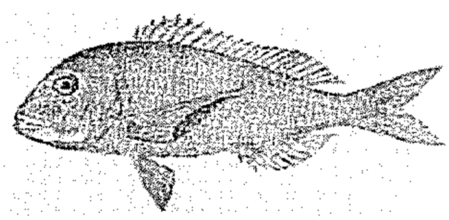
FINAL

AMENDMENT 12
TO THE
FISHERY MANAGEMENT PLAN
FOR THE
SNAPPER GROUPER FISHERY
OF THE
SOUTH ATLANTIC REGION

INCLUDING A FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT, INITIAL REGULATORY FLEXIBILITY ANALYSIS REGULATORY IMPACT REVIEW, AND SOCIAL IMPACT ASSESSMENT/ FISHERY IMPACT STATEMENT



MARCH 2000

South Atlantic Fishery Management Council
1 Southpark Circle, Suite 306
Charleston, South Carolina 29407-4699
(843) 571-4366 / FAX (843) 769-4520
email: safmc@noaa.gov

This is a publication of the South Atlantic Fishery Management Council pursuant to National Oceanic and Atmospheric Administration Award No. NA07FC001

TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

TABLE OF CONTENTS (cont.)

TABLE OF CONTENTS (cont.)

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (cont.)

LIST OF ACTIONS IN AMENDMENT 12

AMENDMENT 12 COVER SHEET

This integrated document contains all elements of the Plan Amendment, Final Supplemental Environmental Impact Statement (FSEIS), Initial Regulatory Flexibility Analysis (IRFA), Regulatory Impact Review (RIR), and Social Impact Assessment (SIA)/Fishery Impact Statement (FIS). Separate Tables of Contents are provided to assist readers and the NMFS/NOAA/DOC reviewers in referencing corresponding sections of the Amendment. Introductory information and/or background for the DSEIS, IRFA, RIR, and SIA/FIS are included within the separate table of contents for each of these sections.

Responsible Agencies

South Atlantic Fishery Management Council
Contact: Robert K. Mahood
1 Southpark Circle, Suite 306
Charleston, South Carolina 29407-4699
(843) 571-4366; FAX (843) 769-4520
Email: safmc@noaa.gov

National Marine Fisheries Service
Contact: Dr. William Hogarth
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, Florida 33702
(727) 570-5301; FAX (727) 570-5300

Name of Action:

(X) Administrative ( ) Legislative

SUMMARY

The Council is proposing the actions shown on page viii to address excessive fishing mortality (Problem #1) and to meet requirements of the Magnuson-Stevens Act.

Public hearings were held during November 1999 (see Section 10 for dates and locations). The Council reviewed public comments and informal review comments during the November/December 1999 meeting in Wrightsville Beach, North Carolina and modified the document based on those comments. Limited copies of a document containing the minutes of hearings and all written comments is available from the Council office.

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

This integrated document contains all elements of the Plan Amendment, Final Supplemental Environmental Impact Statement (FSEIS), Initial Regulatory Flexibility Analysis (IRFA), Regulatory Impact Review (RIR), and Social Impact Assessment (SIA)/Fishery Impact Statement (FIS). The table of contents for the FSEIS is provided separately to aid reviewers in referencing corresponding sections of the Amendment.

( ) Draft (X) Final

SUMMARY

The approved list of problems in the snapper grouper fishery is included in Section 1.1. Problem 1(Excessive fishing mortality.) is addressed by the Draft Supplemental Environmental Impact Statement.

The approved list of objectives in the snapper grouper management plan as amended through Amendment 11 is included in Section 1.2. The Final Supplemental Environmental Impact Statement addresses Objectives 1 (Prevent overfishing.) and 14 (Minimize bycatch.).

To address the problems and objectives stated above, the Council is proposing to implement the actions shown on page ix.

Identification of options in this amendment as "rejected" reflect the Council's actions for purposes of the Magnuson-Stevens Act. They do not reflect actions for the purpose of NEPA, which are not yet final.

DSEIS to NMFS on: **<u>October 13, 1999</u>** **DSEIS to EPA on:** **<u>November 30, 1999</u>**
Comments on DSEIS requested by: **<u>January 30, 2000</u>**

FSEIS to NMFS on: **<u>March 15, 2000</u>** **FSEIS to EPA on:** **<u>May 5, 2000</u>**
Comments on FSEIS requested by: **<u>June 10, 2000</u>**

One letter was received during the DSEIS comment period from the U. S. Environmental Protection Agency dated January 27, 2000 (Appendix J).

EPA Comment: The EPA rated the DSEIS (Amendment 12) as "LO" (Lack of Objections). We support the proper management of the depressed red porgy fishery. Specifically, we prefer the proposed actions as opposed to their options and we particularly support the adoption of Proposed Action 4 which would prohibit the harvest and possession of the red porgy. We also recommend that an adaptive management approach be instituted to measure the success of the FMP and stock recovery and to implement adopted adjustments as needed."

Council Response: At the November/December 1999 meeting, the Council reviewed public hearing minutes, written comments, and held an additional public hearing. The Council modified the total prohibition and chose to: (1) reduce the recreational bag limit from 5 to 1 red porgy per person per day or per trip, whichever is more restrictive; (2) during January, February, March, and April limit the possession of red porgy aboard vessels with Federal commercial or charter/headboat permits for snapper grouper to one red porgy per person per day or one red porgy per person per trip whichever is more restrictive; (3) continue the 14 inch TL minimum size limit for both recreational and commercial fishermen; and (4) allow a 50 pound by-catch per trip for permitted vessels (i.e., vessels with an unlimited or trip-limited commercial vessel permit) from May 1 through December 31. The status of red porgy will be reviewed every two years to determine if management measures should be repealed or modified. The Council chose these measures instead of the moratorium to address the bycatch which would result from a moratorium in the multi-species, mid-shelf snapper grouper fishery and to balance the socioeconomic impacts with the need for rebuilding the red porgy stock. The Council concluded the proposed measures are sufficient to rebuild red porgy within 18 years. In addition, the Council will closely monitor the red porgy stock through assessments every two years. If additional restrictions are necessary, measures will be implemented through the framework. Similarly, if measures can be relaxed, such changes will be implemented through the framework. This process is similar to the one-year transition permit with minimal harvest to minimize socioeconomic impacts discussed in the EPA letter.

The Snapper Grouper Committee and Council discussed the EPA letter during the March 2000 meeting and concluded the issues raised were addressed to the maximum extent practicable during finalization of Amendment 12 at the November/December 1999 Council meeting.

REGULATORY IMPACT REVIEW

This integrated document contains all elements of the Plan Amendment, Draft Supplemental Environmental Impact Statement (DSEIS), Initial Regulatory Flexibility Analysis (IRFA), Regulatory Impact Review (RIR), and Social Impact Assessment (SIA)/Fishery Impact Statement (FIS). A table of contents for the RIR is provided separately to aid the reviewer in referencing corresponding sections of the Amendment.

INTRODUCTION

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

The National Marine Fisheries Service requires a RIR for all regulatory actions that are of public interest. The RIR does three things: 1) it provides a comprehensive review of the level and incidence of impacts associated with a proposed or final regulatory action, 2) it provides a review of the problems and policy objectives prompting the regulatory proposals and an evaluation of the major alternatives that could be used to solve the problem, and 3) it ensures the regulatory agency systematically and comprehensively considers all available alternatives so public welfare can be enhanced in the most efficient and cost effective way.

The RIR also serves as the basis for determining whether any proposed regulations are a "significant regulatory action" under certain criteria provided in Executive Order 12866 and whether the proposed regulations will have a significant economic impact on a substantial number of small entities in compliance with the Regulatory Flexibility Act of 1980 (RFA) as amended by Public Law 104-121. The purpose of the Regulatory Flexibility Act is to relieve small businesses, small organizations, and small governmental entities from burdensome regulations and record–keeping requirements, to the extent possible.

This RIR analyzes the probable impacts on the fishery and habitat of the proposed plan amendment to the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region (FMP).

PROBLEMS AND OBJECTIVES

The Fishery Management Plan for the Snapper Grouper Fishery (SAFMC, 1983) contains a detailed description of the snapper grouper fishery. The problems and issues in the fishery are outlined in the various amendments.

The problems specified in the Snapper Grouper Fishery Management Plan are listed and explained in the Purpose and Need Section.

METHODOLOGY AND FRAMEWORK FOR ANALYSIS

The basic approach adopted in this RIR is an assessment of management measures from the standpoint of determining the resulting changes in costs and benefits to society. The net effects should be stated in terms of producer and consumer surpluses for the harvesting, processing/dealer sectors and for consumers. Ideally, the expected present values of net yield streams over time associated with the different alternatives should be compared in evaluating the impacts. However, lack of data precludes this type of analysis. The approach taken in analyzing alternative management approaches is to describe and/or quantify the changes in short-term net benefits. A qualitative discussion of the long-term impacts is also included.

An economic survey was conducted in 1994 to collect data on snapper grouper permittees in the South Atlantic region by the South Carolina Department of Natural Resources under a MARFIN grant. Snapper grouper permit holders with home ports in North Carolina, South Carolina, Georgia and east coast of Florida were surveyed through in-person interviews. Data were collected on vessel characteristics, fixed and variable costs, revenues and incremental costs associated with switching to and from the fishery. A project report has already been submitted. Results of the data analyses are incorporated into the RIR and IRFA analyses in this document. Also, Section 3 contains an executive summary of the economic survey of commercial snapper grouper vessels along the U.S. south Atlantic Coast (Waters et al., 1997).

Because of the nature of the snapper grouper fishery in the Florida Keys, a separate economic survey was conducted in 1994 for Monroe County in conjunction with the MARFIN grant and NMFS.

Summary of Expected Changes in Net Benefits (Summary of Regulatory Impact Review)

The Council's preferred options are presented in the following table in bold.

Table 1. Summary of Expected Changes in Net Benefits.

Proposed Actions and Rejected Options	POSITIVE IMPACTS	NEGATIVE IMPACTS	NET IMPACTS
Proposed Action 1: Maximum Sustainable Yield (MSY) for red porgy is 4.38 million pounds (1,987 mt).	None	None	This action by itself will not have an impact on the fishery. Measures taken to reach MSY will impact entities in the fishery.
Rejected Options:			
Rejected Option 1: No Action. Maximum sustainable yield for red porgy is unknown.	None	None	This will not have an impact on the fishery. However, the Council will not be allowed to sustainably manage the fishery without information on MSY.
Rejected Option 2: The biomass capable of producing maximom sustainable yield for red porgy is 11.65 million pounds (5,285.3 mt).	None	None	This action by itself will not have an impact on the fishery. Measures taken to reach MSY will impact entities in the fishery.
Proposed Action 2: Optimum Yield (OY) for red porgy is the amount of harvest that can be taken by U.S. fishermen while maintaining the Spawning Potential Ratio (SPR) at or above 45% Static SPR.	None	None	This action by itself will not have an impact on the fishery. Measures taken to allocate and harvest OY will impact entities in the fishery.
Rejected Options:			
Rejected Option 1: No Action. OY for red porgy is the amount of harvest that can be taken by U.S. fishermen while maintaining the SPR at or above 40% Static SPR.	None	None	This action by itself will not have an impact on the fishery. Measures taken to allocate and harvest OY will impact entities in the fishery.
Rejected Option 2: OY for red porgy is the amount of harvest that can be taken by U.S. fishermen while maintaining the biomass at or above 5,285.4 mt (11.65 million pounds) (based on 14" TL minimum size limit) or 5,285.3 mt (11.65 million pounds) (based on 12" TL minimum size limit).	None	None	This action by itself will not have an impact on the fishery. Measures taken to allocate and harvest OY will impact entities in the fishery.
Rejected Option 3: OY for red porgy is the amount of harvest that can be taken by U.S. fishermen while maintaining a total spawning stock size (biomass) of 10,000 mt or 22 million pounds.	None	None	This action by itself will not have an impact on the fishery. Measures taken to allocate and harvest OY will impact entities in the fishery.

Table 1 (continued). Summary of Expected Changes in Net Benefits.

Proposed Actions and Other Possible Options	POSITIVE IMPACTS	NEGATIVE IMPACTS	NET IMPACTS
Proposed Action 3: Overfishing Level & Rebuilding Timeframe. The two components of the status determination criteria are: A. A maximum fishing mortality threshold (MFMT) - A fishing mortality rate (F) corresponding to a 35% Static SPR (F=0.43) based on a 14" TL minimum size limit. B. A minimum stock size threshold (MSST) - The minimum stock size threshold is defined as the maximum of either 0.5 or 1-M (M=natural mortality=0.28) times Bmsy. The Council is specifying the minimum stock size associated with 35% Static SPR which is 3,328 mt or 7.34 million pounds. The rebuilding timeframe for red porgy is 18 years with 1999 being Year 1.	None	None	The overfishing level and timeframe chosen by the council will determine the actions to be taken to rebuild this fishery. It is these actions that will have an impact on the various sectors in the fishery.
Rejected Options:			
Rejected Option 1: No Action. Overfishing for red porgy is defined as a fishing mortality rate (F) in excess of the fishing mortality rate at 30% Static SPR (F30%Static SPR) which is the red porgy MSY proxy. The "threshold level" for red porgy is defined as 10% Static SPR.	None	None	The overfishing level and timeframe chosen by the council will determine the actions to be taken to rebuild this fishery. It is these actions that will have an impact on the commercial and recreational entities in this fishery.
Rejected Option 2: The two components of the status determination criteria are: A. A maximum fishing mortality threshold (MFMT) - A fishing mortality rate (F) in excess of F30% Static SPR which is 0.45. B. A minimum stock size threshold (MSST) - The minimum stock size threshold is 2,854.1 mt or the stock size associated with 20% SPR which is estimated at 3,000 mt.	None	None	The overfishing level and timeframe chosen by the council will determine the actions to be taken to rebuild this fishery. It is these actions that will have an impact on the commercial and recreational entities in this fishery.

Table 1 (continued). Summary of Expected Changes in Net Benefits.

Proposed Actions and Other Possible Options	POSITIVE IMPACTS	NEGATIVE IMPACTS	NET IMPACTS
Proposed Action 4: Establish measures for red porgy that will: (1) reduce the recreational bag limit from 5 to 1 red porgy per person per day or per trip, whichever is more restrictive; (2) during January, February, March, and April prohibit purchase or sale of and limit the possession of red porgy aboard vessels with Federal commercial or charter/headboat permits for snapper grouper to one red porgy per person per day or one red porgy per person per trip whichever is more restrictive; (3) continue the 14 inch TL minimum size limit for both recreational and commercial fishermen; and (4) allow a 50 pound by-catch per trip for permitted vessels (i.e., vessels with an unlimited or trip-limited commercial vessel permit) from May 1 through December 31. The status of red porgy will be reviewed every two years to determine if management measures should be repealed or modified.	There will be no short-term positive impacts from this action.	It is expected that this measure could reduce revenue in the commercial sector by $159,358 per year over the reduction from Amendment 9 regulations. Also, annually it is possible that there would be an additional 20% reduction in the charterboat harvest, a 13% reduction in the private/rental sector, and a 5% reduction in the headboat sector over the reduction from Amendment 9.	This action will result in increased benefits in the long-term when the red porgy stock increases so the fishery can provide higher, sustainable benefits.
Rejected Options:			
Rejected Option 1: Prohibit the harvest and possession of red porgy by recreational and commercial fishermen. The status of red porgy will be reviewed every 3 years to determine if the moratorium should be repealed.	There will be no short-term positive impacts from this action.	Compared to Amendment 9, this option could further reduce revenue in the commercial harvesting sector by $224,517 per year. In addition, this option could further reduce recreational harvest by 50% in the private/rental and charterboat sectors, and 31% in the headboat sector.	This action will result in increased benefits in the long-term when the red porgy stock increases so the fishery can provide higher, sustainable benefits.
Rejected Option 2: No Action. Maintain the 14" TL minimum size limit, 5-fish bag limit, and prohibition on harvest and possession over the bag limit during March and April (sale prohibited during March and April).	None	There would be no short-term economic losses.	This option would not allow the fishery to support higher sustainable benefits in the future.
Rejected Option 3: Allow the retention of 50 pounds of red porgy per trip. Some allowance for multi-day trips would make this more equitable (e.g., 50 pounds per day).	None	This option would result in short-term losses in gross revenues that could amount to $78,210 annually.	It is unclear whether this option would allow the stock to be rebuilt in a timely fashion, which would not optimize economic benefits.

Table 1 (continued). Summary of Expected Changes in Net Benefits.

Proposed Actions and Other Possible Options	POSITIVE IMPACTS	NEGATIVE IMPACTS	NET IMPACTS
Proposed Action 5: Modify the Snapper Grouper Framework by adding the following list of management options and measures that could be implemented via framework action: A. Description, identification, and regulations of fishing activities to protect EFH and EFH-HAPCs. B. Management measures to reduce or eliminate the adverse effects of fishing activities or fishing gear on EFH or EFH-HAPCs. C. Regulations of EFH-HAPCs.	None	None	None
Rejected Options:			
Rejected Option 1: No Action.	None	None	None
Proposed Action 6: Modify the Snapper Grouper Limited Access System to allow same owner permit transfers regardless of vessel size (length and tonnage) for individuals harvesting snapper grouper species with a non-transferable 225 pound trip limit permit.	Could allow permit holders constrained from landing 225 pounds to increase benefits.	There could be a decrease in net benefits if this measure resulted in excess capacity in the fishery.	Unable to determine whether this action could optimize long-term benefits.
Rejected Options:			
Rejected Option 1: No Action.	None.	May impede some vessel operators from harvesting their trip limit.	Unable to determine the net impact of this action.

SOCIAL IMPACT ASSESSMENT/FISHERY IMPACT STATEMENT

This integrated document contains all elements of the Plan Amendment, Final Supplemental Environmental Impact Statement (FSEIS), Initial Regulatory Flexibility Analysis (IRFA), Regulatory Impact Review (RIR), and Social Impact Assessment (SIA)/Fishery Impact Statement (FIS). A table of contents for the SIA/FIS is provided separately to aid reviewers in referencing corresponding sections of the Amendment.

INTRODUCTION

Mandates to conduct Social Impact Assessments (SIA) come from both the National Environmental Policy Act (NEPA) and the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). NEPA requires Federal agencies to consider the interactions of natural and human environments by using a "systematic, interdisciplinary approach which will ensure the integrated use of the natural and social sciences...in planning and decision-making" [NEPA section 102 (2) (a)]. Under the Council on Environmental Quality's (CEQ, 1986) *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* a clarification of the terms "human environment" expanded the interpretation to include the relationship of people with their natural and physical environment (40 CFR 1508.14). Moreover, agencies need to address the aesthetic, historic, cultural, economic, social, or health effects which may be direct, indirect or cumulative (Interorganizational Committee on Guidelines and Principles for Social Impact Assessment, 1994).

Under the MSFCMA, fishery management plans (FMPs) must "...achieve and maintain, on a continuing basis, the optimum yield from each fishery" [MSFCMA section 2 (b) (4)]. When considering "a system for limiting access to the fishery in order to achieve optimum yield" the Secretary of Commerce and Regional Fishery Management Councils are to consider both the social and economic impacts of the system [MSFCMA section 303 (b) (6)]. Recent amendments to the MSFCMA require that FMPs address the impacts of any management measures on the participants in the affected fishery and those participants in other fisheries that may be affected directly or indirectly through the inclusion of a fishery impact statement [MSFCMA section 303 (a) (9)]. Most recently, with the addition of National Standard 8, FMPs must now consider the impacts upon fishing communities to assure their sustained participation and minimize adverse economic impacts upon those communities [MSFCMA section 301 (a) (8)]. Consideration of social impacts is a growing concern as fisheries experience increased participation and/or declines in stocks. With an increasing need for management action, the consequences of such changes need to be examined in order to mitigate the negative impacts experienced by the populations concerned.

PROBLEMS AND METHODS

Social impacts are generally the consequences to human populations that follow from some type of public or private action. Those consequences may include alterations to "the ways in which people live, work or play, relate to one another, organize to meet their needs and generally cope as members of a society...." (Interorganizational Committee on Guidelines and Principles for Social Impact Assessment, 1994:1). In addition, cultural impacts which may involve changes in values and beliefs which affect people's way of identifying themselves within their occupation, communities and society in general are included under this interpretation. Social impact analyses help determine the consequences of policy action in advance by comparing the status quo with the projected impacts. Therefore, it is extremely important that as much information as possible concerning a fishery and its participants be gathered for an assessment. Although public hearings and scoping meetings do provide input from those concerned with a particular action, they do not constitute a full overview of the fishery.

Without access to relevant information for conducting social impact analyses it is important to identify any foreseeable adverse effects on the human environment. With quantitative data often lacking, qualitative data can be used to provide a rough estimate of some impacts. In addition, when there is a body of empirical findings available from the social science literature, it needs to be summarized and referenced in the analysis.

In attempting to assess the social impacts of the proposed amendment it must be noted that data available for this analysis did not represent a comprehensive overview of the fishery therefore the analyses do not include all social impacts. What information was available pertains primarily to the commercial harvesting sector of the snapper grouper fishery. Thus social impacts on non-commercial harvesters, the processing sector, the consumer, fishing communities and society as a whole are not fully addressed due to data limitations. The fishery impact statement consists of the description of the commercial fishery and the social impacts under each action item and options. Data to define or determine impacts upon fishing communities are very limited.

SOCIAL IMPACT SUMMARY

Table 2. Social impact (SIA/FIS) summary.

ACTION	SOCIAL IMPACTS
Action 1. Maximum Sustainable Yield (MSY) for red porgy is 4.38 million pounds (1,987 mt).	Due to lack of long-term impact data, it is not possible to currently prediet the social impacts of setting MSY at this level. Short-term positive or negative social benefits will depend on the management measures adopted to keep the fishery from exceeding the chosen overfishing threshold.
Action 2. Optimum Yield (OY) for red porgy is the amount of harvest that can be taken by U.S. fishermen while maintaining the Spawning Potential Ratio (SPR) at or above 45% Static SPR.	Due to lack of long-term impaet data, it is not possible to currently predict the social impacts of setting OY at this level. Short-term positive or negative social benefits will depend on the management measures adopted to keep the fishery from exceeding the chosen overfishing threshold.
Action 3. Overfishing Level & Rebuilding Timeframe. The two components of the status determination eriteria are: A. A maximum fishing mortality threshold (MFMT) - A fishing mortality rate (F) corresponding to a 35% Static SPR (F=0.43) based on a 14" TL minimum size limit. B. A minimum stock size threshold (MSST) - The minimum stock size threshold is defined as the maximum of either 0.5 or 1-M (M=natural mortality=0.28) times Bmsy. The Council is specifying the minimum stock size associated with 35% Static SPR which is 3,328 mt or 7.34 million pounds. The rebuilding timeframe for red porgy is 18 years with 1999 being Year 1.	Due to lack of long-term impact data, it is not possible to currently predict the social impacts of setting the overfishing criteria at these levels. Short-term positive or negative social benefits will depend on the management measures adopted to keep the fishery from exceeding the chosen overfishing level and threshold. The rebuilding timeframe for red porgy is 18 years with 1999 being Year 1. Due to lack of long-term impact data, it is not possible to currently predict the social impacts of setting the rebuilding timeframe at 18 years.
Action 4: Establish measures for red porgy that will: (1) reduce the recreational bag limit from 5 to 1 red porgy per person per day or per trip, whichever is more restrictive; (2) during January, February, March, and April prohibit purchase or sale of and limit the possession of red porgy aboard vessels with Federal commercial or charter/headboat permits for snapper grouper to one red porgy per person per day or one red porgy per person per trip whichever is more restrictive; (3) continue the 14 inch TL minimum size limit for both recreational and commercial fishermen; and (4) allow a 50 pound by-catch per trip for permitted vessels (i.e., vessels with an unlimited or trip-limited commercial vessel permit) from May 1 through December 31. The status of red porgy will be reviewed every two years to determine if management measures should be repealed or modified.	The proposed measures will have a negative short-term social impact on all sectors of the fishery, however, the negative impacts are much less than those associated with a total moratorium. While effort and catch are highest among the commercial harvesters of North and South Carolina, for-hire and recreational fishers will also feel an impact, as will processors, wholesalers, retailers, and the informal sector of the fishery. Decreased quality of life is predicted to affect all sectors of the fishery. Increased perceived conflict between recreational and commercial fishers will likely occur. A shifting of effort to other fisheries may occur, which may ameliorate the losses caused by the prohibition. Long-term benefits are predicted to occur as the fishery regains viability and is opened again to all sectors. In view of the negative impacts expected to accrue from a closure of the red porgy fishery, allowing a 50 pound incidental bycatch limit within the commercial sector will have a positive soeial impact by improving the legitimacy of the proposed action. Fishermen have expressed concern that if they have incidental bycatch of red porgy they will be subject to prosecution by law enforcement. An allowance of a 50-pound bycatch is seen by fishermen as a realistic assessment of their fishing experience, and is in the same spirit of allowing a one fish per person per day bag limit in the recreational fishing sector. This allowance for both sectors reduces the potential for large regulatory discards, a concept that is perceived by fishers as wasteful and inherently out of place in good fisheries management. The importance of heeding stakeholders' concerns and suggestions cannot be overemphasized. Giving the participants in a fishery the ability to construct or have a role in constructing the policy that impacts them increases the ineentive to comply with new regulations.

Table 2 (continued). Social impact (SIA/FIS) summary.

ACTION	SOCIAL IMPACTS
Action 5. Modify the Snapper Grouper Framework by adding the following list of management options and measures that could be implemented via framework action: A. Description, identification, and regulations of fishing activities to protect EFH and EFH-HAPCs. B. Management measures to reduce or eliminate the adverse effects of fishing activities or fishing gear on EFH or EFH-HAPCs. C. Regulations of EFH-HAPCs.	A positive impact might be predicted in this case, as the regulatory process will become more efficient and less burdensome on all sectors of the fishery.
Action 6. Modify the Snapper Grouper Limited Access System to allow same owner permit transfers regardless of vessel size (length and tonnage) for individuals harvesting snapper grouper species with a non-transferable 225 pound trip limit permit.	This action will produce a positive social impact for existing permit holders by reducing the complexity of regulations, leading to a reduction of time and effort spent to comply with existing laws. Furthermore, the original purpose of creating this class of permit holders will be upheld. As individuals naturally "cycle out" of the fishery, no new permits will be issued. Vessel safety and safety at sea will be improved with this action.

SOCIAL IMPACT ASSESSMENT DATA NEEDS

The recent socio-demographic survey and economic survey were snapshots of the commercial fishery. Full and useful profiles of fishing communities in the South Atlantic are virtually non-existent, and fishing communities need to be identified and their dependence upon fishing and fishery resources needs to be established. In order to achieve these goals, data needs to be gathered in three or more ways.

First, in order to establish both baseline data and to contextualize the information already gathered by survey methods, there is a great need for in-depth, ethnographic study of the different fishing sectors, or subcultures. Second, existing literature on social/cultural analyses of fisheries and other sources in social evaluation research need to be culled in order to offer a comparative perspective and guide the SIAs. Third, socio-economic data need to be collected on a continuing basis for both the commercial and recreational sectors, including the for-hire sector. Methods for doing this would include regular collection of social and economic information in logbooks for the commercial sector and similar add-ons to the MRFSS data collection system can provide this type of data for recreational fishermen.

The following is a guideline to the types of data needed:

1. Demographic information may include but not necessarily limited to: population; age; gender; ethnic/race; education; language; marital status; children, (age & gender); residence; household size; household income, (fishing/non-fishing); occupational skills; association with vessels & firms (role & status).

2. Social Structure information may include but not necessarily limited to: historical participation; description of work patterns; kinship unit, size and structure; organization & affiliation; patterns of communication and cooperation; competition and conflict; spousal and household processes; and communication and integration.

3. Emic culture information may include but not necessarily limited to: occupational motivation and satisfaction; attitudes and perceptions concerning management; constituent views of their personal future of fishing; psycho-social well-being; and cultural traditions related to fishing (identity and meaning).

4. Fishing community information might include but not necessarily limited to: identifying communities, dependence upon fishery resources (this includes recreational use), identifying businesses related to that dependence, determine the number of employees within these businesses and their status.

This list of data needs is not exhaustive or all inclusive. The upcoming issues within the snapper grouper fishery will undoubtedly focus upon allocation and the need for reliable and valid information concerning the social environment will become necessary for managing this fishery.

1.0 PURPOSE AND NEED

1.1 Issues/Problems

The Fishery Management Plan for the Snapper Grouper Fishery (SAFMC, 1983) contains a detailed description of the snapper grouper fishery. The problems and issues in the fishery are outlined in the various amendments and are shown below.

Problems identified in the Snapper Grouper Fishery Management Plan as modified by Amendment 8 (SAFMC, 1997) are:

1. Excessive fishing mortality is jeopardizing the biological integrity of the snapper grouper resource of the South Atlantic.

2. Adequate management has been hindered by lack of current and accurate biological, statistical, social, and economic information.

Progress has been made in determining the status of additional species. However, data to calculate stock status remains limited and in many cases the status of particular stocks are disputed between fishermen and scientists.

The permitting system defines the universe of participants, and social and economic survey results are available for portions of the commercial fishery. Information for the recreational fishery remains very limited.

3. Intense competition exists among recreational, part-time, and full-time commercial users of the snapper grouper resources; and between commercial users employing different gears (hook and line, traps, entanglement nets, longlines, and powerheads/bang sticks).

4. Habitat degradation caused by some types of fishing gear and poor water quality have adversely affected fish stocks and associated habitat.

5. The existence of inconsistent State and Federal regulations makes it difficult to coordinate, implement and enforce management measures and may lead to overfishing. Inconsistent management measures create public confusion and hinders voluntary compliance.

6. Excess Capacity: The size and capacity of the fleet have increased significantly in recent years. Despite bag and trip limits, and other regulatory measures, some of the stocks are still overfished or near the overfished stage. Any gains from current regulatory measures under open access are likely to attract new entrants to the fishery and provide incentive for those already in the fishery to increase harvest capacity even when gains in production are marginal or when economies of scale are not necessarily realized.

7. Inefficiency: Past and present measures to control harvest (TAC, gear restrictions, trip limits, size limit and bag limits), and future measures that would likely be implemented under continued open access, would increase fishing costs and decrease potential consumer and producer benefits from the fishery. This inefficiency could be minimized if access to the fishery is controlled.

8. Low Conservation and Compliance Incentives: Under open access there is little incentive on the part of fishermen to promote conservation and to voluntarily comply with regulations. This is because the benefits from doing so may accrue to other fishermen or to new entrants. A controlled access management system would provide a mechanism for those who participate in conservation measures to share in the resulting benefits.

9. Potential Conflicts among Participants: As the number of vessels continues to increase over time, competitive fishing conditions may eventually lead to gear and area conflicts as a large number of vessels compete for the available resources on the same fishing grounds. (At the other extreme, stocks may decline to the point where marginal fishermen may not find it economically viable to fish. This situation could lead to a decline in fishing effort.)

10. High Regulatory Costs: The progression of regulatory measures already implemented in the snapper grouper fishery has resulted in increasing management and enforcement costs. However, the full benefit from these measures has not been realized due to the open access nature of the fishery. More management measures under open access would further increase these costs to the point where management costs could outweigh the benefits.

11. Low Marketing Incentives: Short–run oversupply and lack of product continuity continues to create price fluctuation and uncertainty in the marketplace for these species. The likelihood of additional harvest restrictions under open access increases uncertainty and instability which discourages long–term planning and investment by dealers.

12. Localized Depletion: Localized depletion where a species' abundance in an area is reduced by high fishing effort can cause conflict among fishermen.

1.2 Management Objectives

The objectives are spelled out in the Fishery Management Plan and its amendments. It should be noted that various actions implemented under the FMP and its amendments established the management structure for stabilizing yield at maximum sustainable yield (MSY), for recovery of overfished stocks, and for maintaining population levels sufficient to ensure adequate recruitment.

Objectives of the Snapper Grouper Fishery Management Plan as modified by Amendment 8 (SAFMC, 1997) are:

1. Prevent overfishing in all species by maintaining the spawning potential ratio (SPR) at or above target levels.

2. Collect necessary data to develop, monitor, and assess biological, economic, and social impacts of management measures designed to prevent overfishing, obtain desired SPR levels, and address the other stated problems.

3. Promote orderly utilization of the resource.

4. Provide for a flexible management system that minimizes regulatory delays while retaining substantial Council and public involvement in management decisions, and rapidly adapts to changes in resource abundance, new scientific information, and changes in fishing patterns among user groups.

5. Minimize habitat damage due to direct and indirect effects of recreational and commercial fishing activities as well as other non-fishery impacts.

6. Promote public comprehension of, voluntary compliance with, and enforcement of the management measures.

7. Mechanism to Vest Participants: A controlled access system provides a means whereby participants have a stake in conserving the resource. This ensures that participants consider the long–run benefits of conserving the resource because they know it is in their best interest. Unlike open access, controlled access would ensure that those who conserve the resource share in the long–run benefits. This gives fishermen incentive to protect the resource and expose those who are violating regulations. As a result, voluntary compliance would increase and enforcement costs would likely decrease.

8. Promote Stability and Facilitate Long–run Planning: Participants in the fishery will have access to the resource based on certain criteria to be determined by the Council after reviewing public comments. This would give participants the flexibility to employ the most profitable way to fish and also fish when it is most profitable in terms of market conditions. Such a system will promote stability in the fishery by providing a regular supply of fish throughout the fishing year, and maintain stable prices. Both fishermen and fish dealers will have the incentive to engage in long–run planning and investment activities.

9. Create Market–Driven Harvest Pace and Increase Product Continuity: A system that ensures participants can harvest their allocations (whether in terms of individual quotas, effort units, trip limits, etc.) anytime during the fishing year would ensure that fishermen conduct their fishing activities to supply the market according to its structure and demand situation. There would be no incentive on the part of fishermen to flood the market with fish. This could result in product continuity, improved product quality, and better prices.

10. Minimize Gear and Area Conflicts among Fishermen: Presently, allowable gear provision (implemented under Snapper Grouper Amendment 6) controls the types of gear in the fishery. Controlled access and effort unit controls would limit the number of allowable gear in the fishery.

11. Decrease Incentives For Overcapitalization: If some form of vested interest is provided to fishermen, their objective would be to maximize profits subject to certain conditions. In order to maximize profits they would explore the least cost method for harvesting in the fishery. This means they would employ fishing effort only to the point where the difference between the anticipated total revenue and total cost is greatest. This practice would reduce incentives for overcapitalization.

12. Prevent Continual Dissipation of Returns from Fishing through Open Access: It is a well known fact that under open access any measure(s) that generate "pure profits" will provide an opportunity for those already in the fishery to dissipate those profits and also attract new entrants into the fishery. This can only be prevented if measures are taken to prevent those already in the fishery from increasing their effort without any restriction and also to create a barrier against unlimited entry into the fishery. A controlled access system will reduce the incentive for present participants to violate the regulations, and also prevent unlimited entry into the fishery.

13. Evaluate and minimize localized depletion. High fishing mortality rates have resulted in localized depletion of some species in certain areas. Certain species are overfished throughout their range; however, there are particular areas where the overfishing rate is more severe than in the rest of the range. There may also be some cases where the stock as a whole is not overfished, but the numbers in a localized area have been significantly reduced.

14. Minimize bycatch.

Reflects greater responsibility under recent Magnuson-Stevens Act amendment which added the following national standard: "(9) Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch."

Amendment 8, which became effective on December 14, 1999, was developed to solve the problems associated with open access fisheries (Problems 6 through 12).

1.3 History of Management

1.3.1 Snapper Grouper Fishery Management Plan and Amendments

The **Fishery Management Plan** (FMP) for the Snapper Grouper Fishery of the South Atlantic Region (SAFMC, 1983) was prepared by the South Atlantic Fishery Management Council and implemented by the Secretary of Commerce on August 31, 1983 [48 Federal Register 39463]. The FMP was prepared to prevent growth overfishing in thirteen species in the snapper grouper complex and to establish a procedure for preventing overfishing in other species. The FMP established a 12" total length minimum size for red snapper, yellowtail snapper, red grouper and Nassau grouper; an 8" total minimum size for black sea bass; and a 4" trawl mesh size to achieve a 12" minimum size for vermilion snapper. Additional harvest and gear limitations were also included in the original plan.

Amendment 1 (SAFMC, 1988) was implemented by the Secretary effective January 12, 1989 [54 Federal Register 1720] to address the problems of habitat damage and growth overfishing in the trawl fishery. The amendment prohibited use of trawl gear to harvest fish in the directed snapper grouper fishery south of Cape Hatteras, North Carolina (35° 15' N Latitude) and north of Cape Canaveral, Florida (Vehicle Assembly Building, 28° 35.1' N Latitude). A vessel with trawl gear and more than 200 pounds of fish in the snapper grouper fishery (as listed in Section 646.2 of the regulations) on board was defined as a directed fishery. The amendment also established a rebuttable presumption that a vessel with fish in the snapper grouper fishery (as listed in Section 646.2 of the regulations) on board harvested its catch of such fish in the Exclusive Economic Zone (EEZ).

Amendment 2 (SAFMC, 1990b) prohibited the harvest or possession of jewfish in or from the EEZ in the South Atlantic due to its overfished status and defined overfishing for jewfish and other snapper grouper species according to the National Marine Fisheries Service

(NMFS) 602 guidelines requirement that definitions of overfishing be included for each fishery management plan. The harvest or possession of jewfish was prohibited by emergency rule. The amendment was approved on October 10, 1990 and final regulations were effective October 30, 1990 [55 Federal Register 46213].

Amendment 3 (SAFMC, 1990a) established a management program for the wreckfish fishery. The Council was concerned that the rapid increase in effort and catch threatened the wreckfish resource with overfishing and that the concentration of additional vessels in the relatively small area where the resource is located could also create problems with vessel safety because of overcrowding. Actions included: (1) adding wreckfish to the management unit; (2) defining optimum yield; (3) defining overfishing for wreckfish; (4) requiring an annual permit to fish for, land or sell wreckfish; (5) collecting data necessary for effective management; (6) establishing a control date of March 28, 1990 after which there would be no guarantee of inclusion in a limited entry program should one be developed (this was later limited to the area bounded by 33° and 30° N. latitude based on public hearing testimony); (7) establishing a fishing year beginning April 16; (8) establishing a process whereby annual total allowable catch (annual quotas) would be specified, with the initial quota set at 2 million pounds; (9) establishing a 10,000 pound trip limit; and (10) establishing a spawning season closure from January 15 through April 15. Actions (7), (9) and (10) were based on public testimony. An emergency rule effective August 3, 1990 [55 Federal Register 32257] added wreckfish to the management unit, established a fishing year for wreckfish commencing April 16, 1990, established a commercial quota of 2 million pounds and established a catch limit of 10,000 pounds per trip. The Secretary of Commerce closed the fishery for wreckfish in the EEZ effective August 8, 1990 when the 2 million pound TAC was reached [55 Federal Register 32635]. The Council requested an extension of the emergency rule which was approved [55 Federal Register 40181]. Amendment 3 was approved on November 9, 1990 and final regulations were effective January 31, 1991 [56 Federal Register 2443].

Amendment 4 (SAFMC, 1991b) was prepared to reduce fishing mortality on overfished species, to establish compatible regulations, where possible, between state and federal agencies, to identify the universe of fishermen, and to gather the data necessary for management. Amendment 4 prohibits: (1) use of fish traps in South Atlantic federal waters with the exception of black sea bass traps when used north of Cape Canaveral, Florida; (2) use of entanglement nets, which includes gill and trammel nets; (3) use of longline gear inside 50 fathoms (300 feet) in the snapper grouper fishery in South Atlantic federal waters; (4) use of bottom longlines for wreckfish; and (5) use of powerheads and bangsticks in all designated special management zones (SMZs) off the South Carolina coast. In addition, fishermen who fish for other species with gear prohibited in the snapper grouper fishery may not have bycatch of snapper and grouper species in excess of the allowed bag limit. No bycatch would be allowed for those species that have no bag limit or that are prohibited.

The amendment established the following minimum sizes: 8" total length for lane snapper and black sea bass; 10" total length for vermilion snapper (recreational fishery only); 12" total length for red porgy, vermilion snapper (commercial fishery only), gray, yellowtail, mutton, schoolmaster, queen, blackfin, cubera, dog, mahogany and silk snappers; 20" total length for red snapper, gag, and red, black, scamp, yellowfin, and yellowmouth groupers; 28" fork length for greater amberjack (recreational fishery only); 36" fork length or 28" core length for greater amberjack (commercial fishery only); and no retention of Nassau grouper. Amendment 4 also requires that all snappers and groupers possessed in South Atlantic federal waters must have head and fins intact through landing.

Bag limits established under Amendment 4 for the recreational fishery are: a bag limit of 10 vermilion snapper per person per day; a bag limit of three greater amberjack per person per day; a snapper aggregate bag limit of 10 fish per person per day, excluding vermilion snapper and allowing no more than two red snappers; and a grouper aggregate bag limit of five per person per day, excluding Nassau grouper and jewfish for which no retention is allowed. Charter and head boats are allowed to have up to a two–day possession limit as long as there are two licensed operators on board and passengers have receipts for trips in excess of 12 hours. Excursion boats would be allowed to have up to a three–day possession limit on multi–day trips. Fish harvested under the bag limit may be sold in conformance with state laws if they meet the commercial minimum sizes. The commercial harvest and/or landing of greater amberjack in excess of the three–fish bag limit is prohibited in April south of Cape Canaveral, Florida. The commercial harvest and/or landing of mutton snapper in excess of the snapper aggregate bag limit is prohibited during May and June.

To exceed bag limits in the snapper grouper fishery, an owner or operator of a vessel that fishes in South Atlantic federal waters is required to obtain an annual vessel permit. For individuals to qualify for a permit they must have at least 50 percent of their earned income, or $20,000 in gross sales, derived from commercial, charter, or headboat fishing. For a corporation to be eligible for a permit, the corporation or shareholder or officer of the corporation or the vessel operator would be required to have at least $20,000 in gross sales derived from commercial fishing. For partnerships, the general partner or operator of the vessel is required to meet the same qualifications as a corporation. A permit, gear, and vessel and trap identifications are required to fish with black sea bass traps. Amendment 4 also addresses enforcement concerns that surfaced with wreckfish trip limit. Amendment 4 was approved on August 26, 1991 by the Secretary of Commerce and all regulations were effective on January 1, 1992 except the bottom longline prohibition for wreckfish was implemented on October 25, 1991 [56 Federal Register 56016].

Bottom longline gear was being used to a limited extent in the wreckfish fishery and fishermen indicated that gear loss, habitat damage and lost gear continuing to fish were problems. The Council subsequently requested and was granted **emergency regulations** [56 Federal Register 18742] that prohibited the use of bottom longline gear in the wreckfish fishery effective April 19, 1991 and were granted an **extension** on July 19,1991 [56 Federal Register 33210].

A **control date** of July 30, 1991 for possible future limited entry was established for the entire snapper grouper fishery excluding wreckfish [56 Federal Register 36052].

Amendment 5 (SAFMC, 1991a) established Individual Transferable Quota (ITQ) management program for the wreckfish fishery. The Council submitted the amendment to the Secretary of Commerce on September 12, 1991. Amendment 5 was implemented with an effective date of April 6, 1992, except that the sections dealing with permits and fees, falsifying information, and percentage shares was effective March 5, 1992 [57 Federal Register 7886]. The amendment included the following: (1) a limited entry program for the wreckfish sector of the snapper grouper fishery consisting of transferable percentage shares of the annual total allowable catch (TAC) of wreckfish and individual transferable quotas (ITQs) based on a person's share of each TAC; (2) required dealer permits to receive wreckfish; (3) removed the 10,000 pound (4,536 kilogram) trip limit for wreckfish; (4) required that wreckfish be off loaded from fishing vessels only between 8:00 a.m. and 5:00 p.m.; (5) reduced the occasions when 24–hour advance notice must be made to NMFS Law Enforcement for off–loading of wreckfish; and (6) specified the procedure for initial distribution of percentage shares of the wreckfish TAC. At its February

1996 meeting, the Council approved staying with the 2 million pound TAC for fishing year 1996/97.

Implementation of Amendment 4 resulted in a prohibition on black sea bass pot fishermen making multi–gear trips and retaining other species which resulted in large, unintended economic losses. The Council subsequently requested **emergency regulations** on July 8, 1992 to modify the definition of black sea bass pot, allow multi–gear trips, and allow retention of incidentally caught fish. These regulations became effective on August 31, 1992 [57 Federal Register 39365] and were extended on November 30, 1992 [57 Federal Register 56522]. On December 11, 1992 the Council submitted a **regulatory amendment** implementing the above changes on a permanent basis. An interim final rule and request for comments was published on March 2, 1993 with an effective date of March 1, 1993 [58 Federal Register 11979]. The final rule was published on July 6, 1993 [58 Federal Register 36155] with an effective date of July 6, 1993.

The Council submitted a **regulatory amendment** requesting implementation of eight special management zones off South Carolina on August 12, 1992. The proposed rule was published in the federal register on March 15, 1993 [58 Federal Register 13732]. The final rule was published on July 2, 1993 [58 Federal Register 35895] with the effective date of July 31, 1993.

Amendment 6 (SAFMC, 1993b) was submitted to the Secretary of Commerce in December 1993. The amendment was developed to rebuild the snowy grouper, golden tilefish, speckled hind, warsaw grouper, misty grouper, and yellowedge grouper resources and proposed to phase–in quotas over a three year period beginning January 1994. Commercial trip limits, recreational bag limits, and an experimental closed area were also proposed to manage and rebuild these economically and ecologically important resources. Data will be collected to evaluate shifts in fishing effort (effort shifts) among fisheries and for future evaluation of an "Individual Transferable Quota" (ITQ) type of management approach. Amendment 6 was approved on May 5, 1994 with the exception of the 100 percent logbook coverage and the anchoring prohibition within the Oculina Bank. Commercial trip limits for snowy grouper and golden tilefish became effective June 6, 1994, and the remainder of the regulations became effective June 27, 1994 [59 Federal Register 27242].

Amendment 7 (SAFMC, 1994a) was submitted to the Secretary of Commerce on June 16, 1994. It establishes a 12" fork length size limit for hogfish; increases the mutton snapper size limit from 12" to 16" total length; requires dealer, charter and headboat federal permits; allows sale under specified conditions; specifies allowable gear and makes allowance for experimental gear; makes allowance for multi–gear trips in North Carolina; adds localized overfishing to the list of problems and objectives; adjusts the bag limit and crew specification for charter and headboats; modifies the management unit for scup to apply south of Cape Hatteras, North Carolina; modifies the framework procedure to increase the timeliness of action by the Council. The final rule was published on December 23, 1994 [59 Federal Register 66270] and the regulations became effective January 23, 1995 except for application and possession of dealer, charter and headboat federal permits which became effective December 23, 1994 and March 1, 1995 respectively.

At the request of the State of Florida, the Council submitted **Regulatory Amendment 6** (SAFMC, 1994b) on October 21, 1994 to the Secretary of Commerce for bag limits on hogfish and cubera snapper, and a size limit on gray triggerfish. It proposes to establish a daily recreational bag limit of five hogfish per person; limit the harvest and possession to two per day; of cubera snapper to 30" total length or larger and establish a minimum size limit for gray triggerfish of 12" total length. These measures would apply only in the EEZ off the Atlantic coast of Florida. The proposed rule was published on February 15, 1995 [60 Federal Register 8622]. The final rule was published on April 20, 1995 [60 Federal Register 19683 with effective date of May 22, 1995].

In a letter dated February 6, 1997, the Council requested establishment of **a control date for the black sea bass pot fishery** effective upon publication in the federal register. The advanced notice of proposed rulemaking was published in the federal register on April 23, 1997 [62 Federal Register 19732], thus April 23, 1997 is the control date for the black sea bass pot fishery.

Amendment 8 (SAFMC, 1997) established a program to limit initial eligibility for participation in the snapper grouper fishery to owners of boats/vessels that: (1) can demonstrate any landings of species in the snapper grouper management unit in 1993, 1994, 1995 or 1996 (as of August 20, 1996) and (2) held a valid snapper grouper permit between February 11, 1996 and February 11, 1997. Vessels landing at least 1,000 pounds of species in the snapper grouper management unit in any of these years received a transferable permit. All other vessels received a non-transferable permit and are limited to a 225 pound trip limit. Amendment 8 also modified the problems, objectives, Optimum Yield and overfishing definition in the snapper grouper management plan. In addition, the habitat responsibility was expanded and measures to modify allowable gear and allow possession of fillets from the Bahamas were included. Amendment 8 was submitted to the Secretary of Commerce on July 10, 1997. The notice of availability of Amendment 8 was published in the federal register on October 30, 1997 [62 Federal Register 58703] thereby beginning the formal review process. The Secretary of Commerce partially approved Amendment 8 on January 28, 1998. All measures were approved except the overfishing and overfished levels, including the 10% threshold level. The proposed rule was published in the federal register on January 12, 1998 [63 Federal Register 1813]. The final rule was published in the federal register on July 16, 1998 [63 Federal Register 38298]. Amendment 8 became fully effective in December 1998.

Amendment 9 (SAFMC, 1998a), which was based on the 1994 stock assessment, was finalized and sent to the Secretary of Commerce for formal review and implementation on February 3, 1998. Recognizing the need for measures contained in Amendment 9, particularly for red porgy, the Council requested implementation of Amendment 9 (except the black sea bass pot construction measure) as an interim request under the Magnuson-Stevens Act on January 16, 1998. On May 14, 1998 the National Marine Fisheries Service informed the Council that they suspended action on the interim rule and that they intended, instead, to address these measures under Amendment 9.

On September 24, 1998 the Council requested that all measures in Amendment 9 be implemented through emergency action. Once again, the Council was attempting to begin rebuilding of overfished species, particularly red porgy, as soon as possible. On January 22, 1999 the National Marine Fisheries Service informed the Council that the final rule for Amendment 9 was to be filed with the Office of the Federal Register on January 21, 1999, with an effective date of February 24, 1999. Thus regulations addressing red porgy based on the 1994 stock assessment using data through 1992 took effect on February 24, 1999, a full year after the Council submitted the document to the Secretary of Commerce. Neither the Council's interim rule or emergency rule requests were approved.

The notice of availability of Amendment 9 was published in the federal register on September 8, 1998 [63 Federal Register 47461] thereby beginning the formal review process. The proposed rule was published in the federal register on November 12, 1998 [63 Federal

Register 63276]. The Secretary of Commerce partially approved Amendment 9 on December 9, 1998. All measures were approved except the 1,000 pound trip limit for greater amberjack. The final rule was published in the federal register on January 25, 1999 [64 Federal Register 3624]. Amendment 9 became effective February 24, 1999.

Measures approved in Amendment 9 were to: Increase the **red porgy** minimum size limit from 12" TL to 14" TL for both recreational and commercial fishermen, establish a recreational bag limit of 5 red porgy per person per day, prohibit harvest and possession in excess of the bag limit during March and April, and prohibit purchase and sale during March and April; Increase **the black sea bass** minimum size limit from 8" TL to 10" TL for both recreational and commercial fishermen, and establish a recreational bag limit of 20 black sea bass per person per day; **Require escape vents and escape panels** with degradable fasteners in black sea bass pots; Establish measures for **greater amberjack** that will: reduce the recreational bag limit from 3 to 1 greater amberjack per person per day, prohibit harvest and possession in excess of the bag limit during April throughout the EEZ, establish a quota at 63% of 1995 landings (quota=1,169,931 pounds), begin the fishing year on May 1, prohibit sale of fish harvested under the bag limit when the season is closed, and prohibit coring; Increase the recreational **vermilion snapper** minimum size limit from 10" to 11" TL and retain the current 10-fish bag limit; Increase the **gag grouper** minimum size limit from 20" TL to 24" TL for both recreational and commercial fishermen, prohibit harvest and possession in excess of the bag limit during March and April, and prohibit purchase and sale during March and April; Increase the **black grouper** minimum size limit from 20" to 24" TL for both recreational and commercial fishermen, prohibit harvest and possession in excess of the bag limit during March and April, and prohibit purchase and sale during March and April; Specify that within the **5-fish aggregate grouper bag limit** (which currently includes tilefish and excludes jewfish and Nassau grouper), no more than 2 fish may be gag grouper or black grouper (individually or in combination); Establish an **aggregate recreational bag limit** of 20 fish per person per day inclusive of all snapper grouper species currently not under a bag limit, excluding tomtate and blue runners (there would be no bag limit on tomtate and blue runners); and Specify that **vessels with longline gear** aboard may only possess snowy grouper, warsaw grouper, yellowedge grouper, misty grouper, golden tilefish, blueline tilefish, and sand tilefish.

On April 6, 1999 the Council requested a prohibition on harvest and possession of red porgy be implemented through **emergency action**. The request was approved and is effective September 8, 1999 through March 1, 2000 [64 Federal Register 48324]. At the December 1999 meeting, the Council requested the emergency rule be extended. The extension, through August 28, 2000, was approved on February 25, 2000 [65 Federal Register 10039].

On July 13, 1999 the Council requested the Snapper Grouper Amendment 8 application process be reopened through **emergency action**. The request was approved effective September 3, 1999 [64 Federal Register 48326].

Amendment 10 (SAFMC, 1998b), which addressed the Habitat requirement of the Magnuson-Stevens Act, as amended in 1996, contained the following snapper grouper items [Note: Detailed information is presented in the Council's Habitat Plan (SAFMC, 1998c)]:

ACTION 1. Identify Essential Fish Habitat for Species in the Snapper Grouper Management Unit.

Essential fish habitat for snapper-grouper species includes coral reefs, live/hard bottom, submerged aquatic vegetation, artificial reefs and medium to high profile outcroppings on and around the shelf break zone from shore to at least 600 feet (but to at least 2000 feet for wreckfish) where the annual water temperature range is sufficiently warm to maintain adult populations of members of this largely tropical complex. EFH includes the spawning area in the water column above the adult habitat and the additional pelagic environment, including *Sargassum*, required for larval survival and growth up to and including settlement. In addition the Gulf Stream is an essential fish habitat because it provides a mechanism to disperse snapper grouper larvae.

For specific life stages of estuarine dependent and nearshore snapper-grouper species, essential fish habitat includes areas inshore of the 100-foot contour, such as attached macroalgae; submerged rooted vascular plants (seagrasses); estuarine emergent vegetated wetlands (saltmarshes, brackish marsh); tidal creeks; estuarine scrub/shrub (mangrove fringe); oyster reefs and shell banks; unconsolidated bottom (soft sediments); artificial reefs; and coral reefs and live/hard bottom.

Refer to Section 3.0 in the Habitat Plan (SAFMC, 1998c) for a more detailed description of habitat utilized by the managed species. Also, it should be noted that the Gulf Stream occurs within the EEZ.

ACTION 2. Establish Essential Fish Habitat-Habitat Areas of Particular Concern (EFH-HAPCs) for Species in the Snapper Grouper Management Unit.

Areas which meet the criteria for essential fish habitat-habitat areas of particular concern (EFH-HAPCs) for species in the snapper-grouper management unit include medium to high profile offshore hard bottoms where spawning normally occurs; localities of known or likely periodic spawning aggregations; nearshore hard bottom areas; The Point, The Ten Fathom Ledge, and Big Rock (North Carolina); The Charleston Bump (South Carolina); mangrove habitat; seagrass habitat; oyster/shell habitat; all coastal inlets; all state-designated nursery habitats of particular importance to snapper grouper (e.g., Primary and Secondary Nursery Areas designated in North Carolina); pelagic and benthic *Sargassum*; Hoyt Hills for wreckfish; the Oculina Bank Habitat Area of Particular Concern; all hermatypic coral habitats and reefs; manganese outcroppings on the Blake Plateau; and Council-designated Artificial Reef Special Management Zones (SMZs).

The Council's Comprehensive Habitat Amendment, which includes Amendment 10, was sent to the Secretary of Commerce for formal review on October 9, 1998 The notice of availability for Amendment 10 was published in the federal register on March 5, 1999 Amendment 10 was approved on June 3, 1999 The proposed rule was published on July 9, 1999 The final rule has not been published as of this date.

Amendment 11 (SAFMC, 1998d), which addressed the non-habitat requirements of the Magnuson-Stevens Act, as amended in 1996, contained the following snapper grouper items:

Action 1. Maximum Sustainable Yield (MSY).

Maximum sustainable yield for species in the snapper grouper management unit is unknown. The Council reviewed alternatives and concluded the best available data supports using 40% Static SPR as a proxy for MSY for jewfish and Nassau grouper, and 30% Static SPR as a MSY proxy for the remaining species.

Action 2. Optimum Yield (OY).

Optimum Yield (OY) for the snapper grouper fishery is the amount of harvest that can be taken by U.S. fishermen while maintaining the Spawning Potential Ratio (SPR) at or above 40% Static SPR for all species in the snapper grouper management unit except the following:

A. Hermaphroditic groupers (that is, those that switch sex, generally from females to males as they grow older) will be managed for an OY of 45% Static SPR.

B. Jewfish and Nassau Grouper will be managed for an OY of 50% Static SPR.

Action 3. Overfishing Level to meet Magnuson-Stevens Mandate.

Overfishing for all species in the snapper grouper management unit, except for jewfish and Nassau grouper, is defined as a fishing mortality rate (F) in excess of the fishing mortality rate at 30% Static SPR (F30%Static SPR) which is the snapper grouper MSY proxy.

Overfishing for jewfish and Nassau grouper is defined as a fishing mortality rate (F) in excess of the fishing mortality rate at 40% Static SPR (F40% Static SPR) which is the MSY proxy for jewfish and Nassau grouper.

Overfishing for black sea bass is defined in terms of the Checklist (Appendix D) and information provided by Dr. Doug Vaughan, NMFS Beaufort Lab (Table 50). The two components of the status determination criteria are:

A. A maximum fishing mortality threshold (MFMT) — A fishing mortality rate (F) in excess of F30% Static SPR which is 0.72 (Table 50).

B. A minimum stock size threshold (MSST) — The minimum stock size threshold is 3.72 million pounds (Table 50).

The "threshold level" for all species in the snapper grouper management unit, except for jewfish and Nassau grouper, is defined as 10% Static SPR. For jewfish and Nassau grouper, the "threshold level" is defined as 30% Static SPR.

Action 4. Rebuilding Timeframe.

Rebuilding projections are not available at this time. The Council recommends that projections be incorporated into the next stock assessment to the extent practicable to determine whether the overfished snapper grouper species can be rebuilt in less than 10 years. Until such time as this information is provided to the Council, the current timeframe for recovery remains in effect: The timeframe for recovery of snappers (excluding red snapper), greater amberjack, black sea bass, and red porgy is not to exceed 10 years. For red snapper and the groupers, the timeframe is not to exceed 15 years. Year 1 was the 1991 fishing year.

Action 5. Overfishing Evaluation to meet the Current Definition.

The Council made the determinations shown for each species based on having Snapper Grouper Amendment 8 and Snapper Grouper Amendment 9 in place. The Council is in a difficult situation, particularly for species in the snapper grouper management unit, because these two major amendment have not been implemented and previous amendments have not been incorporated into assessment results for some species. The Council's previous actions will have major impacts on rebuilding overfished species. The Council's conclusions reflect the belief that regulations already approved should be implemented and evaluated before determinations can be made whether additional regulations are required. The Council will continue to monitor the snapper grouper fishery and will use the framework procedure to implement any additional species specific measures as may be necessary following updated stock assessments received through the SAFE process described earlier.

The Council's evaluations are as follows:

1. **Black sea bass** remain overfished. Black sea bass are above the "threshold level" with a static SPR of 26%. Black sea bass are overfished given that the MSST is 3.72 million pounds and the 1995 biomass was estimated to be 1.33 million pounds. Black sea bass are also experiencing overfishing given that the MFMT is 0.72 and the average fishing mortality rate (F) for 1991-1995 was 0.95. The measures proposed in Snapper Grouper Amendment 9 will reduce commercial catch by 26%, recreational catch by 36%, and total catch by 30%.

The Council concluded these reductions are sufficient to rebuild black sea bass above the overfished level.

2. **Vermilion snapper** remain overfished with a static SPR of 21% to 27%. The measures proposed in Snapper Grouper Amendment 9 will reduce headboat catch by 29%, MRFSS catch by 70%, and total catch by 13%. **The Council concluded these reductions are sufficient to rebuild vermilion snapper above the overfished level.**

3. **Red porgy** remain overfished with a static SPR of 14% to 19%. The measures proposed in Snapper Grouper Amendment 9 will reduce commercial catch by 65%, recreational catch by 50%, and total catch by 59%. **The Council concluded these reductions are sufficient to rebuild red porgy above the overfished level.**

4. **Red snapper** remain overfished with a static SPR of 24% to 32%. The measures proposed through Snapper Grouper Amendment 7 will result in a projected SPR of 35%. **The Council concluded these reductions and the measures contained in Snapper Grouper Amendments 8 and 9 are sufficient to rebuild red snapper above the overfished level.**

5. **Gag** remain overfished with a static SPR of 27%. The measures proposed in Snapper Grouper Amendment 9 will reduce commercial catch by 37%, recreational catch by 13%, and total catch by 27%. **The Council concluded these reductions are sufficient to rebuild gag above the overfished level.**

6. **Scamp** are no longer overfished with a static SPR of 35%. The measures proposed in Snapper Grouper Amendment 9 will provide some additional protection. **The Council concluded no additional measures are necessary to maintain scamp above the overfished level.**

7. **Speckled hind** remain overfished with a static SPR of 8% to 13%. The measures proposed through Snapper Grouper Amendment 7 include a limit of 1 fish per vessel per trip, no sale, and establishment of the experimental closed area. Measures in Amendment 8 and 9 may provide some additional protection. **The Council concluded these reductions are sufficient to rebuild speckled hind above the overfished level.**

8. **Warsaw grouper** remain overfished with a static SPR of 6% to 14%. The measures proposed through Snapper Grouper Amendment 7 include a limit of 1 fish per vessel per trip, no sale, and establishment of the experimental closed area. Measures in Amendment 8 and 9 may provide some additional protection. **The Council concluded these reductions are sufficient to rebuild warsaw grouper above the overfished level.**

9. **Snowy grouper** remain overfished with a static SPR of 5% to 15%. The measures proposed through Snapper Grouper Amendment 7 include a quota, trip limit, bag limit, and establishment of the experimental closed area. Measures in Amendment 8 and 9 may provide some additional protection. **The Council concluded these reductions are sufficient to rebuild snowy grouper above the overfished level.**

10. **Golden tilefish** remain overfished but the Assessment Group concluded there was inadequate information to update the existing SPR of 21%. The measures proposed through Snapper Grouper Amendment 7 include a quota, trip limit, bag limit, and establishment of the experimental closed area. Measures in Amendment 8 and 9 may provide some additional protection. **The Council concluded these reductions are sufficient to rebuild golden tilefish above the overfished level.**

11. **Nassau grouper** remain overfished but there is insufficient information to calculate a SPR. The measures proposed through Snapper Grouper Amendment 7 allow no retention and establishment of the experimental closed area. **The Council concluded no**

further action is required for Nassau grouper at this time. This position is supported by the letter from NMFS (Appendix F.).

12. **Jewfish** remain overfished but there is insufficient information to calculate a SPR. The measures proposed through Snapper Grouper Amendment 7 allow no retention and establishment of the experimental closed area. **The Council concluded no further action is required for jewfish at this time.** This position is supported by the letter from NMFS (Appendix F.).

13. **White grunt** are no longer overfished with a static SPR of 29% to 39%. The measures proposed in Snapper Grouper Amendments 8 and 9 will provide some additional protection. **The Council concluded no additional measures are necessary to maintain white grunt above the overfished level.**

The Council's SFA Comprehensive Amendment, which includes Amendment 11, was submitted for formal Secretary of Commerce review on October 7, 1998. The notice of availability for Amendment 11 was published in the federal register on February 18, 1999. The SFA Comprehensive Amendment, including Amendment 11, was partially approved on May 19, 1999. The proposed rule has yet to be published.

1.3.2 Development of Amendment 12

The Council received a new red porgy stock assessment in 1999 which consisted of a complete virtual population analysis (VPA) and included data through 1996 for VPA analyses and through 1997 for other analyses (Vaughan, 1999). The spawning potential ratio (SPR) was determined to be 24%.

The level of information available for red porgy also allowed for examination of the biomass and recruitment levels (Table 3). The assessment report concluded that biomass had decreased from an annual estimate of 9,913 metric tons during the time period 1972-78, to 3,557 metric tons during 1982-86, and to 685 metric tons during 1992-96. This represents a 93% reduction from 1972-78 to 1992-96. Over the same time periods, recruitment (the number of age 1 fish entering the population) declined from 6.53 million fish per year (1972-78), to 2.38 million fish per year (1982-86), and to 0.66 million fish per year (1992-96). This represents a 90% reduction from 1972-78 to 1992-96.

1.4 Issues/Problems Requiring Plan Amendment

The red porgy assessment (Vaughan, 1999; Appendix B) provided biomass estimates for red porgy (Table 3). Directly measuring biomass is a much more effective way of ensuring there are sufficient fish to reproduce and support the continued productivity of a species rather than using spawning potential ratio (SPR). Review of these data make it clear that measures must be taken to increase the stock size to get the stock above the minimum stock size threshold (Vaughan, 1999; Appendix B). Additional data showed that annual recruitment had declined from 6.53 million fish during the years 1972-78 to 2.38 million fish during 1982-86 and to 0.66 million fish during 1992-96 (Vaughan, 1999; Appendix B). Further, the most recent recruitment level (1997) is substantially below the 1992-96 average. Recruitment, total stock biomass, and landings still appear to be trending down. Also, the size at maturity and size at transition from females to males have occurred at progressively smaller sizes for 1988-90 and 1991-94 (Harris and McGovern, 1997; Attachment H). Such changes in life history parameters indicates severe overfishing. Most recent data suggest some potential upturn based on MARMAP catch-per-unit-effort data.

In light of the new stock assessment, the Council determined an emergency existed and had no choice but to take the drastic step of voting to prohibit all harvest and possession of red porgy. The Council requested implementation of a prohibition on harvest and possession in a letter to Dr. Andrew Kemmerer, NMFS Regional Administrator, dated April 6, 1999. The Council requested the emergency regulations be effective no later than May 1, 1999 when the red porgy closure implemented through Amendment 9 was scheduled to end. This action was deemed necessary to meet the Congressionally-mandated deadline to prevent overfishing and rebuild overfished resources. The emergency rule was implemented in September and is effective September 8, 1999 through March 1, 2000.

Amendment 12 was developed to address the situation on a more permanent basis. The Council requested an extension of the emergency rule during their November/December 1999 meeting to ensure the closure remains in effect until Amendment 12 is implemented. The extension, through August 28, 2000, was approved on February 25, 2000.

1.5 Proposed Measures

The Council is proposing the actions shown on page viii.

Table 3. Summary of stock status for red porgy. Source: Dr. Doug Vaughan, NMFS Beaufort Lab.

Biological Reference Point	Partial Recruitment (Average 1992-96 with12" TL min. size)	Partial Recruitment based on Amendment 9 (14" TL)
Full F (fishing mortality rate)	0.64	0.47
Fishing Mortality Reference Points		
F30%	0.45	0.58
F35%	0.35	0.43
F40%	0.28	0.33
F45%	0.23	0.26
SSB Reference Points		
SSB/R	2024.7 grams	2024.7 grams
SSB/R (30%)	607.4 grams	607.0 grams
SSB (30%)	3964.0	3963.9
SSB/R (35%)	705.7 grams	708.2 grams
SSB (35%)	4,605.4 mt	4,621.7 mt
SSB/R (40%)	809.9 grams	809.9 grams
SSB (40%)	5285.3 mt	5285.4 mt
SSB/R (45%)	911.1 grams	909.2 grams
SSB (45%)	5945.9 mt	5933.4 mt
Biomass Reference Points		
Bmsy (with 40% Static SPR)	5285.3	5285.4
MSST (with 40% Static SPR)	3805.4	3805.4

Recruitment (R) used to convert SSB/R to SSB was the mean for 1972-78 which was 6,526,000 fish per year. **Note: Updated biomass reference points are proposed in Action 3.**

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

National Environmental Policy Act (NEPA) regulations indicate that Section 2.0 should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public. The Council's documents must also conform to Magnuson-Stevens Act and "Other Applicable Law" requirements. National Environmental Policy Act regulations are one of the "other applicable laws" referenced. The Council decided to blend Magnuson-Stevens Act and "other applicable law" (including NEPA) requirements in one consolidated, non-duplicative, and non-repetitive document. The bulk of the evaluation of alternatives and discussion about the effects on the environment is in Section 4.0 Environmental Consequences. Section 2.0 Alternatives presents a summary of Section 4.0. The Council concluded this meets NEPA regulatory requirements.

Management measures (proposed actions) address the management objectives and issues discussed in Section 1. Each management measure has a number of alternatives that have been considered by the Council.

The Council is proposing to implement the measures shown on page viii.

The following problem in the snapper grouper fishery is addressed by this amendment. The summary title is used in the impact table (Table 4) to identify which issue/problem is addressed by which proposed management measure.

Biological

- Excessive fishing mortality. Overfishing

The following table (Table 4) summarizes how the alternatives address the problem identified by the Council. Management alternatives are in the rows and issues and problems are in the columns.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES
(Effects of Alternatives on the Issues/Problems)

Table 4. Summary of Environmental Consequences.

Alternatives	Issues/Problems Biological: Overfishing	 SocioEconomic: Cost
Proposed Action 1: Maximum Sustainable Yield (MSY) for red porgy is 4.38 million pounds (1,987 mt).	None. Biological consequences arise from the measures taken to prevent exceeding MSY.	The impact from designation of MSY will stem from how MSY is tied to management measures taken to achieve this goal.
Rejected Option 1: No Action. Maximum sustainable yield for red porgy is unknown.	None. Biological consequences arise from the measures taken to prevent exceeding MSY.	The impacts of no action will not allow the council to select management actions that can optimize benefits.
Rejected Option 2: The biomass capable of producing maximum sustainable yield for red porgy is 11.65 million pounds (5,285.3 mt).	None. Biological consequences arise from the measures taken to prevent exceeding MSY.	The impact from designation of MSY will stem from how MSY is tied to management measures taken to achieve this goal.

Alternatives	Issues/Problems Biological: Overfishing	 SocioEconomic: Cost
Proposed Action 2: Optimum Yield (OY) for red porgy is the amount of harvest that can be taken by U.S. fishermen while maintaining the spawning potential ratio (SPR) at or above 45% Static SPR.	None. Biological consequences arise from the measures taken to prevent exceeding OY. This OY level is more conservative than the other two options shown below.	The impact from specifying optimum yield is tied to management measures taken to achieve this goal.
Rejected Option 1: No Action. OY for red porgy is the amount of harvest that can be taken by U.S. fishermen while maintaining the SPR at or above 40% Static SPR.	None. Biological consequences arise from the measures taken to prevent exceeding OY.	The impact from specifying optimum yield is tied to management measures taken to achieve this goal.
Rejected Option 2: OY for red porgy is the amount of harvest that can be taken by U.S. fishermen while maintaining the biomass at or above 5,285.4 mt (11.65 million pounds) (based on 14" TL minimum size limit) or 5,285.3 mt (11.65 million pounds) (based on 12" TL minimum size limit).	None. Biological consequences arise from the measures taken to prevent exceeding OY.	The impact from specifying optimum yield is tied to management measures taken to achieve this goal.
Rejected Option 3: OY for red porgy is the amount of harvest that can be taken by U.S. fishermen while maintaining a total spawning stock size (biomass) of 10,000 mt or 22 million pounds.	None. Biological consequences arise from the measures taken to prevent exceeding OY.	The impact from specifying optimum yield is tied to management measures taken to achieve this goal.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES
(Effects of Alternatives on the Issues/Problems)

Table 4 (cont.). Summary of environmental consequences.

Alternatives	Issues/Problems	
	Biological: Overfishing	**SocioEconomic: Cost**
Proposed Action 3: Overfishing Level & Rebuilding Timeframe. The two components of the status determination criteria are: A. A maximum fishing mortality threshold (MFMT) - A fishing mortality rate (F) corresponding to a 35% Static SPR (F=0.43) based on a 14" TL minimum size limit. B. A minimum stock size threshold (MSST) - The minimum stock size threshold is the stock size defined as the maximum of either 0.5 or 1-M (M=natural mortality=0.28) times Bmsy. The Council is specifying the minimum stock size associated with 35% Static SPR which is 3,328 mt or 7.34 million pounds. The rebuilding timeframe for red porgy is 18 years with 1999 being Year 1.	None. Biological consequences arise from the measures taken to prevent exceeding the fishing mortality rate and minimum stock size threshold. This option is more conservative than the options shown below.	The impact from specifying an overfishing level and choosing a rebuilding timeframe will influence management measures chosen to rebuild the stock. These harvesting regulations will have long-term and short-term socio-economic impacts on the fishery.
Rejected Option 1: No Action. Overfishing for red porgy is defined as a fishing mortality rate (F) in excess of the fishing mortality rate at 30% Static SPR (F30%Static SPR) which is the red porgy MSY proxy. The "threshold level" for red porgy is defined as 10% Static SPR.	None. Biological consequences arise from the measures taken to prevent exceeding the fishing mortality rates specified.	The impact from specifying an overfishing level will influence management measures chosen to rebuild the stock. These harvesting regulations will have long-term and short-term socio-economic impacts on the fishery.
Rejected Option 2: The two components of the status determination criteria are: A. A maximum fishing mortality threshold (MFMT) - A fishing mortality rate (F) in excess of F30% Static SPR which is 0.45. B. A minimum stock size threshold (MSST) - The minimum stock size threshold is 2,854.1 mt or the stock size associated with 20% SPR which is estimated at 3,000 mt.	None. Biological consequences arise from the measures taken to prevent exceeding the fishing mortality rate and minimum stock size threshold.	The impact from specifying an overfishing level will influence management measures chosen to rebuild the stock. These harvesting regulations will have long-term and short-term socio-economic impacts on the fishery.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES
(Effects of Alternatives on the Issues/Problems)

Table 4 (cont.). Summary of environmental consequences.

Alternatives	Issues/Problems: Biological: Overfishing	Issues/Problems: SocioEconomic: Cost
Proposed Action 4: Establish measures for red porgy that will: (1) reduce the recreational bag limit from 5 to 1 red porgy per person per day or per trip, whichever is more restrictive; (2) during January, February, March, and April prohibit purchase or sale of and limit the possession of red porgy aboard vessels with Federal commercial or charter/headboat permits for snapper grouper to one red porgy per person per day or one red porgy per person per trip whichever is more restrictive; (3) continue the 14 inch TL minimum size limit for both recreational and commercial fishermen; and (4) allow a 50 pound by-catch per trip for permitted vessels (i.e., vessels with an unlimited or trip-limited commercial vessel permit) from May 1 through December 31. The status of red porgy will be reviewed every two years to determine if management measures should be repealed or modified.	This action is necessary to rebuild the red porgy stock above the minimum stock size threshold and ultimately to the OY level.	There will be short-term economic losses to the recreational and commercial sectors from this action. However, if populations rebuild this action will increase economic benefits to society over the long-term.
Rejected Option 1: Prohibit the harvest and possession of red porgy by recreational and commercial fishermen. The status of red porgy will be reviewed every 3 years to determine if the moratorium should be repealed.	This action would to rebuild the red porgy stock above the minimum stock size threshold and ultimately to the OY level. This action is more conservative than the proposed option.	There will be short-term economic losses to the recreational and commercial sectors from this action. However, if populations rebuild this action will increase economic benefits to society over the long-term.
Rejected Option 2: No Action. Maintain the 14" TL size limit, 5-fish bag limit, & prohibition on harvest and possession in excess of the bag limit during March and April (sale prohibited during March & April).	This option would not rebuild the red porgy stock above the minimum stock size threshold.	This option would not optimize benefits to society as populations will decline when subject to current fishing mortality levels.
Rejected Option 3: Allow the retention of 50 pounds of red porgy per trip. Some allowance for multi-day trips would make this more equitable (e.g., 50 pounds per day).	This option, by itself, would not rebuild the red porgy stock above the minimum stock size threshold.	This option would pose short-term economic losses to the commercial sector. However, it may not optimize benefits if stocks cannot be rebuilt within the specified time period.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES
(Effects of Alternatives on the Issues/Problems)

Table 4 (cont.). Summary of environmental consequences.

Alternatives	Issues/Problems: Biological: Overfishing, Data	Issues/Problems: SocioEconomic: Cost
Proposed Action 5: Modify the Snapper Grouper Framework by adding the following list of management options and measures that could be implemented via framework action: A. Description, identification, and regulations of fishing activities to protect EFH and EFH-HAPCs. B. Management measures to reduce or eliminate the adverse effects of fishing activities or fishing gear on EFH or EFH-HAPCs. C. Regulations of EFH-HAPCs.	None. The Council would be able to take action to prevent negative impacts on EFH and EFH-HAPCs more quickly through framework rather than plan amendment.	The framework process would expedite the adoption of fishery management regulations. There would be impacts from the actual regulations adopted to protect EFH and EFH-HAPCs. These measures could affect other fisheries not only the snapper grouper fishery. However, these measures will result in long-term benefits to society.
Rejected Option 1: No Action.	None. However, the Council would not be able to take action to prevent negative impacts on EFH and EFH-HAPCs through framework.	This measure would not expedite the adoption of fishery management regulations.

Alternatives	Issues/Problems: Biological: Overfishing, Data	Issues/Problems: SocioEconomic: Cost
Proposed Action 6: Modify the Snapper Grouper Limited Access System to allow same owner permit transfers regardless of vessel size (length and tonnage) for individuals harvesting snapper grouper species with a non-transferable 225 pound trip limit permit.	None. These vessels are limited to the 225 pound trip limit regardless of vessel size.	The short and long-term impacts of this action are unclear. It could increase efficiency or it could result in some excess harvesting capacity in the fishery.
Rejected Option 1: No Action.	None. These vessels are limited to the 225 pound trip limit regardless of vessel size.	The short and long-term impacts of no action are unclear. It could limit benefits or it could result in a more efficient operation by reducing fishing capacity.

3.0 AFFECTED ENVIRONMENT

The affected environment including a description of the snapper grouper fisheries in the South Atlantic Region are presented in detail in the original FMP (SAFMC, 1983). A description of Council concerns and recommendations on protecting snapper grouper habitat are also included in Amendment 1 (SAFMC, 1988) and updated in subsequent amendments. The Habitat Plan (1998c) and the Comprehensive Habitat Amendment (1998d) provide the most recent habitat information.

3.1 Optimum Yield

The South Atlantic Council's target level of stock status or Optimum Yield (OY) as modified by Amendment 8 (SAFMC, 1997) is 40% static SPR (see discussion under overfishing). The Council's Comprehensive SFA Amendment (SAFMC, 1998d) contained the following: "Optimum Yield (OY) for red porgy is the amount of harvest that can be taken by U.S. fishermen while maintaining the Spawning Potential Ratio (SPR) at or above 40% Static SPR."

3.2 Definition of Overfishing

A. A snapper grouper species (including jewfish) is considered to be overfished when the transitional spawning potential ratio (SPR) is below 30%. Snapper Grouper Amendment 8 proposed changing the overfished level to 20% and adding a threshold level of 10%, however, both measures were rejected.

B. The South Atlantic Council's target level or Optimum Yield (OY) is 40% static SPR.

C. When a stock is overfished (transitional SPR less than 30%), a rebuilding program that makes consistent progress toward restoring stock condition must be implemented and continued until the stock is restored beyond the overfished condition. The rebuilding program must be designed to achieve recovery within an acceptable time frame as specified by the council. The council will continue to rebuild the stock until the stock is restored to the management target (OY).

D. When a stock is not overfished (transitional SPR equal to or greater than 30%), the act of overfishing is defined as a static SPR that exceeds 30% (i.e., $F_{30\%}$). If fishing mortality rates that exceed the level associated with the static SPR overfished level are maintained, the stock may become overfished. Therefore, if overfishing is occurring, a program to reduce fishing mortality rates toward management target levels (OY) will be implemented, even if the stock is not in an overfished condition.

E. For species, when there is insufficient information to determine whether the stock is overfished (transitional SPR), overfishing is defined as a fishing mortality rate in excess of the fishing mortality rate corresponding to a default static SPR of 30%. If overfishing is occurring, a program to reduce fishing mortality rates to at least the level corresponding to management target levels will be implemented.

F. The timeframe for recovery of overfished stocks remains unchanged: (a) not to exceed 10 years for snappers (excluding red snapper), greater amberjack, black sea bass, and red porgy; and (b) not to exceed 15 years for red snapper and the groupers. For species which were not documented as overfished in Amendment 3, Year 1 is the year in which the species is documented as being overfished. For example, gag were documented as being overfished in the 1996 assessment; therefore, Year 1 = 1996.

G. Definitions and Terminology (directly from Mace et al., 1996).

The acronym, SPR, has been used to represent both Spawning Potential Ratio and Spawning (biomass) Per Recruit. As implied by its name, the spawning potential ratio is a relative measure. It expresses the spawning production of a fished population relative to the spawning production of an unfished population with otherwise similar characteristics. By contrast, spawning per recruit is an absolute measure (usually expressed in units of weight or numbers of eggs), intended to be analogous to yield per recruit (YPR). Spawning per recruit is converted to a relative measure by dividing by the maximum spawning per recruit, which occurs under conditions of no fishing, and expressing the result as a percentage. Relative spawning per recruit is commonly abbreviated as %SPR. Thus, spawning potential ratio is usually measured on a scale of 0 to 1 while % spawning per recruit is expressed as a percentage. Use of proportions or percentages in FMP overfishing definitions, in the scientific literature, and even in this report may not be consistent, but it is usually clear which one is being used because %SPR levels less than 1% are rarely considered.

A much more fundamental point of departure between the two SPR measures is that % spawning per recruit is a static measure while spawning potential ratio is a transitional measure. Although the conceptual foundation for the two measures is similar, there are differences in methods of calculation and in the interpretation of results. For spawning per recruit (static measure), the reference points are calculated from a standard (Beverton-Holt "spawning per recruit analysis" which is analogous to the familiar yield per recruit analysis, and uses exactly the same inputs (e.g. constant weights at age, a constant natural mortality vector, and a constant fishing mortality vector), with the addition of a constant maturity ogive. For the spawning potential ratio (transitional measure), the reference points are calculated from empirical estimates of population numbers and fishing mortalities by age and year derived from age-structured stock assessments. With the exception of some of the work conducted by Goodyear (1980, 1993; see original report of the NMFS Overfishing Definition Review Panel), virtually all of the theoretical development and empirical analyses of SPR reference points relate to the static approach, for which each level of SPR (or %SPR) corresponds directly to a unique level of fishing mortality (for a given selectivity ogive).

In this supplemental report, the acronym "SPR" is always preceded by the terms "static," , "static %" or "transitional," to differentiate between the alternative interpretations.

The Review Panel considered two primary measures of transitional SPR; the spawning production in year t relative to that which would have been produced in year t if there had been no fishing on the cohorts that exist in year t; and the spawning production per recruit in year t (called SPR1 and SPR2, respectively, by Powers MS). These measures have been variously referred to as "non-equilibrium," "dynamic," and "transitional." The Review Panel preferred the latter terminology and has used it consistently from here on. SPR1 is referred to as the weighted transitional SPR (where the weighting is by year class strength); while SPR2 is referred to as the unweighted transitional SPR, or simply transitional SPR. Similarly, "static %SPR" has frequently been referred to as "equilibrium %SPR," but since equilibrium conditions are not essential for the measure to be valid, the Review Panel preferred the term "static." The word "static" refers to the underlying assumption that growth rates, maturity schedules, natural mortality, fishing mortality, and selectivity patterns are constant; however, recruitment itself need not be constant.

In terms of the use of transitional SPR measures in control laws, the Review Panel believes that the unweighted transitional SPR can be considered an index of stock condition in terms of whether or not the stock is overfished (i.e. whether or not the age structure is distorted due to historical fishing patterns), but not necessarily in terms of whether or not the stock is depleted (with respect to total or spawning biomass). Thus, controls laws that specify lower thresholds beyond which fishing should cease probably need to consider explicit indices of biomass as well as or instead of the unweighted transitional SPR. Ideally, a control law (or series of control laws) would have axes corresponding to the act of overfishing (indexed by the static %SPR), the overfished condition (indexed by the unweighted transitional SPR), and the extent of stock depletion (indexed by absolute or relative estimates of biomass). This level of complexity is required because spawning or total biomass may be depleted due to adverse environmental effects, yet the stock may not be considered overfished based on estimates of transitional SPR. Similarly, a stock can be overfished, even though spawning or total biomass is high relative to optimum or historical levels. In effect, the term "overfished" can be thought of an index of the degree of distortion in the age structure due to historical fishing practices, whereas "depleted" simply implies low biomass. An overfished stock will often also have low biomass, but need not.

The best way to think of the overfishing and optimum yield definitions is to relate them to the amount of spawners in the water. Research for a number of species has shown that as the percentage of spawners is reduced from the number or amount in pounds that would be in the water if there were no fishing, the risk of stock collapse increases. If the amount of spawning fish is reduced below 20% (which the scientists refer to as 20% SPR), the chance of stock collapse becomes a very real possibility. If it is reduced below 10%, you can be pretty sure you are going to see severe declines in numbers of fish and probably see the stock collapse. If we had sufficient information to accurately determine where this level was for each species we could avoid any biological problems. The problem is our information is incomplete and we do not know what the specific percentage is for each species to prevent risk of stock collapse. As a result, the Council is proposing to aim for having 40% of the spawners in the water that would be there if there was no fishing (scientists call this 40% SPR). In this way, when the stock declines for environmental or other "non-fishing" reasons, the spawners should not go below the 30% level. Some years the quantity of spawners will be above 40% and some years below 40%. The Council wants to ensure it will remain above 30% thereby avoiding potential stock problems.

In the event the quantity of spawners should go below 30%, the Magnuson-Stevens Act requires the Council specify how long they will take to rebuild the stock. The timeframe for recovery of snappers (excluding red snapper), greater amberjack, black sea bass, and red porgy is not to exceed 10 years. For red snapper and the groupers, the timeframe is not to exceed 15 years. These timeframes were established in Amendment 4 and are based on the life history characteristics (growth rate, mortality rate, longevity, etc.). Longer lived, slower growing species are more susceptible to overfishing and will rebuild more slowly, hence the 15 year recovery period. Shorter-lived, faster growing species will recover more quickly and was the basis for choosing 10 years. Year 1 for species considered overfished at that time (Amendment 4) was the 1991 fishing year. The recovery time period may be modified by the framework (regulatory amendment) procedure.

If the quantity of spawners is above 30% but below the Council's long-term target (optimum yield) of 40%, the Council will determine the timeframe to get the stock above 40%.

This allows the Council greater flexibility to balance social and economic costs of rebuilding a stock.

The Council's Comprehensive SFA Amendment (SAFMC, 1998d) contained the following: "Overfishing for red porgy is defined as a fishing mortality rate (F) in excess of the fishing mortality rate at 30% Static SPR (F30% Static SPR) which is the red porgy MSY proxy. The 'threshold level' for red porgy is defined as 10% Static SPR." The Council's SFA Comprehensive Amendment was submitted for formal Secretary of Commerce review on October 7, 1998. The notice of availability for Amendment 11 was published in the federal register on February 18, 1999. The SFA Comprehensive Amendment, including Amendment 11, was partially approved on May 19, 1999. The proposed rule has yet to be published.

3.3 Description of Fishing Activities

3.3.1 Commercial Fishery

The following is taken directly from the executive summary of the economic survey of commercial snapper grouper vessels along the U.S. south Atlantic coast (J.R. Waters et al, 1997). This summary and tabulated results from the survey were presented to the Snapper Grouper Committee at the November 1997 council meeting at Beaufort, North Carolina. The detailed report of this survey is in review and there could be some changes to figures when the final report is released.

This survey provides the first, comprehensive source of economic information about the population of boats in the commercial snapper-grouper fishery along the Atlantic seaboard. One hundred forty seven commercial reef fish boats from Dare County, North Carolina, through Dade County, Florida, were examined in a stratified random sampling design, with strata defined by area, primary gear and length of boat. The sample was selected from a universe of 709 boats with snapper-grouper permits that reported on their permit applications that their most important gear was vertical lines with bandit reels or rods and reels, bottom longlines, or fish traps, even though many of them also used other gears. Interviewers asked respondents for: background information about themselves and their boats; their capital investments in vessel, gear and electronics; and detailed information about fishing effort, catches, revenues, and routine harvesting costs per trip for their two most important kinds of fishing trips for reef fish. If there was only one kind of trip for reef fish, then information was collected about it and the most important kind of trip for other species.

Method of Analysis

Characteristics of respondents and their boats were summarized for boats that primarily used vertical lines, bottom longlines or fish traps in the northern area (i.e., from North Carolina through St. Augustine, FL) and for boats that primarily used vertical lines or bottom longlines in the southern area (i.e., south of St. Augustine, FL). Averages for each characteristic (such as the average age of respondent or average investment in boat and equipment) were calculated for each group of boats and for all boats combined. Group and population totals (such as the total investment for all boats) were derived by expanding the survey responses to the entire sampled population of 709 snapper-grouper boats. Weighting factors accounted for differences among strata in the probabilities of individual boats being included in the sample.

Characteristics of Respondents

Respondents were characterized with regard to their dependence on the commercial snapper-grouper fishery as a source of household income. On average, respondents were in their early to mid forties, with an average of 17 years experience in commercial fishing. Respondents on boats with fish traps were the oldest, on average, and those on boats with vertical lines in the southern area were the youngest. On average, respondents who used bottom longlines or fish traps were more experienced fishermen than were respondents who used vertical lines. Household incomes ranged from less than $10,000 to more than $150,000, with more than 50% of respondents citing household incomes of less than $40,000. Respondents who primarily used bottom longlines or fish traps earned, on average, more than one-half of their household incomes from commercial fishing, whereas respondents who used vertical lines did not. Respondents in the northern area who used bottom longlines comprised the only group to average more than 50% of their household incomes from commercial fishing for reef fishes. Overall, respondents in the northern area relied more heavily on commercial fishing for reef *fishes as a source of household income than did respondents in the southern area. However, respondents in the northern area derived a smaller fraction of their household incomes from other kinds of commercial fishing because they were more likely to charter whereas respondents in the southern area relied more heavily on commercial fishing for non-reef species such as king mackerel. In approximately two-thirds of the households someone other than the respondent also was employed to supplement household income.*

Characteristics of Boats

Boats were described in terms of their physical characteristics. Boats were relatively small. The average length was 32.7 feet, with nearly all sampled boats being less than 50 feet in length. Boats with bottom longlines tended to be the longest, had the most powerful engines, the greatest fuel capacities, and the largest holding boxes for fish and ice. Boats with vertical lines, especially in the southern area, tended to be the shortest, had the least powerful engines, the smallest fuel capacities, and the smallest holding boxes for fish and ice.

Also, boats were described in terms of their financial characteristics. On average, boats and gear in the northern area embodied greater investments than did boats in the southern area. Boats with bottom longlines in the northern area required the greatest investments, and boats with vertical lines in the southern area required the smallest investments. The total investment in boats and equipment for the sampled population of snapper-grouper boats was estimated to be $54.0 million.

Resale value was interpreted as the value of capital currently invested in the snapper-grouper fishery. Average resale value in the northern area was $93,000 for boats with bottom longlines, $55,289 for boats with fish traps and $53,205 for boats with vertical lines. Average resale value in the southern area was $64,860 for boats with bottom longlines and $37,215 for boats with vertical lines. The estimated total resale value of commercial snapper-grouper boats was $35.4 million.

Financial Performance on Different Kinds of Fishing Trips

Some boats fished in one kind of activity year-round whereas others rotated among several kinds of fishing trips according to seasonal availability of fish, seasonal variation in prices, fishery regulations and so forth. An important objective of the survey was to estimate average net operating revenues per boat per trip and per boat per year that were earned on the most important kinds of fishing trips taken by snapper-grouper fishermen. A secondary objective was to estimate the total number of boats that participated in each kind of fishing and total catches, revenues, trip costs and net operating revenues for those boats, although the possibilities for errors in estimation exist because each interview was limited to questions about a maximum of two kinds of fishing even if the boat participated in more than two kinds of fishing per year. Net operating revenues were defined as trip revenues minus routine trip costs, which included fuel, bait, ice, lost gear, food, packing charges if any, and other miscellaneous supplies. Net operating revenues represent the combined payments to boat owner, captain and crew and should not be interpreted as profit because they exclude fixed costs and other variable costs that were not routinely encountered per trip. Average net operating revenue per person per day fished was used to compare the overall economic performance of boats on different kinds of fishing trips after correcting for variations in the duration of trips and the number of persons aboard, and is not an accounting of actual payments or shares to boat owner, captain or crew.

Boats with black sea bass pots constituted an important component of the snapper-grouper fishery in the northern area. An estimated 90 boats landed nearly 2.7 million pounds of *all species worth $4.1 million on trips with pots for black sea bass, with average revenues of $44,965 per boat per year. After adjusting for variation among fishing activities in duration of trips and number of persons aboard, pot-fishing for black sea bass was, on average, the most profitable activity examined in this survey. Boats with black sea bass pots averaged $349 per person per day fished for black sea bass and $30,494 per year after deducting routine trip costs. Peak fishing activity for black sea bass occurred between November and March, with some boats having additional sources of income during the remainder of the year. Commonly mentioned alternatives to black sea bass were fishing with vertical lines for gag throughout the year but primarily between April and October, chartering between May and October, and fishing for king mackerel between October and April.*

Trips for king mackerel represented the next most profitable fishing activity examined here for the northern area. Net operating revenues on king mackerel trips averaged $292 per person per day fished, but only $16,046 per year because average catches per trip were relatively low compared to other fishing activities in the northern area, and because average days fished for king mackerel per boat per year were relatively low. An estimated 107 boats targeted king mackerel, primarily between October and April, with peak fishing activity occurring in March. The main alternative activities to king mackerel were gag, especially between April and November, fishing charters between April and October, and black sea bass, primarily between November and January.

Deep water groupers and tilefish constituted an important component of the snapper-grouper fishery in both northern and southern areas, although small sample size necessitated that analyses be completed with observations for both areas combined rather than for each area separately. An estimated 66 boats used bottom longlines to land a total catch of 3.3 million pounds worth $5.3 million in the northern and southern areas combined. Golden tilefish and snowy grouper were the primary target species caught with bottom longlines, with yellowedge grouper, greater amberjack, sharks and blackbelly rosefish being among the non-target species. Boats with bottom longlines fished year-round for deep water species, and averaged more days fished per year (105 days), landed greater quantities of fish per year (50,552 pounds), received more revenue per year ($79,860), and earned higher net returns per year after deducting routine trip costs ($45,598) than did boats when fishing in other sectors of the snapper-grouper fishery. However, these trips were the longest among the fishing activities examined here. Hence, net operating revenues per person per day fished, at $235, averaged less than trips for black sea bass or king mackerel in the northern area.

The temperate, mid-shelf complex clearly was the mainstay of the snapper-grouper fishery in the northern area. An estimated 339 boats took trips in the northern area for mid-shelf groupers and snappers (but not necessarily at the same time or continuously throughout the year), with an estimated total catch of nearly 7.0 million pounds worth nearly $14.4 million. Revenues averaged $42,425 per boat per year on trips for mid-shelf species. Gag and vermilion snapper were the species most often targeted, with porgies and triggerfish being the most frequently caught non-target species. Other species landed on mid-shelf trips included grunts, black sea bass, greater amberjack, scamp, red snapper and king mackerel. Gag were landed throughout the year, with the fewest number of boats being active during January, February and March. Vermilion snapper were also caught throughout the year with the least fishing activity occurring during May and June. The most frequently cited alternatives to fishing for mid-shelf species were fishing charters between April and October, king mackerel fishing between October and April, and fishing for black sea bass between November and March.

Trips for mid-shelf species were among the least profitable in the northern area, perhaps because of the high level of participation in the mid-shelf fishery. Average quantities landed and revenues per trip ranked second to trips with bottom longlines for deep water groupers and tilefish, but trips for mid-shelf species were relatively long with a relatively large number of persons aboard. Hence, boats averaged only $167 per person per day fished after deducting routine trip costs. Nevertheless, net operating revenues averaged $28,556 per boat per year because mid-shelf species were available throughout the year, with allowances for bad weather during the winter months.

Snowy grouper were caught by boats with vertical lines in a segment of the snapper-grouper fishery that also landed mid-shelf species such as vermilion snapper. An estimated 41 boats landed 0.4 million pounds of deep water groupers, tilefish and mid-shelf species worth $0.6 million. Trips by boats with vertical lines for deep water species averaged $160 per person per day fished, which was slightly lower than the average net return of trips for mid-shelf species. The main fishing alternative was king mackerel, especially in October, November and December.

In general, the fishing activities examined for the southern area were not as profitable as the activities in the northern area. Catches per trip tended to be lower in the southern area than in the northern area. Also, the average number of days fished per boat per year in each activity was relatively low. Hence, net revenues per person per day fished and per boat per year after deducting routine trip costs were relatively low.

Trips for mid-shelf groupers and snappers represented the most profitable fishing activity examined for the southern area. When fishing for mid-shelf species, boats averaged $229 per person per day fished and $13,747 per year after deducting routine trip costs. An estimated 97 boats landed 0.8 million pounds worth approximately $1.7 million. Boats averaged 42 days fished per year for mid-shelf species. Gag was caught year-round, especially between January and March. A smaller number of boats caught red snapper, especially between January and July. Supplemental species included mutton snapper, red grouper, greater amberjack and cobia, among others. The main fishing alternatives included king mackerel throughout the year, mutton snapper between April and August, greater amberjack in March and May, gray snapper from March through June and yellowtail snapper from March through September.

Trips for king mackerel represented the next most profitable fishing activity examined here for the southern area. Net operating revenues on king mackerel trips averaged $195 per person per day fished and $13,306 per year. An estimated 51 boats targeted king mackerel, with fishing activity occurring throughout the year but with peak activity between December and May. Boats averaged 36 days fished per year for king mackerel. Their main alternatives were gag between January and March, and mutton snapper, yellowtail snapper, golden tilefish and snowy grouper year-round.

Trips for greater amberjack averaged $185 per person per day fished and $11,770 per boat per year. Greater amberjack were targeted throughout the year, with peak fishing activity occurring in March and May, and minimal activity occurring in April, July and August. An estimated 66 boats landed 1.1 million pounds worth $1.0 million. Alternative species included gag between January and March, mutton snapper between April and June, yellowtail snapper between May and September, and king mackerel between December and April.

The fishery for tropical snappers attracted the greatest number of boats in the southern area. There were an estimated 170 boats that landed nearly 1.0 million pounds worth nearly $2.0 million. Target species included yellowtail snapper, mutton snapper, and gray snapper. More than 20 species were listed as supplemental catches, with black grouper, red grouper, *mutton snapper, gray triggerfish, and greater amberjack being frequently mentioned. The chief alternative fishing activities included king mackerel throughout the year, spiny lobster between August and March, gag between January and March, greater amberjack in March, May and June, and charter fishing between May and December.*

As was the case in the northern area, the fishing activity with the greatest level of participation was one of the least profitable. Boats that fished for tropical snappers averaged only 236 pounds and revenues of $440 per trip. Net returns after deducting routine trip costs averaged only $128 per person per day fished and $8,747 per boat per year.

Overall Financial Performance

Interviewers also asked respondents about their boat's gross revenues and net income before taxes for all fishing activities combined. The estimated total revenues for the sampled population of snapper-grouper boats were $31.8 million, with aggregate net incomes of $9.5 million. In general, boats with bottom longlines achieved the highest gross revenues and earned the highest net incomes, while boats with vertical lines achieved the lowest revenues and net incomes. Average net incomes, in declining order, were $83,224 for boats that primarily used bottom longlines in the northern area, $23,075 for boats that primarily used black sea bass pots in the northern area, $15,563 for boats that primarily used bottom longlines in the southern area, $11,649 for boats that primarily used vertical lines in the southern area, and $8,307 for boats that primarily used vertical lines in the northern area. Overall, boats in the northern area averaged $14,143 net income based on average revenues of $48,702, while boats in the southern area averaged $12,388 net income based on average revenues of $39,745.

General Characteristics of Snapper Grouper Fishermen

An economic and a socio-demographic survey were recently completed with two different samples of snapper grouper fishermen in the South Atlantic. Interviews conducted for the economic survey took place during the summer of 1994, while those for the socio-demographic survey (which excludes the Florida Keys) were conducted during 1996. The following summary has been constructed using either or both the economic survey contract report (Rhodes, Waltz, and Wiggers, 1996) and the contract report for the socio-demographic survey (Rhodes, Backman, and Hawkins, 1997).

A target population of snapper grouper fishermen was identified from the NMFS permits file and then a stratified random sample was selected for interviewing in both surveys. A total of 162 interviews were completed for the economic survey, while 232 interviews with active/inactive snapper grouper fishermen were completed for the socio-demographic survey. Further discussion of the sampling frame and response rate is found in Rhodes, Waltz, and Wiggers 1996 and Rhodes, Backman, and Hawkins 1997.

Certain characteristics of each sample based on questions included in both surveys are summarized in Table 5. It is not known whether the differences between these samples are statistically significant. The average age for each sample is similar with respondents in the economic survey being slightly older on average. This difference in average age may account for the longer tenure as commercial fishermen for those included in the economic sample, also. Years as a snapper grouper fisherman was the same for respondents in both the socio-demographic and economic survey. Respondents were not asked their marital status or number of dependents on the economic survey, however 73% of active snapper grouper fishermen in the socio-demographic survey were married and 45% had children. For the most part, the samples were similar with regard to education, gear types and percent of income from snapper grouper fishing. The dissimilarity regarding outside employment may be related to the larger number of respondents in the economic survey from the Georgia/Carolina region, since a larger percentage from that area reported having employment other than commercial fishing. The majority (54%) of those who responded that they did have some type of employment outside of commercial fishing on the economic survey indicated that employment was either charter fishing or other fishing/boating industry related activity. In response to a slightly different question on the socio-demographic survey respondents were asked whether they had employment other than fishing; some may have interpreted the question to include charter fishing as 22% indicated some type of income from charter fishing. Therefore, the lower percentage may be an indication that some included charter fishing as a part of their general fishing occupation. In both surveys, approximately half indicated that 25% or less of their income comes from snapper grouper. Slightly over 20% in both surveys said that 50% or more of their income comes from snapper grouper fishing.

Table 5. General Characteristics of Survey Participants for 1995/6. Source: Rhodes, Waltz, and Wiggers (1996) and Rhodes, Backman, and Hawkins (1997).

Variable	Socio-Demographic Survey	Economics Survey
Age (in years)	43	45
Years as a Commercial Fisherman (in years)	15	19
Years as a Snapper Grouper Fisherman (in years)	13	14
Education (Percent)		
Some high school	18%	20%
High school graduate or more	82%	79%
Region (Percent)		
Florida	53%	35%
Georgia/Carolinas	47%	65%
Gear Type (Percent)		
Bandit Reel	42%	35%
Rod & Reel	29%	35%
Traps	1%	15%
Longline	6%	14%
Spear	4%	-
Other	18%	-
Have Other Employment (Percent)	32%	52%
Percent of Income from S/G Fishing (Percent)		
25% or less	48%	50%
50% or more	25%	21%

Because the socio-demographic survey did not include as many questions about vessel characteristics as did the economic survey, Table 6 includes information from the economic survey only. When examining vessel characteristics by region, vessels in the GA/C area were larger, more powerful, had a larger fuel capacity and had a larger fish hold capacity. This is most likely related to the distance to fishing grounds and subsequent environmental conditions fishermen must endure farther north. Fishermen from St. Augustine north travel greater distances to fish and often withstand heavier seas than fishermen to the south. Therefore, they need larger vessels that can travel the longer distance to fishing grounds and withstand the harsher environmental conditions. The associated trip and fixed costs are also naturally higher with a larger vessel.

Table 6. Vessel and economic characteristics by region.* Source: Rhodes, Waltz, and Wiggers (1996).

Variable	All Areas	GA/C	S/CFL
Average Vessel Length (ft.)	34	38	31
Average Vessel Horsepower (hp)	343	352	325
Average Vessel Fuel Capacity (gal)	469	553	313
Average Vessel Fish Hold Capacity (lb.)	3,585	4,143	2,557
Average Vessel Trip Costs ($)	527	973	357
Average Vessel Fixed Costs ($)	17,007	19,566	12,228

* GA/C - St. Augustine, FL and north; S/CFL - South of St. Augustine to Dade/Monroe County Line.

Characteristics by Gear Type

Fishermen exhibit differences based upon a number of characteristics. Gear type is certainly one which will differentiate snapper grouper fishermen on both demographic and other fishery related variables. Table 7 furnishes averages for a number of characteristics subdivided by gear type based upon questions included in the economic survey. Trap fishermen in this sample have a higher average age and average tenure as commercial fishermen than those using other types of gear. In addition, they tend to have been in their current position longer. Rod & reel fishermen and trap fishermen are more likely to be owner operators. Also rod & reel fishermen are more likely to have a high school education or more, and most likely to have outside employment.

Table 7. Demographic and vessel characteristics by gear type for snapper grouper fishermen. Source: Rhodes, Waltz, and Wiggers (1996).

Variable	Bandit Gear	Rod & Reel	Traps	Bottom Longline
Personal Characteristics				
Age (yrs.)	46	43	48	43
Years as a fisherman	18	15	27	20
Years in current position	13	13	18	14
High school education or more	74%	86%	76%	83%
Owner/Operator	67%	88%	88%	52%
Have outside employment	46%	68%	40%	39%
Vessel Characteristics				
Vessel Length (ft.)	36	33	38	41
Fuel Capacity (gal.)	393	321	422	1074
Horsepower (hp)	271	387	357	395
Fish Box Capacity (lb.)	4372	1740	2744	7122

When examining vessel characteristics bottom longline vessels are larger on average with greater fuel and fish box capacity. Those characteristics are likely an indication of the need for a vessel to withstand the harsher environmental conditions endured when fishing deep shelf species farther offshore, in addition to the prohibition of bottom longlines within nearshore waters south of St. Lucie Inlet. Fish trap vessels also have a higher average length and are more powerful than rod & reel or bandit vessels. Black sea bass pots are the only type of fish traps allowed in the South Atlantic. The fishery is north of Florida where fishermen must travel farther to reach deep waters, therefore needing larger vessels as discussed previously.

Table 8 shows active snapper grouper fishermen in the socio-demographic survey to have demographic characteristics similar to those in the economic survey when the sample is stratified by gear type. The one characteristic that is not similar is the percent having outside employment. Fishermen in the socio-demographic sample, on average, are less likely to have outside employment. However, as mentioned earlier, that difference may be an artifact of the different manner in which the question was worded on each survey. Fishermen included in the socio-demographic survey may have included charter fishing as part of their general commercial fishing occupation and did not make a distinction. Whereas, on the economic survey fishermen were more likely to make a distinction between their commercial snapper grouper fishing and their charter fishing.

Table 8. Demographic characteristics by gear type for active snapper grouper fishermen in social survey. Source: Rhodes, Backman, and Hawkins (1997).

Variable	Bandit Gear	Rod & Reel	Traps	Bottom Longline
Personal Characteristics				
Age in years	45	43	50	44
Years as a fisherman	17	12	24	20
Years in current position	15	12	18	17
Have outside employment (%)	21%	37%	15%	17%

In Table 9 revenue and trip costs by gear type are provided from the economic survey and again bottom longline vessels have the highest trip costs. They also have the highest average gross and net revenue per trip. These average revenues and costs again reflect the larger vessel used in the fishery and the associated cost and returns needed for fishing offshore.

Table 9. Revenue and trip costs by gear type for snapper grouper fishermen. Source: Rhodes, Waltz, and Wiggers (1996).

Reported Averages	Bandit Gear	Rod & Reel	Traps	Bottom Longline
Gross Revenue Per Trip	$1,880	$846	$1,306	$3,583
Trip Costs	$557	$557	$362	$1,303
Net Revenue Per Trip	$1,323	$1,323	$944	$2,280
Captain's Share of Net	$357	$357	$438	$490
Boat's Share of Net	$390	$390	$320	$816
Crew Share of Net	$360	$360	$235	$753

High Volume and Low Volume Active Snapper Grouper Fishermen

The sample of active snapper grouper fishermen in the socio-demographic survey was also stratified by the category high volume/low volume. A fisherman was classified high volume if more than 14,250 pounds of snapper grouper were landed and classified low volume if less than 14,250 pounds were landed. Fishermen were also grouped according to region fished by combining Georgia and the Carolinas. This corresponds to a similar classification used in the economic survey as outlined in notes to Table 6. As shown in Table 10 low volume fishermen are generally older. Fishermen from Florida were more likely to have a longer tenure as commercial fishermen and have been snapper grouper fishing longer with low volume fishermen from Florida having the highest average tenure for both.

Table 10. Demographic characteristics of active snapper grouper fishermen by high volume/low volume and region. Source: Rhodes, Backman, and Hawkins (1997).

Variable (Mean)	High Volume GA, SC & NC	High Volume FL	Low Volume GA, SC & NC	Low Volume FL
Age (yrs.)	44	44	50	48
Years as a commercial fisherman (yrs.)	16	17	13	18
Years as a snapper grouper fisherman (yrs.)	13	16	10	14

Low volume fishermen have smaller vessels in general, while fishermen from Georgia and the Carolinas fish farther offshore on average no matter what their volume classification (Table 11). High volume fishermen from Georgia and the Carolinas reported higher average landings than high volume fishermen from Florida, while low volume fishermen from Florida reported a higher average landings than low volume fishermen from Georgia and the Carolinas.

Table 11. Average characteristics of fishing operations for active snapper grouper fishermen by high volume/low volume and region. Source: Rhodes, Backman, and Hawkins (1997).

Variable (Mean)	High Volume GA, SC & NC	High Volume FL	Low Volume GA, SC & NC	Low Volume FL
Boat length (ft.)	34	32	31	29
Miles fished off shore (mi.)	42	26	32	23
Pounds of snapper grouper landed in 1994 (lb.)	31,608	20,584	610	720

When comparing perceptions of future fishing high volume fishermen are more likely to respond that they intend to continue fishing than low volume fishermen (See Table 12). Low volume fishermen from Georgia and the Carolinas are the least likely to perceive that they will stay with snapper grouper or commercial fishing in general.

Table 12. Average perceptions of fishing future for active snapper grouper fishermen by high volume/low volume and region. Source: Rhodes, Backman, and Hawkins (1997).

Variable*	High Volume GA, SC & NC	High Volume FL	Low Volume GA, SC & NC	Low Volume FL
Intend to stay with snapper grouper fishing for next 2/3 years	1.9	2.0	3.1	3.0
Intend to leave snapper grouper fishing in next 2/3 years	3.8	3.7	2.7	3.1
Intend to leave commercial fishing in next 2/3 years	4.0	3.9	2.8	3.6

* Scale: 1 = strongly agree; 5 = strongly disagree

General Characteristics of Active and Inactive Snapper Grouper Fishermen

As part of the sampling frame for the socio-demographic survey, fishermen who had not fished for snapper grouper species in 1995 or had quit commercial fishing altogether, but still had a snapper grouper permit were also included. A total of 27 inactive fishermen completed surveys included in the results. The following tables compare snapper grouper fishermen from the socio-demographic survey stratified by whether they were active or inactive snapper grouper fishermen.

In general the two groups are very much alike with regard to general demographic characteristics (See Table 13). Inactive fishermen have a higher average age and are less likely to be an owner captain, but have an average tenure as a fisherman and education level comparable to those who are active. There was a larger percentage of inactive fishermen from the Georgia/Carolinas, as there was active fishermen from Florida. When stratified by gear type the two samples were similar with percentages in each category very much the same, except for traps. One likely reason for the higher percentage of trap fishermen in the inactive category is the prohibition on trap fishing implemented in the early 1990s by the South Atlantic Council.

Active and Inactive Snapper Grouper Fishermen's Perceptions of Fishing

While active and inactive fishermen may be similar regarding their demographic characteristics, they have some rather marked differences in other areas. Fishermen were asked to score their perceptions regarding quality of life as commercial fishermen on a scale of one (1) to ten (10), with ten being the best life possible. When comparing their perceptions in Table 14, a greater percentage of inactive fishermen see their present quality of life as being worse as a commercial fisherman than do active fishermen. This perception is likely related to their reasons for not actively participating in snapper grouper fishing. More active fishermen, on the other hand, see their life as a commercial fisherman as being better five years ago. Future perceptions of being a commercial fisherman five years from now seem poor for inactive fishermen as they have a larger percentage (68%) who score their future perception of fishing with five (5) or below. Again, their perception of their current status and future for commercial fishing seem to indicate their inactive status and perception of the future are linked.

Table 13. A comparison of general characteristics for active and inactive snapper grouper fishermen. Source: Rhodes, Backman, and Hawkins (1997).

Variable	Active S/G Fishermen	Inactive S/G Fishermen
Age (in years)	43	49
Years as a Commercial Fisherman (in years)	15	15
Years as a Snapper Grouper Fisherman (in years)	13	10
Education (Percent)		
Some high school	18%	15%
High school graduate or more	82%	85%
Position on Boat		
Owner and Captain	82%	69%
Region (Percent)		
Florida	53%	33%
Georgia/Carolinas	47%	67%
Gear Type (Percent)		
Bandit Reel	42%	33%
Rod & Reel	29%	26%
Traps	1%	22%
Longline	6%	8%
Spear	4%	-
Other	12%	11%

Table 14. Perceptions of quality of life by inactive and active snapper grouper fishermen. Source: Rhodes, Backman, and Hawkins (1997).

Quality of Life Scale Item Score	Inactive (Percent)	Active (Percent)
Life as a commercial fisherman		
1-3	33	14
4-5	29	42
6-7	9	18
8-10	29	26
Five years ago		
1-3	12	11
4-5	36	22
6-7	16	25
8-10	36	42
Five years from now		
1-3	46	28
4-5	23	26
6-7	4	16
8-10	27	30

Inactive status in the snapper grouper fishery may indicate a possibility of leaving commercial fishing altogether. A larger percentage of inactive fishermen (46%) than active fishermen (11%) indicate they may leave commercial fishing altogether as shown in Table 15.

Another indication of intent to leave fishing is reflected by the larger percentage of inactive fishermen (33%) to active fishermen (19%) who indicate they agree or strongly agree that people important to them want them to stop fishing. In addition, a much larger percentage of inactive fishermen (58%) than active fishermen (42%) see the future of fishing as being risky or hopeless. Although, a large percentage of active fishermen seem to have a rather dim view of the future of commercial fishing also.

Table 15. Perceptions of commercial fishing future by inactive and active snapper grouper fishermen. Source: Rhodes, Backman, and Hawkins (1997).

Variable	Inactive (Percent)	Active (Percent)
Likelihood to leave commercial fishing altogether		
Very likely	33	6
Likely	13	5
Not sure	13	18
Not likely	12	35
Unlikely	29	36
People Important to me want me to stop fishing		
Strongly agree	11	6
Agree	22	13
Neither agree/disagree	7	33
Disagree	22	29
Strongly agree	37	19
Future for commercial fishing		
Good	15	18
Unstable	27	33
Risky	42	34
Hopeless	16	8

Preferred Management Option

Fishermen were asked to choose their preferred management option on the socio-demographic survey from the options presented in Table 16. Of those who had a preference, the largest percentage of respondents chose license limitation. The next highest percentage choice was co-management, with ITQs and limited closure both being chosen about 8% of the time. However, 30% of respondents did not have a preferred choice or decided that some other management option was their preferred. Further analysis may provide more insight into which snapper grouper fishermen prefer license limitation. At this time, we can only say there seems to be some support for license limitation among this sample of fishermen.

Table 16. Preferred Management option of active/inactive commercial snapper grouper fishermen. Source: Rhodes, Backman, and Hawkins (1997).

	Active		Inactive	
Variable	Percent	n	Percent	n
License Limitation	39%	77	12%	3
Co-Management	17%	40	44%	11
Individual Transferable Quota	7%	14	0%	0
Limited Closure	11%	21	12%	3
Not Sure of Best	13%	25	24%	6
Other	12%	24	8%	2

Fishermen from the Keys were also given an opportunity to select their preferred type of management as indicated in Table 17. Respondents in the economic survey were given the opportunity to choose more than one management option, therefore the sum may be greater than the number of samples (n) provided in the table. Keys fishermen differed markedly from those snapper grouper fishermen in the socio-demographic survey in their preferred management option. Limiting the number of boats was near the bottom while use of seasonal closures was the preferred management alternative.

Table 17. Management preference for Keys fishermen. Source: Waters (1996).

Type of Management	Upper Keys n = 21	Middle Keys n = 24	Lower Keys n = 57	Total n = 102
Limit number of boats	3	2	7	10
Limit number of fishing days	2	0	3	5
Limit boat size	2	3	1	6
Limit size/amount of gear	5	4	9	18
Limit catch per trip	1	5	7	13
Use of seasonal closures	7	7	27	41
Favor other limitations	8	8	18	34

Profile of Commercial Snapper/Grouper Fishing Regions

The following description was provided by Kim Iverson of SC Department of Natural Resources. This profile of the snapper grouper fishery is not complete, but gives an indication of the number vessels and their homeport locations. It does not constitute a profile of fishing communities, but is the only information available to describe fishing communities involved in snapper grouper fishing in the South Atlantic, at this time. Again, this research did not include the Florida Keys, therefore, excludes an important aspect of the South Atlantic snapper grouper fisheries.

The following information was compiled during in-person interviews with commercial snapper grouper fishermen during the MARFIN project "Socio-demographic Assessment of Commercial Reef Fishermen in the South Atlantic Region" (Rhodes, et al. 1997) and from Robert Wiggers, currently a port sampler with the SC Department of Natural Resources. Robert Wiggers was the primary field investigator for another MARFIN funded project involving an economic assessment of the commercial snapper grouper fishermen (Rhodes, Waltz and Wiggers 1996). He was responsible for collecting economic data from St. Augustine, Florida north to the Outer Banks of North Carolina. Information from the Socio-Demographic Assessment was collected from Broward County, Florida to Harkers Island, North Carolina. While it is impossible to discuss every fishing port in the South Atlantic in this summary, it does provide a general overview of the fishery by regions.

The commercial reef fishery along the South Atlantic is a diverse and complex business. Many factors influence fishing patterns of snapper grouper fishermen. These include:

- Offshore Environment - proximity to fishing area, bottom composition and currents
- Available Species
- Seasonal Weather patterns

These factors in turn determine vessel size, gear type, days at sea and crew requirements and associated costs.

The Carolinas and Georgia

Outer Banks:

The commercial fishing industry on the Outer Banks of North Carolina is divided among five ports; Manns Harbor, Manteo, Wanchese, Hatteras and Ocracoke. Because of the rough water and strong currents that prevail in the offshore waters, bottom fishing is at best, a hit or miss venture. Most of the snapper grouper permit holders work out of Hatteras and only a small portion of their annual commercial fishing activity is devoted to targeting snapper grouper species. Black sea bass, snowy grouper, and blueline tilefish are the most frequently targeted species by commercial snapper grouper fishermen. Surface longlining for tuna and swordfish is apparently the most productive and profitable style of commercial fishing in the area, and the small towns of Manteo and Wanchese serve as refuge for a large number of both local and non-local long lining boats.

Morehead City to Murrells Inlet:

The Morehead City/Beaufort area is located approximately 50 miles south of Ocracoke. This area is known for its sportfishing activity including several major tournaments each year. There is a small population of full time commercial reef fishermen in Morehead, however the majority of fishermen holding commercial permits are primarily part timers. Many of these fishermen divide their time between charter fishing during the peak tourist season (April through September) and commercial fishing in the winter months. Full time fishermen in this area reported fishing approximately 50 miles straight offshore and fishing from Hatteras to as far south as the South Carolina/Georgia line. Trip lengths vary with the size of the vessel, but the average trip length is 7 days and the larger boats carried up to 3 crew members.

South of New River Inlet is the small community of Sneads Ferry, unique in that the majority of the commercial reef fishermen fish with sea bass pots. According to the 1993 Federal Permit List for the South Atlantic region, there were 58 permit holders who indicated that sea bass pots were their primary gear type. Of those, 13 permit holders worked out of

Sneads Ferry. Subsequently, 72% of fishermen using sea bass pots as their primary gear work out of home ports in North Carolina.

Further south in the Carolinas commercial fishing ports include Southport, NC and Murrells Inlet, SC. One of the largest concentration of snapper grouper vessels is located in Murrells Inlet, SC. Most of the reef fishermen in this area are full time commercial fishermen and consider bandit reels to be the most effective way of catching snapper grouper. There is a wide variety of snapper grouper species off of Murrells Inlet, with gag, scamp, and vermilion snapper being highly targeted. The average trip length is 5 days with some of the larger boats (>40 ft.) fishing up to 10 days. A few smaller bandit boats may stay out for 2-3- days. The Gulf Stream is approximately 62 miles offshore from Murrells Inlet. Most bandit boats fish between the 20-50 fathom line, concentrating on the 25 fathom curve. Winter weather dictates that fishermen fish shallow, in waters 60-90' deep. Several fishermen switch to sea bass trapping during the winter months.

Vessels in Murrells Inlet will fish an area from Frying Pan Shoals off southern NC, south to Savannah. The average boat has two crew members. It is interesting to note that fishermen stated a crew of 3 plus the captain was ideal for this area, but decreasing catches and increased costs have made it necessary to cut back on crew members.

The coast of Georgia contains a small concentration of full-time reef fishermen that fish primarily with bandit reels. Their fishing patterns are similar to those found in SC with vessels fishing from northern Florida north to the SC/NC line.

North Florida to Cape Canaveral

Concentrations of reef fishermen can be found in the communities of Mayport, Port Orange and New Smyrna, north of Cape Canaveral. Bandit reels are the primary gear used for reef fishing in these areas, although a few bottom longline vessels are present. In northern Florida, bandit fishermen report trips lasting 5-6 days and fish 30-50 miles offshore. They average between 2 to 3 crew members depending on vessel size and gear. Vessels from the Mayport area reported fishing from the Georgia line south to the Daytona area. The larger longline vessels are required by regulations to fish past the 50 fathom line. As a result, trip lengths of up to 10 days are reported, with fishing taking place as far as 100 miles from shore. These bottom longline vessels fish for deep water species such as tilefish in water 600 - 900' deep.

South of Cape Canaveral

South of Cape Canaveral, one begins to see large changes in fishing trips as the reef is found closer to shore and accessibility is increased. Commercial fishing communities include Sebastian, Ft. Pierce, Jupiter, and West Palm and Boyton Beaches. Small numbers of full-time commercial fishermen are found scattered throughout south Florida. In addition to reef fishing, many are involved in other fisheries including king mackerel. Beginning at Ft. Pierce, snapper grouper fishermen report fishing an average of 20 miles offshore while moving down to West Palm they fish 1 to 2 miles offshore. Day trips are common with a few fishermen staying out overnight. In general, vessel size decreases and most captains fish alone or with an occasional crew member.

3.3.2 Recreational Fishery

Recreational total catches and catch rates for traditional snapper grouper species, such as red snapper, vermilion snapper, and several of the groupers have declined substantially during the 1980s and 1990s. The average size of vermilion snappers, black sea bass, and groupers is quite small in recreational catches. The small average size of recreational fish is partly due to the habit of some species to stratify in size by depth. Another important reason is that total inshore fishing pressure is so high that fish are not allowed to grow to optimum size before capture. As soon as fish reach legal size they are caught. This is an example of growth overfishing.

Recreational fishing pressure by private boats will likely continue to increase as the coastal population continues to grow in the South Atlantic. The virtual absence of larger fish in the near shore waters of the management unit, as well as the shifting of target species by both recreational and commercial sectors, are other indicators that many, especially the highly prized, traditional species (red snapper, gag, scamp, etc.), are under intense fishing pressure and require management.

Recreational catches, average size, and catch-per-unit-effort are included under stock status.

3.4 Status of the Red Porgy Stock

3.4.1 1994 Assessment

This assessment consisted of a complete virtual population analysis (VPA) and included data through 1992. The spawning potential ratio (SPR) was determined to be 13%. The Council used this assessment to develop Snapper Grouper Amendment 9.

3.4.2 1998 Updated Trends Analysis

This assessment consisted of a "snap-shot" estimate of SPR using virtual population analysis (VPA) and 1996 data. The spawning potential ratio (SPR) was determined to be 14-19%.

3.4.3 1999 Assessment

This assessment consisted of a complete virtual population analysis (VPA) and included data through 1996 for VPA analyses and through 1997 for other analyses (Vaughan, 1999; Appendix B). The spawning potential ratio (SPR) was determined to be 24%.

The level of information available for red porgy also allowed for examination of the biomass and recruitment levels. The assessment report concluded that biomass had decreased from an annual estimate of 9,913 metric tons during the time period 1972-78, to 3,557 metric tons during 1982-86, and to 685 metric tons during 1992-96. This represents a 93% reduction from 1972-78 to 1992-96. Over the same time periods, recruitment (the number of age 1 fish entering the population) declined from 6.53 million fish per year (1972-78), to 2.38 million fish per year (1982-86), and to 0.66 million fish per year (1992-96). This represents a 90% reduction from 1972-78 to 1992-96.

The NOAA, Center for Coastal Fisheries and Habitat Research, Beaufort Laboratory's Fish Biology Team was requested by the Council to provide graphical and tabular data reflecting trends in catches of 15 major snapper grouper species. Weight of landings (kilograms), mean fish size, and headboat fishery catch per unit effort (CPUE) are presented below for red porgy compiled for the entire southeastern United States fishing area: North Carolina through the east coast of Florida, including the Florida Keys and Dry Tortugas. Three data bases, each with a landings and fish size (bioprofiles) component, were utilized: Headboat, Commercial, and Marine Recreational Fisheries Statistical Survey (MRFSS). [Note: This information is from Potts, J.C., and K. Brennan, Trends in catch data for fifteen species of reef fish landed along the southeastern United States, NOAA/NMFS Beaufort Lab, February 2000.]

Descriptions of the data limitations and outputs are:

1. **Headboat:** Landings were available for the entire region for 1981-1998; restricted to NC and SC for 1972-1975; NC through North Florida for 1976-1977, and partial coverage of South Florida for 1978-1980. Headboat data is part of the "For Hire" recreational data. Mean weights were obtained from the bioprofiles data for 1972-1998 with the same geographic restrictions as the landings. CPUE was calculated in terms of number of fish caught as well as kilograms of fish caught, all per angler day. CPUE trends were plotted in terms of one data point per year per species. For a given species, CPUE calculations were done only for those areas in which the species was a common and frequent occurrer. This was done to avoid negatively biasing the CPUE calculation (i.e., inclusion of areas of infrequent or rare occurrence would involve including both low landings data and high effort data, resulting in low and inaccurate CPUE values).

2. **Commercial:** Landings were available from 1986-1998. 1986 was the first year that most fish were identified to species. Mean weights were generated from intercept (TIP) lengths, which were then applied to weight-length relationships for each species, 1983-1998.

3. **MRFSS:** Landings data were available for 1981-1998, and were recorded as charter boat ("For Hire") landings and other recreational platforms (e.g., private boat, pier, shore, etc.). However, 1981-1985 data provide crude estimates of charter boat landings because they were combined with party boats (headboats) landings for those years. To adjust, we used the intercept data to obtain the proportion of charter boat and party boat samples for each species. We then applied those proportions to the landings data for each species, and discarded the party boat segment because it was already included in the official headboat data. Monroe County landings are not included because county codes are not included in the landings data, and could not be easily broken out. Mean weights for each species were obtained from the intercept data. For the samples with no weight recorded, the length-weight relationship for each species was used to convert the lengths to weights.

For simplicity, all information for red porgy is included here under the heading of a Figure. We recognize this mixes tables and figures, however, it does group all material together and reduces the requirement to number each table and figure separately. We hope this makes reviewing the material easier.

Figure 1. Trends in catches and CPUE for red porgy (Source: Potts and Brennan, 2000).

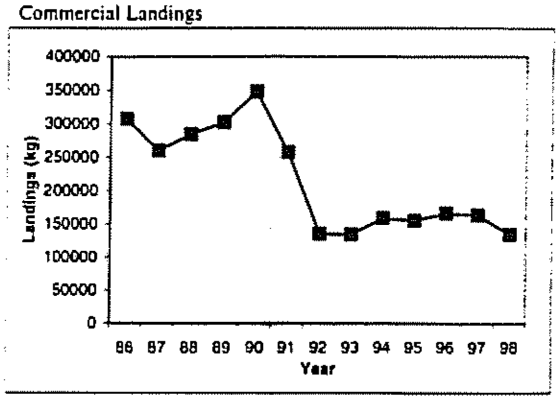
Red porgy data (landings, mean weights, and CPUE-Wt are in kg.)

	Commercial			Headboat					Charter boat			Other Recreational		
Year	Landings	Mean Wt	N	Landings	Mean Wt	N	CPUE-# (NC - NEFL)	CPUE-Wt (NC - NEFL)	Landings	Mean Wt	N	Landings	Mean Wt	N
72				235351	1.06	2115	4.4	4.8						
73				334125	1.13	2508	5.1	5.8						
74				233116	1.07	1798	2.8	2.8						
75				202542	1.05	1148	2.4	2.2						
76				186310	1.09	1240	2.2	1.9						
77				240348	1.01	1100	2.4	2.5						
78				239757	1.02	843	1.9	2.2						
79				162176	1.05	458	1.5	1.7						
80				161668	0.95	727	1.7	1.7						
81				147625	0.85	575	2.0	1.8	0			5789	0.58	8
82				195923	0.72	1246	2.8	2.0	0	0.67	3	2503	0.55	4
83		1.05	337	118592	0.78	1206	1.7	1.3	19158	0.85	19	2487	0.33	4
84		0.92	3347	98446	0.78	1284	1.3	1.0	43250	0.65	24	4835	0.85	2
85		0.93	3447	118106	0.66	967	1.7	1.2	35	0.50	1	93437	0.64	31
86	307283	0.89	3770	100737	1.39	1228	1.4	0.9	1284	0.58	8	7538	0.60	12
87	260159	0.78	3306	100006	0.58	1203	1.3	0.8	9574	0.69	23	23407	0.57	35
88	284672	0.74	1721	97764	0.59	811	1.3	0.8	32207	0.53	27	148055	0.60	27
89	302010	0.72	2035	74865	0.50	1511	1.4	0.7	45587	0.61	51	16277	0.40	29
90	347227	0.65	2463	56819	0.48	1312	1.0	0.5	7078	0.79	47	14016	0.32	10
91	256559	0.62	2457	63874	0.48	649	1.1	0.5	50482	0.68	17	14741	0.43	28
92	134958	0.69	1384	49830	0.49	828	0.8	0.5	32513	0.65	77	20206	0.50	23
93	133897	0.74	1979	45824	0.54	1011	0.7	0.4	15797	0.65	43	10564	0.92	5
94	158678	0.74	1745	39721	0.52	780	0.7	0.4	4115	0.58	50	10503	0.51	8
95	155473	0.68	2260	42198	0.57	851	0.7	0.4	33755	0.60	54	2427	0.58	6
96	166084	0.65	2679	37294	0.57	868	0.7	0.4	53391	0.70	21	32952	0.98	11
97	163169	0.66	3208	34155	0.60	635	0.5	0.3	4984	0.67	14	2845	0.76	11
98	134576	0.61	3559	31417	0.58	793	0.4	0.2	3621	0.60	15	1689		

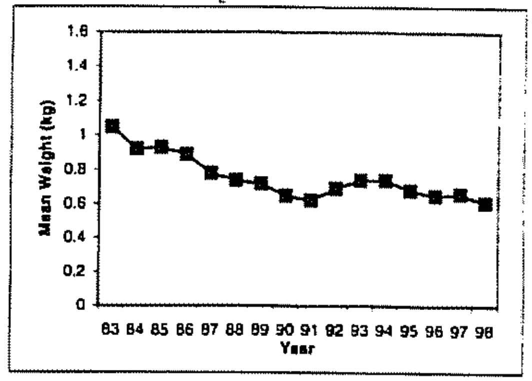
1989 - Gear restrictions as listed in text
1992 - Gear restrictions as listed in text
12" TL minimum size limit, all fisheries

Figure 1 (continued).

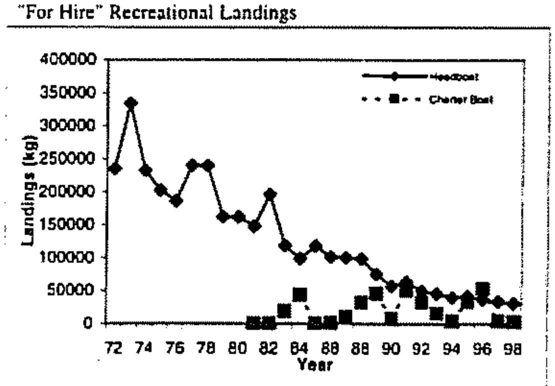
Commercial Landings



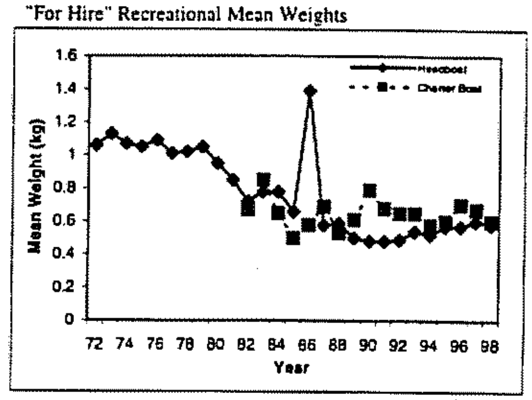
Commercial Mean Weights



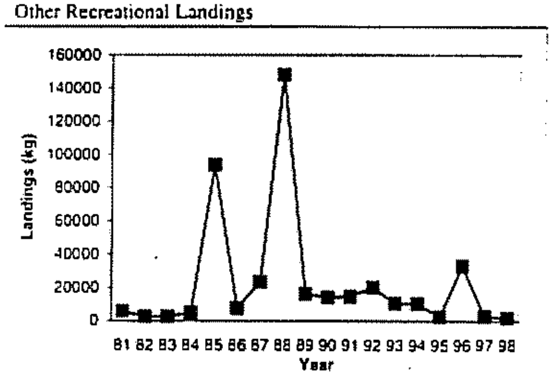
"For Hire" Recreational Landings



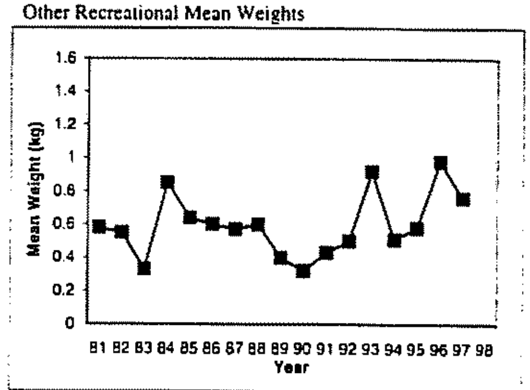
"For Hire" Recreational Mean Weights



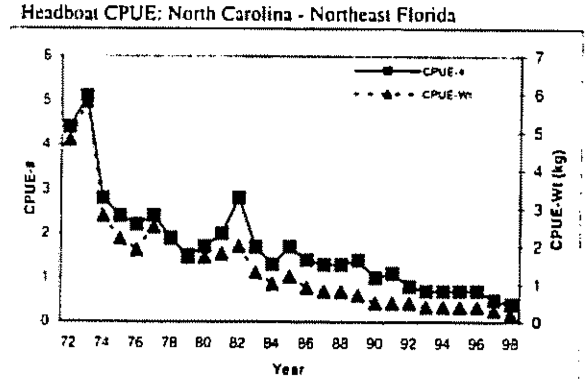
Other Recreational Landings



Other Recreational Mean Weights



Headboat CPUE: North Carolina - Northeast Florida



3.5 Status of Snapper Grouper Habitat

The Council has adopted a general habitat policy and developed policy statements to address concerns and present recommendations on ocean dumping, dredging and dredge disposal, plastic pollution, oil and gas exploration, development and transportation, and submerged aquatic vegetation. The text of the policy statements are included in Section 8.3.

Section 8.2, Description of the Habitat Comprising the Management Unit, is a compilation of Habitat information contained in the original FMP (SAFMC, 1983), Amendment 1 (SAFMC, 1988), Amendment 6 (SAFMC, 1993b), the Habitat Plan for the South Atlantic Region (SAFMC, 1998c), and the Amendment 10: Comprehensive Amendment Addressing Essential Fish Habitat in Fishery Management Plans of the South Atlantic Region (SAFMC, 1998b). The sections have been combined and updated to reflect modification to the Council habitat policy and policy statements, more accurately reflect information on and the status of essential snapper grouper habitat. The policies presented were developed to provide guidance for resource managers in the protection and restoration of the environmental quality and habitat quantity in the South Atlantic region.

Essential snapper grouper habitat as defined in the reauthorized Magnuson-Stevens Fishery Conservation and Management Act is that which includes "water and substrate necessary to fish for spawning, breeding or growth to viability." The Council's definition of habitat mirrors the intent by stating that essential habitat is "the physical, chemical and biological parameters that are necessary for continued productivity of the species that is being managed." The objectives of the Council's policy will be accomplished through a short-term goal and recommendation of no net loss or significant environmental degradation of existing habitat. The Council's long-term objective is to promote net-gain of fisheries habitat through restoration and rehabilitation of the productive capacity of habitats that have been degraded, and the creation and development of productive habitats where increased fishery production is probable.

Essential snapper grouper habitat includes, but is not limited to, coral and coral reefs, live/hard bottom habitat, inshore tidal marsh, submerged aquatic vegetation, mangroves, and *Sargassum* habitat. Therefore essential habitat for species in the snapper grouper management unit extends from inshore to offshore including pelagic *Sargassum* habitat.

The available information on distribution of these habitat types in the South Atlantic region is presented in various fishery management plans including the associated environmental impact statement or environmental assessment: the distribution of coral, coral reefs and live/hardbottom habitat (GMFMC and SAFMC, 1982; SAFMC and GMFMC, 1994; and SAFMC, 1995); the distribution of submerged aquatic vegetation (SAFMC, 1995); and distribution of wetland habitat (SAFMC, 1993a).

Snapper Grouper Amendment 10 (SAFMC, 1998b), which addressed the Habitat requirement of the Magnuson-Stevens Act, as amended in 1996, contained the following snapper grouper items [Note: Detailed information is presented in the Council's Habitat Plan (SAFMC, 1998c)]:

ACTION 1. Identify Essential Fish Habitat for Species in the Snapper Grouper Management Unit.

Essential fish habitat for snapper-grouper species includes coral reefs, live/hard bottom, submerged aquatic vegetation, artificial reefs and medium to high profile outcroppings on and around the shelf break zone from shore to at least 600 feet (but to at least 2000 feet for wreckfish) where the annual water temperature range is sufficiently warm to maintain adult populations of members of this largely tropical complex. EFH includes the spawning area in the water column above the adult habitat and the additional pelagic environment, including *Sargassum*, required for larval survival and growth up to and including settlement. In addition the Gulf Stream is an essential fish habitat because it provides a mechanism to disperse snapper grouper larvae.

For specific life stages of estuarine dependent and nearshore snapper-grouper species, essential fish habitat includes areas inshore of the 100-foot contour, such as attached macroalgae; submerged rooted vascular plants (seagrasses); estuarine emergent vegetated wetlands (saltmarshes, brackish marsh); tidal creeks; estuarine scrub/shrub (mangrove fringe); oyster reefs and shell banks; unconsolidated bottom (soft sediments); artificial reefs; and coral reefs and live/hard bottom.

Refer to Section 3.0 in the Habitat Plan for a more detailed description of habitat utilized by the managed species. Also, it should be noted that the Gulf Stream occurs within the EEZ.

ACTION 2. Establish Essential Fish Habitat-Habitat Areas of Particular Concern (EFH-HAPCs) for Species in the Snapper Grouper Management Unit.

Areas which meet the criteria for essential fish habitat-habitat areas of particular concern (EFH-HAPCs) for species in the snapper-grouper management unit include medium to high profile offshore hard bottoms where spawning normally occurs; localities of known or likely periodic spawning aggregations; nearshore hard bottom areas; The Point, The Ten Fathom Ledge, and Big Rock (North Carolina); The Charleston Bump (South Carolina); mangrove habitat; seagrass habitat; oyster/shell habitat; all coastal inlets; all state-designated nursery habitats of particular importance to snapper grouper (e.g., Primary and Secondary Nursery Areas designated in North Carolina); pelagic and benthic *Sargassum*; Hoyt Hills for wreckfish; the Oculina Bank Habitat Area of Particular Concern; all hermatypic coral habitats and reefs; manganese outcroppings on the Blake Plateau; and Council-designated Artificial Reef Special Management Zones (SMZs).

The Council's Sargassum Fishery Management Plan (SAFMC, 1998e) proposed to protect *Sargassum* by prohibiting any directed harvest in the long-term while phasing-out harvest in the short-term to minimize negative impacts on the one entity in the fishery. The Council concluded this action was necessary to protect *Sargassum* because it is both EFH and EFH-HAPC for species in the snapper-grouper management unit. Given the extremely overfished status of many of the species in the snapper-grouper management unit, the Council concluded any additional fishing mortality must be prevented in order to allow rebuilding of these important commercial and recreational species. Failure to take such action would violate the Council's habitat policies and the habitat mandates of the Magnuson-Steven Act while also contributing to the continued overfishing of snapper-grouper species which would also violate the mandates of the Magnuson-Stevens Act. The NMFS rejected the Sargassum FMP in a letter dated November 24, 1999.

3.6 The Effects of The Proposed Measures on Snapper Grouper Habitat

The proposed actions, and their alternatives, are not expected to have any adverse effect on the ocean and coastal habitats.

Management measures adopted in the original management plan through Amendment 9 combined have significantly reduced the impact of the fishery on essential habitat. The Council has reduced the impact of the fishery and protected essential habitat by prohibiting use of poisons and explosives, prohibiting use of fish traps and entanglement nets in the EEZ, defining allowable gear, banning use of bottom trawls on live/hard bottom habitat north of Cape Canaveral, Florida, restricting use of bottom longlines to depths greater than 50 fathoms north of

St. Lucie Inlet, Florida and prohibiting bottom longline use south of St. Lucie Inlet, and only for species other than wreckfish, and prohibiting the use of black sea bass pots south of Cape Canaveral, Florida. These gear restrictions have significantly reduced the impact of the fishery on coral and live/hard bottom habitat in the South Atlantic region.

Management measures in Amendment 8 include specifying allowable net gear and limiting the number of commercial fishermen which will protect habitat by reducing the quantity of gear used in the fishery.

Additional measures in Amendment 9 include further restricting longlines to retention of only deepwater species which will protect habitat by making existing regulations more enforceable. In addition, the requirement that black sea bass pots have escape vents and escape panels with degradable fasteners will reduce catch of undersized fish and insure that the pot, if lost, will not continue to "ghost" fish.

Measures adopted in the coral plan and shrimp plan have also protected essential snapper grouper habitat including the designation of the Oculina Bank Habitat Area of Particular Concern and the rock shrimp closed area (see Section 8.2 of this document and the FMP document (SAFMC, 1983) for additional information).

3.7 Habitat Responsibilities as Defined in the Magnuson-Stevens Fishery Conservation and Management Act

The following wording is taken directly from the Magnuson-Stevens Fishery Conservation and Management Act, Public Law 104-208 and reflects the new Secretary of Commerce and Fishery Management Council authority and responsibilities for the protection of essential fishery habitat. A new section was added in Amendment 8 as follows:

Section 305 (b) Fish Habitat.—(1)(A) The Secretary shall, within 6 months of the date of enactment of the Sustainable Fisheries Act, establish by regulation guidelines to assist the Councils in the description and identification of essential fish habitat in fishery management plans (including adverse impacts on such habitat) and in the consideration of actions to ensure the conservation and enhancement of such habitat. The Secretary shall set forth a schedule for the amendment of fishery management plans to include the identification of essential fish habitat and for the review and updating of such identifications based on new scientific evidence or other relevant information.

(B) The Secretary, in consultation with participants in the fishery, shall provide each Council with recommendations and information regarding each fishery under that Council's authority to assist it in the identification of essential fish habitat, the adverse impacts on that habitat, and the actions that should be considered to ensure the conservation and enhancement of that habitat.

(C) The Secretary shall review programs administered by the Department of Commerce and ensure that any relevant programs further the conservation and enhancement of essential fish habitat.

(D) The Secretary shall coordinate with and provide information to other Federal agencies to further the conservation and enhancement of essential fish habitat.

(2) Each Federal agency shall consult with the Secretary with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any essential fish habitat identified under this Act.

(3) Each Council—

(A) may comment on and make recommendations to the Secretary and any Federal or State agency concerning any activity authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by any Federal or State agency that, in the view of the Council, may affect the habitat, including essential fish habitat, of a fishery resource under its authority; and

(B) shall comment on and make recommendations to the Secretary and any Federal or State agency concerning any such activity that, in the view of the Council, is likely to substantially affect the habitat, including essential fish habitat, of an anadromous fishery resource under its authority.

(4) (A) If the Secretary receives information from a Council or Federal or State agency or determines from other sources that an action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by any State or Federal agency would adversely affect any essential fish habitat identified under this Act, the Secretary shall recommend to such agency measures that can be taken by such agency to conserve such habitat.

(B) Within 30 days after receiving a recommendation under subparagraph (A), a Federal agency shall provide a detailed response in writing to any Council commenting under paragraph (3) and the Secretary regarding the matter. The response shall include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on such habitat. In the case of a response that is inconsistent with the recommendations of the Secretary, the Federal agency shall explain its reasons for not following the recommendations.'

A proposed rule was published by NMFS on April 23, 1997 specifying regional fishery management council guidelines for the description and identification of essential fishery habitat (EFH) in fishery management plans, adverse impacts on EFH, and actions to conserve and enhance EFH. In order to address the new essential fish habitat mandates in the Magnuson-Stevens Act, the South Atlantic Council completed: (1) a habitat plan which serves as a source document describing EFH; (2) a comprehensive amendment which amended each of the existing fishery management plans, identifying and describing EFH and addressing impacts of fishing gear and/or fishing practices on EFH; and (3) a monitoring program for each fishery management plan to determine new impacts from fishing gear and/or fishing practices in an effort to minimize, to the extent practicable, the adverse impacts on EFH.

An interim final rule was published in the federal register on December 19, 1997 [62 Federal Register 66531]. These guidelines became effective on January 20, 1998.

The South Atlantic Council completed a Habitat Plan (SAFMC, 1998c) and a Comprehensive Habitat Amendment (SAFMC, 1998b). The Habitat Plan and Comprehensive Amendment have been approved but the final rule implementing the amendment has not been published as of this date.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

This section presents management measures and alternatives considered by the Council and the environmental consequences of management. The final supplemental environmental impact statement (FSEIS), regulatory impact review (RIR), and social impact assessment (SIA)/fishery impact statement/FIS are incorporated into the discussion under each of the proposed action items.

Actions 1, 2, 3, and 5 are followed by one sub-heading: Discussion. These measures do not in themselves have direct biological, economic, and social impacts. Rather, it is through subsequent measures that such impacts result and that is where more specific discussion is presented. For Actions 4 and 6, each is followed by four sub-headings: Biological Impacts, Economic Impacts, Social Impacts, and Conclusion. These are self explanatory with the first three presenting the impacts of each measure considered. The Council's rationale for taking or rejecting the actions/options are presented under the heading "Conclusion". The Council's preferred action is listed below the Action number and options considered by the Council are indicated under the heading "Other Possible Options".

4.2 Management Options

4.2.1 ACTION 1. Maximum Sustainable Yield (MSY) for red porgy is 4.38 million pounds (1,987 metric tons).

The biomass capable of producing maximum sustainable yield (MSY) is termed B_{msy} and varies depending on the Static SPR target level (Source: Doug Vaughan, NMFS Beaufort Lab). Estimates based on the 14 inch TL minimum size limit in Snapper Grouper Amendment 9 are shown below:

	30% Static SPR	35% Static SPR	40% Static SPR	45% Static SPR
B_{msy}	= 3,963.9 mt = 8.74 M lb	= 4,621.7 mt = 10.19 M lb	= 5,285.4 mt = 11.65 M lb	= 5,933.4 mt = 13.08 M lb

The NMFS suggested as a "critical comment" that the following text be added. Critical comments identify items that could prevent approval if not addressed. Therefore, the following wording is included directly from the letter to Bob Mahood from William T. Hogarth dated November 30, 1999:

The national standard guidelines require that each fishery management plan specify the MSY and OY for each fishery. The MSY is the maximum level of yield that a fishery can produce on average over a sustained period of time. The MSY limit is a threshold and is dependent upon the productivity of the stock and the selectivity pattern in the fishery. The MSY limit is a yield and in most circumstances should be expressed in units of weight. Biomass is a measure of living mass, and is an appropriate measure of stock size but not of yield. In some instances where a MSY limit estimate can not be estimated, a proxy may be used but should be biomass based. For the same stock, estimates for MSY may vary depending on what type of gear is used or what type of selectivity pattern exists in the fishery. For example, the maximum yield that can be sustained by a gear that removes all fish greater than 13" may be different than the yield sustained by a gear that removes all fish greater than 14".

In the case of red porgy the Council has chosen to set the MSY limit at a level that corresponds to a static SPR of 35%. Since the MSY is a limit, any greater harvest would be excessive. Furthermore, any fishing mortality level that resulted in a static SPR of less than 35%, would exceed the MFMT and would result in overfishing.

The first status determination criterion that the Council needs to consider is the Maximum Fishing Mortality Threshold (MFMT). The MFMT usually is equal to the fishing mortality rate that results in the MSY. In the case of red porgy this results in a F of 0.43. $F_{CURRENT}/F_{MSY}$ *should be less than 1 or overfishing is occurring.*

The second status determination criterion used to judge the status of the resource is the Minimum Stock Size Threshold (MSST). This threshold represents the minimum stock size that must be maintained in order for the stock to be able to produce MSY. This parameter is measured in units of weight and is $(1\text{-}M)*B_{MSY}$*, or the minimum stock size at which rebuilding to* B_{MSY} *will occur within 10 years of fishing at the MFMT. For red porgy MSST = (1-0.28)*4,621.7 mt = 3,327.6 mt.*

The fishing mortality rate at equilibrium that results in MSY is termed F_{MSY}*. The corresponding equilibrium biomass is known as* B_{MSY}*. In an equilibrium situation, the product of the fishing mortality rate (*F_{MSY}*) times the* B_{MSY} *can be used to obtain a MSY estimate. Consequently,*

$$MSY = F_{MSY}\ X\ B_{MSY}$$

or in this case,

$$MSY = 0.43\ X\ 4621.7\ mt = 1987.3\ mt$$

For red porgy, the MSY is estimated to be 1987.3 metric tons (mt). This estimate is based on the following assumptions:

1) *the biomass at MSY (*B_{MSY}*) is 4621.7 mt,*
2) *the MFMT is the fishing mortality rate corresponding to a 35% static SPR, (F35% is 0.43)*
3) *the selectivity pattern currently existing in the fishery is assumed such that the gear used selects all fish equal to or greater than 14".*

NOTE: The Council's specification of MSY follows below as Action 1. The status determination criteria and overfishing are specified in Action 3.

The Council's current Optimum Yield (OY) is 40% Static SPR which results in a B_{msy} of 5,285.4 metric tons (mt). The Council chose to use an equilibrium yield associated with a fishing mortality rate equivalent to a static SPR of 35% on which to base MSY. A first order approximation of MSY can be obtained from (Source: Doug Vaughan, NMFS Beaufort Lab):

$$MSY = F_{msy} * B_{msy}$$

Based on the Council's choice of obtaining MSY at a static SPR of 35%, then MSY = 0.43 (from Table 3) * 4,621.7 metric tons which equates to 1,987.3 metric tons or 4.38 million pounds.

Discussion

The B_{msy} values presented above are based upon the 14" TL minimum size limit specified in Snapper Grouper Amendment 9 (SAFMC, 1998a). The actual numbers in the proposed action and under Option 2 below are virtually identical. On the surface this is surprising given that Option 2 is based on a 12" TL size at entry and the proposed action is based on a 14" TL size at entry. The explanation is that both are based on average recruitment from 1972-78. One would expect, over time, to see improved recruitment with the 14" TL minimum size limit, however, this was not incorporated into the projection methodology.

This measure by itself will not impact entities in this fishery. Short-term positive or negative economic and social benefits will depend on the management measures adopted to keep the fishery from exceeding the MSY.

Rejected Options for Action 1:

Rejected Option 1. No Action. Maximum sustainable yield for red porgy is unknown. The Council reviewed alternatives and concluded the best available data supports using 30% Static SPR as a MSY proxy for the remaining species.

Discussion

This wording was included in the Comprehensive SFA Amendment (SAFMC, 1998b) and followed the Technical Guidance Document developed by NMFS using the level of data available at that time. The level of data has improved such that the Council can now specify MSY based on the Technical Guidance Document, therefore, this option was rejected. These values are shown under the proposed action.

Rejected Option 2. The biomass capable of producing maximum sustainable yield varies depending on the Static SPR target level (Source: Doug Vaughan, NMFS Beaufort Lab). Estimates based on the 12 inch TL minimum size limit in Snapper Grouper Amendment 4 are shown below:

	30% Static SPR	35% Static SPR	40% Static SPR	45% Static SPR
B_{msy}	= 3,964 mt = 8.74 M lb	= 4,605.4 mt = 10.15 M lb	= 5,285.3 mt = 11.65 M lb	= 5,945.9 mt = 13.11 M lb

The Council's current Optimum Yield (OY) as modified by Amendment 8 is 40% Static SPR which results in a Bmsy of 5,285.3 metric tons or 11.65 million pounds.

Discussion

These numbers are based on pre-Amendment 9 (SAFMC, 1998a) measures. Under Snapper Grouper Amendment 9, the minimum size limit was increased from 12" to 14" TL which results in changing the MSY. The new values (based on 14" TL) are shown under the proposed action. This option was rejected because it is based on the 12 inch size limit.

4.2.2 ACTION 2. Optimum Yield (OY) for red porgy is the amount of harvest that can be taken by U.S. fishermen while maintaining the Spawning Potential Ratio (SPR) at or above 45% Static SPR.

Discussion

Red porgy change sex from females to males and the SPR level specified as Optimum Yield (OY) should be similar to the level specified for other species in the snapper grouper management unit which change sex. This method of specifying OY conforms to the "critical comments" recommendation from NMFS in the November 30, 1999 letter from William Hogarth to Bob Mahood. It also conforms to the comments from the SEFSC in the November 22, 1999 memorandum from Bradford Brown to William Hogarth. This specification links the limit and target stock sizes directly and does not require assumptions about possible interactions between changes in catch and estimated population size.

This measure by itself will not impact entities in this fishery. Short-term positive or negative economic and social benefits will depend on the management measures adopted to keep the fishery from exceeding the OY.

Rejected Options for Action 2:

Rejected Option 1. No Action. Optimum Yield (OY) for red porgy is the amount of harvest that can be taken by U.S. fishermen while maintaining the Spawning Potential Ratio (SPR) at or above 40% Static SPR.

Discussion

This wording was included in the Comprehensive SFA Amendment (SAFMC, 1998a). The Council concluded this option was not sufficiently conservative given that red porgy switch sex from females to males. Therefore the Council rejected this option in favor of the proposed action.

Rejected Option 2. Optimum Yield (OY) for red porgy as the amount of harvest that can be taken by U.S. fishermen while maintaining the biomass at or above 5,285.4 mt (11.65 million pounds) (based on 14" TL minimum size limit) or 5,285.3 mt (11.65 million pounds) (based on 12" TL minimum size limit).

Discussion

Total spawning stock biomass declined sharply after 1980 from about 10,000 mt (22.05 million pounds) to around 3,000 mt (6.61 million pounds) during the mid to late 1980s (see Figure 10 in Appendix A). Specifying OY at about 5,000 mt (11.02 million pounds) would not have prevented the stock declines. Therefore the Council rejected this option in favor of the proposed action.

Rejected Option 3. Optimum Yield (OY) for red porgy is the amount of harvest that can be taken by U.S. fishermen while maintaining a total spawning stock size (biomass) of 10,000 metric tons or 22 million pounds.

Discussion

Total spawning stock biomass (metric tons, mt) was about 10,000 mt (22.05 million pounds) just prior to the decline from 1980 onwards (see Figure 10 in Appendix B). Maintaining the total spawning stock size at this level should rebuild the stock size and should also prevent future declines.

This measure by itself will not impact entities in this fishery. Short-term positive or negative economic and social benefits will depend on the management measures adopted to keep the fishery from exceeding the OY.

The SEFSC noted that this level may be overly conservative as a stock size to produce optimum yield because lower catches during the early 1980s may have been sustainable. Therefore the Council rejected this option in favor of the proposed action.

4.2.3 ACTION 3. Overfishing, Overfished & Rebuilding Time Period

Overfishing for red porgy is defined in terms of the NMFS Guidelines Checklist (Appendix B in SFA Comprehensive Amendment; SAFMC, 1998a) and information provided in the new stock assessment from the NMFS Beaufort Lab. The two components of the status determination criteria are:

A. A maximum fishing mortality threshold (MFMT) — A fishing mortality rate (F) corresponding to a 35% Static SPR (F=0.43) based on a 14" TL minimum size limit. Current fishing mortality was estimated as 0.47 based on a 14" TL minimum size limit and data through 1996.

B. A minimum stock size threshold (MSST) — The minimum stock size threshold is defined as the maximum of either 0.5 or 1-M (M = natural mortality = 0.28) times Bmsy. The Council is specifying the minimum stock size associated with 35% Static SPR which is 3,328 metric tons (MSST=(1-0.28)*4,622=3,328 mt) or 7.34 million pounds. Current stock size was estimated to be 685 metric tons (1.51 million pounds) based on data through 1996.

Rebuilding timeframe. Red porgy cannot be rebuilt in less than 10 years (see NMFS SEFSC results as shown in Figure 1) and a generation time is estimated as 8 years. Therefore, the rebuilding timeframe for red porgy is 18 years with 1999 being Year 1 given the emergency closure was implemented on September 8, 1999.

Discussion

The National Standards Guidelines provided the following two definitions: (1) "To overfish means to fish at a rate or level that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis" and (2) "Overfishing occurs whenever a stock or stock complex is subjected to a rate or level of fishing mortality that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis." The Guidelines go on to indicate that "In all cases, status determination criteria must specify both of the following: (i) A maximum fishing mortality threshold or reasonable proxy thereof, and (ii) A minimum stock size threshold or reasonable proxy thereof." Overfishing is occurring when the fishing mortality rate (F) is greater than maximum fishing mortality threshold (MFMT). The stock is overfished when the biomass (B) is less than the minimum stock size threshold (MSST). If the stock is overfished, the Council must develop a rebuilding program.

In addition to providing the stock status with data through 1996 for the VPA analyses such that the Council would have a new SPR value, the new level of information contained in the 1999 stock assessment required the Council to respecify the overfishing criteria in terms related to biomass as was done for black sea bass in the SFA Comprehensive Amendment. This requirement is contained in the Magnuson-Steven Act, as amended, and associated guidelines prepared by the National Marine Fisheries Service. Biomass levels and/or proxies must be specified for all data-moderate species which currently include black sea bass and now red porgy. These new values are shown above. These new values conform to the NMFS "critical comments" in the letter from William Hogarth to Bob Mahood dated November 30, 1999. These values are also consistent with the SEFSC comments as reflected in the memorandum from Bradford Brown to William Hogarth dated November 22, 1999. The %SPR proxy for MSY is the same for both the overfishing and Bmsy levels. The SEFSC comments go on to indicate that "The MSST cannot be set less than this unless specific simulations are conducted demonstrating that recovery to B_{msy} can occur within ten years. No evidence is presented that these calculations were in fact conducted. Likewise, the rebuilding time frame should have calculations associated with it that give T_{min}, the time required for the stock to recover from current levels to B_{msy} under no fishing. Then the rebuilding time, T_{max}, is set as ten years if T_{min} is less than ten years or as T_{min} plus one generation time if T_{min} is greater than ten years. However, as first approximation, ten years plus one generation time is reasonable, especially given management action 4."

The Council agrees with the SEFSC comments. The Council nor staff performed any simulations. In fact, the Council was expecting such simulations as a part of the red porgy assessment as outlined in the annual NMFS/Council Operations Plan. The only information received is shown in Figure 2. The Council was not provided with estimates of T_{max} and T_{min}. Therefore, the Council had little choice but to accept the analyses prepared by Dr. Joe Powers, SEFSC, and specify the rebuilding timeframe as 18 years. The Council hopes NMFS will provide such values in all future assessment as required by the Magnuson-Stevens Act.

Red porgy cannot be rebuilt within 10 years based on analyses provided by NMFS (Figure 2). This is due to the extremely low stock size based on data through 1996 and the fact that species that switch sex appear to be more susceptible to overfishing. NMFS recommended the Council specify the rebuilding timeframe as 10 years plus one generation time which equates to 18 years.

The choice of overfishing levels and rebuilding timeframes will determine the measures taken to reach these goals. Management actions taken will have short-term and long-term economic impacts on the entities fishing in the snapper grouper fishery.

<u>Rejected Options for Action 3</u>:

Rejected Option 1. No action. <u>Overfishing</u> for red porgy is defined as a fishing mortality rate (F) in excess of the fishing mortality rate at 30% Static SPR (F30%Static SPR) which is the red porgy MSY proxy.

The "<u>threshold level</u>" for red porgy is defined as 10% Static SPR.

<u>Discussion</u>

This wording was included in the Comprehensive SFA Amendment. Data are now available to specify biomass based values as outlined in the NMFS Technical Guidance Document. Therefore the Council rejected this option in favor of the proposed action.

Rejected Option 2. <u>Overfishing</u> for red porgy is defined in terms of the NMFS Guidelines Checklist (Appendix D in SFA Comprehensive Amendment) and information provided in the new stock assessment from the NMFS Beaufort Lab. The two components of the status determination criteria are:

A. A maximum fishing mortality threshold (MFMT) — A fishing mortality rate (F) in excess of F30% Static SPR which is 0.45. Current fishing mortality was estimated as 0.64 based on 12 inch minimum size limit (Figure 2) and data through 1996.

B. A minimum stock size threshold (MSST) — The minimum stock size threshold is 2,854.1 metric tons or the stock size associated with 20% SPR which is estimated at 3,000 mt. Current stock size was estimated to be 685 metric tons based on data through 1996.

<u>Discussion</u>

The Council's proposed action is more conservative and attempts to address the increased risk in managing a species that switches sex (hermaphroditic species). Therefore the Council rejected this option in favor of the proposed action.

4.2.4 ACTION 4. Establish measures for red porgy that will: (1) reduce the recreational bag limit from 5 to 1 red porgy per person per day or per trip, whichever is more restrictive; (2) during January, February, March, and April, prohibit purchase or sale of and limit the possession of red porgy aboard vessels with Federal commercial or charter/headboat permits for snapper grouper to one red porgy per person per day or one red porgy per person per trip, whichever is more restrictive; (3) continue the 14 inch TL minimum size limit for both recreational and commercial fishermen; and (4) allow a 50 pound by-catch per trip for permitted vessels (i.e., vessels with an unlimited or trip-limited commercial vessel permit) from May 1 through December 31. The status of red porgy will be reviewed every two years to determine if management measures should be repealed or modified.

These measures would apply to red porgy in or from the South Atlantic EEZ and red porgy in the South Atlantic harvested on board a permitted vessel (commercial or charter/headboat) without regard to where the red porgy is harvested or possessed. The prohibition on purchase would apply to all permitted dealers without regard to where the red porgy is harvested or possessed (i.e., state or federal waters). However, fish could be purchased from areas outside the South Atlantic provided there was an appropriate paper trail documenting the area of origin.

Section 304(e)(7) of the Magnuson-Stevens Act states "The Secretary shall review any FMP, plan amendment, or regulations required by this subsection at routine intervals that may not exceed 2 years."

Biological Impacts

In Amendment 7 (SAFMC, 1994a) the Council's position was to defer action on a red porgy quota until a new assessment became available. An updated stock assessment was presented to the Council in June 1994 (Huntsman, Vaughan, and Potts, 1994). The following points are taken directly from the assessment report (Note: The assessment results refer to SSR. Later assessments refer to SPR.):

- Evidence from every source: catch size, observations by fishermen, and analyses of size distributions, indicate that the red porgy is drastically overfished. The history of the red porgy fishery appears to follow what is now regarded as a classic three-phase pattern exhibited by fisheries for many species: (1) an early period of increasing catches as effort increased on a near-virgin stock, (2) a peak of yield as the stock reached maximum productivity, and (3) a period of declining catches (late 1980's and early 1990's) occurring as effort (including increased effectiveness of existing fishermen and vessels) became sufficiently high to take catches that limited the reproductive capacity of the stock.
- Population biomass of red porgy increased from 1972, the first year of study, to a peak of 130% to 190% (depending on M and analysis) of the initial value and declined almost continuously until 1992, the final year of study.
- The change in numbers of red porgy over time is very much like the change in biomass except that any peak in numbers occurred earlier (1975-1979 depending on the estimate of M). Peak population numbers were 112% to 132% of values in 1972; and population numbers declined more or less continually from the peak to 1992.
- The number of recruits to age 1 has irregularly declined since 1972. Depending on the estimate of M (M=0.2 or 0.3), recruitment by 1991 had decreased to 12% from 29% of that in 1972, and in 1992 recruitment was only 7% to 14% of the 1972 value.

- Fishing mortality in the fishery exhibits three historical phases: (1) in the 1970's F (for full recruited ages, 5-9) was nearly constant at values of 0.2 to 0.3, (2) in the early and mid 1980's F was nearly constant, but gradually increasing, at values, depending on M, of 0.4 to 0.6, and (3) in the late 1980's and early 1990's, F increased rapidly to 1.2 to 1.4, values five to six times those in the 1970's.
- For adult biomass and egg production, Spawning Stock Ratio (SSR) was 0.50-0.60 in the early high period, about 0.30 in the mid-period, and about 0.15 recently. Based on female biomass, SSR values were 0.60 - 0.70 in the 1970's, about 0.40 in the early 1980's and declined through the late 1980's and early 1990's to a value in 1992 near 0.20. Using male biomass resulted in the lowest estimates of SSR. Even in the 1970's values only ranged from 0.30 - 0.50. In the stable mid period male-based SSR was about 0.12, and present values are 0.20 - 0.40.
- In 1992, F was 1.28 and SSR was 0.13. To achieve a SSR of 0.30 the Council's current minimum size of 12" is insufficient and a 14" size limit is necessary. Reducing F by 73% to 0.35 (an approximate catch of 54 tons or 120,960 pounds) would provide an SSR of 0.30.
- Based on observations at sea, the mortality of red porgy released from commercial handline vessels is 9% (n=23) and from headboats is 18% (n=115). Overall mortality was estimated to be 13% and an additional 7% was added for deaths occurring after the fish return to the bottom; the approximate overall mortality rate for released red porgy is 20%. Thus, a size limit of 15" is required to achieve a SSR of 0.30.

Similar results were reported by Harris and McGovern (1997). Their abstract is shown below (the full paper is contained as Appendix H):

Aspects of the life history of red porgy from the South Atlantic Bight (SAB) were examined for four periods (1972-74, 1979-81, 1988-90, and 1991-94), and annual changes in the age and growth of red porgy were described for data collected during 1988-94. The life history of red porgy during 1972-74 were assumed to represent that of an unfished population, although this population had been subject to light fishing pressure. From 1972-74 to 1979-81, the back-calculated size-at-age increased slightly for ages 2-8. By 1988-90 and 1991-94, however, the back-calculated size-at-age for the same age classes was significantly smaller than that in 1979-81. In addition, size-at-maturity and size-at-transition occurred at progressively smaller sizes for 1988-90 and 1991-94. The mean size-at-age (observed and back-calculated) declined for most ages between 1988 and 1994. Von Bertalanffy growth curves fitted to the mean back-calculated size-at-age for each year showed similar decreasing trends. Changes in life history may be a response to sustained 20-year overexploitation that has selectively removed individuals predisposed towards rapid growth and larger size.

Of particular concern are the impacts fishing can have on reproduction as reported by Harris and McGovern (1997)(Note: Tables included in Appendix H.):

Our examination of 4,293 gonads (n=1,397, 1979-81; n=727, 1988-90; n=2,169, 1991-94) revealed that sexual transition was occurring at smaller sizes in the later periods. There was a significant increase (P<0.001) in the number of males with time (Table 4). However, in 1988-90 and in 1991-94, the proportion of males to the total number of fish sexed was significantly greater at smaller sizes than during 1979-81 (Table 4). At 301-350 mm TL, male red porgy made up 24% of the fish that were sexed during 1991-94, in contrast with 7%

at the same size interval during 1979-81 (P<0.001; Table 4). In 1979-81, male red porgy constituted 12% of the fish examined at 351-400 mm TL compared with 32% in 1988-90 (P<0.01) and 49% in 1991-94 (P<0.001; Table 4).

Size at maturity of female red porgy has also changed. Female red porgy became sexually mature at smaller sizes in 1991-94 than in 1979-81. During 1991-94, female red porgy first became sexually mature at 176-200 mm TL (mean age = 0.9). In 1979-81, the first mature female was at 201-225 mm TL (mean age = 0.9)(Table 5). There were significantly more mature females (54%; P<0.001) at 251-275 mm TL (mean age = 1.9) in 1991-94 than during 1979-81 (27%; mean age = 1.7).

Size at age information is presented in Table 18a. Red porgy undergo a sex change from female to male as they age. Females predominate at smaller sizes (less than 400 mm) while males predominate at larger sizes (greater than 450 mm).

Table 18a. Red Porgy Size at Age Relationship (Data Source: Gene Huntsman, NMFS Beaufort Lab, pers. comm.; March 1993).

Age	1	2	3	4	5	6	7	8	9	10
Red Porgy TL (inches)	7.2	9.3	11.2	13.0	14.5	15.9	17.2	18.4	19.5	20.4
Red Porgy TL (mm)	184	237	285	329	369	405	438	468	495	519

Information on age-specific sex ratios provided by Roumillat and Waltz (1993) was used in the most recent stock assessment. Their results, based on 1993 data, are presented in Table 18b.

Table 18b. Red Porgy Age-Specific Sex Ratios (Data Source: Roumillat and Waltz, 1993).

Age	1	2	3	4	5	6	7	8
% Females	89	91	77	67	59	51	25	21
% Females with Mature Gonads	19	85	100	100	100	100	100	100

This information suggests that females reach sexual maturity by the end of age 1 and 100% are mature by the end of age 3.

The following abstract is from the most recent stock assessment (Appendix B):

"The age structure and status of the U.S. south Atlantic stock of red porgy is examined, using recorded and estimated landings and size frequencies of fish from commercial, recreational, and headboat fisheries from 1972-1997. Two catch-in-numbers-at-age matrices were developed from age-length keys based on fishery-dependent and fishery-independent data, respectively. For these two catch matrices, estimates of annual, age-specific population numbers and fishing mortality rates (F) for different levels of natural mortality (M = 0.20, 0.28, and 0.35 yr^{-1}) were obtained by application of a calibrated virtual population analyses (VPA) using fishery-independent data from MARMAP hook-and-line and trap gears in the calibration procedure.

With the catch matrix using fishery-dependent age-length keys, fishing mortality rates (F) increased from 0.05 in 1974 to 1.34 in 1997 for fully recruited ages (assumed 4+ throughout for comparative purposes) with M = 0.28, while spawning potential ratios declined from 90% to 32% based on mature female biomass and from 89% to 17% based on total mature (male and female) biomass. A similar pattern results from the catch matrix using fishery-independent age-length keys: fishing mortality rates (F) increased from 0.06 to 0.85 between 1974 and 1997 for fully recruited ages, while spawning potential ratios declined from 88% to 35% based on mature female biomass and from 80% to 19% based on total mature biomass. The use of spawning potential ratio based on total mature biomass was used for comparison to biological reference points.

Recruits to age 1 declined from a peak in 1973 of 7.6 million age-1 red porgy to 12,000 age-1 red porgy in 1997 (based on catch matrix using fishery-dependent age-length keys); while total spawning stock (mature) biomass declined from a peak in 1978 of 11,700 mt to 323 mt in 1997. A similar pattern is noted for recruits to age 1 and total spawning stock biomass obtained from catch matrix using fishery-independent age-length keys. Retrospective bias in calibrated VPA (FADAPT) output suggests underestimates of these population values in the most recent years.

Despite the retrospective problems with overestimation of F (and hence underestimation of total spawning stock biomass, recruits to age 1, and SPR) in the current year, long-term declining recruitment to age 1, headboat CPE, and MARMAP Survey CPE raise concerns about overfishing. Generally static SPR has been at or below the South Atlantic Fishery Management Council's criteria for overfishing (SPR = 30%) since 1981. During this time period, recruitment and spawning stock, have continued to decline. Keeping in mind the difference between thresholds and targets, it would appear that reducing F to a level at or below that equivalent to 40% static SPR is necessary for rebuilding the U.S. south Atlantic red porgy stock."

Red porgy biomass and limit control rule information developed by the NMFS Beaufort and Miami Labs and provided by Dr. Brad Brown, NMFS Southeast Science Director, is shown in Figure 2. The rebuilding time frame and control rule were used to develop the measures proposed in Amendment 12.

The MARMAP program provides very important fishery independent data for monitoring the stock status of species in the snapper grouper management unit. MARMAP information was incorporated into the 1999 stock assessment completed by Dr. Doug Vaughan. In addition, updated material recently became available (McGovern and Machowski, 1999); the following material is taken from this publication. The 1999 MARMAP random sites for trapping are shown in Figure 3 and the sites for chevron trap deployment are shown in Figure 4. These figures show the extent of sampling under the MARMAP program. Catch-per-unit-effort (CPUE) declined significantly for red porgy taken at shelf-edge stations (Figure 5). There were very few red porgy taken at the four study sites during 1997-1999. The mean length of red porgy decreased from 1983 to 1990 and then increased steadily through 1996 (Figure 6). The length-frequency distribution of red porgy indicated a gradual decrease in the number of individuals >30 cm FL from 1985 through 1989 (Figure 6). After 1993, there was a slight increase in the number of red porgy >30 cm FL. The number of individuals <23 cm FL gradually diminished during 1983 to 1990. After 1990 red porgy <23 cm FL were absent from collections. CPUE of red porgy taken on the southeast continental shelf declined during 1983 through 1999. The mean length of red porgy declined through 1988 and then increased through 1996 (Figures 7 and 8). The increase in the mean length of red porgy was due to fewer smaller fish being caught (poor recruitment).

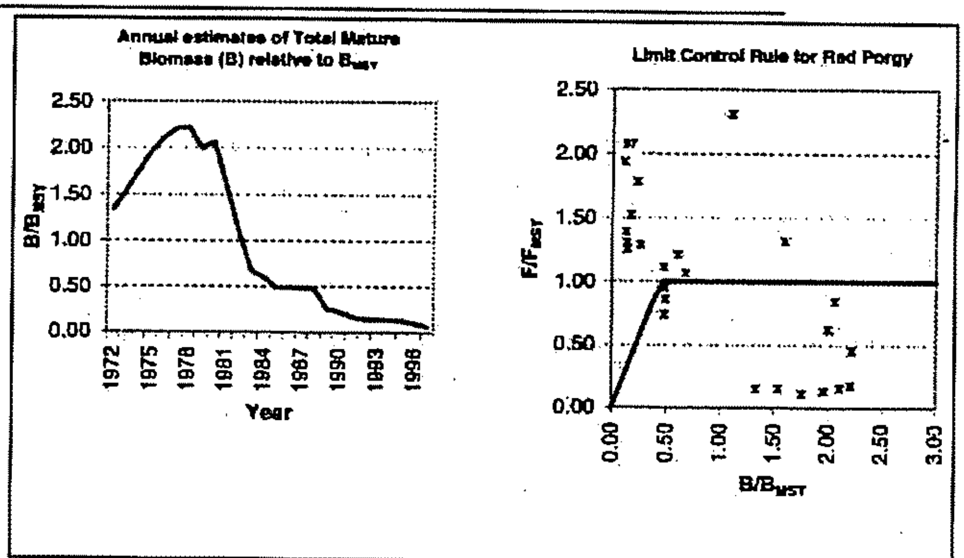
Figure 2. Red porgy biomass and limit control rule.

Information Level: Level I

Estimates of Key Parameters:

Parameter	Estimate or Proxy	Notes
M	0.28	Assessments have used range of 0.2 to 0.35
F_{MSY}	0.45	$F_{30\% SPR}$ based on partial recruitment for 1992-96
F_{target}	0.28	$F_{40\% SPR}$ based on partial recruitment for 1992-96
B_{MSY}	5285	$SSB/R_{30\% SPR}*R_1$: R_1 is 1972-78 mean; units in mt
MSST	3805	$max(0.5, 1-M)*B_{MSY}$; units in mt
F_{now}/F_{MSY}	0.64/0.45	$F_{1992-95}/F_{30\% SPR}$
B_{now}/B_{MSY}	685/5285	$B_{1992-95}/B_{MSY}$

If B_{now} < MSST, can the stock recover within 10 years with no fishing? Generation time is less than 10 years (~8 years) with no fishing. However, given extent of stock depletion and uncertainty over whether recruitment will improve in the future, rebuilding in less than 10 years is unlikely.



Red Porgy: Left Panel: trajectory of B/B_{MSY} estimates; **Right Panel:** observations of F and B (x's) compared to limit control rule; the most recent year is labeled (97).

Methodology: F_{MSY} and B_{MSY} based on static SPR proxies from FADAPT virtual population analyses applied to 1972-97 catch at age matrix. Tuning uses fishery-independent (MARMAP) tuning indices based on trapping gear and hook and line.

Data Quality and Uncertainty: After black sea bass, this species probably has the best data set of all the species in the U.S. South Atlantic snapper-grouper complex. Concern over use of fishery-dependent vs fishery-independent age-length keys for catch matrix.Limited aging over entire time span from fishery-dependent sources. Other data concerns are referred to in detail in the latest assessment for the SAFMC (Vaughan 1999). Static SPR is based on weight of mature males and females, because individuals of this species can transition from female to male.

Vaughan, D.S. 1999. Population characteristics of the red porgy *Pagrus pagrus* from the U.S. southern Atlantic Coast. Report for South Atlantic Fishery Management Council, Charleston, SC.

Figure 3. 1999 MARMAP Random Sites for Trapping. Source: McGovern and Machowski (1999).

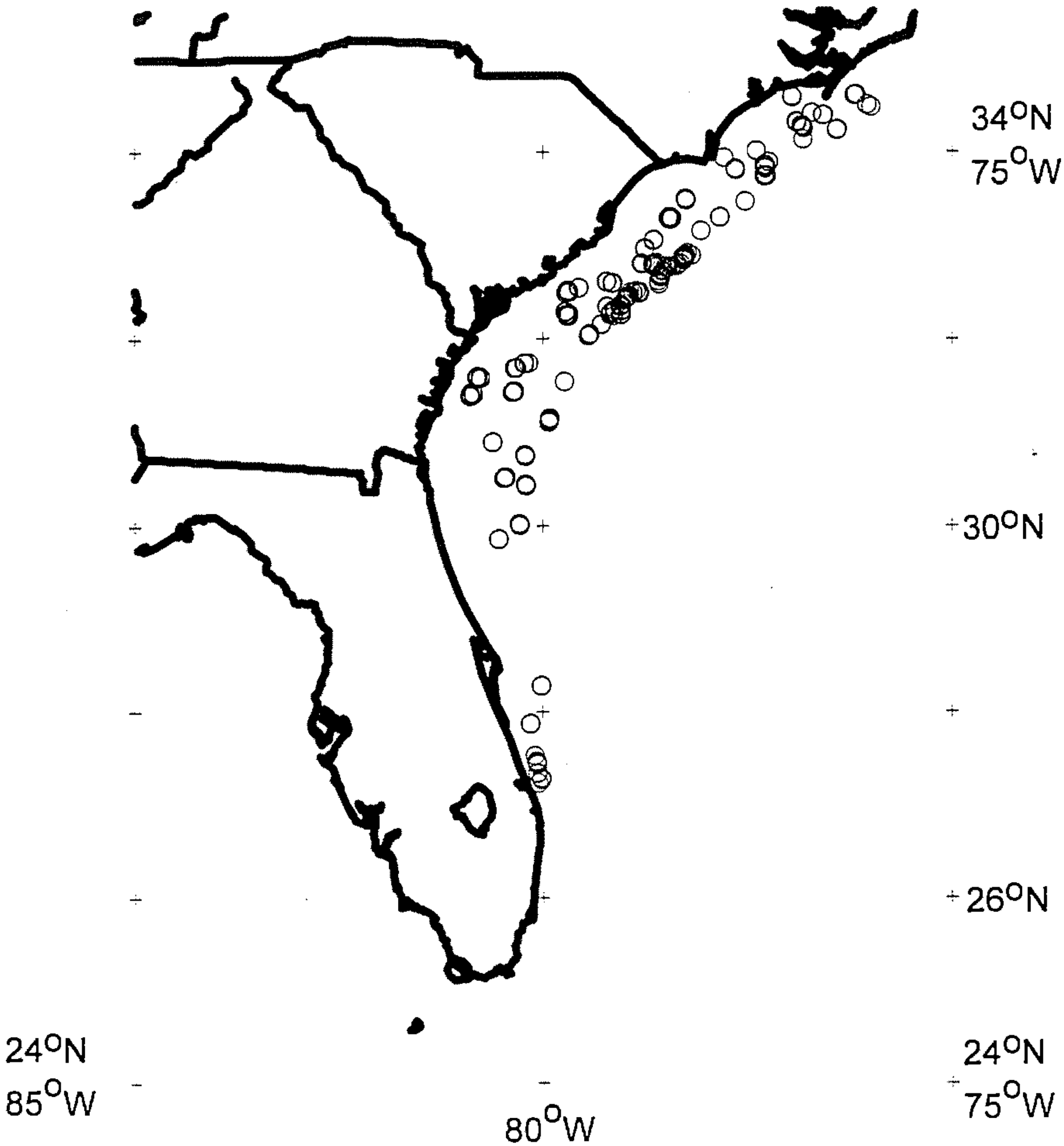


Figure 4. 1999 MARMAP Chevron Deployment Sites. Source: McGovern and Machowski (1999).

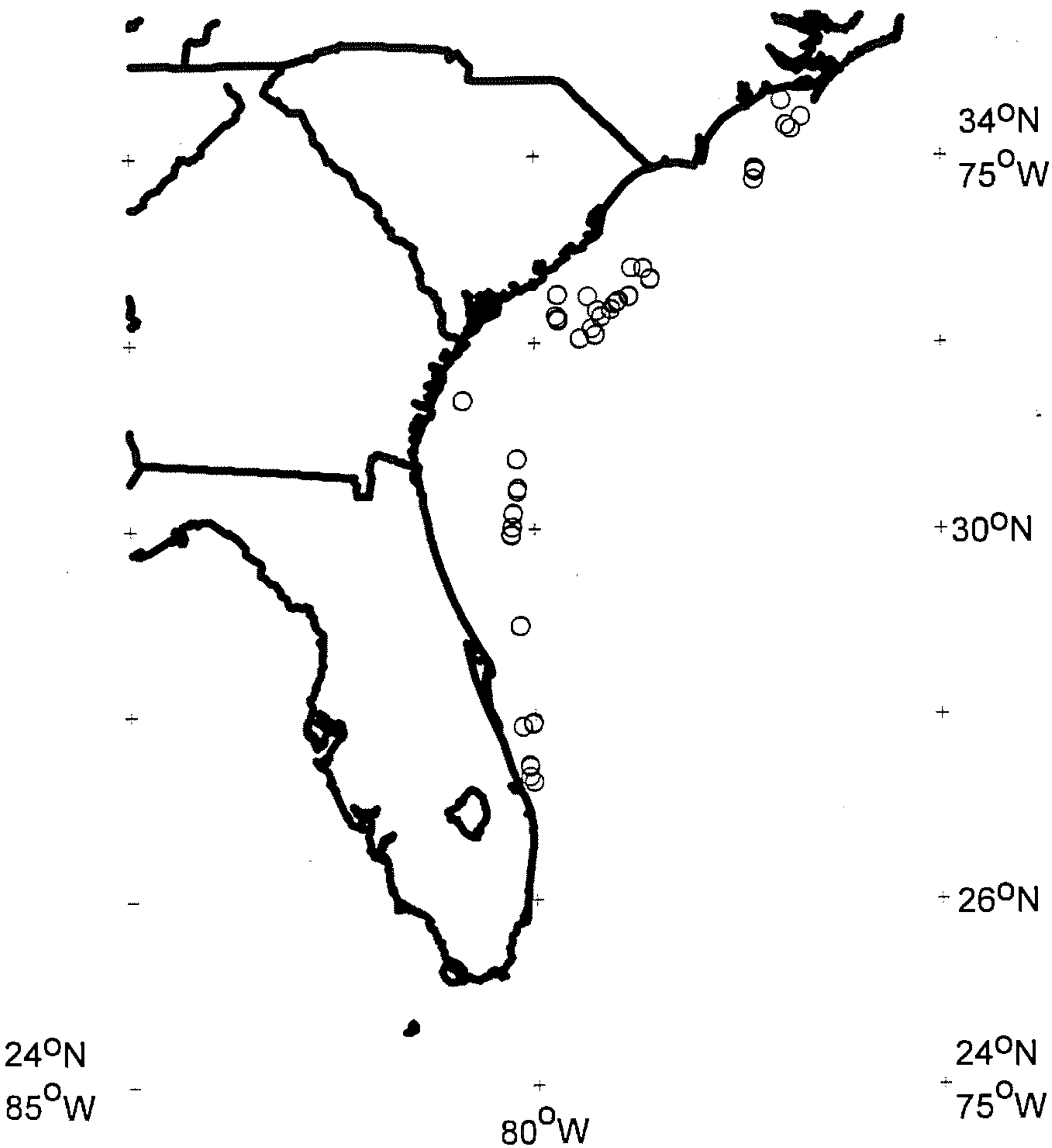
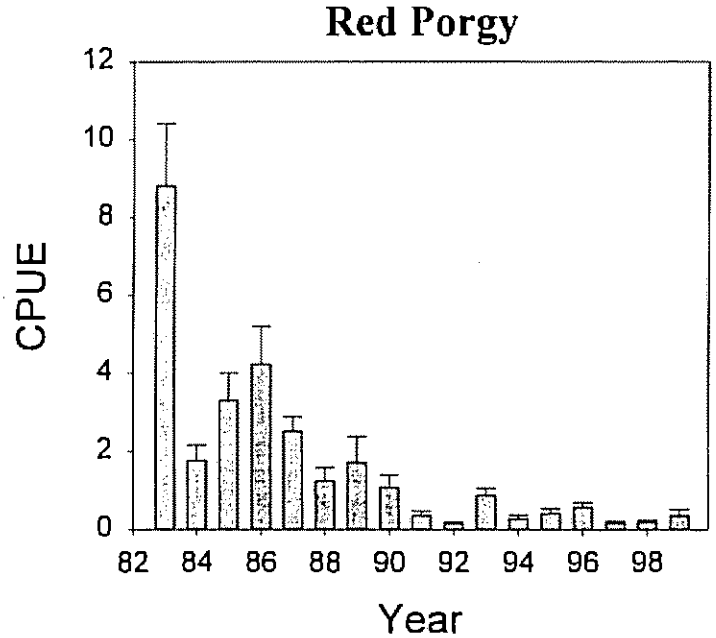


Figure 5. Red porgy (shelf edge) catch-per-unit-effort (CPUE) and mean fork length results from 1982-1999. Source: McGovern and Machowski (1999).



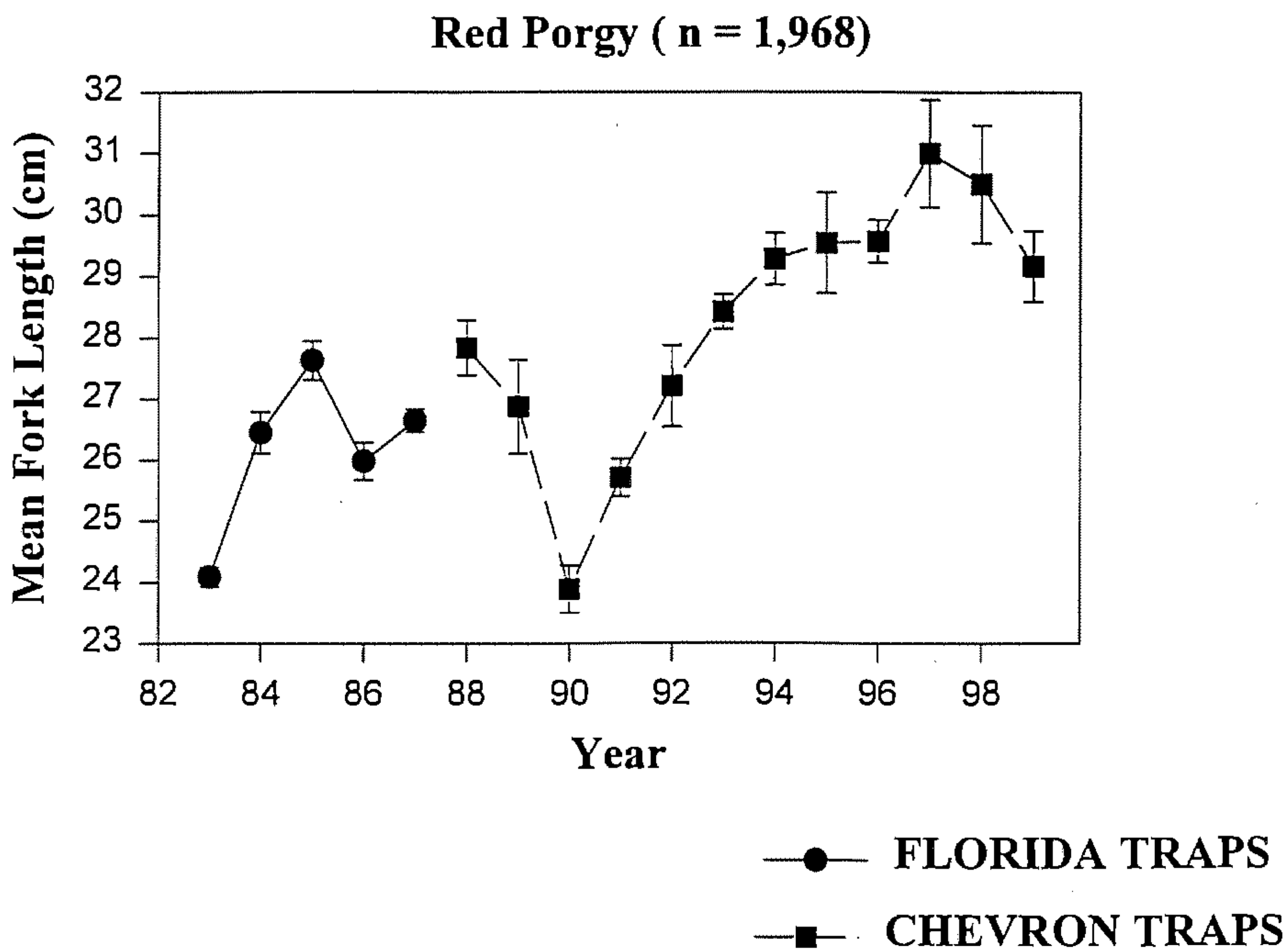


Figure 6. Red porgy (shelf edge) length frequency results from 1983-1999. Source: McGovern and Machowski (1999).

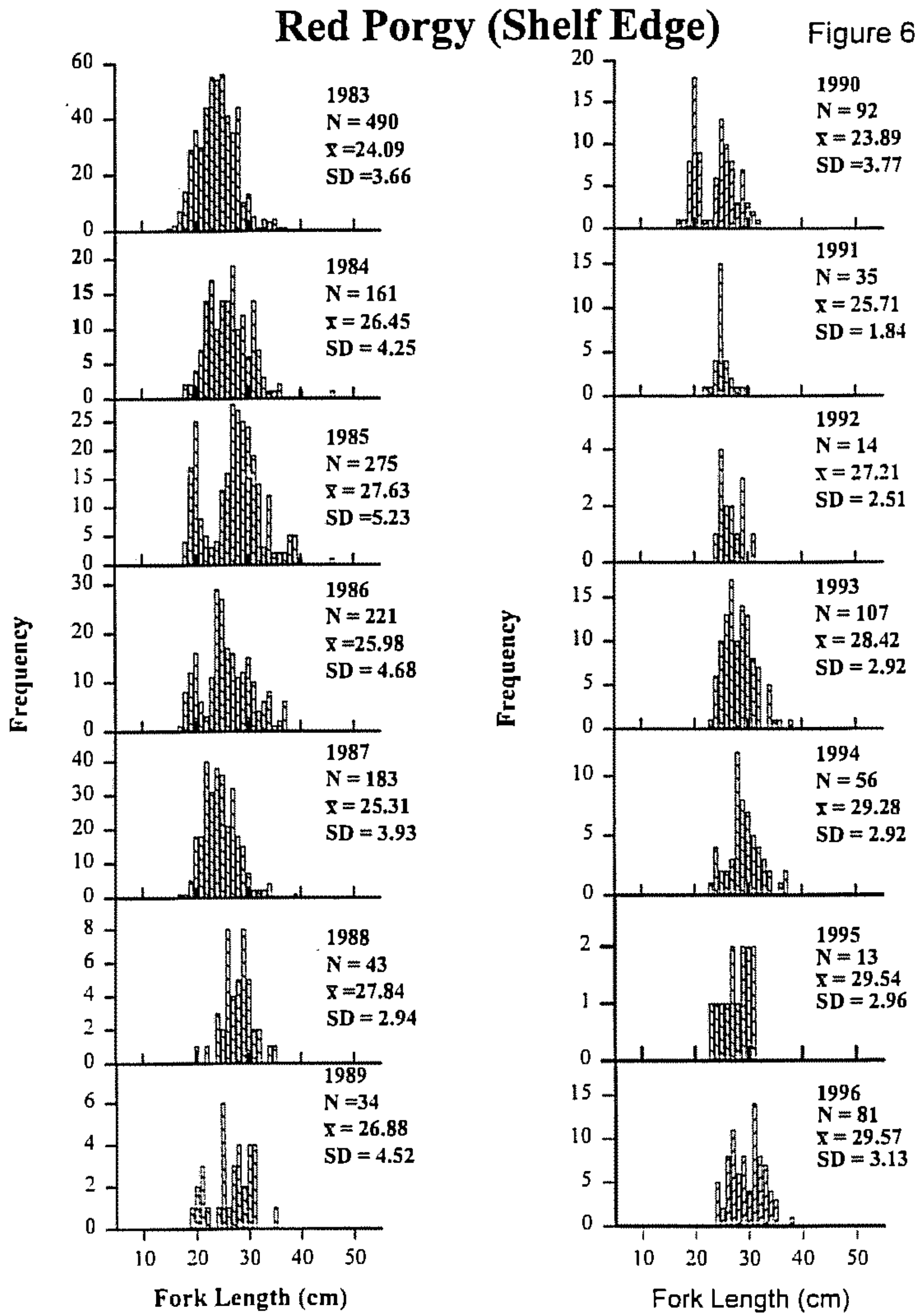


Figure 6 Continued.

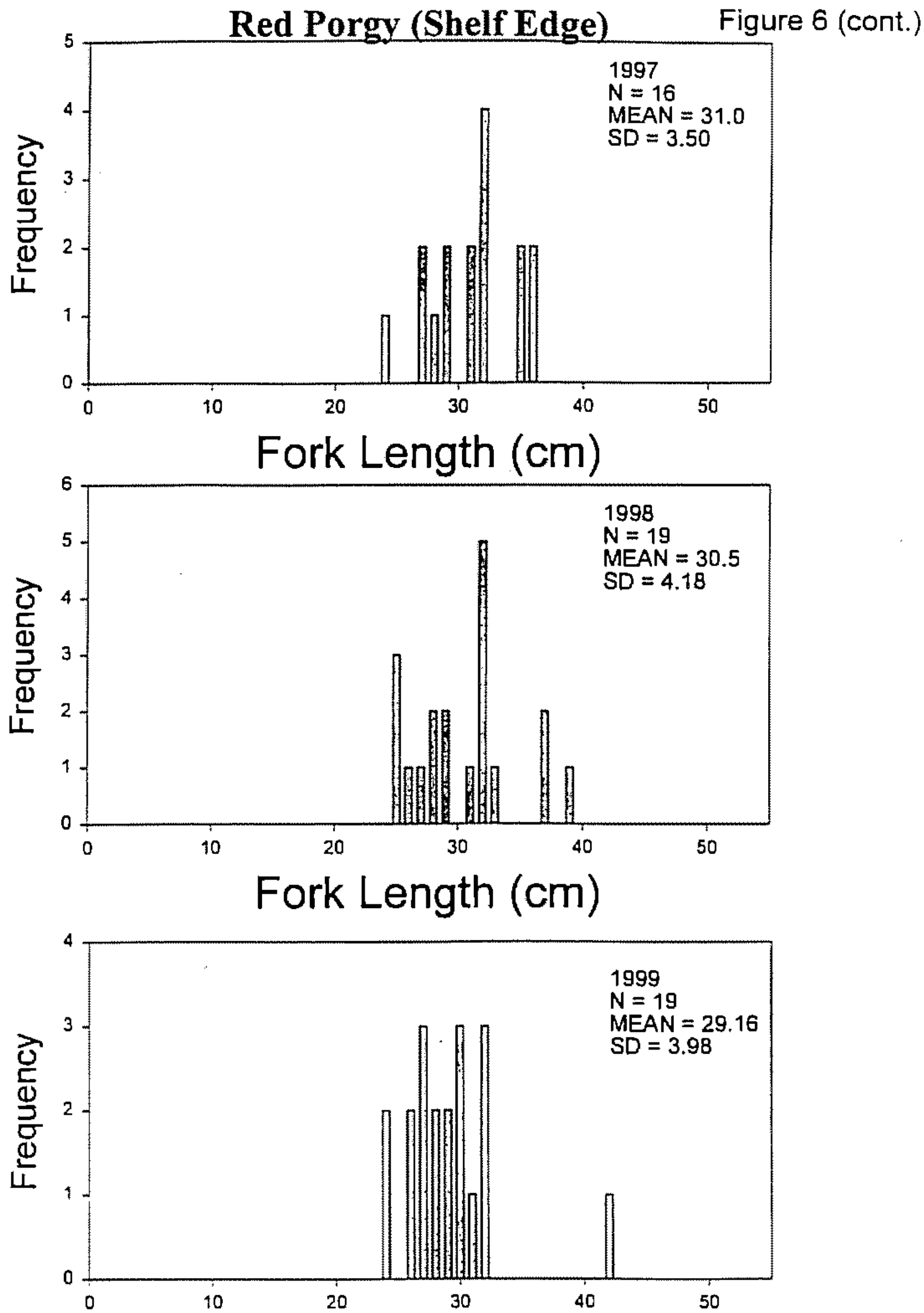


Figure 7. Red porgy (continental shelf) length frequency results from 1983-1999. Source: McGovern and Machowski (1999).

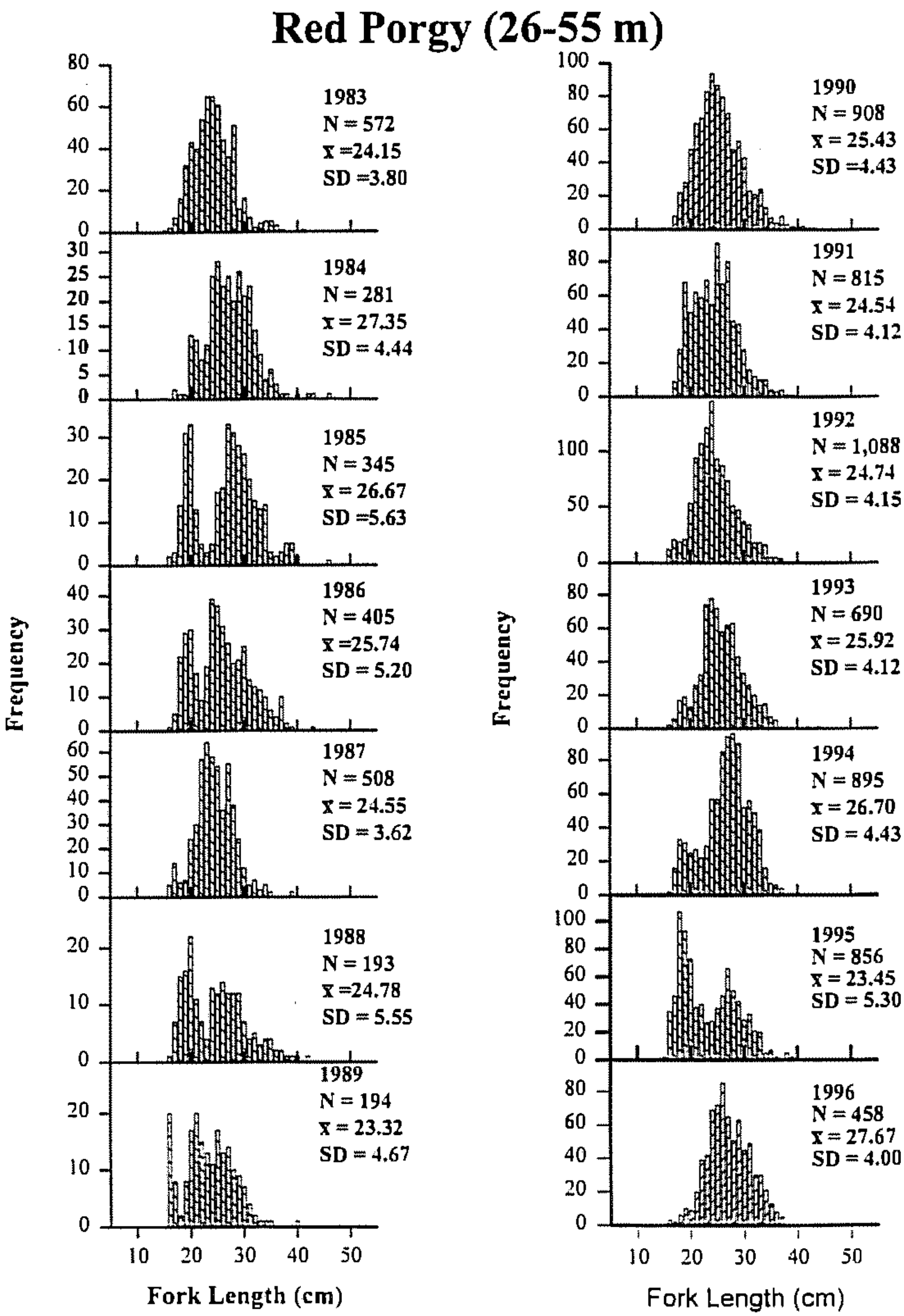


Figure 7 Continued.

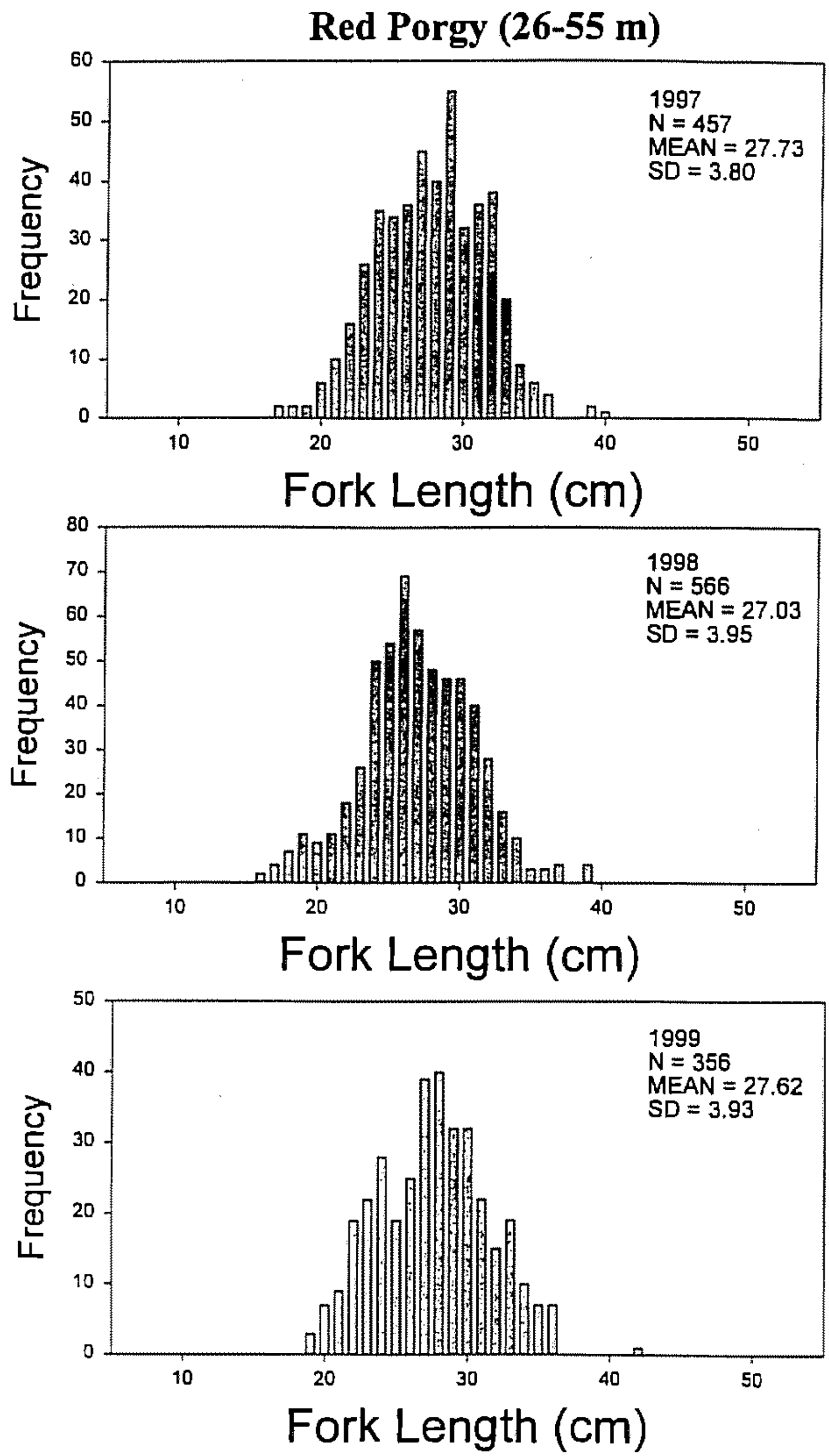
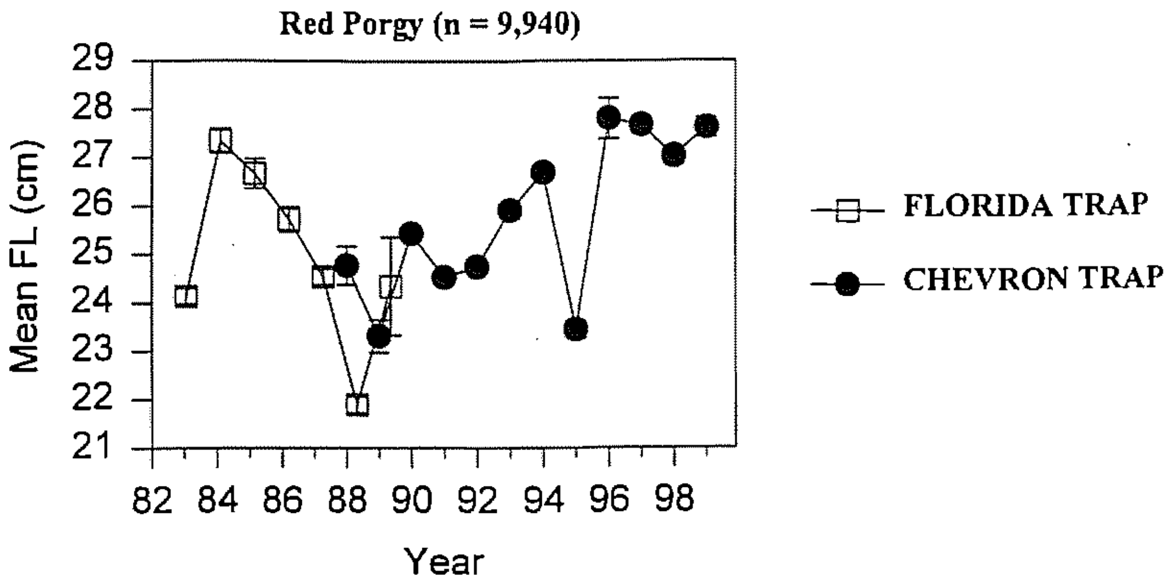


Figure 8. Red porgy (continental shelf) mean fork length results from 1982-1999. Source: McGovern and Machowski (1999).



Economic Impacts

The economic analysis for both the recreational and commercial sectors are limited to short run effects. This is due to the fact that there is little information on the future allowable harvest levels during the time in which the stock rebuilds, and the sustainable harvest set when the stock of red porgy has rebuilt to the point where it is no longer classified as overfished.

The data available for analysis of the economic impact of this action were obtained prior to the date when Amendment 9 regulations went into effect on February 24, 1999. Amendment 9 regulations include a 14" minimum size limit for the commercial and recreational fisheries, a five fish recreational bag limit, and a two month prohibition on sale and harvest in excess of the bag limit during March and April. Therefore, the analysis first accounts for the effect of these regulations and then estimates the impact of this proposed action.

Data from the 1995 harvest of red porgy indicate that for the commercial sector a 14 inch minimum size limit could reduce catches by 24.85% by weight (Table 32). Using data for 1998, it was estimated that the proportional reduction in numbers of fish harvested could be 52% from a 14 inch minimum size restriction (Burton, 1999; Appendix I). This translates into a 33% reduction in weight assuming that the size distribution in the 1998 catch is similar to the size distribution of the commercial landings in 1995, where a 39.55% reduction in numbers of fish from a 14 inch minimum size regulation translated into a 24.85% reduction in the weight of commercial landings (Table 32). These estimates are calculated assuming that standard operating practices do not change in the fishery such that larger fish are targeted.

Table 19. The Impact of Prohibiting Red Porgy Landings Between January 1 and April 30, and a 50 lb. Bycatch Trip Limit in Other Months. Data Used in This Analysis were Taken From The Snapper-Grouper Logbook as of July 21, 1998 (Waters, 1999).

FISHING YEAR	TOTAL BOATS	TOTAL TRIPS	TOTAL POUNDS GUTTED	POUNDS WITHIN BYCATCH LIMIT	POUNDS OVER BYCATCH LIMIT	EXPECTED LOSS IN REVENUE	TRIPS OVER LIMIT	BOATS OVER LIMIT
1993	319	3,137	292,137	75,851	216,286	$269,814	1,864	251
1994	318	3,420	296,592	69,270	227,322	$206,792	2,089	261
1995	344	3,663	310,723	75,268	235,455	$315,157	2,282	282
1996	334	3,438	346,619	79,074	267,545	$360,703	2,112	274
1997	338	3,522	325,217	77,072	248,145	$356,518	2,041	273
Average	331	3,436	314,258	75,307	238,951	$301,797	2,078	268

The data used to analyze these impacts were taken from the snapper grouper logbook database for fishing years 1993-1997. Average measures during this period are used in the following analysis. A closure from January 1 to April 31 followed by a bycatch trip limit of 50 pounds per trip could result in a loss of $301,797 annually (Table 19). This assumes that commercial fishermen do not increase the number of trips taken to increase the overall red porgy harvest and that standard operating practices remain the same as they were during the 1993-1997 period. It is assumed that the effect of the 14 inch minimum size limit would reduce the remaining revenue by an additional 33%, which translates into an additional $30,319 (75,307 x $1.22 x 0.33; based on an ex-vessel price of $1.22/lb from the logbook report) annually. This decrease in ex-vessel revenue ($301,797 + $30,319 = $332,116) represents the cumulative impacts from Amendments 9 and 12.

It is estimated that the two month closure implemented under Amendment 9 would reduce the commercial harvest by 50,963 pounds, the combined harvest during March and April (Snapper/grouper logbook data provided by Jim Waters, NMFS Beaufort Lab; pers. comm.). The reduction in revenue amounts to $62,175 (50,963 x $1.22). It is assumed that the loss in revenue from the 14 inch minimum size limit would be 33% of the remaining revenue ($397,275 from Table 21 less $62,175) and is estimated to be $110,583 (33% of $335,101).

Annual revenue from red porgy averaged $397,275 (Table 21). Amendment 9 regulations would reduce this to $335,101, based on reductions of $62,175 from the two month closure and a further reduction of $110,583 based on the 14 inch minimum size limit (33% reduction. Therefore, Amendment 9 resulted in a loss of $172,758 annually. Thus, this proposed action under Amendment 12 could reduce ex-vessel revenue by $159,358 over the impact of Amendment 9 regulations ($332,116-$172,758). This represents a loss of $481 per vessel annually based on an average of 331 vessels (Table 21). With Amendment 9 in place it is expected that the revenue from snapper grouper trips where red porgy are caught would average $6.135 million ($6.308 million from Table 21 less $0.173 million) annually. This proposed action would further reduce total revenue from snapper grouper trips to $5.976 million annually ($6.135 million less $0.159 million) and thus there would be a reduction of 3% in annual gross revenue. If some trips are not taken as a result of the bycatch trip limit then there would be an additional loss in the average revenue per vessel.

Data on the recreational fishery available for this analysis reflect the regulatory environment when a 12 inch minimum size limit was in effect, that is prior to the implementation of Amendment 9. The average weight of red porgy in the recreational fishery for 1998 was 1.28 pounds in the headboat sector, 1.32 pounds in the charter boat sector, and 1.68 pounds in the private/rental sector (1997 data for private/rental sector) (Figure 1).

The analysis on the MRFSS data for 1995 indicates that a 14 inch minimum size limit was projected to reduce recreational catches by 37% based on the number of fish and 25% by weight (Table 32). Also, the analysis conducted for Amendment 9 indicated that a 5 fish bag limit in conjunction with a 14 inch minimum size limit would reduce harvests in the private/rental sector by as much as 33%. These data also indicated that there would be no additional savings with a bag limit of 1-5 fish and a 12-14 inch minimum size limit for this portion of the recreational sector. For the charter boat sector, a 1 fish bag limit together with a 14 inch minimum size limit could reduce the charter boat harvest by 64.8 % in number and 63.4% in weight (Table 33).

The MRFSS data for 1998 indicates that red porgy were caught on 6,678 recreational trips, and landings were greater than zero on 6,144 trips (Steve Holiman, NMFS SERO; pers. comm.). The data on the size distribution of the red porgy catch for 1998 indicated that a 14 inch minimum size limit could reduce harvests by 50% for the charter and private recreational sectors (Burton, 1999; Appendix I). These figures are based on a sample size of 14 (Burton, 1999). The 1998 MRFSS intercept data was analyzed to determine the additional impact from a 1-5 fish bag limit restriction assuming that a 14 inch minimum size regulation had already taken effect (Table 20). It is assumed that all trips would be affected by this size limit where more than 1 fish was harvested per trip, and 50% of all trips would be affected where 1 fish was harvested. In addition, these values were calculated by assuming that the size distribution of fish would be the same for each bag limit category.

Table 20. Proportional Reduction in number of fish harvested from a 1-5 fish bag limit restriction on the recreational sector in the South Atlantic Region. The analysis was conducted after accounting for the 14 inch minimum size restriction. Estimates are based on a small sample size (n=37). Data source: MRFSS 1998 (Steve Holiman, SERO, NMFS, 1999).

Bag Limit	Charter/Party	Private/Rental	Total
1	20.5%	13.0%	17.8%
2	10.0%	6.5%	8.5%
3	4.5%	2.0%	3.6%
4	1.0%	0.0%	0.6%
5	0.0%	0.0%	0.0%

With the 14 inch minimum size limit in place, there is no additional reduction in harvest from a 5 fish bag limit. (Table 20). However, with a one fish bag limit in place, after the 50% reduction from the minimum size regulation, there would be an additional reduction in harvest of 20.5% in the charter/party sector, and a 13% reduction in the private/rental sector based on number of fish. These impacts represent the effect of Amendment 12 regulations over the existing Amendment 9 regulations.

These latter values are based on the assumption that recreational anglers do not change their standard operating practices in the fishery and there is no increase in effort targeting red porgy. Estimates were calculated from a small sample size (37 observations). During 1998, charter boats harvested 8,708 fish and the private recreational sector harvested 3,934 fish (Steve Holiman, SERO, NMFS, 1999). Thus, the 14 inch minimum size limit is expected to reduce harvest to 4,354 fish in the charter boat sector and to 1,967 fish in the private recreational sector. With the 1 fish bag limit, annual recreational harvest could be reduced to 3,461 fish in the charter boat sector and to 1,711 fish in the private recreational sector.

In 1998, 864 red porgies were sampled for length and weight from the South Atlantic headboat fishery (Robert Dixon, NMFS Beaufort Lab; pers. comm.). Of these 864 fish, 552 were less than 14 inches (356 mm) total length. This was 63.89 % of the sampled fish. In 1998, a total of 104,751 red porgies were reported on headboat landing records. A 63.89% reduction due to a 14 inch size limit would have resulted in estimated landings of 37,826 red porgies. A one fish bag limit would have reduced landings by an additional 5.01% or 1,895 fish (Robert Dixon, NMFS Beaufort Lab; pers. comm.).

If recreational anglers do not change their standard operating practices in the fishery, and there is no increase in effort targeting red porgy, it is estimated that headboat landings could be reduced by as much as 68.9% (63.89% + 5.01%) under a 14 inch size limit and a one fish bag limit. These findings are consistent with the data in 1995, where a one fish bag limit would have reduced headboat harvest by 69% by number and 56.3% by weight (Table 33). The impact of Amendment 12 by itself would be to reduce the number of fish harvested by 5.01% in the headboat sector. This assumes that the headboat sector does not increase effort or change fishing practices to target larger red porgy.

<u>Social Impacts</u>

Red porgy have been documented as overfished since 1991. Commercial and recreational catches reveal a downward trend in size and weight of the fish caught since before 1991. In light of continuing bleak estimates of a depleted and overfished stock, the Council had no choice but to propose severe restrictions on the catch and retention of red porgy. Because this action is of an extreme nature, it is predicted that the social impacts on fishermen will also be felt on a larger scale than other proposed management measures with the exception of a total prohibition. The overall magnitude of social impacts from imposing such severe measures will depend upon the ability of fishermen to adjust economically, socially, and psychologically to such actions. However, if the proposed actions are not taken there would be a high level of uncertainty as to the future status of red porgy. If commercial fishermen can easily substitute another species, or replace lost income, they may see benefits as the stock rebounds over time. Red porgy is an important species for commercial fishermen in North and South Carolina. Species substitution may not be easy as their dependence upon this particular fishery may be seasonal and important to the household or business at that time. If substitution is not easy, fishermen may increase their effort on other species. Where that effort shift would occur is unclear as most snapper grouper fishermen hold a variety of permits. The coastal pelagic fisheries could see substantial effort increases with this action, in addition to other species within the snapper grouper management unit.

The combined impact on commercial fishermen of these measures with other measures proposed in this amendment could be substantial. There is the possibility that some individuals whose businesses have been operating on the margin may be forced to leave if alternative fisheries or other means of substituting for lost income are not readily available. Their ability to enter other fisheries will depend upon their present capability to diversify their fishing practices. Other alternatives for replacing lost income will depend upon the ability of fishermen or other household members to take on any or additional responsibilities for the household income. That capability is certainly tied to the availability of work and the possession of individual skills needed for jobs that are available. Many fishing communities are located in rural areas where job opportunities are limited, although, fishermen often have skills that are compatible with many of the short-term and/or part-time work opportunities available in rural areas. The key is whether those opportunities will exist at the same time fishermen will be in need of them.

Recreational fishermen may experience less fishing satisfaction with a 1 fish bag limit being in place but the degree of their dissatisfaction will depend upon past fishing practices and whether or not they have become accustomed to catching red porgies. There will likely be species substitution once these measures are in place, thereby increasing pressure on other species. As is the case with commercial fishermen, which species would act as a substitute for red porgy is not known, but will likely be other species in the snapper grouper complex that are also overfished.

These measures will likely have a similar impact on the charter/headboat sectors. It is difficult to predict exactly if they will cause a loss in trips taken in these sectors, however, charter and headboats can always target other fish.

One other issue stands out as a potential negative social impact resulting from these measures: intensified conflict between the commercial and recreational fishing sectors. Each group desires to blame someone for the need for severe restrictions on harvesting red porgy, and a drastic management action such as is proposed will tend to intensify existing conflict between the different users.

In view of the negative impacts expected to accrue from a closure of the red porgy fishery, allowing a 50 pound incidental bycatch limit within the commercial sector will have a positive social impact by improving the legitimacy of the proposed action. Fishermen have expressed concern that if they have incidental bycatch of red porgy they will be subject to prosecution by law enforcement. An allowance of a 50-pound bycatch is seen by fishermen as a realistic assessment of their fishing experience, and is in the same spirit of allowing a one fish per person per day bag limit in the recreational fishing sector. This allowance for both sectors reduces the potential for large regulatory discards, a concept that is perceived by fishers as wasteful and inherently out of place in good fisheries management.

The importance of heeding stakeholders' concerns and suggestions cannot be overemphasized. Giving the participants in a fishery the ability to construct or have a role in constructing the policy that impacts them increases the incentive to comply with new regulations.

Conclusion

In light of the new stock assessment, the Council determined an emergency existed and on April 6, 1999 requested implementation of a prohibition on harvest and possession of red porgy through emergency regulations immediately. The Council requested the emergency regulations be effective no later than May 1, 1999 when the current red porgy closure established in Amendment 9 was scheduled to end. This action was deemed necessary to meet the Congressionally-mandated deadline to prevent overfishing and rebuild overfished resources. The request was approved and emergency regulations prohibiting harvest and possession of red porgy were effective September 8, 1999 through March 1, 2000. Amendment 12 was developed to implement appropriate management measures on a permanent basis. At the December 1999 meeting, the Council requested an extension of the emergency regulations to remain in effect until replaced by implementation of Amendment 12. The extension, through August 28, 2000, was approved on February 25, 2000.

The Council recognized the severely overfished status of red porgy as indicated in the most recent stock assessment based on data through 1996 for the VPA analyses. More recent data from the MARMAP program presented at the November/December 1999 meeting indicate an increase in the stock size based on CPUE data: North Carolina CPUE (Chevron trap data at 26-55 m depth) increased from 0.61 in 1996, to 0.99 in 1997, and to 1.53 in 1998; there was a slight decrease in 1999 to 1.30. In addition, extensive public comments in letters and during the public hearings express disagreement with the stock assessment. Public input supports some rebuilding of the stock since 1996 while recognizing that red porgy remain overfished. The majority of public input suggest the status of red porgy warrants tough management but not a total prohibition. The Council balanced the public input with the status of red porgy from the most stock assessment and concluded that fishing mortality must be reduced significantly to allow red porgy to rebuild to sustainable levels and ultimately to levels capable of producing MSY.

The Council concluded a small allowance for harvest and possession of red porgy could be justified based on consideration of the status determinations for overfishing and overfished. First, the Council evaluated the fishing mortality rate which may or may not need to be reduced to get below the maximum fishing mortality threshold. Amendment 9 measures, which were implemented on February 24, 1999, were projected to reduce the commercial catch by 65%, the recreational catch by 50%, and the total catch by 59%. Thus, the fishing mortality rate should have been reduced by any necessary amount required to get above the maximum fishing mortality threshold. So, no additional action was required as far as the fishing mortality rate component of the new status determination criteria is concerned.

Secondly, the Council had to look at the biomass estimate which is a much more effective way than using SPR of ensuring there are sufficient fish to reproduce and support the continued productivity of a species. The stock size must be increased by 386% (from 685 to 3,328 metric tons) just to get the stock above the proposed minimum stock size threshold. Given the additional data that annual recruitment had declined from 6.53 million fish during the years 1972-78 to 2.38 million fish during 1982-86 and further to 0.66 million fish during 1992-96, the Council had no choice but to take the drastic step of prohibiting all harvest and possession of red porgy through an emergency rule.

Preliminary projections from the NMFS Southeast Fisheries Science Center (see Rejected Option 1 for Action 4) indicate that Amendment 9 actions are not sufficient to rebuild the red porgy stock. Further, the benefits from a total closure exceed those from the measures contained in Amendment 9.

The Council concluded a small allowance for harvest and possession of red porgy could be justified based on minimizing bycatch (Objective 14). In evaluating a total moratorium, the Council recognized there would be regulatory discards given that red porgy are a part of the mutli-species, mid-depth snapper grouper fishery. Commercial and charter/headboat fishermen are better able to fish away from red porgy than are private recreational anglers due to the lower experience level of private anglers and smaller vessel size which limits distance from shore and catch diversity. In developing the proposed measures, the Council attempted to limit fishing mortality to the level that would result from regulatory discards under a total moratorium. The Council concluded the controlled access program implemented through Amendment 8 would allow commercial fishermen to plan for the long-term and these fishermen would fish away from red porgy. The 50 pound bycatch trip limit would allow commercial fishermen to retain the red porgy caught incidentally while fishing for other species rather than discard these fish dead. Commercial fishermen are encouraged to release red porgy that are alive and to release them in a manner to best ensure survival. This minimal bycatch trip limit will convince fishermen that the Council is willing to work with them in designing appropriate measures to rebuild red porgy. The Council concluded this measure will best achieve the snapper grouper FMP objectives to promote voluntary compliance (Objective 6) and minimize bycatch (Objective 14) while at the same time preventing overfishing by rebuilding red porgy (Objective 1).

The Council concluded the 14 inch total length minimum size limit would protect red porgy through ages 4 to 4.5. Female red porgy are all mature at age 3 and 19% are mature at age 1. The 14 inch minimum size limit allows 100% of the females to reproduce at ages 3 and 4 which should result in significant increases in recruitment. In addition, limiting retention to one red porgy during January through April will protect red porgy during their spawning period. The Council concluded these two measures will increase recruitment sufficiently to rebuild the biomass above the minimum stock size threshold (MSST) within 18 years.

The Council is concerned that the MSY, OY, and overfishing levels may have been set too high given that the MSY of 4.38 million pounds has never been harvested. The Council will review these estimates when the stock assessment is updated in two years. If changes are necessary, the appropriate levels will be specified through the framework procedure.

The Council recognizes the impacts these measures will have on fishermen in the short-term, however, such action is necessary to rebuild the red porgy stock and provide long-term benefits. The Council has requested NMFS expand the fishery independent monitoring program for red porgy. In addition, the Council is indicating their intent to reexamine the status of red porgy every two years to determine whether the proposed measures should continue. Certainly if information becomes available sooner indicating the stock is rebuilding quickly, the Council will evaluate whether the measures should be relaxed. If future stock assessments indicates the stock is not rebuilding at a rate to get above the minimum stock size threshold within 18 years, the Council will evaluate implementing more stringent measures. Should the Council determine changes to the management program are necessary, such changes will be implemented through the framework.

The Council concluded the proposed measures are sufficient to result in rebuilding within the 18 year rebuilding period. The red porgy fishery is currently closed and will remain closed through August 28, 2000 when measures in Amendment 12 will be implemented. The 50 pound bycatch trip limit, 1-fish bag limit, and 14 inch size limit will be effective for September through December and then the four-month limitation to the bag limit, which equates to a commercial closure, takes effect. Therefore, overall fishing mortality would have been reduced significantly during 1999 and 2000. The Council concluded the large reduction in fishing mortality during 1999 and 2000 and the significant protection to be implemented through Amendment 12, are sufficient to rebuild red porgy and to comply with the Magnuson-Stevens requirements.

Rejected Options for Action 4:

Rejected Option 1. Prohibit the harvest and possession of red porgy by recreational and commercial fishermen. The status of red porgy will be reviewed every three years to determine if the moratorium should be repealed.

Biological Impacts

In considering a moratorium on red porgy catches, a question that has arisen is: what benefit is a moratorium over the previously proposed actions in Amendment 9? The following simple analyses addresses that question. [Note: Much of this section was taken directly from analyses developed by the NMFS SEFSC.]

The main concern coming from the red porgy assessment is the continual trend of reduced recruitment. Thus under any management scenario, a major objective would be to improve recruitment. Unfortunately, predicting changes in recruitment resulting from management actions are beyond our data and abilities at the present time. The next best thing would be to increase the biomass of spawning age fish with the objective that an improvement in spawner abundance would increase the likelihood of better recruitment in the future. Therefore, the spawning biomass per recruit (SSB/R) was used as a measure of the relative benefits of one regulatory regime versus another.

The mean stock condition by age for 1992-96 (from the red porgy assessment) was projected ahead assuming two alternative management scenarios: Amendment 9 and a Moratorium. The projections were made for five years using average recruitment from 1992-96, maturity and weight at age from the assessment, and natural mortality rates of M=0.28 (intermediate values from the assessment). The two management scenarios were estimated by modifying the average fishing mortality rate vector (F vector; mean of 92-96) to mimic Amendment 9 and the Moratorium.

Adjustments to the F vector to mimic Amendment 9 were based upon the estimated changes in catch that were given in the amendment. These were translated into relative changes in F at age by fishing sector taking into account the minimum size, bag limit, the seasonal closure and catch/release mortality. Similarly, the Moratorium F at age were specified as the F resulting from catch/release mortality. Results of relative SSB/R as developed by NMFS are given below:

	Projections of Relative	SSB/R Under	%Increase with
Year	Moratorium	Amendment 9	Moratorium over Am.9
1998	1.040	1.040	0.00%
1999	1.206	1.117	8.00%
2000	1.317	1.128	16.70%
2001	1.386	1.095	26.58%
2002	1.426	1.050	35.88%
2003	1.447	1.020	41.82%

These results suggest that over a period of five years or so, a Moratorium would produce approximately 35-40% more spawning biomass per recruitment than would Amendment 9.

Having made the above statements, there are a number of caveats which should be considered. First, the Amendment 9 scenario was estimated assuming that closure and bag limit

These results suggest that over a period of five years or so, a Moratorium would produce approximately 35-40% more spawning biomass per recruitment than would Amendment 9.

Having made the above statements, there are a number of caveats which should be considered. First, the Amendment 9 scenario was estimated assuming that closure and bag limit effects act independently and that the fishing effort will be distributed in space and time similar to that in the past. If, in fact, the fishery can maintain effort through redistribution of their activities, then some of the benefits of Amendment 9 (in terms of SSB/R) would be reduced. Also, if the bycatch mortality is greater (smaller) than that which we use here, then the benefits of a moratorium would be less (more). Additionally, the overall assessment (the basis for these regulatory projections) suffers from uncertainty in the stock and F at age estimates. This source of uncertainty means that these regulatory projections are also uncertain. Nevertheless, recognizing these uncertainties, the estimate from this simple analysis indicated above that the moratorium would provide a 35-40% increase in SSB/R in the next five years over Amendment 9.

Economic Impacts

This economic consequences statement is limited largely to short-run effects. This is due to the lack of information as to the year that the red porgy resource would recover to the point where a directed fishery could be prosecuted and there is no information relative to the allowable catches once the fishery recovers and is once again open. Hence, there is no basis upon which to describe the long term economic effects of the closure of the red porgy fishery. [Note: Much of this section was taken directly from analyses developed by the NMFS SERO.]

A moratorium on the possession and sale of red porgy obliges commercial fishermen to either stop fishing for red porgy or to return their catches of red porgy to the water. In either event, a moratorium would cause economic losses for commercial fishermen. These losses would be associated with a loss of revenues that otherwise would have been earned from the sale of red porgy, the costs of changing fishing locations when high concentrations of red porgy are encountered, the costs of remaining at sea longer in order to replace red porgy with catches of other species, a decrease in net operating revenues per trip by boats that switch to less profitable species and a loss in net revenues per trip by boats that stop fishing altogether when red porgy are particularly abundant. Some of the revenue losses will be partially offset by savings of harvesting costs not incurred because some trips are not taken and bait costs may decline due to the moratorium if incidental catches of red porgy are used as bait rather than returned to the water.

Snapper-grouper logbook reports were examined for trips on which red porgy were landed. Since 1993, all boat owners with Federal permits to fish in the Atlantic snapper-grouper fishery have been required to submit a logbook report of each trip's landings by species. Revenues per trip were approximated with average monthly prices as derived from NMFS general canvass data, which are monthly estimates of landings and revenues for each species that were obtained from dockside fish buyers.

Red porgy are part of the multi-species, mid-depth snapper-grouper complex that includes vermilion snapper, gag, scamp, gray triggerfish, greater amberjack and other species. During the 1993-1997 period, an average of 331 boats combined to average 3,436 trips per year on which red porgy were landed (Table 21). An average of 99 boats averaged 229 trips per year on which red porgy was the top revenue-generating species (Table 22). However, red porgy was a secondary species on most trips, with 326 boats averaging 3,207 trips per year on which red porgy was not the top revenue species (Table 23).[1] Fishermen reported landing an annual average of 326,800 pounds of red porgy per year worth approximately $397,300 (Table 21). Landings of all species on these trips averaged 3.99 million pounds per year worth $6.31 million. Hence, red porgy contributed an annual average of less than 10% of total landings and revenues earned on trips on which red porgy were landed.[2]

TABLE 21. TRIPS WITH CATCHES OF RED PORGY
THAT WERE REPORTED TO THE SNAPPER-GROUPER REEF FISH LOGBOOK PROGRAM
Snapper-grouper logbook data as of July 21, 1998

YEAR	BOATS	TRIPS	POUNDS OF RED PORGY	POUNDS OF ALL SPECIES	REVENUES FROM RED PORGY	REVENUES FROM ALL SPECIES
1993	319	3,137	303,823	3,356,834	$364,437	$5,120,270
1994	318	3,420	308,456	3,846,734	$270,505	$5,365,904
1995	344	3,663	323,152	4,364,848	$414,986	$7,171,462
1996	334	3,438	360,484	4,042,069	$468,745	$6,658,218
1997	338	3,522	338,225	4,342,555	$467,701	$7,222,845
AVERAGE	331	3,436	326,828	3,990,608	$397,275	$6,307,740

TABLE 22. TRIPS ON WHICH RED PORGY WAS THE TOP REVENUE GENERATING SPECIES
AS REPORTED TO THE SNAPPER-GROUPER REEF FISH LOGBOOK PROGRAM
Snapper-grouper logbook data as of July 21, 1998

YEAR	BOATS	TRIPS	POUNDS OF RED PORGY	POUNDS OF ALL SPECIES	REVENUES FROM RED PORGY	REVENUES FROM ALL SPECIES
1993	102	289	83,695	196,391	$100,393	$255,158
1994	84	163	50,557	102,357	$44,152	$109,717
1995	97	239	60,657	130,071	$78,808	$188,862
1996	112	236	70,996	163,889	$91,276	$242,113
1997	99	216	71,195	168,323	$99,870	$252,269
AVERAGE	99	229	67,420	152,206	$82,900	$209,624

1 Some boats made trips on which red porgy was the top revenue species and other trips on which it was not. Hence, the average number of boats in Tables 22 and 23 do not sum to the average number in Table 21 that reported having landed red porgy.

2 From the annual averages presented in Table 21, the overall contribution of red porgy to landings of all species was 326,828 / 3,990,608 = 8.2%. Similarly, the contribution of red porgy to average annual revenues was $397,275 / $6,307,740 = 6.3%.

TABLE 23. TRIPS ON WHICH RED PORGY WAS A SECONDARY SPECIES
AS REPORTED TO THE SNAPPER-GROUPER REEF FISH LOGBOOK PROGRAM
Snapper-grouper logbook data as of July 21, 1998

YEAR	BOATS	TRIPS	POUNDS OF RED PORGY	POUNDS OF ALL SPECIES	REVENUES FROM RED PORGY	REVENUES FROM ALL SPECIES
1993	314	2,848	220,128	3,160,443	$264,045	$4,865,111
1994	315	3,257	257,899	3,744,377	$226,352	$5,256,187
1995	338	3,424	262,495	4,234,777	$336,178	$6,982,599
1996	331	3,202	289,487	3,878,180	$377,469	$6,416,105
1997	334	3,306	267,030	4,174,232	$367,831	$6,970,576
AVERAGE	326	3,207	259,408	3,838,402	$314,375	$6,098,116

The effect of a moratorium on the possession and sale of red porgy was examined with a simple analysis of logbook data for the 1993-1997 period. Revenues from red porgy were deducted from total revenues per trip. The remaining revenues per trip were compared with average harvesting costs per trip[3] to determine if trips were worth taking even without revenues from red porgy.

If the remaining revenues per trip exceeded average trip costs, then it was assumed that the boat would have made the trip anyway despite the moratorium and would have released or discarded its incidental catches of red porgy. The loss per trip due to the moratorium was approximated as the ex-vessel value of red porgy that otherwise would have been landed.[4] Most trips fell into this category (Table 24). It was predicted that an average of 2,559 out of 3,436 total trips would have occurred anyway despite the moratorium, and that an average of 290,100 pounds of red porgy would have been either released (alive) or discarded (dead). This amounts to about 88% of the pre-moratorium average annual catch of red porgy.[5] Losses in ex-vessel revenues would have averaged approximately $354,600 per year.

If the remaining revenues per trip were less than average trip costs, then it was assumed that the trip would not have been taken, and that losses could be approximated as total revenues

---

3 Routine harvesting costs for boats that targeted the mid-depth snapper-grouper complex averaged $498.90 per trip based on 79 sampled boats from North Carolina through St. Augustine, Florida, and $261.46 per trip based on 18 sampled boats that fished from Flagler through Dade Counties in Florida. (Source: James R. Waters, Raymond J. Rhodes, Wayne Waltz and Robert Wiggers. Manuscript. An economic survey of commercial reef fish boats along the U.S. south Atlantic coast. NMFS, 101 Piver's Island Road, Beaufort, NC 28516.) Average routine harvesting costs of $91.69 per trip based on 11 sampled boats that fished for deep water groupers and snappers in the Florida Keys were used in the analysis for a small number of boats that reported landing red porgy in the Keys. (Source: James R. Waters, Raymond J. Rhodes and Robert Wiggers. Manuscript. Description of economic data collected with a random sample of commercial reef fish boats in the Florida Keys. NMFS, 101 Piver's Island Road, Beaufort, NC 28516.) The average costs per trip vary due to differences among regions in distance of fishing grounds from shore, number of days fished per trip, number of persons aboard, and so forth.

4 This method underestimates the true losses imposed on boats that incur extra harvesting costs by changing fishing locations or taking longer trips in response to the moratorium, and overestimates true losses for boats that compensate by adding catches and revenues for other species by changing the species composition of each trip.

5 The overall fraction of red porgy that would have been released or discarded was calculated as the average annual pounds that would have been released or discarded (290,124 pounds from Table 24) divided by the average annual total catch of red porgy (326,828 pounds from Table 21).

per trip minus average harvesting costs per trip (Table 24).[6] Usually, these trips were relatively low- volume, with an annual average of 36,700 pounds of red porgy not being caught due to the moratorium. The predicted losses from trips not taken due to the moratorium averaged only $10,700 per year because red porgy generally was not a primary species on trips taken in the snapper-grouper fishery.

The predicted total losses to commercial fishermen would have averaged approximately $365,300 per year between 1993 and 1997 (Table 24). This prediction is a modeled result based on average harvesting costs per trip. The actual short-term economic effect of a moratorium will depend on each individual boat's trip costs. The long-term economic effects of the moratorium cannot be estimated without additional information about the rate at which the red porgy population would recover.

TABLE 24. EFFECTS OF A MORATORIUM ON COMMERCIAL LANDINGS OF RED PORGY
Snapper-grouper logbook data as of July 21, 1998

YEAR	TOTAL TRIPS	TRIPS NOT TAKEN	LOSS ON TRIPS NOT TAKEN	POUNDS OF RED PORGY NOT CAUGHT	TRIPS TAKEN ANYWAY	LOSS ON TRIPS TAKEN ANYWAY	POUNDS R.P. RELEASED OR DISCARDED	TOTAL LOSS DUE TO MORATORIUM
1993	3,137	969	$10,045	37,118	2,168	$319,914	266,704	$329,959
1994	3,420	1,097	$10,235	48,364	2,323	$228,324	260,092	$238,559
1995	3,663	876	$13,121	38,284	2,787	$367,369	284,869	$380,490
1996	3,438	757	$8,938	32,092	2,681	$427,716	328,392	$436,654
1997	3,522	686	$11,141	27,662	2,836	$429,742	310,563	$440,883
AVERAGE	3,436	877	$10,696	36,704	2,559	$354,613	290,124	$365,309

The preceding analysis was based on data prior to Amendment 9 going into effect. With Amendment 9 in place, this option would reduce ex-vessel revenue by $224,517 per year ($397,275 from Table 21 minus $172,758). This is based on the assumption that Amendment 9 would reduce ex-vessel revenue by $172,758 (see analysis under the proposed action). Also, it is assumed that the moratorium would not result in the cancellation of fishing trips even when red porgy was the primary target.

Except for estimates of harvest and effort by the various recreational sectors, there is very little information available to describe the potential economic consequences of a closure of the recreational fishery. Projects currently in progress may be able to provide additional information about red porgy, perhaps by reference to more highly sought species. These studies, which involve the private recreational sector as well as the for-hire sector, will become available later in 1999 and 2000.

Red porgy is neither a major target species nor does it comprise a major component of the private, charter and shore recreational harvest. MRFSS data indicate that from 1990-97 an average of 66,000 pounds of red porgy were harvested annually in the South Atlantic. This equates to approximately 0.1% of the total annual average harvest of approximately 45 million pounds for all species. Further, while an average of 20,000 angler trips harvest red porgy

[6] This procedure overestimates true losses for boats that would take a different kind of fishing trip rather than not fish at all

annually, since 1991 no anglers from these sectors have identified red porgy as their primary or secondary target species. Red porgy catch effort for the private and charter sector averages approximately 0.1% of the total 17 million angler trips taken annually in the South Atlantic. Table 25 demonstrates that the red porgy fishery is primarily prosecuted in North Carolina and South Carolina. Tables 26 and 27 show the relative importance of red porgy to total harvest by these sectors in these states in numbers of fish and pounds of fish, respectively. Red porgy account for an average of 0.5% of total fish harvested and 0.3% of total pounds harvested by these sectors in these two states.

Red porgy are a more important species for the headboat sector where harvests averaged approximately 101,000 pounds during 1990-97, or about 50% higher than the private, charter and shore harvests combined. Headboat landings have trended down since the early 1970s when the landings usually exceeded 200,000 pounds. There is no similar trend in private recreational and charter boat landings. These landings appear to have fluctuated over time for no apparent reason. Similar to the data from the private, charter and shore sectors, the headboat data indicates that the red porgy harvest occurs primarily in North Carolina and South Carolina. Tables 28 and 29 show the relative importance of red porgy to total harvest by the headboat sector in each state (Florida and Georgia are combined for confidentiality considerations) in numbers of fish and pounds of fish, respectively. While red porgy comprises a larger component of total harvest in the headboat sector as compared to other sectors, the species still accounts for less than 10% of total harvest in terms of both numbers of fish and pounds of fish. Table 30 shows the rank of red porgy relative to all other species in terms of number of fish harvested. For North Carolina and South Carolina combined, on average red porgy ranks fourth in total harvest. Vermilion snapper, white grunt, sea basses and gray triggerfish are more numerous harvest species. Red porgy target or harvest effort is not available for the headboat sector. However, over the 1990-97 period there were an average of 40,000 headboat angler days in North Carolina and 61,000 headboat angler days in South Carolina per year (an angler day is equal to one 10-12 hour headboat trip by one angler). Combining these figures with average harvests in these states shows that on average North Carolina headboat anglers harvested one red porgy per angler per angler day, while South Carolina anglers harvested 0.6 red porgy.

Economic inferences are difficult to make because there are no data, which can be used to determine if trips would be canceled as a result of a closure. Given the lack of importance of red porgy to the private, charter and shore sectors, as evidenced by the lack of target effort and low harvest levels, it is unlikely that a closure would result in the cancellation of trips. Even if trips were taken there would be a loss of benefits if anglers are constrained by the moratorium. For headboat trips red porgy comprise less than 10% of total harvest and thus could be considered a relatively minor species. Nevertheless, in the absence of the ability to project trip cancellation, it is not possible to describe the resulting effects on the economic performance of the headboat sector. As previously indicated, information of this type is being assembled, but is not yet available.

The preceding analysis was conducted prior to Amendment 9 going into effect. With Amendment 9 in place, there would be a 50% reduction in recreational harvest in the private/rental and charterboat sectors. The moratorium would therefore result in an additional 50% reduction in the recreational harvest over Amendment 9. For the headboat sector the 14 inch minimum size restriction would decrease harvest by 68.9%, and thus the moratorium would reduce harvest by an additional 31% (see discussion under the proposed action).

per trip minus average harvesting costs per trip (Table 24).[6] Usually, these trips were relatively low- volume, with an annual average of 36,700 pounds of red porgy not being caught due to the moratorium. The predicted losses from trips not taken due to the moratorium averaged only $10,700 per year because red porgy generally was not a primary species on trips taken in the snapper-grouper fishery.

The predicted total losses to commercial fishermen would have averaged approximately $365,300 per year between 1993 and 1997 (Table 24). This prediction is a modeled result based on average harvesting costs per trip. The actual short-term economic effect of a moratorium will depend on each individual boat's trip costs. The long-term economic effects of the moratorium cannot be estimated without additional information about the rate at which the red porgy population would recover.

TABLE 24. EFFECTS OF A MORATORIUM ON COMMERCIAL LANDINGS OF RED PORGY
Snapper-grouper logbook data as of July 21, 1998

YEAR	TOTAL TRIPS	TRIPS NOT TAKEN	LOSS ON TRIPS NOT TAKEN	POUNDS OF RED PORGY NOT CAUGHT	TRIPS TAKEN ANYWAY	LOSS ON TRIPS TAKEN ANYWAY	POUNDS R.P. RELEASED OR DISCARDED	TOTAL LOSS DUE TO MORATORIUM
1993	3,137	969	$10,045	37,118	2,168	$319,914	266,704	$329,959
1994	3,420	1,097	$10,235	48,364	2,323	$228,324	260,092	$238,559
1995	3,663	876	$13,121	38,284	2,787	$367,369	284,869	$380,490
1996	3,438	757	$8,938	32,092	2,681	$427,716	328,392	$436,654
1997	3,522	686	$11,141	27,662	2,836	$429,742	310,563	$440,883
AVERAGE	3,436	877	$10,696	36,704	2,559	$354,613	290,124	$365,309

The preceding analysis was conducted prior to Amendment 9 going into effect. With Amendment 9 in place, this option would reduce ex-vessel revenue by $229,158 per year ($397,275-$168,117). This is based on the assumption that Amendment 9 would reduce ex-vessel revenue by $168,117 (see analysis under the proposed action). Also, it is assumed that the moratorium would not result in the cancellation of fishing trips even when red porgy was the primary target.

Recreational consequences

Except for estimates of harvest and effort by the various recreational sectors, there is very little information available to describe the potential economic consequences of a closure of the recreational fishery. Projects currently in progress may be able to provide additional information about red porgy, perhaps by reference to more highly sought species. These studies, which involve the private recreational sector as well as the for-hire sector, will become available later in 1999 and 2000.

Red porgy is neither a major target species nor does it comprise a major component of the private, charter and shore recreational harvest. MRFSS data indicate that from 1990-97 an average of 66,000 pounds of red porgy were harvested annually in the South Atlantic. This equates to approximately 0.1% of the total annual average harvest of approximately 45 million pounds for all species. Further, while an average of 20,000 angler trips harvest red porgy

[6] This procedure overestimates true losses for boats that would take a different kind of fishing trip rather than not fish at all

annually, since 1991 no anglers from these sectors have identified red porgy as their primary or secondary target species. Red porgy catch effort for the private and charter sector averages approximately 0.1% of the total 17 million angler trips taken annually in the South Atlantic. Table 25 demonstrates that the red porgy fishery is primarily prosecuted in North Carolina and South Carolina. Tables 26 and 27 show the relative importance of red porgy to total harvest by these sectors in these states in numbers of fish and pounds of fish, respectively. Red porgy account for an average of 0.5% of total fish harvested and 0.3% of total pounds harvested by these sectors in these two states.

Red porgy are a more important species for the headboat sector where harvests averaged approximately 101,000 pounds during 1990-97, or about 50% higher than the private, charter and shore harvests combined. Headboat landings have trended down since the early 1970s when the landings usually exceeded 200,000 pounds. There is no similar trend in private recreational and charter boat landings. These landings appear to have fluctuated over time for no apparent reason. Similar to the data from the private, charter and shore sectors, the headboat data indicates that the red porgy harvest occurs primarily in North Carolina and South Carolina. Tables 28 and 29 show the relative importance of red porgy to total harvest by the headboat sector in each state (Florida and Georgia are combined for confidentiality considerations) in numbers of fish and pounds of fish, respectively. While red porgy comprises a larger component of total harvest in the headboat sector as compared to other sectors, the species still accounts for less than 10% of total harvest in terms of both numbers of fish and pounds of fish. Table 30 shows the rank of red porgy relative to all other species in terms of number of fish harvested. For North Carolina and South Carolina combined, on average red porgy ranks fourth in total harvest. Vermilion snapper, white grunt, sea basses and gray triggerfish are more numerous harvest species. Red porgy target or harvest effort is not available for the headboat sector. However, over the 1990-97 period there were an average of 40,000 headboat angler days in North Carolina and 61,000 headboat angler days in South Carolina per year (an angler day is equal to one 10-12 hour headboat trip by one angler). Combining these figures with average harvests in these states shows that on average North Carolina headboat anglers harvested one red porgy per angler per angler day, while South Carolina anglers harvested 0.6 red porgy.

Economic inferences are difficult to make because there are no data, which can be used to determine if trips would be canceled as a result of the proposed closure. Given the lack of importance of red porgy to the private, charter and shore sectors, as evidenced by the lack of target effort and low harvest levels, it is unlikely that a closure will result in the cancellation of trips. Even if trip are taken there will be a loss of benefits if anglers are constrained by the moratorium. For headboat trips red porgy comprise less than 10% of total harvest and thus could be considered a relatively minor species. Nevertheless, in the absence of the ability to project trip cancellation, it is not possible to describe the resulting effects on the economic performance of the headboat sector. As previously indicated, information of this type is being assembled, but will not be available until later in 1999.

The preceding analysis was conducted prior to Amendment 9 going into effect. With Amendment 9 in place, there would be a 50% reduction in recreational harvest in the private/rental and charterboat sectors. The moratorium would therefore result in an additional 50% reduction in the recreational harvest over Amendment 9. For the headboat sector the 14 inch minimum size restriction would decrease harvest by 68.9%, and thus the moratorium would reduce harvest by an additional 31% (see discussion under the proposed action).

TABLE 25. SOUTH ATLANTIC RECREATIONAL RED PORGY CATCH, BY STATE, MRFSS DATA. 1998 DATA IS PRELIMINARY.

	STATE							
	FLORIDA		GEORGIA		NORTH CAROLINA		SOUTH CAROLINA	
	TOTAL LANDING	POUNDS LANDED	TOTAL LANDING	POUNDS LANDED	TOTAL LANDING	POUNDS LANDED	TOTAL LANDING	POUNDS LANDED
YEAR								
1990	888	3,131	.	.	211,358	43,244	111	129
1991	14,481	11,351	.	.	19,377	16,015	19,040	17,828
1992	2,262	2,685	622	933	42,403	60,006	46,720	52,603
1993	1,418	1,410	4,844	13,884	22,692	40,036	6,293	9,551
1994	2,535	2,542	.	.	23,837	30,979	8,422	10,753
1995	1,672	2,119	408	719	15,587	19,749	41,283	57,181
1996	.	.	5,334	9,048	11,169	14,561	40,752	86,491
1997	1,280	705	.	.	8,976	13,170	2,111	3,542

TABLE 26. SOUTH ATLANTIC PRIVATE, CHARTER AND SHORE LANDINGS (NUMBERS OF FISH), BY STATE, MRFSS DATA.

	NORTH CAROLINA			SOUTH CAROLINA			TOTAL		
YEAR	ALL FISH	RED PORGY	%	ALL FISH	RED PORGY	%	ALL FISH	RED PORGY	%
1990	11,446,808	211,358	1.85%	1,495,460	111	0.01%	24,389,076	422,827	1.73%
1991	8,062,389	19,377	0.24%	3,255,415	19,040	0.58%	19,380,193	57,794	0.30%
1992	7,629,193	42,403	0.56%	3,274,242	46,720	1.43%	18,532,628	131,526	0.71%
1993	8,172,493	22,692	0.28%	3,237,301	6,293	0.19%	19,582,287	51,677	0.26%
1994	12,681,060	23,837	0.19%	3,930,548	8,422	0.21%	29,292,668	56,096	0.19%
1995	9,208,157	15,587	0.17%	2,879,821	41,283	1.43%	21,296,135	72,457	0.34%
1996	6,703,592	11,169	0.17%	3,129,060	40,752	1.30%	16,536,244	63,090	0.38%
1997	7,421,372	8,976	0.12%	3,352,743	2,111	0.06%	18,195,487	20,063	0.11%
AVERAGE	8,915,633	44,425	0.45%	3,069,324	20,592	0.65%	20,900,590	109,441	0.50%

TABLE 27. SOUTH ATLANTIC PRIVATE, CHARTER AND SHORE LANDINGS (POUNDS OF FISH), BY STATE, MRFSS DATA.

	NORTH CAROLINA			SOUTH CAROLINA			TOTAL		
YEAR	ALL FISH	RED PORGY	%	ALL FISH	RED PORGY	%	ALL FISH	RED PORGY	%
1990	12,264,318	43,244	0.35%	2,406,289	129	0.01%	26,934,925	86,617	0.32%
1991	10,966,851	16,015	0.15%	5,203,324	17,828	0.34%	27,137,026	49,858	0.18%
1992	10,101,230	60,006	0.59%	5,353,021	52,603	0.98%	25,555,481	172,615	0.68%
1993	12,353,105	40,036	0.32%	3,745,850	9,551	0.26%	28,452,060	89,623	0.32%
1994	17,025,329	30,979	0.18%	4,193,365	10,753	0.26%	38,244,023	72,711	0.19%
1995	16,595,002	19,749	0.12%	3,555,718	57,181	1.61%	36,745,722	96,679	0.26%
1996	16,000,528	14,561	0.09%	3,828,153	86,491	2.26%	35,829,209	115,613	0.32%
1997	19,747,429	13,170	0.07%	4,493,751	3,542	0.08%	43,988,609	29,882	0.07%
AVERAGE	14,381,724	29,720	0.23%	4,097,434	29,760	0.72%	32,860,882	89,200	0.29%

TABLE 28. SOUTH ATLANTIC HEADBOAT LANDINGS (NUMBERS OF FISH), BY STATE.

	FLORIDA-GEORGIA			NORTH CAROLINA			SOUTH CAROLINA			TOTAL		
YEAR	ALL FISH	RED PORGY	%	ALL FISH	RED PORGY	%	ALL FISH	RED PORGY	%	ALL FISH	RED PORGY	%
1990	1,782,805	7,265	0.41%	464,688	48,283	10.39%	665,855	49,214	7.39%	2,913,348	104,762	3.60%
1991	1,343,861	7,141	0.53%	564,208	68,515	12.14%	745,160	54,223	7.28%	2,653,229	129,879	4.90%
1992	1,096,317	4,810	0.44%	413,040	47,278	11.45%	692,108	33,805	4.88%	2,201,465	85,893	3.90%
1993	963,940	3,177	0.33%	420,935	43,801	10.41%	584,870	34,717	5.94%	1,969,745	81,695	4.15%
1994	987,931	2,651	0.27%	415,124	38,020	9.16%	599,907	29,719	4.95%	2,002,962	70,390	3.51%
1995	819,432	3,953	0.48%	482,064	42,365	8.79%	538,382	24,395	4.53%	1,839,878	70,713	3.84%
1996	760,102	3,715	0.49%	383,338	33,459	8.73%	511,442	27,733	5.42%	1,654,882	64,907	3.92%
1997	727,677	4,069	0.56%	381,561	25,261	6.62%	539,456	24,535	4.55%	1,648,694	53,865	3.27%
AVERAGE	1,060,258	4,598	0.44%	440,620	43,373	9.71%	609,648	34,793	5.62%	2,110,525	82,763	3.89%

TABLE 29. SOUTH ATLANTIC HEADBOAT LANDINGS (POUNDS OF FISH), BY STATE.

	FLORIDA-GEORGIA			NORTH CAROLINA			SOUTH CAROLINA			TOTAL		
YEAR	ALL FISH	RED PORGY	%	ALL FISH	RED PORGY	%	ALL FISH	RED PORGY	%	ALL FISH	RED PORGY	%
1990	2,610,445	6,459	0.25%	541,087	56,163	10.38%	561,874	63,641	11.33%	3,713,406	126,263	3.40%
1991	1,954,888	12,020	0.61%	1,197,347	70,851	5.92%	733,954	57,946	7.90%	3,886,189	140,817	3.62%
1992	1,878,958	4,943	0.26%	583,869	65,803	11.27%	590,389	39,110	6.62%	3,053,216	109,856	3.60%
1993	1,905,544	3,850	0.20%	583,017	52,235	8.96%	679,661	44,940	6.61%	3,168,222	101,025	3.19%
1994	1,830,806	3,096	0.17%	555,149	46,969	8.46%	606,848	37,506	6.18%	2,992,803	87,571	2.93%
1995	1,422,599	4,756	0.33%	650,217	56,988	8.76%	593,198	31,287	5.27%	2,666,014	93,031	3.49%
1996	1,347,080	4,510	0.33%	513,183	42,886	8.36%	581,502	34,821	5.99%	2,441,765	82,217	3.37%
1997	1,193,857	5,397	0.45%	535,776	38,633	7.21%	634,231	21,267	3.35%	2,363,864	65,297	2.76%
AVERAGE	1,768,022	5,629	0.33%	644,956	53,816	8.66%	622,707	41,315	6.66%	3,035,685	100,760	3.29%

TABLE 30. RANKING (NUMBER OF FISH HARVESTED) OF RED PORGY IN HEADBOAT HARVEST.			
YEAR	NORTH CAROLINA	SOUTH CAROLINA	GEORGIA/NORTH FLORIDA
1990	4	4	17
1991	4	4	22
1992	3	4	14
1993	4	4	19
1994	4	4	16
1995	5	5	12
1996	5	4	8
1997	6	5	8

APPENDIX

Commercial Results Assuming Unprofitable Trips are Not Taken

Trips were assumed to be unprofitable with a moratorium on the sale of red porgy if revenues per trip without red porgy were less than cost per trip. While the preceding analysis used revenues that were unique to each trip, cost per trip was an average based on information obtained from a sample of boats. The result was that there may be errors in the identification of trips that would no longer be profitable with the moratorium. For example, if low-volume boats had lower-than-average costs, then their trips might be erroneously judged unprofitable because the estimated average cost per trip was too high. Similarly, if high-volume boats had higher-than-average costs, then their trips might be erroneously judged profitable because the average cost per trip was too low.

Tables A1-A4 recalculated the short-term costs of a moratorium under four alternative assumptions about how to determine if trips would be profitable or unprofitable without revenues from the sale of red porgy. Trips were assumed to be unprofitable if revenues from red porgy exceeded 40% (Table A1), 30% (Table A2), 20% (Table A3) or 10% (Table A4) of total revenues per trip. However, the estimate of short-term economic losses of trips not taken still would be subject to error since loss was evaluated as trip revenues minus average cost per trip. Losses for trips with lower-than-average costs would be underestimated whereas losses for trips with higher-than-average costs would be overestimated.

TABLE A1. EFFECTS OF A MORATORIUM ON COMMERCIAL LANDINGS OF RED PORGY ASSUMING THAT TRIPS WOULD NOT BE TAKEN IF REVENUES FROM RED PORGY CONTRIBUTED **40%** OR MORE TO TOTAL TRIP REVENUES

Snapper-grouper logbook data as of July 21, 1998

YEAR	TOTAL TRIPS	TRIPS NOT TAKEN	LOSS ON TRIPS NOT TAKEN	POUNDS OF RED PORGY NOT CAUGHT	TRIPS TAKEN ANYWAY	LOSS ON TRIPS TAKEN ANYWAY	POUNDS R.P. RELEASED OR DISCARDED	TOTAL LOSS DUE TO MORATORIUM
1993	3,137	174	$65,154	48,469	2,963	$306,299	255,354	$371,453
1994	3,420	102	$18,986	29,252	3,318	$245,075	279,204	$264,060
1995	3,663	151	$38,648	35,057	3,512	$369,455	288,095	$408,103
1996	3,438	138	$44,210	34,664	3,300	$424,200	325,819	$468,410
1997	3,522	118	$66,194	39,228	3,404	$412,807	298,997	$479,001
AVERAGE	3,436	137	$46,638	37,334	3,299	$351,567	289,494	$398,206

TABLE A2. EFFECTS OF A MORATORIUM ON COMMERCIAL LANDINGS OF RED PORGY ASSUMING THAT TRIPS WOULD NOT BE TAKEN IF REVENUES FROM RED PORGY CONTRIBUTED **30%** OR MORE TO TOTAL TRIP REVENUES

Snapper-grouper logbook data as of July 21, 1998

YEAR	TOTAL TRIPS	TRIPS NOT TAKEN	LOSS ON TRIPS NOT TAKEN	POUNDS OF RED PORGY NOT CAUGHT	TRIPS TAKEN ANYWAY	LOSS ON TRIPS TAKEN ANYWAY	POUNDS R.P. RELEASED OR DISCARDED	TOTAL LOSS DUE TO MORATORIUM
1993	3,137	278	$115,185	72,755	2,859	$277,167	231,067	$392,352
1994	3,420	169	$38,806	45,220	3,251	$231,147	263,236	$269,953
1995	3,663	247	$91,172	56,905	3,416	$340,856	266,247	$432,028
1996	3,438	230	$97,965	57,420	3,208	$395,410	303,064	$493,375
1997	3,522	214	$132,002	63,411	3,308	$379,515	274,815	$511,517
AVERAGE	3,436	228	$95,026	59,142	3,208	$324,819	267,686	$419,845

TABLE A3. EFFECTS OF A MORATORIUM ON COMMERCIAL LANDINGS OF RED PORGY
ASSUMING THAT TRIPS WOULD NOT BE TAKEN IF REVENUES FROM RED PORGY CONTRIBUTED **20%** OR MORE TO TOTAL TRIP REVENUES
Snapper-grouper logbook data as of July 21, 1998

YEAR	TOTAL TRIPS	TRIPS NOT TAKEN	LOSS ON TRIPS NOT TAKEN	POUNDS OF RED PORGY NOT CAUGHT	TRIPS TAKEN ANYWAY	LOSS ON TRIPS TAKEN ANYWAY	POUNDS R.P. RELEASED OR DISCARDED	TOTAL LOSS DUE TO MORATORIUM
1993	3,137	495	$271,912	118,770	2,642	$221,972	185,052	$493,884
1994	3,420	355	$128,865	87,197	3,065	$193,964	221,259	$322,829
1995	3,663	450	$246,413	98,718	3,213	$286,526	224,434	$532,939
1996	3,438	479	$385,846	130,325	2,959	$301,707	230,158	$687,553
1997	3,522	409	$344,641	114,080	3,113	$308,682	224,145	$653,323
AVERAGE	3,436	438	$275,535	109,818	2,998	$262,570	217,010	$538,106

TABLE A4. EFFECTS OF A MORATORIUM ON COMMERCIAL LANDINGS OF RED PORGY
ASSUMING THAT TRIPS WOULD NOT BE TAKEN IF REVENUES FROM RED PORGY CONTRIBUTED **10%** OR MORE TO TOTAL TRIP REVENUES
Snapper-grouper logbook data as of July 21, 1998

YEAR	TOTAL TRIPS	TRIPS NOT TAKEN	LOSS ON TRIPS NOT TAKEN	POUNDS OF RED PORGY NOT CAUGHT	TRIPS TAKEN ANYWAY	LOSS ON TRIPS TAKEN ANYWAY	POUNDS R.P. RELEASED OR DISCARDED	TOTAL LOSS DUE TO MORATORIUM
1993	3,137	994	$726,724	192,409	2,143	$133,641	111,413	$860,365
1994	3,420	826	$440,728	163,123	2,594	$127,419	145,333	$568,147
1995	3,663	988	$914,131	193,340	2,675	$165,885	129,813	$1,080,016
1996	3,438	1,032	$1,139,695	234,827	2,406	$165,694	125,657	$1,305,389
1997	3,522	974	$1,089,608	213,651	2,548	$172,526	124,574	$1,262,134
AVERAGE	3,436	963	$862,177	199,470	2,473	$153,033	127,358	$1,015,210

Social Impacts

Red porgy have been documented as overfished since 1991. Commercial and recreational catches reveal a downward trend in size and weight of the fish caught since before 1991. In light of continuing bleak estimates of a depleted and overfished stock, the Council had no choice but to request an emergency moratorium on the catch and retention of red porgy. Because this action is of an extreme nature, it is predicted that the social impacts on fishermen will also be felt on a larger scale than other proposed management measures. The overall magnitude of social impacts from imposing a complete moratorium will depend upon the ability of fishermen to adjust economically, socially, and psychologically to such an action. However, if the proposed actions are not taken, there would be a high level of uncertainty as to the future status of the species being impacted. If commercial fishermen can easily substitute another species, or replace lost income, they may see benefits to complete prohibition as the stock rebounds over time. Red porgy is an important species for commercial fishermen in North and South Carolina. Species substitution may not be easy as their dependence upon this particular fishery may be seasonal and important to the household or business at that time. If substitution is not easy, fishermen may increase their effort on other species. Where that effort shift would occur, is unclear as most snapper grouper fishermen hold a variety of permits. The coastal pelagic fisheries could see substantial effort increases with this action, in addition to other species within this amendment.

The combined impact on commercial fishermen of this measure with other measures proposed in this amendment could be substantial. There is the possibility that some individuals whose businesses have been operating on the margin may be forced to leave if alternative fisheries or other means of substituting for lost income are not readily available. Their ability to enter other fisheries will depend upon their present capability to diversify their fishing practices. Other alternatives for replacing lost income will depend upon the ability of fishermen or other household members to take on any or additional responsibilities for the household income. That capability is certainly tied to the availability of work and the possession of individual skills needed for jobs that are available. Many fishing communities are located in rural areas where job opportunities are limited, although, fishermen often have skills that are compatible with many of the short-term and/or part-time work opportunities available in rural areas. The key is whether those opportunities will exist at the same time fishermen will be in need of them.

Recreational fishermen may experience less fishing satisfaction with a moratorium being in place but the degree of their dissatisfaction will depend upon past fishing practices and whether or not they have become accustomed to catching red porgies. There will likely be species substitution once the moratorium is in place, thereby increasing pressure on other species. As is the case with commercial fishermen, which species would act as a substitute for red porgy is not known, but will likely be other species in the snapper grouper complex that are also overfished.

The moratorium would likely have a similar impact on the charter/headboat sectors. It is difficult to predict exactly if a moratorium will cause a loss in trips taken in these sectors, however, charter and headboats can always target other fish.

One other issue stands out as a potential negative social impact resulting from the moratorium: intensified conflict between the commercial and recreational fishing sectors. Each group desires to blame someone for the ban on harvesting red porgy, and a drastic management action such as a moratorium will tend to intensify existing conflict between the different users.

Fishers have expressed concern that if they have an incidental bycatch of red porgy they will be subject to prosecution by law enforcement. No allowance for bycatch is seen by fishers as wasteful and represents an unrealistic assessment of their fishing experience. A total prohibition will have negative social impacts on both commercial and recreational fishers. No bycatch allowance for commercial and recreational sectors increases the potential for large regulatory discards, a concept that is perceived by fishers as wasteful and inherently out of place in good fisheries management.

The importance of heeding stakeholders' concerns and suggestions cannot be overemphasized. Giving the participants in a fishery the ability to construct or have a role in constructing the policy that impacts them increases the incentive to comply with new regulations. Under this option, the incentive to comply with new regulations would be greatly diminished.

Conclusion

The Council evaluated the impacts the moratorium would have on fishermen in the short-term, and concluded such action is not necessary to rebuild the red porgy stock and provide long-term benefits. The proposed action will, in the Council's opinion, result in rebuilding at a slightly slower rate than a moratorium but the stock will rebuild nonetheless. The Council has requested NMFS expand the fishery independent monitoring program for red porgy. In addition, the Council is indicating their intent to reexamine the status of red porgy every two years to determine whether the measures should be modified. Certainly if information becomes available sooner indicating the stock is rebuilding or is not rebuilding, the Council will evaluate whether the measures should be modified. Should the Council determine the measures should be modified, changes would be implemented through the framework procedure. The Council determine that although a moratorium on the harvest of red porgy would rebuild the resource, it would also result in regulatory discards and fisherman non-compliance. The proposed action will rebuild the resource and allow for minimal harvest of red porgy that would have been discarded dead..

Rejected Option 2. No Action. Maintain the following actions which were specified in Amendment 9 (implemented February 24, 1999): Increased the red porgy minimum size limit from 12" TL to 14" TL for both recreational and commercial fishermen; established a recreational bag limit of 5 red porgy per person per day; prohibited harvest and possession in excess of the bag limit during March and April; and prohibited purchase and sale during March and April.

These measures apply to red porgy in or from the South Atlantic EEZ and red porgy in the South Atlantic harvested on board a permitted vessel (commercial or charter/headboat) without regard to where the red porgy is harvested or possessed. The prohibition on purchase applies to all permitted dealers without regard to where the red porgy is harvested or possessed (i.e., state or federal waters). However, fish can be purchased from areas outside the South Atlantic provided there was an appropriate paper trail documenting the area of origin.

[Note: The following information is taken directly from Amendment 9. The referenced tables and figures are included below or can be found in Amendment 9. The conclusions section was modified slightly.]

Biological Impacts

Based on 1995 data, approximately 67% of the catch was harvested by commercial fishermen (155,000 kg or 342,000 lb) and 33% by recreational fishermen (78,000 kg or 172,000 lb). Figure 1 (page 48) contains information for additional years.

The red porgy minimum size limit of 12" was implemented in January 1992 (Snapper Grouper Amendment 4). The red porgy minimum size limit became 12" TL in the State of Florida effective March 1, 1994. Data from 1991 are included as a comparison of pre-size limit catches. During 1996, 6% of the recreational (MRFSS) catch, 10% of the headboat catch, and 5% of the commercial catch was below the 12" minimum size limit (Table 31). Although compliance with the minimum size limit is improving, non-compliance is negatively impacting stock rebuilding.

Impacts of size limits are presented in two ways. First, the direct reduction in landings by sector is examined using data for each species as shown for red porgy in Table 32. Then the overall reduction is determined by weighting the reduction for each sector by the landings for each sector. This methodology is described under the Economic Impacts heading for red porgy (see below) and is the same for each species. The total percent reduction in numbers of fish is then compared with the percent reduction in fishing mortality required to reach 30% SPR. Analyses for all measures assume the reduction in numbers of fish is equivalent to an equal reduction in fishing mortality (F). This assumption is valid as long as the number of trips does not increase significantly. We have no way of gauging the future number of trips. In addition, reductions in terms of weight are presented and used to gauge economic value based on price per pound.

A 14" size limit would reduce the recreational catch by 37% based on numbers of fish (Table 32). Based on 1995 data on numbers of fish, a bag limit of 5 in combination with a 14" size limit would reduce the charter boat and headboat catches by 36% and 61% respectively (Table 33). There are no bag limit savings for bag limits of 1-5 fish with size limits of 12-14" for the private/rental sector; the 14" size limit in conjunction with a 5-fish bag limit would reduce the private/rental boat catch by 33% based on numbers of fish (NMFS Beaufort Lab analyses of impacts, 1996). It should be noted that increasing the size limit would result in about a two year loss in yield before the increased size limit would produce a weight gain.

The size limit will reduce the commercial catch by 40% based on numbers of fish (Table 32). Closure of the commercial fishery during March and April will reduce the commercial catch by 25% based on numbers of fish (Table 34).

To achieve a transitional SPR of 30% (overfished level), total fishing mortality must be reduced by 65%. To achieve the long-term goal of 40% static SPR, fishing mortality must be reduced by 75%. The proposed combination of recreational and commercial measures will reduce the commercial catch by 65%, the recreational catch by 50%, and the total catch by 59% based on numbers of fish.

Table 31. Percent of Red Porgy Catch Below Legal Size Limit. (Source: Mays and Manooch, 1997).

Year	Headboat	Recreational (MRFSS)	Commercial
1996	10%	6%	5%
1995	8%	30%	5%
1994	11%	37%	5%
1993	13%	6%	6%
1992	24%	66%	NO DATA
1991	32%	51%	24%

Table 32. Red Porgy Catch Reduction By Size Limits. (Source: 1995 NMFS Beaufort Lab).

Size Limit TL (in)	NUMBER			WEIGHT		
	Commercial Cumulative %	Recreational Cumulative %	Total Cumulative %	Commercial Cumulative %	Recreational Cumulative %	Total Cumulative %
12	4.91	5.91	5.06	2.24	2.86	2.33
13	21.87	20.79	21.70	12.07	12.03	12.06
14	**39.55**	37.29	**39.20**	**24.85**	**24.86**	**24.85**
15	60.18	89.99	64.69	43.15	75.14	47.70
16	73.72	96.08	77.10	57.74	82.20	61.22
17	85.17	98.42	87.16	72.42	85.43	74.27
18	90.19	99.55	91.59	80.10	87.28	81.12
19	94.26	99.61	95.05	87.38	98.99	89.03
20	98.82	99.73	98.94	96.90	99.26	97.23
21	99.57	100.01	99.62	98.72	99.98	98.89
22	99.86		99.87	99.53		99.59
23	99.94		99.94	99.78		99.80
24	99.97		99.96	99.78		99.89
25						
26	100.00		99.98	100.01		100.00

Table 33. Reduction in Landings from Size and Bag Limits. Red Porgy 14" Size Limit from 1995 MRFSS Data. (Source: R. L. Dixon et al, NMFS Beaufort Laboratory, April 1997).

BAG LIMIT	HEADBOAT		CHARTER BOAT	
	% REDUC. #	% REDUC. WT.	% REDUC. #	% REDUC. WT.
1	69.0	56.3	64.8	63.4
2	63.3	49.3	48.5	44.1
3	61.6	47.2	41.6	35.9
4	60.8	46.1	38.4	32.1
5	**60.5**	**45.7**	**35.9**	**29.2**

Table 34. Monthly Landings of Red Porgy in 1995 for the entire South Atlantic Region from the General Canvass Database. Source: Linda Hardy, NMFS Beaufort Laboratory, October 10, 1997.

MONTH	WEIGHT (LBS)	CUM. WEIGHT	# OF FISH
JANUARY	18,549	18,549	12,366
FEBRUARY	24,003	42,552	16,002
MARCH	55,614	98,166	37,076
APRIL	30,823	128,989	20,549
MAY	28,504	157,493	19,003
JUNE	38,387	195,880	25,591
JULY	51,874	247,754	34,583
AUGUST	33,729	281,483	22,486
SEPTEMBER	15,583	297,066	10,389
OCTOBER	12,435	309,501	8,290
NOVEMBER	16,595	326,096	11,063
DECEMBER	19,404	345,500	12,936
TOTAL	**345,500**		**230,333**
MARCH & APRIL CLOSURE	**Av. wt. = 1.50 pounds (from Figure 1)**		
Total savings (lbs):	**55,614 + 30,823 = 86,437**		
Total savings (# of fish):	**37,076 + 20,549 = 57,625**		
% reduction (# of fish):	**57,625/230,333 = 25%**		

Economic Impacts

Commercial fishermen would incur a 40% reduction (in numbers of fish) in landings due to the size increase alone in the first year (Table 32). Based on 1995 (Trends database), this could result in reduced landings of 137,102 pounds ($164,500 in gross revenue from red porgy sales) in the first year. The average exvessel price is $1.20 per pound (1995 Snapper Grouper Commercial Logbook Report). The March and April closure would result in a 25% decrease (in numbers of fish) in landings for commercial fishermen in the first year based on 1995 landings (General Canvass; Table 34). This is equivalent to a reduction of 86,437 pounds ($104,000) of fish in the first year. Thus, the total reduction to commercial fishermen as a result of the combined measures is likely to be 65% or 223,539 pounds of fish with an estimated ex-vessel value of $268,000.

It is not known to what extent fishermen would be able to compensate for a reduction in red porgy landings by increasing fishing effort on other species. However, it is possible that fishermen are getting to the point where no substitutes are available because virtually all of the species have a number of restrictive regulations in place or contemplated to be put in place. Assuming that some fishermen may be able to switch to alternative fisheries, this would be done at a cost to them because the alternative fisheries are second best by definition. Also, their switching would be at a cost to the fishermen currently targeting the alternative species.

The extent of the impact on the recreational fishery would depend on the number of recreational fishermen targeting red porgy. If fewer target red porgy, the impact would be less than if a large number target this species. Based on 1995 data, a 14" size limit in conjunction with a 5-fish bag limit would reduce the private/rental boat catch by 33% in numbers of fish in the first year (Bob Dixon's April 1997 Report). For the headboat category, catch would be reduced by 61% in numbers of fish in the first year (Table 33). Total catch for the charter boat sector would be reduced by 36% in numbers of fish in the first year (Table 33). The combined catch for the recreational sector would be reduced by 50% in numbers of fish in the first year. Using 1995 landings data for both sectors (Trends and General Canvass database), total catch for the red porgy fishery would be reduced by 59% in numbers of fish in the first year.

The preceding analysis demonstrates the impact of Amendment 9 regulations over Amendment 8 regulations.

Social Impacts

Support for changing the size limit was mixed during the two sets of public hearings held to address this issue. Many people commenting suggested a smaller size limit than the 14" proposed originally during public hearings for Amendment 8. There was some support for a 5 fish bag limit expressed in several of the public hearings. Because the reductions will be substantial, the overall social impacts from increasing the size limit to 14" and imposing a 5 fish bag limit will depend upon the ability of fishermen to adjust to such an action.

If commercial fishermen can easily substitute another species, or replace lost income, they may see benefits to such an increase as the stock rebounds over time. Red porgy is an important species for commercial fishermen in the northern area. Species substitution may not be easy as their dependence upon this particular fishery may be seasonal and important to the household or business at that time. If substitution is not easy, fishermen may increase their effort on this species. Where that effort shift would occur, is unclear as most snapper grouper *fishermen hold a variety of permits. There will be a moratorium imposed on issuing king mackerel permits once Amendment 8 to the FMP for Coastal Pelagic Resources is implemented that is retroactive to October, 1995. However, with over 1,300 king and Spanish mackerel permits for the south Atlantic in 1994, it is likely that most snapper grouper fishermen who would shift their effort to mackerel already hold the necessary permit and would be eligible under the moratorium. The coastal pelagic fisheries could see substantial effort increases with this action, in addition to others within this amendment.*

The combined impact on commercial fishermen of this measure with other measures proposed in this amendment could be substantial. There is the possibility that some individuals whose business has been operating on the margin may be forced to leave if alternative fisheries or other means of substituting for lost income are not readily available. Their ability to enter other fisheries will depend upon their present capability to diversify their fishing practices. Other alternatives for replacing lost income will depend upon the ability of fishermen or other household members to take on any or additional responsibilities for the household income. That capability is certainly tied to the availability of work and the possession of individual skills needed for jobs that are available. Many fishing communities are located in rural areas where job opportunities are limited, although, fishermen often have skills that are compatible with many of the short term and/or part time work opportunities available in rural areas. The key is whether those opportunities will exist at the same time fishermen will be in need of them.

Recreational fishermen may be satisfied with a 5 fish bag limit, but, this will depend upon past fishing practices and whether or not they have become accustomed to keeping larger numbers of red porgies. Bag limits are an acceptable form of management to recreational fishermen as long as that limit does not go below a certain preference level. That preference level is species specific and may vary according to region. From previous public comments, it seems that recreational fishermen may be satisfied with a 5 fish bag limit on red porgy as there was some support for it shown during public hearings. There will likely be species substitution once fishermen have reached their bag limit, thereby increasing pressure on other species, or possibly high-grading for larger fish. Which species would act as a substitute for red porgy is not known, but will likely be other species in the snapper grouper complex that are also overfished.

This action will likely have the greatest impact in the headboat/charter boat sectors with 61% and 36% reductions in numbers of fish respectively. Although there was no clear consensus from the public hearings, many fishermen from the northern areas indicated that a 14" size limit for red porgies may be too strict; a five fish bag limit did receive support. Charter and headboats can always target other fish, however if porgies continue to be caught, release mortality may become a factor.

Conclusion

The Council's preferred option in the public hearing draft of Amendment 8 was a 14" TL size limit for both recreational and commercial fishermen and a bag limit of 2 red porgy. Based on comments that the impacts were too great, the Council modified their preferred option to a 13" TL size limit and a 2-fish bag limit in the public hearing draft of Amendment 9. Additional commercial restrictions were evaluated under Action 11 in the public hearing draft of Amendment 9.

Red porgy were documented as overfished in 1991, and the Council established a rebuilding timeframe of 10 years or by the year 2001. Using SPR as the measure of stock status precludes the production of yield streams which would allow the Council to project which year the red porgy stock would be rebuilt. Such yield streams are available from yield-per-recruit analyses. The Council has requested the NMFS Southeast Fisheries Science Center to explore techniques to provide projections of yield streams. Results of such projections were not available at the August 1997 Council meeting. Also, at the August 1997 meeting, the Council was informed by NMFS that the proposed 20% overfishing level included in Snapper Grouper Amendment 8 would be disapproved. Further, in finalizing Snapper Grouper Amendment 9, the Council should propose actions that would be expected to rebuild overfished species above the 30% SPR level within 10 years. Recent guidance from NMFS indicates year one begins upon implementation of measures proposed to restore a stock above the overfished level. In the case of Amendment 9 that should have been sometime in 1998, however, due to significant delays in the review and implementation process, Amendment 9 was not implemented until February 24, 1999. The red porgy stock would have to be rebuilt by 2009. [Note: During development of Amendment 12, the NMFS provided the Council with an 18 year rebuilding time frame.]

Fishing mortality needs to be reduced by 75% to achieve the long-term goal or optimum yield (OY) of 40% static SPR and by 65% to reach the short-term goal (overfished level) of 30% transitional SPR. The combined 14" TL recreational and commercial size limit, 5-fish bag limit for the recreational fishery, and March/April commercial closure reduces the commercial catch by 65% and the recreational catch by 50%. The total catch would be reduced by 59% which is 6% less than the necessary reduction to achieve 30% SPR.

It is important to remember that the SPR estimate of 13% for red porgy the Council is working from is based on data only through 1992. Because the results of management measures to reduce fishing mortality on red porgy (that have been in place since 1991) have not been factored into a subsequent stock assessment, the Council believes the SPR estimate of 13% is low. The Council requested an updated assessment which would include more years of data under measures implemented in 1992 (Snapper Grouper Amendment 4) and has been told by NMFS the assessment would not be available until November 1998. Given that the Council did not actually know the current SPR but believed it to be greater than 13%, the Council concluded, in Amendment 9 that, the proposed actions would achieve the target reduction and meet the mandates of the Magnuson-Stevens Act to rebuild the red porgy stock above the overfished level. Also, some additional reductions in fishing mortality may occur through implementation of Snapper Grouper Amendment 8 which established a limited entry program.

The Council indicated their intent to monitor red porgy stock status and evaluate the 1998 updated stock assessment with data through 1997. If additional measures are necessary to rebuild above 30% transitional SPR and ultimately to 40% static SPR, the framework would be used to implement additional measures.

This option was the Council's preferred action in Snapper Grouper Amendment 9 and represents the "no action" alternative for the red porgy moratorium. The Council rejected this option because it would not result in rebuilding red porgy.

Rejected Option 3. Allow the retention of 50 pounds of red porgy per trip. Some allowance for multi-day trips would make this more equitable (e.g., 50 pounds per day).
[Note: The 50 pound trip limit was incorporated into the proposed action; see Action 4.]

Biological Impacts

This option alone would not rebuild red porgy above the minimum spawning stock threshold. A 50 pound trip limit, when combined with several other measures in the Council's proposed action, will result in rebuilding red porgy within 18 years.

Economic Impacts

First this analysis looks at the effect of the trip limit pre-Amendment 8. Then the effect of this option are compared to Amendment 9.

A restriction of 50 pounds of red porgy per trip could result in loss of gross revenue to commercial fishermen who participate in this fishery if the current operating practices in the fishery remained the same and if the price per pound of red porgy did not increase as a result of a reduction in landings. Most likely there would be a loss in net revenue as the harvesting costs per pound of fish landed would increase for those vessels that catch in excess of 50 lb per trip. To analyze the short term economic consequences of this option the data in Table 35 on catch distribution per trip was utilized.

Data on the frequency of trips that landed red porgy in the South Atlantic region in various poundage categories for 1993 to 1997 are provided in Table 35. For more than 50% of all trips, reported landings were 50 pounds or less, and for around 90% of all trips, landings amounted to 250 pounds or less, during this period. Based on the data from 1997, this 50 pound trip limit would impact 1,541 trips (Table 36). The decrease in revenue was calculated by assuming that all trips would be taken and standard operating practices in the fishery would not change. For example fishermen would not shift targeting behavior away from red porgy to other species in order to recoup some of the losses from a 50 pound trip limit.

The total reduction in exvessel value to commercial fishermen participating in this fishery as a result of a 50 pound trip limit could range from $137,051 to $317,256 (Table 36), averaging 250,968. There would be an additional reduction in revenue from the 14 inch minimum size limit. It is assumed that this would be 33% of the remaining revenue, which is $34,793 (($356,400 - $250,968 = $105,432)*0.33). If the trip limit results in lower total landings per unit of time, exvessel price could increase and some of the lost revenue from the reduced trip limit may be captured through an increase in exvessel price. Also, if fishermen put more emphasis on targeting other species then this range could overestimate revenue losses. Another matter to consider is that some trips may not be taken if trip costs exceed ex-vessel revenue from all species caught.

Table 35. Trip distribution by poundage categories for red porgy in the South Atlantic Region. Source: Dr. James Waters, NMFS Beaufort Lab.

POUNDS PER TRIP	1993		1994		1995		1996		1997	
	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%
0 - 50	1,716	54.7	1,899	55.5	2,082	56.8	1,862	54.2	1,981	56.2
51- 100	553	17.6	575	16.8	602	16.4	545	15.9	561	15.9
101- 150	269	8.6	305	8.9	339	9.3	300	8.7	322	9.1
151- 200	175	5.6	207	6.1	171	4.7	209	6.1	189	5.4
201- 250	121	3.9	137	4	145	4	122	3.5	115	3.3
251- 300	75	2.4	81	2.4	89	2.4	99	2.9	89	2.5
301- 350	54	1.7	61	1.8	64	1.7	67	1.9	50	1.4
351- 400	38	1.2	44	1.3	41	1.1	45	1.3	48	1.4
401- 450	25	0.8	27	0.8	23	0.6	28	0.8	40	1.1
451- 500	21	0.7	15	0.4	32	0.9	35	1	27	0.8
501- 550	16	0.5	19	0.6	17	0.5	27	0.8	13	0.4
551- 600	18	0.6	9	0.3	13	0.4	12	0.3	26	0.7
601- 650	9	0.3	6	0.2	8	0.2	18	0.5	10	0.3
651- 700	12	0.4	4	0.1	8	0.2	20	0.6	10	0.3
701- 750	7	0.2	4	0.1	8	0.2	6	0.2	7	0.2
751- 800	7	0.2	5	0.1	7	0.2	5	0.1	5	0.1
801- 850	1	0	6	0.2	3	0.1	8	0.2	5	0.1
851- 900			4	0.1	4	0.1	10	0.3	1	0
901- 951	7	0.2	3	0.1	2	0.1	2	0.1	2	0.1
951-1000	2	0.1					5	0.1	6	0.2
1001-1050			2	0.1	3	0.1	2	0.1	3	0.1
1051-1100	1	0					2	0.1		
1101-1150	1	0			1	0	3	0.1	3	0.1
1151-1200			2	0.1			2	0.1	1	0
1201-1250									1	0
1251-1300	1	0			1	0				
1301-1350	1	0	2	0.1			1	0.0	3	0.1
1351-1400	1	0								
1401-1450	2	0.1					1	0.0		
1451-1500			1	0			1	0.0	1	0
1501-2000	3	0.1	1	0			1	0.0	3	0.1
2001-2500	1	0	1	0						
TOTAL TRIPS	3,137		3,420		3,663		3,438		3,522	

Table 36. Trips where landings of red porgy exceeded 50 pounds. Source: Snapper Grouper Logbook Report, NMFS Beaufort Lab.

YEAR	TOTAL VESSELS	TOTAL TRIPS	REVENUE FROM RED PORGY	REVENUE FROM ALL SPECIES	LOSS IN REV. FROM A 50 LB TRIP LIMIT*	EXPECTED GROSS REV. FROM ALL SPECIES UNDER A 50 POUND TRIP LIMIT*
1993	211	1,421	327,000	3,252,579	228,951	3,023,628
1994	215	1,521	242,000	3,166,247	137,051	3,029,196
1995	229	1,581	367,000	3,970,304	257,911	3,712,393
1996	215	1,576	426,000	4,083,669	317,256	3,766,413
1997	217	1,541	420,000	4,085,948	313,671	3,772,277

* This represents the loss in red porgy revenue if vessels make the same number of trips and do not change current and standard operating procedures.

Results from the preceding analysis includes the impact of Amendment 9 (except the two month elosure) and this option. With Amendment 9 in place, this option would reduce ex-vessel revenue by $78,210 per year ($250,968-$172,758). This is based on the assumption that Amendment 9 would reduce ex-vessel revenue by $172,758 (see analysis under the proposed action).

Social Impacts

Without a total prohibition on the harvest and possession of red porgy, it is difficult to predict how both the commercial and recreational sectors will react. The 50 pound trip limit on red porgy is not seen as referring to bycatch reduction. As such, such a limit may not be viewed by either fishing sector as something to cover incidental bycatch of red porgy, but rather as a limit to be reached for each trip. There is no built in incentive for either commercial or recreational fishers to not catch the full limit each time they leave the dock. In the short-term, fishers may see a 50 pound limit as a less harsh restriction on their activities, and having less social repercussions. The long-term impact may be to retard the rebuilding timeframe. If this is the case, and the fishery collapses, the long-term impact of a 50 pound trip limit becomes increasingly negative on both the commercial and recreational fishing populations.

Conclusion

While this action would address some of the discards resulting from catching red porgy as a part of the multi-species, mid-depth snapper grouper fishery, the Council concluded this option would not result in rebuilding the red porgy resource, and rejected this option.

4.2.5 ACTION 5. Modify the Snapper Grouper Framework by adding the following list of management options and measures that could be implemented via framework action:

A. Description, identification, and regulations of fishing activities to protect EFH and EFH-HAPCs.

B. Management measures to reduce or eliminate the adverse effects of fishing activities or fishing gear on EFH or EFH-HAPCs.

C. Regulations of EFH-HAPCs.

Discussion

This action would allow the Council to address issues that impact negatively on EFH or EFH-HAPCs through the framework process. The framework procedure is included as Appendix G.

Rejected Options for Action 5:

Rejected Option 1. No Action.

Discussion

This action would not allow the Council to address issues that impact negatively on EFH or EFH-HAPCs through the framework process. Therefore, the Council rejected this option.

4.2.6 ACTION 6. Modify the Snapper Grouper Limited Access System to allow same owner permit transfers regardless of vessel size (length and tonnage) for individuals harvesting snapper grouper species with a non-transferable 225 pound trip limit permit.

Biological Impacts

None. These permit holders will still be limited to the 225 pound trip limit.

Economic Impacts

If individuals were allowed to transfer their permits to another vessel they would be constrained by the 225 pound trip limit. For permitted vessels that are not currently capable of harvesting the 225 lb trip limit, this action would result in increased gross revenue to those entities. However it is unclear as to whether this action would maximize benefits in the long term.

Social Impacts

Allowing boat owners to transfer their permits to another vessel will not change the end result of the action, which is to set a trip limit of 225 pounds. The only impacts for this action are positive ones, as it streamlines and lessens the paperwork necessary for vessel owners and retains the original spirit of Amendment 8. In addition, vessel safety and safety at sea are improved.

Conclusion

While one could construct mathematical examples where a permit holder may not be able to make a trip with a 16' boat in 3'-5' seas but could make such a trip in a 30'-40' boat, the Council concluded in Amendment 8 to allow the fishing mortality inflicted from all 225 pound trip limit permit holders making however many trips they wanted to make until they retired from the fishery. These permits are not transferable to another individual. It was not the Council's intent to prevent the permit holder from transferring the permit to a replacement vessel, nor was it the Council's intent to limit the vessel size under the 225 pound trip limit. In addition, this measure increases vessel safety and safety at sea.

Rejected Options for Action 6:

Rejected Option 1. No Action.

Biological Impacts

None. These permit holders will still be limited to the 225 pound trip limit.

Economic Impacts

If some vessels in the fishery were not able to catch and land 225 pounds, and this posed a constraint to the fishermen, then the no action option will not allow fishermen to increase revenue. At this time it is not possible to determine the long-term net economic benefits of this option.

Social Impacts

Transfer is consistent with the Council's original intent in developing Amendment 8. A probable social impact would be increasing mistrust of the federal fisheries regulatory process, which will further hinder future regulatory resolutions. Vessel safety and safety at sea would not be improved.

Conclusion

This option would not allow permit holders to transfer their permit to a replacement vessel. It was not the Council's intent to prevent permit holders from transferring the permit to a replacement vessel, nor was it the Council's intent to limit the vessel size under the 225 pound trip limit. Vessel safety and safety at sea would not be improved. Therefore, the Council rejected this option.

4.3 Research Needs

The research needs are listed in the original FMP (SAFMC, 1983) and Amendments 1-11 for snapper grouper. Also, the Council works with NMFS on an annual "Operations Plan" which identifies specific items to be done during the next year and identifies research needs. Red porgy demonstrate the need for additional fishery independent monitoring. The Council has requested NMFS increase the level of fishery independent data collection and monitoring for red porgy and other snapper grouper species. Expansion of the existing MARMAP Program would accomplish this goal.

4.4 Unavoidable Adverse Effects

The following summarizes the short-term losses which will be mitigated by long-term gains with the snapper grouper resources at Optimum Yield (see Table 1 and the discussion under each action item for more details):

Action 1. Maximum Sustainable Yield (MSY). This action by itself will not have an impact on the fishery.

Action 2. Optimum Yield (OY). This action by itself will not have an impact on the fishery.

Action 3. Overfishing & Rebuilding Timeframe. This action by itself will not have an impact on the fishery.

Action 4. Limit the Harvest and Possession of Red Porgy. It is expected that there would be a loss of about $159,358 in the commercial fishery in the short-term. There will be an additional loss of benefits to the recreational sector in the short-term.

Action 5. Modify the Snapper Grouper Framework. This action by itself will not have an impact on the fishery.

Action 6. Modify the Snapper Grouper Limited Access System. There could be a decrease in net benefits if this measure resulted in excess capacity in the fishery.

Without these management actions, red porgy would continue to be overfished and the requirements of the Magnuson-Stevens Act would not be met.

Therefore, the potential adverse effects resulting from the continued overfished status of the red porgy resource will be avoided. Also, the resulting large negative social and economic costs will be avoided. For additional justification see Sections 1.4, 1.5, 3.4, 4.2, 4.7, and 4.9.

4.5 Relationship of Short-term Uses and Long-term Productivity

The level of reduction proposed is necessary to ensure the long-term productivity of the red porgy resource. Without such regulations, the long-term yield of red porgy would be jeopardized. Again it must be remembered the measures contained in Amendment 8 established a limited entry program which changed the way in which fishermen think about the snapper grouper resource. It is now in their best interest to plan for the long-term and voluntary compliance will increase. They will bear the burden of management regulations (e.g., size limits, quotas, etc.) but the benefits will not be reduced by new entrants to the fishery.

The Council weighed the likely short-term losses to fishermen against the long-term yield in target species and the effect of the snapper grouper fishery on the ecosystem, and concluded the proposed actions would likely result in net benefits to society. For additional justification see Sections 1.4, 1.5, 3.4, 4.2, 4.7, and 4.9.

4.6 Irreversible and Irretrievable Commitments of Resources

There are no irreversible or irretrievable commitments of resources associated with the proposed actions. If the Council does not take action to regulate the red porgy fishery there would continue to be a reductions in yield.

4.7 Effects of the Fishery on the Environment

4.7.1 Damage to Ocean and Coastal Habitats

The proposed actions, and their alternatives, are not expected to have any adverse effect on the ocean and coastal habitats.

Management measures adopted in the original management plan through Amendment 7 combined have significantly reduced the impact of the fishery on essential habitat. The Council has reduced the impact of the fishery and protected essential habitat by prohibiting the use of poisons and explosives, prohibiting use of fish traps and entanglement nets in the EEZ, banning use of bottom trawls on live/hard bottom habitat north of Cape Canaveral, Florida, restricting use of bottom longlines to depths greater than 50 fathoms north of St. Lucie Inlet and only for species other than wreckfish and prohibit use of bottom longlines south of St. Lucie Inlet, and prohibiting use of black sea bass pots south of Cape Canaveral, Florida. These gear restrictions have significantly reduced the impact of the fishery on coral and live/hard bottom habitat in the South Atlantic region. For additional discussion see Sections 1.3, 8.4, and Appendix H.

Additional management measures in Amendment 8, including specifying allowable bait nets and capping effort, will protect habitat by making existing regulations more enforceable. Establishing a controlled effort program will limit overall fishing effort and to the extent there is damage to the habitat from the fishery (e.g., black sea bass pots, anchors from fishing vessels, impacts of weights used on fishing lines and bottom longlines), such impacts will be limited.

In addition, measures in Amendment 9, which include further restricting longlines to retention of only deepwater species and requiring that black sea bass pots have escape vents and escape panels with degradable fasteners, will reduce the catch of undersized fish and bycatch and ensure that the pot, if lost, will not continue to "ghost" fish. Also, limiting the overall fishing mortality will reduce the likelihood of overharvesting of species with the resulting loss in genetic diversity, ecosystem diversity, and sustainability. For additional discussion see the information under each of the proposed measures in Section 4.2.

Measures adopted in the coral plan and shrimp plan have further restricted access by fishermen that had potential impacts on essential snapper grouper habitat. These measures include the designation of the Oculina Bank Habitat Area of Particular Concern and the Rock shrimp closed area (see Section 8.0 of this document and the Shrimp and Coral FMP/Amendment documents for additional information).

The Council's Comprehensive Habitat Amendment (SAFMC, 1998b) contains measures to expand the Oculina Bank HAPC and to add additional HAPCs.

4.7.2 Public Health and Safety

The proposed actions, and their alternatives, are not expected to have any substantial adverse impact on public health or safety. The proposed measures do not directly increase hazards for vessels or crew safety, however, to the extent the proposed measures result in a decrease in crew size, there may be vessel and/or crew safety issues.

4.7.3 Endangered Species and Marine Mammals

The original FMP prohibited use of poisons and explosives and limited use of fish traps to depths greater than 100 feet. In 1983, a Section 7 consultation under the ESA with NMFS concluded that the management actions contained in the Snapper Grouper FMP were not likely to adversely affect the continued existence of threatened or endangered sea turtles or marine mammals or result in the destruction or adverse modification of habitat that may be critical to those species. Amendment 1 to the FMP prohibited roller-rig trawls. Amendment 4 prohibited the use of fish traps and entanglement nets in the fishery. In addition, an "allowable gear" provision was implemented. Subsequent amendments have limited the use of sea bass pots to north of Cape Canaveral, Florida; limited the use of bottom longlines to depths greater than 50 fathoms and to areas north of St. Lucie Inlet, Florida; established special management zones where all gear other than hook-and-line and diving are prohibited; and prohibited fishing for bottom species in the Oculina Bank HAPC. Consultations on these actions concluded on April 28, 1989; July 6, 1990; March 7, 1991; May 3, 1991; September 19, 1991; December 30, 1992; September 21, 1993; and March 18, 1994. The latest consultation was for Amendment 8 on May 16, 1997. All consultations concluded that neither the proposed management measures nor the fishery would adversely affect the recovery of endangered or threatened species, or their critical habitat. A description of the need for management and fishing practices is given in Section 1 and Section 3.3.

The gear currently allowed, as described above, are believed to have few, if any interactions with endangered species and marine mammals. NMFS currently has no information on documented interactions with marine mammals or endangered species in this fishery. Consequently, the fishery is listed as a Category III fishery (indicating interactions are rare to non-existent) in the 1997 List of Fisheries.

Amendment 12 will further reduce fishing pressure on red porgy. Therefore, the Council has concluded that neither the proposed management measures in Amendment 12 nor the fishery will adversely affect the recovery of endangered or threatened species, or their critical habitat.

4.7.4 Cumulative Effects

The proposed actions, and their alternatives, are not expected to result in cumulative adverse effects that could have a substantial effect on the snapper grouper resource or any related stocks, including endangered and threatened species, such as turtles. In fact, the proposed measures will improve status of red porgy stock. See Table 1 for more information.

There will also be cumulative positive effects. Rebuilding the overfished red porgy will ensure the long-term productivity of the red porgy resource. This will achieve the Council's biological objective of preventing overfishing.

4.7.5 Effects of Fishery on Human Environment

Red porgy remain overfished. Amendment 8 implemented a controlled access program and Amendment 9 contained measures to rebuild red porgy. Amendment 9 was not implemented until February 24, 1999 and has not been in effect long enough to generate much progress towards rebuilding red porgy.

Amendment 12 proposes measures to further reduce fishing mortality on red porgy. For additional discussion please refer to the information presented for each Action in Section 4.2.

Social and economic information on fishermen is extremely limited. Surveys of portions of the commercial snapper grouper fishery have been completed in the recent past. Preliminary results are included in Section 3.3.1 and have been used in analyzing the social and economic impacts of each Action as shown in Section 4.2.

Detailed discussions of the proposed measures on the human environment are presented under each Action in Section 4.2. For a summary of the economic and social impacts please refer to Tables 1 and 2 which summarize the impacts described in Section 4.2.

4.8 Public and Private Costs

Preparation, implementation, enforcement, and monitoring of this and any federal action involves expenditure of public and private resources which can be expressed as costs associated with the regulation. Costs associated with Amendment 12 include:

Council costs of document preparation, meetings, scoping meetings, public hearings and information dissemination	$20,000
NMFS administrative costs of document preparation, meetings and review	$5,000
NMFS law enforcement costs	$10,000

Total	$35,000

4.9 Effects on Small Businesses: Initial Regulatory Flexibility Analysis

The Regulatory Flexibility Act requires a determination as to whether or not a proposed rule has a significant impact on a substantial number of small entities. If the rule does have this impact then an Initial Regulatory Flexibility Analysis (IRFA) has to be completed for public comment. The IRFA becomes final after the public comments have been addressed. If the proposed rule does not meet the criteria for "substantial number" and "significant impact" then a certification to this effect must be prepared.

This proposed rule, if promulgated, will :

- (i) Action 1. Maximum Sustainable Yield (MSY).
- (ii) Action 2. Optimum Yield (OY).
- (iii) Action 3. Overfishing & Rebuilding Timeframe.
- (iv) Action 4. (1) A recreational bag limit of 1 fish per person per day; (2) No harvest or possession over the bag limit and no possession or sale during the months of January, February, March, and April; (3) Maintain the 14 inch size limit; and (4) A 50 lb. by-catch per trip for permitted vessels from May 1 through December 31.
- (v) Action 5. Modify the Snapper Grouper Framework.
- (vi) Action 6. Modify the Snapper Grouper Limited Access System.

All of the commercial and recreational (headboats, charter boats, and private / rental boats) entities harvesting red porgy affected by the rule will qualify as small business entities because their gross revenues are less than $3.0 million annually. Hence, it is clear that the criterion of a substantial number of the small business entities comprising the snapper grouper harvesting industry being affected by the proposed rule will be met. The outcome of "significant impact" is less clear but can be triggered by any of the five conditions or criteria discussed below.

The regulations are likely to result in a change in annual gross revenues by more than 5 percent. The discussions under economic impacts in Section 4 details the effects on commercial and recreational entities for each proposed action to the extent possible. For the commercial sector, it is estimated that the red porgy action would reduce annual gross revenue by approximately $481 per vessel in the first year. This represents at least 3% reduction in revenue.

The recreational entities that are likely to experience any change in annual gross revenue as a result of the proposed actions are the headboat and charter boat sectors. This will occur if the restrictions on harvest causes decreased recreational satisfaction to anglers to the extent that demand for headboat and charter boat trips declines.

Annual compliance costs (annualized capital, operating, reporting, etc.) increase total costs of production for small entities by more than 5 percent. The actions will not increase compliance costs.

Compliance costs as a percent of sales for small entities are at least 10 percent higher than compliance costs as a percent of sales for large entities. All the firms expected to be impacted by the rule are small entities and hence there is no differential impact.

Capital costs of compliance represents a significant portion of capital available to small entities considering internal cash flow and external financing capabilities. The proposed actions do not require any existing fishing entity to acquire new equipment or to completely refit existing equipment for compliance purposes.

The requirements of the regulation are likely to result in a number of the small entities affected being forced to cease business operations. This number is not precisely defined by SBA but a "rule of thumb" to trigger this criterion would be two percent of the small entities affected. Given the information available for these analyses (refer to economic impacts for each proposed action), it is not possible to determine if any of these entities will be forced out of business. The results show that there would be some short-term reduction in annual gross revenue and some increase in operating costs, but these would be compensated for by the projected increase in overall net benefits from the fishery in the long-term.

Considering all the criteria discussed above, the conclusion is that small businesses will be significantly affected by the proposed rule. Hence, the determination is made that the proposed rule will have a significant impact on a substantial number of small business entities and an Initial Regulatory Flexibility Analysis (IRFA) is required.

The full details of the economic analyses conducted for the proposed rule are contained in the RIR under the heading "Economic Impacts" in Section 4. Some of the relevant results are summarized below for the purposes of the IRFA.

Description of the reasons why action by the agency is being considered. The Magnuson-Stevens Fishery Conservation and Management Act provides for the management of fish stocks at the maximum sustainable yield (MSY) level. This will require rebuilding schedules for fish stocks that are below such level. Excessive fishing mortality are currently being applied to some fish stocks thus jeopardizing the biological integrity of those stocks. The use of some types of fishing gear results in habitat degradation, which adversely affects fish stocks and associated habitat.

Statement of the objectives of, and legal basis for, the proposed rule. The following objective is a part of these actions: (1) Prevent overfishing in all species by maintaining the spawning potential ratio (SPR) at or above optimum yield levels. The Magnuson-Stevens Fishery Conservation and Management Act (Public Law 94-265) as amended through October 11, 1996 provides the legal basis for the rule.

Description and estimate of the number of small entities to which the proposed rule will apply: The proposed rule will apply to all of the entities that will qualified for a snapper grouper permit under the limited entry program implemented in Amendment 8 and recreational entities (headboats, charter boats). As of 2/24/99 the National Marine Fisheries Service reported that there were 1,178 snapper grouper permits issued in the South Atlantic region. Of these 883 are transferable and 295 are non-transferable. Preliminary results from an economic survey of commercial snapper grouper fishermen conducted in 1994 (Waters, pers. comm.) indicate that the average investment in vessel and equipment ranged from $53,000 for vessels operating with vertical lines to $237,000 for vessels operating with bottom longlines. The estimated cost of new vessels comparably equipped ranged from an average of $113,000 for vessels with vertical lines to $340,000 for vessels with bottom longlines. Data extrapolated from the General Canvass data for 1995 indicate an estimated annual exvessel value of $15.5 million generated by commercial vessels that landed snapper grouper species. An average of 331 vessels land red porgy. Log book catch records indicate that Amendment 12 regulations are likely to impact 268 boats.

Description of the projected reporting, recordkeeping and other compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirement and the type of professional skills necessary for the preparation of the report or records: The proposed rule will not require any additional reporting or recordkeeping on the part of commercial and recreational entities. Compliance will be monitored through existing systems established by the National Marine Fisheries Service and the U.S. Coast Guard. The professional skills necessary to meet these requirements will not change relative to the level that all the fishermen are familiar with and have previously used.

Identification of all relevant Federal rules which may duplicate, overlap or conflict with the proposed rule. No duplicative, overlapping or conflicting Federal rules have been identified.

Description of significant alternatives to the proposed rule and discussion of how the alternatives attempt to minimize economic impacts on small entities. In Section 4, each proposed action includes a number of options under the heading: "Other Possible Options for Actions 1 - 5". Each of these options include an economic impact assessment. Refer to Section 4.2: "Management Options" for details of the economic impact assessment on small entities for each option. The status quo or "no action" option was also considered for each proposed action. Relative to the proposed actions, all the other possible options would result in lesser net benefits from the fishery in the long-term. Some of the options would minimize economic impacts on small entities in the short-term, but would not achieve the council's goal of managing species in the management unit at the optimum yield level. Thus, these options would not meet the stated objectives of the Snapper Grouper FMP.

5.0 LIST OF PREPARERS

Gregg T. Waugh, Deputy Executive Director, South Atlantic Fishery Management Council
Dr. Vishwanie Maharaj, Fishery Economist, South Atlantic Fishery Management Council
Dr. Kathi Kitner, Fishery Cultural Anthropologist, South Atlantic Fishery Management Council
Roger Pugliese, Fishery Biologist, South Atlantic Fishery Management Council
Kerry O'Malley, Fishery Biologist, South Atlantic Fishery Management Council

The following individuals assisted by reviewing drafts of this document:
Robert K. Mahood, Executive Director, South Atlantic Fishery Management Council

Analyses developed by the following NMFS scientists were used in development of Amendment 12:
Dr. Joseph E. Powers, NMFS SEFSC, Miami Lab
Dr. Douglas S. Vaughan, NMFS SEFSC, Beaufort Lab
Dr. James R. Waters, NMFS SEFSC, Beaufort Lab
Jennifer C. Potts, NMFS SEFSC, Beaufort Lab
Dr. Charles S. Manooch, III, NMFS SEFSC, Beaufort Lab
Michael L. Burton, NMFS SEFSC, Beaufort Lab
G. Nelson Johnson, NMFS SEFSC, Beaufort Lab
Linda F. Hardy, NMFS SEFSC, Beaufort Lab
Bob Dixon, NMFS SEFSC, Beaufort Lab

Work by the following South Carolina State and University scientists was invaluable in preparing Amendment 12:
Ray J. Rhodes, SC DNR
Wayne Waltz, SC DNR
Robert Wiggers, SC DNR
Dr. Ken Backman, Clemson
G. Hawkins, SC DNR
Kim Iversen, SC DNR
Dr. Jack McGovern, SC DNR
Dr. Pat Harris, SC DNR
Daniel J. Machowski, SC DNR

6.0 LIST OF AGENCIES AND ORGANIZATIONS

Responsible Agency
South Atlantic Fishery Management Council
1 Southpark Circle
Southpark Building, Suite 306
Charleston, South Carolina 29407-4699
(843) 571-4366
(843) 769-4520 (FAX)
safmc@noaa.gov (email)

List of Agencies, Organizations, and Persons Consulted
SAFMC Law Enforcement Advisory Panel
SAFMC Snapper Grouper Advisory Panel
SAFMC Scientific and Statistical Committee
North Carolina Coastal Zone Management Program
South Carolina Coastal Zone Management Program
Florida Coastal Zone Management Program
Florida Department of Environmental Protection
Florida Marine Fisheries Commission
Georgia Department of Natural Resources
Gulf and South Atlantic Fisheries Development Foundation
Gulf of Mexico Fisheries Management Council
South Carolina Department of Natural Resources
North Carolina Department of Environment, Health, and Natural Resources
Monroe County Commercial Fishermen, Inc.
New River Fisherman's Association
North Carolina Fisheries Association, Inc.
National Marine Fisheries Service
- Washington Office
- Office of Ecology and Conservation
- Southeast Region
- Southeast Fisheries Science Center

National Oceanic and Atmospheric Administration
- General Counsel

United States Coast Guard
United States Environmental Protection Agency, Region IV
Center for Marine Conservation
National Fisheries Institute
Florida Sea Grant
Atlantic Coast Conservation Association
Atlantic States Marine Fisheries Commission
North Carolina Fisheries Association
Organized Fishermen of Florida
Recreational Fishing Alliance (RFA)
Southeastern Fisheries Association

7.0 OTHER APPLICABLE LAW

7.1 Vessel Safety

PL. 99-659 amended the Magnuson Act to require that a fishery management plan or amendment must consider, and may provide for, temporary adjustments (after consultation with the U.S. Coast Guard and persons utilizing the fishery) regarding access to the fishery for vessels otherwise prevented from harvesting because of weather or other ocean conditions affecting the safety of the vessels.

No vessel will be forced to participate in the fishery under adverse weather or ocean conditions as a result of the imposition of management regulations set forth in this amendment. Therefore, no management adjustments for fishery access will be provided.

There are no fishery conditions, management measures, or regulations contained in this amendment which would result in the loss of harvesting opportunity because of crew and vessel safety effects of adverse weather or ocean conditions. No concerns have been raised by people engaged in the fishery or the Coast Guard that the proposed management measures directly or indirectly pose a hazard to crew or vessel safety under adverse weather or ocean conditions. Therefore, there are no procedures for making management adjustments in this amendment due to vessel safety problems because no person will be precluded from a fair or equitable harvesting opportunity by the management measures set forth.

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

Amendment 8 to the Snapper Grouper Fishery Management Plan established a limited entry program. This program will remove much of the potential for creating "derby" fishing. Fishermen in the snapper grouper fishery will be better able to plan their fishing trips and avoid areas/times which pose safety risks (e.g., due to weather conditions).

7.2 Coastal Zone Consistency

Section 307(c)(1) of the federal Coastal Zone Management Act of 1972 requires that all federal activities which directly affect the coastal zone be consistent with approved state coastal zone management programs to the maximum extent practicable. While it is the goal of the Council to have complementary management measures with those of the states, federal and state administrative procedures vary and regulatory changes are unlikely to be fully instituted at the same time. Based upon the assessment of this amendment's impacts in previous sections, the Council has concluded this amendment is an improvement to the federal management measures for snapper grouper species.

This amendment is consistent with the Coastal Zone Management Plans of Florida, South Carolina, Georgia, and North Carolina to the maximum extent practicable.

This determination was submitted to the responsible state agencies under Section 307 of the Coastal Zone Management Act administering approved Coastal Zone Management Programs in the states of Florida, South Carolina, and North Carolina.

7.3 Endangered Species and Marine Mammal Acts

The original FMP prohibited the use of poisons and explosives and limited the use of fish traps to depths greater than 100 feet. In 1983, a Section 7 consultation under the ESA with NMFS concluded that the management actions contained in the Snapper Grouper FMP were not likely to adversely affect the continued existence of threatened or endangered sea turtles or marine mammals or result in the destruction or adverse modification of habitat that may be critical to those species. Amendment 1 to the FMP prohibited roller-rig trawls. Amendment 4 prohibited the use of fish traps and entanglement nets in the fishery. In addition, an "allowable gear" provision was implemented. Subsequent amendments have limited the use of sea bass pots to north of Cape Canaveral, Florida; limited the use of bottom longlines to depths greater than 50 fathoms and to areas north of St. Lucie Inlet, Florida; established special management zones where all gear other than hook-and-line and diving are prohibited; and prohibited fishing for bottom species in the Oculina Bank HAPC. Consultations on these actions concluded on April 28, 1989; July 6, 1990; March 7, 1991; May 3, 1991; September 19, 1991; December 30, 1992; September 21, 1993; and March 18, 1994. The latest consultation was for Amendment 8 on May 16, 1997. All consultations concluded that neither the proposed management measures nor the fishery would adversely affect the recovery of endangered or threatened species, or their critical habitat. A description of the need for management and fishing practices is given in Section 1 and Section 3.3.

The gear currently allowed, as described above, are believed to have few, if any interactions with endangered species and marine mammals. NMFS currently has no information on documented interactions with marine mammals or endangered species in this fishery. Consequently, the fishery is listed as a Category III fishery (indicating interactions are rare to non-existent) in the 1997 List of Fisheries.

Amendment 9 further restricted use of allowable gear and reduced fishing pressure. Therefore, the Council has concluded that neither the proposed management measures in Amendment 12 nor the fishery will adversely affect the recovery of endangered or threatened species, or their critical habitat.

Listed and protected species under the Endangered Species Act (ESA) and Marine Mammals Protection Act (MMPA) and governed by the jurisdiction of NMFS include:

	Whales:	Date Listed
(1)	The northern right whale- *Eubalaena glacialis* (ENDANGERED)	12/2/70
(2)	The humpback whale- *Magaptera novaeangliae* (ENDANGERED)	12/2/70
(3)	The fin whale- *Balaenoptera physalus* (ENDANGERED)	12/2/70
(4)	The sei whale- *Balaenoptera borealis* (ENDANGERED)	12/2/70
(5)	The sperm whale- *Physeter macrocephalus* (ENDANGERED)	12/2/70
(6)	The blue whale- *Balaenoptera musculus* (ENDANGERED)	

	Sea Turtles:	Date Listed
(1)	The Kemp's ridley turtle- *Lepidochelys kempii* (ENDANGERED)	12/2/70
(2)	The leatherback turtle- *Dermochelys coriacea* (ENDANGERED)	6/2/70
(3)	The hawksbill turtle- *Eretmochelys imbricata* (ENDANGERED)	6/2/70
(4)	The green turtle- *Chelonia mydas* (THREATENED/ENDANGERED)	7/28/78
(5)	The loggerhead turtle- *Caretta caretta* (THREATENED)	7/28/78

Other:

(1) The manatee- *Trichechus manatus* (ENDANGERED)

On November 3, 1999, NMFS conducted a Section 7 consultation on Amendment 12 and determined that the proposed management measures will not adversely affect federally-listed endangered or threatened species, or their critical habitat.

7.4 Paperwork Reduction Act

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

The Council is not proposing measures under this amendment that will involve increased paperwork and consideration under this Act.

7.5 Federalism

No federalism issues have been identified relative to the actions proposed in this amendment and associated regulations. The affected states have been closely involved in developing the proposed management measures and the principal state officials responsible for fisheries management in their respective states have not expressed federalism related opposition to adoption of this amendment.

7.6 National Environmental Policy Act

The discussion of the need for this amendment, proposed actions and alternatives, and their environmental impacts are contained in Sections 1.0 and 2.0 of this amendment and the supplemental environmental impact statement. A description of the affected environment is contained in Section 3.0 and Council recommendations for protection and restoration of essential snapper grouper habitat and are contained in Section 8.0.

The proposed amendment is a major action having a significant positive impact on the quality of the marine and human environment of the South Atlantic. The proposed action will have a significant positive impact by reducing fishing mortality on overfished species. A formal Environmental Impact Statement (EIS) was prepared for the snapper grouper fishery for the original fishery management plan (SAFMC, 1983).

Mitigating measures related to proposed actions are unnecessary. No unavoidable adverse impacts on protected species, wetlands, or the marine environment are expected to result from the proposed management measures in this amendment.

The proposed regulations will further protect other species presently caught and discarded as unwanted bycatch. Overall, the benefits to the nation resulting from implementation of this amendment are greater than management costs.

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

Section 4.0 describes the Council's management measures in detail. Section 1508.27 of the CEQ Regulations list 10 points to be considered in determining whether or not impacts are significant. The analyses presented below are based on the detailed information contained in Section 4.0 Environmental Consequences including the Regulatory Impact Review, Regulatory Flexibility Determination, and Social Impact Assessment.

Beneficial and Adverse Impacts

There are beneficial and adverse impacts from the proposed actions. The impacts are described for each action in Section 4.0 and summarized in Section 2.0.

The Council is proposing to:

Action 1. Maximum Sustainable Yield (MSY).
Action 2. Optimum Yield (OY).
Action 3. Overfishing & Rebuilding Timeframe.
Action 4. Limit the Harvest and Possession of Red Porgy.
Action 5. Modify the Snapper Grouper Framework.
Action 6. Modify the Snapper Grouper Limited Access System.

Summary of Adverse Impacts: There will be short-term economic losses to both the commercial and recreational fisheries. These short-term losses are necessary to rebuild the overfished stock. The short-term losses will be outweighed by the long-term benefits from a sustainable red porgy resource.

Without management, red porgy would remain overfished. In the absence of additional management measures limiting fishing mortality rate, such declines would be expected to continue and could reach such low levels that the red porgy fishery would no longer be economically feasible. If this situation were allowed to continue, the fishery would ultimately collapse. For a detailed discussion of the biological, social, and economic adverse impacts of the proposed measures refer to the biological, social, and economic impact discussions under each Action in Section 4.2.

Summary of Beneficial Impacts: The proposed measures will limit fishing mortality and rebuild the red porgy resource. These measures will, over time, result in rebuilding the resource to the long-term goal (Optimum Yield) of the amount of harvest while maintaining the SPR at or above 45% static SPR. For a detailed discussion of the biological, social, and economic beneficial impacts of the proposed measures refer to the biological, social, and economic impact discussions under each Action in Section 4.2.

Public Health or Safety

The proposed actions, and their alternatives, are not expected to have any substantial adverse impact on public health or safety. The proposed measures do not directly increase hazards for vessels or crew safety, however, to the extent the proposed measures result in a decrease in crew size, there may be vessel and/or crew safety issues.

Unique Characteristics

The proposed actions have no impacts on characteristics of the area such as proximity to historic or cultural resources, park lands, wetlands, or ecologically critical areas.

Prior amendments (see snapper grouper, shrimp, and coral amendments) established an experimental closed area in the Oculina Habitat Area of Particular Concern (see Section 8.4). This area is being studied to evaluate the effectiveness of closed areas for protecting long-lived species such as snapper and groupers (see Section 1.5). Such areas are useful in preserving the genetic diversity present in such species. In addition, special management zones have been established around artificial reefs to preserve the original intent of such areas.

Controversial Effects

The proposed actions are expected to have significant controversial effects. The Council provided extensive opportunity for input by holding public hearings, and by providing the opportunity for interested persons to provide written comments. During development of this amendment, the Council addressed suggestions from the public. Additionally, states incorporate public input into their management measures which track the federal measures.

Uncertainty or Unique/Unknown Risks

The proposed actions are not expected to have any significant effects on the human environment that are highly uncertain or involve unique or unknown risks. Benefits from management cannot be quantified but the direction and relative magnitude are known and are positive. If the proposed actions were not implemented there would be a high level of uncertainty as to the future status of the species being impacted.

Precedent/Principle Setting

The proposed actions are not expected to have any significant effects by establishing precedent and do not include actions which would represent a decision in principle about a future consideration.

Relationship/Cumulative Impact

The proposed actions, and their alternatives, are not expected to result in cumulative adverse effects that could have a substantial effect on the snapper grouper resource or any related stocks, including endangered and threatened species, such as turtles. In fact, the proposed measures will improve status of stocks, minimize habitat damage, rebuild overfished stocks, minimize user conflicts, and protect threatened and endangered species. See Table 1 for more information.

The Council recognizes the actions proposed in Amendment 12 will result in some effort shift into other fisheries. It should be remembered these individuals are currently permitted in these fisheries and as a result would not represent "new" effort.

Fishermen have suggested the Council consider establishing a limited entry program for commercial fishermen versus the current fishery specific approach. The Council has discussed this in the past and will over the next two years further evaluate establishing a "Comprehensive Commercial Fishing Limited Entry Program" that crosses all fisheries under the Council's jurisdiction.

There will also be cumulative positive effects. Rebuilding the overfished red porgy resource will ensure the long-term productivity of this resource. This will achieve the Council's biological objective of preventing overfishing.

Historical/Cultural Impacts

The proposed actions are not expected to have any significant effects on historical sites listed in the National Register of Historic Places and will not result in any significant impacts on significant scientific, cultural, or historical resources.

Endangered/Threatened Species Impacts

The original FMP prohibited the use of poisons and explosives and limited the use of fish traps to depths greater than 100 feet. In 1983, a Section 7 consultation under the ESA with NMFS concluded that the management actions contained in the Snapper Grouper FMP were not likely to adversely affect the continued existence of threatened or endangered sea turtles or marine mammals or result in the destruction or adverse modification of habitat that may be critical to those species. Amendment 1 to the FMP prohibited roller-rig trawls. Amendment 4 prohibited the use of fish traps and entanglement nets in the fishery. In addition, an "allowable gear" provision was implemented. Subsequent amendments have limited the use of sea bass pots to north of Cape Canaveral, Florida; limited the use of bottom longlines to depths greater than 50 fathoms and to areas north of St. Lucie Inlet, Florida; established special management zones where all gear other than hook-and-line and diving are prohibited; and prohibited fishing for bottom species in the Oculina Bank HAPC.

The gear currently allowed, as described above, are believed to have few, if any interactions with endangered species and marine mammals. NMFS currently has no information on documented interactions with marine mammals or endangered species in this fishery. Consequently, the fishery is listed as a Category III fishery (indicating interactions are rare to non-existent) in the 1997 List of Fisheries.

Amendment 9 further restricted use of allowable gear and reduce fishing pressure. Therefore, the Council has concluded that neither the proposed management measures in Amendment 12 nor the fishery will adversely affect the recovery of endangered or threatened species, or their critical habitat.

Interaction With Existing Laws for Habitat Protection

The proposed actions are not expected to have any significant interaction which might threaten a violation of federal, state, or local law or requirements imposed for the protection of the environment. The habitat of stocks comprising the management unit is described in Section 8.2 and existing habitat protection programs are described in Section 8.2.4. Habitat areas of particular concern are described in Section 8.4. Federal habitat protection laws, programs, and policies are described in Section 8.5.1 and State habitat protection programs are described in Section 8.5.2.

The Council has adopted a habitat policy which is included Section 8.3.1. In addition, the Council has prepared and adopted a number of positions that direct the protection of essential habitat (see Sections 8.3.2, 8.3.3, 8.3.4, and 8.3.5. The Council has subsequently adopted a seagrass policy statement and presented available distribution maps (maps are in SAFMC, 1996) of this habitat essential to various snapper grouper species (including gag) as well as many other managed and non-managed species. This and other habitat policy statements are included in Section 8.3.2.

Effects of the Fishery on the Environment

Section 8.2 describes the habitat essential to species in the snapper grouper management unit. Section 3.0 Affected Environment combined with Section 4.0 Environmental Consequences, present the detailed information on the impacts of the proposed actions and alternatives on the environment.

Management measures adopted in the original management plan through Amendment 11 combined have significantly reduced the impact of the fishery on essential habitat. The Council has reduced the impact of the fishery and protected essential habitat by prohibiting use of poisons and explosives, prohibiting use of fish traps and entanglement nets in the EEZ, describing allowable gear, banning use of bottom trawls on live/hard bottom habitat north of Cape Canaveral, Florida, restricting use of bottom longlines to depths greater than 50 fathoms north of St. Lucie Inlet and only for species other than wreckfish and prohibiting use of bottom longlines south of St. Lucie Inlet, and prohibiting the use of black sea bass pots south of Cape

Canaveral, Florida. These gear restrictions have significantly reduced the impact of the fishery on coral and live/hard bottom habitat in the South Atlantic region. For additional discussion see Sections 1.3 and 8.4.

Additional management measures implemented through Amendment 9, further restricting longlines to retention of only deepwater species, will protect habitat by making existing regulations more enforceable. In addition, the requirement that black sea bass pots have escape vents and escape panels with degradable fasteners will reduce catch of undersized fish and bycatch and insure that the pot, if lost, will not continue to "ghost" fish. Also, limiting the overall fishing mortality will reduce the likelihood of overharvesting of species with the resulting loss in genetic diversity, ecosystem diversity, and sustainability. For additional discussion see the information under each of the proposed measures in Section 4.2.

Measures adopted in the coral plan and shrimp plan have further restricted access by fishermen that had potential impacts on essential snapper grouper habitat. These measures include the designation of the Oculina Bank Habitat Area of Particular Concern and the Rock shrimp closed area (see Section 8.0 of this document and the Shrimp and Coral FMP/Amendment documents for additional information).

Bycatch

Prior Council actions prohibiting roller-rig trawls (Snapper Grouper Amendment 1); prohibiting entanglement nets and fish traps, establishing allowable gear, and bottom longline restrictions (Snapper Grouper Amendment 4) have reduced bycatch in the snapper grouper fishery.

Measures implemented through Amendment 9 to address bycatch include: requiring escape vents and escape panels with degradable fasteners in black sea bass pots (Action 3), additional restrictions on longline gear (Action 10), and establishment of an aggregate recreational bag limit (Action 9). These actions will result in there being less of a bycatch issue in the snapper grouper fishery.

Amendment 12 will result in regulatory discards. The Council considered a total prohibition on harvest and possession but concluded the regulatory discards would be too great and represented a waste of red porgy that would be discarded dead without contributing to rebuilding. Instead, the Council settled on a 1-fish bag limit, a 50 pound trip limit, and 4-month seasonal closure that would allow fishermen to retain fish that would otherwise be discarded dead. The Council recognizes this will result in a slower rate of rebuilding but concluded the benefits outweighed the costs. In addition, the snapper grouper fishery operates under a controlled access program and fishermen have been asked to cooperate in avoiding red porgy to the maximum extent practicable. The Council concluded these measures minimize bycatch to the maximum extent practicable while allowing rebuilding of red porgy.

Effort Directed at or From Other Fisheries

The Council recognizes the actions proposed in Amendment 12 will result in some effort shift into other fisheries. It should be remembered these individuals are currently permitted in these fisheries and as a result would not represent "new" effort. Further, those not included in the limited entry program currently catch limited amounts of snapper grouper species and therefor must be actively fishing in these other fisheries. If this is the case, then any impacts from effort shifting would be expected to be minimal. Effort shifts into other fisheries would have been greater under a total moratorium.

8.0 DESCRIPTION OF HABITAT AND STOCKS COMPRISING THE MANAGEMENT UNIT

8.1 Description of the Stocks Comprising the Management Unit

Sections 8.1.1 through 8.1.10 of the original snapper grouper FMP (SAFMC, 1983), and the draft revised source document (SAFMC, 1991c) present detailed information on the stocks comprising the management unit. A complete list of species in the management unit is contained in Appendix A.

8.2 Description of Habitat of the Stocks Comprising the Management Unit

Snapper grouper utilize both pelagic and benthic habitats during their life cycle. A planktonic larval stage lives in the water column and feeds on zooplankton and phytoplankton. Juveniles and adults are typically demersal and usually associated with bottom topographies on the continental shelf (less than 100 m) that have high relief; i.e., coral reefs, artificial reefs, rocky hard-bottom substrates, ledges and caves, sloping soft-bottom areas, and limestone outcroppings. More detail on these habitat types is found in the Fishery Management Plan for Corals and Coral Reefs (GMFMC and SAFMC, 1982). However, several species are found over sand and soft-bottom substrates. Some juvenile snapper and grouper such as *Lutjanus analis*, *L. griseus*, *L. jocu*, *L. synagris*, *Ocyurus chrysurus*, *Epinephelus itajara*, *E. morio*, *Mycteroperca microlepis* and *M. venenosa*, may occur in inshore seagrass beds, mangrove estuaries, lagoons, and bay systems.

The principal snapper grouper fishing areas are located in live bottom and shelf-edge habitats, and to a lesser extent the lower habitat. Temperatures range from 11° to 27° C over the continental shelf and shelf-edge due to the proximity of the Gulf Stream, with lower shelf habitat temperatures varying from 11° to 14° C. Depths range from 54 to 90 feet or greater for live-bottom habitats, 180 to 360 feet for the shelf-edge habitat, and from 360 to 600 feet for the lower-shelf habitat.

The exact extent and distribution of productive snapper grouper habitat on the continental shelf north of Cape Canaveral is unknown. Current data suggest that from 3 to 30 percent of the shelf is suitable bottom. These hard, live-bottom habitats may be low relief areas supporting sparse to moderate growth of sessile invertebrates, moderate relief reefs from 1.6 to 6.6 feet, or high relief ridges at or near the shelf break consisting of outcrops of rock that are heavily encrusted with sessile invertebrates such as sponges and sea fans. Live-bottom habitat is scattered irregularly over most of the shelf north of Cape Canaveral, but is most abundant off northeastern Florida.

South of Cape Canaveral the continental shelf narrows from 35 to 10 miles and less off the southeast coast of Florida and the Florida Keys. The lack of a large shelf area, presence of extensive, rugged living fossil coral reefs, and dominance of a tropical Caribbean fauna are distinctive characteristics. The coral rock reefs, from 30 to 46 feet at the shallowest lies between West Palm Beach and Miami and from 80 to 125 feet for the deepest most rugged reefs, are natural habitats for snappers and groupers. These reefs comprise from 20 to 30 percent of the shelf area south of Cape Canaveral.

Man-made artificial reefs also are utilized to attract fish and increase fish harvests. Research on man-made reefs including those composed of cars, tires, pipes, etc., is limited and opinions differ as to whether or not artificial structures actually promote an increase of biomass or merely concentrate fishes by attracting them from nearby natural areas. Some evidence indicates that artificial reefs actually increase the standing stock of snappers and groupers (Stone, 1978; Stone et al., 1979). Driessen (1985) believes that, "offshore platforms and other artificial reefs raise primary productivity levels, create new habitats, augment carrying capacities, and increase the variety, numbers, range, size, and growth rates of highly desirable fish and shellfish." The following excerpt from Bohnsack and Sutherland (1985) adequately portrays the current state of knowledge on artificial reefs:

"Artificial reef literature was critically reviewed to determine what knowledge about the biology, ecology, and economics of artificial reefs had been scientifically established and to identify and recommend future projects, areas, and methods of research. General agreement exists that artificial reefs are effective fish attractants and an important fishery management tool. Most published papers deal with building artificial reefs or are qualitative descriptive studies detailing successional changes and species observed. Conclusions were often based on little or no scientific data. Few studies used quantitative experimental methods and many lacked scientifically valid controls.

Drastically different approaches to artificial reefs in terms of purpose, funding, research, materials, and size have been taken by Japan and the United States. Most marine artificial reefs in the United States are large, low budget, and haphazardly constructed from scrap materials, using volunteer labor. These reefs are usually built in deeper offshore waters for use by recreational fishermen with boats. Japan's artificial reefs, however, are designed and constructed by engineers, built of durable, non-waste, prefabricated materials, placed in scientifically selected sites in shallow and deep water, and are primarily used by commercial fishermen.

In this paper, 29 recommendations are made for future studies. Improved professional publication standards and more carefully controlled studies using an experimental approach are suggested. Greater emphasis should be placed on determining optimal design, size, and placement of artificial reefs to maximize production. More attention should be given to small, shallow, nearshore artificial reefs that are accessible without a boat. Also, reefs designed for increasing larval and juvenile recruitment, survival, and growth should be considered. Improved quantitative assessment techniques are needed to describe artificial reefs, reef communities, and to monitor biotic changes. Artificial reef data bases should be maintained so that the effectiveness of various artificial reefs can be more easily assessed. The importance of fish attraction versus fish production and the relationship between standing crop and fish catch have not been adequately addressed. The economics and social impact of artificial reefs also have not been carefully examined, especially the benefits from alternative designs and approaches."

Currently, Florida has the most active artificial reef program in the nation with over 300 constructed since 1986 representing over 50% of reefs created in US waters to date (Lindberg, 1996). Artificial reef programs also are underway in Georgia, South Carolina, and North Carolina.

8.2.1 Habitat Condition

Offshore areas used by adults appear to be the least affected by nearshore habitat alterations and water quality degradation. Since most of the catch comes from offshore in deeper water, there is an unknown effect of pesticides, herbicides, and other harmful wastes which have been considered as deleterious to many inshore fisheries (Ketchum, 1972; Walsh et al., 1981;

Walsh, 1984). Nearshore reefs have been adversely affected to various degrees by man (see later discussion), but overall are in good condition. Some coral reef tracts are protected. These include Dry Tortugas (Ft. Jefferson National Monument), Looe Key, Biscayne National Park, and Grays Reef. Other important areas are listed below.

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

- construction and maintenance of navigation channels;
- discharges from wastewater plants and industries;
- dredge and fill for land use development;
- agricultural runoff;
- ditching, draining, or impounding wetlands;
- oil spills;
- thermal discharges;
- mining, particularly for phosphate, and petroleum;
- entrainment and impingement from electric power plants;
- dams;
- marinas;
- alteration of freshwater inflows to estuaries;
- saltwater intrusion;
- non-point-source discharges of contaminants.

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

Important coral reef tracts have been identified in the South Atlantic in the Corals and Coral Reefs Fishery Management Plan (GMFMC and SAFMC, 1982). These include the Key Largo Coral Reef, Looe Key, Dry Tortugas, Biscayne National Park, *Oculina* Banks, and Grays Reef. Since these reefs play an essential role in the life cycle of the species by providing excellent snapper grouper habitat, they are again identified here.

Other valuable areas include John Pennekamp Coral Reef State Park at Key Largo, Florida, the Florida Reef Tract and the other reefs and live bottoms between North Carolina and Cape Canaveral, Florida. The relationship between snapper grouper and the estuaries is still poorly understood. If an obligatory relationship is determined in specific estuaries, then these estuaries also will be listed as Habitat Areas of Particular Concern.

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

8.2.2 Habitat Threats

Currently, the primary threat to offshore habitat comes from oil and gas development and production, offshore dumping, and the discharge of contaminants by river systems. The destruction of suitable reefs (natural and man-made) or other types of live bottom areas also may prove deleterious to this fishery as most of the current data indicate an affinity for these habitats by snapper grouper (Starck, 1968; Shinn, 1974; Huntsman and Waters, 1987). Natural impacts on reef habitat may arise from severe weather conditions such as hurricanes and excessive freshwater discharge resulting from heavy rain. Human impacts on reef habitat result from activities such as pollution, dredging and treasure salvage, boat anchor damage, fishing and diving-related perturbations, and petroleum hydrocarbons (Jaap, 1984). Ocean dumping and nutrient over-enrichment also may cause local problems. Discussion of some of these factors occurs in the Corals and Coral Reefs Fishery Management Plan (GMFMC and SAFMC 1982) and will not be repeated here.

Nearshore reefs, especially off Florida, may be impacted by coastal pollution such as sewage and non-point-source discharges, urban runoff, herbicides, and pesticides (Jaap, 1984). Residues of the organochlorine pesticides DDT, PCB, dieldrin, and endrin have been found in gag, red grouper, black grouper, and red snapper (Stout, 1980). Heavy metal accumulations in sediment and reef biota near population centers have been noted (Manker, 1975). Disposal of wastes has created local problems. Jaap (1984) reports of batteries and refuse disposed of on the reef flat at Carysfort Lighthouse in Florida. Juvenile snapper and grouper temporarily residing in estuaries may be adversely affected by coastal pollutants and alterations (Figure 9).

Any life stage of snapper grouper species may be affected by pollution (Figure 10) but during the first months is the time when fish can be particularly sensitive to toxins. Factors affecting prerecruit mortality are more significant in determining long-term population stability (Sindermann, 1994). Critical aspects determining the effects of pollution on fish presented by Sindermann (1994) include:

- location of spawning (freshwater, estuarine, coastal, offshore)
- location of egg deposition (pelagic, demersal)
- depth preference of hatched larvae in the water column - surface film to bottom
- location of nursery area for postlarvae and juveniles
- feeding behavior and diets of all life stagers
- extent of migration into and out of polluted zones, and duration of occupation of those zones

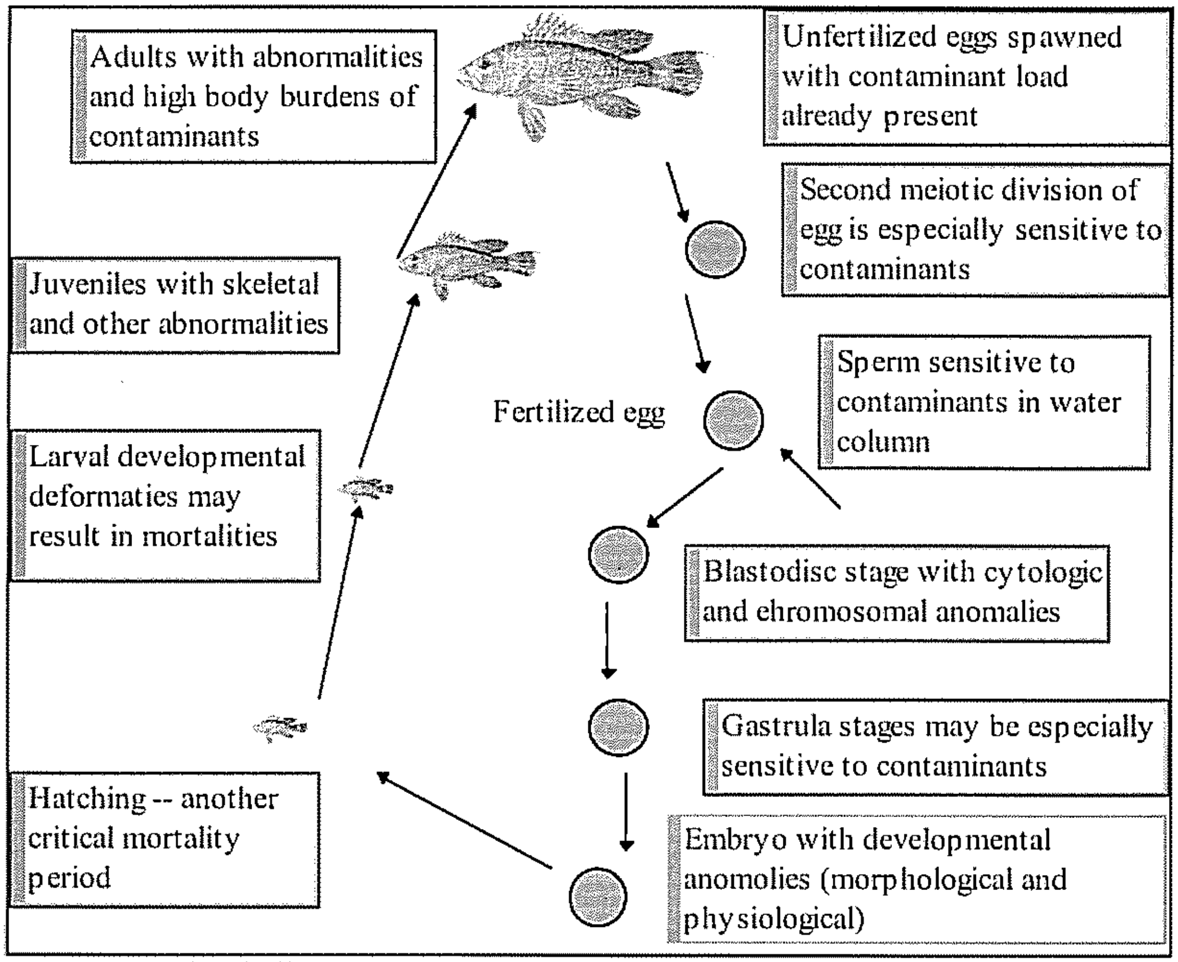


Figure 9. Points in life cycle where snapper grouper species are especially sensitive to pollutants (Adapted from Sinderman, 1994).

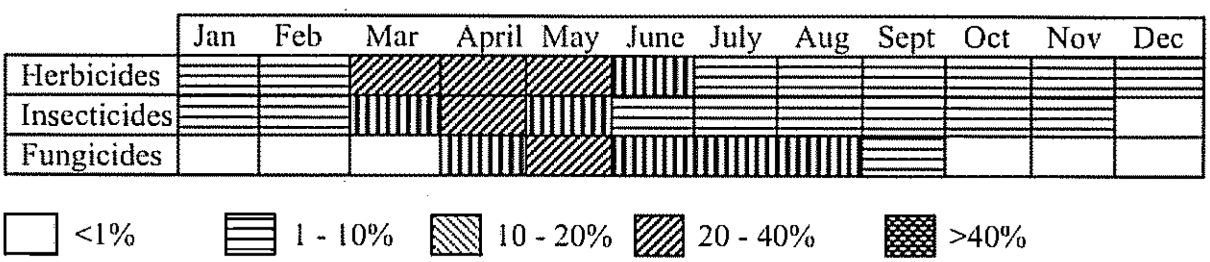


Figure 10. Seasonal application of pesticides in the South Atlantic region (Data Source: NOAA, 1992b).

Hydrocarbon pollution also may adversely affect fish and other biota. Malins (1982) reviewed laboratory experiments describing the deleterious effects of petroleum fractions on fish. Pierce et al. (1980) documented that wild fish have been injured by petroleum pollutants. Grizzle (1983) suggested that larger liver weights in fish collected in the vicinity of production platforms versus control reefs could have been caused by increased toxicant levels near the platforms. He also suspected that severe gill lamella epithelium hyperplasia and edema in red snapper, vermilion snapper, wenchman, sash flounder, and creole fish were caused by toxicants near the platforms. These types of lesions are consistent with toxicosis.

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

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

Recreational spearfishing, especially with explosive power heads, has damaged corals and may become more of a problem in areas of heavy diver concentration. Divers often overturn corals and cause other damage. Specimen collecting also may result in localized reef damage, especially when chemical collecting agents are improperly used. Collecting corals and the use of chemicals are regulated under the Coral Fishery Management Plan (GMFMC and SAFMC, 1982).

8.2.3 Habitat Information Needs

The vast majority of our highly valued living marine resources are critically dependent upon healthy environments. Declines in several of these commercially and recreationally important fisheries have been attributed to overfishing, loss of habitat, pollution, environmental alteration, disease, and natural variability of the stocks. Effective fisheries management requires an improved understanding of these factors.

The Council's chief concern related to living marine resources is how human activities impact fishery productivity. Research is needed to provide knowledge of the factors that affect energy flow. This understanding of ecological processes must then be combined with information on the health, distribution, and abundance of ecologically important organisms. By understanding the ecological linkages and information on the status of fishery stocks, managers of fisheries and habitat will be better able to manage estuarine dependent living marine resources.

To understand the causes of fishery declines and better predict the effects of human activities on fishery populations, the following research needs relative to snapper grouper habitat are provided so that state, federal, and private research efforts can focus on those areas that would allow the South Atlantic Fishery Management Council to develop measures to better manage snapper grouper and their habitat:

1. Identify optimum snapper grouper habitat and environmental and habitat conditions that limit snapper grouper production (e.g., what are the critical fisheries habitats for food, cover, spawning, nursery areas, and migration?);

2. Determine the relationship between juvenile snapper grouper and estuarine habitat. If an obligatory relationship is found, determine the distributions, rates of change, and documented causes of loss for estuarine habitat types;

3. Quantify the relationships between snapper grouper production and habitat (e.g., what are the key trophic pathways in the ecosystem, and how does the flux of essential nutrients, carbon compounds, and energy through these systems influence fisheries productivity?);

4. Determine the relative effects of fishing, pollution, and natural mortality on fishery population dynamics. Also determine the effects of cumulative habitat loss on fisheries productivity and economic value;

5. Determine methods for restoring snapper grouper habitat and/or improving existing environmental conditions that adversely affect snapper grouper production. The 29 recommendations for future studies in Bohnsack and Sutherland (1985) are supported here; and

6. Identify areas of particular concern for snapper grouper.

8.2.4 Habitat Protection Programs

State and Federal laws and policies that affect snapper grouper habitat are found in Section 8.3. Specific involvement by other federal agencies are noted as follows:

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

National Marine Fisheries Service. The Magnuson-Stevens Act provides for exclusive management of fisheries seaward of state jurisdiction. This includes both specific fishery stocks and habitat. The process for developing Fishery Management Plans is highly complex. It includes plan development by various procedures through fisheries management councils. National Marine Fisheries Service implements approved plans. The Coast Guard, National Marine Fisheries Service, and states enforce Fishery Management Plans. The National Marine Fisheries Service is responsible for data collection, research and resource assessment in support of Fishery Management Plans. Fishery Management Plans under authority of the South Atlantic Fishery Management Council for corals and coral reefs, snapper grouper, shrimp, golden crab, coastal migratory pelagics, and spiny lobster are in force.

National Park Service. National parks and monuments are under the jurisdiction of the National Park Service. Management, enforcement, and research are accomplished within the agency.

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

Fish and Wildlife Service. Fish and Wildlife Service assists with environmental impact review, develops biological resource evaluations, and administers the endangered species program with the National Marine Fisheries Service. The Fish and Wildlife Service manages parks and refuges for wildlife in the South Atlantic.

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

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

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

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

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

In administering the oil and gas resources on the Outer Continental Shelf, the Department of Interior through the Mineral Management Service has not been recognizing the authority of the Fish and Wildlife Coordination Act. Instead they have contended that the Outer Continental Shelf Lands Act, as amended, supersedes the Fish and Wildlife Coordination Act. They also require that the oil and gas lease permit stipulations be more closely coordinated with other

Department of Interior bureaus, e.g., Fish and Wildlife Service, as provided in Departmental Manual 655. Coordination with other federal and state agencies is less frequent. For example, coordination between National Marine Fisheries Service and Mineral Management Service results from NOAA participation in the Outer Continental Shelf Advisory Board and from authorities under the Endangered Species Act and National Environmental Policy Act. The latter involves the periodic review of environmental statements for proposed lease sales. While review under Endangered Species Act generally involves exploration and development plans, it is very difficult for agencies like National Marine Fisheries Service to have Mineral Management Service implement less environmentally damaging procedures in oil and gas operations around reefs, etc., if the Fish and Wildlife Service has not already objected to the procedure during the Department of Interior, Departmental Manual 655 coordination. However, though not required to do so, Fish and Wildlife Service frequently informally coordinates their proposed actions under Departmental Manual 655 with National Marine Fisheries Service. None of the fish and wildlife agencies have veto power over Mineral Management Service permitting for oil and gas exploration, development and production on the Outer Continental Shelf, or on essentially the Exclusive Economic Zone.

Environmental Protection Agency is the permitting agency for chemical discharges into waters of the South Atlantic, under the National Pollution Discharge Elimination System program of the Clean Water Act for chemicals used or produced in the South Atlantic (i.e., drilling muds, produced water or biocides) and then released, or under the Ocean Dumping Regulations of the Marine Protection, Research and Sanctuaries Act if the chemicals are transported into the Atlantic Ocean for the purpose of dumping. When discharge or dumping permits are proposed, federal and state fish and wildlife agencies may comment and advise under the Fish and Wildlife Coordination Act and National Environmental Policy Act. The South Atlantic Fishery Management Council may do likewise under the Magnuson-Stevens Act and National Environmental Policy Act. The South Atlantic Fishery Management Council also protects snapper grouper habitat under both the Coral, Coral Reefs and Live/Hard Bottom Habitat Fishery Management Plan and the Shrimp Fishery Management Plan.

8.2.5 Pollution and Habitat Degradation along the Atlantic Coast

8.2.5.1 Concerns in the South Atlantic States

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

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

<u>North Carolina</u>

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

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

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

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

8.2.5.2 SAFMC Habitat Priorities

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

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

8.2.5.3 Habitat Loss

Degradation of estuarine, nearshore, and offshore environments is in direct conflict with attempts to maintain optimal habitat conditions for shrimp spawning, survival, and growth. The loss of seagrass beds in North Carolina and Florida has reduced preferred habitat areas available to larval, juvenile, and adult shrimp. These losses are due in part to dredge and fill operations; to increased turbidity resulting from discharges of waste materials and runoff; and from elevated levels of suspended solids. In addition to seagrass losses, the entire Atlantic Coast has had a large portion of its salt marsh and estuarine systems degraded or lost to development through dredge and fill operations. In South Carolina and Georgia the marsh systems are of principal importance as nursery areas. Major threats to shrimp habitat include: impoundment of unaltered estuarine wetlands and the reimpoundment of wetlands that have reverted to productive estuarine wetlands; open water disposal of dredged material in shallow water estuarine bottom; and agricultural practices that allow rapid introduction of soil and pesticides into the marine environment. Tables 37 and 38 present baseline estimates of coastal wetland acreage by estuarine drainage area in the South Atlantic region compiled through a cooperative effort of NOAA and USFWS (NOAA 1991a).

Table 37. Estimated wetlands acreage remaining (in thousands of acres), by Atlantic coast state as derived from the National Wetland Inventory Program. (Source: DOC, 1987).

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

N/A - not available.

Table 38. Coastal wetlands by estuarine drainage area in the south Atlantic. (Source: NOAA 1991a).

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

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

More detailed estimates of wetland by county are presented in Appendix G of the Shrimp FMP (SAFMC, 1993a). This compilation of existing wetland habitat may, as refined to hydrological units, begin to serve as a baseline upon which to implement the policy directive of no net loss and the long-term objective of a net gain of wetland habitats in the South Atlantic region. One program that is presently being developed in response to the National Wetlands Policy Forum recommendation to improve inventory, mapping, and monitoring programs by USFWS and NOAA is Coastwatch. The Coastwatch program's purpose is to develop a nationally standardized geographic information system using ground-based and remote sensing data to assess changes in land cover and habitat in U.S. coastal regions to improve understanding of coastal uplands, wetlands, and seagrass beds and their links to distribution, abundance, and health of living marine resources.

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

8.2.5.4 Plastic Pollution (Persistent Marine Debris)

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

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

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

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

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

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

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

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

8.2.5.5 Oil and Gas Exploration

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

SAFMC recommendations submitted to MMS pertaining to this EIS are contained in Section 8.3.4.

8.2.5.6 Ocean Dumping

The western Atlantic Ocean, including state territorial seas and the EEZ off the eastern United States, have long been used for disposal of such wastes as dredged material, sewerage sludge, chemical waste, plastic waste, and radioactive material. Approximately 149 million metric tons (wet) of dredge material is disposed in estuaries, the territorial seas, and areas of the EEZ along the entire Atlantic coast and Gulf of Mexico. Approximately 27.8 million metric tons (wet) of dredge spoil, is presently disposed of in the EEZ. Composition of dredge material varies among areas with some being contaminated with heavy metals and organic chemicals originating from industrial and municipal discharges and non-point source pollution. The U.S. Army Corps of Engineers classifies only a small portion of the total dredge material as contaminated, but presently has no specific numerical criteria to define such contamination (Office of Technology and Assessment, 1987). The SAFMC has adopted a policy statement on ocean dumping (Section 8.3.2).

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

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

8.2.5.8 Relationship of Habitat Quality to the Ability to Harvest Snapper Grouper Species

Preservation of quantity and environmental quality of estuarine, nearshore, and offshore habitat in the South Atlantic region is essential to maintaining snapper grouper species stocks. Discharge of pollutants may result in direct mortality of snapper grouper species at various stages of their life history. Exposure to certain chemicals could limit the desirability or the possibility of consumption, as occurred in bluefish with PCBs. Presently there is limited information on the concentrations or occurrence of chemicals such as PCBs or Dioxin in snapper grouper species coastwide.

Pesticides, herbicides, fungicides, oil, grease, heavy metals are all resident in sediments of certain coastal estuaries, rivers, bays and harbors. These pollutants have the potential to impact the aquatic resources utilizing the system. Pollutant sources are as diverse as point source discharges from industry and sewerage disposal from municipalities, to non-point source runoff from residential neighborhoods and agricultural fields. Various pollutants known to be harmful to fish and humans when consumed have been identified in bottom sediments of various southeastern estuary systems.

A 1989 National Research Council report indicated there may be substantial risk to the ecosystem and potentially human health from contaminated sediments (NRC, 1989). "In addition to the carcinogenic nature of many of these contaminants, reproductive impairments and other sub-lethal effects in humans are concerns that require increased attention."

Table 39 presents sites NOAA has identified in the South Atlantic region with concentrations of PCB, DDT, PAH, mercury, and lead in excess of levels that cause adverse biological effects (Millemann and Kinney, 1992).

Table 39. South Atlantic sites identified by NOAA as having sediments containing PCB, DDT, PAH, mercury, or lead in excess of levels that cause biological effects (Source: Millerman and McKinney, 1992).

NOAA Sediment Sites with Concentrations of PCBs, DDT, PAHs, Mercury and Lead in Excess of Levels Adverse Biological Effects					
States and Sites	**PCBs (50-380ppb)**	**DDT (3-350ppb)**	**PAHs (4,000-35,000 ppb)**	**Mercury (0.15-1 ppm)**	**Lead (35-110ppm)**
South Carolina					
Charleston Harbor		3.5			
Georgia					
Sapelo Island		3.2			
Florida					
Apalachicola Bay		5.2			
Choctawhatchee Bay		818.3			86.7
Choctawhatchee Bay		12.5			
Saint Andrews Bay	940.8	41.1	9,233	0.32	40.9
Saint Johns River		8.2			
St. Johns River	98				

Research is underway and as information becomes available, the Council will readdress the issue and include information in subsequent amendments to the snapper grouper species management plan.

8.2.5.9 National Status and Trends Program

The Mussel Watch Project, a component of NOAA's National Status and Trends Program (NSTP) (NOAA, 1989) has annually collected contaminant data for 12 fixed stations along the Atlantic Coast. The chemical contaminants analyzed included polyaromatic hydrocarbons, polychlorinated biphenyls, chlorinated pesticides, and 12 trace elements. Aquatic organisms, especially shellfish like mussels and oysters, accumulate contaminants within their tissue at higher levels than surrounding waters. Contaminant levels therefore increase or decrease depending on the condition of the surrounding waters. The NSTP was initiated to monitor and assess temporal trends in coastal and estuarine waters of the United States. Based on data compiled from 1986 through 1988, the following trends were noted for some southeast estuaries: cadmium levels in the Charleston Harbor (SC) and the Sapelo Sound (GA) sites were decreasing; chromium levels in the Savannah River estuary and Matanzas River (FL) sites were increasing; copper levels in Sapelo Sound were decreasing; levels of mercury for Roanoke Sound (NC), Cape Fear (NC) and Matanzas River were increasing; nickel concentrations were increasing in both the Pamlico Sound (NC) and Savannah River sites; silver levels were decreasing at both the Roanoke River and Cape Fear (NC) sites; zinc concentrations were shown to be decreasing in the Matanzas River site; and only the Matanzas River site was shown to have concentrations of more than two contaminants showing statistically significant changes with arsenic, chromium, and mercury increasing and zinc decreasing.

8.2.5.10 National Coastal Pollutant Discharge Inventory Program

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

8.2.5.11 Agricultural Pesticide use in Coastal Areas

Pesticides including herbicides, insecticides, fungicides, nematicides, algaecides, wood preservatives, and fumigants have been used extensively in the southeast coastal zone (Table 40 and Figures 5-8). Despite the fact that most organochlorine pesticides are no longer approved for agricultural use in the U. S., 29.4 million pounds of pesticides were applied to U.S. coastal watersheds in 1987 (NOAA, 1992b) with over 33% or 9.8 million pounds being applied in the southeast coastal region alone. As part of the NCPDI, NOAA accomplished a comprehensive review of pesticide use in coastal areas (Table 40). Detailed information on use and impacts of pesticides in the southeast based on NOAA's final national summary of agricultural pesticide use in coastal areas in the South Atlantic region follows.

The transport of pesticides from agricultural areas upstream may impact coastal water quality. Assuming pesticide use upstream provides an indicator of pesticide sources. The use of pesticides, herbicides, and fungicides varies substantially between South Atlantic states. To a degree, this is related to agricultural and pest patterns in each area. Major harvested crops in the South Atlantic region include soybean, corn, wheat, and peanuts. Other important crops in the region include tobacco, cotton, and citrus. The Albemarle/Pamlico Sound estuarine drainage area (EDA) has the second highest pesticide use in the U.S. (40 million pounds).

Table 40. List of Selected Agricultural pesticides used in the South Atlantic region (Data Source: NOAA, 1992b).

Number	Pesticide	Pounds Used
1	2,4-D	568,000
2	Alachlor	2,025,000
3	Atrazine	1,579,000
4	Butylate	691,000
5	Metolachlor	503,000
6	Carbaryl	613,000
7	Carbofuran	461,000
8	Chloropyrifos	398,000
9	Terbufos	243,000
10	Chlorothalonil	614,000

Herbicides were used the most in the Albemarle/Pamlico Sound EDA in 1987, followed by use in Winyah Bay, South Carolina. and Cape Fear, North Carolina. The major herbicide used in the region was athrazine. Around Biscayne Bay, Florida, over 163,000 pounds of atrazine was used the same year. 937,000 pounds of insecticides representing 26% of all used in 1987, were applied in the Albemarle/Pamlico Sound EDA. In addition, the amount used in Winyah Bay area amounted to 760,000 pounds and 273,000 pounds were used in 1987 in the Cape Fear area. The highest use of fungicides occurred in the St. Andrews / St. Simon EDA with 159,000 pounds total of which 132,000 was chlorothalonil. Herbicides were mostly applied March through June (Figure 6) as pretreatment for grass and weeds. However, in Florida, alachlor and atrazine were used in August and September. Insecticides were generally applied March through September but are used to a degree throughout the year. The fungicide chlorothalonil is predominantly applied to peanuts and tomatoes from April through September (Figures 11-14).

Fish kills, pesticide residues in aquatic organisms, and changes in community biomass are examples of stresses on the marine environment caused by pesticides (NOAA, 1992b). Due to the development of pesticides that have shorter persistence, lower bioconcentration potential, lower application rates, coupled with a greater public awareness, the impact of pesticides on the marine environment has somewhat been reduced. However, even with the overall degree of reduced impacts (as compared to the use of DDT), impacts are still significant because the compounds are just as toxic to aquatic biota (NOAA, 1992b). Some pesticides cause greater impacts and are more hazardous. Endosulfan for example, was responsible for most fish kills in US estuaries between 1980 and 1989. It was the most often found pesticide and is considered to be the most hazardous because it is highly toxic, may affect estuarine biomass, has a high bioaccumulation factor, and has a long soil half-life.

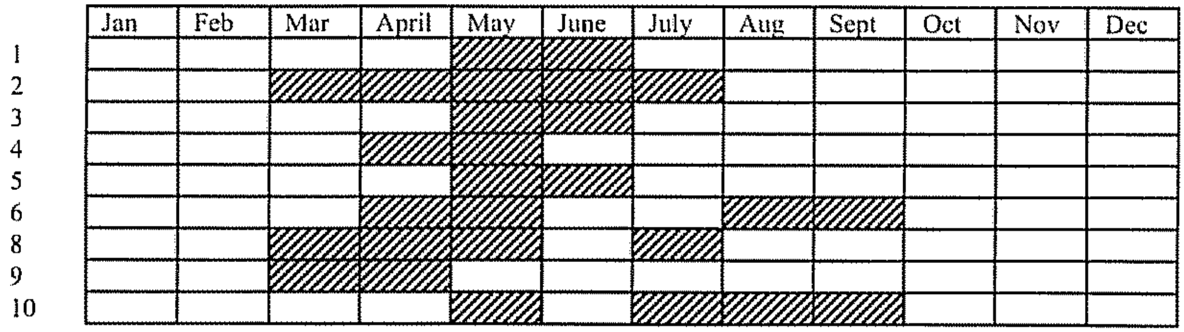


Figure 11. Seasonality of selected pesticides in North Carolina (Data Source: NOAA, 1992b).

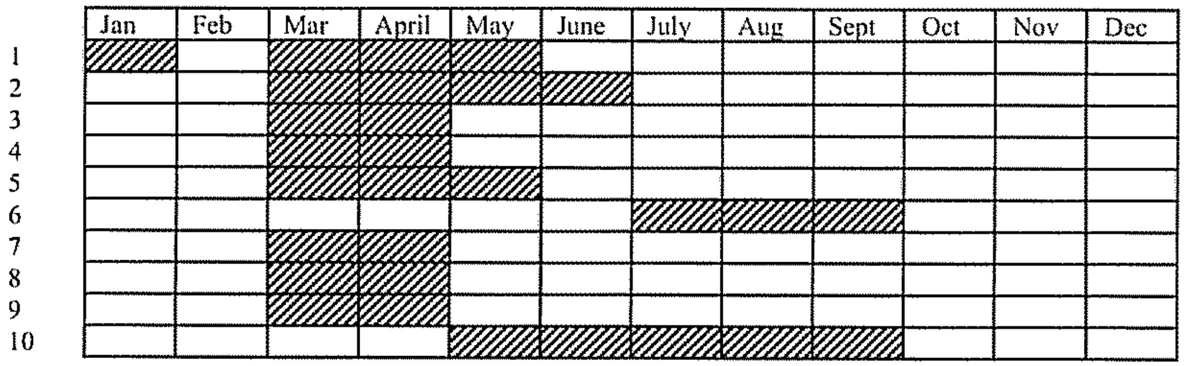


Figure 12. Seasonality of selected pesticides in South Carolina (Data Source: NOAA, 1992b).

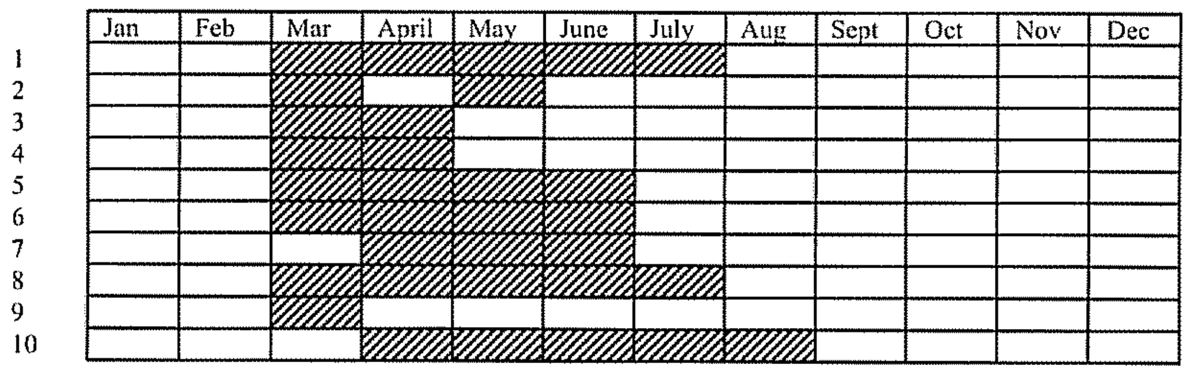


Figure 13. Seasonality of selected pesticides in Georgia (Data Source: NOAA, 1992b).

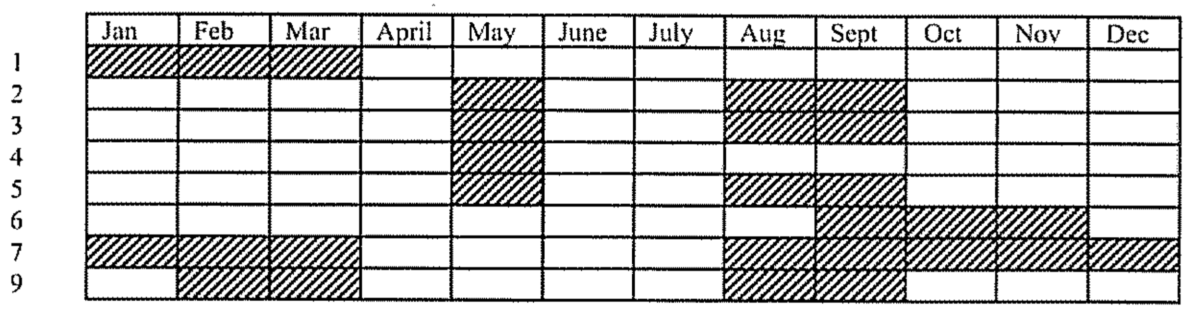


Figure 14. Seasonality of selected pesticides in Florida East Coast (Data Source: NOAA, 1992b).

The insecticide which was found the most in aquatic biota was chloropyrifos; also one of the most hazardous pesticides in the NOAA inventory. The herbicide trifluralin readily bioaccumulates and is again very toxic to aquatic organisms. Combined endosulfan, chloropyrifos, and trifluralin are the most commonly found pesticides as well as being the most toxic (NOAA, 1992b). Other pesticides which are hazardous to aquatic biota include fenvalerate, phorate, and chlorothalonil. Malathion is also highly toxic and responsible for the second highest number of fish kills, over 50% attributable to spraying for mosquitoes. Most fish kills occurred in the spring and summer months corresponding to major growing seasons in coastal areas. Methyl parathion an organophosphorous insecticide, found in water and sediment, is rarely found in tissue. The organophosphorous insecticides (diazinon, malathion, methyl parathion) do not have a high bioaccumulation factor however they are all extremely toxic especially to crustaceans.

The Albemarle/Pamlico Sound EDA has the highest hazard rating of any EDA in the U.S. followed by the Chesapeake Bay and then Winyah Bay.

Very few studies have been accomplished to determine the long-term effects of pesticides on aquatic environments and aquatic communities. In the South Atlantic region one study was undertaken on the North Edisto River in South Carolina. The study showed that the biomass in the control site in a non-agricultural area, was 5 times greater than in the site impacted by agricultural runoff.

8.3 Habitat Preservation Recommendations

8.3.1 SAFMC Habitat and Environmental Protection Policy

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

8.3.2 SAFMC Policy Statement Concerning Dredging and Dredge Material Disposal Activities

8.3.2.1 Ocean Dredged Material Disposal Sites (ODMDS) and SAFMC Policies

The shortage of adequate upland disposal sites for dredged materials has forced dredging operations to look offshore for sites where dredged materials may be disposed. These Ocean

Dredged Material Disposal Sites (ODMDSs) have been designated by the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (COE) as suitable sites for disposal of dredged materials associated with berthing and navigation channel maintenance activities. The South Atlantic Fishery Management Council (SAFMC; the Council) is moving to establish its presence in regulating disposal activities at these ODMDSs. Pursuant to the Magnuson Fishery Conservation and Management Act of 1976 (the Magnuson Act), the regional fishery management Councils are charged with management of living marine resources and their habitat within the 200 mile Exclusive Economic Zone (EEZ) of the United States. Insofar as dredging and disposal activities at the various ODMDSs can impact fishery resources or essential habitat under Council jurisdiction, the following policies address the Council's role in the designation, operation, maintenance, and enforcement of activities in the ODMDSs:

The Council acknowledges that living marine resources under its jurisdiction and their essential habitat may be impacted by the designation, operation, and maintenance of ODMDSs in the South Atlantic. The Council may review the activities of EPA, COE, the state Ports Authorities, private dredging contractors, and any other entity engaged in activities which impact, directly or indirectly, living marine resources within the EEZ.

The Council may review plans and offer comments on the designation, maintenance, and enforcement of disposal activities at the ODMDSs.

ODMDSs should be designated or redesignated so as to avoid the loss of live or hard bottom habitat and minimize impacts to all living marine resources.

Notwithstanding the fluid nature of the marine environment, all impacts from the disposal activities should be contained within the designated perimeter of the ODMDSs.

The final designation of ODMDSs should be contingent upon the development of suitable management plans and a demonstrated ability to implement and enforce that plan. The Council encourages EPA to press for the implementation of such management plans for all designated ODMDSs.

All activities within the ODMDSs are required to be consistent with the approved management plan for the site.

The Council's Habitat and Environmental Protection Advisory Panel when requested by the Council will review such management plans and forward comment to the Council. The Council may review the plans and recommendations received from the advisory sub-panel and comment to the appropriate agency. All federal agencies and entities receiving a comment or recommendation from the Council will provide a detailed written response to the Council regarding the matter pursuant to 16 U.S.C. 1852 (i). All other agencies and entities receiving a comment or recommendation from the Council should provide a detailed written response to the Council regarding the matter, such as is required for federal agencies pursuant to 16 U.S.C. 1852 (i).

ODMDSs management plans should indicate appropriate users of the site. These plans should specify those entities/ agencies which may use the ODMDSs, such as port authorities, the U.S. Navy, the Corps of Engineers, etc. Other potential users of the ODMDSs should be acknowledged and the feasibility of their using the ODMDSs site should be assessed in the management plan.

Feasibility studies of dredge disposal options should acknowledge and incorporate ODMDSs in the larger analysis of dredge disposal sites within an entire basin or project. For example, Corps of Engineers analyses of existing and potential dredge disposal sites for harbor maintenance projects should incorporate the ODMDSs as part of the overall analysis of dredge disposal sites.

The Council recognizes that EPA and other relevant agencies are involved in managing and/or regulating the disposal of all dredged material. The Council recognizes that disposal activities regulated under the Ocean Dumping Act and dredging/filling carried out under the Clean Water Act have similar impacts to living marine resources and their habitats. Therefore, the Council urges these agencies apply the same strict policies to disposal activities at the ODMDSs. These policies apply to activities including, but not limited to, the disposal of contaminated sediments and the disposal of large volumes of fine-grained sediments. The Council will encourage strict enforcement of these policies for disposal activities in the EEZ. Insofar as these activities are relevant to disposal activities in the EEZ, the Council will offer comments on the further development of policies regarding the disposal/ deposition of dredged materials.

The Ocean Dumping Act requires that contaminated materials not be placed in an approved ODMDS. Therefore, the Council encourages relevant agencies to address the problem of disposal of contaminated materials. Although the Ocean Dumping Act does not specifically address inshore disposal activities, the Council encourages EPA and other relevant agencies to evaluate sites for the suitability of disposal and containment of contaminated dredged material. The Council further encourages those agencies to draft management plans for the disposal of contaminated dredge materials. A consideration for total removal from the basin should also be considered should the material be contaminated to a level that it would have to be relocated away from the coastal zone.

8.3.2.2 Offshore and Near shore Underwater Berm Creation

The use of underwater berms in the South Atlantic region has recently been proposed as a disposal technique that may aid in managing sand budgets on inlet and beachfront areas. Two types of berms have been proposed to date, one involving the creation of a long offshore berm, the second involving the placement of underwater berms along beachfronts bordering an inlet. These berms would theoretically reduce wave energy reaching the beaches and/or resupply sand to the system.

The Council recognizes offshore berm construction as a disposal activity. As such, all policies regarding disposal of dredged materials shall apply to offshore berm construction. Research should be conducted to quantify larval fish and crustacean transport and use of the inlets prior to any consideration of placement of underwater berms. Until the impacts of berm creation in inlet areas on larval fish and crustacean transport is determined, the Council recommends that disposal activities should be confined to approved ODMDSs. Further, new offshore and near shore underwater berm creation activities should be reviewed under the most rigorous criteria, on a case-by-case basis.

8.3.2.3 Maintenance Dredging and Sand Mining for Beach Renourishment

The Council recognizes that construction and maintenance dredging of the seaward portions of entrance channels and dredging borrow areas for beach re-nourishment occur in the EEZ. These activities should be done in an appropriate manner in accordance with the policies adopted by the Council.

The Council acknowledges that endangered and threatened species mortalities have occurred as a result of dredging operations. Considering the stringent regulations placed on commercial fisherman, dredging or disposal activities should not be designed or conducted so as to adversely impact rare, threatened or endangered species. NMFS Protected Species Division should work with state and federal agencies to modify proposals to minimize potential impacts on threatened and endangered sea turtles and marine mammals.

The Council has and will continue to coordinate with Minerals Management Service (MMS) in their activities involving exploration, identification and dredging/mining of sand resources for beach renourishment. This will be accomplished through membership on state task forces or directly with MMS. The Council recommends that live bottom/hard bottom habitat and historic fishing grounds be identified for areas in the South Atlantic region to provide for the location and protection of these areas while facilitating the identification of sand sources for beach renourishment projects.

8.3.2.4 Open Water Disposal

The SAFMC is opposed to the open water disposal of dredged material into aquatic systems which may adversely impact habitat that fisheries under Council jurisdiction are dependent upon. The Council urges state and federal agencies, when reviewing permits considering open water disposal, to identify the direct and indirect impacts such projects could have on fisheries habitat.

The SAFMC concludes that the conversion of one naturally functioning aquatic system at the expense of creating another (marsh creation through open water disposal) must be justified given best available information.

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

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

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

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

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

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

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

3) That adequate spill containment and cleanup equipment be maintained for all development and transportation facilities and, that the equipment be available on site within the trajectory time to land, and have industry post a bond to assure labor or other needed reserves.
4) That exploration and development activities should be scheduled to avoid northern right whales in coastal waters off Georgia and Florida as well as migrations of that species and other marine mammals off South Atlantic states.
5) That the EIS for lease Sale 56 be updated to address impacts from activities related to specifically natural gas production, safety precautions which must be developed in the event of a discovery of a "sour gas" or hydrogen sulfide reserve, the potential for southerly transport of hydrocarbons to near shore and inshore estuarine habitats resulting from the cross-shelf transport by Gulf Stream spin-off eddies, the development of contingency plans to be implemented if problems arise due to the very dynamic oceanographic conditions and the extremely rugged bottom, and the need for and availability of onshore support facilities in coastal North and South Carolina, and an analysis of existing facilities and community services in light of existing major coastal developments.

The SAFMC recommends the following concerns and issues be addressed by the MMS prior to approval of any application for a permit to drill any exploratory wells in Lease Sale 56 and that these concerns and issues also be included in the Environmental Impact Statement for the Outer Continental Shelf (OCS) Leasing Plan for 1992-1997:
1) Identification of the on-site fisheries resources, including both pelagic and benthic communities, that inhabit, spawn, or migrate through the lease sites with special focus on those specific lease blocks where industry has expressed specific interest in the pre-lease phases of the leasing process. Particular attention should be given to critical life history stages. Eggs and larvae are most sensitive to oil spills, and seismic exploration has been documented to cause mortality of eggs and larvae in close proximity.
2) Identification of on-site species designated as endangered, threatened, or of special concern, such as shortnose sturgeon, striped bass, blueback herring, American shad, sea turtles, marine mammals, pelagic birds, and all species regulated under federal fishery management plans.
3) Determination of impacts of all exploratory and development activities on the fisheries resources prior to MMS approval of any applications for permits to drill in the Exploratory Unit area, including effects of seismic survey signals on fish behavior, eggs and larvae; temporary preclusion from fishing grounds by exploratory drilling; and permanent preclusion from fishing grounds by production and transportation.
4) Identification of commercial and recreational fishing activities in the vicinity of the lease or Exploratory Unit area, their season of occurrence and intensity.
5) Determination of the physical oceanography of the area through field studies by MMS or the applicant, including on-site direction and velocity of currents and tides, sea states, temperature, salinity, water quality, wind storms frequencies, and intensities and icing conditions. Such studies must be required prior to approval of any exploration plan submitted in order to have an adequate informational database upon which to base subsequent decision making on-site specific proposed activities.
6) Description of required existing and planned monitoring activities intended to measure environmental conditions, and provide data and information on the impacts of exploration activities in the lease area or the Exploratory Unit area.

7) Identification of the quantity, composition, and method of disposal of solid and liquid wastes and pollutants likely to be generated by offshore, onshore, and transportation operations associated with oil and gas exploration development and transportation.
8) Development of an oil spill contingency plan which includes oil spill trajectory analyses specific to the area of operations, dispersant-use plan including a summary of toxicity data for each dispersant, identification of response equipment and strategies, establishment of procedures for early detection and timely notification of an oil spill including a current list of persons and regulatory agencies to be notified when an oil spill is discovered, and well defined and specific actions to be taken after discovery of an oil spill.
9) Studies should include detailing seasonal surface currents and likely spill trajectories.
10) Mapping of environmentally sensitive areas (e.g., spawning aggregations of snappers and groupers); coral resources and other significant benthic habitats (e.g., tilefish mudflats) along the edge of the continental shelf (including the upper slope); the calico scallop, royal red shrimp, and other productive benthic fishing grounds; other special biological resources; and northern right whale calving grounds and migratory routes, and subsequent deletion from inclusion in the respective lease block(s).
11) Planning for oil and gas product transport should be done to determine methods of transport, pipeline corridors, and onshore facilities. Siting and design of these facilities as well as onshore receiving, holding, and transport facilities could have impacts on wetlands and endangered species habitats if they are not properly located.
12) Develop understanding of community dynamics, pathways, and flows of energy to ascertain accumulation of toxins and impacts on community by first order toxicity.
13) Determine shelf-edge down-slope dynamics and resource assessments to determine fates of contaminants due to the critical nature of canyons and steep relief to important fisheries (e.g., swordfish, billfish, and tuna).
14) Discussion of the potential adverse impacts upon fisheries resources of the discharges of all drill cuttings that may result from activities in, and all drilling muds that may be approved for use in the lease area or the Exploration Unit area including: physical and chemical effects upon pelagic and benthic species and communities including their spawning behaviors and effects on eggs and larval stages; effects upon sight feeding species of fish; and analysis of methods and assumptions underlying the model used to predict the dispersion and discharged muds and cuttings from exploration activities.
15) Discussion of secondary impacts affecting fishery resources associated with on-shore oil and gas related development such as storage and processing facilities, dredging and dredged material disposal, roads and rail lines, fuel and electrical transmission line routes, waste disposal, and others.

The following section addresses the recommendations, concerns and issues expressed by the South Atlantic Council (Source: Memorandum to Regional Director, U.S. Fish and Wildlife Service, Atlanta, Georgia from Regional Director, Gulf of Mexico OCS Region dated October 27, 1995):

"The MMS, North Carolina, and Mobil entered into an innovative Memorandum of Understanding on July 12, 1990, in which the MMS agreed to prepare an Environmental Report (ER) on proposed drilling offshore North Carolina. The scope of the ER prepared by the MMS was more comprehensive than and EIS would be. The normal scoping process used in preparation of a NEPA-type document would not only "identify significant environmental issues deserving of study" but also "deemphasize insignificant issues, narrowing the scope" (40 CFR 1500.4) by scoping out issues not ripe for decisions.

Of particular interest to North Carolina are not the transient effects of exploration, but rather the downstream and potentially broader, long-term effects of production and development. The potential effects associated with production and development would normally be "scoped out" of the (EIS-type) document and would be the subject of extensive NEPA analysis only after the exploration phase proves successful, and the submittal of a full-scale production and development program has been received for review and analysis. The ER addressed three alternatives: the proposed Mobil plan to drill a single exploratory well, the no-action alternative; and the alternative that the MMS approve the Mobil plan with specific restrictions (monitoring programs and restrictions on discharges). The ER also analyzes possible future activities, such as development and production, and the long-term environmental and socioeconomie effects associated with such activities. The MMS assured North Carolina that all of the State's comments and concerns would be addressed in the Final ER (MMS, 1990).

The MMS also funded a Literature Synthesis study (USDOI MMS, 1993a) and a Physieal Oceanography study (USDOI MMS, 1994), both recommended by the Physical Oceanography Panel and the Environmental Sciences Review Panel (ESRP). Mobil also submitted a draft report to the MMS titled, Characterization of Currents at Manteo Block 467 off Cape Hatteras, North Carolina. The MMS also had a Cooperative Agreement with the Virginia Institute of Marine Science to fund a study titled, Seafloor Survey in the Vicinity of the Manteo Prospect Offshore North Carolina (USDOI MMS, 1993b). The MMS had a Cooperative Agreement with East Carolina University to conduct a study titled, Coastal North Carolina Socioeconomic Study (USDOI MMS, 1993c). The above-mentioned studies were responsive to the ESRP's recommendations as well as those of the SAFMC and the State of North Carolina.

<u>Citations:</u>

USDOI, MMS. 1990. Atlantic Outer Continental Shelf, Final Environmental Report on Proposed Exploratory Drilling Offshore North Carolina, Vols. I-III.

USDOI, MMS. 1993a. North Carolina Physical Oceanography Literature Study. Contract No. 14-35- 0001-30594.

USDOI, MMS. 1993b. Benthic Study of the Continental Slope Off Cape Hatteras, North Carolina. Vols. I-III. MMS 93-0014, -0015, -0016.

USDOI, MMS. 1993c. Coastal North Carolina Socioeconomic Study. Vols. I-V. MMS 93-0052, -0053, -0054, -0055, and -0056.

USDOI, MMS. 1994. North Carolina Physical Oceanographic Field Study. MMS 94-0047.

Copies of these studies can be acquired from the address below:

Minerals Management Service
Technical Communication Services
MS 4530
381 Elden Street
Herndon, VA 22070-4897
(703) 787-1080

8.3.4 SAFMC Policy for Protection and Enhancement of Marine Submerged Aquatic Vegetation (SAV) Habitat.

The South Atlantic Fishery Management Council (SAFMC) and the Habitat and Environmental Protection Advisory Panel has considered the issue of the decline of Marine Submerged Aquatic Vegetation SAV (or seagrass) habitat in Florida and North Carolina as it relates to Council habitat policy. Subsequently, the Council's Habitat Committee requested that the Habitat Advisory Panel develop the following policy statement to support Council efforts to protect and enhance habitat for managed species.

Description and Function:

In the South Atlantic region, SAV is found primarily in the states of Florida and North Carolina where environmental conditions are ideal for the propagation of seagrasses. The distribution of SAV habitat is indicative of its importance to economically important fisheries: in North Carolina, total SAV coverage is estimated to be 200,000 acres; in Florida, the total SAV coverage is estimated to be 2.9 million acres. SAV serves several valuable ecological functions in the marine systems where it occurs. Food and shelter afforded by SAV result in a complex and dynamic system that provides a primary nursery habitat for various organisms that is important both to the overall system ecology as well as to commercial and recreationally important fisheries. SAV habitat is valuable both ecologically as well as economically; as feeding, breeding, and nursery ground for numerous estuarine species, SAV provides for rich ecosystem diversity. Further, a number of fish and shellfish species, around which is built several vigorous commercial and recreational fisheries, rely on SAV habitat for a least a portion of their life cycles. For more detailed discussion, please see Appendix 1.

Status:

SAV habitat is currently threatened by the cumulative effects of overpopulation and consequent commercial development and recreation in the coastal zone. The major anthropogenic threats to SAV habitat include:

(1) mechanical damage due to:
- (a) propeller damage from boats,
- (b) bottom-disturbing fish harvesting techniques,
- (c) dredging and filling;

(2) biological degradation due to:
- (a) water quality deterioration by modification of temperature, salinity, and light attenuation regimes;
- (b) addition of organic and inorganic chemicals.

SAV habitat in both Florida and North Carolina has experienced declines from both natural and anthropogenic causes. However, conservation measures taken by state and federal agencies have produced positive results. The national Marine Fisheries Service has produced maps of SAV habitat in the Albemarle-Pamlico Sound region of North Carolina to help stem the loss of this critical habitat. The threats to this habitat and the potential for successful conservation measures highlight the need to address the decline of SAV. Therefore, the South Atlantic Council recommends immediate and direct action be taken to stem the loss of this essential habitat. For more detailed discussion, please see Appendix 2.

Management:

Conservation of existing SAV habitat is critical to the maintenance of the living resources that depend on these systems. A number of federal and state laws and regulations apply to modifications, either direct or indirect, to SAV habitat. However, to date the state and federal regulatory process has accomplished little to slow the decline of SAV habitat. Furthermore, mitigative measures to restore or enhance impacted SAV have met with little success. These habitats cannot be readily restored; the South Atlantic Council is not aware of any seagrass restoration project that has ever prevented a net loss of SAV habitat. It has been difficult to implement effective resource management initiatives to preserve existing seagrass habitat resources due to the lack of adequate documentation and specific cause/effect relationships. (for more detailed discussion, please see Appendix 3)

Because restoration/enhancement efforts have not met with success, the South Atlantic Council considers it imperative to take a directed and purposeful action to protect remaining SAV habitat. The South Atlantic Council strongly recommends that a comprehensive strategy to address the disturbing decline in SAV habitat in the South Atlantic region. Furthermore, as a stepping stone to such a long-term protection strategy, the South Atlantic Council recommends that a reliable status and trend survey be adopted to verify the scale of local declines of SAV.

The South Atlantic Council will address the decline of SAV, and consider establishing specific plans for revitalizing the SAV resources of the South Atlantic region. This may be achieved by the following integrated triad of efforts:

Planning:

- The Council promotes regional planning which treats SAV as a integral part of an ecological system.
- The Council supports comprehensive planning initiatives as well as interagency coordination and planning on SAV matters.
- The Council recommends that the Habitat Advisory Panel members actively seek to involve the Council in the review of projects which will impact, either directly or indirectly, SAV habitat resources.

Monitoring and Research:

- Periodic surveys of SAV in the region are required to determine the progress toward the goal of a net resource gain.
- The Council supports efforts to
  (1) standardize mapping protocols,
  (2) develop a Geographic Information System databases for essential habitat including seagrass, and
  (3) research and document causes and effects of SAV decline including the cumulative impacts of shoreline development.

Education and Enforcement:

- The Council supports education programs designed to heighten the public's awareness of the importance of SAV. An informed public will provide a firm foundation of support for protection and restoration efforts.

- Existing regulations and enforcement need to be reviewed for their effectiveness.

- Coordination with state resource and regulatory agencies should be supported to assure that existing regulations are being enforced.

SAFMC SAV Policy Statement- Appendix 1

DESCRIPTION AND FUNCTION

Worldwide, Submerged Aquatic Vegetation (SAV) constitutes one of the most conspicuous and common shallow-water habitat types. These angiosperms have successfully colonized standing and flowing fresh, brackish, and marine waters in all climatic zones, and most are rooted in the sediment. Marine SAV beds occur in the low intertidal and subtidal zones and may exhibit a wide range of habitat forms, from extensive collections of isolated patches to unbroken continuous beds. The bed is defined by the presence of either aboveground vegetation, its associated root and rhizome system (with living meristem), or the presence of a seed bank in the sediments, as well as the sediment upon which the plant grows or in which the seed back resides. In the case of patch beds, the unvegetated sediment among the patches is considered seagrass habitat as well.

There are seven species of seagrass in Florida's shallow coastal areas: turtle grass (Thalassia testudium); manatee grass (Syringodium filiforme); shoal grass (Halodule wrightii); star grass (Halophila engelmanni); paddle grass (Halophila decipiens); and Johnson's seagrass (Halophila johnsonii) (See distribution maps in Appendix 4). Recently, H. johnsonii has been proposed for listing by the National Marine Fisheries Service as an endangered plant species. Areas of seagrass concentration along Florida's east coast are Mosquito Lagoon, Banana River, Indian River Lagoon, Lake Worth and Biscayne Bay. Florida Bay, located between the Florida Keys and the mainland, also has an abundance of seagrasses, but is currently experiencing an unprecedented decline in SAV distribution.

The three dominant species found in North Carolina are shoalgrass (Halodule wrightii), eelgrass (Zostera marina), and widgeongrass (Ruppia maritima). Shoalgrass, a subtropical species has its northernmost distribution at Oregon Inlet, North Carolina. Eelgrass, a temperate species, has its southernmost distribution in North Carolina. Areas of seagrass concentration in North Carolina are southern and eastern Pamlico Sound, Core Sound, Back Sound, Bogue Sound and the numerous small southern sounds located behind the beaches in Onslow, Pender, Brunswick, and New Hanover Counties (See distribution maps in Appendix 4).

Seagrasses serve several valuable ecological functions in the marine estuarine systems where they occur. Food and shelter afforded by the SAV result in a complex and dynamic system that provides a primary nursery habitat for various organisms that are important both ecologically and to commercial and recreational fisheries. Organic matter produced by these seagrasses is transferred to secondary consumers through three pathways: herbivores that consume living plant matter; detritivores that exploit dead matter; and microorganisms that use seagrass-derived particulate and dissolved organic compounds. The living leaves of these submerged plants also provide a substrate for the attachment of detritus and epiphytic organisms, including bacteria, fungi, meiofauna, micro- and marcroalgae, macroinvertebrates. Within the seagrass system, phytoplankton also are present in the water column, and macroalgae and microalgae are associated with the sediment. No less important is the protection afforded by the variety of living spaces in the tangled leaf canopy of the grass bed itself. In addition to biological benefits, the SAVs also cycle nutrients and heavy metals in the water and sediments, and dissipate wave energy (which reduces shoreline erosion and sediment resuspension).

There are several types of association fish may have with the SAVs. Resident species typically breed and carry out much of their life history within the meadow (e.g., gobiids and syngnathids). Seasonal residents typically breed elsewhere, but predictably utilize the SAV during a portion of their life cycle, most often as a juvenile nursery ground (e.g., sparids and lutjanids). Transient species can be categorized as those that feed or otherwise utilize the SAV only for a portion of their daily activity, but in a systematic or predictable manner (e.g., haemulids).

In Florida many economically important species utilize SAV beds as nursery and/or spawning habitat. Among these are spotted seatrout (Cynoscion nebulosus), grunts (Haemulids), snook (Centropomus sp.), bonefish (Albulu vulpes), tarpon (Megalops atlanticus) and several species of snapper (Lutianids) and grouper (Serranids). Densities of invertebrate organisms are many times greater in seagrass beds than in bare sand habitat. Penaeid shrimp, spiny lobster (Panulirus argus), and bay scallops (Argopecten irradians) are also dependent on seagrass beds.

In North Carolina 40 species of fish and invertebrates have been captured on seagrass beds. Larval and juvenile fish and shellfish including gray trout (Cynoscion regalis), red drum (Sciaenops ocellatus), spotted seatrout (Cynoscion nebulosus), mullet (Mugil cephalus), spot (Leiostomus xanthurus), pinfish (Orthopristis chrysoptera), gag (Mycteroperca microlepis), white grunt (Haemulon plumieri), silver perch (Bairdiella chrysoura), summer flounder (Paralichthys dentatus), southern flounder (P. lethostigma), blue crabs (Callinectes sapidus), hard shell clams (Mercenaria mercenaria), and bay scallops (Argopecten irradains) utilize the SAV beds as nursery areas. They are the sole nursery grounds for bay scallops in North Carolina. SAV meadows are also frequented by adult spot, spotted seatrout, bluefish (Pomatomus saltatrix), menhaden (Brevortia tyrannus), summer and southern flounder, pink and brown shrimp, hard shell clams, and blue crabs. Offshore reef fishes including black sea bass (Centropristis striata), gag (Mycteroperca microlepis), gray snapper (Lutjanus griseus), lane snapper (Lutjanus synagris), mutton snapper (Lutjanus annalis), and spottail pinfish (Displodus holbrooki). Ospreys, egrets, herons, gulls and terns feed on fauna in SAV beds, while swans, geese, and ducks feed directly on the grass itself. Green sea turtles (Chelonia mydas) also utilize seagrass beds, and juveniles may feed directly on the seagrasses.

SAFMC SAV Policy Statement- Appendix 2

STATUS

The SAV habitat represents a valuable natural resource which is now threatened by overpopulation in coastal areas. The major anthropogenic activities that impact seagrass habitats are: 1) dredging and filling, 2) certain fish harvesting techniques and recreational vehicles, 3) degradation of water quality by modification of normal temperature, salinity, and light regimes, and 4) addition of organic and inorganic chemicals. Although not caused by man, disease ("wasting disease" of eelgrass) has historically been a factor. Direct causes such as dredging and filling, impacts of bottom disturbing fishing gear, and impacts of propellers and boat wakes are easily observed, and can be controlled by wise management of our seagrass resources (See Appendix 3). Indirect losses are more subtle and difficult to assess. These losses center around changes in light availability to the plants by changes in turbidity and water color. Other indirect causes of seagrass loss may be ascribed to changing hydrology which may in turn affect salinity levels and circulation. Reduction in flushing can cause an increase in salinity and the ambient temperature of a water body, stressing the plants. Increase in flushing can mean decreased salinity and increased turbidity and near-bottom mechanical stresses which damage or uproot plants.

Increased turbidity and decreasing water transparency are most often recognized as the cause of decreased seagrass growth and altered distribution of the habitats. Turbidity may result from upland runoff, either as suspended sediment or dissolved nutrients. Reduced transparency due to color is affected by freshwater discharge. The introduction of additional nutrients from terrigenous sources often leads to plankton blooms and increased epiphytization of the plants, further reducing light to the plants. Groundwater enriched by septic systems also may infiltrate the sediments, water column, and near-shore seagrass beds with the same effect. Lowered dissolved oxygen is detrimental to invertebrate and vertebrate grazers. Loss of these grazers results in overgrowth by epiphytes.

Large areas of Florida where seagrasses were abundant have now lost these beds from both natural and man-induced causes. (This is not well documented on a large scale except in the case of Tampa Bay). One of these depleted areas is Lake Worth in Palm Beach County. Here, dredge and fill activities, sewage disposal and stormwater runoff have almost eliminated this resource. North Biscayne Bay lost most of its seagrasses from urbanization. The Indian River Lagoon has lost many seagrass beds from stormwater runoff has caused a decrease in water transparency and reduced light penetration. Many seagrass beds in Florida have been scarred from boat propellers disrupting the physical integrity of the beds. Vessel registrations, both commercial and recreational, have tripled from 1970-71 (235, 293) to 1992-93 (715,516). More people engaged in marine activities having an effect on the limited resources of fisheries and benthic communities, Florida's assessment of dredging/propeller scar damage indicates that Dade, Lee, Monroe, and Pinellas Counties have the most heavily damaged seagrass beds. Now Florida Bay, which is rather remote from human population concentrations, is experiencing a die-off of seagrasses, the cause of which has not yet been isolated. Cascading effects of die-offs cause a release of nutrients resulting in algal blooms which, in turn, adversely affect other seagrass areas, and appear to be preventing recolonization and natural succession in the bay. It appears that Monroe County's commercial fish and shellfish resources, with a dockside landing value of $50 million per year, is in serious jeopardy.

In North Carolina total SAV coverage is estimated a 200,000 acres. Compared to the state's brackish water SAV community, the marine SAVs appear relatively stable. The drought and increased water clarity during the summer of 1986 apparently caused an increase in SAV abundance in southeastern Pamlico Sound and a concomitant increase in bay scallop densities. Evidence is emerging, however, that characteristics of "wasting disease" are showing up in some of the eelgrass populations in southern Core Sound, Back Sound, and Bogue Sound. The number of permits requested for development activities that potentially impact SAV populations is increasing. The combined impacts of a number of small, seemingly isolated activities are cumulative and can lead to the collapse of large seagrass biosystems. Also increasing is evidence of the secondary removal of seagrasses. Clam-kicking (the harvest of hard clams utilizing powerful propeller wash to dislodge the clams from the sediment) is contentious issue within the state of North Carolina. The scientific community is convinced that mechanical harvesting of clams damages SAV communities. The scallop fishery also could be harmed by harvest-related damage to eelgrass meadows.

SAFMC SAV Policy Statement- Appendix 3

MANAGEMENT

Conservation of existing SAV habitat is critical to the maintenance of the living resources that depend on these systems. A number of federal and state laws require permits for modification and/or development in SAV. These include Section 10 of the Rivers and Harbors Act (1899), Section 404 of the Clean Water Act (1977), and the states' coastal area management programs. Section 404 prohibits deposition of dredged or fill material in waters of the United States without a permit from the U.S. Army Corps of Engineers. The Fish and Wildlife Coordination Act gives federal and state resource agencies the authority to review and comment on permits, while the National Environmental Policy Act requires the development and review of Environmental Impact Statements. The Magnuson Fisheries Conservation and Management Act has been amended to require that each fishery management plan include a habitat section. The Council's habitat subcommittee may comment on permit requests submitted to the Corps of Engineers when the proposed activity relates to habitat essential to managed species.

State and federal regulatory processes have accomplished little to slow the decline of SAV habitat. Many of the impacts cannot be easily controlled by the regulations as enforced. For example, water quality standards are written so as to allow a specified deviation from background concentration, in this manner standards allow a certain amount of degradation. An example of this is Florida's class III water transparency standard, which defines the compensation depth to be where 1% of the incident light remains. The compensation depth for seagrass is in excess of 10% and for some species is between 15 and 20%. The standard allows a deviation of 10% in the compensation depth which translates into 0.9% incident light or an order of magnitude less than what the plants require.

Mitigative measures to restore or enhance impacted areas have met with little success. SAV habitats cannot be readily restored; in fact, the South Atlantic Council is not aware of any seagrass restoration project that has ever avoided a net loss of seagrass habitat. It has been difficult to implement effective resource management initiatives to preserve seagrass habitat due to the lack of documentation on specific cause/effect relationships. Even though studies have identified certain cause/effect relationships in the destruction of these areas, lack of long-term, ecosystem-scale studies precludes an accurate scientific evaluation of the long-term deterioration of seagrasses. Some of the approaches to controlling propeller scar damage to seagrass beds include: education, improved channel marking restricted access zones, (complete closure to combustion engines, pole or troll areas), and improved enforcement. The South Atlantic Council sees the need for monitoring of seagrass restoration and mitigation not only to determine success from plant standpoint but also for recovery of faunal populations and functional attributes of the essential habitat type. The South Atlantic Council also encourages long-term trend analysis monitoring of distribution and abundance using appropriate protocols and Geographic Information System approaches.

SAFMC SAV Policy Statement- Appendix 4
(SAV Distribution Maps in SAFMC 1995)

8.3.5 Joint Agency Habitat Statement

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

8.4 Habitat Areas of Particular Concern

No habitat areas of particular concern are proposed or designated for species in the snapper grouper management unit. However, important habitat includes those areas required during the each individual species life cycle. Offshore and nearshore areas of particular concern include those habitats required during larval, postlarval, juvenile and adult stages. Although these areas are generally less vulnerable to habitat alteration than the salt marsh and estuarine areas, deep water mining (oil, gas and sand) and fishing gear-related damage (traps, anchors and grapples) can result in habitat and water quality degradation.

Oculina coral (*Oculina varicosa*) is distributed along the South Atlantic shelf with concentrations occurring off the central east coast of Florida (Reed, 1992). According to Reed (1980) the majority of massive *Oculina* growth occurs between 27° 30' N. latitude and 28° 30' N. latitude. *Oculina*, a slow growing coral species, constitutes essential habitat to a complex of species, including those managed under the snapper grouper fishery management plan (SAFMC, 1983).

Deep water coral communities support a very rich and diverse community composed of large numbers of species of mollusks, amphipods, echinoderms with *Oculina varicosa*, *Lophelia prolifera*, and *Emallopsamia profunda* constituting the dominant species. The diversity of this system is equivalent to that of many tropical reef systems (Reed, 1992). The geomorphological nature of the deep water Oculina Banks is characterized by high current regimes which trap fine sand, mud and coral debris forming the basis for the diverse invertebrate community (Reed, 1992).

Lophelia prolifera is similar in gross morphology to *Oculina varicosa* but is distributed in depths from 60-2,170 meters. *Emallopsamia profunda* banks are found at depths from 500-800 meters between Miami and South Carolina, and between 640 and 869 meters in over 200 banks mapped on the outer eastern edge of the Blake Plateau.

Reed (1992) contains a detailed description of submersible studies of deep water *Oculina*, *Lophelia* and *Emallopsamia* conducted along the shelf edge off central Florida over the last ten years and includes information on distribution, structure, and function of this protected coral resource and essential habitat.

To protect this fragile and limited coral habitat, a 92 square mile Oculina Bank Habitat Area of Particular Concern (HAPC) was established under the Federal Fishery Management Plan for Coral and Coral Reefs (GMFMC and SAFMC, 1982) (Figure 15). Existing regulations protecting the Oculina HAPC are as follows:

Regulations in the Snapper Grouper and Coral Fishery Management Plans:

The Oculina Bank is located approximately 15 nautical miles east of Fort Pierce, Florida, at its nearest point to shore and is bounded on the north by 27° 53' N. latitude., on the south by 27° 30' N. latitude, on the east by 79° 56' W. longitude, and on the west by 80° 00' W. longitude.

In the HAPC, fishing with bottom longlines, traps, pots, dredges, or bottom trawls is prohibited. Additional prohibitions on fishing for snapper-grouper in the Oculina Bank HAPC.

No fishing for fish in the snapper-grouper fishery may be conducted in the Oculina Bank HAPC; such fish may not be retained in or from the Oculina Bank HAPC. Fish in the snapper-grouper fishery taken incidentally in the Oculina HAPC by hook-and-line must be released immediately by cutting the line without removing the fish from the water. It is a rebuttable presumption that fishing aboard a vessel that is anchored in the HAPC constitutes fishing for fish in the snapper-grouper fishery.

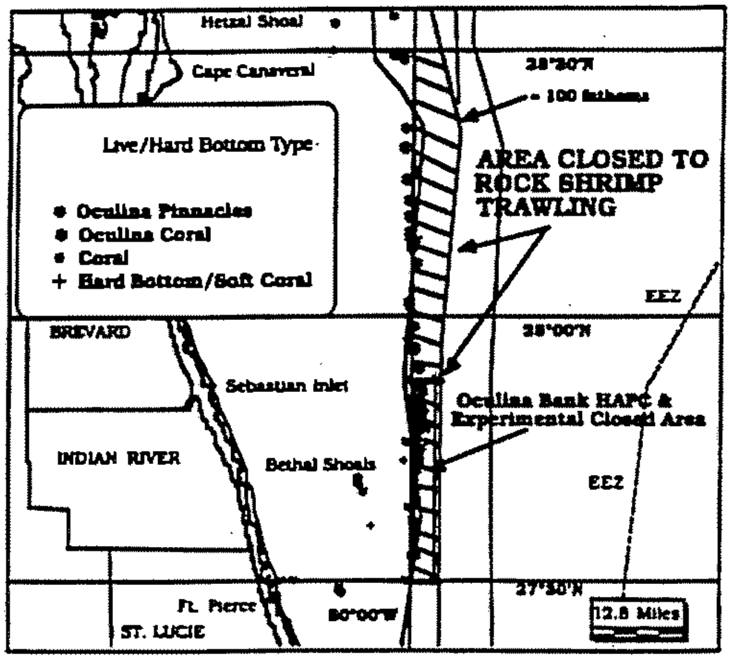
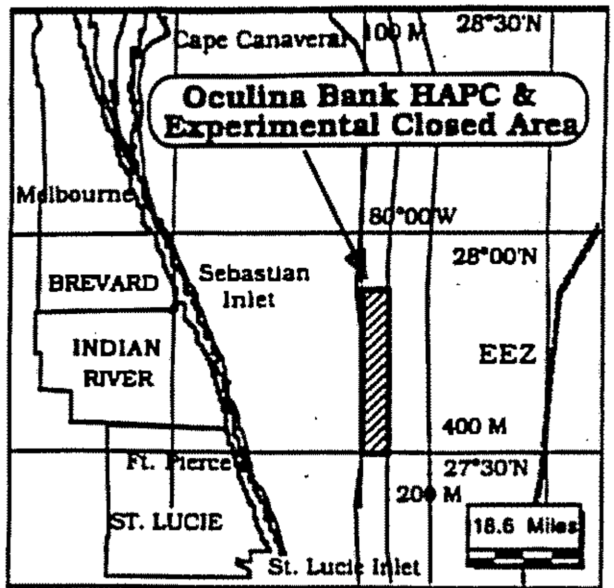


Figure 15. Florida east coast showing location of Oculina Bank Habitat Area of Particular Concern (HAPC). Source: SAFMC, 1996.

<u>South Atlantic Rock Shrimp Regulations.</u>

<u>South Atlantic EEZ Area Closure:</u>

Effective October 9, 1996, no person may trawl for rock shrimp in area east of 80°.00' W. longitude between 27° 30' N. latitude and 28° 30' N. latitude shoreward of the 100-fathom (183-m) contour (Figure 16), as shown on the latest edition of NOAA chart 11460; and no person may possess rock shrimp in or from this area on board a fishing vessel.



Location of the Oculina Bank HAPC and Experimental Closed Area.

Figure 16. Area closed to protect Oculina coral and live / hard bottom habitat from rock shrimp trawling

8.4.1 Federal Habitat Protection Laws, Programs, and Policies.

See Appendix E for a listing and brief description of environmental laws directly, or indirectly protecting marine resources and the habitat they depend on. One program is discussed below, the Florida Keys National Marine Sanctuary.

The Florida Keys National Marine Sanctuary is part of a national system of marine sanctuaries around the U.S. Four sanctuaries have been established in the South Atlantic Region based on the existence of significant natural or cultural resources. These sanctuaries include: Grays Reef, Key Largo, Looe Key and the Florida Keys National Marine Sanctuary (Figure 17).

The most recent sanctuary designated in the South Atlantic is the Florida Keys National Marine Sanctuary. The measures will adopted will protect essential snapper grouper habitat including coral reefs and the surrounding marine communities. The problems addressed in the sanctuary plan include the following:

- Deteriorating water quality
- Declining health of the living coral reefs
- Physical damage to the coral reefs and seagrass communities
- User conflict
- Visitor safety
- Quality of life
- Declining marine resources

The following ten action plans were developed to address the problems identified, mainly through non-regulatory actions.

- Channel / reef marking
- Education / outreach
- Mooring buoys
- Regulatory measures
- Research and monitoring
- Submerged cultural resources
- Water quality
- Volunteer
- Zoning.

For details on the measures included in the plan refer to the Florida Keys National Marine Sanctuary Plan and Environmental Impact Statement (FKNMS, 1996).

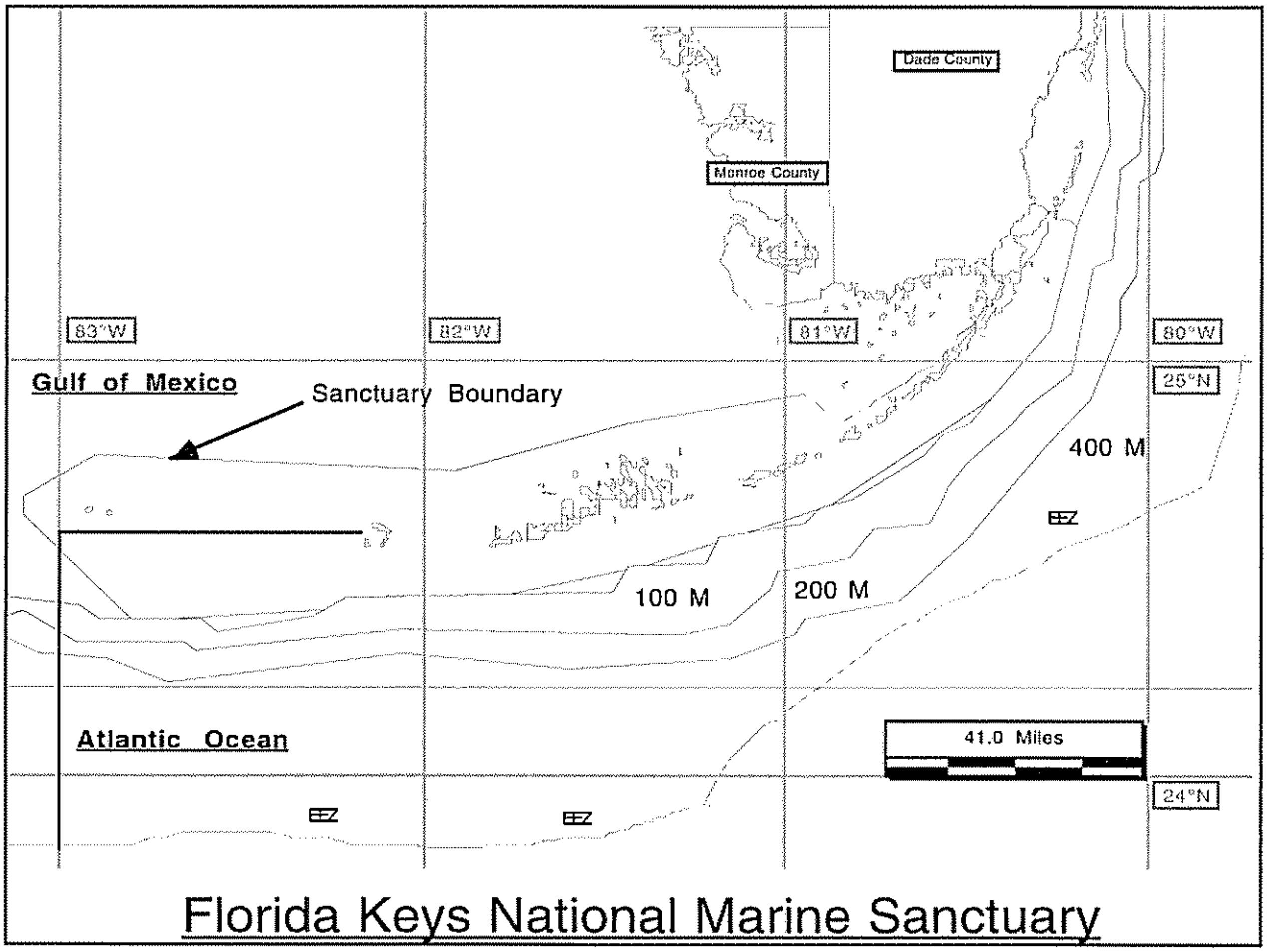


Figure 17. Florida Keys National Marine Sanctuary.

8.4.2 State Habitat Protection Programs

8.4.2.1 North Carolina

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

8.4.2.2 South Carolina

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

8.4.2.3 Georgia

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

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

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

8.4.2.4 Florida

The Florida Coastal Management Program was approved by the Secretary of Commerce in September 1981. The Department of Environmental Protection is responsible for coordinating and monitoring implementation of the laws and rules which comprise the Coastal Management Program.

9.0 REFERENCES

Burton, M. 1999. Compliance with Reef Fish Minimum Size Regulations as Indicated by Headboat, MRFSS, and Commercial Intercept Data for the Southeastern United States. NMFS Beaufort Lab, 101 Pivers Island Road, Beaufort, NC 28516-9722.

Bohnsack, J. A. and D. L. Sutherland. 1985. Artificial reef research: a review with recommendations for future priorities. Bull. Mar. Sci. 37(1):11-39.

Burton, M. L. 1999. Compliance with Reef Fish Minimum Size Regulations as Indicated by Headboat, MRFSS, and Commercial Intercept Data for the Southeastern United States. NMFS, Beaufort Laboratory. Prepared for South Atlantic Fishery Management Council. October, 1999. 27pp.

CEE. 1987. Plastics in the ocean: More than a litter problem. Center for Environmental Education. 128 pp.

CEQ. 1986. U.S. Council on Environment Quality. 1986. Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (40 CFR 1500-1508). Washington: Government Printing Office, Washington, D. C. 20402.

Department of Commerce. 1988a. In File.

Department of Commerce. 1988b. Fisheries Grant-in-Aid 1987 Program Activities. U.S. DOC, October 1988.

Department of Commerce. 1988c. Report of the Interagency Task Force on Persistent Marine Debris. U.S. DOC, May 1988. 170 pp.

Department of Commerce. 1987. In File.

Driessen, P. K. 1985. Studying 'Neptune's Gallery', Offshore rigs provide a habitat for marine life as the largest artificial reef system. Sea Technology 26:34-36.

Fish and Wildlife Service. 1980. Ecological characterization of the sea island coastal region of South Carolina and Georgia. Volume II: Socioeconomic features of the characterization area. USFWS. FWS/OBS-79/41. 321 pp.

FKNMS. 1996. Florida Keys National Marine Sanctuary. Final Management Plan/Environmental Impact Statement. USDOC 1996.

Grizzle, J. M. 1983. Histopathology of fishes in relation to drilling operations near Flower Garden Banks. Vol. II. In: Ecological effects of energy development on reef fish, ichthyoplankton and benthos populations in the Flower Garden Banks of the northwestern Gulf of Mexico, 1980-1982. A Final Report to EPA, EPA-79-D-X0514, 131 pp.

GMFMC and SAFMC. 1982. Fishery Management Plan and Final Environmental Impact Statement for Coral and Coral Reefs of the Gulf of Mexico and South Atlantic. Gulf of Mexico Fishery Management Council, 5401 West Kennedy Boulevard, Suite 881, Tampa, Florida. 316 pp.

Harris, P. J. and J. C. McGovern. 1997. Changes in the life history of red porgy, *Pagrus pagurs*, from the southeastern United States, 1972-1994. Fish Bull. 95:732-747.

Huntsman, G. R., D. S. Vaughan, and J. C. Potts. 1994. Trends in populations status of the red porgy Pagrus pagrus in the Atlantic Ocean off North Carolina and South Carolina, USA, 1972-1992. Report to the South Atlantic Fishery Management Council, June 1994. NMFS Beaufort Lab, 101 Pivers Island Road, Beaufort, NC, 28516-9722.

Huntsman, G.R. and J.R. Waters. 1987. Development of management plans for reef fishes--Gulf of Mexico and U. S. South Atlantic. pp. 533-560. In: Polovina, J. J. and S. Ralston (eds.). Tropical Snappers and Groupers, Biology and Fishery Management. Westview Press, London.

Interorganizational Committee on Guidelines and Principles. 1994. Guidelines and principles for social impact assessment. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-16, 29p.

Ketchum, B.H. 1972. The waters edge--critical problems of the coastal zone. MIT Press, Cambridge, Ma.. 393 pp.

Mace et al., 1996. Gulf of Mexico SPR Management Strategy Committee. 1996. An Evaluation of the use of SPR Levels as the Basis for Overfishing Definitions in Gulf of Mexico Finfish Fishery Management Plans. Prepared by the Gulf of Mexico SPR Management Strategy Committee for the GMFMC. Final Report: May 6, 1996.

Mays, R.W. and C.S. Manooch, III. 1997. Compliance with Reef Fish Minimum Size Regulations as Indicated by Headboat, MRFSS, and Commercial Intercept Data for the Southeastern United States. Prepared for: SAFMC. NOAA/NMFS Beaufort Laboratory, 101 Pivers Island Road, Beaufort, NC 28516-9722. 26 pp.

Malins, D. C. 1982. Alterations in the cellular and subcellular structure of marine teleosts and invertebrates exposed to petroleum in the laboratory and field: a critical review. Can. J. Fish. Aquatic Sci. 39:877-889.

Manker, J. P. 1975. Distribution and concentration of mercury, lead, cobalt, zinc, and chromium in suspended particles and bottom sediments - Upper Florida Keys, Florida Bay and Biscayne Bay. Ph.D. Thesis. Rice University, Houston, TX. 114 pp.

McGovern, J.C. and D.J. Machowski. 1999. Data report on the status of some reef fish stocks off the Southeast United States, 1983-1999. MARMAP Report. December 1999. South Carolina Department of Natural Resources, P.O. Box 12259, Charleston, SC 29422.

Millemann, B. and E. Kinney. 1992. Getting to the bottom of it: Threats to human health and the environment from contaminated underwater sediment. Coast Alliance. Wash. D.C. 18pp.

National Oceanic and Atmospheric Administration. 1992a. Assessing nonpoint source pollution in coastal areas: NOAA's current and future capabilities. NOAA strategic assessment program. NOAA/NOS. October 1992. 2pp.

National Oceanic and Atmospheric Administration. 1992b. Agricultural pesticide use in coastal areas: A national summary. Rockville, MD: Strategic Environmental Assessments Division, Office of Ocean Resources Conservation and Assessment. Prepublication Draft. 112pp.. USDOC and USFWS. 59 pp.

National Oceanic and Atmospheric Administration. 1991a. On File.

National Oceanic and Atmospheric Administration. 1989. National Status and Trends Program for marine environmental quality. Program report. A summary of data on tissue contamination from the first three years (1986-1988) of the mussel watch project. NOAA/NOS. NOSOMA 49. 151pp.

NRC. 1989. National Research Council, Committee on Contaminated Marine Sediments, Marine Board, Commission on Engineering and Technical Systems. Contaminated Marine Sediments - Assessment and Remediation. national Academy Press: Washington, D.C.

Office of Technology and Assessment. 1987. Wastes in Marine Environments. US Congress, Office of Technology and Assessment, U.S. Government Printing Office, Washington, D.C. OTA-0-334.

Polovina, J. J. and S. Ralston, (eds.). 1987. Tropical Snappers and Groupers: Biology and Fisheries Management. Westview Press. Boulder, CO. 659p.

Pierce, K. V., B. B. McCain, and S. R. Wellings. 1980. Histopathology of abnormal livers and other organs of starry flounder *Platichthys stellus* (Pallus) from the estuary of the Duwamish River, Seattle, Washington. J. Fish Dis. 3:811-91.

Reed, J. K. 1992. Submersible Studies of Deep-Water *Oculina* and *Lophelia* Coral Banks off Southeastern U.S.A. Proc. The American Academy od Underwater Sciences Twelfth Annual Scientific Diving Symposium. Sept. 24-27, 1992. 143-151.

Reed, J. K. 1980. Distribution and structure of deepwater *Oculina varicosa* coral reefs off central eastern Florida. Bull. Mar. Sci. 30(3) 667-677.

Rhodes, R., K. Backman, and G. Hawkins. 1997. Socio-demographic Assessment of Commercial Reef Fishermen in the South Atlantic Region. MARFIN No. NA57FF0059. Final Report. Office of Fisheries Management, Division of Marine Resources, SC Department of Natural Resources, P.O. Box 12559, Charleston, SC 29422-2559.

Rhodes, R., W. Waltz, and R. Wiggers 1996. Economic Assessment of Commercial Reef Fishermen in the South Atlantic Region. MARFIN No. NA47FS0014 Final Report. Office of Fisheries Management, Division of Marine Resources, SC Department of Natural Resources, P.O. Box 12559, Charleston, SC 29422-2559.

SAFMC. 1998a. Amendment Number 9, Final Supplemental Environmental Impact Statement, Initial Regulatory Flexibility Analysis/Regulatory Impact Review, and Social Impact Assessment/Fishery Impact Statement for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699.

SAFMC. 1998b. Comprehensive Amendment Addressing Essential Fish Habitat in Fishery Management Plans of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699.

SAFMC. 1998c. Habitat Plan for the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699.

SAFMC. 1998d. Comprehensive Amendment Addressing Sustainable Fishery Act Definitions and Other Required Provisions in Fishery Management Plans of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699.

SAFMC. 1998e. Sargassum Fishery Management Plan, Final Supplemental Environmental Impact Statement, Initial Regulatory Flexibility Analysis/Regulatory Impact Review, and Social Impact Assessment/Fishery Impact Statement. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699.

SAFMC. 1997. Amendment Number 8, Regulatory Impact Review, Social Impact Assessment, Initial Regulatory Flexibility Analysis and Supplemental Environmental Impact Statement for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699.

SAFMC. 1996. Amendment 1 to the Fishery Management Plan for the Shrimp Fishery of the South Atlantic Region (Rock Shrimp). South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699, 196 pp.

SAFMC. 1995. Amendment 3 to the fishery management plan for coral, coral reefs and live /hard bottom habitats of the South Atlantic region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699. 237 pp.

SAFMC. 1994a. Amendment Number 7, Regulatory Impact Review, Initial Regulatory Flexibility Analysis and Environmental Assessment for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699. 282 pp.

SAFMC. 1994b. Regulatory Amendment Number 6, Regulatory Impact Review, Initial Regulatory Flexibility Analysis and Environmental Assessment for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699. 300 pp.

SAFMC. 1993a. Fishery Management Plan for Shrimp Fishery of the South Atlantic Region Including a Final Environmental Impact Statement and Regulatory Impact Review. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699. 300 pp.

SAFMC. 1993b. Amendment Number 6, Regulatory Impact Review, Initial Regulatory Flexibility Analysis and Environmental Assessment for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699. 155 pp.

SAFMC. 1991a. Amendment Number 5, Regulatory Impact Review, Initial Regulatory Flexibility Analysis and Environmental Assessment for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699. 111 pp.

SAFMC. 1991b. Amendment Number 4, Regulatory Impact Review, Initial Regulatory Flexibility Analysis and Environmental Assessment for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699. 200 pp.

SAFMC. 1991c. Draft Source Document for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Circle, Suite 306, Charleston, South Carolina, 29407-4699.

SAFMC. 1990a. Amendment Number 3, Regulatory Impact Review, Initial Regulatory Flexibility Analysis and Environmental Assessment for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699. 65 pp.

SAFMC. 1990b. Amendment Number 2, Regulatory Impact Review, Initial Regulatory Flexibility Analysis and Environmental Assessment for the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699. 42 pp.

SAFMC. 1988. Amendment Number 1 and Environmental Assessment and Regulatory Impact Review to the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699. 63 pp.

SAFMC. 1983. Fishery Management Plan, Regulatory Impact Review and Final Environmental Impact Statement for the Snapper Grouper Fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 Southpark Circle, Suite 306, Charleston, South Carolina, 29407-4699.

SAFMC and GMFMC. 1994. Amendment 2 to the Fishery Management Plan for Coral and Coral Reefs, (Including Supplemental Environmental Impact Statement, Regulatory Impact Review, and Initial Regulatory Flexibility Analysis). South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, S.C. 29407-4699. 140 pp.

Shinn, E.A. 1974. Oil structures as artificial reefs. pp. 91-96 in L. Colunga and R. Stone, eds. Proceedings of an international conference on artificial reefs. Center for Marine Resources, Texas A&M University, College Station, Tx.

Sindermann, C. J. 1994. Quantitative Effects of Pollution on Marine and Anadromous Fish Populations. NOAA Technical Memorandum. NMFS-F/NEC-104. 22p.

Starck, W. A., II. 1968. A list of fishes of Alligator Reef, Florida, with comments on the nature of the Florida reef fish fauna. Undersea Biol. 1:1-40.

Stone, R. B., H. L. Pratt, R. O. Parker, Jr. and G. E. Davis. 1979 A comparison of fish populations on an artificial and natural reef in the Florida Keys. Mar. Fish. Rev. 41:1-11.

Stone, R. B. 1978. Artificial reefs and management. Fisheries 3(1):2-9.

Stout, V. F. 1980. Organochlorine residues in fishes from the northwest Atlantic Ocean and Gulf of Mexico. Fish. Bull. 78(1):51-58.

Vaughan, D. S. 1999. Population characteristics of the red porgy, *Pagrus pagrus*, from the U.S. Southern Atlantic Coast. Prepared for the South Atlantic Fishery Management Council. January 26, 1999. NMFS SEFSC Beaufort Lab.

Walsh, J. J., G. T. Rowe, R. L. Iverson and C. P. McRoy. 1981. Biological export of shelf carbon is a sink of the global C02 cycle. Nature 291:198-201.

Walsh, J. J. 1984. Delaware Bay on the rebound. Science 223:1385.

Waters, J.R., R.J. Rhodes, W. Waltz, and R. Wiggers. 1997. Executive Summary: An economic survey of commercial reeffish boats along the U.S. South Atlantic Coast. USDC/NOAA/NMFS and SCDNR. November 1997. Unpublished.

Waters, J.R. 1999. Analyses prepared for NMFS and the SAFMC. Unpublished Manuscript. NMFS SEFSC Beaufort Lab.

10.0 PUBLIC HEARING LOCATIONS AND DATES

Wednesday, November 3, 1999
Sombrero Resort and Marina
19 Sombrero Blvd.
Marathon, FL 33050
Phone: 305-743-2250

Wednesday, November 10, 1999
Richmond Hill City Hall
40 Richard R. Davis Drive
Richmond Hill, GA 31324
Phone: 912-756-3345

Thursday, November 11, 1999
Carteret Community College
3505 Arendell Street
Morehead City, NC 28557
Phone: 252-247-3093

Monday, November 15, 1999
Ramada Inn Surfside
3125 S. Atlantic Avenue
Daytona Beach Shores, FL 32118
Phone: 1-800-255-3838

Wednesday, November 17, 1999
Town & Country Inn
2008 Savannah Highway
Charleston, SC 29407
Phone: 843-571-1000

Monday, November 29, 1999
Blockade Runner
275 Waynick Boulevard
Wrightsville Beach, NC 28480
Phone: 910-256-2251

11.0 APPENDIXES

Appendix A. Species in the snapper grouper management unit.

SPR Estimates Available

Lane snapper	*Lutjanus synagris*
Yellowtail snapper	*Ocyurus chrysurus*
Gray snapper	*Lutjanus griseus*
Mutton snapper	*Lutjanus analis*
Vermilion snapper	*Rhomboplites aurorubens*
Red Snapper	*Lutjanus campechanus*
SPR Estimates Unavailable	
Black snapper	*Apsilus dentatus*
Queen snapper	*Etelis oculatus*
Schoolmaster	*Lutjanus apodus*
Blackfin snapper	*Lutjanus buccanella*
Cubera snapper	*Lutjanus cyanopterus*
Mahogany snapper	*Lutjanus mahogoni*
Dog snapper	*Lutjanus jocu*
Silk snapper	*Lutjanus vivanus*

SEA BASSES - Serranidae

SPR Estimates Available	
Black sea bass	*Centropristis striata*
SPR Estimates Unavailable	
Bank sea bass	*Centropristis ocyurus*
Rock sea bass	*Centropristis philadelphica*

GROUPERS - Serranidae

SPR Estimates Available	
Gag	*Mycteroperca microlepis*
Scamp	*Mycteroperca phenax*
Red grouper	*Epinephelus morio*
Black grouper	*Mycteroperca bonaci*
Speckled hind*	*Epinephelus drummondhayi*
Snowy grouper*	*Epinephelus niveatus*
Warsaw grouper*	*Epinephelus nigritus*
Wreckfish	*Polyprion americanus*
SPR Estimates Unavailable	
Rock hind	*Epinephelus adscensionis*
Graysby	*Epinephelus cruentatus*
Yellowedge grouper*	*Epinephelus flavolimbatus*
Coney	*Epinephelus fulva*
Red hind	*Epinephelus guttatus*
Jewfish	*Epinephelus itajara*
Misty grouper*	*Epinephelus mystacinus*
Nassau grouper	*Epinephelus striatus*
Yellowmouth grouper	*Mycteroperca interstitialis*
Tiger grouper	*Mycteroperca tigris*
Yellowfin grouper	*Mycteroperca venenosa*

SPR Estimates Available	
Red porgy	*Pagrus pagrus*
SPR Estimates Unavailable	
Sheepshead	*Archosargus probatocephalus*
Grass porgy	*Calamus arctifrons*
Jolthead porgy	*Calamus bajonado*
Saucereye porgy	*Calamus calamus*
Whitebone porgy	*Calamus leucosteus*
Knobbed porgy	*Calamus nodosus*
Longspine porgy	*Stenotomus caprinus*
Scup	*Stenotomus chrysops*

TRIGGERFISHES - Balistidae

SPR Estimates Available	
Gray triggerfish	*Balistes capriscus*
SPR Estimates Unavailable	
Queen triggerfish	*Balistes vetula*
Ocean triggerfish	*Canthidermis sufflamen*

JACKS - Carangidae

SPR Estimates Available	
Greater amberjack	*Seriola dumerili*
SPR Estimates Unavailable	
Yellow jack	*Caranx bartholomaei*
Blue runner	*Caranx crysos*
Crevalle jack	*Caranx hippos*
Bar jack	*Caranx ruber*
Almaco jack	*Seriola rivoliana*
Lesser amberjack	*Seriola fasciata*
Banded rudderfish	*Seriola zonata*

*These species form the deep water grouper fishery.

Appendix A. Species in the snpper grouper management unit. (cont.)

GRUNTS - Pomadasyidae

SPR Estimates Available

White grunt	*Haemulon plumieri*

SPR Estimates Unavailable

Black margate	*Anisotremus surinamensis*
Porkfish	*Anisotremus virginicus*
Margate	*Haemulon album*
Tomtate	*Haemulon aurolineatum*
Smallmouth grunt	*Haemulon chrysargyreum*
French grunt	*Haemulon flavolineatum*
Spanish grunt	*Haemulon macrostomum*
Cottonwick	*Haemulon melanurum*
Sailors choice	*Haemulon parrai*
Blue striped grunt	*Haemulon sciurus*

TILEFISHES - Malacanthidae

SPR Estimates Available

Tilefish (Golden)*	*Lopholatilus chamaeleonticeps*

SPR Estimates Unavailable

Blueline tilefish*	*Caulolatilus microps*
Sand tilefish*	*Malacanthus plumieri*

SPR ESTIMATES ARE UNAVAILABLE FOR THE FOLLOWING SPECIES

SPADEFISHES - Ephippidae

Spadefish	*Chaetodipterus faber*

WRASSES - Labridae

Hogfish	*Lachnolaimus maximus*
Puddingwife	*Halichoeres radiatus*

*These species form the deep water grouper fishery.

Appendix B. Red Porgy Stock Assessment (Source: NMFS Beaufort Lab, 1999).

BLANK

BLANK

Population Characteristics of the Red Porgy *Pagrus pagrus* from the U.S. Southern Atlantic Coast

Douglas S. Vaughan
National Marine Fisheries Service
Beaufort Laboratory
101 Pivers Island Road
Beaufort, North Carolina 28516-9722

Prepared for:

South Atlantic Fishery Management Council
One Southpark Circle, Suite 306
Charleston, South Carolina 29407

January 26, 1999

ABSTRACT

The age structure and status of the U.S. south Atlantic stock of red porgy is examined, using recorded and estimated landings and size frequencies of fish from commercial, recreational, and headboat fisheries from 1972-1997. Two catch-in-numbers-at-age matrices were developed from age-length keys based on fishery-dependent and fishery-independent data, respectively. For these two catch matrices, estimates of annual, age-specific population numbers and fishing mortality rates (F) for different levels of natural mortality (M = 0.20, 0.28, and 0.35 yr^{-1}) were obtained by application of a calibrated virtual population analyses (VPA) using fishery-independent data from MARMAP hook-and-line and trap gears in the calibration procedure.

With the catch matrix using fishery-dependent age-length keys, fishing mortality rates (F) increased from 0.05 in 1974 to 1.34 in 1997 for fully recruited ages (assumed 4+ throughout for comparative purposes) with M = 0.28, while spawning potential ratios declined from 90% to 32% based on mature female biomass and from 89% to 17% based on total mature (male and female) biomass. A similar pattern results from the catch matrix using fishery-independent age-length keys: fishing mortality rates (F) increased from 0.06 to 0.85 between 1974 and 1997 for fully recruited ages, while spawning potential ratios declined from 88% to 35% based on mature female biomass and from 80% to 19% based

on total mature biomass. The use of spawning potential ratio based on total mature biomass was used for comparison to biological reference points.

Recruits to age 1 declined from a peak in 1973 of 7.6 million age-1 red porgy to 12,000 age-1 red porgy in 1997 (based on catch matrix using fishery-dependent age-length keys); while total spawning stock (mature) biomass declined from a peak in 1978 of 11,700 mt to 323 mt in 1997. A similar pattern is noted for recruits to age 1 and total spawning stock biomass obtained from catch matrix using fishery-independent age-length keys. Retrospective bias in calibrated VPA (FADAPT) output suggests understimates of these population values in the most recent years.

Despite the retrospective problems with overestimation of F (and hence underestimation of total spawning stock biomass, recruits to age 1, and SPR) in the current year, long-term declining recruitment to age 1, headboat CPE, and MARMAP Survey CPE raise concerns about overfishing. Generally static SPR has been at or below the South Atlantic Fishery Management Council's criteria for overfishing (SPR = 30%) since 1981. During this time period, recruitment and spawning stock have continued to decline. Keeping in mind the difference between thresholds and targets, it would appear that reducing F to a level at or below that equivalent to 40% static SPR is necessary for rebuilding the U.S. south Atlantic red porgy stock.

Introduction

In this paper, changes in age structure and population size of the U.S. south Atlantic red porgy stock are computed and documented. The red porgy, a protogynous sparid also known as silver snapper and pink snapper, is a reef-associated, demersal species commonly found over very irregular and low profile hard bottom at depths ranging from 18 to 183 m (Manooch and Hassler 1978). Red porgy occur off the southern U.S. Atlantic coast, in the Gulf of Mexico, in the Atlantic off South America from Brazil to Argentina, off Portugal and Spain, in the Mediterranean Sea, off Africa south to the Cape Verde Islands, and around the Azores, Madeira, and Canary Islands.

In this analysis, the geographic range for the definition of stock from North Carolina and South Carolina has been expanded to include landings from Georgia and the east coast of Florida (Vaughan et al. 1992; Huntsman et al.[1]). Tagging studies show neither long range migrations nor extensive local movements of adult (>1 yr) red porgy (Manooch and Hassler 1978). Nor is there circumstantial or anecdotal information to suggest substantial movements. Red porgy are far less abundant in catches off

---

[1] Huntsman, G. R., D. S. Vaughan, and J. C. Potts. 1993. Trends in population status of the red porgy *Pagrus pagrus* in the Atlantic Ocean of North Carolina and South Carolina, USA, 1971-1992. South Atlantic Fishery Management Council, 1 South Park Circle, Charleston, SC 29422.

Georgia and Florida. Red porgy eggs and larvae are pelagic, are believed to survive transport by ocean currents for 30 days or more (Manooch et al. 1981), and could provide recruitment to the population off the U.S. south Atlantic coast from the Gulf of Mexico. However, it seems reasonable to treat the U.S. south Atlantic red porgy population off the coast of North Carolina through the east coast of Florida as a single stock.

Peak spawning occurs from March through April, with first maturation for females at age 2 (Manooch et al. 1981). Eggs are pelagic, spherical, and hatch 28 to 38 h after fertilization. Red porgy attain their maximum size slowly and live relatively long (18 yr or older). Red porgy are protogynous hermaphrodites, but mature males assumed to occur in all age groups. Thus, females predominate at smaller size intervals, and the existence of individuals with both testicular and ovarian tissue suggests protogyny. Age-specific sex ratios are provided by Roumillat and Waltz[2]. These are by age from their Table 6: 89% female at age 1, 91% at age 2, 77% at age 3, 67% at age 4, 59% at age 5, 51% at age 6, 25% at age 7, and 21% at age 8. They also found mature gonads in 18.8% of the females at age 1, 85.2% at age 2, 99.7% at age 3, and 100% at all older ages. These values for age-specific sex ratios and female maturity are used in preference to those

---

[2] W. A. Roumillat, and C. W. Waltz. 1993. Biology of the red porgy *Pagrus pagrus* from the southeastern United States. Data Report 1993.MARMAP, South Carolina Wildlife and Marine Resources Department, P.O. Box 12559, Charleston, SC 29422-2559.

used in earlier assessments (Vaughan et al. 1991; Huntsman et al.[1])

At the request of the South Atlantic Fishery Management Council (SAFMC), this analysis of the status of stock for red porgy in the U.S. south Atlantic bight was conducted to update that of Vaughan et al. (1991) and Huntsman et al.[1]. The earlier analyses used commercial, recreational, and headboat data through 1986 and 1992, respectively. This new analysis expands the geographic range, revises the historical data, uses additional aging data, uses new information on sex ratios and sexual maturity, adds 11 more years of fishery-dependent data to the analysis, and uses fishery-independent MARMAP data to calibrate the VPA. The effect on VPA output from two sets of catch matrices developed from two sets of age-length keys are compared in this analysis: one set is based on ages obtained with fish collected from fishery-dependent sources, and one set is based on ages obtained with fish collected from fishery-independent sources. This new analysis uses a different calibrated virtual population analytic (VPA) approach based on ADAPT (Gavaris 1988).

In this report, changes in age structure and population size of red porgy found off the eastern Atlantic coast of the United States south of Cape Hatteras, North Carolina are computed and documented. Specifically, given age-specific estimates of instantaneous fishing mortality rates and information on growth, sex ratios, maturity and fecundity, analyses of trends in population values (fishing mortality, recruitment and spawning stock biomass), and biological reference points from yield per recruit (YPR), spawning potential ratio (SPR), and surplus production model(ASPIC) are used to determine the status of the U.S. south Atlantic red porgy stock.

Methods

There are three fisheries for red porgy in the U.S. south Atlantic: commercial, recreational, and headboat. The commercial fishery is principally prosecuted by hook & line, with some landings by trap and trawl. The recreational fishery includes fishing from shore, and from private and charter boats. For sampling purposes, the headboat fishery (charter-type operations that charge recreational fisherman per person or "head") is considered separate from the recreational fishery. Annual catch (number and weight) and length data from these three fisheries, together with length at age information, permitted development of a catch-in-numbers-at-age matrix (or simply catch matrix) for 1972-1997.

Development of estimates of catch in numbers at age allows application of catch curve approaches by year class or cohort for estimation of Z. Independent estimates of instantaneous natural mortality (M), based on life history relationships (Pauly 1979, Hoenig 1983), permit estimation of instantaneous fishing mortality rates (F = Z - M). Separable and calibrated virtual population analyses (Doubleday 1976; Pope and Shepherd 1982, 1985; and Gavaris 1988) are used to reconstruct the estimates of annual age-specific population size and instantaneous fishing mortality rates (F) for 1972-1997.

Development of Catch-in-Numbers-at-Age Matrices

Data for development of the catch matrices for the study area of the U.S. south Atlantic come from several sources. Commercial fishery data are obtained from NMFS (Southeast Fisheries Science Center, Beaufort, NC, and Miami, FL) from the General Canvas data base (for catch statistics, 1972-1997) and from the Trip Interview Program (TIP) data base (for length and weight statistics, 1983-1997). Length frequencies for commercial landings from South Carolina were available for 1976-1980 (Vaughan et al. 1992). Recreational catch and effort estimates and length and weight information are obtained through the Marine Recreational Fisheries Statistics Survey (MRFSS) data base (NMFS, Washington, DC) for 1979-1997. Headboat catch and effort estimates and length and weight sampling data are obtained from NMFS (Southeast Fisheries Science Center, Beaufort, NC) for 1972-1997. Fishery-independent length, weight and age data from commercial gears (hook & line and several types of traps, 1979-1997) are from the MARMAP (Marine Resources Monitoring, Assessment, and Prediction) Program (South Carolina Department of Natural Resources, Charleston).

Estimation of catch in numbers at age is similar to that in Vaughan et al. (1992). The basic approach consists of multiplying the catch in numbers (n, scalar) by an age-length key (A, matrix) by a length-frequency distribution (L, vector) to obtain catch in numbers at age (N, vector):

$$N_{ax1} = n \cdot A_{axb} \cdot L_{bx1}, \qquad (1)$$

where a is the number of ages (e.g., ages 0 to 8+ years) and b is the number of length intervals (e.g., 25 mm increments from 200 mm to 550+ mm). If catch is available only in weight (as is the case with commercial landings), then catch is converted to numbers by dividing catch in weight by mean weight per fish landed for the same fishery/gear, time period (annual), and geographic region (U.S. south Atlantic coast). Length data for a given fishery/gear is converted to weight by a weight-length relationship and the average mean weight per fish for that fishery is calculated annually.

Historical Landings. Adjustments are necessary to obtain commercial landings for 1972-1983. As in Vaughan et al. (1992), commercial landings for that period were multiplied by 0.9, to account for reporting of the pooled category of porgies. Since then no adjustment is necessary (Huntsman et al.[1]). To obtain annual landings in numbers by gear from annual catch in weight by gear, landings in weight by gear (General Canvas data) are divided by mean weight of fish landed by that gear (TIP data).

Estimates of the recreational catch statistics in weight and numbers are obtained from the Marine Recreational Fishery

Statistics Survey conducted from 1979 through 1997 (Gray et al. 1994; **http://remora.ssp.nmfs.gov/index.html**). Three catch types are defined for the recreational fishery: **Type A** refers to catches that are available for identification and measurements; and **Type B** refers to catches that are not available for identification or measurement. The latter category is subdivided into: **Type B1** catches, used for bait, filleted, discarded dead, etc.; and **Type B2** catches, released alive. An estimate of 18% post-release mortality (Dixon and Huntsman[3]) was used to include a portion of the type B2 fish in the landings.

An additional adjustment to account for the inclusion of headboat estimates within the charter/party boat mode for 1979-1985 was required before the recreational catch data could be incorporated into the catch-at-age matrix (as for black sea bass in Vaughan et al. 1995). Intercept sampling for length is assumed proportional to catch for separating headboat from party/charter boat modes. Headboat landings for the period 1979-1985 are adjusted by state. About 90% of the intercept samples (e.g., length measurements) in Florida identified under the combined charter/headboat mode are from headboats, so about 90% of the landings for this mode are estimated as from headboats, and the remaining 10% from charter boats. Similarly, an estimate

[3] Dixon, R. L. and G. R. Huntsman. Survival rates of released undersized fishes. Sixth Annual MARFIN Conference, Atlantic, GA, 12-13 October 1993.

of about 100% of the charter/headboat mode landings in Georgia are from charter boats, 4% in South Carolina, and 51% in North Carolina (south of Hatteras) based on intercept samples. Additionally, mean landings by mode of fishing from the recreational fishery is calculated for the period 1979-1997 and used for the period 1972-1978.

Headboat landings are estimated from the NMFS Beaufort Laboratory sampling program (Dixon and Huntsman, In Press). To aid in distinguishing from charter boats (sampled by MRFSS), which ordinarily charge by the trip, the working definition for headboat is any vessel that usually carries 15 or more passengers regardless of manner of payment. Headboat landings in weight and numbers are available for North and South Carolina from 1972 through 1997. Estimated landings for northeast Florida (south to Sebastian) are available from 1976 through 1997, and for southeast Florida (from Fort Pierce through Miami) from 1981 through 1997. No-intercept regressions northeast Florida or southeast Florida landings on Carolina landings were used to extend estimates of headboat landings in weight and number for northeast (0.052 for weight and 0.060 for numbers) and southeast (0.024 for weight and 0.033 for numbers) Florida back to 1972.

Total headboat effort in angler days and catch of red porgy in weight per unit effort are available for the same time period (1972-1997 for North and South Carolina, 1976-1997 for northeast

Florida, and 1981-1997 for southeast Florida. Catch per effort (CPE) is calculated by dividing catch in numbers by effort in angler days. Again no-intercept regressions of northeast Florida or southeast Florida effort on Carolina effort were used to extend effort estimates for northeast (0.819) and southeast (1.668) Florida back to 1972.

Length Frequency Distributions. Commercial length and weight data are available from sampling of commercial landings through the NMFS Trip Interview Program (TIP) database between 1984 through 1997 from North Carolina through the east coast of Florida. Only North Carolina data are available for 1983. Sampling adequacy (or intensity) is assessed using the informal standard developed by the NMFS, Northeast Regional Stock Assessment Workshop (USDOC 1996). This standard presumes that at least 100 fish lengths should be recorded per 200 mt of fish landed. Hence, a value greater than 200 mt/100 samples suggests inadequate sampling.

Commercial length frequencies for 1972-1982 are as in Vaughan et al. (1992). Separate annual length frequency distributions were developed for commercial hook & line, traps and trawls from 1983-1997. With trap and trawl landings being limited since the mid-1980's and few fish sampled (1611 for trap; and 1455, mostly between 1986-1988, trawl), one overall length frequency distribution for each gear is used for all years 1984-

1997. All annual gear-specific commercial length frequency distributions are weighted by catch in number caught by state.

The MARMAP Program collects standardized trap and hook & line data annually in the South Atlantic Bight (Collins and Sedberry 1991). The geographic scope of MARMAP is Cape Hatteras to Cape Canaveral, but with most sampling between Cape Fear and Jacksonville, Florida. The seasonal scope for reef fish sampling is late spring through summer (generally mid- to late-April through September). The data available for this analysis come from several gears: Hook & line (1979-1995), blackfish traps (1979-1989), Florida snapper traps (1980-1989), and Chevron traps (1988-1995). Based on analytic work in Vaughan et al. (In Press), the CPE from the Chevron trap is extended back to 1980 using the Florida snapper trap. For later calibration purposes only CPE from the MARMAP hook & line and extended Chevron trap are used. Length frequency distribution for red porgy (measured in total length to the nearest centimeter) are estimated by gear for the years available.

Recreational length frequency distributions from the MRFSS data base are available from 1979-1997. All length frequency distributions are weighted by catch in number (A+B1) caught during that mode, season (2-month wave), and state. Headboat length frequency distributions from the MRFSS (1979-1985) are not used in the development of the catch matrix.

Annual headboat length frequency distributions from NMFS

Beaufort Laboratory are available for the period 1972-1997, and used in developing the catch-in-numbers-at-age matrix. All length frequency distributions are weighted by catch in number caught during that season (Jan-May, Jun-Aug, Sep-Dec), and state (NC, SC, NE FL, and SE FL).

Age-Length Keys. Age-length keys were developed from data from two sources: fishery dependent and fishery independent (MARMAP).

The first set of age-length keys were based strictly on fish collected from fishery-dependent sources. Age-length keys were available for the period 1972-1974 (Manooch and Huntsman 1977) and for 1986 (Vaughan et al. 1992). Additionally, Potts et al.[4] recently aged red porgy collected from the commercial and headboat fisheries between 1989 and 1998 (511 fish, with 389 fish from 1996-1998) by sectioned otoliths. This last key was assumed to represent the period 1996-1997. As in Vaughan et al. (1992), age-length keys for missing periods (1975-1985 and 1987-1995) were obtained by linear interpolation from the three age-length keys for 1972-1974, 1986, and 1996-1997.

A second series of age-length keys were obtained from fish collected in MARMAP program samples taken from the South Atlantic Bight during 1979-1994 (Harris and McGovern 1997). Red porgy were

[4] Potts, J. C., C. S. Manooch, III, and E. H. Laban. In preparation. Estimated ages of red porgy from fishery-dependent and fishery-independent data with comparison of growth parameters. National Marine Fisheries Service, 101 Pivers Island Road, Beaufort, NC 28516.

collected with a variety of gears, but primarily with hook & line, blackfish traps, Florida snapper traps, and more recently Chevron traps (Collins 1990). Weights (nearest g) and lengths (total and standard, nearest mm) were recorded, and otoliths (sagittae) were removed and stored dry. Otoliths were examined whole under reflected light with a dissecting microscope, and age estimates were based on the number of opaque zones visible.

MARMAP aging data were grouped in 3- and then 2-year periods from 1979-1994 (1979-1981, 1982-1984, 1985-1987, 1988-1990, 1991-1992, 1993-1994). Potts et al.[4] also aged 111 red porgy collected during 1996-1997 by the MARMAP program. An age-length key from these data was used for the period 1995-1997. Because no aging of fish from fishery-independent sources was available prior to 1979, the commercial key for 1972-1974 (Manooch and Huntsman 1977) was used, with linear interpolation between that key and the key from MARMAP data for 1979-1981.

Growth in total length as a function of age was fit to the von Bertalanffy (1938) growth equation using nonlinear regression with the Marquardt option (SAS Institute Inc. 1987). Parameters were estimated using various combinations of years and data sources with equal weights among the individual fish. The von Bertalanffy parameters were re-estimated so as not to include multiple, back-calculated length measurements, but only the most measurement of length at age per fish (Vaughan and Burton 1994). Total lengths in millimeters were used in the analysis.

Age-length keys (matrices) are needed to convert length frequency distributions to age frequency distributions. The keys consist of the proportion of fish of each age sampled from a given length interval. As regards the fishery-independent age-length keys, an overall age-length key for 1979-1994 with total length divided into 25 mm increments from 200 mm to 550+ and ages 0 through 8+ years was developed (n = 8,660 red porgy). Next, separate keys were developed for temporal periods described above. When fewer than 10 fish were available for a given length interval, data were used from a key representing the time period of greater duration (1979-1994). Total lengths greater than 575 mm (0 out of 8660 observations) and ages greater than 8 years (67 out of 8660 observations) are pooled with lengths of 550 mm and 8 years, respectively.

Catch-in-Numbers-at-Age Matrix. Annual application of Eq. (1) to each fishery/gear (commercial hook & line, commercial traps, commercial trawls, recreational, and headboat) were performed separately and accumulated for each year to obtain annual estimates of catch in numbers at age for 1972-1997 (referred to as catch matrix). Eq. (1) was also applied annually to the MARMAP Survey estimates of red porgy catch per effort (CPE), series of fishery-independent age-length keys, and corresponding length frequency data for each gear, available from 1979-1997, to obtain age-specific calibration indices (hook & line and extended

Chevron trap).

Coherency of the catch matrices are assessed by considering the pair-wise correlations among ages such that catch at age are lined up by cohort. One would expect that, after the age of full recruitment by the gear, high correlations should be obtained. Hence, one should be able to follow a strong or weak cohort through the catch matrix (fishery-dependent and fishery-independent age-length keys) and MARMAP CPE matrices (hook & line and extended Chevron trap).

Mortality and Population Dynamics

Instantaneous total mortality rate (Z) was estimated from catch curve analysis (Ricker 1975) by year class (cohort) from the fishery catch matrices (obtained from either fishery-dependent or fishery-independent age-length keys). Estimates were obtained by regressing the natural logarithm of catch in numbers against age for recent cohorts over fully recruited ages (descending right-hand limb, ages 4 through 7). These estimates are used solely to provide starting values for F in the application of separable VPA (obtain average Z from 1989-1991 cohorts for each catch matrix, and F from Z-M).

<u>Natural Mortality</u>. Pauly (1979) obtained the following

relationship for estimating M based on growth parameters and mean environmental temperature:

$$\log_{10}M = 0.0066 - 0.279 \cdot \log_{10}L_\infty + 0.6543 \cdot \log_{10}K + 0.4634 \cdot \log_{10}T \qquad (2)$$

where M equals instantaneous natural mortality rate, L_∞ (cm) and k (yr^{-1}) are parameters from the von Bertalanffy growth equation, and T(°C) is mean environmental temperature. A mean annual seawater temperature of 22°C (Manooch et al. 1998) was used to represent mean nearshore temperature off of the southeastern U.S. Atlantic coast. Estimates of M based on Pauly's (1979) approach ranged from 0.27 to 0.57. Lower estimates of M are associated with higher estimates of L_∞ and lower estimates of K.

Another major life history approach suggested by Hoenig (1983) is based on the maximum age observed in the population. Because the relationship he developed is based on Z, instead of M, the maximum age in the unfished population ($F = 0$; $M = Z-F$) would provide an estimate of M. The oldest fish in the MARMAP data set was age 14, yielding an estimate of M equal to 0.30; while the oldest age from fishery-dependent sources was 18 yielding an estimate of M equal to 0.23. Higher ages provide lower estimates of M.

A few other approaches were also considered. That of Ralston (1987), based solely on the growth parameter, K, gave estimates ranging from 0.22 for K = 0.1 to 0.64 for K = 0.3. The method of Alagaraja (1984), also based on maximum age, gave estimates ranging from 0.17 to 0.26 using the maximum age of 18, and a range of expected survival to maximum age (0.01 to 0.05).

Because aging data sets typically contain large numbers of young and relatively few older fish, problems often result in estimating L_∞ and K in the von Bertalanffy growth curve (Vaughan and Kanciruk 1982). Greater confidence is associated with aging, especially in recent years, with ages based on sectioned otoliths (Potts et al.[4]). Estimates based on maximum age tend to suggest lower M than those based on growth parameters. As in Vaughan et al. (1992), most of our analyses are based on M equal to 0.28, with additional analyses for M equal to 0.20 and 0.35.

Fishing Mortality and Population Estimates. The two catch matrices (based on fishery-dependent and fishery-independent age-length keys) were interpreted using virtual population analysis (VPA) approach to obtain annual age-specific estimates of fishing mortality rates and population size. Virtual population analysis sequentially estimates population size and fishing mortality rates for younger ages of a cohort from a starting value of fishing mortality for the oldest age (Murphy 1965). An estimate of natural mortality, typically assumed constant across years and ages, was also required. The separable method of Doubleday (1976), which assumes that age- and year-specific estimates of F can be separated into products of age and year components, was run on the 1992-1997 portion of the catch matrix to develop estimates of partial recruitment by age. These estimates of partial recruitment serve as input to the calibrated VPA program used. The period 1992-1997 represents the time period since the introduction of a 12-inch minimum size limit in Amendment 4 to the Snapper-Grouper FMP (SAFMC 1991). The FORTRAN program developed by Clay (1990), based on Pope and Shepherd (1982), was used to obtain estimates of age-specific availability, or the partial recruitment vector, to aid in setting up the calibrated VPA described next.

A method of VPA that uses fishery-independent indices of abundance (Pope and Shepherd 1985) in the calibration process was used. The specific calibration approach was that developed by Gavaris (1988) and modified by Dr. Victor Restrepo (Cooperative Institute of Fisheries Oceanography, University of Miami, Miami, FL) as the program FADAPT. Indices used for calibration was limited to MARMAP data for hook & line (1979-1997) and extended Chevron trap (1980-1997). The Chevron trap (1988-1997) was extended back in time (to 1980) with another trap gear using a conversion factor determined by the MARMAP program from synoptic sampling during 1988-1989 (Collins 1990, and Vaughan et al., In Press). This conversion factor (5.58) was applied to the Florida snapper trap for the period 1980-1987. Most calibration runs were made with both indices, but a few runs were made with each index separately.

The catch matrix analyzed consisted of catch in numbers for ages 1 through 8+ and fishing years 1972 through 1997 (partial recruitment for age-0 red porgy was essentially 0 for all years). For the SVPA, starting values for F were based on the mean of the final three year class estimates of Z (~0.8 yr^{-1}) and final F obtained by subtracting M from Z. Sensitivity of estimated F (and recruitment to age 1) to uncertainty in M was investigated by conducting the above VPAs with alternate values of M (0.20 and 0.35). A starting partial recruitment vector for FADAPT was based on an SVPA run for the period 1992-1997.

Retrospective analyses were conducted for the calibrated VPA approach to investigate the potential for bias in F (and recruitment to age 1) for the most recent years by varying the final year used in the analysis from 1992 to 1997 (initial year was 1972 throughout). The proportional difference (D) between estimates of F (or recruits to age 1) from historical data (last year of catch matrix used was varied between 1992 and 1996) and from the full catch matrix (last year of catch matrix used was 1997) were compared:

$$D = (X_i - X_{97})/X_{97} \qquad (3)$$

where X_{97} is the parameter estimate based on the analysis on catch matrix for 1972-1997, and X_i is the parameter estimate based on the reduced catch matrix beginning in 1972 and ending in year i: 1992-1996. The variable X can be mean F (ages 4-8), recruits to age 1, or any other value of interest.

Yield per Recruit. Equilibrium yield per recruit analysis was conducted based on the method of Ricker (1975), who subdivided the exploited phase into a number of segments (e.g., years) during which mortality and growth rates are assumed constant. This approach permits instantaneous natural and fishing mortality rates to vary during the fishable life span and permits a general growth pattern to be used. Total equilibrium yield per recruit is obtained by summing the catches in each segment over the total number of segments. Input data were based on both sexes and all years combined.

Spawning Potential Ratio. Gabriel et al. (1989) developed maximum spawning potential (%MSP) as a biological reference point. The currently favored acronym for this approach is referred to as static spawning potential ratio (static SPR). A recent evaluation of this reference point is given in a report by the Gulf of Mexico SPR Management Strategy Committee (1996) for the Gulf of Mexico Fishery Management Council (see also Mace and Sissenwine (1993), and Mace (1994)). Static or equilibrium SPR was calculated as a ratio of spawning stock size when fishing mortality was equal to the observed or estimated F divided by the spawning stock size calculated when F equal to zero. All other life history parameters were held constant (e.g., maturity schedule and age-specific sex ratios). Hence, the estimate of static SPR increases as fishing mortality decreases.

Comparisons of age-specific spawning stock biomass were based on mature female biomass, egg production, or even on total mature biomass (both males and females). To address the change in male to female ratio with increasing mortality, the reduction in the proportion of mature males to mature males and females in numbers was estimated compared to what that proportion would be when F equals zero.

We used the relationship between fecundity (E, number of eggs) and total length (TL, mm) based on the least-squares linear-regression equation ($r^2 = 0.66$, $n = 50$) (Manooch 1976):

$$\ln E = -14.1325 + 4.3598 (\ln TL), \qquad (4)$$

to provide an alternative to female spawning stock biomass as a measure of spawning potential. Separate sex-based growth relationships were used for males and females in these calculations.

<u>Spawner-Recruit Relationships.</u> As for spawning potential ratio, spawning stock biomass is calculated from age-specific estimates

of population numbers, mean weight, sex ratios, and sexual maturity. Because red porgy are gonochoristic, results presented are based mostly on total mature biomass. Recruits to age 1 are compared to the spawning stock biomass that produced them.

Surplus Production Model (ASPIC). The ASPIC program for estimation of the Schaefer surplus production model was implemented for the U.S. south Atlantic red porgy population (Prager 1994). Data used in this implementation included total landings (commercial, recreational and headboat landings combined in weight from 1972-1997) and catch per effort (CPE) indices from the MARMAP fishery-independent survey (hook & line for 1979-1997 and the extended Chevron trap for 1980-1997).

Results

<u>Historical Data</u>. For the study period (1972-1997), total landings in weight rose from about 339 mt in 1972, to a peak of 1,481 mt in 1982 (Table 1). Landings have been at or below 300 mt since 1992, with 228 mt in 1997. Peak in total landings in numbers was over 1.8 million in 1984. During the 1970s, the landings by weight were 53% commercial, 7% recreational, and 40% headboat. During the 1980s and 1990s, the importance of headboat landings to total landings by weight was reduced, with 81% commercial, 5% recreational, and 14% headboat for the 1980s, and 77%, 9%, and 14%, respectively, for the 1990s.

Commercial landings in weight rose from 60 mt in 1972, to 1,279 mt in 1982, and declining to near or under 200 mt during most of the 1990s (Table 1). Similarly, commercial landings in numbers rose from below 0.1 million fish in 1972, to just over 1.6 million fish in 1984, and generally below 0.3 million fish during most of the 1990s. Between 1975 and 1984, trawl landings in weight were as larger or larger than commercial hook & line landings (Fig. 1a). However, since 1985, commercial hook & line landings by weight made up about 93% of all commercial landings, with commercial trap landings making up about 5% and trawl landings less than 2%.

Recreational landings in weight fluctuated between 6 and 96 mt (Table 1). Recreational landings in numbers during the period 1979-1997 showed no particular trend, averaging about 69,000 fish (A + B1 + 18% B2), although some large estimates (>100,000) were obtained between 1985 and 1990. Catches by mode of fishing have been highly variable by (Fig. 1b). Shore-based catches have averaged 2,600 kg or 4,600 fish, charter boat catches have averaged 15,400 kg 27,300 fish, and private boat catches have averaged 20,800 kg or 36,900 fish over the period 1979-1997.

Similarly, headboat landings were consistently high during the 1970s (> 200,000 red porgy), were generally between 100,000-200,000 fish during the 1980s, and less than 100,000 fish beginning in 1992 (Table 1). Most of the landings have come from North and South Carolina, with only small landings from Georgia and the east coast of Florida (Fig. 1c). A declining trend in headboat catch in numbers per angler days is apparent for both North and South Carolina (Fig. 2).

Declines in catch per effort (CPE) are also noted in indices based on MARMAP sampling using hook & line and extended Chevron trap (Fig. 2). Trap effort was standardized by "soak time" and hook & line effort by "angling time" (Collins and Sedberry 1991). There is a precipitous decline in the extended Chevron trap CPE, with a similar, but somewhat less dramatic, decline noted in the hook & line CPE.

Adequacy of Length Frequency Sampling. Adequacy of sampling for fish lengths was generally excellent for commercial and headboat landings, and adequate for recreational landings (Table 2). However, each fishery was stratified by year, area, etc., for which some cells were lacking samples.

Headboat sampling for lengths offered only slight problems in the early years when no length samples were available south of the Carolinas prior to 1976, and for southeast Florida prior to 1981. Length frequencies from Georgia and northeast Florida were used for southeast Florida between 1976 and 1980, and mean length frequency distributions for the period 1976-1980 were used for 1972-1975 from all areas south of the Carolinas. Because landings by headboat from these areas were minimal, little bias should be associated with these assumptions (Fig. 1b).

Even with generally small landings for the recreational component, the small sample sizes would suggest only occasional problems in certain years. However, when different areas and modes of fishing are considered, sample sizes are generally inadequate. Pooled length frequency distributions were obtained across years as weighted by catch in numbers by bi-monthly period (wave), state and mode of fishing.

Greater difficulties arise from sampling for fish lengths for the commercial fishery, especially when gear specific sampling is considered. As noted in Vaughan et al. (1992), no fish length samples were available for 1972-1975 and 1981-1982. Most of the commercial fish length samples are from the hook &

line gear. Of course most of the commercial landings have been from this gear, except when the trawl landings predominated between 1978 and 1984. Length samples from trawl landings were pooled and applied to landings from the trawl gear. Similarly, length samples from trap landings were also pooled and applied to landings from the trap gear. Generally annual length samples for hook & line were available. As in Vaughan et al. (1992), the length frequency distribution of 1976-1980 was used for 1972-1975, and linear interpolation was used for 1981-1982 from 1980 and 1983 length frequency distributions.

Growth in Weight and Length. The estimated relationship for weight (kg, W) as a function of total length (mm, L) are from published values. For fishery-dependent modeling, values for *a* and *b* (in $W = aL^b$) were from Manooch and Huntsman (1977; a = 0.00002524 and b = 2.8939) for the 1970s and 1980s; and from Potts et al.[4] (a = 0.00000885 and b = 3.060) for the 1990s). For fishery-independent modeling, values were from Manooch and Huntsman (1977) for 1972-78; and from MARMAP data (1979-1994 ; a = 0.00003064 and b = 2.8653) for the remaining years.

Parameter estimates were estimated for the von Bertalanffy growth equation are summarized in Table 3. Different estimates of von Bertalanffy parameters are for different time periods and from different data sources (fishery-dependent and fishery-independent sources).

Annual estimates of mean weight for commercial hook & line and headboat for the Carolinas are obtained directly from sampled fish lengths (using weight-length relations described above) (Fig. 3). Dividing catch in weight by catch in numbers, annual estimates of overall mean weight (kg) of fish landed were obtained. The overall trend was generally downward, especially since about 1978.

Fishery Catch Matrices and Coherency. Catch matrices were estimated using Eq. (1) using two sets of age-length keys (Table 4). Because catch in numbers for age-0 red porgy were often 0 or very small, they have been dropped from the catch matrices. The catch matrix, obtained using fishery-dependent age-length keys, shows a modal age of age 5 for 1972-1982, followed by an abrupt drop in modal age to age 2. Modal age has gradually increased back to age 4. Although the catch matrix, obtained using fishery-independent age-length keys, has some modal ages of age 5 in the 1970s, there are several exceptions (i.e., age 2 in 1975 or age 3 in 1976). The pattern is similar to the other catch matrix, but much more variable.

Pair-wise correlations among lagged catch at age were calculated for both catch matrixes (Table 5). Both generally showed significant (at 0.1 level) correlations between lagged catches at adjacent ages. A few significant correlations were found among lagged catches for non-adjacent ages.

<u>MARMAP Indices and Coherency.</u> The calibrated virtual population analysis (FADAPT) uses MARMAP catch-per-effort (CPE) that was broken into gear- and age-specific values comparable to development of the fishery catch matrix, but only using the fishery-independent age-length keys. Estimates of CPE at age for hook & line are from 1979-1997, and for the extended Chevron trap from 1980-1997 (Table 6). As with the fishery catch matrices, CPE for age 0 was always less than 0.001, so this age was dropped from the index CPE at age. Coherency of these matrices are also explored using pair-wise correlations among lagged CPE (Table 7). The hook & line gear shows greatest coherency among the younger ages (e.g., ages 1-4), while the extended Chevron trap appears very coherent over a wider, older range of ages (e.g., ages 3-7).

<u>Trends in Mortality and Recruitment</u>. As stated above, FADAPT requires input of the age-specific availability of each age in the calibration index, so ages greater than or equal to the modal age were set to one, and for ages younger than the modal age, the CPE for that age was divided by the CPE for the modal age. Estimates of F for ages 4 through 7 were assumed fully recruited for all years for the purpose of comparison across years. Estimates of F were averaged over these ages weighted by population numbers at those ages (referred to as mean or full F).

Recruitment is the population numbers at age 1 at the beginning of the calendar year (referred to as recruits to age 1).

Using FADAPT applied to the catch matrix based on fishery-dependent age-length keys with a range of M, annual estimates of F for all ages (1, 2, 3, 4+) tended to be lowest for the period 1972-1978 compared to the periods 1982-1986 and 1992-1996 (Table 8). F on ages 1 and 2 initially increased between 1972-1978 and 1982-1986, and then decreased between 1982-1986 and 1992-1996. Meanwhile F on ages 3 and 4+ initially increased between 1972-1978 and 1982-1986, but remained essentially unchanged between 1982-1986 and 1992-1996.

The trend in annual estimates of full F with M = 0.28 starts low, rising abruptly during the late 1970s, peaks in 1982, decreases (though not to the low values of the early-mid 1970s), and then gradually rises to very high estimates for the most recent years (Fig. 4a). A similar pattern is noted in full F from FADAPT applied to the catch matrix based on fishery-independent age-length keys with M = 0.28, but with lower values for the most recent years (Fig. 4b).

The FADAPT approach was conducted with M equal to 0.20 and 0.35 with the catch matrix based on fishery-dependent age-length keys (Fig. 5). Full F is underestimated slightly if M is overestimated (e.g., if M = 0.20 instead of assumed M = 0.28), and full F is overestimated slightly if M is underestimated (e.g., if M = 0.35 instead of assumed M = 0.28) (Fig. 5a).

The bias in estimates of recruits to age 1 due to mis-specification of M increases as one proceeds back in time (Fig. 5b). However, the pattern of initially high recruitment, followed by a long period of declining recruitment persists, regardless of level of M. With catch matrix from fishery-dependent age-length keys with M = 0.28, recruits to age 1 peaked in 1975 with 7.6 million fish, and steadily declined to 399,000 fish in 1995 and 12,000 fish in 1997. Corresponding values for M = 0.20 are 4.5 million in 1975, 321,000 in 1995, and 10,000 in 1997; and for M = 0.35, 12.5 million in 1975, 490,000 in 1995 and 15,000 in 1997.

In using FADAPT, the program was allowed to estimate the relative weighting among the fishery-independent indices used in the calibration process. Weighting varied slightly among the different FADAPT runs with varying M, yielding weighting values of 0.05 for hook & line and 0.95 for the extended Chevron trap from the catch matrix using fishery-dependent age-length keys (corresponding weightings of about 0.07 and 0.93 for the other catch matrix). A comparison is made based on using only the hook & line index, or only the extended Chevron trap index (Fig. 6). Very small differences are noted in full F or recruits to age 1, although some deviation in full F in the most recent two years (1996-1997) is apparent.

Because virtual population analyses work backwards from an assumed or starting F for the oldest age of a cohort to the youngest age, confidence in estimated F (or population biomass) was least for the most recent estimate and converges towards "truth" for the youngest ages. Estimates generally converged within about 2 to 3 years. Proportional differences in estimates of fully recruited fishing mortality rates (age 4+) and recruits to age 1 are compared for analyses based on catch matrices restricted to earlier final years (1992-1996) to analysis based on complete catch matrix (1997) to determine whether there was any consistent bias (Fig. 7). There was a large positive bias in full F (overestimate) in the most recent year. Subsequent population-level analyses were based on averaging instantaneous fishing mortality rates for three time periods: 1972-1978, 1982-1986, and 1992-1996 (Table 8 and 9).

Yield per Recruit. Estimates of equilibrium yield per recruit are summarized for the calibrated VPA (FADAPT) runs with catch matrix based on fishery-dependent age-length keys (Table 9) for different levels of M and three time periods (1972-1978, 1982-1986, and 1992-1996). Because of the bias observed in estimated F for 1997 (Fig. 7a), estimates of F for 1997 were not included in calculations for the recent time period. Increasing natural mortality led to decreasing estimates of yield per recruit. Yield per recruit is plotted against full fishing mortality (ages 4-8+) for three time periods (Fig. 8). Two traditional biological reference points obtained from the yield per recruit approach are F_{max} and $F_{0.1}$ (Sissenwine and Shepherd 1987). Using estimates of F for the most recent time period (1992-1996; assumes partial recruitment value based on average F at age) from calibrated VPA applied to each catch matrix, these reference points were estimated as F_{max} = 0.6 and 1.4, respectively, and $F_{0.1}$ = 0.3 and 0.4, respectively, for fully recruited ages (Table 10). The first value for each reference point (F_{max} = 0.6 and $F_{0.1}$ = 0.3) should be considered the appropriate value, since the age-length keys better represent the age-structure of fish removed by the fisheries.

Spawning Potential Ratio. Estimates of equilibrium spawning potential ratio using estimated F (Table 8) from calibrated VPA applied to the two catch matrices are summarized by time period and assumed level of M (Table 9). Because of the bias observed in estimated F for 1997 (Fig. 7a), estimates of F for 1997 were not included in calculations for the recent time period. Estimated equilibrium SPR is plotted against full F for three time periods. Using calibrated VPA (FADAPT) estimates of F from the catch matrix based fishery-dependent age-length keys (with M of 0.28) for three periods, SPR estimates based on total mature biomass, female biomass, and male biomass are compared (Fig. 9). Mature female biomass is less affected by increasing F than mature male biomass, precisely because the younger fish are predominantly females and the older fish are males. Full F that would produce an estimated 30% SPR was found to be about 0.45 for total mature biomass, and 0.27 for mature male biomass (Table 10).

Corresponding estimates were made of the reduction in proportion of males in the population for three periods (Table 9). For example, a value of 60% under 'Percent Male' implies that if the proportion of males in the unfished population (all mature ages) were 50%, then the introduction of fishing mortality would reduce this proportion to 30% (60% of 50%). If the initial proportion were 10%, then a reduction of 60% would reduce the proportion of males to 6%.

Spawning stock biomass, based on the total weight of mature males and females, is seen to peak about 1978 at 11,700 mt, and then decline to 670 mt in 1995 and 323 mt in 1997 (M=0.28) (Fig. 10a). Similar patterns are noted for M=0.20 and M=0.35.

Meanwhile, total static SPR was high during the 1970's (peaking in 1974 at 83%, and declining to a minimum in 1990 at 17%, increasing to a recent maximum in 1993 at 27%, in declining to about 17% in 1997 (M=0.28) (Fig. 10b). Similar patterns are found with M=0.20 and M=0.35. For M=0.28, total spawning potential ratio has been generally below 30% since 1981 (except during the period 1985-1987).

Spawner-Recruit Relationships. Recruits to age 1 are plotted against the total spawning stock biomass that produced them (lagged 1 year) for three levels of M. During the early to mid 1970's, high spawning stock was producing high recruitment (Fig. 11a). Note that the upper right represents the older years, while the lower left represents the most recent years. With high landings during the 1980's, the spawning stock was reduced to a level that has not supported good recruiment.

Following up on Huntsman et al.[1], recruits to age 1 was also plotted against total static SPR for three levels of M (Fig. 11b). Again, the values in the upper right represent the early years, while values in the lower left represent the most recent years.

<u>Surplus Production Model (ASPIC).</u> A series of runs were made with ASPIC to investigate this alternate approach to assessing the status of the red porgy stock. Separate runs were made using CPE from just MARMAP hook & line gear and from the extended Chevron gear, as well as both CPE indices included. All runs suggest that early relative biomass was high ($B/B_{msy}>>1$), and recent relative biomass is low ($B/B_{msy}<<1$). The reverse is noted for relative fishing mortality rate. As an example, plots of relative biomass and fishing mortality based on an ASPIC run, with both MARMAP CPE indices included, is shown with 80% bootstrapped confidence intervals (Fig. 12).

Discussion and Management Implications

Numerous changes have been made in this analysis to extend and improve on those shown in Vaughan et al. (1992) and Huntsman et al.[1]. The major improvement has been additional aging data from both fishery-dependent and fishery-independent sources, and fishery-independent indices for calibrating virtual population analysis. Linear interpolation for the catch matrix using fishery-dependent age-length keys was necessary for 1975-1985 (as in Vaughan et al. 1992) and for 1987-1995. Although more consistent aging data were available for the catch matrix using fishery-independent age-length keys, it was still necessary to substitute the fishery-dependent age-length keys for 1972-1974 and linearly interpolate for 1975-1978. These catch matrices demonstrate a moderate level of coherence (significant correlations between adjacent ages), but with relatively large F's significant correlations between catch at age lagged several years should not necessarily be expected. However, CPE at age for the MARMAP gear (hook & line and extended Chevron trap) showed a high degree of coherency, especially for the extended Chevron.

The analyses on the catch matrix from fishery-independent sources tend to provide lower estimates of fishing mortality rates and higher estimates of population and spawning biomass.

However, they do not differ in the temporal pattern, which suggests much higher population size and spawning biomass during the 1970's, and a significant degradation of this stock through the 1980's and 1990's. Other changes from earlier analyses include expanding the geographic range to include landings from the Atlantic coast of Georgia and Florida, new estimates of sex ratios and maturity schedules, new growth parameters, and application of FADAPT over SVPA and CAL.

At the fishery level, sampling intensity appears to be moderate to excellent. However, there are still data gaps with respect to fish length distributions that must be estimated, generally by linear interpolation from years when fish length data was available, or pooling data across many years. The latter were generally performed on gear (trawl or trap) and fishery (recreational) which contribute small amounts to the landings. The primary exception concerned the commercial trawl gear during the early 1980's, when commercial trawl landings dominated. Hence, additional uncertainty is probably extant for specific annual estimates, but minimal effect on temporal patterns and mean values across specific time periods.

Potential bias from mis-specification in M do little to change the overall pattern of a population in decline. Although higher M (e.g., M = 0.35) may suggest that static SPR is above the South Atlantic Fishery Management Council's definition of overfishing (30% static SPR), this long term population decline would then suggest that a higher level of static SPR may be required to prevent population collapse. Little difference was also noted when FADAPT was calibrated separately to either MARMAP hook & line or the extended Chevron. FADAPT calibrated to both indices was most similar to the results from calibration to the extended Chevron trap, because the final weighting value heavily favored CPE from this gear.

A major bias is associated with estimating fishing mortality (F) in the most recent years, but this bias as shown in the retrospective analyses is principally associated with the most recent year (Fig. 7a). In spite of this estimation problem, declining trends in headboat CPE and in CPE from MARMAP sampling (Fig. 2), combined with the observed decline in recruits to age 1 (other than the terminal year for FADAPT) (Fig. 7b), raise significant concerns about the possibility of overfishing.

Most of the protection from the implementation of the 12" minimum size limit (Amendment 4, SAFMC 1991) appears to have reduced F only on ages 1 and 2 (Table 8). Little, if any, improvements are evident for ages 3 and full recruited ages (4+).

With data through 1986 (and restricted to the Carolinas), Vaughan et al. (1992) noted the beginnings of population decline. For the two time periods that can be compared (1972-1978 and 1982-1986), mean F from this new analysis are somewhat lower than those in Vaughan et al. (1992) for the early period and somewhat higher for the later period. Vaughan et al. (1992) suggested static SPR of 69-86% for the early period and 38-53% for the later period. In this analysis, 60-85% was found for the early period (range based on range in M), and 15-40% for the later period. Results from Huntsman et al.[1], based on data from 1972 through 1992, are intermediate to those presented in this paper. They show the continued degradation in recruitment and spawning stock, increasing F and decreasing static SPR through the late 1980's.

Yield per recruit analysis was conducted to obtain two traditional biological reference points: F_{max} and $F_{0.1}$. Estimates for these two values are 0.6 and 0.3, respectively (for M = 0.28). Mean full F (0.64, averaging over 1992-1996; Table 10) is slightly above F_{max}, but about double $F_{0.1}$. Estimated full F for the early period (0.09 for 1972-1978) was well below both reference points, while the estimate for the middle period (0.56 for 1982-1986) is slightly less than F_{max}, but almost twice $F_{0.1}$.

Estimates of static SPR based on female biomass and egg production are higher than 40%, which is greater than the 30% biological reference point used to define overfishing by the South Atlantic Fishery Management Council (SAFMC 1991). However, red porgy are protogynous hermaphrodites with most functioning initially as females and then as males. Hence, increasing fishing mortality on all ages reduces the proportion of mature males to mature females. Whether this will alter the age of transition is not known, and it was not possible to account for the effect of population density on transformation rate in population models. Whether males are currently limiting, or the degree to which increasing fishing mortality can cause them to become limiting is unknown. Increased rate of transformation from females to males due to reduced abundance of males, which has been reported in other protogynous reef fish (Shapiro 1979), would lead to additional declines in mature female biomass. If females do not transform at a greater rate when the population is depressed, then the complementary concern may arise as to whether sufficient numbers of mature males will be present during spawning.

The modal values of age-specific mature female biomass, egg production, and mature male biomass are shifted to younger age with increasing F (Vaughan et al. 1995). Hence, the greatest effect of increasing F would be on males. This is because fewer older fish remain with higher F, and most older fish are males. Thus, estimates of SPR for males are smaller than for females. Estimates of SPR based on mature male biomass ranged between 10% and 14% during the recent period (1992-1996, M = 0.28), and between 38% and 45% for females for the same period. The proportion of mature males relative to mature females is expected to be reduced to about 64% from mean fishing mortality rate for 1992-1996 (M = 0.28), which is not obviously suggestive that there will be insufficient numbers of males for the spawning process.

Estimates of SPR for total mature biomass, recommended biological reference point in Vaughan et al. (1992, 1995), were generally found to be in the range of 20% to 27% during the recent period (1992-1996). Spawning potential ratio (based on total spawning stock biomass) for red porgy is estimated at 76% for 1972-1978, 28% for 1982-1986, and 24% for 1992-1996 (Table 9 for M of 0.28). Mean values for the two most recent periods are below the value of 30% used by the South Atlantic Fishery Management Council to define overfishing for red porgy (SAFMC 1991). However, it should be noted that the value of 24% for the recent period is slightly underestimated as suggested by the retrospective analysis (even with leaving out values for 1997), but the bias is unlikely to be enough to raise the mean estimate above 30%.

When plotting recruits to age 1 against either spawning stock biomass or static SPR, the decline over time is apparent (Fig. 11). The presumption is that high levels of fishing during the late 1970's into the early 1980's was the primary causative factor. While fishing mortality declined from the peak value in 1982, it has shown some increase over the 1990's for fully recruited ages (Fig. 4). Meanwhile estimates of static SPR have remained fairly consistent since about 1980, varying at or below 30% static SPR.

Population analyses based on a surplus production modeling approach (ASPIC; Fig. 12) also suggest that the population was well above the level capable of producing MSY during the 1970's, but since the early 1980s has been well below the level capable of producing MSY.

The U.S. south Atlantic red porgy stock appears to be in poor condition, given the long term decline noted in spawning stock biomass. Despite the retrospective problems with overestimation of F (and hence underestimation of total spawning stock biomass, recruits to age 1, and static SPR) in the current year, long-term declining recruitment to age 1, headboat CPE, and MARMAP Survey CPE raise concerns about overfishing. Generally static SPR has been at or below the South Atlantic Fishery Management Council's criteria for overfishing (SPR = 30%) since 1981. During this time period, recruitment and spawning stock have continued to decline. Keeping in mind the difference between thresholds and targets, it would appear that reducing F to a level at or below that equivalent to 40% static SPR (0.28 for M = 0.28) is necessary for rebuilding the U.S. south Atlantic red porgy stock.

Acknowledgments

The author wishes to thank the following for the data obtained through their efforts for this analysis: Robert Dixon (headboat data); Laura Bishop, Guy Davenport and Linda Hardy (commercial data); Jack McGovern and Boxian Zhao (MARMAP data). New aging data from fishery-dependent collections were provided by Chuck Manooch and Jennifer Potts.

Literature Cited

Alagaraja, K. 1984. Simple methods for estimation of parameters for assessing exploited fish stocks. Indian J. Fish. 31:177-208.

Clay, D. 1990. TUNE: a series of fish stock assessment computer programs written in FORTRAN for microcomputers (MS DOS). Int. Comm. Conserv. Atl. Tunas, Coll. Vol. Sci. Pap. 32:443-460.

Collins, M. R. 1990. A comparison of three fish trap designs. Fish. Res. 9:325-332.

Collins, M. R., and G. R. Sedberry. 1991. Status of vermilion snapper and red porgy stocks off South Carolina. Trans. Amer. Fish. Soc. 120:116-120.

Collins, M. R., S. B. Van Sant, D. J. Schmidt and G. R. Sedberry. In press. Age validation, movements, and growth rates of tagged gag (*Mycteroperca microlepis*), black sea bass (*Centropristis striata*), and red porgy (*Pagrus pagrus*). Proceedings of the ICLARM/EPOMEX International Workshop on Tropical Snappers and Groupers. Campeche, Mexico, 1993.

Dixon, R. L. and G. R. Huntsman. In Press. Estimating catches and fishing effort of the southeast United States headboat fleet, 1972-1982. NOAA Tech. Rep. NMFS.

Doubleday, W. G. 1976. A least squares approach to analyzing catch at age data. Res. Bull. Int. Comm. Northw. Atl. Fish. 12:69-81.

Gabriel, W. L., M. P. Sissenwine and W. J. Overholtz. 1989. Analysis of spawning stock biomass per recruit: an example for Georges Bank haddock. N. Am. J. Fish. Manage. 9:383-391.

Gavaris, S. 1988. An adaptive framework for the estimation of population size. Canadian Atl. Fish. Sci. Adv. Comm. (CAFSAC) Res. Doc. 88/29. 12 pp.

Gray, G. W., L. L. Kline, M. F. Osburn, R. J. Salz, D. A. Van Vorhees, and J. F. Witzig. 1994. MRFSS User's Manual: A Guide to the National Marine Fisheries Service Marine Recreational Fisheries Statistics Survey Database. Special Report No. 37, Atlantic States Marine Fisheries Commission, Washington, DC.

Gulf of Mexico SPR Management Strategy Committee. 1996. An evaluation of the use of SPR levels as the basis for overfishing definitions in Gulf of Mexico finfish fishery management plans. Report to Gulf of Mexico Fishery Management Council, 6 May 1996. 46 pp.

Harris, P. J., and J. C. McGovern. 1997. Changes in the life history of red porgy, Pagrus pagrus, from the southeastern United States, 1972-1994. Fish. Bull. U.S. 95:732-747.

Hoenig, J. M. 1983. Empirical use of longevity data to estimate mortality rates. Fish. Bull., U.S. 82:898-903.

Mace, P. M. 1994. Relationships between common biological reference points used as thresholds and targets of fisheries management strategies. Can. J. Fish. Aquat. Sci. 41:110-122.

Mace, P. M., and M. P. Sissenwine. 1993. How much spawning per recruit is enough? Can. Spec. Publ. Fish. Aquat. Sci. 120:101-118.

Manooch, C. S., III. 1976. Reproductive cycle, fecundity, and sex ratios of the red porgy, *Pagrus pagrus* (Pisces: Sparidae) in North Carolina. Fish. Bull., U.S. 74:775-781.

Manooch, C. S., III, and W. W. Hassler. 1978. Synopsis of biological data on the red porgy, *Pagrus pagrus* (Linnaeus). NOAA Tech. Rep. NMFS Circ. 412, 19 p. (FAO Fish. Synop. No. 116).

Manooch, C. S., III, and G. R. Huntsman. 1977. Age, growth, and mortality of the red porgy, *Pagrus pagrus*. Trans. Am. Fish. Soc. 106:26-33.

Manooch, C. S., III, L. E. Abbas, and J. L. Ross. 1981. A biological and economic analysis of the North Carolina charter boat fishery. Mar. Fish. Rev. 43(8):1-11.

Manooch, C. S., III, J. C. Potts, D. S. Vaughan, and M. L. Burton. 1998. Population assessment of the red snapper from the southeastern United States. Fish. Res. 38:19-32.

Murphy, G. I. 1965. A solution of the catch equation. J. Fish. Res. Board Can. 22:191-201.

Pauly, D. 1979. On the inter-relationships between natural mortality, growth parameters and mean environmental temperature in 175 fish stocks. J. Cons. 39:175-192.

Pope, J. G. and J. G. Shepherd. 1982 A simple method for the consistent interpretation of catch-at-age data. J. Cons. 40:176-184.

Pope, J. G. and J. G. Shepherd. 1985. A comparison of the performance of various methods for tuning VPAs using effort data. J. Cons. 42:129-151.

Prager, M. H. 1994. A suite of extensions to a nonequilibrium surplus-production model. Fish. Bull., U.S., 92:374-389.

Ralston, S. 1987. Mortality rates of snappers and groupers. Pages 375-404 *in* J.J. Polovina and S. Ralston (eds.), Tropical Snappers and Groupers: Biology and Fisheries Management, Westview Press, Boulder and London, 659 p.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191:1-382.

SAS Institute Inc. 1987. SAS/STAT guide for personal computers. Version 6 Ed. SAS Institute Inc., Cary, NC. 1028 pp.

Shapiro, D. Y. 1979. Social behavior, group structure, and the control of sex reversal in hermaphroditic fish. Adv. Stud. Behav. 10:43-102.

Sissenwine, M. P., and J. G. Shepherd. 1987. An alternative perspective on recruitment overfishing and biological reference points. Can. J. Fish. Aquat. Sci. 44:913-918.

South Atlantic Fishery Management Council (SAFMC). 1991. Amendment Number 4, regulatory impact review, initial regulatory flexibility analysis and environmental assessment for the fishery management plan for the snapper grouper fishery of the South Atlantic region. South Atlantic Fishery Management Council, Charleston, SC. 87 pp.

Vaughan, D. S., and M. L. Burton. 1994. Estimation of von Bertalanffy growth parameters in the presence of size-selective mortality: A simulated example with red grouper. Trans. Am. Fish. Soc. 123:1-8.

Vaughan, D. S., M. R. Collins, and D.J. Schmidt. 1995. Population characteristics of the black sea bass *Centropristis striata* from the southeastern U.S. Bull. Mar. Sci. 56:250-267.

Vaughan, D. S., G. R. Huntsman, C. S. Manooch III, F. C. Rohde and G. F. Ulrich. 1992. Population characteristics of the red porgy, *Pagrus pagrus*, stock off the Carolinas. Bull. Mar. Sci. 50:1-20.

Vaughan, D. S., and P. Kanciruk. 1982. An empirical comparison of estimation procedures for the von Bertalanffy growth equation. J. Cons. 40:211-219.

Vaughan, D. S., B. Zhao, M. R. Collins, J. C. McGovern, and H. S. Meister. In Press. Evaluation of multiple survey indices in assessment of black sea bass from the U.S. south Atlantic coast. Pages __-__ in Fishery Stock Assessment Models, Alaska Sea Grant College Program, AK-SG-98-01.

von Bertalanffy, L. 1938. A quantitative theory of organic growth. Hum. Biol. 10:181-213.

Table 1. U.S. south Atlantic red porgy landings in weight and numbers by fishery, 1972-1997.

Year	Commercial	Recreational	Headboat	Total
		Thousands of Kilograms		
1972	60.0	38.9[a]	240.4[b]	339.3
1973	54.7	38.9[a]	339.9[b]	433.4
1974	61.3	38.9[a]	234.7[b]	334.9
1975	131.9	38.9[a]	205.3[b]	376.0
1976	190.6	38.9[a]	177.5[c]	407.0
1977	234.0	38.9[a]	245.9[c]	518.8
1978	715.5	38.9[a]	240.2[c]	994.5
1979	969.0	50.1	157.3[c]	1176.4
1980	1046.4	31.9	162.4[c]	1240.7
1981	1274.5	16.8	147.3	1438.6
1982	1278.9	6.2	195.9	1481.0
1983	824.9	10.8	118.6	954.3
1984	878.1	46.5	98.4	1023.1
1985	251.5	95.8	118.1	465.4
1986	385.2	8.8	100.7	494.8
1987	328.1	32.8	100.0	460.9
1988	360.0	75.2	97.8	533.0
1989	403.4	62.8	74.9	541.1
1990	484.0	21.1	56.8	561.9
1991	341.8	20.5	63.9	426.2
1992	198.7	53.7	49.8	302.2
1993	185.3	29.7	45.8	260.9
1994	198.7	20.2	39.7	258.7
1995	207.3	37.8	42.2	287.2
1996	213.6	49.3	37.3	300.2
1997	185.9	8.0	34.2	228.0

[a] Estimated from MRFSS using mean of landings in weight and numbers for 1979-1997.

[b] Includes separate estimates for North and South Florida using no-intercept regression with North and South Carolina headboat landings.

[c] Includes estimates for South Florida using no-intercept regression with North and South Carolina headboat landings, with headboat landings available for North Florida.

Table 1. (cont.)

Year	Commercial	Recreational	Headboat	Total
		Thousands of Fish		
1972	82.5	68.8[a]	220.0[b]	371.3
1973	72.5	68.8[a]	299.7[b]	441.0
1974	82.6	68.8[a]	219.9[b]	371.2
1975	167.3	68.8[a]	215.5[b]	451.6
1976	210.3	68.8[a]	186.7[c]	465.7
1977	222.2	68.8[a]	243.6[c]	534.6
1978	647.0	68.8[a]	223.8[c]	939.5
1979	864.2	57.3	156.5[c]	1078.0
1980	929.5	61.2	168.5[c]	1159.2
1981	1162.8	27.2	168.0	1357.9
1982	1250.3	21.3	272.9	1544.5
1983	1304.7	28.9	155.7	1489.4
1984	1640.3	74.1	130.0	1844.3
1985	282.4	137.9	176.6	596.9
1986	497.3	16.1	161.0	674.4
1987	457.0	62.2	173.6	692.7
1988	522.8	127.9	168.6	819.2
1989	567.2	132.5	146.5	846.2
1990	748.9	212.4	104.8	1066.0
1991	566.9	52.9	129.9	749.7
1992	263.8	93.7	85.9	443.4
1993	245.3	35.7	81.7	362.7
1994	256.2	35.0	70.4	361.7
1995	276.0	61.3	70.7	408.0
1996	300.7	56.6	64.9	422.3
1997	260.5	12.5	53.9	326.8

[a] Estimated from MRFSS using mean of landings in weight and numbers for 1979-1997.

[c] Includes separate estimates for North and South Florida using no-intercept regression with North and South Carolina headboat landings.

[c] Includes estimates for South Florida using no-intercept regression with North and South Carolina headboat landings, with headboat landings available for North Florida.

Table 2. Sample size and sampling adequacy for U.S. south Atlantic red porgy fish lengths by fishery. Sampling adequacy, in parenthesis, is measured as tons of fish landed per 100 sampled fish. Informal standard of less than 200 tons of fish landed per 100 sampled fish is deemed adequate (USDOC 1996, inadequate samples in **bold**).

Year	Commercial	Recreational	Headboat
1972	**0**	**0**	4227 (6)
1973	**0**	**0**	4988 (7)
1974	**0**	**0**	3623 (7)
1975	**0**	**0**	2314 (9)
1976	1351 (14)	**0**	2511 (7)
1977	1694 (14)	**0**	2207 (11)
1978	2016 (35)	**0**	1720 (14)
1979	2365 (41)	29 (173)	906 (17)
1980	1429 (73)	53 (58)	1435 (11)
1981	**0**	**8 (210)**	1133 (13)
1982	**0**	7 (88)	2501 (8)
1983	**337 (244)**	26 (41)	2269 (5)
1984	3264 (27)	**13 (358)**	2517 (4)
1985	3397 (7)	**32 (295)**	1897 (6)
1986	5939 (7)	7 (126)	2056 (5)
1987	6027 (5)	57 (57)	2290 (4)
1988	4063 (9)	82 (92)	1602 (6)
1989	3430 (12)	122 (51)	1506 (5)
1990	3878 (13)	129 (16)	1289 (4)
1991	5257 (7)	45 (46)	645 (10)
1992	3239 (6)	101 (52)	824 (6)
1993	4999 (4)	46 (64)	1006 (5)
1994	3363 (6)	74 (27)	777 (5)
1995	6695 (3)	57 (63)	847 (5)
1996	4025 (5)	32 (151)	1012 (4)
1997	3189 (6)	25 (31)	649 (5)

Table 3. Estimated parameters for von Bertalanffy growth equation [TL(mm) = $L_\infty(1 - \exp(-k(age - t_0)))$] with U.S. south Atlantic red porgy data from 1972-1998. The maximum age in the sample is given by t_{max}. These parameters were estimated from observed mid-length interval at age for fishery-dependent data for 1972-1974 and 1986; from back-calculated length at oldest age for fishery-dependent data for 1989-1998 and fishery-independent data for 1996-1997; and from observed length at age adjusted from month of collection for fishery-independent data for 1979-1994.

Type	n	L_∞	k	t_0	t_{max}
		Fishery-Dependent Data			
1972-74	1913	575.8	0.16	-1.88	15
1986	524	1252.9	0.40	-4.05	12
1989-98	631	650.8	0.14	-0.80	18
		Fishery-Independent (MARMAP) Data			
1979-94	8601	485.5	0.23	-1.48	14
1979-81	1171	501.3	0.34	-0.15	13
1982-84	2159	626.1	0.15	-1.61	14
1985-87	2332	542.5	0.16	-2.24	12
1988-90	1268	424.2	0.31	-1.06	12
1991-92	842	425.1	0.25	-1.62	13
1993-94	829	375.7	0.43	-0.78	12
1996-97[a]	111	756.2	0.10	-1.28	6

[a] Otoliths from fish collect during 1996-1997 by MARMAP but aged by C. Manooch and J. Potts (NMFS Beaufort Laboratory).

Table 4. U.S. south Atlantic red porgy catch-in-numbers-at-age (in thousands) matrices for ages 1 through 8+ (and total numbers) and years 1972 through 1997. Note that 18% of catch-release recreationally caught fish (type B2 fish from MRFSS) are included in estimates by number (modal age underlined).

Year	Age (yr)								Total
	1	2	3	4	5	6	7	8+	(1000)
				Based on Fishery-Dependent Age-Length Key					
1972	13.2	61.2	58.4	61.1	98.0	50.7	28.4	26.4	397.6
1973	13.7	63.2	63.8	67.0	107.2	58.3	39.1	49.7	461.9
1974	13.7	65.3	65.1	63.6	86.6	41.5	26.2	32.7	394.6
1975	18.8	72.2	85.0	95.7	101.9	63.6	35.9	57.8	530.7
1976	15.2	59.6	81.2	116.6	143.2	93.8	53.0	68.6	631.1
1977	14.2	65.8	85.9	118.0	154.2	105.5	70.0	129.5	743.2
1978	16.7	89.8	145.7	247.5	401.0	305.4	186.9	289.5	1682.3
1979	16.3	103.5	180.1	300.5	474.3	367.7	239.1	349.9	2031.4
1980	16.2	107.2	229.9	406.9	569.1	330.3	203.4	432.3	2295.3
1981	17.3	144.4	279.2	455.8	648.2	391.8	254.7	404.7	2596.1
1982	26.5	233.9	367.4	503.7	643.6	335.9	211.2	323.4	2645.6
1983	208.5	409.1	258.5	215.2	199.5	77.2	51.4	70.1	1489.5
1984	300.1	588.8	348.5	258.4	212.6	65.3	32.1	38.5	1844.4
1985	28.5	116.8	126.9	116.5	127.3	43.4	18.4	19.2	596.9
1986	24.8	117.3	152.9	159.5	122.8	48.3	21.0	28.8	675.4
1987	6.9	86.6	196.4	171.3	122.2	52.9	24.4	32.1	692.7
1988	15.2	108.8	250.9	211.5	132.2	50.0	21.9	28.6	819.2
1989	15.1	131.2	251.7	195.6	138.3	57.5	24.8	32.0	846.2
1990	32.1	212.4	321.7	238.5	152.5	55.3	22.0	31.5	1066.0
1991	22.0	160.0	228.2	172.5	99.3	32.4	13.8	21.4	749.7
1992	10.5	63.1	127.2	117.4	80.0	26.7	8.8	9.8	443.4
1993	1.9	28.5	98.4	117.9	76.2	23.5	8.0	8.5	362.7
1994	1.7	27.1	91.7	119.5	79.6	24.1	9.0	8.9	361.7
1995	3.7	38.6	110.9	132.2	84.3	23.0	7.2	8.1	408.0
1996	0.3	9.5	110.4	151.1	95.6	33.0	10.3	12.0	422.3
1997	0.1	3.2	74.7	122.9	82.0	27.7	7.8	8.5	326.8

Table 4. (cont.)

Year	Age (yr)								Total
	1	2	3	4	5	6	7	8+	(1000)
				Based on Fishery-Independent Age-Length Key					
1972	13.2	61.2	58.4	61.1	98.0	50.7	28.4	26.4	397.6
1973	13.7	63.2	63.8	67.0	107.2	58.3	39.1	49.7	461.9
1974	13.7	65.3	65.1	63.6	86.6	41.5	26.2	32.7	394.6
1975	16.7	119.9	111.4	68.4	53.7	60.3	46.3	53.2	530.7
1976	13.8	93.8	115.9	95.9	97.6	85.5	62.6	65.6	631.1
1977	12.9	93.3	109.0	102.7	129.2	100.5	80.4	114.8	743.1
1978	15.3	119.1	176.1	232.7	397.1	279.1	201.7	260.8	1682.1
1979	15.0	197.6	342.6	282.7	199.5	353.2	305.7	334.4	2031.3
1980	15.0	216.3	468.2	340.3	212.5	346.3	291.9	404.2	2295.3
1981	24.3	357.3	493.4	559.5	432.7	256.3	166.6	306.1	2596.1
1982	37.3	504.1	556.3	553.4	393.6	216.7	136.4	247.8	2645.6
1983	180.1	391.2	352.2	263.7	116.0	72.5	48.3	65.3	1489.4
1984	260.2	554.9	469.3	310.6	113.6	61.8	32.8	41.2	1844.3
1985	35.2	111.4	105.9	130.4	102.4	66.3	29.0	16.4	596.9
1986	28.6	139.0	129.1	151.7	110.7	66.1	30.0	20.3	675.4
1987	70.2	218.9	168.2	90.4	36.0	41.7	30.3	36.4	692.7
1988	85.5	276.6	207.0	102.1	39.3	43.6	28.2	35.3	819.2
1989	39.7	230.1	243.4	120.9	91.0	36.8	35.9	45.9	846.2
1990	65.1	317.5	312.7	140.7	101.1	38.6	38.7	47.8	1066.0
1991	45.4	154.7	156.0	172.8	92.9	52.2	28.0	47.4	749.7
1992	19.0	60.8	88.0	113.7	67.1	38.6	20.1	35.6	443.4
1993	3.8	36.9	50.1	90.2	89.1	48.0	22.7	21.8	362.7
1994	3.3	32.5	47.6	89.1	90.8	50.3	24.6	23.5	361.7
1995	5.3	40.8	56.1	101.0	100.4	54.5	24.8	25.0	408.0
1996	5.1	47.5	61.5	106.1	101.8	54.2	23.2	22.8	422.3
1997	2.3	31.0	45.1	83.2	83.2	44.1	19.7	18.3	326.8

Table 5. Pair-wise correlations (and significance below) as a measure of coherency in two fishery catch matrices (based on fishery-dependent and fishery independent age-length keys) for the U.S. south Atlantic red porgy fishery. Values of significance below 0.10 are in bold; the lower the value, the greater the likelihood of significant correlation. Sample sizes range from 25 for adjacent ages to 20 between age 1 and age 7.

Age (yr)	Age (yr) 1	2	3	4	5	6	7
	Catch Matrix From Fishery Dependent Age Length Key						
1	1.0	0.46	-0.08	-0.11	-0.16	-0.18	-0.19
		0.0201	0.7060	0.6253	0.4795	0.4454	0.4121
2		1.0	0.37	-0.08	-0.22	-0.31	-0.36
			0.0720	0.7167	0.3222	0.1616	0.1094
3			1.0	0.42	-0.03	-0.39	-0.57
				0.0356	0.9020	**0.0679**	**0.0056**
4				1.0	0.66	0.21	-0.08
					0.0004	0.3192	0.7054
5					1.0	0.73	0.44
						0.0001	**0.0307**
6						1.0	0.84
							0.0001
	Catch Matrix From Fishery Independent Age Length Key						
1	1.0	0.32	-0.12	-0.23	-0.42	-0.36	-0.29
		0.1226	0.5787	0.2863	**0.0544**	0.1042	0.2085
2		1.0	0.55	-0.25	-0.20	-0.40	-0.46
			0.0043	0.2475	0.3494	**0.0677**	**0.0339**
3			1.0	0.74	-0.27	-0.18	-0.39
				0.0001	0.1935	0.3987	**0.0766**
4				1.0	0.50	0.09	-0.20
					0.0103	0.6648	0.3719
5					1.0	0.62	0.34
						0.0010	0.1031
6						1.0	0.82
							0.0001

Table 6. U.S. south Atlantic red porgy catch-per-effort in numbers-at-age from different MARMAP gears for ages 1 through 8+ (and total numbers) available for years 1979 through 1997.

Year	Age (yr)								CPE
	1	2	3	4	5	6	7	8+	
					Hook & line				
1979	0.11	1.08	1.51	0.55	0.22	0.27	0.16	0.11	4.00
1980	0.08	1.05	1.25	0.64	0.42	0.79	0.75	0.61	5.59
1981	0.18	1.10	0.86	0.60	0.32	0.09	0.03	0.02	3.21
1982	0.11	1.75	1.23	0.80	0.44	0.14	0.07	0.15	4.69
1983	0.05	0.39	1.01	0.73	0.19	0.09	0.04	0.04	2.55
1984	0.04	0.37	0.90	0.89	0.35	0.17	0.05	0.04	2.82
1985	0.06	0.27	0.41	0.52	0.34	0.20	0.08	0.04	1.91
1986	0.11	0.43	0.39	0.45	0.30	0.15	0.05	0.01	1.88
1987	0.15	0.49	0.28	0.11	0.03	0.04	0.05	0.04	1.17
1988	0.10	0.43	0.32	0.13	0.04	0.05	0.03	0.04	1.13
1989	0.09	0.49	0.53	0.23	0.15	0.04	0.04	0.05	1.64
1990	0.01	0.15	0.17	0.07	0.04	0.01	0.01	0.01	0.47
1991	0.10	0.15	0.25	0.30	0.18	0.09	0.04	0.04	1.17
1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	0.11	0.49	0.41	0.43	0.30	0.11	0.05	0.04	1.94
1994	0.04	0.12	0.12	0.16	0.13	0.07	0.02	0.02	0.67
1995	0.11	0.11	0.09	0.18	0.17	0.09	0.05	0.04	0.83
1996	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1997	0.01	0.16	0.36	0.65	0.66	0.36	0.08	0.12	2.40
					Extended Chevron Trap				
1980	0.15	1.83	2.17	1.11	0.73	1.37	1.31	1.06	9.74
1981	0.50	3.01	2.36	1.65	0.87	0.25	0.08	0.06	8.78
1982	0.23	3.53	2.49	1.61	0.89	0.28	0.14	0.30	9.45
1983	0.24	1.81	4.72	3.42	0.91	0.44	0.19	0.20	11.92
1984	0.06	0.57	1.36	1.34	0.53	0.25	0.08	0.07	4.26
1985	0.22	0.95	1.43	1.82	1.17	0.68	0.28	0.13	6.68
1986	0.43	1.77	1.57	1.83	1.22	0.62	0.21	0.02	7.66
1987	0.81	2.63	1.49	0.57	0.15	0.22	0.25	0.20	6.32
1988	0.76	0.71	0.35	0.12	0.03	0.04	0.03	0.03	2.14
1989	0.84	1.01	0.57	0.14	0.07	0.02	0.02	0.02	2.75
1990	0.31	0.73	0.50	0.14	0.08	0.02	0.03	0.02	1.85
1991	0.51	0.67	0.43	0.37	0.14	0.05	0.02	0.03	2.24
1992	0.46	0.81	0.46	0.37	0.14	0.06	0.03	0.03	2.38
1993	0.19	0.34	0.27	0.24	0.16	0.07	0.01	0.02	1.31
1994	0.22	0.33	0.30	0.34	0.26	0.12	0.02	0.03	1.62
1995	0.84	0.37	0.26	0.26	0.19	0.09	0.02	0.02	2.08
1996	0.11	0.30	0.26	0.27	0.20	0.09	0.02	0.02	1.27
1997	0.06	0.15	0.15	0.17	0.14	0.07	0.02	0.02	0.78

Table 7. Pair-wise correlations (and significance below) as a measure of coherency in two MARMAP gear indices (hook & line and extended chevron trap) for the U.S. south Atlantic red porgy fishery. Values of significance below 0.10 are in bold; the lower the value, the greater the likelihood of significant correlation. Sample sizes range from 18 for adjacent ages to 13 between age 1 and age 7 for the hook & line gear, and between 17 and 12 for the extended Chevron gear.

Age (yr)	Age (yr) 1	2	3	4	5	6	7
				Hook & Line Index			
1	1.0	0.48	0.56	0.20	0.47	-0.27	0.41
		0.0430	**0.0204**	0.4539	**0.0772**	0.3578	0.1621
2		1.0	0.77	0.72	0.22	0.43	0.26
			0.0002	**0.0010**	0.4194	0.1137	0.3778
3			1.0	0.64	0.41	0.13	0.41
				0.0045	0.1052	0.6270	0.1276
4				1.0	0.20	0.35	0.26
					0.4216	0.1717	0.3344
5					1.0	0.00	0.52
						0.9999	**0.0334**
6						1.0	0.17
							0.5010
				Chevron Trap Index			
1	1.0	-0.11	-0.25	-0.36	-0.12	-0.16	-0.16
		0.6760	0.3414	0.1855	0.6932	0.6103	0.6167
2		1.0	0.78	0.55	0.60	0.78	0.69
			0.0002	**0.0285**	**0.0187**	**0.0010**	**0.0089**
3			1.0	0.63	0.71	0.79	0.81
				0.0070	**0.0019**	**0.0004**	**0.0004**
4				1.0	0.59	0.76	0.58
					0.0125	**0.0006**	**0.0228**
5					1.0	0.71	0.68
						0.0014	**0.0035**
6						1.0	0.43
							0.0852

Table 8. Mean estimates of age-specific instantaneous fishing mortality rate (F) on U.S. south Atlantic red porgy for three time periods using FADAPT virtual population analysis. Exploitation rates are given in the final column based on catches for age 1-8 divided by population estimates for ages. Estimates given for different assumed levels of natural mortality.

Natural Mortality M	Age (yr) 1	2	3	4+	Exploitation Rate (Ages 1-8)
			1972-1978		
0.20	0.004	0.02	0.04	0.11	0.03
0.28	0.003	0.02	0.03	0.09	0.04
0.35	0.002	0.01	0.02	0.07	0.03
			1982-1986		
0.20	0.075	0.25	0.32	0.65	0.23
0.28	0.059	0.20	0.27	0.56	0.19
0.35	0.046	0.16	0.22	0.47	0.15
			1992-1996		
0.20	0.008	0.07	0.30	0.70	0.21
0.28	0.007	0.06	0.27	0.64	0.18
0.35	0.005	0.05	0.25	0.59	0.16

Table 9. Equilibrium yield per recruit (YPR) and spawning potential ratio (SPR) of U.S. south Atlantic red porgy based on mean age-specific fishing mortality rates for three periods from FADAPT virtual population analysis. Estimates based on separate Von Bertalanffy growth parameters for females and males.

Natural Mortality	YPR (g)	Spawning Potential Ratio Total	Female	Eggs	Male	Percent Male[a]
			1972-1978			
0.20	206.5	60	74	65	52	84
0.28	101.4	76	85	80	68	90
0.35	54.4	85	91	88	78	93
			1982-1986			
0.20	352.2	15	31	17	8	57
0.28	263.2	28	46	31	15	66
0.35	199.2	40	57	44	25	73
			1992-1996			
0.20	236.2	15	30	19	7	56
0.28	173.1	24	42	30	13	64
0.35	130.7	34	52	39	20	71

[a] Percent relative reduction in numbers of mature males between fished and unfished conditions.

Table 10. Biological reference points developed from equilibrium yield per recruit (YPR) and spawning potential ratio (SPR) analyses for U.S. south Atlantic red porgy estimated from output from FADAPT using catch matrix based on most recent time period and fishery-dependent age-length key (with corresponding value based on fishery-independent age-length key for M=0.28 in parenthesis).

Biological Reference Point	Natural Mortality (M)		
	0.20	0.28	0.35
YPR:			
$F_{0.1}$	0.2	0.3 (0.4)	0.4
F_{max}	0.4	0.6 (1.4)	0.9
SPR:			
Female:			
F_{30}	0.69	1.44 (>2.0)	>2.0
F_{40}	0.38	0.72 (1.40)	1.19
Male:			
F_{30}	0.20	0.27 (0.39)	0.35
F_{40}	0.14	0.19 (0.26)	0.24
Total:			
F_{30}	0.27	0.45 (0.96)	0.73
F_{40}	0.18	0.28 (0.52)	0.42
Observed Full F by Period:			
1972-78	0.11	0.09 (0.09)	0.07
1982-86	0.65	0.56 (0.48)	0.47
1992-96	0.70	0.64 (0.44)	0.59

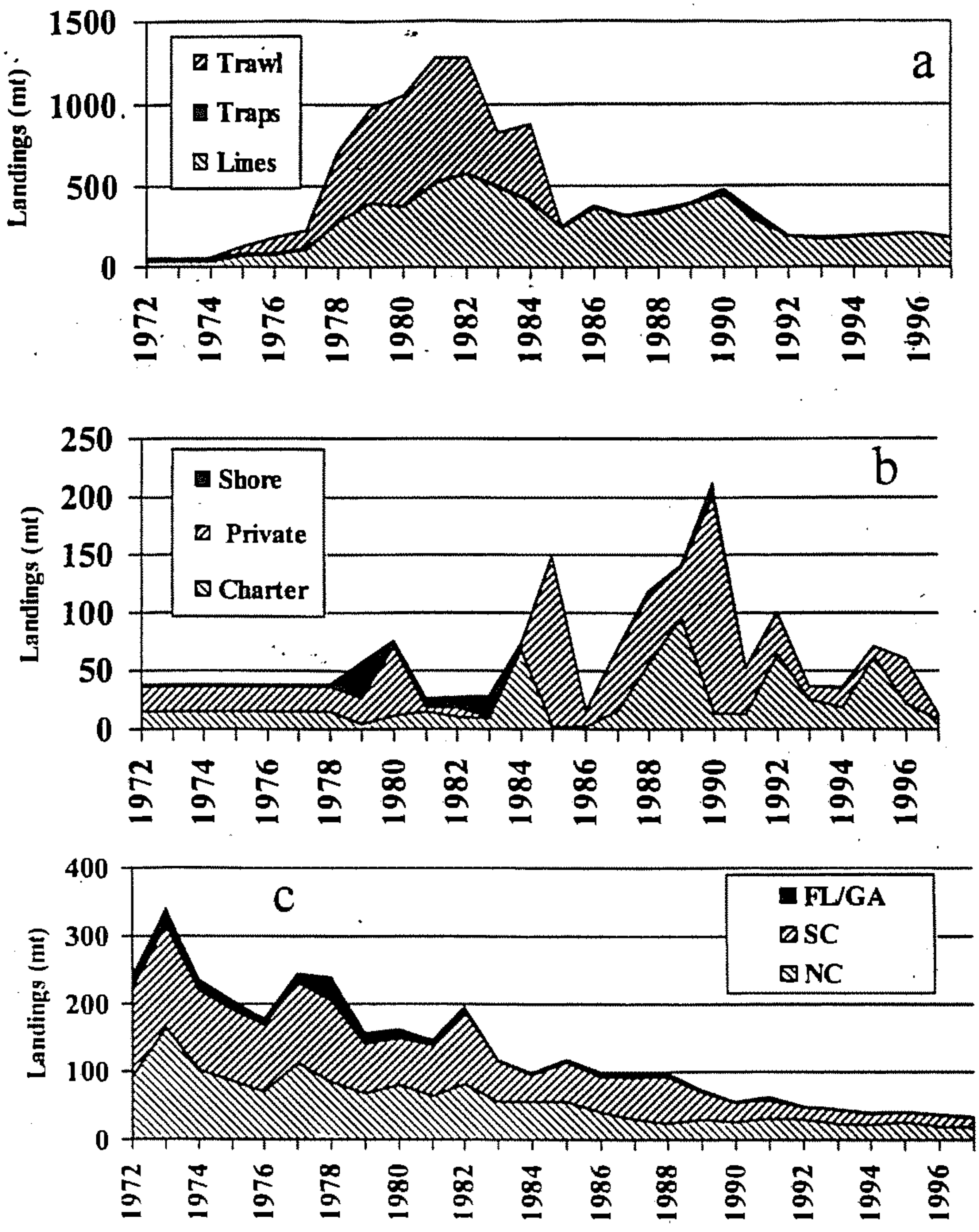


Figure 1. Annual landings of U.S. south Atlantic red porgy by category within fishery: a) commercial landings by gear, b) recreational landings by mode of fishing, and c) headboat landings by state.

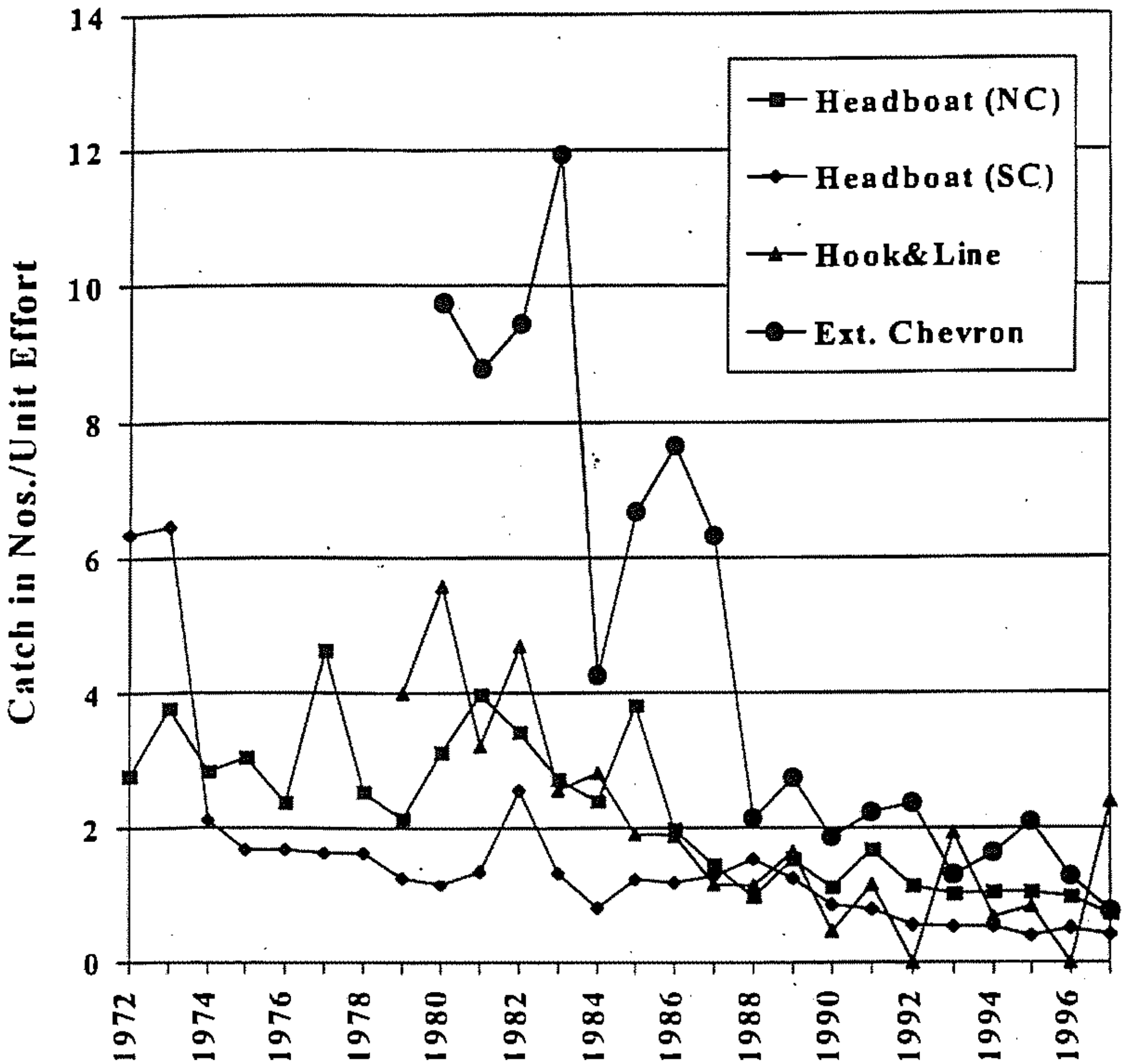


Figure 2. U.S. south Atlantic red porgy catch per unit effort from headboat fishery in North and South Carolina (effort in number fish caught per angler day, 1972-1997); and from MARMAP sampling by gear (hook & line, 1979-1997; and extended Chevron trap, 1980-1997).

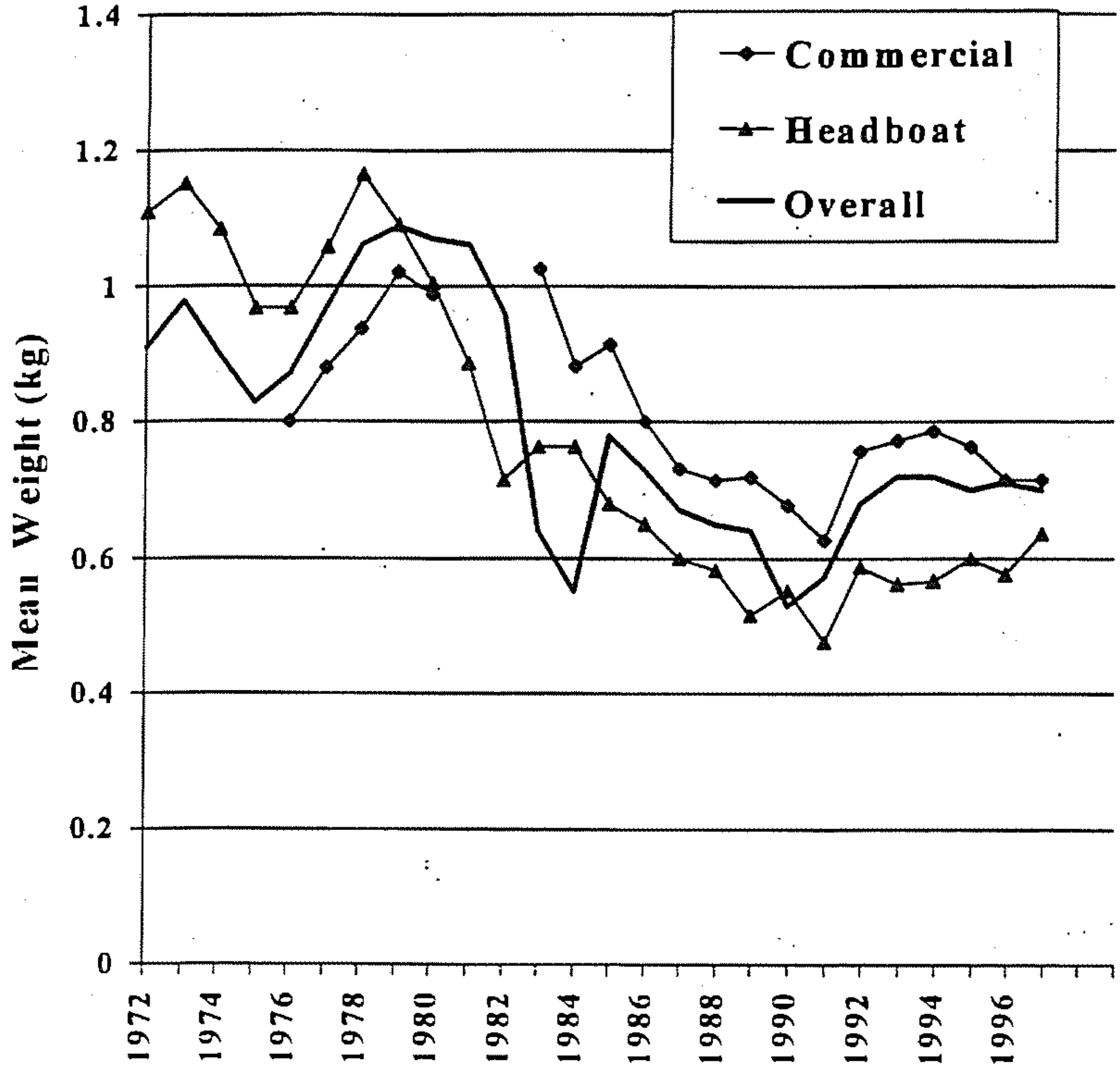


Figure 3. Annual mean weight of U.S. south Atlantic red porgy in the landings for commercial hook & line, headboat from the Carolinas, and overall all fisheries.

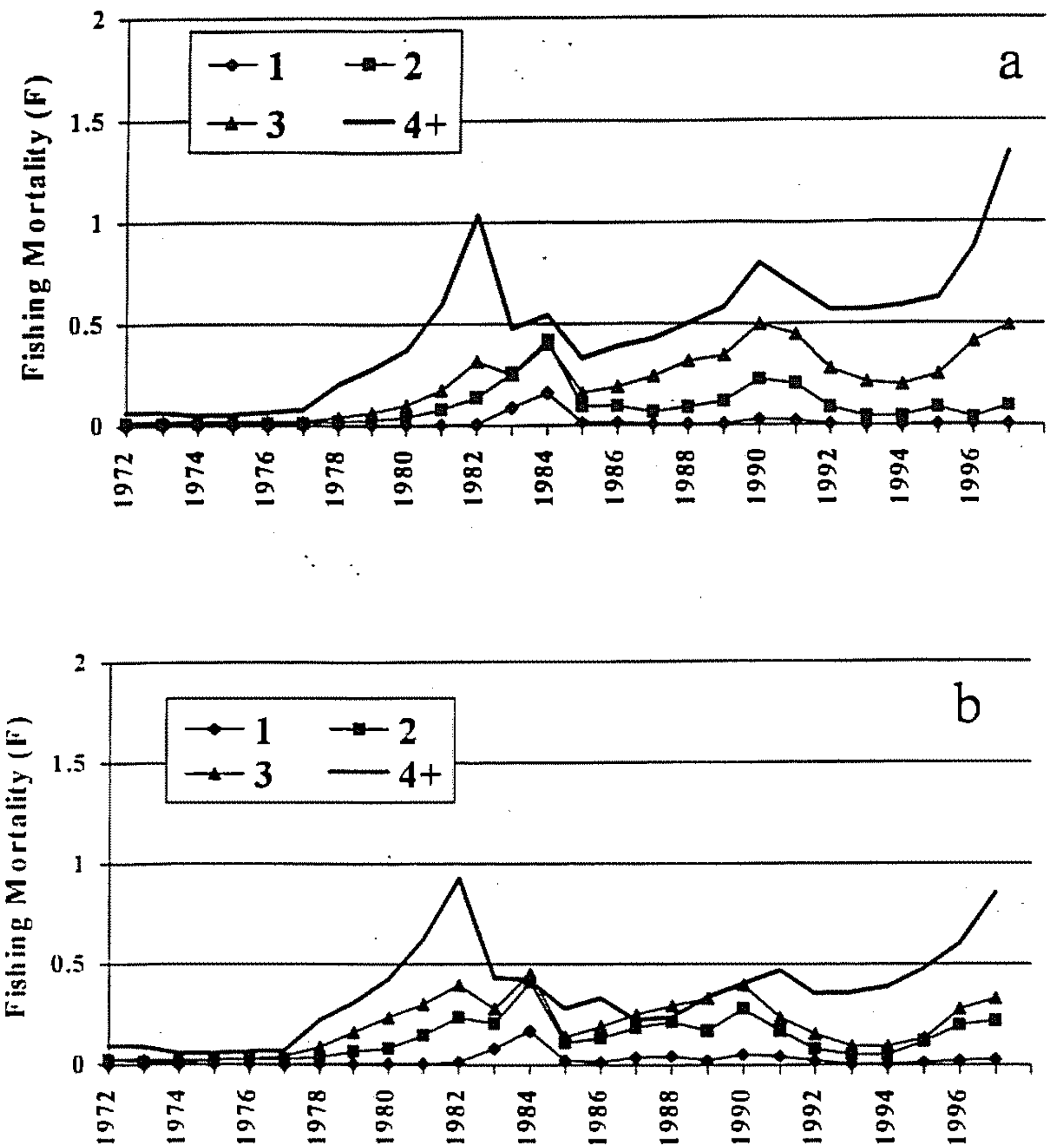


Figure 4. Annual estimates of age-specific instantaneous fishing mortality rate (F) for U.S. south Atlantic red porgy by calibrated virtual population analysis (FADAPT) using a) catch matrix based on fishery-dependent age-length keys, and b) catch matrix based on fishery-independent age-length keys (MARMAP).

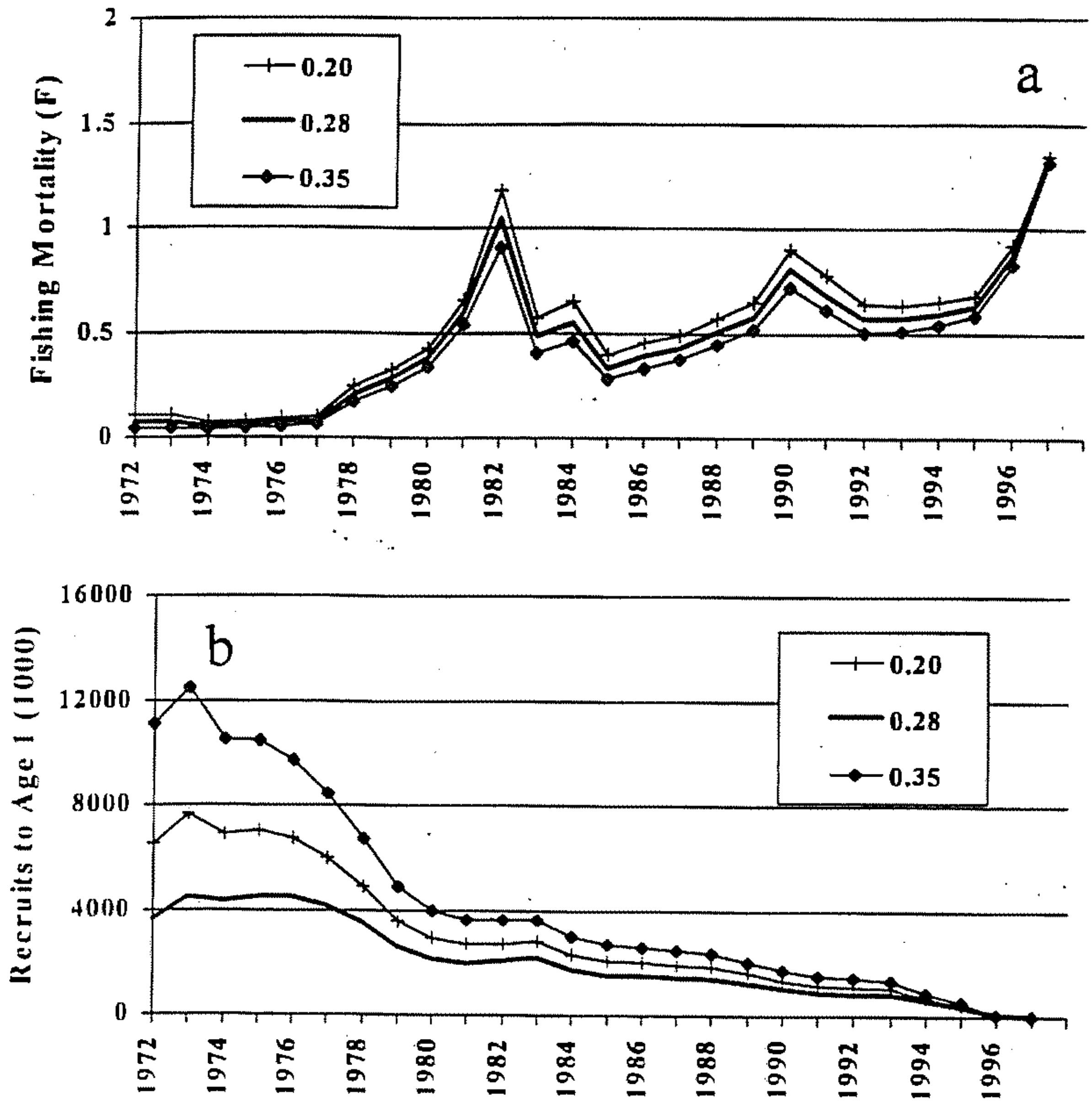


Figure 5. Sensitivity of a) annual estimated instantaneous fishing mortality rates (mean F on ages 4-8), and b) recruits to age 1 from calibrated virtual population analysis (FADAPT) applied to U.S. south Atlantic red porgy (catch matrix based on fishery-dependent age-length keys) to varying range of instantaneous natural mortality rate (M).

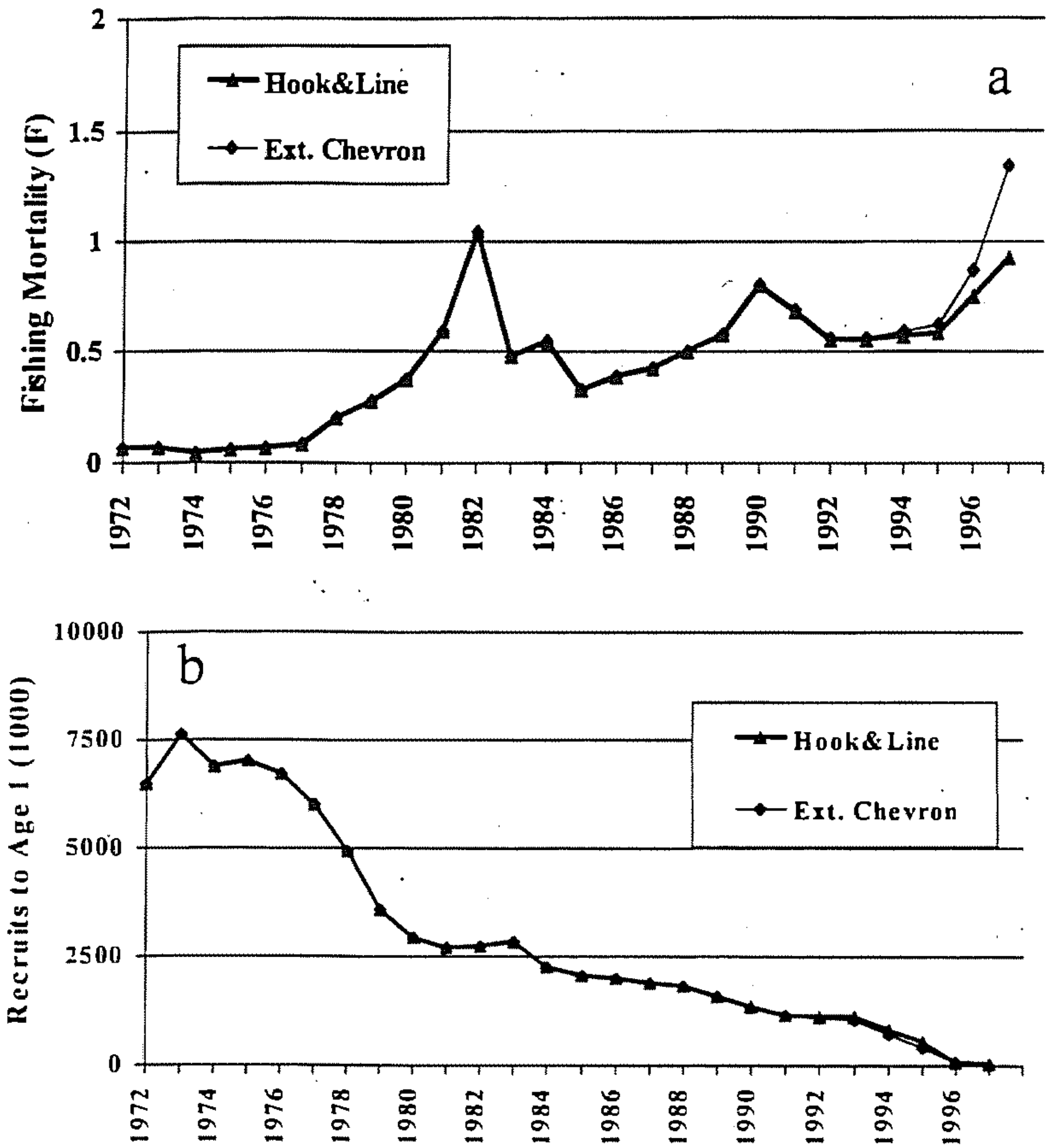


Figure 6. Sensitivity of a) annual estimated instantaneous fishing mortality rates (mean F on ages 4-8), and b) recruits to age 1 from calibrated virtual population analysis (FADAPT) applied to U.S. south Atlantic red porgy (catch matrix based on fishery-dependent age-length keys) using either only extended Chevron trap or only Hook & Line CPE indices.

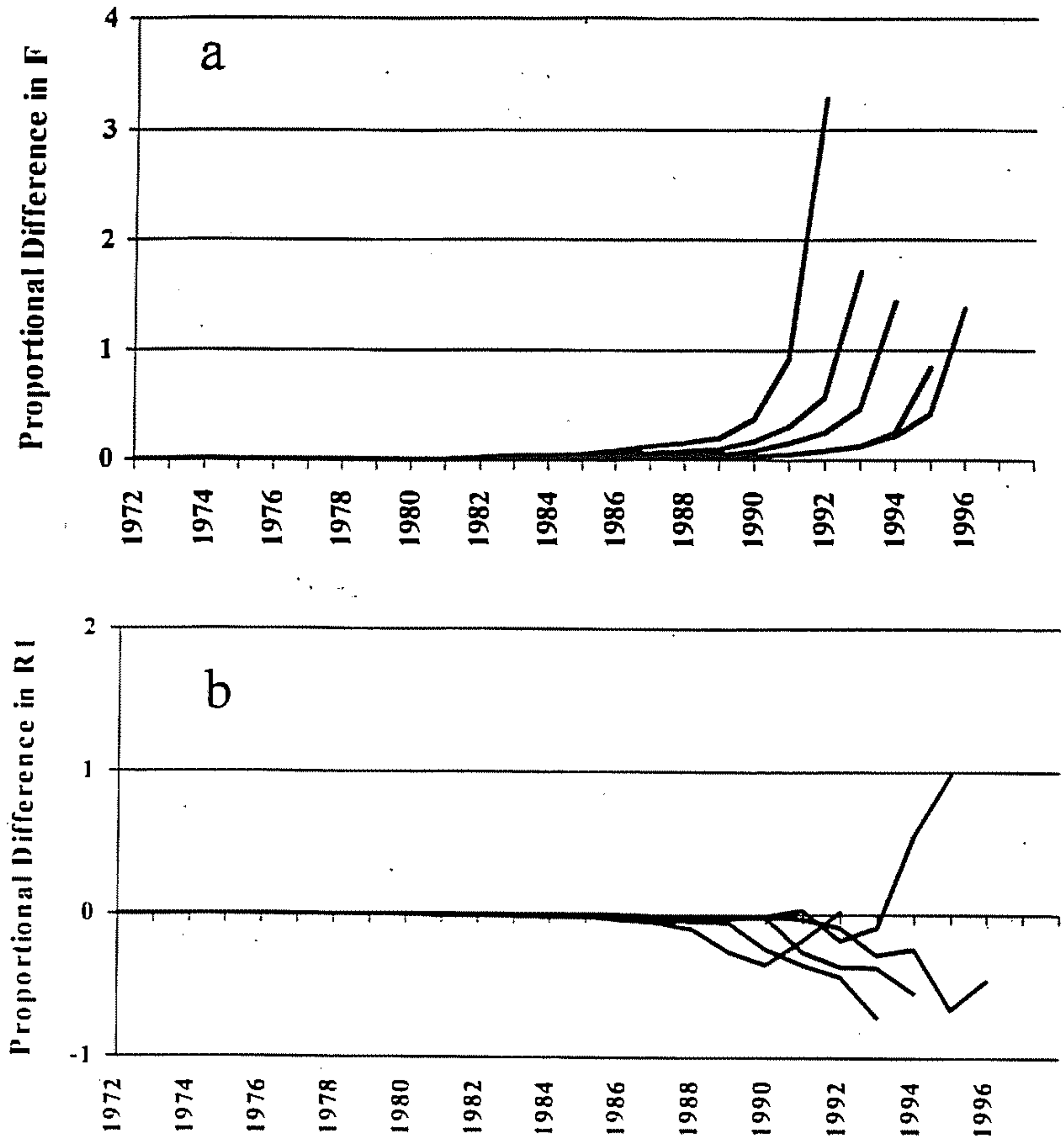


Figure 7. Proportional differences for a) annual estimated instantaneous fishing mortality rates (mean F on ages 4-8), and b) recruits to age 1 from calibrated virtual population analysis (FADAPT) applied to U.S. south Atlantic red porgy (catch matrix based on fishery-dependent age-length keys) with earlier final year compared to analysis with the most recent final year (1997).

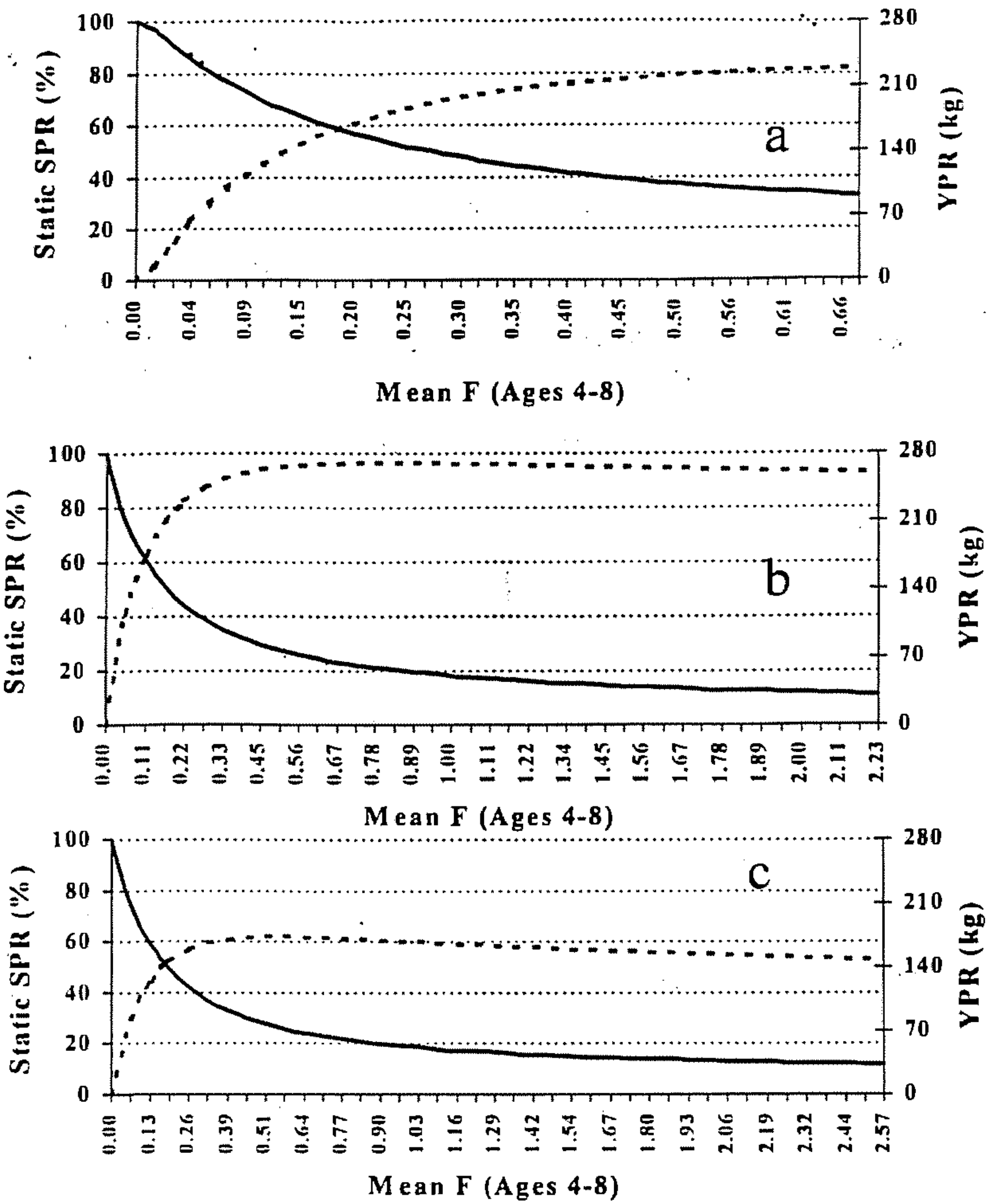


Figure 8. Overlay of equilibrium yield per recruit (YPR, dashed line) and spawning stock biomass (SPR, solid line) from U.S. south Atlantic red porgy (catch matrix based on fishery-dependent age-length keys and M=0.28) with increasing fishing mortality rate for three time periods: a) 1972-1978, b) 1982-1986, and c) 1992-1996.

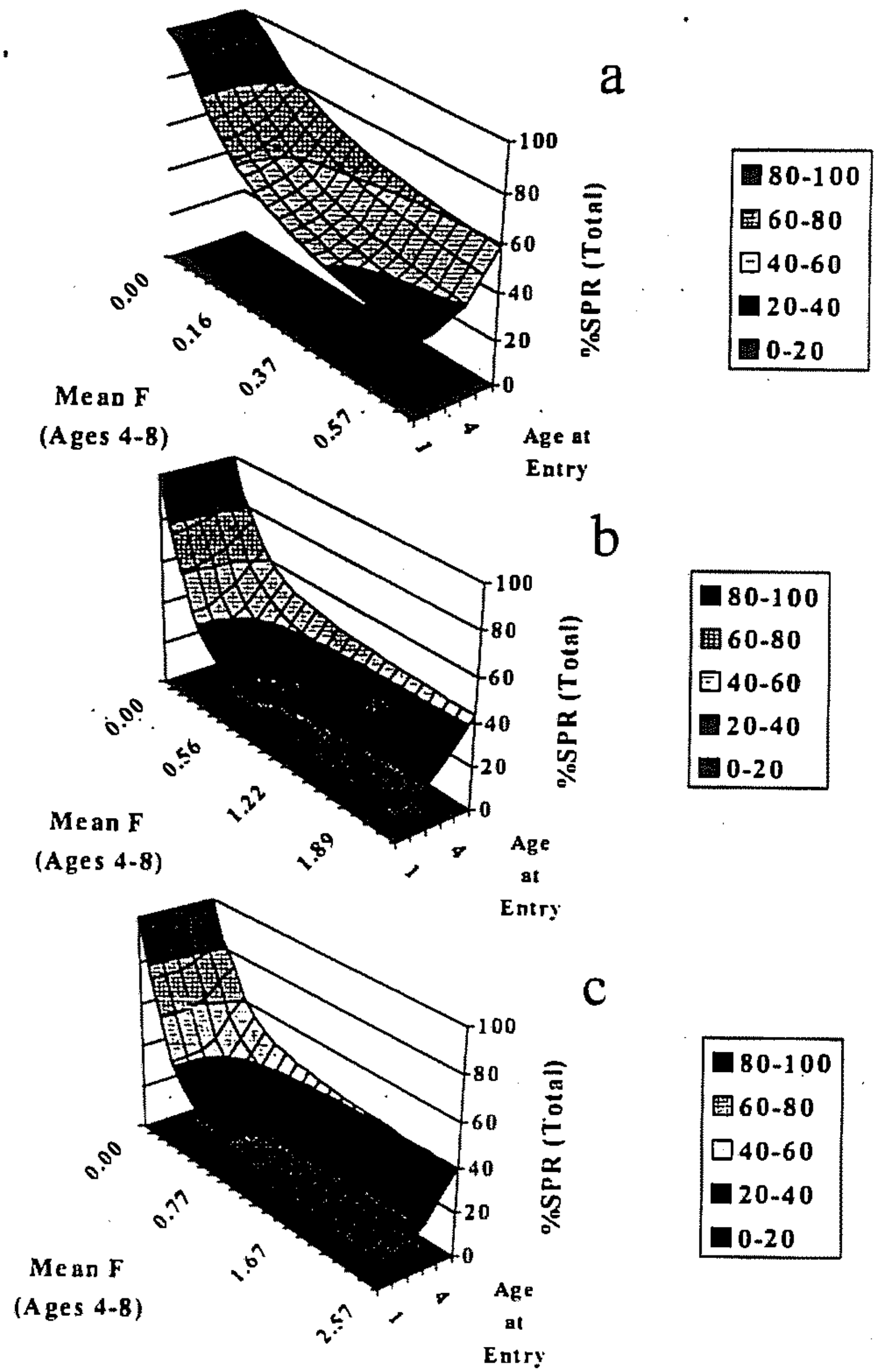


Figure 9. Equilibrium spawning potential ratio (static SPR) from U.S. south Atlantic red porgy (catch matrix based on fishery-dependent age-length keys and M=0.28) for increasing fishing mortality rate (F) and age-at-entry to the fishery for three time periods: a) 1972-1978, b) 1982-1986, and c) 1992-1996.

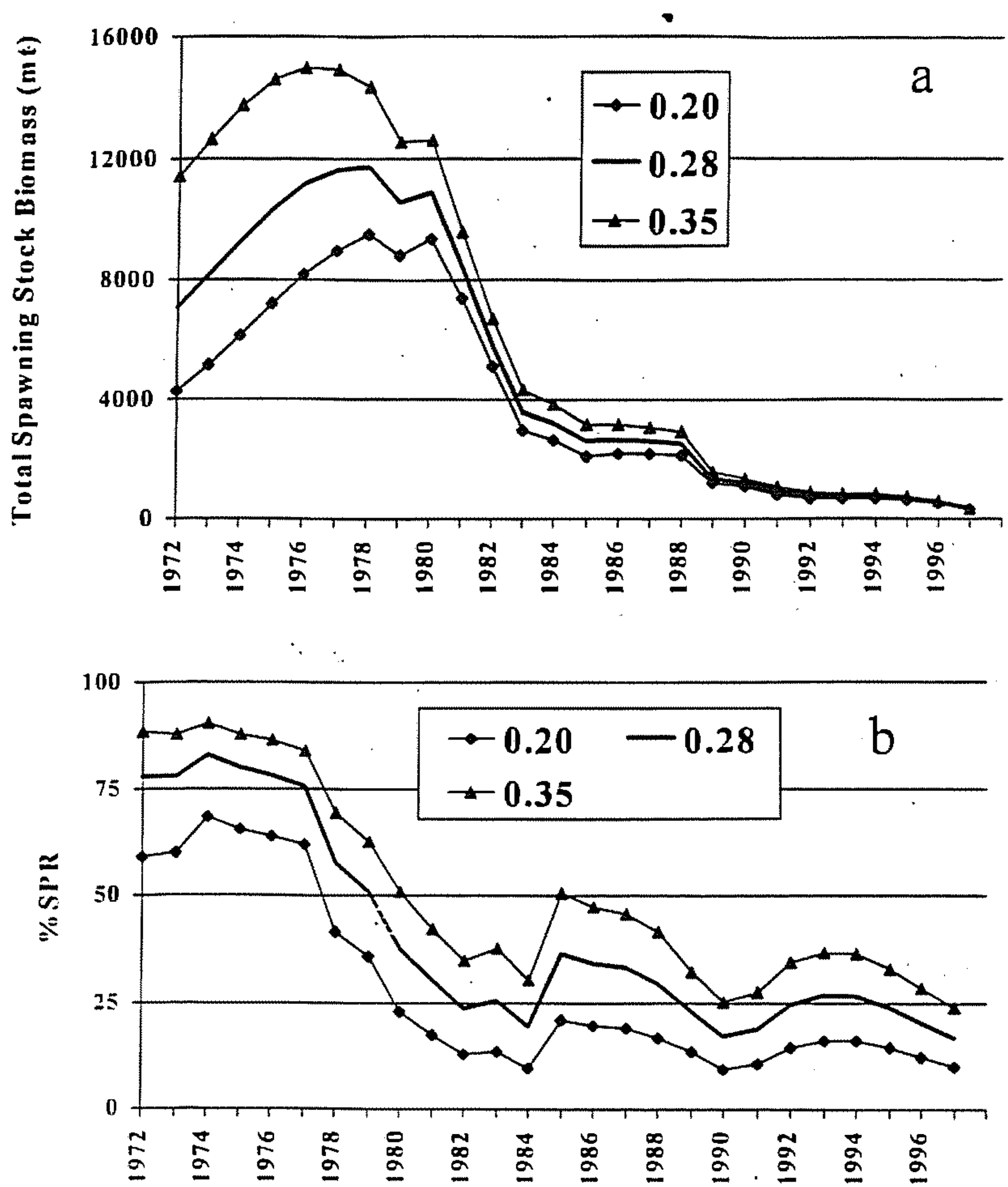


Figure 10. Population estimates from calibrated virtual population analysis (FADAPT) applied to U.S. south Atlantic red porgy (catch matrix based on fishery-dependent age-length keys) for: a) total spawning stock biomass, and b) equilibrium spawning potential ratio (SPR, based on total mature biomass).

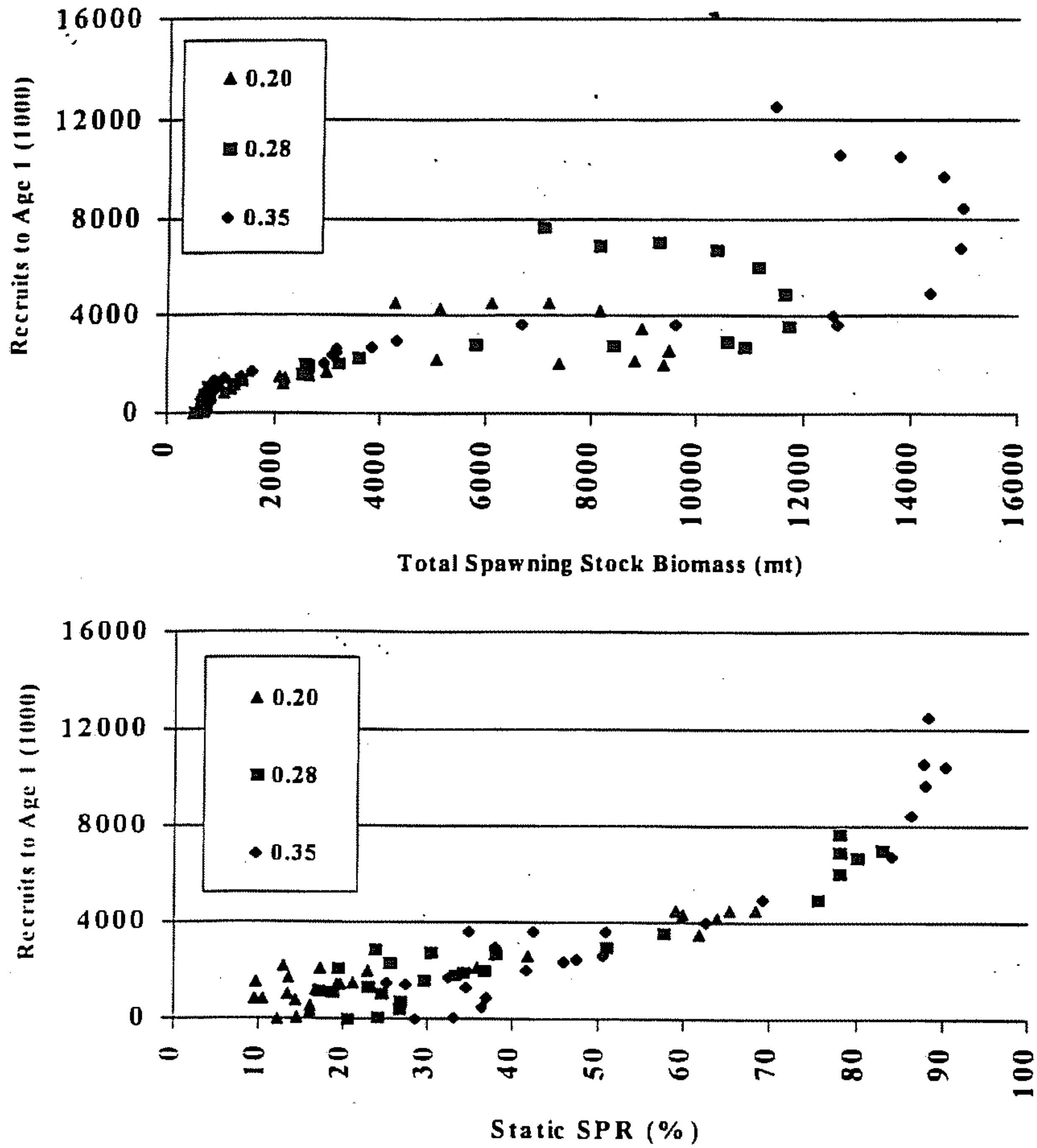


Figure 11. Recruits to age 1 compared with a) total spawning stock biomass and b) static spawning potential ratio (SPR) for U..S. south Atlantic red porgy (based on catch matrix using fishery-dependent age-length keys) from calibrated virtual population analysis (FADAPT) for three levels of M (0.20, 0.28, and 0.35).

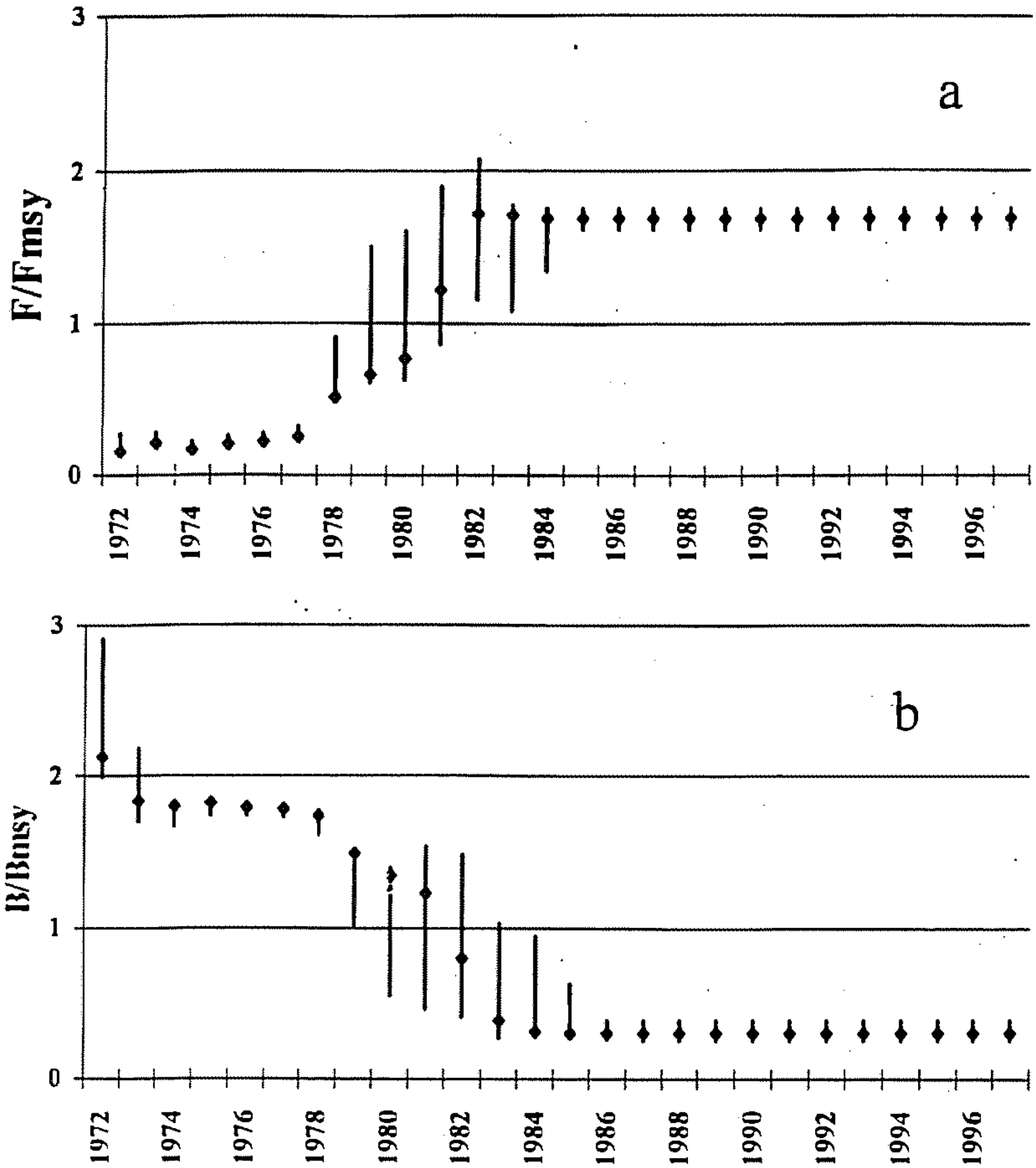


Figure 12. Plots of a) relative fishing mortality (F/Fmsy) and b) relative population biomass (B/Bmsy) from surplus production model (ASPIC) of U.S. south Atlantic red porgy population with total landings and CPE from MARMAP (hook & line and extended Chevron trap). [Vertical lines represent 80% confidence intervals from bootstrap procedure.]

Appendix C. Marpol Annex V- Garbage disposal restrictions(Source: DOC 1988c).

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

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

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

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

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

BLANK

Appendix D. ASMFC Habitat Statement (Source: ASMFC 1994).

JOINT STATEMENT TO CONSERVE MARINE, ESTUARINE AND RIVERINE HABITAT

presented at

Atlantic States Marine Fisheries Commission Meeting
Washington, DC

May 16, 1990
Final Revision November 7, 1990

Statement:

The undersigned parties agree to use available mandates and to expand interagency efforts to minimize adverse effects of human activities on marine, estuarine, and riverine species and their habitats. This statement offers general guidance to states, federal agencies and regional bodies that share responsibility for fish habitats through their respective roles in decisions on research, management, and specific human activities. All decisions related to habitat conservation and use must accommodate the ecological needs of living natural resources in marine, estuarine, and riverine systems.

Objectives:

1. To minimize avoidable adverse impacts to fish stocks and their habitat. Our shared intent is to grant these valuable resources an appropriate level of management concern that reflects their tremendous socioeconomic-cultural value to the Nation. Any determination of public interest should balance these values with other uses.

2. To conserve, restore, and enhance fish habitats for the long-term benefit of all users. This applies equally to habitats of existing fish stocks and the historic ranges of stocks covered by a restoration plan. Aggressive action may be warranted to recover lost benefits.

3. To promote innovative programs that will increase our knowledge of management strategies that may reduce habitat loss or augment fish stocks, including:

   a) Beneficial uses of dredged material;

   b) Mitigation techniques for specific habitats accomplished in a manner that does not adversely impact the habitat needs of other important living natural resources.

   c) Restoration measures for specific stocks.

4. To improve our use of existing authorities and adopt new interagency procedures that will improve our habitat management efforts, including:

   a) Policies, guidelines, and/or regulations regarding "no net loss" of wetlands;

b) Recognition, support, and promotion of ecologically responsible wetland enhancement and management techniques that will add benefits for living resources of special concern while maintaining values for other important living resources.

c) Early identification procedures to accord special recognition to deserving habitats; and,

d) Incorporating all agencies into such efforts as fishery management plans (with the Fishery Management Councils established under the Magnuson Fishery Conservation and Management Act and with the Atlantic States Marine Fisheries Commission).

5. To foster greater interagency cooperation and collaboration, including:

a) Shared priority statements, policies and management plans that will improve overall awareness of habitat programs in other agencies;

b) Joint research and management initiatives to address common issues and needs; and,

c) Improved decision-making protocols, including mechanisms to incorporate best-available information into decisions affecting living resources and their habitat in ecological units within meaningful bio-geographic regions rather than administrative or political jurisdictions.

Recommended Actions:

Our shared responsibilities for marine, estuarine, and riverine habitats invite frequent opportunities for collaboration, including:

1) Share general information, recommendations, and decisions for other important living resources that relate to habitats or related resources, e.g., habitat policies or habitat discussions in Fishery Management Plans.

2) Collaborate with other parties on actions that relate to habitat or living resources, e.g., management plans or mitigation protocols.

3) Initiate new agreements to improve our efforts to conserve and manage living resources and their habitat, e.g. development and implementation of strategic multi-objective resource plans to address issues in resource or habitat management.

This statement of intent to conserve and manage marine, estuarine and riverine habitat is endorsed by the following agencies, states, and regional bodies:

RESOLUTION #1

MARINE, ESTUARINE AND RIVERINE HABITAT POLICY

RESOLUTION OF AGREEMENT

WHEREAS, the fishery stocks which inhabit the coastal rivers, estuaries, and shelf waters of the eastern seaboard of the United States represent commercial and recreational resources of enormous economic and social value to the citizens of our country; and,

WHEREAS, management of these resources is the responsibility of the states, the Atlantic States Marine Fisheries Commission, and the federal government acting through the three regional Fishery Management Councils, namely, New England, Mid-Atlantic, and South Atlantic, and,

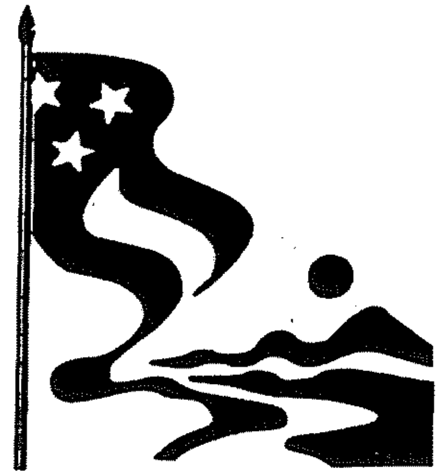
WHEREAS, the efforts to conserve and manage these fishery resources, the necessary habitat, and water quality are the management responsibilities of the aforementioned organizations; and, further that Fishery Management Plans (FMPs) developed by the Commission and Regional Councils include a detailed Habitat Section dealing with the preservation of the fishery environment and the assessment of the degradation caused by human activities; and,

WHEREAS, the state, interstate, and federal agencies that enforce laws or are designated and authorized by law to monitor, assess, permit and/or regulate human activities that affect the habitat, water quality, and the fish stocks; and, further that these agencies (state agencies, interstate compacts, and NOAA/National Marine Fisheries Service, U.S. Fish and Wildlife Service, U.S. Coast Guard, U.S. Army Corps of Engineers, and U.S. Environmental Protection Agency), share with the Commission and Fishery Management Councils a pressing responsibility to address the impact of their planning and regulatory activities affecting the status of fishery resources which are clearly defined in the provisions of FMPs;

NOW THEREFORE BE IT RESOLVED that the Commission, recognizing the requirement for improved coordination, agrees to actively implement the "unified marine habitat policy statement" presented on May 16, 1990 in Washington, D.C. with final revision dated November 7, 1990 attached hereto and made a part hereof, and calls upon the Regional Councils and federal agencies named above to do so also.

BLANK

Appendix E. Habitat laws (Source: EPA 1994).



major environmental laws

If you are interested in becoming active in environmental, health, and community safety issues, you will need to understand many of the following federal laws. These laws, and others enacted by states, have various requirements and are enforced by various agencies. We have presented a brief description of the intent of each law. For more details, you should obtain a copy from your local library, state library, or the relevant federal or state agency. Federal and state officials, community organizations, and interest groups will help you gain a working knowledge of these laws.

the clean air act (CAA)

42 U.S.C. s/s 7401 et seq. (1970)

The Clean Air Act is the comprehensive federal law which regulates air emissions from area, stationary, and mobile sources. This law authorizes the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment. The goal of the Act was to set and achieve NAAQS in every state by 1975. This setting of maximum pollutant standards was coupled with directing the states to develop state implementation plans (SIPs) applicable to appropriate industrial sources in the state.

The Act was amended in 1977 primarily to set new goals (dates) for achieving attainment of NAAQS since many areas of the country had failed to meet the deadlines. The 1990 amendments to the Clean Air Act in large part were intended to meet unaddressed or insufficiently addressed problems such as acid rain, ground level ozone, stratospheric ozone depletion, and air toxics.

the clean water act (CWA)

33 U.S.C. s/s 121 et seq. (1977)

The Clean Water Act is a 1977 amendment to the Federal Water Pollution Control Act of 1972, which set the basic structure for regulating discharges of pollutants to waters of the United States. This law gave EPA the authority to set effluent standards on an industry-by-industry basis (technology-based) and continued the requirements to set water quality standards for all contaminants in surface waters. The CWA makes it unlawful for any person to discharge any pollutant from a point source into navigable waters unless a permit (NPDES) is obtained under the Act. The 1977 amendments focused on toxic pollutants. In 1987, the CWA was reauthorized and again focused on toxic substances, authorized citizen suit provisions, and funded sewage treatment plants (POTWs) under the Construction Grants Program.

The CWA provides for the delegation by EPA of many permitting, administrative, and enforcement aspects of the law to state governments. In states with the authority to implement CWA programs, EPA still retains oversight responsibilities.

the comprehensive environmental response, compensation, and liability act (CERCLA or Superfund)

42 U.S.C. s/s 9601 et seq. (1980)

CERCLA (pronounced SERK-la) provides a federal "Superfund" to clean up uncontrolled or abandoned hazardous waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. Through the Act, EPA was given power to seek out those parties responsible for any release and assure their cooperation in the cleanup. EPA cleans up orphan sites when potentially responsible parties (PRPs) cannot be identified or located, or when they fail to act. Through various enforcement tools, EPA obtains private party cleanup through orders, consent decrees, and other small party settlements. EPA also recovers costs from financially viable individuals and companies once a response action has been completed.

EPA is authorized to implement the Act in all 50 states and U.S. territories. Superfund site identification, monitoring, and response activities in states are coordinated through the state environmental protection or waste management agencies.

the emergency planning & community right-to-know act (EPCRA)

42 U.S.C. 11011 et seq. (1986)

Also known as Title III of SARA, EPCRA was enacted by Congress as the national legislation on community safety. This law was designed to help local communities protect public health, safety, and the environment from chemical hazards.

To implement EPCRA, Congress required each state to appoint a State Emergency Response Commission (SERC). The SERCs were required to divide their states into Emergency Planning Districts and to name a Local Emergency Planning Committee (LEPC) for each district. Broad representation by fire fighters, health officials, government and media representatives, community groups, industrial facilities, and emergency managers ensures that all necessary elements of the planning process are represented.

the endangered species act

7 U.S.C. 136; 16 U.S.C. 460 et seq. (1973)

The Endangered Species Act provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The U.S. Fish and Wildlife Service (FWS) of the Department of Interior maintains the list of 632 endangered species (326 are plants) and 190 threatened species (78 are plants). Species include birds, insects, fish, reptiles, mammals, crustaceans, flowers, grasses, and trees. Anyone can petition FWS to include a species on this list or to prevent some activity, such as logging, mining, or dam building. The law prohibits any action, administrative or real, that results in a "taking" of a listed species, or adversely affects habitat. Likewise, import, export, interstate, and foreign commerce of listed species are all prohibited.

EPA's decision to register a pesticide is based in part on the risk of adverse effects on endangered species as well as environmental fate (how a pesticide will effect habitat). Under FIFRA, EPA can issue emergency suspensions of certain pesticides to cancel or restrict their use if an endangered species will be adversely affected. Under a new program, EPA, FWS, and USDA are distributing hundreds of county bulletins which include habitat maps, pesticide use limitations, and other actions required to protect listed species.

In addition, we are enforcing regulations under various treaties, including the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The U.S. and 70 other nations have established procedures to regulate the import and export of imperiled species and their habitat. The Fish and Wildlife Service works with U.S. Customs agents to stop the illegal trade of species, including the Black Rhino, African elephants, tropical birds and fish, orchids, and various corals.

the federal insecticide, fungicide and rodenticide act (FIFRA)

7 U.S.C. s/s 135 et seq. (1972)

The primary focus of FIFRA was to provide federal control of pesticide distribution, sale, and use. EPA was given authority under FIFRA not only to study the consequences of pesticide usage but also to require users (farmers, utility companies, and others) to register when purchasing pesticides. Through later amendments to the law, users also must take exams for certification as applicators of pesticides. All pesticides used in the U.S. must be registered (licensed) by EPA. Registration assures that pesticides will be properly labeled and that, if used in accordance with specifications, will not cause unreasonable harm to the environment.

the (federal) freedom of information act (FOIA)

U.S.C. s/s 552 (1966)

The Freedom of Information Act provides specifically that "any person" can make requests for government information. Citizens who make requests are not required to identify themselves or explain why they want the information they have requested. The position of Congress in passing FOIA was that the workings of government are "for and by the people" and that the benefits of government information should be made available to everyone.

All branches of the federal government must adhere to the provisions of FOIA with certain restrictions for work in progress (early drafts), enforcement confidential information, classified documents, and national security information.

the national environmental policy act (NEPA)

42 U.S.C. s/s 4321 et seq. (1969)

The National Environmental Policy Act was one of the first laws ever written that establishes the broad national framework for protecting our environment. NEPA's basic policy is to assure that all branches of government give proper consideration to the environment prior to undertaking any major federal action which significantly affects the environment. NEPA requirements are invoked when airports, buildings, military complexes, highways, parkland purchases, and other such federal activities are proposed. Environmental Assessments (EAs) and Environmental Impact Statements (EISs), which are assessments of the likelihood of impacts from alternative courses of action, are required from all federal agencies and are the most visible NEPA requirements.

the occupational safety and health act

29 U.S.C. 61 et seq. (1970)

Congress passed the Occupational and Safety Health Act to ensure worker and workplace safety. Their goal was to make sure employers provide their workers a place of employment free from recognized hazards to safety and health, such as exposure to toxic chemicals, excessive noise levels, mechanical dangers, heat or cold stress, or unsanitary conditions. In order to establish standards for workplace health and safety, the Act also created the National Institute for Occupational Safety and Health (NIOSH) as the research institution for the Occupational Safety and Health Administration (OSHA). OSHA is a division of the U.S. Department of Labor which oversees the administration of the Act and enforces federal standards in all 50 states.

the pollution prevention act

42 U.S.C. 13101 and 13102, s/s 6602 et seq. (1990)

The Pollution Prevention Act focused industry, government, and public attention on reducing the amount of pollution produced through cost-effective changes in production, operation, and raw materials use. Opportunities for source reduction are often not realized because existing regulations, and the industrial resources required for compliance, focus on treatment and disposal. Source reduction is fundamentally different and more desirable than waste management or pollution control. Pollution prevention also includes other practices that increase efficiency in the use of energy, water, or other natural resources, and protect our resource base through conservation. Practices include recycling, source reduction, and sustainable agriculture.

the resource conservation and recovery act (RCRA)

42 U.S.C. s/s 321 et seq. (1976)

RCRA (pronounced "rick-rah") gave EPA the authority to control hazardous waste from "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes.

The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. RCRA focuses only on active and future facilities and does not address abandoned or historical sites (see CERCLA).

HSWA (pronounced "hiss-wa") - The federal Hazardous and Solid Waste Amendments. The 1984 amendments to RCRA which required phasing out land disposal of hazardous waste. Some of the other mandates of this strict law include increased enforcement authority for EPA, more stringent hazardous waste management standards, and a comprehensive underground storage tank program.

the safe drinking water act (SDWA)

43 U.S.C. s/s 300f et seq.(1974)

The Safe Drinking Water Act was established to protect the quality of drinking water in the U.S. This law focuses on all waters actually or potentially designated for drinking use, whether from above ground or underground sources. The Act authorized EPA to establish safe standards of purity and required all owners or operators of public water systems to comply with primary (health-related) standards. State governments, which assume this power from EPA, also encourage attainment of secondary standards (nuisance-related).

the superfund amendments and reauthorization act (SARA)

42 U.S.C. 9601 et seq. (1986)

The Superfund Amendments and Reauthorization Act of 1986 reauthorized CERCLA to continue cleanup activities around the country. Several site-specific amendments, definitions, clarifications, and technical requirements were added to the legislation, including additional enforcement authorities.

Title III of SARA also authorized the Emergency Planning and Community Right-to-Know Act (EPCRA).

the toxic substances control act (TSCA)

15 U.S.C. s/s 2601 et seq. (1976)

The Toxic Substances Control Act of 1976 was enacted by Congress to test, regulate, and screen all chemicals produced or imported into the U.S. Many thousands of chemicals and their compounds are developed each year with unknown toxic or dangerous characteristics. To prevent tragic consequences, TSCA requires that any chemical that reaches the consumer market place be tested for possible toxic effects prior to commercial manufacture.

Any existing chemical that poses health and environmental hazards is tracked and reported under TSCA. Procedures also are authorized for corrective action under TSCA in cases of cleanup of toxic materials contamination. TSCA supplements other federal statutes, including the Clean Air Act and the Toxic Release Inventory under EPCRA.

Appendix F. Pollutants included in the National Pollutant Discharge Inventory, and Their Effects on the Environment, Marine Organisms and Humans (Source: NOAA, 1985).

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

Appendix G. Snapper Grouper Framework.

Snapper Grouper Amendment 4 (1991) established the following framework:
C. ASSESSMENT GROUP & ANNUAL ADJUSTMENTS
ACTION 5: ASSESSMENT GROUP & ANNUAL ADJUSTMENTS

Establish an assessment group and annual adjustments:

1. The Council will appoint an assessment group (Group) that will assess the condition of selected snapper grouper species in the management unit (including periodic economic and sociological assessments as needed) on an annually planned basis. The Group will present a report of its assessment and recommendations to the Council.

2. The Council will consider the report and recommendations of the Group and hold public hearings at a time and place of the Council's choosing to discuss the Group's report. The Council may convene the Advisory Panel and the Scientific and Statistical Committee to provide advice prior to taking final action. After receiving public input, the Council will make findings on the need for changes.

3. If changes are needed in the maximum sustainable yield (MSY), total allowable catch (TAC), quotas, trip limits, bag limits, minimum sizes, gear restrictions, season/area closures (including spawning closures), timeframe for recovery of overfished species or fishing year, the Council will advise the Regional Director in writing of their recommendations accompanied by the Group's report, relevant background material, draft regulations, Regulatory Impact Review and public comments. This report will be submitted each year at least 60 days prior to the start of the fishing season (currently April 16).

4. The Regional Director will review the Council's recommendations, supporting rationale, public comments and other relevant information. If the Regional Director concurs that the Council's recommendations are consistent with the goals and objectives of the fishery management plan, the national standards and other applicable law, the Regional Director will recommend that the Secretary publish proposed and final rules in the Federal Register of any changes prior to the appropriate fishing season (currently April 16).

5. Should the Regional Director reject the recommendations, he will provide written reasons to the Council for the rejection, and existing regulations will remain in effect until the issue is resolved.

6. Appropriate adjustments that may be implemented by the Secretary by proposed and final rules in the Federal Register are:

a. Initial specification of MSY and subsequent adjustment of the best estimate of MSY where this information is available for a particular species.

b. Initial specification of acceptable biological catch (ABC) and subsequent adjustment of the ABC range and/or best estimate when and where this information is available for a particular species.

c. Setting TAC for a particular species. A TAC for wreckfish may not exceed 8 million pounds.

d. Modifying (or implementing for a particular species) TAC, quotas (including zero quotas), trip limits, bag limits (including zero bag limits), minimum sizes, gear restrictions (ranging from modifying current regulations to a complete prohibition) and season/area closures (including spawning closures).

e. The fishing year and spawning closure for wreckfish may not be adjusted by more than one month.

f. Authority is granted to the Regional Director to close any fishery, i.e. revert any bag limit to zero and close any commercial fishery, once a quota has been established through the procedure described above and such quota has been filled. When such action is necessary, the Regional Director will recommend that the Secretary publish a notice in the Federal Register as soon as possible.

g. Modifying (or implementing for a particular species) a timeframe for recovery of an overfished species.

Discussion

The procedure described above will allow for regular stock assessments and provide for timely adjustments to the management program to prevent overfishing and/or rebuild a stock if overfished. It is the Council's intent that all species in the management unit receive periodic assessments. Council staff and the assessment group will select species to be assessed and include those in the annual NMFS/Council planning process (called Operations Plans).

It is the Council's intent that TAC be limited by the upper end of an acceptable biological catch (ABC) range when and if one is provided; however, no limits should be placed on the lower limit of TAC so that a zero TAC could be specified if deemed necessary to protect the resource.

Snapper Grouper Amendment 7 (1994) modified the framework:
ACTION 14. MODIFY THE FRAMEWORK PROCEDURE

Modify the framework (wording included under discussion below) by inserting "where appropriate" after "report" in (3): "...accompanied by the Group's report (where appropriate)..." Modify the last sentence in (3) to read: "For wreckfish and any other species under limited access, this report will be submitted each year at least 60 days prior to the start of the fishing season; for all other species and/or changes, this report will be submitted by any such date as may be specified by the Council but at least 60 days prior to the desired effective date." Also, modify the last sentence in (4) to read: "...changes for species managed under limited access prior to the fishing year, and for all other species and/or changes on such dates as may be agreed upon with the Council."

Biological Impacts

The framework established in Amendment 4 has been interpreted to allow preseason changes for wreckfish prior to the April 16 start of the fishing season, and for all other species and/or changes prior to January 1. The alternatives discussed below will explore retaining the preseason timeframe for wreckfish but allow other changes as needed during the year.

Amendment 4 (SAFMC, 1991a; page 22) discusses the assessment group and annual adjustments. The wording currently in place is as follows:

"3. If changes are needed in the maximum sustainable yield (MSY), total allowable catch (TAC), quotas, trip limits, bag limits, minimum sizes, gear restrictions, season/area closures (including spawning closures), timeframe for recovery of overfished species or fishing year, the Council will advise the Regional Director in writing of their recommendations accompanied by the Group's report, relevant background material, draft regulations, Regulatory Impact Review and public comments. This report will be submitted each year at least 60 days prior to the start of the fishing season (currently April 16).

4. The Regional Director will review the Council's recommendations, supporting rationale, public comments and other relevant information. If the Regional Director concurs that the Council's recommendations are consistent with the goals and objectives of the fishery management plan, the national standards and other applicable law, the Regional Director will recommend that the Secretary publish proposed and final rules in the Federal Register of any changes prior to the appropriate fishing season (currently April 16)."

It is the Council's intent to make most changes prior to the appropriate fishing year (April 16 for wreckfish and January 1 for all other species). However, instances may arise that require action during the fishing year and may not require/allow for a report from the assessment group. This option would allow the Council to take appropriate action that would benefit the resource or the resource users without having to rely on emergency action. If this wording was in Amendment 4, the recent black sea bass pot changes would not have required emergency action. The NMFS Washington Office has made it clear that the Councils are to develop framework provisions that reduce the necessity of requesting emergency action. This change to "any such date as may he specified by the Council" tracks the mackerel framework.

This option would allow for an in-season adjustment to the quota for species managed under an open access quota management program. However, for species under a limited access management program, modifications to the quotas would be pre-season adjustments.

The SAFMC Comprehensive SFA Amendment modified the framework:
4.3.4.2 Framework Adjustment Procedures.

ACTION 6. Add a provision to all framework procedures in all Council FMPs that allows the addition of biomass levels and age structured analyses as they become available.

Discussion

Data are not available to allow the Council to specify biomass levels for the overfished levels. This provision will allow the Council to add specification of biomass levels and/or age structured analyses to address the overfished component of the status determination criteria. Making these adjustments through the framework procedure should be faster than requiring a full plan amendment.

<u>The SAFMC Comprehensive Habitat Amendment added a habitat procedure to the framework in all SAFMC FMPs with a framework:</u>

4.2.8 Mechanism for Determination of Framework Adjustments/ Framework Procedure and Activities Authorized by the Secretary of Commerce.

Establish a procedure to allow for rapid modification to definitions of Essential Fish Habitat (EFH); establishment of new, or modification of existing, Essential Fish Habitat-Habitat Areas of Particular Concern (EFH-HAPCs); and establishment of new, or modification of existing, Coral-Habitat Areas of Particular Concern. This adjustment procedure will allow the Council to add or modify measures through a streamlined public review process. As such, measures that have been identified could be implemented or adjusted at any time during the year. The process is as follows:

1. The Council will call upon the Habitat and Environmental Protection Advisory Panel (Panel) for EFH-related actions and the Coral Advisory Panel for Coral-HAPC related actions. The Habitat and/or Coral Advisory Panel(s) will present a report of their assessment and recommendations to the Council.

2. The Council may take framework action one or more times during a year based on need. Such action(s) may come from the Panel report or the Council may take action based on issues/problems/information that surface separate from the Panel. The steps are as follows:

A. Habitat or Coral Advisory Panel Report— The Council will consider the report and recommendations of the Panel and hold public hearings at a time and place of the Council's choosing to discuss the Panel's report. The Council will consult the Advisory Panel(s) and the Scientific and Statistical Committee to review the Panel's report and provide advice prior to taking final action. After receiving public input, the Council will make findings on the need for changes.

B. Information separate from Panel Report — The Council will consider information that surfaces separate from the Panel. Council staff will compile the information and analyze the impacts of likely alternatives to address the particular situation. The Council staff report will be presented to the Council. A public hearing will be held at the time and place where the Council considers the Council staff report. The Council will consult the Advisory Panel(s) and the Scientific and Statistical Committee to review the staff report and provide advice prior to taking final action. After receiving public input, the Council will make findings on the need for changes.

3. If the Council determines that an addition or adjustment (e.g., in a species or species complex definition of EFH or EFH-HAPCs or a new EFH-HAPC is proposed for a species or species complex) to EFH, EFH-HAPCs, or Coral-HAPCs is necessary to meet the goals and objectives of the Habitat Plan, it will recommend, develop, and analyze appropriate action over the span of at least two Council meetings. The Council will provide the public with:

A. Advance notice of the availability of the recommendation.

B. The appropriate justifications, and biological, economic, and social analyses.

C. An opportunity to comment on the proposed adjustments prior to and at the second Council meeting.

4. After developing management actions and receiving public testimony, the Council will then submit the recommendation to the Regional Administrator. The Council's recommendation to the Regional Administrator must include supporting rationale, an analysis of impacts, and a recommendation to the Regional Administrator on whether to publish the management measure(s) as a final rule.

5. If the Council recommends that the management measures should be published as a final rule, the Council must consider at least the following factors and provide support and analysis for each factor considered:

A. Whether the availability of data on which the recommended management measures are based allows for adequate time to publish a proposed rule.

B. Whether regulations have to be in place for an entire harvest/fishing season.

C. Whether there has been adequate notice and opportunity for participation by the public and members of the affected industry in the development of the Council's recommended management measures.

D. Whether there is an immediate need to protect the resource.

E. Whether there will be a continuing evaluation of management measures adopted following their promulgation as a final rule.

6. If, after reviewing the Council's recommendation and supporting information based on the FMP and the administrative record:

A. The Regional Administrator concurs with tbe Council's recommended management measures and determines that the recommended management measures may be published as a final rule then the action will be published in the Federal Register as a final rule; or

B. The Regional Administrator concurs with the Council's recommendation and determines that the recommended measures should be published first as a proposed rule, the action will be published as a proposed rule in the Federal Register. After additional public comment, if the Regional Administrator concurs with the Council recommendation, the action will be published as a final rule in the Federal Register; or

C. The Regional Administrator does not concur, the Council will be notified, in writing, of the reason for non-concurrence and recommendations to address those concerns.

7. Appropriate adjustments that may be implemented by the Secretary by proposed and final rules in the Federal Register are:

A. Definition of or modification of a current definition of Essential Fish Habitat for a managed species or species complex.
B. Establishment of or modification of EFH-HAPCs for managed species or species complex.
C. Establishment of or modifications of Coral-HAPCs.

The procedure described above will provide for timely adjustments to definitions of Essential Fish Habitat (EFH); establishment of new, or modification of existing, Essential Fish Habitat-Habitat Areas of Particular Concern (EFH-HAPCs); and establishment of new, or modification of existing, Coral-Habitat Areas of Particular Concern. It is the Council's intent that definitions of EFH and the establishment of new or modification of existing EFH-HAPCs or Coral-HAPCs be periodically assessed. Reviews would occur as sufficient information becomes available such that the Panel, the species Advisory Panel, the Scientific and Statistical Committee, and the Council feel confident in the recommendations. Complete reviews will be conducted as needed. Council staff and NMFS will specify such reviews in the annual NMFS/Council planning process (called operations plans).

Appendix H. Changes in the life history of red porgy, Pagrus pagrus, from the southeastern United States, 1972-1994. (Source: Harris and McGovern, 1997.)

Abstract.—Aspects of the life history of red porgy from the South Atlantic Bight (SAB) were examined for four periods (1972–74, 1979–81, 1988–90, and 1991–94), and annual changes in the age and growth of red porgy were described for data collected during 1988–94. The life history of red porgy during 1972–74 was assumed to represent that of an unfished population, although this population had been subject to light fishing pressure. From 1972–74 to 1979–81, the back-calculated size-at-age increased slightly for ages 2–6. By 1988–90 and 1991–94, however, the back-calculated size-at-age for the same age classes was significantly smaller than that in 1979–81. In addition, size-at-maturity and size-at-sexual-transition occurred at progressively smaller sizes for 1988–90 and 1991–94. The mean size-at-age (observed and back-calculated) declined for most ages between 1988 and 1994. Von Bertalanffy growth curves fitted to the mean back-calculated size-at-age for each year showed similar decreasing trends. Changes in life history may be a response to sustained 20-year overexploitation that has selectively removed individuals predisposed towards rapid growth and larger size.

Manuscript accepted 28 May 1997.
Fishery Bulletin 95:732–747 (1997).

Changes in the life history of red porgy, *Pagrus pagrus*, from the southeastern United States, 1972–1994*

Patrick J. Harris
John C. McGovern
South Carolina Department of Natural Resources
PO Box 12559, Charleston, South Carolina 29422
E-mail address (for P. Harris): harrisp@mrd.dnr.state.sc.us

The red porgy, *Pagrus pagrus*, is a protogynous sparid distributed throughout the Atlantic Ocean and Mediterranean Sea at depths of 18 to 280 m (Manooch and Hassler, 1978; Vassilopoulou and Papaconstantinou, 1992). In the South Atlantic Bight (SAB) off the southeastern coast of the United States, red porgy are commonly associated with sponge or coral habitat (or both) with rocky outcrops and rocky ledges (Grimes et al., 1982), frequently referred to as "live bottom." Areas of live bottom are distributed patchily throughout the SAB, and patch size can range from square meters to square kilometers (Powles and Barans, 1980). Nevertheless, red porgy in the SAB are thought to constitute a single stock (Manooch and Huntsman, 1977).

Red porgy are an important segment of the commercial fisheries of the SAB, averaging 6% of the snapper-grouper landings since 1978 (SAFMC[1]). Similarly, red porgy make up a considerable portion of the recreational harvest of reef fishes in the SAB (Huntsman et al.[2]). The fishery for red porgy in the SAB has, however, experienced a serious decline in landings since 1982 (Vaughan et al., 1992; Huntsman et al.[2]), as well as a decline in fishery-independent catch per unit of effort (CPUE) (Fig. 1). Estimates of stock size derived from virtual population analysis (VPA) showed a peak population size in 1975 and a steady decline through 1992 (Vaughan et al., 1992; Huntsman et al.[2]). Although estimates of stock size derived from fishery-independent CPUE for 1993–1995 suggest a slight population recovery (Harris, personal obs.), the spawning stock ratio, estimated at 18% in 1993, is still considerably below the 30% level used by the South Atlantic Fishery Management Council to define when a species is overfished (Huntsman et al.[2]).

Apart from a size limit instituted in 1992, management of the fishery has remained essentially unchanged, in spite of an apparent continual decline of the resource. The ability of fishermen to locate good fishing areas (i.e. patches of live bottom) precisely using LORAN-C and Global Positioning Systems technology and

* Contribution number 394 of the South Carolina Marine Resources Center, Charleston, SC 29422

[1] SAFMC. 1991. Amendment 4, regulatory impact review and final environmental impact statement for the snapper grouper fishery of the South Atlantic Region. South Atlantic Fishery Management Council, 1 South Park Circle, Charleston, SC, 225 p.

[2] Huntsman, G. R., D. S. Vaughan, and J. C. Potts. 1993. Trends in population status of the red porgy *Pagrus pagrus* in the Atlantic Ocean of North Carolina and South Carolina, USA, 1971–1992. South Atlantic Fishery Management Council, 1 South Park Circle, Charleston, SC 29422.

BLANK

an increase in the number of vessels participating in the snapper-grouper fishery in the SAB resulted in a steadily increasing fishing mortality from 1972 through 1993 (Huntsman et al.[2]). For new management regulations to be considered, current life history data need to be made available. The most recent published discussion of SAB red porgy life history was based on data collected between 1972 and 1974 (Manooch, 1976; Manooch and Huntsman, 1977).

It has been shown that age structure, size-at-age, and reproductive strategies of a population will change in a predictable fashion that responds to declining abundance (Lack, 1968; Rothschild, 1986). There is, however, concern over the extent and permanence of these changes (Edley and Law, 1988; Bohnsack, 1990). The effect of sustained heavy exploitation, combined with current management strategies in regard to particular size restrictions and quotas or bag limits on the life history of a fished stock, is poorly documented. Staff of the Marine Resources Monitoring, Assessment, and Prediction Program (MARMAP), a federally funded program based at the South Carolina Department of Natural Resources in Charleston, SC, have collected life history data on red porgy since 1979. When combined with data collected from 1972 through 1974 (Manooch, 1976; Manooch and Huntsman, 1977), data spanning 24 years were available to determine if the life history of the red porgy population in the SAB had changed.

Long-term life history data and the increase in fishing pressure provide a mechanism to test the impact of sustained exploitation on the life history of a reef fish species in the SAB. Therefore, the objectives of this paper were to describe temporal changes in the age, growth, and reproduction of red porgy for four periods during 1972–94 and to identify annual changes in age and growth that occurred during 1988–94.

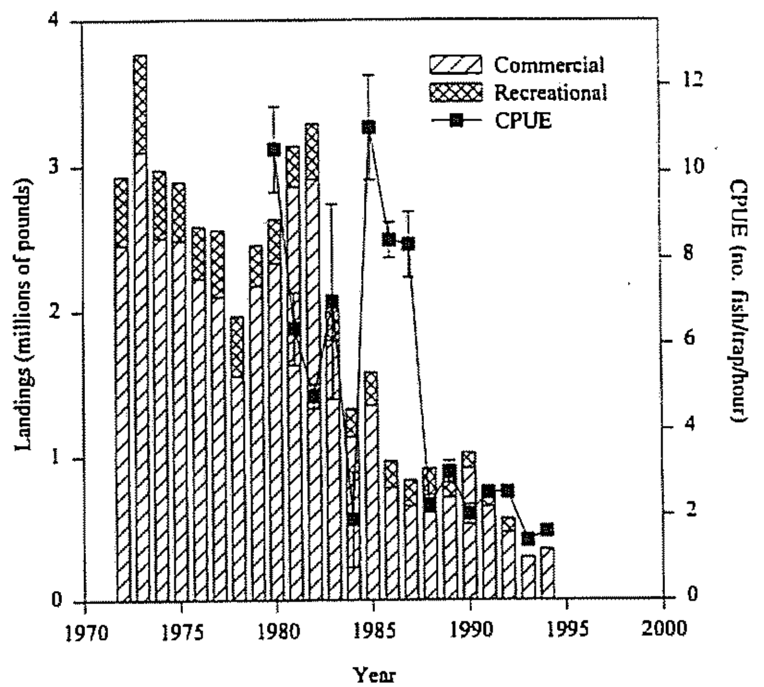


Figure 1

Commercial and recreational landings of red porgy since 1972. Recreational landings are from headboat surveys conducted by the Beaufort Laboratory of the National Marine Fisheries Service (70%), and the Marine Recreational Fisheries Statistics Survey (30%). CPUE = MARMAP trap catch per unit of effort.

Methods

Red porgy were collected from 1979 to 1994 during standard MARMAP sampling with chevron traps, hook-and-line gear, Florida traps, and blackfish traps (Collins, 1990; Collins and Sedberry, 1991) in the SAB from Cape Fear, North Carolina, to Cape Canaveral, Florida. Specimens were collected during daylight hours primarily between May and August of each year.

MARMAP sampling strategies changed slightly between 1979 and 1994. From 1979 to 1987, samples were collected randomly from four large areas of live bottom (identified by using underwater television) with hook-and-line gear, blackfish traps, and Florida traps to follow trends in the abundance of the various species. Additional sites outside these areas were sampled as time and weather conditions allowed (see Collins and Sedberry, 1991). Traps were baited with cut clupeids, buoyed off the research vessel, and soaked for one to four hours. Hook-and-line gear consisted of bandit reels (commercial bottom-fishing hook-and-line gear) or rod and reel with 6/0 Penn Senator high-speed reels and Electramate electric motors. Terminal gear always consisted of three hooks fished vertically and baited with cut squid or cigar minnow (*Decapterus* sp.). All fishes caught were measured (mm fork length [FL]), and the total weight for each species, from each collection, was recorded (g). All red porgy collected during these years were kept for life history studies.

In 1988 and 1989, a chevron trap was added to the gear used to sample reef fishes. During these years, the research vessel was anchored over a known live bottom area that was verified with underwater television. Each of the three trap types (blackfish, Florida, and chevron) was deployed either from the bow, stern, or midships of the research vessel (see Collins, 1990). Hook-and-line collections were taken with rod and reel and with the three-hook terminal rig. Fishes were processed as described for 1979–87. All red porgy collected in 1988 and 1989 were kept for life history studies.

Based on the data collected during 1988 and 1989, a decision was made to discontinue the use of blackfish and Florida traps in 1990 because chevron traps sampled a greater species diversity (Collins, 1990). During the late 1980's, all live bottom locations identified during underwater television surveys and from sampling in previous years were plotted with LORAN-C coordinates to the nearest 0.1 μs and included in a sample site database. Currently, there are over 2,500 live bottom sites in the MARMAP database, from which 300–600 randomly chosen sites have been sampled each year since 1989. In addition, since 1989, the SAB has been stratified on the basis of latitude. Zone 1 includes all sites sampled south of 32°N, zone 2 all sites between 32°N and 33°N, and zone 3 all sites north of 33°N. Buoyed chevron traps were deployed from the research vessel and soaked for approximately 90 minutes. Hook-and-line (rod-and-reel) collections were made for 30 minutes at dawn or dusk. All fishes sampled were processed as in previous years. Because of concerns about potential gear selectivity, the length frequency of all red porgy caught by all four gear types during 1988 and 1989 was compared.

Since 1989, fork lengths (cm) and total weight (10 g) were recorded for all red porgy sampled in each zone for each year with a Limnoterra FMB-IV electronic fish measuring board and a Toledo electronic scale interfaced with a XT-type personal computer. In 1990 and 1994, all red porgy collected during sampling were used for life history studies. In 1991–93, up to 15 fish from each 1-cm size class and all fish larger than 350 mm FL were kept from each zone for life history studies. Red porgy used for life history studies were measured to the nearest mm (total length [TL], FL, and standard length [SL]) with a Limnoterra FMB-IV electronic fish measuring board interfaced with a XT-type personal computer. Individual weights were measured to the nearest gram with a triple beam balance.

Age and growth

Sagittae were removed at sea and stored dry. In the laboratory, the whole right otolith was immersed in cedar wood oil and examined for annuli (one translucent and one opaque zone) (Manooch and Huntsman, 1977) with a dissecting microscope with incandescent reflecting light and an ocular micrometer (1979–87) or with a dissecting microscope and reflected light from a fiber-optic light source (1988–94). The latter microscope had an attached Hitachi KP-C550 video camera connected to a personal computer equipped with a MATROX frame grabber and OPTIMAS image analysis software. The digitized image was viewed on a television monitor, and annuli were measured with OPTIMAS software. For both systems, measurements were taken from the core of each otolith to the outer edge of each opaque zone and to the edge of the otolith on a straight line midway between the posterodorsal dome and the most posterior point on the otolith (Frizzel and Dante, 1965). Annuli on this plane were consistently clearer and easier to enumerate, especially for older fish. For years where large numbers of red porgy were collected, a minimum of 350 randomly chosen fish were aged per year. All fish larger than 350 mm (FL) were aged for all years. The first reader collected measurements from all otoliths, whereas the second reader counted increments from a randomly chosen 35% of otoliths for each year. If agreement between the two counts was less than 90% for any year, the second reader read all otoliths for that year. When counts differed, otoliths were reread by both readers and discarded from further analyses if a difference in readings persisted.

Back-calculated lengths-at-age were computed by using the scale proportional hypothesis (Francis, 1990):

$$L_i = -(a/b) + (L_c + a/b)(O_i/O_c),$$

where L_i = length at the formation of the ith increment;
O_i = otolith radius at the formation of the ith increment;
O_c = otolith radius at the time of capture;
L_c = fish length at the time of capture;
a = intercept of otolith radius on fish length regression;
b = slope of the otolith radius on fish length regression.

Lengths were backcalculated to the most recently formed increment for comparisons of annual growth (1988–94) and to all increments for comparisons between periods (1979–81, 1988–90, and 1991–94). The SigmaPlot curve-fitting module with the Marquardt-Levenburg algorithm was used to fit von Bertalanffy growth curves to the mean back-calculated length-at-age for each year or period (SigmaPlot, 1994).

Because red porgy are protogynous sparids, and undergo a size- and behavior-related transition from females to males, no comparison of size-at-age or growth rates were undertaken for the sexes separately. Life history data collected during four periods (1972–74, 1979–81, 1988–90, and 1991–94) were compared. The first study (1972–74) used red porgy sampled from headboats operating from North and South Carolina (see Manooch, 1976; Manooch and Huntsman, 1977). Specimens were collected throughout the year and gonads from 736 fish were examined macroscopically to assess sex and stage of maturity (Manooch, 1976). Scales from 3,278 individuals were examined to determine ages, and 222 fish were aged from whole otoliths (Manooch and Huntsman, 1977).

Red porgy collected during 1979–81, 1988–91, and 1991–94 were grouped by period. Otolith radius to fork length least-squares regressions were fitted separately for each period (except that of 1972–74) owing to concerns about temporal changes in somatic growth. Von Bertalanffy growth curves (von Bertalanffy, 1938) were fitted to the mean back-calculated size-at-age for each of the four study periods. Size-at-age was backcalculated for all increments measured. Mean observed and back-calculated sizes-at-age were compared between periods for each age with a single-factor ANOVA. Size and age distributions and size-at-age were compared between the three latitudinal zones sampled with single factor and two-way ANOVA's. It appeared from observations during sampling that larger fish may be associated with the shelf break; therefore size and age distributions, and size-at-age were also compared for different depths. Because the shelf break is located at about 48 m, two depth zones—0 to 45 m and 46 to 90 m—were compared. The same tests were performed in comparing annual data collected between 1988–94.

Reproduction

The posterior portion of the gonads of red porgy from 1979 to 1994 was removed from the fish and fixed in 10% seawater formalin for 1–2 weeks, then transferred to 50% isopropanol for 1–2 weeks. Gonad samples were processed with an Auto-Technicon 2A Tissue Processor, vacuum infiltrated, and blocked in paraffin. Three transverse sections (6–8 µm thick) were cut from each sample with a rotary microtome, mounted on glass slides, stained with double-strength Gill haematoxylin, and counter-stained with eosin y. Sex and reproductive state were assessed by one reader according to histological criteria (Table 1). Specimens with developing, ripe, spent, or resting gonads were considered sexually mature. For females, this definition of sexual maturity included specimens with oocyte development at or beyond the yolk vesicle stage and specimens with beta, gamma, or delta stages of atresia. Sex ratios, size-at-first-maturity, and the percent of mature females by 20-cm size class were calculated for all functional males and females, 1989–94. Sex ratio, size-at-first-maturity, and the percent of mature females were determined by size class for 1979–81, 1988–90, and 1991–94, and chi-square (χ^2) analysis was used to determine if there were significant differences in the proportion of males to all fish collected during the three periods and if there were differences in size-at-maturity between periods.

Results

1979–1994

A total of 20,756 (13,120 during 1972–74) red porgy were sampled during the four periods, of which 4,503 were aged and 4,293 sexed and staged (Table 2). The mean FL of fish collected from 1979 to 1994 showed a declining trend; however, there was no trend in mean age (Table 2). Increment formation was assumed to be annual (Collins et al., 1996; Manooch and Huntsman, 1977).

Age and growth

The mean observed size-at-age declined markedly from 1972–94 through 1991–94. Except for fishes aged 2–8 yr collected during 1979–81, the mean sizes-at-age for all ages for the three periods between 1979 and 1994 were smaller than those during 1972–94 (Fig. 2). The observed sizes-at-age in 1988–90 and 1991–94 were significantly smaller than those during 1979–81 ($P<0.01$) for ages 2 through 8. Red porgy aged 3 through 5 collected during 1991–94 were also significantly smaller than fish of the same age collected during 1988–90 ($P<0.01$). We were unable to include data collected by Manooch and Huntsman (1977) in our statistical analyses. The mean back-calculated size-at-age showed trends similar to the mean observed size-at-age (Fig. 3). Fish aged 2–8 were significantly smaller during 1988–90 and 1991–94 than during 1979–81, and fish aged 2–5 significantly smaller in 1991–94 than in 1979–81 and 1988–90.

The von Bertalanffy growth curves derived from mean back-calculated lengths for each period (Fig. 4) showed similar trends. The theoretical mean maximum fork length (L_∞) declined by 100 mm from 1972–74 to 1991–94 (Table 3). The theoretical growth rate (k) was higher between 1991 and 1994 than between 1972 and 1974. This difference is a reflection of the large decline in L_∞, rather than an increase in growth

Table 1

Histological criteria developed by MARMAP (Charleston, SC) to determine reproductive stage in red porgy, *Pagrus pagrus* (see D'Ancona, 1949, 1950; Wallace and Selman, 1981; Alekseev, 1982, 1983; Hunter et al., 1986; Sadovy and Shapiro, 1987; Matsuyama et al., 1988; West, 1990; Roumillat and Waltz[1]).

Reproductive state	Male	Female
Immature (virgin)	No primary males found. Juveniles were either females or, infrequently, simultaneous or transitional (see below).	Previtellogenic oocytes only; no evidence of atresia. In comparison with resting female, most previtellogenic oocytes <80 μm, area of transverse section of ovary is smaller, lamellae lack muscle and connective tissue bundles and are not as elongate, germinal epithelium along margin of lamellae is thicker, ovarian wall is thinner.
Developing	Development of cysts containing primary and secondary spermatocytes through some accumulation of spermatozoa in lobular lumina and dorsomedial sinuses.	Oocytes undergoing cortical granule (alveoli) formation through nucleus migration and partial coalescence of yolk globules.
Running and ripe	Predominance of spermatozoa in lobules and dorsomedial sinuses; little or no occurrence of spermatogenesis.	Completion of yolk coalescence and hydration in most advanced oocytes. Zona radiata becomes thin. Postovulatory follicles sometimes present.
Developing, recent spawn	Not assessed.	Developing stage as described above as well as presence of postovulatory follicles.
Spent	No spermatogenesis; some residual spermatozoa in lobules and sinuses.	More than 50% of vitellogenic oocytes with alpha- or beta-stage atresia.
Resting	Little or no spermatocyte development; empty lobules and sinuses.	Previtellogenic oocytes only; traces of artresia. In comparison with immature female, most previtellogenic oocytes >80 μm, area of transverse section of ovary is larger, lamellae have muscle and connective tissue bundles, lamellae are more elongate and convoluted, germinal epithelium along margin of lamellae is thinner, ovarian wall is thicker.
Mature specimen, stage unknown	Mature, but inadequate quantity of tissue or postmortem histolysis prevent further assessment of reproductive stage.	Mature, but inadequate quantity of tissue or postmortem histolysis prevent further assessment of reproductive stage.
Simultaneous (bisexual)	Presence of distinct ovarian and testicular regions in approximately equal amounts and of the same reproductive state. This gonad structure was infrequently observed in both juvenile and adult fish.	
Transitional	Ventrolateral proliferation of active testicular tissue (spermatogonia through spermatozoa) along the outer surface of the ovarian wall in spent or resting ovary (functional protogyny) or immature ovary (juvenile protogyny). As testicular tissue envelopes regressing ovary, ovary collapses laterally and sperm sinuses form within former ovarian wall.	

[1] Roumillat, W. A., and C. W. Waltz. 1993. Biology of the red porgy, *Pagrus pagrus*, from the southeastern United States. MARMAP Final Data Report, South Carolina Department of Natural Resources, Charleston, SC, 38 p.

rate (i.e. the negative relation between L_∞ and k). However, k was highest for the 1979–81 period, when L_∞ was also still relatively high.

Reproduction

Our examination of 4,293 gonads (n=1,397, 1979–81; n=727, 1988–90; n=2,169, 1991–94) revealed that sexual transition was occurring at smaller sizes in the later periods. There was a significant increase (P<0.001) in the number of males with time (Table 4). However, in 1988–90 and in 1991–94, the proportion of males to the total number of fish sexed was significantly greater at smaller sizes than during 1979–81 (Table 4). At 301–350 mm TL, male red porgy made up 24% of the fish that were sexed dur-

Table 2
Sampling data for the four study periods 1972–74, 1979–81, 1988–90, and 1991–94.

Year	Fish sampled	No. aged	Mean fork length (mm)	Mean age (years)	No. sexed
1972–74	13,120	222	—	—	—
1979–81	1,933	1,177	293	3.07	1,397
1988–90	1,853	1,261	254	2.44	727
1991–94	3,850	1,843	257	3.062	2,169
Total	20,756	4,503	268	2.86	4,293

ing 1991–94, in contrast with 7% at the same size interval during 1979–81 ($P<0.001$; Table 4). In 1979–81, male red porgy constituted 12% of the fish examined at 351–400 mm TL compared with 32% in 1988–90 ($P<0.01$) and 49% in 1991–94 ($P<0.001$; Table 4).

Size-at-maturity of female red porgy has also changed. Female red porgy became sexually mature at smaller sizes in 1991–94 than in 1979–81. During 1991–94, female red porgy first became sexually mature at 176–200 mm TL (mean age=0.9). In 1979–81, the first mature female was at 201–225 mm TL (mean age=0.9) (Table 5). There were significantly more mature females (54%; $P<0.001$) at 251–275 mm TL (mean age=1.9) in 1991–94 than during 1979–81 (27%; mean age=1.7).

Table 3
Von Bertalanffy growth equation parameters derived from the mean back-calculated fork length for each time period.

Parameter	1972–74	1979–81	1988–90	1991–94
k	0.226	0.343	0.273	0.281
L_∞	459.3	391.4	382.7	356.4

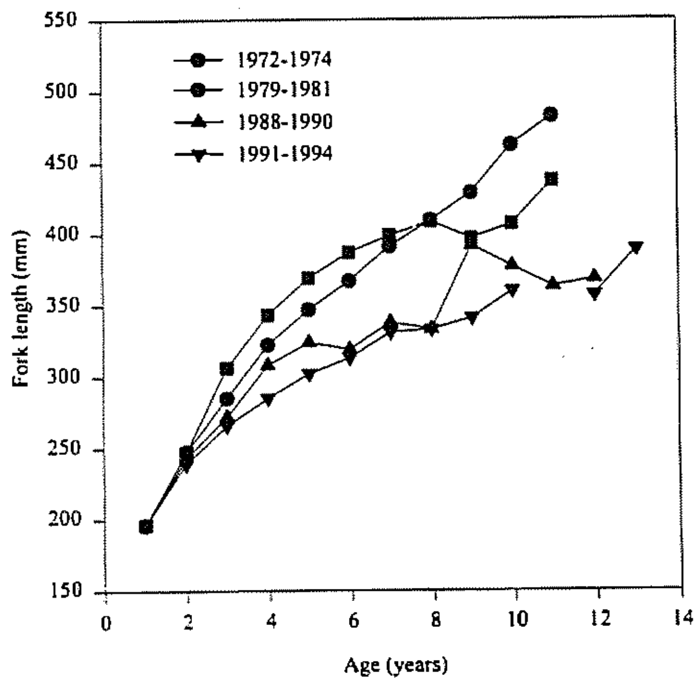


Figure 2
The mean size at capture for red porgy collected in 1972–74, 1979–81, 1988–90, and 1991–94. Ages for red porgy collected between 1972 and 1974 were taken from Manooch and Huntsman (1977).

1988–1994

A total of 2,629 live bottom stations and 5,265 red porgy were sampled May through August 1988–94, of which 4,349 specimens were kept for life history studies (Table 6). The majority of the samples were collected with chevron traps. During 1988 and 1989, there was no difference between the size range of red porgy collected in chevron traps and the size range of red porgy collected in blackfish traps, Florida traps, hook-and-line gear, or all three of these gear types combined (Fig. 5). Similarly, there was no difference in the size range of red porgy sampled by hook-and-line gear and chevron traps between 1990 and 1994 (Fig. 5). Between 1988 and 1991, however, the mean size of red porgy captured with hook and line was significantly larger each year than the mean size of porgy taken with the remaining gear types ($P<0.05$), although there was no significant difference between mean size of fish captured with the gear types used in 1993 and mean size of fish captured with the gear types used in 1994. The size of red porgy sampled during 1988–94 ranged from 90 to 501 mm FL. The mean size was 256 mm FL, with the highest frequency occurring at 240 mm FL. The length frequency of aged red porgy was very similar to the length frequency of all red porgy sampled.

Age and growth

Ages were obtained for 2,935 (67%) of the red porgy otoliths collected (Table 6). Agreement between the first and second reader averaged 93%, and was never less than 90% for any year. The mean observed size-at-age declined for most ages between 1988 and 1994 (Table 7), although there was a significant increase in the mean age of red porgy over the study period (Fig. 6; $P<0.01$; $r^2=0.94$). The mean observed size-at-age for red porgy 2 years and older sampled during 1988 and 1989 was significantly larger than all other years, with the mean observed size-at-age in 1992 and 1993 consistently the smallest (Table 7; Fig. 7). Above age 6, growth rates appeared to taper off sharply for all years (Fig. 7). Age-6 red porgy collected during 1988 had the third highest mean length recorded for all age classes in any year. Similar to the mean observed size at age, mean back-calculated size at the most recent annulus was significantly larger for 1988 and 1989 compared with other years for ages 2 and greater and also appeared to reach asymptotic size at age 6 for each year (Table 8; Fig. 8).

The von Bertalanffy growth curves fitted to the mean back-calculated size at most recent age (ages 1–10) for each year demonstrated some differences between years (Fig. 9), with growth curves from 1988 and 1989 showing larger fish at age, and higher L_∞ and k. Both k and L_∞ tended to decrease during the study period, although neither of these trends were significant (linear regression; $P>0.05$; Fig. 10).

No significant differences were apparent in size distribution, age distribution, or size-at-age between

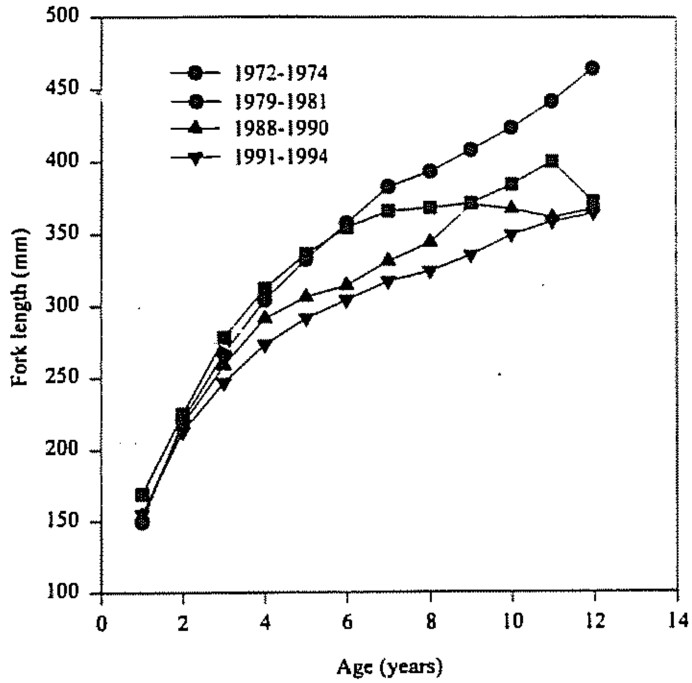


Figure 3

The mean back-calculated size at age for red porgy collected in 1972–74, 1979–81, 1988–90, and 1991–94. Back-calculated lengths for red porgy collected between 1972 and 1974 were derived from scale ages.

Table 4

Percentage of male red porgy relative to the total number of individuals sexed during 1979–81, 1988–90, and 1991–94. A significant difference (χ^2; $P<0.01$) in the proportion of males for a particular size class collected during 1979–81 is denoted by "*A*". A significant difference (χ^2; $P<0.01$) in the proportion of males that were collected during 1988–90 is denoted by "*B*".

	1979–81			1988–90			1991–94		
Size (mm TL)	Total	Males	%Males	Total	Males	%Males	Total	Males	%Males
<200	19	—	—	16	—	—	57	—	—
200–250	216	—	—	140	2	1.43	372	4	1.08
251–300	271	10	3.69	163	5	3.07	491	33	6.72^B
301–350	313	21	6.71	226	25	11.06	814	194	23.83^{AB}
351–400	239	29	12.13	136	44	32.35^A	371	183	49.33^{AB}
401–450	160	38	23.75	38	17	44.74^A	57	25	43.86^A
451–500	158	108	68.35	8	4	50.00	6	4	66.67
501–550	18	12	66.67	—	—	—	1	—	—
551–600	2	1	50.00	—	—	—	—	—	—
Total	1,397	220		727	97		2,169	443	

the three latitudinal zones. However, significant differences were apparent in the size and age distribution between the two depth zones ($P<0.05$), with larger and older fish occurring in the deeper zone. There were no significant differences in the size-at-age between these two zones ($P>0.05$).

Discussion

Samples were collected from throughout the SAB during 1988–94. However, 69% of the collections and 73% of the aged red porgy were taken from zone 2 (32°N–33°N). Zone 2 was sampled most frequently because it was most accessible from Charleston, South Carolina, the base of operations (latitude 32° 45'N). Once settled, red porgy do not appear to move very much (Parker, 1990) and could experience differential growth rates because of differing environments. Therefore the concentration of sampling in zone 2 could have resulted in biased estimates of size-at-age. However, the comparison of size-at-age of red porgy showed no significant differences between latitudinal or depth zones; therefore, although there may be localized differences in growth rates, perhaps associated with different patches of live bottom, the mean growth rate appears to be similar throughout the region. The mean depth and temperature of areas sampled in the MARMAP surveys have not changed significantly since 1987; thus these environmental variables, at least, have not caused the life history changes in red porgy (Fig. 11).

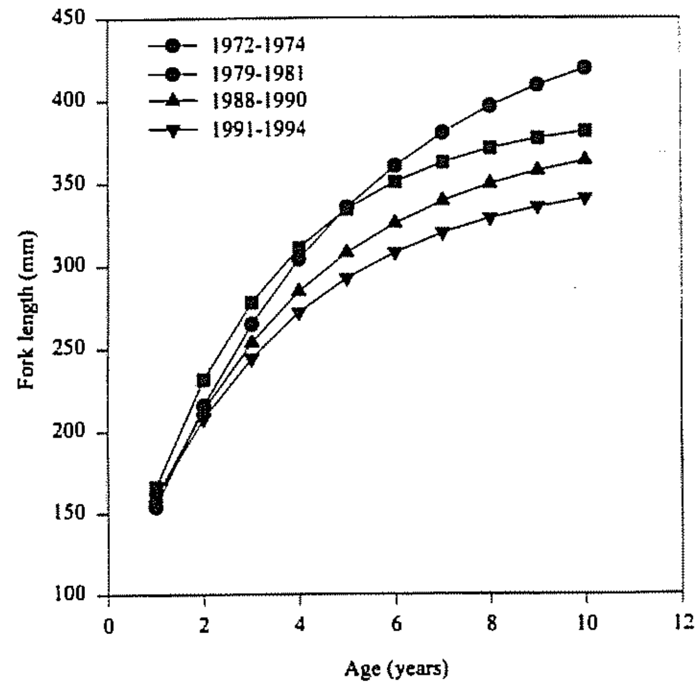


Figure 4

The von Bertalanffy growth curves derived for red porgy collected in 1972–74, 1979–81, 1988–90, and 1991–94. The von Bertalanffy growth curve for red porgy collected between 1972 and 1974 was derived from scale ages.

There were significant differences in size and age by depth, with larger and older fish occurring in deeper water. This difference may be due to fishermen operating in deeper water with larger hooks and baits to target groupers, thus reducing the availability of this gear to red porgy, particularly to smaller

Table 5

Percentage of red porgy females that were sexually mature relative to all females collected during 1979–81 and 1991–94. A significant difference (χ^2; $P<0.01$) in the proportion of mature females is denoted by "*A*".

	1979–81			1991–94		
Size (mm TL)	Total females	Number mature females	Percent mature females	Total females	Number mature females	Percent mature females
<200	16	—	—	55	2	3.64
200–225	91	1	1.10	182	4	2.20
226–250	85	11	12.94	156	26	16.67
251–275	103	28	27.18	157	85	54.14^A
276–300	78	77	98.72	211	189	89.57
>300	512	512	100.00	615	606	98.54
Total	885	62	1,376	912		

individuals. Therefore, red porgy in deeper water may experience reduced fishing mortality in comparision with those in shallower waters. In shallower water, fishermen reduce hook and bait size to catch smaller fishes, and more red porgy of all sizes are landed. Alternatively, the increase in size and age with depth

Table 6

Sampling data for 1988–94, collected from the RV *Oregon* (1988–89) and the RV *Palmetto* (1990–94).

Year	Trap collections	No. porgy	Hook-and-line collections	No. porgy	No. processed	No. aged
1988	84	294	261	170	427	371
1989	65	248	198	174	388	345
1990	348	957	111	44	997	545
1991	306	830	33	25	519	426
1992	324	1,107	25	1	494	419
1993	414	722	52	45	538	385
1994	370	1,107	38	11	986	444
Total	1,911	5,265	718	470	4,349	2,935

Table 7

Mean observed fork length (mm) at age for red porgy (standard error in parenthesis).

Age (yr)	1988	1989	1990	1991	1992	1993	1994
1	191 (2) *n*=124	203 (3) *n*=70	197 (3) *n*=78	200 (2) *n*=126	190 (2) *n*=78	206 (3) *n*=70	186 (1) *n*=53
2	256 (2) *n*=107	248 (2) *n*=149	234 (2) *n*=218	237 (2) *n*=110	228 (2) *n*=119	245 (3) *n*=78	253 (2) *n*=101
3	284 (3) *n*=95	284 (4) *n*=54	264 (2) *n*=180	274 (3) *n*=71	261 (3) *n*=72	267 (3) *n*=104	264 (3) *n*=50
4	328 (7) *n*=26	305 (5) *n*=39	295 (5) *n*=26	282 (4) *n*=70	287 (3) *n*=64	290 (4) *n*=59	283 (3) *n*=106
5	386 (34) *n*=2	328 (6) *n*=18	314 (10) *n*=16	303 (8) *n*=17	305 (4) *n*=43	308 (5) *n*=35	297 (3) *n*=86
6	334 (7) *n*=4	305 (34) *n*=3	317 (13) *n*=5	335 (7) *n*=13	310 (7) *n*=14	305 (5) *n*=25	313 (5) *n*=32
7	374 (10) *n*=5	340 (35) *n*=3	308 (7) *n*=6	339 (20) *n*=5	321 (7) *n*=8	359 *n*=1	334 (5) *n*=9
8	352 (3) *n*=4	335 *n*=1	307 (9) *n*=3	322 (5) *n*=4	328 (5) *n*=2	348 (25) *n*=6	324 (6) *n*=4
9	389 *n*=1	394 (42) *n*=2	384 (17) *n*=2	362 *n*=1	344 (8) *n*=6	322 (18) *n*=2	
10		372 (28) n=2		361 (16) *n*=4		344 (7) *n*=2	390 n=1
11		363 *n*=1					
12		368 *n*=1			360 *n*=1	354 *n*=1	
13					390 (9) *n*=2		

could reflect a gradual movement of red porgy towards deeper water as they age. Grimes et al. (1982) suggested that red porgy associated with shallow reefs may temporarily move to deep water in response to unusually cold water temperatures. However, tagging studies have shown that settled red porgy undertake very little long-term movement (Grimes et al., 1982; Parker, 1990). Another reef species, black sea bass (*Centropristis striata*), has shown limited movement of larger fish to deeper water (Ulrich and Low[3]; Harris and McGovern, personal obs.).

Fishing mortality (F) of red porgy has increased since 1972, although between 1972 and 1975 it showed a slight decline (Vaughan et al., 1992). The F for fully recruited ages (5–9) increased from 0.2 in 1976 to 1.3 in 1991 (Huntsman et al.[2], Murphy VPA, M=0.28). The F for ages 1–4 showed similar trends, although the magnitude of the increase was less (Huntsman et al.[2], Murphy VPA, M=0.28). Owing to the changes in the life history of red porgy since 1972, these estimates of fishing mortality are probably high; yet, the increasing trend in fishing pressure is evident. Except for an increase during 1981–83, landings of red porgy have been declining since 1973 (Fig. 1). Similarly, the number of recruits to age 1 have declined steadily since 1974 (Huntsman et al.[2], Murphy VPA, M=0.28). An estimate of SSR in 1993 was only 18% (Huntsman et al.[2], Murphy VPA, M=0.28). Again, the changes in the life history of red porgy since 1972 indicate that Huntsman et al.[2] may have underestimated the decline in the abundance of age-1 fish.

Concurrent with the fishery becoming increasingly overexploited, there has been corresponding change

[3] Ulrich, G. F., and R. A. Low. 1992. Movement and utilization of black sea bass, *Centropristis striata*, in South Carolina. Final Unpubl. Rep. NOAA Award No. NA90AA-D-FM656, 11 p.

Table 8

Mean back-calculated fork length (mm) at age for red porgy (most recent annulus; standard error in parenthesis).

Age (yr)	1988	1989	1990	1991	1992	1993	1994
1	163 (2) *n*=124	180 (3) *n*=70	173 (4) *n*=78	166 (2) *n*=126	159 (2) *n*=78	171 (2) *n*=70	161 (2) *n*=53
2	230 (2) *n*=107	233 (2) *n*=148	218 (2) *n*=218	219 (2) *n*=110	210 (2) *n*=119	227 (3) *n*=78	237 (2) *n*=101
3	266 (3) *n*=95	273 (3) *n*=54	252 (2) *n*=180	259 (3) *n*=71	246 (3) *n*=72	257 (3) *n*=104	253 (3) *n*=50
4	316 (6) *n*=26	300 (6) *n*=38	286 (5) *n*=26	271 (3) *n*=70	274 (3) *n*=64	281 (4) *n*=59	275 (3) *n*=106
5	382 (31) *n*=2	325 (7) *n*=18	304 (11) *n*=16	292 (8) *n*=17	298 (4) *n*=43	301 (5) *n*=35	291 (3) *n*=86
6	328 (7) *n*=4	301 (32) *n*=3	311 (13) *n*=5	326 (6) *n*=13	299 (7) *n*=14	298 (6) *n*=25	307 (5) *n*=32
7	369 (10) *n*=5	339 (34) *n*=3	294 (7) *n*=6	331 (18) *n*=5	313 (6) *n*=8	354 *n*=1	329 (5) *n*=9
8	347 (3) *n*=4	335 *n*=1	300 (10) *n*=3	314 (5) *n*=4	320 (4) *n*=2	351 (20) *n*=7	320 (6) *n*=4
9	389 *n*=1	392 (40) *n*=2		354 *n*=1	335 (8) *n*=6	292 *n*=1	
10		371 (27) *n*=2	378 (17) *n*=2	350 (16) *n*=4		336 (4) *n*=2	382 *n*=1
11		362 *n*=1					
12		367 *n*=1			356 *n*=1	349 *n*=1	
13					382 (8) *n*=2		

in the life history of red porgy during a 22-year period (1972 to 1994). The first study of age and growth on red porgy (1972–74) (Manooch and Huntsman, 1977) was assumed to describe a stock with the same life history as the virgin population, even though it was subject to light fishing pressure. By the late 1970's and early 1980's, the growth pattern of the stock had changed. The mean observed and back-calculated lengths-at-age as well as the von Bertalanffy growth curve for the 1979–81 period showed a larger size at age for ages 2–6 but a lower theoretical maximum size. The increase in growth rate, and resultant increase in size-at-age observed during this period, is considered a typical density-dependent response to an increase in mortality as the depressed population responds to an increased availability of resources (Pitcher and Hart, 1982; Rothschild, 1986). The decrease in theoretical maximum size between 1979 and 1981 may have resulted from the selective removal of larger individuals from the population by fishermen and not from a biological change in the theoretical maximum size that the fish could attain.

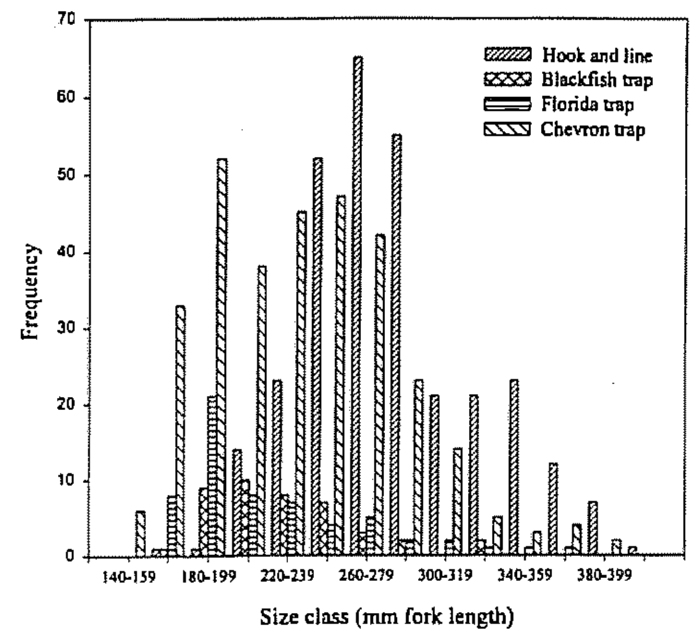


Figure 5

Length frequency for all red porgy sampled in MARMAP surveys between 1988 and 1994 by gear type.

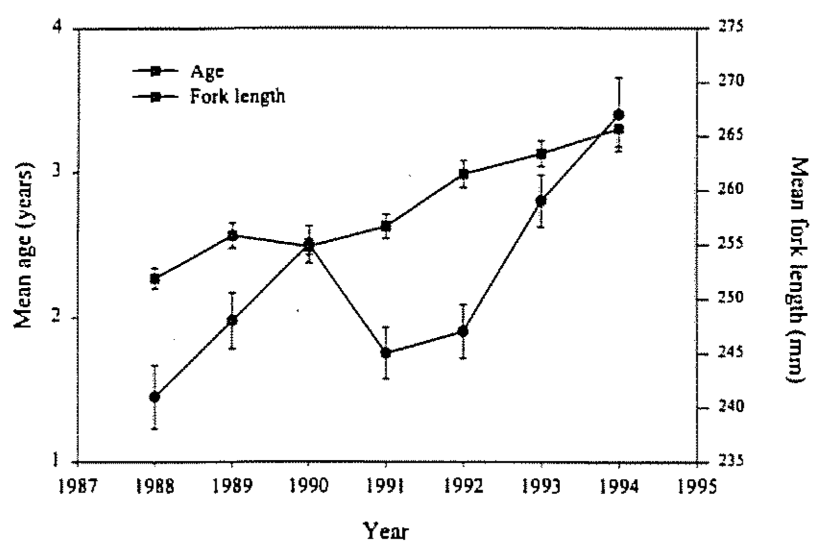


Figure 6

The mean age of red porgy sampled in MARMAP surveys between 1988 and 1994.

During the mid 1980's through the early 1990's, increasing fishing pressure apparently continued the selective removal of larger, faster growing individuals from the population, further exacerbating the changes in the life history of red porgy. By 1988–90, mean back-calculated sizes-at-age were significantly smaller for all ages except age 1 in comparison with 1979–81. In 1988–90, the values of k and L_∞ were smaller than during 1979–81 and 1972–74, indicating a reduced growth rate and a lower theoretical maximum attainable size. Mean back-calculated size-at-age for specimens collected between 1991 and 1994 were significantly smaller than those collected in 1988–90, except for ages 1, 7, and 10. These temporal reductions in the size-at-age and growth rates suggest that many individuals genetically predisposed towards rapid growth and larger size may have been selectively removed from the population, leaving behind individuals that tend to be slower growing and smaller.

Red porgy also responded to the continued removal of larger individuals from the population over many generations by females becoming sexually mature at smaller sizes during 1991–94 than during 1979–81. Manooch (1976) reported that female red porgy became mature at much larger sizes than those found in the present study. Furthermore, the red porgy population has responded to increased fishing pressure by undergoing sexual transition and by producing significantly more males at smaller sizes in recent years than during 1979–81. Koenig et al. (1996) reported that gag, *Mycteroperca microlepis*, a protogynous grouper, was undergoing sexual transition at much smaller sizes during 1991–93 in the Gulf of Mexico than were reported by Hood and Schlieder (1992) for the same region, during 1977–80. Changes in life history aspects of gag from the Gulf of Mexico were attributed to steadily increasing fishing pressure.

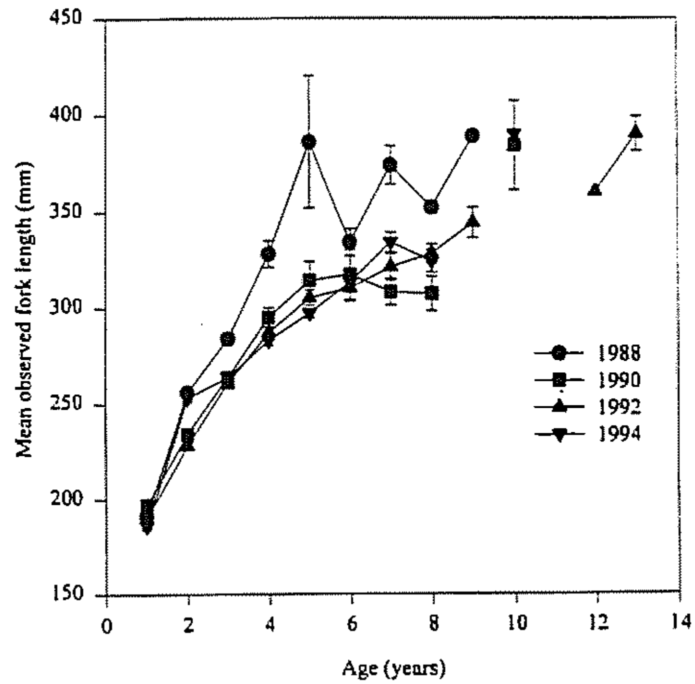


Figure 7

The mean observed size-at-age of red porgy for every second year between 1988 and 1994.

The decrease in mean size-at-age, growth rates, and size-at-maturity during 1988–1994 is probably a continuation of the changing life history pattern of the population that has resulted from sustained fishing pressure and indicates the degree of change that can occur over relatively short periods of time. These relatively rapid changes in size-at-age may reflect the inability of an overfished or depressed population to absorb or respond to further decreases in population size. Apart from the decreases in size-at-age apparent from recent years, the mean age and fork length of the population has increased since 1988. These increases may be due to a decline in the number of younger fish recruiting to the population. The net effect of fewer young fish in the population (and therefore samples) would be an increase in the mean age and size of the sampled fish. Length-frequency data collected in MARMAP surveys since 1988 indicates no strong recruiting year class (age-1) since 1990. Huntsman et al.[2] found that the estimated number of 1-year-old red porgy had declined steadily since 1973 (Murphy VPA, M=0.28); their results also indicate that the population may be experiencing a decline in recruitment.

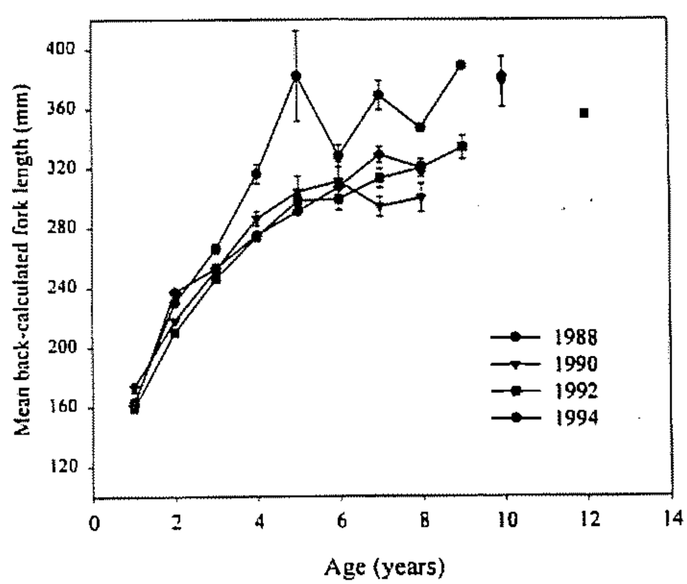


Figure 8

The mean back-calculated size-at-age for every second year between 1988 and 1994.

A decline in recruitment may be attributed to several factors that are the result of sustained overfishing. First, as the number of fish in the population declines, fewer and fewer females are available to spawn, resulting in a decline of total potential egg production (Vaughan et al., 1992; Huntsman et al.[2]). Second, decreases in size-at-maturity and size-at-age result in fish that are less fecund than larger fish (Manooch, 1976). Finally, smaller females may produce eggs that are poorer in quality than those produced by larger females because smaller individuals put more energy into somatic growth rather than into reproductive tissue (Rothschild, 1986). Zhao and McGovern[4] found that an apparent population size threshold at 30% of the virgin spawning biomass existed for vermilion snapper (*Rhomboplites aurorubens*) in the SAB, below which recruitment failure was almost inevitable. A similar situation may exist for red porgy in the SAB, with recruitment failure exacerbated by the reduction in size of mature females.

Reproductive (i.e. recruitment) failure may also be affected by the change in size of male red porgy, as well as the changes in sex ratio that have occurred since 1972–74. Currently, some red porgy undergo transition at 200–250 mm FL. The sex ratio in 1991–94 at 352–400 mm FL was 1.3 males for each female. In 1972–74, the sex ratio for this size class was 0.06 males per female (Manooch, 1976, macroscopic sexing). Males began to outnumber females only above 451 mm FL. Koenig et al. (1996) have hypothesized that sperm limitation may be a factor in the decline of gag, *Mycteroperca microlepis*, in the northern Gulf of Mexico as the number of males in the population has declined. The size and number of male red porgy in the population have similarly been greatly reduced. The reduction in size and number of males may also be a significant factor in the decline in the number of 1-year-old red porgy recruiting to the SAB population.

Huntsman et al.[2] concluded that the red porgy population of the SAB was overfished and that the population was severely depressed. These conclusions were based on the results of Murphy and separable VPA's that used only two age length keys—one from 1972–74 and one from 1986—and that used von Bertalanffy parameters and a length-weight relation from 1972–74. The life history of red porgy has changed markedly since 1986. In fact, as this study shows, significant decreases in size-at-age have occurred within a matter of years in this heavily fished population. The dramatic changes in the life history of red porgy and the resultant changes in parameters used for stock assessment suggest the status of the population in the SAB needs to be reassessed.

Protogynous fishes may be particularly vulnerable to sustained heavy fishing pressure and size selective mortality (Huntsman and Schaaf, 1994), particularly if sex reversal occurs primarily in response to exogenous controls (sociodemographic factors) (Koening et al., 1996). The decline in size at sex transition since 1979 suggests that the timing of transition in red porgy is not determined by size, but rather by some social or behavioral stimulus.

Red porgy probably do not aggregate to spawn; instead they appear to be permanently schooled on the available areas of live bottom in the SAB. Koenig et. al. (1996) suggested that if a population of protogynous fish remained aggregated throughout the year, transition could occur year-round and thus the normal male to female ratio could be maintained. If the numerical sex ratio is maintained, the impact of overfishing on a protygynous species is reduced (Huntsman and Schaaf, 1994). The increase in the sex ratio seen from 1979–81 to 1988–90 may represent overcompensation for the depletion of males from the population. The males of many reef-associated protogynous sparids show strong territoriality (van der Elst, 1988). If these males are more aggressive and are more likely to be caught by fishermen (Koenig et. al.,

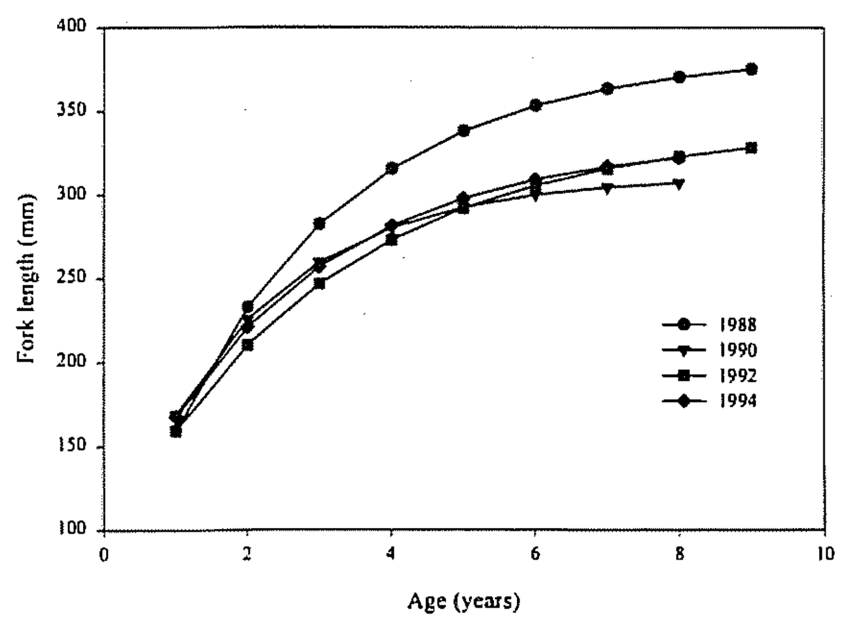


Figure 9

The von Bertalanffy growth curves for red porgy for every second year sampled since 1988.

[4] Zhao, B., and J. C. McGovern. 1995. Population characteristics of the vermilion snapper, *Rhomboplites aurorubens*, from the southeastern United States. Report to the South Atlantic Fishery Management Council, 1 South Park Circle, Charleston, SC 29422, 35 p.

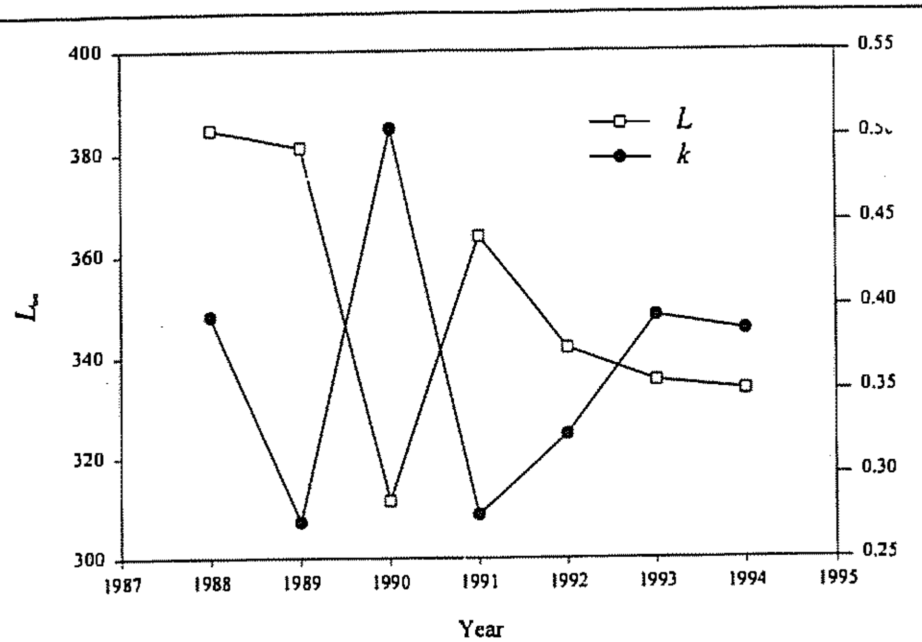


Figure 10

Trends in von Bertalanffy parameters from the growth equations derived for red porgy sampled between 1988 and 1994.

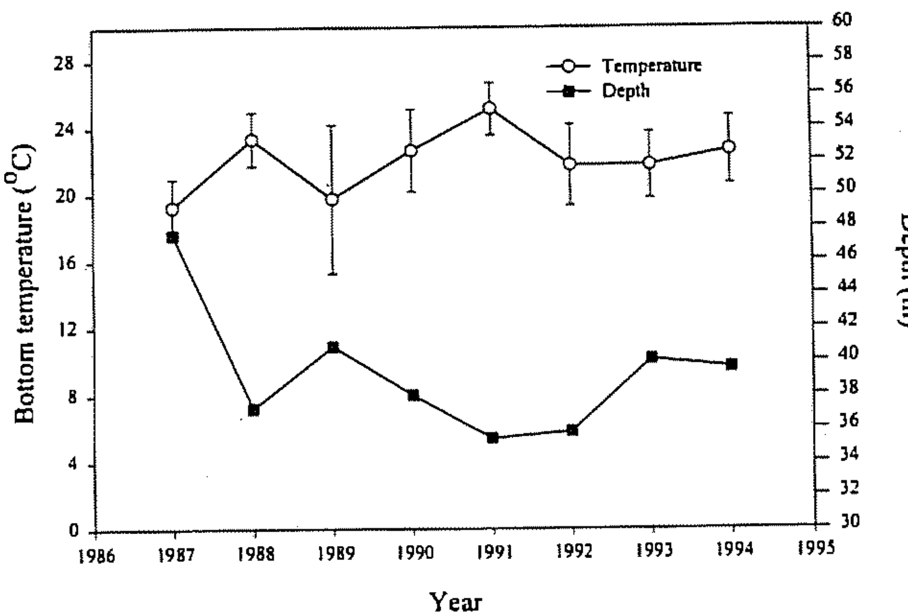


Figure 11

Mean summer bottom temperature of the South Atlantic Bight, 1987–94. Temperatures were recorded between April and October of each year.

1996; Gilmore and Jones, 1992), then another fish, presumably the largest (=dominant) female would take over that territory and begin to undergo transition (Shapiro, 1981). As modern technology allows fishermen to locate good fishing sites precisely, all large fish could be removed from an area. The increase in the number of males seen during 1988–90 may also be a function of fish size. As large males were removed from the population, smaller fish could occupy the now vacant territory and undergo transition. As new males became increasingly smaller, the size of the territory they could successfully hold might also become smaller, freeing territory for additional males. However, as the size of the fish declined even further, it is possible that the males would be unable to compete against other species, thereby further reducing the available habitat for red porgy males and reducing the sex ratio to the same level as that found in 1979–81.

It has been hypothesized that the selective removal of individuals predisposed to rapid growth and greater size may cause a genetic shift resulting in a population of slower growing, smaller individuals than those found in the unfished population (Bohnsack, 1990; Sutherland, 1990). Edley and Law (1988) found that individuals of a population of *Daphnia magna* subjected to size-selective mortality of its large individuals for 10 generations did not return to the size and growth rates of a control population, even after the size selective pressure was removed. Changes in the life history of red porgy over the last two decades strongly confirm the hypothesis of Bohnsack (1990) and Sutherland (1990). Although exploitation may not last long enough to result in a permanent genetic shift to slower growing, smaller individuals, phenotypic changes have already occurred. Failure to consider the potential evolutionary changes that could be induced in a population through fishing mortality could result in a reduction of the maximum potential yield of that stock (Law and Grey, 1989). In addition, a reduced population of smaller red porgy could have implications in reef fish community structure, i.e. the role of smaller red porgy in a reef habitat may be different, or smaller red porgy may be less able to compete for more desirable habitat.

Current management strategies only enhance the impact of the size selective mortality associated with fisheries. In 1992, Amendment 4 of the SAFMC snapper-grouper management plan was enacted, requiring a minimum size of 12 inches (305 mm TL) for red porgy in catches (SAFMC[1]). Fishermen tend to target larger fish because these bring the largest return (economic for commercial fishermen, aesthetic for recreational fishermen). Size-at-maturity for red porgy females was 270 mm TL in 1972–74; 200–225 mm TL in 1979–81; and 175–200 mm TL in 1991–94. However, 100% maturity occurred at 350 mm TL during 1972–74 and >300 mm TL in 1991–94. Thus, many faster growing individuals may reach legal size before they are sexually mature or when they have only had the opportunity to spawn once or twice. Slower growing individuals would take longer to reach the size limit and have a greater chance to spawn before becoming available to the fishery, thus further exacerbating the effect of size-selective mortality.

The SAB population of red porgy has undergone significant changes in life history, presumably in response to sustained, long-term size-selective overexploitation. Individuals in the population are smaller, have reduced growth rates, a reduced theoretical maximum size, and undergo sexual maturity and transition at smaller sizes now than 20 years ago. The selective pressure of fishing mortality may be causing a genetic shift towards a slower growing, smaller population. Unless appropriate management measures are taken, sustained overfishing could result in a permanent genetic shift in the fish or a total collapse of the stock (or both).

Acknowledgments

The authors wish to thank the crews and scientific parties of the research vessels that made collection of these data possible. Bill Roumillat and Wayne Waltz aged, sexed, and identified maturity stages of red porgy collected between 1979 and 1987, and Oleg Pashuk sexed and staged all red porgy collected since 1987. Three anonymous reviewers provided numerous comments that improved the manuscript immeasurably.

Literature cited

Alekseev, F. E.
1982. Hermaphroditism in porgies (Perciformes, Sparidae). I: Protogyny in scups, *Pagrus pagrus* (L.), *P. orphus* Risso, *P. ehernbergi* Val. and *P. auriga* Val. from the West African shelf. J. Ichthyol. 22:85–94.
1983. Hermaphroditism in porgies (Perciformes, Sparidae). II: Sexual structure of the populations, mechanisms of its formation and evolution in scups, *Pagrus pagrus*, *P. orphus*, *P. ehernbergi* and *P. auriga*. J. Ichthyol. 23:61–73.

D'Ancona, U.
1949. Il differentziamento della gonade e l'inversione sessuale degli Sparidae. Arch. Oceanogr. Limnol. 6:97–163.
1950. Determination et differenciation du sexe chez les poissons. Arch. Anat. Microsc. Morphol. Exp. 39(3):274–294.

Bohnsack, J. A.
1990. The potential of marine fishery reserves for reef fish management in the U.S. South Atlantic. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFC-216, 45 p.

Collins, M. R.
1990. A comparison of three fish trap designs. Fish. Res. 9:325–332.

Collins, M. R., and G. R. Sedberry.
1991. Status of vermilion snapper and red porgy stocks off South Carolina. Trans. Am. Fish. Soc. 120:116–120.

Collins, M. R., S. B. Van Sant, D. J. Schmidt, and G. R. Sedberry.
1996. Age validation, movements, and growth rates of

tagged gag (*Mycteroperca microlepis*), black sea bass (*Centropristis striata*), and red porgy (*Pagrus pagrus*). *In* F. Arraguin-Sanchez, J. L. Munro, M. C. Balgos, and D. Pauly (eds.), Biology, fisheries and culture of tropical groupers and snappers, p 161–165. ICLARM Conf. Proc. 48.

Collins, M. R., C. W. Waltz, W. A. Roumillat, and D. L. Stubbs.
1987. Contribution to the life history of gag *Mycteroperca microlepis* (Serranidae), in the South Atlantic Bight. Fish. Bull. 85:648–653.

Edley, M. T., and R. Law.
1988. Evolution of life histories and yields in experimental populations of *Daphnia magna*. Biol. J. Linn. Soc. 34: 309–326.

Francis, R. C. C. C.
1990. Back-calculation of fish length: a critical review. J. Fish Biol. 36:883–902.

Frizzel, D. L., and J. H. Dante.
1965. Otoliths of some early cenozoic fishes of the Gulf coast. J. Palaeontology 39:687–718.

Gilmore, R. G., and R. J. Jones.
1992. Color variation and associated behavior in the epinepheline groupers, *Mycteroperca microlepis* (Goode and Bean) and *M. phenax* (Jordan and Swain). Bull. Mar. Sci. 51(1):83–103.

Grimes, C. B., C. S. Manooch, and G. R. Huntsman.
1982. Reef and rock outcropping fishes in the outer continental shelf of North Carolina and South Carolina, and ecological notes on the red porgy and vermilion snapper. Bull. Mar. Sci. 32:277–289.

Hood, P. B., and R. A. Schlieder.
1992. Age, growth, and reproduction of gag, *Mycteroperca microlepis* (Pisces: Serranidae), in the eastern Gulf of Mexico. Bull. Mar. Sci. 51:337–352.

Hunter, J. R., B. J. Macewicz, and J. R. Sibert.
1986. The spawning frequency of skipjack tuna, *Katsuwonus pelamis*, from the South Pacific. Fish. Bull. 84:895–903.

Huntsman, G. R., and W. E. Schaaf.
1994. Simulation of the impact of fishing on reproduction of a protogynous grouper, the graysby. North Am. J. Fisheries Manage. 14:41–52.

Koenig, C. C., F. C. Coleman, L.A. Collins, Y. Sadovy, and P. L. Colin.
1996. Reproduction in gag, *Mycteroperca microlepis* (Pisces: Serranidae), in the eastern Gulf of Mexico and the consequences of fishing spawning aggregations. *In* F. Arraguin-Sanchez, J. L. Munro, M. C. Balgos, and D. Pauly (eds.), Biology, fisheries and culture of tropical groupers and snappers. ICLARM Conf. Proc. 48.

Lack, D.
1968. Population studies of birds. Clarendon, Oxford, UK, 341 p.

Law, R., and D. R. Grey.
1989. Evolution of yields from populations with age-specific cropping. Evol. Ecol. 3:343–359.

Manooch, C. S.
1976. Reproductive cycle, fecundity, and sex ratios of the red porgy, *Pagrus pagrus*, (Pisces: Sparidae) in North Carolina. Fish. Bull. 74:775–781.

Manooch, C. S., and W. W. Hassler.
1978. Synopsis of biological data on the red porgy, *Pagrus pagrus* (Linnaeus). FAO Fisheries Synopsis 116, 19 p.

Manooch, C. S., and G. Huntsman.
1977. Age, growth, and mortality of the red porgy, *Pagrus pagrus*. Trans. Am. Fish. Soc. 106:26–33.

Matsuyama, M., R.T. Lara, and S. Matsuura.
1988. Juvenile bisexuality in the red sea bream, *Pagrus major*. Environ. Biol. Fishes 21:27–36.

Parker, R. O., Jr.
1990. Tagging studies and diver observations of fish populations on live-bottom reefs of the U.S. southeastern coast. Bull. Mar. Sci. 46:749–760.

Pitcher, T. J., and P. J. B. Hart.
1982. Fisheries ecology. Croom Helm, London, 414 p.

Powles, H., and C. A. Barans.
1980. Groundfish monitoring sponge-coral areas off the southeastern United States. Mar. Fish. Rev. 42(5):21–35.

Rothschild, B. J.
1986. Dynamics of marine fish populations. Harvard Univ. Press, Cambridge, MA, 277 p.

Sadovy, Y., and D. Y. Shapiro.
1987. Criteria for the diagnosis of hermaphroditism in fishes. Copeia 1987:136–156.

Shapiro, D. Y.
1981. Size and maturation and the social control of sex reversal in the coral reef fish *Anthias squamipinis*. J. Zool. Lond. 193:105–128.

SigmaPlot.
1994. Transforms and curve fitting. SigmaPlot Scientific Graphing Software, Jandel Scientific, San Rafael, CA, 249 p.

Sutherland, W. J.
1990. Evolution and fisheries. Nature 344:814–815.

Van der Elst, R.
1988. A guide to the common sea fishes of southern Africa. Struik, Cape Town, South Africa, 398 p.

Vassilopoulou, V., and C. Papaconstantinou.
1992. Age, growth, and mortality of the red porgy, *Pagrus pagrus*, in the eastern Mediterranean Sea (Dodecanese, Greece). Vie Milieu 42:51–55.

Vaughan, D. S., G. R. Huntsman, C. S. Manooch III, F. C. Rhode, and G. F. Ulrich.
1992. Population characteristics of the red porgy, *Pagrus pagrus*, stock of the Carolinas. Bull. Mar. Sci. 50:1–20.

Von Bertalanffy, L.
1938. A quantitative theory of organic growth. II: Inquiries on growth laws. Hum. Biol. 10:181–213.

Wallace, R.A., and K. Selman.
1981. Cellular and dynamic aspects of oocyte growth in teleosts. Am. Zool. 21:325–343.

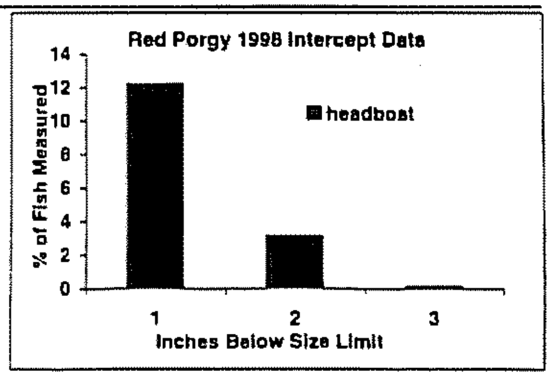
West, G.
1990. Methods of assessing ovarian development in fishes: a review. Aust. J. Mar. Freshwater Res. 41:199–222.

BLANK

Appendix I. Percent of Red Porgy landed below legal size. (Source: Burton, 1999.)

Year	N.C. and S.C.		Ga. and N.Florida		S.Florida and Keys		All regions combined	
Commercial fishery- size limit 12 inches total length effective January 1992.								
	n	Percent	n	Percent	n	Percent	n	Percent
1991	1875	24.2	0		0		1875	24.2
1992	0		0		0		0	
1993	475	5.9	66	0.0	22	0.0	563	5.9
1994	3020	5.1	364	1.4	25	0.0	3409	4.7
1995	3119	4.0	1899	6.0	0		5018	4.8
1996	1619	6.2	939	4.7	1	0.0	2559	5.4
1997	1938	3.9	108	0.9	124	2.4	2170	3.7
1998	2729	3.1	233	5.2	571	11.6	3533	4.6
Headboat fishery- size limit 12 inches total length effective January 1992.								
	n	Percent	n	Percent	n	Percent	n	Percent
1991	630	33.0	8	12.5	9	0.0	647	32.3
1992	805	23.7	12	16.7	7	42.9	824	23.8
1993	976	12.2	19	5.3	16	43.8	1011	12.6
1994	1444	10.4	50	20.0	60	20.0	1554	11.1
1995	704	8.8	75	8.0	68	57.4	847	8.4
1996	962	9.9	50	6.0	0		1012	9.7
1997	516	10.7	27	18.5	9	77.8	552	12.1
1998	738	14.1	53	24.5	37	29.7	**828**	**15.5**
Recreational fishery other than headboats- size limit 12 inches total length effective January 1992.								
	n	Percent	n	Percent	n	Percent	n	Percent
1991	36	36.1	0		10	100.0	46	51.1
1992	100	64.0	0		1	100.0	101	66.0
1993	45	6.7	1	0.0	1	0.0	47	6.4
1994	104	35.6	0		3	66.7	107	36.5
1995	55	27.3	2	100.0	0		57	29.8
1996	31	6.5	1	0.0	3	0.0	35	5.7
1997	23	21.7	0		13	23.1	36	22.2
1998	12	0	3	0	1	0	16	0

Compliance with minimum size limits for red porgy is good for both commercial and MRFSS intercept data. Headboat intercept data indicate non-compliance just exceeding my subjective 15 % criterion, with the majority of these fish within one inch of the limit. A new 14-inch size limit was enacted February 1999, and if it was applied to these 1998 data, non-compliance would be 52 %, 65 %, and 50 % for the commercial, headboat and MRFSS surveys, respectively.



BLANK

Appendix J. Letters Commenting on the DSEIS.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

RECEIVED
00 JAN 31 PM 2:01
NMFS-SERO
ST. PETERSBURG, FL.

January 27, 2000

4EAD/OEA

Dr. William Hogarth
National Marine Fisheries Service
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702

SUBJ: EPA Review of NOAA/NMFS "Draft Supplemental Environmental Impact Statement (DSEIS) for Amendment 12 to the Fishery Management Plan for the Snapper-Grouper Fishery of the South Atlantic Region (Amendment 12);" CEQ No. 990474

Dear Dr. Hogarth:

Consistent with Section 102(2)(C) of the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act, the U.S. Environmental Protection Agency (EPA) has reviewed the referenced DSEIS for Amendment 12 for the South Atlantic Region Snapper-Grouper Fishery Management Plan (FMP). This Amendment was prepared by the South Atlantic Fishery Management Council (Council) for the red porgy (*Pagrus pagrus*: a.k.a. - pink porgy, pinkies, silver snapper) and would be promulgated by the National Marine Fisheries Service (NMFS)/National Oceanic and Atmospheric Administration (NOAA).

We offer the following comments on the Amendment 12 DSEIS:

o **Amendment History** - Considering the number of amendments to this FMP, the summary of the previous amendments and their action items (pg. 4) was helpful from a NEPA public disclosure standpoint. We note that numerous species in the snapper-grouper complex have been managed by the FMP. Of these, the status of black sea bass, vermillion snapper, red snapper, red porgy, gag, scamp, speckled hind, warsaw grouper, snowy grouper, golden tilefish, nassau grouper, jewfish and white grunt were recently reviewed by the Council per Amendment 11. Through the benefit of recent 1999 stock assessment data, it became obvious that the red porgy stocks were seriously overfished, with metric ton data exhibiting a 93% reduction from 1972-78 to 1992-96, and numbers of fish showing a similar 90% reduction over that timeframe. The Council addressed this near collapse of the fishery by voting for an emergency rule to prohibit harvest and possession of the red porgy, which in turn was implemented by NMFS, effective September 8, 1999 through March 1, 2000. This rule is now proposed for extension and more permanent management of the red porgy is to be promulgated in Amendment 12.

Internet Address (URL) • http://www.epa.gov
02/02/00 WED 14:51 [TX/RX NO 7621]

o **Amendment 12 Proposed Actions** - EPA offers the following specific comments on the proposed actions for Amendment 12 outlined in Table 1:

* **Proposed Action 1 (MSY)** - Clearly, a Maximum Sustainable Yield (MSY) figure must be established for the red porgy in order to manage the fishery. The Council appears to have determined an MSY of 5,285.4 metric tons (mt) or 5,285.3 mt, depending on the method used. We assume that this value was based on the best available data from the 1999 stock assessment, and as such, agree with either figure as a management starting point since they do not statistically differ (parenthetically, however, we prefer the 5,285.3 mt figure since it is based on a 14-inch Total Length (TL) minimum size limit as opposed to the12-inch TL, which should benefit the recovery of the fishery). Accordingly, EPA does not concur with Option 1 (No Action: a MSY for Red porgy is unknown) since an MSY must be established to the extent assessment data are available so that species management can be initiated (even if later reassessed via adaptive management).
* **Proposed Action 2 (OY)** - The Optimum Yield (OY) is set at a stock biomass of 10,000 mt. for U.S. fishermen. We agree with this figure, again assuming that it is based on 1999 stock assessment data and was agreed upon by the Council. EPA does not occur with Option 1 (No Action) since it is less conservative than the proposed action, i.e., we believe a conservative approach is needed for the red porgy considering the status of its depressed stock. We also do not prefer Option 3 because it too is not as conservative as the proposed action.
* **Proposed Action 3 (Overfishing Level & Rebuilding Timeframe)** - EPA will defer to the Council and NMFS regarding the appropriate fishing mortality rate for recovery management and the minimum stock size threshold, if these figures (as previously indicated for such fishery values) are based on 1999 stock assessment data and are agreed upon by the Council. With regard to the proposed recovery period of 18 years, however, we recommend that any additional feasible methods be implemented to expedite recovery time, since commercial and sport fisheries would be depressed or nonexistent until recovery. Given the condition of the stock, however, this may not be possible. We do not concur with Options 2 (No Action) or 3 since they are less conservative than the proposed action and would therefore extend recovery time or even preclude recovery.
* **Proposed Action 4 (Prohibit Harvest and Possession)** - Given the near collapse of the fishery, this action appears warranted and is supported by EPA. Option 1 (No Action) would continue the present management which has resulted in stocks declining to near extinction since 1972-78. Option 2 is similarly also not preferred by EPA since it would allow harvest of 50 pounds of red porgy per trip or per day. While this will allow for some income for remaining commercial fishers, it will only provide minimal income and would further slow recovery. Adoption of a potential one-year transition period with minimal harvest might be considered by the Council/NMFS to minimize socio-economic impacts and allow red porgy fishers to pursue other careers. One potential advantage in allowing some commercial harvest is that additional and current fisheries data could be

obtained relative to size of maturation, fecundity, distribution, catch effort, etc. In regard to sport fishers, it is unclear if Proposed Action 4 and its options also apply to sport fishers or only to commercial fishers. Sport fishers could presumably, however, still be allowed to catch and release an unlimited number per day, although fishing methods would need to be limited to gear such as hook and line as opposed to lethal methods such as entanglement nets and bang sticks.

* **Proposed Action 5 (Framework Modifications)** - We strongly concur with proper management of Essential Fish Habitats-Habitat Areas of Particular Concern (EFH-HAPCs) and EFHs since we consider habitat preservation and improvement critical to stock recovery. The proposed action would have the benefit of allowing such management within the existing framework rather than through an FMP amendment (Option 1: No Action), which would delay the management process and therefore possibly the recovery. As such, EPA prefers the proposed action over Option 1.
* **Proposed Action 6 (Same Owner Permit Transfers)** - This proposed action would allow for same owner transfers of non-transferable 225 pound trip limit permits regardless of vessel size, while Option 1 (No Action) would apparently not allow such transfers. The need for this action is somewhat unclear if Proposed Action 4 is promulgated since it would prohibit harvest and possession, or even if Option 2 (limit harvest to 50 pounds per trip or per day) is promulgated. However, if Option 1 (No Action) of Proposed Action 4 is promulgated, Proposed Action 6 could apply. In such an instance, we would not have a strong preference for or against Proposed Action 6 (again, EPA supports Proposed Action 4 as opposed to Options 1 or 2). We do note, however, that Proposed Action 6 would facilitate fishing for red porgy in the sense that permits would be transferrable. Since EPA favors a no harvest no possession approach at this time, any actions that facilitate harvest would not seem appropriate.

o **Additional General Comments** - In addition to these specific comments, we offer the following general comments and observations:

* Bycatch - We strongly support Amendment 4's disallowance of snapper-grouper bycatch beyond bag limits and that, as is proposed for the red porgy, "[n]o bycatch would be allowed for those species that have no bag limit or that are prohibited" (pg. 5). It is unclear however, how or how effectively this rule would be enforced.
* Hermaphroditic Species - We understand that the red porgy is a hermaphroditic species that changes sex within its lifespan, it would seem that the management of such a species would be more complicated. Unless the timing of this metamorphosis is clearly understood and is predictable, it would appear to be another reason to prohibited or severely limit harvesting to ensure that the mature and fecund females (whenever they occur for this species), which are critical to reproduction and stock recovery, are not harvested.
* Adaptive Management - We recommend that an adaptive management approach be adopted so that the success of the FMP and stock recovery can be monitored and adjusted as needed and as determined by the Council and NMFS/NOAA.

* Editorial Note - We suggest that a List of Acronyms be added to future amendments to facilitate public review (e.g., F, EFH, EFH-HAPC, SPR, MSY, etc.).

o **EPA DSEIS Rating** - EPA rates this DSEIS (Amendment 12) as "LO" (Lack of Objections). We support the proper management of the depressed red porgy fishery. Specifically, we prefer the proposed actions as opposed to their options and we particularly support the adoption of Proposed Action 4 which would prohibit the harvest and possession of the red porgy. We also recommend that an adaptive management approach be instituted to measure the success of the FMP and stock recovery and to implement adopted adjustments as needed.

We appreciate the opportunity to comment at this time. Should you have questions, you may wish to contact Chris Hoberg of my staff at 404/562-9619.

Sincerely,

John S. Hamilton for

Heinz J. Mueller, Chief
Office of Environmental Assessment
Environmental Accountability Division

cc: Ms. Susan B. Fruchter
NEPA Coordinator
Room 5805
OPSP
U.S. Department of Commerce
Washington, DC 20230