THE RED GROUPER FISHERY OF THE GULF OF MEXICO

C. Phillip Goodyear
and
Michael J. Schirripa

25 September 1991

Southeast Fisheries Center
Miami Laboratory
Coastal Resources Division
75 Virginia Beach Drive
Miami, FL 33149-1099

Miami Laboratory Contribution No. MIA-90/91-86

TABLE OF CONTENTS

EXECUTIVE SUMMARY ii

BIOLOGICAL CHARACTERISTICS 1
- DATA SOURCES 1
- MORPHOMETRICS 2
  - Weight conversions 2
  - Length conversions 3
  - Length to weight conversions 3
- REPRODUCTION 3
- GROWTH 5
- MORTALITY 8
  - Natural Mortality 8
  - Release Mortality 8
- DISTRIBUTION AND MOVEMENTS 9

HARVEST TRENDS 10
- COMMERCIAL HARVEST 10
  - Data sources 10
  - Temporal trends in commercial landings 10
  - Trends in landings by gear 13
  - Spatial distribution 13
- RECREATIONAL HARVEST 14
  - Data sources 14
  - Recreational catch estimates 15
- COMBINED HARVEST 16
- SEASONAL DISTRIBUTIONS 17

SIZE DISTRIBUTION OF THE HARVEST 17
- COMMERCIAL SIZE COMPOSITION 17
- RECREATIONAL SIZE COMPOSITION 20
- LENGTH DISTRIBUTION FOR THE COMBINED HARVEST 22

FISHING MORTALITY 23
- AGE DISTRIBUTION OF THE HARVEST 23
- ESTIMATES OF MORTALITY 23

MANAGEMENT ALTERNATIVES 24
- ESTIMATES OF $F_{0.1}$ and F_{max} 25
- ALTERNATIVE MINIMUM SIZES 27
  - Yield computations 27
  - Spawning potential 27
  - Results 27
- CATCH LIMITS 28
  - Quotas 28
  - Creel limits 29
  - Combinations of size and creel limits 31

LITERATURE CITED 34

EXECUTIVE SUMMARY

Gulf of Mexico red grouper harvested by U.S. fishermen are primarily caught in the eastern Gulf from Panama City, Florida, to the Florida Keys. The greatest part of the present commercial and recreational harvest is from Tampa southward, and about half of the commercial harvest is landed in the Tampa - St. Petersburg area. Commercial landings of red grouper have been separated from other groupers only since 1986. Before 1986 they were included in landing statistics along with other grouper species as "unclassified groupers."

Prior to the introduction of bottom longline gear in the early 1980s, landings of all groupers exhibited a slow decline from about 7.5 million pounds (gutted weight) in 1962 to about 5 million pounds in the late 1970s. Handlines, and power-assisted (electric or hydraulic) reels accounted for almost all the landings during this period. With the expansion of bottom longline gear in the early 1980s, total grouper landings increased sharply to a maximum of about 12½ million pounds in 1982. This was the predominant gear employed for red grouper harvested in 1990. Traps increased in importance in the mid 1980s but contribute only a small proportion of the grouper catch.

Red grouper accounted for nearly two-thirds of the total commercial grouper catch since 1986 and contributed about 7½ million pounds in 1989. If the proportion of red grouper in the total grouper catch was the same before species were separated in the landings, then the maximum commercial harvest for this species was about 8½ million pounds in 1982. Estimates of the recreational harvest of red grouper are highly variable but averaged about 2.6 million pounds (ca. 700,000 fish) from 1982-1989, or about 29 percent of the total harvest by weight.

Florida enacted an 18-inch (total length) minimum size for groupers in July 1985. This was increased to 20 inches in February 1990 after the Gulf of Mexico Fisheries Management Council (GFMFC) established conservation measures for groupers. These measures included a 20-inch minimum size and a 9.2-million pound (total weight) commercial quota for the shallow water groupers (which include red grouper) occurring in the waters of the Gulf of Mexico under GFMFC jurisdiction.

Red grouper landings by commercial fishermen increased slightly in 1986 after the 18-inch minimum size went into effect. Length frequencies of red grouper sampled from the commercial harvest provide little evidence that Florida's minimum size had any significant conservation effect on the commercial harvest.

Available data suggest an initial decline in the recreational harvest of red grouper after the 18-inch minimum size was established, primarily in Florida's state territorial sea. The bulk of the remaining recreational harvest of red grouper consisted of fish harvested from the EEZ. Most of these were less than 18 inches in length. The initial decline in recreational harvest was followed by a recovery in 1988 and 1989, entirely in the EEZ. Available data indicate that this recovery was also accompanied by a larger increase in the numbers of red grouper that were released.

The regulations that became effective in 1990 caused a 70-percent decline in the recreational harvest by number and a 41-percent decline by weight from the average of the two preceding years. Commercial harvest declined by 21 percent in 1990 from the two prior years. However, the decline would likely have been less than 15 percent if the fishery had not been prematurely closed before the quota had been reached. The effect of the 1990 minimum size is clearly evident in the length-frequency samples from all sectors of the fishery.

Recent measures of length at age suggest that the growth rate of red grouper in the Gulf of Mexico has increased since the first studies were performed in the mid 1960s. A possible explanation for this apparent change in growth is a reduction in density-dependent suppression of growth resulting from a significant reduction in red grouper density caused by fishing. Uncertainty about the current growth characteristics of red grouper is a significant impediment to the application of age-structured methods to the analysis of the status of this stock. Additional data to confirm or refute the available growth information are needed.

If it is assumed that the most recent growth studies are applicable and that natural mortality is about 0.2, then fishing mortality (F) would be estimated to be about 0.2 from catch curve analysis. In the absence of fishing-induced mortality below the 20-inch minimum size, $F_{0.1}$ is estimated to be about 0.19 using these growth data. The corresponding equilibrium spawning stock would be about 40 percent of its unfished biomass.

However, because the 20-inch minimum size and commercial quota were simultaneously put into place, fishing mortality increased in the older fish. Such a recent increase in fishing mortality will not be reflected in the age structure of the stock for a few years and therefore cannot be detected through catch curve analysis. In addition, there is substantial evidence that significant numbers of red grouper are being caught and released below the minimum size. A portion of these fish die from the experience.

If this discard (release) mortality exceeds about 20 percent, then yield per recruit could be raised by lowering the minimum size. If it is about 1/3, then yield per recruit would be maximized with fishing mortality at about the estimated present level (0.2) but at a minimum size of about 16 inches. Thus, *if the recent data are representative of the present growth rate of individuals in the stock*, the conservation effect of quota management for red grouper could be enhanced by lowering the minimum size. However, a lower minimum size would possibly jeopardize the status of the other grouper species because of their larger maximum sizes. This problem might be avoided if a practical scheme could be developed to manage this species separately.

In addition to the uncertainties about growth, the present analysis is weakened by inadequate temporal and spatial sampling of the commercial and recreational fisheries. Also, the reproductive strategy adopted by red grouper may invalidate the analyses of the reproductive potential of the stock, even if growth, fishing and natural mortality were known with certainty.

Consequently, in addition to the research needed to establish the growth characteristics of the stock, there is a need for research to adequately incorporate the reproductive process of protogynous hermaphroditism into models of spawning potential. If growth is found to be as plastic as current data indicate, routine aging of random samples from the fishery may be required to monitor this fishery.

INTRODUCTION

Red grouper (*Epinephelus morio*) is the most common species in the commercial and recreational grouper catch of the U.S. Gulf of Mexico. Most of the fishery for the species in U.S. waters of the Gulf of Mexico occurs within or immediately to the west of Florida's territorial sea. Although the species supports the bulk of the grouper harvest, it has received surprisingly little attention in the form of research or management. The only major study of red grouper in the U.S. fishery was by Moe (1969) on material collected in the early 1960's. Rivas (1970) described the distribution of red grouper in the Gulf from 1950-1970 experimental sample collections made by the Exploratory Data Center, Pascagoula, Mississippi. There are descriptions of the fishery of the Yucatan Peninsula, Mexico (e.g., Ramirez 1970) where red grouper are also important. Also, a number of studies of the reproductive characteristics of the species and its importance to management exist (e.g., Bannerot 1984). However, many aspects of the life history of the species and its fishery in the Gulf remain poorly understood or unknown.

Conservation measures were instituted in Florida in 1985 and in the EEZ in 1990. The 1985 Florida action was an 18-inch minimum size and did not extend to the EEZ. The 1990 measures adopted by the Gulf of Mexico Fishery Management Council included a 20-inch minimum size, 5-fish aggregate grouper bag limit for recreational fishermen, and a commercial grouper quota. Florida modified its regulations in 1990 to be in concert with the Federal regulations.

This study is an attempt to integrate existing knowledge about the species with data from the fishery to develop management advice. We believe it is a first step toward enlightened management of the species, but much work remains to be done.

BIOLOGICAL CHARACTERISTICS

DATA SOURCES

Meristic and growth characteristics were evaluated using a composite of length and other measurements of Gulf of Mexico red grouper that have been collected during research and monitoring programs throughout the years. Moe (1969) provides the most complete characterization of the species in the literature. We also employ data provided by Southern Offshore Fishing Association, Inc. (SOFA); other data collected during the trip intercept portions of the National Marine Recreational Fisheries Statistics Survey (MRFSS); the NMFS Headboat survey; and samples of commercial and recreational catches collected as part of the Trip Interview Program (TIP) of the State/Federal Cooperative Statistics Program. A biological profiles sampling program by the NMFS Panama City (Florida) Laboratory provided additional sample data. These data sources were insufficient to describe all of the conversions between various measures needed to standardize lengths and weights to common bases, and we requested unpublished data from several investigators. The Caribbean Marine Research Center (CMRC, P. Colin, personal communication), University of South Alabama (R. Shipp, personal communication) and Florida DNR (L. Bullock, personal communication) supplied additional data to complete the needed relationships. The NMFS Beaufort (North Carolina) Laboratory also provided growth data for red grouper from the Atlantic headboat fishery (D. Burton, personal communication).

MORPHOMETRICS

Weight conversions. In 1964 the then Bureau of Commercial Fisheries established a policy of recording finfish landings in units of pounds, whole weight (Udall 1964). Since most grouper are landed in gutted condition, a conversion factor was required to convert the landed weight to its equivalent value in whole weight. A conversion factor of 1.18 was adopted for this purpose. The basis for this value is unknown.

The Florida grouper landings from 1986 to the present and those of all other states have been adjusted upward by this factor before entry into the computer files which constitute the historical data base for the grouper fishery. Florida landings prior to 1986 were never converted from landed to whole weight (E. Snell, SEFC, personal communication).

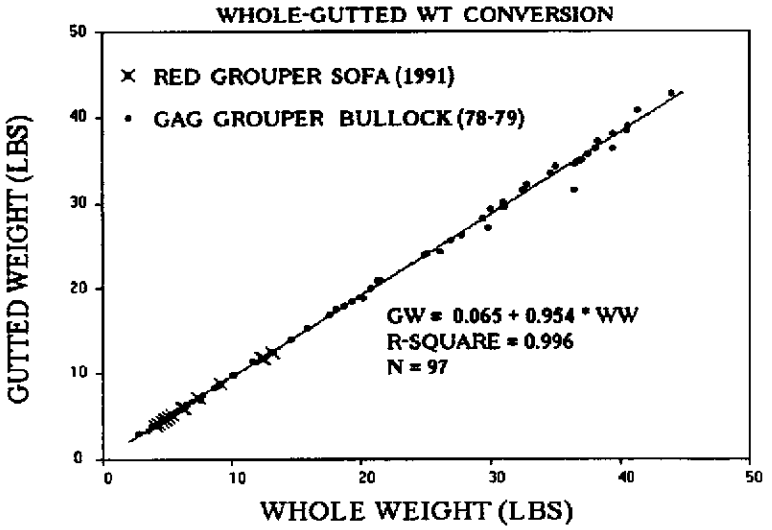

Figure 1. Scattergram of observed whole and gutted weights for red and gag groupers and associated regression estimate of the conversion equation.

The Southern Offshore Fishing Association, Inc., provided a small sample (N=14) of red grouper gutted and whole weight measurements that indicated that the conversion factor should be on the order of 1.03 to 1.06, well below the 1.18 that has been used. We supplemented the SOFA sample with data from gag (data from Bullock) which covered a much wider range of sizes and estimated the conversion factor using regression (Figure 1). The result of this analysis suggests near identical gutted to whole weight relationships between the two species with a slope of about 0.954. This corresponds to a conversion factor of about 1.048 (1/0.954). The relationship of Figure 1 was used in this assessment to convert between whole and gutted units with one exception. That exception is that the historical landings data were divided by 1.18 to convert the erroneously high whole weights recorded in the landings files back to gutted weight where appropriate.

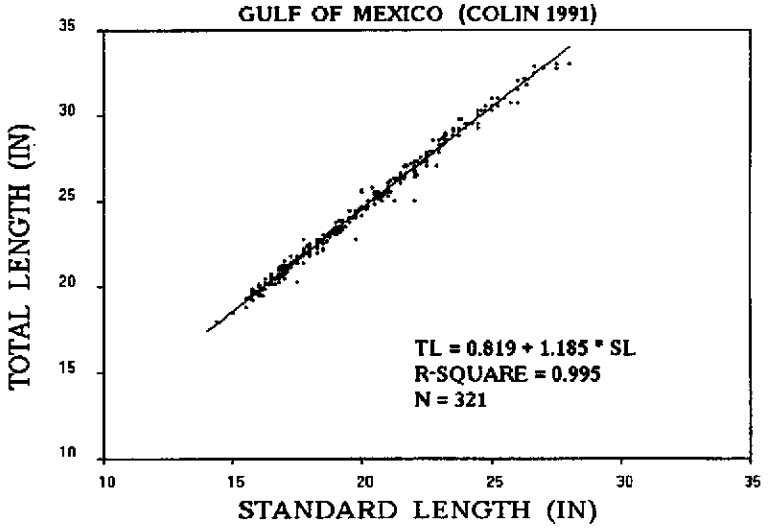

Figure 2. Scattergram of standard and total length for Gulf of Mexico red grouper and associated regression equation.

Length conversions. The length units in this document are all reported in inches, total length for convenience of the expected audience. Many of the original length measurements were recorded in metric units, often as standard or fork length. All conversions of length measurements from metric to English units were made with greater precision than the original measurements to retain the initial precision. If length conversion was necessary, the lengths were converted first to inches and then to total length. The conversion relationships (Figures 2 and 3) were derived from data provided by CMRC (P. Colin, personal communication).

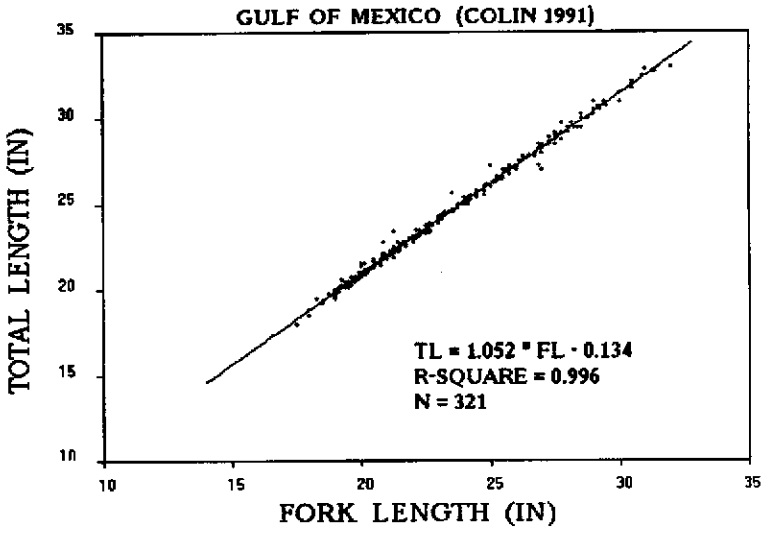

Figure 3. Scattergram of fork and total length for Gulf of Mexico red grouper and associated regression equation.

Length to weight conversions. All weights of landings in this document are reported as pounds, gutted weight. Many of the original weight measurements of individual fish were recorded in kilograms. Conversions from metric units to pounds was done with sufficient precision to maintain the precision of the original measurement.

Since lengths were more commonly measured than weights, it was often necessary to estimate weights from lengths. The propensity for samples to be measured in a particular unit varied among the fisheries sampling program. For example, headboat length samples were recorded as mm total lengths while MRFSS samples were in mm fork length. Where required, total lengths from the headboat survey were first converted to pounds total weight from the relation of Figure 4 and then to gutted weight using the relation of Figure 1.

The TIP samples were used to establish the relation between fork length and gutted weight (Figure 5) and total length and gutted weight (Figure 6). These two regression equations were used to assign weights from lengths for the commercial samples as appropriate. MRFSS intercept samples record lengths as fork length. Consequently, the MRFSS lengths were converted to gutted weight using the equation of Figure 5, as needed.

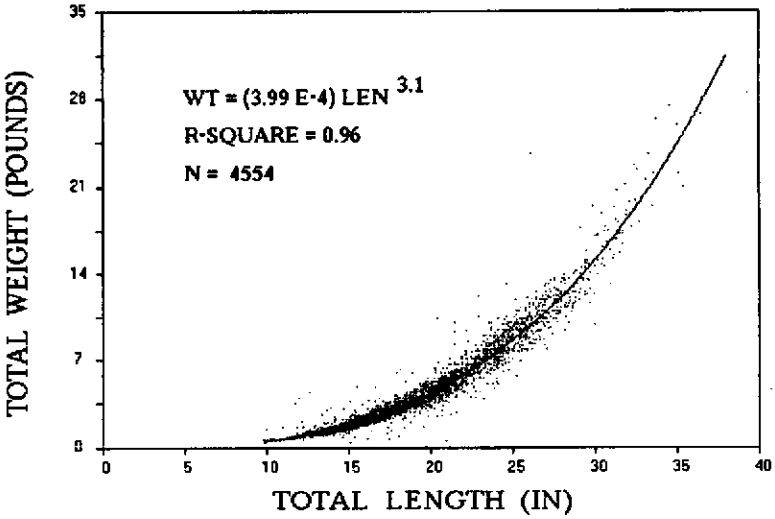

Figure 4. Total weight as a function of total length from length and weights collected by the NMFS headboat survey.

REPRODUCTION

Moe (1969) found that grouper off the west coast of Florida reach peak spawning in late spring; i.e., April and

May. He also found no histological or analytical evidence to suggest that individuals spawned more than once a season; in fact early developers may retain their eggs for several months and all fish will then spawn in May.

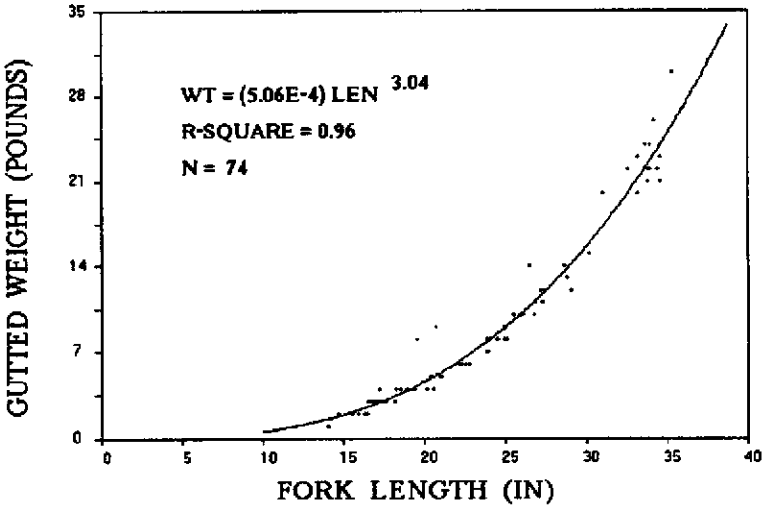

Figure 5. Relation between gutted weight and fork length for red grouper sampled from Gulf of Mexico commercial landings.

Moe (1969) reported fecundity and lengths for a small sample (N=14) of red grouper which he described as insufficient for regression analysis. Additional data are currently being collected by several research programs. Normally, these data would be incorporated into an estimate of the spawning potential ratio (SPR) upon which to judge the condition of the spawning stock. Goodyear (1989), however, noted that the estimation of potential recruit fecundity[1] (required for estimation of SPR) posed a problem for species that change sexes during their life history.

Grouper are among those species which have adopted a reproductive strategy involving sex change (e.g., Bannerot et al. 1986, Ghorab et al. 1986, Shapiro, 1986). Red grouper are categorize as protogynous hermaphrodites, which first mature as females and then change to males at an older age. The age or size of the fish when the sex change occurs is thought to be controlled in part by social interactions that are inherently density dependent.

The problem with the estimation of SPR arises because fishing mortality not only reduces the life expectancy of individuals in the population, it may also reduce the proportion of a surviving fish's life spent as a female. In the extreme, if the presence of males inhibits the transition of females to males then increases in density would tend to increase the lifetime fecundity of an average individual rather than to decrease it. This possibility is exactly the reverse of the normal expectation. Additional research is needed to properly estimate potential recruit fecundity and to fully comprehend the impact of this reproductive strategy on the

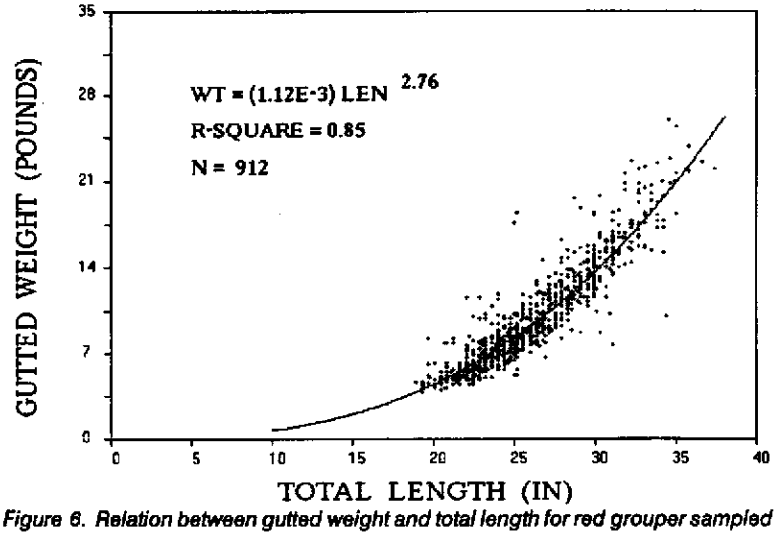

Figure 6. Relation between gutted weight and total length for red grouper sampled from Gulf of Mexico commercial landings.

[1] Potential recruit fecundity is the expected lifetime production of eggs by the average female in the population in the absence of density-dependent suppression of growth or mortality. It is assumed that sufficient males will always be present.

ability of such species to sustain fisheries.

Because of this problem, we use the ratio of fished to unfished spawning stock biomass per recruit as a surrogate for SPR. We include red grouper ages 4 and older in the calculation of spawning stock biomass based on the species profile of Jordy and Iversen (1989).

GROWTH

We reviewed two sets of information related to growth of red grouper for this assessment. The first was the growth analysis by Moe (1969) and the second was the growth data from the Atlantic headboat fishery. The former study characterized growth of red grouper sampled from the 1963-1964 commercial and recreational fisheries from the eastern Gulf of Mexico in the general vicinity of Tampa, Florida.

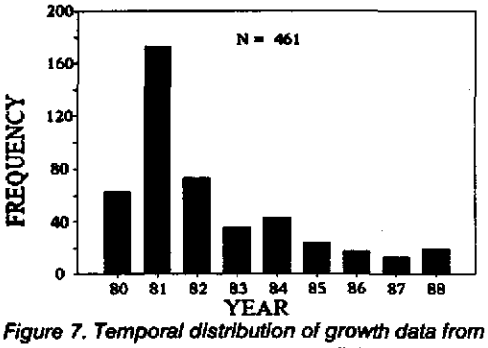

Figure 7. Temporal distribution of growth data from the Atlantic red grouper headboat fishery.

In contrast, the data from the headboat fishery reflects growth of red grouper along the South Atlantic Coast. In addition, samples for this study were taken about 20 years after those Moe used in his analysis (Figure 7). Burton and Stiles (1991) and Stiles and Burton (1991) describe the later study in more detail.

Stiles and Burton (1991) conclude from marginal increment analysis that the rings observed on the otoliths were formed on an annual basis. Annulus formation appears to occur sometime before July (Figure 8).

We back-calculated lengths at annulus formation using Lea's (1910) direct proportionality method corrected for the X intercept of the relation between the otolith radius and total fish length (Tesch 1970). This method provided slightly better agreement between backcalculated and observed lengths at age than the method used in the original analysis (Burton and Stiles 1991). The resulting data provided estimates of mean lengths at annulus formation for ages 1-16 (Table 1). These were used to estimate the parameters of a von Bertalanffy growth model by nonlinear least squares.

The resulting fit is presented in Figure 9 along with a scattergram of the observed lengths at age and the mean of back-calculated lengths. Actual age at capture for these fish was estimated by adding to the integer of the age the fraction of a year which had elapsed from the

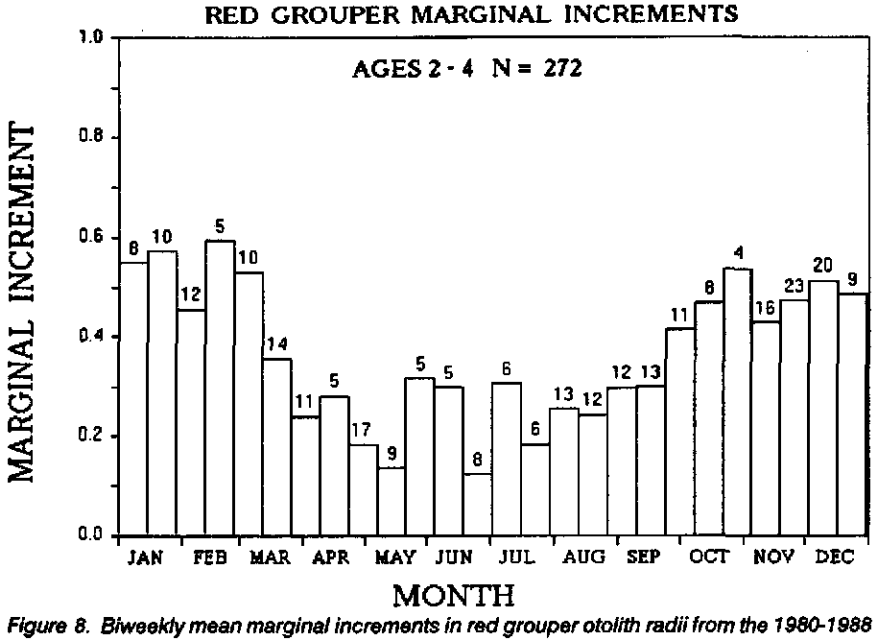

Figure 8. Biweekly mean marginal increments in red grouper otolith radii from the 1980-1988 South Atlantic headboat fishery.

previous June 1 at the time of capture (i.e., annulus formation on June 1).

The predicted lengths from the von Bertalanffy equation compare favorably with observed length at capture for all ages involved in the estimate. There also was good agreement between the mean back-calculated lengths, mean lengths at capture, and the predicted lengths (Figure 9).

We also fitted the inverted von Bertalanffy equation to estimate age as a function of length using the same data (Figure 10).

Size at age for red grouper from the two studies is substantially different (Figures 11 and 12). It is clearly evident that the two models could lead to vastly different conclusions about the age structure that would correspond to a sample length frequency from the fishery. We can find no reason in the available evidence to reject the results of either study as not representing growth of the studied fish. Lacking such evidence we adopt as a working hypothesis that the difference between the findings of the two studies reflects a real difference in growth rates.

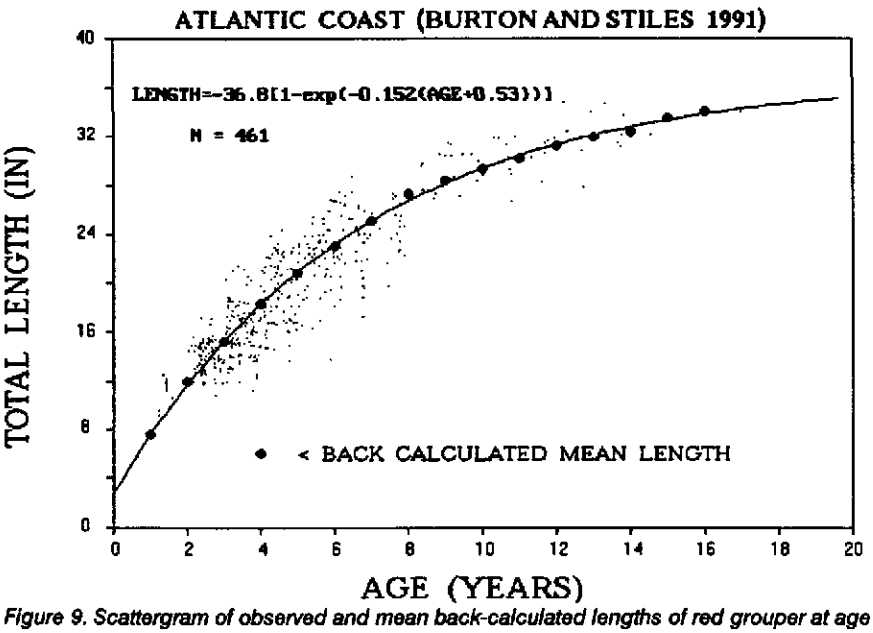

Figure 9. Scattergram of observed and mean back-calculated lengths of red grouper at age with a fitted von Bertalanffy equation. Data are from Burton and Stiles (1991).

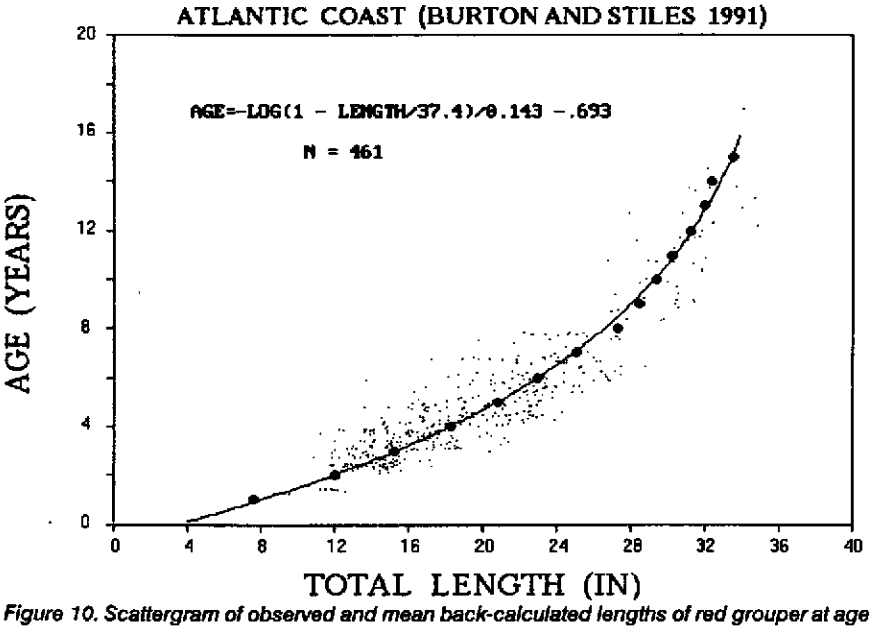

Figure 10. Scattergram of observed and mean back-calculated lengths of red grouper at age with an inverted von Bertalanffy equation fitted to back-calculated total length at age.

Such a difference in growth could result from genetic or environmental factors, or both. A strong candidate for an environmental factor would be a difference in the per capita food resources available for growth. If this is true then the relative density of red grouper would have been lower in the South Atlantic during the 1980s than it was in the East-central Gulf in the 1960s. Further, if growth in red grouper is this plastic, then Moe's model would only be useful if the red grouper density in the Gulf is the same now as it was when he performed his research.

We were able to locate a recent sample of aged Gulf of Mexico red grouper at the University of South Alabama (R. Shipp, personal communication). These fish are clearly larger at assigned age than were those Moe (1969) examined in the early 1960s (Figure 13). They are also somewhat larger than expected from the model of Figure 7, which was derived from the data of Burton and Stiles (1991).

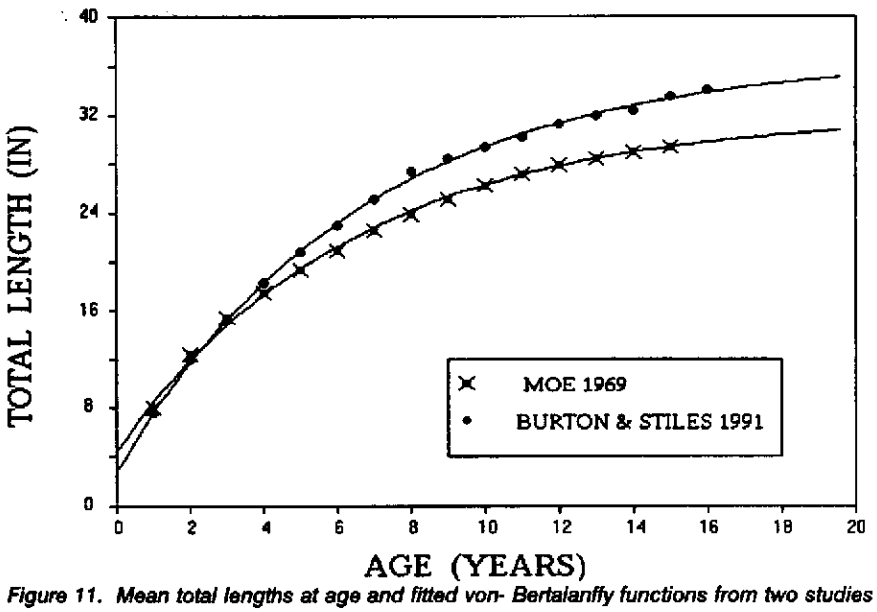

Figure 11. Mean total lengths at age and fitted von- Bertalanffy functions from two studies of red grouper growth.

These observations have several important implications. Moe's growth model is no longer applicable. Red grouper growth has increased substantially, possibly as a result of reduced density caused by fishing mortality. A potentially large part of the compensatory response of red grouper to fishing mortality involves increased individual growth. Further, since the growth rate has been changing over the last few decades the equilibrium size at age cannot be determined from the current distribution of size at age. This is because the younger fish in the current age structure are likely to attain larger sizes than the older individuals when they attain same age (if they survive fishing).

If growth is truly as plastic as these data indicate, then red grouper lengths cannot be used to assign ages unless age-length keys or growth models are developed on a frequent (annual) basis. Such data are not available and constitute a significant impediment to the application of age-structured assessment methods.

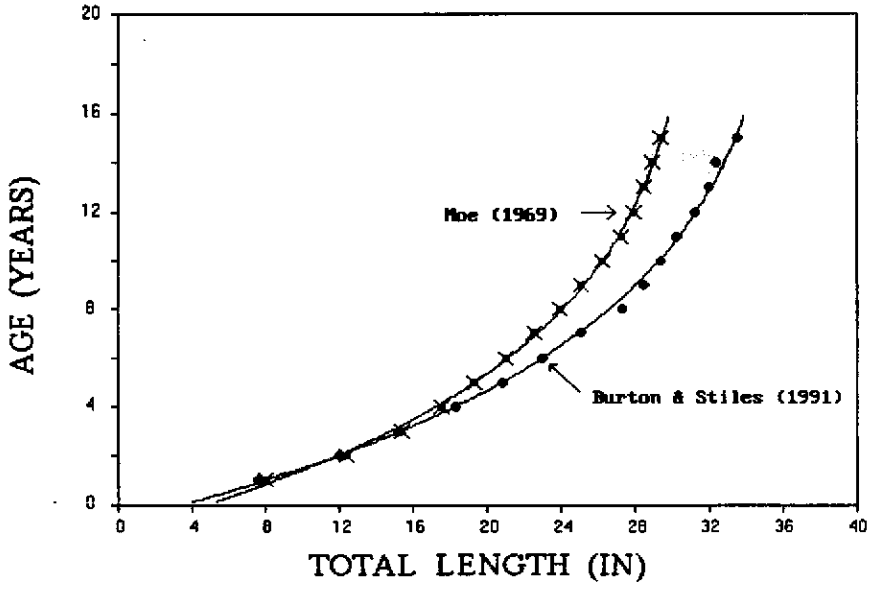

Figure 12. Mean age at length and inverted von-Bertalanffy functions from two studies of red grouper growth.

For the purpose of this assessment we performed several analyses based on catch curves derived from the 1986-1989 average and 1990 length compositions of the catch. We contrast the implications of assuming each of the two models. However, we gave more credence to the results of the latest study because the

recent samples from the Gulf confirm a larger size at age now than was observed in Moe's study.

We strongly recommend that additional research resources be focused on the problem of red grouper growth. Much of what we infer about the current status of the stock is dependent upon the assumption that the data and analyses reported in this section are accurate. Given the large divergence in size at age among the studies and the importance of this information, we are uncomfortable accepting the current interpretation without additional verification. Further, if our present interpretation of the available information is correct, then current growth of red grouper in the Gulf is likely to be different than in either of the two growth studies available to us for this assessment. This conclusion is strengthened by the limited set of recent Gulf data that are available (Figure 13).

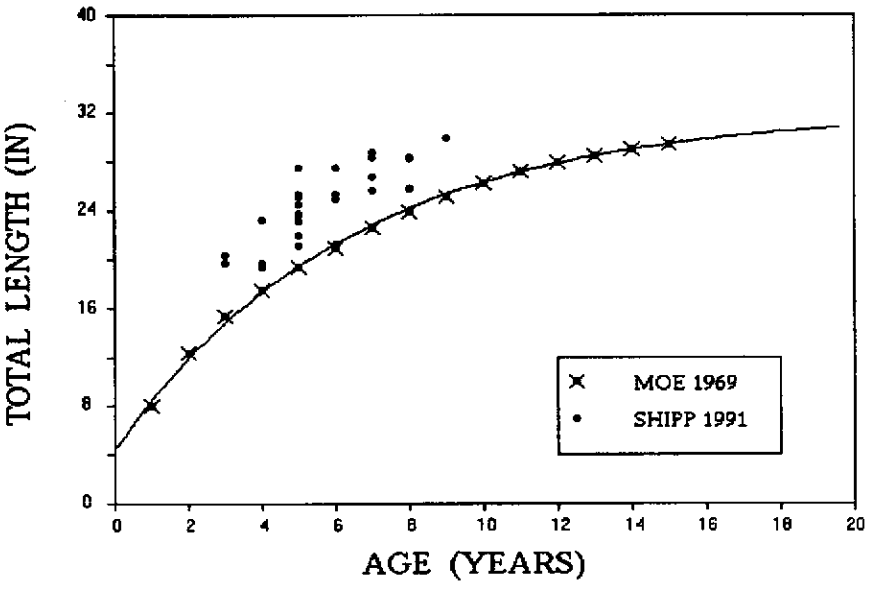

Figure 13. Comparison between 23 recent observations of size and age of red grouper from the Gulf of Mexico (Shipp 1991) and data from the early 1960s (Moe 1969).

MORTALITY

Natural Mortality. As with most exploited fish stocks, the level of natural mortality in the Gulf of Mexico red grouper stock is not well defined. This difficulty arises in part because the long history of the fishery does not permit an evaluation of the unfished age distribution of the stock. Moe (1969) estimated total mortality (Z) to be about 0.32 but did not attempt to decompose the estimate further. Bannerot (1984) and Bannerot et al. (1986) used a value of natural mortality of M=0.2 in their analyses. Stiles and Burton (1991) used M=0.17 in their projections of yield per recruit for red grouper on the Atlantic Coast. We adopt the value of M=0.2 from Bannerot (1984) in our analyses that require an estimate of natural mortality. This value seems reasonable but may be too high given the frequency of older ages in the population.

Release Mortality. Gulf of Mexico red grouper less than 20 inches total length are protected from harvest by a size limit. Anecdotal comments from fishermen suggest significant numbers of red groupers under 20 inches are being released but are not surviving the capture experience. Although research is underway to estimate this mortality, few data yet exist. Investigators from the University of South Florida (R. Wilson, personal communication) reported that 29% of a sample of 21 red grouper (< 508 mm TL), caught by hook and line from a depth of 44m off Florida's west coast, did not survive recompression to that depth for 24 hours in individual recompression chambers.

DISTRIBUTION AND MOVEMENTS

Moe (1966, and 1969) and Beaumariage (1969) concluded from tagging studies and the size and age distribution of the harvest that red grouper spend the first 4-5 years of their life near shore and then migrate into deeper water off-shore upon reaching sexual maturity. Moe (1969) also noted a pattern of inshore movement of red grouper in the summer and offshore movement in the late fall. Rivas (1970) confirmed the gradient of increasing size with depth from exploratory surveys conducted in the Gulf from 1950-1970. His data also suggested a seasonal north-south pattern with a southerly movement of red grouper in the winter.

We examined the lengths of red grouper landed by various gears as a function of depth at capture from TIP samples of the commercial fishery during the period 1984-1991 (Figures 14 to 16). The line evident in each of the figures is a three point moving average of the average lengths of red grouper by depth. The samples from the bottom longline catches show a clear increase in mean lengths of red grouper from about 15 inches at the shallowest depths (about 5 fathoms) to nearly 25 inches at about 25 fathoms (Figure 14). The elimination of samples from catches from waters less than 20 fathoms indicates that the bottom longline fishermen moved further offshore in response to the 20-inch minimum size in 1990.

The same trend of increasing size with depth is evident for power-assisted reels and handlines (Figures 15 and 16).. The distribution of the depths of samples from these gears also reflects the propensity for fishermen using handlines to fish in shallower waters than those using bottom longlines or power-assisted reels. Fishermen using power assisted reels also appeared to move offshore into deeper water in response to the 20-inch minimum size.

These data suggest that a reduction in the catch of small fish by the commercial sector of the fishery has in part been accomplished by a movement of the fishery to deeper water offshore. However, the increase in mean lengths to slightly over 27 inches for waters greater than 20 fathoms in 1990 probably reflects the discard of undersized fish.

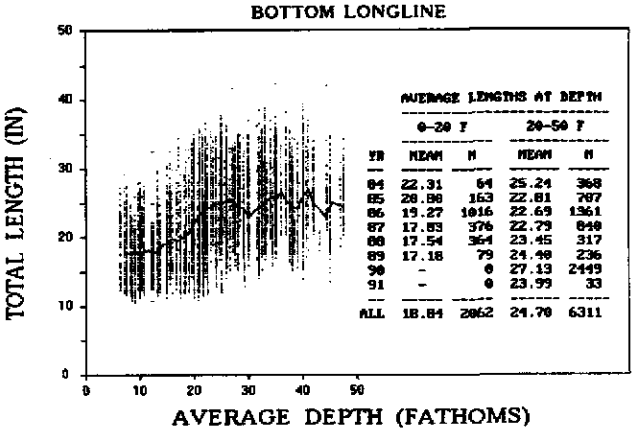

Figure 14. Lengths of red grouper caught by bottom longline as a function of depth at capture.

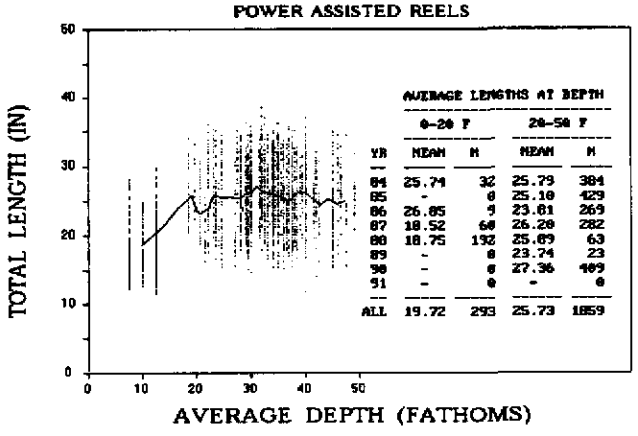

Figure 15. Lengths of red grouper caught by power assisted reels as a function of depth at capture.

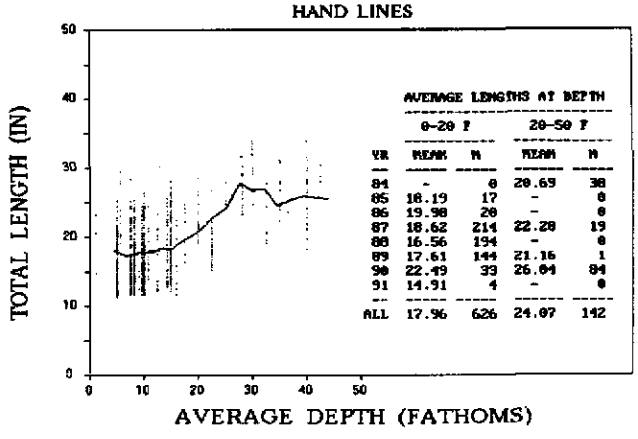

Figure 16. Lengths of red grouper caught by hand lines as a function of depth at capture.

HARVEST TRENDS

COMMERCIAL HARVEST

Data sources. Landings statistics for commercially caught grouper were available from 1962 to 1990 (computer files maintained by the Fishery Dependent Data Group (FDDG), Research Management Division, Southeast Fisheries Center (SEFC), Miami). The U.S. portion of the landings used in this assessment were separated from foreign catches by a location code in the data file. Groupers were not separated to species prior to about 1986 but were included in a category termed "unclassified grouper." In addition to these data, a reeffish logbook reporting program was initiated in 1990 as a part of Amendment 1 to the Gulf of Mexico Reef Fish Management Plan of the Gulf of Mexico Fishery Management Council (Gulf Council). All trap fishermen and a sample of other fishermen landing reeffish were required to report their landings. These data were used to estimate the distribution of the total 1990 red grouper landings by gear and area of capture.

As noted elsewhere, the landings data in the files represent a mixture of records. The weights recorded for Florida records prior to 1986 are in units of gutted weight, whereas all of the other records in the files were converted to whole weight using a factor of 1.18. For the purpose of this assessment we unconverted the "whole weights" back to gutted weight by dividing the appropriate records by 1.18.

TIP data were obtained from FDDG to characterize the size composition of red grouper landed by different commercial gears in different areas and time. These data were supplemented by other similar data gathered by the NMFS Panama City Laboratory's bioprofile sampling program. Data from these sources were available from 1984 through 1990, with a few records for other years.

Temporal trends in commercial landings. Because grouper landings were not separated by species prior to 1986 we are unable to track red grouper separately before that time. Total grouper landings from the U.S. Gulf of Mexico exhibited a slow decline from about 7.5 million pounds in 1962 to about 5 million pounds in the late 1970s (Table 3, Figure 17).

Handlines and power-assisted (electric and hydraulic) reels accounted for almost all the catch prior to the introduction of longlines in the early 1980s (Figure 18). With the expansion of the bottom longline gear in the 1980s the total grouper landings increased sharply to a maximum of about 12½ million pounds in 1982 (Figure 18). The contribution of fish traps to the total grouper catch increased in the mid-1980s but never achieved a large share of the combined landings (Figure 18).

Most of the U.S. Gulf of Mexico grouper catch for all species has been landed in Florida at least since

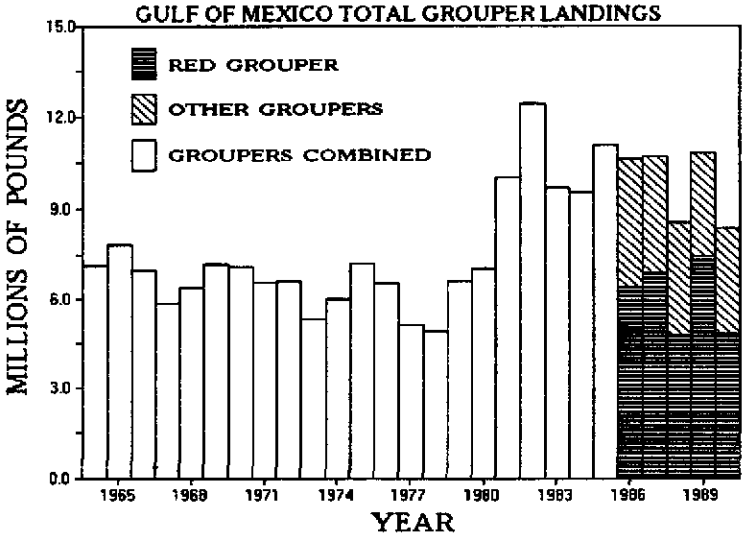

Figure 17. Commercial landings of all groupers from U.S. waters of the Gulf of Mexico.

1962 (Table 3). The commercial U.S. catches of red grouper since 1986 are almost entirely landed in Florida (Table 2). Red grouper also make up a large proportion of the total grouper landings since 1986 (Figure 17, Tables 2 and 3). However, the relative dominance of the various grouper species vary by state and year (Tables 4-29).

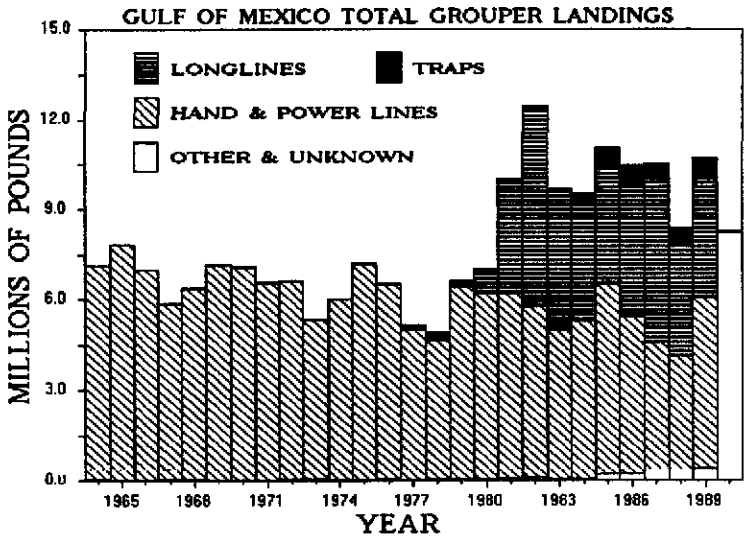

Figure 18. Total commercial harvest of groupers from U.S. waters of the Gulf of Mexico by method of capture.

Mississippi and Alabama once landed modest amounts of unclassified groupers many of which were caught in foreign waters (Table 3). These early landings declined the early 1970s and remain low. Recent grouper landings from these two states are almost entirely from U.S. waters but most are still not recorded as to species (Tables 3 and 4). It is possible that red grouper were an important part of the early grouper landings from these two states but most of the production was from foreign waters.

Louisiana grouper landings have been significant only since about 1984 (Table 3). A large fraction of grouper in the Louisiana catch remains unclassified to species (Table 4), but of the more than half that has been classified since 1986 (Tables 5-29) only a few thousand pounds have been classified as red grouper. It seems unlikely that red grouper were ever an important part of the Louisiana grouper catch.

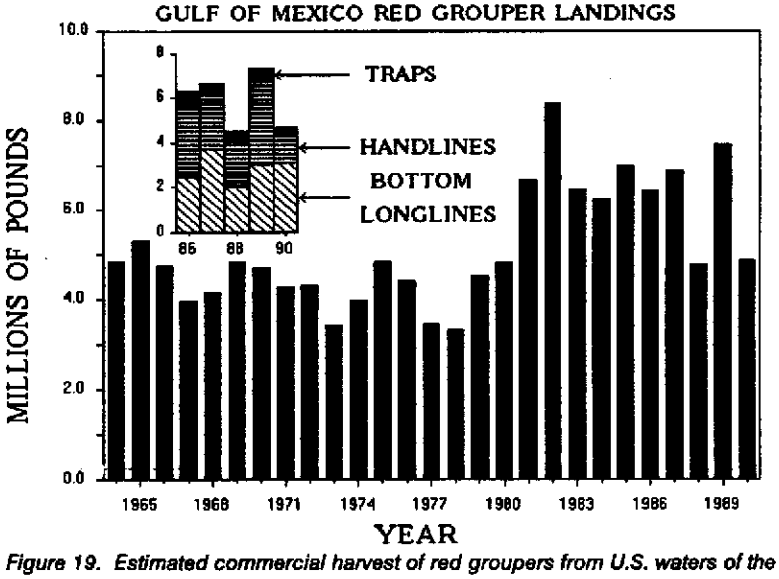

Figure 19. Estimated commercial harvest of red groupers from U.S. waters of the Gulf of Mexico since 1964 and method of capture since 1986.

Texas grouper landings from U.S. waters also increased about 5-10 fold in the early 1980s over the prior decade (Table 3). Large numbers of these groupers also remain unclassified to species (Table 4). However, less than 500 pounds of those classified to species were classified as red grouper (Tables 5-29).

From these observations, we doubt that red grouper was ever a large part of the domestic catch of Gulf of Mexico grouper fishermen west of Florida. It is clear that at the present time almost all of the U.S. Gulf of Mexico red grouper harvest is from Florida (Table 16).

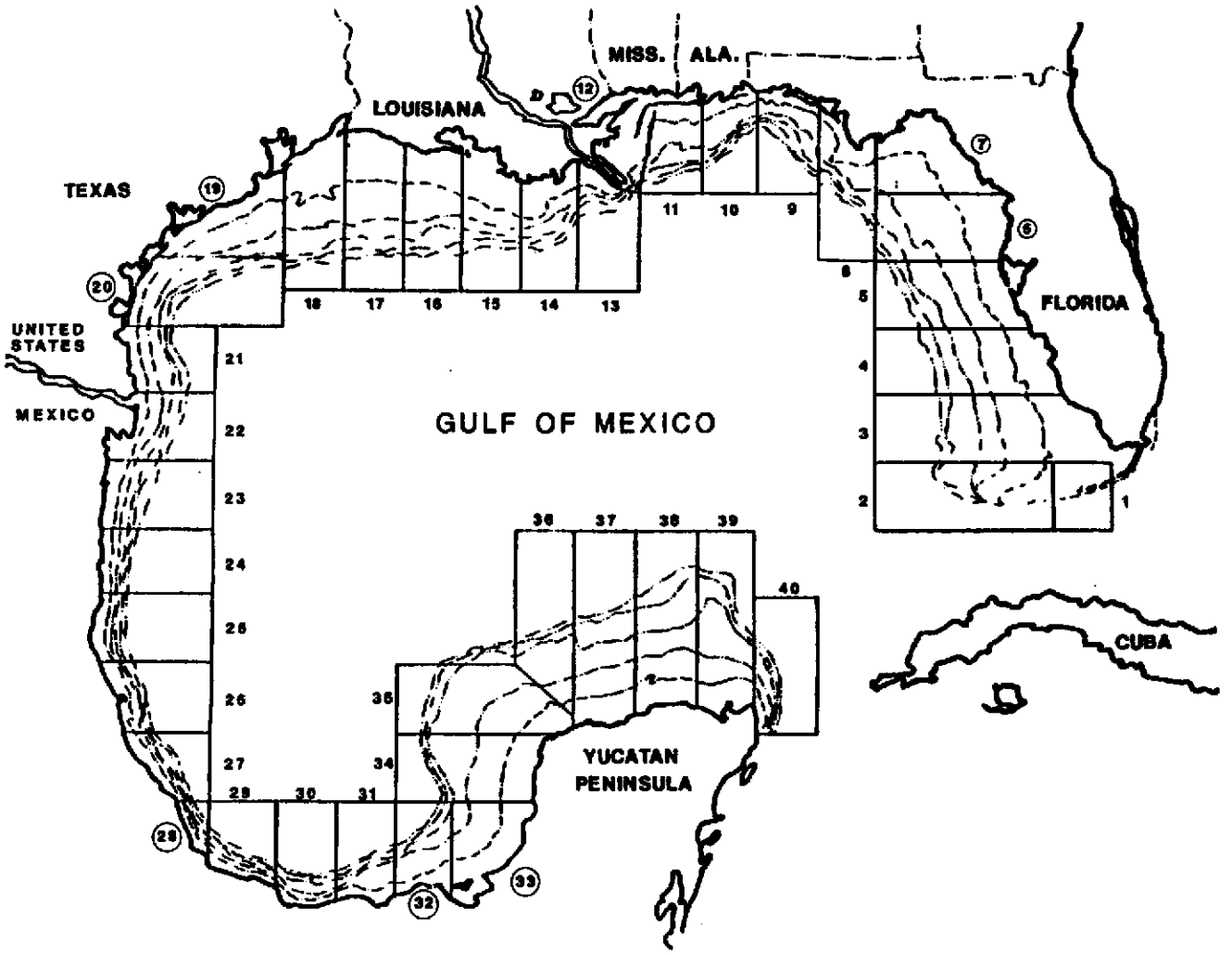

Figure 20. Statistical grids for the Gulf of Mexico used in this study.

Red grouper accounted for an average of 69 percent of the total classified grouper landings for the 5 years where they can be separated into species (range 63 to 74 percent). Moe (1969) noted that red grouper composed about 60 to 75 percent of the total grouper catch. Although he did not specify the period for which this estimate applied, we presume that he was referring to the period in the early to mid 1960s when his data were collected. These data indicate that the red grouper proportion of the total grouper harvest has been relatively constant, at least since the 1960s. Based on this assumption, we estimate the red grouper catches for each year prior to 1986 as the product of the total annual unclassified grouper landings and the mean proportion of red grouper in the 1986-1990 landings (Figure 19).

Trends in landings by gear. Red grouper are commercially harvested with a variety of gears throughout the Gulf of Mexico. Based on the grouper fishery as a whole the predominant historical gear among these are "handlines" (Figure 18). These include lines that are operated either manually or with the assistance of electric or hydraulic power. The landings from all of these gears have been reported under a single gear code. Consequently, they cannot be partitioned into more discrete categories and are referenced herein as "power and hand lines." Bottom longlines have been replacing handlines as the primary gear used to harvest groupers since the early 1980s.

The red grouper landings in the data files were already partitioned into gear and grid for 1986 through 1989, but the 1990 data from the Florida Trip Ticket program had not yet been so partitioned. We estimated the spatial distribution of the 1990 red grouper by gear from the logbook reports. We assumed that the entire trap catch was reported in the logbooks and the remaining catch was distributed in proportion to the catches reported in the logbooks (Table 30). This allowed partitioning the 1990 catch estimated from the Florida Trip Ticket Program into catch by gear and location of capture. This permitted construction of tables of catch by location and gear from 1986 through 1990 (Tables 31-36). It is clear from these data that the trend of increased use of bottom longline gear continued into 1990 when it became the principal gear employed for red grouper (Figure 19).

Spatial distribution. The bulk of the 1986-1990 commercial catch of red grouper was from the eastern Gulf of Mexico to the west and south of Tampa - St. Petersburg, Florida, with a decided peak in grid 5 (Figure 21; Table 31).

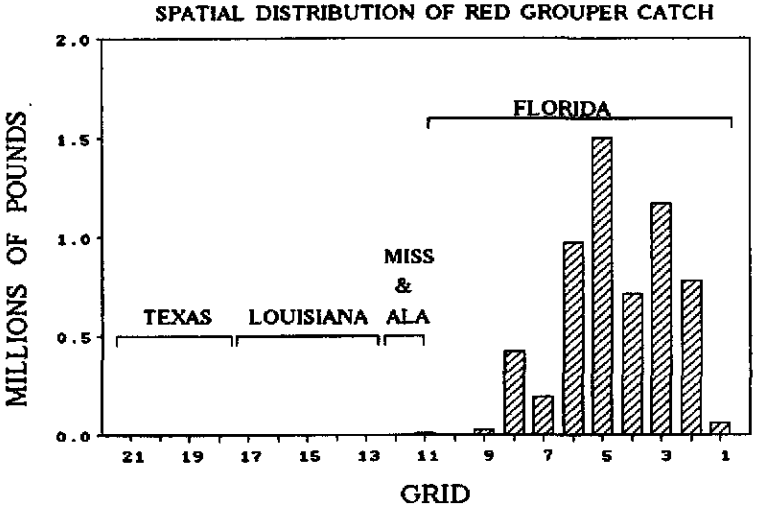

Figure 21. Spatial distribution of the 1986-1990 average U.S. Gulf of Mexico red grouper catch.

Most of the red grouper trap catch through 1989 was in the southern part of the fishery in grids 2 and 3 (Table 32). These fish were landed primarily in Collier and Monroe counties (Table 37), where they contributed up to half the counties' red grouper landings (Table 38). The trap catch diminished in importance in 1990, but some trap landings in 1990 were to the north of Collier County. We expect that some small trap landings had existed in these areas previously but were not coded properly in the landings files.

The other principal gears showed no spatial affinity for a particular subset of the grids from which most red grouper were harvested (Tables 34 and 35). However, most of the landings in counties north of Tampa - St. Petersburg were taken with handlines (Tables 37 and 38).

RECREATIONAL HARVEST

Data sources. The recreational harvest estimates for red grouper are derived from a combination of three sources. The primary data source for the recreational harvest of red grouper is MRFSS, which covers the period 1979-1988. This survey provides estimates of the numbers of red grouper harvested during bimonthly periods (waves) by state and mode (shorebound, private/rental boats and party/charterboats), with several exceptions. There were no estimates of harvest for wave 1 (January-February) in 1981. Texas boat mode was not sampled from 1982-1984. Texas was not included in the survey from 1986-1988. Party boat (headboat) sampling was discontinued after 1985 for all waves and states.

The suspension of the party boat sampling by the MRFSS coincided with an expansion of the NMFS headboat survey conducted by the NMFS Beaufort Laboratory (data courtesy G. Huntsman, SEFC Beaufort Laboratory) to include U.S. Gulf of Mexico ports. These latter data provide estimates of landings by partyboats for all states after 1985 and constitute the second source of recreational harvest estimates.

The third source of recreational harvest estimates is the Texas Parks and Wildlife Department (TPWD) coastal sport fishing survey (data provided by TPWD). This survey provides estimates for numbers harvested by boat modes, exclusive of party boats, for Texas for 1986-1988. Harvest by shorebound fishermen has not been included in the estimates since 1985.

The combination of these three sources provided estimates for all areas, modes, and periods except for wave 1 of 1981, the 1982-1984 Texas boat modes, and Texas shore modes after 1985. The harvest of red grouper from the shore is minimal, and no attempt was made to include this missing stratum in the final estimates.

Values for the other missing strata were estimated from their respective proportional contributions for years when they were sampled. Specifically, the 1981 wave 1 estimates were derived from the 1981 totals using the mean fraction of the annual harvest that occurred in wave 1 in other years. Similarly the harvest by boat modes in Texas in 1982-1984 was estimated from the gulfwide landings in those years and the average proportion of the annual gulfwide landings contributed by the Texas boat modes in years when they were sampled.

Intercept data from MRFSS provide length measurements for samples of fish encountered during the interviews. These data permit characterization of the length frequencies and weights. Similar and more extensive data were gathered in the 1986-1990 headboat survey, and other data were provided by the TPWD annual coastal sport fishing survey, TIP, and the NMFS Panama City Laboratory bioprofiles sampling. These data sources were pooled to estimate mean weights of landings by fishing mode.

The biomass of the annual recreational harvest was estimated as the sum of the products of the estimated number of red grouper harvested by mode and the estimated mean weight of the grouper harvested by that mode during the year. The mean weight of grouper for a given year was estimated as the mean weight of all grouper measured during the intercept portions of all surveys for the year (Table 39). However, if fewer than 50 individuals were measured during the year for a particular mode, then the annual mean weight for all modes was substituted for the mean weight for the mode. This convention affected the biomass estimates for shore mode fishermen each year and the other modes in occasional years.

In addition, if a large number of anglers had been selling their catch, the new requirement for a reef fish permit may have eliminated a large part of the "recreational" effort.

The MRFSS estimates include estimates of fish that were released as well as those that were harvested. Data are available for private/rental and shore mode anglers for harvest and releases from 1979 through 1990 (Table 42, Figure 24). These data show that a clearly increasing fraction of the total catch has been released over the time period, from about 3 percent in 1979 to more than 90 percent in 1990. The estimate of total catch also declined in 1990 below that of 1989 but it was about equal to the 1988 level and higher than any prior year.

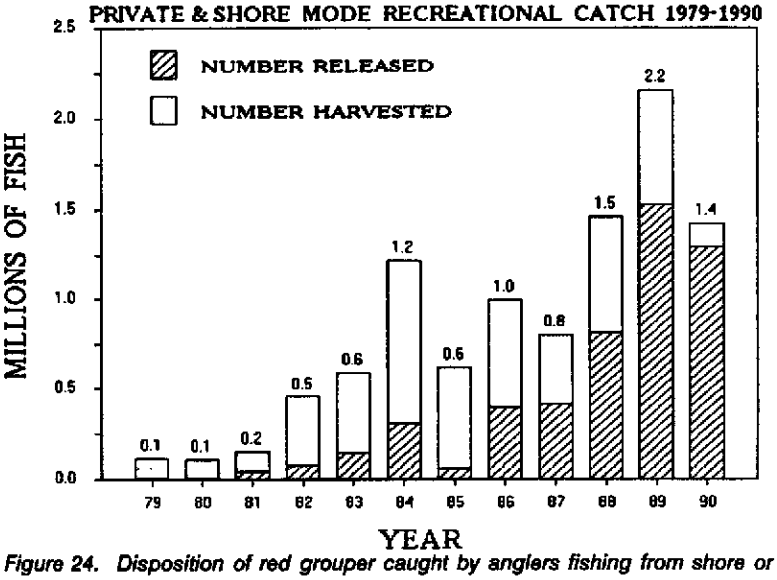

Figure 24. Disposition of red grouper caught by anglers fishing from shore or private/rental vessels, 1979-1990.

These data suggest a decrease in effort directed at red grouper in 1990 over 1989, but probably not very much of one, at least with respect to earlier years. It does not seem likely that a large part of the reduction in recreational harvest in 1990 can be explained by the permit requirement imposed by the Gulf Council in 1990.

COMBINED HARVEST

Because recreational harvest estimates are available only since 1979, it is possible to estimate the combined harvest of red grouper only for the period 1979-1990 (Figure 25). The estimate of combined harvest increased from a 1979-1980 average of about 6½ million pounds to a 1984-1985 average of almost 11 million pounds. Total landings then declined to about 6.2 million pounds in 1990.

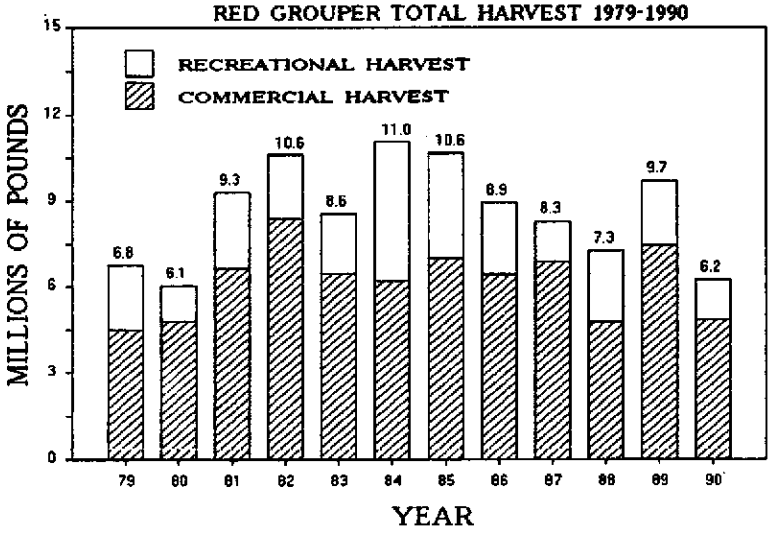

Figure 25. Estimated total harvest of red grouper from U.S. waters of the Gulf of Mexico, 1979-1990.

The decrease from 1985 to 1987 was entirely the result of a decline in the estimate for the recreational fishery, probably in response to Florida's 18-inch minimum size. The estimated 1990 combined harvest was about equal to the levels at the beginning of the time series. Both the recreational and commercial components of the

Recreational catch estimates. Red grouper harvest estimates by state, year, and distance from shore are given in Table 40. These data confirm the impression obtained from the commercial data that the red grouper fishery is primarily confined to the waters off Florida. The estimates are highly variable over the period but average about 700 thousand individuals and 2.6 million pounds from 1982-1989. The 1990 landings declined about 70 percent by number and 41 percent by weight, primarily as a result of the 20-inch minimum size.

It is also clear from Table 40 the recreational harvest occurs offshore, away from the state inshore waters. Much of the recreational harvest was in Florida's territorial sea before Florida enacted an 18-inch minimum size in July 1985 (Table 40, Figure 22). The numbers of red grouper in the recreational harvest initially declined after this measure went into effect, primarily in the territorial sea. However, the harvest recovered to about the prior average in 1989 and 1990, with almost all the growth occurring in the EEZ.

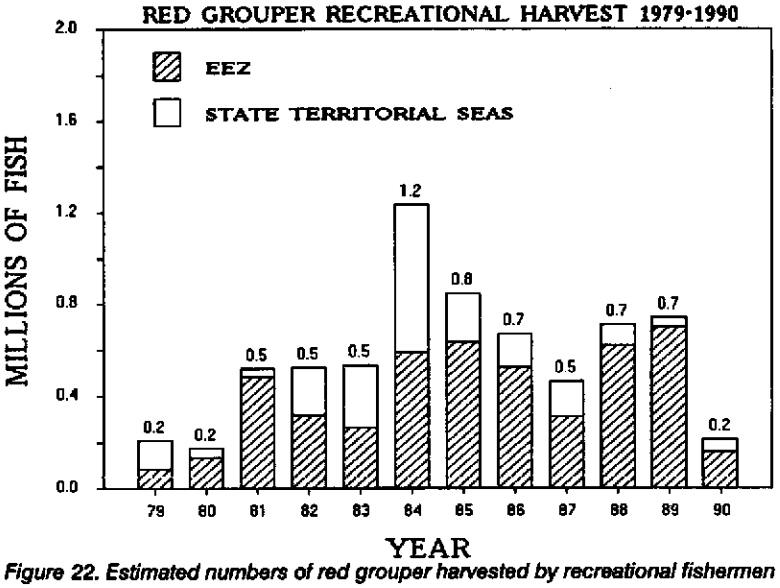

Figure 22. Estimated numbers of red grouper harvested by recreational fishermen in Florida territorial seas and the EEZ, 1979 to 1990.

As expected from the life history of red grouper, shore-based fishermen catch a small fraction of the recreational harvest (Table 41). Because of survey design, the recreational harvests from charter and party boats were combined before 1986. For most years before 1990, anglers fishing from private or rental boats accounted for most of the recreational harvest of red grouper. However, when the conservation measures adopted by the Gulf Council became effective in 1990 the private/rental component of the harvest declined sharply while the charter/partyboat harvest remained nearly constant (Figure 23). Closer inspection reveals that the partyboat sector also declined sharply while the charterboat harvest remained essentially constant in 1990 (Table 41).

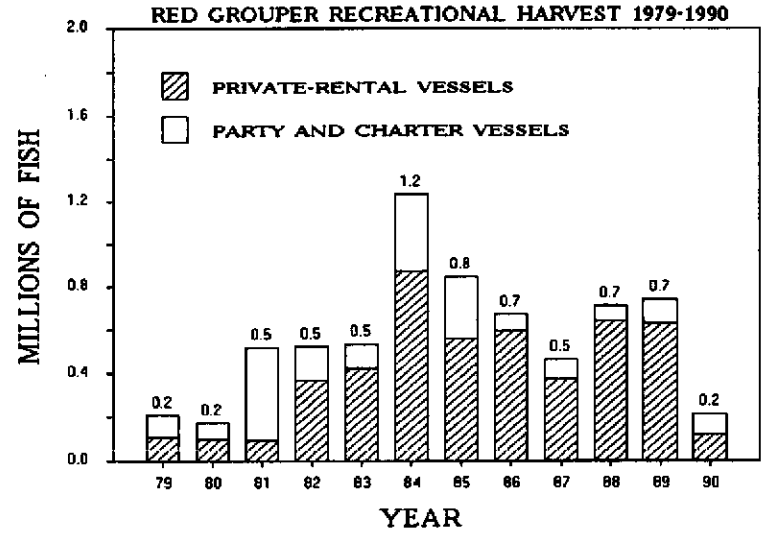

Figure 23. Estimated numbers of red grouper harvested by anglers fishing from private or rented boats and from charter or partyboats, 1979-1990.

The 1990 conservation measures may have reduced the angler harvest in several ways. The 20-inch minimum size may have required a large portion of the catch to be released, which may in turn have reduced the motivation to target the species.

1990 harvest declined from the 1989 estimate, but neither estimate declined to a level much less than had been experienced in the previous 3 years (Figure 25, Tables 2 and 40).

SEASONAL DISTRIBUTIONS

The average seasonal distributions of the commercial and recreational harvests are shown in Figure 26. The most recent year (1990) was not included in the mean for the commercial sector because of the implementation of a quota in 1990. The seasonal distribution of the recreational catch was estimated as the monthly sums of the estimated catches from the three surveys. Where an estimate for a cell spanned more than a month (as in the bimonthly waves of the MRFSS) the estimate was divided equally among the applicable months.

The commercial harvest showed a summer peak in landings but the seasonal variation in landings was not great. The recreational harvest also exhibit a summer peak and midwinter minimum. However the recreational harvest in November and December were about as high as they were in any other month.

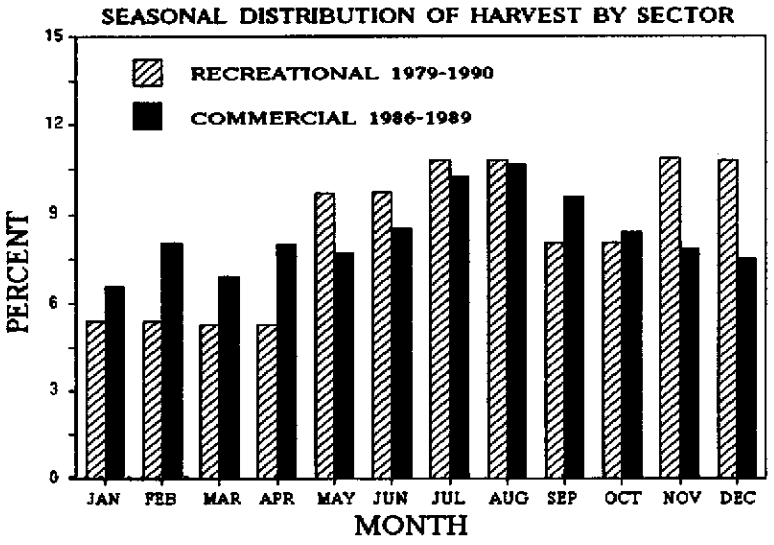

Figure 26. Average seasonal fractions of the commercial and recreational harvest of red grouper in the Gulf of Mexico.

SIZE DISTRIBUTION OF THE HARVEST

COMMERCIAL SIZE COMPOSITION.

Figure 27 is a scattergram of all length samples from the commercial fishery from 1984-1990 by day of sample. Inspection of these data reveals a significant decline in sample size that began in mid 1988 and extended through 1989. The impact of the 20-inch minimum size is also apparent from the 1990 samples.

These data and other samples taken by investigators from the NMFS Panama City Laboratory in 1980 and 1981 were used to construct length frequencies of red grouper by gear type and year of capture (Figure 28).

Red grouper sampled from trap landings are decidedly smaller on average than those sampled from the other fisheries in every year for which samples are available except 1988. Inspection of the 33 observations from traps in 1988 revealed that they were a sample from a single trip in the Florida Keys. The 20-inch minimum size caused an upward shift in the modal size of the trap catch, but red grouper below the minimum size continued to be harvested with traps. There is no indication in these data that the 1985 Florida 18-inch minimum size had any effect on the size composition of the landings.

Red grouper caught with handlines were somewhat larger than those caught with traps but were smaller than those caught with power-assisted reels or longlines from 1984-1986 (Figure 28). The 1980 and 1981 samples from handline fisheries taken by the Panama City Laboratory were larger than in subsequent years prior to the minimum size in 1990, which is clearly apparent. As with the trap fishery, there is little indication that Florida's minimum size had any effect on the size composition of the harvest.

Samples of the catch from power-assisted reels and bottom longlines were larger than with the other gears (Figure 28). These samples also reflect the impact of the 20-inchminimum size but do not indicate any effect of Florida's minimum size.

A primary reason for inspection of these data is to identify the most reasonable way to aggregate the data to estimate the size composition of the harvest. If the samples from the fishery were simple (adequate) random samples of the catch, then they could be used directly to estimate the size composition of the catch. Unfortunately, such is not the case (Table 44).

It is clear from Figure 28 that true handline gear catch a different size distribution of red grouper than do power-assisted reels. Unfortunately, in the landings files handlines and power-assisted gears are reported under a single gear

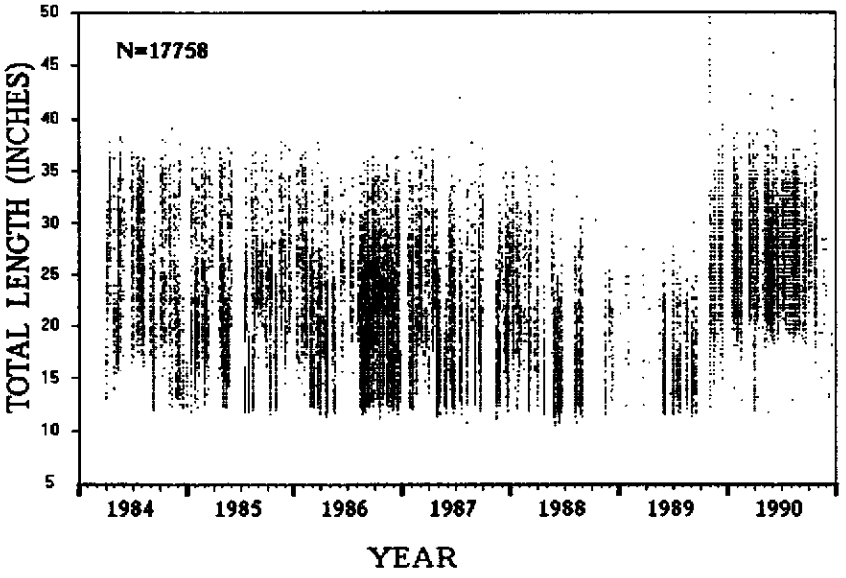

Figure 27. Scattergram of length samples from the commercial fishery for red grouper, 1984-1990.

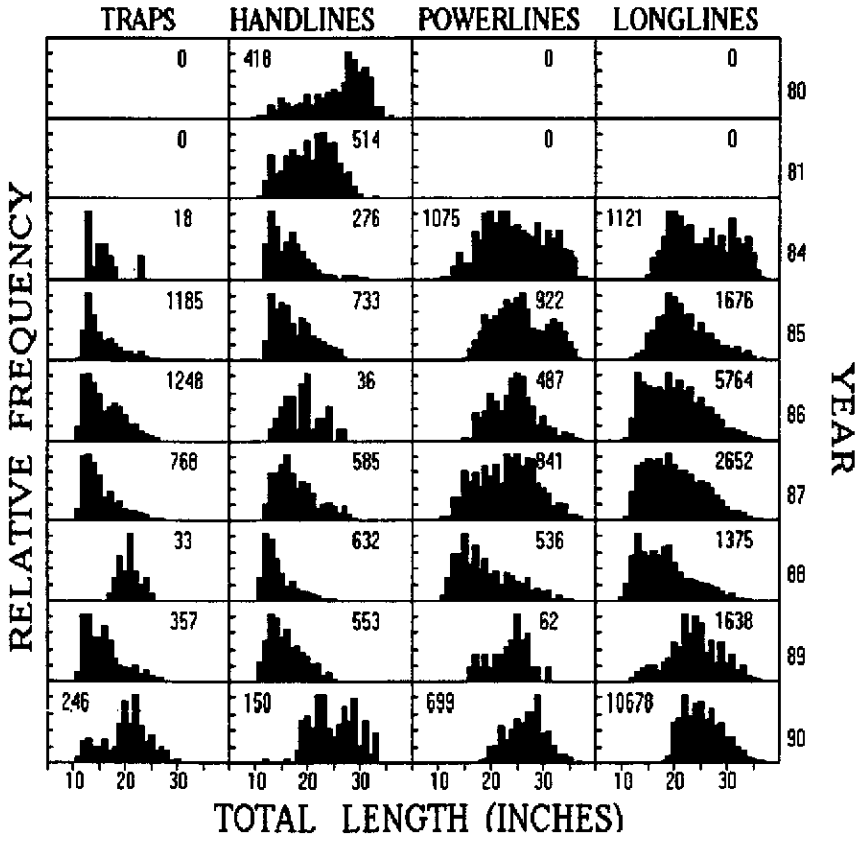

Figure 28. Length frequencies of red grouper from commercial gears 1980-1990.

code (610), and we must, therefore, estimate the length frequency for the combined catch for these two gears. Consequently, we sought a way to stratify the observations so that we could develop an estimate of the length frequency of the harvest from some weighted combination of gear/area strata which would accurately reflect the total harvest.

Tables 45-55 present summaries of the number of length observations by year, gear, location of capture, and county of landing.

The length frequencies of the samples by location of capture are presented in Figure 29 and by location of landing in Figure 30. The samples by county (Figure 30) clearly reflect the paucity of effort in 1989 and the lack of effort directed at the catch from Charlotte to Collier counties.

The samples arranged by area of capture (Figure 29) provide more complete coverage, but still retain disproportionate representation by gear (Tables 51-55)

This information lead us to stratify the samples by gear and area of capture, which we believe to be the best compromise with the available data. Although the effect of this convention on the estimate of the length frequency of harvest is uncertain, we feel the estimate to be reasonable.

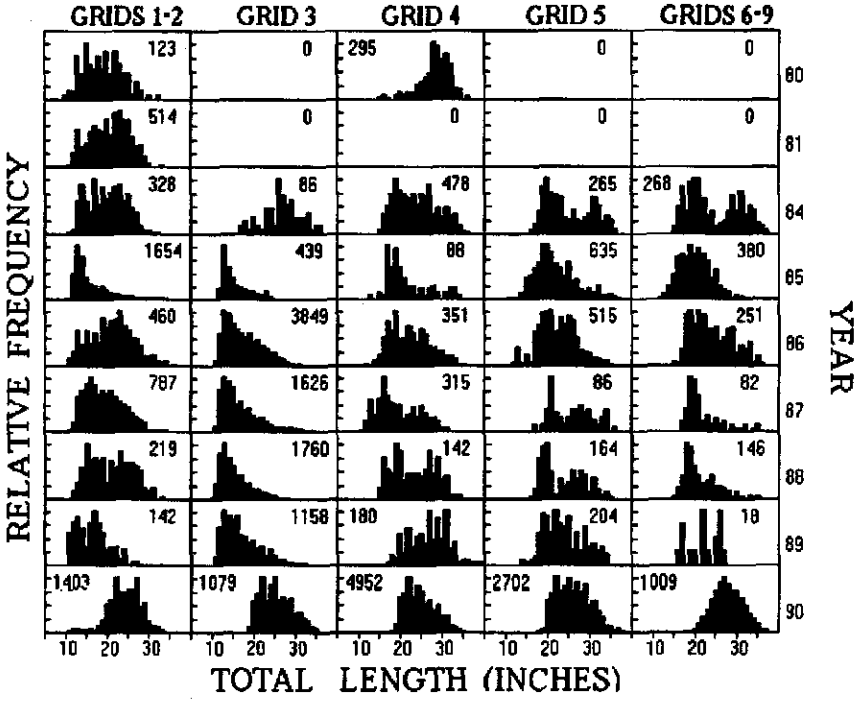

Figure 29. Length frequencies of commercial red grouper landings by area where they were caught, 1980-1990.

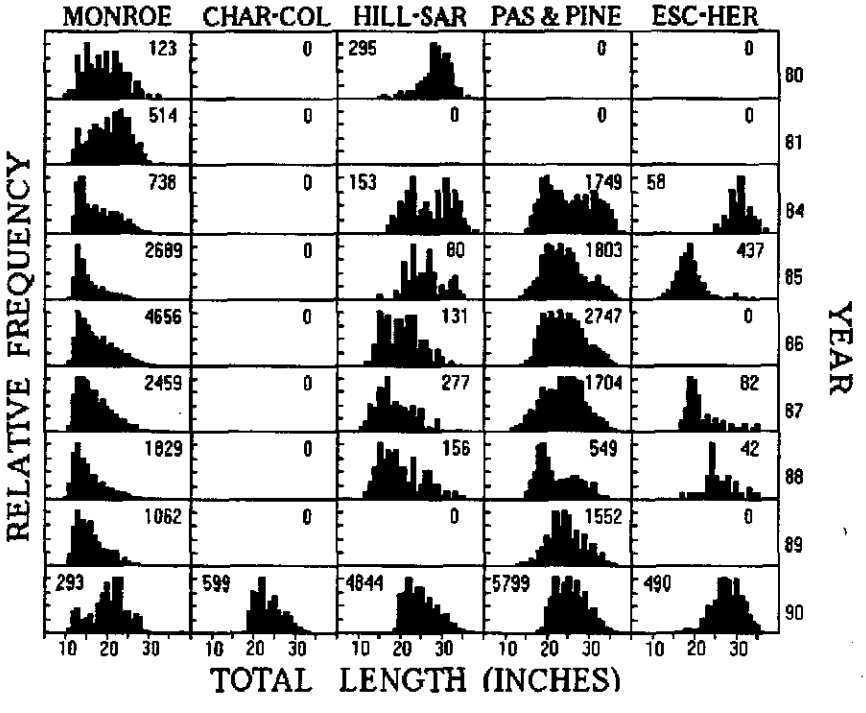

Figure 30. Length frequencies of commercial red grouper catches by counties where they were landed, 1980-1990.

RECREATIONAL SIZE COMPOSITION.

Figure 31 is a scattergram of all length samples from the commercial fishery from 1979-1990 by day of sample. Inspection of these data reveals a gradual increase in sample size through the years. An important part of the increase was the result of the institution of the headboat survey in the Gulf in 1986. As with the commercial data there is a clear signal of the impact of the 20 minimum size in the 1990 samples. There is also a drop in the sample size in the latter half of 1985 that might indicate a response to Florida's 1985 18-inch minimum size.

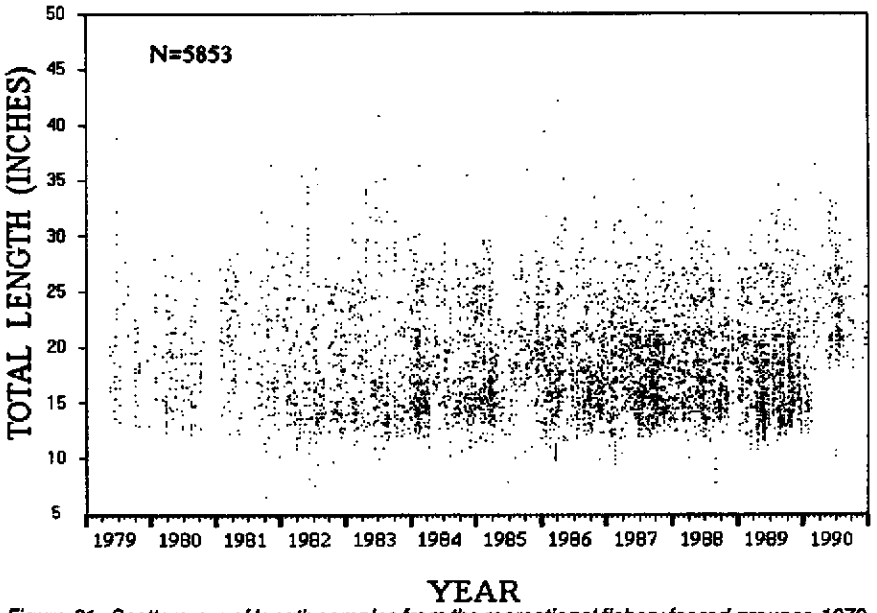

Figure 31. Scattergram of length samples from the recreational fishery for red grouper, 1979-1990.

Inspection of annual variation in the length frequencies of red grouper sampled by mode indicate a mode of 12-15 inches for headboats from 1982 to 1989 with a pronounced shift to a mode of about 20 inches in 1990 (Figure 32). Shore mode samples show no particular pattern and are relatively rare, as expected from the life history of the species. Samples from charterboats are also quite sparse but fairly similar to the headboat samples from 1986-1989. The 1990 sample of the charter catch is very small but clearly reflects the 1990 minimum size. The length frequencies from the private/rental mode follow similar trends.

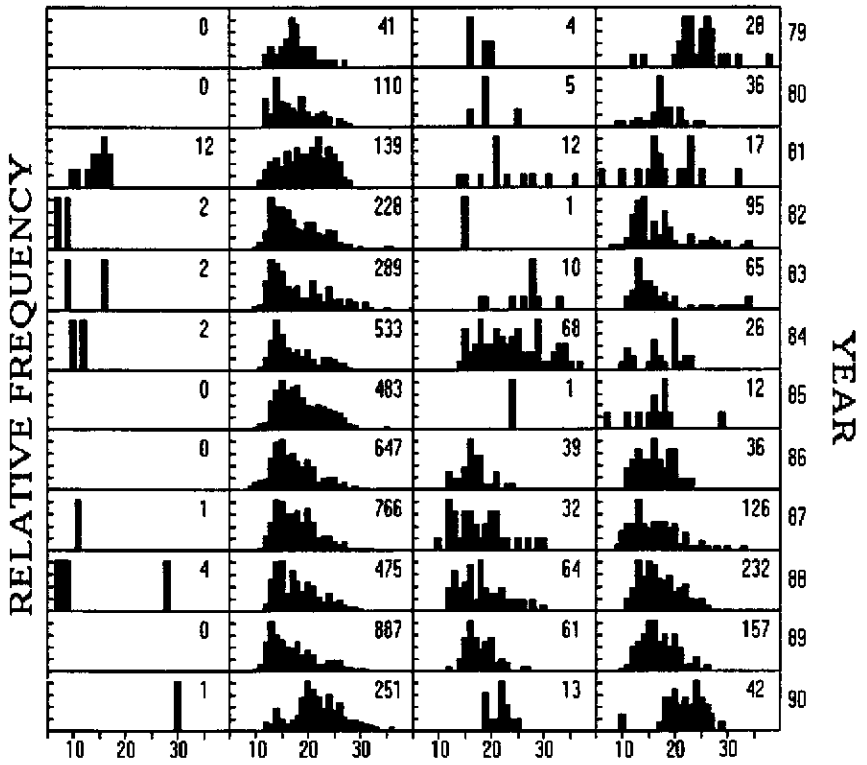

Figure 32. Length frequencies of the recreational harvest of red grouper by fishing mode, 1979-1990.

The length frequencies of the recreational harvest by mode and area summed over years is given in Figure 33. These

data also reflect the scarcity of observations in the western Gulf of Mexico. All of the six observations from west of Alabama were from anglers fishing from private vessels in Texas.

The paucity of intercepts of red grouper in interviews with shorebound fishermen in both Figures 32 and 33 reflects the preference of red grouper for the deeper waters offshore. It is possible that some of these records for shorebound fishermen may reflect data entry errors rather than actual observations of red groupers harvested by anglers fishing from shoreline structures.

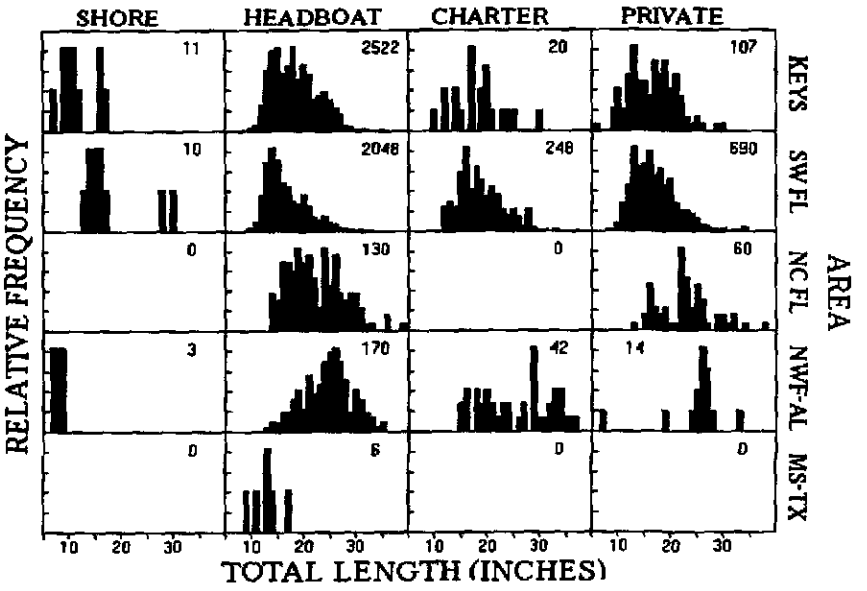

Figure 33. Length frequencies of the recreational harvest of red grouper by fishing mode and area summed across the years 1979-1990.

There is a trend of increasing average size of red grouper harvested by anglers as one moves northward along Florida's west coast (Figure 33). This trend is most apparent in samples from the headboat fishery but is also evident in samples from anglers fishing from charter boats and from private or rental craft (Figure 33).

The length frequencies of red grouper sampled from the recreational harvest by fishing area and year are given in Figure 34. These data suggest that the trend of increased mean size in the more northerly areas was present at least as long ago as the late 1970s. This trend, which was also apparent in the commercial landings, suggests small red grouper are comparably more scarce in the northern part of the fishery.

Recalling the north-south movement pattern (Rivas 1970) and the tendency for larger fish to move further

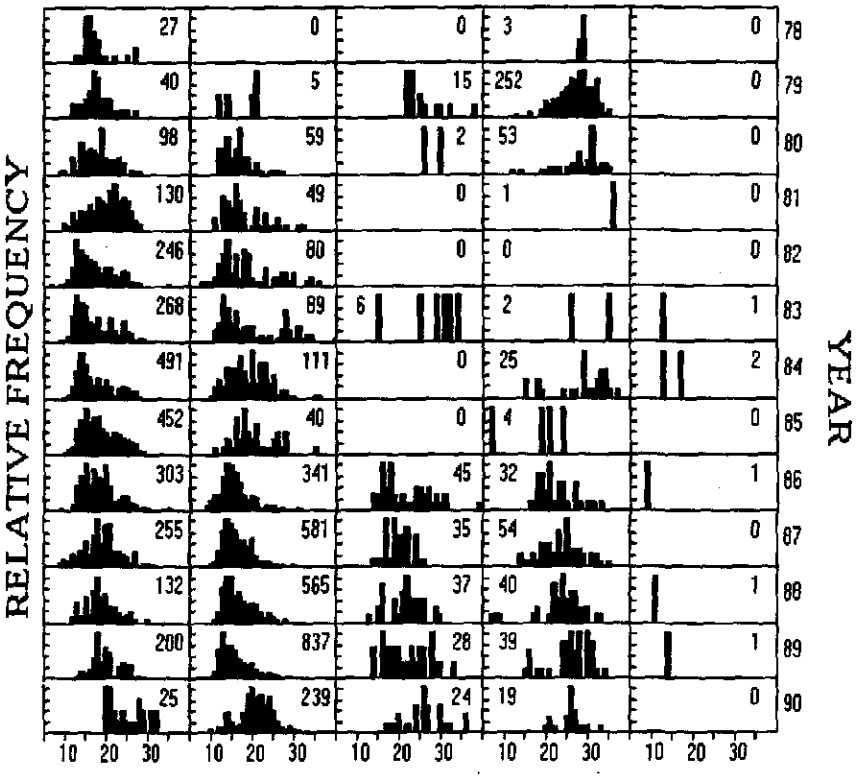

Figure 34. Length frequencies of the recreational harvest of red grouper by area and year, 1979-1990.

than small fish (Moe 1969), it is reasonable that the harvest of red grouper in the northerly part of their range in the eastern Gulf of Mexico is dependent on emigration from a center of abundance to the south. If this is the case, then one of the more important effects of overfishing would be to greatly reduce the catch north of the Tampa-St. Petersburg area.

As with the samples from the commercial harvest, a primary reason for examining these distributions is to identify the most reasonable way to aggregate the data to estimate the size composition of the harvest. Several constraints are imposed by the headboat and MRFSS catch estimates. First, while the length samples have been collected in specific locations and clearly indicate that there is south-north cline in size, the catch estimates must aggregate samples within strata.
The design of MRFSS provides inshore-offshore resolution within states but is not designed to provide catch estimates along the coastline of a state. Consequently, the finest spatial (along-shore) resolution of the catch estimates from MRFSS are by state. The headboat catch estimates are available by areas that correspond to the regions depicted in Figures 33 and 34. After review of the spatial variability of the length-frequency data and the constraints imposed by the catch estimates, we elected to partition the annual recreational catch by mode. The lengths of the catches in these partitions were apportioned according to the corresponding sample length frequencies unless fewer than 50 samples were available. In such cases, the lengths of the catches in the partition were estimated from all samples for the year.

LENGTH DISTRIBUTION FOR THE COMBINED HARVEST

Because commercial grouper data are separated to species only since 1986 and because the headboat survey sampling was expanded to include the Gulf of Mexico in 1986, we chose to restrict our analysis to 1986-1990. The resulting estimates of the length frequencies are presented in Figure 35 and Table 56. These clearly show the propensity for commercial fishermen to harvest red grouper that have an average larger size than those harvested by recreational fishermen. They also clearly show the effect of the 20-inch minimum size in 1990.

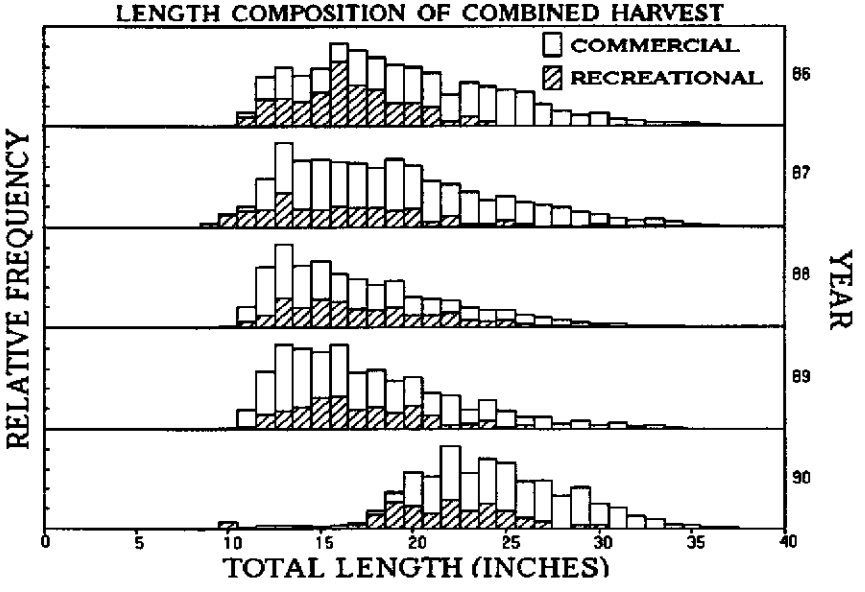

Figure 35. Estimated length composition of the recreational and commercial harvest of Gulf of Mexico red grouper, 1986-1990.

FISHING MORTALITY

AGE DISTRIBUTION OF THE HARVEST.

We estimated the 1986-1990 age composition of the harvest using Moe's (1969) growth model and the growth model derived from the data of Burton and Stiles (1991) by assigning ages from lengths using the appropriate inverted von Bertalanffy equations (Tables 57 and 58). Because of the obvious disparity of the results obtained with the two models we elected not to attempt application of cohort methods for this stock until we have either actual (representative) age samples from the fishery or until the details of red grouper growth are understood.

ESTIMATES OF MORTALITY

Instead, we applied catch curve analysis (Robson and Chapman 1961) to contrast the results from the two models in Figures 36 and 37. Because of the shift in the size composition of the harvest in 1990, we estimate the mortalities for the average of 1986-1989 and 1990 separately. We cannot ascertain from the available data if the assumptions required for the analysis are met.

The estimate of total mortality derived assuming Moe's model for growth is about Z=0.27 for both periods. We doubt the validity of these estimates. Moe estimated total mortality to be about 0.32 in the 1960s using estimates of the actual age composition of the harvest. Annual commercial grouper landings in Florida increased from a 1962-1966 average of about 6.9 million pounds to a 1985-1989 average of about 9.3 million pounds, an increase of about 35 percent. The recreational harvest probably increased even more during the same period. It is unlikely that total mortality declined as the harvest of red grouper increased.

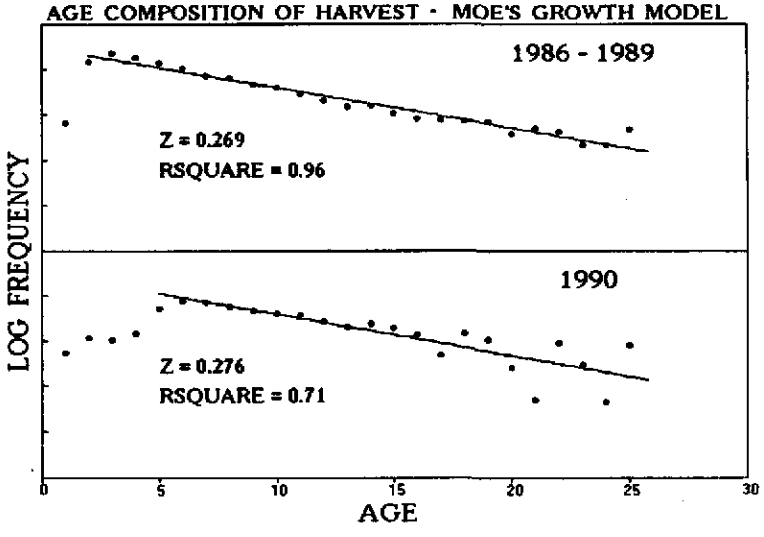

Figure 36. Estimated age distributions of the 1986-1989 average and the 1990 red grouper harvest using the growth model of Moe (1969) and the corresponding estimates of total mortality.

The estimate of total mortality derived from the length composition of the harvest using the Burton and Stiles model for growth is about Z=0.4 for both 1986-1989 and 1990. If natural mortality is on the order of 0.2 and Moe's 1969 estimate is accurate, then these results would indicate fishing mortality increased about 60 percent from 0.12 to 0.2 since the early 1960s. We don't feel that these estimates are unreasonable, but emphasize the uncertainty associated with application of this growth model, which was developed from red grouper sampled from the Atlantic rather than from the Gulf of Mexico. If growth is truly as plastic as the observations indicate, then it is likely that the current sizes of red grouper at age in the Gulf of Mexico are different than those in the Atlantic. If the small sample we obtained from the University of South Alabama (See Figure 5) is representative then sizes at age are somewhat larger than those used by Burton and Stiles. In terms of the present analysis this would raise the estimate of total mortality.

If, as we suspect, the observed difference in growth between the two times and areas involved in the studies is a part of the compensatory response of the population to changes in density then it represents a fundamental change in the nature of the population. Further, the growth characteristic of the population would persist as long as the population level remains constant. The importance of this point is that the cause of the major variation in growth is a functional response to population density and not a random function of its environment. If true, this notion implies that the change in growth between the unfished and fished state would be a smooth transition as the population declined from the increased mortality from fishing.

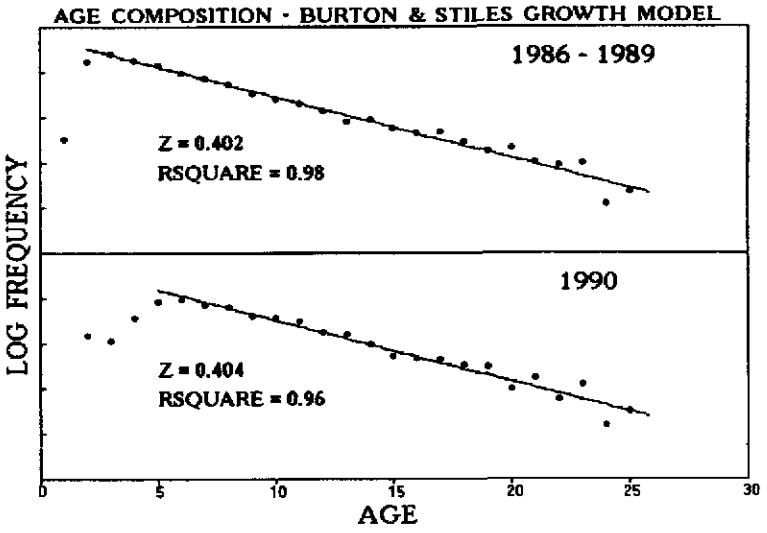

Figure 37. Estimated age distributions of the 1986-1989 average and the 1990 red grouper harvest using the growth model of Burton and Stiles (1990) and the corresponding estimates of total mortality.

One point that is apparent from the results of these analyses is that the slope of the catch curve did not change when the fishery was restricted to 20-inch or larger red grouper in 1990, regardless of which growth model was assumed. This finding supports the notion that prior to 1990, fishing mortality had been evenly distributed over the entire age structure of the stock after about age 3. The effect of the size limit, which increased the harvest of older fish, has not yet had time to alter the relative age distribution in the stock and consequently would not be apparent in the data even if we knew the appropriate growth model for the population. We anticipate that the total mortality will decline in the pre-recruits but will increase in the older fish. However the extent of the decline in mortality in fish below the minimum size will be compromised by the release mortality.

It is noteworthy that future assessments will be unable to use fishery-dependent methods to assess fishing-induced mortality for the undersized fish from the age composition of the catch. Consequently, it may prove difficult to evaluate the actual benefit of the minimum size unless a much more intense and sophisticated data collection program is instituted to monitor the age distribution of the stock and harvest.

MANAGEMENT ALTERNATIVES

The interpretation of the meaning of the mortality estimates arising from these analyses depends upon their magnitude relative to those levels that would maximize long-term yield from the population. This notion is incorporated in the commonly employed management objective of maximum sustainable yield (MSY). Simply put, the theoretical absolute maximum of sustainable yield is obtained by maximizing the biomass harvest of the recruits produced by a spawning stock that is itself producing the maximum number of recruits in excess of those required to replace itself. This would be obtained by harvesting all of the excess recruits at the instant they attained their greatest bulk, where growth is exactly offset by natural mortality (Ricker's critical size, 1975). Because of the obvious constraints imposed by fishing technology, it is not possible to conduct a fishery in this manner.

The biomass harvest of the recruits is a function of growth and mortality of the recruits and is often evaluated through yield-per-recruit analyses. In contrast, the determination of stock levels that produce the maximum numbers of excess recruits is a function of the stock-recruit relationship. Thus, the notion of MSY combines the concept of yield per recruit and stock and recruitment.

When growth rates are constant, yield per recruit is simple to evaluate given knowledge of growth and natural mortality; however, the vagaries imposed by the typically poorly understood spawner-recruit relationship present formidable obstacles to the reliable estimation of MSY. However, under constant physical and biological environmental conditions, yield per recruit and recruitment are both functions of fishing mortality. As a consequence, sustainable harvest can be described as a function of fishing mortality (or effort), and if sufficient data exist MSY can be directly estimated from the data. Notably, environmental conditions are rarely constant, and lacking real knowledge of the underlying processes the fitted estimates are always uncertain. These considerations and experiences with the dangers to reproductive potential associated with the high harvest rates required for maximizing yield have led to recommendations for the abandonment of MSY as a management objective altogether (Larkin 1979).

Nonetheless, the notion of maximizing long-term biological or economic yield is a credible management objective. As noted above, the characterization of harvest strategies to achieve this objective consists of two separable tasks. The first is directed at maximizing the yield from the excess recruits, and the second is directed at maintaining the stock for the future. We address the first of these two issues through analysis of yield per recruit and the second through evaluations of the effect of fishing on equilibrium levels of SPR.

Given the uncertainty associated with the sensitivity of the reproductive strategy of this species to overfishing we feel that SPR should be maintained well above the 20% minimum adopted by the Gulf Council in its definition of overfishing. In the following two sections of this document the recent levels of fishing mortality are contrasted with those rates that are compatible with the objectives of obtaining the maximum harvest with the least impact on the spawning potential of the stock.

ESTIMATES OF $F_{0.1}$ and F_{max}

$F_{0.1}$ and F_{max} are often employed as biological reference points for fisheries management. Both have implications for both maximizing yield and maintaining the spawning potential of the stock (Sissenwine and Shepherd 1987). F_{max} is the fishing mortality rate at which yield from given a recruitment is maximum. $F_{0.1}$ is defined as the fishing mortality rate that corresponds to a point on the yield-per-recruit curve where the slope is 10 percent of the slope at the origin (Gulland and Boerema 1973). Sissenwine and Shepherd (1987) noted that the relation of $F_{0.1}$ to the size of the reproductive stock and maintenance of future recruitment is speculative. However, it remains as one of the more important of the traditional tools used both to assess the implications of alternative fishing mortality schedules and to establish conservation standards aimed at ensuring the persistence of stocks.

Estimates of $F_{0.1}$ and F_{max} were developed for this assessment based on the distribution of fishing mortality before and after the implementation of the 20-inch minimum size (Figures 38 and 39). Both are based upon the Ricker (1975) method for computing yield per recruit. Computations were carried out via a computer program available from the authors (FO1, Goodyear 1989). The estimates of $F_{0.1}$ and F_{max} reported by this program are the fishing mortality rates for the fully vulnerable age classes and do not represent the average fishing mortality for all ages unless all ages are equally vulnerable to fishing. Since the spawning potential ratio varies over the same parameter space we also preset curves of the spawning potential ratio (SPR) in these two figures. As noted earlier because of the ambiguities associated with the reproductive strategy of red grouper we estimate SPR as the ratio of the fished to unfished biomass of the spawners rather than fecundities.

The data of Figure 38 indicates that the pre-1990 age distribution of fishing mortality was at a level between $F_{0.1}$ and F_{max}, and SPR was between 20 and 30 percent.

The analyses presented in Figure 39 assumes no fishing induced mortality for red grouper below the minimum size. Under this condition the estimates of $F_{0.1}$ and F_{max} were 0.19 and 0.59 which produced SPR values of about 40 and 19 percent respectively. Yields are slightly higher for the 20-inch minimum size. SPR at $F_{0.1}$ is also slightly higher and occurs at a value of fishing mortality only slightly below preset levels. If release mortality can be ignored and the allocation between commercial and recreational interests is not an issue then the 20-inch minimum size is clearly a benefit both for the condition of the stock and the yield it produces.

However, we have evidence from one study (R. Wilson, personal communication) that 29 percent of a sample of red grouper caught by hook and line from a depth of 44 M did not survive the experience. Further we have been informed (repeatedly) by a number of sources that large numbers of undersized fish are being caught and that a significant fraction of these fish are killed. We evaluate the effect of this mortality in the following sections.

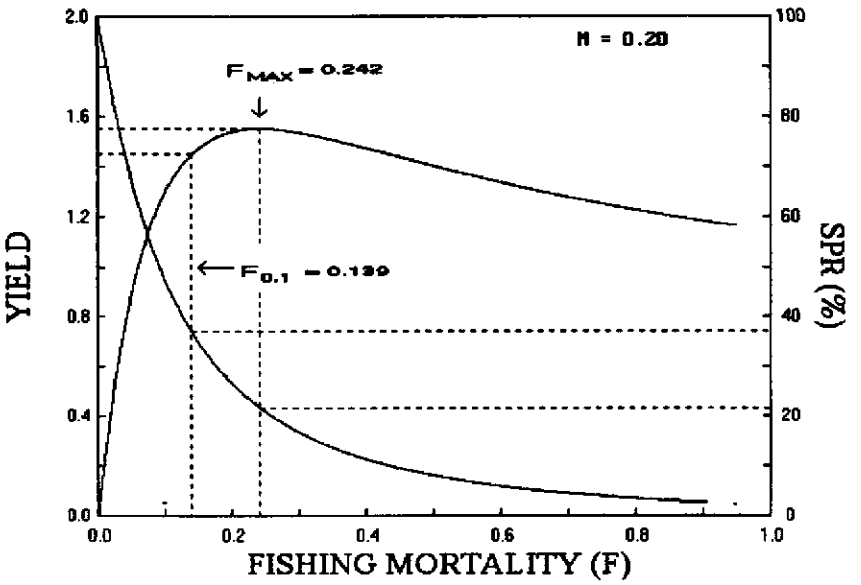

Figure 38. Estimates of $F_{0.1}$ and F_{max} and the ratio of fished to unfished spawning stock biomass per recruit for red grouper assuming 1986-1989 average vulnerabilities at age before the 20 inch minimum size was instituted.

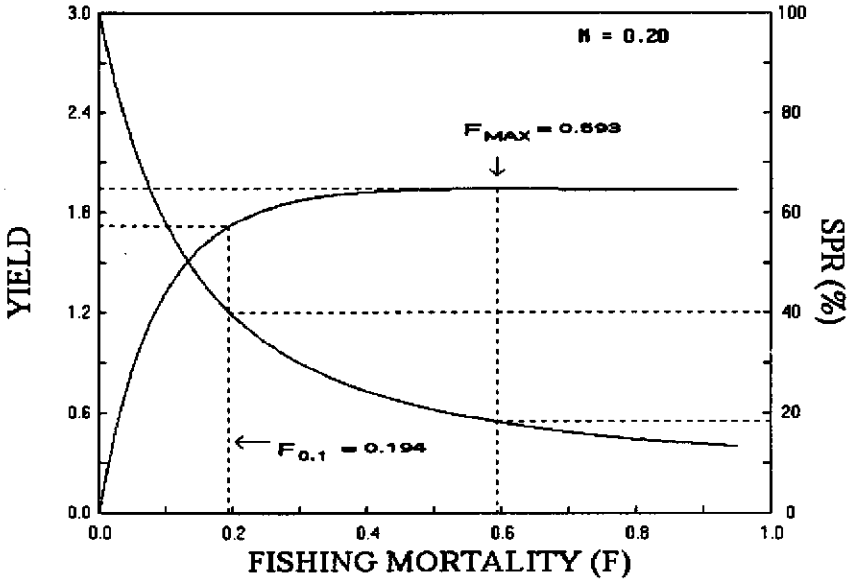

Figure 39. Estimates of $F_{0.1}$ and F_{max} and the ratio of fished to unfished spawning stock biomass per recruit for red grouper assuming 1986-1989 average vulnerabilities at age and a 20 inch minimum size.

ALTERNATIVE MINIMUM SIZES

Yield computations. Yield-per-recruit calculations utilized the Beverton and Holt yield model (Ricker 1975). Age at entry to the fishery was estimated from the minimum size, and survival from the minimum size vulnerable to the fishery was modified to reflect the mortality suffered by undersized fish that are released upon capture (Waters and Huntsman 1986). The rate of capture of the undersized fish was assumed to be the same as the rate of capture of fully recruited fish in the analysis.

Yield was evaluated for fishing mortality rates from 0 to 1.0 and for minimum sizes from 10 to 35 inches. The results are presented as isopleths of constant yield over the range of minimum sizes and fishing mortalities examined. Isopleths were plotted for 25%, 50%, 75%, 90%, 95%, and 99% of the maximum obtainable within the parameter space examined. These isopleths can be identified as they decrease monotonically from the innermost isopleth which is at 99% of the maximum yield per recruit.with increasing minimum sizes above about 20 inches at fishing mortalities of about 0.9.

Based on the observed length frequencies in the existing red grouper fishery, the fish were assumed to be vulnerable to the fishery beginning at about 10 inches total length. Growth parameters were from Figure 9 with the maximum weight (W_∞) estimated from L_∞ using the length-weight relation. Natural mortality (M) was assumed to be 0.20 (Bannerot 1984). The fish were assumed to be vulnerable to capture throughout their lifespan. $F_{0.1}$ and F_{max} were also evaluated for the parameter space.

Spawning potential. SPR (as defined above) was evaluated over the same range of minimum sizes and fishing mortalities examined in the yield-per- recruit analyses. The results are plotted as isopleths corresponding to SPRs of 1%, 5%, 10%, 20%, and 30% of the unfished level. These isopleths can be identified as the lines forming the boundaries of the shaded areas. The lower right such contour is for SPR equal to 1 percent of the unfished level. Areas below and to the right of this contour represent combinations of fishing mortality and lengths at recruitment that reduce SPR below 1 percent. The other SPR isopleths are for SPR equal to 5, 10, 20 and 30 percent (going from the lower right to the upper left).

Results. Yield and SPR were evaluated for release mortality rates for undersized fish of 0, 0.2 and 0.33 (Figures 40, 41 and 42, respectively). If the kill of undersized fish can be avoided then biomass yield could be maximized by delaying harvest until the fish reach about 22 to 23 inches total length and then fishing them heavily (Figure 40). However, if discard mortality cannot be avoided then delaying harvest until the fish achieve 20 inches may reduce harvest on a per recruit basis (Figures 41 and 42). At the higher release mortality the optimum minimum size and fishing

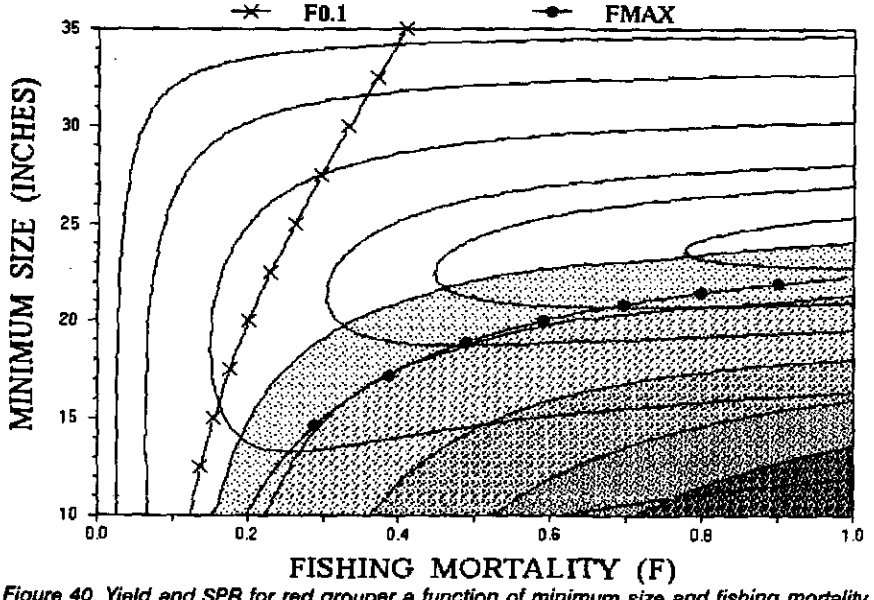

Figure 40. Yield and SPR for red grouper a function of minimum size and fishing mortality (F) assuming no release mortality.

mortality both declined. These results suggest that management for maximum yield per recruit through minimum size regulations must account for existing fishing mortality in setting size limits or somehow control the underlying fishing mortality rate.

SPR was estimated to exceed 25% at maximum yield per recruit, regardless of release mortality (Figures 40 - 42). However, it is clear that the protection afforded the spawning stock by minimum size regulations rapidly disappears as the mortality of released fish rises. Significant release mortality would seriously impair use of minimum sizes to maintain SSR at fishing mortality rates much above 0.5

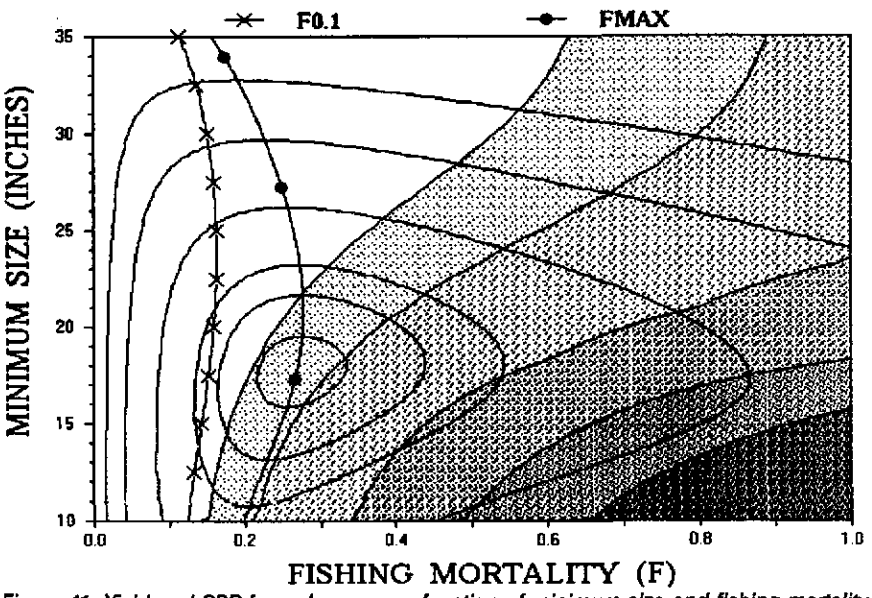

Figure 41. Yield and SPR for red grouper a function of minimum size and fishing mortality (F) assuming a release mortality of 0.20.

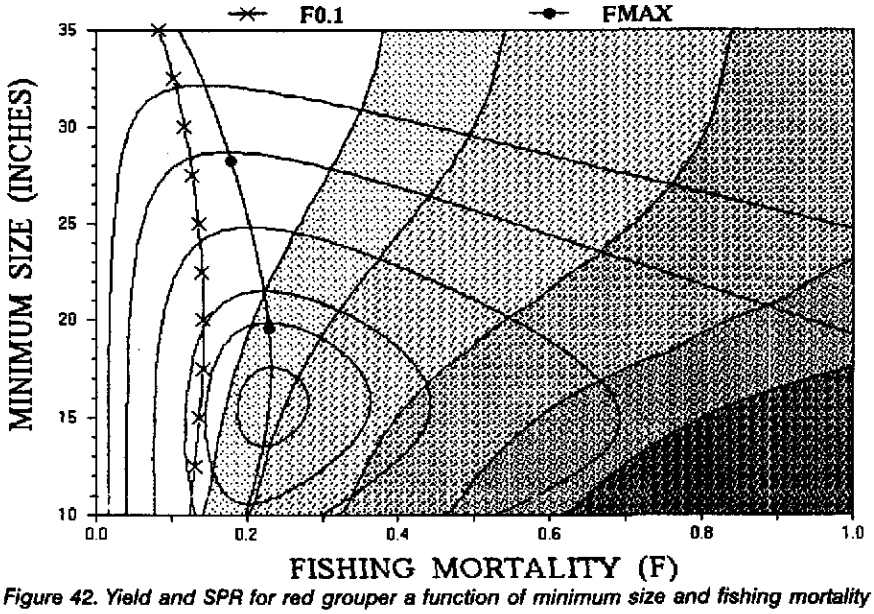

Figure 42. Yield and SPR for red grouper a function of minimum size and fishing mortality (F) assuming a release mortality of 0.33.

CATCH LIMITS

Quotas. The commercial landings of red grouper were limited by a quota in 1990. The original intent of the quota was to reduce fishing mortality by 20 percent. As noted earlier the 1990 commercial catch of red grouper was actually greater than that in 1988 but it was reduced by 21 percent from the 1988-1989 average. Although this reduction is very near the target level the reduction in fishing mortality which includes the discard mortality was probably less than 20 percent. We noted from a shift in the spatial distributions of the length-frequency samples, that commercial fishing effort appeared to have shifted into deeper waters in an attempt to avoid undersized fish. However, they still apparently caught large numbers of red grouper less than the 20-inch minimum size. Significant numbers of these fish probably died from the experience but were not landed as a part of the quota.

We use simulation techniques to evaluate the importance of the discards (LSIM, Goodyear 1989). Mortality rates were taken from the catch curve assuming natural mortality to be 0.2. Equilibrium SPR for the 1989 conditions was estimated to be 0.28. We evaluated the relative impact of 16-inch and 20-inch

minimum sizes for discard mortality rates of 0, 0.2 and 0.33 for assumed quota management for both the recreational and commercial sectors.

If the discard (release) mortality is negligible then the 20-inch minimum size is clearly superior to the 16-inch minimum. However if it exceeds about 20 percent, then SPR could be raised by lowering the minimum size. If it is about 1/3, then yield per recruit would be maximized with fishing mortality at about the estimated present level (0.2) but at a minimum size of about 16 inches. Thus, the conservation effect of quota management for red grouper could be enhanced by lowering the minimum size.

However, a lower minimum size would possibly jeopardize the status of the other grouper species because of their larger maximum sizes. This problem might be avoided if a practical scheme could be developed to manage this species separately.

Creel limits. The evaluation of creel limits requires knowledge of the average number of red grouper caught per fisherman in the absence of regulation. The evaluation of the possible effect of the imposition of a creel limit is based upon both the estimated size of the red grouper population and the cumulative frequency distribution of catch per angler. The cumulative frequency distribution (CFD) of catch per angler from the headboat fishery is given in Figure 43 for 1986-1990. Except for 1986 a relatively small part of the harvest by headboat patrons was associated with catches of more than a very few fish per angler. The 1986 estimates include two trips with very high catches per angler which may or may not be have biased the estimate of the distribution for that year. There is a slight downward shift evident in 1990 which may reflect discards from the size limit. It is unclear whether the 1990 5-fish creel limit had any significant effect on the headboat catch.

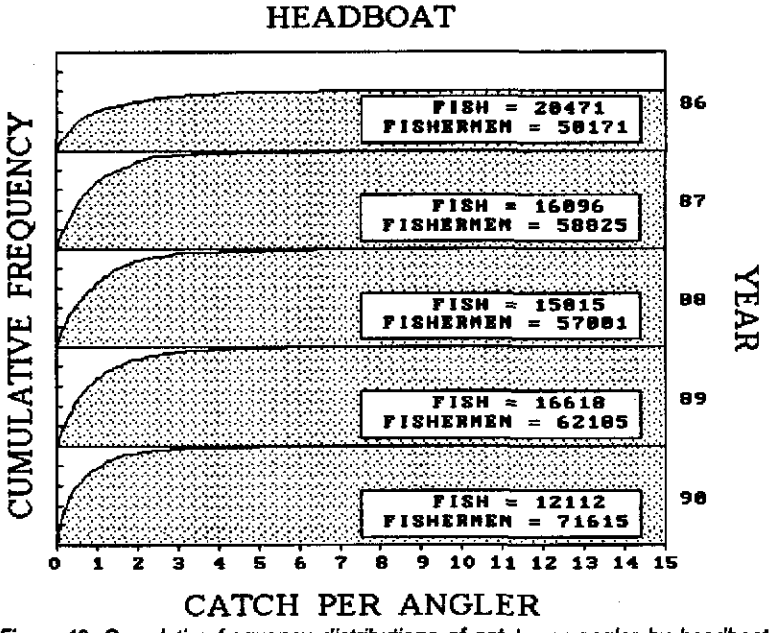

Figure 43. Cumulative frequency distributions of catch per angler by headboat patrons, 1986-1990.

Similar data for the charter boat patrons is presented in Figure 44 and for anglers fishing from private and rental craft in Figure 45. These data are based on all fish caught, including those released. The 1986-1988 catches by the charter boat patrons and those by the private/rental group were estimated from the MRFSS. The 1989-1990 charter boat estimates are from the NMFS Panama City Laboratories charter boat survey. Except for the obvious expansion of sample size, the charter boat data from the two surveys are remarkably similar. In contrast to the headboat data which indicate lower catch frequency the CFDs for the private and charter modes are quite similar.

There is also not an obvious change in the CFDs of the estimated catches with time. However inspection of the data clearly shows the impact of the 5-fish creel limit in 1990, and as we noted before there was a large increase in the proportion of the catch which was reported to have been released in 1990 (Figure 24). We cannot tell from these data whether they are being released in response to the creel limit or size limit. However many fish were already being reported as releases before the regulations of Amendment 1

were put into place in 1990.

Amendment 1 to the Reef Fish Management Plan (GMFMC 1989) adopted a 5-fish creel limit. Given the pooled 1986-1989 CFDs of Figures 44 and 45, this creel limit would be expected to reduce the recreational catch about 22 percent if effort remained constant and fish were released for no other reason (Figure 46). The estimate developed in Figure 46 is the maximum impact of a 5-fish creel limit that might be expected if the creel limit consisted only of red grouper. Since the limit is an aggregate, anglers can fill the limit before catching 5 red grouper. Consequently, the maximum potential effect of the bag limit might be somewhat greater than these analyses indicate.

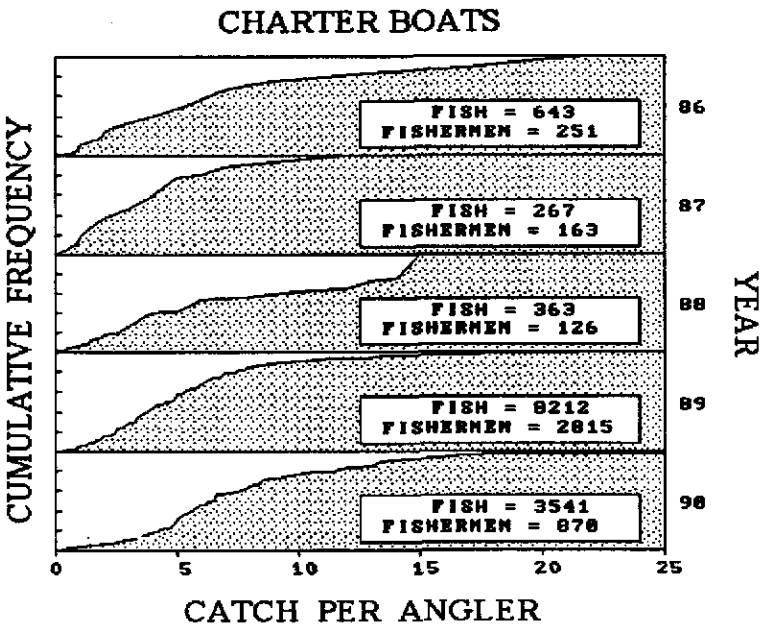

Figure 44. Cumulative frequency distributions of catch per angler by charter boat patrons, 1986-1990.

On the other hand many fish have been released for reasons that are not apparent from the data and the inclusion of these fish in the CFD raises the estimate of the number of fish which would be spared by a creel limit. Further it is assumed here that fishermen would stop fishing for grouper once they achieve their limit; i.e., there is no discard mortality for fish attributable to the creel limit.

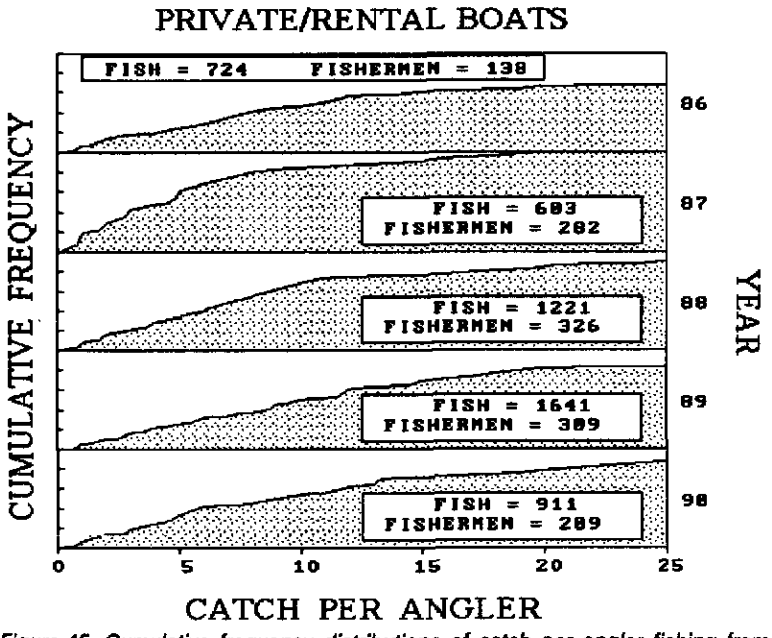

Figure 45. Cumulative frequency distributions of catch per angler fishing from private/rental craft 1986-1990.

The influence of any creel limit on fishing mortality is directly associated with both the size of the limit and the size of the catchable stock. This is illustrated in Figure 47 which is constructed from the same set of pooled data as used with the analysis depicted in Figure 46. These analyses assume a baseline catchable stock equal to the 1987-1989 average using the method presented by Goodyear (1989). They also depict the maximum impact of the creel limit in the absence of other considerations.

These projections are only approximate because they assume no change in effort associated with changing stock size or creel limits or growth in the number of anglers. They also neglect the potential catches by anglers who participated in the 1987-1989 fishery but did not catch fish because of the low stock size. Nonetheless, they serve to illustrate the importance of the size of the stock, particularly as it falls below the levels which existed when the 1987-1989 CFD was estimated. A more sophisticated model could possibly be constructed, but the uncertainties associated with the future behavior of fishermen make even the appraisal of the accuracy of predictions problematical.

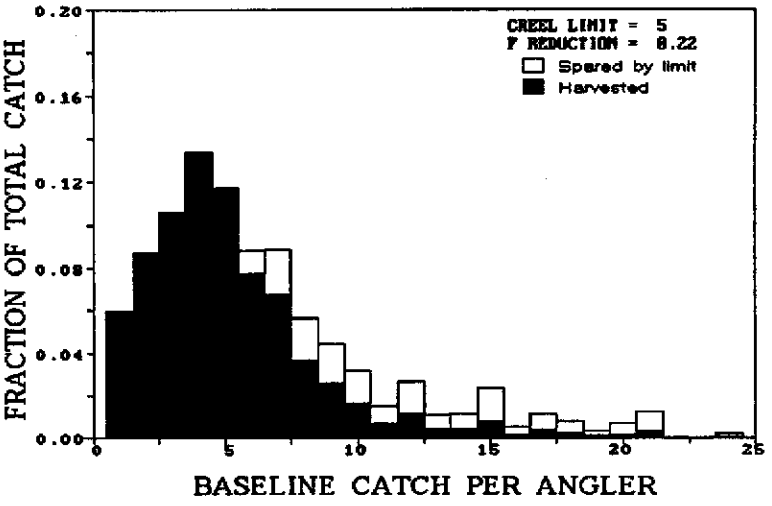

Figure 46. Potential reduction in recreational fishing mortality associated with a seven-fish creel limit.

Furthermore, the actual effect of the 5-fish or other creel limit is a joint function of the effect of the 20-inch minimum size limit.

Combinations of size and creel limits. Analyses of the concurrent impact of minimum size and creel limit alternatives were based on the cumulative frequency distributions of catch per angler and length frequencies for the headboat, charter and private/rental sectors for samples collected during the period 1986-1989. The distributions of catch per angler and size composition of the catch of red grouper were assumed to be independent. The fractional reduction in catch (frcat) associated with each size and creel limit was evaluated as :

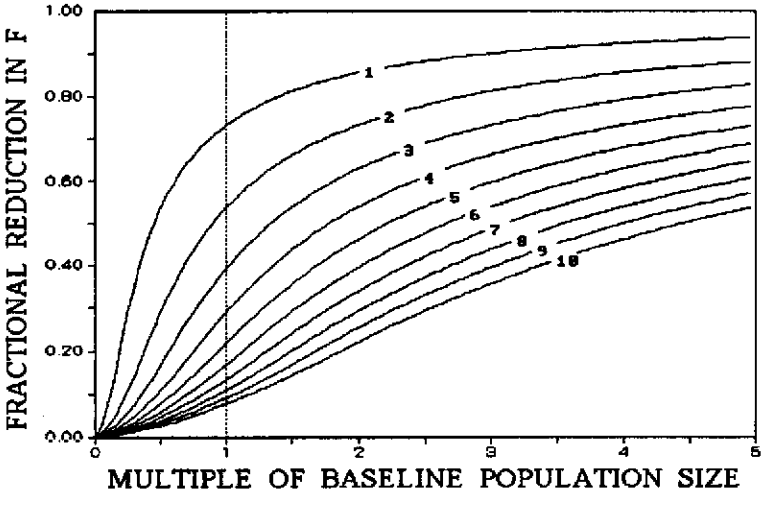

Figure 47. Effect of alternative creel limits on recreational fishing mortality as a function of stock size.

$$frcat = 1 - (S * C)$$

where,

S = the fraction of the catch above the size limit,
C = the fraction of the catch below the creel limit.

The fractional reduction in F (frf) was evaluated as:

$$frf = 1 - (S * C) + (1 - S) * R$$

where no catch in excess of a creel limit is assumed, and:

$$frf = 1 - (S * C) + (1 - S * C) * R$$

where the catch is assumed to continue at historical frequencies with fish caught in excess of the limits released with a release mortality rate, R. We evaluated the reductions in catch and fishing mortality for the headboat, charterboat, and private/rental modes for the catch frequencies by size and by number per angler for samples taken in 1989. We performed three analyses for each set of observations: 1) no discard mortality (e.g. Figure 48); 2) discard mortality of 0.33 for fish landed in excess of the limits (e.g. Figure 49); and 3) no discard mortality for the creel limit but 0.33 for fish caught below the minimum size (e.g. Figure 50). The results are presented in Tables 59-68).

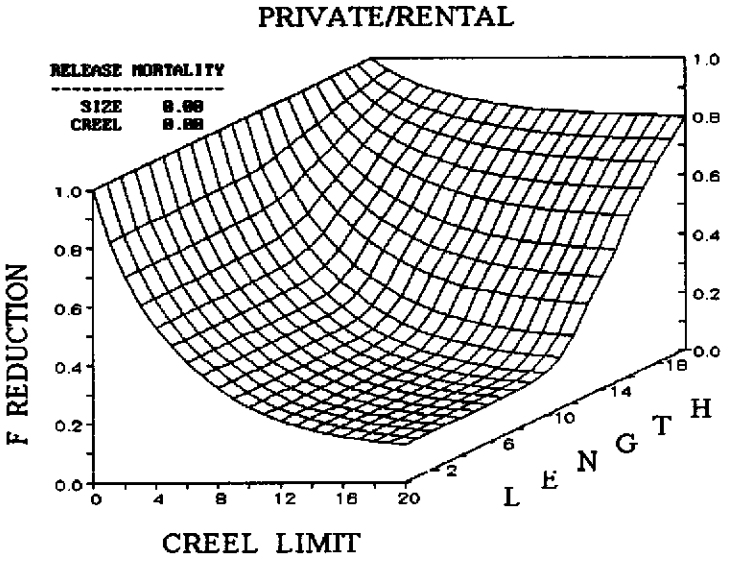

Figure 48. Estimated reduction in fishing mortality (F) by anglers fishing from private/rental craft as a function of size and creel limits if no fish die from catch and release.

If release mortality is assumed to be zero then increasing minimum sizes and decreasing creel limits monotonically decrease both the estimate of catch and the estimate of the reduction in fishing mortality (Figure 48, Tables 59, 63 and 66). The results where the catch was assumed to continue at historical frequencies with fish caught in excess of the limits released with a 0.33 release mortality rate, showed the same trend, but the maximum reduction in fishing mortality was limited by the assumed fishing mortality rate (Figure 49, Tables 61, 65 and 68). However, if the catch in excess of the creel limit is assumed to suffer no release mortality (eg., fishing stops once the creel limit is attained), then reducing the minimum size causes a slight reduction in the

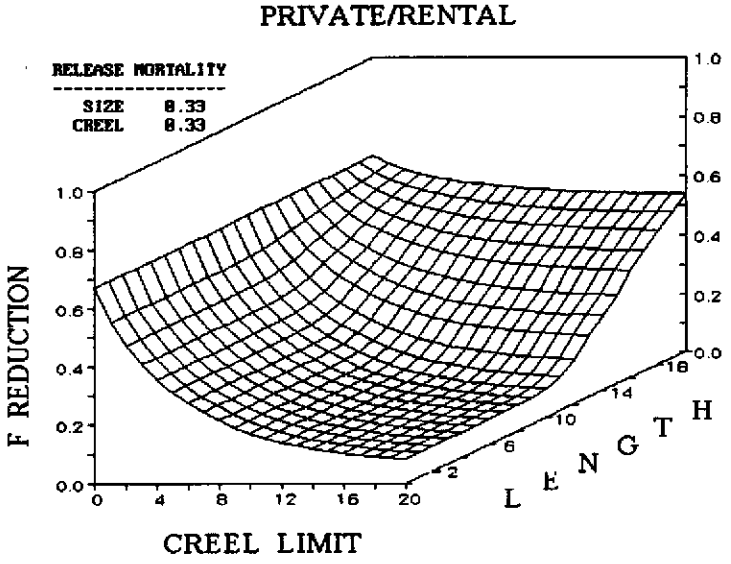

Figure 49. Estimated reduction in fishing mortality (F) by anglers fishing from private/rental craft as a function of size and creel limits if the catch frequency distributions remain the same and 1/3 of the excess catch dies after release.

estimate of F for very restrictive creel limits (Figure 50, Tables 60, 64, and 67). The effect is slight for release mortality rates up to about 0.33 (Figure 3) but could become an important consideration if the average release mortality seriously exceeds the 0.33.

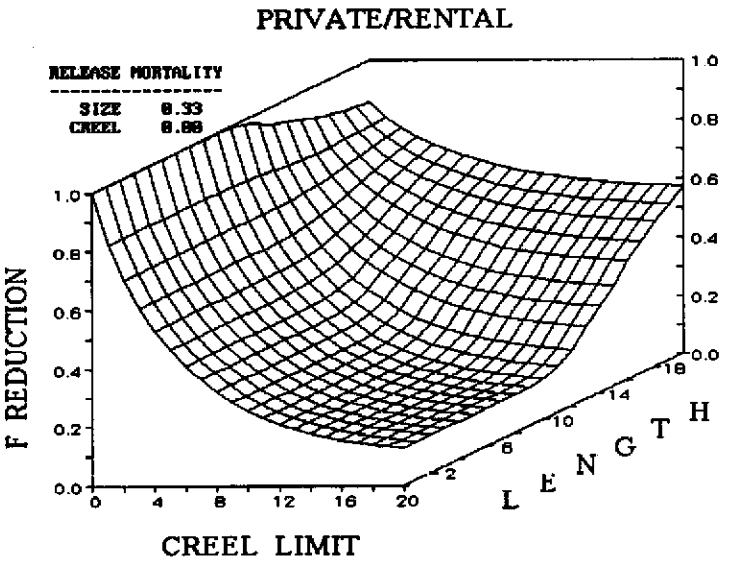

Figure 50. Estimated reduction in F by anglers fishing from private/rental craft as a function of size and creel limits if no fish are caught above the creel limit and 1/3 of the catch smaller than the minimum size dies after release.

These analyses of the relative merits of creel and size limits indicate that under certain conditions a relaxation of length limits can lower fishing mortality rates. This situation occurs if mortality of released fish is high and if anglers do not continue to catch and release fish once they land a limit. However, not all age classes would be equally impacted by a reduction in minimum size. If minimum sizes are lowered to increase the effectiveness of a creel limit, then the fishing mortality is increased on the younger (smaller) fish in the population and lowered on the older ages. Thus while the fishing mortality rate averaged over all ages may decline, the duration of exposure may increase and negate the apparent benefit of the smaller size limit. Because of this shift in the age distribution of fishing mortality, actual benefits which might accrue from the size/creel tradeoff may be much more limited than these analyses indicate.

LITERATURE CITED

Bannerot, S.P. 1984. The dynamics of exploited groupers (serranidae): An investigation of the protogynous hermaphroditic reproductive strategy. PhD dissertation University of Miami, Coral Gables, Fl. 392 pp.

Bannerot, S.P., W.W. Fox and J.E. Powers. 1986. Reproductive strategies and the management of snappers and groupers in the Gulf of Mexico and Caribbean. Pages 295-327 in J.J. Polovina and S Ralston, editors, Tropical snappers and groupers biology and fisheries management. Westview Press Bolder and London.

Beaumariage, D.S. 1969. Returns from the 1964 Schlitz tagging program including a cumulative analysis of previous results. Florida Department of Natural Resources, Marine Research Laboratory, Technical Series No. 59, 38 pp.

Burton, M.L., and T.C. Stiles. 1991. Age, growth and mortality of red grouper, Epinephelus morio, from the Southeastern U.S. Proceedings of the Gulf and Caribbean Fisheries Institute 43: (in press).

Ghorab, H.M., A.R. Bayoumi, M.I. Bebars and A.A. Hassan. 1986. The reproductive biology of the grouper Epinephelus chlorostigma (pices, serranidae) from the Red Sea. Bulletin of the Institute of Oceanography ad fisheries ARE.,12 186:13-33.

Goodyear, C.P. 1988. LSIM - a length-based fish population simulation model. NOAA Technical Memorandum NMFS-SEFC-219, iii plus 55 pages.

Goodyear, C.P. 1989. Spawning stock biomass per recruit: the biological basis for a fisheries management tool. ICCAT working document SCRS/89/82.

Gulf of Mexico Fishery Management Council (GMFMC). 1989. Amendment number 1 to the reef fish fishery management plan. Gulf of Mexico Fishery Management Council, Tampa, Florida. August 1989. 355 p.

Gulland, J.A., and L.K. Borerema. 1973. Scientific advice on catch levels. Fisheries Bulletin of the U.S. 71(2): 325-335.

Jory, D.E., and E.S. Iverson. 1989 Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (south Florida)-- black, red, and Nassau groupers. U.S. Fish and Wildlife Service Biological Report 82(11.110). U.S. Army Corps of Engineers, TR EL-82-4.

Larkin, P.A. 1977. An epitaph for the concept of maximum sustained yield. Transactions of the American Fisheries Society 106:1-11.

Lea, E. 1910. On the methods used in herring investigations. Publs Circonst. Cons. perm. int. Explor. Mer No. 33.

Moe, M.A. Jr. 1966. Tagging fishes in Florida off-shore waters. Fla. Bd. Conserv. Mar. Lab., Tech. Ser. No. 49: 1-40.

Moe, M.A., Jr. 1969. Biology of the red grouper (Epinephelus morio Valenciennes) from the eastern Gulf of Mexico. Prof. Pap. Ser. Mar. Lab. Fla. No. 10. 95 pp.

Ramirez, M.S. 1970. The red grouper fishery of Yucatan Peninsula, Mexico. Proceedings of the 22nd Annual Session Gulf and Caribbean Fisheries Institute, Rosenstiel School of Marine and Atmospheric Sciences, Coral Gables, Florida: 122-129.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada Bulletin 191. 382 p.

Rivas, L.R. 1970. The red grouper of the Gulf of Mexico. Commercial Fisheries Review. Volume 32 Number 10: 24-30.

Robson, D.S. and D.G. Chapman. 1961. Catch curves and mortality rates. Transactions of the American Fisheries Society 90:181-189.

Sissenwine, M.P. and J.G. Shepherd. 1987. An alternative perspective on recruitment overfishing and biological reference points. Canadian Journal of Fisheries and Allied Aquatic Sciences 44:913-918.

Shapiro, D.Y. 1986. Reproduction in groupers. Pages 295-327 in J.J. Polovina and S Ralston, editors, Tropical snappers and groupers biology and fisheries management. Westview Press Bolder and London.

Stiles, T.C., and M.L. Burton. 1991. Age, growth and mortality of red grouper, Epinephelus morio, from the Southeastern United States (manuscript).

Tesch, F.W. 1968. Age and Growth. Pages 93-122 in W.E. Ricker, editor, Methods for assessment of fish production in fresh waters. IBP Handbook No. 3. International biological programme, London, Blackwell scientific publications, Edinburgh.

Udall, S.L. 1964, Manual for conducting statistical surveys of the fisheries of the United States. U.S. Department of the Interior, Bureau of Commercial Fisheries, Washington, D.C. 58 pp.

Waters, J.R., and G.R. Huntsman. 1986. Incorporating mortality from catch and release into yield-per-recruit analyses of minimum size limits. North American Journal of Fisheries Management 6:63-471.

Table 1. Age and back-calculated lengths of red grouper sampled from the headboat fishery of the southeast U.S. Atlantic Coast (data from Burton and Stiles 1990).

BACK-CALCULATED LENGTHS AT AGE

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Num
1	7.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15
2	7.3	11.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	84
3	7.0	11.3	14.4	--	--	--	--	--	--	--	--	--	--	--	--	--	104
4	7.4	11.8	14.8	17.7	--	--	--	--	--	--	--	--	--	--	--	--	84
5	7.5	12.0	15.1	17.8	20.4	--	--	--	--	--	--	--	--	--	--	--	60
6	8.1	12.5	15.5	18.1	20.2	22.2	--	--	--	--	--	--	--	--	--	--	48
7	8.4	13.2	16.3	18.4	20.4	22.2	23.9	--	--	--	--	--	--	--	--	--	20
8	9.2	13.2	17.1	19.3	21.6	23.6	25.3	27.6	--	--	--	--	--	--	--	--	6
9	9.5	13.9	17.7	20.5	22.5	24.5	26.0	27.7	28.9	--	--	--	--	--	--	--	11
10	9.8	13.9	17.6	20.7	22.5	24.4	25.7	27.3	28.6	29.6	--	--	--	--	--	--	9
11	8.7	13.1	16.1	19.7	22.2	24.0	25.4	26.8	28.0	29.0	30.0	--	--	--	--	--	7
12	8.8	12.9	17.2	20.5	22.8	24.4	26.0	27.6	28.6	29.8	30.8	31.5	--	--	--	--	6
13	8.1	12.4	16.6	19.7	21.7	23.8	25.5	27.1	28.3	29.1	30.1	31.2	32.1	--	--	--	5
14	7.7	10.6	14.4	16.8	19.2	21.2	23.6	25.0	26.4	27.4	28.8	29.8	31.2	31.7	--	--	1
15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
16	9.6	14.9	18.6	21.3	23.4	25.1	26.1	28.3	29.9	30.9	31.5	32.0	32.5	33.1	33.6	34.1	1
Mean	7.6	12.0	15.2	18.3	20.8	23.0	25.1	27.4	28.5	29.4	30.3	31.3	32.0	32.4	33.6	34.1	
Num	461	446	362	258	174	114	66	46	40	29	20	13	7	2	1	1	461

Table 2. Estimated U.S. commercial landings of red grouper from the Gulf of Mexico in thousands of pounds gutted weight. These estimates have been adjusted to include a proportion of unclassified grouper equal to the ratio of red grouper to total classified grouper in the landings.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	US	Total	US	Total	US	Total	US	Total	US	Total	US	Total
1986	6440	6477	0	0	0	0	1	1	0	0	6295	6327
1987	6877	6918	0	0	0	0	1	1	0	0	6687	6723
1988	4771	4796	0	0	0	0	0	0	0	0	4565	4583
1989	7460	7636	4	4	0	0	0	0	0	0	7361	7521
1990	4859	4859	0	0	0	0	0	0	0	0	4791	4791

Table 3. Estimated U.S. commercial landings of all groupers from the Gulf of Mexico in thousands of pounds gutted weight.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	US	Total	US	Total	US	Total	US	Total	US	Total	US	Total
1962	6977	6977	201	201	209	209	45	45	96	96	7528	7528
1963	5924	6579	250	250	51	230	20	20	96	132	6342	7211
1964	7025	7662	4	258	39	227	11	11	81	162	7159	8321
1965	7692	8217	3	329	33	273	11	11	87	114	7826	8945
1966	6860	7169	34	324	45	199	13	13	50	76	7003	7782
1967	5717	6407	47	270	68	159	3	3	33	64	5867	6903
1968	6026	6177	148	259	156	279	5	5	43	79	6377	6799
1969	7001	7072	64	211	86	226	3	3	25	45	7179	7556
1970	6814	6901	140	225	132	225	4	4	35	50	7125	7406
1971	6216	6356	121	152	141	193	2	2	115	117	6595	6821
1972	6250	6479	139	194	151	197	4	4	74	83	6618	6957
1973	4973	5086	121	168	159	186	7	7	65	85	5325	5532
1974	5774	6111	73	109	102	111	2	2	50	72	6001	6405
1975	7002	7007	77	97	68	76	4	4	50	61	7202	7244
1976	6385	6657	55	65	60	82	12	12	33	59	6546	6875
1977	4983	5022	54	76	101	107	4	4	14	19	5154	5227
1978	4799	4852	47	58	58	62	2	2	34	34	4940	5007
1979	6537	6537	29	59	38	41	2	2	12	12	6619	6651
1980	6967	6967	15	42	27	32	2	2	17	18	7027	7061
1981	9641	9743	39	58	39	44	4	4	266	267	9990	10117
1982	12156	12272	27	31	77	80	29	29	136	136	12424	12548
1983	9361	9495	52	52	40	40	17	17	207	207	9676	9811
1984	9023	9463	82	82	31	32	229	229	158	158	9522	9963
1985	10145	10272	73	73	27	35	467	467	326	326	11038	11174
1986	9453	9537	87	87	28	35	733	733	166	166	10467	10558
1987	9679	9773	49	49	15	27	475	475	277	277	10494	10601
1988	7224	7313	46	46	29	31	616	616	414	414	8328	8421
1989	10003	10266	12	12	22	22	370	370	275	275	10682	10945
1990	7761	7761	12	12	28	28	347	347	113	114	8262	8262

Table 4. Estimated U.S. commercial landings of unclassified groupers from the Gulf of Mexico in thousands of pounds gutted weight.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	US	Total	US	Total	US	Total	US	Total	US	Total	US	Total
1962	6977	6977	201	201	209	209	45	45	96	96	7528	7528
1963	5924	6579	250	250	51	230	20	20	96	132	6342	7211
1964	7025	7662	4	258	39	227	11	11	81	162	7159	8321
1965	7692	8217	3	329	33	273	11	11	87	114	7826	8945
1966	6860	7169	34	324	45	199	13	13	50	76	7003	7782
1967	5717	6407	47	270	68	159	3	3	33	64	5867	6903
1968	6026	6177	148	259	156	279	5	5	43	79	6377	6799
1969	7001	7072	64	211	86	226	3	3	25	45	7179	7556
1970	6814	6901	140	225	132	225	4	4	35	50	7125	7406
1971	6216	6356	121	152	141	193	2	2	115	117	6595	6821
1972	6250	6479	139	194	151	197	4	4	74	83	6618	6957
1973	4973	5086	121	168	159	186	7	7	65	85	5325	5532
1974	5774	6111	73	109	102	111	2	2	50	72	6001	6405
1975	7002	7007	77	97	68	76	4	4	50	61	7202	7244
1976	6385	6657	55	65	60	82	12	12	33	59	6546	6875
1977	4983	5022	54	76	101	107	4	4	14	19	5154	5227
1978	4799	4852	47	58	58	62	2	2	34	34	4940	5007
1979	6537	6537	29	59	38	41	2	2	12	12	6619	6651
1980	6967	6967	15	42	27	32	2	2	17	18	7027	7061
1981	9641	9743	39	58	39	44	4	4	266	267	9990	10117
1982	12156	12272	27	31	77	80	29	29	136	136	12424	12548
1983	9361	9495	41	41	40	40	17	17	207	207	9666	9800
1984	9023	9463	69	69	31	32	225	225	158	158	9506	9947
1985	10145	10272	54	54	27	35	408	408	216	216	10850	10986
1986	215	221	69	69	28	35	142	142	144	144	598	611
1987	268	275	44	44	15	27	111	111	241	241	678	698
1988	312	323	24	24	29	31	330	330	175	175	870	883
1989	138	161	6	6	22	22	172	172	178	178	518	540
1990	110	110	11	11	28	28	65	65	47	47	260	261

Table 5. Estimated U.S. commercial landings of black grouper from the Gulf of Mexico in thousands of pounds gutted weight.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	US	Total	US	Total	US	Total	US	Total	US	Total	US	Total
1986	1091	1108	0	0	0	0	1	1	0	0	1092	1109
1987	1083	1116	0	0	0	0	0	0	0	0	1084	1117
1988	740	771	7	7	0	0	49	49	1	1	796	828
1989	1114	1156	0	0	0	0	7	7	1	1	1122	1164
1990	1136	1136	0	0	0	0	14	14	0	0	1150	1150

Table 6. Estimated U.S. commercial landings of gag grouper from the Gulf of Mexico in thousands of pounds gutted weight.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	US	Total	US	Total	US	Total	US	Total	US	Total	US	Total
1986	713	714	0	0	0	0	26	26	1	1	740	741
1987	633	634	0	0	0	0	27	27	0	0	661	662
1988	487	487	1	1	0	0	7	7	0	0	495	495
1989	719	727	0	0	0	0	1	1	0	0	720	728
1990	840	840	0	0	0	0	1	1	0	0	842	842

Table 7. Estimated U.S. commercial landings of marbled grouper from the Gulf of Mexico in thousands of pounds gutted weight.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	US	Total	US	Total	US	Total	US	Total	US	Total	US	Total
1986	0	0	0	0	0	0	2	2	0	0	2	2
1987	0	0	0	0	0	0	1	1	0	0	1	1
1988	0	0	0	0	0	0	7	7	0	0	7	7
1989	0	0	0	0	0	0	4	4	0	0	4	4
1990	0	0	0	0	0	0	3	3	0	0	3	3

Table 8. Estimated U.S. commercial landings of misty grouper from the Gulf of Mexico in thousands of pounds gutted weight.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	US	Total	US	Total	US	Total	US	Total	US	Total	US	Total
1986	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	2	2	0	0	2	2

Table 9. Estimated U.S. commercial landings of Nassau grouper from the Gulf of Mexico in thousands of pounds gutted weight.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	US	Total	US	Total	US	Total	US	Total	US	Total	US	Total
1986	5	5	0	0	0	0	0	0	0	0	5	5
1987	0	0	0	0	0	0	0	0	0	0	0	0
1988	3	3	0	0	0	0	0	0	0	0	3	3
1989	4	4	0	0	0	0	0	0	0	0	4	4
1990	3	3	0	0	0	0	5	5	0	0	8	8

Table 10. Estimated U.S. commercial landings of snowy grouper from the Gulf of Mexico in thousands of pounds gutted weight.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	US	Total	US	Total	US	Total	US	Total	US	Total	US	Total
1986	91	110	0	0	0	0	18	18	0	0	109	129
1987	91	108	0	0	0	0	30	30	0	0	121	138
1988	151	177	0	0	0	0	23	23	3	3	176	203
1989	81	100	0	0	0	0	12	12	1	1	94	114
1990	132	132	0	0	0	0	14	14	0	0	145	145

Table 11. Estimated U.S. commercial landings of yellowedge grouper from the Gulf of Mexico in thousands of pounds gutted weight.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	US	Total	US	Total	US	Total	US	Total	US	Total	US	Total
1984	0	0	0	0	0	0	3	3	0	0	3	3
1985	0	0	0	0	0	0	48	48	103	103	151	151
1986	448	453	4	4	0	0	476	476	12	12	940	946
1987	640	640	0	0	0	0	258	258	26	26	925	925
1988	784	787	3	3	0	0	100	100	226	226	1114	1116
1989	387	396	0	0	0	0	13	13	82	82	482	491
1990	555	555	1	1	0	0	162	162	50	50	768	768

Table 12. Estimated U.S. commercial landings of yellowfin grouper from the Gulf of Mexico in thousands of pounds gutted weight.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	US	Total	US	Total	US	Total	US	Total	US	Total	US	Total
1986	345	346	0	0	0	0	14	14	0	0	359	361
1987	26	26	0	0	0	0	2	2	0	0	28	28
1988	5	5	10	10	0	0	51	51	0	0	66	66
1989	1	1	0	0	0	0	119	119	0	0	121	121
1990	15	15	0	0	0	0	29	29	0	0	44	44

Table 13. Estimated U.S. commercial landings of scamp from the Gulf of Mexico in thousands of pounds gutted weight.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	US	Total	US	Total	US	Total	US	Total	US	Total	US	Total
1983	0	0	11	11	0	0	0	0	0	0	11	11
1984	0	0	12	12	0	0	0	0	0	0	12	12
1985	0	0	19	19	0	0	5	5	4	4	27	27
1986	253	253	14	14	0	0	50	50	9	9	325	325
1987	251	251	5	5	0	0	42	42	10	10	307	308
1988	177	178	0	0	0	0	47	47	8	8	233	233
1989	203	205	0	0	0	0	41	41	12	12	257	258
1990	179	179	1	1	0	0	50	50	16	16	246	246

Table 14. Estimated U.S. commercial landings of speckled hind from the Gulf of Mexico in thousands of pounds gutted weight.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	US	Total	US	Total	US	Total	US	Total	US	Total	US	Total
1986	0	0	0	0	0	0	1	1	0	0	1	1
1987	0	0	0	0	0	0	1	1	0	0	1	1
1988	0	0	1	1	0	0	1	1	1	1	3	3
1989	0	0	0	0	0	0	1	1	0	0	1	1
1990	0	0	0	0	1	1	2	2	0	0	2	2

Table 15. Estimated U.S. commercial landings of rock hind from the Gulf of Mexico in thousands of pounds gutted weight.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	US	Total	US	Total	US	Total	US	Total	US	Total	US	Total
1986	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	1	1	0	0	1	1

Table 16. Estimated commercial landings of red groupers from U.S. waters of the Gulf of Mexico in thousands of pounds gutted weight and percentages landed by state.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent
1986	6294	(100.0)	0	(--)	0	(--)	1	(0.0)	0	(--)	6295	(100.0)
1987	6687	(100.0)	0	(--)	0	(--)	1	(0.0)	0	(--)	6687	(100.0)
1988	4565	(100.0)	0	(--)	0	(--)	0	(0.0)	0	(--)	4565	(100.0)
1989	7357	(99.9)	4	(0.1)	0	(--)	0	(0.0)	0	(--)	7361	(100.0)
1990	4791	(100.0)	0	(--)	0	(--)	0	(--)	0	(--)	4791	(100.0)

Table 17. Estimated commercial landings of unclassified groupers from U.S. waters of the Gulf of Mexico in thousands of pounds gutted weight and percentages landed by state.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent
1962	6977	(92.7)	201	(2.7)	209	(2.8)	45	(0.6)	96	(1.3)	7528	(100.0)
1963	5924	(91.2)	250	(3.5)	51	(3.2)	20	(0.3)	96	(1.8)	6342	(100.0)
1964	7025	(92.1)	4	(3.1)	39	(2.7)	11	(0.1)	81	(2.0)	7159	(100.0)
1965	7692	(91.9)	3	(3.7)	33	(3.1)	11	(0.1)	87	(1.3)	7826	(100.0)
1966	6860	(92.1)	34	(4.2)	45	(2.6)	13	(0.2)	50	(1.0)	7003	(100.0)
1967	5717	(92.8)	47	(3.9)	68	(2.3)	3	(0.0)	33	(0.9)	5867	(100.0)
1968	6026	(90.9)	148	(3.8)	156	(4.1)	5	(0.1)	43	(1.2)	6377	(100.0)
1969	7001	(93.6)	64	(2.8)	86	(3.0)	3	(0.0)	25	(0.6)	7179	(100.0)
1970	6814	(93.2)	140	(3.0)	132	(3.0)	4	(0.1)	35	(0.7)	7125	(100.0)
1971	6216	(93.2)	121	(2.2)	141	(2.8)	2	(0.0)	115	(1.7)	6595	(100.0)
1972	6250	(93.1)	139	(2.8)	151	(2.8)	4	(0.1)	74	(1.2)	6618	(100.0)
1973	4973	(91.9)	121	(3.0)	159	(3.4)	7	(0.1)	65	(1.5)	5325	(100.0)
1974	5774	(95.4)	73	(1.7)	102	(1.7)	2	(0.0)	50	(1.1)	6001	(100.0)
1975	7002	(96.7)	77	(1.3)	68	(1.0)	4	(0.1)	50	(0.8)	7202	(100.0)
1976	6385	(96.8)	55	(0.9)	60	(1.2)	12	(0.2)	33	(0.9)	6546	(100.0)
1977	4983	(96.1)	54	(1.5)	101	(2.0)	4	(0.1)	14	(0.4)	5154	(100.0)
1978	4799	(96.9)	47	(1.2)	58	(1.2)	2	(0.0)	34	(0.7)	4940	(100.0)
1979	6537	(98.3)	29	(0.9)	38	(0.6)	2	(0.0)	12	(0.2)	6619	(100.0)
1980	6967	(98.7)	15	(0.6)	27	(0.5)	2	(0.0)	17	(0.3)	7027	(100.0)
1981	9641	(96.3)	39	(0.6)	39	(0.4)	4	(0.0)	266	(2.6)	9990	(100.0)
1982	12156	(97.8)	27	(0.2)	77	(0.6)	29	(0.2)	136	(1.1)	12424	(100.0)
1983	9361	(96.9)	41	(0.4)	40	(0.4)	17	(0.2)	207	(2.1)	9666	(100.0)
1984	9023	(95.1)	69	(0.7)	31	(0.3)	225	(2.3)	158	(1.6)	9506	(100.0)
1985	10145	(93.5)	54	(0.5)	27	(0.3)	408	(3.7)	216	(2.0)	10850	(100.0)
1986	215	(36.2)	69	(11.2)	28	(5.8)	142	(23.3)	144	(23.5)	598	(100.0)
1987	268	(39.4)	44	(6.2)	15	(3.9)	111	(16.0)	241	(34.5)	678	(100.0)
1988	312	(36.6)	24	(2.7)	29	(3.6)	330	(37.3)	175	(19.9)	870	(100.0)
1989	138	(29.8)	6	(1.2)	22	(4.0)	172	(31.9)	178	(33.1)	518	(100.0)
1990	110	(42.1)	11	(4.1)	28	(10.7)	65	(24.9)	47	(18.2)	260	(100.0)

Table 18. Estimated commercial landings of black grouper from U.S. waters of the Gulf of Mexico in thousands of pounds gutted weight and percentages landed by state.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent
1986	1091	(99.9)	0	(--)	0	(--)	1	(0.1)	0	(0.0)	1092	(100.0)
1987	1083	(99.9)	0	(0.0)	0	(--)	0	(0.0)	0	(0.0)	1084	(100.0)
1988	740	(93.2)	7	(0.8)	0	(--)	49	(5.9)	1	(0.1)	796	(100.0)
1989	1114	(99.3)	0	(0.0)	0	(--)	7	(0.6)	1	(0.1)	1122	(100.0)
1990	1136	(98.8)	0	(--)	0	(--)	14	(1.2)	0	(--)	1150	(100.0)

Table 19. Estimated commercial landings of gag from U.S. waters of the Gulf of Mexico in thousands of pounds gutted weight and percentages landed by state.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent
1986	713	(96.4)	0	(--)	0	(--)	26	(3.5)	1	(0.1)	740	(100.0)
1987	633	(95.8)	0	(--)	0	(--)	27	(4.2)	0	(0.0)	661	(100.0)
1988	487	(98.3)	1	(0.2)	0	(--)	7	(1.4)	0	(0.1)	495	(100.0)
1989	719	(99.9)	0	(--)	0	(--)	1	(0.1)	0	(--)	720	(100.0)
1990	840	(99.9)	0	(0.0)	0	(--)	1	(0.1)	0	(0.0)	842	(100.0)

Table 20. Estimated commercial landings of marbled grouper from U.S. waters of the Gulf of Mexico in thousands of pounds gutted weight and percentages landed by state.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent
1986	0	(--)	0	(--)	0	(--)	2	(100.0)	0	(--)	2	(100.0)
1987	0	(--)	0	(--)	0	(--)	1	(100.0)	0	(--)	1	(100.0)
1988	0	(--)	0	(--)	0	(--)	7	(100.0)	0	(--)	7	(100.0)
1989	0	(--)	0	(--)	0	(--)	4	(100.0)	0	(--)	4	(100.0)
1990	0	(--)	0	(--)	0	(--)	3	(100.0)	0	(--)	3	(100.0)

Table 21. Estimated commercial landings of misty grouper from U.S. waters of the Gulf of Mexico in thousands of pounds gutted weight and percentages landed by state.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent
1986	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)
1987	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)
1988	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)
1989	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)
1990	0	(--)	0	(--)	0	(--)	2	(100.0)	0	(--)	2	(100.0)

Table 22. Estimated commercial landings of Nassau grouper from U.S. waters of the Gulf of Mexico in thousands of pounds gutted weight and percentages landed by state.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent
1986	5	(100.0)	0	(--)	0	(--)	0	(--)	0	(--)	5	(100.0)
1987	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)
1988	3	(98.0)	0	(--)	0	(--)	0	(2.0)	0	(--)	3	(100.0)
1989	4	(95.6)	0	(--)	0	(--)	0	(--)	0	(4.4)	4	(100.0)
1990	3	(36.7)	0	(--)	0	(--)	5	(63.3)	0	(--)	8	(100.0)

Table 23. Estimated commercial landings of snowy grouper from U.S. waters of the Gulf of Mexico in thousands of pounds gutted weight and percentages landed by state.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent
1986	91	(85.7)	0	(--)	0	(--)	18	(14.3)	0	(--)	109	(100.0)
1987	91	(78.2)	0	(--)	0	(--)	30	(21.8)	0	(--)	121	(100.0)
1988	151	(87.3)	0	(--)	0	(--)	23	(11.5)	3	(1.3)	176	(100.0)
1989	81	(88.4)	0	(--)	0	(--)	12	(10.5)	1	(1.1)	94	(100.0)
1990	132	(90.7)	0	(--)	0	(--)	14	(9.3)	0	(--)	145	(100.0)

Table 24. Estimated commercial landings of yellowedge grouper from U.S. waters of the Gulf of Mexico in thousands of pounds gutted weight and percentages landed by state.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent
1986	448	(47.9)	4	(0.5)	0	(--)	476	(50.3)	12	(1.3)	940	(100.0)
1987	640	(69.2)	0	(--)	0	(--)	258	(27.9)	26	(2.8)	925	(100.0)
1988	784	(70.5)	3	(0.3)	0	(--)	100	(9.0)	226	(20.2)	1114	(100.0)
1989	387	(80.6)	0	(0.1)	0	(--)	13	(2.6)	82	(16.7)	482	(100.0)
1990	555	(72.3)	1	(0.1)	0	(--)	162	(21.1)	50	(6.5)	768	(100.0)

Table 25. Estimated commercial landings of yellowfin grouper from U.S. waters of the Gulf of Mexico in thousands of pounds gutted weight and percentages landed by state.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent
1986	345	(96.0)	0	(--)	0	(--)	14	(4.0)	0	(--)	359	(100.0)
1987	26	(94.2)	0	(--)	0	(--)	2	(5.8)	0	(--)	28	(100.0)
1988	5	(8.2)	10	(15.0)	0	(--)	51	(76.8)	0	(--)	66	(100.0)
1989	1	(0.9)	0	(0.4)	0	(--)	119	(98.7)	0	(--)	121	(100.0)
1990	15	(34.2)	0	(0.3)	0	(--)	29	(65.5)	0	(--)	44	(100.0)

Table 26. Estimated commercial landings of scamp from U.S. waters of the Gulf of Mexico in thousands of pounds gutted weight and percentages landed by state.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent
1986	253	(77.8)	14	(4.2)	0	(--)	50	(15.3)	9	(2.8)	325	(100.0)
1987	251	(81.5)	5	(1.6)	0	(--)	42	(13.8)	10	(3.1)	307	(100.0)
1988	177	(76.3)	0	(0.1)	0	(--)	47	(20.3)	8	(3.3)	233	(100.0)
1989	203	(79.4)	0	(0.2)	0	(0.1)	41	(15.7)	12	(4.6)	257	(100.0)
1990	179	(72.8)	1	(0.3)	0	(--)	50	(20.3)	16	(6.6)	246	(100.0)

Table 27. Estimated commercial landings of speckled hind from U.S. waters of the Gulf of Mexico in thousands of pounds gutted weight and percentages landed by state.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent
1986	0	(--)	0	(--)	0	(--)	1	(100.0)	0	(--)	1	(100.0)
1987	0	(--)	0	(--)	0	(--)	1	(100.0)	0	(--)	1	(100.0)
1988	0	(--)	1	(48.2)	0	(--)	1	(20.9)	1	(30.9)	3	(100.0)
1989	0	(--)	0	(20.1)	0	(--)	1	(79.9)	0	(--)	1	(100.0)
1990	0	(--)	0	(--)	1	(23.5)	2	(76.5)	0	(--)	2	(100.0)

Table 28. Estimated commercial landings of rock hind from U.S. waters of the Gulf of Mexico in thousands of pounds gutted weight and percentages landed by state.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent
1986	0	(--)	0	(--)	0	(--)	0	(100.0)	0	(--)	0	(100.0)
1987	0	(--)	0	(--)	0	(--)	0	(100.0)	0	(--)	0	(100.0)
1988	0	(--)	0	(--)	0	(--)	0	(100.0)	0	(--)	0	(100.0)
1989	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)
1990	0	(--)	0	(--)	0	(--)	1	(100.0)	0	(--)	1	(100.0)

Table 29. Estimated commercial landings of red hind from U.S. waters of the Gulf of Mexico in thousands of pounds gutted weight and percentages landed by state.

	Florida		Alabama		Mississippi		Louisiana		Texas		Combined	
Year	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent	1000 Lb	Percent
1986	0	(--)	0	(--)	0	(--)	0	(100.0)	0	(--)	0	(100.0)
1987	0	(--)	0	(--)	0	(--)	0	(100.0)	0	(--)	0	(100.0)
1988	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)
1989	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)	0	(--)
1990	0	(--)	0	(--)	0	(--)	0	(100.0)	0	(--)	0	(100.0)

Table 30. Florida west coast landings of red grouper reported by participants in the reef fish logbook program by gear and location of capture (grid) for 1990 (thousands of pounds, gutted weight).

	GRID																							
Gear	Unkn.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Other	Total
TRAP	3	1	63	24	27	10	81	35	6	1	1	0	0	0	0	0	0	0	0	0	0	0	4	256
HAND	9	1	5	28	36	44	80	46	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	258
BLL	14	16	35	73	202	169	82	8	0	5	0	7	0	0	0	0	1	0	0	0	2	0	7	622
SPEAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
UNK	54	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61
ALL	81	18	103	125	265	223	249	88	12	10	2	7	0	0	0	0	1	0	0	0	2	0	11	1198

Table 31. Florida west coast landings of red grouper in thousands of pounds, gutted weight, by year and location of capture (grid).

	GRID																							
Year	Unkn.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Other	Total
1986	0	30	761	1451	543	2365	890	99	69	83	0	0	0	0	0	0	0	0	0	0	0	0	32	6324
1987	0	76	1196	1446	589	1799	1302	159	101	0	0	0	0	0	0	0	0	0	0	0	0	0	36	6704
1988	43	65	713	1129	489	790	514	237	583	0	0	2	0	0	0	0	0	0	1	0	0	0	17	4583
1989	0	37	956	1297	756	1529	1273	166	1299	1	0	0	0	0	0	0	0	0	0	0	0	0	160	7476
1990	371	85	257	505	1163	1028	884	288	32	46	3	34	0	2	0	0	3	0	0	2	9	0	39	4751
Total	414	292	3883	5827	3541	7510	4864	948	2084	131	4	36	0	2	0	0	4	0	1	2	9	0	284	29837

Table 32. Florida west coast landings of red grouper from fish traps in thousands of pounds, gutted weight, by year and location of capture (grid).

	GRID																							
Year	Unkn	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Other	Total
1986	0	8	181	471	59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	727
1987	0	18	112	290	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	467
1988	0	18	142	289	32	0	0	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	555
1989	0	7	136	365	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	580
1990	3	1	63	24	27	10	81	35	6	1	1	0	0	0	0	0	0	0	0	0	0	0	4	256
Total	3	52	634	1439	227	10	81	105	6	1	1	0	0	0	0	0	0	0	0	0	0	0	25	2584

Table 33. Florida west coast landings of red grouper from spear fishing in thousands of pounds, gutted weight, by year and location of capture (grid).

	GRID																						
Year	Unkn	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Other	Total
1986	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
1987	0	4	9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
1988	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
1989	0	1	1	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
1990	0	1	2	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Total	0	8	18	1	13	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41

Table 34. Florida west coast landings of red grouper from power and handlines in thousands of pounds, gutted weight, by year and location of capture (grid).

	GRID																						
Year	Unkn	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Other	Total
1986	0	20	247	538	201	1295	648	41	11	83	0	0	0	0	0	0	0	0	0	0	0	0	20	3103
1987	0	54	438	364	217	666	616	84	35	0	0	0	0	0	0	0	0	0	0	0	0	0	23	2499
1988	0	28	136	276	194	396	357	88	465	0	0	0	0	0	0	0	0	0	1	0	0	0	14	1954
1989	0	30	133	380	223	817	954	86	1057	1	0	0	0	0	0	0	0	0	0	0	0	0	4	3686
1990	41	4	25	132	171	209	380	217	25	20	2	0	0	2	0	0	0	0	0	2	0	0	0	1231
Total	41	136	979	1690	1006	3383	2955	516	1592	105	3	1	0	2	0	0	0	0	1	2	0	0	61	12474

Table 35. Florida west coast landings of red grouper from bottom long lines in thousands of pounds, gutted weight, by year and location of capture (*grid*).

	GRID																							
Year	Unkn	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Other	Total
1986	0	0	328	441	282	1069	241	59	59	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2481
1987	0	0	637	791	332	1133	685	74	66	0	0	0	0	0	0	0	0	0	0	0	0	0	5	3723
1988	43	17	433	564	261	394	157	79	119	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2069
1989	0	0	685	552	453	712	319	80	242	0	0	0	0	0	0	0	0	0	0	0	0	0	155	3198
1990	69	78	167	347	963	807	393	36	0	25	0	34	0	0	0	0	3	0	0	0	9	0	34	2966
Total	112	96	2250	2694	2291	4114	1796	327	485	25	0	36	0	0	0	0	3	0	0	0	9	0	198	14438

Table 36. Florida west coast landings of red grouper from unclassified gears in thousands of pounds, gutted weight, by year and location of capture (grid).

	GRID																							
Year	Unkn	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Other	Total
1986	0	0	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1989	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1990	258	0	0	1	1	1	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	291
Total	258	0	2	3	4	2	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	300

Table 37. Commercial landings of red grouper (1000s of pounds, gutted weight) on the Florida west coast by county and gear type, 1986-1990.

	1986					1987					1988					1989					1990				
County	TRAP	HAND	BLL	UNK	TOT	TRAP	HAND	BLL	UNK	TOT	TRAP	HAND	BLL	UNK	TOT	TRAP	HAND	BLL	UNK	TOT	TRAP	HAND	BLL	UNK	TOT
Bay	-	81	-	-	81	-	27	52	0	79	-	23	58	-	81	-	33	53	-	86	5	13	78	-	96
Franklin	-	42	-	-	42	-	100	-	-	100	-	37	-	-	37	-	278	-	-	278	1	179	37	15	232
Citrus	-	25	-	-	25	-	25	-	-	25	-	19	-	-	19	-	42	14	-	56	63	74	-	-	137
Pasco	-	33	-	-	33	-	16	-	-	16	-	20	-	-	20	-	31	2	-	33	0	28	-	1	28
Pinellas	-	1786	595	-	2381	-	1361	1361	-	2723	-	1021	397	-	1419	-	2166	928	-	3095	19	283	1846	69	2217
Hillsborough	-	36	15	-	52	-	60	26	-	86	-	55	24	-	79	-	187	80	-	267	-	68	34	12	114
Manatee	-	116	1055	1	1172	-	114	1025	-	1139	-	81	545	0	626	-	110	989	0	1099	-	16	496	75	587
Charlotte	-	69	88	1	158	-	92	138	0	230	-	89	124	0	213	-	19	368	0	388	0	9	242	7	259
Lee	-	396	400	4	800	-	314	342	1	657	-	284	349	2	635	24	471	308	9	811	8	177	129	57	370
Collier	527	375	269	-	1171	381	191	699	-	1271	428	160	481	-	1070	524	95	333	-	952	103	163	161	-	427
Monroe	200	138	56	6	400	86	185	78	13	361	127	133	87	3	350	33	131	82	2	248	3	53	79	13	148
Total	727	3103	2481	12	6324	467	2499	3723	15	6704	555	1954	2069	5	4583	580	3686	3198	11	7476	256	1119	3104	274	4753

Table 38. Percentages of Florida west coast county red grouper commercial landings by gear type, 1986-1990.

	1986					1987					1988					1989					1990				
County	TRAP	HAND	BLL	UNK	TOT	TRAP	HAND	BLL	UNK	TOT	TRAP	HAND	BLL	UNK	TOT	TRAP	HAND	BLL	UNK	TOT	TRAP	HAND	BLL	UNK	TOT
Escambia	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	62	38	-	100	100	-	-	-	100
Santa Rosa	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	-	100	-	100	-	100	-	-	100
Okaloosa	-	100	-	-	100	-	100	-	-	100	-	53	47	-	100	-	100	-	-	100	-	8	92	-	100
Walton	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0
Bay	-	100	-	-	100	-	34	66	0	100	-	28	72	-	100	-	38	62	-	100	6	13	81	-	100
Gulf	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	100	-	-	100	-	-	-	-	0
Franklin	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	0	77	16	7	100
Wakulla	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	3	71	1	25	100
Taylor	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	47	12	-	41	100
Dixie	-	100	-	-	100	-	100	-	-	100	-	-	-	-	0	-	100	-	-	100	77	13	-	11	100
Levy	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	100	-	-	-	100
Citrus	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	75	25	-	100	46	54	-	-	100
Hernando	-	-	-	-	0	-	-	-	-	0	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100
Pasco	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	95	5	-	100	0	98	-	2	100
Pinellas	-	75	25	-	100	-	50	50	-	100	-	72	28	-	100	-	70	30	-	100	1	13	83	3	100
Hillsborough	-	70	30	-	100	-	70	30	-	100	-	70	30	-	100	-	70	30	-	100	-	60	30	10	100
Manatee	-	10	90	0	100	-	10	90	-	100	-	13	87	0	100	-	10	90	0	100	-	3	85	13	100
Sarasota	-	60	40	-	100	-	75	25	-	100	-	90	10	-	100	-	40	60	-	100	-	100	-	-	100
Charlotte	-	44	56	0	100	-	40	60	0	100	-	42	58	0	100	-	5	95	0	100	0	3	94	3	100
Lee	-	49	50	0	100	-	48	52	0	100	-	45	55	0	100	3	58	38	1	100	2	48	35	15	100
Collier	45	32	23	-	100	30	15	55	-	100	40	15	45	-	100	55	10	35	-	100	24	38	38	-	100
Monroe	50	34	14	2	100	24	51	22	4	100	36	38	25	1	100	13	53	33	1	100	2	36	53	9	100
TOTAL	11	49	39	0	100	7	37	56	0	100	12	43	45	0	100	8	49	43	0	100	5	24	65	6	100

Table 39. Sample sizes and estimated mean weights in pounds (gutted weight) of red grouper harvested by recreational fishermen by mode and year, 1979-1990.

	MODE									
	Total		Shore		Headboat		Charter		Private	
Year	N	Wt.	N	Wt.	N	Wt.	N	Wt.	N	Wt.
79	312	10.29	0	0.00	41	3.69	4	2.80	267	11.41
80	213	6.51	0	0.00	110	3.84	5	4.33	98	9.61
81	180	4.89	12	1.76	139	5.14	12	6.39	17	4.01
82	326	4.03	2	0.48	228	3.96	1	1.95	95	4.28
83	365	4.29	2	2.06	288	4.23	10	9.76	65	3.82
84	627	4.04	2	1.11	531	3.54	68	8.38	26	3.16
85	496	4.30	0	0.00	483	4.32	1	8.90	12	3.03
86	722	3.67	0	0.00	647	3.78	39	2.59	36	2.83
87	925	3.62	1	0.90	766	3.75	32	3.92	126	2.80
88	775	3.81	4	3.59	475	3.98	64	3.72	232	3.51
89	1105	3.36	0	0.00	887	3.44	61	3.33	157	2.94
90	307	6.47	1	15.84	251	6.51	13	6.05	42	6.15

Table 40. Recreational harvest estimates for Gulf of Mexico red grouper by state and fishing area, 1979-1990. The estimates are based on the 1979-1990 NMRFSS, and the 1986-1990 NMFS Headboat Survey. The weight estimates are the products of the annual harvest and mean weight estimates by mode where the sample size available to estimate mean weight exceeded 50, otherwise the Gulfwide annual mean was used. The estimates have been adjusted for missing data in January and February, 1981 in all states, and for 1982-1984 in Texas by the average proportions observed in years where these strata were sampled. Units are in thousands of fish and pounds (gutted weight).

All Modes and Areas Combined

	Florida		Alabama		Mississippi		Louisiana		Texas		Total Gulf	
YEAR	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt
1979	209	2272	0	0	0	0	0	0	0	0	209	2272
1980	177	1268	0	0	0	0	0	0	0	0	177	1268
1981	524	2656	0	0	0	0	0	0	0	0	524	2656
1982	526	2204	0	0	0	0	0	0	0	0	526	2204
1983	538	2100	0	0	0	0	0	0	0	0	538	2100
1984	1231	4812	0	2	0	0	0	0	0	1	1232	4815
1985	848	3652	0	0	0	0	0	0	0	0	848	3652
1986	672	2456	1	4	0	0	0	0	0	0	672	2460
1987	468	1377	0	4	0	0	0	0	0	0	468	1381
1988	710	2501	0	3	0	0	0	0	0	0	710	2504
1989	743	2196	0	2	0	0	0	0	0	0	743	2197
1990	214	1375	0	1	0	0	0	0	0	0	214	1376

State Inshore Waters

	Florida		Alabama		Mississippi		Louisiana		Texas		Total Gulf	
YEAR	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt
1979	122	1280	0	0	0	0	0	0	0	0	122	1280
1980	11	104	0	0	0	0	0	0	0	0	11	104
1981	6	28	0	0	0	0	0	0	0	0	6	28
1982	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0
1984	47	185	0	0	0	0	0	0	0	0	47	185
1985	2	7	0	0	0	0	0	0	0	0	2	7
1986	0	0	0	0	0	0	0	0	0	0	0	0
1987	1	3	0	0	0	0	0	0	0	0	1	3
1988	35	124	0	0	0	0	0	0	0	0	35	124
1989	1	4	0	0	0	0	0	0	0	0	1	4
1990	9	56	0	0	0	0	0	0	0	0	9	56

State Territorial Sea

	Florida		Alabama		Mississippi		Louisiana		Texas		Total Gulf	
YEAR	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt
1979	0	0	0	0	0	0	0	0	0	0	0	0
1980	31	294	0	0	0	0	0	0	0	0	31	294
1981	29	142	0	0	0	0	0	0	0	0	29	142
1982	206	880	0	0	0	0	0	0	0	0	206	880
1983	272	1047	0	0	0	0	0	0	0	0	272	1047
1984	591	2348	0	0	0	0	0	0	0	0	591	2348
1985	211	909	0	0	0	0	0	0	0	0	211	909
1986	144	530	0	0	0	0	0	0	0	0	144	530
1987	151	453	0	0	0	0	0	0	0	0	151	453
1988	51	179	0	0	0	0	0	0	0	0	51	179
1989	38	112	0	0	0	0	0	0	0	0	38	112
1990	45	289	0	0	0	0	0	0	0	0	45	289

EEZ

	Florida		Alabama		Mississippi		Louisiana		Texas		Total Gulf	
YEAR	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt
1979	87	992	0	0	0	0	0	0	0	0	87	992
1980	136	869	0	0	0	0	0	0	0	0	136	869
1981	489	2485	0	0	0	0	0	0	0	0	489	2485
1982	320	1324	0	0	0	0	0	0	0	0	320	1324
1983	266	1053	0	0	0	0	0	0	0	0	266	1053
1984	594	2280	0	2	0	0	0	0	0	1	594	2283
1985	635	2736	0	0	0	0	0	0	0	0	635	2736
1986	527	1927	1	4	0	0	0	0	0	0	528	1931
1987	315	921	0	4	0	0	0	0	0	0	315	925
1988	624	2198	0	3	0	0	0	0	0	0	624	2201
1989	704	2080	0	2	0	0	0	0	0	0	704	2082
1990	160	1029	0	1	0	0	0	0	0	0	161	1031

Table 41. Recreational harvest estimates for Gulf of Mexico red grouper by mode, 1979-1990. The estimates are based on the 1979-1990 NMRFSS, and the 1986-1990 NMFS Headboat Survey. The weight estimates are the products of the annual harvest and mean weight estimates by mode where the sample size available to estimate mean weight exceeded 50, otherwise the Gulfwide annual mean was used. The estimates have been adjusted for missing data in January and February, 1981 by the average proportions observed in years where these strata were sampled. Units are in thousands of fish and pounds (gutted weight).

MODE

	SHORE		PARTYBOAT		CHARTER		PRIVATE		COMBINED	
YEAR	NUM	WT	NUM	WT	NUM	WT	NUM	WT	NUM	WT
1979	0	0	98	1008	0	0	111	1264	209	2272
1980	0	0	75	289	0	0	102	978	177	1268
1981	15	72	407	2092	0	0	98	479	520	2643
1982	4	17	149	590	0	0	373	1598	526	2204
1983	15	66	93	394	0	0	429	1640	538	2100
1984	38	152	324	1149	0	0	870	3513	1232	4814
1985	0	0	285	1231	0	0	563	2420	848	3652
1986	7	26	36	124	33	122	596	2188	672	2460
1987	11	39	30	104	51	185	377	1054	468	1381
1988	4	16	29	105	34	128	642	2254	710	2504
1989	0	0	52	141	61	202	631	1854	743	2197
1990	10	65	20	119	63	408	121	783	214	1376

Table 42. Recreational catch estimates for Gulf of Mexico red grouper for shore based anglers and those fishing from private/rental craft by area fished, 1979-1990. The estimates are based on the NMRFSS and were adjusted for missing data in January and February, 1981 by the average proportions observed in years where this strata was sampled. Units are in thousands of fish.

AREA

	INSHORE			TERR. SEA			EEZ			COMBINED		
YEAR	Kept	Rel	Rel %	Kept	Rel	Rel %	Kept	Rel	Rel %	Kept	Rel	Rel %
1979	24	0	0.0	0	4	100.0	87	0	0.0	111	4	3.3
1980	11	3	21.4	31	0	0.0	60	3	4.8	102	6	5.5
1981	6	0	0.0	28	2	6.4	77	41	34.7	111	43	27.8
1982	0	0	-	206	22	9.5	171	57	24.9	377	78	17.2
1983	0	0	-	269	106	28.4	176	37	17.3	445	143	24.3
1984	40	0	0.0	511	220	30.1	356	88	19.8	907	308	25.4
1985	0	0	-	208	35	14.4	355	25	6.5	563	60	9.6
1986	0	4	100.0	140	99	41.5	463	292	38.7	603	395	39.6
1987	1	18	93.7	127	168	57.0	259	230	47.0	387	416	51.8
1988	35	34	49.0	50	80	61.5	562	701	55.5	647	815	55.8
1989	1	49	97.6	37	280	88.2	592	1197	66.9	631	1526	70.8
1990	9	98	91.8	39	292	88.1	83	902	91.6	131	1292	90.8

Table 43. Recreational harvest estimates for Gulf of Mexico red grouper by state and period of the year for the period 1979-1990. The estimates are based on the 1979-1990 NMRFSS, the 1986-1990 NMFS Headboat Survey, and 1981-1990 length-frequency samples and 1986-1990 catch estimates compiled by Texas Parks and Wildlife. The estimates have been adjusted for missing data in January and February, 1981 in all states, and for 1982-1984 in Texas by the average proportions observed in years where these strata were sampled. The Texas estimates do not include shore mode after 1985. Units are in thousands of fish.

	Florida		Alabama		Mississippi		Louisiana		Texas		Total Gulf	
YEAR	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
1979	184	25	0	0	0	0	0	0	0	0	184	25
1980	118	59	0	0	0	0	0	0	0	0	118	59
1981	56	467	0	0	0	0	0	0	0	0	56	467
1982	114	412	0	0	0	0	0	0	0	0	114	412
1983	111	427	0	0	0	0	0	0	0	0	111	427
1984	166	1065	0	0	0	0	0	0	0	0	166	1066
1985	265	583	0	0	0	0	0	0	0	0	265	583
1986	175	496	0	0	0	0	0	0	0	0	176	497
1987	257	211	0	0	0	0	0	0	0	0	257	211
1988	296	414	0	0	0	0	0	0	0	0	296	414
1989	329	414	0	0	0	0	0	0	0	0	329	414
1990	97	116	0	0	0	0	0	0	0	0	98	116
Mean	217	469	0	0	0	0	0	0	0	0	315	586
Percent	31.6	68.4	51.1	48.9	0.0	0.0	0.0	100.0	14.9	85.1	34.9	65.1

Table 44. Commercial landings and Tip length measurements of red grouper landings by county in Florida, 1986-1990.

		1986		1987		1988		1989		1990	
COUNTY	CD	POUNDS	NUM	POUNDS	NUM	POUNDS	NUM	POUNDS	NUM	POUNDS	NUM
Bay	1	95728	0	93641	82	95948	42	142206	0	226958	477
Franklin	13	49141	0	118467	0	43797	0	437821	0	547808	13
Citrus	5	28924	0	29406	0	22580	0	85295	0	322502	0
Pasco	33	39198	0	18929	0	23480	0	48268	0	68556	0
Pinellas	35	2809479	2747	3213008	1704	1673845	549	5327300	1569	5221668	5799
Hillsborough	19	60774	0	101104	0	93497	0	492976	0	266264	0
Manatee	27	1383369	131	1343595	277	738591	156	1829441	0	1385182	4844
Sarasota	39	5925	0	13601	0	35990	0	91087	0	16750	0
Charlotte	3	186468	0	271087	0	251348	0	623666	0	610872	95
Lee	23	943475	0	775819	0	749188	0	1467937	0	874214	206
Collier	7	1381999	0	1499322	0	1262177	0	1600780	0	984422	298
Monroe	29	471763	4656	426510	2459	412583	1829	463795	1062	348982	293

Table 45. Number of length observations from unknown gears and corresponding fractions of total countywide length observations for all gears encountered in TIP sampling in the Florida commercial red grouper fishery.

	YEAR													
	1984		1985		1986		1987		1988		1989		1990	
County	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
1 Escambia	0	-	0	-	0	-	0	-	0	-	0	-	0	-
2 Santa Rosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-
3 Okaloosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-
4 Walton	0	-	0	-	0	-	0	-	0	-	0	-	0	-
5 Bay	0	0.00	0	0.00	0	-	0	0.00	0	0.00	0	-	0	0.00
6 Gulf	0	-	0	-	0	-	0	-	0	-	0	-	0	-
7 Franklin	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
8 Wakulla	0	-	0	-	0	-	0	-	0	-	0	-	0	-
9 Taylor	0	-	0	-	0	-	0	-	0	-	0	-	0	-
10 Dixie	0	-	0	-	0	-	0	-	0	-	0	-	0	-
11 Levy	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12 Citrus	0	-	0	-	0	-	0	-	0	-	0	-	0	-
13 Hernando	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14 Pasco	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-
15 Pinellas	0	0.00	25	0.01	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
16 Hillsborough	0	-	0	-	0	-	0	-	0	-	0	-	0	-
17 Manatee	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	-	0	0.00
18 Sarasota	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19 Charlotte	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
20 Lee	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
21 Collier	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
22 Monroe	100	0.14	744	0.28	0	0.00	0	0.00	0	0.00	1	0.00	0	0.00

Table 46. Number of length observations from fish traps and corresponding fractions of total countywide length observations for all gears encountered in TIP sampling in the Florida commercial red grouper fishery.

	YEAR													
	1984		1985		1986		1987		1988		1989		1990	
County	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
1 Escambia	0	-	0	-	0	-	0	-	0	-	0	-	0	-
2 Santa Rosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-
3 Okaloosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-
4 Walton	0	-	0	-	0	-	0	-	0	-	0	-	0	-
5 Bay	0	0.00	0	0.00	0	-	0	0.00	0	0.00	0	-	0	0.00
6 Gulf	0	-	0	-	0	-	0	-	0	-	0	-	0	-
7 Franklin	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
8 Wakulla	0	-	0	-	0	-	0	-	0	-	0	-	0	-
9 Taylor	0	-	0	-	0	-	0	-	0	-	0	-	0	-
10 Dixie	0	-	0	-	0	-	0	-	0	-	0	-	0	-
11 Levy	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12 Citrus	0	-	0	-	0	-	0	-	0	-	0	-	0	-
13 Hernando	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14 Pasco	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-
15 Pinellas	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
16 Hillsborough	0	-	0	-	0	-	0	-	0	-	0	-	0	-
17 Manatee	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	-	0	0.00
18 Sarasota	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19 Charlotte	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
20 Lee	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
21 Collier	0	-	0	-	0	-	0	-	0	-	0	-	90	0.30
22 Monroe	18	0.02	1185	0.44	1248	0.27	768	0.31	33	0.02	357	0.34	156	0.53

Table 47. Number of length observations from gill nets and corresponding fractions of total countywide length observations for all gears encountered in TIP sampling in the Florida commercial red grouper fishery.

	YEAR													
	1984		1985		1986		1987		1988		1989		1990	
County	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
1 Escambia	0	-	0	-	0	-	0	-	0	-	0	-	0	-
2 Santa Rosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-
3 Okaloosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-
4 Walton	0	-	0	-	0	-	0	-	0	-	0	-	0	-
5 Bay	0	0.00	0	0.00	0	-	0	0.00	0	0.00	0	-	0	0.00
6 Gulf	0	-	0	-	0	-	0	-	0	-	0	-	0	-
7 Franklin	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
8 Wakulla	0	-	0	-	0	-	0	-	0	-	0	-	0	-
9 Taylor	0	-	0	-	0	-	0	-	0	-	0	-	0	-
10 Dixie	0	-	0	-	0	-	0	-	0	-	0	-	0	-
11 Levy	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12 Citrus	0	-	0	-	0	-	0	-	0	-	0	-	0	-
13 Hernando	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14 Pasco	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-
15 Pinellas	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
16 Hillsborough	0	-	0	-	0	-	0	-	0	-	0	-	0	-
17 Manatee	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	-	0	0.00
18 Sarasota	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19 Charlotte	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
20 Lee	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
21 Collier	0	-	0	-	0	-	0	-	0	-	0	-	192	0.64
22 Monroe	108	0.15	0	0.00	0	0.00	0	0.00	0	0.00	3	0.00	60	0.20

Table 48. Number of length observations from hand lines and corresponding fractions of total countywide length observations for all gears encountered in TIP sampling in the Florida commercial red grouper fishery.

	YEAR													
	1984		1985		1986		1987		1988		1989		1990	
County	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
1 Escambia	0	-	0	-	0	-	0	-	0	-	0	-	0	-
2 Santa Rosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-
3 Okaloosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-
4 Walton	0	-	0	-	0	-	0	-	0	-	0	-	0	-
5 Bay	8	0.14	0	0.00	0	-	7	0.09	0	0.00	0	-	40	0.08
6 Gulf	0	-	0	-	0	-	0	-	0	-	0	-	0	-
7 Franklin	0	-	0	-	0	-	0	-	0	-	0	-	13	1.00
8 Wakulla	0	-	0	-	0	-	0	-	0	-	0	-	0	-
9 Taylor	0	-	0	-	0	-	0	-	0	-	0	-	0	-
10 Dixie	0	-	0	-	0	-	0	-	0	-	0	-	0	-
11 Levy	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12 Citrus	0	-	0	-	0	-	0	-	0	-	0	-	0	-
13 Hernando	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14 Pasco	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-
15 Pinellas	72	0.04	0	0.00	0	0.00	35	0.02	0	0.00	0	0.00	40	0.01
16 Hillsborough	0	-	0	-	0	-	0	-	0	-	0	-	0	-
17 Manatee	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	-	0	0.00
18 Sarasota	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19 Charlotte	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
20 Lee	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
21 Collier	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
22 Monroe	196	0.27	733	0.27	36	0.01	421	0.17	632	0.35	553	0.52	57	0.19

Table 49. Number of length observations from power assisted lines and corresponding fractions of total countywide length observations for all gears encountered in TIP sampling in the Florida commercial red grouper fishery.

	YEAR													
	1984		1985		1986		1987		1988		1989		1990	
County	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
1 Escambia	0	-	0	-	0	-	0	-	0	-	0	-	0	-
2 Santa Rosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-
3 Okaloosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-
4 Walton	0	-	0	-	0	-	0	-	0	-	0	-	0	-
5 Bay	13	0.22	0	0.00	0	-	0	0.00	0	0.00	0	-	0	0.00
6 Gulf	0	-	0	-	0	-	0	-	0	-	0	-	0	-
7 Franklin	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
8 Wakulla	0	-	0	-	0	-	0	-	0	-	0	-	0	-
9 Taylor	0	-	0	-	0	-	0	-	0	-	0	-	0	-
10 Dixie	0	-	0	-	0	-	0	-	0	-	0	-	0	-
11 Levy	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12 Citrus	0	-	0	-	0	-	0	-	0	-	0	-	0	-
13 Hernando	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14 Pasco	21	1.00	0	-	0	-	0	-	0	-	0	-	0	-
15 Pinellas	726	0.42	762	0.42	486	0.18	575	0.34	85	0.15	62	0.04	522	0.09
16 Hillsborough	0	-	0	-	0	-	0	-	0	-	0	-	0	-
17 Manatee	47	0.31	0	0.00	0	0.00	64	0.23	132	0.85	0	-	0	0.00
18 Sarasota	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19 Charlotte	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
20 Lee	0	-	0	-	0	-	0	-	0	-	0	-	177	0.86
21 Collier	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
22 Monroe	268	0.36	27	0.01	0	0.00	113	0.05	319	0.17	0	0.00	0	0.00

Table 50. Number of length observations from bottom longlines and corresponding fractions of total countywide length observations for all gears encountered in TIP sampling in the Florida commercial red grouper fishery.

	YEAR													
	1984		1985		1986		1987		1988		1989		1990	
County	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
1 Escambia	0	-	0	-	0	-	0	-	0	-	0	-	0	-
2 Santa Rosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-
3 Okaloosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-
4 Walton	0	-	0	-	0	-	0	-	0	-	0	-	0	-
5 Bay	37	0.64	437	1.00	0	-	75	0.91	42	1.00	0	-	437	0.92
6 Gulf	0	-	0	-	0	-	0	-	0	-	0	-	0	-
7 Franklin	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
8 Wakulla	0	-	0	-	0	-	0	-	0	-	0	-	0	-
9 Taylor	0	-	0	-	0	-	0	-	0	-	0	-	0	-
10 Dixie	0	-	0	-	0	-	0	-	0	-	0	-	0	-
11 Levy	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12 Citrus	0	-	0	-	0	-	0	-	0	-	0	-	0	-
13 Hernando	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14 Pasco	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-
15 Pinellas	930	0.54	1016	0.56	2261	0.82	1094	0.64	464	0.85	1507	0.96	5237	0.90
16 Hillsborough	0	-	0	-	0	-	0	-	0	-	0	-	0	-
17 Manatee	106	0.69	80	1.00	131	1.00	213	0.77	24	0.15	0	-	4844	1.00
18 Sarasota	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19 Charlotte	0	-	0	-	0	-	0	-	0	-	0	-	95	1.00
20 Lee	0	-	0	-	0	-	0	-	0	-	0	-	29	0.14
21 Collier	0	-	0	-	0	-	0	-	0	-	0	-	16	0.05
22 Monroe	48	0.07	0	0.00	3372	0.72	1157	0.47	845	0.46	148	0.14	20	0.07

Table 51. Fractions by county of length observations from power assisted lines in the total observations from hand and power assisted lines combined in TIP sampling in the Florida commercial red grouper fishery.

County	YEAR						
	84	85	86	87	88	89	90
1 Escambia	-	-	-	-	-	-	-
2 Santa Rosa	-	-	-	-	-	-	-
3 Okaloosa	-	-	-	-	-	-	-
4 Walton	-	-	-	-	-	-	-
5 Bay	0.619	-	-	0.000	-	-	0.000
6 Gulf	-	-	-	-	-	-	-
7 Franklin	-	-	-	-	-	-	0.000
8 Wakulla	-	-	-	-	-	-	-
9 Taylor	-	-	-	-	-	-	-
10 Dixie	-	-	-	-	-	-	-
11 Levy	-	-	-	-	-	-	-
12 Citrus	-	-	-	-	-	-	-
13 Hernando	-	-	-	-	-	-	-
14 Pasco	1.000	-	-	-	-	-	-
15 Pinellas	0.910	1.000	1.000	0.943	1.000	1.000	0.929
16 Hillsborough	-	-	-	-	-	-	-
17 Manatee	1.000	-	-	1.000	1.000	-	-
18 Sarasota	-	-	-	-	-	-	-
19 Charlotte	-	-	-	-	-	-	-
20 Lee	-	-	-	-	-	-	1.000
21 Collier	-	-	-	-	-	-	-
22 Monroe	0.578	0.036	0.000	0.212	0.335	0.000	0.000

Table 52. Number of length observations from fish traps and corresponding fractions of total grid length observations for all gears encountered in TIP sampling in the Florida commercial red grouper fishery.

	YEAR													
	1984		1985		1986		1987		1988		1989		1990	
Grid	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
Unkn	0	0.00	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1	0	-	320	0.24	4	0.02	9	0.27	0	-	11	0.08	8	0.01
2	18	0.05	140	0.42	0	0.00	12	0.02	0	0.00	0	0.00	148	0.17
3	0	0.00	439	1.00	1240	0.32	745	0.46	0	0.00	330	0.28	90	0.08
4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
8	0	0.00	0	-	0	-	0	-	0	0.00	0	-	0	0.00
9	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
10	0	-	0	-	0	0.00	0	-	0	-	0	-	0	-
11	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12	0	-	0	-	0	-	0	-	0	-	0	-	0	-
13	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14	0	-	0	-	0	-	0	-	0	-	0	-	0	-
15	0	-	0	-	0	-	0	-	0	-	0	-	0	-
16	0	-	0	-	0	-	0	-	0	-	0	-	0	-
17	0	-	0	-	0	-	0	-	0	-	0	-	0	-
18	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19	0	-	0	-	0	-	0	-	0	-	0	-	0	-
20	0	-	0	-	0	-	0	-	0	-	0	-	0	-
21	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Other	0	0.00	285	0.43	4	0.57	2	0.01	33	0.69	16	0.59	0	0.00

Table 53. Number of length observations from hand and power assisted lines and corresponding fractions of total grid length observations for all gears encountered in TIP sampling in the Florida commercial red grouper fishery.

	YEAR													
	1984		1985		1986		1987		1988		1989		1990	
Grid	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
Unkn	573	0.50	640	0.55	323	0.15	462	0.33	25	0.26	0	0.00	0	0.00
1	0	-	247	0.19	6	0.03	24	0.73	0	-	119	0.91	20	0.04
2	262	0.80	47	0.14	25	0.09	430	0.57	143	0.65	11	1.00	72	0.08
3	37	0.43	0	0.00	3	0.00	59	0.04	915	0.52	415	0.36	71	0.07
4	191	0.40	9	0.10	31	0.09	67	0.21	60	0.42	0	0.00	328	0.07
5	127	0.48	201	0.32	122	0.24	52	0.60	10	0.06	44	0.22	269	0.10
6	134	0.59	5	0.01	9	0.04	7	0.09	0	0.00	18	1.00	33	0.07
7	0	-	0	-	0	-	0	-	0	-	0	-	19	0.20
8	27	0.68	0	-	0	-	0	-	0	0.00	0	-	1	0.00
9	0	-	0	-	0	-	0	-	0	-	0	-	36	0.41
10	0	-	0	-	0	0.00	0	-	0	-	0	-	0	-
11	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12	0	-	0	-	0	-	0	-	0	-	0	-	0	-
13	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14	0	-	0	-	0	-	0	-	0	-	0	-	0	-
15	0	-	0	-	0	-	0	-	0	-	0	-	0	-
16	0	-	0	-	0	-	0	-	0	-	0	-	0	-
17	0	-	0	-	0	-	0	-	0	-	0	-	0	-
18	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19	0	-	0	-	0	-	0	-	0	-	0	-	0	-
20	0	-	0	-	0	-	0	-	0	-	0	-	0	-
21	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Other	0	0.00	373	0.57	3	0.43	114	0.55	15	0.31	8	0.30	0	0.00

Table 54. Number of length observations from bottom longlines and corresponding fractions of total grid length observations for all gears encountered in TIP sampling in the Florida commercial red grouper fishery.

	YEAR													
	1984		1985		1986		1987		1988		1989		1990	
Grid	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
Unkn	492	0.43	489	0.42	1778	0.85	955	0.67	72	0.74	902	1.00	870	1.00
1	0	-	10	0.01	185	0.95	0	0.00	0	-	0	0.00	503	0.91
2	48	0.15	146	0.44	240	0.91	312	0.41	76	0.35	0	0.00	630	0.74
3	49	0.57	0	0.00	2606	0.68	822	0.51	845	0.48	413	0.36	862	0.80
4	287	0.60	79	0.90	320	0.91	248	0.79	82	0.58	180	1.00	4460	0.90
5	138	0.52	434	0.68	393	0.76	34	0.40	154	0.94	160	0.78	2433	0.90
6	94	0.41	375	0.99	208	0.96	75	0.91	104	1.00	0	0.00	450	0.93
7	0	-	0	-	0	-	0	-	0	-	0	-	74	0.80
8	13	0.32	0	-	0	-	0	-	42	1.00	0	-	344	1.00
9	0	-	0	-	0	-	0	-	0	-	0	-	52	0.59
10	0	-	0	-	34	1.00	0	-	0	-	0	-	0	-
11	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12	0	-	0	-	0	-	0	-	0	-	0	-	0	-
13	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14	0	-	0	-	0	-	0	-	0	-	0	-	0	-
15	0	-	0	-	0	-	0	-	0	-	0	-	0	-
16	0	-	0	-	0	-	0	-	0	-	0	-	0	-
17	0	-	0	-	0	-	0	-	0	-	0	-	0	-
18	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19	0	-	0	-	0	-	0	-	0	-	0	-	0	-
20	0	-	0	-	0	-	0	-	0	-	0	-	0	-
21	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Other	0	0.00	0	0.00	0	0.00	93	0.44	0	0.00	0	0.00	0	0.00

Table 55. Number of length observations from other and unknown gears and corresponding fractions of total grid length observations for all gears encountered in TIP sampling in the Florida commercial red grouper fishery.

	YEAR													
	1984		1985		1986		1987		1988		1989		1990	
Grid	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
Unkn	86	0.07	25	0.02	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1	0	-	744	0.56	0	0.00	0	0.00	0	-	1	0.01	21	0.04
2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.00
3	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	56	0.05
4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	164	0.03
5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
8	0	0.00	0	-	0	-	0	-	0	0.00	0	-	0	0.00
9	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
10	0	-	0	-	0	0.00	0	-	0	-	0	-	0	-
11	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12	0	-	0	-	0	-	0	-	0	-	0	-	0	-
13	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14	0	-	0	-	0	-	0	-	0	-	0	-	0	-
15	0	-	0	-	0	-	0	-	0	-	0	-	0	-
16	0	-	0	-	0	-	0	-	0	-	0	-	0	-
17	0	-	0	-	0	-	0	-	0	-	0	-	0	-
18	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19	0	-	0	-	0	-	0	-	0	-	0	-	0	-
20	0	-	0	-	0	-	0	-	0	-	0	-	0	-
21	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Other	122	1.00	0	0.00	0	0.00	0	0.00	0	0.00	3	0.11	10	1.00

Table 56. Number of length observations for all gears enountered in TIP sampling in the Florida commercial red grouper fishery.

	YEAR						
Grid	1984	1985	1986	1987	1988	1990	1991
Unkn	1151	1155	2101	1417	97	902	870
1	0	1321	195	33	0	131	552
2	328	333	265	754	219	11	851
3	86	439	3849	1626	1760	1158	1079
4	478	88	351	315	142	180	4952
5	265	635	515	86	164	204	2702
6	228	380	217	82	104	18	483
7	0	0	0	0	0	0	93
8	40	0	0	0	42	0	345
9	0	0	0	0	0	0	88
10	0	0	34	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
Other	122	658	7	209	48	27	10

Table 57. Estimated total numbers of Gulf of Mexico red grouper landed by length, year and mode of harvest for the period 1986-1990.

	COMMERCIAL HARVEST					RECREATIONAL HARVEST					COMBINED HARVEST				
LNG	1986	1987	1988	1989	1990	1986	1987	1988	1989	1990	1986	1987	1988	1989	1990
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	14	0	0	0	0	14	0	0
8	0	0	0	0	0	0	0	14	0	0	0	0	14	0	0
9	0	0	0	0	0	540	6751	104	78	0	540	6751	104	78	0
10	0	717	2076	0	0	1135	24019	0	4251	6936	1135	24736	2076	4251	6936
11	8233	7986	41771	51339	854	18524	30911	19484	9359	0	26757	38897	61255	60698	854
12	41986	59364	141891	135362	2734	52322	33133	36084	47243	484	94308	92497	177975	182605	3218
13	57463	96587	162030	206696	3211	54733	64437	84509	58259	387	112196	161024	246539	264955	3598
14	47899	92503	125376	185230	1886	47810	35068	57597	70006	1355	95709	127571	182973	255236	3241
15	45790	95487	112187	143778	1957	64504	32195	82670	98129	677	110294	127682	194857	241907	2634
16	34771	85651	82893	164473	3043	122534	38108	75692	100396	387	157305	123759	158585	264869	3430
17	63708	85956	89424	117092	1552	79367	37107	51860	59830	3978	143075	123063	141284	176922	5530
18	60224	75484	72842	117553	3755	69575	36829	51084	68183	14771	129799	112313	123926	185736	18526
19	73956	98646	79644	101011	11691	43884	29465	56583	49340	26141	117840	128111	136227	150351	37832
20	67986	83917	54050	93875	34489	44418	34373	34444	70508	23388	112404	118290	88494	164383	57877
21	65598	77700	46335	72477	37443	35483	9357	36986	39796	15968	101081	87057	83321	112273	53411
22	52181	59251	36908	92469	55563	8732	21262	41906	12066	29496	60913	80513	78814	104535	85059
23	65448	61237	36949	44852	38216	17755	4450	20955	14688	18625	83203	65687	57904	59540	56841
24	67762	47187	30342	65747	45705	9248	4135	18964	24923	26054	77010	51322	49306	90670	71759
25	69456	47515	27718	52351	49206	855	10844	21172	4781	18388	70311	58359	48890	57132	67594
26	64244	42066	24780	26485	37637	208	3609	9796	9737	11277	64452	45675	34576	36222	48914
27	42702	40698	26235	35229	42990	232	787	2826	1273	7386	42934	41485	29061	36502	50376
28	28603	33240	18067	14179	33695	58	3433	4186	136	300	28661	36673	22253	14315	33995
29	20936	28070	15869	26544	38508	79	478	21	239	3838	21015	28548	15890	26783	42346
30	25352	19120	8629	11692	22043	38	3869	3352	35	3671	25390	22989	11981	11727	25714
31	12701	14974	11430	18877	22020	129	92	0	179	177	12830	15066	11430	19056	22197
32	10162	10446	2895	7850	13030	0	4	5	6	80	10162	10450	2900	7856	13110
33	7459	11352	2459	10101	9966	8	3376	5	6	123	7467	14728	2464	10107	10089
34	7271	8867	2145	3971	5082	0	0	0	6	0	7271	8867	2145	3977	5082
35	3720	4385	392	1182	3051	21	2	0	0	0	3741	4387	392	1182	3051
36	1603	1960	0	774	1057	0	0	0	0	53	1603	1960	0	774	1110
37	429	910	0	438	1216	0	0	0	0	0	429	910	0	438	1216
38	0	0	0	438	375	0	0	0	0	0	0	0	0	438	375
39	0	0	0	336	0	8	0	0	0	0	8	0	0	336	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tot	1047643	1291276	1255337	1802401	521975	672200	468094	710313	743453	213940	1719843	1759370	1965650	2545854	735915

Table 58. Estimated total numbers of Gulf of Mexico red grouper landed by length, year and mode of harvest for the period 1986-1990. Lengths for each year were converted to age using the growth model fit to the data of Burton and Stiles (1991).

	COMMERCIAL HARVEST					RECREATIONAL HARVEST					COMBINED HARVEST				
AGE	1986	1987	1988	1989	1990	1986	1987	1988	1989	1990	1986	1987	1988	1989	1990
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	746	6751	133	78	0	746	6751	133	78	0
2	95990	145581	321391	336787	6182	91409	120919	118763	111667	7807	187399	266500	440154	448454	13989
3	136243	288771	346630	545157	7397	269230	136830	231528	270626	2419	405473	425601	578158	815783	9816
4	176968	227602	219774	303318	10921	167383	91983	129714	158960	33325	344351	319585	349488	462278	44246
5	158417	197945	122725	203625	78117	106057	55272	106436	134046	50921	264474	253217	229161	337671	129038
6	117629	122123	73857	155049	105984	26766	25925	63436	30804	48271	144395	148048	137293	185853	154255
7	125810	83544	53836	87810	69379	9816	7616	36767	25547	37109	135626	91160	90603	113357	106488
8	94678	71298	37064	54775	64285	344	11252	15947	9935	25713	95022	82550	53011	64710	89998
9	44548	46026	32578	26621	50774	133	3729	1309	1308	406	44681	49755	33887	27929	51180
10	26178	32634	19533	26151	41158	108	478	2920	251	3865	26286	33112	22453	26402	45023
11	27841	22856	8629	19144	30704	17	494	3352	29	3671	27858	23350	11981	19173	34375
12	9505	12450	8914	15845	17454	149	3466	0	179	80	9654	15916	8914	16024	17534
13	7911	6848	3286	6430	14796	0	4	5	12	123	7911	6852	3291	6442	14919
14	6855	7390	2126	8967	7612	0	3378	0	0	150	6855	10768	2126	8967	7762
15	2369	8728	1360	2894	3654	8	0	5	6	0	2377	8728	1365	2900	3654
16	5108	2623	1099	2690	2997	0	0	0	0	27	5108	2623	1099	2690	3024
17	4182	4833	1721	2018	2899	0	0	0	6	0	4182	4833	1721	2024	2899
18	1664	2766	424	1953	1961	0	0	0	0	0	1664	2766	424	1953	1961
19	1584	1633	0	408	1747	21	2	0	0	0	1605	1635	0	408	1747
20	1991	1955	353	0	412	0	0	0	0	0	1991	1955	353	0	412
21	145	797	0	774	856	0	0	0	0	0	145	797	0	774	856
22	4	1369	39	0	209	0	0	0	0	0	4	1369	39	0	209
23	1031	192	0	336	564	0	0	0	0	0	1031	192	0	336	564
24	0	104	0	0	37	0	0	0	0	0	0	104	0	0	37
25	140	96	0	0	37	0	0	0	0	53	140	96	0	0	90
Tot	1047649	1291274	1255339	1802402	521975	672195	468099	710315	743454	213940	1719844	1759373	1965654	2545856	735915

Table 59. Estimated total numbers of Gulf of Mexico red grouper landed by length, year and mode of harvest for the period 1986-1990. Lengths for each year were converted to age using the growth model reported by Moe (1969).

	COMMERCIAL HARVEST					RECREATIONAL HARVEST					COMBINED HARVEST				
AGE	1986	1987	1988	1989	1990	1986	1987	1988	1989	1990	1986	1987	1988	1989	1990
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1056	16879	133	78	3468	1056	16879	133	78	3468
2	79467	110256	261478	260677	5239	81775	96493	94707	97196	4242	161242	206749	356185	357873	9481
3	129078	261137	339480	498681	6582	182405	120091	207330	221237	2129	311483	381228	546810	719918	8711
4	126921	196754	198712	311984	4797	202417	72873	125015	172568	8317	329338	269627	323727	484552	13114
5	121651	169776	132370	192944	24867	96367	83568	98643	109768	40815	218018	253344	231013	302712	65682
6	110500	122573	78480	145371	76690	70841	21907	64194	75528	35527	181341	144480	142674	220899	112217
7	77767	85838	52559	92752	60503	25899	25117	47951	17480	44143	103666	110955	100510	110232	104646
8	91475	68698	48063	75742	50898	9537	4605	29675	33183	29856	101012	73303	77738	108925	80754
9	74198	50534	27071	53596	48403	1110	3765	19128	4691	11355	75308	54299	46199	58287	59758
10	69304	45769	22869	21730	33966	136	7367	13110	8755	14623	69440	53136	35979	30485	48589
11	33137	28031	21788	34733	32502	249	3901	2837	1341	11118	33386	31932	24625	36074	43620
12	21544	25049	14363	17811	28182	84	3657	21	1022	106	21628	28706	14384	18833	28288
13	15241	18474	10621	7121	20409	8	55	1288	125	273	15249	18529	11909	7246	20682
14	14160	14751	6631	18433	23992	50	55	2904	12	203	14210	14806	9535	18445	24195
15	9010	11372	6447	7718	14799	41	423	16	162	3565	9051	11795	6463	7880	18364
16	3009	8049	6455	7452	12216	17	0	0	78	97	3026	8049	6455	7530	12313
17	12713	6433	3158	475	2989	0	53	558	12	80	12713	6486	3716	487	3069
18	7703	3797	2189	4081	9136	0	388	2788	0	3565	7703	4185	4977	4081	12701
19	3299	7867	1817	7137	8568	8	53	5	12	27	3307	7920	1822	7149	8595
20	4125	3221	1464	0	1351	29	0	0	12	0	4154	3221	1464	12	1351
21	2052	4193	3165	0	160	0	3376	0	0	0	2052	7569	3165	0	160
22	1008	1817	1705	5638	6761	0	55	0	6	0	1008	1872	1705	5644	6761
23	894	3361	39	0	1561	8	35	0	84	27	902	3396	39	84	1588
24	1009	1412	1872	0	110	0	0	0	6	27	1009	1412	1872	6	137
25	1723	487	0	10106	6056	8	0	0	0	27	1731	487	0	10106	6083
+	33841	40444	10408	28122	39402	38	3384	11	23	353	33879	43828	10419	28145	39755
Tot	1047649	1291273	1255336	1802406	521977	672194	468100	710314	743457	213943	1719843	1759373	1965650	2545863	735920

Table 60 . Estimated percentage reductions in the indicated recreational component of fishing mortality on red grouper assuming there is no mortality of fish caught and released in excess of the respective limits. These estimates are based on the cumulative frequency distributions of catch at size and catch per angler. It is assumed that the two distributions are independent and that the catch frequencies will be unchanged by the conservation action. The estimates are based on 1989 catch rates and are applicable only for the first year in which they might be imposed since the length composition and size of the stock are expected to change in response to conservation measures.

HEADBOATS - NO MORTALITY OF RELEASED FISH

	CREEL LIMIT																				
Size	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	100.0	14.6	4.5	1.7	0.8	0.5	0.4	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
10	100.0	14.9	4.9	2.1	1.2	0.9	0.8	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
11	100.0	15.8	5.8	3.1	2.2	1.9	1.8	1.8	1.7	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
12	100.0	19.3	9.8	7.1	6.3	6.0	5.9	5.8	5.8	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
13	100.0	26.6	17.9	15.5	14.7	14.5	14.4	14.3	14.3	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2
14	100.0	35.7	28.1	26.1	25.4	25.1	25.1	25.0	25.0	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9
15	100.0	44.3	37.7	35.9	35.3	35.1	35.0	35.0	35.0	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9
16	100.0	50.4	44.5	42.9	42.4	42.2	42.1	42.1	42.1	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0
17	100.0	56.5	51.4	50.0	49.5	49.4	49.3	49.3	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2
18	100.0	62.9	58.5	57.3	56.9	56.7	56.7	56.7	56.6	56.6	56.6	56.6	56.6	56.6	56.6	56.6	56.6	56.6	56.6	56.6	56.6
19	100.0	67.5	63.6	62.6	62.2	62.1	62.1	62.1	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0
20	100.0	73.5	70.3	69.5	69.2	69.1	69.1	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0

Table 61. Estimated percentage reductions in the indicated recreational component of fishing mortality on red grouper assuming there is a 33 percent mortality of fish caught and released in excess of the size limit, but that no fish are killed in excess of the creel limit. These estimates are based on the cumulative frequency distributions of catch at size and catch per angler. It is assumed that the two distributions are independent and that the catch frequencies will be unchanged by the conservation action. The estimates are based on 1989 catch rates and are applicable only for the first year in which they might be imposed since the length composition and size of the stock are expected to change in response to conservation measures.

HEADBOATS - 33% MORTALITY OF RELEASED FISH WITH NO CATCH IN EXCESS OF CREEL LIMITS

	CREEL LIMIT																				
Size	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	100.0	14.4	4.3	1.5	0.6	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	99.9	14.5	4.4	1.7	0.8	0.4	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
10	99.8	14.7	4.7	1.9	1.0	0.7	0.6	0.6	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
11	99.5	15.3	5.3	2.6	1.7	1.4	1.3	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
12	98.1	17.4	7.9	5.3	4.4	4.1	4.0	4.0	3.9	3.9	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
13	95.3	21.9	13.2	10.8	10.1	9.8	9.7	9.6	9.6	9.6	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
14	91.8	27.5	19.9	17.8	17.2	16.9	16.9	16.8	16.8	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7
15	88.5	32.8	26.2	24.4	23.8	23.6	23.5	23.5	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4
16	86.1	36.5	30.6	29.0	28.5	28.3	28.3	28.2	28.2	28.2	28.1	28.1	28.1	28.1	28.1	28.1	28.1	28.1	28.1	28.1	28.1
17	83.8	40.3	35.2	33.7	33.3	33.1	33.1	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0
18	81.3	44.2	39.8	38.6	38.2	38.1	38.0	38.0	38.0	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9
19	79.5	47.0	43.2	42.1	41.8	41.7	41.6	41.6	41.6	41.6	41.5	41.5	41.5	41.5	41.5	41.5	41.5	41.5	41.5	41.5	41.5
20	77.2	50.7	47.6	46.7	46.4	46.3	46.3	46.3	46.3	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2

Table 62. Estimated percentage reductions in the indicated recreational component of fishing mortality on red grouper assuming there is a 33 percent mortality of fish caught and released in excess of the respective limits. These estimates are based on the cumulative frequency distributions of catch at size and catch per angler. It is assumed that the two distributions are independent and that the catch frequencies will be unchanged by the conservation action. The estimates are based on 1989 catch rates and are applicable only for the first year in which they might be imposed since the length composition and size of the stock are expected to change in response to conservation measures.

HEADBOATS - 33% MORTALITY OF RELEASED FISH

	CREEL LIMIT																				
Size	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	67.0	9.7	2.9	1.0	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	67.0	9.7	2.9	1.0	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	67.0	9.7	2.9	1.0	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	67.0	9.7	2.9	1.0	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	67.0	9.7	2.9	1.0	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	67.0	9.7	2.9	1.0	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	67.0	9.7	2.9	1.0	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	67.0	9.7	2.9	1.0	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	67.0	9.7	2.9	1.0	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	67.0	9.8	3.0	1.2	0.6	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
10	67.0	10.0	3.3	1.4	0.8	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
11	67.0	10.6	3.9	2.1	1.5	1.3	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
12	67.0	12.9	6.5	4.8	4.2	4.0	4.0	3.9	3.9	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
13	67.0	17.8	12.0	10.4	9.9	9.7	9.6	9.6	9.6	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
14	67.0	23.9	18.9	17.5	17.0	16.8	16.8	16.8	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7
15	67.0	29.7	25.3	24.1	23.7	23.5	23.5	23.5	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4
16	67.0	33.7	29.8	28.7	28.4	28.3	28.2	28.2	28.2	28.2	28.1	28.1	28.1	28.1	28.1	28.1	28.1	28.1	28.1	28.1	28.1
17	67.0	37.9	34.4	33.5	33.2	33.1	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0
18	67.0	42.1	39.2	38.4	38.1	38.0	38.0	38.0	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9
19	67.0	45.2	42.6	41.9	41.7	41.6	41.6	41.6	41.6	41.6	41.5	41.5	41.5	41.5	41.5	41.5	41.5	41.5	41.5	41.5	41.5
20	67.0	49.2	47.1	46.5	46.4	46.3	46.3	46.3	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2

Table 63. Estimated percentage reductions in the indicated recreational component of fishing mortality on red grouper assuming there is no mortality of fish caught and released in excess of the respective limits. These estimates are based on the cumulative frequency distributions of catch at size and catch per angler. It is assumed that the two distributions are independent and that the catch frequencies will be unchanged by the conservation action. The estimates are based on 1989 catch rates and are applicable only for the first year in which they might be imposed since the length composition and size of the stock are expected to change in response to conservation measures.

CHARTER BOATS - NO MORTALITY OF RELEASED FISH

	CREEL LIMIT																				
Size	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
1	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
2	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
3	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
4	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
5	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
6	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
7	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
8	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
9	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
10	100.0	70.3	48.9	33.2	22.3	15.0	10.1	7.1	5.2	4.1	3.3	2.7	2.2	1.8	1.6	1.4	1.2	1.1	0.9	0.8	0.7
11	100.0	70.3	48.9	33.2	22.3	15.0	10.1	7.1	5.2	4.1	3.3	2.7	2.2	1.8	1.6	1.4	1.2	1.1	0.9	0.8	0.7
12	100.0	71.2	50.4	35.1	24.6	17.5	12.8	9.8	8.0	6.9	6.1	5.5	5.0	4.7	4.4	4.2	4.1	3.9	3.8	3.7	3.6
13	100.0	71.8	51.5	36.6	26.3	19.3	14.7	11.8	10.1	9.0	8.2	7.7	7.2	6.9	6.6	6.4	6.3	6.1	6.0	5.9	5.8
14	100.0	73.1	53.8	39.5	29.7	23.1	18.7	15.9	14.2	13.2	12.5	12.0	11.5	11.2	11.0	10.8	10.6	10.5	10.4	10.3	10.2
15	100.0	76.1	58.9	46.2	37.5	31.5	27.6	25.2	23.7	22.8	22.1	21.6	21.2	21.0	20.7	20.6	20.4	20.3	20.2	20.1	20.1
16	100.0	79.7	65.1	54.3	46.9	41.9	38.6	36.4	35.2	34.4	33.9	33.5	33.1	32.9	32.7	32.6	32.4	32.3	32.3	32.2	32.1
17	100.0	81.4	68.0	58.2	51.4	46.8	43.8	41.9	40.7	40.0	39.5	39.1	38.8	38.6	38.4	38.3	38.2	38.1	38.0	38.0	37.9
18	100.0	84.4	73.1	64.8	59.1	55.3	52.7	51.1	50.1	49.5	49.1	48.8	48.5	48.4	48.2	48.1	48.0	47.9	47.9	47.8	47.8
19	100.0	86.9	77.4	70.5	65.7	62.4	60.3	58.9	58.1	57.6	57.3	57.0	56.8	56.6	56.5	56.4	56.4	56.3	56.2	56.2	56.1
20	100.0	89.0	81.0	75.2	71.1	68.4	66.6	65.5	64.8	64.4	64.1	63.9	63.7	63.5	63.4	63.4	63.3	63.2	63.2	63.2	63.1

Table 64. Estimated percentage reductions in the indicated recreational component of fishing mortality on red grouper assuming there is a 33 percent mortality of fish caught and released in excess of the size limit, but that no fish are killed in excess of the creel limit. These estimates are based on the cumulative frequency distributions of catch at size and catch per angler. It is assumed that the two distributions are independent and that the catch frequencies will be unchanged by the conservation action. The estimates are based on 1989 catch rates and are applicable only for the first year in which they might be imposed since the length composition and size of the stock are expected to change in response to conservation measures.

CHARTER BOATS - 33% MORTALITY OF RELEASED FISH WITH NO CATCH IN EXCESS OF CREEL LIMITS

	CREEL LIMIT																				
Size	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
1	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
2	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
3	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
4	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
5	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
6	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
7	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
8	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
9	100.0	70.2	48.7	32.9	22.0	14.6	9.8	6.7	4.8	3.7	2.9	2.3	1.8	1.4	1.2	1.0	0.8	0.7	0.5	0.4	0.3
10	99.9	70.2	48.8	33.0	22.2	14.9	10.0	6.9	5.1	4.0	3.2	2.6	2.1	1.7	1.4	1.2	1.1	0.9	0.8	0.7	0.6
11	99.9	70.2	48.8	33.0	22.2	14.9	10.0	6.9	5.1	4.0	3.2	2.6	2.1	1.7	1.4	1.2	1.1	0.9	0.8	0.7	0.6
12	98.9	70.1	49.3	34.0	23.5	16.4	11.7	8.7	6.9	5.8	5.0	4.4	4.0	3.6	3.3	3.1	3.0	2.8	2.7	2.6	2.5
13	98.2	70.0	49.7	34.8	24.5	17.5	12.9	10.0	8.2	7.2	6.4	5.9	5.4	5.0	4.8	4.6	4.4	4.3	4.2	4.1	4.0
14	96.7	69.9	50.5	36.3	26.5	19.8	15.4	12.7	11.0	10.0	9.2	8.7	8.3	7.9	7.7	7.5	7.3	7.2	7.1	7.0	6.9
15	93.5	69.6	52.3	39.6	30.9	25.0	21.1	18.6	17.1	16.2	15.6	15.1	14.7	14.4	14.2	14.0	13.9	13.8	13.7	13.6	13.5
16	89.5	69.2	54.5	43.8	36.4	31.3	28.0	25.9	24.7	23.9	23.4	22.9	22.6	22.4	22.2	22.0	21.9	21.8	21.7	21.7	21.6
17	87.6	69.0	55.6	45.7	39.0	34.4	31.3	29.4	28.3	27.6	27.1	26.7	26.4	26.2	26.0	25.9	25.8	25.7	25.6	25.5	25.5
18	84.3	68.7	57.4	49.1	43.4	39.6	37.0	35.4	34.4	33.8	33.4	33.1	32.8	32.6	32.5	32.4	32.3	32.2	32.2	32.1	32.1
19	81.5	68.4	58.9	52.0	47.2	44.0	41.8	40.5	39.6	39.2	38.8	38.5	38.3	38.2	38.0	37.9	37.9	37.8	37.8	37.7	37.7
20	79.2	68.2	60.2	54.4	50.4	47.6	45.8	44.7	44.0	43.6	43.3	43.1	42.9	42.7	42.6	42.6	42.5	42.5	42.4	42.4	42.3

Table 65. Estimated percentage reductions in the indicated recreational component of fishing mortality on red grouper assuming there is a 33 percent mortality of fish caught and released in excess of the respective limits. These estimates are based on the cumulative frequency distributions of catch at size and catch per angler. It is assumed that the two distributions are independent and that the catch frequencies will be unchanged by the conservation action. The estimates are based on 1989 catch rates and are applicable only for the first year in which they might be imposed since the length composition and size of the stock are expected to change in response to conservation measures.

CHARTER BOATS - 33% MORTALITY OF RELEASED FISH

	CREEL LIMIT																				
Size	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	67.0	47.0	32.6	22.0	14.8	9.8	6.5	4.5	3.2	2.5	1.9	1.5	1.2	1.0	0.8	0.6	0.5	0.4	0.4	0.3	0.2
1	67.0	47.0	32.6	22.0	14.8	9.8	6.5	4.5	3.2	2.5	1.9	1.5	1.2	1.0	0.8	0.6	0.5	0.4	0.4	0.3	0.2
2	67.0	47.0	32.6	22.0	14.8	9.8	6.5	4.5	3.2	2.5	1.9	1.5	1.2	1.0	0.8	0.6	0.5	0.4	0.4	0.3	0.2
3	67.0	47.0	32.6	22.0	14.8	9.8	6.5	4.5	3.2	2.5	1.9	1.5	1.2	1.0	0.8	0.6	0.5	0.4	0.4	0.3	0.2
4	67.0	47.0	32.6	22.0	14.8	9.8	6.5	4.5	3.2	2.5	1.9	1.5	1.2	1.0	0.8	0.6	0.5	0.4	0.4	0.3	0.2
5	67.0	47.0	32.6	22.0	14.8	9.8	6.5	4.5	3.2	2.5	1.9	1.5	1.2	1.0	0.8	0.6	0.5	0.4	0.4	0.3	0.2
6	67.0	47.0	32.6	22.0	14.8	9.8	6.5	4.5	3.2	2.5	1.9	1.5	1.2	1.0	0.8	0.6	0.5	0.4	0.4	0.3	0.2
7	67.0	47.0	32.6	22.0	14.8	9.8	6.5	4.5	3.2	2.5	1.9	1.5	1.2	1.0	0.8	0.6	0.5	0.4	0.4	0.3	0.2
8	67.0	47.0	32.6	22.0	14.8	9.8	6.5	4.5	3.2	2.5	1.9	1.5	1.2	1.0	0.8	0.6	0.5	0.4	0.4	0.3	0.2
9	67.0	47.0	32.6	22.0	14.8	9.8	6.5	4.5	3.2	2.5	1.9	1.5	1.2	1.0	0.8	0.6	0.5	0.4	0.4	0.3	0.2
10	67.0	47.1	32.8	22.2	15.0	10.0	6.8	4.7	3.5	2.7	2.2	1.8	1.5	1.2	1.1	0.9	0.8	0.7	0.6	0.6	0.5
11	67.0	47.1	32.8	22.2	15.0	10.0	6.8	4.7	3.5	2.7	2.2	1.8	1.5	1.2	1.1	0.9	0.8	0.7	0.6	0.6	0.5
12	67.0	47.7	33.8	23.5	16.5	11.7	8.5	6.5	5.3	4.6	4.1	3.7	3.4	3.1	3.0	2.8	2.7	2.6	2.6	2.5	2.4
13	67.0	48.1	34.5	24.5	17.6	13.0	9.9	7.9	6.7	6.0	5.5	5.1	4.8	4.6	4.4	4.3	4.2	4.1	4.0	4.0	3.9
14	67.0	49.0	36.0	26.5	19.9	15.5	12.5	10.7	9.5	8.9	8.4	8.0	7.7	7.5	7.3	7.2	7.1	7.0	7.0	6.9	6.8
15	67.0	51.0	39.4	30.9	25.1	21.1	18.5	16.9	15.9	15.3	14.8	14.5	14.2	14.0	13.9	13.8	13.7	13.6	13.6	13.5	13.4
16	67.0	53.4	43.6	36.4	31.4	28.1	25.8	24.4	23.6	23.1	22.7	22.4	22.2	22.0	21.9	21.8	21.7	21.7	21.6	21.6	21.5
17	67.0	54.6	45.6	39.0	34.5	31.4	29.3	28.0	27.3	26.8	26.5	26.2	26.0	25.9	25.7	25.7	25.6	25.5	25.5	25.4	25.4
18	67.0	56.5	49.0	43.4	39.6	37.0	35.3	34.2	33.6	33.2	32.9	32.7	32.5	32.4	32.3	32.2	32.2	32.1	32.1	32.0	32.0
19	67.0	58.2	51.9	47.2	44.0	41.8	40.4	39.5	38.9	38.6	38.4	38.2	38.1	37.9	37.9	37.8	37.8	37.7	37.7	37.6	37.6
20	67.0	59.6	54.3	50.4	47.7	45.8	44.6	43.9	43.4	43.1	42.9	42.8	42.7	42.6	42.5	42.4	42.4	42.4	42.3	42.3	42.3

Table 66. Estimated percentage reductions in the indicated recreational component of fishing mortality on red grouper assuming there is no mortality of fish caught and released in excess of the respective limits. These estimates are based on the cumulative frequency distributions of catch at size and catch per angler. It is assumed that the two distributions are independent and that the catch frequencies will be unchanged by the conservation action. The estimates are based on 1989 catch rates and are applicable only for the first year in which they might be imposed since the length composition and size of the stock are expected to change in response to conservation measures.

PRIVATE/RENTAL BOATS - NO MORTALITY OF RELEASED FISH

	CREEL LIMIT																				
Size	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	100.0	82.1	70.2	60.5	52.8	46.3	40.8	36.3	32.2	28.5	25.6	23.1	20.9	19.4	18.0	16.7	15.7	14.7	14.0	13.5	12.9
1	100.0	82.1	70.2	60.5	52.8	46.3	40.8	36.3	32.2	28.5	25.6	23.1	20.9	19.4	18.0	16.7	15.7	14.7	14.0	13.5	12.9
2	100.0	82.1	70.2	60.5	52.8	46.3	40.8	36.3	32.2	28.5	25.6	23.1	20.9	19.4	18.0	16.7	15.7	14.7	14.0	13.5	12.9
3	100.0	82.1	70.2	60.5	52.8	46.3	40.8	36.3	32.2	28.5	25.6	23.1	20.9	19.4	18.0	16.7	15.7	14.7	14.0	13.5	12.9
4	100.0	82.1	70.2	60.5	52.8	46.3	40.8	36.3	32.2	28.5	25.6	23.1	20.9	19.4	18.0	16.7	15.7	14.7	14.0	13.5	12.9
5	100.0	82.1	70.2	60.5	52.8	46.3	40.8	36.3	32.2	28.5	25.6	23.1	20.9	19.4	18.0	16.7	15.7	14.7	14.0	13.5	12.9
6	100.0	82.1	70.2	60.5	52.8	46.4	40.9	36.4	32.2	28.6	25.7	23.2	21.0	19.5	18.1	16.8	15.7	14.8	14.1	13.5	13.0
7	100.0	82.1	70.2	60.6	52.9	46.5	41.0	36.5	32.4	28.7	25.8	23.4	21.1	19.7	18.3	16.9	15.9	15.0	14.3	13.7	13.2
8	100.0	82.2	70.3	60.6	53.0	46.6	41.0	36.6	32.4	28.8	25.9	23.4	21.2	19.7	18.4	17.0	16.0	15.1	14.4	13.8	13.3
9	100.0	82.2	70.4	60.8	53.2	46.8	41.3	36.8	32.7	29.1	26.2	23.8	21.5	20.1	18.7	17.4	16.3	15.4	14.7	14.2	13.6
10	100.0	82.5	70.8	61.3	53.7	47.4	42.0	37.6	33.5	29.9	27.1	24.7	22.5	21.0	19.7	18.4	17.3	16.4	15.7	15.2	14.7
11	100.0	83.1	71.8	62.7	55.4	49.4	44.1	39.9	36.0	32.5	29.7	27.4	25.3	23.9	22.6	21.4	20.4	19.5	18.8	18.3	17.8
12	100.0	84.2	73.6	65.0	58.2	52.5	47.6	43.6	40.0	36.7	34.1	32.0	30.0	28.7	27.5	26.3	25.4	24.5	23.9	23.4	22.9
13	100.0	86.0	76.6	69.1	63.0	58.0	53.6	50.1	46.9	44.0	41.7	39.8	38.1	36.9	35.8	34.8	34.0	33.2	32.7	32.2	31.8
14	100.0	87.4	79.0	72.2	66.8	62.3	58.4	55.2	52.3	49.7	47.7	46.0	44.4	43.4	42.4	41.4	40.7	40.1	39.5	39.2	38.8
15	100.0	88.9	81.4	75.4	70.6	66.6	63.2	60.4	57.8	55.5	53.7	52.2	50.8	49.9	49.0	48.2	47.5	47.0	46.5	46.2	45.8
16	100.0	90.8	84.7	79.7	75.7	72.4	69.6	67.3	65.1	63.2	61.7	60.5	59.3	58.6	57.9	57.2	56.6	56.2	55.8	55.5	55.2
17	100.0	92.2	87.0	82.8	79.4	76.6	74.2	72.2	70.4	68.8	67.6	66.5	65.5	64.9	64.3	63.7	63.2	62.8	62.5	62.3	62.0
18	100.0	93.6	89.4	85.9	83.2	80.9	78.9	77.3	75.8	74.5	73.5	72.6	71.8	71.3	70.8	70.3	70.0	69.6	69.4	69.2	69.0
19	100.0	94.7	91.2	88.4	86.1	84.2	82.6	81.3	80.1	79.0	78.1	77.4	76.7	76.3	75.9	75.5	75.2	74.9	74.7	74.6	74.4
20	100.0	95.9	93.2	91.0	89.3	87.8	86.6	85.5	84.6	83.8	83.1	82.6	82.0	81.7	81.4	81.1	80.9	80.6	80.5	80.4	80.2

Table 67. Estimated percentage reductions in the indicated recreational component of fishing mortality on red grouper assuming there is a 33 percent mortality of fish caught and released in excess of the size limit, but that no fish are killed in excess of the creel limit. These estimates are based on the cumulative frequency distributions of catch at size and catch per angler. It is assumed that the two distributions are independent and that the catch frequencies will be unchanged by the conservation action. The estimates are based on 1989 catch rates and are applicable only for the first year in which they might be imposed since the length composition and size of the stock are expected to change in response to conservation measures.

PRIVATE/RENTAL BOATS - 33% MORTALITY OF RELEASED FISH WITH NO CATCH IN EXCESS OF CREEL LIMITS

	CREEL LIMIT																				
Size	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	100.0	82.1	70.2	60.5	52.8	46.3	40.8	36.3	32.2	28.5	25.6	23.1	20.9	19.4	18.0	16.7	15.7	14.7	14.0	13.5	12.9
1	100.0	82.1	70.2	60.5	52.8	46.3	40.8	36.3	32.2	28.5	25.6	23.1	20.9	19.4	18.0	16.7	15.7	14.7	14.0	13.5	12.9
2	100.0	82.1	70.2	60.5	52.8	46.3	40.8	36.3	32.2	28.5	25.6	23.1	20.9	19.4	18.0	16.7	15.7	14.7	14.0	13.5	12.9
3	100.0	82.1	70.2	60.5	52.8	46.3	40.8	36.3	32.2	28.5	25.6	23.1	20.9	19.4	18.0	16.7	15.7	14.7	14.0	13.5	12.9
4	100.0	82.1	70.2	60.5	52.8	46.3	40.8	36.3	32.2	28.5	25.6	23.1	20.9	19.4	18.0	16.7	15.7	14.7	14.0	13.5	12.9
5	100.0	82.1	70.2	60.5	52.8	46.3	40.8	36.3	32.2	28.5	25.6	23.1	20.9	19.4	18.0	16.7	15.7	14.7	14.0	13.5	12.9
6	100.0	82.1	70.2	60.5	52.8	46.4	40.8	36.3	32.2	28.5	25.6	23.2	20.9	19.5	18.1	16.7	15.7	14.8	14.1	13.5	13.0
7	99.9	82.0	70.1	60.5	52.8	46.4	40.9	36.4	32.3	28.6	25.7	23.3	21.0	19.6	18.2	16.8	15.8	14.9	14.2	13.6	13.1
8	99.9	82.0	70.1	60.5	52.9	46.4	40.9	36.4	32.3	28.7	25.7	23.3	21.1	19.6	18.2	16.9	15.9	14.9	14.2	13.7	13.1
9	99.7	82.0	70.1	60.5	52.9	46.5	41.0	36.5	32.4	28.8	25.9	23.5	21.3	19.8	18.4	17.1	16.1	15.2	14.4	13.9	13.3
10	99.3	81.8	70.1	60.6	53.1	46.8	41.3	36.9	32.9	29.3	26.4	24.0	21.8	20.4	19.0	17.7	16.7	15.8	15.1	14.5	14.0
11	98.2	81.2	70.0	60.8	53.6	47.5	42.3	38.0	34.1	30.7	27.9	25.6	23.5	22.1	20.8	19.5	18.5	17.7	17.0	16.5	15.9
12	96.2	80.4	69.8	61.2	54.4	48.7	43.8	39.8	36.2	32.9	30.3	28.2	26.2	24.9	23.7	22.5	21.6	20.7	20.1	19.6	19.1
13	92.8	78.8	69.5	61.9	55.9	50.8	46.5	43.0	39.7	36.9	34.6	32.7	30.9	29.8	28.7	27.6	26.8	26.1	25.5	25.1	24.6
14	90.2	77.6	69.2	62.4	57.0	52.5	48.6	45.4	42.5	39.9	37.9	36.2	34.6	33.6	32.6	31.6	30.9	30.3	29.7	29.4	29.0
15	87.5	76.4	69.0	62.9	58.2	54.2	50.7	47.9	45.3	43.1	41.2	39.7	38.3	37.4	36.5	35.7	35.1	34.5	34.0	33.7	33.4
16	84.0	74.8	68.6	63.6	59.7	56.4	53.5	51.2	49.1	47.2	45.7	44.5	43.3	42.5	41.8	41.1	40.6	40.1	39.8	39.5	39.2
17	81.4	73.6	68.4	64.2	60.8	58.0	55.6	53.6	51.8	50.2	48.9	47.9	46.9	46.3	45.6	45.1	44.6	44.2	43.9	43.7	43.4
18	78.7	72.4	68.1	64.7	61.9	59.6	57.7	56.1	54.6	53.3	52.3	51.4	50.6	50.1	49.6	49.1	48.7	48.4	48.1	47.9	47.7
19	76.7	71.4	67.9	65.1	62.8	60.9	59.3	58.0	56.8	55.7	54.8	54.1	53.4	53.0	52.6	52.2	51.9	51.6	51.4	51.3	51.1
20	74.5	70.4	67.7	65.5	63.8	62.3	61.1	60.0	59.1	58.3	57.6	57.0	56.5	56.2	55.9	55.6	55.3	55.1	55.0	54.8	54.7

Table 68. Estimated percentage reductions in the indicated recreational component of fishing mortality on red grouper assuming there is a 33 percent mortality of fish caught and released in excess of the respective limits. These estimates are based on the cumulative frequency distributions of catch at size and catch per angler. It is assumed that the two distributions are independent and that the catch frequencies will be unchanged by the conservation action. The estimates are based on 1989 catch rates and are applicable only for the first year in which they might be imposed since the length composition and size of the stock are expected to change in response to conservation measures.

PRIVATE/RENTAL BOATS - 33% MORTALITY OF RELEASED FISH

	CREEL LIMIT																				
Size	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	67.0	55.0	47.0	40.5	35.4	31.1	27.3	24.3	21.5	19.1	17.1	15.5	14.0	13.0	12.1	11.2	10.5	9.9	9.4	9.0	8.7
1	67.0	55.0	47.0	40.5	35.4	31.1	27.3	24.3	21.5	19.1	17.1	15.5	14.0	13.0	12.1	11.2	10.5	9.9	9.4	9.0	8.7
2	67.0	55.0	47.0	40.5	35.4	31.1	27.3	24.3	21.5	19.1	17.1	15.5	14.0	13.0	12.1	11.2	10.5	9.9	9.4	9.0	8.7
3	67.0	55.0	47.0	40.5	35.4	31.1	27.3	24.3	21.5	19.1	17.1	15.5	14.0	13.0	12.1	11.2	10.5	9.9	9.4	9.0	8.7
4	67.0	55.0	47.0	40.5	35.4	31.1	27.3	24.3	21.5	19.1	17.1	15.5	14.0	13.0	12.1	11.2	10.5	9.9	9.4	9.0	8.7
5	67.0	55.0	47.0	40.5	35.4	31.1	27.3	24.3	21.5	19.1	17.1	15.5	14.0	13.0	12.1	11.2	10.5	9.9	9.4	9.0	8.7
6	67.0	55.0	47.0	40.5	35.4	31.1	27.4	24.4	21.6	19.1	17.2	15.6	14.0	13.1	12.1	11.2	10.5	9.9	9.4	9.1	8.7
7	67.0	55.0	47.1	40.6	35.5	31.2	27.5	24.4	21.7	19.2	17.3	15.7	14.2	13.2	12.2	11.3	10.7	10.0	9.6	9.2	8.8
8	67.0	55.1	47.1	40.6	35.5	31.2	27.5	24.5	21.7	19.3	17.3	15.7	14.2	13.2	12.3	11.4	10.7	10.1	9.6	9.2	8.9
9	67.0	55.1	47.2	40.7	35.6	31.3	27.7	24.7	21.9	19.5	17.5	15.9	14.4	13.4	12.5	11.6	10.9	10.3	9.8	9.5	9.1
10	67.0	55.2	47.4	41.0	36.0	31.8	28.1	25.2	22.5	20.1	18.1	16.5	15.1	14.1	13.2	12.3	11.6	11.0	10.5	10.2	9.8
11	67.0	55.7	48.1	42.0	37.1	33.1	29.6	26.7	24.1	21.8	19.9	18.4	17.0	16.0	15.2	14.3	13.7	13.1	12.6	12.3	11.9
12	67.0	56.4	49.3	43.6	39.0	35.2	31.9	29.2	26.8	24.6	22.9	21.4	20.1	19.2	18.4	17.6	17.0	16.4	16.0	15.7	15.4
13	67.0	57.6	51.3	46.3	42.2	38.9	35.9	33.6	31.4	29.5	28.0	26.7	25.5	24.7	24.0	23.3	22.8	22.3	21.9	21.6	21.3
14	67.0	58.6	52.9	48.4	44.8	41.7	39.1	37.0	35.0	33.3	31.9	30.8	29.7	29.0	28.4	27.8	27.3	26.8	26.5	26.2	26.0
15	67.0	59.5	54.6	50.5	47.3	44.6	42.3	40.5	38.7	37.2	36.0	35.0	34.0	33.4	32.8	32.3	31.8	31.5	31.2	30.9	30.7
16	67.0	60.8	56.7	53.4	50.7	48.5	46.6	45.1	43.6	42.4	41.4	40.5	39.8	39.3	38.8	38.3	38.0	37.6	37.4	37.2	37.0
17	67.0	61.8	58.3	55.5	53.2	51.3	49.7	48.4	47.2	46.1	45.3	44.5	43.9	43.5	43.1	42.7	42.4	42.1	41.9	41.7	41.6
18	67.0	62.7	59.9	57.6	55.7	54.2	52.9	51.8	50.8	49.9	49.2	48.7	48.1	47.8	47.4	47.1	46.9	46.7	46.5	46.4	46.2
19	67.0	63.5	61.1	59.2	57.7	56.4	55.3	54.5	53.6	52.9	52.3	51.9	51.4	51.1	50.9	50.6	50.4	50.2	50.1	50.0	49.8
20	67.0	64.3	62.5	61.0	59.8	58.8	58.0	57.3	56.7	56.1	55.7	55.3	55.0	54.7	54.5	54.3	54.2	54.0	53.9	53.8	53.8