TAB 4

THE RED GROUPER FISHERY OF THE GULF OF MEXICO

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EXECUTIVE SUMMARY

Gulf of Mexico red grouper harvested by U.S. fishermen are primarily caught in the e[redacted] 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, U.S. 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 U.S. grouper landings increased sharply to a maximum of about 12½ million pounds in 1982. Handpower lines and longlines were the predominant gear employed for red grouper harvested in 1992. 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 U.S. commercial harvest for this species was about 8½ million pounds in 1982. In earlier years Cuban fishermen also harvested red grouper in the waters off the Florida West Coast and contributed to peak annual catches of about 12 million pounds in the mid 1950s. 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) [redacted] 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 from Florida's state territorial seas after the 18-inch minimum size was established in Florida, however the total recreational harvest was little affected by this regulation with the bulk of the remaining recreational harvest of red grouper coming from fish harvested from the EEZ. Many of these were less than 18 inches in length.

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 commercial landings in 1992 were about 4.3 million pounds, the lowest since the mid 1970s, at least in part because of changes in the fishery associated with the minimum size. The effect of the 1990 minimum size is clearly evident in the length-frequency samples from all sectors of the fishery. The commercial quota for shallow water groupers has had not been met since 1990 and consequently, the quota itself has had no conservation effect since then, except perhaps by discouraging additional participants in the fishery.

An examination of growth suggests that there has been a significant increase in length at age of red grouper resulting from an increase in growth rate during the first year of life. A possible explanation for this change in growth is a reduction in density-dependent suppression of growth resulting from a significant reduction in red grouper density caused by excessive mortality; fishing or otherwise. However, there was no other supporting evidence for this explanation of the growth pattern. Because size-at-age in red grouper is not constant but rather a function of the year of birth, standard age-structured conservation benchmarks based on yield per recruit are likewise year specific.

Using the time dependent growth model developed here and a natural mortality rate of 0.2, fishing mortality (F) for age 8 in 1992 is estimated to be about 0.44 from VPA analysis. In the absence of fishing induced mortality below the 20-inch minimum size, $F_{0.1}$ is estimated to be about 0.27 using the 1992 gear selectivities. The corresponding equilibrium spawning potential ratio would be about 42 percent of its unfished state.

However, because the 20-inch minimum size and commercial quota were simultaneously put into place, fishing mortality both decreased for younger fish and increased for the older fish. Consequently, the equilibrium assumption is not met. This shift in effort to the older fish is evident when comparing the gear selectivities for the 1986-1989 and 1991-1992. In addition, there is substantial evidence that significant numbers of red grouper are being caught and released below the minimum size. It is estimated that 33 percent of these die from the experience. SPR estimated for the conditions existing in 1989 was estimated to be about 0.17-0.24. Equilibrium estimates for the fishing rates observed in 1992 would be about 0.3. However, our confidence in the estimates of fishing mortality from which these values are derived is low, as is the applicability of the method used to estimate SPR for protogynous hermaphrodites such as red grouper.

If this discard (release) mortality exceeds about 33 percent, then yield per recruit could be raised by lowering the minimum size. Given current estimates of selectivities at age, minimum sizes between 16 and 20 inches TL provide approximately the same protection of spawning potential for the same TAC. At higher levels of release mortality, the conservation effect of quota management for red grouper could be enhanced by lowering the minimum size from 20 inches. However, a lower minimum size would possibly jeopardize the status of the other grouper species because of their larger maximum sizes.

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

Due to the uncertainty in the growth rate of this species it is highly advisable that future assessments rely on actual age samples from the catch and an annual age-length key developed, rather than estimating age from a growth model. Furthermore, there is a need for research to adequately incorporate the reproductive process of protogynous hermaphroditism into models of spawning potential. Finally, the development of an accurate index of recruitment into the stock would greatly reduce the uncertainty about the estimates of fishing mortality derived from age structured assessment techniques such as the virtual population analysis used in this assessment.

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 prior to our first assessment (Goodyear and Shirripa 1991). 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, Arreguin Sanchez, F. 1987) 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). Richardson and Gold (1993) examined the genetic structure of the stock using mitochondrial DNA. 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 useful 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 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), and Florida DNR (L. Bullock, personal communication) supplied additional data to complete the needed relationships. Additional age and growth data for red grouper was provided by the NMFS Beaufort (North Carolina) Laboratory from the Atlantic Headboat fishery (M. Burton, personal communication) and University of Florida (C. Koenig, personal communication). Tagging data of red grouper caught off the west coast of Florida was provided by Mote Marine Laboratory (K. Burns, 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).

The Southern Offshore Fishing Association, Inc. and Pizzuti provided data 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 (Figure 1). The result of this analysis estimates a gutted to whole weight relationship 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.

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

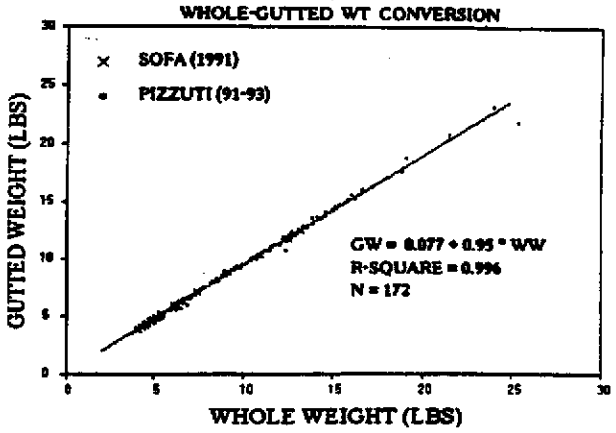

Figure 1. Scattergram of observed whole and gutted weights for red grouper and associated regression estimate of the conversion equation.

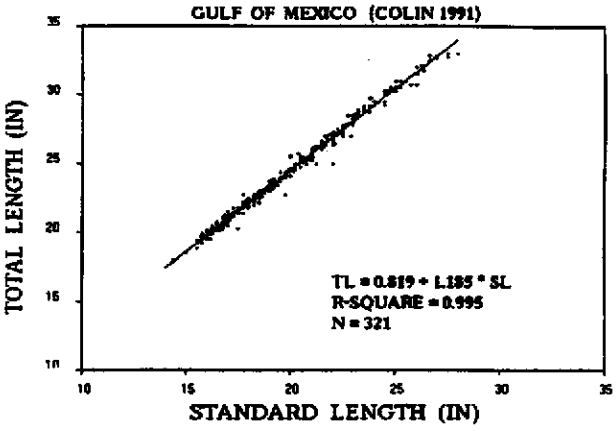

Figure 2. Scattergram of standard and total length for Gulf of Mexico red grouper and associated regression equation.

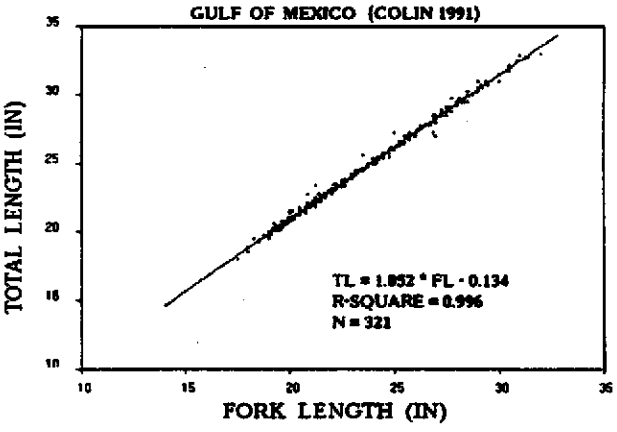

Figure 3. Scattergram of fork and total length for Gulf of Mexico red grouper and associated regression equation.

relationships (Figures 2 and 3) were derived from data provided by CMRC (P. Colin, personal communication).

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.

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. In more recent work, Koenig (1993) concluded, based on oocyte diameters, that red grouper are batch spawners, releasing

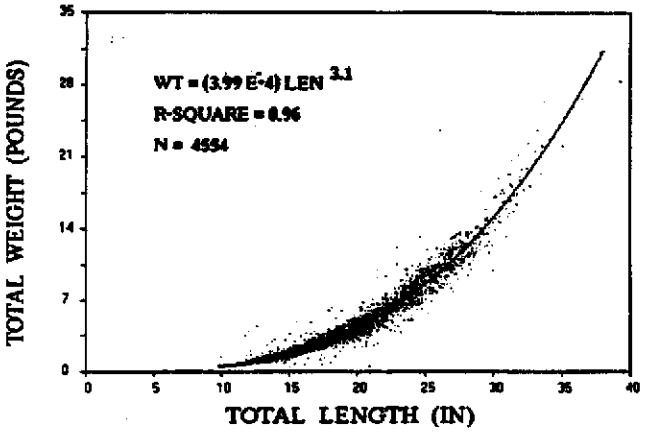

Figure 4. Total weight as a function of total length from length and weights collected by the NMFS headboat survey.

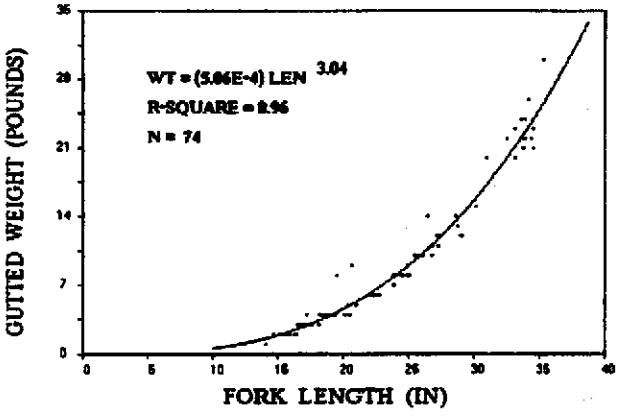

Figure 5. Relation between gutted weight and fork length for red grouper sampled from Gulf of Mexico commercial landings.

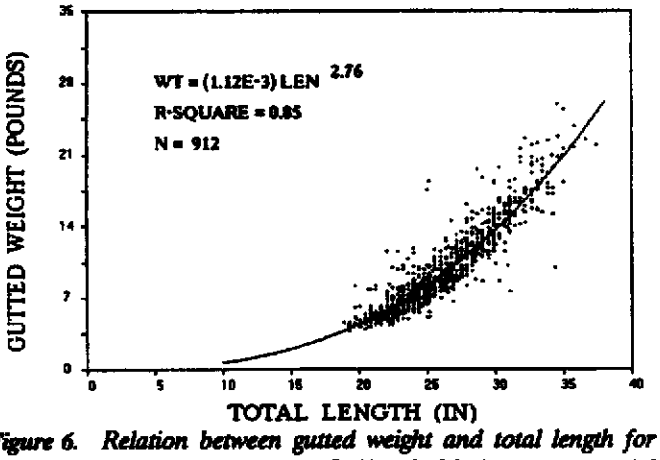

Figure 6. Relation between gutted weight and total length for red grouper sampled from Gulf of Mexico commercial landings.

their complement of eggs over a protracted spawning season. Furthermore, neither egg diameter analysis or back-calculation of spawning dates from otoliths revealed any type of spawning periodicity in the species. Gonadosomatic indexes (GSI=100*(gonad weight/total body weight) showed peaks in April and May. GSIs by day of year from Koenig (1993) and mean egg diameter by month from Moe (1969) are shown in Figure 7.

The estimation of potential recruit fecundity[1] (required for estimation of SPR) is most accurately made based on the reproductive capacity of the female immediately prior to spawning (Goodyear 1989). Towards this end, an estimation of gonad weight as a function of total length was made using the maximum gonad weight for each of ten, three inch length intervals. Data from all three available sources (Moe 1969, Collins 1991, and Koenig 1993) was considered for the function. A sigmoid curve fit with the logistic equation (weighted by the number of samples in which the maximum was selected from) represented the maximum gonad weights the best (Figure 8). Goodyear (1989) however, also noted that the estimation of potential recruit fecundity 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. Shapiro (1984) points out that there is no direct

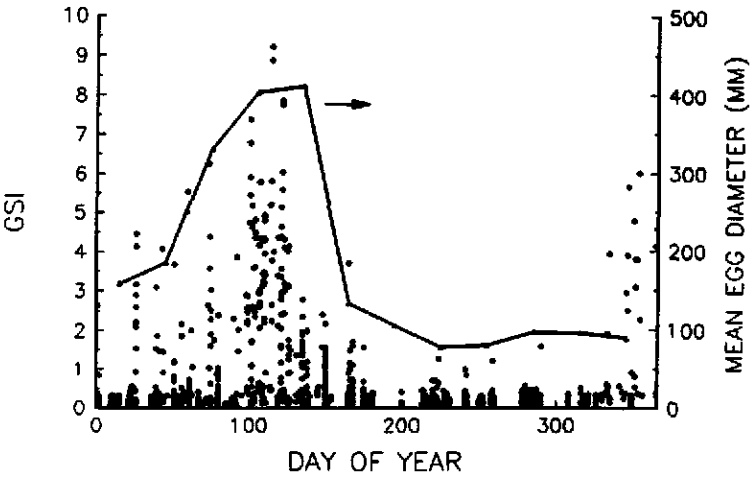

Figure 7. GSI (Koenig 1993) and mean egg diameter (Moe 1969) for red grouper as a function of day of year.

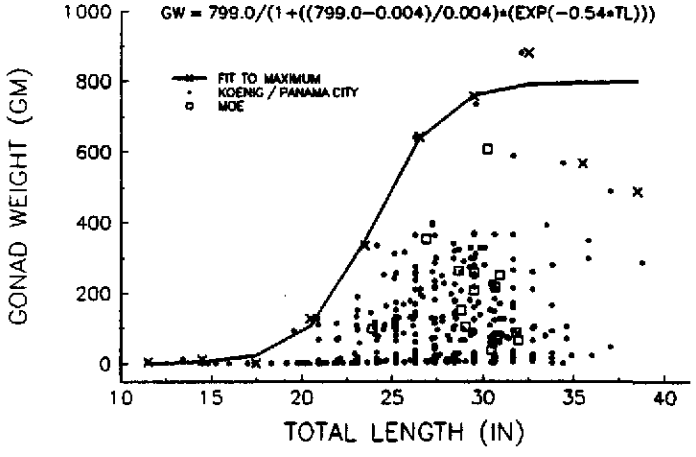

Figure 8. Maximum gonad weight for each length interval as a function of total length for red grouper.

[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.

evidence to suggest that females change sex upon attaining a particular size, age, or stage of development. However, it is thought that the stimulus to change sex is controlled in part by social interactions that are inherently density dependent. The percentage of male, female, and transitional (female in the process of turning male) by length category from Moe (1969) and Koenig (1993) are shown in Figures 9 and 10, respectively.

Two of the most notable differences in the distributions are that 1.) the size at which males are first observed has increased from approximately 15 inches to 21 inches, as did the age of the first observed transitional stage increase from 16 to 29 inches; and 2.) the percentage of fish larger than 36 inches that are male decreased from 100% to approximately 75 percent. Furthermore, the overall female to male ratio from 1964 was 5:1 while in 1992 it was only 3.6:1. If it is assumed that the rate of sex-change is influenced by male density, then it would follow that male densities were presumably higher in 1992 than in 1964.

Because growth in red grouper has been shown to be quite plastic, we examined sex ratios by age as well. Fish from the 1992 time period were aged according to the growth model described later in this document. The percent females by age for the two time periods are shown in Figure 11. Although the data suggests that the percentage of females at any given age has decreased over time, it must be kept in mind that size-at-age has changed significantly between the two time periods. Since fecundity is more a function of size than age, the overall potential fecundity of the stock may have remained the same.

The problem with the estimation of SPR arises because fishing mortality not only reduces the life expectancy of

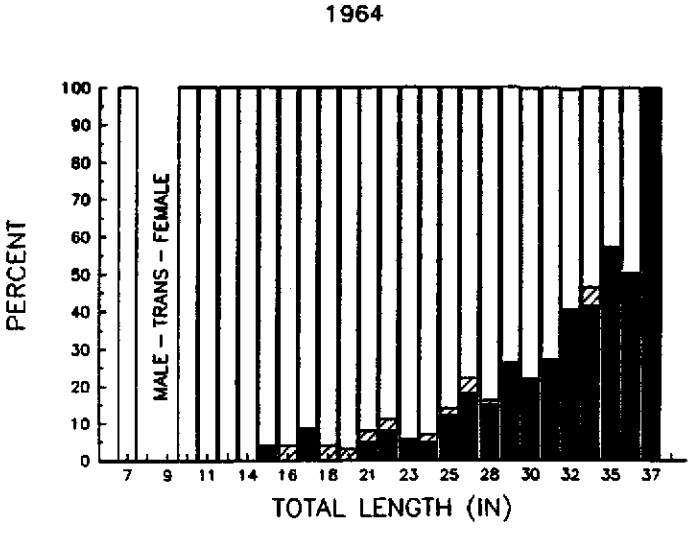

Figure 9. Sex ratio as a function of length for red grouper in 1964 (from Moe 1969).

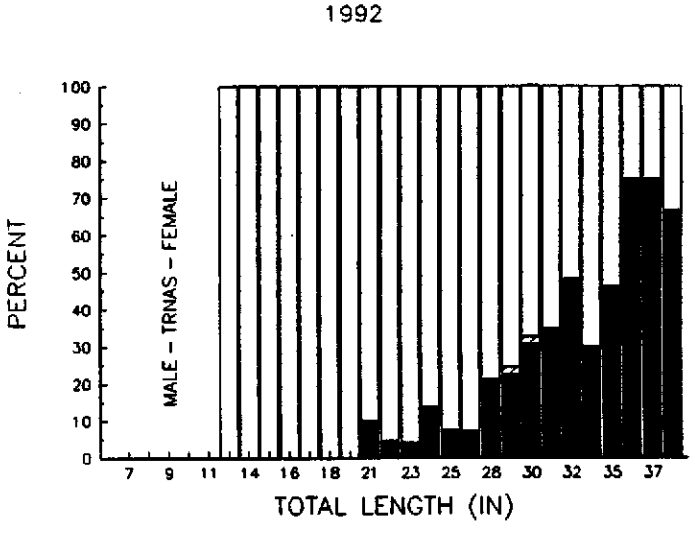

Figure 10. Sex ratio as a function of length for red grouper in 1992 (from Koenig 1993).

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 ability of such species to sustain fisheries.

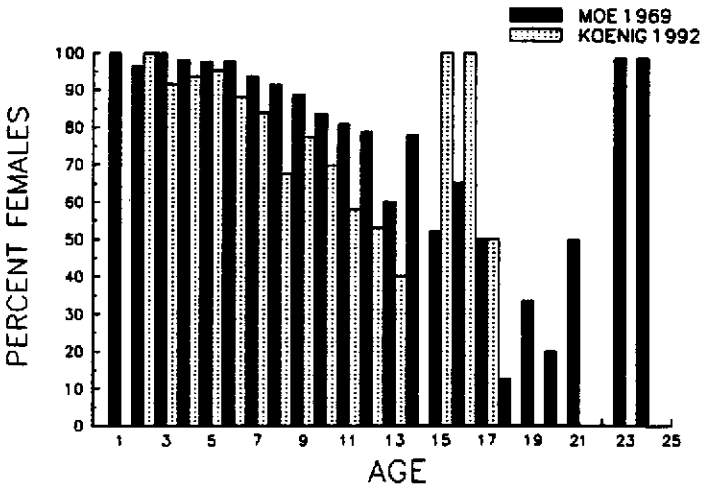

Figure 11. Percentage of females by age in 1964 (Moe 1969) and 1992 (Koenig 1993).

GENETIC STOCK STRUCTURE

Richardson and Gold (1993) used restriction length polymorphism (RFLP) to estimate evolutionary effective female population size $N_{f(e)}$ in red grouper from the Gulf of Mexico. Effective female population size is a measure of the genetic diversity within that particular stock of fish. Richardson and Gold report a $N_{f(e)}$ value for red grouper of 10,000, but no confidence intervals are given for the estimate. Relative to similar studies done on other species in the Gulf of Mexico a $N_{f(e)}$ of 10,000 is low, indicating a low population size. However, the study goes on to note that the three lowest $N_{f(e)}$ values were all found in species that are protogynous hermaphrodites, red grouper and two subspecies of black sea bass (*Centropristis striata striata* and *Centropristis striata melana*). How this particular life history trait may affect estimates of $N_{f(e)}$ is still unknown.

FOOD HABITS

While not examined quantitatively, Moe (1969) noted the stomach contents of several specimens of red grouper. Food items consisted of small fish of many species, crabs (notably *Portunus* and *Calappa*), panulirids, scyllarids, shrimps, octopuses, squids, and unidentified crustaaceans.

Bullock and Smith (1991) report findings on the diet of juvenile red grouper (18-25 mm) from Tampa Bay to consist of a variety of shrimp and amphipods. Larger individuals (300-500 mm) captured south-southwest of Ft. Myers during November 1987 regurgitated the following invertebrates: an octopus, various shrimps, and hermit crabs. Regurgitated fish included belted sandfish, tomtate, blue goby, yellowhead jawfish, and cardinal fish. This report goes on to cite work done by Hildebrand (1941) in the Dry Tortugas. These fish consumed fishes, octopuses, and crustaceans (including spiny lobster, shrimps, and stomatopods).

Food habits of juvenile red grouper from Campeche Bank, Yucatan, Mexico was reported by Brule et al. (1993). The stomach contents of a total of 163 fish were examined for contents. Of the total prey items, the dominant species was true crab *Pilumnus dasypodus*. In terms of relative importance, preferential prey consisted of reptant crustaceans, anomurans, and brachyurans. No size related preference nor regional variation was evident in the feeding habits.

GROWTH

In the 1991 stock assessment of red grouper in the Gulf of Mexico (Goodyear and Schirripa 1991) we strongly suspected that red grouper had not maintained a consistent growth rate for the time period between 1967 (Moe 1967) and 1991 (R. Shipp pers. comm data). Ekland (1992) examined the problem in more detail and found temporal differences in size-at-age using data collected by the NMFS Laboratory in Panama City, Florida (A. Johnson). These data were collected from the Gulf of Mexico at two different time periods (1979 and 1992, hereafter referred to a PC-79 and PC-92, respectively). This apparent violation of equilibrium growth made the standard von Bertalanffy growth model inappropriate. Estimates of age composition of the catch based on samples of fish lengths requires an alternate model that accounts for temporal changes in growth.

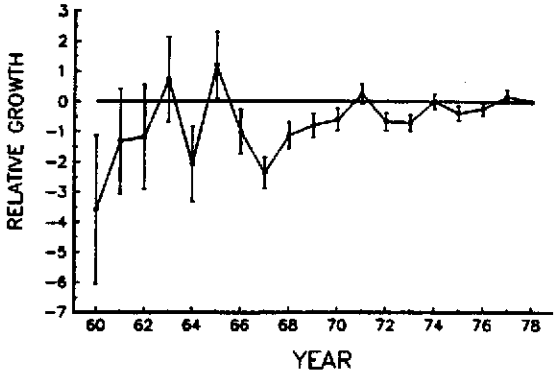

Figure 12. Growth rate and standard error relative to last year as effected by year/environmental effects for PC-79 data.

The otoliths from PC-79 and PC-92 were all measured and aged in an identical fashion and by the same reader. These data sets were selected for analysis because we felt they offered the best opportunity to examine this change in growth rate. Indirect validation of annuli for these data sets was done by Ekland (1992) using marginal increment analysis. We first examined PC-79 and PC-92 for a difference in size at age using the general linear model (GLM)

$$\text{growth} = \text{age} + \text{year}$$

where growth is described as an effect of age and time (year and/or environmental effect) (Weisburg 1986). The GLM first tests the hypothesis that there is no interaction between the age effect and year effect. If no significant interaction is found, then main effects are examined separately for either a significant age effect and/or a year effect.

There was not sufficient evidence to conclude that a significant ($\alpha = 0.05$) interaction existed between the age and year effects. However, in both data sets there was sufficient evidence to conclude that a significant year effect existed (as well an age effect, but this is expected as fish grow slower with age). With the age effect removed, variation in growth was plotted to show only a year effect for PC-79 (Figure 12) and PC-92 (Figure 13). Annual growth rates are plotted relative the terminal year in the data set. A slight increasing trend is evident in the relative growth rate from 1960 to 1978, but a much more pronounced trend can be seen from 1980 to 1991. This significant year effect, along with the difference in size at age, adds more support to the argument that red grouper growth rates have increased.

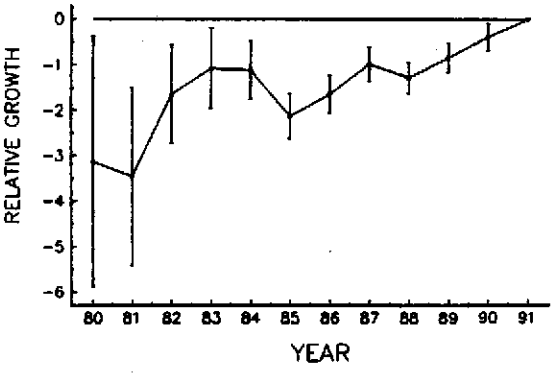

Figure 13. Growth rate and standard error relative to last year as effected by year/environmental effects for PC-92 data.

The next concern was to quantify the change in growth that took place on an annual basis. To this end we constructed a time series of size at age from otolith increment measurements from each aged individual in the two data sets PC-79 and PC-92. Aged fish from both studies were combined and sorted based on the fish's year of birth. In order to measure only that growth which occurred during a particular year, a growth increment (GI) was calculated as the distance between each successive annuli, rather than the total radius (Boehlert et al. 1989). In this way, GI(1) was represented as the distance from the focus to the first annulus, GI(2) the distance from the annulus 1 to annulus 2, and so on. This measurement was calculated for all ages and years of birth. All GIs for a given age and year of birth were then used to calculate a mean $GI_{age,year}$ for each available combination of age and year of birth. The oldest individual in PC-92 (age 12) was used to represent age 1 growth in 1980 (it's year of birth), and the youngest individual in PC-79 (age 1) was used to represent age 1 growth in 1979. This "connected" the two databases, and by treating all other fish from the two studies in a similar manner, the result was a complete annual representation of growth by age for the time period between 1964 to 1989. Although sample size varied for each year, only six of the twenty six years had a sample size less than 4 (Figure 14). These were years 1964, 1965, 1979, 1980, 1982 and 1989. These years were not included in any further analysis.

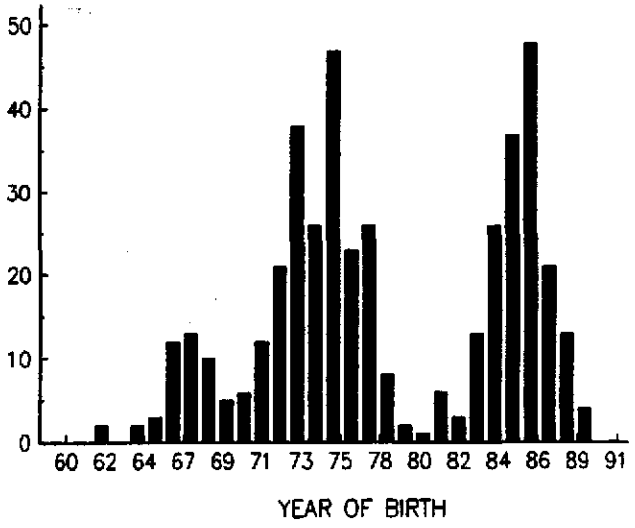

Figure 14. Sample size for each year of birth used to calculate mean growth increments.

Because the magnitude of growth changes as a function of age, GIs were converted to Z scores (Z = (observation - sample mean) / sample standard deviation) (Byrkit 1987). Years of average growth would have a Z score of 0, years of below average growth a negative Z score, and years above average a positive Z score. In this way, GIs between ages could be directly compared. Because of the increased variability in growth in the younger ages, Z scores for ages 1 through 4 proved to be the most useful in tracking growth over time. The time series of Z scores for GIs ages 1 through 4 and years 1966 to 1988 are shown in Figure 15 and 16.

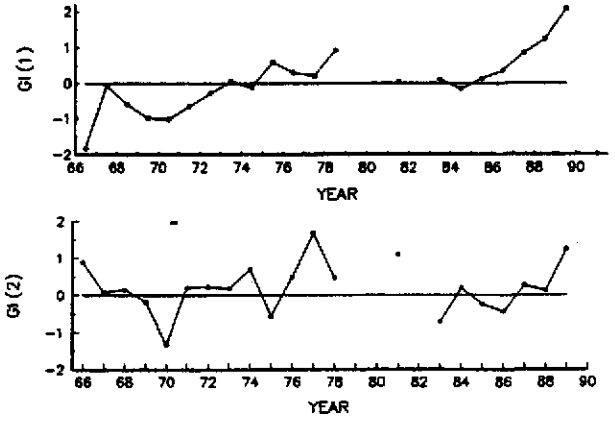

Figure 15. Z scores for GI(1) and GI(2) by year of birth.

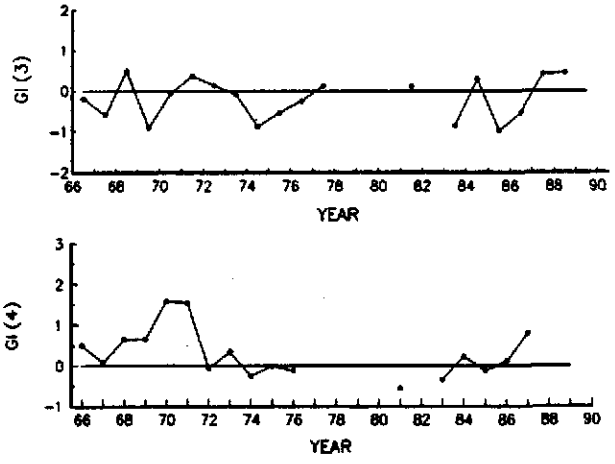

Figure 16. Z scores for GI(3) and GI(4) by year of birth.

An increasing trend in growth during the first year of life, GI(1), is obvious from Figure 15. However, this increase is not seen in GI(2), GI(3), or GI(4). This suggests that whatever factor(s) is responsible for increasing the fish's growth rate is affecting it only during the first year of life. One possible

explanation for the increasing growth rate is a decrease in fish density during this part of the fish's life cycle. It could be hypothesized that red grouper juvenile abundance has been steadily decreasing with time, possibly through decreased reproduction or survivorship. However, other environmental trends could result in the same observed increase in growth rates. Interesting to note is the coincidence of what appears to be the start of an upward trend in growth rate for GI(1) in 1971 and a red tide event that occurred that same year. Smith (1976) reported apparent differential mortality between gag and red grouper as a result of this event. Red grouper, previously seen on a regular basis on the study reef, were non-existent after the red tide event. If their absence was in fact due to a massive die-off, the relaxation in density may have contributed to the increase in growth rate.

For each age, 1 through 4, a Kruskal-Wallis test was used to test the hypothesis that the population mean GIs by year did not differ significantly. Ages 1 through 3 tested significantly different (α = 0.01) and age 4 did not. Assuming that otolith growth is coupled to somatic growth, this furthers the argument that an equilibrium growth rate is invalid.

A four by four matrix of annual mean GIs was constructed to determine whether or not any correlation existed between the four ages examined. There was a significant negative relation between annual mean GI for age 1 and age 4 (p = 0.007) with 34% of the variability being explained (Figure 17). If the mean population growth was faster than average during the first year of life it tended to be slower than average during the fourth year. When individual observations were tested in the same way (rather than annual means), the relation was not as pronounced (slope = -0.076, 0.10 > p > 0.05). This suggests that this negative correlation is more of a population phenomena rather than an individual based one.

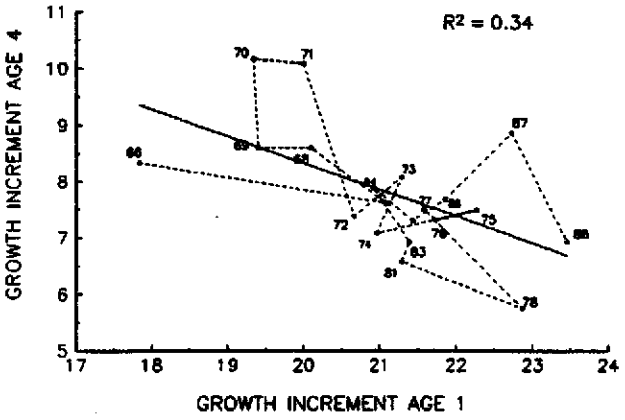

Figure 17. Correlation between GI(1) and GI(4).

Backcalculation. Using the $GI_{age,year}$ matrix described above for ages 1 - 19, a similar matrix was constructed using the total radius to each annuli ($Radius_{age,year}$) where year is again year of birth of the individual fish. To ensure that the relationship between total length and otolith radius could be considered constant for the two data sets (PC-79 and PC-92), both regressions were plotted together with 95% confidence intervals (Figure 18). The 95% confidence interval of PC-79 lie totally within the confidence intervals of PC-92. Consequently, analysis was continued under the assumption that this relationship did not differ significantly between the two data sets.

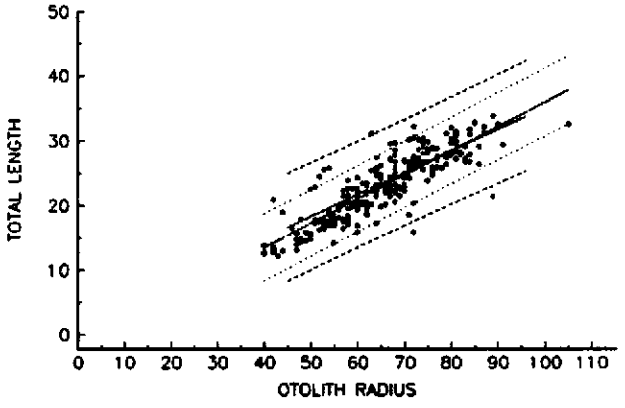

Figure 18. Relation between otolith radius and total length from PC-79 and PC-92.

We back-calculated lengths at each $Radius_{age,year}$ using Lea's (1910) direct proportionality method corrected for the Y intercept of the relation between the otolith radius and total fish length (Bagenal et

al. 1978) using a functional regression. This resulted in a final matrix whose cells were then represented by Observed $Length_{age,year}$ (Table 1). The mean back-calculated length-at-age showed an increasing trend with time for all ages. However, as discussed above, ages beyond age 1 are most probably showing the cumulative effects of increased growth during the first year of life.

We started with the standard three parameter von Bertalanffy growth equation:

$$Length = L\infty(1-\exp^{-k(t-t_0)})$$

which describes length as a function of age. By adding a fourth parameter (b) and one more variable (y), the equation was modified to describe length as a function of age and year of birth:

$$Length = (1+b(y-66)) \times (L\infty(1-\exp^{-k(t-t_0)}))$$

where y equals the year of birth and b represents the rate of increase in growth. The modified growth equation was then fit to the four parameters using the Observed $Length_{age,year}$ matrix (SAS 1989) and used to construct a Model $Length_{age,year}$ matrix in which the cells represented the size of the fish at each age for each month for each year of birth. The surface described by the Model $Length_{age,year}$ matrix is shown in Figure 19 and Table 2.

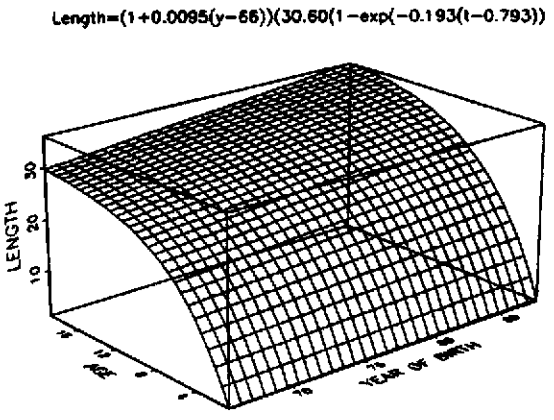

Figure 19. Length as function of age and year of birth as described by the time dependent growth model.

Individual fish were aged by first assigning them a fractional year age based on a spawning date of June 1 and their month of capture. Then it was necessary to choose the most correct integer age to add to the fractional age. This was done comparing the observed length of the fish to each of the model lengths for that fish's particular month of capture. The observed length was compared to the model lengths until it fell between the value of two consecutive ages. To determine which of the two ages to assign to the fish, two Z scores were calculated using each of the two ages model lengths as means and the standard deviation around those means. The age generating the lowest Z score (lowest deviation from the model length) was then assigned to that fish.

In order to determine if the time dependent growth model estimated age from length more accurately than the standard von Bertalanffy model, fish of a known age from PC-79 and PC-91 databases were re-aged using only their lengths using both growth models. A summary this analysis is given in Tables 3 and 4. Observed age frequencies from the combined data sets were plotted along with the predicted ages using both the von Bertalanffy model (Figure 20) and the time dependent model (Figure 21). When the two age frequencies distributions were compared, the time dependent growth model resulted in a lower chi-square ($X^2 = 86.57$) than did the standard model ($X^2 = 123.50$). The standard growth model more accurately predicted ages 2, 3, and 9 but was inferior to the time dependent model with regard to all other ages. Furthermore, the

dominant age class in the combined data sets (age 5) was successfully predicted from only the time dependent model (Figures 20 and 21).

A sample of aged fish from a separate study (Koenig pers. comm.) were used to further test the accuracy of the time dependent growth model in relation to the standard equilibrium growth model. Use of the standard growth model resulted in correctly aging approximately 12% of the fish while the time dependent model correctly aged 27%. This same procedure was carried out on data from the Atlantic from Burton and Stiles (1991). Use of the standard growth model resulted in correctly aging approximately 15% of the fish while the time dependent model correctly aged 24%.

AGE	X^2 standard	X^2 time dependent
1	----	----
2	0.08	5.33
3	0.43	3.27
4	60.75	15.19
5	24.50	6.59
6	8.56	3.24
7	2.77	1.92
8	0.71	0.26
9	7.36	36.36
10	1.00	0.56
11	1.45	1.45
12	9.60	9.60
13	3.57	1.29
14	1.00	0.00
15	1.00	1.00
16	0.50	0.50
17	----	----
18	0.00	0.00
19	----	----
19+	44	54
TOTAL	123.30	86.57

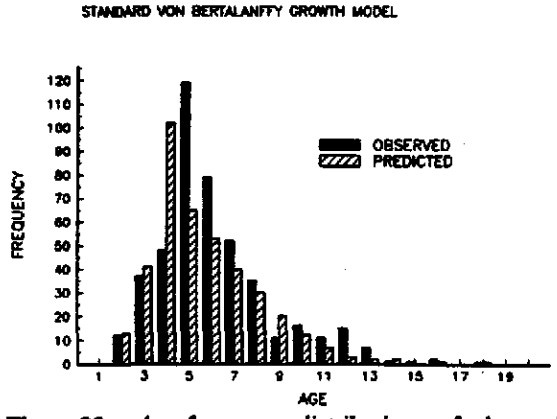

Figure 20. Age frequency distributions of observed and predicted ages using standard von Bertalanffy growth model.

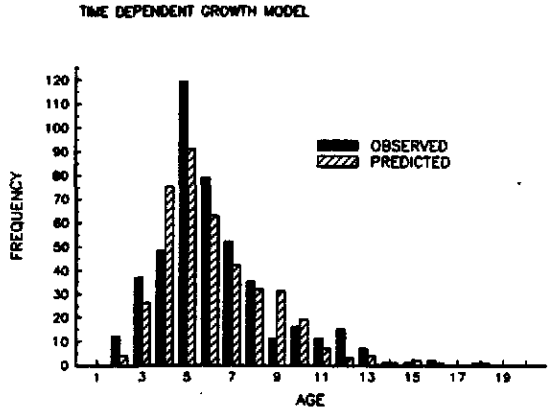

Figure 21. Age frequency distributions of observed and predicted ages using time dependent growth model.

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.

Further complications arise when sex specific rates of natural mortality are considered. Moe (1969) found

total mortality, Z, to be higher in females than in males. Likewise, Sadovy (1993) found differences in Z by sex for the red hind (*Epinephelus guttatus*), also a protogynous hermaphrodite. These differences in Z by sex can be attributed to differences in either fishing (F), natural mortality, or both. Because the number of females by age is decremented not only by "natural" phenomena (predation, disease, etc.) but also by the process of transition to males, it would follow that estimates of M for female should be higher than those for male. Furthermore, if it is assumed that the rate of transition to males is due, at least in part, to year specific phenomena (i.e. male density) then estimates of female natural mortality could also be suspected of having significant year to year variation. This variation is most important when considering calculations of spawning potential ratios.

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. Wilson (1992) conducted research on survivorship of released red grouper after deflating swim bladders. She reported 65% survival (15 of 23) for fish between 12 and 25" fork length caught by hook and line near 145 ft. in the eastern Gulf of Mexico based on shipboard repressurization experiments and observations from 20 to 26 hours following capture. Schirripa et al. (1993) examined red grouper tagging data from Mote Marine Laboratory for insights into release mortality. They concluded that depth of capture had a significant effect on the probability of recapture, suggesting increased release mortality for fish captured at depths greater than 25 feet. Furthermore, a high percentage of recaptured red grouper was caught within the first three weeks at large, but a rapid decay of return rate after three weeks suggests a high incidence of tag shedding or delayed release mortality.

DISTRIBUTION AND MOVEMENTS

Moe (1966, and 1969) and Beaumariage (1969)

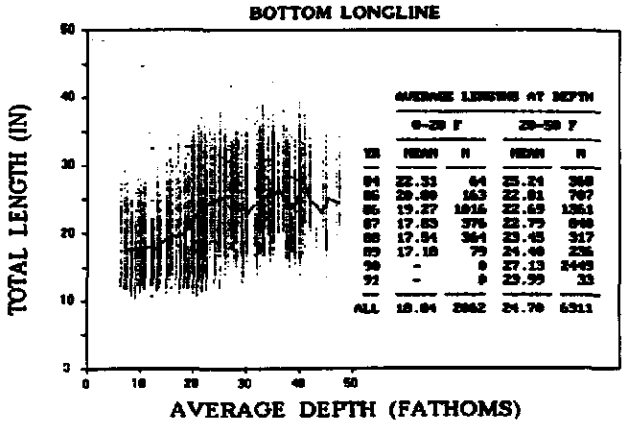

Figure 22. Lengths of red grouper caught by bottom longline as a function of depth at capture.

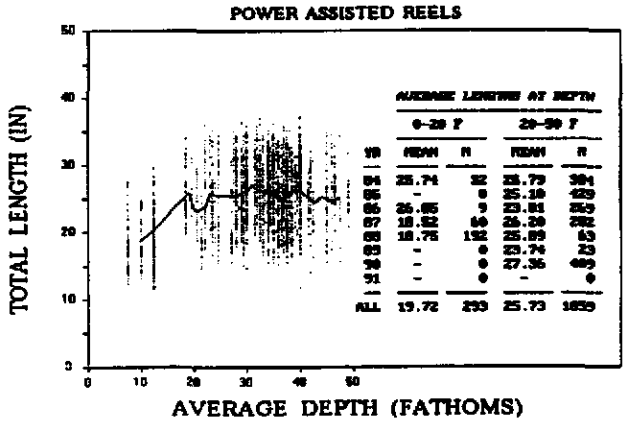

Figure 23. Lengths of red grouper caught by power assisted reels as a function of depth at capture.

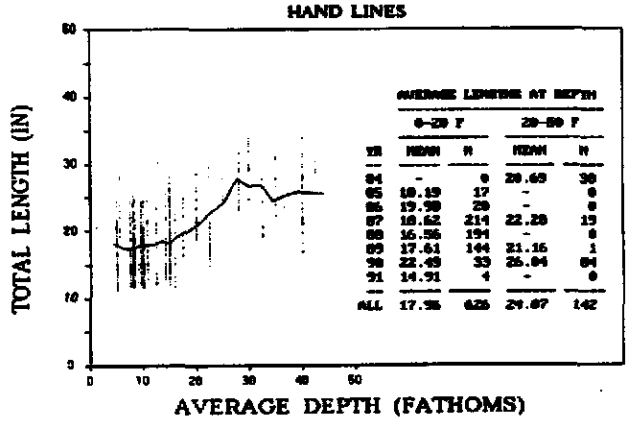

Figure 24. Lengths of red grouper caught by hand lines as a function of depth at capture.

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 22 to 24). 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 20). 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 23 and 24). 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.

Similar analysis was done on data provided from Mote Marine Laboratory tagging program. These data represent recreational hook and line fishing off the west coast of Florida (Figure 25). The same pattern of increasing size with increasing depth is evident here as well (Figure 26). The trend in this data set in probably more pronounced because fishermen participating in

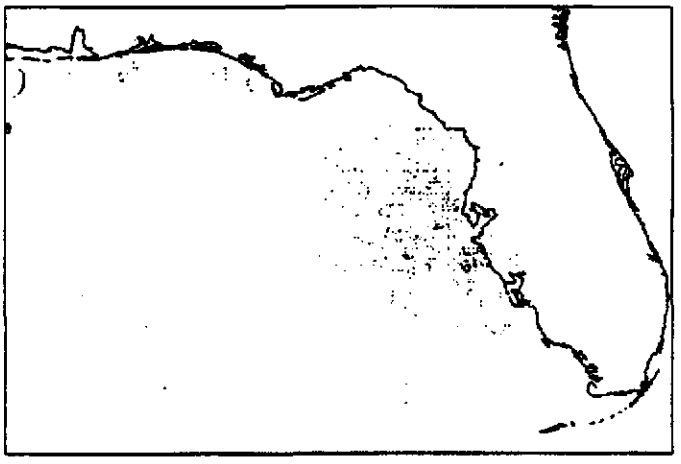

Figure 25. Dispersion of tagged red grouper from Mote Marine Laboratory Tagging Program.

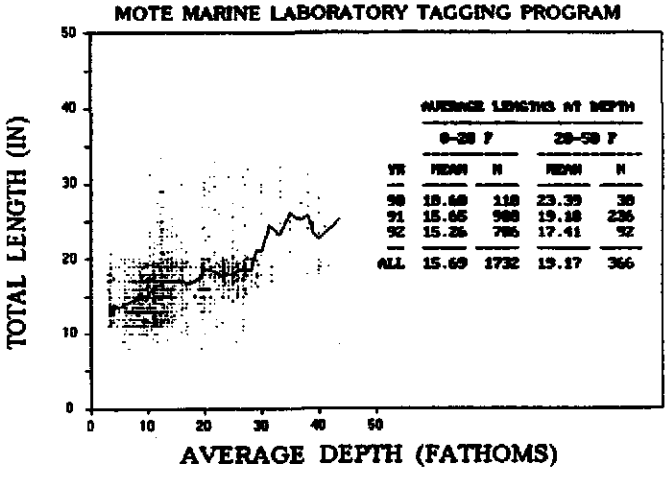

Figure 26. Lengths of red grouper caught from Mote Marine Laboratory tagging program as a function of depth of capture.

the tagging program recorded lengths of sub-legal fish as well, as they where presumably tagging all fish that were brought into the boat. Because of these mean lengths at capture are not biased by any minimum size regulations, the fact that this mean decreases on an annual basis for both depth categories could be of some significance. Despite the apparent trend of increasing size with increasing depth, the mean length of red grouper caught in the 20-50 fathom range in 1992 (17.41 inches) is still less than the mean for the 0-20 fathom range just two years previous (18.6 inches in 1990).

From this same database, it can be seen that red grouper were generally recaptured at the same location in which they were tagged, suggesting that the species is very sedentary (Figure 29). Two exceptional animals did however travel over 70 miles while at large. The rate of movement (miles traveled / days at large) of tagged/returned red grouper is shown in Figure 28. As with distance traveled, the majority of fish had correspondingly zero rate of movement. But again, there was one exceptional individual that traveled an averaged of 0.8 miles per day.

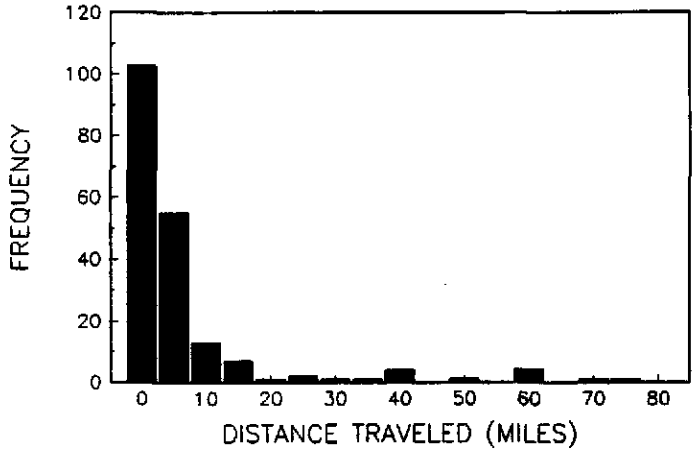

Figure 27. Distance traveled for recaptured red grouper form Mote Marine Laboratory tagging program.

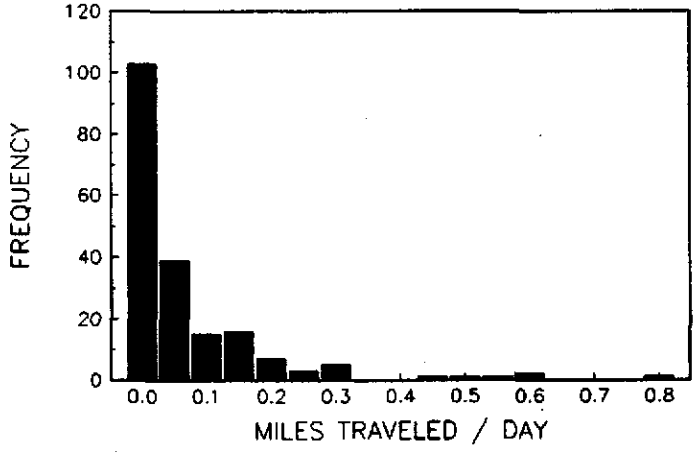

Figure 28. Rate of movement (miles traveled/day at large) of tagged red grouper from Mote Marine Laboratory tagging program.

Effective Date	Description of Regulation
November 1, 1984	Stressed area defined (see below). Within this stressed area: Prohibit the use of powerheads for taking reeffish; Prohibit the use of roller trawls; Prohibit the use of fish traps (GMFMC).
	Fish traps: Minimum mesh size of 1 X 2 inches with two 2 x 2 escape windows on 2 sides: 33 cubic feet maximum size for traps fished shoreward of the 300 foot contour; Maximum of 200 fish traps per vessel (GMFMC).
	Harvest of reef fish with poisons or explosives is illegal.
July 29, 1985	Minimum size set to 18 inches for red, (gag, black, yellowfin, Nassau groupers and jewfish) (FMFC).
December 11, 1986	Bag limit set to 5 per recreational fishermen daily, with off-the-water possession limit of 10 per recreational fishermen, for any combination of groupers, excluding rock hind and redhind (FMFC).
	Use of longline gear by commercial fishermen prohibited; bycatch of 5% is permitted harvesters of other species using this gear (FMFC).
	Use of stab nets (or sink nets) to take (snapper or) grouper is prohibited in Atlantic waters of Monroe County (FMFC)
	5% of (snapper and) grouper in possession of harvester may be smaller than the minimum size limit (FMFC)
	Must be landed in whole condition (head and tail intact) (FMFC)
January 22, 1990	Permit required to commercially fish for reef fish. Fish traps limit reduced to 100 traps maximum per permittee. Stressed areas extended off Louisiana and Texas (see below) (GMFMC).
February 1, 1990	All (snapper and) grouper designated as "restricted species" (FMFC)
	Minimum size limit set to 20 inches for red (gag, black, yellowfin, Nassau, scamp and yellowmouth) grouper (FMFC)
	Bag limit set to 5 daily per person for any combination of grouper (FMFC)
	Off-the-water recreational possession limits set to 10 per person for any combination of grouper (FMFC)
	Allowable gear defined as hook and line, black sea bass trap, spear, gig, or lance (except powerheads, bangsticks, or explosive devices) for (snapper and) grouper (FMFC)
	All commercial harvest of any species of (snapper, sea bass, and) grouper is prohibited in state waters whenever harvest of that species is prohibited in adjacent federal waters (FMFC)
	(Snapper and) grouper must be landed in whole condition (FMFC)
April 23, 1990	Recreational bag limit set to 5 per angler per day (GMFMC).
	Minimum size limit set to 20 inches for red (gag, black, Nassau, and yellowmouth) grouper (GMFMC)
	Commercial quota (1990) set for 11.0 million pounds for grouper with this quota subdivided into a 9.2 million pound (whole weight) shallow-water quota (red grouper) and a 1.8 million pound deep-water quota. Ratio of 1.18 used to convert gutted weight to whole weight for grouper (GMFMC)
April, 1991	Commercial shallow-water quota (1991) temporarily increased 700k pounds to 9.9 million pounds (whole weight) (GMFMC).
April, 1992	Commercial shallow-water quota (1992) increased by 1.6 million pounds; new ratio of 1.05 used to convert gutted weight to whole weight; quotas now expressed in gutted weight for a quota of 9.8 million pounds (gutted weight) for 1992 and 1993. (GMFMC).

Stressed areas are defined as waters shoreward of a line:

1. From the boundary separating the jurisdiction of the Gulf and South Atlantic Councils terminating at 24°35' 83°0.0' northward and eastward around the Dry Tortugas to a point north of Rebecca Shoal at 82°35' the outer boundary is the 100-foot contour.
2. From 82°35' to the south end of Sanibel Island (26°26') the outer boundary is 60-foot contour.
3. From 26°26' north to a point off Tarpon Springs (28°10') the outer boundary is the 120-foot contour.
4. From 28°10' to a point of Cape San Blas at 85°52' 29°30.5' the boundary is the 60-foot contour.
5. From 85°52' 29°30.5' west to a point off Mobile Bay at 88° longitude the boundary is the 150-foot contour. The boundary is then a line from the point at 88° longitude northwest to 88°23.7' 30°01.5', at the 80-foot contour off the AL/MS state line.
6. From 88°23.7' 30°01.5' the boundary runs due west to Chandeleur Islands, La.
7. From the TX/LA state line to a point on 95° the boundary is the 100-foot contour.

Amendment 1 extended the boundaries to include:

Texas waters out to the 30-fathom isobath

Louisiana waters out to the 10-fathom isobath

HARVEST TRENDS

HISTORY OF REGULATIONS

The red grouper fishery is regulated at both the state and federal waters. The state waters on the west coast of Florida extend 10 miles out from shore and are managed by the Florida Marine Fisheries Commission (FMFC). Beyond the 10 mile contour is the Exclusive Economic Zone (EEZ) which extends another 200 miles from shore. Fishing in the EEZ is managed by the Gulf of Mexico Fisheries Management Council (GMFMC). The 20 inch minimum size regulation (in both state and federal waters) of 1990 moved the fishery into predominately federal waters. Currently, red grouper harvest is regulated by a commercial shallow-water quota of 9.8 million pounds. This quota is reviewed for modification on an annual basis. A history of pertinent fishing regulations put forth by both FMFC and GMFMC have been outlined on the preceding page.

COMMERCIAL HARVEST

Data sources. Landings statistics for commercially caught grouper were available from 1962 to 1992 (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. Also available were records of commercial catch and effort of the Cuban grouper fishery on the west coast of Florida from 1950 to 1976 (E. Klima, pers. comm.). 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 1990-1992 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 1992, with a few records for other years.

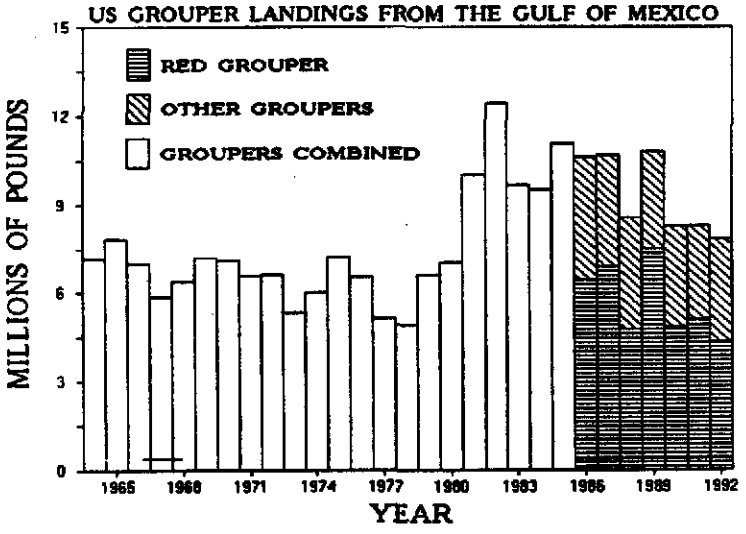

Figure 29. Commercial landings of all groupers from U.S. waters of the Gulf of Mexico.

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 29).

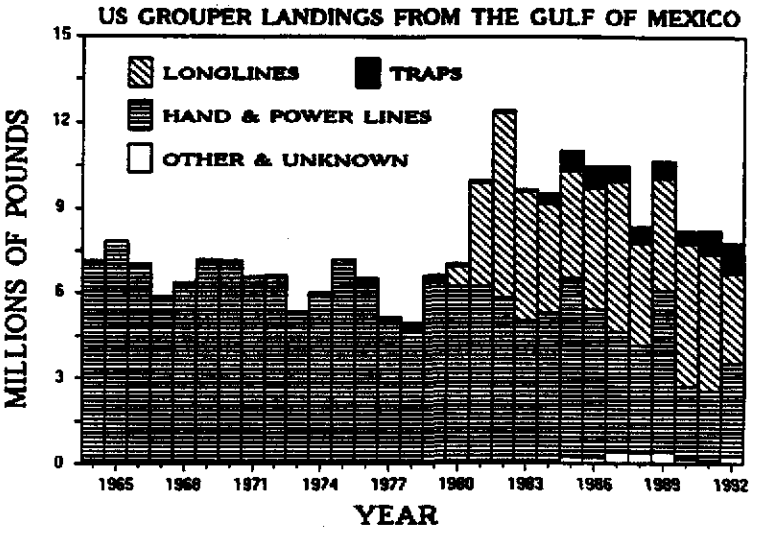

Figure 30. Total commercial harvest of groupers from U.S. waters of the Gulf of Mexico by method of capture.

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 30). 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 30). 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 30).

Most of the U.S. Gulf of Mexico grouper catch for all species has been landed in Florida at least since 1962 (Table 4). The commercial U.S. catches of red grouper since 1986 are almost entirely landed in Florida (Table 6). Red grouper also make up a large proportion of the total grouper landings since 1986 (Figure 29, Tables 4 and 5). However, the relative dominance of the various grouper species vary by state and year (Tables 6-31).

A very substantial portion of the commercial harvest in the 1950's is attributable to the Cuban grouper fishery operating off the west coast of Florida at that time (Figure 31). The Cuban fishing effort was directed at red grouper, which constituted approximately 90-percent of the total catch (Abascal 1968, as cited in Tashiro et al. 1977). The principle gear used was bottom longline. Estimates of harvest during this time period ranged from 7 to 13 million pounds; approximately double the U.S. landings for the same time period. In the 1960's the Cuban catch dropped off to approximately 2-3 million pounds per year and then increased again in the 1970's to 4-5 million pounds, very close to the U.S. landing estimates for that time. None of the Cuban fleet's catch of grouper were exported, but rather remained in that country for domestic consumption.

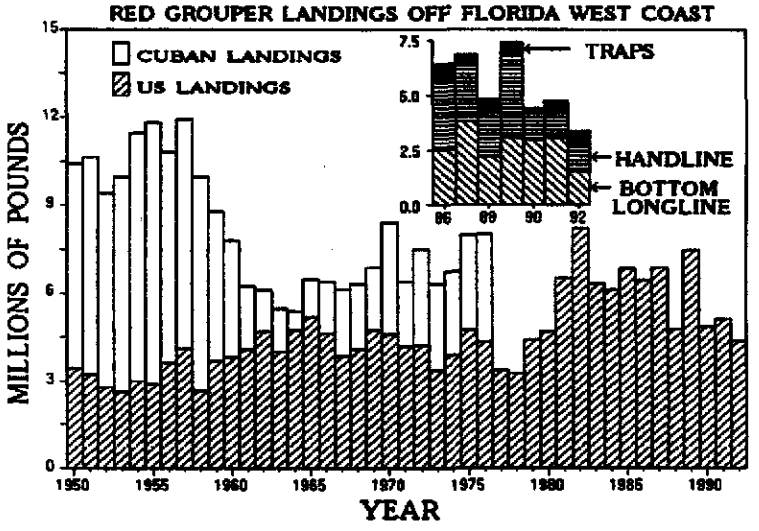

Figure 31. Estimated commercial landings of red grouper from Florida West Coast since 1950 and method of capture since 1986.

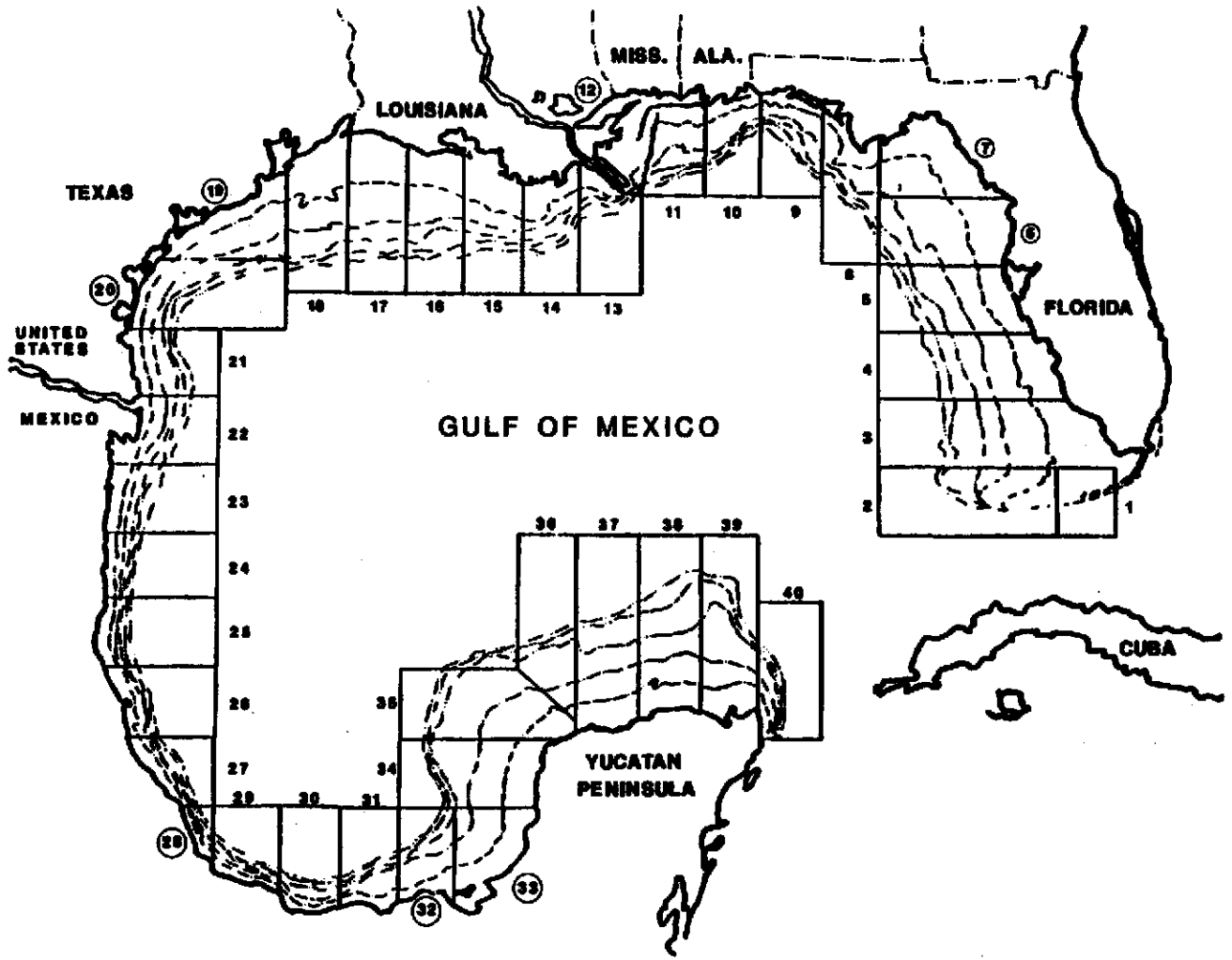

Figure 32. Statistical grids for the Gulf of Mexico used in this study.

The Fishery Conservation and Management Act of 1976 prohibited foreign countries from fishing within the Fishery Conservation Zone (extending 200 nautical miles off shore) after March 1, 1977 without a U.S. fishing permit.

Mississippi and Alabama once landed modest amounts of unclassified groupers many of which were caught in foreign waters (Table 5). 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 5). A large fraction of grouper in the Louisiana catch remains unclassified to species (Table 6), 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.

Texas grouper landings from U.S. waters also increased about 5-10 fold in the early 1980s over the prior decade, however the last two years of record (1991 and 1992) show a decrease back to the pre 1980's levels (Table 5). Large numbers of these groupers also remain unclassified to species (Table 6). However, less than 500 pounds of those classified to species were classified as red grouper (Tables 7-31).

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 18). 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 31).

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 30). 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 data since 1990 are only available by month and port of landing. We estimated the spatial distribution of the 1990-1992 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 32). This allowed partitioning the 1990-1992 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 1992 (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 31). The bottom longline catch of red grouper declined in 1992 to the lowest level since this gear came into common use in the 1980s.

Spatial distribution. The bulk of the 1986-1992 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 33; Table 33).

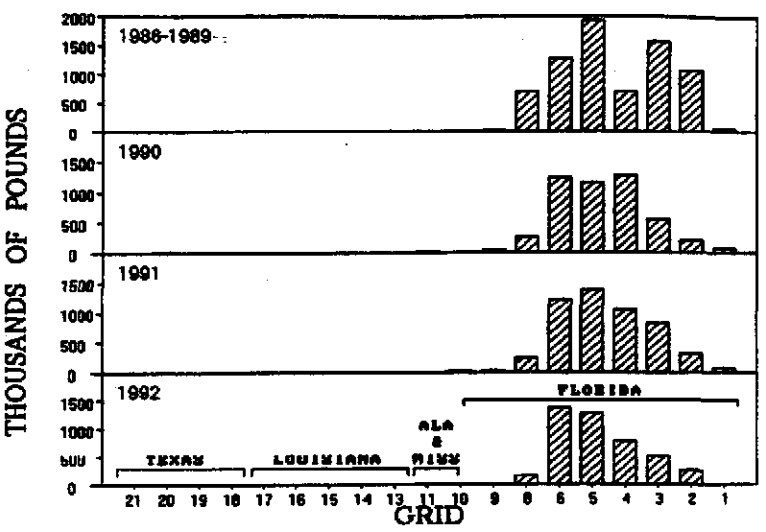

Figure 33. Spatial distribution of the 1986-1992 average U.S. Gulf of Mexico red grouper catch.

Most of the red grouper trap catch through 1989 was in the southern part of the fishery in grids 2 and 3 (Table 34). These fish were landed primarily in Collier and Monroe counties (Table 39), where they contributed up to half the counties' red grouper landings (Table 40). Taylor and McMichael (1983) report that red grouper was the most abundant target species in the Collier County trap fishery, making up 91% of the target weight and 73% of the target number. Starting in 1990 however an expanding trap fishery was established in grids 6 and 7. In 1992 more red grouper were caught in grid 6 than grids 2 and 3. Furthermore, the trap fishery landed as much fish in Citrus county as it did in Collier that year. The trap catch diminished in importance in 1990, but landings increased again in 1991 and 1992 to near previous levels. 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 1979-1992. 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 1986-1992. 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.

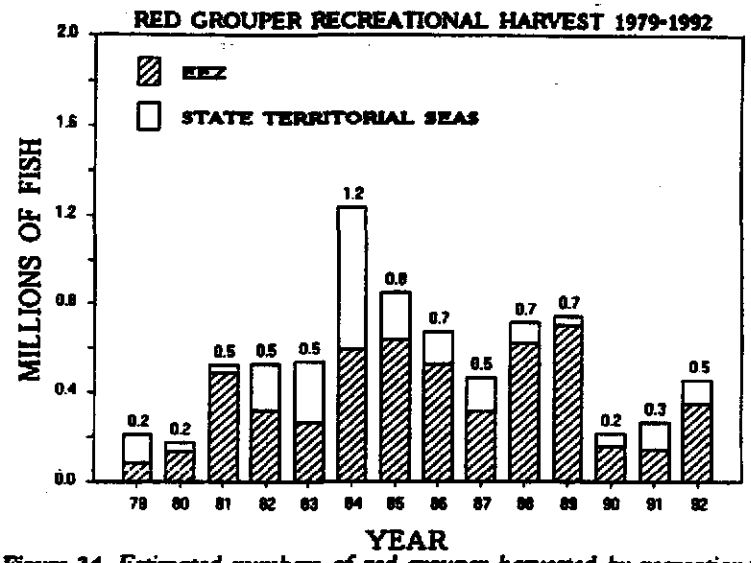

Figure 34. Estimated numbers of red grouper harvested by recreational fishermen in Florida territorial seas and the EEZ, 1979 to 1992.

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 1986-1992 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 41). 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.

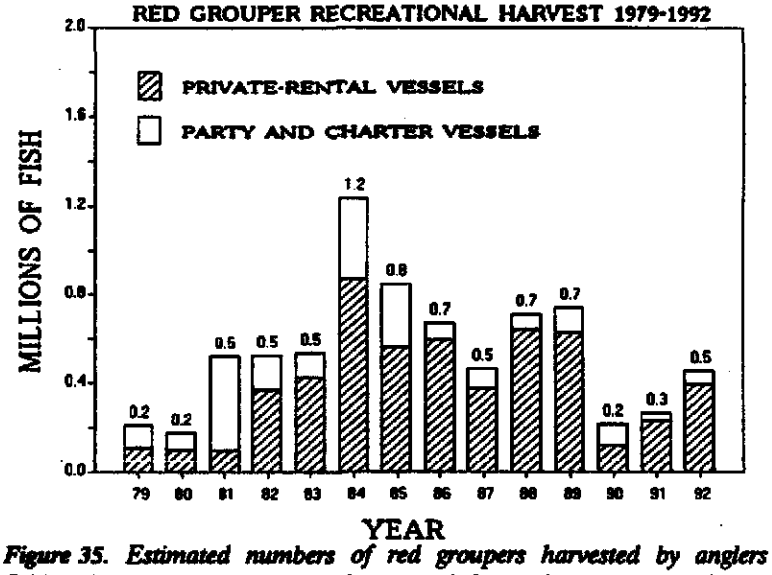

Figure 35. Estimated numbers of red groupers harvested by anglers fishing from private or rented boats and from charter or partyboats, 1979-1992.

Recreational catch estimates. Red grouper harvest estimates by state, year, and distance from shore are given in Table 42. 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 550 thousand individuals and 2.4 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.

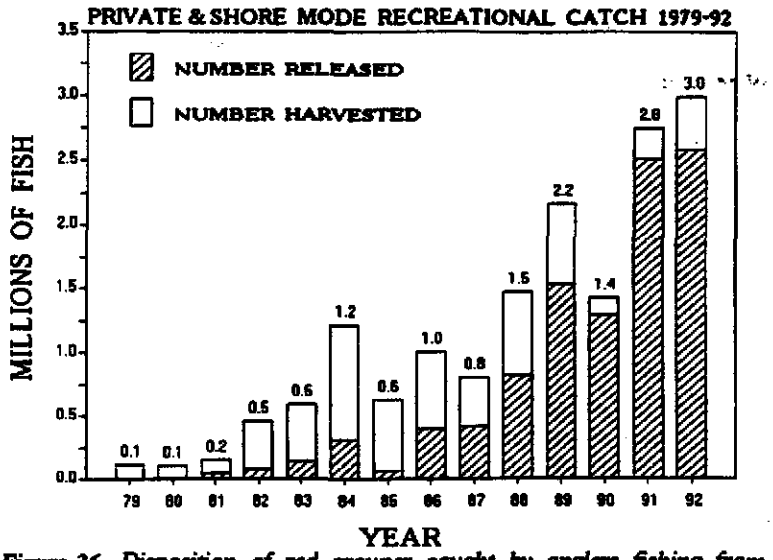

Figure 36. Disposition of red grouper caught by anglers fishing from shore or private/rental vessels, 1979-1992.

It is also clear from Table 42 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 42, Figure 34). 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. Similarly, in 1990 the catch declined after the minimum size was increased to 20 inches, but a recovery would seem to be underway as the catch increased the next two years. Most of this increase was again in the EEZ.

As expected from the life history of red grouper, shore-based fishermen catch a small fraction of the recreational harvest (Table 43). 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 35). Closer inspection reveals that the partyboat sector also declined sharply while the charterboat harvest remained essentially constant in 1990 (Table 43). After 1990 private-rental boat harvest started to increase again while party and charter vessel harvest remained fairly constant.

The 1990 conservation measures may have reduced the angler harvest in several ways. The 20-inch minimum size required a large portion of the catch to be released, which may in turn have reduced the motivation to target the species. In addition, if a large number of anglers had been selling their catch, the new requirement for a reef fish permit may have eliminated 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 1992 (Table 44, Figure 36). These data show that a clearly increasing fraction of the total catch has been reported to be released over the time period, from about 3 percent in 1979 to more than 91 percent in 1991. There was a slight decrease to about 86% by 1992. However, the estimate of total catch (including both harvested and released fish) for the years following the 20-inch minimum size increased in 1992 to levels higher than any prior year.

These data suggest no significant decrease in recreational effort directed at red grouper between 1989 and 1992, despite the permit requirement for the sale of reef fish 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 1979-1992 (Figure 37). 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. Annual increases for 1991 and 1992 brought the combined harvest back up to 7.2 million pounds for the last year.

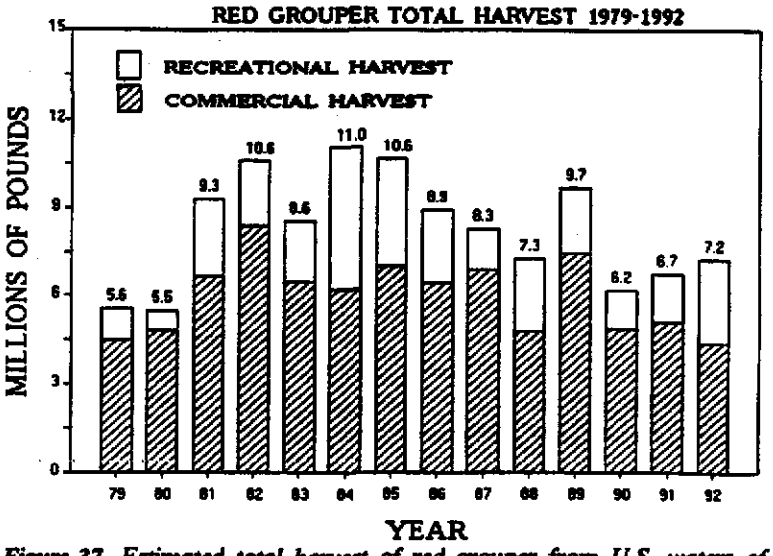

Figure 37. Estimated total harvest of red grouper from U.S. waters of the Gulf of Mexico, 1979-1992.

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 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 37, Tables 2 and 40). The increase to 7.2 million pounds in 1992 was due entirely to an increase in the recreational harvest.

SEASONAL DISTRIBUTIONS

The average seasonal distributions of the commercial and recreational harvests are shown in Figure 37. 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.

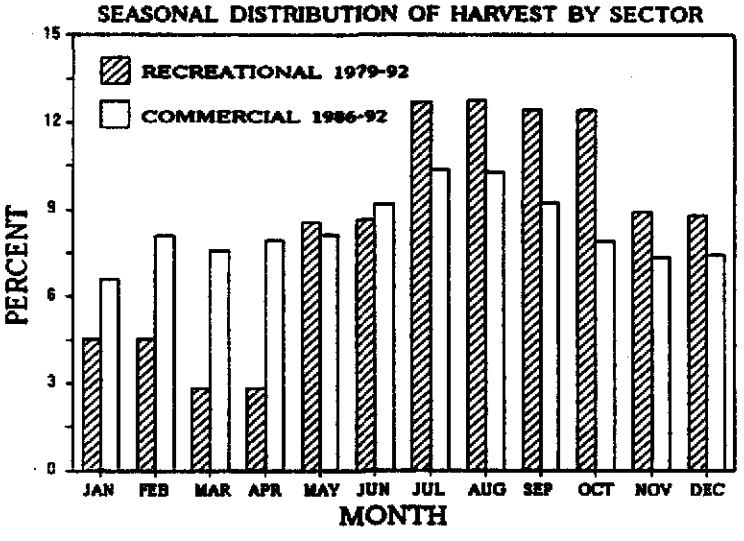

Figure 38. Average seasonal fractions of the commercial and recreational harvest of red grouper in the Gulf of Mexico.

TRENDS IN CATCH-PER-UNIT-EFFORT

Estimates of catch-per-unit-effort (CPUE) were available for three different gear types and two separate time periods. Records of the Cuban fleet fishing off the West Coast of Florida include number of days fished and total poundage of harvest each year from 1940-1976. This was predominately a bottom longline fishery. Additional CPUE data were available from the Reefish Logbook Program which were used to estimate monthly CPUE for fish traps, handlines, and bottom longlines from August 1990 to December 1992 (Tables 45-57).

From 1940 to 1957, CPUE estimates from the Cuban fishery were relatively stable at approximately 900 pounds per day (Figure 39). However starting 1958 CPUE and total harvest both began a nine year decline. Some leveling off of this decline was apparent in 1986, however by this time CPUE was only about a third of the previous time period (approximately 300 pounds per day). Despite the decreased CPUE, total effort increased on an almost annual basis from 1964 to 1976, the final year the fishery was allowed to operate in U.S. waters.

CPUE estimates from the trap fishery (pounds per trap hour) are given in Figure 40. Neither the time trends of means or medians show any apparent annual or seasonal trends. Mean monthly CPUE estimates varied from about 0.38 pounds per trap hour.

CPUE estimates from the handline fishery (pounds per hook-hour) are given in Figure 41. As with the trap fishery CPUE estimates, the estimates from hand lines showed no apparent annual or seasonal trends. Mean CPUE since August 1990 has averaged approximately 2.5 pounds per hook-hour and are far more efficient than bottom longlines in this respect.

Bottom longline CPUE estimates (pounds per hook-hour) are shown in Figure 42. The only possible trend from these data is an increase from approximately 0.06 pounds per hook-hour in late 1990 to 0.12 pounds per hook-hour in early 1991. After this increase, however CPUE again returned to previous levels. This trend did not repeat itself the following spring, suggesting a transient effect of the 1990 closure.

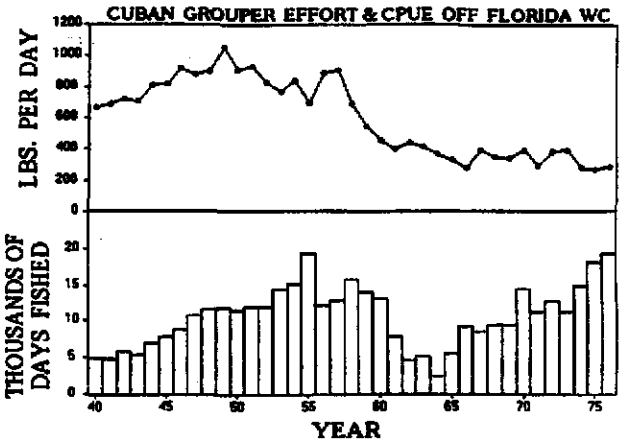

Figure 39. Catch-per-unit effort for Cuban red grouper fishery off the west coast of Florida, 1949-1976.

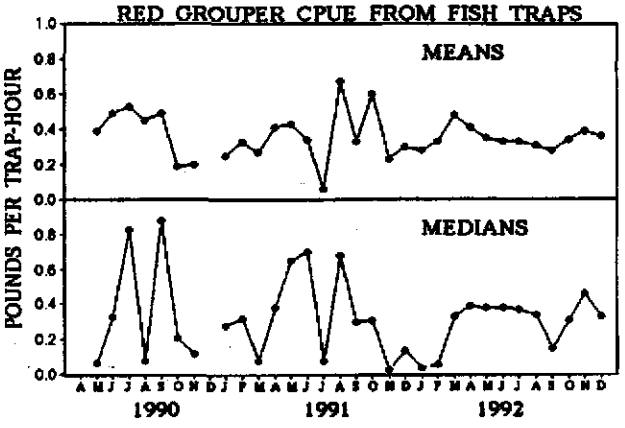

Figure 40. Catch-per-unit effort for trap fishery in Gulf of Mexico.

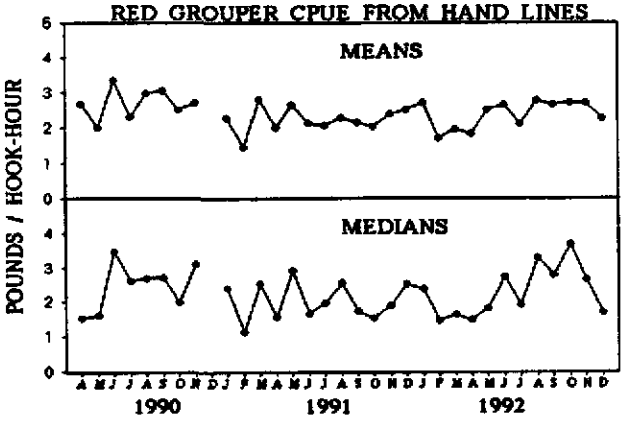

Figure 41. Catch-per-unit effort for hand line fishery in Gulf of Mexico.

The two sources of CPUE data provide somewhat different perspectives on the status of the red grouper stock that supports the current U.S. red grouper fishery. Taken alone, the CPUE statistics from the logbook data suggest a relatively stable current fishery. The data from the Cuban fishery, however, suggest that a meaningful decline in abundance occurred by the mid 1960s, possibly as a result of the removal of the accumulated biomass of older fish that often accompanies a new fishery.

Taken together, these data are consistent with a fishing-induced decline in the standing stock of red grouper in the 1950s and early 1960s followed by a relatively stable fishery on a much reduced stock, resulting in a much reduced catch per unit effort.

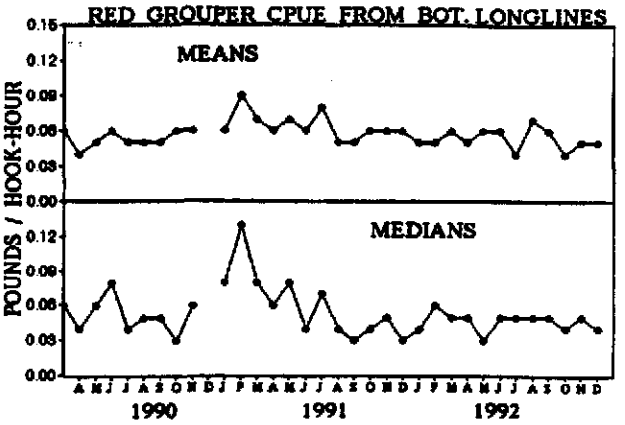

Figure 42. Catch-per-unit effort for bottom longline fishery in Gulf of Mexico.

SIZE DISTRIBUTION OF THE HARVEST

COMMERCIAL SIZE COMPOSITION.

Figure 43 is a scattergram of all length samples from the commercial fishery from 1984-1992 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 samples from 1990-1992.

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 44).

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, although observations of these undersized fish eventually dissipated. 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.

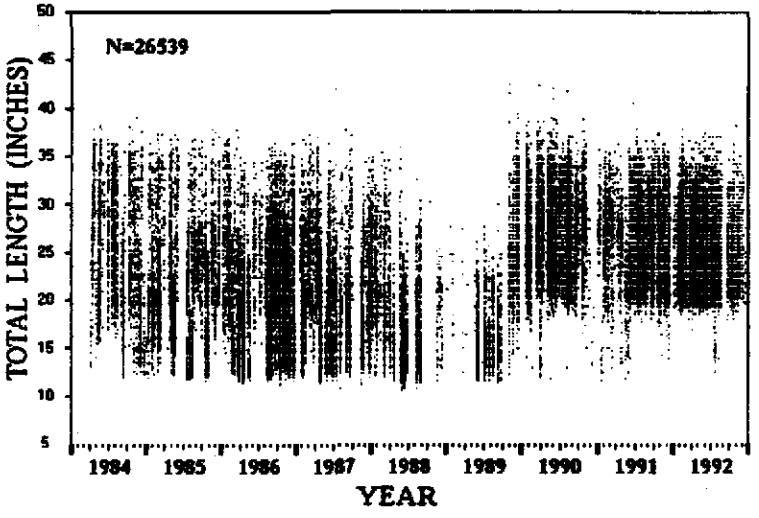

Figure 43. Scattergram of length samples from the commercial fishery for red grouper, 1984-1992.

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 44). As with the trap fishery, sub-legal size fish were still being harvested the first two years of the regulation (1990 and 1991), but were essentially eliminated from the samples by 1992. Also as in 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 44). A decreasing trend in the relative abundance of red grouper 30 inches and greater is evident for both of these gears. These samples also reflect the impact of the 20-inch minimum 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 59).

It is clear from Figure 44 that true handline gear catch a different size distribution of red grouper than do power-assisted reels. Unfortunately,

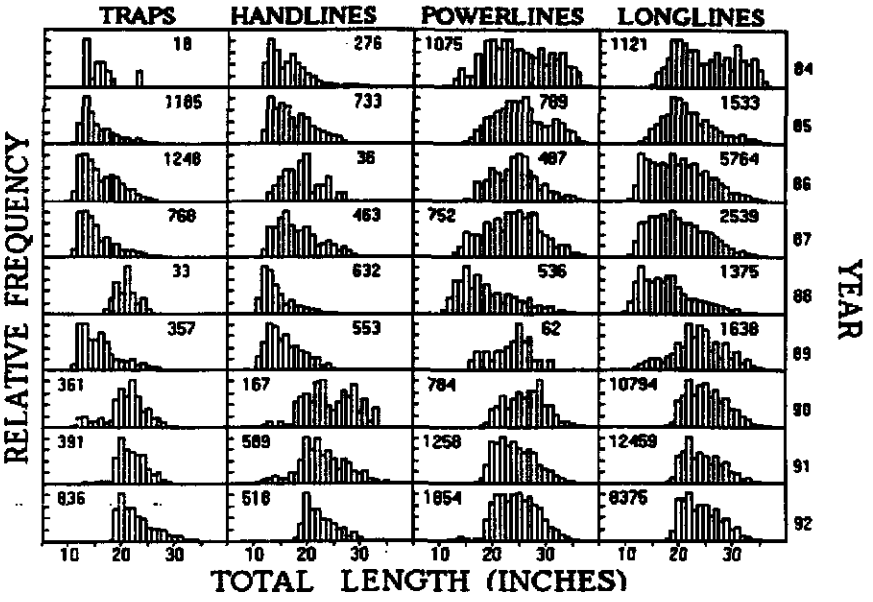

Figure 44. Length frequencies of red grouper from commercial gears 1980-1992.

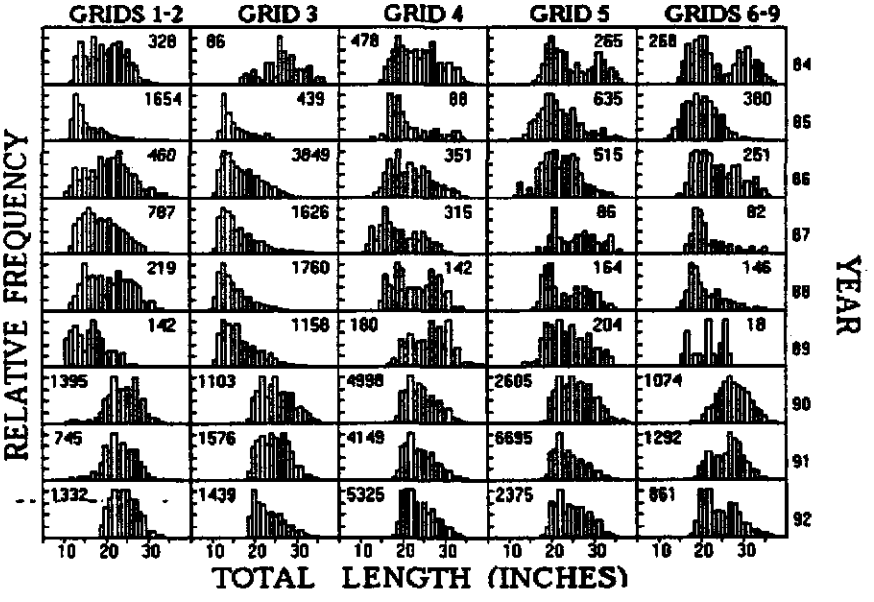

Figure 45. length frequencies of commercial red grouper landings by area where they were caught, 1980-1992.

in the landings files handlines and power-assisted gears are reported under a single gear 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 45 and by location of landing in Figure 46. The samples by county (Figure 46) clearly reflect the paucity of sampling 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 45) provide more complete coverage, but still retain disproportionate representation by gear (Tables 51-55)

This data 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.

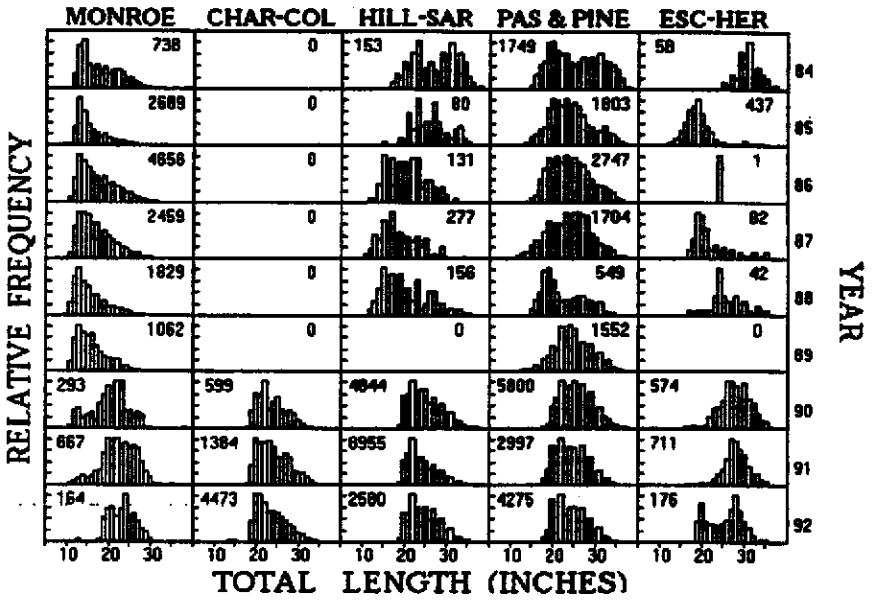

Figure 46. Length frequencies of red grouper catches by counties where they were landed, 1980-1992.

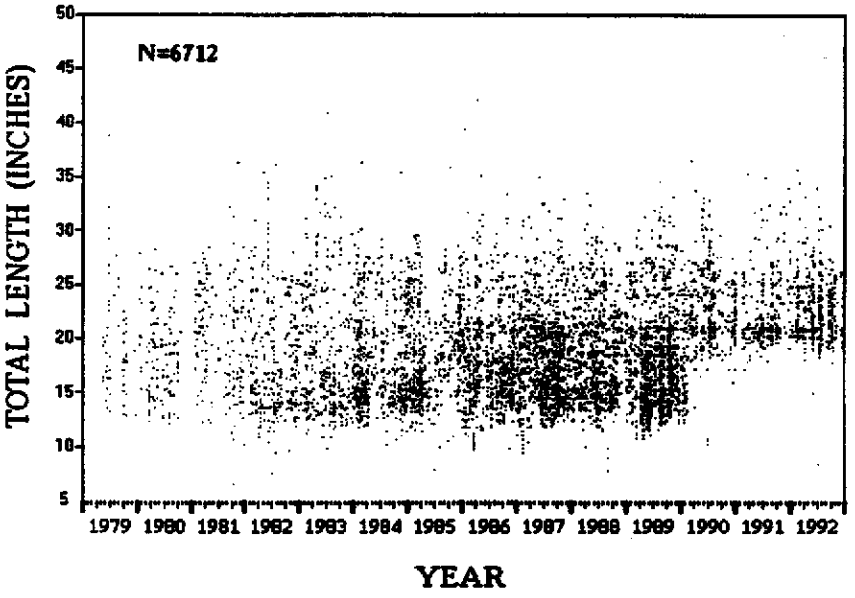

Figure 47. Scattergram of length samples from the recreational fishery for red grouper, 1979-1992.

RECREATIONAL SIZE COMPOSITION.

Figure 47 is a scattergram of all length samples from the recreational fishery from 1979-1992 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 1990-1992 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.

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 48). 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 and 1990-1992. 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.

The length frequencies of the recreational harvest by mode and area summed over years is

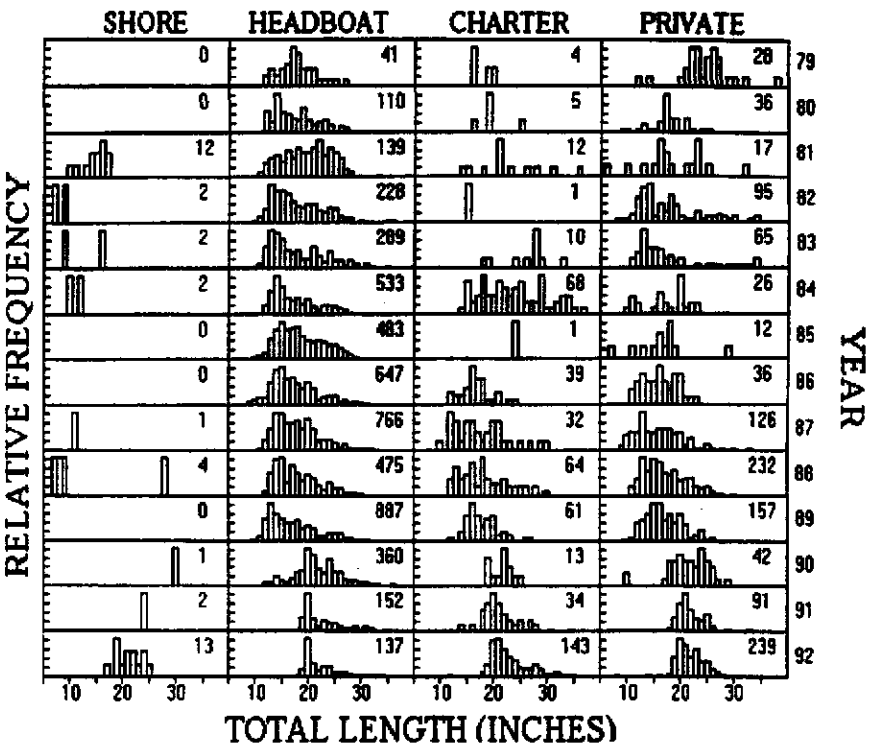

Figure 48. Length frequencies of recreational harvest of red grouper by fishing mode, 1979-1992.

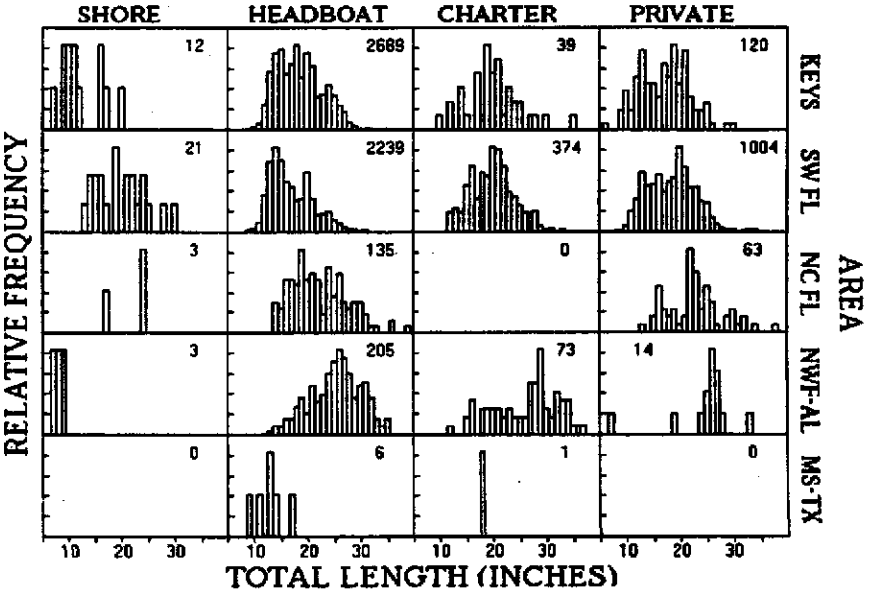

Figure 49. Length frequencies of the recreational harvest of red grouper by fishing mode and area summed across the years 1979-1992.

given in Figure 49. 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 48 and 49 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.

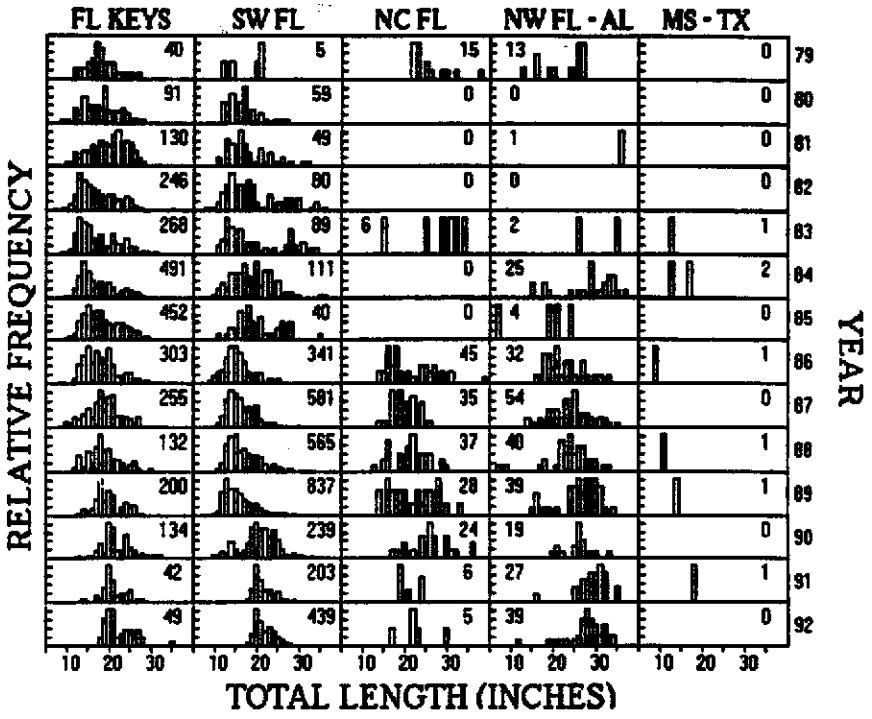

Figure 50. Length frequencies of recreational harvest of red grouper by area and year, 1979-1992.

There is a trend of increasing average size of red grouper harvested by anglers as one moves northward along Florida's west coast (Figure 49). 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 49).

The length frequencies of red grouper sampled from the recreational harvest by fishing area and year are given in Figure 50. 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 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 49 and 50. 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.

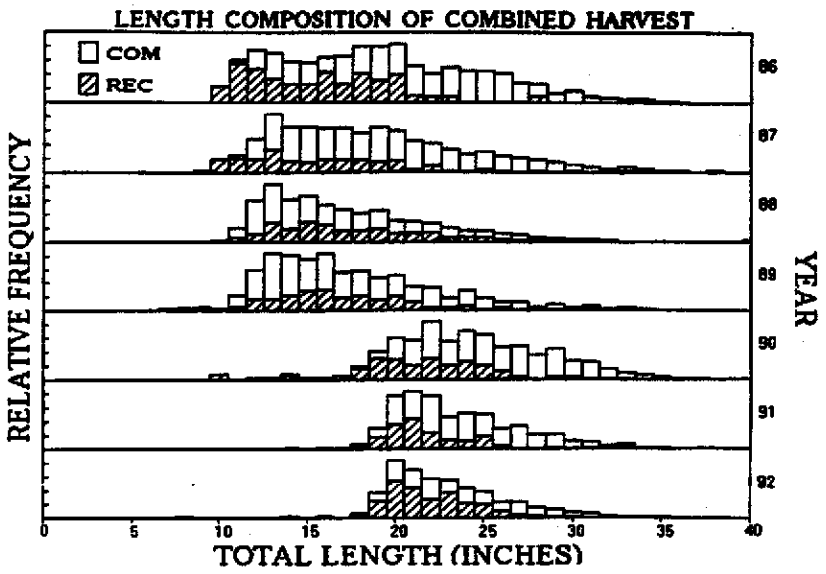

Figure 51. Estimated length composition of the recreational and commercial harvest of Gulf of Mexico red grouper, 1986-1992.

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 1986-1992. The resulting estimates of the length frequencies are presented in Figure 51 and Table 71-74. 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. As was seen in the previous length-frequency analysis, the frequency of red grouper greater than 30 inches total length has decreased since the years 1986 and 1987. A decrease in the number of larger, and presumably older, individuals in the stock is evidence that fishing mortality has altered the age structure of the stock.

FISHING MORTALITY

BACKGROUND

To date, only one direct estimate of mortality exists for red grouper in the Gulf of Mexico (Moe 1969) and one for the Atlantic (Stiles and Burton 1991). Moe (1969) estimated total mortality to be about Z=0.32 in the 1960's using estimates of the actual age composition of the harvest. Stiles and Burton (1991) used similar analysis on data from the recreational fishery from Morehead City, NC to Key West, although 76 percent of the samples were from south Florida or the Florida Keys. They obtained an estimate of Z=0.46. Both of these studies derived estimates of mortality that represent the average fishing mortality across all fully recruited ages.

As stated in the previous section, discard mortality on red grouper can be significant. The 20 inch minimum size regulation put on in 1990 resulted in a marked increase in the numbers of red grouper subject to discard mortality. Furthermore, while this mortality will contribute to total mortality (and fishing mortality) the full "benefit" of this mortality will not be realized in the subsequent yield. Discard mortality results in some fishing mortality which does not contribute to the yield.

In this study, fishing mortality rates consistent with the age distributions of harvested red grouper are estimated using virtual population analysis (VPA) methods. These methods require estimates of the age composition of the catch through time.

AGE DISTRIBUTION FOR THE COMBINED HARVEST

The ages of red grouper have not been routinely sampled from the Gulf of Mexico harvest. As a consequence, it was necessary to estimate the age composition from samples of the lengths of harvested fish. This was accomplished by using the time dependent growth model derived in the previous section using the appropriate inverted equation. Fish from the observed data of known length and age (and thus cohort) were used to refit the inverted equation using a least-squares minimization routine, resulting in the following equation:

$$Length=(1+0.011(y-66))\times(31.8(1-\exp^{-0.18(t-0.76)}))$$

Fish were assigned to a cohort in the same manner that was described for the assignment of ages in the previous section.

Expansion method. The length and age frequencies of the catch in each strata were estimated from the length frequency of the sample for that strata as the product of the estimated length or age distribution of the sample and a weighting factor. This process amounts to the expansion of each measured fish to the entire harvest based upon its contribution to the cumulative frequency distribution of the sample of sizes of the fish associated with its particular stratum. The extent of the expansion can be estimated by computing the value of a weighting factor for the individual observations.

The landings estimates for the commercial fishery are in biomass units. Thus, the weighting factors used to expand the individual length observations from the commercial fishery samples to the lengths of the harvest must account for the weights of the fish. Thus, for the commercial harvest, the weighting factor is determined as the ratio of the estimated combined weight of the fish comprising the length-frequency sample to the weight of the landings in the strata; i.e.,

$$\text{weighting factor} = \frac{\text{total pounds landed}}{\sum_{i=1}^{n} aL_i^b},$$

where n is the number of fish in the length sample, L_i is the length of the ith fish in the length sample, and a and b are the coefficients of the length-weight equation. This procedure simply expands the number of fish in the length sample to that number which would equal the weight of the landings.

In contrast to the commercial landings, which are recorded in pounds, the annual catches for the recreational fishery are estimated in numbers of individuals. This allows the length frequencies of the harvest to be directly extrapolated from the length frequencies of the samples by multiplying the estimated harvest by the proportions of the observations of lengths in the cumulative frequencies of lengths in the strata, i.e.,

$$\text{weighting factor} = \frac{\text{total numbers landed}}{\text{total sample of lengths}},$$

This procedure required sufficient knowledge of the catch and length frequencies by gear and year to completely characterize the harvest. Constraints imposed by sample sizes for length measurements and by coding conventions for gears in the landings data, required stratifications to obtain reasonable gear-space groupings for further analysis. Insufficient data are available to characterize the length composition of the commercial harvest prior to 1986 so analyses were restricted to subsequent years. The combined estimated age frequencies are shown in Figure 52.

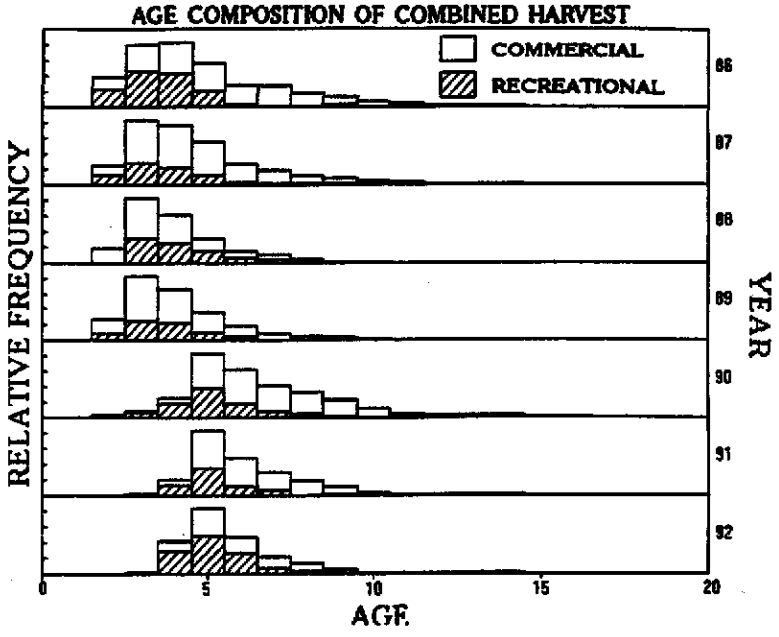

Figure 52. Estimated age composition of the recreational and commercial harvest of Gulf of Mexico red grouper, 1986-1992.

ESTIMATES OF MORTALITY

Catch curve estimates. Total mortality estimates for fully recruited age classes were derived through catch curve analysis of the age data from Table 75-77. This method assumes constant recruitment to the age which is fully available to fishing, constant fishing and natural mortality for fully recruited ages and that these conditions have been true for at least as long as the oldest age in the analysis has been alive. Although these conditions are rarely met, the results of catch-curve analyses often provide useful information with which to judge the extent of mortality in the population.

Because of the shift in the size composition of the harvest in 1990, we estimate the mortalities for the average of 1986-1989 and 1990-1992 separately. We cannot ascertain from the available data if the assumptions required for the analysis are met.

The estimates of total mortality for the

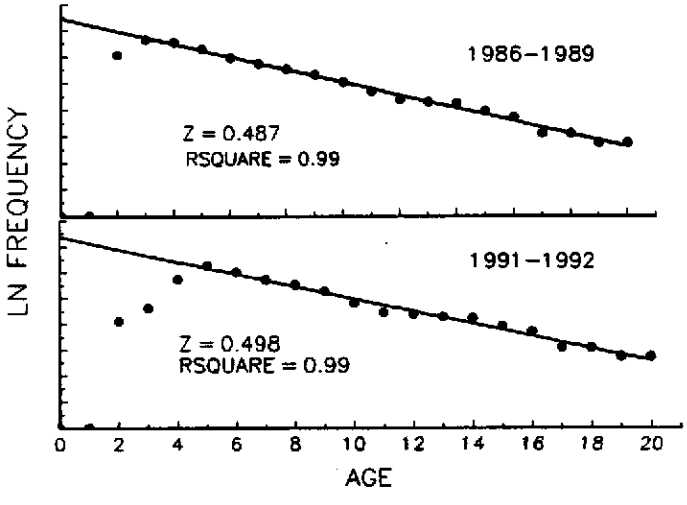

Figure 53. Estimated age distributions of the 1986-1989 average and the 1990-1992 red grouper harvest and the corresponding estimates of total mortality.

two time periods are virtually identical (Figure 53), about 0.484 for 1986-1989 and about 0.497 for 1990-1992. By comparison, in the previous assessment (Goodyear and Schirripa 1991) we used two growth models to estimate age from length that lead to lower estimates of total mortality (ranging from Z=0.27 from Moe's equation to approximately Z=0.40 for the equation of Burton and Stiles). Because growth rates have clearly increased since Moe's work, the results from the application of his model are clearly spurious. The current best catch-curve estimate of fishing mortality for fully recruited ages is approximately F=0.28 for M=0.20, or about 0.33 for M=0.15.

Virtual population estimates. Fishing mortality was also estimated through VPA analysis using an extension (Powers and Restrepo 1991) of the ADAPT methodology (Garvis 1988). This methodology provides for inclusion of indices of relative abundance in the estimation procedure through a least-squares minimization of the differences between estimates of cohort(s) abundance(s) and the indices. No fishery independent estimates of abundance were available for this analysis, consequently catch per unit effort measures derived from fishery statistics were evaluated. These included indices derived from both the recreational and commercial fisheries. In general, the available data lead to different conclusions about the status of the stock. Because of this finding, and the lack of fishery independent knowledge of the status of the stock, our confidence about the accuracy of either result is low. Both are presented here.

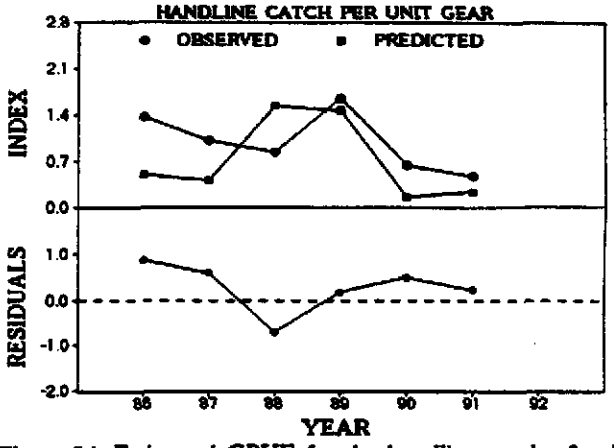

Figure 54. Estimated CPUE for the handline catch of red grouper, values fitted in the VPA procedure, and residuals.

Both analyses required estimates of natural mortality (M) and age specific estimates of gear vulnerability (selectivity). Natural mortality of fished populations is typically estimated with a high degree of uncertainty. Based on the range of M reported in the literature a value of M=0.20 was chosen (Goodyear and Schirripa 1991). Selectivities describe how fishing mortality is distributed among ages. Selectivities were initially estimated from deviations from the catch curve for 1991-92. The VPA was run to estimate selectivity for the previous years. The estimates from the 1990 and 1991 were then averaged and used for the terminal year selectivity for the next trial. This process was repeated until selectivities converged and demonstrated minimal change with further trials. The resulting selectivities for ages 4-6 were then compared to that expected based on the proportions of each age class above the 20 inch minimum size. The values for ages 5 and 6 agreed well with the expected values. The value for age 4 was adjusted upward by the ratio of its expected proportion and the selectivity of the first fully available age class (age 7).

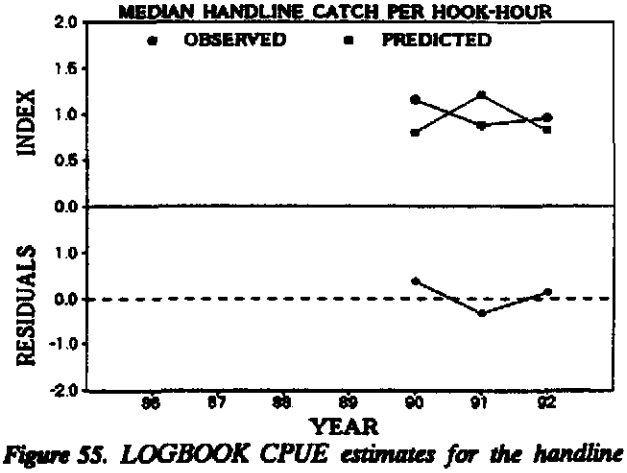

Figure 55. LOGBOOK CPUE estimates for the handline catch of red grouper, values fitted in the VPA procedure, and residuals.

The VPA analysis that resulted in the highest estimates of fishing mortality utilized cpue values derived from

the commercial statistics. Two time series were constructed for the handline catch. The first was the ratio of the handline catch to the estimated number of handlines on vessels fishing from Florida ports by year. The later data were available for 1986-1991 from the SEFSC Operating Units Files. The second time series was the median handline catch per hook-hour derived from the Reef Fish Logbook program data files. The later data source should provide a better measure of CPUE but were only available for 1990-1992. VPA results derived from these data are presented in Tables 78-80 and the relations between and CPUE indices and population abundances along with corresponding residuals are shown in Figures 54 and 55. The associated estimates of population size and F by age and year are given in Tables 78 and 79. In general, the model fit was poor as evidenced by estimates of coefficients of variation for numbers at age in the terminal year that were greater than 1.0.

The VPA analysis that resulted in the lowest estimates of fishing mortality utilized abundance indices derived from recreational fishery (Table 81-83). The performance of each of several cpue statistics from the recreational fishery was evaluated. In general, catch per angler trip tended to be low and declined with the onset of the 20-inch minimum size in 1990. None of the cpue indices evaluated proved satisfactory. A large fraction of the CPUE values derived from the Private-Rental intercepts in the MRFSS survey involved few fish per angler-trip. If fluctuations in abundance favor changes in the fraction of anglers catching fish more than the number of fish caught by individual anglers then the total catch might be a better index of abundance than the available cpue values. Consequently, we employed the estimated catch of age-5 red grouper by the private-rental sector of the recreational fishery.

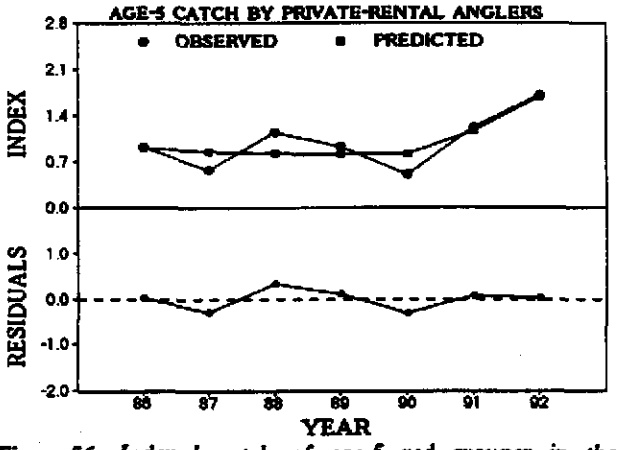

Figure 56. Indexed catch of age-5 red grouper in the private-rental mode, values fitted in the VPA procedure and residuals.

VPA results derived from these data are presented in Tables 81-83 and the relations between the CPUE indices and population abundances along with corresponding residuals are shown in Figure 56. The model fit is much better than that observed for the analyses using CPUE estimates from the commercial fishery, with CVs for numbers at age for the terminal year of in the range of 0.25 to 0.3. The terminal year fishing mortality estimates for ages over the minimum size limit were about 0.3 (80% confidence interval ca. 0.21 to 0.40) from this analysis. These rates are much more consistent with the catch curve estimates of total mortality than were the values estimated using indices derived with the commercial handline statistics. Because of the better model fit and the better agreement with the catch-curve result, the VPA estimates derived with these recreational statistics were selected for subsequent analyses. Although, our confidence in the accuracy of these estimates is lower than their computed confidence intervals would suggest, the estimates from this analysis seemed most reasonable given the catch curve results, therefore they were adopted for

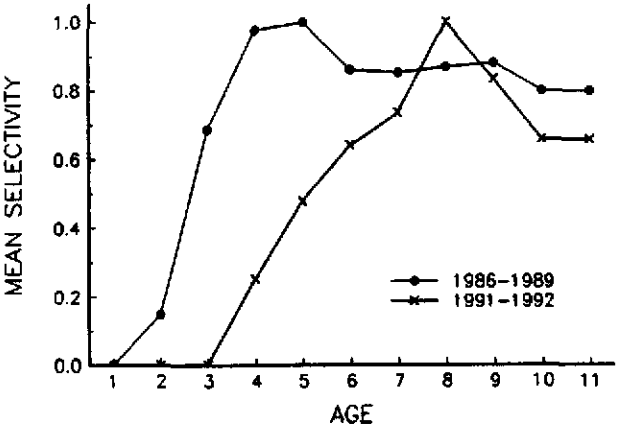

Figure 57. Annual mean selectivity by age for red grouper in the Gulf of Mexico before and after the 20 inch minimum size was instituted.

subsequent analyses where required.

The estimates of age specific population size and fishing mortality are given in Tables 81 and 82. The fishing mortality estimates appear to reflect a dome shaped selectivity curve with highest values at intermediate ages (Figure 57). There was also a reduction in fishing mortalities for the younger ages in recent years, presumably as a result of the implementation of the 20-inch minimum size that went into effect in 1990. This is reflected in a change in peak mean selectivity from age 4 for 1986-1989 to age 8 for 1990-1992. However, because we have no estimates of the number of discards of sublegal fish, the associated fishing mortality is not included in the VPA results. Consequently, all of the values for fishing mortality for ages less than 7 are presumed to be underestimated after 1990.

We use simulation techniques to evaluate the possible current level of SPR. We performed two analyses. In the first, mortality rates were the averages of the 1986-1989 VPA analysis assuming natural mortality to be 0.2. The resulting estimate was about 0.17. The second analysis used the same selectivity curve but the catch curve estimate of fishing mortality for the period (F=0.287). This resulted in an estimate of SPR of about 0.24. The same analyses performed on the 1992 selectivities produced SPR=.3 for the VPA results and SPR=0.3 for the catch curve estimate. Based on these results, we expect that the present condition of the stock is slightly improved from the 1989 condition. However, given our low confidence in the VPA results, it is possible that the current state of the is somewhat worse (or better) than this estimate suggests. As discussed elsewhere, the utility of these estimates is uncertain because of the reproductive characteristics of the species. However, given the susceptibility of this life history pattern to overfishing, these estimates urge additional conservation measures.

MANAGEMENT ALTERNATIVES

EQUILIBRIUM ANALYSIS

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.

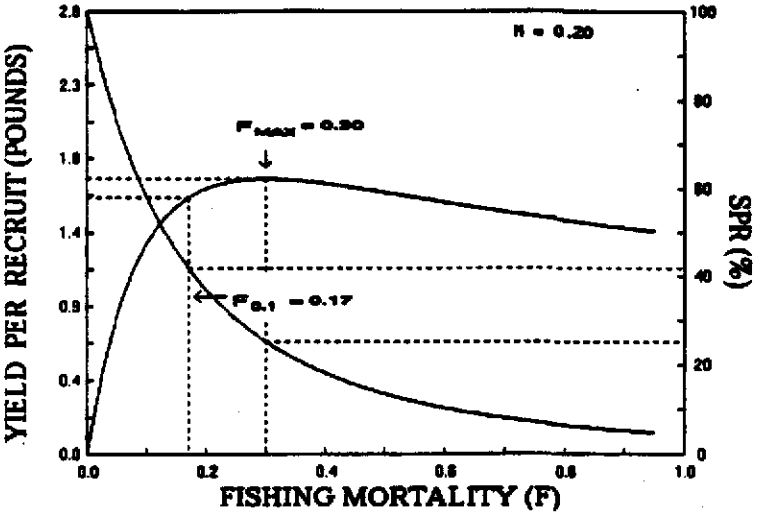

Figure 58. Estimates of $F_{0.1}$ and F_{max} and SPR for red grouper assuming 1986-1989 average vulnerabilities at age before the 20 inch minimum size was instituted.

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 58 and 59). 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 present 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 our estimates SPR are based on female fish that remain female throughout their entire life and does

not attempt to incorporate the probabilities of sex change.

$F_{0.1}$ and F_{max} for the pre-1990 selectivities were estimated to be 0.17 and 0.30, respectively. The data of Table 82 indicates that the pre-1990 age distribution of fishing mortality exceeded the estimates of $F_{0.1}$ and F_{max}.

The analyses presented in Figure 59 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 0.27 and 0.63 which produced SPR values of about 46 and 26 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 present 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.

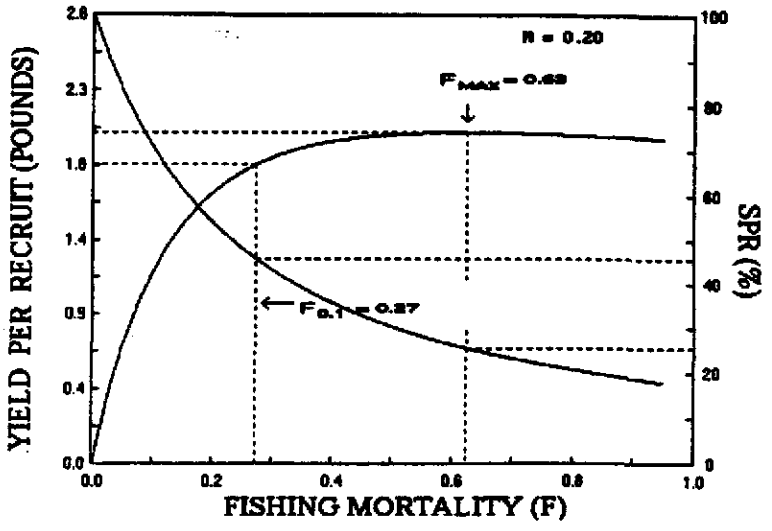

Figure 59. Estimates of F0.1 and Fmax and SPR for red grouper assuming 1991-1992 average vulnerabilities at age (after the 20 inch minimum size was instituted).

However, as evidenced in the preceding section (release mortality) undersize red grouper suffer an estimated 33% mortality from the catch-release 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.

Alternative minimum sizes. 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

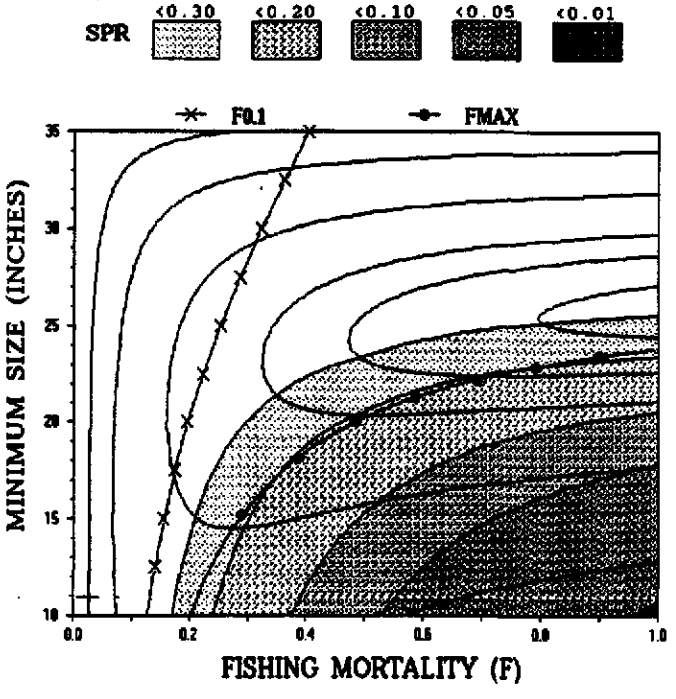

Figure 60. Yield and SPR for red grouper as a function of minimum size and fishing mortality (F) assuming current estimated growth and no release mortality.

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 used were for the last year of estimated growth (1988) and the first year (1966) with the maximum weight ($W\infty$) estimated from $L\infty$ using the length-weight relation. Natural mortality (M) was assumed to be 0.20. 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 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 of Figures 60 - 63. 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 60, 61 and 62, respectively). If the kill of undersized fish can be avoided then biomass yield could be maximized by delaying harvest until the fish

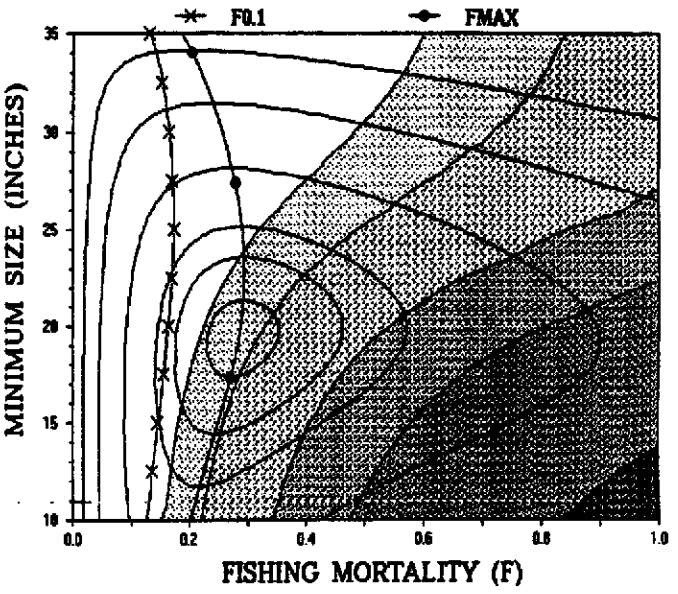

Figure 61. Yield and SPR for red grouper as a function of minimum size and fishing mortality (F) assuming current growth and a release mortality of 0.20.

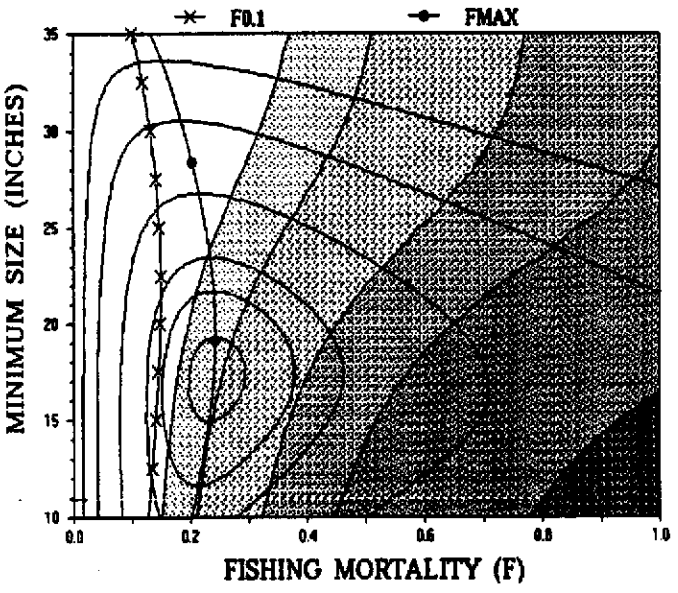

Figure 62. Yield and SPR for red grouper as a function of minimum size and fishing mortality (F) assuming current estimated growth and a release mortality of 0.33.

reach about 25 inches total length and then fishing them heavily (Figure 60). However, if discard mortality cannot be avoided then delaying harvest until the fish achieve 19 inches may reduce harvest on a per recruit basis (Figures 61 and 62). At the higher release mortality the optimum minimum size and fishing 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 20% at maximum yield per recruit, regardless of release mortality (Figures 60 - 62). 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 SPR at fishing mortality rates much above 0.4.

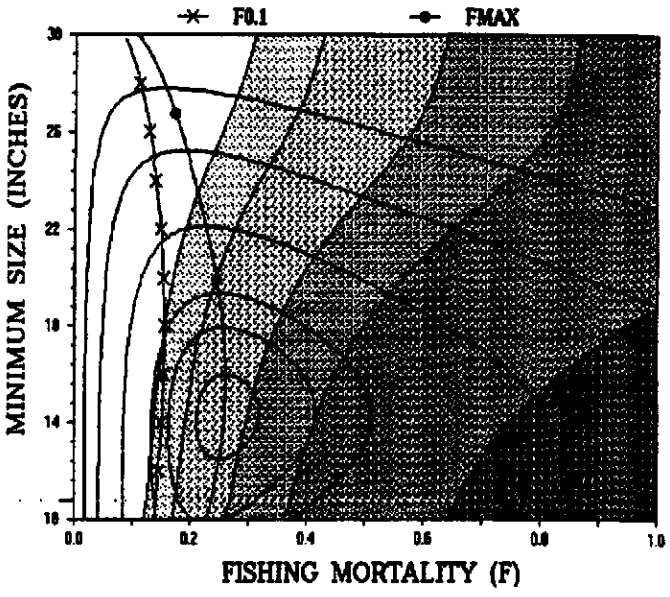

Figure 63. Yield and SPR for red grouper as a function of minimum size and fishing mortality (F) assuming 1966 growth and a release mortality of 0.33.

Because yield and SPR are functions of growth rate, we did similar analysis using growth parameters estimated for the 1966 cohort for comparison (Figure 63). The minimum size corresponding to the maximum obtainable yield increased from approximately 14 to 17 inches with the change in growth. Furthermore, the point of maximum yield moved from an estimate of SPR of approximately 15 to over 20 percent. This is due to the increase in Fmax given the 1966 growth rate. As red grouper increase in size at age, the effort required to maximize yield decreases and the minimum size required increases.

POSSIBLE MANAGEMENT MEASURES

Commercial 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. The commercial quota for shallow water groupers has not been met since 1990 and consequently, the quota itself has had no conservation effect since then, except perhaps by discouraging additional participants in the fishery. More stringent catch limits could be imposed which would reduce fishing mortality from present levels.

Commercial trip limits. Another possible management measure is to limit the catch of red grouper on a per-trip basis. In order to determine the potential impact such a measure might have the commercial fishery it is useful to determine the distribution of the catch-per-trip before such a measure is undertaken. Data for this analysis was obtained from the Logbook reporting program. The cumulative frequency distributions by catch-per-trip are given in Figure 64 and Table 84.

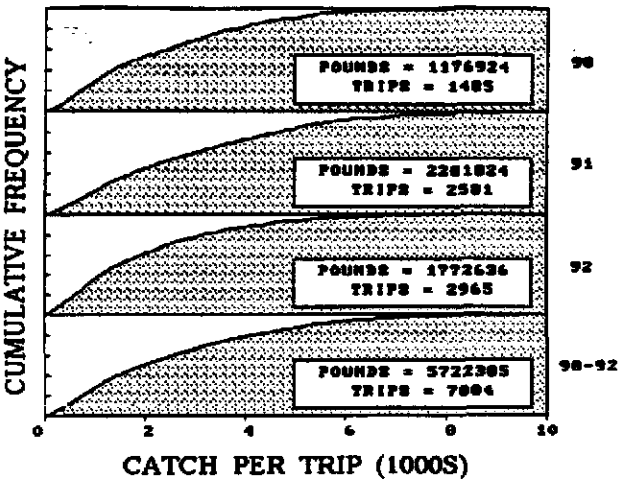

Figure 64. Cumulative frequency distributions of catch per trip by commercial gears, 1990-1992.

It can be seen in Table 84 that a catch-per-trip of 1000 pounds accounts for only about 28 percent of all trips, leaving the remaining 72 percent of trips effected by a 1000 pounds-per-trip limit. Likewise, trips of up to 2000 pounds account for approximately 50 percent of all trips, leaving the other 50 percent of the trips to be reduced from their "unregulated" levels. Trips of up to 5000 pounds-per-trip are make up about 87 percent of all trips, meaning that a 5000 pound trip limit would limit only 13 percent of all trips.

One point that needs to be kept in mind is that the above percentages are based on the distribution of catch-per-trip of the *current* fishery. Should the red grouper fishery be managed with some sort of trip limit, larger fishing vessels with capacities well in excess of the trip limit may be less economically efficient. Should these vessels be replaced with smaller, more efficient ones, the percentage of vessels (and thus trips) that are affected by a particular trip limit would decrease.

Recreational 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 65 for 1979-1992. 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.

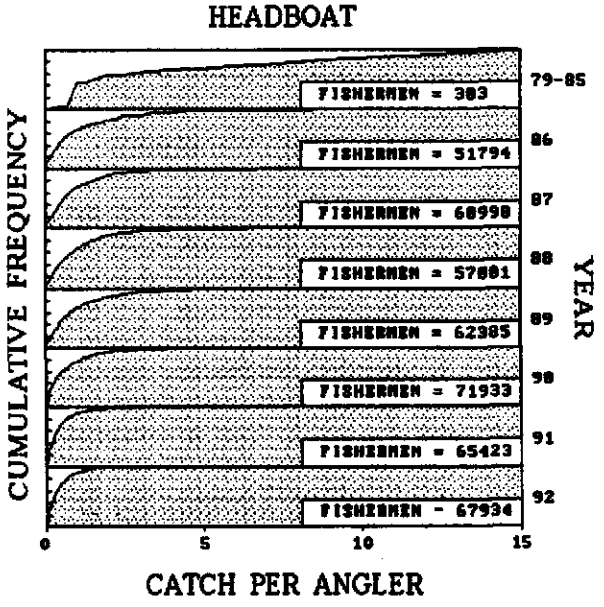

Figure 65. Cumulative frequency distributions of catch per angler by headboat patrons, 1986-1992.

Similar data for the charter boat patrons is presented in Figure 66 and for anglers fishing from private and rental craft in Figure 67. 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 are obvious changes in the CFDs of the estimated catches/angler with time. Notably the data clearly shows the impact of the 5-fish creel limit in 1990, particularly in the private-rental mode. 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 67). 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 1979-1985 CFDs of Figures 66 and 67, this creel limit would be expected to reduce the recreational catch about 10 percent if effort remained constant and fish were released for no other reason (Figure 68). The estimate developed in Figure 68 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.

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. We attempted to minimize this problem by restricting the analysis to data collected in interviews conducted in 1979-1985.

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 69 which is constructed from the same set of pooled data as used with the analysis depicted in Figure 68.

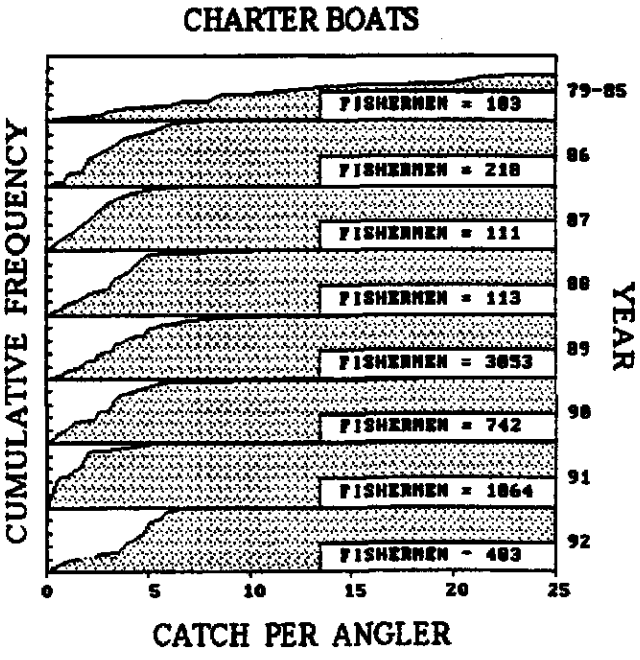

Figure 66. Cumulative frequency distributions of catch per angler by charter boat patrons, 1986-1992.

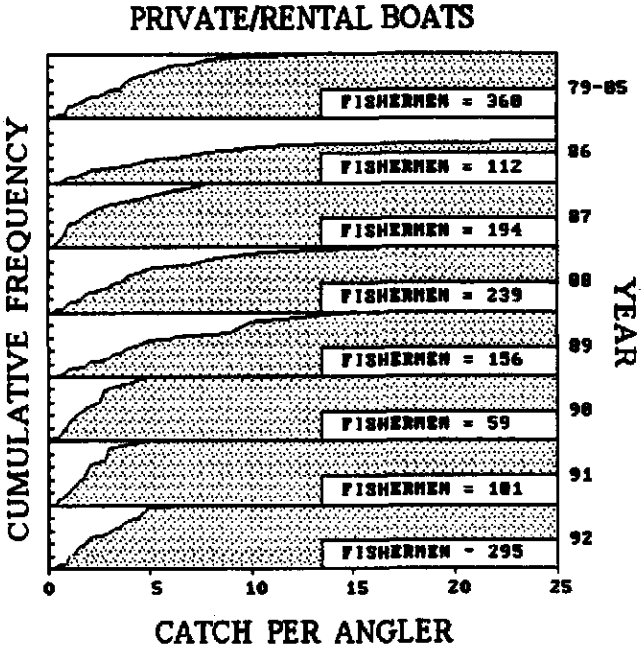

Figure 67. Cumulative frequency distributions of catch per angler fishing from private/rental craft 1986-1992.

These analyses assume a baseline catchable stock equal to the 1979-1985 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 1979-1985 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 if it falls below the levels which existed when the 1979-1985 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.

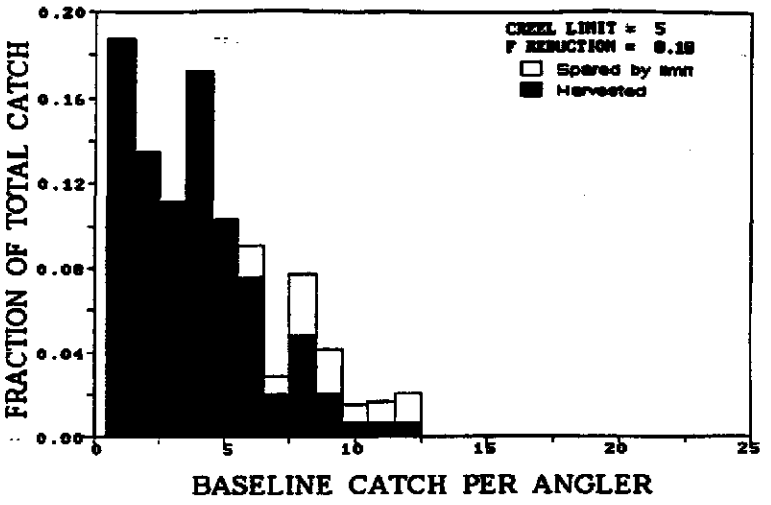

Figure 68. Potential reduction in recreational fishing mortality by anglers fishing from private vessels associated with a five-fish creel limit.

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 and the creel 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 1979-1985 and length frequencies for the headboat, charter and private/rental sectors for samples collected during the period 1979-1989. 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 :

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

where,

S = the fraction of the catch above the size limit,

C = the fraction of the catch below the creel limit.

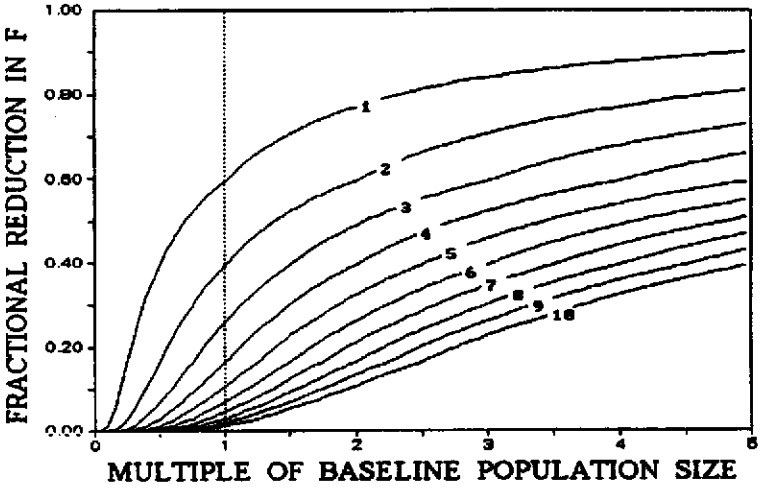

Figure 69. Effect of alternative creel limits on recreational fishing mortality as a function of stock size.

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. We performed three analyses for each set of observations: 1) no discard mortality (e.g. Figure 70); 2) discard mortality of 0.33 for fish landed in excess of the limits (e.g. Figure 71); and 3) no discard mortality for the creel limit but 0.33 for fish caught below the minimum size (e.g. Figure 72). The results are presented in Tables 85-93.

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 70, Tables 85, 88 and 91). 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 71, Tables 87, 90 and 93). 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

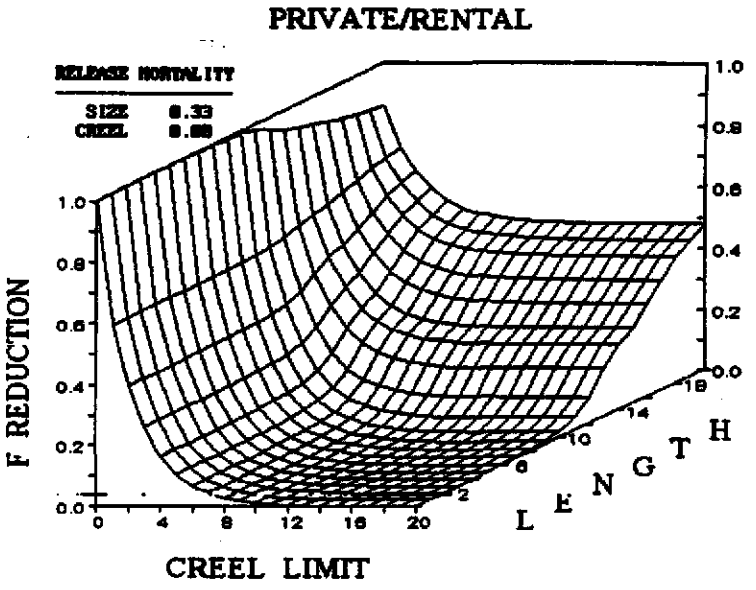

Figure 70. Estimated reduction in F by anglers fishing from private/rental craft as a function of size and creel limits if no fish are caught above the creel limit and 1/3 of the catch smaller than the minimum size dies after release.

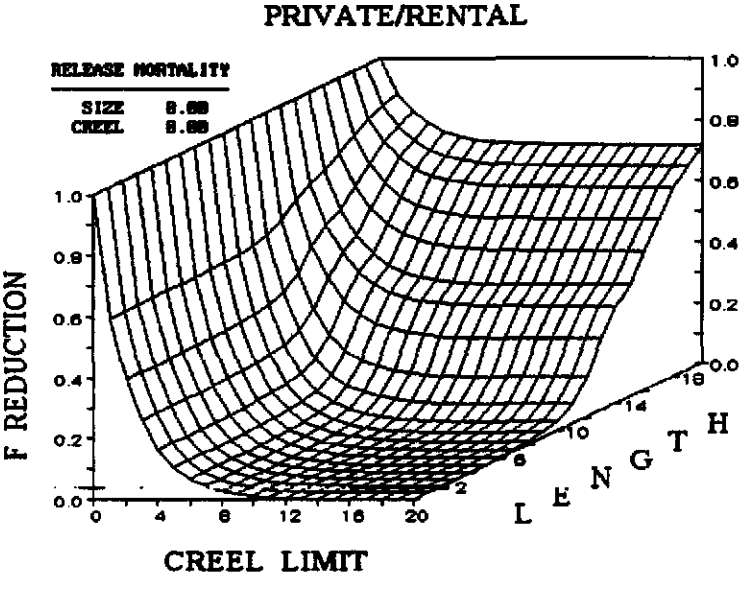

Figure 71. Estimated reduction in fishing mortality (F) by anglers fishing from private/rental craft as a function of size and creel limits if no fish die from catch and release.

estimate of F for very restrictive creel limits (Figure 69, Tables 86, 89, and 92). The effect is slight for release mortality rates up to about 0.33 but could become an important consideration if the average release mortality seriously exceeds 0.33.

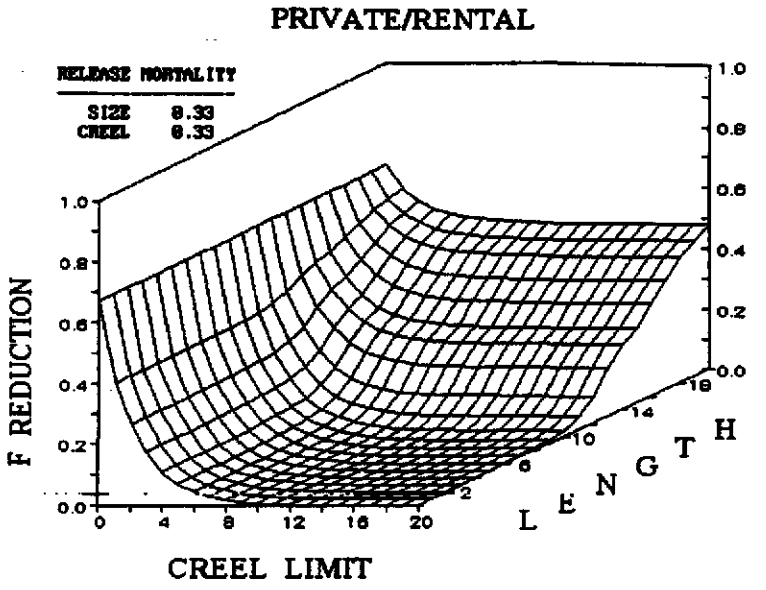

Figure 72. Estimated reduction in fishing mortality (F) by anglers fishing from private/rental craft as a function of size and creel limits if the catch frequency distributions remain the same and 1/3 of the excess catch dies after release.

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.

ESTIMATES OF TOTAL ALLOWABLE CATCH (TAC)

We derived estimates of TAC for a variety of conditions including various combinations of release mortalities and minimum sizes. Furthermore, we considered two possible scenarios: a "worst" case scenario, where gear selectivities were assumed to be those estimated before any regulations were in effect (1986-1989), and a "best" case scenario, where gear selectivities were assumed to be those estimated after the 20 inch minimum size regulation (1991-1992). The difference between these two scenarios is the amount of fishing/release mortality exerted on the younger ages. In the "worst" case scenario fishing pressure on the younger ages remains relatively high due to the lack of any size regulation. However, as noted in the previous section, the increase in minimum size in 1990 tended to move the fishery further offshore, thus shifting fishing effort away from the younger fish and more to the larger (older) individuals of the stock. These 1991-1992 gear selectivities are reflected in the "best" case scenario. In this way, the simulations considering the smaller minimum size (16 inches) are best associated with the 1986-1989 selectivities and the larger minimum size (20 inches) with the 1991-1992 selectivities.

We considered two aspects in our estimates of TAC. The first reflects the long term productivity of the fishery assuming equilibrium conditions (Tables 94 - 97). This section describes biological reference points that would be associated with equilibrium harvest levels given constant recruitment at estimated recent levels. The second evaluates the implications of various levels of TAC based on the estimated 1992 condition of the stock. These are addressed in the following two sections.

Equilibrium Allowable Harvest for constant recruitment. Estimates of the values of various biological reference points for harvest levels in equilibrium are useful for evaluating the long term potential yield of the stock. Given the current gear selectivities and minimum size, and our best estimate of release mortality (33 percent), fishing mortality could be maintained at a level of F0.1 (F0.1=0.24) with a harvest of approximately 9.8 million pounds (Table 95). This level of harvest would actually exceed the total annual estimated harvest each year since 1985. However, because current estimate of fishing mortality already exceeds the level estimated for maximum yield, the current age structure of the stock is depressed and thus not in a condition to maintain this level of harvest. An interim period of reduced fishing mortality to rebuild the stock will be required before a long term TAC of 9.8 million pounds can be achieved.

TAC under current stock conditions. We use simulation techniques to evaluate the importance of the discards and the utility of alternative levels of TAC. Age-specific selectivities to fishing were taken from the VPA analysis assuming natural mortality to be 0.2, as in the previous section.

We assume for the subsequent analyses that the management objective for this fishery is to optimize biomass yield and consequently ignore the numbers of fish that might be harvested under different options. We evaluated the relative impact of 16-inch, 18-inch and 20-inch minimum sizes for discard mortality rates of 0, 0.33, 0.5 and 0.6 for TAC of 2, 4, 8, and 10 million pounds given the two possible selectivity curves discussed above (Tables 98-99). We recommend reducing fishing mortality to F=0.27 so that the long term yield might be enhanced. If taken in the first year, this action would set a TAC at about 4 million pounds or about 56 percent of the 1992 catch.

In considering the options, we note that if the discard (release) mortality is negligible then the 20-inch minimum size is clearly superior to a 16 or 18-inch minimum in obtaining maximum biomass yield. However, if it exceeds about 33 percent, then the conservation effect on the spawning stock could be enhanced by lowering the minimum size. Such a move might also be used to adjust the commercial/recreational share of the harvest. However, we note that 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.

LITERATURE CITED

Abascal, J. 1968. Cuba y la pesca: 10 años de revolucion. Mar Pesca 38/39:8-15.

Bagenal, T.B., and F.W. Tesch. 1978. Age and growth, Chap. 5 in Methods for assessment of fish production in fresh waters. T.B. Bagenal (ed.) Blackwell Scientific Publications. Oxford, England. 365 pp.

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., and L.H. Bullock. 1976. Biological research on snappers and groupers as related to fishery *management requirements*. Pages 86-94 in H.R. Bullis, Jr., and A.C. Jones, editors, Proceedings: colloquium on snapper-grouper fishery resources of the western central Atlantic Ocean. Florida Sea Grant Colloquium Report 17. 333 pp.

Boehlert, G.W., M.M. Yoklavich and D.B. Chelton. 1989. Time series of growth in the genus Sebastes from the Northeast Pacific Ocean. Fishery Bulletin, U.S. 87: 791-806.

Brule, T. L.G. Rodriguez Canche. 1993. Food habits of juvenile red groupers, *Epinephelus morio* (Valenciennes, 1828), from Campeche Bank, Yucatan, Mexico. Bull. Mar. Sci. 52(2): 772-779.

Bullock L.H. and G.B. Smith. 1991. Memoirs of the Hourglass cruises: Vol VIII, part 2. *Seabasses (Pisces: Serranidae)* Florida Marine Research Institute.

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:

Byrkit, D.R. 1987. Statistics today: A comprehensive introduction. Benjamin/Cummings Pub. Com., Inc. Menlo Park, Calf. 850 pp.

Eklund, A.M. 1992. Age and growth of red grouper, (*Epinephelus morio*), from the Gulf of Mexico. National Marine Fisheries Service, Southeast Fisheries Center, Miami Laboratory, Miami CRD-91/92-73.

Gavaris, S. 1988. An adaptive framework for the estimation of population size. Canadian Atl. Fish. Sci. Adv. Comm. (CAFSAC) Res. Doc. 88/29. 12p.

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.

Goodyear, C.P. and M.J. Schirripa. 1991. The red grouper fishery of the Gulf of Mexico. National Marine Fisheries Service, Southeast Fisheries Center, Miami Laboratory, Miami CRD-90/91-86.

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. Boreremа. 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.

Koenig, C.C. 1993. Spawning biology of shallow-water Gulf of Mexico groupers: Final report. MARFIN contract No. NA90AA-H-MF748.

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.

Longley, W.H. and S.F. Hildebrand. 1941. Systematic catalogue of the fishes of Tortugas, Florida, with observations on color, habits and local distributions. Carnegie Inst. Wash. Publ. 535. xiii +331 p., 34 pls.

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.

Powers, J.E. and V.R. Restrepo. 1991. Additional options for age-sequenced analysis. ICCAT working document SCRS/91/40.

Ramirez, M.S. 1970. The red grouper fishery of Yucatan Peninsula Mexico. Proceedings of the 22nd Annual Session Gulf and Caribbean Fisheries Institute, Rossenstiel 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.

Tashiro, J.E. and S.E. Coleman. 1977. The Cuban grouper and snapper fishery in the Gulf of Mexico. Mar. Fish. Rev. 39(10): 1-6.

Richardson, L.R. and J.R. Gold. 1993. Mitochondrial DNA variation in red grouper (*Epinephelus morio*) and greater amberjack (*Seriola dumerili*) from the Gulf of Mexico. ICES J. mar. Sci., 50: 53-62.

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

SAS Institute, Inc. 1989. SAS/STAT User's Guide, Version 6, Fourth Edition Volume 2. Cary, NC: SAS Institute Inc. 846 pp.

Sadovy, Y. 1993. Spawning stock biomass per recruit: *Epinephelus guttatus* (Puerto Rico). MS.

Schirripa, M.J., K. Burns and J.A. Bohnsack. 1993. Reef fish release survival based on tag and recovery data. National Marine Fisheries Service, Southeast Fisheries Center, Miami Laboratory, Miami CRD-92/93-34.

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. 1984. Sex reversal and sociodemographic processes in coral reef fishes. In G.W. Potts and R.J. Wotton (editors), Fish reproduction: Strategies and tactics, p. 103-118. Academic Press, Lond.

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.

Smith, G.B. 1976. Ecology and distribution of mid-eastern Gulf of Mexico reef fishes. Fla. Mar. Res. Publ. No. 19. 78 p.

Taylor R.G. and R.H. McMichael, Jr. 1983. The wire fish-trap fisheries in Monroe and collier counties, Florida. Prof. Pap. Ser. Mar. Lab. Fla. No. 39. 19 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.

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.

Weisburg, S. 1986. A linear model approach to backcalculation of fish length. Journal of the American Statistical Association. 81:922-929.

Wilson, R.R., Jr. 1992. Survivorship of released undersized red groupers in the eastern gulf grouper fishery: Final report. Grant No. NA90aa-H-SK118.

Table 1. Mean backcalculated length at age by year of birth including sample size for red grouper in the Gulf of Mexico.

YEAR OF	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17	
BIRTH	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean
1962	2	0.85	2	4.97	2	7.77	2	10.57	2	12.44	2	14.12	2	15.62	2	16.75	2	17.87	2	19.00	2	20.13	2	21.06	2	22.19	2	23.49	2	24.99	2	25.93	2	26.86
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	—
1964	2	4.60	2	7.94	2	13.54	2	15.47	2	17.21	2	18.31	2	20.22	2	22.40	2	23.48	2	24.76	2	26.27	2	27.12	2	28.20	2	29.28	1	25.99	1	26.80	0	—
1965	3	1.66	3	7.51	3	11.73	3	14.89	3	17.90	3	20.45	3	21.95	3	23.29	3	24.49	3	25.53	3	26.57	3	27.92	3	29.12	1	28.15	1	29.04	0	—	0	—
1966	12	1.74	12	7.91	12	12.09	12	15.74	12	19.09	12	21.42	12	22.94	12	24.07	12	25.28	12	26.41	12	27.46	12	28.36	0	—	0	—	0	—	0	—	0	—
1967	13	3.09	13	8.62	13	12.31	13	15.69	13	18.67	13	20.74	13	22.36	13	23.85	13	25.56	13	26.80	13	27.87	6	27.34	5	27.82	0	—	0	—	0	—	0	—
1968	10	2.91	10	8.66	10	13.49	10	17.40	10	20.59	10	22.98	10	24.89	10	26.47	10	27.95	10	29.26	1	24.97	1	26.29	0	—	0	—	0	—	0	—	0	—
1969	5	2.52	5	8.11	5	11.59	5	15.50	5	18.08	5	20.21	5	22.23	5	23.65	5	25.52	3	24.59	3	25.72	0	—	0	—	0	—	0	—	0	—	0	—
1970	6	2.94	6	7.78	6	12.22	6	17.08	6	19.95	6	23.03	6	25.17	6	26.91	1	25.61	1	26.07	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1971	12	2.35	12	7.77	12	12.27	12	16.72	12	19.45	12	21.63	12	23.51	6	22.50	5	23.03	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1972	21	2.83	21	8.41	21	12.78	21	16.06	21	18.66	21	21.11	15	21.65	13	23.03	1	25.09	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1973	38	3.30	38	8.96	38	13.14	38	16.79	38	19.87	20	20.79	18	21.93	1	21.99	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1974	26	2.79	26	8.54	26	11.83	26	14.86	25	17.36	24	19.49	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1975	47	3.57	47	8.62	47	12.32	47	15.65	47	18.70	2	21.48	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1976	23	3.93	23	10.10	23	14.26	23	17.68	2	18.19	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1977	26	3.69	26	10.58	26	15.06	2	20.08	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1978	8	4.74	8	10.96	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1979	2	3.98	2	8.52	1	9.30	1	11.03	1	13.20	1	15.36	1	16.66	1	18.82	1	21.85	1	23.59	1	25.75	1	27.48	0	—	0	—	0	—	0	—	0	—
1980	1	2.79	1	9.59	1	16.39	1	20.92	1	23.19	1	25.46	1	26.82	1	28.18	1	30.45	1	32.26	1	34.53	0	—	0	—	0	—	0	—	0	—	0	—
1981	6	3.04	6	9.03	6	13.35	6	16.13	6	19.26	6	21.54	6	23.75	6	26.09	6	28.27	5	29.85	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1982	3	3.17	3	9.13	3	13.20	3	15.98	3	18.60	3	21.01	3	22.85	3	24.92	3	26.50	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1983	13	4.13	13	9.56	13	13.27	13	16.65	13	20.00	13	23.15	13	25.88	13	28.01	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1984	26	3.30	26	9.07	26	13.71	26	17.33	26	20.13	26	22.67	25	25.55	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1985	37	3.60	37	9.33	37	12.87	37	16.20	37	19.14	37	21.96	1	25.25	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1986	48	3.87	48	9.66	48	13.81	48	17.37	48	20.64	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1987	21	3.85	21	9.76	21	14.52	21	18.54	1	22.49	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1988	13	4.64	13	10.37	12	14.53	2	17.71	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
1989	4	4.89	4	11.30	1	14.73	1	16.84	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—

Table 2. Predicted length at age by year of birth for red grouper in the Gulf of Mexico using time dependent growth model.

YEAR OF BIRTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1966	1.20	6.36	10.61	14.12	17.01	19.40	21.36	22.98	24.32	25.42	26.33	27.08	27.70	28.21	28.62	28.97	29.26
1967	1.21	6.42	10.71	14.25	17.17	19.58	21.57	23.20	24.55	25.66	26.58	27.34	27.96	28.47	28.90	29.25	29.53
1968	1.22	6.48	10.81	14.39	17.33	19.76	21.77	23.42	24.78	25.90	26.83	27.59	28.22	28.74	29.17	29.52	29.81
1969	1.23	6.54	10.91	14.52	17.50	19.95	21.97	23.64	25.01	26.15	27.08	27.85	28.49	29.01	29.44	29.80	30.09
1970	1.24	6.60	11.01	14.66	17.66	20.13	22.17	23.86	25.24	26.39	27.33	28.11	28.75	29.28	29.71	30.07	30.37
1971	1.25	6.66	11.12	14.79	17.82	20.32	22.38	24.07	25.47	26.63	27.58	28.36	29.01	29.54	29.98	30.35	30.65
1972	1.26	6.72	11.22	14.92	17.98	20.50	22.58	24.29	25.71	26.87	27.83	28.62	29.27	29.81	30.26	30.62	30.92
1973	1.28	6.78	11.32	15.06	18.14	20.69	22.78	24.51	25.94	27.11	28.08	28.88	29.54	30.08	30.53	30.90	31.20
1974	1.29	6.84	11.42	15.19	18.30	20.87	22.99	24.73	26.17	27.35	28.33	29.14	29.80	30.35	30.80	31.17	31.48
1975	1.30	6.90	11.52	15.33	18.47	21.05	23.19	24.95	26.40	27.59	28.58	29.39	30.06	30.62	31.07	31.45	31.76
1976	1.31	6.96	11.62	15.46	18.63	21.24	23.39	25.17	26.63	27.84	28.83	29.65	30.33	30.88	31.34	31.72	32.04
1977	1.32	7.02	11.72	15.59	18.79	21.42	23.59	25.38	26.86	28.08	29.08	29.91	30.59	31.15	31.62	32.00	32.31
1978	1.33	7.08	11.82	15.73	18.95	21.61	23.80	25.60	27.09	28.32	29.33	30.17	30.85	31.42	31.89	32.27	32.59
1979	1.34	7.14	11.92	15.86	19.11	21.79	24.00	25.82	27.32	28.56	29.58	30.42	31.12	31.69	32.16	32.55	32.87
1980	1.36	7.20	12.02	16.00	19.27	21.98	24.20	26.04	27.55	28.80	29.83	30.68	31.38	31.96	32.43	32.82	33.15
1981	1.37	7.26	12.12	16.13	19.44	22.16	24.41	26.26	27.78	29.04	30.08	30.94	31.64	32.22	32.70	33.10	33.43
1982	1.38	7.32	12.22	16.27	19.60	22.34	24.61	26.48	28.02	29.29	30.33	31.19	31.91	32.49	32.98	33.37	33.70
1983	1.39	7.38	12.33	16.40	19.76	22.53	24.81	26.69	28.25	29.53	30.58	31.45	32.17	32.76	33.25	33.65	33.98
1984	1.40	7.44	12.43	16.53	19.92	22.71	25.02	26.91	28.48	29.77	30.83	31.71	32.43	33.03	33.52	33.93	34.26
1985	1.41	7.50	12.53	16.67	20.08	22.90	25.22	27.13	28.71	30.01	31.08	31.97	32.70	33.30	33.79	34.20	34.54
1986	1.42	7.56	12.63	16.80	20.24	23.08	25.42	27.35	28.94	30.25	31.33	32.22	32.96	33.56	34.06	34.48	34.82
1987	1.43	7.62	12.73	16.94	20.41	23.27	25.62	27.57	29.17	30.49	31.58	32.48	33.22	33.83	34.34	34.75	35.09
1988	1.45	7.69	12.83	17.07	20.57	23.45	25.83	27.79	29.40	30.73	31.83	32.74	33.48	34.10	34.61	35.03	35.37

Table 3. Result of application of growth model to estimate ages from size for aged red grouper from Gulf of Mexico (data courtesy A. Johnson, NMFS).

STANDARD VON BERTALANFFY MODEL

ACTUAL AGES			NUMBER CLASSIFIED BY AGE																				
AGE	dist 1979	percent	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	19+	PERCENT CORRECT
1	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2	9	3.5	0	6	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66.7
3	24	9.3	0	3	8	4	4	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	33.3
4	24	9.3	0	1	5	5	2	5	3	0	3	0	0	0	0	0	0	0	0	0	0	0	20.8
5	65	25.3	0	0	4	17	12	9	8	7	4	1	1	0	1	0	1	0	0	0	0	0	18.5
6	35	13.6	0	0	4	3	7	4	4	5	2	0	0	2	0	0	0	0	0	0	1	3	11.4
7	25	9.7	0	0	1	2	0	6	0	3	2	1	3	2	2	1	0	0	0	0	0	2	0.0
8	20	7.8	0	0	1	0	2	1	2	0	1	3	4	0	1	0	0	1	0	0	0	4	0.0
9	7	2.7	0	0	0	0	2	0	1	0	0	1	0	0	1	0	0	0	0	0	0	2	0.0
10	10	3.9	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	8	0.0
11	10	3.9	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	7	10.0
12	14	5.4	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	1	1	0	8	7.1
13	7	2.7	0	0	0	0	0	0	1	0	1	1	0	0	2	0	0	0	0	0	0	2	28.6
14	1	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0
15	1	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0
16	3	1.2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	33.3
17	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	---
18	2	0.8	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	50.0
19	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
ALL	257	100	0	10	25	31	30	27	20	16	13	9	9	8	7	2	2	4	1	2	1	40	
EST.	PERC.		0.0	3.9	9.7	12.1	11.7	10.5	7.8	6.2	5.1	3.5	3.5	3.1	2.7	0.8	0.8	1.6	0.4	0.8	0.4	15.6	

ACTUAL AGES			NUMBER CLASSIFIED BY AGE																				
AGE	dist 1979	percent	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	19+	PERCENT CORRECT
1	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2	3	1.6	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3	13	6.9	0	0	1	5	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7.7
4	23	12.2	0	0	0	4	9	5	2	2	1	0	0	0	0	0	0	0	0	0	0	0	17.4
5	53	28.0	0	0	0	0	12	18	7	3	6	0	1	2	0	0	0	2	0	1	0	1	22.6
6	44	23.3	0	0	0	0	11	9	5	2	4	3	1	2	2	1	0	1	0	0	0	3	20.5
7	27	14.3	0	0	0	0	0	3	1	0	2	2	3	3	0	1	0	2	0	0	0	10	3.7
8	15	7.9	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	2	0	10	0.0
9	4	2.1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0.0
10	5	2.6	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.0
11	1	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0
12	1	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0
13	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
14	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
15	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
16	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
17	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
18	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
19	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
ALL	189	100	0	0	1	11	38	39	16	7	13	6	5	7	3	2	0	5	0	3	0	40	
EST.	PERC.		0.0	0.0	0.5	5.8	20.1	20.6	8.5	3.7	6.9	3.2	2.6	3.7	1.6	1.1	0.0	2.6	0.0	1.6	0.0	21.2	

Table 3. (cont.)

TIME DEPENDENT GROWTH MODEL

ACTUAL AGES			NUMBER CLASSIFIED BY AGE																				
AGE	dist 1979	percent	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	19+	PERCENT CORRECT
1	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2	9	3.5	0	3	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33.3
3	24	9.3	0	1	11	4	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	45.8
4	24	9.3	0	0	4	6	4	6	1	3	0	0	0	0	0	0	0	0	0	0	0	0	25.0
5	65	25.3	0	0	2	18	13	13	8	6	3	0	1	0	1	0	0	0	0	0	0	0	20.0
6	35	13.6	0	0	3	3	8	6	7	2	0	2	0	1	0	0	0	0	0	0	0	3	17.1
7	25	9.7	0	0	0	3	0	6	3	2	4	2	3	0	0	0	0	0	0	0	0	2	12.0
8	20	7.8	0	0	1	0	2	2	1	2	5	2	1	1	0	0	0	0	0	0	0	3	10.0
9	7	2.7	0	0	0	0	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0	2	14.3
10	10	3.9	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	8	10.0
11	10	3.9	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	7	0.0
12	14	5.4	0	0	0	0	0	0	0	0	0	1	1	0	2	1	1	0	0	0	0	8	0.0
13	7	2.7	0	0	0	0	0	0	1	2	0	2	0	0	0	0	0	0	0	0	0	2	0.0
14	1	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0
15	1	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0
16	3	1.2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	33.3
17	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
18	2	0.8	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	50.0
19	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
ALL	257	100	0	4	25	35	35	36	22	18	16	12	6	3	3	1	1	1	0	1	0	40	
EST. PERC.			0.0	1.6	9.7	13.6	13.6	14.0	8.6	7.0	6.2	4.7	2.3	1.2	1.2	0.4	0.4	0.4	0.0	0.4	0.0	15.6	

ACTUAL AGES			NUMBER CLASSIFIED BY AGE																				
AGE	dist 1979	percent	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	19+	PERCENT CORRECT
1	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
2	3	1.6	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
3	13	6.9	0	0	1	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7.7
4	23	12.2	0	0	0	10	8	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43.5
5	53	28.0	0	0	0	8	27	11	3	3	1	0	0	0	0	0	0	0	0	0	0	0	50.9
6	44	23.3	0	0	0	9	13	9	7	4	2	0	0	0	0	0	0	0	0	0	0	0	20.5
7	27	14.3	0	0	0	0	4	1	9	4	5	4	0	0	0	0	0	0	0	0	0	0	33.3
8	15	7.9	0	0	0	0	1	0	1	3	5	1	1	0	1	0	0	0	0	0	0	2	20.0
9	4	2.1	0	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	25.0
10	5	2.6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0.0
11	1	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0
12	1	0.5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0.0
13	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
14	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
15	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
16	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
17	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
18	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
19	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---
ALL	189	100	0	0	1	40	56	27	20	14	15	7	1	0	1	0	1	0	0	0	0	13	
EST. PERC.			0.0	0.0	0.5	21.2	29.6	14.3	10.6	7.4	7.9	3.7	0.5	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	6.9	

Table 4. 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	6441	6478
1987	6877	6918	0	0	0	0	1	1	0	0	6877	6919
1988	4771	4796	0	0	0	0	0	0	0	0	4771	4796
1989	7460	7636	4	4	0	0	0	0	0	0	7465	7641
1990	4844	4844	0	0	0	0	0	0	0	0	4844	4844
1991	5099	5099	0	0	0	0	0	0	0	0	5099	5099
1992	4354	4354	0	0	0	0	0	0	0	0	4354	4354

Table 5. 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	7700	7700	12	12	28	28	347	347	113	113	8201	8201
1991	7743	7743	38	38	22	22	333	333	86	86	8222	8222
1992	7261	7261	36	36	20	20	419	419	40	40	7775	7776

Table 6. 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	108	108	11	11	28	28	65	65	47	47	259	259
1991	58	58	37	37	22	22	52	52	27	27	196	196
1992	60	60	35	35	16	16	40	40	14	14	165	165

Table 7. 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	1142	1142	0	0	0	0	14	14	0	0	1156	1156
1991	890	890	0	0	0	0	9	9	1	1	900	900
1992	850	850	0	0	0	0	3	3	0	0	854	854

Table 8. 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	792	792	0	0	0	0	1	1	0	0	793	793
1991	762	762	0	0	0	0	12	12	0	0	774	774
1992	919	919	0	0	0	0	11	11	0	0	929	929

Table 9. 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
1991	0	0	0	0	0	0	8	8	0	0	8	8
1992	0	0	0	0	0	0	34	34	0	0	34	34

Table 10. 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
1991	2	2	0	0	0	0	0	0	0	0	2	2
1992	1	1	0	0	0	0	0	0	0	0	1	1

Table 11. 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
1991	2	2	0	0	0	0	0	0	0	0	2	2
1992	7	7	0	0	0	0	0	0	0	0	7	7

Table 12. 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	146	146
1991	140	140	0	0	0	0	12	12	1	1	153	153
1992	152	152	0	0	0	0	27	27	0	0	179	179

Table 13. 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
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	563	563	1	1	0	0	162	162	50	50	775	775
1991	426	426	0	0	0	0	185	185	49	49	660	660
1992	575	575	1	1	0	0	263	263	20	21	860	860

Table 14. 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	5	5	0	0	0	0	29	29	0	0	34	34
1991	65	65	0	0	0	0	1	1	0	0	66	66
1992	66	66	0	0	0	0	1	1	0	0	67	67

Table 15. 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
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
1991	246	246	0	0	0	0	51	51	9	9	307	307
1992	230	230	0	0	4	4	39	39	5	5	278	278

Table 16. 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	1	1	0	0	1	1	2	2	0	0	3	3
1991	38	38	0	0	0	0	0	0	0	0	38	38
1992	40	40	0	0	0	0	0	0	0	0	40	40

Table 17. 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
1991	0	0	0	0	0	0	1	1	0	0	1	1
1992	0	0	0	0	0	0	0	0	0	0	0	0

Table 18. 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	6440	(100.0)	0	(--)	0	(--)	1	(0.0)	0	(--)	6441	(100.0)
1987	6877	(100.0)	0	(--)	0	(--)	1	(0.0)	0	(--)	6877	(100.0)
1988	4771	(100.0)	0	(--)	0	(--)	0	(0.0)	0	(--)	4771	(100.0)
1989	7460	(99.9)	4	(0.1)	0	(--)	0	(0.0)	0	(--)	7465	(100.0)
1990	4844	(100.0)	0	(--)	0	(--)	0	(--)	0	(--)	4844	(100.0)
1991	5099	(100.0)	0	(--)	0	(--)	0	(0.0)	0	(--)	5099	(100.0)
1992	4354	(100.0)	0	(--)	0	(--)	0	(0.0)	0	(--)	4354	(100.0)

Table 19. 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	108	(41.7)	11	(4.1)	28	(10.8)	65	(25.1)	47	(18.2)	259	(100.0)
1991	58	(29.3)	37	(19.0)	22	(11.2)	52	(26.6)	27	(13.9)	196	(100.0)
1992	60	(36.3)	35	(21.2)	16	(10.0)	40	(24.1)	14	(8.5)	165	(100.0)

Table 20. 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	1142	(98.8)	0	(--)	0	(--)	14	(1.2)	0	(--)	1156	(100.0)
1991	890	(99.0)	0	(--)	0	(--)	9	(1.0)	1	(0.1)	900	(100.0)
1992	850	(99.6)	0	(--)	0	(--)	3	(0.4)	0	(--)	854	(100.0)

Table 21. 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	792	(99.8)	0	(0.0)	0	(--)	1	(0.1)	0	(0.0)	793	(100.0)
1991	762	(98.4)	0	(--)	0	(--)	12	(1.6)	0	(--)	774	(100.0)
1992	919	(98.9)	0	(--)	0	(--)	11	(1.1)	0	(--)	929	(100.0)

Table 22. 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)
1991	0	(--)	0	(--)	0	(--)	8	(100.0)	0	(--)	8	(100.0)
1992	0	(--)	0	(--)	0	(--)	34	(100.0)	0	(--)	34	(100.0)

Table 23. 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)
1991	2	(100.0)	0	(--)	0	(--)	0	(--)	0	(--)	2	(100.0)
1992	1	(96.9)	0	(--)	0	(--)	0	(3.1)	0	(--)	1	(100.0)

Table 24. 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	(36.8)	0	(--)	0	(--)	5	(63.2)	0	(--)	8	(100.0)
1991	2	(100.0)	0	(--)	0	(--)	0	(--)	0	(--)	2	(100.0)
1992	7	(100.0)	0	(--)	0	(--)	0	(--)	0	(--)	7	(100.0)

Table 25. 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	(--)	146	(100.0)
1991	140	(91.8)	0	(0.0)	0	(--)	12	(7.8)	1	(0.4)	153	(100.0)
1992	152	(84.9)	0	(--)	0	(--)	27	(15.1)	0	(--)	179	(100.0)

Table 26. 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	563	(72.6)	1	(0.1)	0	(--)	162	(20.9)	50	(6.5)	775	(100.0)
1991	426	(64.6)	0	(--)	0	(--)	185	(28.1)	49	(7.4)	660	(100.0)
1992	575	(66.9)	1	(0.1)	0	(--)	263	(30.6)	20	(2.4)	860	(100.0)

Table 27. 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	5	(13.8)	0	(0.3)	0	(--)	29	(85.9)	0	(--)	34	(100.0)
1991	65	(98.2)	0	(0.3)	0	(--)	1	(1.5)	0	(--)	66	(100.0)
1992	66	(99.2)	0	(--)	0	(--)	1	(0.8)	0	(--)	67	(100.0)

Table 28. 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	(72.9)	1	(0.3)	0	(--)	50	(20.3)	16	(6.5)	246	(100.0)
1991	246	(80.3)	0	(0.0)	0	(--)	51	(16.7)	9	(2.9)	307	(100.0)
1992	230	(82.6)	0	(--)	4	(1.3)	39	(14.1)	5	(1.9)	278	(100.0)

Table 29. 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	1	(23.8)	0	(--)	1	(17.9)	2	(58.3)	0	(--)	3	(100.0)
1991	38	(99.4)	0	(--)	0	(--)	0	(0.6)	0	(--)	38	(100.0)
1992	40	(99.2)	0	(--)	0	(--)	0	(0.8)	0	(--)	40	(100.0)

Table 30. 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)
1991	0	(33.5)	0	(--)	0	(--)	1	(66.5)	0	(--)	1	(100.0)
1992	0	(13.0)	0	(--)	0	(--)	0	(87.0)	0	(--)	0	(100.0)

Table 31. 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)
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)
1991	51	(97.8)	0	(--)	0	(--)	1	(2.2)	0	(--)	52	(100.0)
1992	38	(98.8)	0	(--)	0	(--)	0	(1.2)	0	(--)	39	(100.0)

Table 32. Gulf of Mexico landings of red grouper reported by participants in the reef fish logbook program by gear and location of capture (grid) 1990-1992 (thousands of pounds, gutted weight).

1990	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	17	1	26	41	45	8	70	47	7	1	1	0	0	0	0	0	0	0	0	0	0	0	0	263
HAND	18	1	5	30	31	37	73	51	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	257
BLL	47	11	26	68	192	170	98	12	0	2	0	4	0	0	0	0	1	0	0	0	2	0	0	633
SPEAR	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
UNK	10	0	0	0	0	0	6	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	19
ALL	92	13	57	139	269	215	247	110	17	6	2	4	0	0	0	0	1	0	0	0	2	0	0	1174

1991	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	22	3	57	120	103	29	146	45	17	3	0	0	0	0	2	0	0	0	0	0	0	0	0	547
HAND	59	2	12	38	52	92	132	53	17	5	3	2	1	3	3	1	0	0	1	0	0	0	0	476
BLL	64	24	73	189	258	352	179	9	19	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1173
SPEAR	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
UNK	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
ALL	145	29	144	347	414	474	458	107	53	12	3	2	1	3	5	1	1	0	1	0	0	0	0	2202

1992	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	135	1	91	130	15	3	213	83	4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	677
HAND	105	1	9	27	37	82	172	34	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	471
BLL	117	2	19	47	136	209	44	4	0	1	0	0	0	0	3	0	0	0	2	0	0	0	0	584
SPEAR	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
UNK	29	0	1	2	0	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38
ALL	387	4	121	206	188	298	432	121	8	1	1	0	0	0	4	0	0	0	2	0	0	0	0	1773

Table 33. Gulf of Mexico 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	399	60	180	520	1174	1052	966	366	55	27	4	23	0	2	0	0	4	0	0	2	10	0	0	4844
1991	360	75	290	754	963	1265	1009	211	116	30	10	4	1	2	5	2	1	0	1	0	0	0	0	5099
1992	974	11	192	387	596	994	950	212	15	3	3	0	0	0	10	0	0	0	5	0	1	0	0	4354

Table 34. Gulf of Mexico 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	17	1	27	42	46	8	71	48	7	1	1	0	0	0	0	0	0	0	0	0	0	0	0	269
1991	22	3	57	121	104	30	148	46	17	3	0	0	0	0	2	0	0	0	0	0	0	0	0	553
1992	137	1	92	132	15	3	216	84	4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	685

Table 35. Gulf of Mexico 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	1	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
1991	0	0	1	0	2	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
1992	2	0	0	0	0	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10

Table 36. Gulf of Mexico 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	90	2	22	139	154	187	366	257	48	7	2	0	0	2	0	0	0	0	0	2	0	0	0	1277
1991	161	4	22	106	145	255	360	141	47	13	10	4	1	2	3	2	1	0	1	0	0	0	0	1276
1992	348	2	32	90	125	275	577	114	8	0	3	0	0	0	0	0	0	0	0	0	1	0	0	1576

Table 37. Gulf of Mexico 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	239	57	131	337	971	854	496	61	0	11	0	23	0	0	0	0	4	0	0	0	10	0	0	3194
1991	176	68	203	526	712	980	498	24	52	14	0	0	0	0	0	0	0	0	0	0	0	0	0	3254
1992	393	7	65	157	456	703	147	13	1	3	0	0	0	0	9	0	0	0	5	0	0	0	0	1957

Table 38. Gulf of Mexico 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	53	0	0	0	1	2	33	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	97
1991	2	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
1992	95	0	3	8	0	10	8	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	126

Table 39. Florida west coast landings of red grouper (1000s of pounds, gutted weight) on the Gulf of Mexico by county and gear type, 1986-1992

	1986					1987					1988					1989				
County	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
Franklin	-	42	-	-	42	-	100	-	-	100	-	37	-	-	37	-	278	-	-	278
Citrus	-	25	-	-	25	-	25	-	-	25	-	19	-	-	19	-	42	14	-	56
Pasco	-	33	-	-	33	-	16	-	-	16	-	20	-	-	20	-	31	2	-	33
Pinellas	-	1786	595	-	2381	-	1361	1361	-	2723	-	1021	397	-	1419	-	2166	928	-	3095
Hillsborough	-	36	15	-	52	-	60	26	-	86	-	55	24	-	79	-	187	80	-	267
Manatee	-	116	1055	1	1172	-	114	1025	-	1139	-	81	545	0	626	-	110	989	0	1099
Charlotte	-	69	88	1	158	-	92	138	0	230	-	89	124	0	213	-	19	368	0	388
Lee	-	396	400	4	800	-	314	342	1	657	-	284	349	2	635	24	471	308	9	811
Collier	527	375	269	-	1171	381	191	699	-	1271	428	160	481	-	1070	524	95	333	-	952
Monroe	200	138	56	6	400	86	185	78	13	361	127	133	87	3	350	33	131	82	2	248
Total	727	3103	2481	12	6324	467	2499	3723	15	6704	555	1954	2069	5	4583	580	3686	3198	11	7476

	1990					1991					1992				
County	TRAP	HAND	BLL	UNK	TOT	TRAP	HAND	BLL	UNK	TOT	TRAP	HAND	BLL	UNK	TOT
Bay	5	13	78	-	96	6	17	63	-	86	2	32	0	-	34
Franklin	1	182	53	-	236	12	150	87	3	252	5	48	41	7	102
Citrus	63	74	-	-	137	168	41	0	-	208	254	28	-	-	282
Hernando	-	2	-	-	2	-	2	-	-	2	-	2	-	-	2
Pasco	0	28	-	-	28	0	22	0	-	22	19	62	1	4	86
Pinellas	19	298	1915	-	2232	9	478	1902	-	2389	2	844	1239	3	2087
Hillsborough	-	77	38	-	115	-	80	13	-	93	-	92	0	-	92
Manatee	-	15	572	-	587	-	63	637	-	700	2	27	318	17	365
Charlotte	0	6	178	76	260	3	4	195	3	205	-	2	3	173	178
Lee	14	178	147	32	371	10	223	123	-	356	4	156	216	-	376
Collier	103	137	136	51	427	251	50	97	-	397	257	28	51	11	346
Monroe	1	53	95	0	150	15	31	91	15	151	19	55	25	12	112
Total	263	1136	3213	165	4778	547	1282	3229	31	5088	677	1562	1900	229	4368

Table 40. Percentages of Florida west coast red grouper commercial landings by county and gear type, 1986-1992.

	1986					1987					1988					1989				
County	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
Santa Rosa	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	-	100	-	100
Okaloosa	-	100	-	-	100	-	100	-	-	100	-	53	47	-	100	-	100	-	-	100
Walton	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0
Bay	-	100	-	-	100	-	34	66	0	100	-	28	72	-	100	-	38	62	-	100
Gulf	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	100	-	-	100
Franklin	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100
Wakulla	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100
Taylor	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100
Dixie	-	100	-	-	100	-	100	-	-	100	-	-	-	-	0	-	100	-	-	100
Levy	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100
Citrus	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	75	25	-	100
Hernando	-	-	-	-	0	-	-	-	-	0	-	100	-	-	100	-	100	-	-	100
Pasco	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100	-	95	5	-	100
Pinellas	-	75	25	-	100	-	50	50	-	100	-	72	28	-	100	-	70	30	-	100
Hillsborough	-	70	30	-	100	-	70	30	-	100	-	70	30	-	100	-	70	30	-	100
Manatee	-	10	90	0	100	-	10	90	-	100	-	13	87	0	100	-	10	90	0	100
Sarasota	-	60	40	-	100	-	75	25	-	100	-	90	10	-	100	-	40	60	-	100
Charlotte	-	44	56	0	100	-	40	60	0	100	-	42	58	0	100	-	5	95	0	100
Lee	-	49	50	0	100	-	48	52	0	100	-	45	55	0	100	3	58	38	1	100
Collier	45	32	23	-	100	30	15	55	-	100	40	15	45	-	100	55	10	35	-	100
Monroe	50	34	14	2	100	24	51	22	4	100	36	38	25	1	100	13	53	33	1	100
TOTAL	11	49	39	0	100	7	37	56	0	100	12	43	45	0	100	8	49	43	0	100

	1990					1991					1992				
County	TRAP	HAND	BLL	UNK	TOT	TRAP	HAND	BLL	UNK	TOT	TRAP	HAND	BLL	UNK	TOT
Escambia	100	-	-	-	100	-	7	93	-	100	-	7	93	-	100
Santa Rosa	-	100	-	-	100	-	-	-	-	0	-	100	-	-	100
Okaloosa	-	8	92	-	100	-	4	96	0	100	-	4	96	0	100
Walton	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0
Bay	6	13	81	-	100	7	19	73	-	100	5	94	0	-	100
Gulf	-	-	-	-	0	-	-	-	-	0	-	60	-	40	100
Franklin	0	77	22	-	100	5	60	34	1	100	5	47	41	7	100
Wakulla	3	96	1	0	100	2	87	11	1	100	20	80	-	-	100
Taylor	57	43	-	-	100	31	69	-	-	100	67	33	-	-	100
Dixie	79	11	-	10	100	100	-	-	-	100	72	20	8	-	100
Levy	100	-	-	-	100	9	67	5	20	100	3	96	-	2	100
Citrus	46	54	-	-	100	81	19	0	-	100	90	10	-	-	100
Hernando	-	100	-	-	100	-	100	-	-	100	-	100	-	-	100
Pasco	0	100	-	-	100	0	100	0	-	100	23	72	1	4	100
Pinellas	1	13	86	-	100	0	20	80	-	100	0	40	59	0	100
Hillsborough	-	67	33	-	100	-	86	14	-	100	-	100	0	-	100
Manatee	-	3	97	-	100	-	9	91	-	100	1	7	87	5	100
Sarasota	-	94	-	6	100	-	91	9	-	100	-	100	-	0	100
Charlotte	0	2	68	29	100	1	2	95	1	100	-	1	1	97	100
Lee	4	48	40	9	100	3	63	35	-	100	1	41	57	-	100
Collier	24	32	32	12	100	63	13	24	-	100	74	8	15	3	100
Monroe	1	36	63	0	100	10	20	60	10	100	17	49	22	11	100
TOTAL	6	24	67	3	100	11	25	63	1	100	15	36	43	5	100

Table 41. Sample sizes and estimated mean weights in pounds (gutted weight) of red grouper harvested by recreational fishermen by mode and year, 1979-1992.

	MODE									
	Total		Shore		Headboat		Charter		Private	
Year	N	Wt.	N	Wt.	N	Wt.	N	Wt.	N	Wt.
79	73	5.08	0	0.00	41	3.69	4	2.80	28	7.44
80	151	3.98	0	0.00	110	3.84	5	4.33	36	4.36
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	416	6.15	1	15.84	360	6.14	13	6.05	42	6.00
91	279	6.50	2	6.80	152	6.95	34	5.30	91	6.20
92	532	6.67	13	5.88	137	6.47	143	7.82	239	6.13

Table 42. Recreational harvest estimates for Gulf of Mexico red grouper by state and fishing area, 1979-1992. The estimates are based on the 1979-1992 NMRFSS, and the 1986-1992 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	1060	0	0	0	0	0	0	0	0	209	1060
1980	177	695	0	0	0	0	0	0	0	0	177	695
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	1312	0	1	0	0	0	0	0	0	214	1314
1991	263	1634	0	2	0	0	1	4	0	0	264	1640
1992	456	2854	0	1	0	0	0	0	0	0	456	2855

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	619	0	0	0	0	0	0	0	0	122	619
1980	11	43	0	0	0	0	0	0	0	0	11	43
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	53	0	0	0	0	0	0	0	0	9	53
1991	1	8	0	0	0	0	0	0	0	0	1	8
1992	14	85	0	0	0	0	0	0	0	0	14	85

Table 42. (Continued).

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	122	0	0	0	0	0	0	0	0	31	122
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	275	0	0	0	0	0	0	0	0	45	275
1991	114	713	0	0	0	0	1	4	0	0	115	717
1992	90	563	0	0	0	0	0	0	0	0	90	563

EEZ

	Florida		Alabama		Mississippi		Louisiana		Texas		Total Gulf	
YEAR	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt	Numb	Wt
1979	87	442	0	0	0	0	0	0	0	0	87	442
1980	136	530	0	0	0	0	0	0	0	0	136	530
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	984	0	1	0	0	0	0	0	0	161	986
1991	148	913	0	2	0	0	0	0	0	0	148	915
1992	352	2207	0	1	0	0	0	0	0	0	352	2208

Table 43. Recreational harvest estimates for Gulf of Mexico red grouper by mode, 1979-1992. The estimates are based on the 1979-1992 NMRFSS, and the 1986-1992 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	497	0	0	111	563	209	1060
1980	0	0	75	289	0	0	102	405	177	695
1981	14	69	406	2088	0	0	98	481	519	2639
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	62	20	119	63	388	121	744	214	1314
1991	7	49	11	61	14	91	232	1439	264	1640
1992	17	116	11	66	32	250	395	2424	456	2855

Table 44. Recreational catch estimates for Gulf of Mexico red grouper for shore based anglers and those fishing from private/rental craft by area fished, 1979-1992. 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
1991	1	87	98.5	110	885	89.0	128	1545	92.4	239	2517	91.3
1992	14	107	88.6	87	668	88.4	312	1810	85.3	413	2585	86.2

Table 45. Red grouper catch and effort reported by fishermen participating in the Gulf of Mexico Reef Fish Logbook Program who landing in Florida West Coastports. The colums labeled 'any in catch' include all trips in which red grouper were landed. The colums labeled '>25% of catch, >50% of catch, and >75% of catch' include only trips where red grouper exceeded the indicated percentage of the catch by weight.

FLORIDA WEST COAST 1990

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	3	45	1033	1	7	900	1	7	900	1	7	900
2	3	17	153	0	0	0	0	0	0	0	0	0
3	4	43	3965	2	29	3590	2	29	3590	2	29	3590
4	96	585	64076	60	390	58030	32	233	49188	20	156	37120
5	212	1336	161116	143	932	151016	79	537	112910	46	317	71769
6	228	1422	188667	176	1097	183515	119	748	150499	53	375	89439
7	223	1617	191259	169	1198	185981	120	876	162683	66	497	112547
8	240	1707	205570	188	1291	194990	149	1081	180096	83	663	120937
9	216	1468	164249	163	1113	155415	123	851	131685	73	534	87235
10	152	1082	131397	119	887	126683	80	614	103265	56	448	78361
11	68	480	50618	47	334	48501	30	200	36132	19	134	23588
12	11	80	694	2	11	261	1	1	208	1	1	208
SUM	1456	9882	1162797	1070	7289	1108881	736	5177	931156	420	3161	625694

FLORIDA WEST COAST 1991

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	201	1335	186948	136	976	178620	83	672	158630	52	431	121565
2	176	1273	137152	112	860	130506	74	590	111993	41	365	82631
3	179	1477	194285	114	1048	187003	76	774	166414	46	493	121233
4	220	1496	204078	150	1103	197883	100	835	180192	53	510	133076
5	253	1588	217024	186	1220	208378	128	913	185363	65	560	139074
6	255	1690	239493	196	1400	228033	153	1102	208679	84	687	149899
7	272	1965	232710	214	1507	224936	163	1191	200593	103	752	147630
8	235	1492	183084	174	1132	177494	139	952	164930	105	756	136278
9	233	1556	184987	187	1192	179692	152	945	164268	112	744	137690
10	175	1183	124771	122	809	120789	104	706	115072	74	506	87616
11	153	1087	121321	110	800	116606	79	626	102814	44	409	82271
12	147	1004	115358	86	639	109447	69	545	103901	44	370	79629
SUM	2499	17146	2141210	1787	12686	2059389	1320	9851	1862848	823	6583	1418593

FLORIDA WEST COAST 1992

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	163	1141	102126	112	825	97925	80	571	84822	50	314	57649
2	140	1098	120660	93	748	114414	64	527	97950	44	366	80359
3	186	1243	98511	108	820	91728	66	528	79451	43	372	60008
4	199	1177	95371	103	663	84542	63	493	74901	33	274	51043
5	303	1635	155936	198	1132	146321	129	747	121997	75	484	82536
6	305	1514	177204	212	1120	167804	159	882	155486	81	497	107721
7	329	1745	249784	252	1442	243393	218	1283	230691	145	911	184662
8	298	1555	193240	232	1237	186655	195	1055	175296	136	760	138499
9	291	1543	159394	214	1167	148698	175	984	138526	106	591	88191
10	230	1334	114638	153	941	104281	121	740	89976	63	335	46694
11	158	985	90570	104	703	86709	78	562	79009	41	301	52850
12	207	1255	129095	129	816	119752	90	621	109338	52	360	84225
SUM	2809	16225	1686531	1910	11614	1592221	1438	8993	1437445	869	5565	1034437

Table 46. Red grouper catch and effort reported by fishermen participating in the Gulf of Mexico Reef Fish Logbook Program who landing in Alabama and Mississippiports. The colums labeled 'any in catch' include all trips in which red grouper were landed. The colums labeled '>25% of catch, >50% of catch, and >75% of catch' include only trips where red grouper exceeded the indicated percentage of the catch by weight.

ALABAMA-MISSISSIPPI 1990

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	1	5	351	1	5	351	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	1	6	1781	1	6	1781	1	6	1781	1	6	1781
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
SUM	2	11	2132	2	11	2132	1	6	1781	1	6	1781

ALABAMA-MISSISSIPPI 1991

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	0	0	0	0	0	0	0	0	0	0	0	0
2	1	15	116	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	3	30	2102	3	30	2102	2	13	863	1	1	26
5	3	3	176	3	3	176	3	3	176	3	3	176
6	1	1	24	1	1	24	1	1	24	1	1	24
7	1	1	22	1	1	22	1	1	22	1	1	22
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	1	4	2653	1	4	2653	1	4	2653	1	4	2653
SUM	10	54	5093	9	39	4977	8	22	3738	7	10	2901

ALABAMA-MISSISSIPPI 1992

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	1	2	14	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	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
7	0	0	0	0	0	0	0	0	0	0	0	0
8	1	6	908	1	6	908	1	6	908	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
SUM	2	8	922	1	6	908	1	6	908	0	0	0

Table 47. Red grouper catch and effort reported by fishermen participating in the Gulf of Mexico Reef Fish Logbook Program who landing in Louisianaports. The colums labeled 'any in catch' include all trips in which red grouper were landed. The colums labeled '>25% of catch, >50% of catch, and >75% of catch' include only trips where red grouper exceeded the indicated percentage of the catch by weight.

LOUISIANA 1990

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	1	5	35	0	0	0	0	0	0	0	0	0
7	1	12	9	0	0	0	0	0	0	0	0	0
8	2	11	84	1	3	80	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	2	15	1013	2	15	1013	1	5	286	1	5	286
11	1	10	1856	1	10	1856	1	10	1856	1	10	1856
12	0	0	0	0	0	0	0	0	0	0	0	0
SUM	7	53	2997	4	28	2949	2	15	2142	2	15	2142

LOUISIANA 1991

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	1	1	30	0	0	0	0	0	0	0	0	0
2	1	11	50	0	0	0	0	0	0	0	0	0
3	1	8	4	0	0	0	0	0	0	0	0	0
4	4	36	3649	3	27	3631	2	20	3227	1	11	1451
5	3	6	548	3	6	548	3	6	548	2	5	497
6	5	33	2511	2	12	2494	1	11	2486	1	11	2486
7	5	19	621	2	2	590	1	1	431	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	1	5	558	1	5	558	1	5	558	0	0	0
10	2	14	83	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
SUM	23	133	8054	11	52	7821	8	43	7250	4	27	4434

LOUISIANA 1992

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	4	14	142	1	4	139	1	4	139	1	4	139
2	0	0	0	0	0	0	0	0	0	0	0	0
3	1	5	33	0	0	0	0	0	0	0	0	0
4	3	16	1113	2	11	1097	1	5	913	0	0	0
5	1	2	9	0	0	0	0	0	0	0	0	0
6	2	25	145	0	0	0	0	0	0	0	0	0
7	1	8	44	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	1	1	174	1	1	174	1	1	174	1	1	174
SUM	13	71	1660	4	16	1410	3	10	1226	2	5	313

Table 48. Red grouper catch and effort reported by fishermen participating in the Gulf of Mexico Reef Fish Logbook Program who landing in Texasports. The colums labeled 'any in catch' include all trips in which red grouper were landed. The colums labeled '>25% of catch, >50% of catch, and >75% of catch' include only trips where red grouper exceeded the indicated percentage of the catch by weight.

TEXAS 1990

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	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
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
SUM	0	0	0	0	0	0	0	0	0	0	0	0

TEXAS 1991

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	1	5	10	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	1	11	746	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	1	8	970	1	8	970	1	8	970	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	1	10	1853	1	10	1853	1	10	1853	1	10	1853
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
SUM	4	34	3580	2	18	2823	2	18	2823	1	10	1853

TEXAS 1992

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	1	4	56	1	4	56	0	0	0	0	0	0
6	1	11	1	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	1	6	200	0	0	0	0	0	0	0	0	0
10	1	9	1	0	0	0	0	0	0	0	0	0
11	1	8	7	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
SUM	5	38	265	1	4	56	0	0	0	0	0	0

Table 49. Red grouper catch and effort reported by fishermen participating in the Gulf of Mexico Reef Fish Logbook Program who landing in unknownports. The colums labeled 'any in catch' include all trips in which red grouper were landed. The colums labeled '>25% of catch, >50% of catch, and >75% of catch' include only trips where red grouper exceeded the indicated percentage of the catch by weight.

UNKNOWN 1990

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	0	0	0	0	0	0	0	0	0	0	0	0
2	1	7	211	0	0	0	0	0	0	0	0	0
3	2	16	573	0	0	0	0	0	0	0	0	0
4	3	39	280	0	0	0	0	0	0	0	0	0
5	2	18	397	0	0	0	0	0	0	0	0	0
6	2	15	739	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	3	28	603	1	11	530	0	0	0	0	0	0
9	2	18	1661	1	10	1581	0	0	0	0	0	0
10	1	7	447	0	0	0	0	0	0	0	0	0
11	3	23	357	1	2	32	0	0	0	0	0	0
12	3	10	383	2	2	23	0	0	0	0	0	0
SUM	22	181	5651	5	25	2166	0	0	0	0	0	0

UNKNOWN 1991

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	1	11	1800	1	11	1800	1	11	1800	0	0	0
2	3	26	4058	2	19	4039	1	18	3925	0	0	0
3	1	5	270	1	5	270	1	5	270	0	0	0
4	4	42	8024	4	42	8024	3	26	6646	1	11	5068
5	12	91	7112	7	58	5649	4	36	4311	2	5	1226
6	7	79	6250	6	70	6137	4	49	5712	2	9	2041
7	1	10	119	1	10	119	1	10	119	1	10	119
8	2	6	2777	2	6	2777	2	6	2777	2	6	2777
9	8	41	4996	6	38	4956	4	28	4736	2	19	2569
10	3	23	3326	3	23	3326	2	22	3229	2	22	3229
11	3	12	216	1	4	88	1	4	88	0	0	0
12	10	47	4833	6	26	3928	2	11	3451	0	0	0
SUM	55	393	43782	40	312	41114	26	226	37064	12	82	17029

UNKNOWN 1992

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	6	47	10542	2	21	10266	2	21	10266	2	21	10266
2	6	39	1377	2	9	782	2	9	782	1	2	128
3	8	67	3718	3	29	2457	2	21	2291	2	21	2291
4	17	96	6645	9	57	4804	8	49	4331	3	18	1364
5	12	50	6363	7	38	6157	5	26	5493	3	21	5097
6	17	102	8949	13	93	8699	8	42	7866	5	31	5882
7	18	63	6454	8	43	5885	6	38	5586	4	35	5318
8	20	79	8680	13	62	7824	10	55	7435	7	30	5156
9	14	92	9722	12	74	9492	9	62	8662	3	29	2642
10	5	28	2034	2	20	1765	1	6	1697	0	0	0
11	4	23	3363	2	21	3122	1	13	2938	0	0	0
12	10	53	3409	4	18	2567	4	18	2567	3	11	1789
SUM	137	739	71255	77	485	63821	58	360	59915	33	219	39933

Table 50. Red grouper catch and effort reported by fishermen participating in the Gulf of Mexico Reef Fish Logbook Program who landing in any Gulf stateports. The colums labeled 'any in catch' include all trips in which red grouper were landed. The colums labeled '>25% of catch, >50% of catch, and >75% of catch' include only trips where red grouper exceeded the indicated percentage of the catch by weight.

ALL STATES COMBINED 1990

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	3	45	1033	1	7	900	1	7	900	1	7	900
2	4	24	364	0	0	0	0	0	0	0	0	0
3	6	59	4538	2	29	3590	2	29	3590	2	29	3590
4	99	624	64356	60	390	58030	32	233	49188	20	156	37120
5	214	1354	161513	143	932	151016	79	537	112910	46	317	71769
6	232	1447	189792	177	1102	183866	119	748	150499	53	375	89439
7	224	1629	191268	169	1198	185981	120	876	162683	66	497	112547
8	245	1746	206257	190	1305	195600	149	1081	180096	83	663	120937
9	218	1486	165910	164	1123	156996	123	851	131685	73	534	87235
10	156	1110	134638	122	908	129476	82	625	105331	58	459	80427
11	72	513	52831	49	346	50389	31	210	37988	20	144	25444
12	14	90	1076	4	13	284	1	1	208	1	1	208
SUM	1487	10127	1173576	1081	7353	1116128	739	5198	935079	423	3182	629617

ALL STATES COMBINED 1991

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	204	1352	188789	137	987	180420	84	683	160430	52	431	121565
2	181	1325	141376	114	879	134545	75	608	115918	41	365	82631
3	182	1501	195305	115	1053	187273	77	779	166684	46	493	121233
4	231	1604	217852	160	1202	211640	107	894	190927	56	533	139621
5	271	1688	224860	199	1287	214752	138	958	190398	72	573	140973
6	269	1811	249249	206	1491	237659	160	1171	217871	88	708	154449
7	279	1995	233473	218	1520	225667	166	1203	201165	105	763	147771
8	237	1498	185861	176	1138	180271	141	958	167707	107	762	139055
9	243	1612	192394	195	1245	187059	158	988	171415	115	773	142112
10	180	1220	128180	125	832	124116	106	728	118301	76	528	90845
11	156	1099	121537	111	804	116694	80	630	102902	44	409	82271
12	158	1055	122844	93	669	116028	72	560	110005	45	374	82282
SUM	2591	17760	2201719	1849	13107	2116125	1364	10160	1913723	847	6712	1444809

ALL STATES COMBINED 1992

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch	Trips	Days	Catch
1	174	1204	112824	115	850	108330	83	596	95227	53	339	68054
2	146	1137	122037	95	757	115196	66	536	98732	45	368	80487
3	195	1315	102262	111	849	94185	68	549	81742	45	393	62299
4	219	1289	103129	114	731	90443	72	547	80145	36	292	52407
5	317	1691	162364	206	1174	152534	134	773	127490	78	505	87633
6	325	1652	186299	225	1213	176503	167	924	163352	86	528	113603
7	348	1816	256282	260	1485	249278	224	1321	236277	149	946	189980
8	319	1640	202827	246	1305	195388	206	1116	183640	143	790	143655
9	306	1641	169316	226	1241	158190	184	1046	147188	109	620	90833
10	236	1371	116673	155	961	106046	122	746	91673	63	335	46694
11	163	1016	93940	106	724	89831	79	575	81947	41	301	52850
12	218	1309	132679	134	835	122493	95	640	112079	56	372	86188
SUM	2966	17081	1760634	1993	12125	1658416	1500	9369	1499493	904	5789	1074683

Table 51. Red grouper catch, catch per trip and catch per day reported by fishermen participating in the Gulf of Mexico Reef Fish Logbook Program who landed in Florida West Coast ports. The colums labeled 'any in catch' include all trips in which red grouper were landed. The colums labeled '>25% of catch, >50% of catch, and >75% of catch' include only trips where red grouper exceeded the indicated percentage of the catch by weight.

FLORIDA WEST COAST 1990

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	344	23	1033	900	129	900	900	129	900	900	129	900
2	51	9	153	0	0	0	0	0	0	0	0	0
3	991	92	3965	1795	124	3590	1795	124	3590	1795	124	3590
4	667	110	64076	967	149	58030	1537	211	49188	1856	238	37120
5	760	121	161116	1056	162	151016	1429	210	112910	1560	226	71769
6	827	133	188667	1043	167	183515	1265	201	150499	1688	239	89439
7	858	118	191259	1100	155	185981	1356	186	162683	1705	226	112547
8	857	120	205570	1037	151	194990	1209	167	180096	1457	182	120937
9	760	112	164249	953	140	155415	1071	155	131685	1195	163	87235
10	864	121	131397	1065	143	126683	1291	168	103265	1399	175	78361
11	744	105	50618	1032	145	48501	1204	181	36132	1241	176	23588
12	63	9	694	131	24	261	208	208	208	208	208	208
SUM	799	118	1162797	1036	152	1108881	1265	180	931156	1490	198	625694

FLORIDA WEST COAST 1991

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	930	140	186948	1313	183	178620	1911	236	158630	2338	282	121565
2	779	108	137152	1165	152	130506	1513	190	111993	2015	226	82631
3	1085	132	194285	1640	178	187003	2190	215	166414	2636	246	121233
4	928	136	204078	1319	179	197883	1802	216	180192	2511	261	133076
5	858	137	217024	1120	171	208378	1448	203	185363	2140	248	139074
6	939	142	239493	1163	163	228033	1364	189	208679	1785	218	149899
7	856	118	232710	1051	149	224936	1231	168	200593	1433	196	147630
8	779	123	183084	1020	157	177494	1187	173	164930	1298	180	136278
9	794	119	184987	961	151	179692	1081	174	164268	1229	185	137690
10	713	105	124771	990	149	120789	1106	163	115072	1184	173	87616
11	793	112	121321	1060	146	116606	1301	164	102814	1870	201	82271
12	785	115	115358	1273	171	109447	1506	191	103901	1810	215	79629
SUM	857	125	2141210	1152	162	2059389	1411	189	1862848	1724	215	1418593

FLORIDA WEST COAST 1992

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	627	90	102126	874	119	97925	1060	149	84822	1153	184	57649
2	862	110	120660	1230	153	114414	1530	186	97950	1826	220	80359
3	530	79	98511	849	112	91728	1204	150	79451	1396	161	60008
4	479	81	95371	821	128	84542	1189	152	74901	1547	186	51043
5	515	95	155936	739	129	146321	946	163	121997	1100	171	82536
6	581	117	177204	792	150	167804	978	176	155486	1330	217	107721
7	759	143	249784	966	169	243393	1058	180	230691	1274	203	184662
8	648	124	193240	805	151	186655	899	166	175296	1018	182	138499
9	548	103	159394	695	127	148698	792	141	138526	832	149	88191
10	498	86	114638	682	111	104281	744	122	89976	741	139	46694
11	573	92	90570	834	123	86709	1013	141	79009	1289	176	52850
12	624	103	129095	928	147	119752	1215	176	109338	1620	234	84225
SUM	600	104	1686531	834	137	1592221	1000	160	1437445	1190	186	1034437

Table 52. Red grouper catch, catch per trip and catch per day reported by fishermen participating in the Gulf of Mexico Reef Fish Logbook Program who landed in Alabama and Mississippi ports. The colums labeled 'any in catch' include all trips in which red grouper were landed. The colums labeled '>25% of catch, >50% of catch, and >75% of catch' include only trips where red grouper exceeded the indicated percentage of the catch by weight.

ALABAMA-MISSISIPPI 1990

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	351	70	351	351	70	351	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	1781	297	1781	1781	297	1781	1781	297	1781	1781	297	1781
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
SUM	1066	194	2132	1066	194	2132	1781	297	1781	1781	297	1781

ALABAMA-MISSISIPPI 1991

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	0	0	0	0	0	0	0	0	0	0	0	0
2	116	8	116	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	701	70	2102	701	70	2102	431	66	863	26	26	26
5	59	59	176	59	59	176	59	59	176	59	59	176
6	24	24	24	24	24	24	24	24	24	24	24	24
7	22	22	22	22	22	22	22	22	22	22	22	22
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	2653	663	2653	2653	663	2653	2653	663	2653	2653	663	2653
SUM	509	94	5093	553	128	4977	467	170	3738	414	290	2901

ALABAMA-MISSISIPPI 1992

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	14	7	14	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	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
7	0	0	0	0	0	0	0	0	0	0	0	0
8	908	151	908	908	151	908	908	151	908	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
SUM	461	115	922	908	151	908	908	151	908	0	0	0

Table 53. Red grouper catch, catch per trip and catch per day reported by fishermen participating in the Gulf of Mexico Reef Fish Logbook Program who landed in Louisiana ports. The colums labeled 'any in catch' include all trips in which red grouper were landed. The colums labeled '>25% of catch, >50% of catch, and >75% of catch' include only trips where red grouper exceeded the indicated percentage of the catch by weight.

LOUISIANA 1990

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	35	7	35	0	0	0	0	0	0	0	0	0
7	9	1	9	0	0	0	0	0	0	0	0	0
8	42	8	84	80	27	80	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	506	68	1013	506	68	1013	286	57	286	286	57	286
11	1856	186	1856	1856	186	1856	1856	186	1856	1856	186	1856
12	0	0	0	0	0	0	0	0	0	0	0	0
SUM	428	57	2997	737	105	2949	1071	143	2142	1071	143	2142

LOUISIANA 1991

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	30	30	30	0	0	0	0	0	0	0	0	0
2	50	5	50	0	0	0	0	0	0	0	0	0
3	4	1	4	0	0	0	0	0	0	0	0	0
4	912	101	3649	1210	134	3631	1613	161	3227	1451	132	1451
5	183	91	548	183	91	548	183	91	548	248	99	497
6	502	76	2511	1247	208	2494	2486	226	2486	2486	226	2486
7	124	33	621	295	295	590	431	431	431	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	558	112	558	558	112	558	558	112	558	0	0	0
10	42	6	83	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
SUM	350	61	8054	711	150	7821	906	169	7250	1108	164	4434

LOUISIANA 1992

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	36	10	142	139	35	139	139	35	139	139	35	139
2	0	0	0	0	0	0	0	0	0	0	0	0
3	33	7	33	0	0	0	0	0	0	0	0	0
4	371	70	1113	549	100	1097	913	183	913	0	0	0
5	9	5	9	0	0	0	0	0	0	0	0	0
6	73	6	145	0	0	0	0	0	0	0	0	0
7	44	5	44	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	174	174	174	174	174	174	174	174	174	174	174	174
SUM	128	23	1660	353	88	1410	409	123	1226	157	63	313

Table 54. Red grouper catch, catch per trip and catch per day reported by fishermen participating in the Gulf of Mexico Reef Fish Logbook Program who landed in Texas ports. The colums labeled 'any in catch' include all trips in which red grouper were landed. The colums labeled '>25% of catch, >50% of catch, and >75% of catch' include only trips where red grouper exceeded the indicated percentage of the catch by weight.

TEXAS 1990

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	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
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
SUM	0	0	0	0	0	0	0	0	0	0	0	0

TEXAS 1991

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	10	2	10	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	746	68	746	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	970	121	970	970	121	970	970	121	970	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	1853	185	1853	1853	185	1853	1853	185	1853	1853	185	1853
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
SUM	895	105	3580	1412	157	2823	1412	157	2823	1853	185	1853

TEXAS 1992

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	56	14	56	56	14	56	0	0	0	0	0	0
6	1	0	1	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	200	33	200	0	0	0	0	0	0	0	0	0
10	1	0	1	0	0	0	0	0	0	0	0	0
11	7	1	7	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
SUM	53	7	265	56	14	56	0	0	0	0	0	0

Table 55. Red grouper catch, catch per trip and catch per day reported by fishermen participating in the Gulf of Mexico Reef Fish Logbook Program who landed in unknown ports. The colums labeled 'any in catch' include all trips in which red grouper were landed. The colums labeled '>25% of catch, >50% of catch, and >75% of catch' include only trips where red grouper exceeded the indicated percentage of the catch by weight.

UNKNOWN 1990

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	0	0	0	0	0	0	0	0	0	0	0	0
2	211	30	211	0	0	0	0	0	0	0	0	0
3	287	36	573	0	0	0	0	0	0	0	0	0
4	93	7	280	0	0	0	0	0	0	0	0	0
5	199	22	397	0	0	0	0	0	0	0	0	0
6	370	49	739	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	201	22	603	530	48	530	0	0	0	0	0	0
9	831	92	1661	1581	158	1581	0	0	0	0	0	0
10	447	64	447	0	0	0	0	0	0	0	0	0
11	119	16	357	32	16	32	0	0	0	0	0	0
12	128	38	383	11	11	23	0	0	0	0	0	0
SUM	257	31	5651	433	87	2166	0	0	0	0	0	0

UNKNOWN 1991

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	1800	164	1800	1800	164	1800	1800	164	1800	0	0	0
2	1353	156	4058	2020	213	4039	3925	218	3925	0	0	0
3	270	54	270	270	54	270	270	54	270	0	0	0
4	2006	191	8024	2006	191	8024	2215	256	6646	5068	461	5068
5	593	78	7112	807	97	5649	1078	120	4311	613	245	1226
6	893	79	6250	1023	88	6137	1428	117	5712	1021	227	2041
7	119	12	119	119	12	119	119	12	119	119	12	119
8	1389	463	2777	1389	463	2777	1389	463	2777	1389	463	2777
9	625	122	4996	826	130	4956	1184	169	4736	1285	135	2569
10	1109	145	3326	1109	145	3326	1615	147	3229	1615	147	3229
11	72	18	216	88	22	88	88	22	88	0	0	0
12	483	103	4833	655	151	3928	1726	314	3451	0	0	0
SUM	796	111	43782	1028	132	41114	1426	164	37064	1419	208	17029

UNKNOWN 1992

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	1757	224	10542	5133	489	10266	5133	489	10266	5133	489	10266
2	229	35	1377	391	87	782	391	87	782	128	64	128
3	465	55	3718	819	85	2457	1146	109	2291	1146	109	2291
4	391	69	6645	534	84	4804	541	88	4331	455	76	1364
5	530	127	6363	880	162	6157	1099	211	5493	1699	243	5097
6	526	88	8949	669	94	8699	983	187	7866	1176	190	5882
7	359	102	6454	736	137	5885	931	147	5586	1330	152	5318
8	434	110	8680	602	126	7824	744	135	7435	737	172	5156
9	694	106	9722	791	128	9492	962	140	8662	881	91	2642
10	407	73	2034	883	88	1765	1697	283	1697	0	0	0
11	841	146	3363	1561	149	3122	2938	226	2938	0	0	0
12	341	64	3409	642	143	2567	642	143	2567	596	163	1789
SUM	520	96	71255	829	132	63821	1033	166	59915	1210	182	39933

Table 56. Red grouper catch, catch per trip and catch per day reported by fishermen participating in the Gulf of Mexico Reef Fish Logbook Program who landed in any Gulf state ports. The colums labeled 'any in catch' include all trips in which red grouper were landed.. The colums labeled '>25% of catch, >50% of catch, and >75% of catch' include only trips where red grouper exceeded the indicated percentage of the catch by weight.

ALL STATES COMBINED 1990

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	344	23	1033	900	129	900	900	129	900	900	129	900
2	91	15	364	0	0	0	0	0	0	0	0	0
3	756	77	4538	1795	124	3590	1795	124	3590	1795	124	3590
4	650	103	64356	967	149	58030	1537	211	49188	1856	238	37120
5	755	119	161513	1056	162	151016	1429	210	112910	1560	226	71769
6	818	131	189792	1039	167	183866	1265	201	150499	1688	239	89439
7	854	117	191268	1100	155	185981	1356	186	162683	1705	226	112547
8	842	118	206257	1029	150	195600	1209	167	180096	1457	182	120937
9	761	112	165910	957	140	156996	1071	155	131685	1195	163	87235
10	863	121	134638	1061	143	129476	1285	169	105331	1387	175	80427
11	734	103	52831	1028	146	50389	1225	181	37988	1272	177	25444
12	77	12	1076	71	22	284	208	208	208	208	208	208
SUM	789	116	1173576	1032	152	1116128	1265	180	935079	1488	198	629617

ALL STATES COMBINED 1991

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	925	140	188789	1317	183	180420	1910	235	160430	2338	282	121565
2	781	107	141376	1180	153	134545	1546	191	115918	2015	226	82631
3	1073	130	195305	1628	178	187273	2165	214	166684	2636	246	121233
4	943	136	217852	1323	176	211640	1784	214	190927	2493	262	139621
5	830	133	224860	1079	167	214752	1380	199	190398	1958	246	140973
6	927	138	249249	1154	159	237659	1362	186	217871	1755	218	154449
7	837	117	233473	1035	148	225667	1212	167	201165	1407	194	147771
8	784	124	185861	1024	158	180271	1189	175	167707	1300	182	139055
9	792	119	192394	959	150	187059	1085	173	171415	1236	184	142112
10	712	105	128180	993	149	124116	1116	163	118301	1195	172	90845
11	779	111	121537	1051	145	116694	1286	163	102902	1870	201	82271
12	777	116	122844	1248	173	116028	1528	196	110005	1828	220	82282
SUM	850	124	2201719	1144	161	2116125	1403	188	1913723	1706	215	1444809

ALL STATES COMBINED 1992

	Any in catch			>25% of catch			>50% of catch			>75% of catch		
Mon	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch	/Trip	/Day	Catch
1	648	94	112824	942	127	108330	1147	160	95227	1284	201	68054
2	836	107	122037	1213	152	115196	1496	184	98732	1789	219	80487
3	524	78	102262	849	111	94185	1202	149	81742	1384	159	62299
4	471	80	103129	793	124	90443	1113	147	80145	1456	179	52407
5	512	96	162364	740	130	152534	951	165	127490	1123	174	87633
6	573	113	186299	784	146	176503	978	177	163352	1321	215	113603
7	736	141	256282	959	168	249278	1055	179	236277	1275	201	189980
8	636	124	202827	794	150	195388	891	165	183640	1005	182	143655
9	553	103	169316	700	127	158190	800	141	147188	833	147	90833
10	494	85	116673	684	110	106046	751	123	91673	741	139	46694
11	576	92	93940	847	124	89831	1037	143	81947	1289	176	52850
12	609	101	132679	914	147	122493	1180	175	112079	1539	232	86188
SUM	594	103	1760634	832	137	1658416	1000	160	1499493	1189	186	1074683

Table 57. Mean and median CPUE values for red grouper caught in various gears based on logbooks submitted by participants in the Gulf of Mexico reef fish logbook program by month and year. Only trips in which red grouper consisted of 50 percent or more of the total catch for the trip are included in the table. Units for each gear type are pounds per trap-hour for fish traps, and pounds per hook-hour for hand lines and bottom longlines.

		FISH TRAPS			HAND LINES			BOTTOM LONGLINES		
YEAR	MONTH	OBS	MEDIAN	MEAN	OBS	MEDIAN	MEAN	OBS	MEDIAN	MEAN
1990	3	0	0.00	0.00	0	0.00	0.00	2	0.06	0.06
1990	4	0	0.00	0.00	10	1.57	3.20	9	0.04	0.09
1990	5	5	0.07	0.60	15	1.63	2.13	19	0.06	0.08
1990	6	12	0.33	1.40	38	3.47	4.08	20	0.08	0.09
1990	7	19	0.83	1.58	30	2.62	6.27	14	0.04	0.04
1990	8	18	0.08	0.38	42	2.70	4.46	14	0.05	0.07
1990	9	15	0.88	1.67	43	2.72	3.66	13	0.05	0.05
1990	10	5	0.21	0.51	22	2.00	4.08	18	0.03	0.07
1990	11	2	0.12	0.12	9	3.08	4.15	6	0.06	0.07
1990	12	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
1991	1	3	0.28	0.25	23	2.40	3.92	24	0.08	0.12
1991	2	8	0.32	0.83	24	1.24	14.05	13	0.11	0.11
1991	3	5	0.08	0.16	18	2.53	2.62	23	0.08	0.11
1991	4	16	0.38	0.54	28	1.73	10.76	22	0.05	0.13
1991	5	19	0.65	0.78	37	3.03	6.03	21	0.08	0.09
1991	6	23	0.70	1.48	40	1.68	5.31	15	0.04	0.07
1991	7	13	0.08	0.80	53	1.98	3.71	19	0.07	0.07
1991	8	17	0.68	1.72	46	2.57	3.52	11	0.04	0.10
1991	9	16	0.30	0.97	47	1.76	2.95	8	0.03	0.04
1991	10	8	0.31	0.38	38	1.57	3.02	14	0.04	0.07
1991	11	14	0.03	0.46	23	1.92	2.89	12	0.05	0.05
1991	12	13	0.14	0.61	22	2.55	3.08	9	0.03	0.05
1992	1	18	0.04	0.95	33	2.38	4.83	14	0.05	0.14
1992	2	9	0.04	0.19	26	1.40	2.98	20	0.06	0.12
1992	3	14	0.29	0.31	19	1.56	2.55	20	0.05	0.12
1992	4	23	0.47	0.72	19	1.63	2.17	13	0.05	0.08
1992	5	40	0.35	0.66	46	2.06	3.20	20	0.03	0.05
1992	6	62	0.37	0.62	54	3.19	7.47	17	0.06	0.10
1992	7	79	0.39	0.66	81	1.94	6.00	14	0.04	0.12
1992	8	39	0.30	1.03	46	3.29	7.17	10	0.05	0.07
1992	9	45	0.11	1.04	91	2.97	10.60	13	0.05	0.05
1992	10	20	0.33	1.18	66	3.52	5.34	12	0.04	0.06
1992	11	16	0.46	0.91	36	3.24	10.83	10	0.06	0.06
1992	12	11	0.33	1.37	49	1.70	4.94	18	0.04	0.10

Table 58. Recreational harvest estimates for Gulf of Mexico red grouper by state and period of the year for the period 1979-1992. The estimates are based on the 1979-1992 NMRFSS, the 1986-1992 NMFS Headboat Survey, and 1981-1992 length-frequency samples and 1986-1992 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	57	467	0	0	0	0	0	0	0	0	57	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
1991	119	144	0	0	0	0	1	0	0	0	120	145
1992	135	321	0	0	0	0	0	0	0	0	135	321
Mean	242	516	0	0	0	0	0	0	0	0	378	836
Percent	32.0	68.0	50.7	49.3	0.0	0.0	93.2	6.8	14.7	85.3	31.1	68.9

Table 59. Commercial landings (LBS, = thousands of pounds) and numbers of TIP length samples (NUM) of red grouper landings for selected counties in Florida, 1986-1992.

	1986		1987		1988		1989		1990		1991		1992	
COUNTY	NUM	LBS	NUM	LBS	NUM	LBS	NUM	LBS	NUM	LBS	NUM	LBS	NUM	LBS
Escambia	0	0	0	1	0	0	0	0	0	1	0	4	0	0
Santa Rosa	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Okaloosa	0	2	0	0	0	1	0	1	0	1	0	5	0	3
Walton	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bay	0	96	82	94	42	96	0	101	561	96	716	86	29	34
Gulf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Franklin	0	49	0	118	0	44	0	328	13	236	0	252	0	102
Wakulla	0	0	0	1	0	1	0	34	0	54	0	45	0	55
Taylor	0	1	0	1	0	1	0	5	0	12	0	13	0	41
Dixie	0	2	0	2	0	0	0	71	0	57	0	39	0	31
Levy	0	0	0	0	0	0	0	0	0	3	0	51	0	78
Citrus	0	29	0	29	0	23	0	66	0	137	0	208	147	282
Hernando	0	0	0	0	0	2	0	3	0	2	0	2	0	2
Pasco	0	39	0	19	0	23	0	39	0	28	0	22	73	86
Pinellas	2747	2809	1704	3213	549	1674	1569	3652	5800	2232	2997	2389	4318	2087
Hillsborough	0	61	0	101	0	93	0	315	0	115	0	93	0	92
Manatee	131	1383	277	1344	156	854	0	1297	4844	587	8964	700	2580	365
Sarasota	0	6	0	14	0	36	0	79	0	7	0	45	0	49
Charlotte	0	186	0	271	0	251	0	457	95	260	61	205	10	178
Lee	0	943	0	776	0	749	0	957	206	371	444	356	3700	376
Collier	0	1382	0	1499	0	1262	0	1123	298	427	1274	397	763	346
Monroe	4656	472	2459	427	1829	413	1062	292	293	150	687	151	164	112

Table 60. 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		1991		1992	
County	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
1 Escambia	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
2 Santa Rosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
3 Okaloosa	0	-	0	-	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-
4 Walton	0	-	0	-	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	0	0.00	0	0.00
6 Gulf	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
7 Franklin	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	-	0	-
8 Wakulla	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
9 Taylor	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
10 Dixie	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
11 Levy	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12 Citrus	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
13 Hernando	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14 Pasco	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
15 Pinellas	0	0.00	25	0.01	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	-	0	-	0	-
17 Manatee	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	-	0	0.00	0	0.00	0	0.00
18 Sarasota	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19 Charlotte	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	0.00	0	0.00
20 Lee	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	0.00	0	0.00
21 Collier	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	0.00	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	14	0.02	0	0.00

Table 61. 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		1991		1992	
County	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
1 Escambia	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
2 Santa Rosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
3 Okaloosa	0	-	0	-	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-
4 Walton	0	-	0	-	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	0	0.00	15	0.52
6 Gulf	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
7 Franklin	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	-	0	-
8 Wakulla	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
9 Taylor	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
10 Dixie	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
11 Levy	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12 Citrus	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	147	1.00
13 Hernando	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14 Pasco	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
15 Pinellas	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	43	0.01	34	0.01
16 Hillsborough	0	-	0	-	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	0	0.00	0	0.00
18 Sarasota	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19 Charlotte	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	0.00	0	0.00
20 Lee	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	0.00	0	0.00
21 Collier	0	-	0	-	0	-	0	-	0	-	0	-	189	0.63	692	0.54	598	0.78
22 Monroe	18	0.02	1185	0.44	1248	0.27	768	0.31	33	0.02	357	0.34	172	0.59	51	0.07	42	0.27

Table 62. 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		1991		1992	
County	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
1 Escambia	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
2 Santa Rosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
3 Okaloosa	0	-	0	-	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-
4 Walton	0	-	0	-	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	0	0.00	0	0.00
6 Gulf	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
7 Franklin	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	-	0	-
8 Wakulla	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
9 Taylor	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
10 Dixie	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
11 Levy	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12 Citrus	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
13 Hernando	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14 Pasco	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
15 Pinellas	0	0.00	0	0.00	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	-	0	-	0	-
17 Manatee	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	-	0	0.00	0	0.00	0	0.00
18 Sarasota	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19 Charlotte	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	0.00	0	0.00
20 Lee	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	0.00	0	0.00
21 Collier	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	0.00	0	0.00
22 Monroe	108	0.15	0	0.00	0	0.00	0	0.00	0	0.00	3	0.00	2	0.01	0	0.00	0	0.00

Table 63. 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		1991		1992	
County	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
1 Escambia	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
2 Santa Rosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
3 Okaloosa	0	-	0	-	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-
4 Walton	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
5 Bay	8	0.14	0	0.00	0	-	7	0.09	0	0.00	0	-	45	0.08	88	0.12	8	0.28
6 Gulf	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
7 Franklin	0	-	0	-	0	-	0	-	0	-	0	-	13	1.00	0	-	0	-
8 Wakulla	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
9 Taylor	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
10 Dixie	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
11 Levy	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12 Citrus	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
13 Hernando	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14 Pasco	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-	0	-	73	1.00
15 Pinellas	72	0.04	0	0.00	0	0.00	35	0.02	0	0.00	0	0.00	40	0.01	14	0.00	220	0.05
16 Hillsborough	0	-	0	-	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	59	0.01	132	0.05
18 Sarasota	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19 Charlotte	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	4	0.07	0	0.00
20 Lee	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	93	0.21	19	0.01
21 Collier	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	80	0.06	0	0.00
22 Monroe	196	0.27	733	0.27	36	0.01	421	0.17	632	0.35	553	0.52	69	0.24	272	0.40	66	0.43

Table 64. 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		1991		1992	
County	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
1 Escambia	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
2 Santa Rosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
3 Okaloosa	0	-	0	-	1	1.00	0	-	0	-	0	-	0	-	0	-	0	-
4 Walton	0	-	0	-	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	1	0.00	4	0.14
6 Gulf	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
7 Franklin	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	-	0	-
8 Wakulla	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
9 Taylor	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
10 Dixie	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
11 Levy	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12 Citrus	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
13 Hernando	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14 Pasco	21	1.00	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
15 Pinellas	726	0.42	762	0.42	486	0.18	575	0.34	85	0.15	62	0.04	522	0.09	242	0.08	410	0.09
16 Hillsborough	0	-	0	-	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	196	0.02	0	0.00
18 Sarasota	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19 Charlotte	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	0.00	0	0.00
20 Lee	0	-	0	-	0	-	0	-	0	-	0	-	177	0.86	317	0.71	1275	0.35
21 Collier	0	-	0	-	0	-	0	-	0	-	0	-	57	0.19	502	0.39	165	0.22
22 Monroe	268	0.36	27	0.01	0	0.00	113	0.05	319	0.17	0	0.00	28	0.10	0	0.00	0	0.00

Table 65. 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		1991		1992	
County	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac	N	Frac
1 Escambia	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
2 Santa Rosa	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
3 Okaloosa	0	-	0	-	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-
4 Walton	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
5 Bay	37	0.64	437	1.00	0	-	75	0.91	42	1.00	0	-	516	0.92	627	0.88	2	0.07
6 Gulf	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
7 Franklin	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	-	0	-
8 Wakulla	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
9 Taylor	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
10 Dixie	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
11 Levy	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12 Citrus	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
13 Hernando	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14 Pasco	0	0.00	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00
15 Pinellas	930	0.54	1016	0.56	2261	0.82	1094	0.64	464	0.85	1507	0.96	5238	0.90	2695	0.90	3654	0.85
16 Hillsborough	0	-	0	-	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	8709	0.97	2448	0.95
18 Sarasota	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19 Charlotte	0	-	0	-	0	-	0	-	0	-	0	-	95	1.00	57	0.93	10	1.00
20 Lee	0	-	0	-	0	-	0	-	0	-	0	-	29	0.14	34	0.08	2331	0.64
21 Collier	0	-	0	-	0	-	0	-	0	-	0	-	52	0.17	0	0.00	0	0.00
22 Monroe	48	0.07	0	0.00	3372	0.72	1157	0.47	845	0.46	148	0.14	20	0.07	350	0.51	46	0.30

Table 66. 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.

	YEAR								
County	84	85	86	87	88	89	90	91	92
1 Escambia	-	-	-	-	-	-	-	-	-
2 Santa Rosa	-	-	-	-	-	-	-	-	-
3 Okaloosa	-	-	1.000	-	-	-	-	-	-
4 Walton	-	-	-	-	-	-	-	-	-
5 Bay	0.619	-	-	0.000	-	-	0.000	0.011	0.333
6 Gulf	-	-	-	-	-	-	-	-	-
7 Franklin	-	-	-	-	-	-	0.000	-	-
8 Wakulla	-	-	-	-	-	-	-	-	-
9 Taylor	-	-	-	-	-	-	-	-	-
10 Dixie	-	-	-	-	-	-	-	-	-
11 Levy	-	-	-	-	-	-	-	-	-
12 Citrus	-	-	-	-	-	-	-	-	-
13 Hernando	-	-	-	-	-	-	-	-	-
14 Pasco	1.000	-	-	-	-	-	-	-	0.000
15 Pinellas	0.910	1.000	1.000	0.943	1.000	1.000	0.929	0.945	0.651
16 Hillsborough	-	-	-	-	-	-	-	-	-
17 Manatee	1.000	-	-	1.000	1.000	-	-	0.769	0.000
18 Sarasota	-	-	-	-	-	-	-	-	-
19 Charlotte	-	-	-	-	-	-	-	0.000	-
20 Lee	-	-	-	-	-	-	1.000	0.773	0.985
21 Collier	-	-	-	-	-	-	1.000	0.863	1.000
22 Monroe	0.578	0.036	0.000	0.212	0.335	0.000	0.289	0.000	0.000

Table 67. 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		1991		1992	
Grid	N	Frac	N	Frac	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	2	0.01	15	0.05
1	0	-	320	0.24	4	0.02	9	0.27	0	-	11	0.08	22	0.04	0	0.00	0	0.00
2	18	0.05	140	0.42	0	0.00	12	0.02	0	0.00	0	0.00	148	0.18	49	0.07	42	0.03
3	0	0.00	439	1.00	1240	0.32	745	0.46	0	0.00	330	0.28	90	0.08	186	0.12	529	0.37
4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	99	0.02	113	0.03	69	0.01
5	0	0.00	0	0.00	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	0	0.00	181	0.21
7	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	43	1.00	0	-
8	0	0.00	0	-	0	-	0	-	0	0.00	0	-	0	0.00	0	0.00	0	-
9	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	-	0	-
10	0	-	0	-	0	0.00	0	-	0	-	0	-	0	0.00	0	-	0	-
11	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
13	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
15	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
16	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
17	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
18	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
20	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
21	0	-	0	-	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	2	0.20	393	0.96	0	0.00

Table 68. 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		1991		1992	
Grid	N	Frac	N	Frac	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	196	0.74	94	0.28
1	0	-	247	0.19	6	0.03	24	0.73	0	-	119	0.91	25	0.05	50	1.00	18	0.90
2	262	0.80	47	0.14	25	0.09	430	0.57	143	0.65	11	1.00	73	0.09	157	0.23	101	0.07
3	37	0.43	0	0.00	3	0.00	59	0.04	915	0.52	415	0.36	143	0.13	470	0.30	272	0.19
4	191	0.40	9	0.10	31	0.09	67	0.21	60	0.42	0	0.00	370	0.07	449	0.11	1162	0.22
5	127	0.48	201	0.32	122	0.24	52	0.60	10	0.06	44	0.22	205	0.08	504	0.08	335	0.14
6	134	0.59	5	0.01	9	0.04	7	0.09	0	0.00	18	1.00	73	0.09	0	0.00	387	0.45
7	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	0.00	0	-
8	27	0.68	0	-	0	-	0	-	0	0.00	0	-	20	0.26	26	0.10	0	-
9	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	-	0	-
10	0	-	0	-	0	0.00	0	-	0	-	0	-	36	1.00	0	-	0	-
11	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
13	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
15	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
16	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
17	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
18	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
20	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
21	0	-	0	-	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	6	0.60	16	0.04	3	1.00

Table 69. 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		1991		1992	
Grid	N	Frac	N	Frac	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	925	1.00	54	0.20	224	0.67
1	0	-	10	0.01	185	0.95	0	0.00	0	-	0	0.00	503	0.91	0	0.00	0	0.00
2	48	0.15	146	0.44	240	0.91	312	0.41	76	0.35	0	0.00	622	0.74	489	0.70	1277	0.89
3	49	0.57	0	0.00	2606	0.68	822	0.51	845	0.48	413	0.36	870	0.79	920	0.58	638	0.44
4	287	0.60	79	0.90	320	0.91	248	0.79	82	0.58	180	1.00	4529	0.91	3589	0.86	4019	0.75
5	138	0.52	434	0.68	393	0.76	34	0.40	154	0.94	160	0.78	2400	0.92	6200	0.92	2040	0.86
6	94	0.41	375	0.99	208	0.96	75	0.91	104	1.00	0	0.00	780	0.91	992	1.00	293	0.34
7	0	-	0	-	0	-	0	-	0	-	0	-	56	1.00	0	0.00	0	-
8	13	0.32	0	-	0	-	0	-	42	1.00	0	-	57	0.74	228	0.90	0	-
9	0	-	0	-	0	-	0	-	0	-	0	-	52	1.00	0	-	0	-
10	0	-	0	-	34	1.00	0	-	0	-	0	-	0	0.00	0	-	0	-
11	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
13	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
15	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
16	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
17	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
18	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
20	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
21	0	-	0	-	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	0	0.00	0	0.00

Table 70. 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		1991		1992	
Grid	N	Frac	N	Frac	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	14	0.05	0	0.00
1	0	-	744	0.56	0	0.00	0	0.00	0	-	1	0.01	2	0.00	0	0.00	2	0.10
2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	8	0.01
3	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	75	0.01
5	0	0.00	0	0.00	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	3	0.00	0	0.00
7	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	0.00	0	-
8	0	0.00	0	-	0	-	0	-	0	0.00	0	-	0	0.00	0	0.00	0	-
9	0	-	0	-	0	-	0	-	0	-	0	-	0	0.00	0	-	0	-
10	0	-	0	-	0	0.00	0	-	0	-	0	-	0	0.00	0	-	0	-
11	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
12	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
13	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
14	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
15	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
16	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
17	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
18	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
19	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
20	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
21	0	-	0	-	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	2	0.20	0	0.00	0	0.00

Table 71. 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	1989	1990	1991	1992
Unkn	1151	1155	2101	1417	97	902	925	266	333
1	0	1321	195	33	0	131	552	50	20
2	328	333	265	754	219	11	843	695	1428
3	86	439	3849	1626	1760	1158	1103	1576	1439
4	478	88	351	315	142	180	4998	4151	5325
5	265	635	515	86	164	204	2605	6704	2375
6	228	380	217	82	104	18	853	995	861
7	0	0	0	0	0	0	56	43	0
8	40	0	0	0	42	0	77	254	0
9	0	0	0	0	0	0	52	0	0
10	0	0	34	0	0	0	36	0	0
11	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0
Other	122	658	7	209	48	27	10	409	3

Table 72. Estimated total numbers of Gulf of Mexico red grouper landed by length and year in the commercial harvest for the period 1986-1992.

	COMMERCIAL HARVEST						
LEN	1986	1987	1988	1989	1990	1991	1992
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	717	2076	0	0	0	0
11	8233	7986	41771	51339	441	0	0
12	41986	59364	141891	135362	1249	234	25
13	57463	96587	162030	206696	1471	306	67
14	47899	92503	125376	185230	860	657	121
15	45790	95487	112187	143778	894	533	70
16	34771	85651	82893	164473	1508	817	45
17	63708	85956	89424	117092	917	1768	44
18	60224	75484	72842	117553	2490	3781	3104
19	73956	98646	79644	101011	9062	20871	20635
20	67986	83917	54050	93875	28960	61028	54219
21	65598	77700	46335	72477	32900	59424	45227
22	52181	59251	36908	92469	48177	77435	52766
23	65448	61237	36949	44852	32564	48139	31666
24	67762	47187	30342	65747	39294	57766	36878
25	69456	47515	27718	52351	42509	46982	32329
26	64244	42066	24780	26485	31673	35099	23135
27	42702	40698	26235	35229	40518	48142	31333
28	28603	33240	18067	14179	31553	32486	22267
29	20936	28070	15869	26544	35376	29742	21396
30	25352	19120	8629	11692	21439	17291	11487
31	12701	14974	11430	18877	23456	15009	11095
32	10162	10446	2895	7850	13219	6637	4633
33	7459	11352	2459	10101	9439	6200	4033
34	7271	8867	2145	3971	5962	2135	2034
35	3720	4385	392	1182	3498	1557	1412
36	1603	1960	0	774	1096	229	718
37	429	910	0	438	1162	226	283
38	0	0	0	438	315	0	105
39	0	0	0	336	0	0	0
40	0	0	0	0	0	0	0
Tot	1047643	1291276	1255337	1802401	462002	574494	411127

Table 73. Estimated total numbers of Gulf of Mexico red grouper landed by length and year in the recreational harvest for the period 1986-1992.

	RECREATIONAL HARVEST						
LEN	1986	1987	1988	1989	1990	1991	1992
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	14	3710	0	0	0
8	0	0	14	11131	0	0	1698
9	540	6221	104	14919	0	0	0
10	36865	34563	2736	3944	6583	0	0
11	84919	38499	19154	16165	0	297	0
12	74183	34021	35518	51591	429	596	267
13	52330	63671	85924	54572	370	297	0
14	41985	33324	56748	69108	4492	596	1698
15	42589	29939	84132	91678	627	0	0
16	67240	36007	74512	93945	370	1786	1698
17	41362	34368	51058	56143	3897	621	44
18	63879	34134	50328	63575	14274	6686	7632
19	49526	27255	55687	46268	28048	24189	45386
20	61971	31854	33925	65900	25914	50086	92778
21	14770	8691	36420	37032	18807	62561	77888
22	12154	19628	41246	11451	27950	35175	47779
23	13132	4140	20625	13767	17712	20114	64277
24	1203	3870	18681	23080	25010	16693	38426
25	855	10004	20842	4474	17539	27350	34206
26	208	3686	9654	9122	10672	8410	17026
27	232	741	2779	1273	3669	1113	10208
28	11968	3168	4138	136	234	334	5614
29	79	432	21	239	3596	3091	3052
30	38	3559	3305	35	3440	12	3969
31	129	92	0	179	132	256	553
32	0	4	5	6	47	396	819
33	8	3111	5	6	101	3194	286
34	0	0	0	6	0	0	286
35	21	2	0	0	0	322	267
36	0	0	0	0	31	0	0
37	0	0	0	0	0	0	0
38	0	3111	0	0	0	0	0
39	8	0	0	0	0	0	0
40	0	0	2736	0	0	0	0
Tot	672194	468095	710311	743455	213944	264175	455857

Table 74. Estimated total numbers of Gulf of Mexico red grouper landed by length and year in the combined harvest for the period 1986-1992.

	COMBINED HARVEST						
LEN	1986	1987	1988	1989	1990	1991	1992
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	14	3710	0	0	0
8	0	0	14	11131	0	0	1698
9	540	6221	104	14919	0	0	0
10	36865	35280	4812	3944	6583	0	0
11	93152	46485	60925	67504	441	297	0
12	116169	93385	177409	186953	1678	830	292
13	109793	160258	247954	261268	1841	603	67
14	89884	125827	182124	254338	5352	1253	1819
15	88379	125426	196319	235456	1521	533	70
16	102011	121658	157405	258418	1878	2603	1743
17	105070	120324	140482	173235	4814	2389	88
18	124103	109618	123170	181128	16764	10467	10736
19	123482	125901	135331	147279	37110	45060	66021
20	129957	115771	87975	159775	54874	111114	146997
21	80368	86391	82755	109509	51707	121985	123115
22	64335	78879	78154	103920	76127	112610	100545
23	78580	65377	57574	58619	50276	68253	95943
24	68965	51057	49023	88827	64304	74459	75304
25	70311	57519	48560	56825	60048	74332	66535
26	64452	45752	34434	35607	42345	43509	40161
27	42934	41439	29014	36502	44187	49255	41541
28	40571	36408	22205	14315	31787	32820	27881
29	21015	28502	15890	26783	38972	32833	24448
30	25390	22679	11934	11727	24879	17303	15456
31	12830	15066	11430	19056	23588	15265	11648
32	10162	10450	2900	7856	13266	7033	5452
33	7467	14463	2464	10107	9540	9394	4319
34	7271	8867	2145	3977	5962	2135	2320
35	3741	4387	392	1182	3498	1879	1679
36	1603	1960	0	774	1127	229	718
37	429	910	0	438	1162	226	283
38	0	3111	0	438	315	0	105
39	8	0	0	336	0	0	0
40	0	0	2736	0	0	0	0
Tot	1719837	1759371	1965648	2545856	675946	838669	866984

Table 75. Estimated total numbers of Gulf of Mexico red grouper landed by age and year in the commercial harvest for the period 1986-1992.

	COMMERCIAL HARVEST						
AGE	1986	1987	1988	1989	1990	1991	1992
0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0
2	67648	60881	157003	182607	3269	641	0
3	158784	298421	435575	580926	4893	3149	1111
4	185548	306223	308149	445389	16909	25811	51629
5	169776	233443	138845	248681	100160	179854	139036
6	121993	131029	80032	148461	94232	136213	82399
7	126190	89190	51824	72749	72529	85956	54043
8	89241	59771	40156	48761	61116	65918	39737
9	48512	44202	18810	30900	46366	39548	19816
10	32081	28732	11185	16529	23353	13139	5733
11	22198	12573	3353	6678	9550	5914	4295
12	7523	7777	3018	6011	8595	5323	3866
13	6045	6337	2460	4897	7003	4336	3150
14	5502	5767	2238	4458	6375	3947	2867
15	3029	3175	1233	2454	3509	2173	1579
16	1917	2009	780	1553	2220	1375	998
17	557	583	226	450	644	399	290
18	557	583	226	450	644	399	290
19	275	288	112	223	318	197	143
20	275	288	112	223	318	197	143
Tot	1047651	1291272	1255337	1802400	462003	574489	411125

Table 76. Estimated total numbers of Gulf of Mexico red grouper landed by age and year in the recreational harvest for the period 1986-1992.

	RECREATIONAL HARVEST						
AGE	1986	1987	1988	1989	1990	1991	1992
0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0
2	111461	77698	4227	89844	3919	1488	1965
3	222486	159823	268940	260962	12869	5932	3466
4	208122	118527	208302	230721	39174	47248	110526
5	101505	69850	123959	106407	82662	131967	189066
6	14865	15164	52632	43866	40023	44741	104302
7	1146	7875	36825	8546	17974	25231	29448
8	248	7880	6833	2585	10846	1428	11472
9	12161	5067	2006	145	4062	3547	978
10	93	1353	3611	263	565	535	1592
11	33	1186	726	28	450	502	742
12	22	1066	653	25	406	452	667
13	18	870	532	20	329	368	543
14	16	791	484	19	301	335	495
15	9	436	267	10	165	184	272
16	6	276	169	6	105	117	172
17	2	80	48	2	31	34	50
18	2	80	48	2	31	34	50
19	1	40	24	1	15	17	24
20	1	40	24	1	15	17	24
Tot	672197	468102	710310	743453	213942	264177	455854

Table 77. Estimated total numbers of Gulf of Mexico red grouper landed by age and year in the combined harvest for the period 1986-1992.

	COMBINED HARVEST						
AGE	1986	1987	1988	1989	1990	1991	1992
0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0
2	179109	138579	161230	272451	7188	2129	1965
3	381270	458244	704515	841888	17762	9081	4577
4	393670	424750	516451	676110	56083	73059	162155
5	271281	303293	262804	355088	182822	311821	328102
6	136858	146193	132664	192327	134255	180954	186701
7	127336	97065	88649	81295	90503	111187	83491
8	89489	67651	46989	51346	71962	67346	51209
9	60673	49269	20816	31045	50428	43095	20794
10	32174	30085	14796	16792	23918	13674	7325
11	22231	13759	4079	6706	10000	6416	5037
12	7545	8843	3671	6036	9001	5775	4533
13	6063	7207	2992	4917	7332	4704	3693
14	5518	6558	2722	4477	6676	4282	3362
15	3038	3611	1500	2464	3674	2357	1851
16	1923	2285	949	1559	2325	1492	1170
17	559	663	274	452	675	433	340
18	559	663	274	452	675	433	340
19	276	328	136	224	333	214	167
20	276	328	136	224	333	214	167
Tot	1719848	1759374	1965647	2545853	675945	838666	866979

Table 78. Estimated abundance of U.S. Gulf of Mexico red grouper by age and year from the VPA tuned to the commercial handline CPUE.

	STOCK AT AGE AT BEGINNING OF YEAR						
Age	86	87	88	89	90	91	92
0	4010209	2395627	1153618	2681598	1881124	783	641
1	4083371	3283282	1961373	944503	2195506	1540134	641
2	3241685	3343181	2688124	1605836	773293	1797528	1260955
3	2317594	2492442	2612080	2055371	1069478	626627	1469769
4	1578239	1554213	1628243	1505873	929705	859574	504838
5	955884	938422	891054	869855	628890	710575	637871
6	534616	539066	496317	493666	394528	350791	229824
7	365761	314753	310061	287199	232031	202668	125937
8	255676	185343	170614	174275	162153	108964	66971
9	165715	129136	91148	97492	96601	68460	29461
10	98309	81330	61617	55912	51975	34159	17837
11	65681	51638	39643	37149	30708	21194	15732

Table 79. Estimates of fishing mortality at age by year for U.S. Gulf of Mexico red grouper arising from the VPA analysis tuned to the commercial handline CPUE.

	F AT AGE DURING YEAR						
Age	86	87	88	89	90	91	92
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.063	0.047	0.068	0.206	0.010	0.001	0.002
3	0.200	0.226	0.351	0.593	0.018	0.016	0.003
4	0.320	0.356	0.427	0.673	0.069	0.098	0.434
5	0.373	0.437	0.391	0.591	0.384	0.652	0.821
6	0.330	0.353	0.347	0.555	0.466	0.824	1.101
7	0.480	0.412	0.376	0.372	0.556	0.907	1.261
8	0.483	0.510	0.360	0.390	0.662	1.108	1.721
9	0.512	0.540	0.289	0.429	0.840	1.145	1.432
10	0.444	0.519	0.306	0.399	0.697	0.575	0.595
11+	0.400	0.499	0.229	0.369	0.691	0.680	0.923

Table 80. Estimated fishing mortality rate at age during terminal year (1992) of the VPA tuned to the commercial handline CPUE.

Age	F	Std Error	Approx. 80% CI
0	0.000	0.000	0.000 <=F<= 0.000
1	0.000	0.000	0.000 <=F<= 0.000
2	0.002	0.002	0.000 <=F<= 0.004
3	0.003	0.004	0.001 <=F<= 0.007
4	0.434	0.472	0.094 <=F<= 0.911
5	0.821	0.893	0.179 <=F<= 1.725
6	1.101	1.199	0.240 <=F<= 2.314
7	1.261	1.373	0.275 <=F<= 2.651
8	1.721	1.874	0.375 <=F<= 3.616
9	1.432	1.560	0.312 <=F<= 3.009
10	0.595	0.649	0.129 <=F<= 1.252
11+	0.923	1.007	0.279 <=F<= 1.925

Table 81. Estimated abundance of U.S. Gulf of Mexico red grouper by age and year from the VPA tuned to the private-rental mode recreational harvest of age-5 red grouper.

	STOCK AT AGE AT BEGINNING OF YEAR						
Age	86	87	88	89	90	91	92
0	5803458	5869296	3837446	10524252	7394478	3080	2522
1	4783993	4751469	4805373	3141835	8616529	6054086	2522
2	3550360	3916802	3890174	3934307	2572317	7054617	4956667
3	2471503	2745149	3081707	3039474	2975349	2099542	5773909
4	1712507	1680146	1834985	1889726	1732562	2419967	1710757
5	1082680	1048181	993961	1038680	941425	1367871	1915342
6	622516	642671	585933	577733	532117	606283	839585
7	423301	386611	394743	360449	300573	315035	333991
8	289000	232303	229316	243484	222021	164875	158298
9	183280	156329	129471	145481	153168	117240	74743
10	107348	95656	83796	87259	91190	80187	57389
11	70676	59017	51330	55289	56333	53176	53342

Table 82. Estimates of fishing mortality at age by year for U.S. Gulf of Mexico red grouper arising from the VPA analysis tuned to the private-rental mode recreational harvest of age-5 red grouper.

	F AT AGE DURING YEAR						
Age	86	87	88	89	90	91	92
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.057	0.040	0.047	0.079	0.003	0.000	0.000
3	0.186	0.203	0.289	0.362	0.007	0.005	0.001
4	0.291	0.325	0.369	0.497	0.036	0.034	0.110
5	0.322	0.382	0.343	0.469	0.240	0.288	0.209
6	0.276	0.287	0.286	0.453	0.324	0.396	0.280
7	0.400	0.322	0.283	0.285	0.401	0.488	0.321
8	0.414	0.385	0.255	0.264	0.439	0.591	0.437
9	0.450	0.424	0.195	0.267	0.447	0.514	0.364
10	0.398	0.422	0.216	0.238	0.339	0.208	0.288
11+	0.357	0.418	0.178	0.267	0.417	0.299	0.288

Table 83. Estimated fishing mortality rate at age during terminal year (1992) of the VPA tuned to the private-rental mode recreational harvest of age-5 red grouper.

Age	F	Std Error	Approx. 80% CI
0	0.000	0.000	0.000 <=F<= 0.000
1	0.000	0.000	0.000 <=F<= 0.000
2	0.000	0.000	0.000 <=F<= 0.001
3	0.001	0.000	0.001 <=F<= 0.001
4	0.110	0.027	0.078 <=F<= 0.147
5	0.209	0.052	0.148 <=F<= 0.277
6	0.280	0.070	0.198 <=F<= 0.372
7	0.321	0.080	0.227 <=F<= 0.426
8	0.437	0.109	0.310 <=F<= 0.582
9	0.364	0.091	0.258 <=F<= 0.484
10	0.288	0.071	0.203 <=F<= 0.380
11+	0.288	0.071	0.203 <=F<= 0.380

Table 84. 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 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	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
1	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
2	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
3	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
4	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
5	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
6	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
7	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
8	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
9	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
10	100.0	42.8	30.5	24.3	19.5	16.1	13.0	10.4	8.3	6.6	5.5	4.6	3.8	2.9	2.0	1.2	0.3	0.3	0.3	0.3	0.3
11	100.0	43.4	31.3	25.1	20.4	17.0	14.0	11.4	9.3	7.6	6.5	5.7	4.8	4.0	3.1	2.3	1.4	1.4	1.4	1.4	1.4
12	100.0	45.9	34.3	28.4	23.9	20.6	17.7	15.3	13.3	11.6	10.6	9.8	9.0	8.1	7.3	6.5	5.7	5.7	5.7	5.7	5.7
13	100.0	51.0	40.4	35.0	31.0	28.0	25.4	23.2	21.3	19.9	18.9	18.2	17.5	16.7	16.0	15.2	14.5	14.5	14.5	14.5	14.5
14	100.0	57.8	48.7	44.1	40.6	38.0	35.8	33.9	32.3	31.0	30.2	29.6	28.9	28.3	27.7	27.0	26.4	26.4	26.4	26.4	26.4
15	100.0	63.8	56.0	52.1	49.1	46.9	45.0	43.3	42.0	40.9	40.2	39.6	39.1	38.5	38.0	37.4	36.9	36.9	36.9	36.9	36.9
16	100.0	68.5	61.7	58.2	55.6	53.7	52.0	50.6	49.4	48.5	47.9	47.4	46.9	46.4	46.0	45.5	45.0	45.0	45.0	45.0	45.0
17	100.0	72.5	66.6	63.6	61.3	59.7	58.2	57.0	55.9	55.1	54.6	54.2	53.8	53.3	52.9	52.5	52.1	52.1	52.1	52.1	52.1
18	100.0	76.9	72.0	69.5	67.5	66.2	64.9	63.9	63.0	62.3	61.9	61.5	61.2	60.8	60.5	60.1	59.8	59.8	59.8	59.8	59.8
19	100.0	80.1	75.8	73.6	72.0	70.8	69.7	68.8	68.1	67.5	67.1	66.8	66.5	66.2	65.9	65.6	65.3	65.3	65.3	65.3	65.3
20	100.0	83.4	79.8	78.0	76.6	75.6	74.7	74.0	73.3	72.8	72.5	72.3	72.0	71.8	71.5	71.3	71.0	71.0	71.0	71.0	71.0

Table 85. 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 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	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
1	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
2	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
3	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
4	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
5	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
6	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
7	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
8	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
9	100.0	42.6	30.3	24.0	19.3	15.8	12.8	10.2	8.0	6.3	5.2	4.3	3.5	2.6	1.7	0.9	0.0	0.0	0.0	0.0	0.0
10	99.9	42.7	30.4	24.2	19.4	16.0	12.9	10.3	8.2	6.5	5.4	4.5	3.7	2.8	1.9	1.1	0.2	0.2	0.2	0.2	0.2
11	99.5	43.0	30.8	24.6	19.9	16.5	13.5	11.0	8.8	7.1	6.1	5.2	4.4	3.5	2.6	1.8	0.9	0.9	0.9	0.9	0.9
12	98.1	44.0	32.4	26.5	22.0	18.7	15.9	13.4	11.4	9.7	8.7	7.9	7.1	6.3	5.5	4.6	3.8	3.8	3.8	3.8	3.8
13	95.2	46.2	35.6	30.3	26.2	23.2	20.6	18.4	16.6	15.1	14.2	13.4	12.7	11.9	11.2	10.5	9.7	9.7	9.7	9.7	9.7
14	91.3	49.1	40.0	35.4	31.9	29.3	27.1	25.2	23.6	22.3	21.5	20.9	20.2	19.6	19.0	18.3	17.7	17.7	17.7	17.7	17.7
15	87.8	51.6	43.8	39.9	36.9	34.7	32.8	31.1	29.8	28.7	28.0	27.5	26.9	26.4	25.8	25.3	24.7	24.7	24.7	24.7	24.7
16	85.2	53.6	46.8	43.4	40.7	38.8	37.2	35.7	34.6	33.6	33.0	32.5	32.1	31.6	31.1	30.6	30.1	30.1	30.1	30.1	30.1
17	82.8	55.3	49.4	46.4	44.1	42.5	41.0	39.8	38.7	37.9	37.4	37.0	36.6	36.2	35.7	35.3	34.9	34.9	34.9	34.9	34.9
18	80.3	57.2	52.2	49.7	47.8	46.4	45.2	44.2	43.3	42.6	42.2	41.8	41.5	41.1	40.8	40.4	40.1	40.1	40.1	40.1	40.1
19	78.5	58.5	54.3	52.1	50.4	49.2	48.2	47.3	46.5	45.9	45.6	45.3	45.0	44.7	44.4	44.1	43.8	43.8	43.8	43.8	43.8
20	76.6	59.9	56.4	54.5	53.2	52.2	51.3	50.5	49.9	49.4	49.1	48.8	48.6	48.3	48.1	47.8	47.6	47.6	47.6	47.6	47.6

Table 86. 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 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	28.6	20.3	16.1	12.9	10.6	8.6	6.8	5.4	4.2	3.5	2.9	2.3	1.7	1.2	0.6	0.0	0.0	0.0	0.0	0.0
1	67.0	28.6	20.3	16.1	12.9	10.6	8.6	6.8	5.4	4.2	3.5	2.9	2.3	1.7	1.2	0.6	0.0	0.0	0.0	0.0	0.0
2	67.0	28.6	20.3	16.1	12.9	10.6	8.6	6.8	5.4	4.2	3.5	2.9	2.3	1.7	1.2	0.6	0.0	0.0	0.0	0.0	0.0
3	67.0	28.6	20.3	16.1	12.9	10.6	8.6	6.8	5.4	4.2	3.5	2.9	2.3	1.7	1.2	0.6	0.0	0.0	0.0	0.0	0.0
4	67.0	28.6	20.3	16.1	12.9	10.6	8.6	6.8	5.4	4.2	3.5	2.9	2.3	1.7	1.2	0.6	0.0	0.0	0.0	0.0	0.0
5	67.0	28.6	20.3	16.1	12.9	10.6	8.6	6.8	5.4	4.2	3.5	2.9	2.3	1.7	1.2	0.6	0.0	0.0	0.0	0.0	0.0
6	67.0	28.6	20.3	16.1	12.9	10.6	8.6	6.8	5.4	4.2	3.5	2.9	2.3	1.7	1.2	0.6	0.0	0.0	0.0	0.0	0.0
7	67.0	28.6	20.3	16.1	12.9	10.6	8.6	6.8	5.4	4.2	3.5	2.9	2.3	1.7	1.2	0.6	0.0	0.0	0.0	0.0	0.0
8	67.0	28.6	20.3	16.1	12.9	10.6	8.6	6.8	5.4	4.2	3.5	2.9	2.3	1.7	1.2	0.6	0.0	0.0	0.0	0.0	0.0
9	67.0	28.6	20.3	16.1	12.9	10.6	8.6	6.8	5.4	4.2	3.5	2.9	2.3	1.7	1.2	0.6	0.0	0.0	0.0	0.0	0.0
10	67.0	28.7	20.4	16.3	13.1	10.8	8.7	7.0	5.6	4.4	3.7	3.1	2.5	1.9	1.4	0.8	0.2	0.2	0.2	0.2	0.2
11	67.0	29.1	21.0	16.8	13.7	11.4	9.4	7.7	6.2	5.1	4.4	3.8	3.2	2.7	2.1	1.5	0.9	0.9	0.9	0.9	0.9
12	67.0	30.8	23.0	19.0	16.0	13.8	11.9	10.2	8.9	7.8	7.1	6.6	6.0	5.5	4.9	4.4	3.8	3.8	3.8	3.8	3.8
13	67.0	34.1	27.1	23.5	20.8	18.8	17.0	15.5	14.3	13.3	12.7	12.2	11.7	11.2	10.7	10.2	9.7	9.7	9.7	9.7	9.7
14	67.0	38.7	32.6	29.5	27.2	25.5	24.0	22.7	21.6	20.8	20.2	19.8	19.4	19.0	18.5	18.1	17.7	17.7	17.7	17.7	17.7
15	67.0	42.8	37.5	34.9	32.9	31.4	30.1	29.0	28.1	27.4	26.9	26.6	26.2	25.8	25.5	25.1	24.7	24.7	24.7	24.7	24.7
16	67.0	45.9	41.3	39.0	37.2	36.0	34.9	33.9	33.1	32.5	32.1	31.7	31.4	31.1	30.8	30.5	30.1	30.1	30.1	30.1	30.1
17	67.0	48.6	44.6	42.6	41.1	40.0	39.0	38.2	37.5	36.9	36.6	36.3	36.0	35.7	35.5	35.2	34.9	34.9	34.9	34.9	34.9
18	67.0	51.6	48.2	46.5	45.3	44.3	43.5	42.8	42.2	41.8	41.5	41.2	41.0	40.8	40.5	40.3	40.1	40.1	40.1	40.1	40.1
19	67.0	53.7	50.8	49.3	48.2	47.4	46.7	46.1	45.6	45.2	45.0	44.8	44.6	44.4	44.2	44.0	43.8	43.8	43.8	43.8	43.8
20	67.0	55.9	53.5	52.2	51.3	50.6	50.1	49.5	49.1	48.8	48.6	48.4	48.2	48.1	47.9	47.7	47.6	47.6	47.6	47.6	47.6

Table 87. 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 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	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
1	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
2	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
3	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
4	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
5	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
6	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
7	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
8	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
9	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
10	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
11	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
12	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
13	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
14	100.0	85.3	75.8	67.6	61.3	56.2	51.4	47.2	43.7	40.7	38.5	36.4	34.4	32.5	30.9	29.7	28.5	27.2	26.0	24.8	23.6
15	100.0	86.3	77.5	69.9	64.0	59.3	54.9	50.9	47.7	44.9	42.8	40.8	39.0	37.3	35.8	34.6	33.5	32.4	31.2	30.1	28.9
16	100.0	87.1	78.7	71.5	66.0	61.5	57.3	53.6	50.6	47.9	45.9	44.1	42.4	40.7	39.3	38.2	37.2	36.1	35.0	33.9	32.8
17	100.0	87.5	79.5	72.5	67.1	62.8	58.8	55.2	52.2	49.7	47.8	46.0	44.3	42.7	41.4	40.3	39.3	38.2	37.2	36.1	35.1
18	100.0	88.7	81.4	75.1	70.3	66.4	62.7	59.5	56.8	54.5	52.8	51.2	49.7	48.2	47.0	46.1	45.1	44.2	43.2	42.3	41.3
19	100.0	89.9	83.4	77.7	73.4	69.9	66.7	63.8	61.4	59.3	57.7	56.3	55.0	53.6	52.6	51.7	50.9	50.0	49.2	48.4	47.5
20	100.0	90.5	84.3	79.0	74.9	71.6	68.6	65.9	63.6	61.7	60.2	58.8	57.6	56.3	55.3	54.5	53.7	52.9	52.1	51.3	50.6

Table 88. 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 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	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
1	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
2	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
3	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
4	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
5	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
6	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
7	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
8	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
9	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
10	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
11	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
12	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
13	100.0	85.0	75.3	66.9	60.5	55.3	50.4	46.2	42.6	39.5	37.2	35.1	33.1	31.1	29.5	28.3	27.0	25.8	24.5	23.3	22.0
14	99.3	84.6	75.1	66.9	60.6	55.5	50.8	46.6	43.1	40.1	37.8	35.7	33.8	31.8	30.3	29.0	27.8	26.6	25.4	24.1	22.9
15	97.1	83.4	74.6	66.9	61.0	56.3	51.9	48.0	44.8	42.0	39.9	37.9	36.1	34.3	32.9	31.7	30.6	29.4	28.3	27.1	26.0
16	95.4	82.5	74.2	66.9	61.4	56.9	52.7	49.1	46.0	43.4	41.4	39.5	37.8	36.1	34.7	33.6	32.6	31.5	30.4	29.3	28.3
17	94.5	82.0	73.9	66.9	61.6	57.2	53.2	49.7	46.7	44.1	42.2	40.4	38.8	37.2	35.8	34.8	33.7	32.7	31.6	30.6	29.6
18	91.8	80.5	73.3	66.9	62.1	58.2	54.6	51.3	48.6	46.3	44.6	43.0	41.5	40.0	38.8	37.9	36.9	36.0	35.0	34.1	33.2
19	89.2	79.1	72.6	66.9	62.6	59.1	55.9	53.0	50.6	48.5	47.0	45.5	44.2	42.9	41.8	40.9	40.1	39.2	38.4	37.6	36.7
20	87.9	78.4	72.3	66.9	62.9	59.6	56.5	53.8	51.5	49.6	48.1	46.8	45.5	44.3	43.2	42.4	41.6	40.9	40.1	39.3	38.5

Table 89. 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 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	56.9	50.5	44.8	40.5	37.0	33.8	30.9	28.5	26.5	24.9	23.5	22.2	20.9	19.8	18.9	18.1	17.3	16.4	15.6	14.7
1	67.0	56.9	50.5	44.8	40.5	37.0	33.8	30.9	28.5	26.5	24.9	23.5	22.2	20.9	19.8	18.9	18.1	17.3	16.4	15.6	14.7
2	67.0	56.9	50.5	44.8	40.5	37.0	33.8	30.9	28.5	26.5	24.9	23.5	22.2	20.9	19.8	18.9	18.1	17.3	16.4	15.6	14.7
3	67.0	56.9	50.5	44.8	40.5	37.0	33.8	30.9	28.5	26.5	24.9	23.5	22.2	20.9	19.8	18.9	18.1	17.3	16.4	15.6	14.7
4	67.0	56.9	50.5	44.8	40.5	37.0	33.8	30.9	28.5	26.5	24.9	23.5	22.2	20.9	19.8	18.9	18.1	17.3	16.4	15.6	14.7
5	67.0	56.9	50.5	44.8	40.5	37.0	33.8	30.9	28.5	26.5	24.9	23.5	22.2	20.9	19.8	18.9	18.1	17.3	16.4	15.6	14.7
6	67.0	56.9	50.5	44.8	40.5	37.0	33.8	30.9	28.5	26.5	24.9	23.5	22.2	20.9	19.8	18.9	18.1	17.3	16.4	15.6	14.7
7	67.0	56.9	50.5	44.8	40.5	37.0	33.8	30.9	28.5	26.5	24.9	23.5	22.2	20.9	19.8	18.9	18.1	17.3	16.4	15.6	14.7
8	67.0	56.9	50.5	44.8	40.5	37.0	33.8	30.9	28.5	26.5	24.9	23.5	22.2	20.9	19.8	18.9	18.1	17.3	16.4	15.6	14.7
9	67.0	56.9	50.5	44.8	40.5	37.0	33.8	30.9	28.5	26.5	24.9	23.5	22.2	20.9	19.8	18.9	18.1	17.3	16.4	15.6	14.7
10	67.0	56.9	50.5	44.8	40.5	37.0	33.8	30.9	28.5	26.5	24.9	23.5	22.2	20.9	19.8	18.9	18.1	17.3	16.4	15.6	14.7
11	67.0	56.9	50.5	44.8	40.5	37.0	33.8	30.9	28.5	26.5	24.9	23.5	22.2	20.9	19.8	18.9	18.1	17.3	16.4	15.6	14.7
12	67.0	56.9	50.5	44.8	40.5	37.0	33.8	30.9	28.5	26.5	24.9	23.5	22.2	20.9	19.8	18.9	18.1	17.3	16.4	15.6	14.7
13	67.0	56.9	50.5	44.8	40.5	37.0	33.8	30.9	28.5	26.5	24.9	23.5	22.2	20.9	19.8	18.9	18.1	17.3	16.4	15.6	14.7
14	67.0	57.1	50.8	45.3	41.0	37.6	34.5	31.6	29.3	27.3	25.8	24.4	23.1	21.8	20.7	19.9	19.1	18.3	17.4	16.6	15.8
15	67.0	57.8	51.9	46.8	42.9	39.7	36.8	34.1	32.0	30.1	28.7	27.4	26.2	25.0	24.0	23.2	22.5	21.7	20.9	20.2	19.4
16	67.0	58.3	52.8	47.9	44.2	41.2	38.4	35.9	33.9	32.1	30.8	29.5	28.4	27.3	26.3	25.6	24.9	24.2	23.5	22.7	22.0
17	67.0	58.6	53.2	48.6	45.0	42.1	39.4	37.0	35.0	33.3	32.0	30.8	29.7	28.6	27.7	27.0	26.3	25.6	24.9	24.2	23.5
18	67.0	59.4	54.6	50.3	47.1	44.5	42.0	39.9	38.1	36.5	35.4	34.3	33.3	32.3	31.5	30.9	30.2	29.6	29.0	28.3	27.7
19	67.0	60.2	55.9	52.1	49.2	46.8	44.7	42.7	41.1	39.7	38.7	37.7	36.8	35.9	35.2	34.7	34.1	33.5	33.0	32.4	31.8
20	67.0	60.6	56.5	52.9	50.2	48.0	46.0	44.1	42.6	41.3	40.3	39.4	38.6	37.7	37.1	36.5	36.0	35.5	34.9	34.4	33.9

Table 90. 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 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	59.4	39.4	26.0	16.3	10.5	6.7	4.5	2.8	1.9	1.1	0.7	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1	100.0	59.4	39.4	26.0	16.3	10.5	6.7	4.5	2.8	1.9	1.1	0.7	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
2	100.0	59.4	39.4	26.0	16.3	10.5	6.7	4.5	2.8	1.9	1.1	0.7	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
3	100.0	59.4	39.4	26.0	16.3	10.5	6.7	4.5	2.8	1.9	1.1	0.7	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
4	100.0	59.4	39.4	26.0	16.3	10.5	6.7	4.5	2.8	1.9	1.1	0.7	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
5	100.0	59.4	39.4	26.0	16.3	10.5	6.7	4.5	2.8	1.9	1.1	0.7	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
6	100.0	59.5	39.6	26.3	16.6	10.8	7.1	4.9	3.1	2.3	1.5	1.1	0.8	0.7	0.5	0.4	0.4	0.4	0.4	0.4	0.4
7	100.0	59.7	39.8	26.6	16.8	11.1	7.4	5.2	3.4	2.6	1.8	1.4	1.1	1.0	0.8	0.7	0.7	0.7	0.7	0.7	0.7
8	100.0	59.8	40.1	26.8	17.2	11.5	7.8	5.6	3.8	3.0	2.2	1.8	1.5	1.4	1.2	1.1	1.1	1.1	1.1	1.1	1.1
9	100.0	60.1	40.5	27.4	17.8	12.1	8.4	6.3	4.5	3.7	2.9	2.5	2.2	2.1	1.9	1.8	1.8	1.8	1.8	1.8	1.8
10	100.0	60.7	41.3	28.4	18.9	13.3	9.7	7.6	5.9	5.1	4.3	3.9	3.6	3.5	3.3	3.2	3.2	3.2	3.2	3.2	3.2
11	100.0	62.1	43.5	31.1	21.9	16.6	13.1	11.0	9.4	8.6	7.8	7.4	7.2	7.1	6.9	6.8	6.8	6.8	6.8	6.8	6.8
12	100.0	64.8	47.5	35.9	27.4	22.4	19.2	17.2	15.7	15.0	14.3	13.9	13.7	13.5	13.4	13.3	13.3	13.3	13.3	13.3	13.3
13	100.0	69.1	53.9	43.8	36.4	32.0	29.1	27.5	26.1	25.5	24.8	24.5	24.3	24.2	24.1	24.0	24.0	24.0	24.0	24.0	24.0
14	100.0	72.5	59.0	49.9	43.3	39.4	36.9	35.4	34.2	33.6	33.0	32.8	32.6	32.5	32.4	32.3	32.3	32.3	32.3	32.3	32.3
15	100.0	74.4	61.8	53.3	47.2	43.5	41.2	39.8	38.6	38.1	37.6	37.3	37.2	37.1	37.0	36.9	36.9	36.9	36.9	36.9	36.9
16	100.0	78.0	67.2	60.0	54.7	51.6	49.6	48.4	47.4	46.9	46.5	46.3	46.1	46.0	46.0	45.9	45.9	45.9	45.9	45.9	45.9
17	100.0	81.3	72.2	66.0	61.6	58.9	57.2	56.2	55.4	55.0	54.6	54.4	54.3	54.2	54.2	54.1	54.1	54.1	54.1	54.1	54.1
18	100.0	84.7	77.2	72.2	68.5	66.3	64.9	64.1	63.4	63.1	62.8	62.7	62.6	62.5	62.5	62.4	62.4	62.4	62.4	62.4	62.4
19	100.0	86.6	80.0	75.6	72.4	70.5	69.2	68.5	67.9	67.6	67.4	67.2	67.1	67.1	67.0	67.0	67.0	67.0	67.0	67.0	67.0
20	100.0	88.5	82.8	79.1	76.3	74.7	73.6	73.0	72.5	72.2	72.0	71.9	71.8	71.8	71.7	71.7	71.7	71.7	71.7	71.7	71.7

Table 91. 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 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	59.4	39.4	26.0	16.3	10.5	6.7	4.5	2.8	1.9	1.1	0.7	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1	100.0	59.4	39.4	26.0	16.3	10.5	6.7	4.5	2.8	1.9	1.1	0.7	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
2	100.0	59.4	39.4	26.0	16.3	10.5	6.7	4.5	2.8	1.9	1.1	0.7	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
3	100.0	59.4	39.4	26.0	16.3	10.5	6.7	4.5	2.8	1.9	1.1	0.7	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
4	100.0	59.4	39.4	26.0	16.3	10.5	6.7	4.5	2.8	1.9	1.1	0.7	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
5	100.0	59.4	39.4	26.0	16.3	10.5	6.7	4.5	2.8	1.9	1.1	0.7	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
6	99.9	59.4	39.5	26.2	16.5	10.7	7.0	4.8	3.0	2.2	1.4	1.0	0.7	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.3
7	99.8	59.4	39.6	26.3	16.6	10.9	7.2	5.0	3.2	2.4	1.6	1.2	0.9	0.7	0.6	0.5	0.5	0.5	0.5	0.5	0.5
8	99.6	59.5	39.7	26.5	16.8	11.1	7.4	5.2	3.5	2.6	1.8	1.4	1.1	1.0	0.9	0.7	0.7	0.7	0.7	0.7	0.7
9	99.4	59.5	39.9	26.8	17.2	11.5	7.8	5.7	3.9	3.1	2.3	1.9	1.6	1.5	1.3	1.2	1.2	1.2	1.2	1.2	1.2
10	98.9	59.6	40.3	27.3	17.9	12.3	8.7	6.5	4.8	4.0	3.2	2.8	2.5	2.4	2.3	2.1	2.1	2.1	2.1	2.1	2.1
11	97.8	59.9	41.3	28.8	19.7	14.3	10.8	8.8	7.1	6.4	5.6	5.2	4.9	4.8	4.7	4.6	4.6	4.6	4.6	4.6	4.6
12	95.6	60.4	43.1	31.5	23.0	18.0	14.8	12.9	11.3	10.6	9.9	9.5	9.3	9.1	9.0	8.9	8.9	8.9	8.9	8.9	8.9
13	92.1	61.2	46.0	35.9	28.4	24.0	21.2	19.5	18.2	17.5	16.9	16.6	16.4	16.3	16.2	16.1	16.1	16.1	16.1	16.1	16.1
14	89.3	61.8	48.3	39.3	32.6	28.7	26.2	24.7	23.5	22.9	22.4	22.1	21.9	21.8	21.7	21.6	21.6	21.6	21.6	21.6	21.6
15	87.8	62.2	49.6	41.2	35.0	31.3	29.0	27.6	26.5	25.9	25.4	25.2	25.0	24.9	24.8	24.7	24.7	24.7	24.7	24.7	24.7
16	84.9	62.9	52.1	44.8	39.5	36.4	34.4	33.2	32.2	31.8	31.3	31.1	31.0	30.9	30.8	30.8	30.8	30.8	30.8	30.8	30.8
17	82.1	63.5	54.3	48.2	43.7	41.1	39.3	38.3	37.5	37.1	36.8	36.6	36.4	36.4	36.3	36.2	36.2	36.2	36.2	36.2	36.2
18	79.4	64.1	56.6	51.6	47.9	45.7	44.3	43.5	42.8	42.5	42.2	42.1	42.0	41.9	41.9	41.8	41.8	41.8	41.8	41.8	41.8
19	77.9	64.5	57.9	53.5	50.3	48.3	47.1	46.4	45.8	45.5	45.3	45.1	45.0	45.0	44.9	44.9	44.9	44.9	44.9	44.9	44.9
20	76.3	64.8	59.2	55.4	52.6	51.0	49.9	49.3	48.8	48.6	48.4	48.2	48.2	48.1	48.1	48.0	48.0	48.0	48.0	48.0	48.0

Table 92. 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 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	39.8	26.4	17.4	10.9	7.0	4.5	3.0	1.8	1.3	0.7	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1	67.0	39.8	26.4	17.4	10.9	7.0	4.5	3.0	1.8	1.3	0.7	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
2	67.0	39.8	26.4	17.4	10.9	7.0	4.5	3.0	1.8	1.3	0.7	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
3	67.0	39.8	26.4	17.4	10.9	7.0	4.5	3.0	1.8	1.3	0.7	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
4	67.0	39.8	26.4	17.4	10.9	7.0	4.5	3.0	1.8	1.3	0.7	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
5	67.0	39.8	26.4	17.4	10.9	7.0	4.5	3.0	1.8	1.3	0.7	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
6	67.0	39.9	26.6	17.6	11.1	7.3	4.8	3.3	2.1	1.6	1.0	0.7	0.5	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.3
7	67.0	40.0	26.7	17.8	11.3	7.4	5.0	3.5	2.3	1.8	1.2	0.9	0.7	0.7	0.6	0.5	0.5	0.5	0.5	0.5	0.5
8	67.0	40.1	26.8	18.0	11.5	7.7	5.2	3.7	2.6	2.0	1.5	1.2	1.0	0.9	0.8	0.7	0.7	0.7	0.7	0.7	0.7
9	67.0	40.3	27.1	18.3	11.9	8.1	5.6	4.2	3.0	2.5	1.9	1.7	1.5	1.4	1.3	1.2	1.2	1.2	1.2	1.2	1.2
10	67.0	40.6	27.7	19.0	12.7	8.9	6.5	5.1	3.9	3.4	2.9	2.6	2.4	2.3	2.2	2.1	2.1	2.1	2.1	2.1	2.1
11	67.0	41.6	29.2	20.8	14.7	11.1	8.8	7.4	6.3	5.8	5.2	5.0	4.8	4.7	4.6	4.6	4.6	4.6	4.6	4.6	4.6
12	67.0	43.4	31.8	24.0	18.4	15.0	12.8	11.6	10.5	10.0	9.6	9.3	9.2	9.1	9.0	8.9	8.9	8.9	8.9	8.9	8.9
13	67.0	46.3	36.1	29.3	24.4	21.4	19.5	18.4	17.5	17.1	16.6	16.4	16.3	16.2	16.2	16.1	16.1	16.1	16.1	16.1	16.1
14	67.0	48.6	39.5	33.4	29.0	26.4	24.7	23.7	22.9	22.5	22.1	22.0	21.8	21.8	21.7	21.6	21.6	21.6	21.6	21.6	21.6
15	67.0	49.8	41.4	35.7	31.6	29.1	27.6	26.6	25.9	25.5	25.2	25.0	24.9	24.8	24.8	24.7	24.7	24.7	24.7	24.7	24.7
16	67.0	52.3	45.0	40.2	36.6	34.5	33.2	32.4	31.8	31.5	31.2	31.0	30.9	30.9	30.8	30.8	30.8	30.8	30.8	30.8	30.8
17	67.0	54.5	48.4	44.3	41.2	39.5	38.3	37.6	37.1	36.8	36.6	36.5	36.4	36.3	36.3	36.2	36.2	36.2	36.2	36.2	36.2
18	67.0	56.8	51.7	48.4	45.9	44.4	43.5	43.0	42.5	42.3	42.1	42.0	41.9	41.9	41.8	41.8	41.8	41.8	41.8	41.8	41.8
19	67.0	58.0	53.6	50.6	48.5	47.2	46.4	45.9	45.5	45.3	45.1	45.0	45.0	45.0	44.9	44.9	44.9	44.9	44.9	44.9	44.9
20	67.0	59.3	55.5	53.0	51.1	50.0	49.3	48.9	48.6	48.4	48.2	48.2	48.1	48.1	48.1	48.0	48.0	48.0	48.0	48.0	48.0

Table 93. Estimates of fishing mortality (F), yield-per-recruit (YPR), spawning potential ratio (SPR), F0.1 and Fmax as a function of total allowable catch (TAC), release mortality and minimum size assuming pre-regulation (worst case) and post-regulaton (best case) gear selectivities.

RELEASE MORTALITY = 0%

Minimum Size = None

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.02	0.32	91.0	2	0.02	0.32	90.9
	4	0.04	0.67	80.1	4	0.04	0.67	81.4
	6	0.07	1.02	67.7	6	0.07	1.02	70.3
	8	0.12	1.36	51.9	8	0.12	1.36	56.7
	10	----	----	----	10	----	----	34.4
F0.1	8.9	0.16	1.52	41.3	8.9	0.16	1.52	41.3
Fmax	9.4	0.26	1.62	26.2	9.4	0.26	1.62	26.2

Minimum Size = 16"

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.02	0.33	91.3	2	0.02	0.34	91.7
	4	0.04	0.68	81.4	4	0.04	0.67	83.0
	6	0.06	1.02	70.2	6	0.07	1.02	72.9
	8	0.11	1.36	56.5	8	0.12	1.37	61.1
	10	0.23	1.71	33.4	10	0.21	1.71	45.7
F0.1	10.2	0.17	1.62	41.8	10.3	0.23	1.76	42.5
Fmax	10.9	0.30	1.74	25.4	11.2	0.45	1.91	24.4

Minimum Size = 18"

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.02	0.33	92.7	2	0.02	0.33	92.2
	4	0.04	0.68	84.3	4	0.04	0.67	83.6
	6	0.06	1.02	75.1	6	0.08	1.02	74.0
	8	0.10	1.36	64.7	8	0.12	1.37	62.7
	10	0.16	1.71	51.3	10	0.21	1.71	48.6
F0.1	10.0	0.18	1.72	43.1	10.5	0.25	1.80	43.4
Fmax	10.8	0.33	1.86	25.2	11.5	0.50	1.97	24.7

Minimum Size = 20"

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.02	0.33	92.7	2	0.02	0.34	92.6
	4	0.04	0.68	84.3	4	0.05	0.67	84.7
	6	0.06	1.02	75.1	6	0.08	1.02	75.8
	8	0.10	1.36	64.7	8	0.13	1.36	65.8
	10	0.16	1.71	51.3	10	0.20	1.71	53.4
F0.1	10.6	0.20	1.83	45.6	10.9	0.27	1.87	45.7
Fmax	11.7	0.44	2.01	25.9	12.1	0.63	2.07	25.6

Table 94. Estimates of fishing mortality (F), yield-per-recruit (YPR), spawning potential ratio (SPR), F0.1 and Fmax as a function of total allowable catch (TAC), release mortality and minimum size assuming pre-regulation (worst case) and post-regulaton (best case) gear selectivities.

RELEASE MORTALITY = 33%

Minimum Size = None

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.02	0.32	91.0	2	0.02	0.32	90.9
	4	0.04	0.67	80.1	4	0.04	0.67	81.4
	6	0.07	1.02	67.7	6	0.07	1.02	70.3
	8	0.12	1.36	51.9	8	0.12	1.36	56.7
	10	----	----	----	10	----	----	34.4
F0.1	9.1	0.16	1.55	42.2	10.2	0.23	1.74	42.6
Fmax	9.7	0.27	1.66	26.8	11.0	0.44	1.89	24.9

Minimum Size = 16"

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.02	0.33	91.1	2	0.02	0.34	91.7
	4	0.04	0.67	80.9	4	0.04	0.68	82.5
	6	0.06	1.02	69.1	6	0.08	1.02	72.4
	8	0.11	1.36	54.1	8	0.12	1.37	60.6
	10	----	----	----	10	0.21	1.71	44.6
F0.1	9.1	0.16	1.55	42.2	10.2	0.23	1.74	42.6
Fmax	9.7	0.27	1.66	26.8	11.0	0.44	1.89	24.9

Minimum Size = 18"

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.01	0.32	91.5	2	0.02	0.33	92.0
	4	0.03	0.68	81.1	4	0.04	0.68	82.8
	6	0.06	1.02	70.0	6	0.08	1.02	73.0
	8	0.11	1.37	55.4	8	0.13	1.36	61.2
	10	----	----	----	10	0.22	1.71	45.2
F0.1	9.1	0.16	1.56	43.8	10.1	0.23	1.73	43.8
Fmax	9.7	0.26	1.66	28.7	10.9	0.44	1.87	26.6

Minimum Size = 20"

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.02	0.33	91.7	2	0.02	0.33	92.1
	4	0.04	0.68	81.8	4	0.05	0.68	83.3
	6	0.07	1.02	70.6	6	0.08	1.02	73.5
	8	0.12	1.37	56.2	8	0.14	1.37	61.6
	10	----	----	----	10	0.25	1.71	44.8
F0.1	8.9	0.16	1.52	46.7	9.8	0.24	1.69	46.4
Fmax	9.4	0.26	1.62	32.4	10.6	0.43	1.82	30.4

Table 95. Estimates of fishing mortality (F), yield-per-recruit (YPR), spawning potential ratio (SPR), F0.1 and Fmax as a function of total allowable catch (TAC), release mortality and minimum size assuming pre-regulation (worst case) and post-regulaton (best case) gear selectivities.

RELEASE MORTALITY = 50%

Minimum Size = None

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.02	0.32	91.0	2	0.02	0.32	90.9
	4	0.04	0.67	80.1	4	0.04	0.67	81.4
	6	0.07	1.02	67.7	6	0.07	1.02	70.3
	8	0.12	1.36	51.9	8	0.12	1.36	56.7
	10	----	----	----	10	----	----	34.4
F0.1	9.6	0.16	1.54	41.4	11.1	0.16	1.54	41.4
Fmax	10.2	0.26	1.63	26.6	12.1	0.26	1.63	26.6

Minimum Size = 16"

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.02	0.33	91.0	2	0.02	0.34	91.6
	4	0.04	0.67	80.6	4	0.04	0.68	82.5
	6	0.06	1.02	68.3	6	0.08	1.02	72.3
	8	0.11	1.37	52.7	8	0.12	1.36	60.4
	10	----	----	----	10	0.22	1.71	44.0
F0.1	8.9	0.16	1.52	42.4	10.1	0.23	1.73	42.6
Fmax	9.5	0.26	1.62	27.4	10.9	0.43	1.87	25.1

Minimum Size = 18"

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.01	0.32	91.3	2	0.02	0.33	91.8
	4	0.03	0.68	80.6	4	0.04	0.68	82.6
	6	0.06	1.02	68.4	6	0.08	1.02	72.4
	8	0.11	1.37	52.6	8	0.13	1.36	60.3
	10	----	----	----	10	0.23	1.71	43.1
F0.1	8.7	0.15	1.49	44.1	9.9	0.23	1.70	43.9
Fmax	9.2	0.24	1.58	29.8	10.7	0.42	1.83	27.3

Minimum Size = 20"

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.02	0.32	91.2	2	0.02	0.33	91.9
	4	0.04	0.67	80.8	4	0.05	0.67	82.8
	6	0.07	1.02	67.9	6	0.08	1.02	72.1
	8	0.13	1.37	50.4	8	0.14	1.36	59.5
	10	----	----	----	10	0.32	1.71	36.4
F0.1	8.2	0.15	1.41	47.1	9.3	0.22	1.61	46.7
Fmax	8.7	0.23	1.49	33.8	10.0	0.39	1.72	31.7

Table 96. Estimates of fishing mortality (F), yield-per-recruit (YPR), spawning potential ratio (SPR), F0.1 and Fmax as a function of total allowable catch (TAC), release mortality and minimum size assuming pre-regulation (worst case) and post-regulaton (best case) gear selectivities.

RELEASE MORTALITY = 60%

Minimum Size = None

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.02	0.32	91.0	2	0.02	0.32	90.9
	4	0.04	0.67	80.1	4	0.04	0.67	81.4
	6	0.07	1.02	67.7	6	0.07	1.02	70.3
	8	0.12	1.36	51.9	8	0.12	1.36	56.7
	10	----	----	----	10	----	----	34.4
F0.1	9.6	0.16	1.54	41.4	11.1	0.16	1.54	41.4
Fmax	10.2	0.26	1.63	26.6	12.1	0.26	1.63	26.6

Minimum Size = 16"

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.02	0.33	90.9	2	0.02	0.34	91.6
	4	0.04	0.68	80.0	4	0.04	0.68	82.4
	6	0.06	1.02	68.0	6	0.08	1.02	72.2
	8	0.12	1.37	51.9	8	0.12	1.37	60.61
	10	----	----	----	10	0.22	1.71	43.7
F0.1	8.8	0.16	1.51	42.4	10.0	0.23	1.73	42.6
Fmax	9.3	0.25	1.60	27.7	10.9	0.43	1.86	25.3

Minimum Size = 18"

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.01	0.32	91.1	2	0.02	0.33	91.8
	4	0.03	0.67	80.2	4	0.04	0.68	82.5
	6	0.06	1.02	67.8	6	0.08	1.02	72.2
	8	0.12	1.37	50.8	8	0.13	1.36	59.8
	10	----	----	----	10	0.24	1.71	41.6
F0.1	8.5	0.14	1.45	44.3	9.8	0.22	1.68	44.1
Fmax	9.0	0.23	1.54	30.4	10.5	0.40	1.80	27.7

Minimum Size = 20"

	Worst				Best			
	TAC	F	YPR	SPR	TAC	F	YPR	SPR
	2	0.02	0.32	91.0	2	0.02	0.33	91.7
	4	0.04	0.68	79.7	4	0.05	0.68	82.1
	6	0.07	1.02	66.6	6	0.08	1.02	71.4
	8	0.15	1.37	45.5	8	0.14	1.36	58.1
	10	----	----	----	10	----	----	----
F0.1	7.8	0.14	1.35	47.2	9.1	0.22	1.57	46.8
Fmax	8.3	0.21	1.42	34.4	9.8	0.36	1.67	32.3

Table 97. Estimated levels of fishing mortality and discards for several combinations of minimium size, TAC and release mortality rates assuming that undersized fish are exposed to capture at rates equal to the 1986-1989 mean age specific selectivities.

RELEASE MORTALITY = 0%

	MINIMUM SIZE					
	16 in		18 in		20 in	
TAC	F	Disc	F	Disc	F	Disc
2	0.070	0.00	0.072	0.00	0.087	0.00
4	0.144	0.00	0.148	0.00	0.180	0.00
6	0.224	0.00	0.230	0.00	0.281	0.00
8	0.309	0.00	0.318	0.00	0.391	0.00
10	0.401	0.00	0.413	0.00	0.510	0.00

RELEASE MORTALITY = 33%

	MINIMUM SIZE					
	16 in		18 in		20 in	
TAC	F	Disc	F	Disc	F	Disc
2	0.070	0.04	0.072	0.12	0.087	0.29
4	0.145	0.08	0.148	0.24	0.181	0.58
6	0.224	0.13	0.231	0.36	0.284	0.88
8	0.310	0.17	0.320	0.49	0.396	1.19
10	0.403	0.22	0.416	0.62	0.520	1.52

RELEASE MORTALITY = 50%

	MINIMUM SIZE					
	16 in		18 in		20 in	
TAC	F	Disc	F	Disc	F	Disc
2	0.070	0.06	0.072	0.18	0.087	0.43
4	0.145	0.13	0.148	0.36	0.182	0.88
6	0.224	0.19	0.231	0.55	0.285	1.33
8	0.310	0.26	0.321	0.74	0.399	1.79
10	0.403	0.32	0.418	0.93	0.524	2.26

RELEASE MORTALITY = 60%

	MINIMUM SIZE					
	16 in		18 in		20 in	
TAC	F	Disc	F	Disc	F	Disc
2	0.070	0.08	0.072	0.22	0.087	0.52
4	0.145	0.15	0.149	0.43	0.182	1.05
6	0.225	0.23	0.231	0.66	0.286	1.58
8	0.311	0.31	0.321	0.88	0.400	2.13
10	0.404	0.39	0.419	1.11	0.527	2.68

Table 98. Estimated levels of fishing mortality and discards for several combinations of minimium size, TAC and release mortality rates assuming that undersized fish are exposed to capture at rates estimated for the 1992 mean age specific selectivities for harvested fish corrected for proportions of legal size by age.

RELEASE MORTALITY = 0%

	MINIMUM SIZE					
	16 in		18 in		20 in	
TAC	F	Disc	F	Disc	F	Disc
2	0.091	0.00	0.098	0.00	0.116	0.00
4	0.189	0.00	0.204	0.00	0.241	0.00
6	0.295	0.00	0.317	0.00	0.377	0.00
8	0.408	0.00	0.440	0.00	0.525	0.00
10	0.532	0.00	0.575	0.00	0.688	0.00

RELEASE MORTALITY = 33%

	MINIMUM SIZE					
	16 in		18 in		20 in	
TAC	F	Disc	F	Disc	F	Disc
2	0.092	0.02	0.098	0.07	0.116	0.20
4	0.190	0.04	0.204	0.14	0.242	0.41
6	0.295	0.06	0.318	0.21	0.380	0.62
8	0.409	0.08	0.442	0.29	0.531	0.84
10	0.533	0.10	0.578	0.36	0.699	1.06

RELEASE MORTALITY = 50%

	MINIMUM SIZE					
	16 in		18 in		20 in	
TAC	F	Disc	F	Disc	F	Disc
2	0.092	0.03	0.099	0.11	0.116	0.30
4	0.190	0.06	0.204	0.22	0.243	0.61
6	0.295	0.09	0.319	0.32	0.381	0.93
8	0.409	0.12	0.443	0.44	0.534	1.25
10	0.533	0.15	0.580	0.55	0.704	1.59

RELEASE MORTALITY = 60%

	MINIMUM SIZE					
	16 in		18 in		20 in	
TAC	F	Disc	F	Disc	F	Disc
2	0.092	0.04	0.099	0.13	0.116	0.36
4	0.190	0.07	0.205	0.26	0.243	0.73
6	0.295	0.11	0.319	0.39	0.382	1.11
8	0.409	0.15	0.444	0.52	0.536	1.50
10	0.534	0.19	0.581	0.66	0.708	1.89