--	0.74	1.86
4	Mississippi	$P^{Miss.}_t$	0.1493	0.00076 (0.25)	0.35962 (11.99)	--	0.94	2.04
5	United States	$P^{U.S.}_t$	0.2506	-0.01329 (8.95)	--	0.00004 (26.61)	0.98	1.79

[1] Number of observations is 20 for all equations except Mississippi. There were no reported landings in 1952 in Mississippi. Number shown in parentheses is the t statistic.

[2] Dependent variable is annual dockside price of red snapper in dollars per pound in each region in year t.

[3] Independent variables are:

Q_t = Annual quantity of red snapper landed in each region in year t in millions of pounds.

$P^{Fla.}_t$ = Annual dockside price of red snapper in dollars per pound in Florida in year t

I_t = U.S. total personal income in billions of dollars in year t

Source: Cato and Prochaska (1976)

Appendix Table 64. Price response equations for annual dockside grouper prices in Florida and the United States 1952-1971 [1]

Equation	Region	Dependent Variable [2]	Constant	Independent Variables [3] Q_t	Independent Variables [3] I_t	R^2	Durbin-Watson Statistic
1	Florida	$P_t^{Fla.}$	0.1032	-0.01276 (3.72)	0.00002 (10.54)	0.88	1.52
2	United States	$P_t^{U.S.}$	0.1035	-0.01012 (4.10)	0.00002 (11.32)	0.90	1.78

[1] Number of observations is 20. Number shown in parentheses is the t statistic.

[2] Dependent variable is annual dockside grouper price in dollars per pound in each region in year t.

[3] Independent variables are:

Q_t = Annual quantity of grouper landed in each region in year t in millions of pounds.

I_t = U.S. total personal income in billions of dollars in year t

Source: Cato and Prochaska (1976)

Appendix Table 65. Dockside and New York wholesale values of principal reef fish, 1976

Species	Dockside Value (Gulf of Mexico)	New York Market Value
	.....1,000 dollars.....	
Red Snapper	5,894	12,253
Grouper	3,230	5,692
Other [1]	1,458	4,718
Total	10,582	22,663

[1] Includes all other species in the fishery.

Source: Derived from Fishery Statistics of the U.S., and New York Market News Reports: National Marine Fisheries Service.

Appendix

Table 66. Percent effort on different species in the offshore charterboat fisheries by coastal area in Florida.

	PANHANDLE				WEST COAST				FLORIDA KEYS			
	Sp n=19	Su n=20	Fa n=15	Wi n= 7	Sp n=10	Su n=11	Fa n=10	Wi n=10	Sp n=18	Su n=15	Fa n=15	Wi n=19
BLUE WATER SPECIES												
billfish	2.0	6.0	5.6						15.5	9.5	39.3	41.8
dolphin	2.6	1.9	1.0						39.2	49.3	1.7	
sharks									3.1	2.7	4.7	4.0
tuna									4.2	6.8	6.7	2.4
wahoo											1.7	0.8
Combined bluewater		8.4							68.9	86.4	62.0	49.5
BOTTOM SPECIES												
grouper	31.3	25.2	24.0	62.9	22.2	54.6	68.5	73.5	1.7	3.3	6.9	3.3
snapper					8.5	7.3	2.5	3.5	11.4	1.5	2.4	1.5
grunts								2.5				
seabass				2.9		2.3	1.0	2.5				
tilefish										0.9	4.0	
other												
Combined bottom	38.7	34.0	36.0	78.6	31.2	66.4	72.0	77.0	13.1	6.7	16.3	5.9
COASTAL PELAGIC												
king mackerel	31.4	49.5	50.7	7.9	49.0		19.0	13.0	3.9		9.3	34.3
Spanish mackerel	5.0				4.0	10.0	2.0	2.0				2.1
amberjack	7.6	6.3	6.7		7.0	8.6	5.0		3.3		5.5	
OTHER												
barracuda									2.5	2.7	5.6	2.1
cobia	10.5											
tarpon					4.0				2.2			
other(redfish, flounder, etc)	2.2	0.8		13.6	4.8	15.0	2.0	3.0	6.1	4.2	1.3	4.0

Source: U.S. National Marine Fisheries Service. Personal Communication with Dr. Joan Browder about percent effort on different species in the offshore charterboat fisheries by coastal area, 1978.

n = number of respondents in sample, Sp = Spring, Su = Summer, Fa = Fall, Wi = Winter

Appendix TABLE 67

SELECTED DEMOGRAPHIC CHARACTERISTICS OF THE REEF FISHING COMMUNITIES

State/County/City		Total Population County	Total Population City	Percent Urban County	Percent Foreign Born County	Median Age County	Net Migration County	Net Migration City	Median Education County	Median Education City	Median Family Income County	Median Family Income City	Percent Below Poverty Level City
Alabama													
Baldwin	Bon Secour	59382	850	26.6	5.5	27.8	7.9	--	10.8	--	7337	--	--
Mobile	Mobile	317308	196941	82.0	2.6	25.5	-14.7	2.5	11.1	11.9	7807	8095	18.6
Florida													
Bay	Panama City	92884	38740	76.4	5.1	26.0	-5.3	-3.5	12.0	12.0	7416	7292	17.3
Escambia	Pensacola	59507	67067	83.9	5.5	24.3	-1.0	4.9	12.0	12.1	8020	8319	17.0
Franklin	Carabelle	7943	1180	44.8	4.5	30.7	-3.6	-8.9	9.9	--	4335	--	--
Hillsborough	Tampa	600715	278829	81.2	13.5	28.8	11.8	1.0	11.9	12.0	8161	8162	13.1
Lee	Ft. Meyers	163978	34434	70.3	13.7	39.0	83.1	21.4	12.1	12.0	7878	8142	12.3
Manatee	Bradenton	126160	26204	71.4	14.3	48.7	41.4	8.6	12.1	12.0	6593	6431	17.8
Monroe	Key West	53886	25574	71.2	18.1	27.5	-8.6	-18.8	12.2	12.0	7329	6918	16.7
Okaloosa	Niceville	164356	6197	62.0	7.5	23.0	17.2	-10.9	12.4	12.1	7873	6763	10.7
Pinellas	Madeira Beach	673603	4774	96.1	22.1	48.1	44.2	5.5	12.1	12.3	7640	7802	5.2
Sarasota	Nokomis	165054	4611	75.0	19.1	49.4	57.9	43.7	12.4	12.1	7737	6562	17.5
Louisiana													
La Fourche	Golden Meadow	68941	2681	39.0	1.8	22.4	.8	-13.4	8.5	7.2	7852	7351	12.4
Mississippi													
Jackson	Pascagoula	122650	27264	71.6	3.4	23.5	34.2	58.9	12.2	12.3	8543	9427	11.0
Texas													
Cameron	Port Isabel	140368	3067	77.6	42.3	21.8	-32.1	-14.2	8.5	8.0	5070	5397	36.9
Galveston	Galveston	169812	61809	89.9	11.0	27.8	7.8	-8.0	11.5	10.7	9774	8000	15.6
Aransas		8902		50.5	12.8	35.9	17.4		11.3		6658		
Nueces	Aransas Pass	236544	5813	94.0	14.5	24.1	-12.7	-16.4	11.8	10.3	8165	6583	19.1
San Patricio		47288		64.5	12.9	22.8	-15.0		10.0		7266		

SOURCE: 1970 Census of Population, U.S. Bureau of the Census and Florida Statistical Abstract, 1977.

Appendix Table 68

ECONOMIC INDICATORS OF THE REEF FISHING COMMUNITIES

State/County/City	City Unemployment Rate, 1977		Male Population in County Working Less Than 26 Weeks		County Employment In Manufacturing	
	Percent	Rank [a]	Percent	Rank [a]	Percent	Rank [a]
Alabama:						
Baldwin/Bon Secour	6.7	10	15.5	14	21.4	2
Mobile/Mobile	5.4	6	13.3	10	12.2	11
Florida:						
Bay/Panama City	8.9	15	11.5	5	12.2	11
Escambia/Pensacola	4.0	1	12.4	6	14.8	7
Franklin/Carrabelle	8.4	13	29.2	19	10.7	13
Hillsborough/Tampa	4.8	3	13.3	9	14.5	8
Lee/Fort Myers	4.9	4	15.1	12	7.6	16
Manatee/Bradenton	8.6	14	14.7	11	17.2	4
Monroe/Key West	9.6	16	10.6	4	4.7	17
Okaloosa/Niceville	7.2	12	8.5	1	10.6	14
Pinellas/Madeira Bch	6.4	8	16.1	15	13.5	9
Sarasota/Nokomis	5.1	5	16.1	15	8.3	15
Louisiana:						
La Fourche/Golden Meadow	4.4	2	12.5	7	17.1	5
Mississippi:						
Jackson/Pascagoula	6.1	7	9.4	2	67.6	1
Texas:						
Cameron/Port Isabel	11.3	17	16.8	17	18.9	3
Galveston/Galveston	7.0	11	12.7	8	16.7	6
Aransas	Aransas Pass		19.8	18		
Nueces	Aransas Pass	6.4	9.7	3	12.4	10
San Patricio	Aransas Pass		15.4	13		

[a] A rank of 1 signifies that the county performed the best on that particular economic indicator.

Source: The city unemployment rate and the percent employed in manufacturing: the employment security agencies/commissions of Alabama, Florida, Louisiana, Mississippi, and Texas; and the male population working less than 26 weeks: U.S. Bureau of the Census, 1970 Census of Population.

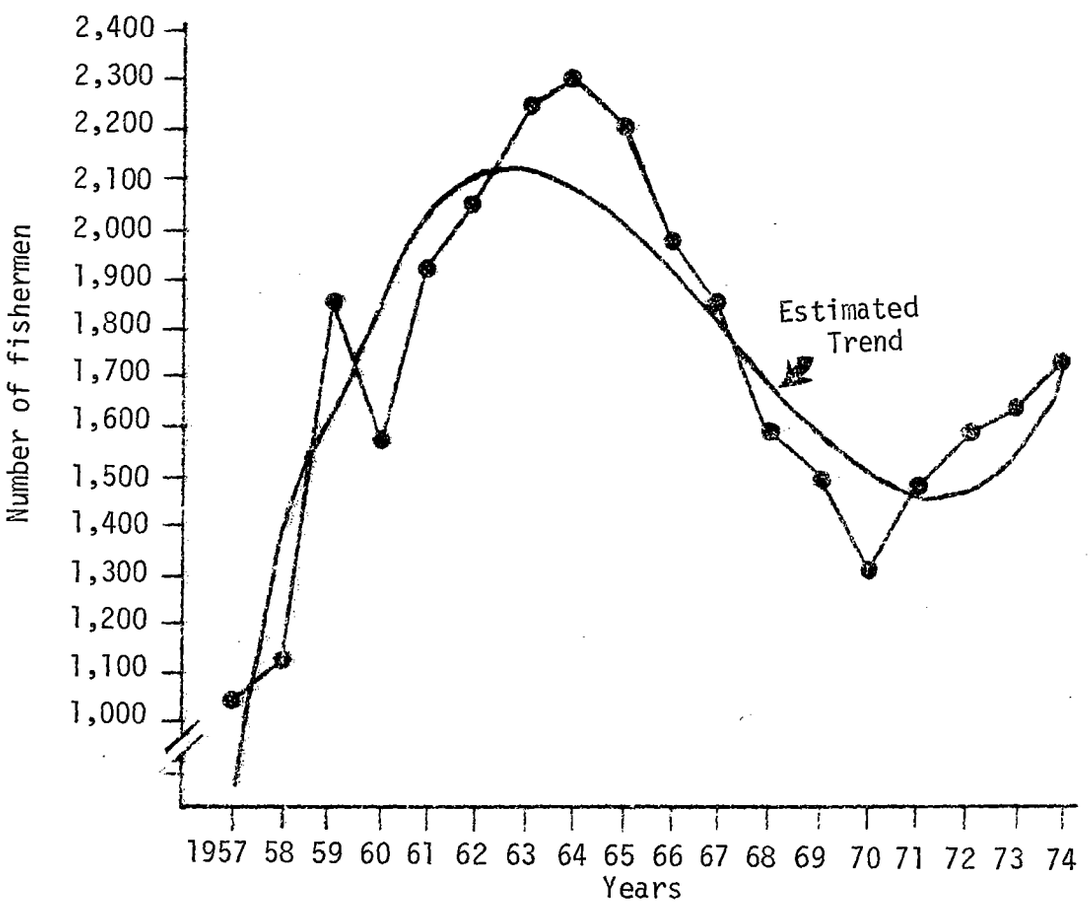


Figure 1. Number of Gulf of Mexico commercial reef fish fishermen, 1957-1974.

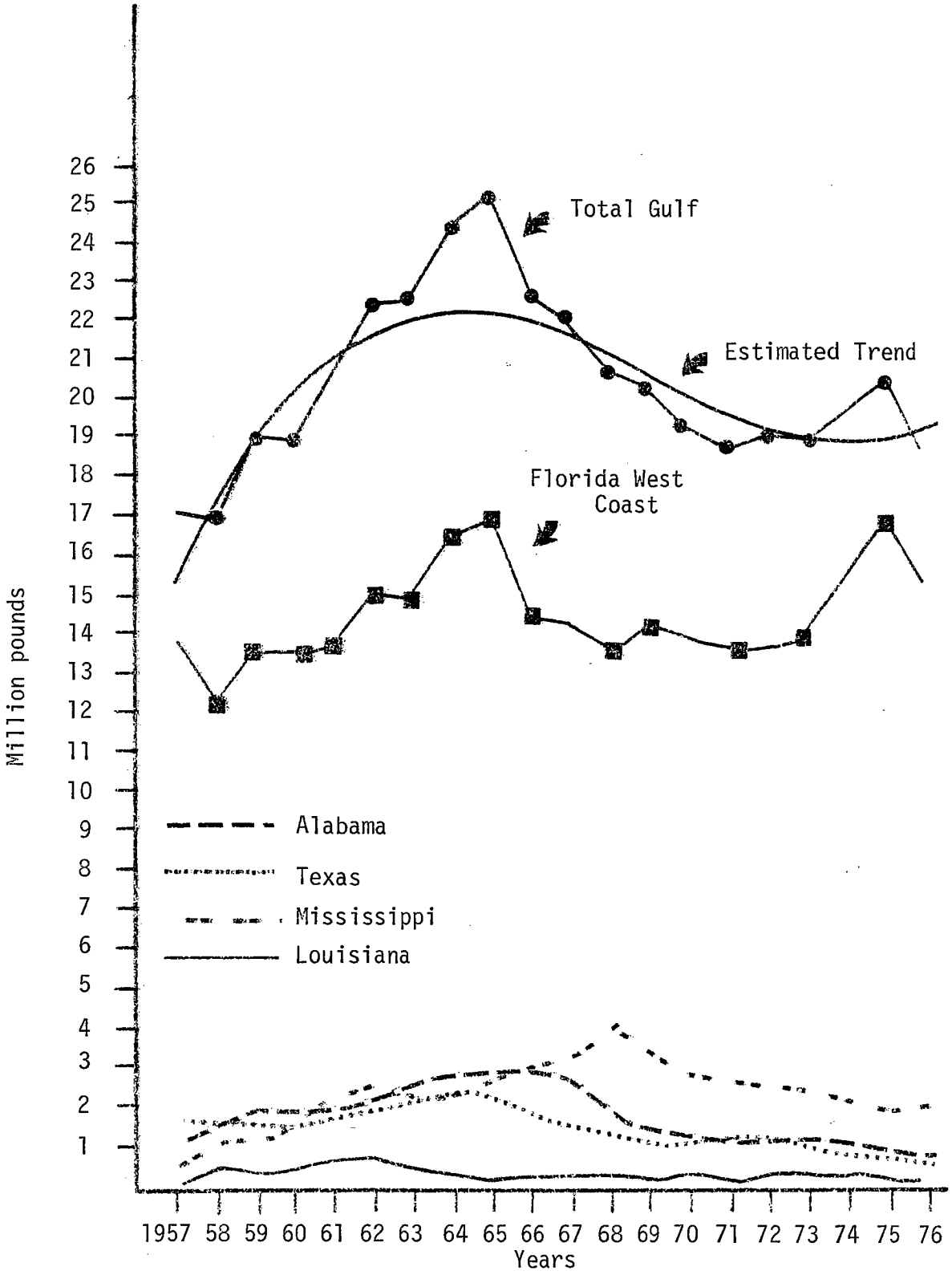


Figure 2. Quantity of Gulf of Mexico commercial reef fish landings, 1957-1976.

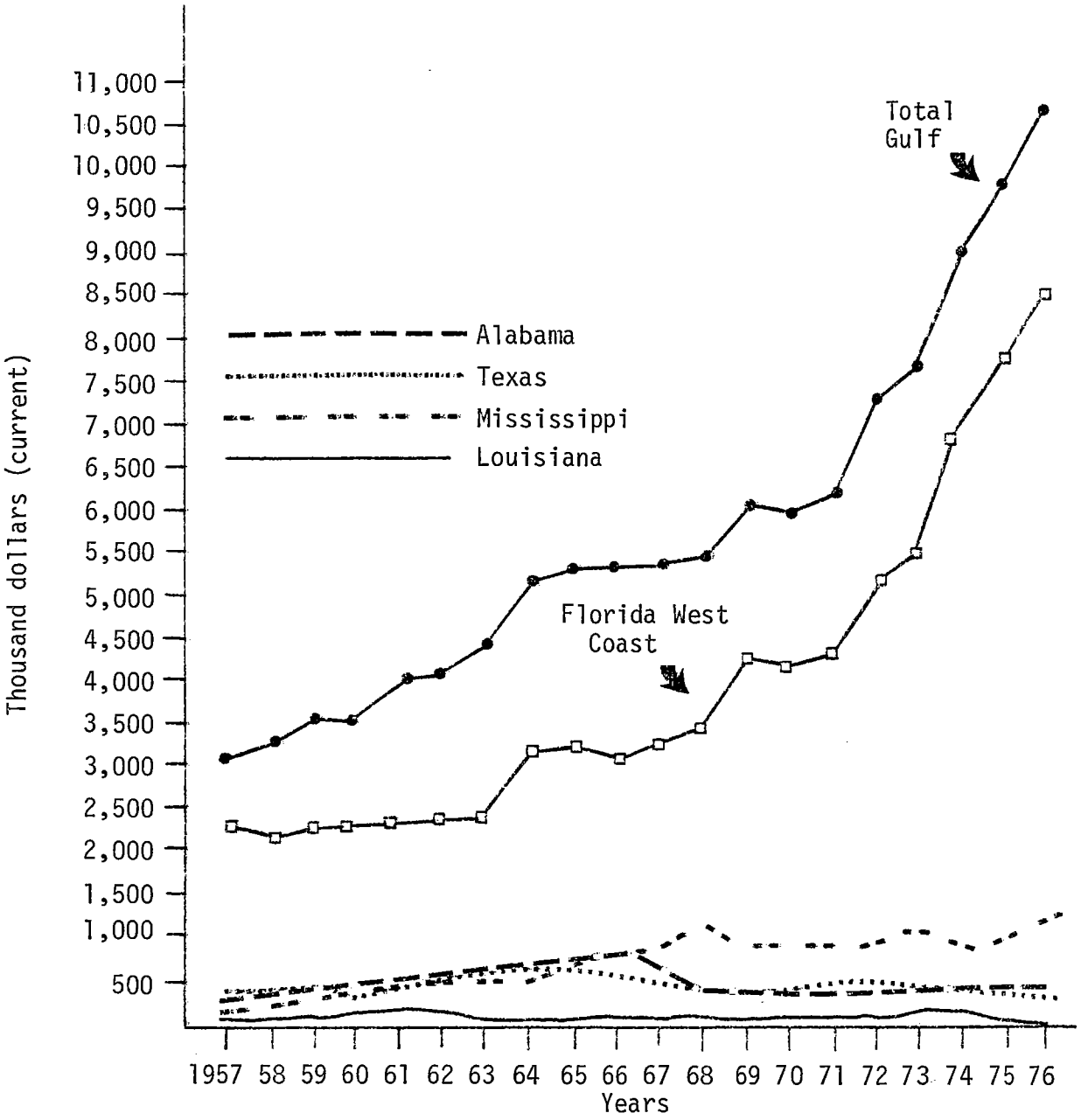


Figure 3. Value of Gulf of Mexico commercial reef fish landings, 1957-1976.

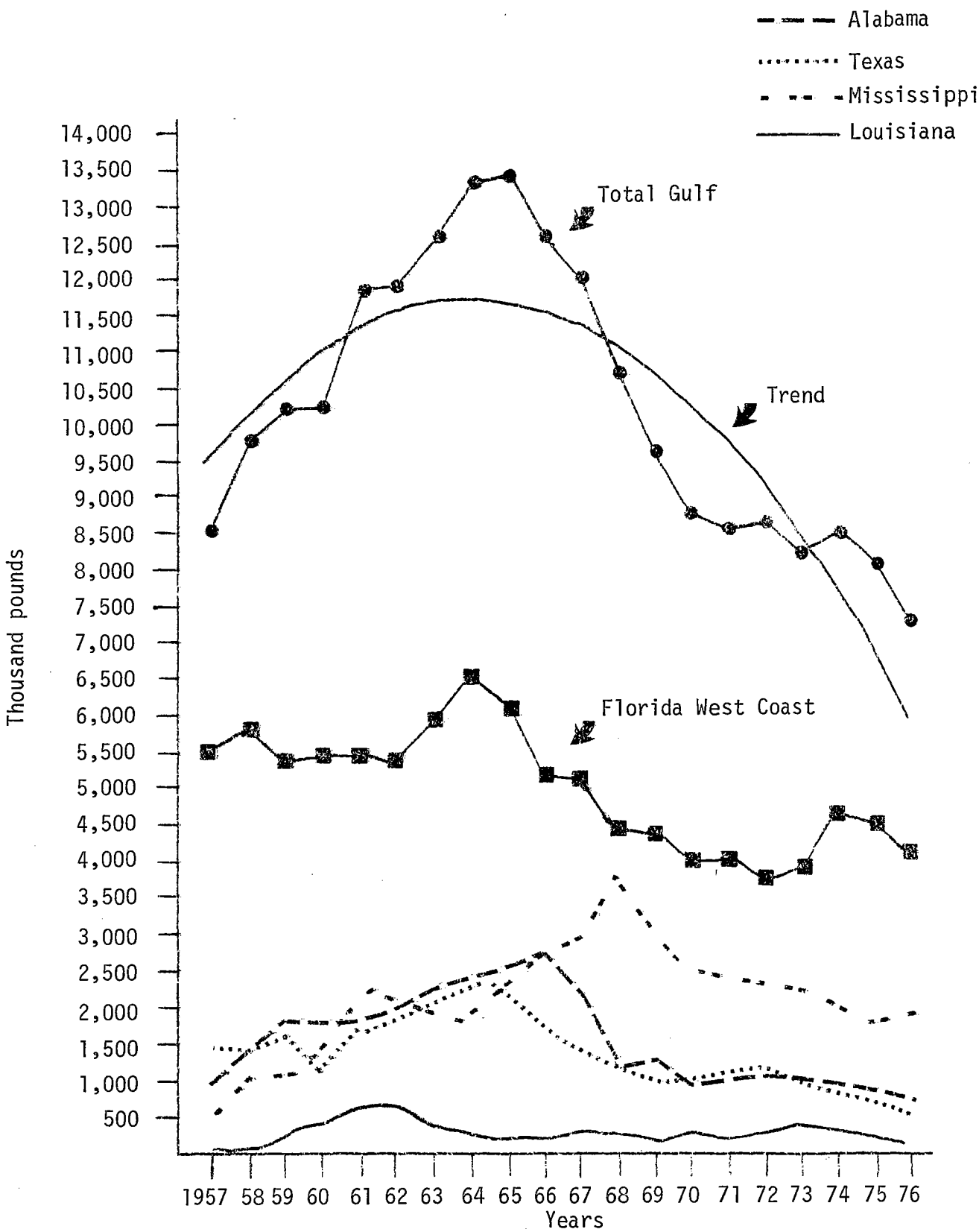


Figure 4. Quantity of Gulf of Mexico commercial red snapper landings, 1957-1976.

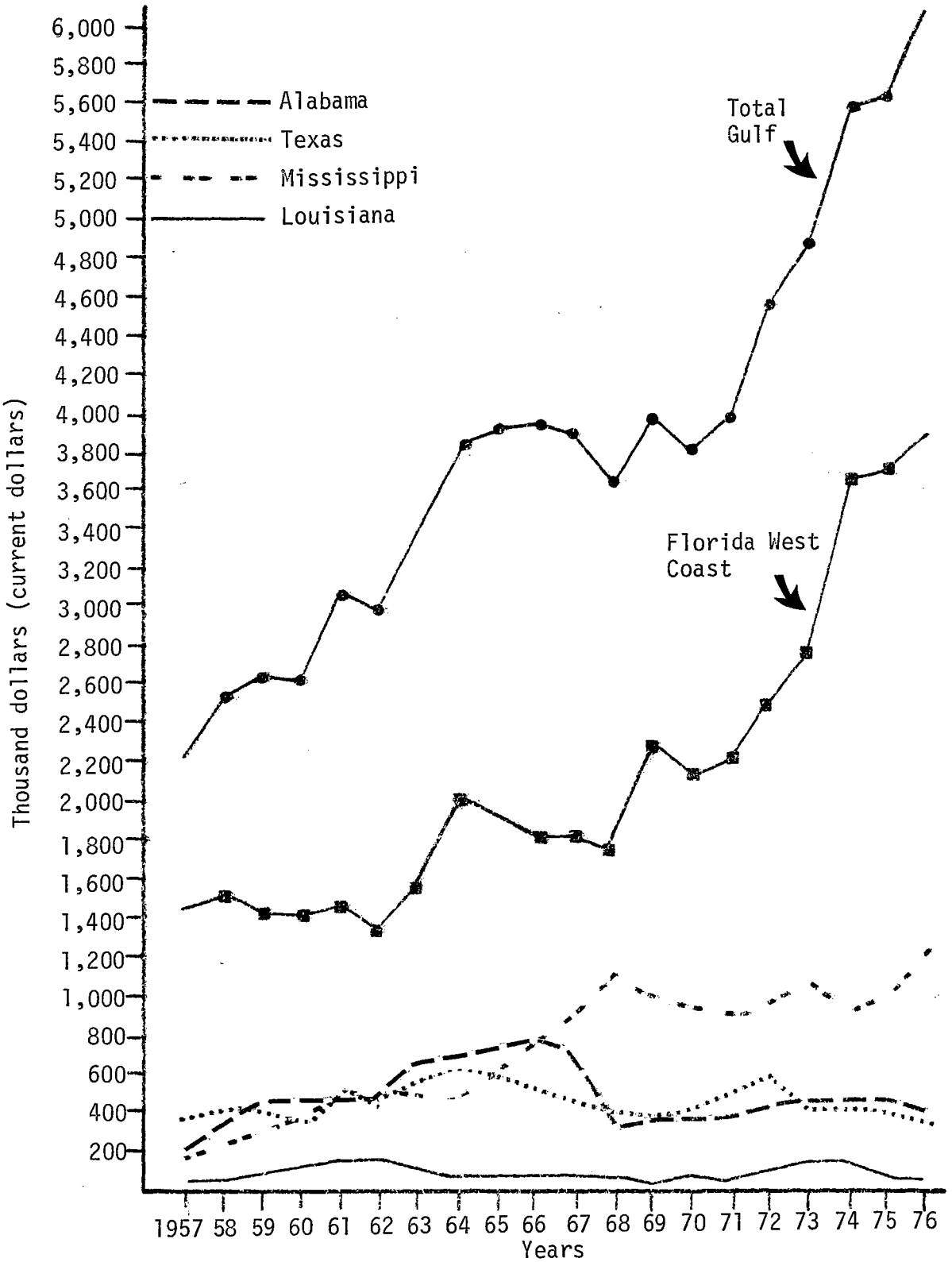


Figure 5. Value of Gulf of Mexico commercial red snapper landings, 1957-1976.

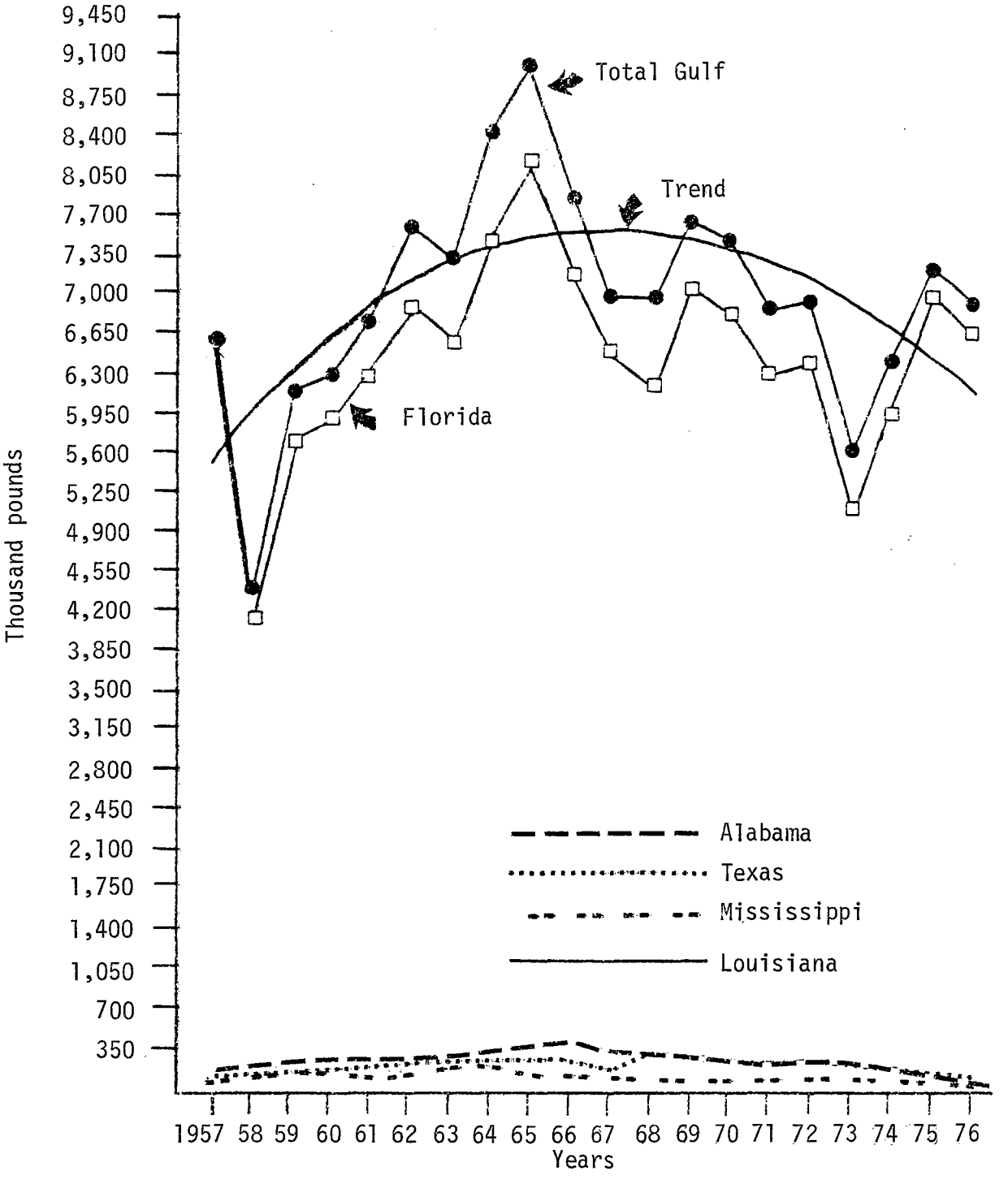


Figure 6. Quantity of Gulf of Mexico commercial grouper landings, 1957-1976.

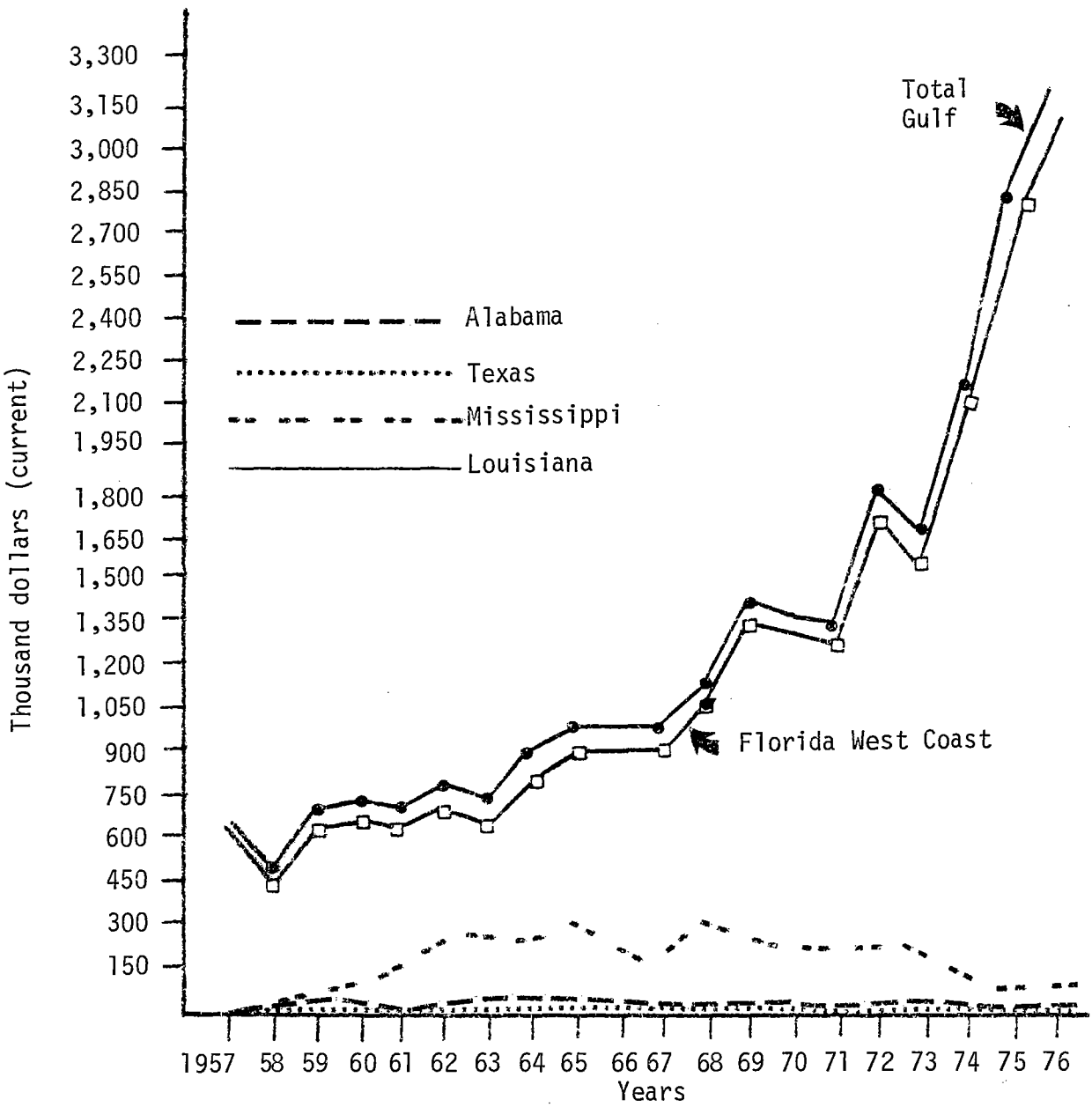


Figure 7. Value of Gulf of Mexico commercial grouper landings, 1957-1976.

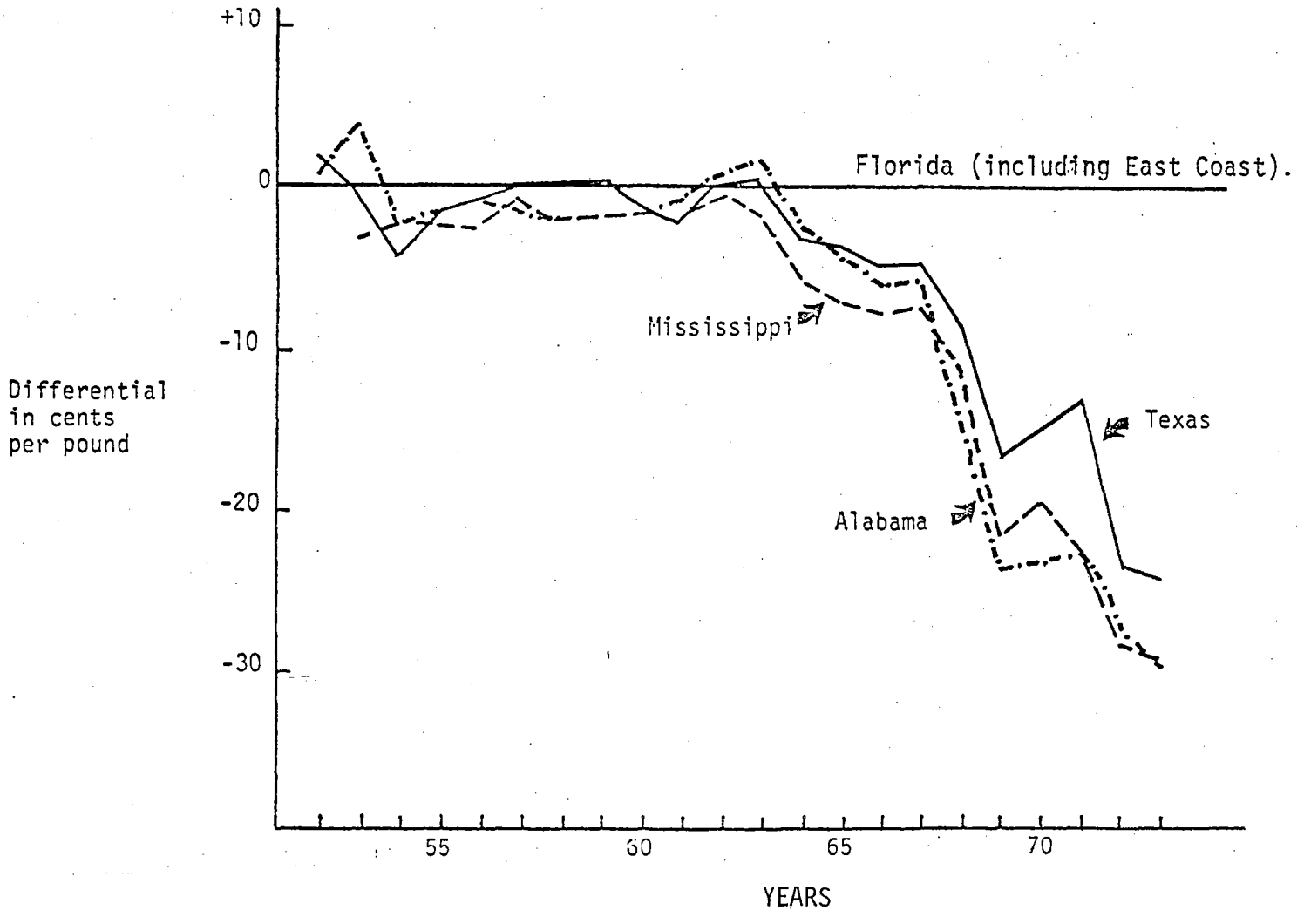


Figure 8. Texas, Alabama, and Mississippi commercial red snapper dockside prices expressed as differentials from Florida prices 1952-73.

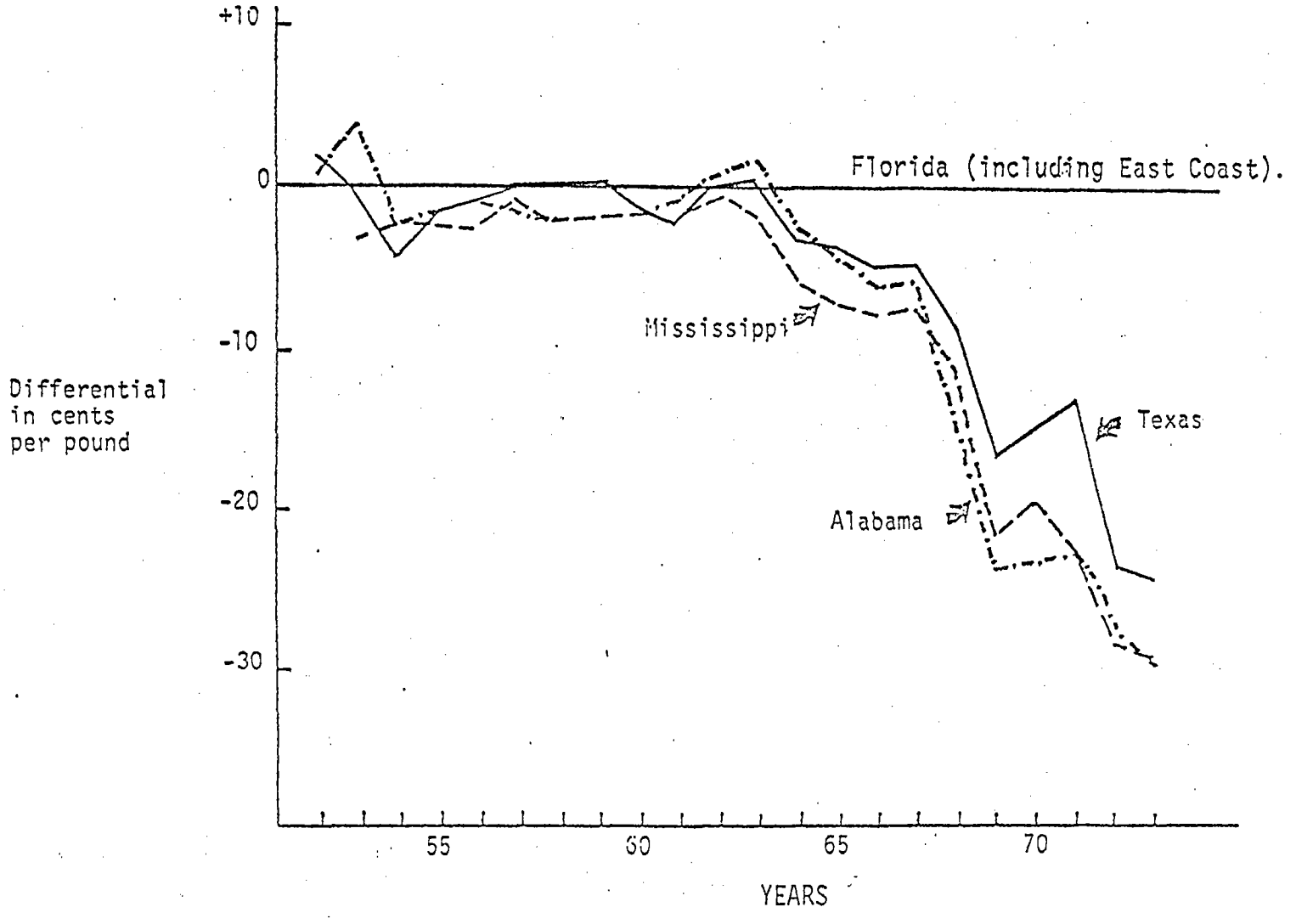


Figure 8. Texas, Alabama, and Mississippi commercial red snapper dockside prices expressed as differentials from Florida prices 1952-73.

Source: Cato, James, C. and Fred J. Prochaska, 1976.

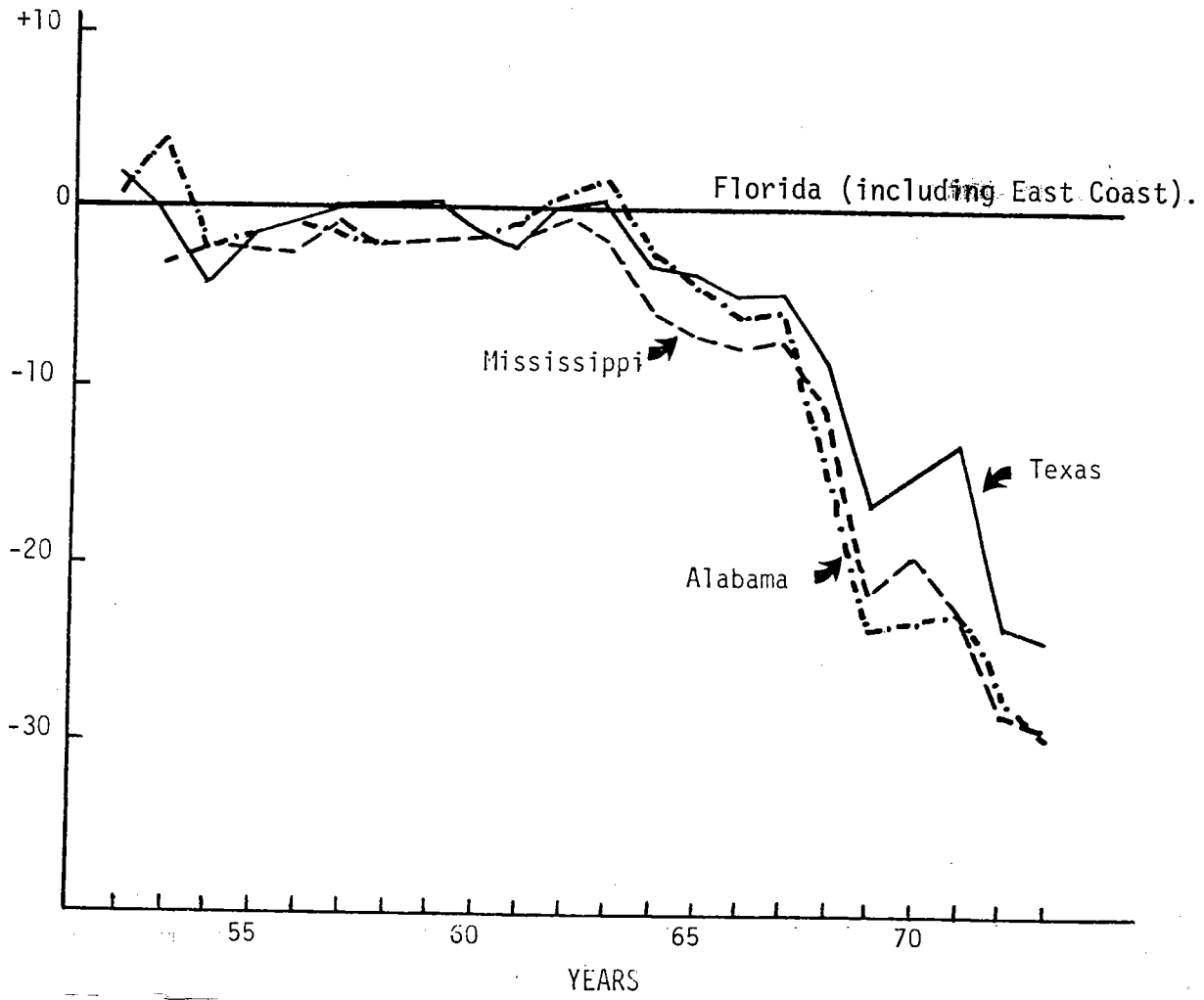


Figure 8. Texas, Alabama, and Mississippi commercial red snapper dockside prices expressed as differentials from Florida prices 1952-73

Source: Cato, James, C. and Fred J. Prochaska. "The Gulf of Mexico Commercial and Recreational Red Snapper-Grouper Fisheries: An Economic Analysis of Production, Marketing, and Prices." Proceedings: Colloquium on Snapper-Grouper Fishery Resources of the Western Central Atlantic Ocean. Florida Sea Grant Report Number 17. Miami: Southeast Fisheries Center, November 1976.

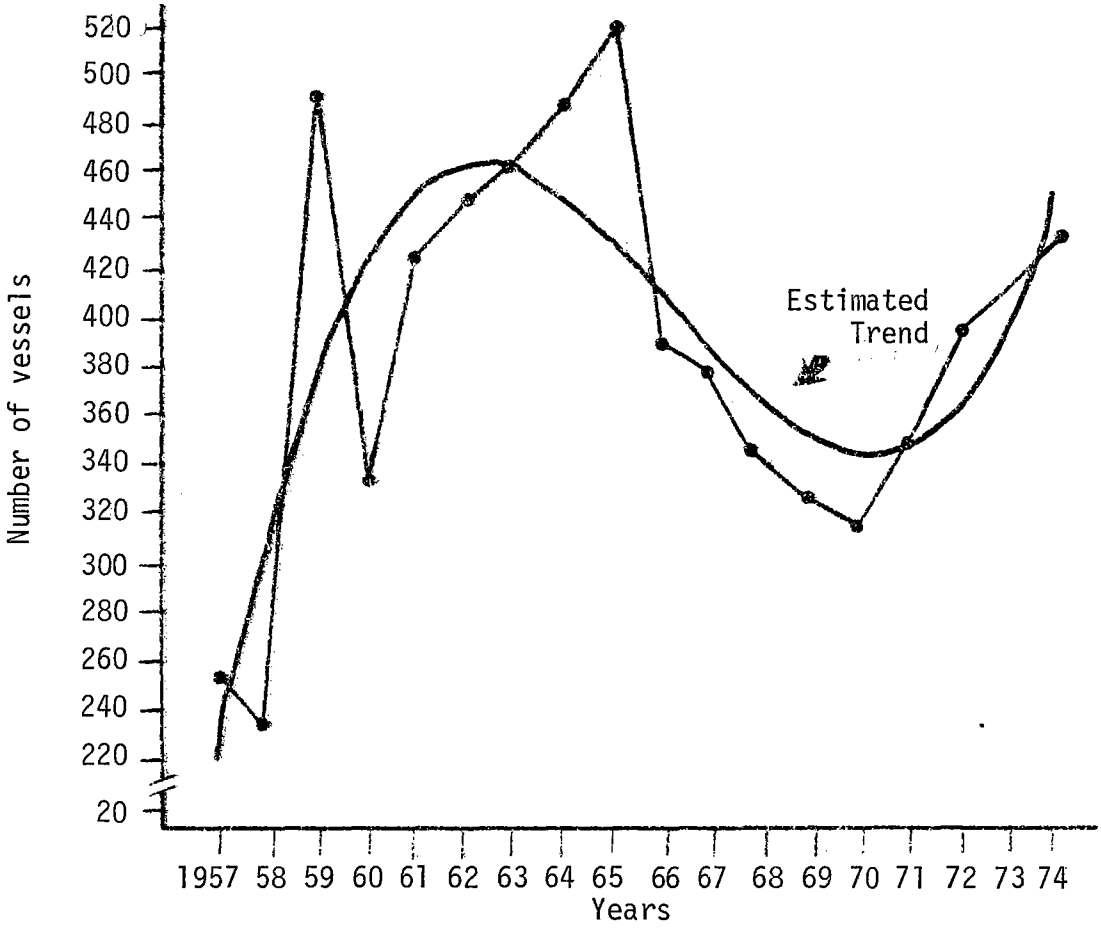


Figure 9. Number of Gulf of Mexico commercial reef fish handline vessels, 1957-1974.

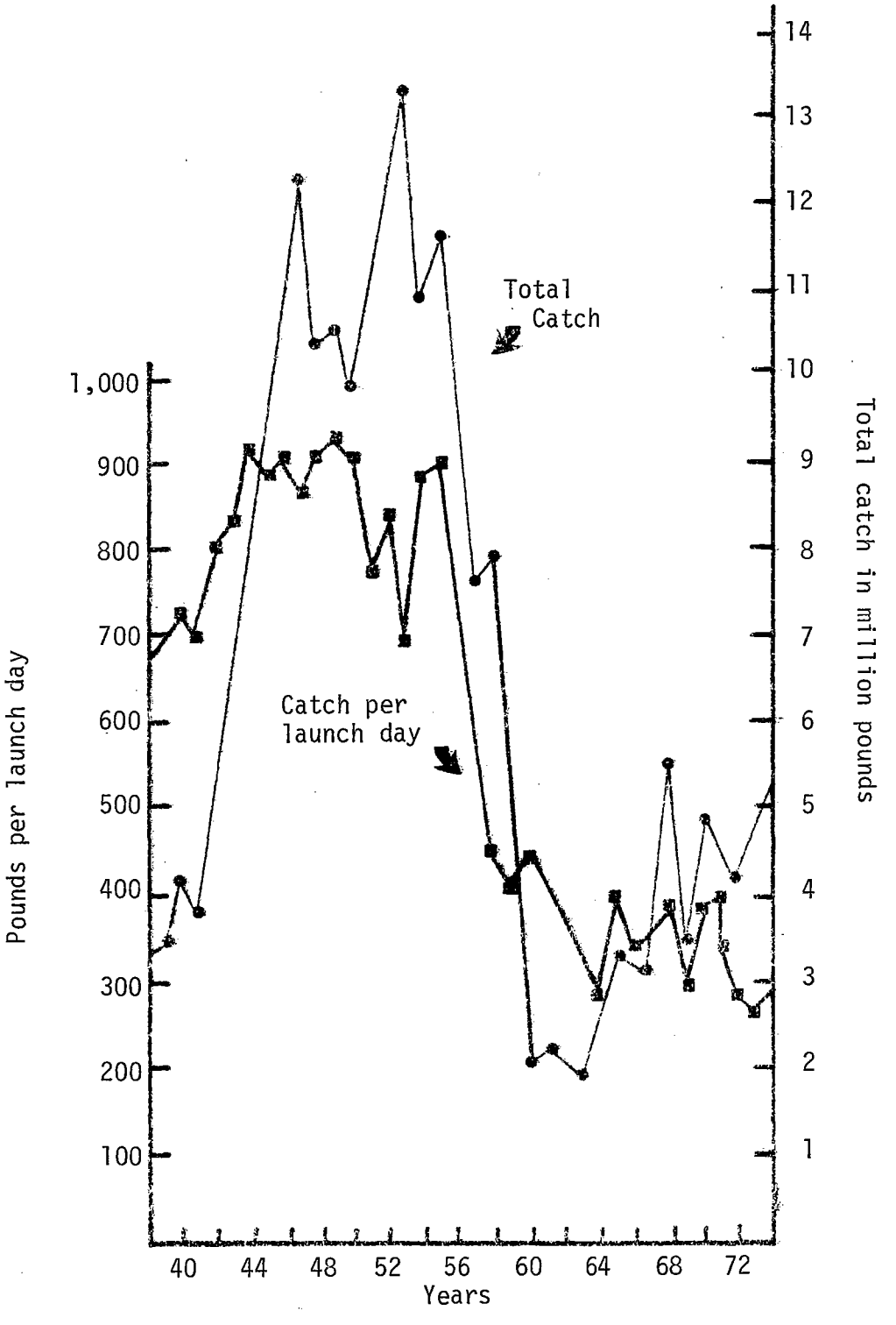


Figure 10. Grouper catch and catch per launch day fished by Cuban commercial fishermen on the West coast of Florida, 1938-1974.

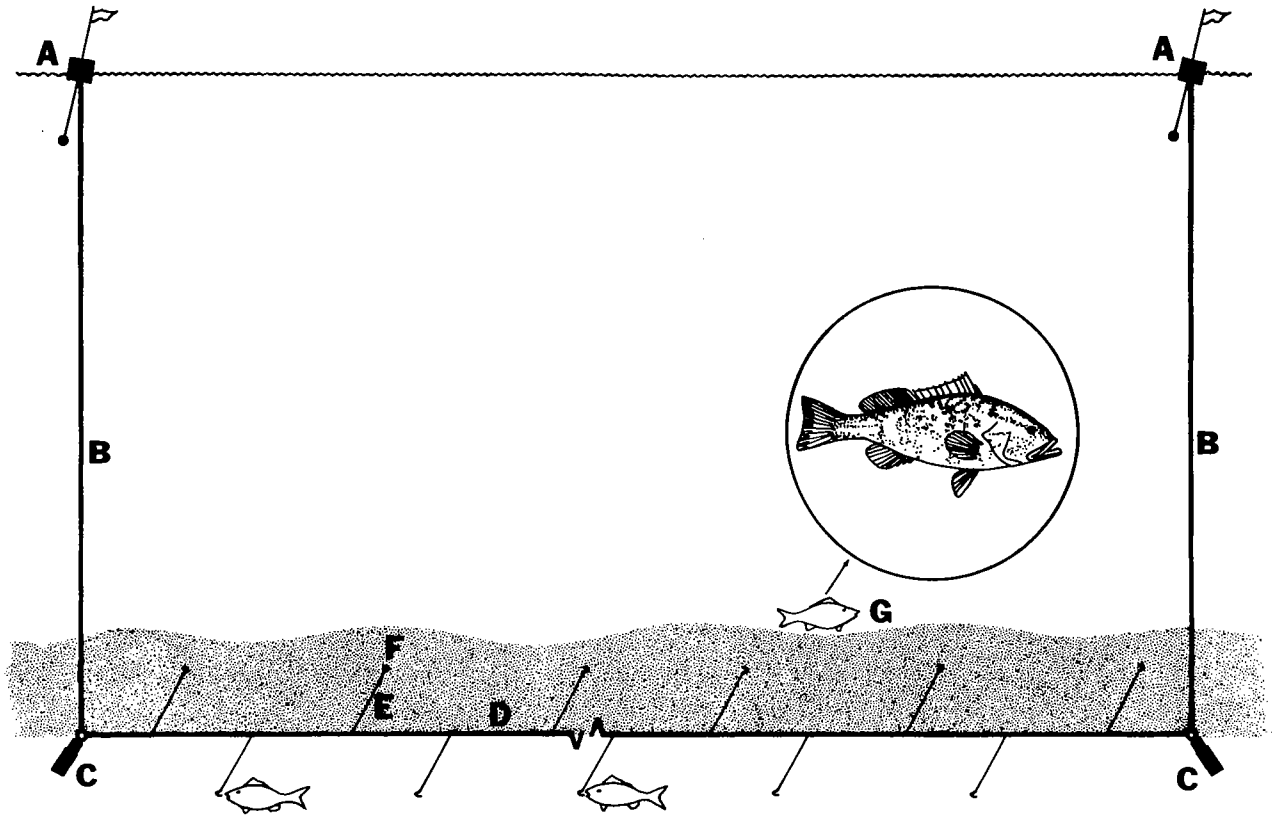


Figure 11. Cuban Gulf Fleet: Diagram of a typical bottom longline for groupers and snappers. A. marker buoy, B. buoy line, C. drag weight, D. mainline, E. branch line, F. bait and hook, G. target fish, the red grouper. Sources: Law Enforcement and Marine Mammal Protection Division, NMFS, NOAA, St. Petersburg, Florida 33702; Saez, 1973.

Source: Tashiro and Coleman, 1977.

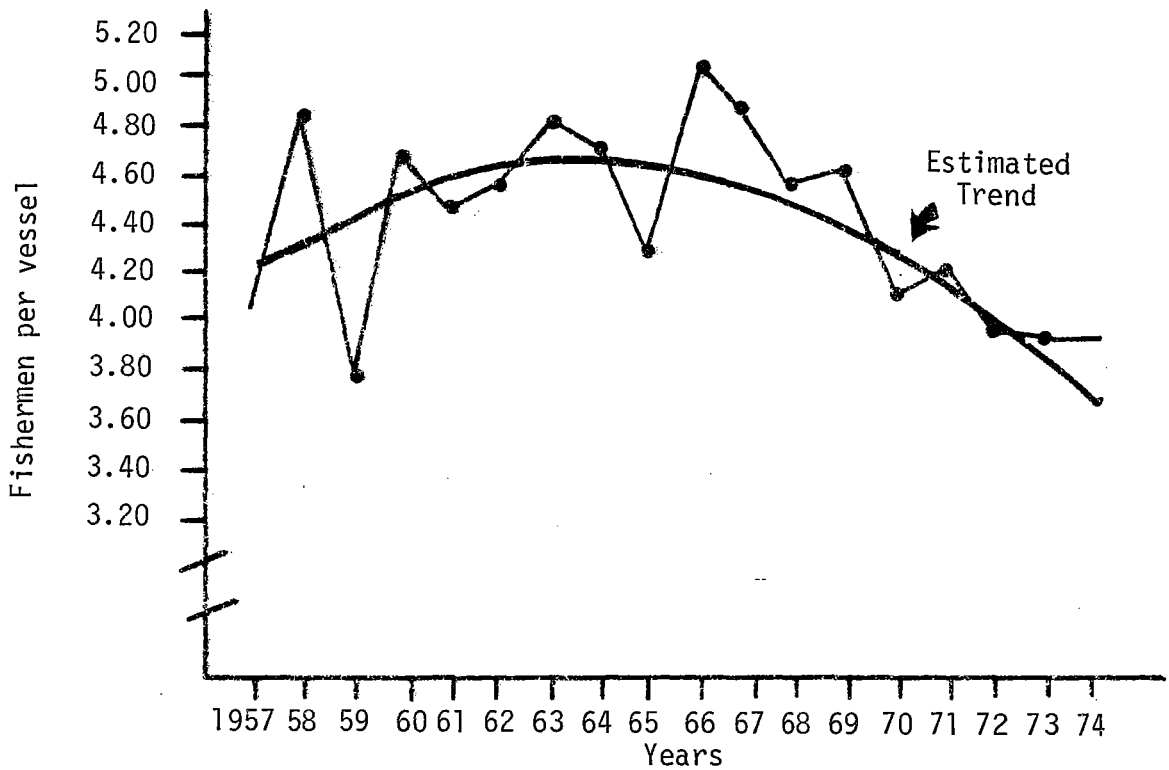


Figure 12. Average crew size in the Gulf of Mexico reef fish handline fisheries, 1957-1974.

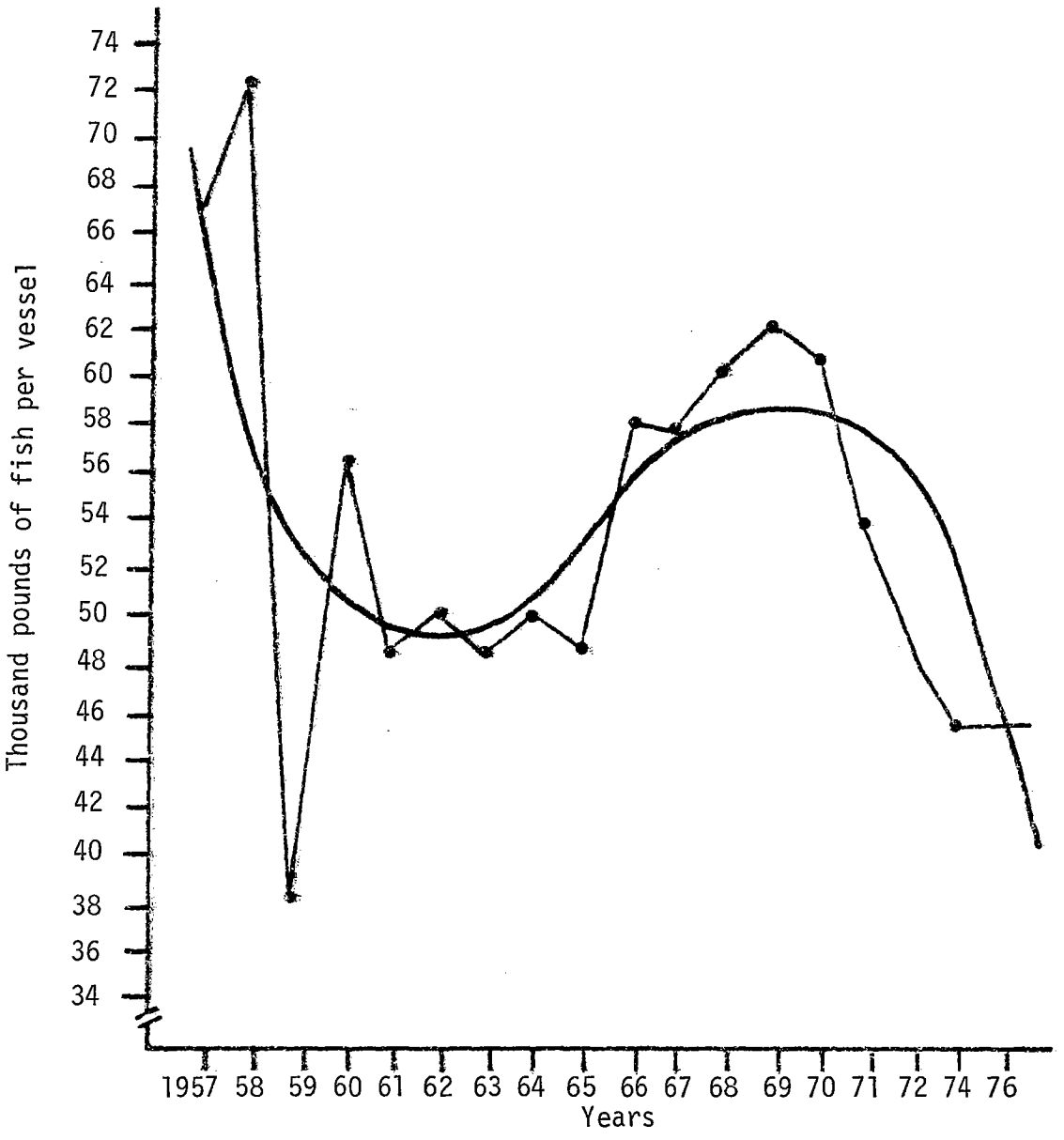


Figure 13. Quantity of Gulf of Mexico reef fish landed per commercial handline vessel, 1957-1974.

Source: Derived from National Marine Fisheries Service data.