7/6/04

FINAL AMENDMENT 22

TO THE

REEF FISH FISHERY MANAGEMENT PLAN

TO SET RED SNAPPER SUSTAINABLE FISHERIES ACT TARGETS AND THRESHOLDS, SET A REBUILDING PLAN, AND ESTABLISH BYCATCH REPORTING METHODOLOGIES FOR THE REEF FISH FISHERY

(Includes Final Supplemental Environmental Impact Statement and Regulatory Impact Review)

MAY 2004

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List of Acronyms

ABC	Acceptable (or Allowable) biological catch
ASAP	Age-structured assessment program
B_{CURR}	Current stock biomass
B_{MSY}	Stock biomass capable of producing maximum sustainable yield
BRD	Bycatch reduction device
CDP	Census-designated place
CEQ	Council on Environmental Quality
CFLP	Coastal Fisheries Logbook Program
Council	Gulf of Mexico Fishery Management Council
CPUE	Catch-per-unit-effort
EA	Environmental Assessment
EEZ	Exclusive economic zone
EFH	Essential fish habitat
EIS	Environmental Impact Statement
— DEIS	Draft Environmental Impact Statement
— FEIS	Final Environmental Impact Statement
— SEIS	Supplemental Environmental Impact Statement
F	Rate of instantaneous fishing mortality, a measure of the rate at which fish are removed from the population by fishing.
— F_{MSY}	F that can sustain maximum sustainable yield
— F_{OY}	F that can produce optimum yield
— F_{CURR}	Current F
— $F_{20\%SPR}$	F that can sustain a population at 20 percent SPR
FAS	Fishery acoustic system
FIS	Fishery Impact Statement

FL	Fork length
FMP	Fishery Management Plan
FMRI	Florida Marine Research Institute
FSAP	Ad Hoc Finfish Stock Assessment Panel
FTEV	Full time equivalent vessel
GBFSM	General Bioeconomic Simulation Model
GMFMC	Gulf of Mexico Fishery Management Council
GOM	Gulf of Mexico
GSMFC	Gulf States Marine Fisheries Commission
HMS	Highly migratory species
HPUE	Harvest per unit effort
IFQ	Individual fishing quota
IRFA	Initial Regulatory Flexibility Analysis
ITQ	Individual transferable quota
M	Rate of Instantaneous Natural Mortality
MFMT	Maximum fishing mortality threshold
MGF	Multispecies Groundfish Fishery
MOU	Memorandum of understanding
mp	Million pounds
MRFSS	Marine Recreational Fisheries Statistical Survey
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSST	Minimum stock size threshold
MSY	Maximum sustainable yield
NEPA	National Environmental Policy Act
NOAA Fisheries	National Marine Fisheries Service Fisheries
NOS	National Ocean Service

NRC	Natural Resource Community
NSG	National Standard Guidelines
NWGB	National Working Group on Bycatch
OY	Optimum yield
Plan	Reef Fish FMP for the Gulf of Mexico
PBR	Potential biological removal
PPI	Producer Price Index
RA	Regional Administrator (NOAA Fisheries Southeast Regional Office) (formerly Regional Director)
RFA	Regulatory Flexibility Act
RFSAP	Reef Fish Stock Assessment Panel
RIR	Regulatory Impact Review
SBA	Small Business Administration
SEAMAP	Southeast Area Monitoring and Assessment Program
SEFC or SEFSC	Southeast Fisheries Science Center
SEP	Socio-economic Panel
SERO	Southeast Regional Office
SIA	Social Impact Assessment
SFA	Sustainable Fisheries Act
SMZ	Special management zone
SPR	Spawning potential ratio
SRD	Southeast Science and Research Director
SSBR	Spawning stock biomass ratio (an older term for SPR)
SSB	Spawning stock biomass
TAC	Total allowable catch
TED	Turtle excluder device

TL	Total length
Y	Yield
VPA	Virtual population analysis
USCG	United States Coast Guard

Supplemental Environmental Impact Statement Cover Sheet

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Name of Action

Final Draft for Amendment 22 to the Reef Fish Fishery Management Plan to Set Red Snapper Sustainable Fisheries Act Targets and Thresholds and to Set a Rebuilding Plan

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Type of Action

(X) Administrative
( ) Legislative
() Draft
(X) Final

Summary

In May 2001, the Council submitted to NOAA Fisheries a regulatory amendment for the Reef Fish FMP to set a red snapper rebuilding plan through 2032. The plan used as its basis the rebuilding plans provided in Powers et al. (2000). However, in July 2002, NOAA Fisheries determined that the regulatory amendment would have a reasonably foreseeable significant adverse effect on the shrimp and (potentially) the directed red snapper fisheries. Therefore, NOAA Fisheries recommended that the Council develop a supplemental environmental impact statement (SEIS) that analyzes current and additional rebuilding alternatives in greater detail. Based on guidance from the NOAA Southeast Office of General Counsel, it was suggested that red snapper SFA criteria and the rebuilding plan would best be addressed in an amendment to the Reef Fish FMP rather than using a regulatory amendment. Additionally, the MSFCMA requires that fishery management plans establish a standardized methodology to assess the amount and type of bycatch occurring in the fishery, and to identify and implement conservation measures that, to the extent practicable, minimize bycatch. Therefore, the purpose of this amendment is:

- To review, and redefine as needed, biological reference points and status determination criteria
- To establish a rebuilding schedule and plan that is consistent with current fishery management standards
- To establish a standardized methodology to collect bycatch information in the fishery, and
- To evaluate the practicability of additional measures to reduce bycatch and bycatch mortality in the fishery.

Filing Dates with EPA

DSEIS filed with EPA on: 1/23/04 (69 FR 4512)
DSEIS comment period end: 3/15/04

Public comments on DSEIS are provided in Section 13.6

Table of Contents for FSEIS

Much of the material in this document is used for both Amendment 22 to the Reef Fish Fishery Management Plan and the FSEIS. The table of contents and sections that comprise the FSEIS are as follows:

Fishery Impact Statement/Social Impact Assessment Summary

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This table of contents and summary of social and economic impacts on fishery participants and communities are provided to aid the reader in reviewing fishery and social impacts by referencing corresponding sections of the amendment that are inclusive of the Fishery Impact Statement (FIS) and the Social Impact Analysis (SIA).

Summary

Biological reference points and status criteria, such as maximum sustainable yield (MSY), minimum stock size threshold (MSST), and maximum fishing mortality threshold (MFMT) are mainly biological in nature but have relevance to the determination of impacts on fishing participants to the extent that they provide the general benchmark for regulatory measures. Regulatory measures that flow from the choice of these parameters are the ones that have immediate impacts on fishing participants. The determination of optimum yield (OY) is considers the biological and socioeconomic conditions that will assure the sustainability of the stock and fishery. The general impacts of these alternatives would become an important issue at such time when the red snapper stock is fully rebuilt, since OY represents the long-term management goal.

The economic issue involved in a rebuilding strategy may be characterized in general as a tradeoff in value of catches over time. A larger harvest now would yield greater commercial and recreational benefits in the short term, but at the expense of a slower stock recovery. Conversely, a smaller harvest now would generate fewer short-term benefits, but likely would also lead to a faster realization of the benefits of a larger red snapper resource in the future made possible by a faster recovery of the fish stock. However, red snapper rebuilding is less dependent on harvest rates in the directed fishery, and driven by the amount of bycatch reduction of juvenile red snapper achieved by the shrimp fishery. Projected estimates of reduction in bycatch are considered sufficient to rebuild red snapper and are obtained through the use of bycatch reduction devices (BRDs) and decreases in shrimp effort resulting from changing economic circumstances in the shrimp fishery.

Since the early 1990's, the Council has adopted an explicit TAC for red snapper and allocated 51 percent of TAC to the commercial sector and 49 percent to the recreational sector. Since 1990, the commercial sector's allocation has been considered a quota subjecting the commercial sector to quota closures. Although the recreational allocation has been considered a quota since 1997, the recreational sector is currently subject to fixed seasonal closures instead of quota closures. The fixed seasonal closure has been so designed as to control the recreational sector to its allocation. The analysis of the various rebuilding scenarios is conducted with the assumption that a hard TAC is adopted, the current commercial/recreational allocation is maintained, and quota closures are imposed on both sectors.

Among the rebuilding strategies, the highest and lowest net present values are associated with Alternative 4 and Alternative 3, respectively. Both constant catch alternatives [Alternative 2 (preferred) and Alternative 3] yield lower net present values than the constant F alternatives. From an economics standpoint then, a constant F strategy is preferable to a constant catch strategy. Between the two constant catch alternatives (Alternative 2 and 3), the difference in their associated net present values is significantly wide, $2.18 million vs. $6.10 million in the first 5 years under a 30 percent shrimp effort reduction, and $1.75 million vs. $6.10 million under a 50 percent shrimp effort reduction. Over the entire period of analysis, these figures increase to $13.96 million vs. $26.48 million and $28.27 million vs. $40.97 million, respectively. Yet, the two scenarios differ by only 1 to 3 years in terms of achieving the target biomass. One clear conclusion that can be derived from this situation is that, at least with respect to the commercial sector, Alternative 2 is preferable to Alternative 3, regardless of the reduction in shrimp effort, when considering both the economics and biology of the red snapper fishery.

Between the two constant F strategies, the difference in their associated net present values is relatively wide for the first years of the rebuilding plan, $2.35 million or $2.46 million vs. $6.10 million. Over the entire analysis period, the difference in net present values narrows, $43.71 million vs. $47.58 million, or $60.70 million vs. $63.50 million. The target biomass is reached by both alternatives at the same time under the assumption of a 50 percent shrimp effort reduction, but is not achieved at all by 2044 under a lower shrimp effort reduction. Considering both the economics and biology of the red snapper fishery, the two constant F alternatives may be considered about equal over the long-run. But in the first few years of the rebuilding plan, Alternative 4 provides for higher benefits than Alternative 5. Thus, considering both short run and long run, Alternative 4 may be considered superior to Alternative 5. It should be reiterated, however, that neither alternative achieves the target biomass under a lower shrimp effort reduction.

The recreational model recognizes three fishing modes – private/rental, charter boats, and headboats. There are two types of net benefits estimated for the recreational sector: (1) consumer surplus to the recreational anglers, and (2) net revenues to the for-hire fishery which is composed of charter boats and headboats. Consumer surplus may be generally described as the excess of benefits derived from red snapper fishing over what anglers pay for the trip.

Among the rebuilding strategies, the highest and lowest net present values are associated with Alternative 4 and Alternative 3, respectively. This result can be stated with certainty even absent full information on Alternative 3 under 50 percent shrimp effort reduction, as discussed above. This conclusion may be drawn from examination of the results under 50 percent shrimp effort reduction for both Alternative 2 and Alternative 3. Although the severe harvest reduction under Alternative 3 (6 mp TAC) is predicted to result in faster stock recovery, the net effect is only a difference of one year, 2029 as opposed to 2030 under Alternative 2 (9.12 mp TAC). Further, in 2030, the allowable TACs for the two scenarios differ by less than 2 percent and, over the remaining period of analysis (through 2053), Alternative 3 supports less than 5 percent total harvest more than under Alternative 2. Thus, assuming Alternative 3 were credited for 105 percent of the value achieved under Alternative 2 during each of the comparable periods, which is excessive considering most of the fourth period (2024-2033) would be prosecuted under the original lower TACs, the latter period gains under Alternative 3 are still insufficient to compensate for the losses, relative to Alternative 2 from the reduced harvests during the earlier years. Hence, it can be concluded that Alternative 2 out performs Alternative 3 economically.

Between the two constant F strategies, the difference in their associated net present values is relatively wide in percentage terms in the early years in terms of net revenues to the for-hire vessels. Over the entire analysis period, the difference narrows for net revenues and for consumer surplus, however the results under Alternative 4 are still superior to those under Alternative 5. Thus, considering both short run and long run, Alternative 4 may be considered superior to Alternative 5. It should be reiterated, however, that neither alternative achieves the target biomass under a lower shrimp effort reduction.

This amendment contains alternatives for improving bycatch reporting methodologies for the commercial and for-hire recreational fisheries, and the private recreational fishery. For the commercial and for-hire recreational fisheries, the effects of each bycatch reporting alternative, other than the no action alternative, are more in the nature of imposing costs on fishing participants. Electronic or paper logbook reporting (Alternatives 2, 3, and 5) imposes additional reporting burden on fishing participants as well as additional cost outlay if vessels have to share in the cost of these reporting programs. An observer program (preferred Alternative 4) is an intrusive data collection system, and thus is likely to create adverse social effects in addition to economic effects. In particular, an observer program can give rise to friction between fishermen and fishery managers. A mandatory observer program would only worsen the situation, although it would lessen sampling bias. In addition, fishermen do not like to take observers on board for a variety of reasons. Some may fear liability for the safety of observers and others feel that observers are simply a nuisance because they are “in the way.” In the particular case of health and safety, an observer program would expose fishermen to the risk that their fishing craft may not be adequately equipped to carry an extra person, although this may be partly addressed by the requirement imposed under Section 403 (a) of the MSFCMA regarding the health and safety of observers. Others do not trust that observer information can be kept confidential. Among the alternatives considered, the status quo would impose the least addition costs on the fishery and associated communities (zero), whereas a mandatory electronic logbook program would likely have the greatest total cost to the fishery, assuming participants were required to bear the costs, due to the expense of the equipment and the mandatory nature.

For the recreational fishery, the effects are also more in the nature of imposing costs on fishing participants. Logbook reporting imposes additional reporting burden on fishing participants. Alternative 2 would also cost recreational anglers extra money for a federal fishing permit. Both Alternative 2 and 3 would shift part of the current cost of collecting catch and bycatch information from the government to fishing participants. Alternative 2 would impose the largest costs and time burden on the fishery participants, though the effects should not be sufficiently great so as to result in cessation of fishing participation. However, no substantial adverse effects are expected by these measures.

1 Executive Summary

The red snapper stock is in an overfished condition and undergoing overfishing. Currently this stock is under a rebuilding plan to restore the stock to 20 percent spawning potential ratio (SPR) by 2019. However, this plan is inconsistent with the National Marine Fisheries Service (NOAA Fisheries) National Standard Guidelines (NSG). Definitions of stock size, the overfished threshold, and yield must be biomass based, but overfishing definitions can be based on SPR proxies. Therefore, before a rebuilding plan can be initiated to halt overfishing and rebuild a stock, targets and thresholds must be specified so that rebuilding goals are known.

For overfished stocks, a recovery plan must be developed to end overfishing and restore the stock to the biomass level capable of producing maximum sustainable yield (MSY) on a continuing basis (B_{MSY}). This goal is more conservative than that currently specified (20 percent SPR), which is estimated to be the minimal level needed to prevent future declines in the stock. Rebuilding is to occur in as short a time period as possible, but should not exceed 10 years unless conditions dictate otherwise. For red snapper, it would take 12 years to rebuild the stock even if the directed fishery was closed and all juvenile red snapper bycatch from the shrimp fishery was halted (Schirripa and Legault, 1999). The longest rebuilding period recommended by the NSGs is the time to recover in the absence of fishing mortality (12 years) plus the mean generation time (19.6 years). This equals 31.6 years for red snapper. The Gulf of Mexico Fishery Management Council (Council) did submit a recovery plan through a regulatory amendment that met the new guidelines in 2001. It set a recovery target of 2032 or earlier for the stock. However, this amendment was returned to the Council by NOAA Fisheries with a request to further explore alternative rebuilding plans based on realistic expectations for future reductions in shrimp trawl bycatch, and to more fully evaluate the effects of alternatives through a supplemental environmental impact statement (SEIS).

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) requires that fishery management plans (FMP) establish a standardized methodology to assess the amount and type of bycatch occurring in the fishery. An additional requirement of the MSFCMA is to identify and implement conservation measures that, to the extent practicable, minimize bycatch.

Therefore, the purpose of this amendment is to:

- Review, and redefine as needed, biological reference points and status determination criteria
- Establish a plan to end overfishing and rebuild the red snapper stock to a level consistent with current fishery management standards
- Establish a standardized methodology to collect bycatch information in the directed red snapper fishery, and
- Evaluate the practicability of additional measures to reduce bycatch and bycatch mortality in the directed red snapper fishery.

1 .1 Description of alternatives

1 .1.1 Biological reference points and status determination criteria

Status determination criteria are defined by 50 CFR §600.310 to include a minimum stock size threshold (MSST), i.e., the overfished criterion, and a maximum fishing mortality threshold (MFMT), i.e, the overfishing criterion. Together with MSY and optimum yield (OY), these parameters are intended to provide fishery managers with the tools to measure fishery status and performance.

Estimates of MSY, B_{MSY}, and the rate of fishing mortality that achieves MSY (F_{MSY}) provided by the most recent peer-reviewed stock assessment (Schirripa and Legault, 1999) serve as the foundation of the alternative bundles of reference points and status determination criteria considered in this amendment for red snapper. The 1999 assessment produced a range of point estimates for MSY based on various assumptions about the stock-recruitment relationship. These assumptions were defined by varying two parameters: (1) steepness and (2) estimated maximum recruitment. These parameters are used to make assumptions about or provide quantitative estimates of the productivity of a stock. The estimated productivity level of a stock increases and decreases in response to a respective increase or decrease in the values used for these parameters in the assessment model. Data from these assessment runs are used to calculate alternative definitions of OY, MSST, and MFMT.

The alternatives for the biological reference points and status criteria are as follows:

1 .1.1.1 Alternative 1. No action. Maintain status quo definitions.

The MSY estimate of 51 million pounds (mp) whole weight (wwt) is defined to apply to the entire snapper/grouper fishery. There is no separate MSY estimate for red snapper.

OY is defined as a harvest level that maintains, or is expected to maintain, over time at least a 20 percent spawning stock biomass per recruit (SSBR) relative to the SSBR that would occur with no fishing.

The stock is overfished when the transitional SPR is less than 20 percent.

Overfishing is defined as a fishing mortality rate (F) that exceeds the F associated with a 20 percent static SPR.

1 .1.1.2 Alternative 2 (Preferred): MSY for red snapper equals the yield associated with fishing at F_{MSY}, or 41.13 million pounds (mp) whole weight (wwt), assuming low maximum recruitment and an initial steepness of 0.90 for the stock-recruitment relationship.

Until recovery, the harvest for red snapper will be defined as consistent with the rebuilding strategy selected in this amendment. After achieving the rebuilding target, the OY for red snapper shall correspond to a fishing mortality rate (F_{OY}) defined as:
A. $F_{OY} = 0.65*F_{MSY} = 0.060$
Preferred - B. $F_{OY} = 0.75*F_{MSY} = 0.069$
C. $F_{OY} = 0.85*F_{MSY} = 0.078$ (incompatible with sub-alternative I, because F_{OY} would then exceed the MFMT)
D. $F_{OY} = F_{MSY} = 0.092$ (incompatible with sub-alternatives H and I, because F_{OY} would then exceed the MFMT)

Red snapper MSST shall equal:
Preferred - E. $(1\text{-}M) *B_{MSY} = 2{,}453$ mp wwt where $B_{MSY} = 2{,}726$ mp wwt and $M = 0.1$
F. $0.50*B_{MSY} = 1{,}360$ mp wwt

Red snapper MFMT is equal to:

Preferred - G. F_{MSY}.

H. $0.90*F_{MSY}$ (incompatible with sub-alternative D, because F_{OY} would then exceed the MFMT)

I. $0.80*F_{MSY}$ (incompatible with sub-alternatives C and D, because F_{OY} would then exceed the MFMT)

The red snapper stock would be considered undergoing overfishing if F_{CURR} is greater than MFMT.

1 .1.1.3 Alternative 3: MSY for red snapper equals the yield associated with fishing at F_{MSY}, or 66.03 mp wwt, assuming low maximum recruitment and an initial steepness of 0.95 for the stock-recruitment relationship.

Until recovery, the harvest for red snapper will be defined as consistent with the rebuilding strategy selected in this amendment. After achieving the rebuilding target, the OY for red snapper shall correspond to a fishing mortality rate (F_{OY}) defined as:

A. $F_{OY} = 0.65*F_{MSY} = 0.075$

B. $F_{OY} = 0.75*F_{MSY} = 0.087$

C. $F_{OY} = 0.85*F_{MSY} = 0.099$ (incompatible with sub-alternative I, because F_{OY} would then exceed the MFMT)

D. $F_{OY} = F_{MSY} = 0.116$ (incompatible with sub-alternatives H and I, because F_{OY} would then exceed the MFMT)

Red snapper MSST shall equal:

E. $(1\text{-}M)*B_{MSY} = 2{,}373$ mp wwt where $B_{MSY} = 2{,}637$ mp wwt and $M = 0.1$

F. $0.50*B_{MSY} = 1{,}319$ mp wwt

Red snapper MFMT is equal to:

G. F_{MSY}.

H. $0.90*F_{MSY}$ (incompatible with sub-alternative D, because F_{OY} would then exceed the MFMT)

I. $0.80*F_{MSY}$ (incompatible with sub-alternatives C and D, because F_{OY} would then exceed the MFMT)

The red snapper stock would be considered undergoing overfishing if F_{CURR} is greater than MFMT.

1 .1.1.4 Alternative 4: MSY for red snapper equals the yield associated with fishing at F_{MSY}, or 67.73 mp wwt, assuming high maximum recruitment and an initial steepness of 0.90 for the stock-recruitment relationship.

Until recovery, the harvest for red snapper will be defined as consistent with the rebuilding strategy selected in this amendment. After achieving the rebuilding target, the OY for red snapper shall correspond to a fishing mortality rate (F_{OY}) defined as:

A. $F_{OY} = 0.65*F_{MSY} = 0.063$

B. $F_{OY} = 0.75*F_{MSY} = 0.073$

C. $F_{OY} = 0.85*F_{MSY} = 0.084$ (incompatible with sub-alternative I, because F_{OY} would then exceed the MFMT)

D. $F_{OY} = F_{MSY} = 0.097$ (incompatible with sub-alternatives H and I, because F_{OY} would then exceed the MFMT)

Red snapper MSST shall equal:

E. $(1\text{-}M)*B_{MSY} = 3{,}671$ mp wwt where $B_{MSY} = 4{,}079$ mp wwt and $M = 0.1$

F. $0.50*B_{MSY}$ = 2,040 mp wwt

Red snapper MFMT is equal to:
G. F_{MSY}.
H. $0.90*F_{MSY}$ (incompatible with sub-alternative D, because F_{OY} would then exceed the MFMT)
I. $0.80*F_{MSY}$ (incompatible with sub-alternatives C and D, because F_{OY} would then exceed the MFMT)
The red snapper stock would be considered undergoing overfishing if F_{CURR} is greater than MFMT.

1 .1.1.5 Alternative 5: MSY for red snapper equals the yield associated with fishing at F_{MSY}, or 108 mp wwt, assuming high maximum recruitment and an initial steepness of 0.95 for the stock-recruitment relationship.

Until recovery, the harvest for red snapper will be defined as consistent with the rebuilding strategy selected in this amendment. After achieving the rebuilding target, the OY for red snapper will correspond to a fishing mortality rate (F_{OY}) defined as:
A. $F_{OY} = 0.65*F_{MSY} = 0.077$
B. $F_{OY} = 0.75*F_{MSY} = 0.089$
C. $F_{OY} = 0.85*F_{MSY} = 0.100$ (incompatible with sub-alternative I, because F_{OY} would then exceed the MFMT)
D. $F_{OY} = F_{MSY} = 0.118$ (incompatible with sub-alternatives H and I, because F_{OY} would then exceed the MFMT)

Red snapper MSST shall equal:
E. $(1-M)*B_{MSY}$ = 3,537 mp wwt where B_{MSY} = 3,930 mp wwt and M = 0.1
F. $0.50*B_{MSY}$ = 1,965 mp wwt

Red snapper MFMT is equal to:
G. F_{MSY}.
H. $0.90*F_{MSY}$ (incompatible with sub-alternative D, because F_{OY} would then exceed the MFMT)
I. $0.80*F_{MSY}$ (incompatible with sub-alternatives C and D, because F_{OY} would then exceed the MFMT)
The red snapper stock would be considered undergoing overfishing if F_{CURR} is greater than MFMT.

Alternative 1 would retain the status quo definitions of MSY, OY, and status determination criteria. The fishing mortality rate associated with that minimum level ($F_{20\%SPR}$) is substantially higher than current estimates of F_{MSY} for red snapper, and the definitions provided by this alternative are not consistent with NOAA Fisheries' technical guidance, which recommends that MSY, OY, and MSST be biomass based, rather than based on fishing mortality rates. This alternative, while not consistent with NOAA Fisheries guidance, is included as a baseline to demonstrate the effects of no action.

Alternatives 2-5 are based on point estimates of MSY rather than on SPR proxies. These alternative bundles differ from each other only in how they would define MSY (and their associated OY, MSST, and MFMT) under prevailing ecological and environmental conditions. Each MSY alternative is derived from a different model run used in the 1999 stock assessment, and are based on different assumptions about the stock-recruitment relationship. Lower productivity levels (e.g., preferred Alternative 2) are more conservative, but could potentially result in foregone yield by needlessly reducing F_{MSY} and F_{OY} below that which would achieve MSY and OY, respectively. Higher productivity levels (e.g., Alternative 5) allow higher harvest levels, but could potentially compromise the ability of the red snapper stock to rebuild to B_{MSY} if the stock-recruitment assumptions on which they are based are overly optimistic.

The range of alternatives for defining OY, MSST, and MFMT is identical in Alternatives 2-5. The definitions adopted in this amendment for the red snapper stock specify a long-term management program, but will have little practical use until the stock is rebuilt. Until that time, the harvest level and fishing mortality rate for the red snapper stock will be dictated by the rebuilding plan adopted by the Council. OY alternatives A-D for all the bundles would define OY as the average yield associated with fishing at some proportion of F_{MSY}. The lower the OY level (and associated F value), the greater the stock biomass can increase, and thus provide more of a buffer for the stock not to fall below MSST or have F exceed MFMT . However, the tradeoff for more precaution is unnecessary forgone yield. MSST alternatives E-F would define an overfished condition as a stock size that is some proportion of B_{MSY}. The closer MSST is to B_{MSY}, the shorter the time needed to rebuild the stock to B_{MSY} should the stock become overfished. However, if MSST is too close to B_{MSY}, then natural variation in recruitment could cause the stock biomass to frequently alternate between an overfished and rebuilt condition. This would result in an administrative burden of constantly needing to develop rebuilding plans. MFMT alternatives G-I would specify various fishing mortality rates that would be used to signal fishery managers that the red snapper stock's ability to produce MSY is in jeopardy. Preferred Alternative G would set that overfishing threshold equal to F_{MSY} and would allow the fishery to be prosecuted at a rate that provides for higher yields relative to Alternatives H and I.

1 .1.2 Plans to end overfishing and rebuild the red snapper stock to B_{MSY}

The cause of the overfishing and overfished status of the red snapper fishery in the Gulf of Mexico (GOM) is unique to many American fisheries. This status was not only the result of fishing mortality from the directed fishery, but also due to a high level of bycatch mortality on juvenile red snapper by the shrimp trawl fishery. This non-directed fishery catches substantial numbers of juvenile red snapper as bycatch such that without some reduction in bycatch, stock assessments have projected that the stock cannot rebuild to B_{MSY} within the next 100 years even if no harvest was allowed by the directed fishery. Therefore, to end overfishing and rebuild the red snapper stock, large reductions in bycatch mortality from the shrimp fishery need to be achieved either through technological means such as bycatch reduction devices (BRD), or through a reduction in effort by the shrimp fishery. Currently, BRDs are estimated to achieve about a 40 percent reduction in red snapper bycatch. In addition, recent analyses of the economic performance of the shrimp fishery have indicated an economic downturn that will likely cause shrimp effort to decline. Projections show that red snapper stock can rebuild within the longest time period recommended period by the NOAA Fisheries NSGs. These guidelines suggest that rebuilding times should not exceed the time it would take to rebuild in the absence of fishing plus one mean generation time . For red snapper, this time period would be 31 years (12 years plus 19.6 years).

Given the unique effect the Gulf shrimp fishery (one of the most economically important fisheries to the United States of which the Gulf of Mexico contributes over 70 percent to the total pounds landed (NOAA Fisheries, 2003a)) has on rebuilding red snapper, the general guidance provided by the NSGs to assist with determining the length of the rebuilding schedule may not apply. Therefore, rebuilding strategy alternatives based on longer rebuilding periods are also explored.

Alternatives for ending overfishing and rebuilding the stock are as follows:

1 .1.2.1 Alternative 1: Status quo - no action

> Maintain the current rebuilding schedule for red snapper. Adjust total allowable catch (TAC) biannually to maintain a rebuilding trajectory that rebuilds the red snapper stock to 20 percent SPR by 2019.

1 .1.2.2 Alternative 2 (Preferred):

> Maintain TAC at 9.12 mp wwt, end overfishing between 2009 and 2010, and rebuild red snapper by 2032. Review and adjust this policy, as necessary, through periodic assessments. Monitor annual landings to ensure quota is not exceeded.

1 .1.2.3 Alternative 3:

> Reduce TAC to 6.0 mp wwt, end overfishing between 2005 and 2007, and maintain this TAC to rebuild red snapper by 2032. Review and adjust this policy, as necessary, through periodic assessments. Monitor annual landings to ensure quota is not exceeded.

1 .1.2.4 Alternative 4:

> Maintain TAC at 9.12 mp wwt until the stock has rebuilt sufficiently that a constant fishing mortality rate, F_{OY}, would grant higher catches, end overfishing between 2009 and 2010, and rebuild the red snapper stock by 2046. Review and adjust this policy, as necessary, through periodic assessments. Monitor annual landings to ensure the quota is not exceeded.

1 .1.2.5 Alternative 5:

> Reduce TAC to 6.0 mp wwt, maintaining this level until the stock has rebuilt sufficiently that a constant fishing mortality rate, F_{OY}, would grant higher catches, end overfishing between 2005 and 2007, and rebuild the red snapper stock by 2045. Review and adjust this policy, as necessary, through periodic assessments. Monitor annual landings to ensure the quota is not exceeded.

Alternative 1 (no action) would maintain the current red snapper rebuilding plan that was put in place in 1996 through a regulatory amendment to the Reef Fish FMP. This amendment raised the red snapper TAC from 6 million pounds (mp) to 9.12 mp (4.65 mp allocated to the commercial sector and 4.47 mp to the recreational sector), and set 2019 as the recovery target date to achieve a 20 percent SPR. However, SPR represents a concept that is inconsistent with NOAA Fisheries guidance that, with the exception of MFMT, biological reference points and status determination criteria should be biomass based. This alternative, while not consistent with the NSGs, is included as a baseline to demonstrate the effects of no action.

Alternatives 2-5 end overfishing and rebuild the red snapper stock to B_{MSY} either by holding TAC constant, or by allowing TAC to increase once the fishing mortality rate (F) of the directed fishery is equal to the F that would achieve OY (F_{OY}). Preferred Alternative 2 would maintain the current TAC of 9.12 mp for the directed red snapper fishery pending periodic reviews.

Advantages of this alternative are: (1) it would end overfishing between 2009 and 2010; (2) it would impose minimal short-term disruption of the directed red snapper fishery because the current TAC would be maintained; (3) based on current stock assessment data and projected reductions in bycatch, it would rebuild the stock by 2032; and (4) it would offer stability in planning because the harvest levels are predicted to stay constant over a long period of time, and may allow fishermen to make rational business decisions with a higher degree of certainty due to the stable TAC than has been recently allowed. Disadvantages include: (1) The risk of additional future restrictions if the stock grows more slowly than expected or not at all; (2) The requirement to increasingly limit effort or restrain harvest rates as the stock grows; and (3) It does not end overfishing as quickly as alternatives 3 and 5.

Alternative 3 is similar to preferred Alternative 2 except that TAC for the directed red snapper fishery would be reduced to 6 mp, and maintained at that level pending periodic reviews. Given the same uncertainty of the stock assessment model and potential reductions in shrimp bycatch as Alternative 2, Alternative 3 will end overfishing between 2005 and 2007, and rebuild the stock one to three years sooner than predicted for Alternative 2. However, this would be accomplished by immediately reducing directed catches by over 30 percent. These reductions would have a certain and significant negative effect on the commercial and recreational fisheries, and the coastal communities dependent on them.

Alternatives 4 and 5 would hold TAC at 9.12 mp or 6.0 mp, respectively, for the directed red snapper fishery, until the stock is rebuilt to such an extent that fishing at a constant OY fishing mortality rate would allow higher harvest limits. An advantage of these alternatives is that the harvest limit would increase with stock size, which would require fewer effort restrictions than Alternatives 2 and 3. Disadvantages include: 1) The risk of additional future restrictions if the stock grows more slowly than expected or not at all; 2) Ddelay successful rebuilding beyond 2032, and the ecological and socioeconomic benefits associated with achieving this target; and 3) Offers less stability than Alternatives 2 and 3 because fishing rates would be based on abundance measures, which are likely to fluctuate over the course of the rebuilding plan. Alternative 5 would end overfishing sooner than Alternative 4 (between 2005 and 2007 vs. between 2009 and 2010). However, as with Alternative 3, this advantage is tempered by the severe short-term adverse effects associated with having to reduce TAC to 6 mp for about 5 years of the rebuilding plan. The conservation benefit of rebuilding the stock three-four years sooner does not warrant the negative short-term effect on the social and economic environment.

1 .1.3 Bycatch reporting methodology

Current regulations require selected commercial and recreational for-hire participants in the Gulf reef fish fishery to maintain and submit a fishing record on forms provided by NOAA Fisheries. Bycatch is reported for the commercial fishery via the Coastal Fisheries Logbook Program (CFLP). The Marine Recreational Fisheries Statistical Survey (MRFSS) collects fishery information including bycatch data from private recreational vessels, as well as the recreational for-hire sector. Methodologies such as expanded reporting programs and observers, are ways to increase the scope of bycatch reporting. While data on bycatch in the GOM shrimp fishery are important to understand the recovery rate of red snapper, it is beyond the scope of this amendment to include bycatch reporting methodologies for the shrimp fishery. Modifications to the bycatch reporting methodologies used in the shrimp fishery must be addressed through an amendment to the Shrimp FMP. Currently such alternatives are being considered in Shrimp Amendment 13.

Methods to collect reef fish fishery bycatch data presented in the following alternatives are not necessarily mutually exclusive. More than one alternative can be selected. Alternatives examined in this amendment to collect information from the commercial and recreational for-hire reef fish fisheries include:

1 .1.3.1 Commercial and recreational for-hire fisheries

1.1.3.1.1 Alternative 1. Status quo - no action. Use the existing bycatch reporting requirements in the NOAA Fisheries CFLP for commercial reef fish permit holders. Charter vessels would be sampled by MRFSS. Headboats would not be sampled

1.1.3.1.2 Alternative 2. Require that all permitted reef fish vessels operating in the U.S. Exclusive Economic Zone (EEZ) participate in an electronic logbook program that includes bycatch reporting administered by NOAA Fisheries. Vessel permits will not be renewed for vessels that fail or refuse to participate in the program.

1.1.3.1.3 Alternative 3. Require that a subset of all permitted reef fish vessels operating in the EEZ participate in an electronic logbook program administered by NOAA Fisheries. NOAA Fisheries will develop a random selection procedure for determining vessels that will be required to report. In selecting vessels, the agency will consider the suitability of the vessel for such purpose and ensure that the universe of vessels selected are representative of all statistical sub-zones in the Gulf. Vessel permits will not be renewed for vessels that fail or refuse to participate in the program.

1.1.3.1.4 Alternative 4 (Preferred). Develop an observer program managed by NOAA Fisheries for the reef fish fishery. NOAA Fisheries will develop a random selection procedure for determining vessels that will be required to carry observers in order to collect bycatch information. In selecting vessels, the agency will consider the suitability of the vessel for such purpose and ensure that the universe of vessels included are representative of all statistical sub-zones in the Gulf. Vessel permits will not be renewed for vessels that fail or refuse to carry observers in accordance with this process. The requirement for the observer program to be implemented is contingent on NOAA Fisheries obtaining sufficient funding for the program.

1.1.3.1.5 Alternative 5. Expand the use of the existing supplemental bycatch reporting requirements in the NOAA Fisheries CFLP for commercial reef fish permit holders to 100 percent and include recreational for-hire vessels in the logbook program.

1.1.3.1.6 Alternative 6 (Preferred). Enhance the MRFSS by including headboats using the same sampling methodology as used for charter vessels.

Alternative 1 (no action) would retain the data collection program currently used in the commercial sector and continue to use MRFSS to sample bycatch for private and for-hire vessels. The recreational for-hire charter vessels would continue to be sampled for catch and bycatch through the MRFSS program. For the commercial fishery, bycatch data is collected by using a supplemental form sent to a stratified, random sample of 20 percent of the commercial reef fish permit holders. Because this reporting is mandatory, it is considered useful in estimating bycatch (Anonymous, 2004). The current MRFSS data collection program provides adequate bycatch coverage for the recreational fishery for red snapper, and includes the charterboat sector. A percent standard error of 20 percent is generally considered acceptable in fisheries data (Van Vorhees et al., 2001). For red snapper, the percent standard error for fish released by the recreational fishery has generally been below 10 percent in recent years. Bycatch from the headboat sector would not be sampled.

Alternatives 2 to 5 would require that all reef fish permit holders, regardless of whether they are participants in commercial or recreational for-hire fisheries, report their bycatch, or carry observers. The electronic logbooks proposed in Alternatives 2 and 3 are advantageous in that they would collect data shortly after fish are landed, and also simplify record keeping and data entry for fishermen. Their disadvantage is that they would carry a high cost, at least in the short term. Alternative 4 (preferred) proposes to supplement the current data collection program with observer data from selected fishing vessels. This type of program would improve the precision of catch and bycatch data. However, this program would also be expensive and dependent on NOAA Fisheries' budget allocations. Alternatives 5 and 6 (preferred) would also enhance the coverage of current bycatch reporting programs. Alternative 5 would add recreational for-hire vessels to the CFLP. Preferred Alternative 6 would add headboats to the current MRFSS survey program.

1 .1.3.2 Private recreational fishery

1.1.3.2.1 Alternative 1 (Preferred). Status quo - no action. Use the existing MRFSS catch and effort program to continue to collect bycatch information from the private recreational sector.

1.1.3.2.2 Alternative 2. Establish a federal recreational fishing permit as a requirement for fishing for reef fish in the Gulf EEZ. Require that a subset of all permitted recreational reef fish fishers operating in the EEZ participate in a logbook program administered by NOAA Fisheries. The agency will develop a random selection procedure for determining fishers that will be required to report. In selecting fishers, the agency will insure that the universe of fishers included are representative of all statistical sub-zones in the Gulf.

1.1.3.2.3 Alternative 3. Establish a volunteer logbook reporting program under NOAA Fisheries that includes bycatch reporting. The agency will use state recreational license files and surveys wherever possible to stratify fishers by fishery and request volunteers stratified by state and subregion.

Alternative 1 (no action) is selected as the preferred alternative and continues the use of MRFSS to obtain bycatch information from the recreational fishery. MRFSS is considered very precise for the Gulf private/rental red snapper fishery because the proportional standard error, a way to view the precision of an estimate, of red snapper bycatch is very low. A percent standard error of 20 percent is generally considered acceptable in fisheries data (Van Vorhees et al., 2001). For red snapper, the percent standard error has generally been below 10 percent in recent years.

Alternative 2 would require a permit to recreationally fish for reef fish in the EEZ, of which a proportion of permit holders would be sampled for bycatch. This program would provide a better method for proportioning bycatch mortality for stock assessments, but would also create a new administrative burden and associated costs on both anglers and fishery management agencies. Alternative 3 establishes a voluntary bycatch reporting program. Bycatch reporting from fewer trips would be obtained than if Alternative 2 was applied. However, these records would be expected to be more reliable for those fishermen who consistently report their bycatch information.

1 .1.4 Bycatch minimization measures

The evaluation of the practicability of additional management measures to reduce bycatch and bycatch mortality considers the composition and magnitude of bycatch in the directed red snapper fishery and the impact of effects of that bycatch on bycatch species, the surrounding ecosystem, and fishery participants. Bycatch is comprised of primarily of red snapperAnecdotal information suggests that the red snapper stock has improved since it was last assessed in 1999, and that red snapper bycatch mortality in the shrimp fishery has declined considerably (estimated 40 percent) due to the implementation of BRDs. The current assessment indicates that any action taken to reduce bycatch in the directed fishery would not likely affect the status of the red snapper stock. However, an assessment is due to be completed in 2004 and is expected to provide additional information on the implications of current bycatch mortality on the red snapper stock from the directed fishery.

The 2004 assessment will incorporate a great deal of new information, including five years of observer data on shrimp trawl bycatch, fishery-dependent data on observed changes in lengths of harvested fish, and estimates of changes in age-one recruitment from the Southeast Area Monitoring and Assessment Program (SEAMAP) data. Additionally, the results of new research into red snapper stock structure in the northern and western Gulf and new estimates of discard mortality should be available to use in the assessment. This new information, combined with four years of data on the fishery under the same management regulations, is expected to provide us with a better understanding of the impacts of BRDs, the effectiveness of regulations in the directed fishery, and the possible impacts of new regulations on the red snapper stock.

The Council plans to use the results of the 2004 assessment to develop logical and defensible measures to reduce shrimp trawl bycatch and/or directed fishery discards as needed. Shrimp trawl bycatch must be addressed in the Shrimp FMP. Options for bycatch minimization are being considered in Amendment 14 of the Shrimp FMP.

The preliminary analysis of the practicability factors indicates that there would not likely be positive biological impacts associated with further reducing bycatch in the directed red snapper fishery unless the 2004 stock assessment shows a major increase in the relative proportion of bycatch taken in the directed fishery. Many of the minimization measures considered (e.g., minimum sizes, seasonal closures, education, and an individual fishing quota for the commercial fishery) would result in short-term adverse economic and social impacts. Consequently, the Council has concluded that it would not be practicable to take action to further reduce bycatch at this time based on the best available scientific information. The Council will review this decision in Amendment 18 to the Reef Fish FMP and may wish to take further actions based on the results of the 2004 red snapper stock assessment.

1 .2 Environmental consequences of alternatives

The environmental consequences of the alternatives for the various actions evaluated in this amendment are described in Sections 4 and 8, and are summarized in Tables 1.2.1-1.2.4.

Alternative biological reference points and status determination criteria would have no direct positive or negative impacts on red snapper, other species, or participants in the red snapper fishery because they simply provide fishery managers with reference point to consider in developing fishery management measures and assessing fishery performance. Theoretically, they could result in indirect biological, ecological, social, and economic effects by influencing the TAC. This would come about through parameter updates from successive stock assessments.

Estimates of biological reference points will be reviewed and redefined in 2004 based on the findings of a new stock assessment.

The goal of a rebuilding plan is to increase the red snapper stock size and insure the stock's ability to sustain itself over the long term. Alternatives that reduce current TAC levels to 6 mp would reduce fishing pressure on the stock. However, the benefits to the stock derived from reducing directed fishing pressure are minor compared to those achieved by reducing the red snapper bycatch by the shrimp fishery. Therefore, decreasing TAC would cause adverse effects to the social and economic environment of the directed fishery and provide little benefit to the biological and ecological environment.

The effects of the alternatives for bycatch reporting methodologies on the physical, biological, and ecological environments are not expected to be adverse because they should not change current fishing practices. The social and economic environment can be adversely affected by increasing time burdens on fishermen's time, and in some cases, by increasing the cost of participating in the fishery. However, the social and economic consequences of these alternatives are expected to be beneficial over the long term as the bycatch data collected are used to improve the assessment and management of the fishery.

Table 1.2.1. Summary of direct, indirect, and cumulative effects on the environment and their significance for biological reference point and status determination criteria alternatives.

Physical environment

Direct effects	No significant beneficial or adverse effects of gear on the habitat by any alternative
Indirect and cumulative effects	Once the stock is rebuilt, possible effects from fishing gear, but difficult to assess level of effects. Alternatives that decrease the overall level of fishing effort should have less of an effect. Selecting estimates of MSY and B_{MSY} determine the level of effort allowed in rebuilding strategies. In terms of effort, Alternative 1 would allow the highest effort, followed by preferred Alternative 2, Alternatives 3, 5, and 4.

Biological, ecological environment

Direct effects	No beneficial or adverse effects to red snapper by any alternative because alternatives only establish management reference points and rebuilding goals.
Indirect and cumulative effects	The level to which the stock rebuilds to based on the selection of management reference points is based on assumptions about stock productivity. I productivity is overestimated, it could be difficult to sustain the stock. Higher levels of stock size could influence interactions by red snapper with prey and competitor species. Interactions are poorly understood and so difficult to assess. Preferred Alternative 2 assumes the lowest stock productivity value and Alternative 5 assumes the highest value. Alternatives 3 and 4 are intermediate to Alternatives 2 and 5.

Social and economic environment

Direct effects	Direct effects accrue from future actions that directly affect harvest or fishing behavior.
Indirect and cumulative effects	More conservative stock parameters (e.g., preferred alternative 2) conserve the stock better, but could incur a loss from forgone yield. Less conservative stock parameters (e.g., Alternative 5) allow a greater socio-economic benefit from increasing yields, but may incur long-term losses if the stock is being fished at levels above the true MSY level.

Administrative environment

Direct effects	For all alternatives, additional administrative effort will be needed as status criteria changes based on new information gathered for the red snapper stock. However, this should not be significant because it is within the scope of the current management system. With the exception of Alternative 1, all alternatives would allow the fishery to achieve legal mandates provided by management reference points.
Indirect and cumulative effects	For all alternatives, as the red snapper stock size increases, red snapper could show up in other fisheries as bycatch. Therefore, actions could be required to address this bycatch. Alternative 1 would maintain the stock at its lowest level resulting in a reduced bycatch. Alternatives 2-5 assume increasing levels of productivity, higher productivity levels would likely have higher levels of bycatch associated with them.

Table 1.2.2 Summary of direct, indirect, and cumulative effects on and their significance for red snapper rebuilding plan alternatives.

Physical environment

Direct effects	Effects likely proportional to measures of fishing effort. With ehe exception of Alternative 1, all would require substantial reductions in effort. Alternatives 3 and 5 would require greatest initial reductions in effort, followed by Alternatives 2 and 4.
Indirect and cumulative effects	No significant adverse or beneficial effects were identified for any of the alternatives.

Biological, ecological environment

Direct effects	All the alternatives have a positive direct effect on the red snapper stock because they allow the stock size to increase. Alternative 3 has the highest positive benefit, followed by Alternatives 2 (preferred), 5, 4, and 1, respectively.
Indirect effects	Indirect effects are difficult to assess because little information is available on the interrelationships between species. Increasing red snapper stock size may have adverse effects on red snapper (as bycatch), prey species, and species that compete with red snapper for resources. In the short term, Alternatives 1, 2, and 4 should have similar effects, as would Alternatives 3 and 5. To rebuild red snapper, changes are needed in the shrimp fishery to reduce bycatch. Currently, market factors are limiting shrimp effort, and hence the amount of gear impacts on the bottom.

Social and economic environment

Direct effects	All the alternatives should have a positive effect because of increasing stock sizes; however, over the short-term, Alternatives 2 (preferred) and 4 have less of an effect because they do not call for decreases in TAC.
Indirect and cumulative effects	Over the short-term, Alternatives 3 and 5 have a lower economic gain creating an adverse spillover to associated businesses and to the community. Over the long-term, all the alternatives benefit the economy from higher stock sizes. If future benefits from rebuilding are large enough to offset negative impacts due to past and current actions, the compound effects of regulations would result in improving fishing participation in the red snapper fishery.

Administrative environment

Direct effects	Alternatives 1, 2 (preferred), and 4 leave TAC at 9.12 mp and so do not require additional administrative actions. Alternatives 3 and 5 require a reduction in TAC and would result in actions designed to further restrict fishing effort.
Indirect and cumulative effects	Alternatives 2 (preferred) and 3 could require potentially significant regulatory efforts to hold TAC constant. As the stock increases, red snapper may become more prevalent as a bycatch species in other fisheries. This could result in management actions to reduce this bycatch.

Table 1.2.3. Summary of direct, indirect, and cumulative effects on and their significance for bycatch reporting methodologies for the commercial and recreational for-hire fisheries.

Physical environment

Direct effects	No significant adverse or beneficial effects were identified for any of the alternatives
Indirect and cumulative effects	No significant adverse or beneficial effects were identified for any of the alternatives

Biological, ecological environment

Direct effects	No significant adverse or beneficial effects were identified for any of the alternatives.
Indirect and cumulative effects	Information on bycatch obtained through any of the alternatives should have a positive effect because it will be used to better assess the condition of the stock.

Social and economic environment

Direct effects	Bycatch reporting through logbooks (Alternatives 1, 2, 3, 5, and 6 (preferred) have a negative effect either from costs or time burdens. Observer programs (Alternative 4 - preferred) could create friction between fishermen and managers.
Indirect and cumulative effects	Effects are equivocal. If the management benefits from bycatch data collection and management for all the alternatives outweigh the cost of data collection, then the programs will be beneficial. Otherwise, they will have a negative effect.

Administrative environment

Direct effects	Alternatives 2 and 3 reduce the amount of paperwork fishermen need to do; but at the cost of having to enter data while at sea. Alternatives 1, 5 and 6 (preferred) maintain or slightly increase the amount of paperwork needed to be filled out. Alternative 4 (preferred) would create a new program with an administrative entity to handle the data.
Indirect and cumulative effects	No significant adverse or beneficial effects were identified for any of the alternatives

Table 1.2.4. Summary of direct, indirect, and cumulative effects on and their significance for bycatch reporting methodologies for the private recreational fishery.

Physical environment

Direct effects	No significant adverse or beneficial effects were identified for any of the alternatives
Indirect and cumulative effects	No significant adverse or beneficial effects were identified for any of the alternatives

Biological, ecological environment

Direct effects	No adverse or beneficial effects were identified for any of the alternatives
Indirect and cumulative effects	Information on bycatch obtained through any the alternatives should have a positive effect because it will be used to better assess the condition of the stock.

Social and economic environment

Direct effects	Alternative 2 would create extra costs as fishermen would need to purchase a fishing permit. Alternative 3 would create a voluntary reporting system, so any incurred costs by fishermen would also be voluntary. Alternative 1 (preferred) would not incur any additional costs.
Indirect and cumulative effects	Effects are equivocal. If the management benefits from bycatch data collection and management for all the alternatives outweigh the cost of data collection, then the programs will be beneficial. Otherwise, they will have a negative effect. Additional bycatch reporting may create a negative experience for the angler; however, if this information support heathier stocks, then the benefits associated with this positive effect may exceed the additional reporting burdens required by Alternatives 2 and 3. Costs for Alternative 3 would be voluntary.

Administrative environment

Direct effects	Alternatives 2 and 3 would require the development of new programs and therefore require a new administrative entity within NOAA Fisheries. Preferred Alternative 1(no action) would maintain the current MRFSS program.
Indirect and cumulative effects	Information on bycatch obtained through all the alternatives should have a positive effect because it will be used to better assess the condition of the stock. Alternatives 2 and 3 could take resources away from existing programs.

1 .3 Major conclusions and areas of controversy

The Council's for preferred alternatives for biological reference points and status determination criteria, rebuilding plans, and bycatch reporting methodology are expected to benefit the red snapper stock and fishery over the long term. The Council selected the most precautionary alternative presented for MSY, which results in the lowest estimate of stock production relative to the other alternatives. The potential disadvantage of this alternative is forgone yield should the stock be more productive. The advantage of using a more conservative estimate of stock productivity is that the chance of over harvesting the stock diminishes. Preferred alternatives for

OY and status determination criteria follow NOAA Fisheries' technical guidance for precautionary approaches to these parameters.

Red snapper stock rebuilding cannot occur without reductions of juvenile red snapper bycatch by the shrimp fishery. Projections indicate that even with a 40 percent reduction of bycatch mortality by using BRDS, the stock cannot rebuild to B_{MSY}. The preferred rebuilding plan alternative selected by the Council takes into account predicted reductions in bycatch achieved through decreases in effort in the shrimp fishery. This plan is projected to rebuild the stock to B_{MSY} by 2032 by holding TAC constant at 9.12 mp. Rebuilding plan Alternative 3 would set TAC at 6 mp and was suggested by the public as a method to more quickly rebuild the stock. This alternative would only rebuild the stock sooner by 1 to 3 years and have substantial negative effects on the economic and social environment of the directed fishery and associated businesses. The Council rejected Alternative 3 in favor of preferred Alternative 2 because this latter alternative better balances the biological, ecological, social, and economic tradeoffs.

Bycatch reporting methodologies are required for FMPs. Data collected on bycatch is important for assessing stocks and developing appropriate management actions. The preferred alternatives selected by the Council for observers and expansion of the MRFSS survey to include headboats should enhance information needs for better management decisions. Observers improve the precision of catch and bycatch data. However, observer programs are expensive and funding would need to be identified before implementing a program. Currently headboats are not sampled for bycatch, so adding this component of the recreational fishery to MRFSS should improve bycatch data. The Council determined that the current MRFSS program was sufficient to obtain bycatch information for the recreational fishery. Instituting a federal fishing permit (Alternative 2) or establishing a volunteer logbook program (Alternative 3) were considered impracticable at this time.

2 History of Management

The Reef Fish FMP (with its associated environmental impact statement (EIS)) was implemented on November 8, 1984. The regulations, designed to rebuild declining reef fish stocks, included: (1) prohibitions on the use of fish traps, roller trawls, and power head-equipped spear guns within an inshore stressed area; (2) a minimum size limit of 13 inches total length (TL) for red snapper with the exceptions that for-hire boats were exempted until May 8, 1987, and each angler could keep 5 undersize fish; and (3) the establishment of optimum yield (OY) for the snapper/grouper complex [49 FR 39548].

The following history of management only pertains to red snapper management so some amendments may not be listed. A more complete history of reef fish management in the Gulf of Mexico can be obtained from the Gulf of Mexico Fishery Management Council.

2 .1 Fishery management plan and regulatory amendments

Amendment 1 to the Reef Fish FMP [with its associated environmental assessment (EA), regulatory impact review (RIR), and initial regulatory flexibility analysis (IRFA)], implemented on February 21, 1990, set as a primary objective of the FMP, the stabilization of long-term population levels of all reef fish species by establishing a survival rate of biomass into the stock of spawning age to achieve at least 20 percent spawning stock biomass per recruit (SSBR), relative to the SSBR that would occur with no fishing. It set a red snapper 7-fish recreational bag limit and 3.1-million pound (MP) commercial quota that together were to reduce fishing mortality by 20 percent and begin a rebuilding program for that stock. A framework procedure for specification of total allowable catch (TAC) was created to allow for annual management changes, and a target date for achieving the 20 percent SSBR goal was set at January 1, 2000. This amendment also established a longline and buoy gear boundary inshore of which the directed harvest of reef fish with longlines and buoy gear was prohibited and the retention of reef fish captured incidentally in other longline operations (e.g., shark) was limited to the recreational bag limit. Subsequent changes to the longline/buoy boundary could be made through the framework procedure for specification of TAC [55 FR 2078].

A regulatory amendment implemented on March 11, 1991, set the red snapper TAC at 4.0 MP to be allocated with a commercial quota of 2.04 MP and a 7-fish recreational daily bag limit (1.96 MP allocation) beginning in 1991. This amendment also contained a proposal by the Council to effect a 50-percent reduction of red snapper bycatch in 1994 by the shrimp trawl fleet operating in the exclusive economic zone (EEZ), to occur through the mandatory use of finfish excluder devices on shrimp trawls, reductions in fishing effort, area or season closures of the shrimp fishery, or a combination of these actions. This combination of measures was projected to achieve a 20 percent SPR by the year 2007. The 2.04 MP quota was reached on August 24, 1991, and the red snapper fishery was closed to further commercial harvest in the EEZ for the remainder of the year.

At the direction of the Council, the Reef Fish Stock Assessment Panel (RFSAP) met in March 1990 and reviewed the 1990 red snapper stock assessment produced by NOAA Fisheries. The recommendation of the RFSAP at that time was to close the directed fishery because the Allowable Biological Catch (ABC) was being harvested as bycatch by the shrimp trawl fishery. No viable alternatives were identified that would achieve the 20-percent SPR goal by the year 2000 without closure of the directed fishery. This was because no means existed for reducing shrimp trawl bycatch that limited the ability of the stock to rebuild. As a result, **Amendment 3** (with its associated EA, RIR, and IRFA), implemented on July 29, 1991, provided additional flexibility in the annual framework procedure for specifying TAC by allowing the target date for rebuilding an overfished stock to be changed depending on changes in scientific advice, except that the rebuilding period cannot exceed 1.5 times the generation time of the species under consideration [56 FR 30513]. It revised the FMP's primary objective, definitions of OY, overfishing, and framework procedure for TAC by replacing the 20 percent SSBR target with 20 percent SPR. The amendment also transferred speckled hind from the shallow-water grouper quota category to the deep-water grouper quota category and established a new red snapper rebuilding target year of 2007 for achieving the 20 percent SPR goal. In 1992, the commercial red snapper quota remained at 2.04 MP. However, extremely heavy harvest rates resulted in the quota being filled in just 53 days, and the commercial red snapper fishery was closed on February 22, 1992 [56 FR 33883]. An emergency rule [56 FR 30513], implemented in 1992 by NOAA Fisheries at the request of the Council, reopened the red snapper fishery from April 3, 1992, through May 14, 1992, with a 1,000-pound trip limit. This rule was implemented to alleviate economic and social upheavals that occurred as a result of the 1992 red snapper commercial quota being rapidly filled. Although this emergency rule resulted in a quota overrun of approximately 600,000 pounds, analysis by NOAA Fisheries' biologists determined that this one-time overrun would not prevent the red snapper stock from attaining its target SPR.

Amendment 4 (with its associated EA and RIR)**,** implemented on May 8, 1992, established a moratorium on the issuance of new reef fish permits for a maximum period of three years. The moratorium was created to moderate short-term future increases in fishing effort and to attempt to stabilize fishing mortality while the Council considered a more comprehensive effort limitation program. It allowed the transfer of permits between vessels owned by the permittee or between individuals when the permitted vessel is transferred. Amendment 4 also changed the time of the year that TAC is specified from April to August and included additional species in the reef fish management unit [57 FR 11914].

A regulatory amendment implemented on March 23, 1993, raised the 1993 red snapper TAC from 4.0 MP to 6.0 MP to be allocated with a commercial quota of 3.06 MP and a recreational allocation of 2.94 MP (to be implemented by a 7-fish recreational daily bag limit). The amendment also changed the target year to achieve a 20 percent red snapper SPR from 2007 to 2009, based on the plan provision that the rebuilding period may not exceed 1.5 times the generation time of the stock and an estimated red snapper generation time of 13 years (Goodyear 1992) [58 FR 16371].

A regulatory amendment implemented on January 1, 1994, set the opening date of the 1994 commercial red snapper fishery as February 10, 1994, and restricted commercial vessels to landing no more than one trip limit per day. The purpose of this amendment was to facilitate enforcement of the trip limits, minimize fishing during hazardous winter weather, and ensure that the commercial red snapper fishery was open during Lent, when there is increased demand for seafood. The TAC was retained at the 1993 level of 6 MP, with a 3.06 MP commercial quota and 2.94 MP recreational allocation [58 FR 68325].

Amendment 5 (with its associated EIS, RIR, and IRFA), implemented on February 7, 1994, established restrictions on the use of fish traps in the Gulf EEZ, implemented a three-year moratorium on additional participation in the fishery by creating a fish trap endorsement and issuing the endorsement only to fishermen who had submitted logbook records of reef fish landings from fish traps between January 1, 1991, and November 19, 1992; created a special management zone (SMZ) with gear restrictions off the Alabama coast; created a framework procedure for establishing future SMZ's; required that all finfish except for oceanic migratory species be landed with head and fins attached; established a schedule to gradually raise the minimum size limit for red snapper to 16 inches over a period of five years; and closed the region of Riley's Hump (near Dry Tortugas, Florida) to all fishing during May and June to protect mutton snapper spawning aggregations. An emergency rule effective December 30, 1992, created a red snapper endorsement to the reef fish permit for the start of the 1993 season. The endorsement was issued to owners or operators of federally permitted reef fish vessels who had annual landings of at least 5,000 pounds of red snapper in two of the three years from 1990 through 1992. For the duration of the emergency rule, while the commercial red snapper fishery was open, permitted vessels with red snapper endorsements were allowed a 2,000-pound possession limit of red snapper, and permitted vessels without the endorsement were allowed 200 pounds. This emergency action was initially effective for 90 days, and was extended for an additional 90 days with the concurrence of NOAA Fisheries and the Council. A related emergency rule delayed the opening of the 1993 commercial red snapper season until February 16 to allow time for NOAA Fisheries to process and issue the endorsements [59 FR 966].

Amendment 6 (with its associated EA and RIR), implemented on June 29, 1993, extended the provisions of the emergency rule for red snapper endorsements for the remainder of 1993 and 1994, unless replaced sooner by a comprehensive effort limitation program. In addition, it allowed the trip limits for qualifying and non-qualifying permitted vessels to be changed under the framework procedure for specification of TAC [58 FR 33025].

Amendment 7 (with its associated EA, RIR, and IRFA), implemented on February 7, 1994, established reef fish dealer permitting and record keeping requirements; allowed transfer of fish trap permits and endorsements between immediate family members during the fish trap permit moratorium; and allowed transfer of other reef fish permits or endorsements in the event of the death or disability of the person who was the qualifier for the permit or endorsement. A proposed provision of this amendment that would have required permitted vessels to sell harvested reef fish only to permitted dealers was disapproved by the Secretary of Commerce [59 FR 6588].

A regulatory amendment implemented on January 1, 1995, retained the 6 MP red snapper TAC and commercial trip limits and set the opening date of the 1995 commercial red snapper fishery as February 24, 1995. However, because the recreational sector exceeded its 2.94 MP red snapper allocation each year since 1992, this regulatory amendment reduced the daily bag limit from 7 fish to 5 fish, and increased the minimum size limit for recreational fishing from 14 inches to 15 inches one year ahead of the scheduled automatic increase [59 FR 67646].

Amendment 8 (with its associated EA, RIR, and IRFA), which proposed establishment of a red snapper Individual Transferable Quota (ITQ) system, was approved by NOAA Fisheries. The final rule was published in the *Federal Register* on November 29, 1995 [60 FR 61200]. This amendment provided for an initial allocation of percentage shares of the commercial red snapper quota to vessel owners and historical operators based on fishermen's historical participation in the fishery during the years 1990-1992, set a 4-year period for harvest under the ITQ system, during which time the Council and NOAA Fisheries would monitor and evaluate the program and decide whether to extend, terminate or modify it, and established a special appeals board, created by the Council, to consider requests by fishermen who contested their initial allocations of shares or determination of historical captain status. The appeals board was originally scheduled to meet during January 1996, with the ITQ system itself to become operational in April 1996. However, the federal government shutdown of December 1995-January 1996 forced an indefinite postponement of the appeals board meetings, and concerns about Congressional funding of the ITQ system made it inadvisable for the ITQ system to become operational, pending Congressional action. In October 1996, Congress, through re-authorization of the Magnuson-Stevens Act, repealed the red snapper ITQ system and prohibited Councils from submitting, or NOAA Fisheries from approving and implementing, any new individual fishing quota program before October 1, 2000.

Amendment 9 (with its associated EA and RIR), implemented on July 27, 1994, provided for collection of red snapper landings and eligibility data from commercial fishermen for the years 1990 through 1992. The purpose of this data collection was to evaluate the initial impacts of the limited access measures being considered under Amendment 8, and to identify fishermen who may qualify for initial participation under a limited access system. This amendment also extended the reef fish permit moratorium and red snapper endorsement system through December 31, 1995, in order to continue the existing interim management regime until longer term measures could be implemented. The Council received the results of the data collection in November 1994, at which time consideration of Amendment 8 resumed [59 FR 39301].

A regulatory amendment, implemented October 16, 1996, raised the red snapper TAC from 6 MP to 9.12 MP, with 4.65 MP allocated to the commercial sector and 4.47 MP allocated to the recreational sector. Recreational size and bag limits remained at 5 fish and 15 inches TL. The recovery target date to achieve 20 percent SPR was extended to the year 2019, based on new biological information that red snapper live longer and have a longer generation time than previously believed. A March 1996 addendum to the regulatory amendment split the 1996 and 1997 commercial red snapper quotas into two seasons each, with the first spring opening on February 1 with a 3.06 MP quota, and the fall season opening on September 15, with the remainder of the annual quota [61 FR 48641].

Amendment 11 (with its associated EA and RIR) was partially approved by NOAA Fisheries and implemented in January 1, 1996. Approved provisions included: (1) limit sale of Gulf reef fish by permitted vessels to permitted reef fish dealers; (2) require that permitted reef fish dealers purchase reef fish caught in Gulf federal waters only from permitted vessels; (3) allow transfer of reef fish permits and fish trap endorsements in the event of death or disability; (4) implement a new reef fish permit moratorium for no more than 5 years or until December 31, 2000, while the Council considers limited access for the reef fish fishery; (5) allow permit transfers to other persons with vessels by vessel owners (not operators) who qualified for their reef fish permit; (6) allow a one time transfer of existing fish trap endorsements to permitted reef fish vessels whose owners have landed reef fish from fish traps in federal waters, as reported on logbooks received by the Science and Research Director of NOAA Fisheries from November 20, 1992, through February 6, 1994; and (7) implemented a charter vessel/headboat permit [60 FR 64356].

The agency disapproved a proposal to redefine OY from 20 percent SPR (the same level as overfishing) to an SPR corresponding to a fishing mortality rate of $F_{0.1}$ until an alternative operational definition that optimizes ecological, economic, and social benefits to the Nation could be developed. In April 1997, the Council resubmitted the OY definition with a new proposal to redefine OY as 30 percent SPR. The re-submission document was disapproved by NOAA Fisheries. Following the Congressional repeal of the red snapper ITQ system in Amendment 8, an emergency interim action was published in the *Federal Register* on January 2, 1996, to extend the red snapper endorsement system for 90 days. That emergency action was superseded by another emergency action, published in the *Federal Register* on February 29, 1996, that extended the red snapper endorsement system through May 29, 1996, and subsequently, by agreement of NOAA Fisheries and the Council, for an additional 90 days until August 27, 1996.

Amendment 12 (with its associated EA and RIR), was implemented on January 15, 1997. NOAA Fisheries disapproved proposed provisions, for the commercial sector, to cancel the automatic red snapper size limit increases to 15 inches TL in 1996 and 16 inches TL in 1998 [61 FR 65983].

Amendment 13 (with its associated EA and RIR), implemented on September 15, 1996, further extended the red snapper endorsement system through the remainder of 1996 and, if necessary, through 1997, in order to give the Council time to develop a permanent limited access system that was in compliance with the new provisions of the Magnuson-Stevens Act [61 FR 48413].

A regulatory amendment implemented on March 17, 1997, changed the opening date of the fall 1997 commercial red snapper season from September 15 to September 2 at noon and closed the season on September 15 at noon; thereafter the commercial season was opened from noon of the first day to noon of the fifteenth day of each month until the 1997 quota was reached. It also complied with the new Magnuson-Stevens Act requirement that recreational red snapper be managed under a quota system by authorizing the NOAA Fisheries Regional Administrator (RA) to close the recreational fishery in the EEZ at such time as projected to be necessary to prevent the recreational sector from exceeding its allocation. Subsequent to implementation of a recreational red snapper quota, the recreational red snapper fishery filled its 1997 quota of 4.47 MP, and was closed on November 27, 1997, for the remainder of the calendar year [61 FR 46677 and 61 FR 48641].

A regulatory amendment implemented on January 1, 1998, canceled a planned increase in the red snapper recreational minimum size limit to 16 inches TL that had been implemented through Amendment 5, and retained the 15-inch TL minimum size limit [63 FR 443].

Amendment 14 (with its associated EA, RIR, and IRFA), implemented on March 25 and April 24, 1997, provided for a 10-year phase-out for the fish trap fishery; allowed transfer of fish trap endorsements for the first 2 years and thereafter, only upon death or disability of the endorsement holder, to another vessel owned by the same entity, or to any of the 56 individuals who were fishing traps after November 19, 1992, and were excluded by the moratorium; and prohibited the use of fish traps west of Cape San Blas, Florida. The amendment also provided the RA with authority to reopen a fishery prematurely closed before the allocation was reached and modified the provisions for transfer of commercial reef fish vessel permits [62 FR 13983].

Amendment 15 (with its associated EA, RIR, and IRFA), implemented on January 29, 1998, established a permanent two-tier red snapper license limitation system to replace the temporary red snapper endorsement system. Under the new system, Class 1 licenses and initial 2,000-pound trip limits were issued to red snapper endorsement holders as of March 1, 1997. Class 2 licenses, and initial 200-pound trip limits are issued to other holders of reef fish permits as of March 1, 1997, who had any landings of red snapper between January 1, 1990, and March 1, 1997. Vessels without a Class 1 or Class 2 red snapper license are prohibited from commercial harvest of red snapper, and licences are fully transferable. The commercial red snapper season was split in two, with two-thirds of the quota allocated to a February 1 opening and the remaining quota to a September 1 opening. The commercial fishery was open from noon of the first day to noon of the fifteenth day of each month during the commercial season [62 FR 67714].

A regulatory amendment proposed maintaining the status quo red snapper TAC of 9.12 MP, but set a zero bag limit for the captain and crew of for-hire recreational vessels in order to extend the recreational red snapper quota season. NOAA Fisheries provisionally approved the TAC, releasing 6 MP, with release of all or part of the remaining 3.12 MP to be contingent upon the capability of shrimp BRDs devices to achieve better than a 50-percent reduction in juvenile red snapper shrimp trawl mortality. The zero bag limit for captain and crew of for-hire recreational vessels was not approved. Following an observer monitoring program of shrimp trawl BRDs conducted during the summer of 1998, NOAA Fisheries concluded that BRDs would be able to achieve the reduction in juvenile red snapper mortality needed for the red snapper recovery program to succeed, and the 3.12 MP of TAC held in reserve was released on September 1, 1998. In lieu of implementing the regulatory amendment, NOAA Fisheries implemented an interim rule effective April 14, 1998 [63 FR 18144] which initially allocated only 2/3 of the TAC of 9.12 MP and reduced the recreational red snapper bag limit from 5 to 4 fish for the period January 1 to August 30, 1998. A subsequent interim rule allocated the remainder of the TAC effective September 1, 1998.

An interim rule implemented by NOAA Fisheries in January 1999 reduced the recreational bag limit for red snapper from 5 to 4 fish per person and retained the 15-inch TL minimum size limit for both the commercial and recreational sectors. It also provided for the reopening of the recreational fishing season to commence in January 1999 [64 FR 47711]. A regulatory amendment implemented on October 1, 1999, maintained the status quo red snapper TAC of 9.12 MP; reduced the recreational bag limit for red snapper to 4 fish for recreational fishermen and zero fish for captain and crew of for-hire vessels (note: the zero fish bag limit for captain and crew was rescinded prior to its going into effect by a December 1999 interim rule); set the opening date of the recreational red snapper fishing season at March 1; reduced the minimum size limit for red snapper to 14 inches TL for both the commercial and recreational fisheries; and changed the opening criteria for the fall commercial red snapper fishing season from the first 15 days to the first 10 days of each month beginning September 1, until the suballocation is met or the season closes on December 31. This regulatory amendment followed up the same set of proposals requested under an emergency action, of which NOAA Fisheries approved only the proposal for a 4-fish bag limit.

Amendment 17 (with its associated EA and RIR) was implemented by NOAA Fisheries on August 2, 2000. It extends the reef fish permit moratorium for another five years, from the existing expiration date of December 31, 2000 to December 31, 2005, unless replaced sooner by a comprehensive controlled access system [65 FR 41016].

A regulatory amendment implemented on September 18, 2000, maintained the status quo red snapper TAC of 9.12 MP for the next two years, pending an annual review of the assessment; increased the red snapper recreational minimum size limit from 15 inches to 16 inches TL; set the red snapper recreational bag limit at 4 fish; reinstated the red snapper recreational bag limit for captain and crew of recreational for-hire vessels; set the recreational red snapper season to be April 15 through October 31, subject to revision by the RA to accommodate reinstating the bag limit for captain and crew; set the commercial red snapper spring season to open on February 1 and be open from noon on the 1st to noon on the 10th of each month until the spring sub-quota is reached; set the commercial red snapper fall season to open on October 1 and be open from noon on the 1st to noon on the 10th of each month until the remaining commercial quota is reached; retained the red snapper commercial minimum size limit at status quo 15 inches TL; and allocated the red snapper commercial season sub-quota at 2/3 of the commercial quota, with the fall season sub-quota as the remaining commercial quota [65 FR 50158]. These measures were first put in place by an interim rule from January 19 to June 19, 2000 [64 FR 71056], and continued through a second interim rule from June 19-December 16, 2000 [65 FR 36643].

Amendment 19, also know as the **Generic Amendment Addressing the Establishment of the Tortugas Marine Reserves** (with its associated EIS, RIR, and IRFA), was submitted to NOAA Fisheries in March 2001, and implemented on August 19, 2002. This amendment, affecting all FMPs for the Gulf fisheries (Amendment 19 to the Reef Fish FMP), establishes two marine reserve areas off the Tortugas area and prohibits fishing for any species and anchoring by fishing vessels inside the two marine reserves [67 FR 47467].

Amendment 20, also known as the **Charter/Headboat Moratorium Amendment** (with its associated EA and RIR), affects the Reef Fish FMP (Amendment 20), the Coastal Pelagic FMP (Amendment 14) was implemented by NOAA Fisheries on June 16, 2003. This amendment establishes a 3-year moratorium on the issuance of new charter and headboat vessel permits in the recreational for-hire fisheries (reef fish and coastal migratory pelagic fisheries only) in the Gulf EEZ. The purpose of this moratorium is to limit future expansion in the recreational for-hire fishery while the Council monitors the impact of the moratorium and considers the need for a more comprehensive effort management system in the for-hire recreational fishery. Although the control date notice which announced that a limited access system would be considered was dated November 18, 1998, the Council set a qualifying cut-off date of March 29, 2001, in order to include all currently permitted vessels and vessels which applied for a permit as of that date. The qualifying provisions also included persons who had a recreational for-hire vessel under construction prior to March 29, 2001, and who can show expenditures of at least five thousand dollars. In addition, persons who met the eligibility requirements to qualify as a historical captain will be issued a letter of eligibility, which will be replaced by a permit/endorsement valid only on the vessel that is operated by the historical captain [68 FR 26230].

Amendment 21 (with its EA, RIR, and IRFA) was approved in March 2004. The amendment will extend the Madison-Swanson and Steamboat Lumps marine reserves closures for an additional six years and modify fishing restrictions allowed within the reserves.

Proposed Amendment 22 (with its Draft Supplemental EIS (DSEIS), RIR, and IRFA) provides alternatives to set biological reference points and status determination criteria for red snapper, establish a rebuilding plan for the red snapper stock, and improve bycatch monitoring in the reef fish fishery.

The **Shrimp FMP** (with its associated EIS, RIR, and IRFA) was prepared by the Council and implemented as federal regulation on May 15, 1981. The original intent of the plan was to enhance yield in volume and value by deferring harvest of small shrimp to allow for growth. Principle actions included: (1) establishing a cooperative Tortugas Shrimp Sanctuary with the state of Florida to close a shrimp trawling area where small pink shrimp comprise the majority of the population; (2) a cooperative 45-day seasonal closure with the state of Texas to protect small brown shrimp emigrating from bay nursery areas; and (3) seasonal zoning of an area of Florida Bay for either shrimp or stone crab fishing to avoid gear conflicts [46 CFR 27489].

Amendment 9 to the Shrimp FMP [with its associated SEIS, RIR, IRFA, and Social Impact Assessment (SIA)], approved in May 1998, required the use of a NOAA Fisheries-certified bycatch reduction devices (BRDs) in shrimp trawls used in the EEZ from Cape San Blas, Florida (85˚30' W. Longitude) to the Texas/Mexico border and provided for the certification of the Fisheye BRD in the 30-mesh position. The purpose of this action was to reduce the bycatch mortality of juvenile red snapper by 44 percent from the average mortality for the years 1984-89. This amendment exempted shrimp trawling for royal red shrimp outside of 100 fathoms, as well as groundfish and butterfish trawls. It also excluded small try nets and no more than two ridged roller frame trawls that do not exceed 16 feet. Amendment 9 also provided mechanisms to change the bycatch reduction criterion and to certify additional BRDs [63 FR 18139].

Amendment 10 to the Shrimp FMP (with its associated EA, RIR, and IRFA), approved in March 2004, required the installation of a NOAA Fisheries-certified BRDs that reduces the bycatch of finfish by at least 30 percent by weight in each net used aboard vessels trawling for shrimp in the Gulf EEZ east of Cape San Blas, Florida (85° 30' W. Longitude). Vessels trawling for groundfish or butterfish are exempted. A single try net with a headrope length of 16 feet or less per vessel and no more than two rigid roller frame trawls limited to 16 feet or less, are also exempted [69 FR 1538].

2 .2 Control date notices

Control date notices are used to inform fishermen that a license limitation system or other method of limiting access to a particular fishery or fishing method is under consideration. If a program to limit access is established, anyone not participating in the fishery or using the fishing method by the published control date may be ineligible for initial access to participate in the fishery or to use that fishing method. However, a person who does not receive an initial eligibility may be able to enter the fishery or fishing method after the limited access system is established by transfer of the eligibility from a current participant, provided the limited access system allows such transfer. Publication of a control date does not obligate the Council to use that date as an initial eligibility criteria. A different date could be used, and additional qualification criteria could be established. The announcement of a control date is primarily intended to discourage entry into the fishery or use of the gear based on economic speculation during the Council's deliberation on the issues. The following summarizes control dates that have been established for the Reef Fish FMP. A reference to the full *Federal Register* notice is included with each summary.

November 1, 1989 - Anyone entering the commercial reef fish fishery in the GOM and South Atlantic after November 1, 1989, may not be assured of future access to the reef fish resource if a management regime is developed and implemented that limits the number of participants in the fishery. [54 FR 46755]

November 18, 1998 - The Council is considering whether there is a need to impose additional management measures limiting entry into the recreational-for-hire (i.e., charter vessel and headboat) fisheries for reef fish and coastal migratory pelagic fish in the EEZ of the GOM and, if there is a need, what management measures should be imposed. Possible measures include the establishment of a limited entry program to control participation or effort in the recreational-for-hire for reef fish and coastal migratory pelagics. [63 FR 64031] (In the Charter/Headboat Moratorium Amendment, approved by the Council for submission to NOAA Fisheries in March 2001, a qualifying date of March 29, 2001, was adopted.)

July 12, 2000 - The Council is considering whether there is a need to limit participation by gear type in the commercial reef fish fisheries in the exclusive economic zone (EEZ) of the GOM and, if there is a need, what management measures should be imposed to accomplish this. Possible measures include modifications to the existing limited entry program to control fishery participation, or effort, based on gear type, such as a requirement for a gear endorsement on the commercial reef fish vessel permit for the appropriate gear. Gear types which may be included are longlines, buoy gear, handlines, rod-and-reel, bandit gear, spearfishing gear, and powerheads used with spears. [65 FR 42978]

March 29, 2001 - The Council is considering whether there is a need to limit participation for the reef fish and coastal migratory pelagics charter and headboat fishery. The intent of this notice is to inform the public that entrants into the charter vessel/headboat fisheries after this date may not be assured of a future access to the reef fish and/or coastal migratory pelagics resources if: 1) an effort limitation management regime is developed and implemented that limits the number of vessels or participants in the fishery; and 2) if the control date notice is used as criterion for eligibility [67 FR 32312].

December 6, 2003 - On April 29, 2003, NOAA Fisheries published an advanced notice of proposed rulemaking that established a control date of December 6, 2003, for the commercial shrimp fishery operating in the Gulf EEZ. By way of the notice, the public is advised that, in the future, the Council may consider management measures to limit entry into the shrimp fishery, and may use this control date as a qualifying criterion for participation in the fishery [68 FR 22667].

2.3 Individual fishing quota (IFQ) program

Overall, it could be concluded that a “derby ” situation in the red snapper fishery had developed by 1992. Despite increased regulations initiated in an attempt to ameliorate the adverse affects of “derby” fishing, including the implementation of a two-tier system with differential trip limits and numerous seasonal closures, the fishery still harvests its quota in a relatively short time. In 2000, for example, the commercial fishery remained open for only 76 days despite a commercial quota of 4.65 MP. In essence, while the commercial quota has increased by 50 percent between 1990 and 2000 (i.e., 3.1 MP to 4.65 MP), the length of the season has been reduced by about three-quarters (from 365 days to 76 days). It is the result of the reduced season length, marketing conditions, and safety-at-sea issues that the Council is now developing options for a red snapper IFQ program.

NOAA Fisheries conducted an initial referendum for the IFQ program and it passed by a majority vote. On February 12, 2004, NOAA Fisheries Southeast Regional Office (SERO) mailed each eligible voter a ballot specifying the number of votes (weighting) that each voter was assigned. In this first referendum, fishermen qualified to vote were asked to decide whether a plan amendment establishing the IFQ Program should be prepared by the Council. NOAA Fisheries mailed a total of 157 ballots and associated explanatory information, via certified mail return receipt requested. All eligible voters received their ballots as evidenced by the return receipts received at SERO. One hundred and forty-five ballots (92%) were returned to SERO by the deadline date of February 27, 2004. One hundred and four ballots totaling 8,194,024 "yes" votes (81%) were received supporting the development of the IFQ program. Forty-one ballots totaling 1,962,433 "no" votes (19%) were received that did not support development of the IFQ program.

The Council elected to proceed with development of an IFQ plan amendment. The plan amendment and regulations would only be submitted to the Secretary for review and approval or disapproval if in a second referendum approval of the submission was passed by a majority of the votes cast by the eligible voters as described in the final rule previously published in the *Federal Register* [69 FR 6921]. NOAA Fisheries will announce the required second referendum by publishing a notice in the *Federal Register* that would provide all pertinent information regarding the referendum. It should be noted, however, that even if both referendums pass, the Secretary is not mandated to enact an IFQ program.

3 Purpose of and Need for Action

The purpose of this integrated FMP amendment is to accomplish the following four actions in the GOM red snapper fishery:

- To review, and redefine as needed, biological reference points and status determination criteria;
- To establish a plan to end overfishing and rebuild the red snapper stock that is consistent with current fishery management standards;
- To establish a standardized methodology to collect bycatch information in the fishery; and
- To evaluate the practicability of additional measures to reduce bycatch and bycatch mortality in the directed red snapper fishery.

These actions are needed to bring the red snapper fishery into compliance with requirements added to the MSFCMA through the 1996 Sustainable Fisheries Act (SFA) and fulfill the need to make the fishery sustainable. These requirements direct the Council to: assess and specify the present and probable future condition of, and the MSY and OY from, fisheries (MSFCMA §303(a)(3)); specify objective and measurable criteria for identifying when a fishery is overfished (MSFCMA §303(a)(10)); end overfishing and rebuild overfished stocks (MSFCMA §304(e)(3)); establish a standardized reporting methodology to assess the amount and type of bycatch occurring in managed fisheries; and, implement conservation and management measures that minimize bycatch and bycatch mortality to the extent practicable (MSFCMA §303(a)(11)).

According to NOAA Fisheries' 2003 Report to Congress (NOAA Fisheries, 2003b) and the most recent red snapper stock assessment (Schirripa and Legault, 1999), the GOM red snapper stock is overfished and is experiencing overfishing. The stock is considered to be overfished when the transitional SPR falls below 20 percent. The stock is considered to be experiencing overfishing when it is fished at a rate that exceeds that corresponding to a 20 percent static SPR (NOAA Fisheries, 2003b). The red snapper fishery is being managed under a rebuilding plan that is intended to restore the stock to a 20 percent transitional SPR by the year 2019. This amendment would redefine criteria for determining when the red snapper stock is overfished and experiencing overfishing based on the NSGs set forth in 50 CFR §600.310. Additionally, it would establish a new rebuilding plan that is designed to restore the stock to B_{MSY}.

The MSFCMA requires that rebuilding plans establish a schedule for rebuilding overfished stocks that is as short as possible, and not to exceed ten years, except in cases where the biology of the stock, other environmental conditions, or management measures under an international agreement dictate otherwise. The NSGs provide a formula for calculating the maximum rebuilding schedule in situations where it would take ten years or longer to rebuild a stock to B_{MSY} in the absence of fishing mortality (50 CFR §600.310). Applied to the red snapper stock, this formula defines the maximum recommended rebuilding schedule as 31 years (e.g., time it would take to rebuild the stock to B_{MSY} in the absence of fishing mortality (12 years) plus one mean generation time (19.6 years)). Implicit to establishing a rebuilding plan for a stock, overfishing will end sometime during the rebuilding period. When overfishing ends depends on the type of rebuilding schedule selected.

In May 2001, the Council submitted to NOAA Fisheries a regulatory amendment to the Reef Fish FMP that proposed to redefine biological reference points and status determination criteria for the red snapper stock based on the 1999 stock assessment (Schirripa and Legault, 1999), and to establish a plan to rebuild the red snapper stock to B_{MSY} by the year 2032. The alternative rebuilding plans evaluated in the regulatory amendment were based on analyses provided by Powers et al. (2000). Because the incidental catch of juvenile, pre-recruit (age 0 - age 1) red snapper in the shrimp trawl fishery comprises a substantial portion of the total fishing mortality on red snapper, the success of these plans depended heavily on potential reductions in shrimp trawl bycatch.

According to Schirripa and Legault (1999), the number of red snapper taken incidental to the shrimp trawl fisheries accounted for about 90 percent of the total red snapper harvest prior to the implementation of a rule requiring the use of bycatch reduction devices (BRD) in May 1998. That rule requires shrimp vessels operating west of Cape San Blas, Florida, to use nets with BRDs certified by NOAA Fisheries to reduce the bycatch mortality of juvenile red snapper. BRDs are estimated to have reduced shrimp trawl bycatch mortality of red snapper by 40 percent (Nichols, no date). However, even greater reductions would be required to rebuild the red snapper stock to B_{MSY} within the maximum recommended 31-year time frame, even if the directed red snapper fishery were eliminated (RFSAP, 1999).

NOAA Fisheries returned the red snapper regulatory amendment to the Council in July 2002, identifying the need to further explore alternative rebuilding plans based on realistic expectations for further reducing shrimp trawl bycatch, and to more fully evaluate the impacts of these alternatives in a SEIS. Additionally, the agency suggested the need to better address the bycatch provisions of the MSFCMA. Amendment 22 to the Reef Fish FMP was developed in response.

4 Alternatives Including the Proposed Action

This section describes the alternatives considered by the Council to achieve the purpose and need stated in Section 3.0. It includes an explanation of the approach used to define the range of alternatives, a description of the alternatives considered, and a comparison of their environmental impacts. Information on alternative biological reference points and status determination criteria is included in Section 4.1. Sections 4.2, 4.3, and 4.4 include information on alternative rebuilding plans, bycatch reporting methodologies, and bycatch minimization measures, respectively.

4 .1 Biological reference points and status determination criteria

The MSFCMA requires that each FMP define reference points in the form of MSY and OY, and specify objective and measurable criteria for identifying when a fishery is overfished or undergoing overfishing. Status determination criteria are defined by 50 CFR §600.310 to include a MSST, i.e., the overfished criterion, and a MFMT, i.e, the overfishing criterion. Together, these four parameters (MSY, OY, MSST, MFMT) are intended to provide fishery managers with the tools to measure fishery status and performance. By evaluating stock biomass (B) and F in relation to MSY, OY, MSST, and MFMT, fishery managers can determine the status of a fishery at any given time and assess whether management measures are achieving established goals.

The primary goal of federal fishery management, as described in National Standard 1 of the MSFCMA, is to conserve and manage U.S. fisheries to "...prevent overfishing while achieving, on a continuing basis, the OY from each fishery for the United States fishing industry" (MSFCMA §301(a)(1)). OY is defined in the MSFCMA as the amount of fish that "will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems..." (MSFCMA §3(28)).

While economic and social factors are to be considered in defining the OY for each fishery, OY may not be defined as an amount of fish that would compromise a stock's ability to produce MSY – or the largest long-term average catch that can be taken continuously (sustained) from a stock under prevailing ecological and environmental conditions. OY must prevent overfishing, and in the case of an overfished stock, must provide for rebuilding. In the case of an overfished fishery, OY must provide for rebuilding to a stock biomass level that is capable of producing MSY (50 CFR §600.10).

Fishery managers use the parameters MSST and MFMT to monitor the current level of biomass (B_{CURR}) and rate of fishing mortality (F_{CURR}) in a fishery in relation to B_{MSY} and F_{MSY}. MSST represents the threshold biomass level below which a stock would not be expected to be capable of rebuilding to B_{MSY} within ten years if exploited at MFMT. A stock with a biomass below the MSST (e.g., B_{CURR} < MSST) would be considered to be overfished. Once this designation is made, a rebuilding plan would need to be put in place to rebuild the stock to B_{MSY}. MFMT represents the maximum level of fishing mortality that a stock can withstand, while still producing MSY on a continuing basis. A fishery experiencing a fishing mortality rate that exceeds the MFMT (e.g., F_{CURR} > MFMT) would be considered to be undergoing overfishing.

4 .1.1 Definition of alternative biological reference points and status determination criteria

This amendment combines various definitions of MSY together with alternative definitions of OY, MSST, and MFMT to provide a range of reasonable "bundles" of alternative reference points and status determination criteria to evaluate for management of red snapper. The range of alternative bundles is defined based on the best available scientific information to encompass a reasonable suite of policy options. The specific alternatives evaluated in each bundle are described below.

4 .1.1.1 Maximum sustainable yield (MSY) as the basis for alternative bundles

MSY, B_{MSY}, and F_{MSY} estimates provided by the most recent peer-reviewed stock assessment (Schirripa and Legault, 1999) serve as the foundation of the alternative bundles of reference points and status determination criteria considered in this amendment. That assessment used an age-structured assessment program (ASAP) to evaluate the status of the GOM red snapper stock. The ASAP model synthesizes a variety of available data to develop reference points that best fit the behavior of a simulated age-structured population.

The 1999 red snapper ASAP model produced a range of point estimates for MSY in whole weight based on various assumptions about recruitment. These assumptions were defined by varying two parameters: (1) steepness and (2) estimated maximum recruitment. The steepness parameter defines the number of recruits produced annually per mature adult when a population is low and competition is virtually non-existent. The maximum recruitment parameter defines the maximum amount of recruitment that could be achieved by a large population.

Together, these parameters shape the Beverton-Holt stock-recruitment relationship. Most stock-recruitment relationships are constructed so that the reproductive success of individuals increases when a population is small, and competition for shared food and shelter resources is low. The Beverton-Holt function allows this relationship to be customized to a given stock based on available data and on other relevant observations.

The stock-recruitment relationship strongly influences the productivity of a stock. Consequently, the steepness and maximum recruitment parameters used in assessments have an important influence on the assessment outcome. Stock assessment scientists can manipulate these parameters to produce outcomes that are based on various potential productivity scenarios, with an aim to matching real patterns observed from the stock. The estimated productivity level of a stock increases and decreases in response to a respective increase or decrease in the values used for these parameters in the assessment model.

When stock biomass is low, the steepness parameter has a greater influence than the maximum recruitment parameter on the stock-recruitment relationship when the spawning stock biomass is low. High steepness values imply rapid recovery from an overfished condition. Low steepness values imply slow stock rebuilding. When the stock biomass is high, the maximum recruitment parameter has a greater influence on the stock-recruitment relationship. The value of that parameter more strongly affects B_{MSY}, which in turn affects the expected yields from a fishery, including MSY and OY.

The RFSAP (1999) selected model runs for further consideration that used steepness values ranging from 0.90 to 0.95. The high value in that range (0.95) provided the best fit between the model and the observed data. The low value in that range (0.90), in the opinion of the RFSAP, better approximated the steepness values of species with life history characteristics that are similar to those of red snapper. It is important to note that the steepness value defining the low end of the range is high relative to that defined for other species (Myers et al., 1999). As a result, estimates of MSY, B_{MSY}, and F_{MSY} derived from model runs that used the “low” steepness value still represent a highly productive stock.

The RFSAP also decided to further evaluate model runs that assumed both high and low levels of estimated maximum recruitment. These maximum recruitment levels were estimated using the fall SEAMAP groundfish data series. The high level was based on the highest annual catch per unit effort (CPUE) that occurred in 1972. The low level was based on the average CPUE for 1972-1976. The MSY, B_{MSY}, and F_{MSY} estimates resulting from the various combinations of these assumed stock-recruitment relationships are described in Table 4.1.1.

These estimates correspond to stock conditions of 32 to 36 percent transitional SPR. The MSY estimates are high relative to the current harvest level of 9.12 mp. However, as noted by the RFSAP, this fishery has been ongoing for over 100 years and has been subjected to substantial fishing pressure. Therefore, although all projections indicate that stock biomass is increasing (see Sections 4.2 and 7.2.2.2), it is reasonable to conclude that the stock is not likely to be near the level that would produce MSY. B_{CURR} in the 1999 stock assessment was estimated to be about seven percent of B_{MSY} using the low recruitment, 0.90 steepness, assessment model.

Table 4.1.1. Biological reference points for four assumed red snapper stock-recruitment relationships. MSY and B_{MSY} are in wwt.

Recruitment	**Low**		**High**	
Steepness	**0.90**	**0.95**	**0.90**	**0.95**
MSY (mp)	41.13	66.03	67.73	108.00
B_{MSY} (mp)	2,726	2,637	4,079	3,930
F_{1999}	0.259	0.432	0.292	0.474
F_{MSY}	0.092	0.116	0.097	0.118
F_{1999}/F_{MSY}	2.82	3.72	3.01	4.02

Estimating the stock level that would produce MSY is extremely difficult given the poor understanding of recruitment at stock sizes that are substantially greater than any that have been observed. Consequently, the B_{MSY} estimates that are produced by the stock assessment model are highly uncertain and have been questioned by both fishery managers and the public (see public comments on this document in Appendix C and D). Models are prone to great uncertainty when they are required to project beyond the range of the data on which they are based. The red snapper stock has been assessed only at a limited range of abundance levels, all of which are characterized by conditions of heavy exploitation. As a result, estimates of B_{MSY} that are based on these data indicate that the stock is capable of producing a yield that is much higher than any observed in the past. Recruitment levels at much greater stock sizes will need to be observed to gain a better understanding of the true value of B_{MSY}.

Some public comments have suggested that because MSY is a technical parameter, scientists, not the Council, should determine this level based on the best scientific information. In this case, stock assessment scientists evaluated the stock and recommended a range of values linked to stock productivity based on the best available scientific information. However, they did not recommend one value as being more reliable than another within the range. Therefore, the Council needs to assess the tradeoffs associated with the alternative definitions of MSY and make a decision about which best fits their objectives for the fishery.

NOAA Fisheries has actively been working on data collection activities designed to improve our understanding of the red snapper fishery since 1998. Besides spending over 20 million dollars within the agency to obtain the needed data, nearly six million dollars has been provided to academic and independent research organizations for red snapper research. These data will be incorporated in the 2004 stock assessment. Estimates of biological parameters may change dramatically as data gaps are filled in. For example, the MSY estimate may decrease (and the outlook on stock status improve) as scientists begin to better understand how density-dependent factors affect recruitment to the fishery. The natural mortality rate of juvenile red snapper is likely to increase when the stock is at high densities because the fish are forced to compete with one another for space, food, and other resources. However, current calculations do not take these factors into account.

Several other factors can also influence the understanding of the status of the stock. The current stock assessment is based on a fixed selectivity assumption. This links the fishing mortality rates associated with the directed and the shrimp trawl bycatch component of the red snapper fishery, and requires that both rates be reduced proportionately to achieve MSY. Consequently, the MSY estimates reviewed in this amendment are conditional on the current selectivity in the fishery, and would require substantial reductions in shrimp trawl bycatch.

Changes in selectivity could significantly affect estimates of MSY, F_{MSY}, and B_{MSY}. Any gains in bycatch reduction beyond those considered in this amendment could increase MSY. Indeed, the theoretical MSY for the fishery would occur with no bycatch in either the directed or bycatch fisheries, a scenario that is unlikely. Economic studies predict a dramatic reduction in effort in the shrimp trawl fishery and, therefore, the partial F attributable to the associated bycatch of juvenile red snapper. These changes could be larger or smaller than the changes in the directed fishery. Unless by coincidence they change to the same degree, selectivity assumptions of the current assessment paradigm will need to be changed to develop more realistic estimates of MSY. Also, assumptions regarding selectivity will need to be reconsidered if analyses in future shrimp amendments indicate that further reductions in bycatch are not practicable.

These factors affect not only the future consideration of the stock, but also the current projections of rebuilding scenarios. These projections assume fixed selectivity on red snapper between the directed and bycatch fishing mortality rates, an assumption that mainly affects the MSY reference points, including the rebuilding target. In lieu of calculating a separate selectivity for each rebuilding alternative, under which selectivity changes through time, the current selectivity pattern will need to be re-evaluated during the periodic assessments required by the selected rebuilding plan.

4 .1.1.2 Optimum yield (OY)

The range of alternative OY values evaluated for the red snapper stock is derived from the technical guidance on the use of precautionary approaches provided by Restrepo et al. (1998). This guidance recommends that the target fishing mortality rate (F_{OY}) be set equal to the average yield available on a continuing basis from fishing at $0.75*F_{MSY}$ (75 percent of F_{MSY}). Studies using Mace's deterministic model (Mace, 1994) indicate that, when a stock is at equilibrium, fishing at $0.75*F_{MSY}$ would produce biomass levels between 125 percent and 131 percent of B_{MSY}, and yields that are equal to 94 percent of MSY or greater (Restrepo et al., 1998). Each alternative bundle also contains a more conservative alternative that would set F_{OY} equal to $0.65*F_{MSY}$, and less conservative alternatives that would set F_{OY} equal to $0.85*F_{MSY}$ or to F_{MSY}.

4 .1.1.3 Minimum stock size threshold (MSST)

The first definition of MSST considered is based on the default proxy recommended by Restrepo et al. (1998). The proxy is defined as a function of the equilibrium biomass expected when fishing constantly at F_{MSY}: MSST = c*B_{MSY}; where c equals 0.50 or (1-M), whichever is greater. The natural mortality rate (M) of a species provides an indication about its productivity, such that a species with a low M generally is not as productive (or capable of recovering to B_{MSY} as quickly) as a species with a high M. By setting c equal to 0.50 or (1-M), whichever is greater, this formula ties MSST to the productivity of a stock, such that MSST could be set further below B_{MSY} for those stocks that are highly productive and capable of recovering to B_{MSY} more quickly. But it would prevent MSST from being set at less than one-half the MSY level even for highly productive stocks, thereby reducing the risk that a highly productive stock could reach a level so low that it would have difficulty recovering to B_{MSY} within ten years. Applied to the red snapper stock, this proxy is equal to 0.90*B_{MSY} because M is estimated to be equal to 0.1 (Shirripa and Legault, 1999).

The second proxy would set MSST equal to 0.5*B_{MSY}. This definition is more risky in that it would allow red snapper biomass to decrease to as little as 50 percent of the MSY level before the stock would be classified as overfished.

A third alternative would set MSST equal to B_{MSY}. If all other factors remained constant, this alternative would build additional conservatism into the definition of MSST by eliminating the buffer between the two parameters so that a stock would never be permitted to fall below B_{MSY} without triggering an "overfished" determination and the need to develop a rebuilding plan within one year of that determination. This alternative was ultimately eliminated from more detailed study because, practically, it does not differ substantially from the first alternative, which would set MSST equal to 0.90*B_{MSY}.

4 .1.1.4 Maximum fishing mortality threshold (MFMT)

Each alternative bundle defines three alternative MFMT values. The first alternative would set MFMT equal to the F corresponding to the MSY (F_{MSY}). This is consistent with the MSFCMA, which states that the terms "overfishing" and "overfished" mean a rate or level of fishing mortality that jeopardizes a stock's capacity to produce MSY (MSFCMA §3(29)). More conservative definitions would set MFMT equal to the F corresponding to 0.9*F_{MSY} or to 0.8*F_{MSY}.

4 .1.2 Description of alternative biological reference points and status determination criteria, and comparison of their environmental impacts

4 .1.2.1 Alternative 1. Status quo - no action. Maintain status quo definitions.

The MSY estimate of 51 mp wwt is defined to apply to the entire snapper/grouper fishery. There is no separate MSY estimate for red snapper.

OY is defined as a harvest level that maintains, or is expected to maintain, over time at least a 20 percent spawning stock biomass per recruit (SSBR) relative to the SSBR that would occur with no fishing.

The stock is overfished when the transitional SPR is less than 20 percent.

Overfishing is defined as an F that exceeds the F associated with a 20 percent static SPR.

4 .1.2.2 Alternative 2 (Preferred): MSY for red snapper equals the yield associated with fishing at F_{MSY}, or 41.13 mp wwt, assuming low maximum recruitment and an initial steepness of 0.90 for the stock-recruitment relationship.

Until recovery, the harvest for red snapper will be defined as consistent with the rebuilding strategy selected in this amendment. After achieving the rebuilding target, the OY for red snapper shall correspond to a fishing mortality rate (F_{OY}) defined as:

A. $F_{OY} = 0.65*F_{MSY} = 0.060$
Preferred - B. $F_{OY} = 0.75*F_{MSY} = 0.069$
C. $F_{OY} = 0.85*F_{MSY} = 0.078$ (incompatible with sub-alternative I, because F_{OY} would then exceed the MFMT)
D. $F_{OY} = F_{MSY} = 0.092$ (incompatible with sub-alternatives H and I, because F_{OY} would then exceed the MFMT)

Red snapper MSST shall equal:
Preferred - E. (1-M) $*B_{MSY}$ = 2,453 mp wwt where B_{MSY} = 2,726 mp wwt and M = 0.1
F. $0.50*B_{MSY}$ = 1,360 mp wwt

Red snapper MFMT is equal to:
Preferred - G. F_{MSY}.
H. $0.90*F_{MSY}$ (incompatible with sub-alternative D, because F_{OY} would then exceed the MFMT)
I. $0.80*F_{MSY}$ (incompatible with sub-alternatives C and D, because F_{OY} would then exceed the MFMT)

The red snapper stock would be considered undergoing overfishing if F_{CURR} is greater than MFMT.

4 .1.2.3 Alternative 3: MSY for red snapper equals the yield associated with fishing at F_{MSY}, or 66.03 mp wwt, assuming low maximum recruitment and an initial steepness of 0.95 for the stock-recruitment relationship.

Until recovery, the harvest for red snapper will be defined as consistent with the rebuilding strategy selected in this amendment. After achieving the rebuilding target, the OY for red snapper shall correspond to a fishing mortality rate (F_{OY}) defined as:

A. $F_{OY} = 0.65*F_{MSY} = 0.075$
B. $F_{OY} = 0.75*F_{MSY} = 0.087$
C. $F_{OY} = 0.85*F_{MSY} = 0.099$ (incompatible with sub-alternative I, because F_{OY} would then exceed the MFMT)
D. $F_{OY} = F_{MSY} = 0.116$ (incompatible with sub-alternatives H and I, because F_{OY} would then exceed the MFMT)

Red snapper MSST shall equal:
E. (1-M)$*B_{MSY}$ = 2,373 mp wwt where B_{MSY} = 2,637 mp wwt and M = 0.1
F. $0.50*B_{MSY}$ = 1,319 mp wwt

Red snapper MFMT is equal to:
G. F_{MSY}.
H. $0.90*F_{MSY}$ (incompatible with sub-alternative D, because F_{OY} would then exceed the MFMT)
I. $0.80*F_{MSY}$ (incompatible with sub-alternatives C and D, because F_{OY} would then exceed the MFMT)

The red snapper stock would be considered undergoing overfishing if F_{CURR} is greater than MFMT.

4 .1.2.4 Alternative 4: MSY for red snapper equals the yield associated with fishing at F_{MSY}, or 67.73 mp wwt, assuming high maximum recruitment and an initial steepness of 0.90 for the stock-recruitment relationship.

Until recovery, the harvest for red snapper will be defined as consistent with the rebuilding strategy selected in this amendment. After achieving the rebuilding target, the OY for red snapper shall correspond to a fishing mortality rate (F_{OY}) defined as:
A. $F_{OY} = 0.65*F_{MSY} = 0.063$
B. $F_{OY} = 0.75*F_{MSY} = 0.073$
C. $F_{OY} = 0.85*F_{MSY} = 0.084$ (incompatible with sub-alternative I, because F_{OY} would then exceed the MFMT)
D. $F_{OY} = F_{MSY} = 0.097$ (incompatible with sub-alternatives H and I, because F_{OY} would then exceed the MFMT)

Red snapper MSST shall equal:
E. $(1-M)*B_{MSY}$ = 3,671 mp wwt where B_{MSY} = 4,079 mp wwt and M = 0.1
F. $0.50*B_{MSY}$ = 2,040 mp wwt

Red snapper MFMT is equal to:
G. F_{MSY}.
H. $0.90*F_{MSY}$ (incompatible with sub-alternative D, because F_{OY} would then exceed the MFMT)
I. $0.80*F_{MSY}$ (incompatible with sub-alternatives C and D, because F_{OY} would then exceed the MFMT)
The red snapper stock would be considered undergoing overfishing if F_{CURR} is greater than MFMT.

4 .1.2.5 Alternative 5: MSY for red snapper equals the yield associated with fishing at F_{MSY}, or 108 mp wwt, assuming high maximum recruitment and an initial steepness of 0.95 for the stock-recruitment relationship.

Until recovery, the harvest for red snapper will be defined as consistent with the rebuilding strategy selected in this amendment. After achieving the rebuilding target, the OY for red snapper will correspond to a fishing mortality rate (F_{OY}) defined as:
A. $F_{OY} = 0.65*F_{MSY} = 0.077$
B. $F_{OY} = 0.75*F_{MSY} = 0.089$
C. $F_{OY} = 0.85*F_{MSY} = 0.100$ (incompatible with sub-alternative I, because F_{OY} would then exceed the MFMT)
D. $F_{OY} = F_{MSY} = 0.118$ (incompatible with sub-alternatives H and I, because F_{OY} would then exceed the MFMT)

Red snapper MSST shall equal:
E. $(1-M)*B_{MSY}$ = 3,537 mp wwt where B_{MSY} = 3,930 mp wwt and M = 0.1
F. $0.50*B_{MSY}$ = 1,965 mp wwt

Red snapper MFMT is equal to:
G. F_{MSY}.
H. $0.90*F_{MSY}$ (incompatible with sub-alternative D, because F_{OY} would then exceed the MFMT)

I. $0.80*F_{MSY}$ (incompatible with sub-alternatives C and D, because F_{OY} would then exceed the MFMT)

The red snapper stock would be considered undergoing overfishing if F_{CURR} is greater than MFMT.

Alternative 1 would retain the status quo definitions of MSY, OY, and status determination criteria. The current definition of MSY used in the original Reef Fish FMP applies to the entire snapper/grouper fishery, of which red snapper is a member. This definition is outdated and is not based on the best available scientific information. The status quo definitions of OY, overfished, and overfishing are designed to maintain a minimum level of spawning stock biomass per recruit relative to that which would occur with no fishing. The fishing mortality rate associated with that minimum level ($F_{20\%SPR}$) is substantially higher than current estimates of F_{MSY} for red snapper, which range from $F_{32\%\ SPR}$ to $F_{37\%\ SPR}$. Consequently, while the no action alternative could provide for a higher yield in the short term, it would prevent the stock from producing MSY on a continuing basis over the long term. Additionally, the definitions provided by this alternative are not consistent with NOAA Fisheries' technical guidance, which recommends that OY and MSST be biomass-based, rather than based on fishing mortality rates. This alternative, while not consistent with NSGs, is included as a baseline to demonstrate the effects of no action.

Alternatives 2-5 differ from Alternative 1 in that all the parameters within each bundle are based on point estimates of MSY rather than on SPR proxies. These alternatives represent the range of MSY estimates provided by the RFSAP (1999). They differ from each other only in how they would define MSY, or the largest, long-term average yield that can be sustained from a stock under prevailing ecological and environmental conditions. Each MSY alternative is derived from a different run of the ASAP model used in the 1999 stock assessment, and is based on a different assumption about the stock-recruitment relationship, and ultimately about stock productivity.

These alternative MSY definitions would have no direct positive or negative impacts on red snapper, other species, or participants in the red snapper fishery because they simply provide fishery managers with a biological goal to consider in developing fishery management measures. Theoretically, they could result in indirect biological, ecological, social, and economic effects by influencing the TAC.

Preferred Alternative 2 assumes the lowest productivity level and, therefore, defines MSY to be lower than the yield that would be defined by Alternatives 3-5. Should stock productivity be higher than what is assumed under this alternative, it could potentially result in foregone yield by needlessly reducing F_{MSY} and F_{OY} below that which would achieve MSY and OY, respectively. Alternatives 3-5 assume sequentially higher productivity levels relative to Alternative 2. However, the harvest levels supported by these alternatives could potentially compromise the ability of the red snapper stock to rebuild to B_{MSY} if the stock-recruitment assumptions on which they are based are overly optimistic.

The RFSAP has never endorsed the use of one stock-recruitment scenario over another. However, in its 1999 report, the panel indicated that the life history characteristics of red snapper do not support the use of the steepness value used to produce the MSY estimates in Alternatives 3 and 5. Additionally, estimates of stock biomass defined using the high maximum recruitment value on which Alternatives 4 and 5 are based have been criticized by the Council and others as unreasonably high. These assumptions regarding productivity will be carefully analyzed and reconsidered in the 2004 stock assessment.

The range of alternatives for defining OY, MSST, and MFMT is identical from bundle to bundle. These parameters constitute a critical component of fishery management programs because they define the targets and thresholds that will be used to assess the status and performance of the fishery. However, the definitions adopted in this amendment for the red snapper stock will have no practical use until the stock is rebuilt. Until that time, the harvest level and fishing mortality rate for the red snapper stock will be dictated by the rebuilding plan adopted by the Council and designed to rebuild the stock within the specified time frame. The definition of MSST adopted in this amendment will provide the benchmark for determining whether the stock is overfished. However, the management measures that are required to rebuild the stock will be dictated by where current biomass is in relation to B_{MSY}, rather than to MSST.

Although these parameters have no immediate practical application, they do provide the Council with the tools needed to define a long-term management program for the red snapper fishery. The alternative definitions evaluated for each parameter are distinguished from one another by the level of risk (and associated tradeoffs) that would be assumed by such a program. Consequently, if the Council retained the definitions adopted in this amendment after the red snapper stock is rebuilt, they could potentially result in indirect effects by influencing the level of TAC that is permitted when the stock is at equilibrium.

OY alternatives A-D for all the bundles would define OY as the average yield associated with fishing at some proportion of F_{MSY} (Alternatives A-C) or at F_{MSY} (Alternative D). The intent of such a definition is to ensure that management measures that are designed to achieve OY would not compromise the red snapper stock's ability to produce MSY over the long term. Alternative A would define the fishing mortality rate associated with OY to be most conservative [(0.65)*F_{MSY}] relative to the other alternatives. This definition would potentially provide for the largest stock biomass and, thus, the greatest insurance that the stock could produce MSY over the long term. A potential tradeoff associated with this added precaution is unnecessary foregone yield.

The fishing mortality rates associated with Alternatives B-D are progressively less conservative than that associated with Alternative A. Restrepo et al. (1998) describe the biological, social, and economic benefits associated with preferred Alternative B. Fishing at the rate specified by that alternative [(0.75)*F_{MSY}] reduces to 20-30 percent the risk that the actual fishing mortality rate would exceed that which would produce MSY on a continuing basis. Studies indicate that fishing at 75 percent of F_{MSY} reduces yield just six percent or less from MSY, while supporting a biomass level that is 25-31 percent greater than B_{MSY}. These studies note that, although the actual performance of fishing at this rate will vary along with the variability in the population dynamics of a stock, in all cases, relatively small sacrifices in yields will result in relatively much larger gains in stock biomass. The socio-economic benefits associated with this balance of tradeoffs should include increased CPUE and decreased costs of fishing (Restrepo et al., 1998).

Alternative C [(0.85)*F_{MSY}] would reduce the safety margin, or buffer, associated with defining OY as the yield produced from fishing at a fraction of F_{MSY}. This could provide for higher yields when managing harvest to attain OY. However, it also could reduce biomass to a level that may make it difficult to sustain the stock over the long term. Alternative D would eliminate the precautionary margin between MSY and OY. While this is permissible under the MSFCMA, it may be risky. Because the fishing mortality rate associated with OY cannot exceed that which defines the overfishing threshold, and because MFMT cannot exceed F_{MSY}, this alternative would require the Council to define MFMT to equal F_{MSY}. It is not logical to define the F_{OY} and MFMT to be equal because F_{OY} specifies the fishing mortality rate fishery managers should strive to attain, and MFMT specifies the threshold level that managers should not allow the fishing mortality rate to exceed.

MSST Alternatives E-F would define an overfished condition as a stock size that is some proportion of B_{MSY}. As noted in Section 3.1.1, the NSGs recommend that the minimum stock size threshold be defined as a stock biomass level that would allow a stock to recover from an overfished condition to B_{MSY} within ten years if exploited at the MFMT. Preferred Alternative E would define the MSST to be a stock size that is just slightly reduced from B_{MSY} ((0.90)*B_{MSY}). This definition is likely to ensure that the red snapper stock could rebuild to B_{MSY} from an overfished condition within ten years.

The tradeoff associated with the assurance provided by Alternative E is that natural variation in recruitment could cause stock biomass to more frequently alternate between an overfished and rebuilt condition — even if the fishing mortality rate applied to the stock was within the limits specified by the MFMT. If realized, this situation would result in administrative and socio-economic burdens related to developing and implementing multiple rebuilding plans.

Alternative F would eliminate this potential complication by establishing a larger buffer between what is considered to be an overfished ((0.50)*B_{MSY}) and rebuilt condition (B_{MSY}). However, this alternative would increase the risk that the stock would not be able to recover from an overfished condition within ten years, and would likely require greater reductions in harvest following an overfished determination. However, simulations on a wide variety of species indicate that stocks at biomass levels below B_{MSY} can rebuild to B_{MSY} with little difficulty as long as fishing mortality is suitably constrained below the MFMT (Myers et al., 1994; Restrepo et al., 1998).

MFMT Alternatives G-I would specify various fishing mortality rates that would be used to signal fishery managers that the red snapper stock's ability to produce MSY is in jeopardy. Preferred Alternative G would set that overfishing threshold equal to F_{MSY}. This definition would allow the fishery to be prosecuted at a rate that provides for higher yields relative to Alternatives H and I. However, that rate would not buffer the fishery's ability to produce MSY over the long term from the influence of other environmental factors. Alternatives H and I would provide such a buffer by defining MFMT as a fraction of F_{MSY}. But this added level of precaution could result in foregone yield. The OY alternative the Council selects will limit the alternative definitions of MFMT that are available to the Council. F_{OY} cannot exceed MFMT.

4 .2 Plans to end overfishing and rebuild the red snapper stock to B_{MSY}

4 .2.1 Development of alternative plans

4.2.1.1 Background

There has been concern over the status of the GOM red snapper stock since 1986. This concern led the Council to implement a rebuilding plan beginning in 1990, which included a series of TAC restrictions on the commercial fishery, and bag limits, a quota which shuts down the fishery when reached, and ultimately a shortened season for the recreational fishery. However, the current rebuilding plan for the GOM red snapper stock is inconsistent with the legal mandates of the MSFCMA.

Juvenile red snapper are frequently caught by shrimp trawls in the GOM. Prior to 1998, shrimp trawls may have accounted for 90 percent of the total red snapper catch (Schirripa and Legault, 1999), all of which was discarded due to a prohibition on landing reef fish caught in trawl gear. Even without this prohibition, the small, juvenile red snapper that are caught in shrimp trawls are an unmarketable size. Consequently, there are some unusual challenges in managing red snapper. The 1999 stock assessment model used two different fishing mortality rates: one for the directed fishery, which was generally low and applied to adult fish, and one for shrimp bycatch, which was generally high and applied to early juvenile fish.

Fishing mortality rates applied to red snapper in the shrimp fishery have changed. Beginning in May 1998, shrimpers fishing west of Cape San Blas, Florida, were required to use BRDs. These devices are designed to reduce the catch of finfish while minimizing shrimp loss. Best estimates indicate that the current configuration of BRDs has reduced the shrimp bycatch fishing mortality rate on red snapper by 40 percent in the shrimp fishery (Nichols, undated).

Results from the most recent stock assessment model (Schirripa and Legault, 1999) indicate that the current reduction in bycatch attributable to BRDs has allowed the red snapper stock to increase, building on stock improvements seen in the latter half of the 1990s. Recruitment levels measured by the Fall Groundfish Trawl Survey were higher in 1995-1997 than in most years since 1982. Additionally, data from the summer SEAMAP trawl survey showed higher abundances in the late 1990s than were observed in the 1980s or early 1990s. Commercial and recreational catch data also suggest a growing red snapper stock (Schirripa and Legault, 1999). However, the assessment, which integrated all of these data, indicates that even the dramatic decrease in bycatch rates is insufficient to end overfishing on red snapper or allow the stock to rebuild to MSY abundance levels if shrimp effort remains constant into the future (Schirripa and Legault, 1999).

Further reductions in bycatch are necessary to rebuild the Gulf red snapper stock to B_{MSY}. These reductions can be achieved either through more effective use of current BRD technology, development of new technology, or reductions in shrimp effort. Field tests conducted by NOAA Fisheries have demonstrated that BRDs may be able to reduce the fishing mortality rate for red snapper in the shrimp fishery by as much as 70 percent (Table 4.2.1; Watson et al., 1999) with small reductions in shrimp catch. Research focusing on the dynamics of water flow and differential behavioral responses of juvenile red snapper and target shrimp promise to further enhance BRD design (Engaas et al., 1999; Watson, 2001). The BRD protocol is being revised to allow for such experimentation and improvements that could further reduce bycatch mortality rates.

Table 4.2.1. Estimates of reduction in fishing mortality rate (F) for juvenile red snapper based on BRD design (from Watson et al., 1999). None of the devices showed a statistically significant decrease in shrimp catches, with absolute changes ranging from a 4 percent decrease to a 1 percent increase in weight of shrimp.

BRD Type	Reduction in fishing mortality rate for red snapper
Jones/Davis	52-67%
Fisheye (2.6 m position)	59-60%
Fisheye (3.8 m position)	66-70%

Reductions in shrimp trawl bycatch are also expected to occur as a result of a future decrease in shrimp effort resulting from extremely adverse economic conditions in the shrimp fishery. While these conditions affect the fishery as a whole, the discussion on projected trends in shrimp effort will primarily focus on the “large” vessel sector of the fleet (herein defined as vessels larger than 60 feet in length) because this component of the fleet primarily operates in offshore waters, and therefore, is believed to have a much higher level of interaction with important finfish species, such as juvenile red snapper, than the "small" vessel sector (vessels less than 60 feet in length).

Prior to an examination of current conditions and projections of expected future conditions, a look at the industry's economic performance over time provides some useful historical context. The most comprehensive analysis of the industry's historical economic performance was conducted in Funk (1998). This analysis examined fleet profitability during the 1965-1995 time period.[1] During these years, the average annual rate of return (net revenue or profit as a percentage of revenue) for the fishery as a whole was 12.5%, which is a respectable figure for capital investors. Given the inherent variability in shrimp stock conditions from year to year and, thus, landings and revenues, it is not surprising that profitability was also quite volatile from year to year, with the industry experiencing exceptionally high profits in some years and very low or negative profits (losses) in other years. In addition to the annual variability in abundance, economic performance appeared to be largely driven by changes in fuel prices, with changes in crew share expenses playing a secondary role. Several researchers have noted that fuel costs have and continue to represent a significant portion of the industry's operating costs (Haby, et al., 2003; Ward et al., 1995). Thus, fluctuations in fuel prices can significantly affect the industry's economic performance.

In addition to variability over time, Funk's analysis also indicated that economic performance varied by vessel size.[2] In general, rates of return tended to be higher on average for smaller vessels than for larger vessels, even though revenues and aggregate profits tended to be higher for the larger vessels. This result indicates that the costs of operating larger vessels also tend to be relatively higher, both in the aggregate and on a per unit basis, than those of smaller vessels. However, Funk hypothesized that ownership status and level of participation in the fishery were two of the most important factors explaining this variation in profitability. That is, smaller vessels tend to be predominantly operated by their owners, but only participate in the shrimp fishery on a part-time basis. These factors increase the flexibility of these vessels' operations. In general, these vessels will only participate in the fishery when revenue and/or profit per unit of effort is relatively high. When low or negative profits are being earned, these vessels and their owners will allocate their time to other fisheries and endeavors.

Conversely, the larger vessels are more frequently operated by hired captains, and participate in the fishery on a full-time basis. In addition to the fact that these captains must be paid, as well as the crew, these vessels have much less flexibility with respect to when they participate in the fishery. Good captains must be retained, lest they be lost to other owners, and bills for relatively high "fixed" costs, such as insurance, mortgage payments, etc., must still be paid regardless of whether the vessel fishes or not. Furthermore, many of these larger vessels are part of a vertically integrated operation (i.e. they are owned by processing firms). In such instances, the goal of the owner is likely to maximize profits for the entire operation as opposed to the individual vessel. A stable supply of shrimp is critical to the profitable operation of processing plants. All of these factors will cause these larger vessels to continue operating in the shrimp

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[1] In this analysis, "profits" were defined as revenue minus cash costs, and thus did not take depreciation or the owner's opportunity cost of capital into account. The analyses by NOAA Fisheries (2002) and Travis and Griffin (2003) cited in this report did take these additional costs into account when examining economic performance.

[2] Three vessel size categories were used in this analysis: small (< 45 feet), medium (45-60 feet), and large (>60 feet). The analyses by NOAA Fisheries (2002) and Travis and Griffin (2003) combined the small and medium categories into a single "small" vessel category.

fishery, even when profits are low or negative. Therefore, on average and over time, a lower rate of return should be expected for larger vessels relative to smaller vessels in this fishery.

Funk's results confirm this expectation. Specifically, small- and medium-sized vessels earned a 30.8% and 18.9% rate of return on average, respectively, during the 1965-1995 time period, whereas large vessels only earned a 6.2% return. In fact, the smallest vessel class did not indicate a negative profit in any year during this time period, though the large vessel class experienced negative profits during several years. Nonetheless, overall, this industry was historically profitable during this time period.

Recent analyses, however, indicate that this trend of historical profitability ended in 2000. These analyses employed Griffin's General Bioeconomic Simulation Model (GBFSM). The details of GBFSM's structure and the calibration process are described in Grant and Griffin (1979) and at http://gbfsm.tamu.edu. The GBFSM currently represents the best available model for analyzing changes in the Gulf shrimp fishery's economic performance.

The GBFSM is flexible in the sense that it can analyze the fishery at different levels of aggregation. In these recent analyses, the fishery has been analyzed at a highly disaggregated level so as to more accurately capture the nature and sources of change in the fishery. Specifically, this version of GBFSM used the following components: five Regions/states of landing (West Florida, Alabama, Mississippi, Louisiana, and Texas); six areas fished - Lower Florida (statistical areas 1 through 3), Upper Florida (statistical areas 4 through 9), Alabama/Mississippi/East Louisiana (statistical areas 10-12), West Louisiana (statistical areas 13-17), Upper Texas (statistical areas 18 and 19), and Lower Texas (statistical areas 20 and 21); five depths fished (inshore, one to five fathoms, six to 10 fathoms, 11 to 20 fathoms, and greater than 20 fathoms); three species of shrimp (brown shrimp, white shrimp, and pink shrimp); six size classes of shrimp (greater than 20 count, 21 to 30 count, 31 to 50 count, 51 to 67 count, 68 to 116 count, and greater than 116 count); two vessel size classes - small (less than 60 feet) and large (greater than or equal to 60 feet); and 48 time steps over the course of a year (i.e., each time step represents approximately an eight day time increment). The model was tuned to average landings over the 1991-1995 time period.[3] A nominal day fished (nominal effort) represents twenty-four hours of trawl time and is, therefore, equivalent to a "trawl day," which is the term commonly employed within the NOAA Fisheries' shrimp stock assessments. However, effort estimates within GBFSM are derived using the method developed by Griffin et al. (1997), as opposed to the "averaging" method used in the NOAA Fisheries' shrimp stock assessments (Nance, 1992). Due to data limitations, the model measures changes in the number of vessels by employing the concept of "full-time equivalent vessels" (FTEVs). The number of FTEVs represents the number of vessels that would be necessary to harvest the resource if each vessel operated on a full-time basis (i.e. eight hours a day for five days a week). Landings, price, and revenue data were obtained from the NOAA Fisheries shrimp landings data files maintained by the NOAA Fisheries' Galveston Laboratory. Due to the lack of current cost data for the fishery, costs were estimated based on the approach developed by Funk et al. (1998). Costs and prices were converted into real or constant dollar terms using the Producer Price Index (PPI). Profits (rents) are defined as the difference between gross revenues and total costs, where total costs are composed of variable costs (i.e. fuel, ice, labor, etc.) and fixed costs (vessel loan payments, vessel insurance, etc.).

[3]Effort data during this time period are exogenous to the model. Various biological coefficients related to recruitment, mortality, growth, and migration were adjusted until simulated landings by area, species, depth zone, size, and month approximate actual landings as closely as possible.

The first of these recent analyses was conducted to examine the impacts of the recently implemented rule that modified Turtle Excluder Device (TED) regulations in the Gulf and South Atlantic shrimp fisheries (NOAA Fisheries, 2002). Part of this analysis examined changes in the Gulf shrimp trawl fishery's economic performance between 1998 and 2001.[4] This analysis indicated that the large vessel component of the fishery was profitable to highly profitable between 1998 and 2000. Nominal shrimp prices were relatively stable and fuel prices were relatively low by historical standards, and abundance tended to be higher than historical averages. Undoubtedly, strong conditions at the macroeconomic level created relatively high levels of consumer demand for shrimp, which in turn engendered strong economic performance in the shrimp industry.

However, economic conditions took an abrupt change in the latter half of 2001. Current evidence indicates that as imports surged, macroeconomic conditions deteriorated, and the post 9/11 era began, the industry was hit by sharply declining prices and higher insurance premiums.[5] At least for the large vessel sector, profits turned into losses by the end of 2001. The deteriorating trend appears to have continued through 2002 and 2003, exacerbated by increases in fuel prices that began in the latter part of 2002 and continued through 2003. According to average price data reported by the Bureau of Labor Statistics, from 2002 to 2003, fuel prices increased between 21% and 29%, depending on the selected fuel price index.[6] Regardless of which index used, fuel prices increased significantly which, in turn, significantly increased shrimp vessels' operating costs.

By 2002, as indicated in the economic analysis of the 2003 Texas Closure policy (Travis and Griffin, 2003) and the supplemental economic analysis of Amendment 10 to the Shrimp Fishery Management Plan (NOAA Fisheries, 2003c), economic conditions deteriorated to the point where all sectors of the Gulf shrimp fishery, regardless of vessel size, state, or gear, were facing negative profits (losses), on average, by the end of 2002. According to the Texas Closure analysis, for the fishery as a whole in 2002, the average rate of return (profits or losses as a percentage of revenue) was expected to be approximately -41%, with lower loss rates being experienced for the small vessel sector (-30%) relative to the large vessel sector (-45%). Regardless of whether the Texas Closure policy was continued or not, projections for 2003 indicated that these economic losses would persist under current conditions.

The analyses clearly indicate that rapidly declining prices have been the primary source of the recent deterioration in the industry's economic condition. In the aggregate, the average nominal price of shrimp in the Gulf decreased by approximately 28% between 2000 and 2002. Revenues decreased even more as a result of relatively lower shrimp abundance and, therefore, landings in 2001 and 2002 relative to 2000. The magnitude of the price decline has varied by shrimp size

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[4] Unlike the other analyses, the TED rule analysis only examined economic performance of the trawl component of the fishery, since non-trawl gear (e.g. skimmers and butterfly nets) is exempt from the TED requirements. The large vessels in the Gulf almost exclusively use trawl gear, whereas non-trawl gear has become increasingly important in the small vessel sector over the past 5 years. Thus, the results of that analysis for the small vessel sector are not directly comparable with results from the other analyses and are therefore not referenced here.

[5] Increases in vessel insurance premiums are documented in a Commercial Fisheries News article, a reprint of which can be found at http://www.fishresearch.org/Articles/2002/10/insurance.asp.

[6] According to information posted to http://data.bls.gov on February 17, 2004, the Consumer Price Index's average price data for fuel oil, Series APU00007251, indicates that fuel prices increased by 21% between 2002 and 2003. However, the PPI's data on average prices for #2 diesel fuel, Series WPU057303, indicates that fuel prices increased by 29% during this time.

category, with the under 15 count ("jumbo") and 68 and over count ("small") size categories seeing the smallest declines (approximately 23%) and the 31-40 and 41-50 count ("large" and "medium") size categories seeing the largest declines (approximately 35%). Due to inflation, these price declines are even larger in real terms.

According to Haby et al. (2003), increases in shrimp imports have been the primary cause of the recent decline in U.S. shrimp prices. A complete discussion of the factors contributing to the increase in imports can be found in Haby et al. (2003). In general, recent surges in imports have been caused by increases in the production of foreign, farm-raised shrimp. More specifically, increased competition from shrimp imports has been due to three primary factors: 1) changes in product form due to relatively lower wages in the exporting countries, 2) shifts in production to larger count sizes, and 3) tariff and exchange rate conditions which have been favorable to shrimp imports into the U.S. With respect to the first factor, relatively lower wage rates have allowed major shrimp exporters (e.g. Thailand) to increase production of more convenient and higher value product forms, such as hand-peeled raw and cooked shrimp. With respect to the second factor, changes in farming technology and species have allowed production of foreign product to shift towards larger, more valuable sizes. As a result of these factors, imports are more directly competing with the product traditionally harvested by the domestic industry, thereby reducing the latter's historical comparative advantage with respect to these product forms and sizes. Finally, with respect to the third factor, the lack of duties on shrimp imports into the U.S., the presence of relatively significant duties on shrimp imports into the European Union, and the recent strength of the U.S. dollar relative to foreign currencies have created favorable conditions for countries exporting products to the U.S.

As Haby et. al. (2003) note, the increase in imports has caused the domestic industry's share of the U.S. shrimp market to decrease from 44.6% to 14.8% between 1980 and 2001. And while the growth in imports was relatively steady throughout most of this time period (for e.g., 4-5% in the late 1990's), shrimp imports surged by 16% in 2001. And since 2001, which is the last year accounted for in their analysis, shrimp imports have continued to rise. Although the increase in 2002 was a modest 7.2%, relative to the increase in 2001, a significant increase of 17.5% occurred in 2003 according to the most recently available data.[7] Undoubtedly, these increases have led to further erosion in the domestic industry's market share and additional price declines.

The economic analysis of the 2003 Texas Closure was recently re-examined and updated to investigate pertains to the industry's current economic status (Travis and Griffen, 2004). Certain changes were incorporated in this examination. First, the original analysis was based on preliminary data for 2002. The new projections incorporate finalized data for 2002.

Second, caps of 5% and 8% were placed on the rate of exit from the fishery for large and small vessels respectively in the original analysis. In general, vessels are expected to exit the fishery when profits (rents) are negative (i.e. losses are being incurred) and enter when profits are positive. The rate of exit and entry is dependent on the magnitude of those profits or losses. The use of caps on the maximum rate of entry and exit within GBFSM has been historically based on the concept of asset fixity. The purpose of this concept is to recognize the fact that capital (the vessel) is not perfectly malleable or transferable. That is, capital cannot be immediately converted for other uses. Differences in the flexibility of large and small vessel operations explain the differential caps between the two sectors. However, as valid as this concept may be, asset fixity becomes less important and relevant if vessels continue to lose money (i.e. operate at

[7]Shrimp import data can be found at http://www.st.nmfs.gov/st1/trade/trade_prdct_cntry.html. Statistics cited in this report were based on data posted as of March 25, 2004.

a loss) over an extended period of time. Losses, particularly large losses, cannot be incurred indefinitely.

The analysis indicated that the cap on the rate of exit was being reached in both the large and small vessel sectors in 2002. Furthermore, the analysis revealed that, on average, vessels were not even able to cover their variable costs in 2002. Preliminary information indicates that prices have continued to decline in 2003,[8] which would lead to the expectation that the vessels' inability to cover their variable costs has continued in 2003. If vessels cannot cover their variable costs, they will be forced to cease operations (i.e. exit the fishery), at least until conditions change. In response to these considerations, when variable costs exceed total revenue in the updated analysis, the caps on the rate of exit were doubled to 10% and 16%, respectively, thereby allowing vessels to exit the fishery more quickly if conditions so warrant.

Third, projections of fleet size (as measured by FTEVs) and nominal effort were updated and extended farther into the future (20 years, or through 2021) to determine how long it would take for the fishery to reach an equilibrium state, assuming no changes in external factors (e.g. imports, regulations, etc.). In general, equilibrium occurs once economic losses are no longer being incurred (i.e. economic profits are zero) and fleet size is stable (i.e. fleet size has reached its minimum level).

According to the new projections (see Tables 4.2.2 and 4.2.3), the average rate of return in the fishery for 2002 is projected to have been approximately -33%, slightly better than initial projection, and the difference between the rates of return in the small vessel sector and large vessel sector also narrowed to a small degree (-27% and -36%, respectively). Economic losses are forecast to continue throughout the fishery on average until 2012, *ceteris paribus*. As would be expected, these losses cause vessels to continue exiting from the fishery during this time. As shown in Table 4.2.2, the size of the large vessel sector and level of associated fishing activity decline continuously, in terms of FTEVs and nominal effort, through 2012 and are expected to have decreased by 39% and 34%, respectively, relative to 2002 levels.[9] However, only the large vessel sector reaches an equilibrium by 2012. Although the number of FTEVs and nominal effort are expected to decrease in the small vessel sector by approximately 29% by 2012, the small vessel sector continues to decrease in size and effort throughout the entire twenty-year simulation (see Table 4.2.3).

The logic behind this differential result between the large and small vessel sectors is fairly straightforward. Specifically, as large vessels, which predominately operate in offshore waters, exit the fishery, their departure leads to an improvement in the economic performance of the large vessels that remain in the fishery, primarily as a result of increases in CPUE in offshore waters. However, given the migration pattern of shrimp from inshore to offshore waters, the departure of large vessels does not generally increase CPUE in inshore waters where the smaller vessels tend to operate. Conversely, the departure of small vessels improves the economic performance of both small and large vessels by removing competition in inshore waters and by allowing more shrimp to escape into offshore waters (i.e., CPUE should increase in both inshore

[8]Current data for 2003, which does not generally include information pertaining to the fourth quarter of the year, indicates that the decline in nominal prices from 2000 is 36% across all size categories. Depending on the size category, the declines range from 27% to 40%.

[9]Within each region, nominal effort and the number of FTEVs are proportional by definition. However, if economic performance varies across regions, then rates of vessel entry and exit will also vary by region. As such, the percentage changes in nominal effort and the number of FTEVs over time will not be exactly proportional for the fishery as a whole.

and offshore waters). Although the economic performance of large vessels is expected to improve more quickly than that of small vessels, *ceteris paribus*, it must be emphasized that, under current conditions, economic recovery even in the large vessel sector is not expected for several years.

It is important to note that these projections assume that external factors such as imports, fuel prices, and other costs remain unchanged from their 2002 status. That is, recent information regarding increases in fuel prices, insurance premiums, and imports, and further declines in shrimp prices during 2003 have not yet been incorporated into the model and analysis since final data are not yet available. Since these changes would be expected to further erode the industry's economic performance, the projections of economic losses, decreases in fleet size and effort, and the period of time before the large vessel sector stabilizes are likely underestimated. Thus, unless other factors change in a manner that would contravene these adverse impacts, these projections should be considered conservative.

If shrimp effort is reduced, particularly that of large vessels, it is anticipated that red snapper bycatch will also decrease and should translate into red snapper savings according to the following formula:

$$F_S(t) = 0.6 F_{Sh} E_S(t) / E_{Sh}$$

where $F_S(t)$ is the fishing mortality rate attributable to bycatch in the shrimp fishery in year t, F_{Sh} represents the historical fishing mortality rate attributable to bycatch in the shrimp fishery prior to the 1998 BRD requirement, $E_S(t)$ is the shrimp fishery effort in year t, and E_{Sh} represents the historical effort of the shrimp fishery. Conceptually, this equation states that the bycatch mortality rates will be lower than historical rates. Given a bycatch reduction by BRDs of 40 percent and according further reductions in effort of between 30 and 50 percent which provides a range around the reduction of effort given in the above analyses, the total bycatch reduction calculated by this equation would be 58 to 70 percent.

Critics of the Council's preferred rebuilding plan alternative have suggested that the plan does not equitably distribute the socio-economic burden associated with rebuilding red snapper between the directed red snapper fishery and the shrimp fishery. Instead, the plan relies on predicted effort reductions in the shrimp fishery to reduce fishing mortality on red snapper.

Predictions about the extent to which effort will be reduced in the shrimp fishery in response to changing economic conditions are based on the best available information. Analyses show that these anticipated reductions would allow the red snapper stock to rebuild to B_{MSY} within the maximum recommended time frame without reducing TAC in the directed fishery below the current level. Instead, the Council's preferred constant-catch strategy would reduce the fishing mortality rate applied to the directed fishery over time as the stock rebuilds. A rebuilding strategy that allows the fishing mortality rate to be reduced gradually over time is less economically costly in the short term compared to a strategy that would require large reductions in fishing mortality in the initial years of the rebuilding schedule.

Because constant-catch strategies allow fishing to occur at higher rates in the initial years of the rebuilding schedule, they increase spawning stock biomass more slowly in the initial years of the rebuilding schedule compared to constant-F strategies. Delaying rebuilding could cause the stock to be more susceptible to adverse environmental conditions that might affect recruitment success, or to unanticipated parameter misestimation that might inadvertently support excessive fishing. However, in the case of red snapper, anticipated reductions in shrimp effort are expected to increase the rate of rebuilding in the initial years of the schedule.

Table 4.2.2. Simulation results for large vessels

Year	FTEVs	Days Fished	Landings (heads-off lbs. thousands)	Revenue ($ thousands)	Price/lb ($)	Variable Costs ($ thousands)	Producer Surplus ($ thousands)	Fixed/ Opportunity Costs ($ thousands)	Rent ($ thousands)	CPUE	Rent per FTEV ($)
2002	2144	158662	72493	190706	2.63	187612	3093	70950	-67857	457	-31650
2003	1954	144599	69964	185923	2.66	173831	12092	64663	-52571	484	-26904
2004	1796	133341	68961	185320	2.69	163558	21763	59434	-37671	517	-20975
2005	1663	124091	68010	184665	2.72	155078	29586	55033	-25446	548	-15301
2006	1555	117077	67281	184240	2.74	148666	35575	51459	-15884	575	-10215
2007	1469	111648	66361	183085	2.76	143509	39576	48613	-9037	594	-6152
2008	1404	107806	65651	182064	2.77	139811	42253	46462	-4209	609	-2998
2009	1359	105423	65278	181717	2.78	137585	44132	44973	-841	619	-619
2010	1331	104279	65220	182004	2.79	136622	45382	44046	1336	625	1004
2011	1318	104131	65469	183008	2.8	136725	46283	43616	2667	629	2024
2012	1313	104707	65945	184518	2.8	137598	46919	43450	3469	630	2642
2013	1315	105751	66566	186310	2.8	138960	47351	43517	3834	629	2916
2014	1320	107042	67264	188233	2.8	140573	47660	43682	3978	628	3014
2015	1325	108459	68003	190214	2.8	142314	47901	43848	4053	627	3059
2016	1331	109978	68771	192215	2.79	144151	48064	44046	4018	625	3019
2017	1337	111589	69560	194225	2.79	146074	48152	44245	3907	623	2922
2018	1342	113171	70326	196130	2.79	147945	48185	44410	3775	621	2813
2019	1347	114853	71115	198071	2.79	149915	48157	44576	3581	619	2659
2020	1352	116625	71919	200034	2.78	151971	48063	44741	3322	617	2457
2021	1357	118494	72726	201958	2.78	154106	47853	44907	2946	614	2171

Table 4.2.3. Simulation results for small vessels

Year	FTEVs	Days Fished	Landings (heads-off lbs. thousands)	Revenue ($ thousands)	Price/lb ($)	Variable Costs ($ thousands)	Producer Surplus ($ thousands)	Fixed/ Opportunity Costs ($ thousands)	Rent ($ thousands)	CPUE	Rent per FTEV ($)
2002	6920	138595	49541	79801	1.61	90828	-11027	10584	-21612	357	-3123
2003	6481	129796	48450	78843	1.63	85834	-6992	9900	-16891	373	-2606
2004	5993	120010	46832	77064	1.65	80150	-3087	9141	-12228	390	-2040
2005	5645	113105	45605	75826	1.66	76176	-351	8629	-8979	403	-1591
2006	5374	107735	44543	74654	1.68	73049	1605	8228	-6623	413	-1232
2007	5259	105450	44186	74371	1.68	71750	2621	8048	-5427	419	-1032
2008	5165	103582	43857	74042	1.69	70669	3373	7902	-4529	423	-877
2009	5084	102007	43542	73671	1.69	69739	3932	7774	-3842	427	-756
2010	5015	100661	43236	73259	1.69	68925	4334	7664	-3330	430	-664
2011	4954	99491	42933	72816	1.7	68201	4615	7566	-2950	432	-595
2012	4900	98452	42633	72346	1.7	67543	4803	7477	-2674	433	-546
2013	4851	97511	42335	71857	1.7	66934	4923	7395	-2472	434	-510
2014	4805	96639	42042	71359	1.7	66362	4997	7318	-2320	435	-483
2015	4762	95819	41753	70858	1.7	65818	5040	7246	-2206	436	-463
2016	4721	95040	41467	70352	1.7	65294	5058	7177	-2119	436	-449
2017	4683	94291	41184	69841	1.7	64786	5055	7112	-2057	437	-439
2018	4645	93566	40912	69349	1.7	64294	5056	7047	-1991	437	-429
2019	4608	92864	40640	68851	1.69	63812	5039	6982	-1943	438	-422
2020	4572	92181	40369	68348	1.69	63339	5009	6919	-1910	438	-418
2021	4537	91513	40098	67840	1.69	62872	4968	6857	-1889	438	-416

It is possible that estimated reductions in shrimp effort will not occur or will be less than what is anticipated. Additionally, it is possible that it will be difficult to maintain catch at current levels as the red snapper stock increases in size over time. The Council's preferred constant-catch strategy also could result in an increase in the incidence of bycatch at higher stock sizes. Should any of these factors compromise the ability of the red snapper stock to rebuild to B_{MSY} within the specified time frame, the Council would need to take additional action as described in Section 4.2.1.2.

4.2.1.2 Range of alternatives

The MSFCMA requires that overfishing be halted over time and that overfished stocks be rebuilt to MSY abundance levels ($B_{MSY)}$. The rebuilding time frame should not exceed 10 years except in cases where biology, other environmental conditions, or international agreements dictate otherwise (MSFCMA § 304(e)(4)). The GOM red snapper stock assessment indicates that it would take 12 years, even in the absence of any directed fishery or bycatch (Schirripa and Legault, 1999) to rebuild the stock. In such cases, the agency's guidelines suggest that rebuilding times should not exceed the time it would take to rebuild in the absence of fishing plus one mean generation time (50 CFR § 600.310(e)(4)(ii)(B)(3)). Applied to Gulf red snapper, this formula yields a maximum 31.6 year rebuilding time frame based on 12 years to rebuild in the absence of fishing and a 19.6 year mean generation time (Schirripa and Legault, 1999). When overfishing ends depends on the type of strategy selected to rebuild the stock. However, a stock cannot rebuild if overfishing is allowed to continue indefinitely.

Efforts to rebuild Gulf red snapper are complicated by the significant amounts of bycatch that occur in the shrimp fishery. The effects of this bycatch on the red snapper population are substantially greater than the effects of the directed fishery. This is illustrated in the fact that ending overfishing and stock rebuilding within the next 100 years cannot be achieved at current bycatch mortality rates (40 percent bycatch reduction) according to the red snapper stock assessment model, even if the directed red snapper fishery were eliminated (Fig. 4.2.1). The effects are also apparent in comparisons of the time it would take to rebuild red snapper. Whereas a 10 percent reduction in shrimp effort (and, presumably, bycatch) typically speeds up the rebuilding time by 10 years or more, a reduction in the directed catch of over 30 percent (from 9.12 to 6 mp wwt) only speeds up rebuilding by a few years (Fig. 4.2.2). This point is further demonstrated by comparing rebuilding times of a TAC equal to zero to a TAC equal to 9.12 mp, given the same bycatch mortality reductions and reductions in shrimp effort. In this case, the stock only rebuilds three to seven years sooner at the zero TAC than if TAC is maintained at 9.12 mp (Table 4.2.4).

As a result, ending overfishing and allowing the red snapper stock to rebuild cannot occur through regulations on the directed fishery alone. At the same time, an amendment to the Reef Fish FMP is not the appropriate place to address regulations to the shrimp fishery. Effort reductions in the shrimp fishery resulting from deteriorating economic conditions are discussed in Section 4.2.1.1, with expected effort declining in excess of 30 percent. This reduction, coupled with efforts to manage effort in the shrimp fishery, not only makes it possible to end overfishing and rebuild GOM red snapper, it makes rebuilding likely without major short-term harvest reductions in the directed fishery.

There are, nonetheless, trade-offs in alternative rebuilding strategies to rebuild red snapper. In considering a range of alternatives, consideration should be paid to balancing short-term costs and long-term benefits to the stock. Some alternatives were considered but rejected because their short-term costs would have been excessive when compared to the likely long-term benefits. Examples include a policy that set fishing rates using a constant OY fishing mortality rate (F_{OY}), and one that eliminated all directed fishing. Both of these rebuilding strategies would be economically devastating to the directed red snapper fishery in the short term and neither would be expected to provide substantive gains in long-term benefits due to the relatively small influence directed harvest has on the recovery of the resource.

Each alternative includes a periodic review of progress made towards rebuilding. These reviews are designed to incorporate new information and to address unanticipated developments in the red snapper and shrimp fisheries, and would be used to make appropriate adjustments in the red snapper regulations should insufficient or unexpectedly rapid rebuilding progress occur. These assessments would be requested as needed by the Council when the Council and NOAA Fisheries' Southeast Regional Office (SERO) develop the yearly operations plan, and would be subject to the availability of funds to conduct the assessment. It should be noted that these periodic stock assessments are not meant to replace the scheduled review by the Secretary of Commerce of rebuilding plans/regulations of overfished fisheries required under §304(e)(7) of the MSFCMA that is to occur at least every two years to ensure adequate progress toward stock rebuilding and ending overfishing. Additionally, NOAA Fisheries annually reports on the status of stocks in its Report to Congress.

Reviews will be based on periodic stock assessments. The next assessment is scheduled to occur this year and should benefit from a substantial investment made by the federal government into studies of the red snapper fishery. Since 1998, NOAA Fisheries has expended over 20 million dollars internally to study red snapper, and has provided nearly six million dollars to academic and independent research organizations towards red snapper research. It is likely that results from this continued research will improve future stock assessments. If this occurs, the perception of the red snapper stock status may change and more or fewer restrictions may be necessary to rebuild the red snapper stock.

Based on annual updates on the harvest or on projected stock status from the periodic stock assessments, the Council may need to take management action because the red snapper harvest exceeds, or is expected to exceed, the harvest dictated by the rebuilding plan. Actions that the Council could employ to further restrict harvest could include, but would not be limited to changes in size limits, bag limits, seasonal closures or area closures. The Council has four options for implementing these measures. The first is to amend the Reef Fish FMP to include new information and management actions. Recent plan amendments put forth by the Council have taken between two and three years from conception to implementation. The second method is a regulatory amendment based on the framework established in Amendments 1 and 4 of the Reef Fish FMP to set TAC. Appropriate regulatory changes that may be implemented through framework include: 1) setting the TAC's for each stock or stock complex to achieve a specific level of ABC; and 2) bag limits, size limits, vessel trip limits, closed seasons or areas, gear restrictions, and quotas designed to achieve the TAC level (GMFMC, 1989; 1991). However, TAC and catch limits may be adjusted only after a new stock assessment has been completed. Recent regulatory amendments have taken between 9 months and two years from conception to implementation.

Table 4.2.4. TAC, F/F_{MSY}, and B/B_{MSY} by year for constant catch rebuilding paths using a zero and 9.12 mp constant catch harvest rate with 30 and 50 percent reductions in shrimp effort. Light gray indicates the stock is not subject to overfishing ($F/F_{MSY}<1$) and dark gray indicates the stock is no longer overfished ($B/B_{MSY}>1$).

	Constant Zero TAC						Constant 9.12 mp TAC (preferred Alternative 2)					
	30% reduction shrimp effort			50% reduction shrimp effort			30% reduction shrimp effort			50% reduction shrimp effort		
year	Yield(mp)	F/F_{MSY}	B/B_{MSY}	Yield(mp)	F/F_{MSY}	B/B_{MSY}	Yield(mp)	F/F_{MSY}	B/B_{MSY}	Yield(mp)	F/F_{MSY}	B/B_{MSY}
1999	10.0326	2.81	0.071	10.0326	2.81	0.071	10.0326	3.75	0.071	10.0326	2.81	0.071
2000	8.77	2.52	0.073	9.02	2.52	0.073	8.77	3.36	0.073	9.02	2.52	0.073
2001	9.13	2.41	0.077	9.4	2.41	0.077	9.13	3.22	0.077	9.4	2.41	0.077
2002	10.11	2.07	0.082	9.32	2.07	0.082	10.11	2.76	0.082	9.32	2.07	0.082
2003	9.16	1.72	0.088	9.12	1.72	0.088	9.16	2.30	0.088	9.12	1.72	0.088
2004	9.12	1.52	0.097	9.12	1.52	0.097	9.12	2.02	0.097	9.12	1.52	0.097
2005	0	0	0.106	0	0	0.106	9.12	1.38	0.106	9.12	1.38	0.106
2006	0	0	0.121	0	0	0.121	9.12	1.28	0.116	9.12	1.28	0.116
2007	0	0	0.137	0	0	0.139	9.12	1.19	0.127	9.12	1.19	0.129
2008	0	0	0.156	0	0	0.162	9.12	1.11	0.139	9.12	1.05	0.145
2009	0	0	0.176	0	0	0.189	9.12	1.04	0.153	9.12	0.85	0.165
2010	0	0	0.198	0	0	0.220	9.12	0.97	0.168	9.12	0.71	0.189
2011	0	0	0.223	0	0	0.256	9.12	0.87	0.185	9.12	0.62	0.216
2012	0	0	0.251	0	0	0.295	9.12	0.76	0.205	9.12	0.56	0.246
2013	0	0	0.282	0	0	0.338	9.12	0.67	0.228	9.12	0.51	0.280
2014	0	0	0.315	0	0	0.384	9.12	0.60	0.253	9.12	0.47	0.317
2015	0	0	0.351	0	0	0.432	9.12	0.55	0.280	9.12	0.43	0.356
2016	0	0	0.389	0	0	0.482	9.12	0.51	0.309	9.12	0.40	0.397
2017	0	0	0.428	0	0	0.534	9.12	0.48	0.339	9.12	0.37	0.439
2018	0	0	0.468	0	0	0.586	9.12	0.45	0.370	9.12	0.34	0.483
2019	0	0	0.508	0	0	0.638	9.12	0.42	0.403	9.12	0.32	0.528
2020	0	0	0.548	0	0	0.693	9.12	0.40	0.436	9.12	0.30	0.574
2021	0	0	0.588	0	0	0.746	9.12	0.38	0.470	9.12	0.28	0.622
2022	0	0	0.628	0	0	0.799	9.12	0.36	0.504	9.12	0.27	0.669
2023	0	0	0.668	0	0	0.850	9.12	0.34	0.538	9.12	0.26	0.715
2024	0	0	0.708	0	0	0.900	9.12	0.33	0.573	9.12	0.25	0.761
2025	0	0	0.745	0	0	0.948	9.12	0.31	0.607	9.12	0.24	0.806
2026	0	0	0.782	0	0	0.994	9.12	0.30	0.640	9.12	0.23	0.849
2027	0	0	0.817	0	0	1.038	9.12	0.29	0.672	9.12	0.22	0.892
2028	0	0	0.850	0	0	1.080	9.12	0.28	0.704	9.12	0.21	0.932
2029	0	0	0.882	0	0	1.120	9.12	0.27	0.734	9.12	0.21	0.972
2030	0	0	0.912	0	0	1.158	9.12	0.27	0.763	9.12	0.20	1.009
2031	0	0	0.940	0	0	1.193	9.12	0.26	0.791	9.12	0.20	1.045
2032	0	0	0.967	0	0	1.226	9.12	0.25	0.818	9.12	0.19	1.079
2033	0	0	0.992	0	0	1.257	9.12	0.25	0.844	9.12	0.19	1.112
2034	0	0	1.015	0	0	1.287	9.12	0.24	0.868	9.12	0.19	1.142
2035	0	0	1.038	0	0	1.314	9.12	0.24	0.891	9.12	0.18	1.171
2036	0	0	1.058	0	0	1.339	9.12	0.23	0.913	9.12	0.18	1.197
2037	0	0	1.077	0	0	1.362	9.12	0.23	0.934	9.12	0.18	1.223
2038	0	0	1.095	0	0	1.384	9.12	0.23	0.953	9.12	0.18	1.246
2039	0	0	1.112	0	0	1.404	9.12	0.22	0.972	9.12	0.17	1.268
2040	0	0	1.127	0	0	1.422	9.12	0.22	0.989	9.12	0.17	1.289
2041	0	0	1.142	0	0	1.439	9.12	0.22	1.005	9.12	0.17	1.308
2042	0	0	1.155	0	0	1.455	9.12	0.22	1.020	9.12	0.17	1.325
2043	0	0	1.167	0	0	1.470	9.12	0.21	1.034	9.12	0.17	1.342
2044	0	0	1.179	0	0	1.483	9.12	0.21	1.047	9.12	0.17	1.357
2045	0	0	1.189	0	0	1.496	9.12	0.21	1.060	9.12	0.16	1.371
2046	0	0	1.199	0	0	1.507	9.12	0.21	1.071	9.12	0.16	1.384
2047	0	0	1.208	0	0	1.517	9.12	0.21	1.082	9.12	0.16	1.396
2048	0	0	1.216	0	0	1.527	9.12	0.21	1.092	9.12	0.16	1.407
2049	0	0	1.224	0	0	1.536	9.12	0.21	1.101	9.12	0.16	1.418

The other two management actions are an emergency action or an interim measure. The MSFCMA states in section §305(c)(2) that "if a Council finds that an emergency or overfishing exists or that interim measures are needed to reduce overfishing for any fishery within its jurisdiction, whether or not a fishery management plan exists for such fishery--

(A) the Secretary shall promulgate emergency regulations or interim measures under paragraph (1) to address the emergency or overfishing if the Council, by unanimous vote of the members who are voting members, requests the taking of such actions; and

(B) the Secretary may promulgate emergency regulations or interim measures under paragraph (1) to address the emergency or overfishing if the Council, by less than a unanimous vote, requests the taking of such action."

Emergency actions and interim measures only remain in effect for 180 days after the date of publication of the rule and may be extended by publication in the *Federal Register* for one additional period of not more than 180 days provided the public has had an opportunity to comment on the emergency actions and interim measures. The MSFCMA further states that when a Council requests that an emergency action and interim measure be taken, the Council should also be actively preparing regulations that address the emergency on a permanent basis.

What type of rule making vehicle the Council decides to select should harvests exceed those described by the rebuilding plan is difficult to predict. Actions would be dictated by the severity of overages in harvest and by the time frame needed to implement a regulatory change. If the overage in harvest is small, but would still allow the stock to recover within the maximum time frame required by NOAA Fisheries guidance, the Council would likely institute a change in existing management measures to reduce harvest through a plan or regulatory amendment. Should the overage be severe, the Council could ask for an emergency action or interim rule that would severely restrict or halt the harvest of red snapper while the Council explores management measures that would bring the harvest to levels consistent with those defined by the rebuilding plan.

4 .2.2 Description of alternatives for ending overfishing and rebuilding s the stock, with comparisons of their environmental impacts

4 .2.2.1 Alternative 1: Status quo - no action

Maintain the current rebuilding schedule for red snapper. Adjust TAC biannually to maintain a rebuilding trajectory that rebuilds the red snapper stock to 20 percent SPR by 2019.

4 .2.2.2 Alternative 2 (Preferred):

Maintain TAC at 9.12 mp wwt, end overfishing between 2009 and 2010, and rebuild red snapper by 2032. Review and adjust this policy, as necessary, through periodic assessments. Monitor annual landings to ensure quota is not exceeded.

4 .2.2.3 Alternative 3:

Reduce TAC to 6.0 mp wwt, end overfishing between 2005 and 2007, and maintain this TAC to rebuild red snapper by 2032. Review and adjust this policy, as necessary, through periodic assessments. Monitor annual landings to ensure quota is not exceeded.

4 .2.2.4 Alternative 4:

Maintain TAC at 9.12 mp wwt until the stock has rebuilt sufficiently that a constant fishing mortality rate, F_{OY}, would grant higher catches, end overfishing between 2009 and 2010, and rebuild the red snapper stock by 2046 . Review and adjust this policy, as necessary, through periodic assessments. Monitor annual landings to ensure the quota is not exceeded.

4 .2.2.5 Alternative 5:

Reduce TAC to 6.0 mp wwt, maintaining this level until the stock has rebuilt sufficiently that a constant fishing mortality rate, F_{OY}, would grant higher catches, end overfishing between 2005 and 2007, and rebuild the red snapper stock by 2045. Review and adjust this policy, as necessary, through periodic assessments. Monitor annual landings to ensure the quota is not exceeded.

Alternative 1 (no action) would maintain the current red snapper rebuilding plan that was put in place in 1996 through a regulatory amendment to the Reef Fish Fishery Management Plan. This amendment raised the red snapper TAC from 6 to 9.12 mp (4.65 mp allocated to the commercial sector and 4.47 mp to the recreational sector), and set 2019 as the recovery target date to achieve a 20 percent SPR. This extension was based on new biological information that red snapper have a longer generation time than was previously believed.

SPR represents the ratio of expected reproductive output under fishing and no-fishing scenarios. This concept is inconsistent with NOAA Fisheries' guidance on addressing the SFA provisions of the MSFCMA because MSY and OY should be based on biomass rather than on fishing mortality rates as is the case with an SPR approach. Moreover, the fishing mortality rate that would achieve 20 percent SPR, the goal of this alternative, is higher than the rate expected to achieve MSY (F_{MSY}), which also defines the upper limit of acceptable fishing rates. Consequently, this alternative would result in continued overfishing and prevent the stock from rebuilding to targets mandated by the MSFCMA.

Preferred Alternative 2 would maintain the current TAC for the directed red snapper fishery, pending periodic reviews. Rebuilding of the red snapper stock and reductions in F to end overfishing would be driven initially by reduced red snapper bycatch in the shrimp fishery due to BRDs and expected reductions in shrimp effort. As the stock increased, reductions in directed fishing effort may be needed to maintain harvest levels as fish became easier to catch, assuming no additional measures are implemented to slow the pace of harvest. The 1999 stock assessment model predicted that rebuilding would be achieved within the recommended maximum time frame under these catch limits and expected effort reductions in the shrimp fishery (Fig. 4.2.3).

An advantage of this alternative is that it would impose minimal short-term disruption of the directed red snapper fishery since the current TAC would be maintained. Stock projections indicate that this strategy should end overfishing between 2009 and 2010, and rebuild the stock to the target of B_{MSY} by 2032. This plan would rebuild the stock about 10 years sooner than Alternatives 4 and 5 (Tables 4.2.5 and 4.2.6). Fast and effective rebuilding offers environmental benefits by allowing the stock to become potentially 15 times more abundant than it is now. Projections also indicate that the fishery may be substantially more lucrative once rebuilding is achieved, with OYs equal to three or four times present harvests (Fig. 4.2.4). Additionally, this alternative would offer stability in planning because the harvest levels are predicted to stay constant over a long period of time, and may allow fishers to make rational business decisions with a higher degree of certainty due to the stable TAC. However, uncertainty associated with measures necessary to keep the sectors within their allocation would remain.

One disadvantage of this alternative is the risk of additional future restrictions if the stock grows more slowly than expected or not at all. However, the chances of poor recovery are fairly low as this is the second most conservative alternative being considered. As a result, this alternative is less likely than most others to require austere future reductions even if new assessments suggest the stock is in worse condition or less capable of rebuilding than currently believed.

A second disadvantage that Alternative 2 shares with Alternative 4, is that overfishing does not end until 2009-2010, whereas overfishing ends in 2005-2007 in Alternatives 3 and 5. This is because the reductions in TAC to 6 mp set forth in Alternatives 3 and 5 reduce F to a value closer to F_{MSY} (Tables 4.2.5 and 4.2.6). However, ending overfishing sooner through reductions in TAC could adversely affect the recreational and commercial fisheries, and coastal fishing communities dependent on them, due to this forgone yield.

A third disadvantage, as indicated above, is the requirement to increasingly limit effort or restrain harvest rates as the stock grows. The increased catchability, if not addressed, would particularly exacerbate the market glut problems encountered by the commercial fishery, and could shorten the current fishing seasons. The stock increase would also likely make red snapper more vulnerable to bycatch in other commercial finfish fisheries. As a result, new conflicts could develop between commercial fishing sectors, although they may not grow to the significance of the current conflict with the shrimp fishery. However, the individual fishing quota (IFQ) system currently being explored by the Council may minimize these conflicts by giving fishermen more flexibility in how they harvest red snapper (GMFMC, 2002). In the recreational fishery, the necessary effort reductions could be an even larger problem. To address this, seasons would most likely have to be shortened, or other measures such as more restrictive bag limits would have to be put in place. Moreover, these restrictions would increase in severity over time to keep catches within the TAC limit as the stock abundance increased.

Alternative 3 would reduce the current TAC for the directed red snapper fishery to 6 mp, and maintain it at that level pending periodic reviews. Even with this reduction, rebuilding of the red snapper stock would be driven initially by reduced red snapper bycatch in the shrimp fleet due to BRDs and expected reductions in effort. As the stock increased, reductions in directed fishing effort would be necessary to maintain catch levels while fish became easier to catch. The 1999 stock assessment model predicted that rebuilding would be achieved within the recommended maximum time frame under these catch limits and expected effort reductions in the shrimp fishery (Fig. 4.2.5).

Table 4.2.5. TAC, F/F_{MSY}, and B/B_{MSY} by year for constant catch rebuilding alternatives 2 and 3 with 30 and 50 percent reductions in shrimp effort. Light gray indicates the stock is not subject to overfishing ($F/F_{MSY}<1$) and dark gray indicates the stock is no longer overfished ($B/B_{MSY}>1$).

	Alternative 2						Alternative 3					
	30% reduction shrimp effort			50% reduction shrimp effort			30% reduction shrimp effort			50% reduction shrimp effort		
year	Yield(mp)	F/F_{MSY}	B/B_{MSY}	Yield(mp)	F/F_{MSY}	B/B_{MSY}	Yield(mp)	F/F_{MSY}	B/B_{MSY}	Yield(mp)	F/F_{MSY}	B/B_{MSY}
1999	10.0326	2.81	0.071	10.0326	2.81	0.071	10.0326	3.75	0.071	10.0326	2.81	0.071
2000	8.77	2.52	0.073	9.02	2.52	0.073	8.77	3.36	0.073	9.02	2.52	0.073
2001	9.13	2.41	0.077	9.4	2.41	0.077	9.13	3.22	0.077	9.4	2.41	0.077
2002	10.11	2.07	0.082	9.32	2.07	0.082	10.11	2.76	0.082	9.32	2.07	0.082
2003	9.16	1.72	0.088	9.12	1.72	0.088	9.16	2.30	0.088	9.12	1.72	0.088
2004	9.12	1.52	0.097	9.12	1.52	0.097	9.12	2.02	0.097	9.12	1.52	0.097
2005	9.12	1.38	0.106	9.12	1.38	0.106	6	1.20	0.106	6	0.90	0.106
2006	9.12	1.28	0.116	9.12	1.28	0.116	6	1.08	0.117	6	0.81	0.117
2007	9.12	1.19	0.127	9.12	1.19	0.129	6	0.99	0.131	6	0.74	0.133
2008	9.12	1.11	0.139	9.12	1.05	0.145	6	0.92	0.145	6	0.65	0.151
2009	9.12	1.04	0.153	9.12	0.85	0.165	6	0.85	0.160	6	0.53	0.173
2010	9.12	0.97	0.168	9.12	0.71	0.189	6	0.79	0.178	6	0.44	0.200
2011	9.12	0.87	0.185	9.12	0.62	0.216	6	0.71	0.198	6	0.39	0.230
2012	9.12	0.76	0.205	9.12	0.56	0.246	6	0.62	0.221	6	0.34	0.263
2013	9.12	0.67	0.228	9.12	0.51	0.280	6	0.54	0.246	6	0.31	0.300
2014	9.12	0.60	0.253	9.12	0.47	0.317	6	0.49	0.274	6	0.29	0.340
2015	9.12	0.55	0.280	9.12	0.43	0.356	6	0.45	0.305	6	0.26	0.382
2016	9.12	0.51	0.309	9.12	0.40	0.397	6	0.42	0.337	6	0.24	0.426
2017	9.12	0.48	0.339	9.12	0.37	0.439	6	0.39	0.370	6	0.23	0.472
2018	9.12	0.45	0.370	9.12	0.34	0.483	6	0.37	0.405	6	0.21	0.519
2019	9.12	0.42	0.403	9.12	0.32	0.528	6	0.34	0.440	6	0.20	0.567
2020	9.12	0.40	0.436	9.12	0.30	0.574	6	0.32	0.476	6	0.19	0.616
2021	9.12	0.38	0.470	9.12	0.28	0.622	6	0.31	0.512	6	0.18	0.666
2022	9.12	0.36	0.504	9.12	0.27	0.669	6	0.29	0.548	6	0.17	0.715
2023	9.12	0.34	0.538	9.12	0.26	0.715	6	0.28	0.585	6	0.16	0.763
2024	9.12	0.33	0.573	9.12	0.25	0.761	6	0.27	0.621	6	0.15	0.810
2025	9.12	0.31	0.607	9.12	0.24	0.806	6	0.26	0.656	6	0.15	0.856
2026	9.12	0.30	0.640	9.12	0.23	0.849	6	0.25	0.691	6	0.14	0.901
2027	9.12	0.29	0.672	9.12	0.22	0.892	6	0.24	0.724	6	0.14	0.944
2028	9.12	0.28	0.704	9.12	0.21	0.932	6	0.23	0.756	6	0.14	0.985
2029	9.12	0.27	0.734	9.12	0.21	0.972	6	0.23	0.787	6	0.13	1.025
2030	9.12	0.27	0.763	9.12	0.20	1.009	6	0.22	0.817	6	0.13	1.063
2031	9.12	0.26	0.791	9.12	0.20	1.045	6	0.22	0.845	6	0.13	1.098
2032	9.12	0.25	0.818	9.12	0.19	1.079	6	0.21	0.872	6	0.12	1.132
2033	9.12	0.25	0.844	9.12	0.19	1.112	6	0.21	0.898	6	0.12	1.164
2034	9.12	0.24	0.868	9.12	0.19	1.142	6	0.20	0.922	6	0.12	1.194
2035	9.12	0.24	0.891	9.12	0.18	1.171	6	0.20	0.944	6	0.12	1.222
2036	9.12	0.23	0.913	9.12	0.18	1.197	6	0.20	0.966	6	0.11	1.248
2037	9.12	0.23	0.934	9.12	0.18	1.223	6	0.19	0.986	6	0.11	1.273
2038	9.12	0.23	0.953	9.12	0.18	1.246	6	0.19	1.005	6	0.11	1.296
2039	9.12	0.22	0.972	9.12	0.17	1.268	6	0.19	1.023	6	0.11	1.317
2040	9.12	0.22	0.989	9.12	0.17	1.289	6	0.19	1.039	6	0.11	1.337
2041	9.12	0.22	1.005	9.12	0.17	1.308	6	0.18	1.055	6	0.11	1.355
2042	9.12	0.22	1.020	9.12	0.17	1.325	6	0.18	1.069	6	0.11	1.372
2043	9.12	0.21	1.034	9.12	0.17	1.342	6	0.18	1.082	6	0.11	1.388
2044	9.12	0.21	1.047	9.12	0.17	1.357	6	0.18	1.095	6	0.11	1.402
2045	9.12	0.21	1.060	9.12	0.16	1.371	6	0.18	1.106	6	0.11	1.416
2046	9.12	0.21	1.071	9.12	0.16	1.384	6	0.18	1.117	6	0.10	1.428
2047	9.12	0.21	1.082	9.12	0.16	1.396	6	0.18	1.127	6	0.10	1.439
2048	9.12	0.21	1.092	9.12	0.16	1.407	6	0.18	1.136	6	0.10	1.450
2049	9.12	0.21	1.101	9.12	0.16	1.418	6	0.17	1.145	6	0.10	1.460

Table 4.2.6. TAC, F/F_{MSY}, and B/B_{MSY} by year for constant catch transitioning to constant F rebuilding alternatives 4 and 5 with 30 and 50 percent reductions in shrimp effort. Light gray indicates the stock is not subject to overfishing(F/F_{MSY}<1) and dark gray indicates the stock is no longer overfished (B/B_{MSY}>1).

	Alternative 4						Alternative 5					
	30% reduction shrimp effort			50% reduction shrimp effort			30% reduction shrimp effort			50% reduction shrimp effort		
year	Yield(mp)	F/F_{MSY}	B/B_{MSY}	Yield(mp)	F/F_{MSY}	B/B_{MSY}	Yield(mp)	F/F_{MSY}	B/B_{MSY}	Yield(mp)	F/F_{MSY}	B/B_{MSY}
1999	10.0326	2.81	0.071	10.0326	2.81	0.071	10.0326	2.81	0.071	10.0326	2.81	0.071
2000	8.77	2.52	0.073	9.02	2.52	0.073	8.77	2.52	0.073	9.02	2.52	0.073
2001	9.13	2.41	0.077	9.40	2.41	0.077	9.13	2.41	0.077	9.40	2.41	0.077
2002	10.11	2.07	0.082	9.32	2.07	0.082	10.11	2.07	0.082	9.32	2.07	0.082
2003	9.16	1.72	0.088	9.12	1.72	0.088	9.16	1.72	0.088	9.12	1.72	0.088
2004	9.12	1.52	0.097	9.12	1.52	0.097	9.12	1.52	0.097	9.12	1.52	0.097
2005	9.12	1.38	0.106	9.12	1.38	0.106	6	0.90	0.106	6.00	0.90	0.106
2006	9.12	1.28	0.116	9.12	1.28	0.116	6	0.81	0.117	6.00	0.81	0.117
2007	9.12	1.19	0.127	9.12	1.19	0.129	6.04	0.75	0.131	6.05	0.75	0.133
2008	9.12	1.11	0.139	9.12	1.05	0.145	6.53	0.75	0.145	6.91	0.75	0.151
2009	9.12	1.04	0.153	9.12	0.85	0.165	7.01	0.75	0.160	8.43	0.75	0.173
2010	9.12	0.97	0.168	9.60	0.75	0.189	7.51	0.75	0.178	9.97	0.75	0.198
2011	9.12	0.87	0.185	10.95	0.75	0.216	8.25	0.75	0.197	11.27	0.75	0.225
2012	9.12	0.76	0.205	12.12	0.75	0.245	9.44	0.75	0.218	12.44	0.75	0.255
2013	10.22	0.75	0.228	13.21	0.75	0.277	10.64	0.75	0.241	13.55	0.75	0.288
2014	11.28	0.75	0.252	14.27	0.75	0.311	11.70	0.75	0.266	14.63	0.75	0.323
2015	12.21	0.75	0.278	15.37	0.75	0.347	12.64	0.75	0.293	15.74	0.75	0.358
2016	13.07	0.75	0.305	16.50	0.75	0.383	13.52	0.75	0.320	16.89	0.75	0.396
2017	13.89	0.75	0.333	17.65	0.75	0.421	14.34	0.75	0.348	18.03	0.75	0.433
2018	14.72	0.75	0.361	18.80	0.75	0.459	15.17	0.75	0.377	19.17	0.75	0.471
2019	15.54	0.75	0.390	19.92	0.75	0.497	15.99	0.75	0.406	20.28	0.75	0.509
2020	16.36	0.75	0.419	21.03	0.75	0.536	16.79	0.75	0.434	21.38	0.75	0.549
2021	17.15	0.75	0.448	22.10	0.75	0.575	17.57	0.75	0.463	22.44	0.75	0.587
2022	17.92	0.75	0.476	23.12	0.75	0.613	18.33	0.75	0.491	23.44	0.75	0.625
2023	18.68	0.75	0.505	24.09	0.75	0.650	19.07	0.75	0.520	24.39	0.75	0.662
2024	19.41	0.75	0.534	25.01	0.75	0.686	19.78	0.75	0.548	25.29	0.75	0.698
2025	20.11	0.75	0.561	25.88	0.75	0.721	20.45	0.75	0.574	26.15	0.75	0.732
2026	20.76	0.75	0.587	26.70	0.75	0.754	21.09	0.75	0.600	26.95	0.75	0.765
2027	21.39	0.75	0.612	27.47	0.75	0.786	21.70	0.75	0.625	27.71	0.75	0.796
2028	21.98	0.75	0.636	28.19	0.75	0.817	22.27	0.75	0.648	28.42	0.75	0.826
2029	22.53	0.75	0.659	28.87	0.75	0.846	22.81	0.75	0.670	29.08	0.75	0.855
2030	23.05	0.75	0.681	29.51	0.75	0.873	23.31	0.75	0.692	29.70	0.75	0.882
2031	23.54	0.75	0.701	30.10	0.75	0.899	23.78	0.75	0.712	30.29	0.75	0.907
2032	24.00	0.75	0.721	30.66	0.75	0.924	24.22	0.75	0.731	30.83	0.75	0.931
2033	24.42	0.75	0.739	31.17	0.75	0.947	24.64	0.75	0.749	31.33	0.75	0.954
2034	24.82	0.75	0.757	31.65	0.75	0.968	25.02	0.75	0.765	31.80	0.75	0.974
2035	25.19	0.75	0.773	32.09	0.75	0.988	25.38	0.75	0.781	32.23	0.75	0.994
2036	25.54	0.75	0.788	32.50	0.75	1.006	25.71	0.75	0.796	32.63	0.75	1.012
2037	25.86	0.75	0.802	32.88	0.75	1.024	26.02	0.75	0.810	33.00	0.75	1.029
2038	26.16	0.75	0.816	33.23	0.75	1.039	26.30	0.75	0.822	33.34	0.75	1.044
2039	26.43	0.75	0.828	33.55	0.75	1.054	26.57	0.75	0.834	33.65	0.75	1.059
2040	26.69	0.75	0.840	33.85	0.75	1.068	26.81	0.75	0.845	33.94	0.75	1.072
2041	26.92	0.75	0.850	34.13	0.75	1.080	27.04	0.75	0.855	34.21	0.75	1.084
2042	27.14	0.75	0.860	34.38	0.75	1.092	27.25	0.75	0.865	34.46	0.75	1.096
2043	27.34	0.75	0.869	34.61	0.75	1.103	27.44	0.75	0.874	34.68	0.75	1.106
2044	27.53	0.75	0.878	34.82	0.75	1.113	27.62	0.75	0.882	34.89	0.75	1.116
2045	27.70	0.75	0.886	35.02	0.75	1.122	27.79	0.75	0.889	35.08	0.75	1.124
2046	27.86	0.75	0.893	35.20	0.75	1.130	27.94	0.75	0.896	35.25	0.75	1.132
2047	28.01	0.75	0.899	35.36	0.75	1.138	28.08	0.75	0.903	35.41	0.75	1.140
2048	28.14	0.75	0.906	35.51	0.75	1.145	28.21	0.75	0.909	35.56	0.75	1.147
2049	28.26	0.75	0.911	35.65	0.75	1.151	28.32	0.75	0.914	35.69	0.75	1.153

An advantage of this alternative is that it should rebuild to B_{MSY} sooner than the preferred alternative, though the stock projections only show the time difference to be 1 to 3 years shorter. This alternative would also end overfishing sooner than alternatives 2 and 4 by about 3 to 5 years. Fast and effective rebuilding offers environmental benefits by allowing the stock to become potentially 15 times more abundant than it is now. Projections also indicate that the fishery may be substantially more lucrative once rebuilding is achieved, with OYs equal to three or four times present catches (which would be an increase by a factor of 5 or more over the TACs allowed through rebuilding in this alternative) (Fig. 4.2.6). This alternative would also offer stability in business planning due to the constant catch levels, assuming the businesses survive the initial reduction in TAC from the status quo. This alternative faces the least risk of additional future restrictions if the stock grows more slowly than expected or not at all. The chances of poor recovery are relatively low because this is the most conservative alternative being considered.

The most immediate disadvantage of this alternative is its requirement to immediately reduce directed catches by over 30 percent. These reductions would have a certain and significant adverse effect on the commercial and recreational fisheries, and the businesses that support them. Economic analyses in Section 5.5.2.5 suggest that these losses could be as great as 84 million dollars from 2005-2009 for the commercial and for-hire fisheries alone. A second disadvantage, similar to that of Alternative 2, is the requirement to increasingly limit effort as the stock grows. The effects of this would be even more severe than those described with regards to Alternative 2 since the TAC is so much lower. Unless the Council implements the IFQ system, the commensurate cuts in commercial harvest would further aggravate the derby fishery currently existing in the fishery.

Alternative 4 would maintain the current TAC for the directed red snapper fishery, pending periodic reviews, until the stock rebuilt to such an extent that fishing at a constant OY fishing mortality rate would allow higher harvest limits. Overfishing would end between 2009 and 2010, prior to when harvest rates could increase (Table 4.2.6). Rebuilding of the red snapper stock would be driven primarily by reduced red snapper bycatch in the shrimp fleet due to BRDs and expected reductions in effort. The 1999 stock assessment model predicted that rebuilding would not be achieved within the recommended maximum time frame under this rebuilding plan even if expected effort reductions in the shrimp fishery are realized. It is estimated that an additional 10 to 15 years would be necessary to achieve the B_{MSY} goals (Table 4.2.6; Figs. 4.2.7 and 4.2.8). While this rebuilding period is beyond what NOAA Fisheries' NSGs recommend, extending the rebuilding period could be appropriate due to the unique nature of this fishery. The NSGs were written to provide guidance for average fishery management conditions. The red snapper fishery is not average because high F levels from the non-directed fishery (shrimp) hinder the ability of this stock to rebuild.

An advantage Alternative 4 is that it would result in minimal short-term disruption of the directed red snapper fishery. This alternative would also benefit from a harvest limit that would increase with stock size, thus requiring fewer effort restrictions than Alternatives 2 and 3.

Disadvantages would include the risk of additional future restrictions if the stock grows more slowly than expected or not at all. The chances of poor recovery are highest for this alternative, which would allow more fishing pressure than any other alternative being considered. As a result, this alternative is the most likely to require austere future reductions if new assessments suggest the stock is in worse condition or less capable of rebuilding than currently believed. This alternative would also delay successful rebuilding beyond the timeframes proposed in Alternatives 2 and 3, and the ecological and socioeconomic benefits associated with achieving this target, as well as delaying the time when overfishing ends. Finally, this alternative would offer less stability than Alternatives 2 and 3 since fishing rates would be based on abundance measures, which are likely to fluctuate over the course of the rebuilding plan.

Alternative 5 would reduce the current TAC for the directed red snapper fishery to 6 mp, pending periodic reviews, until the stock rebuilt to such an extent that fishing at a constant OY fishing mortality rate would allow higher harvest limits. Overfishing would end between 2005 and 2007, prior to when harvest rates could increase (Table 4.2.6). Rebuilding of the red snapper stock would be driven primarily by reduced red snapper bycatch in the shrimp fleet due to BRDs and expected reductions in effort. The 1999 stock assessment model predicted that rebuilding would not be achieved within the recommended maximum time frame under these catch limits and expected effort reductions in the shrimp fishery. It was estimated that an additional 10 to 15 years would be necessary (Table 4.2.6; Fig. 4.2.9). As mentioned for Alternative 4, extending the rebuilding period might be considered appropriate by some due to the unique nature of this fishery. High levels of F from the non-directed (shrimp) ishery hinder the ability of the red snapper stock to rebuild.

Disadvantages of this alternative include the need for large short-term reductions in the directed red snapper harvest. They also include the risk of additional future restrictions if the stock grows more slowly than expected or not at all. The chances of poor recovery are relatively high for this alternative, which would allow more fishing pressure than most other alternatives being considered. As a result, this alternative is more likely than most to require austere future reductions if new assessments suggest the stock is in worse condition or less capable of rebuilding than currently believed. This alternative would also delay successful rebuilding and the ecological and socioeconomic benefits associated with achieving this target beyond the maximum recommended time frame. Finally, this alternative would offer less stability than Alternatives 2 and 3, since fishing rates would be based on abundance measures, which are likely to fluctuate over the course of the rebuilding plan.

More complete discussions of the economic implications of the various rebuilding alternatives are found in the RIR section (Section 5) and IRFA section (Section 6) and are incorporated herein by reference.

Alternative 4 is the alternative that would provide the largest net present values. This indicates that a transitional approach from constant catch to constant F strategy in the directed fishery provides greater economic benefits than a constant catch approach (Alternatives 2 and 3). There are two important issues that need to be recognized, however, regarding this conclusion. First, the constant F approach can achieve the biomass target only under the assumption of a 50 percent shrimp effort reduction. A lower shrimp effort reduction of 30 percent would not allow achievement of the target biomass. Second, the constant catch approach achieves that target biomass some 6 to 7 years before the constant F does.

In comparing Alternatives 2 and 3, it was apparent that a reduction in TAC from 9.12 mp to 6.0 mp would result in relatively large reductions in net present values but would only reduce by one to three years the time required to achieve the target biomass. Predicted losses of Alternative 3 are $13 million in net revenues to the commercial sector, $71 million net revenues to the for-hire sector, and $316 million in consumer surplus (using a 7 percent discount rate) over Alternative 2.

All of the fishing activity sites and fishing communities identified in Section 5 would be expected to shoulder the cost of rebuilding the red snapper stock, and possibly benefit when the stock is rebuilt, although new activity sites could materialize with a recovered stock and expanded fishery.

4 .3 Bycatch reporting methodology

4 .3.1 MSFCMA Provisions

FMPs require fishery managers to establish a standardized methodology to assess the amount and type of bycatch occurring in the fishery (MSFCMA §303(a)(11)). In addition, MSFCMA §303(b)(8) provides authority to require observers to be carried aboard fishing vessels as necessary. The term "bycatch" refers to "fish which are harvested in a fishery, but which are not sold or kept for personal use and includes economic discards and regulatory discards". The term "fish" under MSFCMA means "finfish, mollusks, crustaceans, and *all other forms of marine animal and plant life other than marine mammals and birds.*" Thus, the definition of fish is inclusive of sea turtles, as well as fish species.

4 .3.2 Current reporting requirements/methodologies

Current regulations (50 CFR §622.5) require commercial and recreational for-hire participants in the Gulf reef fish fishery who are selected by the Southeast Science and Research Director (SRD) to maintain and submit a fishing record on forms provided by the SRD. Bycatch data on protected species are currently collected in the commercial reef fish fishery through the supplementary discard form. The SEFSC's Beaufort For-Hire Headboat Survey and MRFSS do not collect data regarding protected species interactions.

4 .3.2.1 Commercial vessels

To address bycatch reporting in the commercial reef fish fishery, the SEFSC added a bycatch reporting requirement to it's CFLP in August 2001. The reporting requirements include numbers and average size of fish, by species, being discarded and the reasons for those discards (regulatory or market conditions). Bycatch data are collected using a supplemental form that is sent to a stratified, random sample of the commercial reef fish permit holders (20 percent coverage). The sample selections are made in July of each year, and the selected fishermen (vessels) are required to complete and submit the discard form along with the logbook form for each trip they make during August through July of the following year. The sampling system is designed so that the 20 percent of fishermen selected to report for a given year are not selected for the next four years but, that over the course of a 5-year period, 100 percent of reef fish permit holders will have been required to report in one of five years. Failure to comply with reporting requirements can result in sanctions precluding permit renewal.

4 .3.2.2 For-hire charter vessels

Harvest and bycatch in the for-hire charter vessel sector have been consistently monitored through the MRFSS since 1979. The survey uses a combination of random-digit-dialed telephone intercepts of coastal households for effort information and dock-side intercepts of individual trips for catch information to statistically estimate total catch and discards by species, for each subregion, state, mode, primary area and wave. Bycatch is enumerated by a disposition code for each fish caught but not kept (type B2 catch). Prior to 2000, sampling of the charter vessel sector resulted in highly variable estimates of catch. However, since 2000, a new sampling methodology has been implemented. A 10 percent sample of charter vessel captains are called weekly to obtain trip level information. In addition, the standard dockside intercept data are collected from charter vessels, and charter vessel clients are sampled through the standard random digit dialing of coastal households. Precision of charter vessel effort estimates have improved by more than 50 percent due to these changes (Van Voorhees et. al., 2000).

4 .3.2.3 For-hire headboats

Harvest from headboats has been monitored by NOAA Fisheries at SEFSC's Beaufort Laboratory since 1986, but no bycatch information is routinely collected. Prior to that, headboats were monitored through the MRFSS. Daily catch records (trip records) are filled out by the headboat operators; or, in some cases, by NOAA Fisheries-approved headboat samplers based on personal communication with the captain or crew. In addition, samplers subsample headboat trips for data regarding species lengths and weights. Biological samples (scales, otoliths, spines, gonads, and stomachs) are taken as time permits. Occasionally, onboard headboat samplers will record lengths of discarded fish; however, these trips are rare, and the data do not become part of the headboat data base.

4 .3.2.4 Private recreational fishing vessels

Bycatch in the private recreational sector has been consistently monitored through MRFSS since 1979. The survey uses a combination of random-digit-dialed telephone intercepts of coastal households for avidity and dock-side intercepts to statistically estimate the catch and bycatch by species, for each subregion, state, mode, primary area and wave. Bycatch is enumerated by a disposition code for each fish landed but not kept. Estimates of harvest and bycatch are considered very precise for the Gulf private/rental red snapper fishery because the proportional standard error of these estimates is below 10 percent. See NOAA Fisheries website (http://www.st.nmfs.gov/st1/recreational/survey/overview.html) for an explanation of precision goals in bycatch monitoring surveys.

4 .3.3 Description of alternative bycatch reporting methodologies, and comparison of their environmental impacts

4 .3.3.1 Commercial and recreational for-hire fisheries

4.3.3.1.1 Alternative 1. Status quo - no action. Use the existing bycatch reporting requirements in the NOAA Fisheries CFLP for commercial reef fish permit holders. Charter vessels would be sampled by MRFSS. Headboats would not be sampled.

4.3.3.1.2 Alternative 2. Require that all permitted reef fish vessels operating in the U.S. EEZ participate in an electronic logbook program that includes bycatch reporting administered by NOAA Fisheries. Vessel permits will not be renewed for vessels that fail or refuse to participate in the program.

4.3.3.1.3 Alternative 3. Require that a subset of all permitted reef fish vessels operating in the EEZ participate in an electronic logbook program administered by NOAA Fisheries. NOAA Fisheries will develop a random selection procedure for determining vessels that will be required to report. In selecting vessels, the agency will consider the suitability of the vessel for such purpose and ensure that the universe of vessels selected are representative of all statistical sub-zones in the Gulf. Vessel permits will not be renewed for vessels that fail or refuse to participate in the program.

4.3.3.1.4 Alternative 4 (Preferred). Direct NOAA Fisheries to develop and manage an observer program for the reef fish fishery. NOAA Fisheries will develop a random selection procedure for determining vessels that will be required to carry observers in order to collect bycatch information. In selecting vessels, the agency will consider the suitability of the vessel for such purpose and ensure that the universe of vessels included are representative of all statistical sub-zones in the Gulf. Vessel permits will not be renewed for vessels that fail or refuse to carry observers in accordance with this process. The implementation of the observer program shall be initiated as soon as NOAA Fisheries obtains sufficient funding for the program.

4.3.3.1.5 Alternative 5. Expand the use of the existing supplemental bycatch reporting requirements in the NOAA Fisheries CFLP for commercial reef fish permit holders to 100 percent and include recreational for-hire vessels in the logbook program.

4.3.3.1.6 Alternative 6 (Preferred). Enhance the MRFSS by including headboats using the same sampling methodology as used for charter vessels.

The above alternatives cover the basic options available to NOAA Fisheries and the Council to monitor bycatch in the commercial and for-hire reef fish fishery. However, there are combinations of these basic options that are likely to improve the accuracy of both catch and bycatch monitoring over any single alternative. For example, combining the use of an observer program in conjunction with the existing logbook requirements or a new electronic logbook for the commercial and for-hire sectors might provide the most accurate estimates of bycatch while remaining practical and affordable. Therefore, descriptions for each alternative below provide the guidance for selecting **one or more alternatives** over others based on how bycatch monitoring might be improved and supplement existing methodologies. However, any of the new approaches to bycatch monitoring would require new funding.

There are no direct biological or ecological impacts from establishing a standardized reporting methodology to estimate bycatch in the commercial and recreational for-hire reef fish fishery of the GOM. The following alternatives discussed below would only establish various means of determining or improving estimates of the amount and type of bycatch that is occurring in the reef fish fishery above the current reporting requirements. However, to the extent that any of these alternatives provides a better understanding of the bycatch, it should improve the quality of data input to stock assessments and thus improve the accuracy of the assessment output and the decisions that must be made based on that output, including decisions regarding the need for additional measures to reduce bycatch or minimize mortality, where appropriate. Enhanced bycatch monitoring will also bring the assessment process one step closer to multi-species assessments since the interactions of management measures with gear and effort for one target species can affect fishing mortality in another target species. These would be considered to be indirect benefits of bycatch reporting to the biological and ecological environment.

Alternative 1 (no action) would retain the data collection program currently used in the commercial sector. The recreational for-hire charter vessels would continue to be sampled for catch and bycatch through the MRFSS program. For the commercial fishery, bycatch data is collected by using a supplemental form sent to a stratified, random sample of 20 percent of the commercial reef fish permit holders. Because this reporting is mandatory, it is considered useful in estimating bycatch (Anonymous, 2004). The current MRFSS data collection program provides adequate bycatch coverage for the recreational fishery for red snapper, and includes the charterboat sector. A percent standard error of 20 percent is generally considered acceptable in fisheries data (Van Vorhees et al., 2001). For red snapper, the percent standard error for fish released by the recreational fishery has generally been below 10 percent in recent years. Bycatch from the headboat sector would not be sampled.

Alternatives 2 through 5 would require that all reef fish permit holders, regardless of whether they are commercial or recreational for-hire, report their bycatch, or accommodate an observer under Alternative 4, if selected by the SRD. This includes commercial fishermen who do not hold Class I or Class II red snapper permits and, therefore, should not be targeting red snapper. All permit holders are likely to encounter red snapper occasionally, even if they are not the species sought and therefore, should be part of any red snapper bycatch monitoring program.

In considering these alternatives, it should be kept in mind that the various vessels affected by a logbook or by an observer program for purposes of bycatch reporting vary in the size and extent of their operations. Given this condition, the effective cost of any of the bycatch reporting requirements would be disproportionally distributed among the various vessels. An electronic logbook, for example, would likely cost the same regardless of vessel size and operation on which it was used. But, if borne by the vessels, this cost would impose a larger burden on smaller operations. An observer program also has the potential to create disparity in impacts on the different size classes of vessels, particularly if the industry shares part of the cost of the observer program. This cost may come in the form of an outright cash expense and/or in the form of liability insurance associated with carrying an observer on board. Larger operations may be able to absorb the potential costs, and smaller operations could be placed at a strong disadvantage. These costs would have to be explicitly determined in designing an observer program.

There are other potential costs associated with the logbook and observer program alternatives for collecting bycatch information. In the case of logbooks, management would have to develop logbooks and a training program for vessel captains and crew. Vessel operators and crew would likely be required to receive training in order to properly identify bycatch species and to fill out logbooks. The time required to complete these tasks could be burdensome to some vessel operations. Electronic logbooks, that for purposes of accuracy need to be completed at sea, would demand time that the crew would otherwise have spent fishing or doing routine tasks on the vessel and equipment. Also, there is a probability that at least some captains and crew would not want to participate in logbook programs. This could result in ill will toward fishery managers that could later result in the inaccurate reporting of bycatch. Fishery managers, upon examination of some logbooks, may observe certain patterns of inaccuracies and would require more work from fishermen. Such additional requirement may be viewed by fishermen as another obstacle for renewing their permits (assuming logbook reporting as a condition for permit renewal).

It should also be kept in mind that unless there is some economic incentive to report bycatch, such as monetary reward or simply the recognition of the value of the information, or economic/legal disincentive not to report bycatch, such as fines or penalties including non-renewal of permits, bycatch reporting through logbooks may simply be seen as an additional burden so that the information provided would likely be far from accurate. Even if fishermen have the willingness to provide bycatch information, they may not possess the right information at the time they fill out logbooks. This could be due to their lack of training in identifying bycatch species, or simply due to recall problems if the logbooks are filled out after the trip is completed.

Requiring an electronic logbook, as in Alternative 2 or 3, can address the recall problem, assuming the electronic format stimulates the fisherman to record the data as the bycatch occurs, and in this regard these two alternatives may be considered superior to Alternatives 1 and 5. But electronic logbooks cannot address the lack of economic incentive to report bycatch information accurately. The proposed observer program, preferred Alternative 4, can improve the accuracy and consistency of bycatch information by transferring the burden of bycatch reporting to the observers. Therefore, Alternative 4 is believed to be superior to the other alternatives in generating bycatch information. One downside of an observer program is that certain vessel characteristics, such as space and facilities, limit the ability of the vessel to carry an observer or not. However, over time as experience with an observer program for reef fish permitted vessels is accumulated, sampling problems can be addressed.

Alternative 2 requires that all permitted vessels fishing for reef fish in the EEZ carry electronic logbooks on board. For the commercial sector, electronic logbooks would be configured to allow the captain to record both retained catch and discards, thus replacing the two paper-copy data collection programs currently required by the SEFSC. This alternative provides the most comprehensive data for both harvest and bycatch because all permitted reef fish vessels would be required to report making it a census rather than a subsample of 20 percent.

The accuracy of both harvest and bycatch data would likely be improved if reported electronically because trip records could be recorded in real time on the vessel rather than using recall after the trip has been completed. Logbook entries could be time-stamped so that collected information could be evaluated for accuracy before use in stock assessments. Additionally, electronic logbooks would simplify record keeping and data entry for fishermen since much of the data could either be preset (vessel, crew, etc.) or automatically recorded at the time of entry such as date, time, start and end location, etc. This would make it more convenient for fishermen to include supplementary information about discards. For instance, length data could be used as a proxy for age to provide a better method for proportioning bycatch mortality into stock assessments. A vessel monitoring system such as that being considered in Reef Fish Amendment 18 and in Shrimp Amendment 13 would simplify the recording of location and possibly gear usage.

Alternative 2 would extend logbook and bycatch reporting requirements to all reef fish charter and headboat vessel permit holders. Estimates of red snapper discards from the for-hire sector are 30 percent higher than commercial estimates so it is critical to provide accurate estimates of bycatch. Currently, charter vessels and headboats are obligated to report under two separate NOAA Fisheries programs using different methodologies with different assumptions about sampling bias and estimation accuracy. Standardizing reporting methodologies could simplify analyses for stock assessments and future bycatch reduction considerations. If this alternative is selected for the recreational for-hire sector, at least initially there would be some duplication of monitoring effort in the MRFSS survey for catch and effort as well as bycatch and in the Beaufort headboat surveys for catch and effort data. Current MRFSS dockside sampling of charter vessels and current dockside headboat sampling could serve as a verification of harvest since there is no direct observation of harvest with this alternative alone.

An electronic logbook costs from $750 to $2,500 to set up on a vessel. On a per trip basis, the current paper logbook is estimated to require 15 minutes to fill in with bycatch information in addition to the 10 minutes required to report catch and other information. On average, each of the 1,158 active vessels with commercial reef fish permits takes an average of 13 to 14 trips per year. There are currently 1,552 active for-hire vessels with federal permits, but the distribution between charter and headboats is not precisely known. A headboat is reported to take an average of 138 trips per year, but applying this number to charter boats is likely to overestimate the number of trips taken by the for-hire sector. Carter (2003) reported that, for full-day trips, headboats took 74 to 177 trips per year depending on geographical location, while charter boats in similar locations as headboats took 61 to 85 trips per year. It is possible that the same or potentially less time burden that applies to paper logbook also applies to electronic logbooks. Based on this information, Alternative 2 would affect 1,158 commercial vessels and 15,054 to 16,212 trips. Also affected by this alternative are 1,552 for-hire vessels and at the maximum 214,176 trips. It should be noted that the vessel numbers are not additive because some vessels hold both for-hire and commercial reef fish permits. For commercial vessels, the cost of Alternative 2 would range from $0.87 million to $2.9 million to set up the system with the time burden ranging from 3,764 to 4,053 hours. For the for-hire vessels, the cost would range from $1.16 million to $3.88 million with a time burden of 89,240 hours. There would be additional costs for NOAA Fisheries to set up supporting hardware and software systems.

Should Alternative 2 be selected, NOAA Fisheries would likely have to implement electronic logbooks over a period of at least several years. NOAA Fisheries would have to obtain additional funds before the program could be started. Initially, the program would most likely be implemented as a smaller pilot to develop procedures specific to the Gulf reef fish fishery before requiring all active permit holders to report electronically. NOAA Fisheries would have to develop a system to download data from approximately 2,700 electronic logbooks but should recover those costs by the eliminating the need for data entry.

Alternative 3 requires that a subset of all vessels fishing for reef fish in the EEZ participate in an electronic logbook program. This could be done with a stratified, random sampling program similar to the one currently employed for the supplemental discard reports. This change to a census rather than a survey would require estimating total catch and discards and, thus, would reduce the accuracy of fishery-wide estimates of harvest over those obtained from Alternative 2 or from the current census methods for estimating harvest. The tradeoff is that this alternative would improve headboat and commercial bycatch monitoring over current methods. However, it may not improve charter vessel estimates over those currently provided by MRFSS with the exception of collecting length measurements of selected bycatch species. Compared to Alternative 1 (no action), this alternative would reduce the overall reporting burden by commercial reef fish permit holders, would reduce equipment costs, and would reduce the data management costs incurred by NOAA Fisheries. When NOAA Fisheries implemented the CFLP, a 20 percent random sampling procedure was used to determine which Florida reef fish permit holders would report. In part, sampling was done to reduce the initial costs associated with implementing the program. But, after several years it was determined that sampling stratification and subsequent expansion of logbook data to the entire fishery was difficult. Thereafter, sub-sampling was discontinued in favor of a 100 percent census.

At a 20 percent sample size, the cost setup of Alternative 3 would range from $0.17 million to $0.58 million for the commercial vessels, with a burden time of 752 hours to 811 hours. The setup costs for the for-hire vessels would range from $0.23 million to $0.78 million, with burden time of 17,848 hours. The monetary costs may be borne by the industry and/or government. The time burden would be solely borne by industry.

Preferred Alternative 4 provides for an observer program to sample supplement current bycatch reporting programs. Techniques for sub-sampling reef fish permit holders would be similar to those used for the current bycatch add on. The precision of catch and bycatch data for the selected trips would be much improved over any of the previous alternatives and any of the sampling methods currently in place for bycatch monitoring. This combination of monitoring for harvest and effort information and observer sampling for catch, effort, discard identification and biological samples is the conceptual method recommended for bycatch monitoring by the National Working Group on Bycatch (NWGB) (NOAA Fisheries, 2003b) and by the Gulf States Marine Fisheries Commission's (GSMFC) Fishery Information Network Committee.

An additional benefit of an observer program would be to provide better information on the interaction of fisheries with protected species. At this time the only information source available regarding protected species interactions with the GOM reef fish fishery is the supplementary discard data form recently implemented. An observer program would improve the data, as well as being a potential means for ground-truthing data collected on the supplementary discard form.

Observer programs are an intrusive data collection system and, thus, are likely to have adverse social effects. In particular, an observer program can give rise to friction between fishermen and fishery managers. A mandatory observer program could only worsen the situation, although it would lessen sampling bias. Generally, fishermen do not like to take observers on board for a variety of reasons. Some fear liability for the safety of observers. Others feel that the observor are a nuisance because they are "in the way." In the particular case of health and safety, an observer program would expose fishermen to the risk that their fishing craft may not be adequately equipped to carry an extra person, although this may be partly addressed by the requirement imposed under MSFCMA §403(a) regarding the health and safety of observers. Others do not trust that observer information can be kept confidential.

An observer program for the reef fish fishery is estimated to cost from $450 to $2,000 per day, or roughly an average of $1,200 per day (NMFS, 2003b). A suggested acceptable sampling rate would cover 2,170 days for commercial vessels, 2,242 days for charter vessels and 520 days for headboat vessels. These sample sizes correspond to 8 percent of trips for commercial vessels, 1 percent of trips for charter vessels, and 4 percent of trips for headboats. The potential cost under Alternative 4 would be $5.92 million per year under the mentioned sample size. These costs would be borne mainly by NOAA Fisheries. Selected vessels would have to shoulder the cost associated with providing food and accommodations for the observer. The cost for food is estimated to be in the range of $20 to $25 per day. At the suggested sample size, the direct cost to the industry would range from $98,640 to $123,300.

Alternative 5 would expand the CFLP, and its bycatch add-on to all commercial vessels (on a census basis) and to the reef fish recreational for-hire sector. The only difference between Alternative 5 and Alternative 2 is that Alternative 5 would implement paper logbooks rather than electronically. The commercial and for-hire vessels that would be affected are those with federal reef fish permits. This alternative would affect 926 additional vessels, with burden time ranging from 3,009 to 3,241 hours, and for 1,552 for-hire vessels, with time burdens of about 89,240 hours. The current bycatch reporting requirement for reef fish and mackerel vessels applies to about 500 vessels and is estimated to cost the government $25,000 to $30,000 annually. Alternative 5 would be expected to increase the cost to the government from about $46,000 to $56,000 assuming that costs increase proportionately with the number of vessels subject to logbook reporting of bycatch,.

Preferred Alternative 6 would establish the MRFSS survey as the method for estimating for-hire recreational bycatch in the reef fish fishery and would require that headboats be included in that survey. Currently, MRFSS samples three modes (shore, charter and private/rental). A fourth mode would be added called headboat. The sampling methodology for headboats should be the same as that of the new charter vessel methodology and would add approximately 85 headboats to be sampled per wave (two-month period). Testing of this concept is currently taking place in the Atlantic as a side-by-side comparison to the current headboat logbook administered by SEFSC out of the Beaufort Laboratory. Additionally, the GSMFC has endorsed this methodology for headboat sampling and has begun to test the new methods in the GOM. Given the success of the charter vessel survey, it is likely that this change will become part of the base MRFSS in the future. Selection of this alternative is independent of whether an observer program is recommended for the recreational for-hire fishery.

4 .3.3.2 Private recreational fishery

4.3.3.2.1 Alternative 1. (Preferred) No Action (status quo). Use the existing MRFSS catch and effort program to continue collecting bycatch information from the private recreational sector.

4.3.3.2.2 Alternative 2. Establish a federal recreational fishing permit as a requirement for fishing for reef fish in the Gulf EEZ. Require that a subset of all permitted recreational reef fish fishers operating in the EEZ participate in a logbook program administered by NOAA Fisheries. The agency will develop a random selection procedure for determining fishers that will be required to report. In selecting fishers, the agency will insure that the universe of fishers included are representative of all statistical sub-zones in the Gulf.

4.3.3.2.3 Alternative 3. Establish a volunteer logbook reporting program under NOAA Fisheries that includes bycatch reporting. The agency will use state recreational license files and surveys wherever possible to stratify fishers by fishery and request volunteers stratified by state and subregion.

There are no direct biological or ecological impacts from establishing a standardized reporting methodology to estimate bycatch in the recreational private/rental reef fish fishery of the GOM. The alternatives discussed below would only establish various methodologies to improve data on the amount and type of bycatch that is occurring in the reef fish fishery. However, to the extent that any of these alternatives provides a better understanding of the magnitude of bycatch, they should improve the quality of data for stock assessments, and thus improve the accuracy of the assessment output. Based on that output, better decisions can be made about additional measures to minimize bycatch and bycatch mortality. Enhanced bycatch monitoring given the interactions of management measures with gear and effort in one target species can affect fishing mortality in another target species. These are considered to be indirect benefits of bycatch reporting methodology alternatives to the biological and ecological environments.

The preferred alternative (Alternative 1) is the no action alternative. MRFSS is specified as the method of choice for the recreational private/rental sector. As mentioned in the discussion of Section 4.3.3, the MRFSS may be enhanced to include headboats in the future. However, no new techniques are being considered at this time to further quantify bycatch (e.g. better differentiation of discard size). However, the degree that these techniques can improve bycatch information may not be cost effective. MRFSS is considered very precise for the Gulf private/rental red snapper fishery because the proportional standard error, a way to view the precision of an estimate, of red snapper bycatch is very low. A percent standard error of 20 percent is generally considered acceptable in fisheries data (Van Vorhees et al., 2001). For red snapper, the percent standard error has generally been below 10 percent in recent years.

Alternative 2 would require a permit to possess recreationally caught reef fish in the EEZ. This permit would be in addition to any other licenses or permits required by the states. The permit would identify the universe of offshore recreational fishermen from which a stratified, random sample could be drawn for participation in logbook and bycatch reporting programs. Logbooks from recreational fishers would provide an independent verification process for estimates of bycatch by species from the MRFSS. Additionally, the lengths of discards could be requested. Lengths of discards, as a proxy for age, would provide a better method for proportioning bycatch mortality into stock assessments relative to the current method. The current method only asks whether the discard was of legal size or a regulatory discard. Details of the permit would need to be developed through a subsequent plan amendment.

Alternative 3 would establish a voluntary logbook reporting program that would include bycatch reporting. Current recreational state licenses do not record information on what species are being targeted. However, special surveys of all current state recreational license holders could be used to identify the universe of recreational reef fish fishermen. It is expected that a volunteer logbook program would produce considerably fewer trip records than a mandatory program. But, those records are expected to be more reliable for those fishermen that report consistently. Estimates of catch across the entire fishery may be inaccurate if volunteers do not represent most levels of avidity and expertise. If the same group of fishers reported over a number of years, trends in CPUE could provide a reliable index of abundance for tuning stock assessments. For volunteer logbooks to be successful, considerable effort must be put into developing good public relations with organized recreational fishing groups and maintaining rapport with individual volunteers.

Both Alternatives 2 and 3 would shift part of the cost and burden time that is currently incurred by the government onto the angling population. Alternative 2 would require a federal license to fish for reef fish in the EEZ. If solely administered by NOAA Fisheries, each permit could cost $50, but if permit administration is coursed through the various states in the Gulf, those costs could be substantially reduced.

A sample of those permitted would be required to report both catch and bycatch information in logbooks. Non-submission of logbooks could potentially result in non-reissuance of permits. However, enforcing permit sanctions would be extremely difficult, especially for non-resident anglers. In addition, the veracity of reported information may be jeopardized if anglers self-report their bycatch through the logbooks. Anglers may not accurately recall or identify the species they caught, or they may just simply write anything to comply with the requirement. The economic incentive is not strong for those sampled to provide the needed information. Alternative 3 may be better than Alternative 2 in generating more accurate logbook reports because those who volunteer can arguably be considered to have some appreciation of the need to collect catch and bycatch information. A major downside of this approach, however, is the need to establish a sampling frame that adequately represents the angling population. In this situation, volunteer reporting would likely produce a non-random sample and, therefore, compromise the accuracy of the required information.

4 .4 Bycatch minimization measures — a practicability analysis

4 .4.1 Background and summary

The Council is required by MSFCMA §303(a)(11) to establish a standardized bycatch reporting methodology for federal fisheries and to identify and implement conservation and management measures that, to the extent practicable and in the following order, (A) minimize bycatch and (B) minimize the mortality of bycatch that can not be avoided. The MSFCMA defines bycatch as "fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards. Such term does not include fish released alive under a recreational catch-and-release fishery management program" (MSFCMA §3(2)). Economic discards are fish that are discarded because they are undesirable to the harvester. This category of discards generally includes certain species, sizes, and/or sexes with a low or no market value. Regulatory discards are fish that are required by regulation to be discarded, or that are required to be retained but not sold.

NOAA Fisheries outlines at 50 CFR §600.350(d)(3)(i) ten factors that should be considered in determining whether a management measure minimizes bycatch or bycatch mortality to the extent practicable. These are:

1. Population effects for the bycatch species;
2. Ecological effects due to changes in the bycatch of that species (effects on other species in the ecosystem);

3. Changes in the bycatch of other species of fish and the resulting population and ecosystem effects;
4. Effects on marine mammals and birds;
5. Changes in fishing, processing, disposal, and marketing costs;
6. Changes in fishing practices and behavior of fishermen;
7. Changes in research, administration, and enforcement costs and management effectiveness;
8. Changes in the economic, social, or cultural value of fishing activities and nonconsumptive uses of fishery resources;
9. Changes in the distribution of benefits and costs; and
10. Social effects.

The directed red snapper fishery is prosecuted primarily with vertical-line gear, followed by demersal longline gear. The fishery is managed with a TAC that is divided in a 51/49 split between the commercial and recreational sectors. Effort restrictions used to manage the commercial and recreational quotas include trip limits, bag limits, closed seasons, and minimum size limits (15" TL minimum size limit for the commercial sector, 16" TL minimum size limit for recreational sector). In the most recent red snapper stock assessment, Schirripa and Legault (1999) assume that these management measures result in a bycatch mortality rate of 33 percent and 20 percent in the commercial and recreational fisheries, respectively.

Red snapper comprises the majority of bycatch in the directed fishery. The analysis provided in Section 4.4.2 suggests that the majority of this bycatch results from the minimum size limits. While minimum size limits promote regulatory discards, they offer tradeoffs in the form of increasing yield per recruit and protecting spawning stock. Analyses indicate that the current size limits approximate levels that best balance these tradeoffs.

Additionally, further reducing bycatch of red snapper in the directed fishery would not likely measurably affect the red snapper stock or associated species. The proportion of bycatch from the directed fishery has been estimated to account for just 0.5 percent of all bycatch of red snapper based on the current red snapper stock assessment. The shrimp trawl fishery is responsible for the remaining 99.5 percent of red snapper bycatch.

Consequently, the Council has concluded that the best available scientific information suggests that existing management measures reduce bycatch to the extent practicable in the directed red snapper fishery. The Council will re-evaluate this conclusion in Amendment 18 to the Reef Fish FMP based on the findings of the 2004 stock assessment and on other available information. The Council will consider the practicability of further reducing bycatch in the shrimp fishery in Amendment 14 to the Shrimp FMP.

4 .4.2 Extent and composition of bycatch in the directed red snapper fishery

Available information about the impacts of the directed red snapper fishery on the extent and composition of bycatch, and on bycatch mortality, is summarized below.

4 .4.2.1 Finfish bycatch

4.4.2.1.1 Commercial fishery

The CFLP used in the GOM commercial reef fish fisheries included a field to collect data on discards from 1993-1995. However, most captains did not complete that field. The few data collected from logbooks during that period of time indicate that about 31 percent of the catch by number was discarded in 1993, 28 percent in 1994, and 30 percent in 1995. These annual variations in discards may be the result of small sample sizes or of variations in geographical coverage (Schirripa and Legault, 1999). The minimum size limit was 13" TL in 1993 and in 1994, before increasing to 14" TL in 1995.

An observer program initiated in 1995 to collect data on the GOM reef fish fisheries recorded the lengths and fates of catch taken by bandit-rigged vessels targeting red snapper. Data collected on thirteen trips during the 1995 fishing season indicated that red snapper comprised the majority (75 percent) of the catch on directed fishing trips, followed by vermilion snapper (11 percent), and gray triggerfish (3 percent). Of 33 additional species, each represented one percent or less of the combined catch (Scott-Denton, 1995, Tables 4 and 5). About 44 percent of the red snapper taken by these vessels was discarded. These fish constituted about 19 percent of the total weight of the red snapper catch. Two percent of the vermilion snapper catch was discarded. Catches were taken from an average depth of 40 m (range 33-62 m), generally offshore of Louisiana and east Texas. While only 1.6 percent of the catch was discarded dead, most of the fish discarded had protruding stomachs or eyes. Many of these fish were believed to have suffered delayed mortality (Scott-Denton, 1995).

The rate at which red snapper are discarded in commercial fisheries may have increased because the minimum size limit for that sector was raised from 14" to 15" TL in 1996. For vermilion snapper, the discard rate may have also increased in response to an increase in the minimum size limit from 8" to 10" TL for that species.

Data collected by the CFLP discard supplement between August 1, 2001 and July 31, 2002, indicate that commercial fishermen are able to reduce red snapper bycatch when the season is closed. About 13,932 fish were discarded in 248 trips taken over 284 days during the closed seasons, compared to 16,857 fish taken in 224 trips over 80 days during the open seasons (John Poffenberger[10], personal communication). This represents a 28 percent reduction per trip.

4.4.2.1.2 Recreational fishery

The MRFSS estimates the number of fish caught and released by recreational anglers. The modes covered by this survey have varied over the years. However, data for each mode indicate that the fraction of the red snapper catch released by recreational fisheries increased over time until 1990 when this trend reversed. The proportion of catch discarded began to increase again from 1994 to 1996. This pattern is consistent with changes in the length frequency of red snapper harvested, and could be attributed to increases in the minimum size limit and to an observed increase in recruitment from 1993-1995 (Schirripa and Legault, 1999).

Schirripa and Legault (1999) examined the impacts of closed seasons on recreational bycatch reported that the number of red snapper captured and released by the recreational sector while the fishery was closed from November through December (MRFSS Wave 6) 1998 was less than half the 1993-1997 average. Catches and discards during that period were about 22 percent and 46 percent, respectively, of the 1993-1997 average (Schirripa and Legault, 1999, Figure 22). Consequently, although the closed season forced fishermen to release 100 percent of their catch, it appeared to have reduced the total number of fish captured. This suggests that recreational fishermen, like commercial fishermen, are able to direct their effort away from red snapper during closed seasons.

[10]John Poffenberger, Southeast Fisheries Science Center, National Marine Fisheries Service, Miami, Florida.

The Wave 6 closure has continued through 2003. MRFSS data collected from 1998-2002 indicate that this closure has reduced discards about 14 percent below pre-closure levels, but that total discards have increased 58 percent annually, compared to a three percent increase in catches (Figures 4.4.1 and 4.4.2). This increase in discards could potentially be attributed to the increased recruitment of small fish or to an increase in directed fishing effort resulting from higher expectations that more legal fish can be found.

4 .4.2.2 Finfish bycatch mortality

Schirripa and Legault (1999) assume a release mortality rate of 20 percent for the recreational sector and 33 percent for the commercial sector based on the depth distribution of their respective effort. These release mortality rates have been reviewed by the RFSAP and are considered to be based on the best available science. However, the preliminary findings of a new study of the commercial fishery suggest that discard mortality in that fishery may be higher (between 33 and 69 percent; David Nieland[11], personal communication). These findings will be further evaluated in the 2004 stock assessment.

Parker (1985) described experiments which recorded a mortality of 21 percent for red snapper that were caught at 22 m depth, then returned to the capture depth and held in wire cages. A similar study at 30 m resulted in a mortality of 11 percent (Schirripa and Legault, 1999). Parker (1985) observed no immediate mortality of 30 red snapper (< 16 in TL) captured at 30 m depth off the coast of Texas and released at the surface.

Gitschlag and Renaud (1994) reported that the mortality of small (< 32 cm) red snapper caught by hook and line off Texas and released at the surface was 1 percent at 21-24 m (n = 138), 10 percent at 27-30 m (n = 27), and 44 percent at 37-40 m (n = 47). The authors observed a mortality of 36 percent for red snapper caught from 50 m, returned to the capture depth and held in wire cages. Render and Wilson (1993) reported a mean mortality of 20 percent for red snapper caught at 21 m and released at the surface into a 9-m deep cage after 48 hours. Release mortality was higher in the fall than in the spring, and there was a non-significant increase in mortality with depth of capture.

Patterson (1999) reported the findings of a mark-recapture study conducted from 1995-1998. A total of 2,932 red snapper were tagged over the course of that study. The recapture rate of 14.6 percent included 463 recaptures of 427 fish through October 31, 1998. Of the recaptured fish, 35 were recaptured twice, and one was recaptured three times (Schirripa and Legault, 1999).

Dorf (2000) examined the fate of red snapper caught by the Texas headboat fishery. Of the nearly 4000 fish observed, 12.9 percent were kept, 52.8 percent were released alive and swam towards the bottom, 13.2 percent were released alive but were floating at the surface, and 1.3 percent were discarded dead. Depth did seem to be a factor in red snapper survival because fish released that were either floating or dead were caught at greater depths.

Burns et al. (2002) found a positive relationship between capture depth and mortality by using caging studies. They estimated that the depth where 50 percent of fish caught die was about 48.6 meters (160 feet). They also found that red snapper were more susceptible to hooking mortality from J hooks than red grouper, gag, or vermilion snapper.

[11]David Nieland, Louisiana State University, Baton Rouge, Louisiana.

Data from a mark-recapture ongoing study in 1999 indicated mortality increased with capture depth. About 14 percent of the fish taken from 30 m showed signs of stress upon release (Robert Shipp, personal communication, in Schirripa and Legault, 1999).

Fish that survive hooking and handling may be more susceptible to predation when they are returned to the water in areas with significant concentrations of large predators. Parker (1985) reported that predation was responsible for a 19.5 percent mortality of reef fish caught and released in 20-30 m depths off Daytona, Florida. In contrast, Gitschlag and Renaud (1994) noted that predation was not apparent in their study (Schirripa and Legault, 1999).

4 .4.2.3 Other bycatch

Little is known about the impact of the directed red snapper fishery on non-finfish species. Those species potentially affected by the fishery are described in Section 7.2, and include a number of marine mammals, sea turtles, and seabirds.

Under Section 118 of the Marine Mammal Protection Act (MMPA), NOAA Fisheries must publish, at least annually, a List of Fisheries that places all U.S. commercial fisheries into one of three categories based on the level of incidental serious injury and mortality of marine mammals that occurs in each fishery. The final rule for the 2003 List of Fisheries classifies the GOM reef fish bottom longline/hook-and-line fisheries as Category III fisheries. This classification indicates that the annual mortality and serious injury of a stock resulting from each fishery is less than or equal to one percent of the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (68 FR 41725).

Sea turtles can be captured with handline and bottom longline gear. However, the frequency with which such interactions occur in the directed red snapper fishery is minimal. The majority of targeted effort occurs in the area west of Cape San Blas, Florida, where the use of longlines and buoy gear is prohibited inside of 50 fathoms. Sea turtle density in the western GOM is significantly lower than in the eastern GOM and along the Florida coast. Sea turtle densities in the western GOM also appears to decrease with increasing depths (Epperly et al. 2002).

Poffenberger[1] reviewed supplementary discard data from reef fish fishery for two survey years (1/8/2001-7/31/2002 and 1/8/2002 - 7/31/2003) and found there were at total of 16 reported interactions with turtles. These interactions were reported for 14 trips. Five of the trips were with bottom longline gear and 9 of them were with handline (vertical) gear. All but 3 of the turtles were not identified by species (i.e., just reported as unknown or unclassified). The reported species were 2 loggerhead turtles and 1 green turtle. There is no evidence that the directed red snapper fishery is adversely affecting seabirds.

4 .4.3 Practicability of management measures in the directed red snapper fishery relative to their impact on bycatch and bycatch mortality

The studies summarized in Section 4.4.2 suggest that red snapper comprises the majority of bycatch in the directed fishery, and that most of this bycatch results from the minimum size limits. Maximizing yield identifies the size that balances the benefits of harvesting fish at larger sizes against losses due to natural mortality. As a cohort of fish ages, the individual fish in the cohort get larger and, thus, become more valuable to the fishery. However, fewer fish survive natural mortality to grow to larger sizes. Scientists use yield-per-recruit analyses to determine at what size the yield from an exploited stock will be maximized, taking into account growth and natural mortality rates.

Goodyear (1995) concluded that yield per recruit in the red snapper fishery would be maximized at a minimum size of 18" TL to 21" TL, based on assumed discard mortality rates of 20 percent and 33 percent in the recreational and commercial fisheries, respectively. A similar analysis conducted by Schirripa and Legault (1997) indicated that increasing the minimum size limit above 15" TL would result in no gains in yield. Because red snapper mature when they are between 10" and 14" TL (Schirripa and Legault, 1999), reducing current size limits would cause the fishery to capture immature fish.

Additionally, although the biological, ecological, social, and economic impacts of red snapper bycatch in the directed fishery are not fully understood, they are believed to be minimal because the directed fishery has a far less effect on stock recovery than the shrimp fishery. Shrimp trawl bycatch accounted for about 90 percent of the total red snapper harvest and for about 99.7 percent of total red snapper bycatch prior to the implementation of BRDs in 1998 (Schirripa and Legault, 1999). Current information indicates that BRDs have reduced bycatch mortality of red snapper in the shrimp trawl fishery by about 40 percent (Nichols, not dated). However, the shrimp trawl fishery still accounts for about 99.5 percent of total red snapper bycatch from the combined commercial, recreational, and shrimp fisheries Based on this information, the Council has concluded that the best available scientific information suggests that existing management measures reduce bycatch to the extent practicable in the directed red snapper fishery.

Several factors indicate that shrimp bycatch will be further reduced during the course of the red snapper rebuilding program. First, NOAA Fisheries is currently revising the BRD testing protocol to more efficiently certify BRDs that meet the bycatch reduction criteria for use in the GOM. This has the potential to increase innovation and, consequently, the effectiveness of BRDs. Additionally, Amendment 10 to the Shrimp FMP will require the installation of a NOAA Fisheries-certified BRDs that reduces the bycatch of finfish by at least 30 percent by weight in each net used aboard vessels trawling for shrimp in the GOM EEZ east of Cape San Blas, Florida (85° 30' W. Longitude). This amendment should be implemented early in 2004. The immediate impact of this action on reducing red snapper bycatch is expected to be minimal because few red snapper occur in the southern area where most of the offshore shrimping occurs. However, this rule could help to reduce red snapper bycatch as the stock expands along the west coast of Florida.

Amendment 11 to the Shrimp FMP established a vessel permit requirement for shrimp vessels operating in the Gulf EEZ. Permits have been required to participate in the fishery since December 6, 2002, and must be renewed annually. These permits will provide the basis for the alternative bycatch reporting programs currently being evaluated in Amendment 13 to the Shrimp FMP.

As discussed in Section 4.2.1.1, further bycatch reduction in the shrimp fishery may also be achieved through effort reduction due to attrition and/or to regulatory action. In recent years, the domestic wild shrimp fleet has faced increasing competition by imported farm-raised shrimp. Fuel and insurance costs have also increased, further cutting into the profitability of the GOM shrimp industry. As a consequence of these economic hardships, the profitability of the domestic wild shrimp fleet has been reduced. It is estimated that, absent any government intervention, the fleet of large boats (those most likely to bycatch red snapper) will shrink 39 percent by 2012 before the industry can once again make a profit (see Section 4.2.1.1).

Fishery managers also are considering in Amendment 14 to the Shrimp FMP a number of management measures that may reduce effort in the shrimp fishery. These include a limited entry program, area and seasonal closures, various permit limitations, trip limitations, buyback programs, and bycatch quota programs.

4 .4.4 Alternatives to minimize bycatch

Amendment18 to the Reef Fish FMP will propose additional measures designed to further reduce bycatch and bycatch mortality in the directed red snapper fishery and in other reef fish fisheries as well. These include seasonal closures, the use circle hooks, reduction or elimination of minimum sizes, and educating fishing participants on how to reduce bycatch and bycatch mortality.

Additionally, the NOAA Fisheries is conducting a referendum, the results of which will determine whether the Council can proceed in considering an IFQ program for the commercial red snapper fishery. Under an IFQ program, commercial fishermen are allocated percentages of a TAC, which is set by fishery managers based on estimates of what level of catch the fishery can sustain. Such a program has the potential to substantially reduce bycatch by providing fishermen more flexibility to decide where and when to fish. Bycatch problems identified by the Council in the red snapper fishery that an IFQ system could minimize include increased red snapper discard mortality associated with the recovery of the stock, regulatory discards during those time periods when the red snapper fishery is closed to commercial harvests, and the creations of additional bycatch when size limits are increased (GMFMC, 2002). Rationale for believing IFQs could achieve these reductions have to do with the flexibility that IFQ systems give fishermen so they can target more favorable harvesting conditions, and thus avoid areas where bycatch are more likely. As an example, the halibut fishery in the Pacific Northwest, bycatch (rockfish and sublegal halibut) decreases substantially as a result of the implantation of an IFQ system (NRC, 1999).

The following section provides a preliminary analysis of the potential effects and practicability of each of these alternatives in further reducing bycatch and bycatch mortality in the red snapper fishery based on the ten factors provided at 50 CFR 600.350(d)(3)(i) and described in Section 4.4.1. The practicability of these alternatives, with the exception of the IFQ program, will be more fully analyzed in Amendment 18 based on data from the 2004 red snapper stock assessment. The Council will further evaluate the bycatch (and other) implications of the IFQ program if the outcome of the referendum results in a decision to proceed in developing such a program.

4 .4.4.1 Population effects for the bycatch species, changes in the composition of bycatch, and resulting ecological effects (Practicability factors 1-3)

Based on the data summarized in Section 4.4.2.1, reducing the minimum size limit would be expected to reduce bycatch. An educational campaign would not be expected to have a measurable impact on bycatch in federal fisheries. These fisheries occur in deeper waters, where bycatch mortality is higher. Additionally, the derby style way in which the fishery operates provides a disincentive to avoid bycatch hot spots or to handle catches with care. Additionally, studies have reported no significant survival benefit from bladder deflation (Schirripa and Legault, 1999). A requirement to use circle hooks may have a greater impact on reducing bycatch mortality.

An IFQ program could substantially reduce bycatch of red snapper and of other species by providing fishery participants an incentive to fish efficiently and to better handle the catch to maximize their profits. An IFQ program could stabilize markets and prices by allowing catches to be delivered to the dock on demand. This would help fishermen target when and where they want to fish.

As stated in Section 4.4.3, any bycatch reduction achieved by these measures is not likely to measurably affect the recovery of the red snapper stock. The proportion of bycatch from the directed fishery has been estimated to be only about 0.5 percent of all bycatch of red snapper based on the current stock assessment. However, this conclusion will be re-evaluated in Amendment 18 based on the 2004 red snapper stock assessment and on other available information.

While only marine mammals and birds are included as one of the ten factors that should be considered in determining whether a management measure minimizes bycatch or bycatch mortality, other endangered and threatened species should be kept in mind under the context of factors 1, 2 and 3 regarding bycatch species.

4 .4.4.2 **Effects on marine mammals and birds** (Practicability factor 4)

Bycatch minimization measures in the directed fishery could indirectly affect marine mammals and seabirds by reducing the amount of food available to those animals that have learned to feed behind fishing vessels. There is no information to determine how reduced discards might affect populations of these animals. However, disassociation with humans may be ecologically beneficial over the long term. Bycatch minimization measures also could benefit marine mammals and seabirds by limiting food availability (e.g., reducing populations of prey species). However, as discussed in Section 4.4.2, available information suggests that red snapper constitutes the majority of bycatch in the directed fishery. Bycatch minimization measures are not expected to have much effect on the recovery of the red snapper stock.

4 .4.4.3 **Changes in fishing, processing, disposal, and marketing costs** (Practicability factor 5)

Bycatch minimization alternatives in the directed fishery would be expected to affect the costs of fishery operations. Reducing the minimum size limit would likely increase harvesting efficiency and the overall commercial value of the product in the marketplace. Circle hooks are at least three times more expensive than J hooks, but would represent just one small increase in total trip costs for both commercial and recreational fishermen. Closing areas to fishing activity to avoid young fish or large concentrations of spawning fish would have a disproportionately negative effect on trip costs of commercial and for-hire vessels that have income associated with red snapper fishing.

An IFQ program may promote greater efficiency in fishing, processing, and disposal. Experience has shown that IFQ programs are effective in controlling fishing effort, removing excess capital, generating profits (Anonymous, 1996; Iudicello et al., 1999; NRC, 1999), reducing the incentive to fish during unsafe conditions, and extending the availability of fresh fish products (NRC, 1999). In some cases, these programs have improved product quality by improving fishing and handling methods, and reducing bycatch by giving fishermen greater flexibility to decide where and when to fish (NRC, 1999).

Additionally, there are factors outside the authority of fishery managers, such as waterfront property values, recent recessionary impacts on discretionary spending, or the availability of less expensive imports, that cumulatively may affect the economic decisions made by recreational and commercial fishermen and processors.

4 .4.4.4 **Changes in fishing practices and behavior of fishermen** (Practicability factor 6)

Any management measures implemented to reduce bycatch would be expected to change fishing practices. Reducing the minimum size limit would increase the CPUE of legal sized fish, decrease bycatch, and influence decisions about where and when to fish. However, if access to the resource were not restricted, such regulations would result in shorter seasons as the quotas would be achieved more quickly. Educating fishermen about methods to reduce bycatch and bycatch mortality might be an effective way to change fishing practices and behavior. However, as noted above, it is not clear that changes in behavior could substantially affect the amount of bycatch taken in the directed red snapper fishery under derby conditions.

Gear requirements, such as hook type, hook size, or bait type, could cause some marginal fishermen to quit fishing for affected species. Closed seasons may cause commercial and recreational fishermen to reduce effort initially. However, any associated bycatch reduction benefit could be negated if fishermen shifted effort to open seasons over time. An IFQ program would likely influence fishing practices and behavior, as described previously. It is unlikely, however, that any of these changes can be quantitatively measured until the effects of bycatch reduction measures have been monitored over a period of several years.

4 .4.4.5 Changes in research, administration, enforcement costs, and management effectiveness (Practicability factor 7)

Gear or size regulations would not be expected to impact administrative costs. However, there could be additional costs associated with enforcing additional gear or size regulations. There would be an administrative cost associated with an educational campaign. Administering seasonal closures or adjustments to existing closures would be no more costly than administering and enforcing existing closures. An IFQ program could increase administrative costs, but would be expected to reduce enforcement costs and improve the overall effectiveness of management.

4 .4.4.6 Changes in the economic, social, or cultural value of fishing activities and nonconsumptive uses of fishery resources (Practicability factors 8, 10)

Any bycatch reduction achieved in the directed red snapper fishery is not likely to change the economic, social, or cultural value of fishing activities, or the non-consumptive uses of affected species, because bycatch in the commercial sector is not believed to have a measurable impact on red snapper or on other species. However, the bycatch reduction measures, themselves, could result in social and/or economic impacts as discussed in Sections 4.4.4.3 and 4.4.4.4. Such effects will be further explored in Amendment 18 to the Reef Fish FMP.

4 .4.4.7 Changes in the distribution of benefits and costs (Practicability factor 9)

All of the bycatch minimization measures the Council is considering in Amendment 18 are likely to be applied equally to all sectors of the fishery. Consequently, these measures are not expected to impact the distribution of benefits and costs. An IFQ program would apply only to the commercial sector, but the percentage of TAC allocated to the IFQ program would probably be consistent with the current commercial allocation. Such a program would change the distribution of benefits and costs in the commercial fishery. The specifics of these changes would be indeterminable until a program is designed/proposed.

4 .4.5 Conclusion

An evaluation of the practicability of additional management measures to reduce bycatch and bycatch mortality should consider the status of the stock, and the impacts that bycatch from the various sources has on that stock. Anecdotal information provided from public testimony to the Council, and as well as in sport fishing publications suggests that the red snapper stock has improved since it was last assessed in 1999, and that red snapper bycatch in the shrimp fishery has declined considerably due to the implementation of BRDs. The current assessment indicates that any bycatch minimization measures in the directed fishery will have no impact on the status of the red snapper stock. However, a new assessment that can more accurately assess the implications of current bycatch mortality on the red snapper stock from the directed fishery and from the shrimp fishery is due to be completed in 2004.

The 2004 assessment will incorporate a great deal of new information, including five years of observer data on shrimp trawl bycatch, fishery-dependent data on observed changes in lengths of harvested fish, better characterizations of discard mortality rates, and estimates of changes in age one recruitment from SEAMAP. Additionally, the results of new research into red snapper stock structure in the northern and western Gulf, and new estimates of discard mortality, should be available for use in the assessment. This new data, combined with four years of data on the fishery under the same management regulations, is expected to provide a better understanding of the impacts of BRDs and of regulations in the directed fishery, and of the possible impacts of new regulations on the red snapper stock.

The Council plans to use the results of the 2004 assessment to develop logical and defensible measures to reduce shrimp trawl bycatch and/or directed fishery discards as necessary and practicable. Shrimp trawl bycatch will be addressed in a future amendment to the Shrimp FMP. Additional measures to reduce bycatch in the directed red snapper fishery are being evaluated in Amendment 18 to the Reef Fish FMP, along with measures to reduce bycatch in the other reef fish fisheries.

The preliminary analysis of the practicability factors provided above indicates that there would likely not be positive biological impacts associated with further reducing bycatch in the directed red snapper fishery unless the 2004 stock assessment shows a major increase in the relative proportion of bycatch taken in the directed fishery. Additionally, many of the minimization measures considered would result in short-term adverse economic and social impacts.

5 Regulatory Impact Review

5 .1 Introduction

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

The RIR also serves as the basis for determining whether the proposed regulation is a "significant regulatory action" under certain criteria provided in Executive Order 12866, and provides the general basis in determining whether the proposed regulation will have a significant economic impact on a substantial number of small entities in compliance with the Regulatory Flexibility Act of 1980 (RFA).

This RIR analyzes the potential impacts that the alternatives in this plan amendment to the Reef Fish FMP would have on participants in the reef fish fishery.

5 .2 Problems and issues in the fishery

The specific problems addressed in this proposed plan amendment are enumerated and discussed in Section 3.0 and are incorporated here by reference. The major issues identified for this plan amendment are: (1) specification of red snapper biological reference points and status determination criteria, (2) rebuilding the overfished red snapper stock, (3) establishing a bycatch reporting methodology, and (4) examine bycatch minimization measures.

5 .3 Objectives

Section 3.0 discusses the specific need for this plan amendment and is incorporated here by reference.

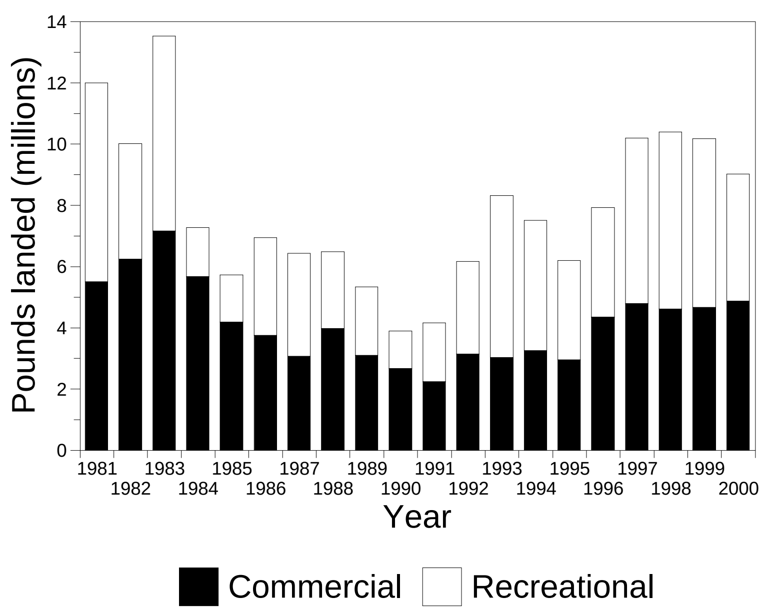
5 .4 Description of the fishery

5 .4.1 General features

Since 1990, the red snapper fishery has been managed through the setting of an annual TAC. An implicit TAC of about 6.0 mp was set in 1990, followed by explicit TACs of 4.0 mp in 1991 and 1992, 6.0 mp in 1993 through 1995, and 9.12 mp from 1996 through the present. Table 5.1 shows a comparison of TACs and harvests from 1990 through 2002.

Table 5.1. Combined red snapper harvest. Note that the MRFSS red snapper landings will be reviewed and updated late in 2003 so that total landings presented in this document may be subject to change.

Year	TAC	Total Directed Harvest
1990	No TAC was explicitly specified	3.90 mp
1991	4.0 mp	4.17 mp
1992	4.0 mp plus emergency season	6.17 mp
1993	6.0 mp	8.31 mp
1994	6.0 mp	7.51 mp
1995	6.0 mp	6.20 mp
1996	9.12 mp	7.92 mp
1997	9.12 mp	10.20 mp
1998	9.12 mp	10.40 mp
1999	9.12 mp	10.18 mp
2000	9.12 mp	8.77 mp
2001	9.12 mp	9.13 mp
2002	9.12 mp	10.11 mp
2003	9.12 mp	9.16 mp (preliminary)



5 .4.2 The commercial fishery

Waters (2003) has recently reviewed the history and status of the commercial red snapper fishery. U.S. fishermen have fished commercially for red snappers since the mid 1800s. During the modern period, landings of red snapper exhibited an almost uninterrupted decline between 1965 and 1980, from 14.0 mp to 5.0 mp (Fig. 5.1). Landings increased for three consecutive years to 7.3 mp in 1983, primarily due to increased catches with bottom longlines, but then dropped to 2.7 mp in 1990. The decline in landings was due in part to a decline in catches from foreign fishing grounds (GMFMC, 1981) and a decline in the size of the domestic fish population (Goodyear and Phares, 1990). Since 1990, the commercial fishery has been managed with annual quotas established as 51 percent of TAC. Table 5.2 shows a comparison of commercial quotas and landings from 1990 through 2002.

Table 5.2. Commercial red snapper harvest (from Tables 8 and 9 in Schirripa and Legault (1999), except 1999-2002 landings from NOAA Fisheries SERO)

Year	Commercial Quota	Commercial Harvest	Days Open (days that open or close at noon are counted as half-days) (“+” = split season)
1990	3.1 mp	2.66 mp	365
1991	2.04 mp	2.23 mp	236
1992	2.04 mp plus emergency season	3.14 mp	52 + 42 = 94
1993	3.06 mp	3.02 mp	104
1994	3.06 mp	3.25 mp	78
1995	3.06 mp	2.95 mp	50 + 2 = 52
1996	4.65 mp	4.35 mp	64 + 22 = 86
1997	4.65 mp	4.79 mp	53 + 18 = 71
1998	4.65 mp	4.61 mp	39 + 28 = 67
1999	4.65 mp	4.67 mp	42 + 22 = 66
2000	4.65 mp	4.84 mp	33 + 25 = 58
2001	4.65 mp	4.61 mp	56 + 23 = 79
2002	4.65 mp	4.78 mp	67 + 27 = 94
2003	4.65 mp	4.58 mp (preliminary)	67 + 27 = 97

Ex-vessel value received by commercial red snapper fishermen in the Gulf of Mexico increased throughout the 1962-1983 period to a record $12.0 million (Fig. 5.1). Much of the increase was due to inflation, as measured by the consumer price index for all items and all urban consumers (CPI-U, with 2002 base year). After adjusting for inflation, total ex-vessel value from sales of red snapper generally followed the trend in landings.

Since 1990, the principal method of managing the commercial fishery for red snapper has been with quotas set at 51% of TAC and seasonal closures after each year's quota was filled. The result has been a race for fish in which fishermen are compelled to fish as quickly as possible to maximize their shares of the overall quota before the season is closed. Seasons have become shorter despite implementation of trip limits in 1992 and larger minimum size limits in 1994 and 1996. The fishing year is now characterized by short periods of intense fishing activity with large quantities of red snapper landed during the open seasons rather than lower levels of activity with landings spread more uniformly throughout the year (Fig. 5.2). Recently, the fishery has been managed with separate spring (beginning in February) and fall (beginning in October) quotas with 10-day open seasons at the beginning of each month, which has spread industry landings over a greater number of months during the year.

One consequence of quota management has been unusually low dockside prices necessary for the market to absorb the large volumes of fish that are landed during relatively short periods of time. Both nominal and real average annual dockside prices generally increased over time from 1962 through 1990, but since then, prices have declined sharply during each open season both in nominal and real terms (Fig. 5.3). The magnitude of the effect of quota management on real average annual dockside prices was estimated by Waters (2001) to be approximately $1.14 per pound, as measured as the vertical distance between the price-quantity relationships for the 1962-1990 and 1992-2002 periods (Fig. 5.4).[12] Figure 5.5 illustrates the sharp declines in average monthly prices associated with exceptionally large landings during each open season. Average annual and monthly nominal prices were calculated as the ratio of dockside revenues and quantities landed as reported by the NOAA Fisheries. Real prices were calculated by adjusting nominal prices for inflation with the CPI for all urban consumers and a base year of 2002.

Management of the red snapper fishery has reduced industry revenues in two ways. First, the race for fish caused by quota management caused a downward shift in the entire price-quantity relationship so that fishermen received lower prices for any given quantity of red snapper landed. However, revenues would have declined even without a race for fish. The observation that trends in real dockside prices have followed trends in landings suggests that dockside demand for red snapper is price elastic. Price elasticity of demand refers to the responsiveness of dockside prices to changes in industry landings, and is measured as a movement along the price-quantity demand relationship. When the demand relationship is price elastic, regulated reductions in landings result in a less than proportional increase in prices, which causes total revenues to fishermen to fall.

Trip limits were implemented in an effort to slow the race for fish. At the beginning of the 1993 season, 131 boats qualified for red snapper endorsements on their reef fish permits that entitled them to land up to 2,000 pounds of red snapper per trip, while boats without endorsements were limited to 200 pounds per trip. The endorsement system remained in effect until formalized into a license limitation system in 1998. Boats with endorsements were granted Class 1 licenses that entitled them to land up to 2,000 pounds per trip. Other boats with a history of landing red

[12] The price-quantity relationship was estimated with data for 1962-1999. Updated information for 2000-2002 appears to follow the same pattern.

snapper qualified for Class 2 licenses to land up to 200 pounds per trip. Boats that did not qualify for either type of license are restricted to the recreational bag limit.

NOAA Fisheries logbook trip reports were examined for measures of fishing effort and productivity in the commercial red snapper fishery. Boats that reported landing red snapper were classified into three groups. Group 1 consists of the top 50 boats when ranked in terms of annual landings of red snapper. Group 2 consists of the next 81 boats, ranked 51 through 131. Group 3 consists of all other boats that reported landing red snapper, and ranged in number from a high of 505 in 1993 to a low of 323 in 1998, and numbered 357 in 2002. Separate rankings and groupings were performed for each year, 1993-2002, to account for changes in ownership and levels of participation in the red snapper fishery.

The top 50 boats accounted for a disproportionately large share of industry landings of red snapper. Between 1998 and 2002, the top 50 boats averaged 2.6 mp of red snapper, or 60% of the industry total (Fig. 5.6). Boats ranked 51-131 averaged 1.5 mp, or 34% of the industry total. Boats in group 3 averaged only 0.28 mp, despite their large numbers.

They supplied an average of 1,500 trips per year (1998-2002) for red snapper (Fig. 5.7), or about 30 trips per boat per year (Fig. 5.8). Boats ranked 51-131 averaged 15 trips per year for red snapper, and other boats landed red snapper on 5 trips per year. The top 50 boats averaged shorter trips (Fig. 5.9), but carried more people on board each trip (Fig. 5.10). The top 50 boats averaged 1.8 days per trip and 4.0 persons aboard per trip, whereas boats in group 2 averaged 2.4 days per trip and 3.4 persons aboard, and boats in group 3 averaged 2.9 days per trip and 2.4 persons aboard.

The result of more productive fishing effort is substantially higher average catch per trip. The top 50 boats averaged 1,766 pounds of red snapper per trip from 1998-2002 compared to 1,245 pounds per trip for boats ranked 51-131 and 160 pounds per trip for other boats (Fig. 5.11). Between 1998 and 2002, 79% of red snapper trips by the top 50 boats landed 1,600 pounds of red snapper or more, while only 1% of trips resulted in less than 200 pounds of red snapper (Fig. 5.12). In contrast, 44% of trips by boats in group 2 landed 1,600 pounds of red snapper or more, and nearly 17% of their trips landed 200 pounds of red snapper or less. Boats in group 3 did not target red snapper, and 91% of their trips with red snapper resulted in 200 pounds or less of red snapper.

Trips within each group of boats were classified according to the main species landed on each trip, with main species defined as that which generated the greatest source of revenue. For example, trips were classified as targeting red snapper if revenues from red snapper were greater than revenues from any other individual species.[13]

Boats in groups 1 and 2 fished primarily for red and vermilion snappers. Fishing trips for king mackerel, primarily in July with participation declining through December, was the next most likely alternative for the top 50 boats. The top 50 boats made 75% of their trips for red snapper, 11% for vermilion snapper, 7% for king mackerel, 5% for groupers, and 4% for other species (Fig 5.13). Trips by boats in group 2 were slightly less focused on red snapper. Approximately 60% of their trips were for red snapper, 17% for vermilion snapper, 5% for king mackerel, 9% for groupers, and 8% for other species (Fig. 5.14). Boats in group 3 fished primarily for groupers and other species. Approximately 53% of their trips were for groupers, 14% for red snapper, 9% for

[13] Fishermen do not report prices or revenues in their logbook submissions. Therefore, trip revenues were approximated as reported landings multiplied by average monthly prices that were calculated from general canvass data.

vermilion snapper, 5% for king mackerel and 19% for other species (Fig. 5.15). These data exclude trips for non-reef fish species that were not reported to the NOAA Fisheries reef fish and coastal migratory pelagics logbook program.

By law commercial vessels landing reef fish, including red snapper, are required to sell their catch only to fish dealers with federal reef fish permits. Based on information from the permit file, there are about 227 dealers possessing permits to buy and sell reef fish species. Most of these vessels are located in Florida (146), with 29 in Louisiana, 18 in Texas, 14 in Alabama, 5 in Mississippi and 15 out of the Gulf States region. There are no specific income or sales restrictions to secure a federal permit for dealers, so the total number of dealers can vary from year to year. Some may be operational one year but not in another year. From logbook information submitted by vessel owners/operators for the years 1997-2002, there were on average of 154 reef fish dealers actively buying and selling in the red snapper market. (These red snapper dealers are distributed around the Gulf states as follows: 7 in Alabama, 96 in Florida, 22 in Louisiana, 7 in Mississippi, and 22 in Texas. Since these numbers are averages, they could differ from the ones based on permit file, but in any one year, the number of dealers reported per state in logbooks does not that contained in the permit file). Dealers in Florida purchased about $1.8 million of red snapper, followed by dealers in Louisiana with purchases of $1.4 million and dealers in Texas with purchases of $1.3 million. Dealers in Mississippi purchased $174 thousand worth of red snappers and those in Alabama, $88 thousand. These dealers may hold multiple types of permits and because we do not know 100% of the business revenues, it is not possible to determine what percentage of their business comes from red snapper fishing activity.

5 .4.3 The recreational fishery

The recreational component of the red snapper fishery in the Gulf includes charter boats, headboats (or party boats), and private anglers fishing from shore or private or rental boats. Recreational red snapper harvest allocations since 1991 have been set at 49 percent of the TAC, or 1.96 mp in 1991 and 1992, 2.94 mp for 1993 through 1995 and 4.47 mp from 1996 to 2001 (Table 5.3a). Before 1997, the recreational red snapper fishery was mainly managed through size and bag limits. In 1997, the recreational red snapper allocation was converted into a quota with accompanying quota closure should the sector exceed its quota. Recreational quota closures occurred in 1997, 1998 and 1999. Fixed closures were subsequently established beginning in 2000 to replace the quota closure. The numerical distribution of catch types for the recreational fishery is shown in Table 5.3b.

Actual recreational harvests in pounds of red snapper have exceeded the allocation every year except 1991, 1996, and 2000 (although 2000 landings are preliminary and may increase as data are finalized). Recreational landings may have been overestimated. Changes in sampling methodology of the charter boat fishery indicates that landings may have been overestimated by 25 to 30 percent for this sector (David Van Voorhees, pers. comm.).

Over time, changes have occurred in landings for the recreational private and for-hire sectors. During the period 1981/1982, the private sector landed about 65 percent of the fish when compared to the for-hire sector (Table 5.4). However, for the periods 1988/1989 and 1996/1997, this pattern reversed with the for-hire sector landing over 60 percent of the fish. Additionally, there has been a shift within the for-hire sector of the fishery with the charter boat sector landing more red snapper (44% of the for-hire landed fish in the time period 1988/1989 compared to 59.9% of the fish in 1996/1997).

The 1999 figures contain preliminary estimates of headboat and Texas Parks and Wildlife harvests. The 2000 figures contain preliminary estimates from all data sources. Further, the 2000

MRFSS estimate utilizes a new data collection methodology for the charter sector and, therefore, should be cautiously compared to estimates from previous years.

The level and changes in recreational effort for red snapper can be partly portrayed by considering recreational trips. Table 5.5 shows the trend in recreational target and catch trips for red snapper based on MRFSS data. Total number of recreational trips in the Gulf of Mexico remained at relatively stable level below 20 million in the early years and above 20 million in the last three years. Individual angler trips targeting red snapper stayed at near or below 200 thousand in the early years, but have increased steadily over the last 5 years with the level remaining above 300 thousand in the last two years. A relatively similar trend is followed by catch trips. In the last 5 years, target trips have stayed at close to half of catch trips.

Table 5.3a. Recreational red snapper harvest (from Table 20 in Schirripa and Legault, 1999 with additional landings provided by NOAA Fisheries SERO for 1999-2002). Note that the MRFSS red snapper landings will be reviewed and updated late in 2003 so that recreational landings presented in this document may be subject to change.

Year	Recreational Allocation/Quota	Recreational Harvest	Days Open
1990	No allocation was explicitly specified	1.24 mp	365
1991	1.96 mp	1.94 mp	365
1992	1.96 mp	3.03 mp	366
1993	2.94 mp	5.29 mp	365
1994	2.94 mp	4.26 mp	365
1995	2.94 mp	3.25 mp	365
1996	4.47 mp	3.57 mp	366
1997	4.47 mp (quota begins)	5.41 mp	330 (closed 11/27/97)
1998	4.47 mp	5.76 mp	272 (closed 9/30/98)
1999	4.47 mp	5.51 mp	240 (closed (8/29/99)
2000	4.47 mp	3.92 mp	194 (4/21/00 to 10/31/00)
2001	4.47 mp	4.52 mp	194 (4/21/01 to 10/31/01)
2002	4.47 mp	5.33 mp	194 (4/21/02 to 10/31/02)
2003	4.47 mp	4.58 mp (estimated)	194 (4/21/03 to 10/31/03)

Table 5.3b. Number of recreationally caught red snapper from the Gulf of Mexico by catch type and year. Type A catch are fish that are brought back to the dock in a form that can be identified by trained interviewers, Type B1 catch are fish that are used for bait, released dead, or filleted -- i.e. they are killed but identification is by individual anglers, and Type B2 catch are fish that are released alive but identification is by individual anglers. PSE is the proportional standard error and expresses the standard error of an estimate as a percentage.

Year	Type A (PSE)	Type B1 (PSE)	Type B2 (PSE)
1981	1,041,792 (22.3)	832,870 (32.1)	55,153 (36.9)
1982	1,001,485 (16.5)	431,953 (51.4)	22,394 (43.5)
1983	2,281,808 (17.6)	336,820 (46.6)	1,982 (61.2)
1984	408,868 (18.6)	262,996 (24.5)	22,008 (76.3)
1985	724,391 (13.6)	165,858 (25.9)	179,209 (27.1)
1986	367,767 (12.7)	459,856 (20.8)	47,663 (24.8)
1987	703,041 (25.3)	79,133 (26.4)	75,153 (23.1)
1988	508,587 (12.7)	207,175 (25.2)	196,555 (28.3)
1989	477,716 (17.2)	210,486 (39.3)	296,875 (23.9)
1990	306,300 (13.9)	84,516 (34.2)	538,893 (21.8)
1991	485,268 (14.1)	154,462 (24.5)	869,741 (13.8)
1992	841,373 (7.6)	130,945 (25.6)	936,044 (8.4)
1993	1,329,003 (6.4)	165,512 (19.1)	963,742 (9.9)
1994	813,062 (6.5)	196,785 (16.8)	905,684 (9.6)
1995	693,743 (9.5)	78,369 (23.0)	753,779 (10.9)
1996	607,518 (10.1)	84,503 (29.5)	1,004,962 (8.7)
1997	1,077,986 (7.3)	48,255 (24.7)	1,857,883 (7.4)
1998	1,281,645 (5.6)	37,216 (23.1)	1,359,913 (5.4)
1999	1,201,315 (5.2)	6,159 (37.2)	1,997,434 (4.6)
2000	740,100 (6.4)	27,011 (24.1)	1,427,306 (7.0)
2001	821,571 (6.7)	26,450 (28.0)	1,806,533 (6.3)
2002	1,030,050 (5.2)	75,753 (21.2)	2,091,051 (6.6)

Table 5.4. Gulf of Mexico landings of red snapper (1,000's of fish) by charter vessel/headboat sectors and percentage of total recreational landings for 3 periods between 1981-1997.

Period	Average Total Landing	Charter Vessels		Headboats		For-Hire
		Average Landing	Percent of Total	Average Landing	Percent of Total	Percent of Total
1981/1982	2099	721	34.3	1/		34.3
1988/1989	**1097**	328	**27.4**	411	**34.3**	**61.7**
1996/1997	1363	577	42.3	387	28.4	70.7

Source: Schirripa (1998)

1/ Headboat landings are combined with charter vessel landings under MRFSS.

Table 5.5. Recreational red snapper effort in the Gulf of Mexico based on MRFSS data, 1986-2002.

	Target Trips		Catch Trips		Total Trips
	Level	% to Total	Level	% to Total	
1986	105,555	0.55	196,510	1.03	19,039,944
1987	175,673	1.09	250,838	1.56	16,089,446
1988	114,975	0.58	196,477	1	19,743,299
1989	137,903	0.88	203,187	1.3	15,622,510
1990	109,142	0.82	200,073	1.5	13,310,226
1991	170,056	0.94	272,410	1.5	18,173,598
1992	186,310	1.03	265,986	1.47	18,079,250
1993	277,158	1.59	417,715	2.4	17,431,009
1994	213,504	1.22	365,466	2.09	17,503,737
1995	201,099	1.16	328,918	1.89	17,390,316
1996	155,137	0.91	313,497	1.84	17,032,778
1997	187,247	1.01	499,910	2.69	18,593,084
1998	146,073	0.87	335,254	2.01	16,703,364
1999	264,572	1.66	569,577	3.58	15,893,729
2000	269,016	1.28	501,673	2.39	21,017,783
2001	385,273	1.68	603,323	2.64	22,889,697
2002	388,199	1.97	610,683	3.11	19,665,578

Notes: Target trips are recreational trips taken by anglers who specified red snapper as their first or second target species regardless of whether red snapper was caught or not. Catch trips are recreational trips taken by anglers who caught red snapper regardless of their target preference. Total trips are recreational trips taken by all anglers in the Gulf of Mexico.

Table 5.6 shows the breakdown of recreational red snapper effort by fishing mode. For both target and catch trips, the shore mode accounts for a relatively small component of recreational red snapper effort. Also for both target and catch trips, the private/rental mode has accounted for the largest amount of recreational red snapper effort. The charter mode, however, has steadily gained ground against the private/rental mode with respect to catch trips but not with respect to target trips. Target trips through the charter mode still pales in comparison to those for the private/rental mode.

Table 5.6. Recreational red snapper effort in the Gulf of Mexico based on MRFSS data, by mode, 1986-2002.

	Target Trips			Catch Trips		
	Shore	Charter	Private	Shore	Charter	Private
1986	8,382	31,480	65,694	2,935	120,053	73,522
1987	28,963	44,227	102,483	8,739	148,303	93,797
1988	5,942	23,964	85,069	6,639	98,304	91,534
1989	11,926	25,938	100,339	14,311	95,954	92,922
1990	17,620	26,438	65,083	37,432	55,254	107,388
1991	50,686	31,667	87,702	31,917	105,504	134,989
1992	3,558	34,553	148,199	4,453	90,255	171,279
1993	2,648	81,431	193,080	6,824	202,206	208,685
1994	2,918	53,048	157,538	2,918	192,014	170,534
1995	5,064	64,695	131,340	2,118	162,151	164,649
1996	0	47,909	107,227	3,248	169,968	140,281
1997	0	82,497	104,750	0	270,224	229,686
1998	4,896	59,056	82,121	2,000	236,084	97,170
1999	3,864	60,615	200,093	4,005	303,123	262,448
2000	7,980	59,419	201,617	3,155	264,938	233,580
2001	13,060	64,271	307,942	8,358	217,645	377,321
2002	1,998	112,192	274,009	3,661	279,037	327,984

5.4.3.1 Private anglers

There are about 2.1 million anglers estimated to be fishing for marine species in the GOM. These anglers targeted drum about 35 percent of the time and spotted sea trout about 33 percent of the time. Red snapper is the most common reef fish targeted by approximately 4.5 percent of intercepted anglers.

Social and economic characteristics of private anglers are collected periodically by the Marine Recreational Economics Survey with an economic add-on survey. The following discussion relies heavily on the economic data add-on conducted during 1997-98 and summarized in Holiman (1999) and Holiman (2000). The typical angler in the Gulf region is 44 years old, male (80 percent), white (90 percent), employed full time (92 percent), with a mean annual household income of $42,700. The mean number of years fished in the state was 16 years for GOM anglers. The average number of fishing trips taken in the 12 months preceding the interview was about 38 and these were mostly (75 percent) one-day trips where expenditures on average were less than $50. Seventy-five percent of surveyed anglers reported that they held saltwater licenses, and 59 percent of them owned boats used for recreational saltwater fishing.

Those anglers who did not own their own boat spent an average of $269 per day on boat fees (Holiman, 1999) when fishing on a party/charter or rental boat. About 76 percent of these anglers who did not own their own boat were employed or self-employed and about 23 percent were unemployed, mostly due to retirement.

5.4.3.2 Charter boats, headboats and party boats

Within the Gulf States, there are about 1,907 charter boats/headboat/party boats with permits that allow them to harvest both reef fish and coastal pelagic fish. The majority of these permits are in Florida (1,194), followed by Texas (300), Louisiana (162), Alabama (159) and Mississippi (92) (NOAA Fisheries permit file as of June 2001).

Between 1987 and 1997, several major changes occurred in the Florida charter and headboat industry. The number of charter boats in the Florida Gulf increased about 16 percent to 615 vessels and that in the Florida Keys increased about 12 percent to 230 vessels. Most of this growth occurred along the Florida peninsula coast; in contrast, the number of charter boats in the Panhandle region decreased by 8 percent. The number of headboats in the Florida Gulf increased about 20 percent, mostly along the southwest Florida coast. In contrast, the number of headboats in the Florida Keys decreased 11 percent. Charter passenger trips remained stable at about 848,458 passengers on 180,523 trips in 1997 while headboat passenger trips increased to 1,137,362 passengers on 44,655 trips in 1997 (Holland et al., 1999).

Between 1987 and 1997, a number of changes also occurred in the charter and headboat industry in Alabama, Mississippi, Louisiana and Texas. The number of charter boats increased about 105 percent to 430 vessels, with the increase occurring primarily in Alabama, Mississippi and Texas. In contrast, the number of headboats decreased 12 percent to 23 vessels. The number of passenger trips taken on both charter and headboats increased threefold. In 1997, there were 318,716 charter boat passenger trips and 117,990 headboat passenger trips (Sutton et al., 1999).

5.4.3.3 Florida charter and headboat industry

Most of the following discussion is taken from two recent studies of the industry: "Operation and Economics of the Charter and Headboat Fleets of the Eastern GOM and South Atlantic Coasts" by Stephen M. Holland, Anthony J. Fedler and J. Walter Milon (1999)

Holland et al. (1999) estimated there were 615 charter and 53 headboats located along the Florida Gulf in 1998 (excluding the Keys). Of the charter boat operators sampled in 1998, 52.9 percent held Gulf reef fish charter permits, 56.8 percent held coastal migratory pelagic permits, 14.3 percent held South Atlantic snapper/grouper permits, 5.2 percent held swordfish permits, 7.8 percent held shark commercial permits, 26.6 percent held king and Spanish mackerel commercial permits, 6.5 percent held South Atlantic snapper/grouper commercial permits, 13.7 percent held red snapper commercial permits, and 22.1 percent held commercial Gulf reef fish commercial permits. Of the headboat operators sampled, 76.5 percent held Gulf fish reef charter permits, none held Gulf reef fish commercial permits, and 70.6 percent held coastal migratory pelagic charter permits.

The average Florida charter boat had a length of 37 feet, with two-thirds less than 43 feet and they carried a maximum of 6 passengers. The length of Florida charter boats varied slightly by region, with a 34-foot mean on the Gulf coast and 39-foot mean length on the Atlantic coast. The average Florida headboat had a length of 62 feet, with 70% less than 66 feet and they carried a maximum of 61 passengers.

About one-third of Florida charter boats targeted three or less species, two-thirds targeted five or less species and 90% targeted nine or less species. About 40% of these charter boats did not target particular species. The species targeted by the largest proportion of Florida charter boats are king mackerel (46%), grouper (29%), snapper (27%), dolphin (26%), and billfish (23%). In Florida Gulf, the species receiving the most effort were grouper, king mackerel and snapper. About one-fourth of Florida headboats targeted three or less species, three-fourths targeted four or less species and 80% targeted five or less species. About 60% of headboats did not target any particular species. The species targeted by the largest proportion of Florida headboats are snapper and other reef fish (35%), red grouper (29%), gag grouper (23%), and black grouper (16%). In Florida Gulf, the species receiving the most effort were snapper, gag and red grouper.

Major activity centers for charter boats in Florida are: Destin, Ft Myers, Ft Myers Beach, Islamorada, Key West, Marathon, Naples, Panama City, Panama City Beach, and Pensacola, The average charter boat was 37 feet in length and carried a maximum of 6 passengers. Most (88 percent) had fiberglass hulls, were diesel fueled (76 percent) with single (41 percent) or dual engines (59 percent). Most offered half-day trips and full-day trips. Only 15 percent offered overnight trips. Average boat fees were $348 for half-day; $554 for full-day and $1,349 for overnight trips. Of the total number of Florida trips, 47 percent were half-day, 50 percent were full day and 3 percent were overnight trips. Almost all headboat trips (98 percent) were made to federal waters (Holland et al., 1999).

Major activity centers for headboats in Florida are: Clearwater, Destin, Ft. Myers, Ft. Myers Beach, Islamorada, Key West, Marathon, Panama City and Panama City Beach. The average headboat in Florida was 62 feet in length and carried a maximum of 61 passengers. About 51 percent had fiberglass hulls and are diesel fueled (97 percent) with single (8 percent) or dual (92 percent) engines. Most (86 percent) offered half-day trips and full-day (64 percent) trips but one in the survey offered overnight trips. Average Florida headboat fees were $29 for half-day and $45 for full day trips. Of the total number of trips, 80 percent were half-day and 20 percent were full day. About two-thirds of these trips were in federal waters offshore and 36 percent of the headboats took 100 percent of their trips in federal waters (Holland et. al., 1999).

The mean age of Florida charter boat operators was 46 years with 82 percent between the ages of 31-60. Sixty-three percent were married and 15 percent were divorced. Florida charter boat operators had an average of 13 years of education, with 95 percent having at least 12 years of education and 34 percent with 16 years or more. About 98 percent of the operators were male. Most (90 percent) operate on a full-time basis and about 61 percent reported 100 percent of their household income was from the charter business. Eighty percent have lived in their home port county for more than 10 years and have operated their boat out of their home port county for an average of 15 years. Twenty-four percent of them belonged to their local chamber of commerce, and 34 percent belonged to their local charter boat association (Holland et. al., 1999).

The mean age of Florida headboat operators was 48 years with 84 percent between the ages of 31-60. Seventy-eight percent were married and 11 percent were divorced. Florida headboat operators had an average of 13 years of education, with 100 percent having at least 12 years of education and 22 percent with 16 years or more. About 86 percent of the operators were male. All operate on a full-time basis and about 92 percent reported that 100 percent of their household income was from their headboat business. Ninety-four percent have lived in their homeport county for more than 10 years and operated their boat out of their homeport county for an average of 19 years. Eighty-one percent of them were members of their local chamber of commerce and 44 percent were members of a local headboat association (Holland et al., 1999).

5.4.3.4 Charter and headboat industry in Alabama, Mississippi, Louisiana and Texas

Most of the following discussion is taken from the study, "A Cross-Sectional Study and Longitudinal Perspective on the Social and Economic Characteristics of the Charter and Party Boat Fishing Industry of Alabama, Mississippi, Louisiana and Texas," by Stephen G. Sutton, Robert B. Ditton, John R. Stoll and J. Walter Milon (1999). Some information from this study should be viewed with caution since some charter industry participants have expressed concerns with respect to the financial sections of the study, notably the underestimation of revenues and cost of engines.

Sutton et al. (1999) estimated there were 430 charter and 23 headboats operating out of the four-state area. Of the charter boat operators sampled in 1998, 85.4 percent held Gulf reef fish charter permits, 83.3 percent held coastal migratory pelagic permits, 5.2 percent held South Atlantic snapper/grouper permits, 4.2 percent held swordfish permits, 6.3 percent held shark commercial permits, 6.3 percent held king and Spanish mackerel commercial permits, 2.1 percent held South Atlantic snapper/grouper commercial permits, 14.6 percent held red snapper commercial permits, and 11.5 percent held commercial Gulf reef fish permits. Of the headboat operators sampled, 100 percent held Gulf reef fish charter permits, 95.2 percent held coastal migratory pelagic fish charter permits, none held South Atlantic snapper/grouper permits or swordfish commercial permits or shark commercial permits or king and Spanish mackerel commercial permits or South Atlantic snapper/grouper commercial permits or red snapper commercial permits, and 9.5 percent held Gulf reef fish commercial permits.

The average charter boat in the four-state area had a length of 39 feet with a total passenger capacity of 12 people. The length and passenger capacity of charter boats varied slightly by state, with Alabama having the largest at an average length of 46 feet and passenger capacity of 15 people and Texas having the smallest at an average length of 35 feet and passenger capacity of 9 people. The average headboat/partyboat in the four-state area had a length of 72 feet, with a total passenger capacity of 60 people.

The majority of charter boats in the four-state area reported targeting snapper (91%), king mackerel (89%), cobia (76%), tuna (55%), and amberjack. The species receiving the largest percentage of effort by charter boats in the four-state area were snapper (49%), king mackerel (10%), red drum (6%), cobia (6%), tuna (5%), and speckled trout (5%). The majority of headboat/partyboat operators reported targeting snapper (100%), king mackerel (85%), shark (65%), tuna (55%), and amberjack (50%). The species receiving the largest percentage of total effort by headboats/partyboats in the four-state area were snapper (70%), king mackerel (12%), amberjack (5%), and shark (5%).

Major activity centers for charter boats in the four-state area are: South Padre Island, Port Aransas, and Galveston/Freeport in Texas; Grand Isle-Empire-Venice in Louisiana; Gulfport-Biloxi in Mississippi; and, Orange Beach-Gulf Shores in Alabama. The average charter boat was 39 feet in length and carried a maximum of 12 passengers. Alabama had the largest charter boats at an average length of 46 feet and an average capacity of 9 passengers while Texas had the smallest charter boats at an average length of 35 feet and an average capacity of 9 passengers. Most had fiberglass hulls (81 percent), were diesel fueled (72 percent) with single (27 percent) or dual engines (73 percent). Most offered half-day trips (63 percent) and full-day trips (98 percent). About 48 percent offered overnight trips. Average boat base fees were $417 for half-day; $762 for full-day and $1,993 for overnight trips. Of the total number of trips taken by operators, 16 percent were half-day, 78 percent were full day and 6 percent were overnight trips. (Sutton et al., 1999).

Major activity centers for headboats in the four-state area are: South Padre Island, Port Aransas, and Galveston/Freeport in Texas and Orange Beach-Gulf Shores in Alabama. The average headboat was 72 feet in length with a total capacity of 60 passengers. Most boats had an aluminum hull (67 percent) and are diesel fueled (100 percent) with dual (100 percent) engines. All boats offered half-day trips, 81 percent offered full-day, and 57 percent offered overnight trips. Average headboat base fees were $41 for half-day trips, $64 for full-day trips and $200 for overnight trips. Of the total number of trips, 25 percent were half-day, 67 percent full-day and 8 percent overnight trips. (Sutton et. al., 1999).

The mean age of charter boat operators in the four-state area was 47 years with 86 percent between the ages of 31-60. Eighty-two percent were married and 8 percent were divorced. Charter boat operators had an average of 14 years of education, with 95 percent having at least 12 years of education and 26 percent with 16 years or more. Most (91 percent) operate on a full-time basis and about 50 percent reported 100 percent of their household income was from the charter business. About 78 percent lived in their home port, and on average they have lived near their home port for 24 years and have operated their boat out of their home port county for an average of 14 years. Forty percent of them belonged to their local chamber of commerce, 60 percent belonged to their local charter boat association, and 61 percent were members of some other fishing-related association. (Sutton et. al., 1999).

The mean age of headboat operators in the four-state area was 49 years with 67 percent between the ages of 31-60. Eighty-one percent were married and none was divorced. Headboat operators had an average of 12 years of education, with 81 percent having at least 12 years of education and 10 percent with 16 years or more. All operated on a full-time basis and about 78 percent reported that 100 percent of their household income was from their headboat business. Ninety-one percent lived near their home port, and on average they have lived near their home port for 26 years and have operated a headboat out of there for 13 years. Eighty-one percent of them were members of their local chamber of commerce, 52 percent were members of a local headboat association, and 44 percent were members of some other fishing-related association. (Sutton et al., 1999).

5 .4.4 Fishing communities

A "fishing community" is defined in the MSFCMA, as amended in 1996, as "a community which is substantially dependent on or substantially engaged in the harvesting or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew and United States fish processors that are based in such community" (Magnuson-Stevens Act section 3(16)). In addition, the NSGs (May 1, 1998; 63FR24211) define a fishing community as a social or economic group whose members reside in a specific location and share a common dependency on commercial, recreational, or subsistence fishing or on directly related fisheries-dependent service and industries (for example, boatyards, ice suppliers, tackle shops).

Several studies have been conducted in various parts of the country to determine and/or characterize fishing communities. The literature on fishing-dependent communities addresses three areas: identification of the communities, selection of variables appropriate for assessment and the assessment method itself. Community identification and selection criteria can be very complex or very simple. A simple first level approach would involve examining social and demographic variables at the county level where some fishing activity occurs. A more complex approach involves attempting to gather data and information on as small an entity as possible that qualifies as a fishing community. As the definition of community moves farther from traditional economic or political entities, less official data are available and more field research is required to complete the baseline profile and include relevant social and cultural value data.

The Pacific Fishery Management Council's web site (http://www.pcouncil.org) presents some baseline fishery descriptions of the West Coast Marine Fishing Communities. These communities are counties where any activity related to Council regulated fisheries occurs. These descriptions provide U.S. Census, county level statistical and demographic data about communities engaged in federally or state regulated fisheries in California, Oregon and Washington.

Dyer and Griffith (1996) conducted a baseline study of communities dependent on the multispecies groundfish fishery (MGF) in New England and the mid-Atlantic. The study examined the deterioration of social, human and cultural capital that would occur with a complete collapse of the MGF. Dyer and Griffith (1996) drew on the concept of Natural Resource Community (NRC) as a basis of their definition of a fishery dependent community. NRCs exist where individuals have dependence on a "renewable natural resource and are rooted in local history and local traditions and derive social and cultural identity from a sense of place whose life rhythms rise and fall with populations of fish, seasonal conditions at sea and the increasingly complex regulatory environment entangling their tradition". They also consider that this fishing activity may be embedded in wider communities and towns contributing to the cultural diversity of those communities and towns. They proceeded to develop a Fishery Dependence Index using measures of infrastructure and support related to fishing such as: numbers of repair and supply facilities, fish dealers and processors; the presence or absence of religious and secular art and architecture dedicated to fishing; and numbers of MGF permits and vessels. Variations in fishery dependency both between and within ports were assessed.

Wilson et al. (1998) conducted a social and cultural impact assessment of the Highly Migratory Species (HMS) FMP and the amendment to the Atlantic Billfish FMP. This report combines baseline descriptions of demographic, social, cultural and economic aspects of affected fishing communities with an analysis of potential impacts--both quantifiable and qualitative--on these communities. The study selected a sample of fishing communities in Puerto Rico, Louisiana, Florida, North Carolina, New Jersey and Massachusetts to illustrate the range of potential impacts of the proposed regulatory changes. The communities were selected partly by examining landings data, but with a recognition that the fishing fleets employing particular gears are dispersed geographically. The existence of previous studies and the suggestions of HMS and Atlantic Billfish industry Advisory Panels also influenced the choice of which communities were studied. Wilson et al. (1998) outlined three categories of impacts on their selected communities: those that "affect the volume of money that is going through the community;" those that "affect the flexibility of the fishing operations;" and those that "impose direct costs on fishing operations." In order to measure social and cultural impacts, they refer to the "economic vulnerability" of the fishery in terms of competition faced in supply and marketing and the extent of social capital or community networks available. They measured fishery dependence with demographic variables, percentage of employment in fishery related industries, income for those industries, landings by species, fishing related businesses (marinas, boat rental shops, dive shops, boat dockage and repair facilities, tackle and bait shops, tourism related to fishing). They also documented the social capital of the fishing community with numbers of recreational or commercial fishing associations the fishermen belonged to or met at.

Griffith (1996) categorized fishermen's dependence on resources in North Carolina by examining: 1) motivation for fishing (e.g., income, recreation, subsistence); 2) percentage of income derived from fishing; 3) time commitment (months/years of experience); 4) flexibility index, from low to high, measuring the numbers of gears, fisheries and species with which the fisherman is engaged; 5) number of different kinds of vessels; 6) number of crew involved in fishing operations; 7) relationship to the seafood marketing/processing sector; 8) principal social problems; 9) principal biological issues; 10) most desired regulations; and 11) most disruptive regulations. Using this system, fishermen were grouped into 7 categories on a continuum from full time, owner operator commercial fisherman to affiliated recreational fisherman (angler). This classification scheme goes beyond simple ranking by income earned from the fishery and introduces economic relationships with crew and market. Ethnographic data also were included in this analysis, including investigations of fishermen's main social and biological concerns related to fishing; these data contributed to an evaluation of how the various categories of fishermen would be affected by a range of proposed licensing systems.

McKay (2000) suggests that assessments of regulatory impacts on fishing-dependent communities consider not only geographic definitions of communities and economic characteristics therein, but also the level of vulnerability or resilience, of fishing communities and operations. That is, questions of fishing dependence and "sustained participation" in fisheries must consider how able participants in a given fishery can move among fishery sectors, and how able they are to move out of the fishery altogether into alternative employment opportunities. The studies reviewed took into account not only the economic characteristics but also the demographic and social characteristics of the areas where fishing activity occurs. Several of them developed strategies for assessing and or ranking these characteristics and variables. The following table summarizes the various measures of fishing dependence.

Jacob et al. (2001) developed a protocol for defining and identifying fishing dependent communities in accordance with National Standard 8. The project used central place theory to identify communities. A central place is where services, goods and other needs are met for the residents in the central place, as well as for those in surrounding hinterlands. It differs from using an administrative unit such as county boundaries, which may distort smaller communities or locality data as it is aggregated. The authors believed central place theory works well for defining and identifying fishing-dependent communities or localities as it provides a geographic basis for including multiplier effects that capture forward and backward linkages. In most fishing communities, forward linkages include those businesses that handle the fish once it is brought to the dock, such as fish houses, wholesalers, exporters, and seafood shops and restaurants. Backward linkages are the goods and services that fishermen depend upon such as boat building and repair; net making and repair; marinas; fuel docks; bait, tackle and other gear vendors. Using their protocol of defining fishing-dependent communities, the authors initially determined 5 communities as commercially fishing dependent and 7 communities as recreationally fishing dependent. Further investigations resulted in validating 5 communities as commercially fishing dependent. The authors expressed little confidence in the data used and indicators developed based on such data to confirm the other communities as recreationally fishing-dependent communities. The five commercially fishing-dependent communities are: Steinhatchee, Apalachicola, Panama City, Ochopee/Everglades City, and Panacea.

In Secretarial Amendment 1 (GMFMC, 2003b), an attempt was made to identify fishing communities that would be affected by the red grouper rebuilding plan. The following criteria were used to include communities. There are some additional cities/locations where grouper sales are significant (e.g. over $100,000 per year) which could reasonably be included in this list after additional analysis. This list should be considered a preliminary effort at designating these communities. First, an area was included if it was associated with commercial vessel reef fish permit holders using these gears: longline, spears, traps, or vertical lines. Second, an area was included if it was associated with greater than 10 charter, party or headboat reef fish permit holders. Third, an area was included if it was in the top 20 locations for grouper sales in the GOM (top 85%). Fourth, an area was included if it was identified as a fishing community or activity center by a previous study. Fifth, an area was included if there were more than 20,000 private anglers holding licenses in the county where the proposed area was located. Using these criteria, 38 cities/ports around the GOM were identified where any of these types of grouper activity occurred. Being included in this universe does not imply that a significant amount of grouper related fishing activity occurred in the area, simply that some activity potentially occurred and that activity might be impacted by the rebuilding plan or other regulations in Secretarial Amendment 1. Port and site visits can further verify and rank which of these areas will be impacted the most from the proposed regulations.

The permit owner addresses for the 156 bottom longline vessels are clustered in Florida: Cortez, Madeira Beach, Miami, St. Petersburg, and Tampa.

The permit owner addresses for 894 vertical line vessels are clustered in: Apalachicola, Carrabelle, Cedar Key, Clearwater, Crystal River, Destin, Ft. Myers, Indian Rocks Beach, Madeira Beach, Marathon, Panacea, Panama City, Pensacola, Nokomis, St. Petersburg, Steinhatchee, Tampa, Tarpon Springs, and Yankeetown in Florida; Orange Beach, AL; New Orleans, LA; Pascagoula, MS; and Houston, TX.

As of May 1998. there were 86 fish trap endorsements to the commercial reef fish permit and currently (as of November 2001) there are 65 endorsements. The permit owner addresses for vessels using fish traps are clustered in these areas: Destin, Homosassa, Naples, Steinhatchee, and Tarpon Springs, FL. Vessels using diving to catch reef fish do not show a clear cluster but are found in several areas of the Gulf. There are more than three reef fish permitted dealers with a facility in these locations: Cameron, LA; Galveston, TX; and Destin, Ft. Myers Beach, Key West, Madeira Beach, Marathon, Panama City, Pensacola, St. Petersburg, Tampa, and Tarpon Springs, FL.

The permit owner addresses for charter/headboat holders of reef fish permits were clustered in these areas: Apalachicola, Biloxi, Carrabelle, Chauvin, Clearwater, Destin, Freeport, Galveston, Houston, Marathon, Naples, Orange Beach, Panama City Beach, Pensacola, Port Aransas, Sarasota/Nokomis/Englewood. In June 2001 a charter vessel/headboat permit moratorium was submitted to NOAA Fisheries for approval and implementation. It should be noted that in the NOAA Fisheries data files, some owners listed ports where vessels were documented rather than actual homeports.

The top 20 cities in terms of grouper sales together accounted for over $18 million of grouper sales in 2000. This is over 85% of all grouper sales in the Gulf for 2000. The sales, coming from various numbers of vessels and dealers in each location, represent a minimum of $200,000 per year per area. The ranking of the cities presented here change relatively little over the period, 1997-2000. These cities are in order of sales ranking: Madeira Beach, Panama City, Apalachicola, St. Petersburg, Tarpon Springs, Crystal River, Ft. Myers Beach, Key West, Tampa, Naples, Clearwater, Steinhatchee, Miami, Cortez, Destin, Homosassa, Panacea, Everglades, Golden Meadow, Stock Island.

The U.S. Census periodic economic survey does not collect economic data (such as numbers of businesses, industry employment by NAISC industrial code) for entities with under 2500 population or for census-designated places. A census-designated place (CDP) is a place recognized by the census but unincorporated as a governmental area. For example, economic data from the US Census economic survey exist for Madeira Beach, FL with a population of about 4,400 while no such data exist for Steinhatchee, FL because it is unincorporated. Data do exist for Cortez, FL because it is a CDP. For places without Census data, other data sources for example by county or by zip code (when the whole area is included in one zip code such as Steinhatchee) may provide information. Otherwise, the data need to be collected through interview and site visits. Data for numbers employed in agriculture, forestry, and fisheries need to be interpreted carefully. Fishermen (captains and crew) would be counted in this number while persons working in wholesale (e.g. processing, fish houses) may be counted in the general category of wholesale rather than in fishery employment.

In general, these areas have small populations, many with less than 7,000 persons (Apalachicola, Carrabelle, Cedar Key Cortez, Homosassa, Ft. Myers Beach, Everglades City, Madeira Beach, Stock Island). Several of these areas have an unusually high rate of less than high school graduation, some as high as 50%. With exceptions (Carrabelle, 13.6% and Cedar Key, 12.2%) many of the areas have relatively low percentages, 2-3%, counted as employed in agriculture, forestry and fishing. These types of demographic statistics provide an idea of the background and labor market conditions within which the various fishing activities operate. Small, isolated areas with low educational attainment among the labor force indicate relatively few alternatives for the labor force. In these cases, losing fishing as a labor choice would impact the area relatively more than an equally situated areas with a more educated workforce.

In order to assess the impacts of Secretarial Amendment 1 on various communities, both social and economic data need to be analyzed. Some of this information is available for these communities in Lucas (2001) for Madeira Beach and in Wilson et al. (1998) for communities along the GOM affected by Billfish regulations. Many cities in Wilson et al. (1998) are the same as listed here: Apalachicola, Clearwater, Madeira Beach, St. Petersburg, Tampa, Destin, Ft. Myers, Ft. Walton Beach, Gulf Breeze, Panama City, Pensacola, Tarpon Springs. Additional field research would be needed to complete the assessment of the impacts.

The Generic Essential Fish Habitat Amendment (GMFMC, 2003a) provides more extensive characterization of fishing communities throughout the Gulf coasts. The fishing communities included in the characterizations are: (1) Alabama: Fairhope, Gulf Shores, Orange Beach, Bayou La Batre, and Dauphin Island; (2) Florida: Pensacola, Gulf Breeze, Ft. Walton Beach, Destin, Panama City, Panama City Beach, Port St. Joseph, Apalachicola, Eastpoint, Carabelle, St. Marks, Horseshoe Beach, Cedar Key, Yankeetown, Inglis, Crystal River, Homosassa, New Port Richey, Tarpon Springs, Clearwater, Madeira Beach, St. Petersburg, Tampa, Cortez, Matlacha, Bokeelia, Ft. Myers Beach, Naples, Marco Island, Everglages, Key Largo, Islamorada, Marathon, Big Pine Key-Summerland Key, and Key West; (3) Louisiana: Venice, Empire, Grand Isle, Golden Meadow, Cutoff, Chauvin, Dulac, Houma, Delcambre, Morgan City, and Cameron; (4) Mississippi: Pascagoula, Gautier, Biloxi, and Gulfport; and, (5) Texas: Port Arthur, Galveston, Freeport, Palacios, Port Lavaca, Seadrift, Rockport, Port Aransas, Aransas Pass, Brownsville, Port Isabel, and South Padre Island.

5 .5 Impacts of management alternatives

5 .5.1 Biological reference points and status determination criteria

The setting of MSYdoes not by itself create socioeconomic impacts. However, it affects the determination of OY, MFMTs and MSSTs and eventually the setting of TACs and associated management measures. Overly conservative parameters can lead to greater conservation than necessary and greater short-term socioeconomic loss from forgone yield due to management restrictions. Conversely, setting the parameters at an insufficiently conservative level can produce greater short-term socioeconomic benefits from increased harvests, but induce long-term losses due to the stock being fished to a level less than the true MSY level.

Alternative 1 does not comply with the provisions of SFA so it is not a viable alternative. From an impact standpoint, Alternative 1 preserves the short-term socioeconomic conditions in the red snapper fishery but leaves no clear direction for purposes of conserving and managing the stock. All other alternatives specify levels of MSY and corresponding fishing parameters. What is notable in all MSY alternatives is that they significantly exceed historical harvest levels. One major implication of this condition is that if the stock is successfully rebuilt, any of the alternatives will result in large future benefits to the fishing participants. If, in addition, a rebuilding strategy is chosen such that no harvest reductions are required in the short run, both short-term and long-term benefits will accrue to the fishing participants.

Long-term benefits from any of the alternatives specifying MSY have to be tempered with the awareness of the seemingly enormous task to rebuild the stock to at least B_{MSY}. Considering only the lowest option under each alternative, MSST ranges from 1.319 billion pounds to 2.04 billion pounds. Any of these levels is the threshold that needs to be exceeded before the stock can be declared as not overfished and TACs significantly increased. Of course, it should be recognized that TACs may be allowed to creep up towards some level near MSY before MSST is surpassed. However, this may require a significant jump from the current biomass level which is only about 7% of biomass at MSY.

5 .5.2 Rebuilding plans

5.5.2.1 Introduction

The discussions under the Section 4.2 and Section 8.2 comprise part of the impact analysis for RIR purposes and are incorporated herein by reference.

In rebuilding the red snapper stock, the Council's main control instruments are TAC and associated regulatory measures to constrain harvests to the chosen TAC. In developing a TAC, the Council may adopt either a constant catch or constant F strategy. Under a constant catch strategy, TAC is generally maintained at the same level over the rebuilding period whereas under a constant F strategy, TAC is generally initially set at a lower level and gradually adjusted upwards as the stock recovers. In addition, the estimated TAC may be considered explicitly or implicitly. An explicit TAC is binding in the sense that either sector (commercial or recreational) is constrained by quotas and is closed once their allocation is reached. If the TAC is implicit, neither sector is closed once their respective allocation is reached. An implicit TAC requires only an adjustment of regulatory measures that are deemed to effectively constrain both the commercial and recreational sectors to their respective allocations.

Since the early 1990's, the Council has adopted an explicit TAC for red snapper and allocated 51% of TAC to the commercial sector and 49% to the recreational sector. Since 1990, the commercial sector's allocation has been considered a quota subjecting the commercial sector to quota closures. Although the recreational allocation has been considered a quota since 1997, the recreational sector is currently subject to fixed seasonal closures instead of quota closures. The fixed seasonal closure has been so designed as to control the recreational sector to its allocation. The analysis of the various rebuilding scenarios is conducted with the assumption that a hard TAC is adopted, the current commercial/recreational allocation is maintained, and quota closures are imposed on both sectors. Some discussions will be devoted to certain measures that would be required in the recreational sector if quota closures are not adopted.

Over the rebuilding period, the economic issue for the red snapper fishery may be characterized as a tradeoff in value of catches over time. A larger TAC now would yield greater commercial and recreational benefits in the short-term, but at the likely expense of a slower stock recovery. Conversely, a smaller TAC now would reduce short-term benefits, but likely would also lead to a faster realization of the benefits of a faster recovery of the stock. The net present value approach is useful in this particular situation.

Net present value is calculated as a weighted sum of annual net benefits expected to be received over time. The weighting factor is determined by the discount rate and declines exponentially over time. The choice of a discount rate plays an important role, especially when net present valuation is done over a longer period. A higher discount rate would favor a rebuilding period that generates more short-term benefits. Conversely, a lower discount rate would favor a rebuilding period with larger benefits in the long-term. In general, a 7 percent discount rate is used for net present valuation in U.S. fisheries, and although this is the discount rate used in most instances here, some results using other discount rates are presented to provide insights into the sensitivity of results under different discount rates.

5.5.2.2 Analytical tool

The primary analytical tool used here is a model developed by Waters (pers. comm.) and Carter (2003) that combines biological information about the red snapper stock with economic information about the fishery. The biological parameters of the model are based on the 1999 stock assessment, with projections on the status of the stock given certain TAC levels. The economic component of the model considers two harvesting sectors, a commercial sector and a recreational sector which includes the for-hire fleet.

The commercial fleet for red snapper is currently composed of two types of vessels: (1) Class 1 licensees that are entitled to a 2,000-pound trip limit per day, and (2) Class 2 licensees that are entitled to a lower trip limit of 200 pounds per day. Based on logbook information, Waters (2003) distinguished between three types of red snapper vessels: (1) top 50 vessels that accounted for 60% of total commercial red snapper landings, (2) vessels ranked 51-131 that accounted for 34% of total commercial red snapper landings, and (3) other vessels that accounted for the remaining 6% of landings. For purposes of net present valuation, vessel net revenue is calculated as gross revenue per vessel less trip costs and fixed costs. Net revenue is then considered as net return to management and capital. Throughout the rebuilding period and thereafter, average price per pound for red snapper and average costs are held constant.

The recreational sector is composed of two major participants, the for-hire vessels and the recreational anglers. The for-hire segment is further composed of charter boats and headboats. Recreational anglers fish through three fishing platforms, the private/rental, charter, and headboat modes. For purposes of net present valuation, consumer surplus is calculated for the recreational anglers and net revenue for the charter boats and headboats. Consumer surplus per day trip is based on the estimates of consumer surplus for a red snapper trip by Gillig et al. (2000). Net revenues for charter boats and headboats are calculated as gross revenues less variable trip costs. Gross revenue calculations are based on average number of annual trips by a charter boat or headboat by geographical areas (i.e., eastern Gulf vs. western Gulf), average number of passengers per trip, and average base fee by type of trips (i.e., half-day, full-day, or overnight). Variable costs include such items as fuel, ice, bait, docking fee, permits/licenses, etc.

5.5.2.3 Potential TACs

There are 5 rebuilding alternatives presented in Section 5 of this amendment. Alternative 1, which is the no action alternative, is considered unacceptable as a rebuilding strategy, thus leaving only 4 viable alternatives. Alternatives 2 and 3 are constant catch alternatives while Alternatives 4 and 5 are constant F alternatives after transitioning from a constant catch strategy in the early years of the rebuilding period. Due to the presence of red snapper as bycatch in other fisheries, notably the shrimp fishery, the constant catch and constant F strategies mainly refer to the constancy of harvest and fishing mortality in the directed red snapper fishery. Red snapper bycatch reductions in the shrimp fishery play an important role in the recovery of the red snapper stock. To take into consideration the impacts of the shrimp fishery on red snapper stock, two scenarios are considered that could affect bycatch of red snapper. One is a 30% reduction in shrimp effort and the other, a 50% reduction in shrimp effort. These two scenarios would result in different TACs under a constant F strategy, as in Alternatives 4 and 5, since stock levels would be different under the two scenarios of shrimp effort reduction. TACs under Alternatives 2 and 3 remain unaffected by varying the level of shrimp effort reductions. In effect then, there are 6 potential TACs – two constant catch TACs, two constant F TACs with 30% shrimp effort reduction, and two constant F TACs with 50% shrimp effort reduction. Tables 5.11 and 5.12 present the 6 potential TACs. It should be noted that the difference in the level and timing of shrimp effort reduction makes a difference in the recovery of the stock, regardless of whether a constant catch or constant F strategy is adopted.

5.5.2.4 Results

5.5.2.4.1 Commercial fishery

Table 5.7 presents the economic implications of the various rebuilding strategies on the commercial sector of the red snapper fishery. Although the rebuilding period started in 2000, the starting date for purposes of economic analysis is 2004, since 2003 will be over before this plan can go into effect. The upper portion of the table presents the net present values associated with each of the alternatives; the lower portion shows the difference in net present values between each of the alternatives relative to Alternative 2. It is worth recalling that Alternative 2 is a constant catch strategy, and since a TAC of 9.12 mp, which is the current TAC, is maintained until the stock is recovered and larger harvests are possible, this alternative can be viewed as a benchmark against which all the other alternatives may be compared. Alternative 3 is also a constant catch strategy, with the TAC at 6.0 mp until stock recovery and larger harvests are allowed. The lower TAC under Alternative 3 explains why net present values under Alternative 3 are lower than those under Alternative 2. Alternative 4 adopts a constant catch strategy with TAC levels held at 9.12 mp until 2013 under the assumption of a 30% reduction in shrimp effort starting in 2009, or until 2010 under the assumption of a 50% reduction in shrimp effort starting in 2006. Thereafter a constant F strategy is adopted which allows a higher TAC. This TAC scenario explains why net present values under Alternative 2 are identical to those under Alternative 4 for the first 5 years of the rebuilding period and net present values under Alternative 2 are lower than those under Alternative 4 for the remainder of the analysis period, regardless of the level and timing of shrimp effort reduction. Alternative 5 assumes the same level and timing of shrimp effort reduction as Alternative 4, but Alternative 5 reduces the TAC in the early years and increases it in later years, with the timing of the increase in TAC earlier under a 50% than under a 30% shrimp effort reduction. This TAC scenario explains why net present values are lower under Alternative 5 than under Alternative 2 in the early years of the rebuilding period, with the situation reversing towards the later years of the rebuilding period.

Among the rebuilding strategies, the highest and lowest net present values are associated with Alternative 4 and Alternative 3, respectively. Both constant catch alternatives (Alternatives 2 and 3) yield lower net present values than the constant F alternatives. From an economics standpoint then, a constant F strategy is preferable to a constant catch strategy.

Between the two constant catch alternatives, the difference in their associated net present values is significantly wide, $2.18 million vs. $6.10 million in the first 5 years under a 30 percent shrimp effort reduction, and $1.75 million vs. $6.10 million under a 50 percent shrimp effort reduction. Over the entire period of analysis, these figures increase to $13.96 million vs. $26.48 million and $28.27 million vs. $40.97 million, respectively. Yet, the two scenarios differ by only 1 to 3 years in terms of achieving the target biomass. One clear conclusion that can be derived from this situation is that, at least with respect to the commercial sector, Alternative 2 is preferable to Alternative 3, regardless of the reduction in shrimp effort, when considering both the economics and biology of the red snapper fishery.

Between the two constant F strategies, the difference in their associated net present values is relatively wide for the first years of the rebuilding, $2.35 million or $2.46 million vs. $6.10 million. Over the entire analysis period, the difference in net present values narrows, $43.71 million vs. $47.58 million, or $60.70 million vs. $63.50 million. The target biomass is reached by both alternatives at the same time under the assumption of a 50% shrimp effort reduction, but is not achieved at all by 2044 under a lower shrimp effort reduction. Considering both the economics and biology of the red snapper fishery, the two constant F alternatives may be considered about equal over the long-run. But in the first few years of the rebuilding, Alternative 4 provides for higher benefits than Alternative 5. Thus, considering both short-run and long-run, Alternative 4 may be considered superior to Alternative 5. It should be reiterated, however, that neither alternative achieves the target biomass under a lower shrimp effort reduction.

Tables 5.8, 5.9, and 5.10 present the economic implications of the various rebuilding strategies on each of the 3 identified commercial fleets. Table 5.8 shows the economic impacts on the top 50 red snapper vessels, Table 5.9 shows the economic impacts on red snapper vessels ranked 51-131, and Table 5.10 shows the economic impacts on vessels that caught a small amount of red snapper. It is very likely that the top 131 vessels are those that hold Class 1 licenses. On an alternative by alternative basis, all three tables depict a similar picture as that portrayed in Table 5.7.

A comparison of Tables 5.7 and 5.8 reveals that more than half of the economic value generated by the commercial sector is accounted for by the top 50 vessels in the red snapper fishery. These vessels are currently profitable and would remain profitable under any of the alternatives, but, as expected, they would suffer profit reductions under Alternative 3 every time period over the entire period of analysis. These vessels would also experience profit reductions for the first 5 years of the rebuilding period under Alternative 5. For these vessels, Alternative 4 would be similar to Alternative 2 for the first 5 years of the rebuilding period. Similar to the overall effects, these vessels would experience significant gains in profits under Alternatives 4 and 5.

Table 5.9 shows that red snapper vessels ranked 51-131 are already experiencing losses under the current TAC of 9.12 mp and would continue to experience losses until harvests are allowed to increase. A lower TAC, as in Alternative 3, would only worsen their losses. The profitability of these vessels would improve under Alternatives 4 and 5 in the later years of the rebuilding period. This is especially the case under a larger bycatch reduction in the shrimp fishery. These results do not indicate that overall these vessels are losing money, but rather, they appear to not be taking enough red snapper trips to cover the fixed costs that have been apportioned to red snapper activity. In this sense, the results presented should be viewed with caution since they are particularly sensitive to the modeling assumptions with regards to fixed costs. For this sector, 45 percent of fixed costs were apportioned to red snapper activity, based on an evaluation of effort data that showed that 45 percent of total days fished by these vessels was accounted for by red snapper trips. Reducing this apportionment to 42 percent produces positive earnings for this sector. Therefore, the negative results may be more an artifact of the assumptions made in the modeling effort rather than actual performance in the fishery.

Table 5.10 pertains to net revenues of vessels that may be considered to catch incidental amounts of red snapper. At the current TAC of 9.12, these vessels appear profitable. As with the other vessel classes, these vessels would experience profit reductions with a reduction in TAC (Alternative 3), and profit increases in the later years of the rebuilding under Alternatives 4 and 5, regardless of the level and timing of effort reduction in the shrimp fishery. The rather profitable nature of these vessels is mainly a function of the nature of their participation in the red snapper fishery. To the extent that they catch red snapper mainly as an incidental part of their fishing operations, they are deemed not to incur any costs in their red snapper fishing operation. In actuality, they do incur those fishing costs, but for the current modeling purpose, their fixed and variable costs are fully assigned to their non-red snapper operations. In a sense, they would undertake their fishing trips whether or not they catch red snapper so that any revenue from catching red snapper would directly contribute to their bottom line. In the current model, there are 360 of these vessels landing an average of 160 pounds of red snapper per trip and taking 5 trips harvesting red snapper per year. Individually, these vessels account for a very minimal portion of profit per red snapper boat, but as a whole they comprise a fairly good portion of net revenues from the red snapper fishery.

Table 5.7. Economic impacts of the various rebuilding alternatives on the commercial red snapper fishery under a 30% or 50% reduction in shrimp fishing effort.

	Alternative 2		Alternative 3		Alternative 4		Alternative 5	
Period	30%	50%	30%	50%	30%	50%	30%	30%
		Net Revenues (million dollars)						
2004-2008	6.1	6.1	2.18	2.18	6.1	6.1	2.35	2.46
2009-2013	4.39	4.39	0.77	0.77	4.61	6.41	3.61	6.52
2014-2023	5.36	5.36	0.94	0.94	13.17	18.91	13.78	19.41
2024-2033	2.73	8.39	0.48	8.9	11.87	16.31	12.08	16.47
2034-2043	3.23	10.94	4.93	11.1	7.59	10.17	7.64	10.21
2044-2053	4.67	5.78	4.66	5.81	4.24	5.61	4.25	5.62
Total	26.48	40.97	13.96	29.71	47.58	63.5	43.71	60.7
		Net Revenues Relative to Alternative 2 (million dollars)						
2004-2008	0	0	-3.92	-3.92	0	0	-3.75	-3.64
2009-2013	0	0	-3.62	-3.62	0.22	2.02	-0.78	2.13
2014-2023	0	0	-4.42	-4.42	7.81	13.55	8.42	14.05
2024-2033	0	0	-2.25	0.51	9.14	7.92	9.35	8.08
2034-2043	0	0	1.7	0.16	4.36	-0.77	4.41	-0.73
2044-2053	0	0	-0.01	0.03	-0.43	-0.17	-0.42	-0.16
Total	0	0	-12.52	-11.26	21.1	22.53	17.23	19.73

Source: Waters (2003).

Table 5.8. Economic impacts of the various rebuilding alternatives on the top 50 vessels in the commercial red snapper fishery under a 30% or 50% reduction in shrimp fishing effort.

	Alternative 2		Alternative 3		Alternative 4		Alternative 5	
Period	30%	50%	30%	50%	30%	50%	30%	30%
		Net Revenues (million dollars)						
2004-2008	3.63	3.63	1.77	1.77	3.63	3.63	1.84	1.9
2009-2013	2.5	2.5	0.8	0.8	2.61	3.46	2.14	3.51
2014-2023	3.06	3.06	0.97	0.97	6.74	9.45	7.03	9.69
2024-2033	1.55	4.23	0.49	4.47	5.87	7.96	5.97	8.04
2034-2043	1.66	5.3	2.46	5.37	3.72	4.94	3.74	4.95
2044-2053	2.27	2.8	2.27	2.81	2.07	2.72	2.07	2.72
Total	14.68	21.52	8.76	16.19	24.63	32.15	22.8	30.81
		Net Revenues Relative to Alternative 2 (million dollars)						
2004-2008	0	0	-1.86	-1.86	0	0	-1.79	-1.73
2009-2013	0	0	-1.7	-1.7	0.11	0.96	-0.36	1.01
2014-2023	0	0	-2.09	-2.09	3.68	6.39	3.97	6.63
2024-2033	0	0	-1.06	0.24	4.32	3.73	4.42	3.81
2034-2043	0	0	0.8	0.07	2.06	-0.36	2.08	-0.35
2044-2053	0	0	0	0.01	-0.2	-0.08	-0.2	-0.08
Total	0	0	-5.92	-5.33	9.95	10.63	8.12	9.29

Source: Waters (2003).

Table 5.9. Economic impacts of the various rebuilding alternatives on vessels ranked 51 through 131 of the commercial red snapper fishery under a 30% or 50% reduction in shrimp fishing effort.

	Alternative 2		Alternative 3		Alternative 4		Alternative 5	
Period	30%	50%	30%	50%	30%	50%	30%	30%
		Net Revenues (million dollars)						
2004-2008	-0.43	-0.43	-1.72	-1.72	-0.43	-0.43	-1.67	-1.63
2009-2013	-0.18	-0.18	-1.38	-1.38	-0.1	0.49	-0.44	0.53
2014-2023	-0.22	-0.22	-1.69	-1.69	2.38	4.29	2.59	4.46
2024-2033	-0.11	1.78	-0.86	1.95	2.94	4.42	3.01	4.47
2034-2043	0.56	3.13	1.12	3.18	2.01	2.87	2.03	2.88
2044-2053	1.29	1.66	1.29	1.67	1.15	1.61	1.15	1.61
Total	0.92	5.74	-3.24	2.01	7.95	13.25	6.67	12.33
		Net Revenues Relative to Alternative 2 (million dollars)						
2004-2008	0	0	-1.29	-1.29	0	0	-1.24	-1.2
2009-2013	0	0	-1.2	-1.2	0.08	0.67	-0.26	0.71
2014-2023	0	0	-1.47	-1.47	2.6	4.51	2.81	4.68
2024-2033	0	0	-0.75	0.17	3.05	2.64	3.12	2.69
2034-2043	0	0	0.56	0.05	1.45	-0.26	1.47	-0.25
2044-2053	0	0	0	0.01	-0.14	-0.05	-0.14	-0.05
Total	0	0	-4.16	-3.73	7.03	7.51	5.75	6.59

Source: Waters (2003).

Table 5.10. Economic impacts of the various rebuilding alternatives on commercial vessels that harvest a small amount of red snapper under a 30% or 50% reduction in shrimp fishing effort.

	Alternative 2		Alternative 3		Alternative 4		Alternative 5	
Period	30%	50%	30%	50%	30%	50%	30%	30%
		Net Revenues (million dollars)						
2004-2008	2.9	2.9	2.14	2.14	2.9	2.9	2.17	2.19
2009-2013	2.06	2.06	1.36	1.36	2.11	2.46	1.91	2.48
2014-2023	2.52	2.52	1.66	1.66	4.04	5.16	4.16	5.26
2024-2033	1.28	2.39	0.84	2.49	3.06	3.93	3.11	3.96
2034-2043	1.01	2.51	1.34	2.55	1.86	2.36	1.87	2.37
2044-2053	1.1	1.32	1.1	1.33	1.02	1.29	1.02	1.29
Total	10.89	13.71	8.44	11.51	15	18.11	14.24	17.55
		Net Revenues Relative to Alternative 2 (million dollars)						
2004-2008	0	0	-0.76	-0.76	0	0	-0.73	-0.71
2009-2013	0	0	-0.7	-0.7	0.05	0.4	-0.15	0.42
2014-2023	0	0	-0.86	-0.86	1.52	2.64	1.64	2.74
2024-2033	0	0	-0.44	0.1	1.78	1.54	1.83	1.57
2034-2043	0	0	0.33	0.04	0.85	-0.15	0.86	-0.14
2044-2053	0	0	0	0.01	-0.08	-0.03	-0.08	-0.03
Total	0	0	-2.45	-2.2	4.11	4.4	3.35	3.84

Source: Waters (2003).

5.5.2.4.2 Recreational fishery

Table 5.13 presents the economic implications of the various rebuilding alternatives on the recreational fishery. The recreational model recognizes three fishing modes – private/rental, charter boats, and headboats. There are two types of net benefits estimated for the recreational sector: (1) consumer surplus to the recreational anglers, and (2) net revenues to the for-hire fishery which is composed of charter boats and headboats. Consumer surplus may be generally described as the excess of benefits derived from red snapper fishing over what anglers pay for the trip. For the current purpose, consumer surplus is considered to be derived by anglers from fishing through the private/rental mode, fishing through charter boats, and fishing through headboats. Net revenue is calculated as gross receipts less operating costs. Fixed costs are excluded from current modeling considerations due to controversy associated with available estimates associated with these costs for participants in the western Gulf for-hire fishery.

The pattern of economic effects of the various alternatives on the recreational sector is similar to that for the commercial sector, although the magnitude of values involved are much larger. The larger magnitude of net revenues to the for-hire sector is partly a function of the method used in calculating net revenues of charter boats and headboats. As may be recalled, fixed costs are included in calculating net revenues for the commercial sector but not for the for-hire sector. The large magnitude for consumer surplus is due to the sheer size of the recreational red snapper angling population and the value of consumer surplus per trip. These numbers, however, are based on best available information. Further, the intent of the analytical exercise is to compare rebuilding strategies and not identify potential harvest sector differences for the purpose of allocation. Hence, the magnitude of the sector differences is of no consequence.

Among the rebuilding strategies, the highest and lowest net present values are associated with Alternative 4 and Alternative 3, respectively. Although the severe harvest reduction under Alternative 3 (6 mp TAC) results in faster stock recovery, the net effect is only a difference of one year, 2029 as opposed to 2030 under Alternative 2. Further, in 2030, the allowable TACs for the two scenarios differ by less than 2 percent and, over the remaining period of analysis (through 2053), Alternative 3 supports less than 5 percent total harvest more than under Alternative 2. Thus, assuming Alternative 3 were credited for 105 percent of the value achieved under Alternative 2 during each of the comparable periods, which is excessive considering most of the fourth period (2024-2033) would be prosecuted under the original lower TACs, the latter period gains under Alternative 3 are still insufficient to compensate for the losses, relative to Alternative 2, of the reduced harvests during the earlier years. Hence, it can be concluded with certainty that Alternative 2 out performs Alternative 3, resulting in Alternative 3 producing the lowest net present values of all the alternatives considered.

Both constant catch alternatives (Alternatives 2 and 3) yield lower net present values, expressed in terms of net revenues and consumer surplus, than the constant F alternatives. From an economics standpoint then, a constant F strategy is preferable to a constant catch strategy.

Table 5.11. TAC and B:B_{MSY} ratio for no directed fishery and constant catch rebuilding plans given for Alternatives 2 and 3. Light gray indicates the stock is rebuilt and dark gray indicates 2032 when the red snapper stock should be rebuilt. Note: B/B_{MSY} projections are based on keeping catch constant. Once the stock is rebuilt, TAC can be set based on F_{OY}.

	No directed fishery		Alternative 2			Alternative 3		
Percent reduction		0%		50 %	30%		50%	30%
Year begin		2005		2006	2009		2006	2009
Year	TAC (mp)	B/B_{MSY}	TAC (mp)	B/B_{MSY}	B/B_{MSY}	TAC (mp)	B/B_{MSY}	B/B_{MSY}
1999	10.03	0.071	10.03	0.071	0.071	10.03	0.071	0.071
2000	8.77	0.073	8.77	0.073	0.073	8.77	0.073	0.073
2001	9.13	0.077	9.13	0.077	0.077	9.13	0.077	0.077
2002	10.11	0.082	10.11	0.082	0.082	10.11	0.082	0.082
2003	9.16	0.088	9.16	0.088	0.088	9.16	0.088	0.088
2004	9.12	0.097	9.12	0.097	0.097	9.12	0.097	0.097
2005	0.00	0.106	9.12	0.106	0.106	6.00	0.106	0.106
2006	0.00	0.121	9.12	0.116	0.116	6.00	0.118	0.118
2007	0.00	0.137	9.12	0.129	0.127	6.00	0.133	0.131
2008	0.00	0.156	9.12	0.145	0.139	6.00	0.151	0.145
2009	0.00	0.176	9.12	0.165	0.153	6.00	0.173	0.160
2010	0.00	0.197	9.12	0.189	0.168	6.00	0.200	0.178
2011	0.00	0.219	9.12	0.216	0.185	6.00	0.230	0.198
2012	0.00	0.243	9.12	0.246	0.205	6.00	0.263	0.221
2013	0.00	0.267	9.12	0.280	0.228	6.00	0.300	0.246
2014	0.00	0.292	9.12	0.317	0.253	6.00	0.340	0.274
2015	0.00	0.318	9.12	0.356	0.280	6.00	0.382	0.305
2016	0.00	0.345	9.12	0.397	0.309	6.00	0.426	0.337
2017	0.00	0.372	9.12	0.439	0.339	6.00	0.472	0.370
2018	0.00	0.398	9.12	0.483	0.370	6.00	0.519	0.405
2019	0.00	0.425	9.12	0.528	0.403	6.00	0.567	0.440
2020	0.00	0.451	9.12	0.574	0.436	6.00	0.616	0.476
2021	0.00	0.476	9.12	0.622	0.470	6.00	0.666	0.512
2022	0.00	0.502	9.12	0.669	0.504	6.00	0.715	0.548
2023	0.00	0.526	9.12	0.715	0.538	6.00	0.763	0.585
2024	0.00	0.550	9.12	0.761	0.573	6.00	0.810	0.621
2025	0.00	0.574	9.12	0.806	0.607	6.00	0.856	0.656
2026	0.00	0.596	9.12	0.849	0.640	6.00	0.901	0.691
2027	0.00	0.618	9.12	0.892	0.672	6.00	0.944	0.724
2028	0.00	0.638	9.12	0.932	0.704	6.00	0.985	0.756
2029	0.00	0.658	9.12	0.972	0.734	6.00	1.025	0.787
2030	0.00	0.677	9.12	1.009	0.763	6.00	1.063	0.817
2031	0.00	0.694	9.12	1.045	0.791	6.00	1.098	0.845
2032	0.00	0.711	9.12	1.079	0.818	6.00	1.132	0.872
2033	0.00	0.727	9.12	1.112	0.844	6.00	1.164	0.898
2034	0.00	0.742	9.12	1.142	0.868	6.00	1.194	0.922
2035	0.00	0.755	9.12	1.171	0.891	6.00	1.222	0.944
2036	0.00	0.768	9.12	1.197	0.913	6.00	1.248	0.966
2037	0.00	0.781	9.12	1.223	0.934	6.00	1.273	0.986
2038	0.00	0.792	9.12	1.246	0.953	6.00	1.296	1.005
2039	0.00	0.803	9.12	1.268	0.972	6.00	1.317	1.023
2040	0.00	0.812	9.12	1.289	0.989	6.00	1.337	1.039
2041	0.00	0.822	9.12	1.308	1.005	6.00	1.355	1.055
2042	0.00	0.830	9.12	1.325	1.020	6.00	1.372	1.069
2043	0.00	0.838	9.12	1.342	1.034	6.00	1.388	1.082
2044	0.00	0.846	9.12	1.357	1.047	6.00	1.402	1.095
2045	0.00	0.852	9.12	1.371	1.060		1.416	1.106
2046	0.00	0.859	9.12	1.384	1.071		1.428	1.117
2047	0.00	0.865	9.12	1.396	1.082		1.439	1.127
2048	0.00	0.870	9.12	1.407	1.092		1.450	1.136
2049	0.00	0.875	9.12	1.418	1.101		1.460	1.145
2050	0.00	0.880	9.12	1.427	1.109		1.469	1.153

Table 5.12. TAC and B:B_{MSY} ratio for constant catch transitioning to constant F_{OY} rebuilding plans given for Alternatives 4 and 5. Light gray indicates the stock is rebuilt and dark gray indicates 2032 when the red snapper stock should be rebuilt.

	Alternative 4				Alternative 5			
Percent reduction		50 %		30%		50%		30%
Year begin		2006		2009		2006		2009
Year	TAC (mp)	B/B_{MSY}	TAC (mp)	B/B_{MSY}	TAC (mp)	B/B_{MSY}	TAC (mp)	B/B_{MSY}
1999	10.03	0.071	10.03	0.071	10.03	0.071	10.03	0.071
2000	8.77	0.073	8.77	0.073	8.77	0.073	8.77	0.073
2001	9.13	0.077	9.13	0.077	9.13	0.077	9.13	0.077
2002	10.11	0.082	10.11	0.082	10.11	0.082	10.11	0.082
2003	9.16	0.088	9.16	0.088	9.16	0.088	9.16	0.088
2004	9.12	0.097	9.12	0.097	9.12	0.097	9.12	0.097
2005	9.12	0.106	9.12	0.106	6.00	0.106	6.00	0.106
2006	9.12	0.116	9.12	0.116	6.00	0.118	6.00	0.118
2007	9.12	0.129	9.12	0.127	6.05	0.133	6.04	0.131
2008	9.12	0.145	9.12	0.139	6.91	0.151	6.53	0.145
2009	9.12	0.165	9.12	0.153	8.43	0.173	7.01	0.160
2010	9.60	0.189	9.12	0.168	9.97	0.198	7.51	0.178
2011	10.95	0.216	9.12	0.185	11.27	0.225	8.25	0.197
2012	12.12	0.245	9.12	0.205	12.44	0.255	9.44	0.218
2013	13.21	0.277	10.22	0.228	13.55	0.288	10.64	0.241
2014	14.27	0.311	11.28	0.252	14.63	0.323	11.70	0.266
2015	15.37	0.347	12.21	0.278	15.74	0.358	12.64	0.293
2016	16.50	0.383	13.07	0.305	16.89	0.396	13.52	0.320
2017	17.65	0.421	13.89	0.333	18.03	0.433	14.34	0.348
2018	18.80	0.459	14.72	0.361	19.17	0.471	15.17	0.377
2019	19.92	0.497	15.54	0.390	20.28	0.509	15.99	0.406
2020	21.03	0.536	16.36	0.419	21.38	0.549	16.79	0.434
2021	22.10	0.575	17.15	0.448	22.44	0.587	17.57	0.463
2022	23.12	0.613	17.92	0.476	23.44	0.625	18.33	0.491
2023	24.09	0.650	18.68	0.505	24.39	0.662	19.07	0.520
2024	25.01	0.686	19.41	0.534	25.29	0.698	19.78	0.548
2025	25.88	0.721	20.11	0.561	26.15	0.732	20.45	0.574
2026	26.70	0.754	20.76	0.587	26.95	0.765	21.09	0.600
2027	27.47	0.786	21.39	0.612	27.71	0.796	21.70	0.625
2028	28.19	0.817	21.98	0.636	28.42	0.826	22.27	0.648
2029	28.87	0.846	22.53	0.659	29.08	0.855	22.81	0.670
2030	29.51	0.873	23.05	0.681	29.70	0.882	23.31	0.692
2031	30.10	0.899	23.54	0.701	30.29	0.907	23.78	0.712
2032	30.66	0.924	24.00	0.721	30.83	0.931	24.22	0.731
2033	31.17	0.947	24.42	0.739	31.33	0.954	24.64	0.749
2034	31.65	0.968	24.82	0.757	31.80	0.974	25.02	0.765
2035	32.09	0.988	25.19	0.773	32.23	0.994	25.38	0.781
2036	32.50	1.006	25.54	0.788	32.63	1.012	25.71	0.796
2037	32.88	1.024	25.86	0.802	33.00	1.029	26.02	0.810
2038	33.23	1.039	26.16	0.816	33.34	1.044	26.30	0.822
2039	33.55	1.054	26.43	0.828	33.65	1.059	26.57	0.834
2040	33.85	1.068	26.69	0.840	33.94	1.072	26.81	0.845
2041	34.13	1.080	26.92	0.850	34.21	1.084	27.04	0.856
2042	34.38	1.092	27.14	0.860	34.46	1.096	27.25	0.865
2043	34.61	1.103	27.34	0.869	34.68	1.106	27.44	0.874
2044	34.82	1.113	27.53	0.878	34.89	1.116	27.62	0.882
2045	35.02	1.120	27.70	0.886	35.08	1.124	27.79	0.889
2046	35.20	1.130	27.86	0.893	35.25	1.132	27.94	0.896
2047	35.36	1.138	28.01	0.899	35.41	1.140	28.08	0.903
2048	35.51	1.145	28.14	0.906	35.56	1.147	28.21	0.909
2049	35.65	1.151	28.26	0.911	35.69	1.153	28.32	0.914
2050	35.78	1.157	28.38	0.916	35.82	1.159	28.43	0.919

Between the two constant F strategies, the difference in their associated net present values is relatively wide in percentage terms in the early years, $30 million vs. $48 million, or 60 percent under 30 percent shrimp effort reduction, and $26 million to $48 million, or 85 percent under 50 percent shrimp effort reduction, in terms of net revenues to the for-hire vessels, or $457 million vs. $732 million, or 60 percent under 30 percent shrimp effort reduction, and 58 percent under 50 percent shrimp effort reduction in terms of consumer surplus. Over the entire analysis period, the difference narrows to 29-32 percent for net revenues and 29-30 percent for consumer surplus, however the results under Alternative 4 are still superior to those under Alternative 5. Thus, considering both short-run and long-run, Alternative 4 may be considered superior to Alternative 5. It should be reiterated, however, that neither alternative achieves the target biomass under a lower shrimp effort reduction.

Tables 5.14, 5.15, and 5.16 present the economic implications of the various rebuilding strategies on each of the 3 fishing modes. Table 5.14 shows the economic impacts on anglers fishing through the private/rental mode, Table 5.15 shows the economic impacts on both anglers and vessels in the charter boat fishery, and Table 5.16 shows the economic impacts on both anglers and vessels in the headboat fishery. On an alternative by alternative basis, all three tables depict a similar picture as portrayed by Table 5.13.

It is worth noting from Tables 5.13 and 5.14 that both charter boats and headboats are profitable, on average, under the current TAC of 9.12 mp, and while profits are diminished under Alternative 3, these vessels still remain profitable. Significant levels of profits are potentially derivable from the constant F alternatives, especially at the 50% shrimp effort reduction.

Table 5.13. Economic impacts of the various rebuilding alternatives on recreational anglers and for-hire vessels
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	Alternative 2		Alternative 3		Alternative 4		Alternative 5	
Period	30%	50%	30%	50%	30%	50%	30%	50%
	Net Revenues of For-hire Vessels (million dollars)							
2004-2008	47.93	47.93	29.58	29.58	47.93	47.93	30.06	26.33
2009-2013	34.17	34.18	17.23	17.23	35.05	42.36	25.87	36.22
2014-2023	41.74	41.74	21.04	21.04	75.00	101.57	63.09	82.71
2024-2033	21.22	35.54	10.70	27.28	63.11	86.19	51.43	66.37
2034-2043	15.54	35.42	14.47	26.75	40.37	54.55	32.39	40.92
2044-2053	16.67	18.75	11.52	13.91	22.37	30.34	18.03	21.35
Total	176.28	213.56	104.54	135.79	284.11	362.95	220.87	273.89
	Angler Consumer Surplus (million dollars)							
2004-2008	731.71	731.71	449.76	449.76	731.71	731.71	457.10	461.91
2009-2013	521.70	521.70	261.33	261.33	535.15	647.21	393.06	526.56
2014-2023	637.17	637.17	319.17	319.17	1,147.49	1,555.67	961.27	1,254.04
2024-2033	323.91	541.24	162.25	414.18	967.35	1,322.36	785.03	1,037.49
2034-2043	236.93	538.73	219.67	406.23	619.35	837.67	494.82	649.32
2044-2053	238.33	285.27	174.94	211.30	347.38	466.05	275.66	359.44
Total	2,689.75	3,255.82	1,587.13	2,061.97	4,348.43	5,560.68	3,366.96	4,288.77
	Net Revenues Relative to Alternative 2 (million dollars)							
2004-2008	0.00	0.00	-18.35	-18.35	0.00	0.00	-17.87	-21.60
2009-2013	0.00	0.00	-16.94	-16.95	0.88	8.18	-8.30	2.04

2014-2023	0.00	0.00	-20.70	-20.70	33.26	59.83	21.35	40.97
2024-2033	0.00	0.00	-10.52	-8.26	41.89	50.65	30.21	30.83
2034-2043	0.00	0.00	-1.07	-8.67	24.83	19.13	16.85	5.50
2044-2053	0.00	0.00	-5.15	-4.84	5.70	11.59	1.36	2.60
Total	0.00	0.00	-71.74	-77.77	107.83	186.67	44.59	97.61
	Angler Consumer Surplus Relative to Alternative 2 (million dollars)							
2004-2008	0.00	0.00	-281.95	-281.95	0.00	0.00	-274.61	-269.80
2009-2013	0.00	0.00	-260.37	-260.37	13.45	125.51	-128.64	4.86
2014-2023	0.00	0.00	-318.00	-318.00	510.32	918.50	324.10	616.87
2024-2033	0.00	0.00	-161.66	-127.06	643.44	781.12	461.12	496.25
2034-2043	0.00	0.00	-17.26	-132.50	382.42	298.94	257.89	110.59
2044-2053	0.00	0.00	-63.39	-73.97	109.05	180.78	37.33	74.17
Total	0.00	0.00	-1102.62	-1193.85	1658.68	2870.93	677.21	1599.02

Table 5.14. Economic impacts of the various rebuilding alternatives on recreational private/rental mode.

	Alternative 2		Alternative 3		Alternative 4		Alternative 5	
Period	30%	50%	30%	50%	30%	50%	30%	50%
	Angler Consumer Surplus (million dollars)							
2004-2008	293.24	293.24	156.83	156.83	293.24	293.24	159.58	161.34
2009-2013	209.08	209.08	83.10	83.10	215.12	266.29	133.69	184.54
2014-2023	255.35	255.35	101.19	101.19	493.02	689.75	361.24	482.60
2024-2033	129.81	200.51	51.59	108.94	438.58	616.80	314.60	425.28
2034-2043	90.04	190.31	56.56	99.85	287.55	399.09	204.05	273.34
2044-2053	84.73	101.47	42.75	51.82	162.89	223.94	115.04	152.94
Total	1,062.25	1,249.97	492.33	602.03	1,890.41	2,489.11	1,288.21	1,680.03
	Angler Consumer Surplus Relative to Alternative 2 (million dollars)							
2004-2008	0.00	0.00	-136.41	-136.41	0.00	0.00	-133.66	-131.90
2009-2013	0.00	0.00	-125.98	-125.98	6.04	57.21	-75.39	-24.54
2014-2023	0.00	0.00	-154.16	-154.16	237.67	434.40	105.89	227.25
2024-2033	0.00	0.00	-78.22	-91.57	308.77	416.29	184.79	224.77
2034-2043	0.00	0.00	-33.48	-90.46	197.51	208.78	114.01	83.03
2044-2053	0.00	0.00	-41.98	-49.65	78.16	122.47	30.31	51.47
Total	0.00	0.00	-569.92	-647.94	828.16	1426.86	225.96	617.78

Table 5.15. Economic impacts of the various rebuilding alternatives on charter boats.

	Alternative 2		Alternative 3		Alternative 4		Alternative 5	
Period	30%	50%	30%	50%	30%	50%	30%	50%
	Net Revenues of For-hire Vessels (million dollars)							
2004-2008	16.10	16.10	12.56	12.56	16.10	16.10	12.74	12.87
2009-2013	11.48	11.48	8.21	8.21	11.70	13.46	11.36	14.60
2014-2023	14.02	14.02	10.03	10.03	21.49	26.70	23.88	29.87
2024-2033	7.12	13.77	5.10	15.70	15.50	19.23	17.28	21.75
2034-2043	5.77	14.76	8.47	16.23	9.16	11.23	10.24	12.80
2044-2053	6.47	7.74	7.02	8.45	4.96	6.03	5.55	6.90
Total	60.98	77.88	51.38	71.17	78.91	92.76	81.04	98.78
	Angler Consumer Surplus (million dollars)							
2004-2008	238.42	238.42	185.95	185.95	238.42	238.42	188.66	190.51
2009-2013	169.99	169.99	121.54	121.54	173.27	199.26	168.16	216.13
2014-2023	207.62	207.62	148.44	148.44	318.14	395.38	353.59	442.21
2024-2033	105.54	203.94	75.46	232.48	229.57	284.78	255.82	322.10
2034-2043	85.47	218.59	125.41	240.27	135.62	166.33	181.58	189.52
2044-2053	95.80	114.58	103.90	125.17	73.37	89.35	82.14	102.17
Total	902.84	1,153.14	760.69	1,053.84	1,168.39	1,373.52	1,199.95	1,462.64
	Net Revenues Relative to Alternative 2 (million dollars)							
2004-2008	0.00	0.00	-3.54	-3.54	0.00	0.00	-3.36	-3.23
2009-2013	0.00	0.00	-3.27	-3.27	0.22	1.98	-0.12	3.12

2014-2023	0.00	0.00	-3.99	-3.99	7.47	12.68	9.86	15.85
2024-2033	0.00	0.00	-2.02	1.93	8.38	5.46	10.16	7.98
2034-2043	0.00	0.00	2.70	1.47	3.39	-3.53	4.47	-1.96
2044-2053	0.00	0.00	0.55	0.71	-1.51	-1.71	-0.92	-0.84
Total	0.00	0.00	-9.60	-6.71	17.93	31.78	20.06	37.80
	Angler Consumer Surplus Relative to Alternative 2 (million dollars)							
2004-2008	0.00	0.00	-52.47	-52.47	0.00	0.00	-49.76	-47.91
2009-2013	0.00	0.00	-48.45	-48.45	3.28	29.27	-1.83	46.14
2014-2023	0.00	0.00	-59.18	-59.18	110.52	187.76	145.97	234.59
2024-2033	0.00	0.00	-30.08	28.54	124.03	80.84	150.28	118.16
2034-2043	0.00	0.00	39.94	21.68	50.15	-52.26	96.11	-29.07
2044-2053	0.00	0.00	8.10	10.59	-22.43	-25.23	-13.66	-12.41
Total	0.00	0.00	-142.15	-99.30	265.55	470.68	297.11	559.80

Table 5.16. Economic impacts of the various rebuilding alternatives on headboats.

	Alternative 2		Alternative 3		Alternative 4		Alternative 5	
Period	30%	50%	30%	50%	30%	50%	30%	50%
	Net Revenues of For-hire Vessels (million dollars)							
2004-2008	31.83	31.83	17.02	17.02	31.83	31.83	17.32	13.46
2009-2013	22.69	22.69	9.02	9.02	23.35	28.90	14.51	21.62
2014-2023	27.72	27.72	11.02	11.02	53.52	74.87	39.21	52.84
2024-2033	14.09	21.76	5.60	11.58	47.61	66.95	34.15	44.62
2034-2043	9.77	20.66	6.00	10.52	31.21	43.32	22.15	28.12
2044-2053	9.20	11.01	4.50	5.46	17.60	24.31	12.49	14.45
Total	115.30	135.68	53.16	64.62	205.20	270.18	139.83	175.11
	Angler Consumer Surplus (million dollars)							
2004-2008	200.05	200.05	106.99	106.99	200.05	200.05	108.87	110.06
2009-2013	142.63	142.63	56.69	56.69	146.76	181.66	91.21	125.89
2014-2023	174.20	174.20	69.24	69.24	336.33	470.54	246.44	329.23
2024-2033	88.56	136.79	35.20	72.76	299.20	420.78	214.62	290.12
2034-2043	61.42	129.83	37.70	66.12	196.17	272.26	139.20	186.47
2044-2053	57.80	69.22	28.30	34.31	111.12	152.77	78.48	104.34
Total	724.66	852.72	334.11	406.10	1,289.63	1,698.06	878.81	1,146.11
	Net Revenues Relative to Alternative 2 (million dollars)							
2004-2008	0.00	0.00	-14.81	-14.81	0.00	0.00	-14.51	-18.37

2009-2013	0.00	0.00	-13.67	-13.67	0.66	6.21	-8.18	-1.07
2014-2023	0.00	0.00	-16.70	-16.70	25.80	47.15	11.49	25.12
2024-2033	0.00	0.00	-8.49	-10.18	33.52	45.19	20.06	22.86
2034-2043	0.00	0.00	-3.77	-10.14	21.44	22.66	12.38	7.46
2044-2053	0.00	0.00	-4.70	-5.55	8.40	13.30	3.29	3.44
Total	0.00	0.00	-62.14	-71.06	89.90	154.88	24.53	59.81
	Angler Consumer Surplus Relative to Alternative 2 (million dollars)							
2004-2008	0.00	0.00	-93.06	-93.06	0.00	0.00	-91.18	-89.99
2009-2013	0.00	0.00	-85.94	-85.94	4.13	39.03	-51.42	-16.74
2014-2023	0.00	0.00	-104.96	-104.96	162.13	296.34	72.24	155.03
2024-2033	0.00	0.00	-53.36	-64.03	210.64	283.99	126.06	153.33
2034-2043	0.00	0.00	-23.72	-63.71	134.75	142.43	77.78	56.64
2044-2053	0.00	0.00	-29.50	-34.91	53.32	83.55	20.68	35.12
Total	0.00	0.00	-390.55	-446.62	564.97	973.40	154.15	421.45

5.5.2.5 Summary of results

Table 5.17 presents an overall summary of estimated net present values for both the commercial and recreational sectors of the red snapper fishery. To examine the sensitivity of results with respect to different discount rates, results using two additional discounting rates (1% and 3%) are shown in the table. On balance, the use of different discounting rates has preserved the direction and order of impacts. Noticeable, though expected, is the big jump in values as the discount rate is lowered from 7% to 1%.

Alternative 4 stands out as the alternative that is associated with the largest net present values, especially if the assumed shrimp effort reduction is 50%. This indicates that a constant F strategy, or more correctly a transitional approach from constant catch to constant F in the directed fishery, provides greater economic benefits than a constant catch approach. Also apparent in the table is that a constant F approach associated with higher effort reduction in the shrimp fishery would result in greater economic benefits to the directed red snapper fishery. It is worth noting here that there are two important issues that need to be recognized regarding the conclusion that a constant F approach is better than a constant catch approach. First, the constant F approach can achieve the biomass target only under the assumption of a 50% shrimp effort reduction. A lower shrimp effort reduction of 30% would not allow the achievement of the target biomass. Second, the constant catch approach achieves the target biomass some 6 to 7 years before the constant F approach does.

In comparing Alternatives 2 and 3, it was revealed that a reduction in TAC from 9.12 mp to 6.0 mp would result in relatively large reductions in net present values but would only save one year in achieving the target biomass under a 50% shrimp effort reduction scenario and 3 years under a 30% shrimp effort reduction scenario. Table 5.17 shows that Alternative 3, under a 30 percent shrimp effort reduction, would result in losses of $13 million in net revenues to the commercial sector, $71 million net revenues to the for-hire sector, and $1,103 million in consumer surplus for the first 5 years of the rebuilding period at a 7% discount rate.

Table 5.17. Summary of economic impacts of the various rebuilding alternatives at various discount rates.

Discount Rate	Alternative 2		Alternative 3		Alternative 4		Alternative 5	
	30%	50%	30%	50%	30%	50%	30%	50%
	Net Revenues to the Commercial Sector (million dollars)							
7%	26.48	40.97	13.96	29.71	47.58	63.5	43.71	60.7
3%	63.66	113.08	48.09	98.95	113.93	154.44	110.42	152.09
1%	118.87	213.31	103.25	197.98	198.95	269.54	196.04	267.75
	Net Revenues to the For-hire Sector (million dollars)							
7%	176	214	105	136	284	363	221	274
3%	364	492	234	336	658	867	522	676
1%	605	850	409	598	1,123	1,493	896	1,165
	Consumer Surplus to the Recreational Anglers (million dollars)							
7%	2,690	3,256	1,587	2,062	4,348	5,561	3,367	4,289
3%	5,556	7,497	3,559	5,098	10,088	13,295	7,970	10,322
1%	9,227	12,949	6,212	9,085	17,214	22,906	13,677	17,799
	Net Revenues to the Commercial Sector Relative to Alternative 2 (million dollars)							
7%	0	0	-13	-11	21	23	17	20
3%	0	0	-16	-14	50	41	47	39
1%	0	0	-16	-15	80	56	77	54
	Net Revenues to the For-hire Sector Relative to Alternative 2 (million dollars)							
7%	0	0	-71	-78	108	149	45	60
3%	0	0	-130	-156	294	375	158	184
1%	0	0	-196	-252	518	643	291	315
	Consumer Surplus to the Recreational Anglers Relative to Alternative 2 (million dollars)							
7%	0	0	-1103	-1194	1,658	2,305	677	1,033
3%	0	0	-1997	-2399	4,532	5,798	2,414	2,825
1%	0	0	-3015	-3864	7,987	9,957	4,450	4,850

5 .5.3 Bycatch reporting methodology

5 .5.3.1 Commercial and recreational for-hire fisheries

Including the no action alternatives, six alternatives are considered for reporting bycatch in the commercial and for-hire reef fish fishery. Alternative 1 is the no action alternative. Alternative 2 requires all permitted reef fish vessels in the Gulf to participate in an electronic logbook program that includes bycatch reporting. Alternative 3 is similar to Alternative 2 but the electronic logbook program would be administered only to a randomly selected sample of reef fish permitted vessels. Alternative 4 would establish an observer program for a randomly selected reef fish permitted vessels. Alternative 5 would expand the current bycatch reporting program for commercial reef fish and mackerel permitted vessels to cover 100% of such vessels and all federally permitted for-hire vessels. Alternative 6 would enhance the MRFSS to include the headboat sector using the same sampling methodology as for charter vessels.

Under current rules (Alternative 1), bycatch information is collected from a sample of commercial reef fish and mackerel permitted vessels as an add-on to the logbook program for such vessels. Bycatch information is also collected from recreational anglers that participate in the for-hire fishery through a sample of charter boats administered through the MRFSS program. No specific requirement to report bycatch information is currently included in the logbook program for headboats. With the exception then, of headboats, all types of fishing participants are subject to bycatch reporting in one form or another. Given this situation, the no action alternative may be considered a viable alternative for bycatch reporting under the Sustainable Fisheries Act.

Each alternative differs in terms of both the information collected and the costs involved. A comparison of the benefits of having bycatch information with the associated costs is the major issue in the determination of socioeconomic impacts of each of the alternatives.

The bycatch information collected would be used to help devise conservation and management measures that would minimize bycatch or minimize the mortality of bycatch which cannot be avoided. The better the information, the more effective would likely be the bycatch reduction measures subsequently developed. But whether or not an effective bycatch reduction measure generates more benefits depends materially on the type of measures adopted, including the overall management strategy governing both the fisheries that are dependent on the bycatch species and those producing the bycatch. In addition, such benefits would have to be compared with the costs of the bycatch reduction measure. While the alternatives considered here pertain only to the directed red snapper fishery and reef fishery at large, another source of bycatch mortality comes from the shrimp fishery. Bycatch reporting for that fishery has been considered in an amendment to the shrimp FMP (see Amendment 10 to the Shrimp FMP). Given such considerations, it is assumed that the alternative that is likely to generate better information is judged to produce greater benefits. A similar presumption on costs cannot be made, although in principle it may be expected that the collection of better information requires relatively higher costs.

Bycatch reporting through logbooks, electronic or otherwise, is highly dependent on the fishermen’s desire and ability to report the information. Unless there is some economic incentive to report bycatch, such as monetary reward or simply the recognition of the value of the information, or economic/legal disincentive not to report bycatch, such as fines or penalties including non-renewal of permits, bycatch reporting through logbooks may simply be seen as an additional burden so that the information provided would likely be far from accurate. Even if fishermen are willing to provide bycatch information, they may not possess the right information at the time they fill out logbooks. This could be due to their lack of training in identifying bycatch species, or simply due to recall problems if the logbooks are filled out after the trip is completed. Requiring an electronic logbook, as in Alternative 2 or 3, can address the recall problem, assuming the electronic format stimulates the vessel operator to record the data as the bycatch occurs, and in this regard these two alternatives may be considered better than Alternatives 5 and 1 in collecting bycatch information. But, like paper logbooks, electronic logbooks cannot address the problem posed by the lack of economic incentive to report bycatch information accurately. An observer program, as in Alternative 4, can improve the accuracy of bycatch information collection by transferring the burden of bycatch reporting to the observers. From this perspective, an observer program is probably the best alternative to validate the accuracy and consistency of bycatch information collected. Therefore, Alternative 4 may be adjudged superior to the other alternatives in generating bycatch information. One downside of an observer program, however, pertains to the potential representativeness of the vessels sampled for data collection in that certain vessel characteristics, such as space and facilities, limit the ability to carry an observer or not. Over time, however, as experience with an observer program for reef fish permitted vessels is accumulated, issues pertaining to sampling problems can be addressed.

In terms of the cost of bycatch data collection, Alternative 1 (no action) is the least costly as it involves no additional burden on the fishermen and the government than what is currently being incurred. Depending on the sample size, Alternative 4 may entail the highest cost.

An electronic logbook costs from $750 to $2,500 to set up. On a per trip basis, the current paper logbook is estimated to require 15 minutes to fill in with bycatch information in addition to the 10 minutes required to report catch and other information. On average, each of the 1,158 active vessels with commercial reef fish permits takes an average of 13 to 14 trips per year. There are 1,552 active for-hire vessels with federal permits, but the distribution between charter and headboats is not precisely known. A headboat is reported to take an average of 138 trips per year, but applying this number to charter boats is likely to overestimate the number of trips taken by the for-hire sector. Carter (2003) reported that, for full-day trips, headboats took 74 to 177 trips per year depending on geographical location while charter boats in similar locations as headboats took 61 to 85 trips per year. It is possible that the same or potentially less time burden that applies to paper logbook also applies to electronic logbooks. Based on this information, Alternative 2 would affect 1,158 commercial vessels and 15,054 to 16,212 trips. Also affected by this alternative are 1,552 for-hire vessels and at the maximum 214,176 trips. It should be noted here that the vessel numbers are not additive because some vessels hold both for-hire and commercial reef fish permits. For commercial vessels, the cost of Alternative 2 would range from $0.87 million to $2.9 million to set up the system with burden time ranging from 3,764 to 4,053 hours. For the for-hire vessels, the cost would range from $1.16 million to $3.88 million to set up the system with burden time of 89,240 hours. There would also be additional costs for NOAA Fisheries to set up the hardware and software systems. The cost of Alternative 3, excluding the NOAA Fisheries set up costs, would be proportional to the sample size. At a 20% sample size, the cost of Alternative 3 would range from $0.17 million to $0.58 million set-up for the commercial vessels, with burden time of 752 hours to 811 hours. The corresponding cost for the for-hire vessels would range from $0.23 million to $0.78 million set-up cost, with burden time of 17,848 hours. The monetary costs may be borne solely by either the industry or government, or may be shared by both industry and the government. The burden time would be borne solely by industry.

An observer program for the reef fish fishery is estimated to cost from $450 to $2,000 per day, or roughly an average of $1,200 per day (NMFS, 2003). A suggested acceptable sampling rate would cover 2,170 days for commercial vessels, 2,242 days for charter vessels and 520 days for headboat vessels. These sample sizes correspond to 8 percent of trips for commercial vessels, 1 percent of trips for charter vessels, and 4 percent of trips for headboats. The potential cost under Alternative 4 would be $5.92 million per year under the mentioned sample size. These costs would be borne mainly by NOAA Fisheries. Selected vessels would have to shoulder the cost associated with providing food and accommodations for the observer. The cost for food is estimated to be in the range of $20 to $25 per day. At the suggested sample size, the direct cost to the industry would range from $98,640 to $123,300.

Alternative 5 would simply extend the current bycatch reporting requirement for commercial vessels from 20% to 100% and at the same time require a 100% logbook coverage together with bycatch reporting requirement for for-hire vessels. As a side note, it should be pointed out that under this amendment, the commercial and for-hire vessels that would be affected would include those with reef fish permits regardless of whether they also have mackerel permits and exclude those with mackerel/coastal pelagics permits only. This alternative would affect 926 additional vessels, with burden time ranging from 3,009 to 3,241 hours and 1,552 for-hire vessels, with burden time of about 89,240 hours. The current bycatch reporting requirement for reef fish and mackerel vessels covering about 500 vessels is estimated to cost the government $25,000 to $30,000 annually. Assuming that costs increase proportionately with the number of vessels subject to logbook reporting of bycatch, Alternative 5 may be expected to increase the cost to the government of about $46,000 to $56,000.

Alternative 6 would mainly affect the headboat vessels and they would be subject to same sampling methodology as for charter vessels, with particular emphasis on reporting bycatch. Using the same sampling technique as for charter vessels, approximately 85 headboats would be sampled per wave (two-month period).

The various vessels affected by either logbook or observer program for purposes of bycatch reporting vary in size and extent of operations. Given this condition, the effective cost of any of the bycatch reporting requirement would be disproportionally distributed among the various vessels. An electronic logbook, for example, could possibly cost the same regardless of vessel size and operation, but if borne by the vessels, such cost could impose a larger burden on smaller operations. An observer program also has the potential to create disparity in impacts on the operations of the various classes of vessels, particularly if the industry shares part of the cost of the observer program. This cost may come in the form of outright cash expense and/or in the form of liability associated with carrying an observer on board. Larger operations may be able to absorb the potential costs, but smaller operations would be placed at a strong disadvantage. These costs would have to be explicitly determined in designing an observer program.

There are other potential costs attendant to logbook and observer program alternatives for collecting bycatch information. In the case of logbooks, management would have to develop logbooks and a training program for vessel captains and crew. Vessel operators and crew would likely be required to receive training in order to properly identify bycatch species as well as how to fill out logbooks. The time required to complete these tasks could be burdensome to some vessel operations. In the particular case of electronic logbooks, which for purposes of accuracy needs to be completed at sea, would demand time on the crew that have been spent fishing or doing routine tasks on the vessel and equipment. Also, there is a probability that at least some captains and crew would be unwilling to participate in a logbook programs, and thus would promote ill will toward fishery managers that could later result in inaccurately reporting bycatch. Fishery managers, upon examination of some logbooks, may observe certain patterns of inaccuracies and would require more work from fishermen. Such additional requirement may be viewed by fishermen as another obstacle from possibly renewing their permits (assuming logbook reporting as a condition for permit renewal).

An observer program is an intrusive data collection system, and thus is likely to create adverse social effects. In particular, an observer program can give rise to some friction between fishermen and fishery managers. A mandatory observer program would only worsen the situation, although it would lessen sampling bias. In addition, fishermen do not like to take observers on board for a variety of reasons. Some may fear liability for the safety of observers and others feel that they are simply a nuisance because they are "in the way." In the particular case of health and safety, an observer program would expose fishermen to the risk that their fishing craft may not be adequately equipped to carry an extra person, although this may be partly addressed by the requirement imposed under Section 403 (a) of the MSFCMA regarding the health and safety of observers. Others do not trust that observer information can be kept confidential.

5 .5.3.2 Private recreational fishery

Inclusive of the no action alternative (Alternative 1), there are three alternatives considered in this section. Alternative 2 establishes a federal recreational fishing permit for fishing reef fish in the Gulf EEZ, with a subset of permittees subject to logbook reporting. Alternative 3 establishes a volunteer logbook reporting program that includes bycatch reporting. Currently, a for-hire permit administered by NOAA Fisheries costs $50 per permit. This cost can be substantially reduced if, where available, states can administer the issuance of federal permits for recreational fishermen. Current estimates of salt-water anglers is abut 2.1 million people (see Section 5.4.3.1), but it is unknown how many of those anglers fish in EEZ waters. Although Alternative 2 or 3 can potentially provide valuable information, particularly on bycatch, they can potentially interfere with the data collection undertaken through the MRFSS program.

5 .6 Private and public costs

The preparation, implementation, enforcement and monitoring of this or any federal action involves the expenditure of public and private resources which can be expressed as costs associated with the regulations. Costs associated with this specific action include:

Council costs of document preparation,
meetings, public hearings, and information
dissemination $40,000

NOAA Fisheries administrative costs of document
preparation, meetings and review 35,000

Industry cost of bycatch reporting program . . . . see note below

NOAA Fisheries cost of bycatch reporting program . . . . see note below

Enforcement cost . . . .

The Council and NOAA Fisheries costs of document preparation are based on staff time, work outsourcing, travel, printing and any other relevant items where funds were expended directly for this specific action. The cost of the bycatch reporting requirement through an observer program is about $5.92 million annually, which could be shared by the industry and government, or borne solely by either entity. Enforcement costs that may be required under the proposed actions in this amendment cannot be adequately estimated. Under a fixed budget, adoption of this amendment would mean a redirection of resources to enforce the new measures.

5 .7 Determination of a significant regulatory action

Pursuant to E.O. 12866, a regulation is considered a "significant regulatory action" if it is likely to result in a rule that may: a) have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments and communities; b) create a serious inconsistency or otherwise interfere with an action taken or planned by another agency; c) materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or d) raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

Proposed actions on red snapper sustainable fishing parameters, namely, MSY, MFMT, MSST, and OY, have no direct impacts on fishing participants in terms of changing harvest and fishing activities in the near and short term. However, these parameters set the stage for the proposed regulatory measures.

For a rebuilding strategy, the viable choices range from a 31-year rebuilding plan to a 41-year rebuilding plan for red snapper. The TAC choices are 6.0 mp or 9.12 mp for the first five years. The TAC will be reviewed every five years or so based on the results of the most recent stock assessment. The current preferred alternative is for a 31-year rebuilding plan, with an initial TAC of 9.12 mp for the first five years. The preferred TAC is the same as the current TAC. For the bycatch reporting requirement by commercial and for-hire reef fish vessels, the choices are to establish an electronic logbook program covering either all or a sample of all commercial and for-hire vessels with reef fish permit, maintain or expand the use of existing supplemental bycatch reporting requirements, develop an observer program, and enhance the MRFSS by including headboats using the same methodology as used for charter vessels. The preferred alternatives are to develop an observer program and to enhance the MRFSS to include headboats in the survey. For bycatch reporting by private recreational anglers, the choices are to use the existing MRFSS, establish a federal recreational fishing permit with a sample of permittees required to submit logbooks, and establish a volunteer logbook program. There is no preferred alternative for this set of measures.

In 2002, the entire Gulf commercial reef fish harvest sector had an ex-vessel value of approximately $32 million, with the red snapper fishery accounting for about $10.6 million (Waters, 2003). The preferred TAC choice is 9.12 mp, which is the same as the current TAC. This TAC has been in effect since 1996, and is thus expected not to result in any revenue changes both to the commercial and for-hire reef fish fishery. Among the choices for bycatch reporting requirements, the observer program, which is the preferred alternative, is estimated at about $6 million annually. Thus, considering the potential impacts on both the commercial and recreational sectors, it is concluded that a $100 million annual impact due to this amendment is not expected.

A TAC of 9.12 mp would maintain the status quo TAC and, thus, would essentially bring about no regulatory-induced changes in the operations of commercial and recreational fishing participants. This measure is therefore not expected to change the investment, competition and employment scenario in the commercial and for-hire sectors of the reef fish fishery. An observer program can potentially raise the cost of fishing operations for both the commercial and for-hire reef fish vessels, especially if part of the cost outlay for an observer program is borne by fishing vessels. However, there is no compelling reason to believe that this measure would impair competition, investment and employment in the commercial and for-hire reef fish fishery. The use of observers can increase employment, albeit in areas other than the harvesting sector. It may only be noted that if an observer program enhances the information that goes into the stock assessment, better information can flow into the decision arena of fishery managers. If management and conservation measures are enacted, the stock will be rebuilt as to allow higher TACs over time, resulting in turn increases in employment and investment. Similar effects on employment and investment may be expected from support industries.

Neither the maintenance of TAC at 9.12 mp nor the observer program for the commercial and for-hire reef fish vessels interferes or creates inconsistency with an action of another agency, including state fishing agencies. Currently, a bycatch reporting program covering about 20% of commercial reef fish and mackerel vessels are subject to a bycatch reporting requirement as part of the vessel logbook program for these fisheries. An observer program, if undertaken simultaneously with the logbook reporting approach, is likely to provide a measure of validating self-reported bycatch information.

At present, none of the entities involved in the red snapper fishery affected by this amendment participate in any government sponsored entitlement, grants, user fees, or loan programs. Permit fees are the only fees that may approximate user fees. Depending on who bears the greater burden of the observer program, the increase in cost to vessels may be significant as to result in lower or negative profits that would only force some of them to leave the fishery. Upon leaving the fishery, they would have to sell or give up their permits, and under a commercial and for-hire reef fish permit moratorium, they could re-enter the fishery only after purchasing permits from existing permit holders. The extent of this effect cannot be ascertained. At any rate, such possibility is inherent in any fishery regulatory actions that would adversely impact the fishing participants. In this manner, it is reasonable to expect that the measures in this amendment would not materially alter the permit fee system established for the commercial and for-hire reef fish fishery. It is then concluded that measures in this amendment do not affect any entitlements, grants, user fees, or loan programs.

The measures in this amendment do not raise novel legal or policy issue. The concept of a rebuilding plan with accompanying management measures such as TACs have been used in the Gulf and South Atlantic in previous actions of the Gulf and South Atlantic Councils, and thus is deemed not to raise novel legal and policy issues. Although a limited observer program has been tried on the commercial reef fish and shrimp fisheries, this program may still be considered relatively new for the Gulf fisheries, particularly the for-hire sector. However, bycatch reporting is mandated by the MSFCMA.

The foregoing discussions relative to the various issues enumerated in E.O. 12866 support the conclusion that, if enacted, the proposed set of actions in this amendment would not constitute a significant regulatory action.

6 Initial Regulatory Flexibility Analysis

6 .1 Introduction

The purpose of the Regulatory Flexibility Act (RFA) is to establish a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure that such proposals are given serious consideration. The RFA does not contain any decision criteria; instead the purpose of the RFA is to inform the agency, as well as the public, of the expected economic impacts of various alternatives contained in the FMP or amendment (including framework management measures and other regulatory actions) and to ensure that the agency considers alternatives that minimize the expected impacts while meeting the goals and objectives of the FMP and applicable statutes.

With certain exceptions, the RFA requires agencies to conduct an Initial Regulatory Flexibility Analysis (IRFA) for each proposed rule. The IRFA is designed to assess the impacts various regulatory alternatives would have on small entities, including small businesses, and to determine ways to minimize those impacts. An IRFA is conducted to primarily determine whether the proposed action would have a "significant economic impact on a substantial number of small entities." In addition to analyses conducted for the Regulatory Impact Review (RIR), the IRFA provides: (1) a description of the reasons why action by the agency is being considered; (2) a succinct statement of the objectives of, and legal basis for, the proposed rule; (3) a description and, where feasible, an estimate of the number of small entities to which the proposed rule will apply; (4) a description of the projected reporting, record-keeping, and other compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirements of the report or record; and, (5) an identification, to the extent practicable, of all relevant federal rules, which may duplicate, overlap, or conflict with the proposed rule.

The measures that have immediate relevance to the determination of significant impacts on a substantial number of small entities are those that affect harvest and/or operating activities of small entities. In this respect, the choice of TAC and bycatch reporting requirements are measures that can affect the status of small entities. The TAC measures would affect mainly the commercial and for-hire red snapper operations while the bycatch reporting measures would affect commercial and for-hire reef fish operations. For a TAC, the preferred alternative 9.12 mp, which is the current TAC. For bycatch reporting, the preferred alternatives are to develop an observer program for the reef fish commercial and for-hire fishery and to enhance the MRFSS by including headboats using the sam sampling methodology as used for charter vessels. There is no preferred alternative for bycatch reporting for the private recreational fishery, but the alternatives are no action, establishing a federal recreational fishing permit system and subjecting a subset of permittees to logbook reporting, and voluntary logbook reporting.

6 .2 Description of the reasons why action by the agency is being considered

The need and purpose of the actions are set forth in Section 3 of this document and incorporated herein by reference.

6 .3 Statement of the objectives of, and legal basis for, the proposed rule

The primary objective of this action is to optimize the net benefits to the Nation of the reef fish stocks by rebuilding the red snapper component to a stock level capable of supporting optimum yield. The following objectives are encompassed within the primary objective:

- 6.3.1. Define the sustainable fishing parameters for the Gulf of Mexico stock of red snapper.
- 6.3.2 Implement a plan to end overfishing of the Gulf of Mexico stock of red snapper and rebuild the stock within 31 or 40 years to a level capable of supporting maximum sustainable yield.

6.3.3 Maintain to the extent practicable the historical allocation of red snapper harvest between commercial and recreational sectors through management measures to rebuild the red snapper stock.
6.3.4 Minimize to the extent practicable socioeconomic disruptions to the largest amount of individuals within each sector while still achieving the necessary levels of harvest reduction to rebuild the stock.
6.3.5 Minimize to the extent practicable bycatch of red snapper and other species, and to the extent that bycatch cannot be avoided, minimize the mortality of such bycatch through management measures to rebuild the red snapper stock.
6.3.6 Minimize to the extent practicable the increase in fishing mortality on alternative /target species for which the status of stock is unknown resulting from management measures to rebuild the red snapper stock.

The Magnuson-Stevens Fishery Conservation and Management Act, as amended, provides the legal basis for the rule.

6 .4 Description and estimate of the number of small entities to which the proposed rule will apply

The Small Business Administration (SBA) defines a small business if it is independently owned and operated and not dominant in its field of operation, and if it has annual receipts not in excess of $3.5 million in the case of commercial harvesting entities or $6 million in the case of for-hire entities, or if it has fewer than 500 employees in the case of fish processors, or fewer than 100 employees in the case of fish dealers.

In 1992, when the moratorium on the issuance of new reef fish commercial permits first began, a total of 2,200 permits were issued to qualifying individuals and attached to vessels, and are deemed to comprise the reef fish fishery in the U.S. Gulf of Mexico. As of October 2003, there are 1,158 active commercial reef fish permits. Of these commercial permittees, 131 entities hold Class 1 licenses that allow a vessel trip limit of up to 2,000 pounds of red snapper and approximately 357 entities hold Class 2 licenses that allow a trip limit of up to 200 pounds of red snapper. Waters (2003) reported that the top 50 red snapper vessels averaged 2.6 mp of red snapper, or 60% of the industry total harvest between 1998 and 2002. Boats ranked 51-131 averaged 1.5 mp, or 34% of industry total for the same period. In effect, the top 131 red snapper vessels accounted for about 94% of industry total landings of red snapper. Waters (2002) also reported that of the vessels with commercial reef fish permits, all of which are required to submit logbooks, 782 vessels in Florida and 207 in other Gulf states indicated they landed reef fish using vertical lines. Also, 155 vessels in Florida and 33 in other Gulf states indicated to have landed reef fish using longlines. Furthermore, 55 vessels reported landing reef fish using fish traps. All fish trap vessels are in Florida.

According to a survey of commercial reef fish fishermen in the Gulf (Waters 1996), fishing vessels in the reef fish fishery have the following annual gross receipts per vessel:

	Gross Income	Net Income
High-volume vessels, vertical lines:		
Northern Gulf:	$110,070	$28,466
Eastern Gulf:	$ 67,979	$23,822
Low-volume vessels, vertical lines:		
Northern Gulf:	$ 24,095	$ 6,801
Eastern Gulf:	$ 24,588	$ 4,479
High-volume vessels, bottom longlines:		
Both areas:	$116,989	$25,452
Low-volume vessels, bottom longlines:		

Both areas:	$ 87,635	$14,978
High-volume vessels, fish traps:	$ 93,426	$19,409
Low-volume vessels, fish traps:	$ 86,039	$21,025

The measures in this amendment would also affect for-hire vessels. In June 2003, the NOAA Fisheries published a final rule implementing a moratorium on the issuance of permits for the charter vessel/headboat (recreational-for-hire) sector of the reef fish and coastal migratory pelagics fishery. The objective of that rule was to cap the number of for-hire vessels permitted to fish for reef fish or coastal migratory pelagics in the EEZ of the Gulf of Mexico at the current level of participation while the Council assesses the actions necessary to restore overfished reef fish and king mackerel stocks and determine whether a more comprehensive effort management system is appropriate for these fisheries. As of October 2003, there are 1,552 active for-hire vessel permits.

Holland et al. (1999) conducted a survey of charter boats and headboats in Florida. Charter boats have an average length of 37 feet and headboats, 62 feet. The major activity centers for charter boats in Florida: Miami and Fort Lauderdale on the Atlantic; Naples and Fort Myers/Fort Myers Beach on the Peninsula Gulf; Destin, Panama City/Panama City Beach and Pensacola on the Panhandle Gulf; and, Key West, Marathon and Islamorada in the Florida Keys. The major activity centers for headboats are: Miami on the Atlantic; Clearwater and Fort Myers/Fort Myers Beach on the Peninsula Gulf; Destin and Panama City/Panama City Beach on the Panhandle Gulf; Islamorada, Key West and Marathon in the Florida Keys.

Sutton et al. (1999) conducted a survey of charter boats and headboats in Alabama, Mississippi, Louisiana and Texas. The average charter boat in the four-state area was 39 feet in length with a total passenger capacity of 12 people while the average headboat was 72 feet in length with a total capacity of 60 passengers. Major activity centers for charter boats in the four-state area are: South Padre Island, Port Aransas, and Galveston/Freeport in Texas; Grand Isle-Empire-Venice in Louisiana; Gulfport-Biloxi in Mississippi; and, Orange Beach-Gulf Shores in Alabama. Major activity centers for headboats in the four-state area are: South Padre Island, Port Aransas, and Galveston/Freeport in Texas and Orange Beach-Gulf Shores in Alabama.

Based on the works of Holland et al. (1999) and Sutton et al. (1999), Carter (2003) developed earnings profiles for charter and headboats in the Gulf using information on the number of trips by categories (half-day, full-day, overnight), number of passengers, base fees, and angler days. On average, charter boats generated gross revenues ranging from $58,000 in the eastern Gulf to $81,000 in the western Gulf, or an overall average of $64,000. Headboats generated gross revenues ranging from $281,000 in the eastern Gulf to $550,000 in the western Gulf, or an overall average of $400,000.

Also affected by the measures in this amendment are fish dealers, particularly those that receive red snapper from harvesting vessels. Currently, a federal permit is required for a fish dealer to receive reef fish from commercial vessels. Based on permits file, there are 227 dealers possessing permits to buy and sell reef fish species. Based on mail address data, most of them are located in Florida (146), with 29 in Louisiana, 18 in Texas, 14 in Alabama, 5 in Mississippi and 15 out of the Gulf States region. In addition, as part of the commercial reef fish logbook program, reporting vessels identify the dealers who receive fish landed by these vessels. Commercial reef fish vessels with federal permits are required to sell their harvest only to permitted dealers. Based on vessel logbook records for 1997-2002, there were on average 154 reef fish dealers actively buying and selling in the red snapper market. These dealers were distributed around the gulf states as follows: 7 in Alabama, 96 in Florida, 22 in Louisiana, 7 in Mississippi, and 22 in Texas. These numbers differ from the ones taken from the permit file, because they are averages for the three-year period. Dealers in Florida purchased about $1.8 million of red snapper, followed by dealers in Louisiana with purchases of $1.4 million and dealers in Texas with purchases of $1.3 million. Dealers in Mississippi purchased $174 thousand worth of red snappers and those in Alabama, $88 thousand. These dealers may hold multiple types of permits and because we do not know 100% of the business revenues, it is not possible to determine what percentage of their business comes from red snapper fishing activity.

Average employment information per reef fish dealer is not known. Although dealers and processors are not synonymous entities, Keithly and Martin (1997), however, reported total employment for reef fish processors in the Southeast at approximately 700 individuals, both part and full time. It is assumed that all processors must be dealers, yet a dealer need not be a processor. Further, processing is a much more labor intensive exercise than dealing. Therefore, given the employment estimate for the processing sector, it is assumed that the average dealer employment would not surpass the SBA employment benchmark of 100 persons.

Based on the gross revenue and employment profiles presented above, all commercial and for-hire fishing vessels and reef fish dealers potentially affected by the proposed regulations are classified as small entities.

6 .5 Description of the projected reporting, record-keeping and other compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirement and the type of professional skills necessary for the preparation of the report or records

Since the preferred alternative for the stock rebuilding program calls for a TAC of 9.12 mp, which is the same as the current TAC, this measure is not expected to change any reporting, record-keeping or other compliance requirements are expected. The preferred alternative for bycatch reporting is to develop an observer program for the commercial and for-hire reef fish fishery. Although only a sample of the 1,158 permitted commercial reef fish vessels and 1,552 permitted for-hire vessels would be selected for the observer program, all these vessels are potentially included in the observer program. A trained observer would be on board selected vessels to record bycatch information. In this way, vessel operators/crew would not be required to develop specialized skills for the preparation of the bycatch reports. Although the bulk of the cost of an observer would be borne by NMFS, selected vessels would have to shoulder the cost of providing food and accommodation for the observer. In this way, vessels would have to expend some costs in complying with the proposed rule. These costs are described in the RIR and summarized in Section 6.7 below.

6 .6 Identification of all relevant federal rules, which may duplicate, overlap or conflict with the proposed rule

No duplicative, overlapping, or conflicting federal rules have been identified. The selection of SFA parameters, the rebuilding strategy and bycatch reporting are necessary to comply with requirements under the MSFCMA.

6 .7 Description of economic impacts on small entities

Among the alternatives considered in this amendment, only the TACs and bycatch reporting measures have impacts on small entities. Because the preferred alternative to set a TAC of 9.12 mp for the next five years and this TAC is the same as the current one, this measure has no impacts on small entities. The preferred alternative for bycatch reporting is an observer program for the commercial and for-hire reef fish fishery. An observer program would also be new to the

Gulf reef fish fishery and is expected to potentially affect all commercial and for-hire vessels although each year only a sample of these vessels would be selected to carry observers. An observer program can lessen the reporting burden for bycatch to the extent that this task would be carried out by a trained observer. Space and liability concerns can pose some problems regarding compliance with the program for vessels selected to carry observers, although the space problem can be addressed before a vessel is selected to participate in the observer program. Assuming the observer program covers 8% of commercial vessel trips, 1% of charter boat trips, and 4% of headboat trips, total costs would be about $5.92 million annually. Of this potential total cost of an observer program, the industry would shoulder about $98,640 to $123,300 mainly in terms of providing food for the observer.

Since there is no expected reduction in harvests and the bycatch reporting through an observer program would be imposed only on vessels, dealers are not expected to be directly affected by the proposed measures in this amendment. The cost to the industry of an observer program is not deemed to substantially affect profitability so that only a minimal number of vessels, if any, would exit the fishery. In this way, the indirect effect on dealers that purchase fish from affected vessels would also be very minimal.

6 .8 Description of significant alternatives to the proposed rule and discussion of how the alternatives attempt to minimize economic impacts on small entities

There are 4 basic alternatives considered for the rebuilding plan, two are constant catch strategies and two are constant F strategies. The no action alternative is not considered a viable alternative, since a rebuilding plan has to instituted for the overfished red snapper stock. Under each alternative, two scenarios are presented with the main difference being the assumption on shrimp effort reduction of 30% or 50%. For the current purpose, only the constant catch strategies are considered. More details are found in the RIR. Among the constant catch strategy, the preferred alternative would hold TAC constant at 9.12 mp while the other alternative would keep TAC constant at 6.0 mp. For the constant F strategy, one alternative would hold the TAC at 9.12 mp for a period of years and would gradually increase it over time while the other would hold the TAC constant at 6.0 mp for a period of years and would increase it over time. In essence then, the other significant alternative to the preferred TAC of 9.12 mp is a TAC of 6.0 mp. Over the first five years, this lower TAC would reduce commercial vessel profits by $3.92 million and for-hire vessel profits by $18.35 million. The profit reduction for dealers cannot be estimated because the needed information is not available. Thus, while the preferred alternative would enable the achievement of the goal to rebuild the stock, it would also minimize the impacts on small entities.

Including the no action alternatives, six alternatives are considered for reporting bycatch in the commercial and for-hire reef fish fishery. Alternative 1 is the no action alternative. Alternative 2 requires all permitted reef fish vessels in the Gulf to participate in an electronic logbook program that includes bycatch reporting. Alternative 3 is similar to Alternative 2 but the electronic logbook program would be administered only to a randomly selected sample of reef fish permitted vessels. Alternative 4 would establish an observer program for a randomly selected group of reef fish permitted vessels. Alternative 5 would expand the current bycatch reporting program for commercial reef fish and mackerel permitted vessels to cover 100% of such vessels and all federally permitted for-hire vessels. Alternative 6 would enhance the MRFSS to include the headboat sector using the same sampling methodology as for charter vessels.

Under current rules (Alternative 1), bycatch information is collected from a sample of commercial reef fish and mackerel permitted vessels as an add-on to the logbook program for such vessels. Bycatch information is also collected from recreational anglers that participate in the for-hire fishery through a sample of charter boats administered through the MRFSS program. No specific requirement to report bycatch information is currently included in the logbook program for headboats. With the exception then, of headboats, all types of fishing participants are subject to bycatch reporting in one form or another. Given this situation, the no action alternative may be considered a viable alternative for bycatch reporting under the Sustainable Fisheries Act.

Among the alternatives, Alternative 1 (no action) is the least costly as it involves no additional burden on the fishermen and the government than what is currently being incurred. Depending on the sample size, Alternative 4 may entail the highest cost.

An electronic logbook costs from $750 to $2,500 to set up. On a per trip basis, the current paper logbook is estimated to require 15 minutes to fill in with bycatch information in addition to the 10 minutes required to report catch and other information. For commercial vessels, the cost of Alternative 2 would range from $0.87 million to $2.9 million to set up the system with burden time ranging from 3,764 to 4,053 hours. For the for-hire vessels, the cost would range from $1.16 million to $3.88 million to set up the system with burden time of 89,240 hours. The cost of Alternative 3 would be proportional to the sample size. At a 20% sample size, the cost of Alternative 3 would range from $0.17 million to $0.58 million set-up for the commercial vessels, with burden time of 752 hours to 811 hours. The corresponding cost for the for-hire vessels would range from $0.23 million to $0.78 million set-up cost, with burden time of 17,848 hours. An observer program under Alternative 4 is estimated to cost $5.92 million per year, of which only $98,640 to $123,300 would be borne by vessels. Alternative 5 would affect 926 additional vessels, with burden time ranging from 3,009 to 3,241 hours and 1,552 for-hire vessels, with burden time of about 89,240 hours. Alternative 6 would mainly affect the headboat vessels and they would be subject to same sampling methodology as for charter vessels, with particular emphasis on reporting bycatch. Using the same sampling technique as for charter vessels, approximately 85 headboats would be sampled per wave (two-month period).

To a large extent, the monetary outlay of a bycatch reporting requirement may be shared by the industry and government, or borne solely by either entity. If borne solely by the industry, an observer program would have the largest negative impacts on small entities. However, if the monetary outlay is borne solely by the government, an observer program may considered as having a similar cost, or even lower cost, to the other alternatives. The major reason for this is that a logbook program, electronic or otherwise, entails additional reporting and record-keeping activities by small entities. Such activities are less likely to increase under an observer program. Under the proposed observer program, an owner of a vessel selected for observer coverage would be responsible only for the cost associated with providing food and accommodations for the observer. NMFS would cover the cost of providing the observer.

7 Affected Environment

7.1 Physical environment

7 .1.1 Geological features

The physical environment has been described in detail in the draft EIS for the Generic Essential Fish Habitat amendment and is incorporated here by reference (GMFMC, 2003a). The GOM is bounded by Cuba, Mexico, and the United States, and has a total area of 564,000 km^2. Continental shelves occupy about 35 percent of the total GOM area and the west Florida shelf (about 150,000 km^2) is the second largest shelf in the United States after Alaska.

The GOM basin was formed during the Jurassic Period with the initial breakup of Pangea. The basin's current position became locked in during the early Cretaceous period. The Mississippi River has had a great effect on the northern GOM since the late Cenozoic period. Approximately 450 million metric tons of sediment are annually deposited in the GOM and this river supplies more sediment than the combined deposition of all other regional rivers by an order of magnitude.

The GOM can be divided into two major sediment provinces. East of DeSoto Canyon and southward along the Florida coast, sediments are primarily carbonates. Coarse surface deposits include quartz sand, carbonate sand, and mixtures of the two. To the west of DeSoto Canyon, sediments are terrigenous. Coarse sediments make up the very shallow nearshore bottoms from the Texas/Mexican border to off central Louisiana from the shore to the central third of the shelf. Beyond 80 m, fine sediments are also strongly represented. Fine sediments are limited to the northern shelf under the influence of the Mississippi and Atchafalaya rivers.

The west Florida shelf provides a large area of hard bottom habitat. It is comprised of low relief hard bottoms that are relict reefs or erosional structures. Some high relief can be found along the shelf edge in waters 130 to 300 m deep. Hard bottom provides extensive areas where reef biota such as corals can become established. These hardbottom have become important reef fish fishing areas and some areas such as the Tortugas North and South closed areas, the Florida Middle Ground habitat area of particular concern (HAPC), the Steamboat Lumps closed area, and the Madison and Swanson closed area limit fishing activities within their boundaries.

Off the Alabama/Mississippi shelf and shelf break, irregular-shaped aggregates of calcareous organic forms called pinnacles are found. These pinnacles average about 9 m in height and are found in waters about 80 to 130 m deep. In addition to the pinnacles, low-relief hardbottom areas can be found in waters less than 40 m adjacent to Florida and Alabama.

While the Louisiana/Texas shelf is dominated by muddy or sandy terrigenous sediments, banks and reefs do occur on the shelf. Rezak et al. (1985) grouped banks into the mid-shelf banks, (defined as those that rise from depths of 80 m of less and have a relief of 4 to 50 m) that are made of relatively bare, bedded Tertiary limestones, sandstones, claystones, and siltstones, and relict reefs (defined as those that rise from water depths of 14 to 40 m and have a relief of 1 to 22 m) that are relict carbonate shelf. The Flower Garden Banks National Marine Sanctuary is located about 150 km directly south of the Texas/Louisiana border. This coral reef is perched atop two salt domes rising above the sea floor and ranges from 15 to 40 m deep.

7 .1.2 Oceanographic features

As stated in the Council's Generic EFH Amendment, the GOM is a semi-enclosed, oceanic basin connected to the Atlantic Ocean by the Straits of Florida and to the Caribbean Sea by the Yucatan Channel. The Mississippi and Atchafalaya rivers account for over half of the freshwater discharge into the Gulf. Oceanic conditions are primarily affected by the Loop Current, the discharge of freshwater in to Northern Gulf, and a semi-permanent, anticyclonic gyre in the western Gulf.

Oceanic temperature regimes have been extensively mapped by Darnell et al. (1983), Darnell and Kleypas (1987), NOAA (1985), MMS (1997), and Donaldson et al. (1997). Water temperatures range from 12° C to 29° C depending on time of year and depth of water. In general, water temperatures decline during cooler months and increase in the summer. The greatest difference is found in nearshore waters where temperatures can be 10 - 15° C warmer in the summer compared to the winter. Along the shelf edge, this difference is only about 1 - 4° C. In the summertime, coastal surface and bottom waters are warmer than offshore waters; however, this trend reverses itself in the winter.

Salinity varies seasonally and is dependent on the amount of freshwater input. During months of low freshwater input, coastal water salinities generally range between 29 and 32 ppt (MMS, 1997). At times of high freshwater input, salinities can decrease to less than 20 ppt. In the open Gulf, salinities are less variable than coastal waters and are generally around 36 ppt (MMS, 1997). The Mississippi and Atchafalaya rivers provide about half the freshwater input into the Gulf; however, the influence of these waters on salinity is generally restricted to surface waters.

Over the entire Gulf, dissolved oxygen averages about 6.5 ppm (Barnard and Froelich, 1981). During warmer months, localized hypoxic events (<2.0 ppm) occur in such places as Mobile Bay, AL and Tampa Bay, FL. Hypoxic events are usually caused by two factors - stratification of marine waters and decomposition of organic matter. A major hypoxic event occurs annually over a large area of the Louisiana continental shelf with seasonally-depleted oxygen levels (< 2 ppm). The oxygen depletion begins in late spring, reaches a maximum in midsummer, and disappears in the fall. The cause of the event is due to nutrient over-enrichment from anthropogenic sources. The excess nutrients lead to increased algal production and increased availability of organic carbon within an ecosystem. When the rate of oxygen use by decomposers exceeds the rate of oxygen resupply from surface waters, hypoxia occurs.

Riverine inputs, wind, and currents are the primary agents that cause turbidity in Gulf waters. Turbidity levels in the western and northern Gulf are higher than the eastern Gulf because of more sources of freshwater input. Surface turbidity is limited to areas of riverine inputs with the Mississippi and Atchafalaya rivers the primary inputs for the Gulf. During the low water periods, the amount of sediment in suspension averages 0.260 g/l. The amount of sediment increases to 0.640 g/l during high water periods. These turbid waters are delivered to offshore locations by tidal currents and winds. Another type of turbidity that is found near the bottom is called the nepheloid layer. This is a body of moving, suspended sediment that is formed when the turbulence of bottom waters is high enough to offset the settling (gravity driven) of the sedimentary particles.

Currents vary with locality and may in some areas exceed 2 m/s. Circulation patterns in the Gulf are dominated by the Loop Current that enters the Gulf through the Yucatan Straits and exits through the Straits of Florida after looping anticyclonically through the southeastern

Gulf. During most years, the Loop Current penetrates northward into the eastern Gulf. Associated with this penetration are the shedding of large anticyclonic eddies that propagate to the west after separation. Following an eddy shedding event, the LC often retreats to the south, hugging the northwest coast of Cuba. The boundary of the Loop Current and its associated eddies is a dynamic zone which meanders, strong convergences and divergences, that can concentrate planktonic organisms including fish eggs and larvae.

7 .2 Biological environment

7.2.1 Red snapper

7.2.1.1 Red snapper life history

Red snapper (*Lutjanus campechanus*) are found from North Carolina to the Florida Keys, and into the GOM to the Yucatan off Mexico (Robins et al., 1986). Adults are found in submarine gullies and depressions; over coral reefs, rock outcrops, and gravel bottoms; and are associated with oil rigs and other artificial structures (GMFMC, 2003a). Eggs and larvae are pelagic while juveniles are found associated with bottom features or over barren bottom. Spawning occurs over firm sand bottom with little relief away from reefs during the summer and fall. Adult females mature as early as 2 years and most are mature by 4 years (Schirripa and Legault, 1999). Red snapper have been aged up to 53 years, but most caught by the directed fishery are 2- to 4-years old (Wilson and Nieland, 2001). Table 7.2.1 summarizes the red snapper life history.

Table 7.2.1. Summary Table of Red Snapper, (Lutjanus campechanus) life history for the Gulf of Mexico. Associations and interactions with environmental and habitat variables are listed with citations.

						Trophic relationships	
Life Stage	Season	Location	Temp(°C)	Salinity(ppt)	Depth(m)	Food	Predators
Eggs	Eggs are found after spawning in summer and fall in the Gulf of Mexico	Found offshore away from reefs			Eggs produced after spawning at depths of 18-37 m		
Citation	Bradley and Bryan (1975); Futch and Bruger (1976)	Bradley and Bryan (1975)			Beaumariage and Bullock (1976)		
Larvae	Collected July through November off Texas	Continental shelf waters	Taken at temperatures ranging from 17.3-29.7° C	Taken at salinities ranging from 32.8 to 37.5ppt	Taken at depths ranging from 17 to 183 m	Feed on alga and rotifers in captivity	
Citation	Collins et al. (1980)	Collins et al. (1980)	Collins et al. (1980)	Collins et al. (1980)	Collins et al. (1980)	Rabalais et al. (1980)	
Post Larvae	Collected July through November off Texas	Continental shelf waters	taken at temperatures ranging from 17.3 to 29.7° C	Taken at salinities ranging from 32.8 to 37.5ppt	Taken at depths ranging from 17 to 183 m		
Citation	Collins et al. (1980)	Collins et al. (1980)	Collins et al. (1980)	Collins et al. (1980)	Collins et al. (1980)		
Early Juveniles	Collected July through November off Texas	Continental shelf waters	Taken at temperatures ranging from 17.3 to 29.7° C	Taken at salinities ranging from 32.8 to 37.5ppt	Taken at depths ranging from 17 to 183 m	Small zooplanktons were the common prey of juveniles up to 150 mm FL	
Citation	Collins et al. (1980)	Collins et al. (1980)	Collins et al. (1980)	Collins et al. (1980)	Collins et al. (1980)	Bradley and Bryan (1975)	

Red Snapper, (Lutjanus campechanus) cont

	Habitat Associations and Interactions			
Life Stage	Habitat Selection	Growth	Mortality	Production
Eggs	Spawned over firm sand bottom with little relief			
Citation	Beaumariage and Bullock (1976)			
Larvae				
Citation				
Post Larvae				
Citation				
Early Juveniles	Most observed associated with structures, objects or small burrows, but some observed over barren bottom		Shrimp trawl bycatch is a significant source of mortality	
Citation	Workman and Foster (1995)		Bradley and Bryan (1975); Gutherz and Pellgrin (1988)	

Red Snapper, (Lutjanus campechanus) cont.							
						Trophic relationships	
Life Stage	Season	Location	Temp(°C)	Salinity(ppt)	Depth(m)	Food	Predators
Late Juveniles	Taken year round	Found on shrimp grounds off Texas in shallower water than adults			Found at 20-46 m depth	These fish are carnivorous, with most stomachs containing shrimp	
Citation	NOAA (1985)	Bradley and Bryan (1975)			Moseley (1966)	Camber (1955)	
Adults	Taken year round	Larger concentration off Yucatan and Texas and Louisiana coast. Concentrated in relatively confined areas of hard limestone bottoms and irregular bottom formations	Taken from areas with bottom temps. ranging from 14 to 30° C	Taken at salinities ranging from 33 to 37ppt	Caught at depths from 7-146 m, and abundant at depths from 40-110 m	Carnivorous eating a large variety of prey including fish, shrimp, squid, octopus, crabs, etc	sharks are known to prey on red snapper
Citation	NOAA (1985)	Camber (1955)	Moseley (1966)	Moseley (1966)	Moseley (1966); Carpenter (1965); Rivas (1970)	Bradley and Bryan (1975); Camber (1955)	Bradley and Bryan (1975)
Spawning Adults	Spawning occurs in summer and fall in the Gulf	Spawn offshore, away from reefs			Spawning reported at depths of 18-37 m		
Citation	Bradley and Bryan (1975); Futch and Bruger (1976)	Bradley and Bryan (1975)			Beaumariage and Bullock (1976)		

Red Snapper, (Lutjanus campechanus) cont.				
	Habitat Assocations and Interactions			
Life Stage	Habitat Selection	Growth	Mortality	Production
Late Juveniles	Most observed associated with structures, objects or small burrows, but some observed over barren bottom		Shrimp trawl bycatch is a significant source of mortality	
Citation	Workman and Foster(1995)		Bradley and Bryan (1975); Gutherz and Pellgrin (1988)	
Adults	Common in submarine gullies and depressions, and over coral reefs, rock outcrops and gravel bottoms	Red snapper grow to 53 yrs of age and to a size of least 1,025 mm TL	Fishing mortality rates are greatly in excess of those consistent with a healthy spawning stock	Commercial harvest has declined from around 7 mil lbs. in the 1960s and 1970s to 2 to 3 million lbs. in the early 1990's.
Citation	Klima (1976); Stearns (1885)	Nelson and Manooch (1982) Wilson and Nieland (2001)	Goodyear (1992)	Goodyear (1992)
Spawning Adults	Spawning in reported over firm sand bottom with little relief			
Citation	Beaumariage and Bullock (1976)			

7.2.1.2 Status of red snapper stocks

The management of red snapper has been surrounded by much controversy over the last decade, in particular because a large number of juvenile fish are caught as bycatch in shrimp trawls. Since the late 1980s, the stock has been considered to be in a severely depleted condition in need of rebuilding. This is one of the few species for which transitional SPR has been used as a measure of stock status, relative to target and limit (threshold) measures of static percent SPR (e.g. Goodyear, 1995, Schirripa, 1998a; 1999).

In recent years, fishers have reported seeing and catching many more and larger fish, and the species appears to be returning to the waters of the eastern Gulf. Yet, the estimate of transitional SPR has remained well below the overfishing limit (threshold) (Schirripa, 1999). With several years of strong recruitment, one would expect the catches to improve. However, since newly recruited year classes take some time to contribute significantly to the reproductive potential of the stock, it also takes time before these year classes generate a corresponding increase in transitional SPR. This is particularly true when the spawning stock is composed of a large number of year classes.

Since 1990, the Council has set targets for recovery of Gulf red snapper based on SPR measures and specified rebuilding times. Monitoring over the period 1993 to 1995 indicated improvements in the stock status, which appeared to indicate that management actions were having a positive effect on the stock. However, simulations conducted by NOAA Fisheries scientists in 1997 indicated that at the constant TAC of 9.12 mp, the goal of 20 percent SPR would not be reached by 2019, even with a reduction of bycatch mortality rate in shrimp fishery by 44 percent. The NOAA Fisheries assessment concluded that to reach the goal, either the TAC had to be lowered to 6 mp or bycatch needed to be reduced by 55 percent. Scientists also noted that future levels of SPR were much more sensitive to differences in bycatch mortality than differences in levels of TAC. Unfortunately, the former is much more difficult to achieve. NOAA Fisheries agreed in early 1998 to adopt the Council's recommendations regarding the use of bycatch reduction devices (BRDs) and agreed to retain the 9.12 mp TAC. However, this was subject to scientific verification of a BRD efficiency rate of at least 60 percent.

In 1999, a new red snapper stock assessment was prepared by the NOAA Fisheries SEFSC (Schirripa and Legault, 1999). In view of new requirements of the Magnuson-Stevens Act, associated Technical Guidelines, and the concern stated in the 1997 Peer Review that uncertainty in the stock assessment had not been fully characterized, a new modeling methodology was used for the Red Snapper Stock Assessment. This methodology, called ASAP, provides greater flexibility in population model structure and provides internally consistent estimates of management parameters of interest (e.g., the instantaneous fishing mortality rate and stock biomass level capable of producing MSY [F_{MSY} and B_{MSY}]). ASAP includes a statistical fitting procedure that provides an improved basis for characterizing uncertainty in the evaluation of a stock's status.

Results of the ASAP model showed that the condition of the stock was, in general, the same as was reported in the 1995 assessment (Goodyear, 1995). The 1995 assessment was the basis for the initial setting of the current 9.12 mp TAC. Fishing mortality has increased in the recreational sector over time, has remained flat in the commercial handline (west) and shrimp bycatch sectors, and has decreased in the commercial handline (east) and commercial longlines.
A 40-percent reduction in juvenile red snapper bycatch mortality in the Gulf shrimp fishery has been achieved, as substantiated by data that NOAA Fisheries submitted to the Council (Nichols, 1990; Nichols & Pellegrin, 1992), and that the RFSAP reviewed. Furthermore, NOAA

Fisheries biologist Dr. Scott Nichols, at the September 20-24, 1999 RFSAP meeting, and at the October 27, 1999 meeting of the Council's Scientific and Statistical Committee, stated that, excluding the now illegal configuration of a fisheye BRD covered by the trawl net's elephant ear, fisheye BRDs are currently attaining a 40-percent reduction in fishing mortality of juvenile red snappers and a 50-percent reduction appears feasible. Additionally, NOAA Fisheries biologist Mr. John Watson, in statements to the Council at its November 8-12, 1999 and November 13-16, 2000 meetings, indicated that a 50-percent bycatch reduction could be achieved from fisheye BRDs. NOAA Fisheries believes that further reductions are possible with improved BRD technology. Tests conducted by NOAA Fisheries have already demonstrated that prototype BRDs can reduce bycatch mortality of red snapper in shrimp trawls by as much as 70 percent. Further reductions of bycatch mortality may be achieved by a reduction in shrimping effort in response to economic factors with this fishery. Waters et al. (2003) suggest a 30 to 50 percent reduction may be needed for the fishery to optimize its economic state.

At this time, there is considerable uncertainty about the estimates of B_{MSY} for red snapper, and therefore, it is difficult to predict to what level B_{MSY} needs to be rebuilt to (see Section 4). This is because the stock has never been assessed at any level approaching B_{MSY} (i.e., $B_{CURR} << B_{MSY}$). However, this parameter is critical in determining the rebuilding strategy as well as understanding a stock's productivity. The uncertainty shows in the range of B_{MSY} values (two to four billion pounds) recommended by the RFSAP and the RFSAP's recognition that density dependent factors such as space, cannibalism, and predation may heavily influence the stock-recruitment relationship. It will not be until the stock size has been able to increase that these factors can be better understood. Additionally, the RFSAP (1999, 2000) indicated that the effects of bycatch and bycatch reduction on the stock assessment are not well understood. Other assumptions challenged in the assessment model include juvenile mortality rates (Gazey and Gallaway, 2000) and historical changes in habitat (Shipp, 2001).

Even with the uncertainty about B_{MSY} and current stock status, projections show that the stock has been rebuilding since 1996 under the current TAC of 9.12 mp. Based on the 1999 stock assessment of red snapper (Schirripa and Legault, 1999), recruitment levels appear to be improving. The 1995 - 1997 estimates of recruitment from the Fall Groundfish Trawl Survey were higher than most years after 1982, and trawl data from the SEAMAP summer survey indicated that mean catch per tow during the late 1990s were generally higher than those reported from the 1980s and early 1990s. This rebuilding should be accelerated from reductions in bycatch fishing mortality rates from BRDs (40 percent as indicated by Nichols (undated)). As F from the shrimp fishery decreases, stock sizes should increase substantially as indicated in stock projections.

Catch data from both the commercial and recreational fisheries also indicate that the stock size is increasing. While it is difficult to estimate catch-per-unit-effort (CPUE) from the commercial logbook data set due to differences in licence classes (Class 1 and 2), the proportion of trips where red snapper are encountered has increased (Schirripa and Legault, 1999). Further, Schirripa and Legault (1999) reported that the efficiency by which red snapper are caught has increased because the hours fished to obtain a trip limit have decreased. In the recreational fishery, evidence that the stock size is increasing include the proportion of released fish has remained constant since 1990 even though minimum sizes have increased and CPUE have been increasing since 1990 (Schirripa and Legault, 1999). Anecdotal information and landings data for the charter and party boat sectors (Table 29; Schirripa and Legault, 1999) indicate an increasing abundance off Florida in the most recent years used in the assessment.

7.2.2 Other reef fish resources

The Reef Fish Fishery Management Plan applies to 40 species. Of these, six have had stock assessments performed by NOAA Fisheries (red grouper, red snapper, vermilion snapper, gag, greater amberjack, and gray triggerfish). A review of the stock assessment results for each of these species is presented below. (A stock assessment for yellowedge grouper and a new stock assessment for red grouper were recently completed by NOAA Fisheries and are currently undergoing review by the Reef Fish Stock Assessment Panel. Those assessments are not included in this discussion.)

Of the six reef fish species for which stock assessments have been completed and reviewed, four are classified by NOAA Fisheries as overfished (red grouper, red snapper, greater amberjack, and vermilion snapper). Gag were recently reclassified from not overfished but approaching an overfished condition to neither overfished not undergoing overfishing. Gray triggerfish are classified as unknown for both overfished and overfishing status. Goliath grouper and Nassau grouper are also classified as overfished but not undergoing overfishing (harvest of both species is prohibited). Neither species has had stock assessments performed. The remaining reef fish species are classified as unknown status for both overfishing and overfished.

Most of the stock assessments previously used SPRs to determine overfishing and if stock is in an overfished condition. However, MRAG Americas (in press) demonstrates that while SPR effectively indexes overfishing (F is too high), it does not index the overfished condition (biomass too low). SPR does not track recruitment trends, so biomass can increase or decrease independently of SPR. Thus, the practice of using SPR as a proxy for MSY is not appropriate. The extent of stock depletion and appropriate harvest levels should be indexed by absolute or relative estimates of biomass. The Council recognized this problem and through its Generic SFA amendment modified the framework procedure for specifying TAC for all the finfish stocks to provide for adopting biomass-based overfished thresholds as NOAA Fisheries and the stock assessment panels develop these parameters.

7.2.2.1 Vermilion snapper

Vermilion snapper are caught throughout the GOM, and most landings occur in Florida (Schirripa, 1998b). Fishermen who catch vermilion snapper also catch a variety of other species. Florida leads in landings for both commercial and recreational fisheries, while Louisiana has the second most commercial landings, and Alabama has the second most recreational landings. Handline fishermen dominate commercial landings, and a small fraction of the fleet (2-3 percent) catches most of the harvest (50 percent). About 10 headboats account for 50 percent of harvest from that mode. Vermilion snapper landings increased regularly from 1981 to 1993, and declined through 1995. Schirripa (1998b) concluded that vermilion snapper were not over harvested, but recruitment and catch trends point to possible declining future abundance. SPR from 1986-1995 ranged from 0.26-0.28.

Schirripa and Legault (2000) updated the previous stock assessment with data through 1998, with some catch data from 1999. The commercial fishery accounts for 70-80 percent of fish landed weight. Commercial landings increased from around 1 mp in the early 1980s to a peak near 2.7 mp in 1993. Catch declined for three years, and remained in the 2.3-2.6 mp range from 1996-1998,comparable to landings in the early 1980s. Longline fisheries took a small fraction, mostly in the 1980s. Recreational harvest jumped from 0.1-0.6 million fish in the early 1980s to 1.0-1.5 million fish from 1986 to 1995. Harvest for 1996-1998 decreased to 0.4-0.6 million fish, slightly above harvest of the early 1980s. The headboat fishery accounts for 1/3 - ½ of the recreational catch, and charter boats account for most of the rest. The recreational fisheries discard about 15-25 percent of its catch. Schirripa and Legault (2000) suggested that vermilion snapper is a bycatch of the red snapper fishery, and Schirripa (1998b) noted that vermilion snapper catch varied inversely with red snapper catch. Declining catch may, therefore, be associated with increasing abundance of red snapper. While CPUE of the commercial vessels has varied with out trend since 1990, the recreational headboat CPUE has declined more than 50 percent since 1993.

Schirripa and Legault (2000) assessed stock condition using two VPA models that added abundance indices to the model used in 1998. Both models used a recruitment index from the NOAA Fisheries Fall Groundfish Survey. One model incorporated CPUE from both the handline and the headboat fisheries, while the other did not use the handline CPUE. The handline-headboat CPUE represents data from virtually the entire fishery, while the headboat-only CPUE incorporates data from about 10 percent of the landings. The handline-headboat model indicated a high probability of overfishing and the overfished condition, while the headboat-only model indicated a low probability of overfishing and the overfished condition.

The most recent assessment of the vermilion snapper fishery was undertaken in 2001 using data through 1999, with some commercial catch data for 2000 (Porch and Cass-Calay, 2001). Two models were used: VPA and a non-equilibrium production model. The majority of the six VPA runs and the production model runs that used the full time series of data indicate that the stock is overfished and is undergoing overfishing based on the default thresholds. These results were considered to be consistent with the results of Schirripa and Legault (2000). Two of the VPA runs and one of the production model runs (one that did not use the last three years of data) indicated that the stock is not overfished and that no reduction in the current rate of fishing is required. Of the model runs that indicated the stock was overfished, the VPAs indicated the need for a reduction in the rate of fishing by one to two thirds. The production models indicated that the fishing mortality needs to be reduced to about half its current level. One of the main problems cited in the assessment was conflicting trends in time series of catch per unit effort. The commercial CPUE series suggests there has been little change in the relative abundance of vermilion snapper, but the eastern headboat index suggests that they have declined dramatically.

In summary, the authors of the most recent assessment conclude that, based on the default thresholds, the vermilion snapper stock may now be overfished and that overfishing will continue at the current rates of fishing. Some reduction is therefore necessary. The authors prefer the production model approach to assessing this species because it avoids the need to use uncertain catch at age (arising from highly variable lengths at any given age).

7.2.2.2 Red grouper

Red grouper are caught mostly in the GOM from Panama City, Florida to the Florida Keys, and primarily south of Tampa. Red grouper catch statistics were no longer lumped with other grouper species in 1986 (Goodyear and Schirripa, 1993). Cuban fishermen caught a significant amount of red grouper from US waters prior to extended jurisdiction in 1976. Handline/power reel fishermen caught most of the red grouper until the early 1980s when longlines increased operations and dominated the catch. Florida implemented an 18-inch minimum size limit in 1985 for state waters and the Council implemented a 20-inch minimum size limit in 1990 for the EEZ, which Florida matched in state waters. Goodyear and Schirripa (1993) concluded that red grouper were not overfished through the early 1990s. They estimated SPR at around 30 percent.

Schirripa et al. (1999) updated the previous assessment with data through 1997. By applying the ratio of red grouper to all grouper from 1986-1997 to the total US grouper catch and incorporating the Cuban red grouper catch, Schirripa et al. (1999) estimated the historical catch. Total catch, including Cuban, US commercial and recreational, peaked during the late 1940s to 1950s at 14 to 18 mp. A substantial decrease in Cuban catch led to a total catch around the 8-10 mp range from the 1960 until the exclusion of the Cuban fleet in 1977. Subsequently, the US catch fluctuated from 6-11 mp. Since 1986, the commercial handline catch of red grouper declined by about half, while the longline catch showed no trend. Trap fisheries represented a minor component. The recreational fishery peaked in the mid- to late-1980s at about 0.6-1.0 million fish retained per year. Catch decreased to 0.2 million fish in 1990 following the minimum size limit, increased somewhat in 1992-1993, and declined to 0.2-0.1 in 1996-1997. Since 1983, recreational fishermen released most red grouper, up to 80-90 percent in the 1990s.

Commercial CPUE values, estimated from logbook data, for the longline, handline, and trap fisheries remained fairly constant from 1990 when logbook coverage began (Schirripa et al., 1999). Recreational CPUE (retained plus discarded) showed different patterns from the Harvest Per Unit Effort (HPUE) (retained only). HPUE for private/charter boats and for headboats declined from the mid- to late-1980s to reach minimum historical values in 1996 and 1997. Private/charter HPUE decreased following the minimum size limit of 1985 (no data available for headboats) and decreased minimally in 1990. Headboats HPUE decreased about 50 percent in 1990. Private/charter CPUE increased in 1990 indicating increased catch of discarded fish. Later declines in CPUE paralleled HPUE. Schirripa et al. (1999) suggested that the CPUE could index undersized red grouper, and the recent decline could portend declining recruitment. However, the parallel CPUE-HPUE pattern could also suggest a declining legal component, but not necessarily declining sublegal component.

Use of a stock production model (ASPIC) and a virtual population analysis (ASAP) both demonstrated an overfished condition and overfishing occurring, based on the default thresholds (Schirripa et al., 1999). Using ASPIC, the estimated biomass relative to biomass at MSY (B_{MSY}) declined rapidly from the 1940s to 1960, then declined gradually to current levels less than half B_{MSY}. Over the same time period, estimated fishing mortality increased to over twice the fishing mortality at MSY (F_{MSY}). $B/ B_{MSY} < 0.8$ and $F/F_{MSY} > 1.0$ indicate an overfished condition and overfishing occurring for red grouper. Estimates from a series of ASAP models with different assumptions showed B_{MSY} ranging from 0.19 to 0.60 and F/F_{MSY} ranging from 1.4 to 3.2.

The Reef Fish Stock Assessment Panel (RFSAP, 1999), reviewing Schirripa et al. (1999), chose the ASAP model with the full time series as most representative of the stock status, but noted that the similarities of the ASAP and ASPIC model results increase confidence in the ASAP model. The RFSAP (1999) recommended a recovery time of F = 0 plus one generation (2018 target date). Subsequently, the RFSAP (2000a) reevaluated the red grouper stock assessment, especially suitability of the Cuban data, and requested additional runs of the ASAP model to explore other assumptions. The Panel selected the data since 1986 (no Cuban data) as most representative and that overfishing and the overfished condition were not as great as with the longer data set. Since the results now indicated that the stock could be recovered to B_{MSY} in less than 10 years in the absence of fishing mortality, the Panel recommended a maximum 10-year rebuilding period.

In 2002, a new red grouper stock assessment was prepared by NOAA Fisheries and reviewed by the RFSAP. The new assessment updated the landings data to 2001, and developed a new relative fecundity-at-age relationship that assigned slightly higher fecundities to the younger age groups. The 2002 assessment also incorporated the effect of a strong 1996 year-class which began entering the fishery in 1999, too late to have been included in the previous assessment.

The RFSAP settled on a recommendation that the steepness value of the spawner-recruit relationship in the ASAP model be set at 0.7 rather than the range of 0.7 to 0.8 used in the previous recommendations. The new assessment confirmed the previous assessment's finding that the red grouper stock was below the overfished threshold of 80 percent*B_{MSY} in 1997, but the stock was found to be less severely overfished due to the effect of incorporating the new fecundity-at-age relationship. At a steepness of 0.7, the previous assessment had found the red grouper spawning stock biomass to be at 56 percent of B_{MSY} in 1997. The revised estimate from the 2002 assessment was that the stock was at 62 percent of B_{MSY} in 1997, and at 84 percent of B_{MSY} in 2001. Although the most recent status estimate now put the stock above the overfished threshold, the confirmation that it was below the threshold in 1997 left intact the overfished designation and the requirement to rebuild the stock to B_{MSY} in no more than 10 years.

Status criteria and a 10-year rebuilding plan are currently being reviewed as part of Secretarial Amendment 1 to the Reef Fish FMP.

7.2.2.3 Gag

Gag are primarily caught off the west coast of Florida from northern Pinellas County to the northern extent of the state (Schirripa and Goodyear, 1994). Misidentification of gag and black grouper caused problems in all data sets except for scientific research data. Schirripa and Goodyear (1994) used species composition obtained by trained staff in MRFSS and headboat observations from 1990-1992 to correct recreational and commercial catch and landing data. They did not use information from commercial logbooks because some fishermen non-quantifiably changed reporting from black grouper to gag and because of large discrepancies between MRFSS-headboat and commercial logbook data. After re-apportioning gag-black grouper catches based on scientific data collections and observed recreational catch, Schirripa and Goodyear (1994) concluded that gag were not overfished, although the male to female ratio had decreased from the late 1970s to the early 1990s. They estimated SPR at approximately 30 percent.

Schirripa and Legault (1997) most recently updated the previous assessment with data through 1996, used preliminary estimates of discard mortality rates of sublegal-sized gag, and evaluated the implications of protogynous hermaphroditism in the stock assessment. For 1986-1996, years with gag harvest separated from other groupers, the commercial catch remained fairly constant in the range of 1.5 mp. The commercial harvest does not show an effect of a 20-inch minimum size limit set in 1990. Applying the average ratio of gag to other groupers (1986-1996) to catches from 1965 suggested lower commercial gag harvest of around 1.0 mp through the 1980s. The recreational fishery showed the effects of a minimum size limit with lower catch since 1990. The recreational fishery showed an order of magnitude increase in discarded gag since 1990.

CPUE for commercial (handline, bottom longline, and trap) and recreational (headboat and private) fisheries, though variable, also remained fairly stable during the 1986-1996 period Schirripa and Legault (1997). Recreational fisheries harvest smaller fish than do the commercial fisheries. The average size of gag in the commercial and recreational fisheries showed no trend during the 1986-1996 period, although the average size increased following implementation of a minimum size in 1990. Harvest, CPUE, and mean size indices suggest that the fishery for gag has not changed much since 1986.

Fishing mortality estimated with catch curve analysis and with several VPA models indicated recent $F > F_{0.1}$ or F_{max}, generally by a factor of 2 or more. F values estimated with VPA that incorporated variable recruitment were higher than estimates with constant recruitment, but the estimates from variable-recruitment were judged unreasonable. About 25 percent of the estimated F came from estimated mortality of discarded gag.

SPR values ranged widely depending on estimation of F in the VPA models and on assumptions about fecundity. The fecundity function had the most effect on SPR. The RFSAP (1998) judged that the transitional SPR from the most reasonable assumptions were slightly above the Council's current threshold of 20 percent. Schirripa and Legault (1997) noted that protogynous hermaphrodites such as gag do not fit the assumptions for SPR, and that SPR may not apply well to gag. They recommended maintaining SPR well above the 20 percent threshold as a cautionary measure. However, the shift from female to male is equivalent of a higher natural mortality for females, which would underestimate actual SPR, and provide more conservative management (MRAG Americas in press). Even so, SPR does not adequately reflect the condition of stock biomass.

Schirripa and Legault (1997) and the RFSAP (1998) expressed concern that spawning aggregations of gag may be more vulnerable to harvest than suggested by the standard models and reference points. This concern is reflected in the spawning ground closures implemented by the Council in a 1999 regulatory amendment.

In the 2000 gag assessment (Turner et al., 2000), the method for determining age from length was reevaluated. The 1997 assessment (Schirripa and Legault, 1997) had used the recruitment-and-mortality modulated catch-at-age (RMM) procedure to estimate ages from length information, due to the sparse nature of available length-at-age data at that time (RFSAP, 1998). For 2000, new length-at-age information was available (Fitzhugh et al., 2001), and a method for aging that combines a semi-annual age-length key with a stochastic growth estimation procedure for periods when the aged fish were not available, called the ALK (age-length key) method (Cummings and Parrack in prep.) was deemed more suitable by the RFSAP (2000b). This method used semiannual age-length keys applied to 1992-1994, the latter 6-months of 1995 and 1996, and 1998-1999. Gag catch at length densities for which age length keys did not exist were aged using the stochastic ageing approach.

The RFSAP (2001) reconsidered the previous use of a fishing mortality rate of $F_{30\%\ SPR}$ as a proxy for F_{MSY}. This usually works well with fish that do not change sex, since egg production remains fairly proportional to biomass throughout a fish's life. However, gag is a protogynous hermaphrodite, and the relationship between egg production and biomass does not hold. The $F_{30\%\ SPR}$ proxy is based on the potential number of eggs produced by each age class, which decreases rapidly after a peak at age 8 because older fish turn into males. The F_{max} proxy, on the other hand, is based on the average weight of each age class, which increases a great deal after age 8. Thus, it seems clear that, for gag, an F_{max} policy is more compatible with the concept of MSY than is an $F_{30\%\ SPR}$ policy. The RFSAP (2000a) recommended that efforts be undertaken to maintain a harvest strategy that maintains F at F_{MAX}, or moves toward F_{OY}. This strategy allows higher yields than fishing at $F_{30\%\ SPR}$, allows male biomass to be about 10 percent of its unfished biomass, and reduces harvest costs to the fishery.

Using the default thresholds of F_{MAX} for overfishing and 85 percent (1-M) of B_{MSY} for overfished status, the VPA was bootstrapped 500 times for use in estimating uncertainty about the current status and benchmark statistics. The results indicated that there was an 85 percent probability the stock biomas was above the MSY level, and only a 41 percent probability that overfishing was occurring. Although the model recommended a maximum ABC of 6.23 mp gutted weight, this high end of the ABC range reflected assumptions about the future status of the stock that are not inherent in the current status and have not yet been demonstrated to be true. Therefore, the RFSAP (2000) recommended a precautionary approach of not allowing landings to exceed the recent levels of about 5 mp.

7.2.2.4 Yellowedge grouper

Yellowedge groupers are caught primarily off the west coast of Florida in deep waters. Recreational landing comprise only a small proportion of the yellowedge harvest (<2 percent) This fishery is mainly conducted with longline and handline gear. Western Florida Landings account for about 2 thirds of the landings, followed by Louisiana and Texas. Alabama and Mississippi landings are negligible. During 1986-1994, longline yields averaged 297 MT per year, and since 1994, yields have been around 340 MT per year. For handlines, the total yield of yellowedge has decreased five-fold since 1986. Handline landings off western Florida decreased from an average 137.5 MT from 1984-1988, to 37 MT from 1989-1994, to 12 MT since 1994.

In 2002, the yellowedge grouper stock was assessed using a state-space, age structured production model by Cass-Calay and Bahnick (2002). The assessment used age and growth data from 535 otoliths collected between 1979-2001. Ages ranged from 0 to 85 years. CPUE data obtained from the Reef fish Logbook Program, MRFSS, and fishery-independent longline surveys were relatively flat and variable, and so provided no clear information on the stock. In addition, the size distribution appeared stable and the yields from the fishery were without trends. Therefore, the RFSAP (2002) concluded that the status of the yellowedge grouper stock remains essentially undetermined. The RFSAP (2002) did caution though because of the longevity of yellowedge grouper, they may be particularly susceptible to even relatively low fishing mortality rates. Based on the lack of trends in the landings data and longevity of this species, the RFSAP recommended that the commercial yield should not greatly exceed the historical average of 381 MT. They further recommended that the proportion of yellowedge grouper in the deepwater grouper complex be closely monitored for landings greater than the historical average which comprises 73 percent of the deep-water grouper landings.

7.2.2.5 Greater amberjack

Amberjacks in the GOM are caught primarily along the west coast of Florida westward to about the Mississippi River. Amendment 1 of the Reef Fish Fishery Management Plan concluded that amberjacks were overfished, and that the fishery harvests had increased in the recent years prior to the Amendment. The RFSAP concluded in 1993 that available data were too poor in quality and quantity to use for stock assessment, but that data existed to monitor the trends in the fishery. McClelland and Cummings (1996) cited severe under-sampling of the amberjack fisheries for length and weight data. They updated landing, catch per effort, and biological data, and presented results of a VPA analysis for greater amberjack. Declining biological sampling after 1993 diminished reliability of results after 1994. McClellan and Cummings (1996) concluded that fishing mortality for adult fish (ages 4-7+) during 1987-1995 ranged from 0.10-0.45, with values below 0.15 in 1994 and 1995; that fishing mortality on young fish (ages 1-3) decreased in 1990 after a minimum size limit went into effect. Abundance estimates were variable, with increases in 1993-1995. They found an SPR of 0.43 in 1994.

Turner et al. (2000) reassessed the greater amberjack stock using data through 1998. They used a calibrated VPA and data on catch-at-age, selectivity, and indices of abundance from private and charter boats, headboats, and handline fisheries. Turner et al. (2000) made runs with a variety of assumptions and a combination of the abundance indices that showed variability in the results. The RFSAP selected four of the runs as most likely to represent stock conditions, all of which showed an overfished condition for greater amberjack in 1998. Two of the runs indicated that overfishing also occurred, including the run considered most likely by the RFSAP. The Panel also concluded that management actions (closed seasons, bag limits, and size limits) taken in 1998 might reduce fishing mortality sufficiently to eliminate overfishing. NOAA Fisheries notified the Council in January of 2001 that the stock was overfished. Status criteria and a 10-year rebuilding plan have been implemented as part of Secretarial Amendment 2 to the Reef Fish FMP.

7.2.2.6 Gray triggerfish

The gray triggerfish is widely distributed in tropical and temperate waters throughout the Atlantic; in the Western Atlantic it ranges from Nova Scotia through Bermuda and the GOM to Argentina (Harper and McClellan, 1997). This species is an important component of the GOM reef fishery, particularly for the recreational fishing sector (Goodyear and Thompson, 1993). Prior to the 1980s, gray triggerfish were not considered a desirable catch by most fishers, but there has been an increase in targeting of this and other “under-utilized” species, probably caused by the decline in other reef fish stocks (e.g., red snapper and groupers).

There was an initial increase in average annual landings from 1.46 mp in 1986 to 2.88 mp in 1990. This was followed by a steady decline to 0.85 mp in 1998. The cause of this decline has not been determined, but it could be attributed to a consistent increase in fishing effort and a possible consequent decrease in stock size. In response to this problem, the first assessment for the gray triggerfish was published in March 2001 (Valle et al., 2001).

Standardized indices of abundance were estimated from five recreational and commercial fisheries data sets: the MRFSS, the SEFSC-NOAA Fisheries Headboat Survey, the Alabama Charter boat Survey, the Panama City Charter boat Survey, and the commercial Florida Logbook System Program. A sixth data set from the Texas Park and Wildlife Department (TPWD) Recreational Creel Survey was examined but the indices developed were not considered for subsequent analyses. The standardized indices were estimated using Generalized Linear Mixed Models under a delta lognormal model approach.

Catch-effort statistics from the recreational and commercial sectors for years 1986 to 1998 were used for stock assessment. The standardized catch rates were used to tune a non-equilibrium production model (ASPIC).

Problems were encountered in the assessment. The model frequently failed to converge on a satisfactory solution, due to the limited time series of catch and effort data. Nevertheless, the authors considered there was reasonable evidence that the current rate of removal is not sustainable: a steady decline in landings since the peak in 1990 to a level (in 1998) that is below the MSY range. Estimated biomass levels are low and exploitation rates are high. The assessment concludes that the evidence suggests the stock is overfished, that overfishing is still occurring, and catches should be at least held constant, or preferably reduced to allow stock rebuilding (Valle et al., 2001).

7.2.2.7 Yellowtail Snapper

Yellowtail snapper occurs from North Carolina to southern Brazil and is abundant in south Florida. Adults typically inhabit sandy areas near offshore reefs at depths of 10–70 m (32–230 feet). Yellowtail snapper eat fish, shrimp, and crabs near the bottom but also feed in the water column. Spawning occurs in south Florida during the spring and summer with a peak during May-July. Females reach the 50% maturity at 209 mm TL (about eight inches) at an average

age of 1.7 years. Yellowtail snapper grow quickly initially but size is a poor indicator of age because of high variability in length at age.

The status of yellowtail snapper was assessed through NOAA Fisheries SEDAR process with the Florida Fish and Wildlife Conservation Commission (FWC) taking the lead. The SEDAR process consists of three workshops. The Data Workshop was held in March 2003, followed by a Stock Assessment Workshop that was held in June 2003. The assessment was then reviewed at the Peer-Review Workshop held in July 2003. The following discussion of the stock assessment is based on Muller et al. (2003).

Two types of models were used to assess the condition of yellowtail snapper: surplus production and age-structured, statistical models. The two surplus production models, ASPIC (a non-equilibrium model) and ASP (an age-structured model) were not stable. This instability was most likely due to lack of contrast in the tuning indices or catch rates. The Stock Assessment Panel noted that the generally flat or monotonic CPUE indices could create parameter estimation convergence issues with surplus production models. Both the Stock Assessment and Peer-Review Panels agreed with the Data Workshop recommendation that age-structured assessment approaches were appropriate for yellowtail snapper. Year-specific aging information was available for 1994-2001 and age-structured approaches could make use of all available data increasing our confidence in the predictions of the current status of the stock.

Two age-structured, statistical models were also used to assess the stock. Both indicated that the stock was not undergoing overfishing nor was it overfished. The first model was the Integrated Catch-at-Age which used the combined catch-at-age data from the three fisheries (recreational, headboat, and commercial) and tuning indices to estimate the population sizes by age in the most recent year, fishing mortality rates on the earliest fully recruited age of fish, selectivity patterns by age, and catchability coefficients for the tuning indices (76 parameters in this configuration). In the base case run, the full fishing mortality rate in 2001 was 0.21 per year and the spawning biomass in 2001 was 4,943 mt. The numbers of age-1 fish and the spawning biomass a year earlier were used to estimate the biomass based management benchmarks given a steepness of 0.8 and alternatives of 0.7 and 0.9. The steepness is merely the proportion of the recruitment at a spawning biomass of 20% of the virgin biomass to the recruitment at the virgin biomass. With the Stock Assessment Panel recommendation of using a steepness value of 0.8, MSY was estimated to be 941 mt and the F_{2001}/F_{MSY} ratio was 0.62 and the SSB_{2001}/SSB_{MSY} ratio was 1.35 indicating that the stock was not undergoing overfishing and was not overfished. The ratios were 0.57 and 1.43, respectively when the analyses were rerun using indices calculated without the interaction terms.

The second age-structured model allowed estimating separate fishing mortality rates for the three fisheries simultaneously. This fishery-specific model estimated the population sizes in the first year (1981), recruitment from a stock-recruit relationship, selectivities by fishery and two periods corresponding to before and after the 12 inch (305 mm) size limit was implemented in 1983, and catchability coefficients for the tuning indices. This model estimated the sum of the fishing mortality rates on fully recruited fish in 2001 at 0.24 per year and a spawning biomass of 5,200 mt which is similar to the 0.21 per year and 4,900 mt estimated by ICA. The fishery specific model estimated a higher MSY of 1,366 mt but only a slightly higher F_{MSY} (0.36 per year as compared to 0.33 per year from ICA). The biomass based benchmarks were F_{2001}/F_{MSY} = 0.65 and SSB_{2001}/SSB_{MSY} = 1.06. Using the revised indices, the fishing mortality rates on fully recruited fish in 2001 remained 0.24 per year and the estimated spawning biomass increased slightly to 5,300 mt. The revised biomass based benchmarks were F_{2001}/F_{MSY} = 0.72 and SSB_{2001}/SSB_{MSY} = 0.99. This supported the same conclusion as the ICA model that the stock was neither undergoing overfishing nor overfished. The retrospective analyses using terminal years of 1998, 1999, 2000, as well as 2001 did not indicate that the models consistently over- or underestimated either the fishing mortality rates in the last year or the spawning biomass.

7.2.3 Habitat use by managed reef fish species

The amended MSFCMA of 1996 included new EFH requirements, and as such, each existing, and any new, FMPs must describe and identify EFH for the fishery, minimize to the extent practicable adverse effects on that EFH caused by fishing, and identify other actions to encourage the conservation and enhancement of that EFH. In 1999, a coalition of several environmental groups brought suit challenging the agency's approval of the EFH FMP amendments prepared by the Gulf of Mexico, Caribbean, New England, North Pacific, and Pacific Fishery Management Councils (American Oceans Campaign et al. v. Daley et al., Civil Action No. 99-982(GK)(D.D.C. September 14, 2000). The court found that the agency's decisions on the EFH amendments were in accordance with the MSFCMA, but held that the EA on the amendments were in violation of the National Environmental Policy Act (NEPA) and ordered NOAA Fisheries to complete new, more thorough NEPA analyses for each EFH amendment in question. Consequently, NOAA Fisheries entered into a Joint Stipulation with the plaintiff environmental organizations that called for each affected Council to complete EISs rather than EAs for the action of minimizing adverse effects of fishing to the extent practicable on EFH. See AOC v. Evans/Daley et al., Civil No. 99-982 (GK)(D.D.C. December 5, 2001). However, because the court did not limit its criticism of the EAs to only efforts to minimize adverse fishing effects on EFH, it was decided that the scope of these EISs should address all required EFH components as described in section 303 (a)(7) of the MSFCMA.

To address these requirements the Council has, under separate action, drafted an EIS to analyze within each fishery a range of potential alternatives to: (1) describe and identify EFH for the fishery; (2) identify other actions to encourage the conservation and enhancement of such EFH; and (3) identify measures to minimize to the extent practicable the adverse effects of fishing on such EFH (GMFMC, 2003a). Depending on the preferred alternatives identified in this EIS the Council FMPs may require amendments to comply with the guidelines articulated in the EFH Final Rule to implement the EFH provisions of the M-S Act (See 50 CFR Part 600, Subpart J). NOAA Fisheries published the Draft EIS on August 29, 2003 and a Record of Decision is expected by the end of July 2004.

As documented in the Council’s DEIS for the Generic EFH Amendment (GMFMC, 2003a), many aspects of the biological environment are unknown or unavailable. Lack of data limits ability of management agencies to specifically develop management programs for managed species or the essential habitat needed by those species. The number of managed species and the complex components of the environment exceed the capability of state and federal management and scientific organizations to provide information. In general, data collections and analyses have been limited to selected species or components of the environment. Several federal agencies and all state fishery/natural resource agencies have programs underway to expand necessary information.

- NOAA Fisheries has the lead responsibility for fishery management and protection in the federal waters of the GOM (beyond 9-miles off Texas and the west coast of Florida, and 3-miles off the other states).
- The US Army Corp of Engineers requires permits for many activities in state and federal navigable waters, and has biological assessment capabilities.
- The Mineral Management Service has a responsibility to assess biological effects of federally authorized mineral extraction (especially oil and gas in the GOM).

- The US Geological Service has biological research division that emphasizes shallow-water processes and is also engaged in mapping the benthic habitat of the Gulf.
- The US Fish and Wildlife Service has responsibility for marine birds, anadromous fish and some marine mammals (e.g., manatees).

7.2.3.1 Red snapper

Red snapper are managed under the Reef Fish FMP. In the Council's Draft Environmental Impact Statement for the Generic Essential Fish Habitat Amendment, the EFH alternative for the Reef Fish FMP (GMFMC, 2003a) consists of GOM waters and substrates extending from the US/Mexico border to the boundary between the areas covered by the GOM Fishery Management Council and the South Atlantic Fishery Management Council from estuarine waters out to depths of 100 fathoms (Figure 7.2.1).

Red snapper occur throughout the GOM shelf. They are particularly abundant on the Campeche Banks and in the northern Gulf. The relatively high abundance once known on the shelf areas of west Florida was significantly reduced in the 1980s and 1990s (e.g. GMFMC, 1981a), but recent evidence points to increasing abundance in this area (Mike Murphy[14], personal communication). The species is demersal and is found over sandy and rocky bottoms, around reefs, and underwater objects from shallow water to 200 m, and possibly even beyond 1200 m. Adults favor deeper water in the northern Gulf. Spawning occurs in offshore waters from May to October at depths of 18 to 37 m over fine sand bottom away from reefs. Eggs are found offshore in summer and fall. Larvae, postlarvae and early juveniles are found July through November in shelf waters ranging in depth of 17 to 183 m. Early and late juveniles are often associated with structures, objects or small burrows, but also are abundant over barren sand and mud bottom. Late juveniles are taken year round at depths of 20 to 46 m. Adults are concentrated off Yucatán, Texas, and Louisiana at depths of 7 to 146 m and are most abundant at depths of 40 to 110 m. They commonly occur in submarine gullies and depressions, and over coral reefs, rock outcroppings, gravel bottoms, and under oil and gas rigs.

7.2.3.2 Other species

7.2.3.2.1 Balistidae-Triggerfishes

FMP species list: Gray triggerfish *Balistes capriscus*

Information is sparse, particularly for the early life stages (i.e., eggs, larvae and postlarvae). Eggs occur in late spring and summer in nests prepared in sand near natural and artificial reefs. Eggs are guarded by the female and/or male. Larvae and postlarvae are pelagic, occurring in the upper water column, usually associated with Sargassum and other flotsam. Early and late juveniles also are associated with Sargassum and other flotsam and may be found in mangrove estuaries. Triggerfish leave the surface sargassum habitat in the fall when juvenile fish (5 to 7 inches) move to reef habitat on the bottom. Adults are found offshore in waters greater than 10 m where they are associated with natural and artificial reefs. However, triggerfish may move away from the reef structure in order to feed. They have been observed working soft bottoms by aiming a jet of water at the sand with enough force to reveal sand dollars and sea urchins hidden just under the surface. Spawning adults occur in late spring and summer, also around natural and artificial reefs in water depth greater than 10 m.

[14] Michael Murphy, Florida Marine Research Institute, St. Petersburg, FL

7.2.3.2.2 Carangidae-Jacks

FMP species list	Greater amberjack	*Seriola dumerili*
	Lesser amberjack	*Seriola fasciata*
	Almaco jack	*Seriola rivoliana*
	Banded rudderfish	*Seriola zonata*

General habitat use:

Most carangids are believed to spawn offshore. Juveniles associate with floating objects such as clumps of sargassum, bits of wood and debris, and jellyfish. As the fish grow they drift inshore and assume an inshore schooling existence. However, some of the larger amberjacks follow a solitary existence.

Species-specific habitat use:

<u>Greater Amberjack</u>

The greater amberjack occurs throughout the Gulf coast to depths of 400 m. Information is sparse on habitat associations for all life stages of amberjack. Adults are pelagic and epibenthic, occurring over reefs and wrecks and around buoys. Very little information exists on spawning adults, but in the northern Gulf spawning occurs from May to July and may be as early as April based on histology. Spawning occurs offshore year- round. Juveniles also are pelagic and often attracted to floating plants and debris in the nursery areas that also are offshore (NOAA, 1985).

<u>Lesser Amberjack</u>

Information is sparse, particularly for the early life stages (i.e., eggs, larvae and postlarvae). Juveniles occur offshore in the late summer and fall in the northern Gulf. Small juveniles are associated with floating Sargassum. Adults are found offshore year round in the northern Gulf where they are associated with oil and gas rigs and irregular bottom. Spawning occurs offshore September-December and February-March, probably in association with oil and gas structures and irregular bottom.

<u>Almaco jack</u>

Very little information is available on the habitat associations of the almaco jack. Juveniles use Sargassum as a refuge in open waters and off barrier islands. Adults are found far offshore, often associated with rigs in the northern GOM. Spawning is thought to occur from spring through fall.

<u>Banded rudderfish</u>

Adult Banded rudderfish are pelagic or epibenthic and confined to coastal waters over the continental shelf where they feed on fish and shrimps. They are not common in the central part of the northern GOM. They spawn in offshore waters of the eastern GOM, the Yucatan Channel and Straits of Florida. Juveniles occur in offshore waters and associate with jellyfish and drifting weeds, such as Sargassum and Physalia.

7.2.3.2.3 Labridae-Wrasses

FMP species list Hogfish *Lachnolaimus maximus*

General habitat use

Hogfish are large wrasses that inhabit areas of moderate-high relief in shelf waters. They range from North Carolina south, through the Caribbean Sea and GOM to the northern coast of South America. Juveniles can be found in shallow seagrass beds in Florida Bay where they feed on benthic crustaceans, mollusks, and echinoderms. Adults are widely distributed on coral reefs and rocky flats, where they consume bivalves, gastropods, sea urchin, crabs, and other mollusks (Sierra et al, 1994; Randall, 1967). Adult hogfish feed mostly by winnowing hard shelled animals from the bottom substrate and crushing their prey with their pharyngeal jaws (Clifton and Motta, 1998).

7.2.3.2.4 Lutjanidae-Snappers

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

General habitat use:

Snappers are common in all warm marine waters of the world. Most are inshore dwellers, although some occur in open-water. Some species enter estuaries and mangroves, with the latter functioning as nursery grounds.

Species-specific habitat use:

<u>Queen snapper</u>

Very little information is available on the habitat associations of the queen snapper. Queen snapper are a deep-water species with adults distributed in the southern portion of the GOM where they commonly associate with rocky bottoms and ledges between 135 and 450 meters, feeding on small fish, squid and crustaceans.

<u>Mutton snapper</u>

Mutton snapper spawn on steep drop offs near reef areas, and larvae and post larvae are found in shallow continental shelf waters. Juveniles and adults inhabit shallow seagrass beds in tidal creeks and bights surrounded by mangroves, and in shallow protected bays. Adults are also found on patch reefs and deep barrier reefs and are most abundant off south Florida and in the Caribbean.

Schoolmaster

Juvenile schoolmaster occupy shallow and offshore habitats, moving to deeper offshore waters with growth. As juveniles they are associated with shallow seagrass beds and mangrove habitats, and congregate around jetties. Late juveniles are found over grass flats Inshore and offshore rocky and coral reefs and may enter estuaries and mangrove habitats. Adult schoolmaster occur throughout coastal waters, from shallow water to about 90 m. They are found over various substrates including rock, vegetated sand, inshore and offshore reefs, esp. elkhorn coral, and mud. Late juveniles may enter mangrove swamps and tidal creeks due to their capability to tolerate low salinities.

Blackfin snapper

This species of snapper occupies shelf edge habitats, where it feeds on fish and crustaceans. It is most commonly found at depths of 40 to 300 meters. Juveniles occur in shallower hard bottom areas at 12-40 meters.

Cubera snapper

This species occurs infrequently in the GOM. It is the largest of the snapper species occurring in the Western Atlantic. Adult cubera snapper are found on both shallow and deep reefs and wrecks (to at least 85 meters deep) and in mangroves. Unusual among snappers, they have a high range of salinity tolerance and can enter water that is nearly fresh (e.g. the intra-coastal waterway on the east coast of Costa-Rica. Adults feed on fishes, shrimps, and crabs, and notably spiny lobster. Juveniles are found in streams, canals, seagrass beds, mangrove areas, and lagoons. Spawning aggregations have been observed in June and July. Two spawning sites have been recorded in the eastern Gulf: both wrecks located in 67-85 m of water, off Key West and the Dry Tortugas. Similar aggregations have been recorded in Belize, Buttonwood Cay and Cay Bokel.

Gray Snapper

Gray snapper occur on the shelf waters of the Gulf and are particularly abundant off south and southwest Florida. Gray snapper occur in almost all of the Gulf's estuaries but are most common in Florida. Considered to be one of the more abundant snappers inshore, the gray snapper inhabits waters to depths of about 180 m. Adults are demersal and mid-water dwellers, occurring in marine, estuarine, and riverine habitats. They occur up to 32 km offshore and inshore as far as coastal plain freshwater creeks and rivers. They are found among mangroves, sandy grassbeds, and coral reefs and over sandy, muddy and rocky bottoms. Spawning occurs offshore around reefs and shoals from June to August. Eggs are pelagic and are present June through September after the summer spawn, occurring in offshore shelf waters and near coral reefs. Larvae are planktonic, occurring in peak abundance June through August in offshore shelf waters and near coral reefs from Florida through Texas. Postlarvae move into estuarine habitat and are found especially over dense grass beds of Halodule and Syringodium. Juveniles also are marine, estuarine, and riverine dwellers, often found in estuaries, channels, bayous, ponds, grassbeds, marshes, mangrove swamps, and freshwater creeks. They appear to prefer Thalassia grass flats, marl bottoms, seagrass meadows, and mangrove roots. They are also associated with oil and gas rigs (see 7.2.6.2). More detailed information on habitat associations of gray snapper is provided in Nelson (1992) and Pattillo et al. (1997).

Dog snapper

Adult dog snapper are found throughout coastal waters from shallow waters down to over 150 m depth. They occupy a diverse variety of habitats ranging from shallow vegetated areas to deep reefs. They are most commonly found on coral reefs and display territoriality, tending to occupy a home range. The diet comprises mainly fish, but can also include crustaceans and other invertebrates. Early juveniles are found on shallow water seagrass beds of coastal waters and estuaries, and may enter rivers. Late juveniles also occur around mangrove roots and jetties and pilings. Dog snapper tend to move to deeper water as they grow larger.

Mahogany snapper

Adult mahogany snappers occur throughout the Gulf, especially around islands and in reef areas. They occupy a shallower range than other snappers, being found from shallow waters down to 30 meters. Specific habitat associations include rocky bottoms and reefs, where, like other snappers they feed on fish, crustaceans and invertebrates. They are less frequently found on sandy and vegetated bottoms.

Lane Snapper

Lane snapper occur throughout the shelf area of the Gulf in depths ranging from zero to 130 m. The species is demersal, occurring over all bottom types, but is most common in coral reef areas and sandy bottoms. Spawning occurs in offshore waters from March through September (peak July-August). Information on habitat preferences of larvae and postlarvae is non-existent and is in need of research. Nursery areas include the mangrove and grassy estuarine areas in the southern Texas and Florida and shallow areas with sandy and muddy bottoms off all Gulf states. Early and late juveniles appear to favor grass flats, reefs, and soft bottom areas to offshore depths of 20 m (NOAA, 1985). Adults occur offshore at depths of 4 to 132 m on sand bottom, natural channels, banks, and man-made reefs and structures.

Silk snapper

Silk snapper is a deeper water species found near the edge of continental and island shelves, usually ascending to shallower waters at night. It is common between 90 and 140m, but is also found in deeper waters over 200m. Its diet consists of fish and crustaceans such as shrimps and crabs. Juveniles are found in shallower water than adults.

Yellowtail Snapper

Yellowtail snapper are distributed throughout the shelf area of the GOM, but are most common off central and southern Florida. This species occurs over hard irregular bottoms, such as coral reefs and near the edge of shelves and banks. Spawning occurs February through October (peaks in February - April and September - October) in offshore areas. Information on eggs, larvae, and postlarvae is sparse and represents an area of needed research. Juveniles are found in nearshore nursery areas over vegetated sandy substrate and in muddy shallow bays (NOAA, 1985). Thalassia beds and mangrove roots are apparent Proposed habitat for early juveniles. Late juveniles apparently select shallow reef areas as primary habitat. Adults are found from shallow waters to depths of 183 m but generally are taken in less than 50 m depths. Adults are considered to be semi-pelagic wanderers over reef habitat.

Wenchman

Wenchman occupy hard bottom habitats of the mid to outer shelf where they feed mainly on small fish. They are found at depths ranging from 19 to 378m, but are most abundant between 80 and 200m.

Vermilion Snapper

Vermilion snapper are found throughout the shelf areas of the GOM. The species is demersal, occurring over reefs and rocky bottom from depths of 20 to 200 m. Spawning occurs from April to September in offshore waters. Juveniles occupy reefs, underwater structures and hard bottom habitats in 20 to 200 m depths (NOAA, 1985).

7.2.3.2.5 Malacanthidae-Tilefishes

Species list	Goldface tilefish	*Caulolatilus chrysops*
	Blackline tilefish	*Caulolatilus cyanops*
	Anchor tilefish	*Caulolatilus intermedius*
	Blueline tilefish	*Caulolatilus microps*
	(Golden) Tilefish	*Lopholatilus chamaeleonticeps*

Species-specific habitat use:

Goldface tilefish, Blackline tilefish, Anchor tilefish and Blueline tilefish

Blueline tilefish are distributed mainly on the eastern / southeastern GOM and the Campeche-Yucatán outer continental shelf, shelf edge and upper slope. Anchor tilefish are most common in the northern and western Gulf. Blueline tilefish are found over irregular bottom, including troughs and terraces, sand, mud and rubble, and shell hash. They may be associated with goldface tilefish and blackline tilefish and occur in the same habitat/ fish assemblage as snowy, warsaw and yellowedge groupers, silk and vermilion snappers and *Pagrus pagrus* the common seabream. They construct burrows in soft sediments and may also utilize existing holes and crevices. Blueline tilefish are epibenthic browsers; feeding primarily on benthic invertebrates, and also some demersal fishes. Larger adults and feed increasingly on fish.

Tilefish

Tilefish (also known as golden tilefish) occur throughout the deeper waters of the GOM. The species is demersal, occurring at depths from 80 to 450 m, but is most commonly found between depths of 250 to 350 m. Preferred habitat is rough bottom and steep slopes. Spawning occurs in the months of March to November throughout the species range. Eggs and larvae are pelagic; early juveniles are pelagic-to-benthic. Nursery areas are throughout the species range (NOAA, 1985). Late juveniles burrow and occupy shafts in the substrate. Adults also dig and occupy burrows along the outer continental shelf and on flanks of submarine canyons.

7.2.3.2.6 Serranidae-Groupers

Species list	Dwarf sand perch	*Diplectrum bivittatum*
	Sand perch	*Diplectrum formosum*
	Rock hind	*Epinephelus adscensionis*
	Speckled hind	*Epinephelus drummondhayi*

Yellowedge grouper	*Epinephelus flavolimbatus*
Red hind	*Epinephelus guttatus*
Goliath grouper (jewfish)	*Epinephelus itajara*
Red grouper	*Epinephelus morio*
Misty grouper	*Epinephelus mystacinus*
Warsaw grouper	*Epinephelus nigritus*
Snowy grouper	*Epinephelus niveatus*
Nassau grouper	*Epinephelus striatus*
Black grouper	*Mycteroperca bonaci*
Yellowmouth grouper	*Mycteroperca interstitialis*
Gag	*Mycteroperca microlepis*
Scamp	*Mycteroperca phenax*
Yellowfin grouper	*Mycteroperca venenosa*

General habitat use:

The serranids form a large and important element of the tropical marine fish faunas around the world. Of the species included in the Reef Fish FMP, most are carnivorous bottom dwellers, associated (as adults) with hard-bottomed substrates, and rocky reefs, with the exception of the sand perches, which are found on soft bottoms and grassy areas.

Species-specific habitat use:

<u>Dwarf sand perch</u>

Adult dwarf sand perch are found on soft bottoms (Cervigón et al, 1992).

<u>Sand perch</u>

Adult sand perch inhabit bays, coastal grassy areas and shallow banks in the northern GOM, particularly off the coast of Florida. They are solitary and retreat into shelter when frightened.

<u>Rock hind</u>

The rock hind occupies shallow hard bottom habitats, including rocky reefs; rock piles, oil well rigs, high profile-steep crevices and ledges. Adults occur from 2 to 100 m, but larger adults are more common in deeper waters (50-100 m). The species is usually captured in waters more than 30 m deep off the west Florida shelf. They feed on crustaceans, (especially crabs) and fishes. Rock hind grow faster and are shorter-lived than most other groupers.

<u>Speckled hind</u>

The speckled hind is a deep water grouper distributed in the North and eastern GOM on offshore hard bottom habitats, including rocky bottoms and both high and low profile hard bottoms. Adults are considered to be an apex predator on midshelf reefs, feeding on a variety of fishes, invertebrates and cephalopods. They occur between 25 to 183 meters and are most common at 60-120 meters depth. Juveniles are most commonly found in the shallow portion of the depth range.

Yellowedge grouper

Yellowedge grouper is another deep water species found throughout the Gulf continental shelf, with areas of high abundance off of Texas and west Florida. On the outer continental shelf the species occupies high relief hard bottoms, rocky out-croppings and is often found co-occur with snowy grouper and tilefish. Both adults and juveniles are also known to inhabit burrows. Major components of the diet comprise brachyuran crabs, fishes and other invertebrates. The species depth range is from 35 to 370 m with adults most common in waters greater than 180 meters deep.

Red hind

Within the GOM, the red hind is most abundant in southeastern reef areas. It occupies reefs, stony coral, and actively seeks holes and crevices. It may also be found on sandy bottoms with isolated coral patches and low-relief habitats. The species depth range is 18 to 110 m, with inshore populations being mostly female. Juveniles occupy patch reefs, coral and limestone rock, and move deeper as they increase in size. The diet comprises crustaceans (especially brachyuran crabs), fishes and other invertebrates. Spawning occurs in late spring and summer on the Florida Middle Grounds, where fish aggregate on the seaward side of submerged ridges. Individuals of this species are known to return to same spawning site.

Goliath grouper (jewfish)

Goliath grouper are a protected species found in the shallow waters of the GOM and are most abundant on the southwest Florida and Campeche Banks. Younger adults are found inshore around docks, bridges and jetties, reef crevices, while large adults prefer offshore ledges and wrecks. The species depth range in the Gulf is ranged down to 95m, with the highest abundance at 2-55m. Early juveniles are found in bays and estuaries, inshore grassbeds, canals, and mangroves. Larger juveniles are also found around ledges, reefs, and holes in shallow waters. Adults feed mainly on crustaceans, (especially lobsters), fish, and mollusks (cephalopods). The diet of juveniles is mainly blue crabs and other crustaceans. Spawning occurs from June to December with peaks between July and September. Spawning occurs off southeast and southwest Florida, and other parts of the Gulf around offshore structures, wrecks and patch reefs. Spawning aggregations can contain 10-150 individuals when formed and have been reported from depths of 36-46m.

Red Grouper

The red grouper is demersal and occurs throughout the GOM at depths from 3 to about 200 m, preferring 30 to 120 m depths. It is particularly abundant off west Florida and the Yucatan coasts. Spawning occurs at depths of approximately 25 to 90 m on the Florida Banks with peaks during April and May. Eggs are pelagic and require at least 32 ppt salinity for buoyancy. Larvae leave the planktonic stage to become benthic at about 20 mm standard length. Late juveniles select inshore hardbottom to depths of about 50 m, seeking shelter in crevices and other hiding places. Favored nursery areas for juveniles are grass beds, rock formations, and shallow reefs. Juveniles remain in the nursery areas until mature before moving to deeper Gulf waters (NOAA, 1985). Adults select rocky outcrops, wrecks, reefs, ledges, crevices and caverns of rock bottom, as well as “live bottom” areas, in depths of 3 to 190 m. Spawners occur in offshore coastal waters in depths of 20 to 100 m.

Misty grouper

Misty Grouper is a deep-water grouper found offshore throughout the Gulf on hard-bottom slope and shelf substrates, including high-relief rocky ledges and pinnacles. Adults occur mainly between 100 and 400 m, with juveniles distributed in shallower water. Adults feed on crustaceans (especially crabs), fishes and cephalopods. Spawning occurs April through July in the Gulf.

Warsaw grouper

Habitat associations of the warsaw grouper are similar to those of the misty grouper. Both are deep-water species distributed throughout the GOM, in association with hard bottoms. Warsaw grouper occur from 40 to 525 m, more commonly down to 250 m, and prefer rough, rocky bottoms with high profiles such as steep cliffs and rocky ledges. Adults feed on crabs, shrimp, lobsters, and fish. Early juveniles occur in shallow nearshore habitats and may enter bays, moving into deeper water as they grow.

Snowy grouper

In the GOM, snowy grouper are found in largest numbers in deep waters off of South Florida and the northwestern coast of Cuba. They occur on rocky bottoms, well offshore, such as around boulders and ridges, and relief up to 10 m interspersed with sand shell and rock fragments. They are common on Florida Oculina reefs and are often found with other deep-water species such as yellowedge grouper and tilefishes. Adults feed on fish, crabs and other crustaceans, cephalopods and gastropods. As with other groupers, the young occur in shallower habitats, such as nearshore reefs, and move into deeper water with growth.

Nassau grouper

According to Sadovy & Eklund (1999) Nassau grouper are found in the Florida Keys, but are absent from the GOM being replaced by red grouper. Nassau grouper is a protected species that occupies reefs and crevice caves down to about 100m depth. Older fish tend to occur deeper. The diet is not particularly specialized, comprising crustaceans and fish. Spawning aggregations are formed in areas of soft corals, sponges, stony corals, and sand from December to February coordinated with the times of the full moon. Early juveniles associate with inshore seagrass beds, macroalgal mats, tilefish mounds and small coral clumps. Later juveniles become piscivorus at 20-25cm TL and move to offshore reefs at 30-35cm TL.

Black Grouper

The black grouper is found along the eastern GOM and Yucatan Peninsula, but is considered rare in the western half of the Gulf. The species is demersal and is found from shore to depths of 150 m. Adults occur over wrecks and rocky coral reefs, irregular bottoms, ledges and high-to-moderate relief habitat. Spawning occurs from late winter through to spring and summer throughout all adult areas. Ripe females were found in May on Campeche Banks, and late winter- spring in eastern Gulf with peak activity in January to March. Spawning aggregations have been observed in the Florida Keys at 18 to 28 m depth. Juveniles occupy shallow water reefs and rocky bottoms and patch reefs. They may also be found over muddy bottoms of mangrove lagoons and may venture into estuaries occasionally (NOAA, 1985). They move to deeper water with growth.

Yellowmouth grouper

In the GOM, yellowmouth grouper occur off of Campeche Banks, the west coast of Florida, Texas Flower Garden Banks, and northwest coast of Cuba. They occupy rocky bottoms and coral reefs and feed on Primarily fishes, and also crustaceans and other invertebrates. Spawning occurs primarily in spring and summer, with peak in April and May off of west coast of Florida. Juveniles commonly occur in mangrove-lined lagoons and move into deeper water as they grow.

Gag

Gag are demersal and most common in the eastern Gulf, especially the west Florida shelf. Adults occupy hard bottom substrates, including offshore reefs and wrecks, coral and live bottoms, and depressions and ledges. Spawning adults form aggregations in depths of 50 to 120 m. Spawning occurs December - April with a peak in the early spring (March - April) on the west Florida shelf, a major spawning area. Eggs are pelagic, occurring in December - April, with areas of greatest abundance offshore on the west Florida shelf. Larvae are pelagic and are most abundant in the early spring. Postlarvae and pelagic juveniles move through inlets into coastal lagoons and high salinity estuaries in April - May where they become benthic and settle into grass flats and oyster beds. Late juveniles move offshore in the fall to shallow reef habitat in depths of one to 50 m. Adults are found in deeper waters (10 to 100 m) on hardbottoms, offshore reefs and wrecks, coral, and live bottom.

Scamp

Scamp are demersal and widely distributed throughout shelf areas of the Gulf, especially off Florida. As with many of the reef species, detailed information on habitat relationships is sparse. Adults occupy ledges and high relief hard bottoms in depths of 12-189 m, but most are captured at 40-80 m depths. They prefer complex structures such as Oculina coral reefs. They are primarily piscivorus, but also feed on crustaceans and cephalopods. Spawning adults have been taken at depths of 60-100 m. Spawning occurs from late February to early June in aggregations. Scamp prefer to spawn at the shelf edge and have been observed in apparent spawning locations used by gag grouper. Oculina formations are a key spawning habitat. Eggs and larvae are pelagic, occurring offshore in the spring. Early and late juveniles occur on inshore hard bottoms and reefs in depths of 12-33 m.

Yellowfin grouper

The yellowfin grouper is not common in the GOM, occurring primarily in the southern Gulf and West Indies. Its habitat comprises rocky bottoms and coral reefs from the shoreline to mid-shelf depths. These groupers prefer reef ridge and high-relief spur and groove reefs. Adults feed primarily on fish, but also on squid and shrimp. This species is able to capture swift-moving fish. Juveniles occupy shallow seagrass beds and move to deeper rocky bottoms with growth. Spawning takes place from March to August in the eastern Gulf. Juveniles occupy shallow seagrass beds and move to deeper rocky bottoms as they increase in size.

7.2.3.3 Reef fish habitat

The National Ocean Service (NOS) of NOAA collaborated with NOAA Fisheries and the Council to develop distributions of reef fish (and other species) in the GOM (SEA, 1998). The NOS obtained fishery independent data sets for the GOM, including SEAMAP, state trawl surveys, and GUS trawl surveys. Data from the Estuarine Living Marine Resources (ELMR) Program contain information on relative abundance (highly abundant, abundant, common, rare, not found, and no data) for a series of estuaries, by five life stages (adult, spawning, egg, larva, and juvenile) and month for five seasonal salinity zones (0-0.5, 0.5-5, 5-15, 15-25, and >25). NOS staff analyzed the data to determine relative abundance of the mapped species by estuary, salinity zone, and month. For some species not in the ELMR database, distribution consisted of only observed-not observed for adult, juvenile, and spawning stages.

In general, reef fish are widely distributed in the GOM, occupying both pelagic and benthic habitats during their life cycle. A planktonic larval stage lives in the water column and feeds on zooplankton and phytoplankton. Juvenile and adult reef fish are typically demersal and usually associated with bottom topographies on the continental shelf (<100m) which have high relief, i.e., coral reefs, artificial reefs, rocky hard-bottom substrates, ledges and caves, sloping soft-bottom areas, and limestone outcroppings. However, several species are found over sand and soft-bottom substrates. For example, juvenile red snapper are common on mud bottoms in the northern Gulf, particularly off Texas through Alabama. Also, some juvenile snapper (e.g. mutton, gray, red, dog, lane, and yellowtail snappers) and grouper (e.g. jewfish, red, gag, and yellowfin groupers) have been documented in inshore seagrass beds, mangrove estuaries, lagoons, and larger bay systems (GMFMC, 1981). More detail on hardbottom substrate and coral can be found in the Fishery Management Plan (FMP) for Corals and Coral Reefs (GMFMC and SAFMC, 1982). Figures 7.2.2 and 7.2.3 provide information on habitat use.

7.2.4 Environmental sites of special interest

7.2.4.1 GOM marine protected areas established by the Council

Tortugas Shrimp Sanctuary - A shrimp nursery ground in the Florida Keys permanently closed to use of trawls and harvest or possession of shrimp. Result in shrimp growing to about 47 count/pound before harvest (3,652 square nautical miles).

Cooperative Texas Shrimp Closure - A shrimp nursery ground off Texas cooperatively closed by the Council and state of Texas for 45 to 60 days out to either 15 or 200 miles. This closure results in shrimp growing to about 39 count/pound (5,475 square nautical miles).

Southwest Florida Seasonal Closure (Shrimp/Stone Crab) - Closure of federal and state waters to shrimping from November 1 through May 20 inshore of the line to protect juvenile stone crab and prevent loss of stone crab traps in trawls (4,051 square nautical miles).

Central Florida Shrimp/Stone Crab Separation Zones - Closure of state and federal waters to either shrimping or crabbing from October 5 to May 20. Crab or shrimp fishing alternate in zones IV and V. (174 square nautical miles).

Longline/Buoy Gear Area Closure - Permanent closure to use of these gears for reef fish harvest inshore of 20 fathoms off the Florida shelf and inshore of 50 fathoms for the remainder of the Gulf (72,300 square nautical miles).

Florida Middle Grounds HAPC - Pristine coral area protected by preventing use of any fishing gear interfacing with bottom (348 square nautical miles).

Madison/Swanson and Steamboat Lumps Marine Reserves - No-take marine reserves sited on gag spawning aggregation areas where all fishing is prohibited (219 square nautical miles).

Stressed Area - Permanent closure Gulf-wide of the nearshore waters to use of fish traps, power heads, and roller trawls (i.e., “rock hopper trawls”) (48,400 square nautical miles).

Flower Garden Banks HAPC - Pristine coral area protected by preventing use of gear interfacing with the bottom. Subsequently made a marine sanctuary by NOS (41 square nautical miles).

Tortugas North and South Marine Reserves - No-take marine reserves cooperatively implemented by the state of Florida, NOS, the Council, and National Park Service (see jurisdiction on chart) (185 square nautical miles).

7.2.4.2 Existing GOM fishery management plan area closures

Closure Area	Area (square nautical miles)
Gulf Wide Closures	
Stressed Area Closure*	48400
Longline/Buoy Gear Area Closure	
Eastern Gulf	24400
Central/Western Gulf*	47900
Total	72300
Florida Closures	
Tortugas Shrimp Sanctuary*	3652
Southwest Florida Seasonal Closure (Shrimp/Stone Crab)**	
State Waters (1 October - 31 May)	2562
Federal Waters (1 January - 20 May)	1489
Total	4051
Central Florida Shrimp/Stone Crab Separation Zones	174
Florida Middle Grounds HAPC*	348
Tortugas South Marine Reserve	60
Madison/Swanson Marine Reserve	115
Steamboat Lumps Marine Reserve	104
Florida Total	8594
Texas Closures	
Cooperative Shrimp Closure (15 May - 15 July)	
Initial 15 nautical miles offshore*	5475
200 miles**	NA
Flower Garden Banks HAPC*	41
Texas Total	5516
Overall Total	**134720**

* EFH Closures
** Gear Closures

7.2.4.3 Reef fish habitat sites off of the Gulf Coast of Florida

The following are descriptions of habitat sites identified by Dr. Chris Koenig and Chris Gledhill. Most of these sites are far offshore. Site locations are identified both by latitude/longitude boundaries and by USGS lease blocks. Discussion text is that of Chris Gledhill and Chris Koenig. Kathy Scanlon, U.S. Geological Survey, calculated the size of each area in square nautical miles.

1. 29 Edge/27 Edge, North and West rim of the DeSoto Canyon (several sites within the same area - total area = 367 sq. naut. mi.)

Area A (62 sq. naut. mi), USGS lease blocks 853-857, 897-901; boundaries:
N= 30 º09'N, S= 30º 04'N, E=86º 43'W, W=86º 58'W.
Area B (75 sq. naut. mi), USGS lease blocks 939-942; 983-986, 15-18; boundaries: N=30º 04'N, S=29º 57'N, E=86º 53'W, W=87º 05'W.
Area C (86 sq. naut. mi), USGS lease blocks 57, 58, 101, 102, 145, 146; boundaries: N=29º 57'N, S=29º 48'N, E=87º 05,W, W=87º 16'W.
Area D (144 sq. naut. mi), USGS lease blocks 185-188, 229-232, 273-276, 317-320, 361-364; boundaries: N=29º 48'N, S=29º 33'N, E=87º 11'W, W=87º 22'W.

Discussion: This area includes a site that has been slated for oil and gas development (proposed Chevron Development unit 56). It is a high relief area, which has been significant in reef fish fishery production but due to proximity from shore has historically received high fishing pressure (Moe, 1963). The area is large, but the most significant habitat occurs between 50 and 150 meters. A ridge extends about 8 km (5 miles) thru the Chevron site in lease blocks 99, 56, and 57. We broke the area into four discrete blocks, each covered by smaller (5x5 kin) lease blocks.

The following sites (on charts) are arranged from north to south along the West Florida Shelf:

2. "Woodward-Clyde" Pinnacles (42 sq. naut. mi)

Destin Dome USGS lease blocks 473, 474, 516, 517, 518, 562.

Boundaries:	NW= 29º 33'N, 86º 11'W	NE= 29º 33'N, 86º 05' W
	SW= 29º 25'N, 86º 11'W	SE= 29º 25'N, 86º 05'W

Discussion: These are high relief (up to 11 m) pinnacles on the 90 m contour reported by Woodward-Clyde consultants.

3. "3-to-Ss" area (76 sq. naut. mi)

Destin Dome USGS lease blocks 434, 478, 522, 566, Apalachicola USGS lease blocks 397, 398, 441, 442, 485, 486, 529, 530.

Boundaries:	NW= 29º 35'N, 85º 56'W	NE= 29º 35'N, 85º 47'W
	SW= 29º 25'N, 85º 56'W	SE= 29º 25'N, 85º 47'W

Discussion: This is a rugged area along the 20-fathom contour just off Panama City. This was listed in Martin Moe's 1963 survey of offshore fishing in Florida and has similar features to the Middle Grounds. The bottom is mostly sand with irregular reef relief of 3 to 4 fathoms.

4. Area North of Johnny Walker site (denoted as Mud Banks by Moe, 1963) (28 sq. naut. mi)

Apalachicola USGS lease blocks 654, 617, 618, 619.

Boundaries:	NW= 29º 22'N, 85º 56'W	NE = 29º 22'N, 85º 45'W
	SW = 29º 19'N, 85º 45'W	SE = 29º 19'N, 85º 5'W

Discussion: This area is a 7-8 mile rock ledge with a steep seaward slope just north of the Johnny Walker, Madison and Swanson sites. The depth is about 30 fathoms.

5. Madison and Swanson sites (denoted as Whoopie Grounds by Moe, 1963) (115 sq. naut. mi).

Apalachicola USGS lease blocks 706, 707, 708, 709, 750, 751, 752, 753, 794, 795, 796, 797, 838, 839, 840, 841.

Boundaries:	NW= 29º 17'N, 85º 50'W	NE= 29º 17'N, 85º 38' W
	SW= 29º 06'N, 85º 50'W	SE= 29º 06'N, 85º 38'W

Discussion: This area is denoted in Moe's (1963) fishing survey as having rock ledges with relief up to 5 fathoms (9 m). There is also plenty of recent anecdotal fishing information from port samplers (Debbie Fable[15], personal communication). This site also shows confirmed outcrops of limestone and reef fish habitat from the reef fish survey (Chris Gledhill[16], personal communication). Also, (2) transects through this area by Ludwick and Walton (1957) showed pinnacle trends. Some of these formations have names- Madison and Swanson's Rocks.

6. Twin Ridges site (5 sq. naut. mi).

USGS lease block 979 bordering Apalachicola and Florida Middle Ground bathymetric maps.

Boundaries:	NW= 29º 00'N, 85º 24'W	NE= 29º 00'N, 85º 21'W
	SW= 28º 58'N, 85º 24'W	SE= 28º 58'N, 85º 21'W

Discussion: This is the rugged double ridgeline that was mapped with side-scan sonar during the spring 1997 cruise (NOAA Fisheries Panama City, Pascagoula/USGS Woods Hole) showing notable reef fish habitat features at 70-80 meters (233-262 feet) depths. This site covers about one lease block and is embedded in a larger area marked by Moe (1963). This area was originally picked for survey by NOAA Fisheries because it enclosed a concentrated area of gag/copperbelly catches recorded from recent at-sea reports.

7. Florida Middle Grounds. (340 sq. naut. mi).

Large area (irregular polygon) on the 20-fathom isobath that covers about 40 USGS lease blocks.

Boundaries: (A). 28º 42.S'N, 84º 24.8'W;
(B). 28º 42.S'N, 84º 16.3'W;

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[15]Debbie Fable, SEFSC, Panama City Laboratory, NOAA Fisheries, Panama City, FL

[16]Christopher Gledhill, SEFSC, Pascagoula NOAA Fisheries Laboratory, Pascagoula, MS

(C). 28º 11'N, 84º 0'W;
(D). 28º 11'N, 84º 07'W;
(E). 28º 26.6N, 84º 24.8'W.

Discussion: This area was designated in the Coral Reef Fishery Management Plan (1982) as a HAPC (habitat areas of particular concern). Its coordinates are therefore already fixed. Current restrictions apply to gear - no bottom longlines, traps, pots or bottom trawls. It is thought that many species of grouper and snapper spawn in this area.

9. 40 Fathom Contour West of the Middle Grounds (denoted as The Edges by Moe, 1963) (several sites within the same area - total area = 436 sq. naut. mi.).

Area A (61 sq. naut. mi), Florida Middle Grounds USGS lease blocks 147, 148, 149, 150,151, 191, 192, 193, 194, 195;

Boundaries: NW= 28º 51'N, 85º 12'W NE= 28º 51'N, 84º 57'W,
SE= 28º 46'N, 84º 57'W SW= 28º 46'W, 85º 12'W;

Area B (67 sq. naut. mi), Florida Middle Grounds USGS lease blocks 237, 238, 239, 240, 281, 282, 283, 284;

Boundaries: NW= 28º 46'N, 85º 06'W NE= 28º 46'N, 84º 54'W,
SE= 28º 40'N, 84º 54'W SW= 28º 40'W, 85º 06'W;

Area C (57 sq. naut. mi), Florida Middle Grounds USGS lease blocks 326, 327, 328, 329, 370, 371, 372, 373;

Boundaries: NW= 28º 40'N, 85º 03'W NE= 28º 40'N, 84º 51'W,
SE= 28º 34'N, 84º 51'W SW= 28º 34'W, 85º 03'W;

Area D (143 sq. naut. mi), Florida Middle Grounds USGS lease blocks 415, 416, 417, 418, 419, 459, 460, 461, 462, 463, 503, 504, 505, 506, 507, 547, 548, 549, 550, 551;

Boundaries: NW= 28º 34'N, 85º 01'W NE= 28º 34'N, 84º 45'W,
SE= 28º 24'N, 84º 45'W SW= 28º 24'W, 85º 01'W;

Area E (108 sq. naut. mi), Florida Middle Grounds USGS lease blocks 593, 594, 595, 596, 637, 638, 639, 640, 681, 682, 683, 684, 725, 726, 727, 728;

Boundaries: NW= 28º 24'N, 84º 54'W NE= 28º 24'N, 84º 42'W,
SE= 28º 14'N, 84º 42'W SW= 28º 14'W, 84º 54'W;

Discussion: Although this site is of low relief, we directly observed a gag and scamp spawning aggregations with an ROV on a R/V Chapman survey in 1994. NOAA Fisheries Panama City and Pascagoula conducted a Fishery Acoustic System (FAS) survey in 1996. This site is also listed in Moe's (1963) survey as an extensive linear area along the 40-fathom isobath scattered high relief rocky outcrops of limestone rock extending parallel to the coastline. At-sea fishing surveys also revealed this is currently an active region of commercial grouper fishing.

8. "Steamboat lumps". (104 sq. naut. mi.)

Florida Middle Grounds USGS lease blocks 771, 772, 816, 860, 861, 862, 906

Boundaries: NW= 28º 14'N, 84º 48'W NE= 28º 14'N, 84º 37'W
SW= 28º 03'N, 84º 48'W SE= 28º 03'N, 84º 37'W

Discussion: This area is due W. of Clearwater, Fla. and SW of the Middle Grounds at a depth of 40-50 fathoms. These are prominent features reported to be low relief areas with limestone rock.

9. "The Elbow". (107 sq. naut. mi).

Elbow USGS lease blocks 36, 37, 80, 81, 124, 125, 168, 169, 212, 213, 256, 257, 300, 301;

Boundaries: NW= 27º 57'N, 84º 11'W NE= 27º 57'N, 84º 05'W
SW= 27º 38'N, 84º 11'W SE= 27º 38'N, 84º 05'W

Discussion: This is a large ridge as wide as 3 nautical miles composed of limestone rock (Moe, 1963). It rises 4-8 fathoms above the bottom and can be seen on the bathymetric map by the 30fathom isobath due west of Tampa Bay.

10. "Christmas Ridge". (191 sq. naut. mi).

Charlotte Harbor USGS lease blocks 444, 445, 446, 488, 489, 490, 532, 533, 534, 576, 577, 578, 620, 621, 622, 664, 665, 666, 708, 709, 710, 752, 753, 754, 796, 797, 798;

Boundaries: NW= 26º 31'N, 83º 51'W NE= 26º 31'N, 83º 41'W
SW= 26º 06'N, 83º 49'W SE= 26º 06'N, 83º 42'W

Discussion: The main features of this area are rock ridges of several fathoms in relief at about 45 fathom depths. These ridges follow the depth contours.

11. "Hambone Ridge/the Finger". (153 sq. naut. mi).

Pulley Ridge USGS lease blocks 445, 446, 447, 489, 490, 491, 533, 534, 535, 577, 578, 579, 621, 622, 623, 665, 666, 667, 709, 710, 711;

Boundaries: NW= 25º 31'N, 83º 46'W NE= 25º 31'N, 83º 37'W
SW= 25º 12'N, 83º 46'W SE= 25º 12'N, 83º 37'W

Discussion: Moe (1963) describes these as well defined rock ridges rising 4-5 F above a flat sand bottom along the 40-fathom contour.

13. " Northwest Peaks". (182 sq. naut. mi).

Pulley Ridge USGS lease blocks 617, 618, 619, 620, 661, 662, 663, 664, 705, 706, 707, 708, 749, 750, 751, 752, 793, 794, 795, 796, 837, 838, 839, 840, 881, 882, 883, 884.

Boundaries: NW= 25º 20'N, 830 57'W NE= 25º 20'N, 83º 46'W
SW= 25º 02'N, 830 57'W SE= 25º 02'N, 83º 46'W

Discussion: This is a relatively deep site with depths below 50 fathoms. This area is northwest of the Tortugas and has high rock pinnacles with one peak rising to 25 fathoms, but it is not depicted on the bathymetric chart.

14. “Riley's Hump”. (11 sq. naut. mi).

Boundaries: NW= 24º 32.2'N, 83º 08.7'W NE= 24º 32.2'N, 83º 05.2'W
SW= 24º 28.7'N, 83º 05.2' W SE= 24º 28.7'N, 83º 08.7'W

Discussion: This area is a rise between the 20 and 30 fathom isobaths southwest of the Dry Tortugas and it covers about one lease block of area. This area is designated as a mutton snapper spawning grounds in Amendment 5 (supplement) of the Reef Fish FMP. No fishing is allowed in this area in May and June but other times of the year fishing is not restricted.

7.2.5 Marine mammals and protected species

There are 28 cetacean, one sirenian, and one non-native pinneped (California sea lion) species that have confirmed occurrences in the GOM (Davis and Fargion, 1996). Of these, six marine mammal species are listed as endangered species. Additionally, all five of the sea turtles found in the GOM (Kemp's ridley, loggerhead, green, leatherback, and hawksbill) are protected under the Endangered Species Act (ESA). Fish species listed under the ESA in the GOM include the threatened Gulf sturgeon and the endangered smalltooth sawfish. Thirteen species of fish in the Gulf of Mexico are currently on the candidate list. The NOAA Fisheries recently completed a Biological Opinion for sperm whales, sea turtles, and Gulf sturgeon on the Gulf of Mexico Outer Continental Shelf Oil and Gas Lease Sales 189 and 197 Opinion. These reports contain the most updated information on GOM protected species at this time.

7.2.5.1 Marine mammals

7.2.5.1.1 Sperm whale

Sperm whales were listed as endangered under the ESA in 1973 (NOAA Fisheries, 2001a). They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the Marine Mammal Protection Act of 1972. Critical habitat has not been designated for sperm whales. The primary factor for the species' decline, that precipitated ESA listing, was commercial whaling (Blaylock et al. 1995). Sperm whales were hunted in America from the 17th century through the early 1900s, but the exact number of whales harvested in the commercial fishery is not known. A commercial fishery for sperm whales operated in the GOM during the late 1700s to early 1900s. Since the ban on nearly all hunting of sperm whales, there has been little evidence that human-induced mortality or injury is significantly affecting the recovery of sperm whale stocks. NOAA Fisheries believes there are insufficient data to determine population trends for this species.

There has been speculation, based on a year-round occurrence of strandings, opportunistic sightings and whaling catches, that sperm whales in the GOM may constitute a distinct stock, and indeed, they are treated as such in NOAA Fisheries' Marine Mammal Stock Assessment Report (Waring et al., 2000). Sperm whale sightings recorded from the National Oceanic and Atmospheric Administration (NOAA) vessel Oregon II from 1991 - 1997 are concentrated just beyond the 100 m depth contour in the northern GOM, east of the Mississippi River Delta. These waters are the only known breeding and calving area in the GOM.

The GOM sperm whale stock is estimated at 530 sperm whales, calculated from an average of estimates from 1991-1994 surveys (Waring et al., 2000). The minimum population estimate (N_{min}) is 411 sperm whales (Waring et al., 2000). The estimate of Nmin is calculated as the lower limit of the two-tailed 60 percent confidence interval of the lognormal distributed abundance estimate (or the equivalent of the 20th percentile of the lognormal distributed abundance estimate as specified by NOAA Fisheries. N_{min} is a required component of the Potential Biological Removal level (PBR) calculation as required under the MMPA. The estimated PBR for the Gulf sperm whale stock is 0.8 sperm whales. PBR is an estimate of the number of animals, which can be removed (in addition to natural mortality) annually from a marine mammal population or stock while maintaining that stock at OSP (optimum sustainable population level) or without causing the population or stock to slow its recovery to OSP by more than 10 percent. Stock size is considered to be low relative to OSP; there is no trend in population size discernable from estimates of abundance over time (Waring et al., 2000 and references within).

7.2.5.1.2 Other whales

During spring through late fall, right whales are found off Canada and the northeast United States in feeding areas (MMS, 2000). Winter distribution for the majority of the population is unknown, but coastal waters between Georgia and Florida are the only known calving areas for these whales. Existing records of this species in the GOM represent strays from the wintering grounds, outside of the normal distribution range.

There are only two reliable records (strandings on the Texas coast) of blue whales in the GOM, and they are not thought to be regular inhabitants of the Gulf (MMS, 2000).

The sei whale probably has only an accidental occurrence in the Gulf (though it is interesting to note that three of the four reliable records were from strandings on the eastern Louisiana coast) (MMS, 2000).

Humpback whales spend winter in warm waters to calve, and then move to colder waters to feed during the summer (MMS, 2000). The few reports of humpback whales in the Gulf are considered to be whales that may have lost their way on return northerly migrations (from the Caribbean) in the western North Atlantic.

The fin whale is found in all major oceans in the world. Like other large baleen whales, it migrates seasonally from temperate waters where it mates and calves in the winter to polar feeding grounds in the summer (USM no date). The wintering grounds of the north Atlantic stock are the Caribbean Sea and GOM. Stocks of the North Atlantic were heavily fished and soon depleted. There are now only a few thousand fin whales in the North Atlantic. Pre-exploitation populations have been estimated at over 464,000, with about 18,000 in the North Atlantic, 45,000 in the North Pacific, and 400,000 in the Southern Ocean (NOAA Fisheries, 1991). Current stocks were estimated to include about 119,000 individuals, with about 17,221 in the North Atlantic, 16,625 in the North Pacific, and 85,200 in the Southern Ocean. Sightings and strandings indicate that fin whales continue to use the GOM as part of their wintering habitat, although in limited number (Davis et al., 1995). If the protected populations in the Atlantic increase, the Gulf will likely be used more frequently as a wintering ground for these mammals.

7.2.5.1.3 Dolphins

Nine species of dolphins occur in the GOM (Waring et al., 2000). All are members of the family Delphinidae, and none are considered threatened or endangered. Most inhabit deeper waters in the Gulf, with the exception of the bottlenose and Atlantic spotted dolphins.

The bottlenose (*Tursiops truncatus*) is the most common dolphin in nearshore waters and outer edge of the continental shelf in the Gulf. The Atlantic spotted dolphin *(Stenella frontalis*) is the only other species that commonly occurs over the continental shelf, typically inhabiting shallow waters within the 250-m isobath.

The Risso's (*Grampus griseus*), Clymene (*Stenella clymene*), and spinner *(Stenella longirostris*), striped (*Stenella coeruleoalba*), and rough-toothed (*Steno bredanensis*) dolphins are deepwater species endemic to tropical and subtropical waters. Other Gulf species include the pantropical spotted dolphin (*Stenellas attenuata*) and Fraser's dolphin (*Lagenodelphis hosei*).

7.2.5.1.4 Manatees

The West Indian manatee (*Trichechus manatus latirostris*) is found throughout the coastal waters of Florida (Waring et al., 2000). These large mammals are normally found in near-shore shallow coastal and estuarine waters where they feed on sea-grasses and aquatic vegetation. Manatees also are found far up freshwater rivers and streams. On Florida's Gulf coast, they commonly range from the Everglades northward to the Suwanee River, are somewhat less abundant northward in the Big Bend area, and occur even less frequently westward. However, manatees have been occasionally found as far west as Louisiana and Texas (Powell and Rathbun, 1984; Rathbun et al., 1990; Schiro et al., 1998).

Their winter range is more restricted than their summer range due to their migration toward warmer areas. Manatees have a very low metabolic rate and high thermal conductance that can lead to energetic stresses during cold periods (O'Shea et al., 1995). Thus, in winter, they are generally found at the southern tip of Florida or congregated at warm-water sources, most commonly power plants. On the Gulf Coast, there are nine aggregation sites, the major ones being the natural springs on the Crystal and Homosassa Rivers; Tampa Electric Company's Big Bend Power Plant on the east side of Tampa Bay (Apollo Beach); Florida Power Corporation's Bartow Power Plant at Weedon Island, west side of Tampa Bay; Florida Power & Light Company's Fort Myers Power Plant in Lee County; and Port of the Islands Marina in Collier County.

In January 2001, a record number of manatees were counted in three synoptic aerial surveys. Favorable weather conditions were considered to have contributed in part to the record count, which produced a total number of 3,276 manatees, including 1,765 counted by observers on Florida's Gulf Coast (Florida Marine Research Institute, 2001). For the five years from 1995 to 2000, the annual count averaged 2,293 manatees.

As herbivores, manatees feed opportunistically on a wide variety of submerged, floating, and emergent vegetation. They often use secluded canals, creeks, embayments, and lagoons near mouths of coastal rivers and sloughs for feeding, resting, mating, and calving (USDOI, 2001; FWS, 1995).

The primary threats to manatees are loss of essential manatee habitats and human-related mortality, injury, (both generally due to collision with vessels) and disturbance. In 2000, there were 273 total manatee deaths statewide, with 78 of these due to collision with watercraft, eight due to floodgates or canal locks, eight due to other human causes and 62 undetermined. All other deaths were perinatal (58), due to natural causes and cold stress (14), or unrecovered (8). In Gulf Coast counties alone, there were 35 deaths due to collision with watercraft, 35 that were undetermined, and four due to other human causes (Florida Marine Research Institute, 2001).

7.2.5.2 Sea turtles

7.2.5.2.1 Green (*Chelonia mydas*)

The green sea turtle was listed under the ESA on July 28, 1978. Green turtles are distributed circumglobally, mainly in waters between the northern and southern 20^{o} C isotherms (Hirth, 1971). Green turtles were traditionally highly prized for their flesh, fat, eggs, and shell. Fisheries in the United States and the Caribbean are largely to blame for the decline of the species. Poffenberger[1] reported only one interaction with a green turtle by the Gulf of Mexico commercial reef fish fishery during the two survey years (1/8/2001-7/31/2002 and 1/8/2002 - 7/31/2003).

In the continental United States, green turtle nesting occurs on the Atlantic coast of Florida. Occasional nesting has been documented along the Gulf coast of Florida, at Southwest Florida beaches, as well as the beaches on the Florida Panhandle (Meylan et al., 1995). The vast majority of green turtle nesting within the Southeast Region occurs in Florida where green turtle nesting has been extensively and consistently surveyed during the period 1989-1999 (NOAA Fisheries, 2001a). In Florida during the 11-year period, green turtle abundance from nest counts ranges 109-1389 nesting females per year. High biennial variation and a predominant two-year re-migration interval (Witherington and Ehrhart, 1989, Johnson and Ehrhart, 1994) warrant combining even and odd years into two-year cohorts. This gives an estimate of total nesting females that ranges 705-1509 during the period 1990-1999. In Florida during the period 1989-1999, numbers of green turtle nests by year show no trend ($n = 11$, $r^2 = 0.055$, $p = 0.49$). However, odd-even year cohorts of nests (as described and as justified above) did show a significant increase ($n = 5$, $r^2 = 0.72$, $p = 0.033$) during the period 1990-1999 (Florida Marine Research Institute, Index Nesting Beach Survey Database). Total nest counts and trends at index beach sites during the past decade suggest that green turtles that nest within the Southeast Region are recovering and have only recently reached a level of approximately 1000 nesting females.

While nesting activity is obviously important in identifying population trends and distribution, the majority portion of a green turtle's life is spent on the foraging grounds. Green turtles are herbivores and appear to prefer marine grasses and algae in shallow bays, lagoons, and reefs (Rebel, 1974). Some of the principal feeding pastures in the GOM include inshore south Texas waters, the upper west coast of Florida and the northwestern coast of the Yucatan Peninsula. The Proposed food sources in these areas are *Cymodocea*, *Thalassia, Zostera, Sagittaria*, and *Vallisneria* (Babcock, 1937; Underwood, 1951; Carr, 1952; 1954).

Green turtles were once abundant enough in the shallow bays and lagoons of the GOM to support a commercial fishery, which landed over one mp of green turtles in 1890 (Doughty, 1984). Doughty reported the decline in the turtle fishery throughout the GOM by 1902. Currently, green turtles are uncommon in offshore waters of the northern Gulf, but abundant in some inshore embayments. Shaver (1994) live-captured a number of green turtles in channels entering into Laguna Madre in south Texas. She noted the abundance of green turtle strandings in Laguna Madre inshore waters and opined that the turtles may establish residency in the inshore foraging habitats as juveniles.

7.2.5.2.2 Hawksbill (*Eretmochelys imbricata*)

Hawksbill turtles feed primarily on a wide variety of sponges but also consume bryozoans, coelenterates, and mollusks. Nesting areas in the western North Atlantic include Puerto Rico and the Virgin Islands. In the Western Atlantic, the largest hawksbill nesting population occurs in the Yucatán Peninsula of Mexico, where several thousand nests are recorded annually in the states of Campeche, Yucatán, and Quintana Roo (NOAA Fisheries, 2001a). In the northern GOM, a number of small hawksbills are encountered in Florida and Texas. Most of the Texas records are probably in the 1-2 year class range. Many of the individuals captured or stranded are unhealthy or injured (Hildebrand, 1983). Pinellas County, Florida, including Tampa Bay, has the largest share of west coast hawksbill strandings. It is likely that immature hawksbills utilize the various hard-bottom habitats off the west coast as developmental habitat (NOAA Fisheries, 2001a). The lack of sponge-covered reefs and the cold winters in the northern GOM probably prevent hawksbills from establishing a strong presence in that area.

7.2.5.2.3 Kemp's Ridley (*Lepidochelys kempii*)

Of the seven extant species of sea turtles of the world, the Kemp's ridley has declined to the lowest population level (NOAA Fisheries, 2001a). The Recovery Plan for the Kemp's Ridley Sea Turtle (USFWS and NOAA Fisheries, 1992) contains a description of the natural history, taxonomy, and distribution of the Kemp's ridley turtle. Kemp's ridleys nest in daytime aggregations known as arribadas, primarily at Rancho Nuevo, a stretch of beach in Mexico. Most of the population of adult females nest in this single locality (Pritchard, 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand, 1982). Recent observations of increased nesting suggest that the decline in the ridley population has stopped, and there is cautious optimism that the population is now increasing.

The near shore waters of the GOM are believed to provide important developmental habitat for juvenile Kemp's ridley and loggerhead sea turtles. Ogren (1988) suggests that the Gulf coast, from Port Aransas, Texas, through Cedar Key, Florida, represents the primary habitat for subadult ridleys in the northern GOM. Stomach contents of Kemp's ridleys along the lower Texas coast had a predominance of near shore crabs and mollusks, as well as fish, shrimp and other foods considered to be shrimp fishery discards (Shaver, 1991). Analyses of stomach contents from sea turtles stranded on upper Texas beaches apparently suggest similar near shore foraging behavior (Pamela Plotkin, personal communication in GMFMC, 2003a).

Research being conducted by Texas A&M University suggests that subadult Kemp's ridleys stay in shallow, warm, near shore waters in the northern GOM until cooling waters force them offshore or south along the Florida coast (Maurice Renaud, personal communication in GMFMC, 2003a).

In recent years, unprecedented numbers of Kemp's ridley carcasses have been reported from Texas and Louisiana beaches during periods of high levels of shrimping effort (NOAA Fisheries, 2000). NOAA Fisheries established a team of population biologists, sea turtle scientists, and managers, known as the Turtle Expert Working Group (TEWG), to conduct a status assessment of sea turtle populations. Analyses conducted by the group have indicated that the Kemp's ridley population is in the early stages of recovery (NOAA Fisheries, 1998).

Nesting data indicated that the number of adults declined from a population that produced 6,000 nests in 1966 to a population that produced 924 nests in 1978 and a low of 702 nests in 1985 (NOAA Fisheries, 2000). This trajectory of adult abundance tracks trends in nest abundance from an estimate of 9,600 in 1966 10 1,050 in 1985. The TEWG estimated that in 1995 there were 3,000 adult ridleys. The TEWG (1998) indicated that the Kemp's ridley population appears to be in the early stage of exponential expansion. Over the period 1987 to 1995, the rate of increase in the annual number of nests accelerated in a trend that would continue with enhanced hatchling production and the use of TEDs. It determined that the data reviewed suggested that adult Kemp's ridley turtles were restricted somewhat to the GOM in shallow near shore waters, and benthic immature turtles of 20-60 cm straight line carapace length are found in near shore coastal waters including estuaries of the GOM and the Atlantic. In 2000 these were 6,277 nests counted (G&SAFF Newsletter July 2001).

7.2.5.2.4 Leatherback turtle (*Dermochelys coriacea*)

The Recovery Plan for Leatherback Turtles (*Dermochelys coriacea*) contains a description of the natural history and taxonomy of this species (NOAA Fisheries and USFWS, 1992). Leatherbacks are widely distributed throughout the oceans of the world, and are found throughout waters of the Atlantic, Pacific, Caribbean, and the GOM (Ernst and Barbour, 1972). Leatherbacks are predominantly pelagic, feeding primarily on jellyfish such as *Stomolophus*, *Chryaora*, and *Aurelia* (Rebel, 1974). They may come into shallow waters if there is an abundance of jellyfish near shore.

The status of the leatherback population is difficult to assess since major nesting beaches occur over broad areas within tropical waters outside the United States (NOAA Fisheries, 2000). The primary leatherback nesting beaches occur in French Guiana and Suriname in the western Atlantic and in Mexico in the eastern Pacific. Although increased observer effort on nesting beaches has resulted in increased reports of leatherback nesting, declines in nest abundance have been reported from the beaches of greatest nesting densities. Some nesting occurs on Florida's east coast.

7.2.5.2.5 Loggerhead turtle (*Caretta caretta*)

Loggerhead sea turtles occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans and are the most abundant species of sea turtle occurring in U.S. waters (NOAA Fisheries, 2001a). The loggerhead is a highly migratory species and is found in waters around the globe. The threatened loggerhead is the most abundant species of sea turtle occurring in U.S. waters. The near shore waters of the GOM are believed to provide important developmental habitat for juvenile loggerheads. Studies conducted on loggerheads stranded on the lower Texas coast (south of Matagorda Island) have indicated that stranded individuals were feeding in near shore waters shortly before their death (Plotkin et al., 1993). Poffenberger[1] reported only two interactions with loggerhead turtles by the Gulf of Mexico commercial reef fish fishery during the two survey years (1/8/2001-7/31/2002 and 1/8/2002 - 7/31/2003).

In the western Atlantic, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf coast of Florida. The TEWG report (NOAA Fisheries, 1998) identified four nesting subpopulations of loggerheads in the western North Atlantic based on mitochondrial DNA evidence. These include: (1) the northern subpopulation producing approximately 6,200 nests/year from North Carolina to northeast Florida; (2) the south Florida subpopulation occurring from just north of Cape Canaveral on the east coast of Florida and extending up to Naples on the west coast and producing approximately 64,000 nests/year; (3) the Florida Panhandle subpopulation, producing approximately 450 nests/year; and (4) the Yucatán subpopulation occurring on the northern and eastern Yucatán Peninsula in Mexico, producing approximately 1,500-2,000 nests/year.

The TEWG (NOAA Fisheries, 1998) considered nesting data collected from index nesting beaches to index the population size of loggerheads and to consider trends in the size of the population. The TEWG constructed total estimates by considering a ratio between nesting data (and associated estimated number of adult females and therefore adults in near shore waters), proportion of adults represented in the strandings, and in one method, aerial survey estimates. These two methods indicated that for the 1989-1995 period, there were averages of 224,321 or 234,355 benthic loggerheads, respectively. The TEWG listed the methods and assumptions in their report, and suggested that these numbers are likely underestimates. Aerial survey results suggest that loggerheads in U.S. waters are distributed in the following proportions: 54 percent in the southeast U.S. Atlantic, 29 percent in the northeast U.S. Atlantic, 12 percent in the eastern GOM, and 5 percent in the western GOM (NOAA Fisheries, 1998).

The TEWG report (NOAA Fisheries, 1998) considered long-term index nesting beach data sets when available to identify trends in the loggerhead population. Overall, the TEWG determined that trends could be identified for two loggerhead subpopulations. The northern subpopulation appears to be stabilizing after a period of decline; the south Florida subpopulation appears to have shown significant increases over the last 25 years suggesting the population is recovering, although the trend could not be detected over the most recent 7 years of nesting. An increase in the numbers of adult loggerheads has been reported in recent years in Florida waters without a concomitant increase in benthic immature animals. These data may forecast limited recruitment to south Florida nesting beaches in the future. Since loggerheads take approximately 20-30 years to mature, the effects of decline in immature loggerheads might not be apparent on nesting beaches for decades. Therefore, the TEWG report (NOAA Fisheries,1998) cautions against considering trends in nesting too optimistically.

Briefly, the TEWG report (NOAA Fisheries, 1998) made a number of conclusions regarding the loggerhead population. The recovery goal of "measurable increases" for the south Florida subpopulation (south of Canaveral and including southwest Florida) appears to have been met, and this population appears to be stable or increasing. However, index nesting surveys have been done for too short a time; therefore, it is difficult to evaluate trends throughout the region. Recovery rates for the entire subpopulation cannot be determined with certainty at this time

7.2.5.3 Fish

7.2.5.3.1 Gulf sturgeon

NOAA Fisheries and US Fish and Wildlife Service (USFWS) listed the Gulf sturgeon as a threatened species on September 30, 1991. NOAA Fisheries and FWS share jurisdiction for this species under the Endangered Species Act (NOAA Fisheries, 2001b; 2001a).

The Gulf sturgeon, also known as the GOM sturgeon, is a subspecies of the Atlantic sturgeon (USFWS, 1994). The Gulf sturgeon is restricted to the GOM and its drainages, primarily from the Mississippi River to the Suwannee River, in Louisiana, Mississippi, Alabama, and Florida. The subspecies may also occur sporadically as far west as Texas, and in marine waters in Florida south to Florida Bay. While little is known about the abundance of Gulf sturgeon through most of its range, estimates exist for the Suwannee and Apalachicola rivers (NOAA Fisheries, 2001a). The USFWS reported an average of 115 individuals larger than 45 cm TL over-summering in the Apalachicola River below Jim Woodruff Lock and Dam. For the Suwannee River, population size estimates ranging from 2,250 to 3,300 individuals have been made.

Subadult and adult fish begin migration into rivers from the GOM in early spring and continuing until early May (Carr, 1983; Wooley and Crateau, 1985; Odenkirk, 1989; Clugston et al., 1995). In late September or October, subadult or adult sturgeon begin downstream migrations. Sturgeon apparently only feed during their stay in marine waters; food items are rarely found in the stomachs of specimens sampled from rivers. Gulf sturgeon are long-lived, reaching an age of at least 28 years. Age at sexual maturity for females ranges from 8 to 17 years, and for males from 7 to 21 years (Huff, 1975). Spawning of Gulf sturgeon is not well documented. However, a few larval sturgeon have been collected in early April and early May in the Apalachicola River (Wooley et al., 1982).

Habitat destruction and degradation, exacerbated by potential over-exploitation of the species, are primarily responsible for the sturgeon's decline. Dams have prevented access to historic sturgeon migration routes and spawning areas (Wooley and Crateau, 1985). Dredging and other navigation maintenance, possibly including lowering of river elevations and elimination of deep holes and altered rock substrates, may have adversely affected Gulf sturgeon habitats (Wooley and Crateau, 1985). A decrease in groundwater flows has reduced cool water habitats, which are thought to be warm water refugia for sturgeon (S. Carr, personal communication in GMFMC, 2003a); recent droughts in the Apalachicola River system have aggravated the loss of cool water refugia. Increased groundwater withdrawal for irrigation in southwest Georgia may result in a 30 percent reduction of discharge to streams (Hayes et al., 1983).

Breeding populations take years to establish because of their advanced age at sexual maturity. In addition, Gulf sturgeon appear to be home stream spawners with little, if any, natural repopulation from migrants from other rivers (USFWS and GSMFC, 1995).

7.2.5.3.2 Smalltooth sawfish

The National Oceanic and Atmospheric Administration's National Marine Fisheries Service on April 1, 2003 listed as endangered the U.S. population of smalltooth sawfish that once ranged in shallow waters off the GOM and Eastern Seaboard. An extensive status review concluded that the U.S. population of smalltooth sawfish, currently found only off South Florida, is in danger of extinction (NOAA Fisheries, 2001c).

Sawfish, like sharks, skates and rays, belong to a class of fish called elasmobranchs, whose skeletons are made of cartilage (NOAA Fisheries, 2001d). Sawfish are actually modified rays with a shark-like body, and gill slits on their ventral side. Early sawfish arose around 100 million years ago, but these first sawfish are actually distant cousins to the modern day sawfishes, which first appeared around 56 million years ago. Sawfish get their name from their “saws” - long and flat snouts edged with pairs of teeth that are used to locate, stun and kill prey. Their diet includes mostly fish but also some crustaceans.

Smalltooth sawfish is one of two species of sawfish that inhabit U.S. waters (NOAA Fisheries, 2001c). Smalltooth sawfish commonly reach 18 ft (5.5 m) in length, and may grow to 25 ft (7 m). Little is known about the life history of these animals, but they may live up to 25-30 years and mature after about 10 years. Like many elasmobranchs, smalltooth sawfish are ovoviviparous, meaning the mother holds the eggs inside of her until the young are ready to be born, usually in litters of 15 to 20 pups.

Sawfish species inhabit shallow coastal waters of tropical seas and estuaries throughout the world (NOAA Fisheries, 2001c). They are usually found in shallow waters very close to shore over muddy and sandy bottoms. They are often found in sheltered bays, on shallow banks, and in estuaries or river mouths. Certain species of sawfish are known to ascend inland in large river systems, and they are among the few elasmobranchs that are known from freshwater systems in many parts of the world.

Smalltooth sawfish has been reported in both the Pacific and Atlantic Oceans, but the U.S. population is found only in the Atlantic (NOAA Fisheries, 2001c). Historically, the U.S. population was common throughout the GOM from Texas to Florida, and along the east coast from Florida to Cape Hatteras. The current range of this species has contracted to peninsular Florida, and smalltooth sawfish are relatively common only in the Everglades region at the southern tip of the state. No accurate estimates of abundance trends over time are available for this species. However, available records, including museum records and anecdotal fisher observations, indicate that this species was once common throughout its historic range and that smalltooth sawfish have declined dramatically in U.S. waters over the last century.

Sawfish are extremely vulnerable to overexploitation because of their propensity for entanglement in nets, their restricted habitat, and low rate of population growth (NOAA Fisheries, 2001c). The decline in smalltooth sawfish abundance has been caused primarily by bycatch in various fisheries, likely compounded by habitat degradation. In order to protect this species, the states of Florida and Louisiana have prohibited the take of sawfish. Three National Wildlife Refuges in Florida also protect their habitat.

7.2.5.3.3 Candidate list for protection

7.2.5.3.3.1 Goliath grouper

Goliath grouper are the largest of the western north Atlantic groupers (Porch et. al., 2002), with a maximum length of about 250 cm TL, and a maximum weight of 400 kg (FAO, 2003). They are long-lived (up to 37 years) and late-maturing (4 to 6 years males; 6 to 7 years females) (Cass-Clay and Schmidt, 2003). Diagnostic characters include a robust and oblong body with an extremely broad head and small eyes. Body color is generally brownish yellow, but can also be grey or greenish. The dorsal part of the head, body and fins may have small black dots. Large adults are often found in shallow water, and also offshore on wrecks and in areas of high relief; juveniles common in mangroves and both juveniles and adults occur in bays and harbors (FAO, 2002). Adults occur either as solitary individuals or in groups of up to 100 in shallow water (typically in less than 40 m depth) (Sadovy and Eklund, 1999). Spawning is presumed to occur in the summer months when adults form offshore aggregations (Bullock and Smith, 1991). Unlike many other groupers, there is no evidence for hermaphroditism (FAO, 2002). Adults and juveniles feed predominantly on crustaceans (shrimps, crabs, and lobsters) (Heemstra and Randall, 1993).

Recent analysis indicates that the stocks are recovering in the Gulf of Mexico; however there is a paucity of information from the Atlantic Ocean and Caribbean Sea. Information from a limited part of the range indicate that relative abundance of goliath grouper was very high in the mid-1990's, suggesting that strong year classes had recently occurred.

Goliath grouper was added to the candidate list after a precipitous decline in numbers during the 1970s and 1980s. In the US, from 1979-88, commercial catches of goliath grouper increased from 15,454 kg to 61,818 kg and then declined drastically. The rapid increase in fishing effort coupled with the decline in landings led to extreme regulatory measures by the Gulf of Mexico Fishery Management Council: initially a 50-inch size limit was implemented, then Amendment 2 of the Gulf of Mexico Reef Fish Fishery Management Plan in 1990 prohibited all capture of goliath grouper in federal Gulf waters (Cass-Clay and Schmidt, 2003). The South Atlantic Fishery Management Council followed suit shortly thereafter in prohibiting capture, followed by the Caribbean Fishery Management Council in 1993 (Porch et. al., 2003). The State of Florida banned the capture of goliath grouper in 1990, and, although rarely caught in the Atlantic north of Florida, there are regulations restricting the take of this species from special management zones around artificial reefs off South Carolina and Georgia. While the main factor of decline is fishing pressure, juvenile habitat may also be impacted due to coastal development and runoff. Juvenile goliath grouper rely heavily on shallow mangrove shorelines (Sadovy and Eklund, 1999).

A 2003 assessment was conducted by the Southeast Fisheries Science Center and indicated that there is a 90% chance that the population will have recovered to a spawning potential ration

(SPR) of 50% by 2006 and essentially a 100% chance that it will recover by 2009. Another less optimistic result, obtained by utilizing catch rate data, indicated that there is a 50% chance that the population will have recovered to a 50% SPR by 2008 and a 100% chance that it will recover by 2011. NOAA Fisheries funded, via Recover Protected Species funds to SEFSC, numerous goliath grouper research projects in the 1990s.

7.2.5.3.3.2 Speckled hind

Speckled hind derive their name from the multitude of tiny white spots that cover their reddish-brown head, body and fins (Manooch, 1984). Speckled hinds are deep-water groupers: adults inhabit offshore rocky bottoms in depths of 25 to 183 m but are most common between 60 and 120 m (Heemstra and Randall, 1993). Speckled hind are protogynous hermaphrodites (change from female to male); females mature at 4 or 5 years of age (45-60 cm TL) (FAO, 2002). Spawning occurs from July to September (FAO, 2002). Maximum size is about 110 cm TL and weight to 30 kg (FAO, 2002). Prey items, which can be engulfed whole, include fishes, crabs, shrimps, lobsters and mollusks (Manooch, 1984).

The rationale for listing this species as a "Species of Concern" was that speckled hind are caught as bycatch from the deepwater snapper/grouper fisheries off the coast of N.C. through Texas (Manooch, 1984). There is a paucity of data for this species: the stock structure is not characterized, population size is unknown and much of their life history has not been thoroughly investigated (Huntsman et al., 1997).

The major threat to the speckled hind is mortality as a result of fishing or by-catch release mortality (due to barotrauma). Both recreational and commercial fisheries for speckled hind are currently regulated in the south Atlantic; the South Atlantic Fisheries Management Council considers the species as overfished and undergoing overfishing. In the Gulf of Mexico commercial fishery, there are no possession limits for the species for federally permitted reef fish vessels, and the both species is managed under the Deep-water grouper commercial quota. The Gulf of Mexico Fishery Management Council classifies the status of speckled hind as "unknown.".

NOAA Fisheries funded, via Recover Protected Species funds to SEFSC in 2000, a project entitled "Identifying aggregations of candidate grouper species through acoustic signatures."

7.2.5.3.3.3 Nassau grouper

The Nassau grouper is a top-level predator found from inshore to about 100 m (Smith 1971). Adults are generally found near shallow high-relief coral reefs and rocky bottoms to a depth of at least 90 m (Heemstra and Randall, 1993); juveniles (25-150 mm TL) have been found in and around coral clumps covered with macroalgae (*Laurencia* spp.) and over seagrass beds (Randall, 1983) (Eggleston, 1995). Nassau grouper are characterized by 5 dark brown vertical bars on a pale tan or gray body, black dots around the eye, a large black saddle-blotch on the caudal peduncle and a wide "tuning-fork" pattern on forehead (Sadovy and Eklund, 1999). They reach a maximum size of about 100 cm TL and 25 kg (FAO, 2003). They are late-maturing (between 4-7 years). Unlike most groupers, Nassau groupers are primarily gonochoristic; however protogynous (female to male) hermaphroditism has not been disproved (Sadovy and Colin, 1995). Nassau grouper are known to assemble in very large numbers (aggregations of a few dozen to 100,000 individuals) at transient, site-specific areas each year to spawn presumably cued by temperature and moon phase (Smith, 1972). Aside from the spawning season, Nassau grouper are solitary fish (Randall, 1968). Nassau grouper are ambush suction foragers: they lie and wait for prey and then engulf the organism in a current of water by opening their mouth and quickly dilating their gill covers (Thompson and Munro, 1978; Carter, 1986). Their diet is predominated by fish (Eggleston et al., 1998).

The rationale for listing this species as a “Species of Concern” is that although Nassau grouper are abundant in the Bahamas (they are the most important finfish landed, second only to lobster and conch), the Florida population is considered overfished. The Florida population is likely a separate stock as mixing in unlikely.

Commercial and recreational landings data from 1986-1991 indicate that the Nassau grouper harvest decreased in both pounds landed and average size. As a result of this decrease in yield, the Carribean (1990), South Atlantic (1991), and the Gulf of Mexico (1996) Fishery Management Councils (FMC), and the State of Florida (1993) prohibited take and possession of Nassau grouper; all three FMCs currently classify them as overfished.

NOAA Fisheries funded, via Recover Protected Species funds to SEFSC, numerous Nassau grouper research project in the 1990s. Research on Nassau grouper and their associated habitats continues to be conducted by NOAA Fisheries, Recover Protected Species Program, National Undersea Research Center for the Caribbean, South Carolina State University, and the Reef Environmental Education Foundation.

7.2.5.4 Seabirds

Seabirds are a diverse group of birds that spend much of their lives on or over saltwater. Some can live far from land for long extended periods of time, coming back to coastal areas to breed and nest. Seabirds fish for prey from the sea through dipping, plunging, surface seizing, as well as the behaviors of piracy and scavenging.

Three of the four primary orders of seabirds are represented in the GOM, Procellariiformes (petrels, albatrosses, and shearwaters), Pelecaniformes (pelicans, gannets and boobies, cormorants, tropic birds, and frigate birds), and Charadriiformes (phalaropes, gulls, terns, noddies, and skimmers) (Clapp et al., 1982; Harrison, 1983). Additionally, the orders Gaviiformes (loons) and Podicipediformes (grebes) are also found in the Gulf.

Species of seabirds and other coastal species that inhabit or frequent the northern GOM that are recognized by the U.S. Fish and Wildlife Service as either endangered or threatened include: piping plover, least tern, roseate tern, bald eagle, and brown pelican (the brown pelican is endangered in Mississippi and Louisiana and de-listed in Florida and Alabama). The southeastern snowy plover is a species of concern to the state of Florida.

The incidental catch of seabirds in various fisheries around the world has generated much concern over the long-term ecological effects, during past two decades. In particular, longline fishing is susceptible to seabird bycatch. The U.S. voluntarily developed a National Plan of Action for reducing the Incidental Catch of Seabirds in Longline Fisheries (NPOA-S) as requested in the International Plan of Action for Reducing the Incidental Catch of seabirds in Longline Fisheries (IPOA-S) (see Section 7.2.3.4).

The brown pelican, Pelecanus occidentalis (Family: Pelicanidae), one of two pelican species in North America, has been listed as endangered since 1970 in its entire range, except that it is a delisted taxon, recovered (and were being monitored for the first five years) in Alabama and Florida since 1985. Although not listed as endangered in Florida, it is listed as a species of special concern by the State.

Pelicans feed entirely upon fishes that they capture by plunge diving into coastal waters. They seldom venture to more than 20 miles out to sea except to take advantage of especially good fishing conditions, and even then it is rare to find one more than 40 miles out. Sand spits and offshore sandbars are used extensively as daily loafing and nocturnal roost areas. The Proposed nesting sites are small coastal islands, which provide protection from mammal predators, especially raccoons, and sufficient elevation to prevent wide scale flooding of nests.

Primary factors affecting the eastern subspecies include human disturbance of nesting colonies and mortalities that result from the birds being caught on fishhooks and subsequently entangled in monofilament line. Oil or chemical spills, erosion, plant succession, hurricanes, storms, heavy tick infestations, and unpredictable food availability are other threats.

7.3 Social and economic environment

Section 5.4 provides a detailed description of the social and economic environment potentially affected by measures in this amendment, and is incorporated herein by reference. In summary, the red snapper fishery is mainly composed of the commercial and recreational sectors that share almost equally in the TAC established for the red snapper stock. Within the commercial sector are fishing vessels, dealers, support industries, and fishing communities. Recreational anglers participate in the red snapper fishery through several fishing modes, such as shore, private/rental, charter boats, and headboats. Charter boats and headboats comprise the for-hire fishery. In addition, there are also areas that may be considered as fishing communities that may either provide place of residence, business or employment associated with the recreational pursuit of the red snapper stock. Some of these areas similarly provide residence or business opportunities for the commercial fishing sector.

The red snapper fishery is part of the general reef fish fishery. Some of the commercial vessels that participate in the red snapper fishery also participate in other reef fish fisheries, such as vermilion, grouper, and amberjack. Although some particular reef fish species, such as red snapper, are targeted by for-hire vessels, these vessels generally target a motley of species, reef fish or others, such as mackerel.

7.4 Administrative environment

7.4.1 Federal fishery management

Federal fishery management is conducted under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) (16 U.S.C. 1801 et seq.), originally enacted in 1976 as the Fishery Conservation and Management Act. The MSFCMA claims sovereign rights and exclusive fishery management authority over most fishery resources within the U.S. EEZ, an area extending 200 nautical miles from the seaward boundary of each of the coastal states, and authority over U.S. anadromous species and continental shelf resources that occur beyond the U.S. EEZ.

Responsibility for federal fishery management decision-making is divided between the U.S. Secretary of Commerce and eight regional fishery management councils that represent the expertise and interests of constituent states. Regional councils are responsible for preparing, monitoring, and revising management plans for fisheries needing management within their jurisdiction. The Secretary of Commerce (Secretary) is responsible for promulgating regulations to implement proposed plans and amendments after ensuring that management measures are consistent with the MSFCMA, and with other applicable laws summarized in Section 9. In most cases, the Secretary has delegated this authority to NOAA Fisheries.

The Gulf of Mexico Fishery Management Council is responsible for fishery resources in federal waters of the GOM. These waters extend to 200 nautical miles offshore from the nine-mile seaward boundary of the states of Florida and Texas, and the three-mile seaward boundary of the states of Alabama, Mississippi, and Louisiana. The length of the GOM coastline is approximately 1,631 miles. Florida has the longest coastline of 770 miles along its Gulf coast, followed by Louisiana (397 miles), Texas (361 miles), Alabama (53 miles), and Mississippi (44 miles).

The Council consists of seventeen voting members: 11 public members appointed by the Secretary; one each from the fishery agencies of Texas, Louisiana, Mississippi, Alabama, and Florida; and one from NOAA Fisheries. Public interests are also involved in the fishery management process through participation on advisory panels and through council meetings that, with few exceptions for discussing personnel matters, are open to the public. In addition, the regulatory process is in accordance with the Administrative Procedures Act, in the form of "notice and comment" rulemaking, which provides extensive opportunity for public scrutiny and comment, and requires consideration of and response to those comments.

Regulations contained within FMPs are enforced through actions of the NOAA's Office of Law Enforcement, the U.S. Coast Guard, and various state authorities. To better coordinate enforcement activities, federal and state enforcement agencies have developed cooperative agreements in which federal and state governments are working together to enforce the MSFCMA. These activities are being coordinated by the Council's Law Enforcement Advisory Panel (LEAP) and the Gulf States Marine Fisheries Commission''s (GSMFC) Law Enforcement Committee (LEC), which are made up of mostly the same individuals, who have developed a 5-year "Gulf of Mexico Cooperative Law Enforcement Strategic Plan - 2001-2006."

7.4.2 State fishery management

Each state fishery management agency has a designated seat on the Council. The purpose of state representation at the council level is to ensure state participation in federal fishery management decision-making and to promote the development of compatible regulations in state and federal waters. The state governments of Texas, Louisiana, Mississippi, Alabama, and Florida have the authority to manage their respective state fisheries. Each of the five Gulf States exercises legislative and regulatory authority over their states' natural resources through discrete administrative units. Although each agency listed below is the primary administrative body with respect to the states natural resources, all states cooperate with numerous state and federal regulatory agencies when managing marine resources. A brief description of each states primary regulatory agency for marine resources is provided below.

7.4.2.1 The Texas Parks & Wildlife Department

The Texas Parks and Wildlife Department (TPWD) manages and conserves the natural and cultural resources of Texas and to provide opportunities for hunting, fishing and outdoor recreation. The agency currently has ten internal divisions including Coastal Fisheries and Law Enforcement. The Coastal Fisheries Division manages the marine fishery resources of Texas' 1.62 million ha of saltwater, including the bays and estuaries and out to nine nautical miles in the GOM. Coastal fisheries management strategies are directed toward optimizing the long-term utilization of the marine resources of Texas. This management is designed to sustain fisheries harvest at levels that are necessary to ensure sustainable stocks of commercially and recreationally important species and to provide for balanced food webs within Texas marine ecosystems. Technical data to assess population levels and develop appropriate fishing regulations are collected through year-round standardized monitoring programs. In addition, life history studies and genetic research provide state-of-the-art knowledge for enhancing fishery stocks. The Coastal Fisheries staff work closely with other department divisions as well as federal and international fishery management agencies to provide optimum opportunities from and conservation for the biological diversity inherent in Texas' marine waters.

The Law Enforcement Division provides a comprehensive statewide law enforcement program to protect Texas' wildlife, other natural resources, and the environment. Texas Game Wardens are responsible for enforcement of the Parks and Wildlife Code, all TPW regulations, the Texas Penal Code and selected statutes and regulations applicable to clean air and water, hazardous materials and human health. Wardens fulfill these responsibilities through educating the public about various laws and regulations, preventing violations by conducting high visibility patrols, and apprehending and arresting violators.

7.4.2.2 The Louisiana Department of Wildlife and Fisheries

The Louisiana Department of Wildlife and Fisheries (LDWF), Marine Fisheries Division conserves and protects Louisiana’s renewable aquatic resources by controlling harvest, and by replenishing and enhancing stocks and habitat. This is accomplished by setting seasons, size and possession limits, gear restrictions, or other means of protecting key resources; replenishing species and enhancing or developing species or habitats, as needed, to provide for the needs of consumptive and non-consumptive users, or environmental health. Research provides insights into the proper functioning of natural systems, education of the public, and promoting the wise use of these resources (LDWF, 2000). Programs within the Marine Fisheries Division include: Crustacean (shrimp and crabs), Mollusk (oyster), Finfish, Habitat, Coastal Ecology, and Research.

The Enforcement Division is responsible for enforcing laws enacted by the Louisiana Legislature relative to fish and wildlife resources and boating safety regulations, as well as federal regulations pertaining to migratory birds and endangered species. The Saltwater Enforcement Patrol Unit was formed in 1982 to help combat the massive overfishing of Louisiana saltwater resources. Two vessels dedicated to this program provide resource protection, respond to environmental emergencies, and constantly provide search and rescue services throughout the saltwater areas of the state. The Enforcement Division also has special programs such as investigations of commercial fisheries, marine theft prevention, and oyster closure enforcement.

7.4.2.3 The Mississippi Department of Marine Resources

The Mississippi Department of Marine Resources (DMR) manages all marine life, public trust wetlands, adjacent uplands and waterfront areas, and provides for the balanced commercial, recreational, educational and economic uses of these resources consistent with environmental concerns and social changes. The Department is responsible for maintaining the quality of Mississippi’s seafood harvest through the use of fishing regulations and monitoring of the water quality in harvest areas. The principle function the DMR’s Marine Fisheries Department is the design and initiation of projects which collect and analyze data required for population dynamics estimates and other fisheries management-related projects. The Marine Fisheries Department also develops management recommendations based on specific criteria, and monitor the existing condition of the stocks and fisheries that depend on them. The Marine Fisheries Department also provides information transfer and liaison activities with regional fisheries management entities and other stakeholders. The Marine Fisheries office provides technical support to the Mississippi Commission on Marine Resources in developing fishery management plans, amendments, stock assessments, and technical analysis. The Marine

Fisheries Department also provides a representative to serve on fisheries-related boards, committees, and panels. Finally, the Marine Fisheries Department finally provides for the administrative services, general maintenance, locating suitable funding sources and other fisheries management support services.

Marine law enforcement is conducted by the Mississippi Department of Wildlife, Fisheries, and Park's (DWFP) Marine Law Enforcement Unit. This unit serves as a deterrent to fishing violations, which is a factor in long-term damage to marine resources. Financial penalties imposed for most violations are higher than the average value of daily catches and should be sufficient to deter potential violators. When developing ordinances and regulations to protect the state's marine resources, the DMR solicits and receives input from DWFP's Marine Law Enforcement Unit. The development of these ordinances routinely incorporates comments from officers on the enforceability of the ordinance or regulation.

7.4.2.4 The Alabama Department of Conservation and Natural Resources

The Alabama Marine Resource Division (AMRD) of the Alabama Department of Conservation and Natural Resources (ADCNR) manages Alabama’s marine fisheries resources with assessment and monitoring, applied research, and enforcement programs. The Fisheries Section is responsible for collecting data, and making recommendations to the Administrative Section concerning management of commercial and recreational fisheries in Alabama waters. The Fisheries Section maintains ongoing biological sampling, data analysis, and basic research programs. The greatest effort is directed toward commercially and recreationally important finfish, shrimp and oyster populations. Section biologists continually monitor and assess, fish, shrimp, and oyster habitat and populations, checking the size and number of organisms.

The Enforcement Section of the AMRD patrols Alabama's coastal waters, enforcing state and federal laws and regulations relating to the conservation and protection of marine resources. Officers also enforce laws and regulations relating to boating safety and freshwater fishing and hunting, conduct search and rescue missions, and participate in drug interdiction operations. Officers are cross-trained and deputized as NOAA Fisheries and U. S. Customs agents and cooperate extensively with these agencies and other federal agencies in the coordination of joint enforcement operations, investigative and fisheries enforcement expertise, training, public safety, and other natural resource issues. Facilities for the Enforcement Section consist of headquarters at Dauphin Island and a district office in Gulf Shores.

7.4.2.5 The Florida Fish and Wildlife Conservation Commission

The Florida Fish and Wildlife Conservation Commission’s (FWC) Division of Marine Fisheries develops proposals for regulatory and management options for marine fishery resources for consideration by a seven-member commission. In the GOM, state jurisdiction reaches out three leagues (approximately nine nm) from shore. Major responsibilities of the Division include monitoring of catch quotas of marine fisheries stocks, issuance of seafood dealer and commercial fishing licenses, facilitating artificial reef development and deployment, and educational activities. The Florida Marine Research Institute (FMRI) conducts research and work on a great array of marine issues. FMRI collaborates extensively with other academic, non-profit, and private research institutions on marine conservation and management issues. It also collects fishery independent and dependent data for use in estimating fish abundance and population trends through stock assessments.

The Division of Law Enforcement emphasizes compliance with fishing and hunting regulations, enforcement of state and federal laws that protect threatened and endangered species, enforcement of laws dealing with commercial trade of wildlife and wildlife products, and enforcement of boating safety laws and regulations. Field Operations consists of two bureaus which are divided into North and South Operations. These Bureaus house most of the uniform patrol functions within the Division as they relate to wildlife, saltwater fish, and freshwater fish resources.

8 Environmental Consequences

This section describes the potential direct, indirect, and cumulative effects on the physical, biological, socioeconomic, and administrative environments associated with each management alternative. The CEQ regulations (40 CFR 1508.8) define direct effects as those "which are caused by the action and occur at the same time and place." Indirect effects are defined as those "which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable." Cumulative effects are defined as "The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts could result from individually minor but collectively significant actions taking place over a period of time."

8 .1 MSY, OY, MFMT (overfishing), and MSST (overfished) Alternatives for Red Snapper

8 .1.1 Direct and indirect effects on physical environment and their significance

Direct effects: **Alternatives 1 through 5** simply establish management reference points and so will not directly affect the physical environment.

Indirect effects: Specifying management targets and thresholds could indirectly affect the physical environment by defining the level of fishing effort that will sustain the stock over the long term which, in turn, can affect the magnitude of fishing gear interactions with the sea floor. Management targets and thresholds that call for decreasing fishing effort would generally be expected to have a positive effect on the physical environment by reducing such interactions. Conversely, targets and thresholds that allow fishing effort to increase would generally be expected to have a negative effect on the physical environment by increasing the frequency with which fishing gear interacts with bottom habitat.

The red snapper fishery is composed of two basic types of fishing gear: bottom longlines; and vertical lines, including handline, rod-and-reel, and small vertical longlines known as bandit gear. Particularly during retrieval, bottom longlines have the potential to break or move hard structures on the sea floor, including rocks, corals, sponges, other invertebrates, and algae, when the line sweeps the bottom (Barnette, 2001). However, longlines are only used by a small sector of this fishery. Landings from longline gear grew from 2 to about 15 percent of the catch during the first half of the 1980s. In recent years, these landings have made up less than 1 percent of the total catch (Schirripa and Legault, 1999). Vertical line gear catches most of the landed red snapper. This gear is less likely to contact the bottom than is bottom longline gear, but it still has the potential to snag and entangle bottom structures. The line and weights used by this gear type also can cause abrasions (Barnette, 2001). While the impacts described for both bottom longline and vertical gear are negative, they are not believed to be as harmful as those impacts associated with more intrusive gears, such as bottom trawls (Barnette, 2001).

It is impossible to determine with any accuracy how **Alternatives 1-5** would indirectly affect the interactions of bottom longlines and vertical line gear with the sea floor. However, we can theorize about differences in the magnitude of effects associated with each by considering the various levels of fishing effort each would support over the long term. The no action **Alternative 1** would allow the highest effort levels. Of the remaining alternatives, **Preferred Alternative 2** would support the highest effort levels, followed by **Alternatives 3, 5, and 4**, respectively.

Regardless of potential differences in the magnitude of indirect effects associated with **Alternatives 1-5**, all are expected to only minimally impact the physical environment because the gear used in this fishery is believed to have minimal adverse impacts on the sea floor. Selection of management targets and thresholds may also indirectly affect fishing effort through the selection of the rebuilding plan. The rebuilding plan adopted in this amendment will determine the level of fishing effort applied over the course of the rebuilding period. Additionally, indirect effects on the physical environment may change throughout the course of the rebuilding plan because the biological reference points and status determination criteria adopted in this amendment will be reviewed and redefined in based on the findings of future stock assessments.

8 .1.2 Direct and indirect effects on biological/ecological environment and their significance

The discussion of the biological implications of the various bundled biological reference points and stock status determination criteria proposed in **Alternatives 1-5** in Section 4.1.2 is incorporated here by reference.

Direct effects: Establishing these parameters would not directly impact red snapper, other species, or participants in the red snapper fishery because they simply provide fishery managers with defined targets and thresholds to consider in developing fishery management measures. Managers use these targets and thresholds to evaluate whether the stock biomass and fishing mortality rate are within desirable ranges.

Indirect effects: Defining biological reference points and status determination criteria could result in indirect biological and ecological effects by influencing decisions about the level of catch that will be permitted during and after rebuilding conditions. The potential indirect effects of the various alternatives are described below to enable a comparison of their respective benefits and drawbacks.

All of the alternative bundled biological reference points and stock status determination criteria with the exception of **Alternative 1** are expected to indirectly benefit the biological environment by defining a management program that would sustain the red snapper stock over the long term.

The stock assessment models used to derive estimates of MSY and other status criteria in **Alternatives 2-5** are dependent on the stock-recruitment relationship. The stock-recruitment relationship that forms the basis of **Alternative 5** (0.95 steepness, high maximum recruitment) assumes the highest productivity for the population relative to the other alternatives. The stock-recruitment relationship specified in **Alternative 2** (0.90 steepness, low maximum recruitment) assumes the lowest population productivity. **Alternatives 3 and 4** assume productivity levels that are intermediate to those described in **Alternatives 5 and 2**.

If productivity is overestimated, the resulting policies could result in overfishing which, if left unchecked, could make it difficult to sustain the stock over the long term. Fishing the stock to a level that compromises its long-term viability would result in adverse biological impacts to the stock. If productivity is instead underestimated, the resulting policies could be more restrictive than what would be needed to ensure that the stock is maintained at a healthy level, without resulting in any additional biological benefits.

Definitions of OY, MSST, and MFMT are influenced by the adopted MSY estimate and its associated B_{MSY}. Consequently, if MSY is overestimated, these values also will be overestimated and provide less protection for the stock. The purpose of the defined periodic review is to examine current data and information on the fishery to ensure that assumptions about stock productivity are based on the best available scientific information.

Changes in the abundance of red snapper are likely to have ecological effects. Red snapper prey on other fishes (Moran, 1988), and may compete with other predators, such as red grouper, greater amberjack, and vermilion snapper, which have a similar diet (Nelson 1988; Bullock and Smith, 1991; Andaloro and Pipitone, 1997). Consequently, it is possible that forage species and competitor species could decrease in abundance in response to an increase in abundance of red snapper. Conversely predators of red snapper could in response to an increase in abundance of red snapper. However, the relationships among species in marine ecosystems are complex and poorly understood. As a result, the nature and magnitude of ecological effects are difficult to predict with any accuracy.

Recent advances in ecosystem modeling may provide some insight into the cascading effects of an increasing or decreasing red snapper stock. Currently, the only model for the GOM that could address these issues is an Ecopath model being developed by Florida Marine Research Institute and NOAA Fisheries. The development of this model is in the early stages and, at present, the precision of the model is low (Behzad Mahmoudi[7], personal communication). Therefore, it would be impracticable to apply the model at this time.

Maintaining the red snapper stock at a larger abundance level relative to the current abundance level could also increases levels of red snapper bycatch. **Alternative 1** would require that the stock be maintained at the smallest size relative to the other alternatives. The stock size supported by **Alternatives 2-5** would be progressively larger. The incidence of bycatch would be expected to be higher at larger population sizes simply because there would be more fish in the water. This would impact both the directed red snapper fishery and the shrimp fishery because red snapper comprises the majority of bycatch in both fisheries (see Section 4.4). It also could impact other finfish fisheries that target co-occurring stocks.

8 .1.3 Direct and indirect effects on social and economic environment and their significance

The discussion of the social and economic implications of the various bundled biological reference points and stock status determination criteria proposed in **Alternatives 1-5** in Sections 4.1.2 and 5.5.1 is incorporated here by reference.

Direct effects: Since establishing SFA parameters merely sets benchmarks against which stock status and fishery conditions are evaluated, none of the SFA parameter alternatives (**Alternatives 1-5**) has any direct consequences in terms of affecting the operations of participants in the red snapper fishery. Direct effects would only accrue to future actions that directly restrict harvest or behavior, should such be necessary.

Indirect effects: While the establishment of SFA parameters produces no direct effects, the levels selected influence the setting of TACs and associated management measures. Overly conservative parameters can lead to greater conservation than necessary and greater short-term socioeconomic loss from forgone yield due to any management restrictions implemented. Conversely, establishing

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[7] Behzad Mahmoudi, Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, St. Petersburg, Florida

insufficiently conservative parameters can produce greater short-term socioeconomic benefits from increased yield, but lead to long-term losses due to the stock being fished to a level less than the true MSY level.

Although **Alternative 1** preserves the short-term socioeconomic conditions in the red snapper fishery, it leaves no clear direction for purposes of conserving and managing the stock. As such, **Alternative 1** does not comply with the provisions of SFA and is, therefore, not a viable alternative. Adoption of **Alternative 1** could, therefore, result in both inadequate benchmarks with which to evaluate future action, and result in litigation as a result of failure to demonstrate proper stewardship and management of the resource.

Each of the other alternatives (**Alternatives 2-5**) specify potentially suitable levels of MSY and corresponding fishing parameters and, therefore, would meet required mandates. Further, all specifications exceed current stock status conditions and would, therefore, equally trigger the need for a recovery plan. What is also notable in all the MSY alternatives and associated bundled parameters is that they all significantly exceed both current and historical landing levels, indicating that substantial and extended recovery is required. At the same time, should successful recovery be achieved, the parameters indicate the substantial benefits that potentially exist from a recovered resource.

8 .1.4 Direct and indirect effects on administrative environment and their significance

Direct effects: Section 2 outlines the history of management of red snapper in the GOM. This stock is one of the most heavily regulated in that region. Commercial fishermen are required to obtain specific licenses to land red snapper (Class 1 and 2) with their reef fish permits. Charter vessel and headboat fishermen also need a reef fish permit to harvest red snapper. In addition, the NOAA Fisheries monitors both commercial and recreational catches to manage their respective catch quotas. The purpose of the five alternative bundles of biological reference points and status determination criteria (**Alternatives 1-5**) is to define a management program that will sustain the red snapper stock over the long term. The TAC levels that would be defined by all the alternatives after the stock rebuilds would likely be different from those prescribed during the rebuilding period and, thus may require that administrators make minor adjustments through the Reef Fish FMP. However, such adjustments would fall within the scope and capacity of the current management system. Therefore, we do not consider such an administrative effect to be significant.

Indirect effects: The only foreseeable indirect effect to the administrative environment associated with **Alternatives 1-5** relates to a potential increase in bycatch that could result from maintaining the stock at a larger abundance level relative to the current abundance level. **Alternative 1** would require that the stock be maintained at the smallest size relative to the other alternatives. The stock size supported by **Alternatives 2-5** would be progressively larger. The incidence of bycatch would be expected to be higher at larger population sizes simply because there would be more fish in the water. This would impact both the directed red snapper fishery and the shrimp fishery because red snapper comprises the majority of bycatch in both fisheries (see Section 4.4). It also could impact other finfish fisheries that target co-occurring stocks. Managing such an increase in bycatch would be expected to place an additional burden on administrators.

8 .1.5 Mitigation measures

The analysis of the range of biological reference point alternatives reveals few significant negative impacts. Selection of the no action alternative (Alternative 1) could have a negative effect on the stock because it would be difficult to define rebuilding goals. Alternatives 2-5 would have negative short-term economic effects on the social and economic environment as they are integral to selecting a rebuilding plan (see Section 8.2.3), and will create a burden on the administrative environment. No alternatives are being considered that would avoid these negative effects because they are a necessary cost associated with the significant benefits of rebuilding red snapper. The fundamental trade-off between these costs and benefits make them impossible to mitigate. Instead, managers must choose an alternative based on balancing the costs and benefits.

8 .2 Rebuilding plan strategies

8 .2.1 Direct and indirect effects on physical environment and their significance

Direct effects: As discussed in Section 8.1.1, the gear used to harvest red snapper by the directed fishery is believed to have only a minor effect on the physical environment. Consequently, there is little difference in the significance of the effects of alternative rebuilding strategies on the physical environment. The magnitude of the effects associated with the various alternatives can be discussed qualitatively in terms of the various levels of fishing effort each would define. Since adverse effects to the physical environment are most likely to be caused by deploying and retrieving fishing gear, these effects should be proportional to measures of fishing effort.

There is no reason to believe that the various rebuilding alternatives would have differential effects on various sectors of the fishing fleet. Consequently, none could be considered to be more or less beneficial than another in terms of regulating the type of gear interactions with the sea floor. All of the alternatives with the exception of **Alternative 1** would require substantial effort reductions in the short term (Figs. 8.2.1-8.2.4), which could result in minor benefits to the physical environment.

Alternatives 3 and 5 would require the greatest initial reductions, immediately reducing the total allowable catch to 6 mp. The level of effort prescribed by **Alternative 5** would remain constant after 2007 when overfishing is projected to end. **Alternative 3** would require a decrease in effort after that time. **Alternatives 1 and 2** would maintain the current TAC of 9.12 mp throughout the rebuilding period. **Alternative 4** would initially set TAC at 9.12 mp, but would allow TAC to increase using a constant fishing mortality rate strategy after overfishing has been halted.

Indirect effects: We do not foresee any indirect effects to the physical environment associated with any of the alternative rebuilding strategies. However, there exists the potential for indirect effects if, for example, fishing activity reduces the populations of species that create living biological structure on the sea floor. In this hypothetical case, excessive damage to these biological structures could limit the populations' ability to regenerate in the future, especially because many structure-forming marine invertebrates have short dispersal phases, and little potential to spread into affected areas (Thorpe et al., 2000). However, our current understanding of the ecosystem is insufficient to predict such impacts with any accuracy. Additionally, the impacts of the gears used in this fishery to the sea bottom are minimal relative to other types of fishing gears (see Section 8.1.1).

8 .2.2 Direct and indirect effects on biological/ecological environment and their significance

Direct effects: The rebuilding strategy alternatives would directly affect the biological and ecological environment by defining the level of harvest that can be taken by the commercial and recreational fisheries. Over the short term, the population is expected to slowly increase (Figs. 4.2.3, 4.2.5, 4.2.7, and 4.2.9) for **Alternatives 2-5**. Because the harvest rate associated with **Alternative 1** is similar to **Alternatives 2 and 4**, any short-term increases in stock size should be similar.

Increases in stock size do provide biological benefits to the stock and include strengthening the stock's ability to sustain itself as well as providing a food resource to species that prey upon red snapper. **Alternative 1** (no action) would provide the least biological/ecological benefits because it sets the rebuilding target lower and would get there through fewer cuts in harvest, and thus slower growth in the red snapper stock than other alternatives. **Alternatives 2-5** would all rely on the same target, so their long-term benefits would be equivalent as long as each eventually achieved rebuilding. Among these, **Alternative 3** would rebuild the stock most quickly, followed closely by **Preferred Alternative 2**, and more distantly by **Alternatives 5 and 4**, respectively. In rebuilding more quickly, **Alternatives 2 (preferred) and 3** would provide more immediate biological/ecological benefits than **Alternatives 4 and 5**. An effect of the red snapper stock increasing (described in Section 4.4) is the likelihood of a greater bycatch of red snapper in the directed and non-directed fisheries. Red snapper bycatch in the directed fishery and other reef fish fisheries will occur generally as regulatory discards.

Indirect effects: While the rebuilding the red snapper stock to MSY abundance levels (B_{MSY}) will generally have a positive effect on red snapper (the stock size will increase), the indirect effects on the biological/ecological environment are uncertain. As discussed in Section 8.2.2, increases in red snapper abundance could have positive or negative effects on other species; however, our ability to predict these effects are impracticable until adequate models showing species' interactions are developed.

As described in Section 4.2.2, the rebuilding of red snapper is very dependent on the degree of bycatch reduction in the shrimp fishery. The degree of these effects is dependent on how the alternatives are designed to allow the red snapper stock to grow in size. At present, the red snapper stock is estimated to be below 10 percent of B_{MSY}, which is also the target of rebuilding for **Alternatives 2-5**. Even **Alternative 1** would achieve substantial increases in red snapper abundance.

8 .2.3 Direct and indirect effects on social and economic environment and their significance

Direct effects: A discussion of the social and economic effects of the various rebuilding strategies can be found in Section 4.2, Section 5, and Section 6, and is incorporated herein by reference. In summary, all the alternatives except the no action alternative (**Alternative 1**) would enhance the long-term viability of both the commercial and recreational sectors of the red snapper fishery by establishing a plan to rebuild the stock. **Alternative 1** is not considered a viable rebuilding plan since it is based on SFA parameters that have been determined to be insufficient. Each of the other alternatives would allow increased expectations of enhanced commercial and recreational opportunities in the future. Two alternatives, **Alternatives 3 and 5**, would require reductions in TAC to 6.0 mp, thereby imposing immediate reductions in harvest revenues to the commercial sector, consumer surplus to recreational anglers, and net revenues to the for-hire sector. These reductions would be long-term in the case of **Alternative 3** and short-term for **Alternative 5**. **Preferred Alternative 2** would allow the current TAC to remain throughout the recovery period. Therefore, in relation to the direct effects of **Alternative 2**, **Alternative 3** would produce losses of approximately \$16 million, \$71 million, and \$1,103 million in commercial net revenues, for-hire net revenues, and recreational consumer surplus, respectively. Gains under **Alternative 4** relative to **Alternative 2** range from \$21-\$23 million in commercial net revenues, \$108-\$149 million in for-hire net revenues, and \$1,658-\$2,305 million in recreational consumer surplus under assumptions of 30 percent and 50 percent shrimp effort reduction, respectively. The respective figures for **Alternative 5** relative to **Preferred Alternative 2** range from gains of \$17-\$20 million in commercial net revenues, \$45-\$60 million in for-hire net revenues, and \$677-\$1,033 million in recreational consumer surplus.

Indirect effects: For those alternatives that require reductions in TAC, **Alternatives 3 and 5**, the expected reductions in net revenues and consumer surplus would be expected to have subsequent adverse spillover effects in associated businesses and communities. Expected conditions would appear worse under **Alternative 3**, since the TAC reduction and associated losses are persistent throughout the recovery period. However, the short-term losses under **Alternative 5** may be sufficiently severe so as to substantially eliminate the opportunity of some current participants surviving in the fishery long enough to benefit from the subsequent increased TACs. Additionally, depending on the methodology employed to constrain the recreational sector to its allocation, additional reductions in consumer surplus and lost for-hire revenues due to trip cancellation could result, leading to increased losses over those described. Conversely, as the stocks recover and TACs increase, harvests and revenues increase, along with angler trips and for-hire receipts, these increases would similarly ripple through the economic and social structures of those that are in some way linked to the fishery. These long-term positive effects of the various rebuilding alternatives would enhance business and recreational opportunities of the support industries and fishing communities. One other important fishing sector that would be eventually affected by red snapper rebuilding plan alternatives is the commercial shrimp fishery. Since a significant portion of red snapper bycatch is attributed to the shrimp fishery, recovery (or failure to recover) the red snapper stock would be expected to have implication on the presence or absence of additional restrictions on the shrimp fishery.

8 .2.4 Direct and indirect effects on administrative environment and their significance

Direct effects: As outlined in Section 3 in the history of management, red snapper are one of the most heavily regulated fisheries in the GOM. Commercial fishermen need specific licenses to land red snapper (Class 1 and 2) with their reef fish permits. Charter vessel and headboat fishermen need a reef fish permit to harvest red snapper. In addition, the NOAA Fisheries monitors both commercial and recreational catches for quota management. The five alternative rebuilding strategies specify harvest levels that are predicted to rebuild the stock to B_{MSY} over the various time frames. **Alternatives 3 and 5** would cut TAC from 9.12 to 6 mp in 2005. **Alternatives 2 (preferred) and 3** would require potentially significant regulatory efforts to limit effort to maintain constant catches in the face of a growing red snapper population.

Indirect effects: The principal indirect effect that could pose a challenge to the administrative environment is bycatch in other finfish fisheries. As the red snapper stock grows, the chances of red snapper being caught by fishers targeting other species will increase. As red snapper become harder to avoid, the effort reductions necessary to rebuild them would affect fishers targeting other species. Either they will be forced to discard the red snapper. Or, they will be forced to change their fishing behavior and possibly end fishing earlier than they would have in order to minimize their impacts on red snapper. Because of the effort reductions they would require, **Alternatives 2 and 3** have the greatest potential to cause this indirect effect.

8 .2.5 Mitigation measures

The analysis of the range of rebuilding strategy alternatives reveals only two significant negative impacts. Regardless of which alternative is selected, we expect the process of rebuilding red snapper will have negative short-term economic effects on the social and economic environment, and will create a burden on the administrative environment. No alternatives are being considered that would avoid these negative effects because they are a necessary cost associated with the significant benefits of rebuilding red snapper. Indeed, the alternatives include a range from alternatives that have less short-term economic costs and administrative burdens but would provide smaller and more delayed long-term benefits to alternatives that have greater negative effects but provide more immediate long-term biological/ecological, social, and economic benefits. The fundamental trade-off between these costs and benefits make them impossible to mitigate. Instead, managers must choose an alternative based on balancing the costs and benefits.

8 .3 Bycatch reporting methodology

8.3.1 Commercial and recreational for-hire fisheries

8 .3.1.1 Direct and indirect effects on physical environment and their significance

Direct effects: If the alternatives change fishing behavior, the interaction between the fishing gear and the physical environment could change. Fishermen are very unlikely to change the vessels, gear or decisions they make on when or where to fish based on requirements to report harvest or bycatch. Commercial and for-hire captains will fish where they believe the profit-margin is best for them. It is possible, although unlikely, that a fisherman might alter their fishing behavior with an observer on board (**preferred Alternative 4**). However, the impact of such a change would be difficult to measure. Socioeconomic gains from fishing in fish-poor areas with an observer would have to overcome fishing in a fish-rich area for this fishing behavior to shift. Therefore, the selection of any of the **Alternatives 1-6** for bycatch reporting will have no direct measurable effect on the physical environment.

Indirect effects: Because fishermen are unlikely to change their behavior related to fishing gear impacting the bottom as a result of bycatch reporting requirements, any future, foreseeable impacts to the physical environment as a result of bycatch reporting requirements is unlikely and not measurable. Therefore, the selection of any of **Alternatives 1-6** for bycatch reporting will not be expected to indirectly effect the physical environment.

8 .3.1.2 Direct and indirect effects on biological/ecological environment and their significance

Direct effects: For bycatch reporting requirements to have a direct effect on the biological/ecological environment, commercial and for-hire fishermen would have to change fishing behavior. This is very unlikely and not measurable (see Section 8.3.1.1). Therefore, the selection of any of the **Alternatives 1-6** for bycatch reporting is not expected to directly effect the biological/ecological environment.

Indirect effects: Any improvement in the methods for enumeration and species composition of bycatch from the directed reef fish fishery will have an indirect and positive effect on red snapper resources and all other reef fish fishery resources in the GOM. This will occur primarily through the development of more accurate stock assessments which, in turn, should give the public and resource managers more confidence in the results and lead to better and more consistent regulations. Additionally, enhanced bycatch monitoring will bring the assessment process one step closer to multi-species assessments since management measures with respect to gear and effort for one target species can affect fishing mortality on another target species. Unfortunately, bycatch from the shrimp fishery of the GOM has such an enormous impact on the red snapper stock that any improvements in bycatch enumeration from the directed fishery will have no significant impact on the stock. As red snapper bycatch in the shrimp fishery is reduced and red snapper stock size increases, the impacts of bycatch in the directed fishery will become more important. **Alternatives 2-6** each will have a positive impact on the accuracy of bycatch enumeration and thus would improve the assessment process, whereas **Alternative 1 (No Action)** provides no improvement.

Preferred Alternative 4 would provide the most accurate bycatch enumeration for each vessel trip sampled because bycatch would be directly observed. However, other information about effort across a wide variety of strata would need to be used to estimate total bycatch. Improvements in the accuracy of Gulf-wide estimates of bycatch will depend on how well the sampled trips represent all trips in the Gulf. **Alternatives 2 and 5** use self reporting methodologies which are less reliable than direct observation, particularly for discards, but they are each a census of all permit holders and thus should provide good estimates of harvest and effort. Harvest and effort should be verifiable through various mandatory trip ticket programs administered by the states. However, there is no current method to verify bycatch in the directed reef fish fishery. **Alternatives 3 and 6 (preferred)** are self-reporting methods but unlike **Alternatives 2 and 5**, they would use scientific survey techniques to estimate harvest and bycatch by strata and must rely on estimates of numbers of trips by strata from some other source such as trip tickets for **Alternative 3** or MRFSS telephone intercepts for **Alternative 6.**

8 .3.1.3 Direct and indirect effects on social and economic environment and their significance

Direct effects: A discussion of the social and economic effects of the various bycatch reporting measures can be found in Section 4.2, Section 5, and Section 6, and is incorporated herein by reference. In summary, the direct effects of each bycatch reporting alternative, other than the no action alternative, relate to the costs they would impose on fishing participants. Electronic or paper logbook reporting proposed in **Alternatives 2, 3, and 5** imposes additional reporting burden on fishing participants as well as additional cost outlay if vessels have to share in the cost of these reporting programs. An observer program (**Alternative 4**) is an intrusive data collection system, and thus is likely to create adverse social effects in addition to economic effects. In particular, an observer program can give rise to friction between fishermen and fishery managers. A mandatory observer program would only worsen the situation, although it would lessen sampling bias. In addition, fishermen do not like to take observers on board for a variety of reasons. Some may fear liability for the safety of observers and others feel that observers are simply a nuisance because they are “in the way.” In the particular case of health and safety, an observer program would expose fishermen to the risk that their fishing craft may not be adequately equipped to carry an extra person, although this may be partly addressed by the requirement imposed under Section 403 (a) of the MSFCMA regarding the health and safety of observers. Others do not trust that observer information can be kept confidential. Among the alternatives considered, the status quo (**Alternative 1**) would impose the least additional costs on the fishery and associated communities (zero), whereas a mandatory electronic logbook program (**Alternative 2**) would likely have the greatest total cost to the fishery, assuming participants were required to bear the costs, due to the expense of the equipment.

Indirect effects: There are two general types of indirect effects associated with all of the bycatch reporting alternatives. The first type of effect is that once a program is adopted, especially if successful in generating the needed bycatch information, it increases the likelihood that the methodology is extended to other fisheries or fishing participants. In that event, the impacts on social and economic environment would be similar to those described above as direct effects. The second type of indirect effects is the benefits that accrue to the receipt and use of the data in supporting improved management of the resources, leading to the benefits of a healthy and sustained fishery. The presumption of management and data collection is that the benefits of this improved management exceed the costs of collection and management.

8 .3.1.4 Direct and indirect effects on administrative environment and their significance

Direct effects: Any modification to existing bycatch monitoring requirements would directly alter the administrative environment of NOAA Fisheries. **Alternatives 2 and 3** would require the use of electronic logbooks on board reef fish permitted vessels. NOAA Fisheries currently has a paper logbook program for 100 percent of the commercial permit holders. Charter vessels and headboats do not currently report via logbooks. Changes to an electronic logbook would significantly complicate the distribution of supplies (equipment and maintenance) and would require new procedures and requirements for submitting logbook reports. The cost of equipment can range from $750 to well over $2,000. There are currently about 1150 active commercial reef fish permit holders and another 1550 active recreational for-hire permit holders. Initial costs to fully implement an electronic logbook under **Alternative 2** would be between $2 million and $5 million, or for **Alternative 3,** the cost would be about 20 percent of that or $0.4 million to $1 million. There will be annual maintenance, repair and replacement costs that may reach 10 percent of the initial equipment costs annually. It is obvious that these alternative methodologies could not be implemented in one year even if the funds were available because the new technology for the Gulf would have to be tested in pilot programs first. Since the funds are not available at this time, the only prudent way to implement such a program is over a three to five year period. The data management costs to NOAA Fisheries for electronic logbooks will probably be the same or less than the current requirements for the paper logbooks because the data will already be digitized and QA/QC at the data entry level should reduce the number of entry errors. **Preferred Alternative 4** would add a new program, requiring either the management of a contract or new federal personnel, forms and equipment, none of which are available at this time. Overall costs for such a program are itemized in NWGB document, Evaluating Bycatch (NOAA Fisheries, 2003b). The estimated overall costs as summarized in Table 4.1 are about $6 million. **Alternative 5** would require minor change within NOAA Fisheries. The personnel and procedures, including forms, data entry, QA/QC and computer programs are all available. **Preferred Alternative 4** would at least double the number of reports submitted to NOAA Fisheries which would increase the data entry cost but possibly little else. **Preferred Alternative 6** is likely to have the least impact to NOAA Fisheries' administrative environment. MRFSS techniques for sampling charter vessels have been in place for three years. NOAA Fisheries is already testing this sampling methodology for headboats in the South Atlantic and Gulf and may switch once side-by-side comparisons have been done. Monies currently applied to headboat sampling which does not include discards could then be applied to the new methodology. **Alternative 1** would have no direct impact on the administrative environment of NOAA Fisheries.

Indirect effects: Other programs within NOAA Fisheries could suffer as a result of additional administrative burden due to new bycatch reporting requirements if no new funding is available. **Alternatives 2-5** have substantial costs associated with them ($400,000 to $6 million). NOAA Fisheries may be able to re-program some funds by prioritizing current programs based on some criteria such as clear Congressional mandates. Otherwise all programs including research and other monitoring programs would need to be weighed against one another within the funding constraints of NOAA Fisheries.

8 .3.1.5 Mitigation measures

There are no mitigation measures being proposed to offset the costs of **Alternatives 1-6**. These bycatch reporting methodologies are dependent on NOAA Fisheries being able to provide funding to cover the program costs. Because FMP amendments can not re-prioritize existing NOAA Fisheries funds or provide new resources, the implementation of these methodologies will be dependent on available funds.

8 .3.2 Private recreational fishery

8 .3.2.1 Direct and indirect effects on physical environment and their significance

Direct effects: If the alternatives change fishing behavior, the interaction between the fishing gear and the physical environment could change. Fishermen are very unlikely to change the vessels, gear or decisions they make on when or where to fish based on requirements to report harvest or bycatch. Private recreational fishermen will fish where they believe their efforts will provide the best catch. Therefore, the selection of any of the **Alternatives 1-3** for bycatch reporting will have no direct measurable effect on the physical environment.

Indirect effects: Since fishermen are unlikely to change their behavior related to fishing gear impacting the bottom as a result of bycatch reporting requirements, any future, foreseeable impacts to the physical environment as a result of bycatch reporting requirements is unlikely and not measurable. Therefore, the selection of any of the **Alternatives 1-3** for bycatch reporting will not be expected to indirectly effect the physical environment.

8 .3.2.2 Direct and indirect effects on biological/ecological environment and their significance

Direct effects: For bycatch reporting requirements to have a direct effect on the biological/ecological environment, recreational fishermen would have to change fishing behavior. This is very unlikely and not measurable (see 8.3.2.1). Therefore, the selection of any of the **Alternatives 1-3** for bycatch reporting will have no direct effect on the biological/ ecological environment in the GOM.

Indirect effects: Any improvement in the methods for enumeration and species composition of bycatch from the directed reef fish fishery will have an indirect and positive effect on red snapper resources and all other reef fish fishery resources in the GOM (see Section 8.3.2.1). **Alternatives 2 and 3** each will have a positive impact on the accuracy of bycatch enumeration and thus would improve the assessment process, whereas **Preferred Alternative 1 (No Action)** provides no improvement.

8 .3.2.3 Direct and indirect effects on social and economic environment and their significance

Direct effects: A discussion of the social and economic effects of the various bycatch reporting measures can be found in Section 4.2, Section 5, and Section 6, and is incorporated herein by reference. In summary, the direct effects of each bycatch reporting alternative, other than the no action alternative, relate to the costs they would impose on fishing participants. Logbook reporting imposes additional reporting burden on fishing participants. **Alternative 2** would also cost recreational anglers extra money for a federal fishing permit. Both **Alternative 2 and 3** would shift part of the current cost of collecting catch and bycatch information from the government to fishing participants. **Alternative 2** would impose the largest costs and time burden on the fishery participants, though the effects should not be sufficiently great so as to result in cessation of fishing participation. Therefore, no substantial adverse direct effects are expected.

Indirect effects: There are two general types of indirect effects of the adoption of any of the bycatch reporting alternatives. The first type of effect is that once a program is adopted, especially if successful in generating the needed bycatch information, it increases the likelihood that the methodology is extended to other fisheries or fishing participants. In that event, the impacts on social and economic environment would be similar to those described above as direct effects. The second type of indirect effects is the benefits that accrue to the receipt and use of the data in supporting improved management of the resources, leading to the benefits of a healthy and sustained fishery. The presumption of management and data collection is that the benefits of this improved management exceed the costs of collection and management.

8 .3.2.4 Direct and indirect effects on administrative environment and their significance

Direct effects: Any modification to existing bycatch monitoring requirements as provided for in **Preferred Alternative 1** would directly alter the administrative environment of NOAA Fisheries. Alternative 1 provides an adequate level of precision in red snapper recreational catch estimates for fishery stock assessments (see Section 4.3.2.4) without additional costs to fisheries management. **Alternative 2** has a significant effect on NOAA Fisheries. NOAA Fisheries would have to implement a new license for recreational fishermen. This has been discussed in the past and created considerable debate with states who have a saltwater fishing license and who believe that any new federal recreational license would cause a reduction in number of state licenses sold. Additionally, new staff and web-based applications would be required to handle the several million license applications that would be expected. New databases would have to be built to handle the volume of data. However, there are service companies that will contract to manage fishing licenses through point-of-sales and web applications and charge about a $1.50 per license that would be borne by the licensee. There are a number of Gulf states that currently use such service companies for their fishing license management. **Alternative 3** would have a minor impact on NOAA Fisheries provided that recreational surveys of state licensed fishers were not needed to find volunteers. There might be no more than several hundred volunteers and average numbers of trips per year per volunteer would likely be under 25; the data base and management of same would be minimal.

Indirect effects: Other programs within NOAA Fisheries could suffer as a result of additional administrative burden due to mandated new bycatch reporting requirements if no new funding is available. **Alternatives 2 and 3** would require resources for surveys, data collection, and analysis. NOAA Fisheries may be able to re-program some funds by prioritizing current programs based on some criteria such as clear Congressional mandates. Otherwise all programs including research and other monitoring programs may suffer if an unfunded alternative were to be implemented. **Preferred Alternative 1** (no action) would continue to collect bycatch information without affecting other programs.

8 .3.2.5 Mitigation measures

There are no mitigation measures being proposed for **Alternative 1-3**. These bycatch reporting methodologies are dependent on NOAA Fisheries being able to provide funding to cover the program costs. Because FMP amendments can not re-prioritize existing NOAA Fisheries funds or provide new resources, the implementation of these methodologies will be dependent on available funds.

8 .4 Cumulative effects analysis

Principles of Cumulative Effects Analysis

Cumulative effects were evaluated in light of eight guiding principles promulgated by the Council on Environmental Quality in its 1997 handbook, <u>Considering Cumulative Effects Under the National Environmental Policy Act</u>. The handbook notes that although agencies routinely address direct and indirect effects of their proposed actions on the environment, analyzing cumulative effects is more challenging, mainly due to the difficulty in defining geographic (spatial) and time (temporal) boundaries. The eight principles are as follows:

1. Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions.

2. Cumulative effects are the total effect, including both direct and indirect effects, on a given

resource, ecosystem, and human community of all actions taken, no matter who (federal, nonfederal, or private) has taken the actions.

3. Cumulative effects need to be analyzed in terms of the specific resource, ecosystem, and human community being affected.

4. It is not practical to analyze the cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful.

5. Cumulative effects on a given resource, ecosystem, and human community are rarely aligned with political or administrative boundaries.

6. Cumulative effects may result from the accumulation of similar effects or the synergistic interaction of different effects.

7. Cumulative effects may last for many years beyond the life of the action that caused the effects.

8. Each affected resource, ecosystem, and human community must be analyzed in terms of its capacity to accommodate additional effects, based on its own time and space parameters.

The CEQ regulations (40 CFR 1508.7) define cumulative impacts as "The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." Past actions on red snapper are summarized in Section 2.0 and are summarized here.

Actions that effect fishing such as bag limits, size limits, and seasonal limits will have effects on how fishing is conducted, and so will likely have effects on the physical environment. Status determination criteria and rebuilding plan alternatives, because they are setting harvest goals, could affect fishing behavior because further regulations may be needed. The Council is currently evaluating a red snapper IFQ system for the directed commercial red snapper fishery. If this system is implemented, commercial vessels may become more efficient in how they harvest red snapper because vessel operators will more flexibility in choosing when and where they fish (NRC, 1999). This increased efficiency could minimize the amount of gear used by the fishery and reduce the impacts on the bottom.

Probably the most significant cumulative effect on the red snapper fishery is shrimp trawl bycatch. In large part, this occurs because the EFH for juvenile red snapper and brown shrimp in the Gulf of Mexico overlap to a great extent (Figs. 8.4.1 and 8.4.2). As described in Section 4.2, the current estimate of the red snapper stock size is about 7 percent of B_{MSY}. The principal element deterring recovery of the stocks is the high mortality of 0- and 1-age classes caught in shrimp trawls as bycatch. These young recruits inhabit open bottom along with penaeid shrimp, moving to the more secure reef habitat when they reach 15 to 20 cm, about one year after they are spawned. Should future actions be directed at effort in the shrimp fishery to assist in the rebuilding of red snapper, gear impacts by shrimp trawls on the physical habitat may be reduced. Additionally, there exists the potential for ecological changes resulting from nutrient additions and from loss of structure due to bottom trawls. However, there is no reason to believe that these potential negative effects would be exacerbated or reduced by the implementation of any of the alternative biological references points or rebuilding plans.

Bycatch reporting methodologies should not have cumulative effects on the physical environment because they should not change the behavior of fishermen in how they fish. However, as a result of better assessment and management, there is a possibility that the biological/ecological environment would improve as benthic and demersal ecosystem species may become more naturally balanced as overfished species are returned to a healthy state. It is also possible that imbalances will occur with negative impacts unless anthropogenic changes (including management) occur in the right order in relation to biomass levels of competitors, predators and prey. There are very limited data to support these kinds of analyses and there would be major costs to obtain such information reliably enough to make single species management decisions based on ecosystem impacts at this time. These kinds of ecosystem-based models are being developed and tested in both the Gulf and Atlantic.

Cumulative effects of setting the various bundled biological reference points and stock status determination criteria proposed in Alternatives 2-5 (Alternative 1 does not relate to any rebuilding plans), and the rebuilding plan alternatives should have a generally positive effect to the biological/ecological environment. This is because these measures call for an increase in the stock size to a level allowing a sustainable harvest. However, as stated in Section 4.2 , the red snapper stock is not projected to rebuild to B_{MSY} unless there is at least a 40 percent reduction in juvenile red snapper bycatch and 6 percent reduction in effort by the shrimp fishery. Amendment 9 to the Shrimp FMP implemented the use of bycatch reduction devices (BRDs) in shrimp trawls in the western Gulf of Mexico. Shrimp Amendment 10 extends the requirement of BRDs into the eastern Gulf of Mexico. Currently, this amendment is under final review. Recently implemented Shrimp Amendment 11 requires shrimp vessels fishing in the EEZ to have permits (considered the first step to effort limitation). The Council is also working on two additional amendments to the shrimp plan. Amendment 13 includes alternatives to better obtain bycatch and effort data. Amendment 14 contains alternatives for vessel monitoring systems (VMS) which could allow for closed areas, and effort reduction that could ultimately reduce bycatch.

Current management actions in the Reef Fish FMP, as summarized in Section 2, should allow the stock to rebuild. The ultimate stock size that it rebuilds to is dependent on the biology of red snapper, which is currently considered uncertain as evidenced by the wide range of MSY and B_{MSY} between Alternatives 2-5 for the bundled biological reference points. As the red snapper stock is being rebuilt, the increase in the stock size may affect other stocks. Rebuilding plans are in effect for greater amberjack (Secretarial Amendment 2) and being put in place for red grouper (Secretarial Amendment 1) and vermilion snapper (Amendment 23). Because red snapper, red grouper, greater amberjack, and to a certain extent, vermilion snapper are upper level predators preying primarily on fish, benthic invertebrates, and in some cases, squid (Moran, 1988; Nelson, 1988; Bullock and Smith,1991; Andovora and Pipitone, 1997), the degree of competition for food resources between these species may increase as stock abundance increases. In addition, red snapper may begin to compete for habitat with vermilion snapper and red grouper (primarily in the eastern Gulf of Mexico) as their respective stocks rebuild. Public testimony from hearings conducted to examine vermilion snapper management measures suggests that vermilion and red snapper may compete directly for resources as adults and that adult red snapper prey on juvenile vermilion snapper. To assess potential competition, complex models would need to be developed. Currently, one of the best models for the Gulf of Mexico that could address these issues is the Ecopath model being developed by FMRI and NMFS. The development of this model is in the early stages and at present, the precision of the model is low. Therefore, an analysis of these potential cumulative effects is not possible at this time.

Cumulative effects of the red snapper fishery on the biological/ecological environment are derived from the interaction of the alternatives with existing and proposed regulations, and with the interaction of the alternatives with other fishing activities affecting the same environment. There are a number of existing and proposed regulations that facilitate rebuilding of red snapper. For example, the current list of allowable gear is relatively selective, thus facilitating the management of red snapper independently of other fisheries. Additionally, the Council is putting together a ballot process that, if approved by a majority of fishing interests, would lead to the development of an IFQ system. By granting individual fishermen rights to a certain share of the quota, this system could reduce bycatch and facilitate the effort reductions in the red snapper fishery that are likely to be necessary. In sum, existing regulations offer the potential to make the chosen rebuilding plan alternative easier to achieve, but there do not appear to be significant differences within the alternatives.

Interactions with other fisheries are another matter. In particular, there is a significant and ongoing conflict between the red snapper and shrimp fisheries based on their cumulative impacts on the red snapper stock. As has been demonstrated in this document, rebuilding of the red snapper stock is more conditional on reductions of bycatch in the shrimp fishery than it is on reductions on the directed red snapper fishery. While the range of alternatives here encompass varying degrees of restriction on the directed fishery both initially and over time, they all rely heavily on assumed reductions of bycatch in the shrimp fishery to achieve rebuilding in the specified time frame. This linkage is nowhere more apparent than in the fact that red snapper are not predicted to rebuild, even with no directed fishery, unless bycatch of red snapper is reduced in the shrimp fishery (Fig. 4.2.1).

Rather than accentuating differences between alternatives, this cumulative effect diminishes them. The bulk of the changes that make red snapper rebuilding come from existing gear restrictions on shrimp vessels and expected large reductions in the shrimp fleet. Compared to the magnitude of these effects, the directed fishery has relatively little influence on the health of the red snapper stock at current directed fishing rates. The Council has implemented or is examining changes to the shrimp fishery that should allow for the needed reductions in bycatch. Amendment 9 to the Shrimp FMP implemented the use of BRDs in shrimp trawls in the western Gulf of Mexico. Amendment 10 extends the requirement of BRDs into the eastern Gulf of Mexico and is currently under final review. Recently implemented Shrimp Amendment 11 requires shrimp vessels fishing in the EEZ to have permits. Permits are considered the first step to effort limitation. The Council is also working on two additional amendments to the shrimp plan. Amendment 13 includes alternatives to better obtain bycatch and effort data. Amendment 14 contains alternatives for vessel monitoring systems (VMS) that could allow for closed areas, and effort reduction that could ultimately reduce bycatch.

There is one way in which changes in the shrimp fishery could make red snapper recovery more difficult. Red snapper population growth is very dependent on bycatch reductions in the shrimp fishery. This makes management of red snapper more difficult, particularly during rebuilding. These changes in shrimp effort are expected to allow the red snapper stock to grow rapidly in size. Maintaining TAC in the directed fishery could become difficult while the stock is growing. Analyses would suggest that effort in the directed fishery will need to be reduced to between a quarter and third of current levels in the long-term (Figs. 8.2.1-8.2.4). For rebuilding plan Alternatives 2 and 3, effort might have to be reduced to one-tenth of current levels temporarily (Figs. 8.2.1-8.2.2).

To the extent that a rebuilding strategy for red snapper is successful, regulations undertaken in the short-run can result in improving fishing opportunities in the future and have a positive effect on the social and economic environment. If future benefits from rebuilding the red snapper stock are large enough to offset negative impacts due to past and current actions, the compound effects of regulations would result in improving fishing participation in the red snapper fishery. The potentially large pay-off in terms of potential future yield from the red snapper fishery, as can be inferred from the various MSY levels provided by the biological reference point alternatives, offers a good chance that the net effect of past, present and future regulations affecting the red snapper fishery would be positive. The preferred alternative for rebuilding the red snapper stock preserves current situation in the fishery while at the same is expected to rebuild the red snapper stock. This is a relatively rare case where there is no adverse impacts in the short-run but the long-run scenario provides opportunities for expansion of economic and social activities in the red snapper fishery.

If the current regulatory regime of fixed seasonal closures for the recreational sector is maintained over time, a rebuilding stock would only result in this sector exceeding its quota by larger and larger amounts. This could only negate the effort to rebuild the stock, unless the excess can be accommodated by the expanding stock size such that the rebuilding schedule is on track. But if such were the case, it would be better to just increase TAC and recreational quota over time. The preferred strategy does this but the increases in TAC occur only relatively far into the future. In the intervening years, overruns can occur. And if more restrictions are imposed, the recreational fishery would only suffer more negative economic and social impacts. It appears then that in the intervening years before the TAC is increased, some form of effort control that does not make the fishery inefficient may have to be adopted for this sector. A similar situation can occur in the commercial sector. In fact, the situation may be worse since this sector is basically governed by quota closures, although at relatively fixed date per year. The current approach to adopt an ITQ program for the fishery is in the right direction.

From a social and economic perspective, additional bycatch reporting requirements increase the cost of fishing operations and/or use time that previously was spent pursuing other business or leisure activities in the commercial and for-hire fisheries. This leads to a deterioration of the general quality of life. If more intrusive programs, such as an observer program, are instituted disruptions in fishing operations can occur. Additionally, the presence of a non-worker in the boat can potentially create frictions not only among individuals aboard the vessel but also among fishermen and fishery managers. Conversely, should the collection of this information support healthier conditions in the resource and fishery, the benefits associated with such may exceed the additional burden imposed.

For the recreational fishery, additional bycatch reporting requirements increase the cost of fishing and/or use time that previously was spent pursuing other leisure activities. This leads to a deterioration of the general quality of life. Conversely, should the collection of this information support healthier conditions in the resource and fishery, the benefits associated with such may exceed the additional burden imposed. Alternative 2 or 3 for recreational bycatch reporting would also place an additional burden on fishing participants, particularly those that would by chance happen to also be sampled under the current MRFSS program. It is possible, though, that such a situation will be kept to a minimum when designing a sample for logbook reporting under Alternative 2 or 3. In the particular case of Alternative 3, which only samples those on the volunteer list for logbook reporting, any additional reporting burden may be considered inconsequential as the persons involved would have agreed to participate with the knowledge of the burden that a volunteer logbook program entails.

Cumulative effects on the administrative environment should be minimal for the alternatives presented for biological reference points and rebuilding plans. While the stock size should increase during the rebuilding period, the administrative environment should not change. Permits are currently issued to various fishermen and the red snapper quota is monitored by NOAA Fisheries. However, the Council is examining an IFQ system for the commercial red snapper fishery. Should this system be implemented, the administrative environment could become more complex. At this time, there are no cost estimates either for time or money for implementing the IFQ system.

Cumulative effects of bycatch monitoring on the administrative environment are an extension of the indirect effects (Sections 8.3.1.1.4 and 8.3.2.1.4). Each time an unfunded mandate is added to

NOAA Fisheries duties; either the most recent mandate is not implemented, re-programming must take place or other programs have to live with fewer resources. The impact of spreading available resources thinner in the long-term is that results using the available information from all programs are less accurate, possibly to the point of being unusable.

Overall, cumulative effects from the actions proposed in this amendment are dependent on future actions within the directed and shrimp fisheries. The alternatives for biological reference points and rebuilding plans generally effect the physical, biological, ecological, and economic environments more than the social and administrative environment. While increasing the stock size is beneficial to the red snapper stock and directed fishery, how this increase will affect interactions between the stock and other fish populations is highly speculative. Bycatch reporting requirements would generally effect the social and administrative environments more than the other aspects of the fishery.

8 .5 Unavoidable adverse effects

8 .5.1 Red snapper biological reference points and status determination criteria alternatives

MSY, OY, MSST, and MFMT are intended to provide fishery managers with measures of a fishery's status and performance. As such, they provide guidance on how large the stock should be to sustain catches over the long term and what level of harvest will maintain or restore the stock to that level. For overfished stocks such as red snapper, these values have little short-term value in that the rebuilding plan will dictate harvest rates and TAC. However, they do provide the goals necessary for the stock to rebuild to.

The effects of the biological reference points and status determination criteria alternatives are primarily positive in that the goals set for the stock require the stock to increase in size. Effects from these alternatives result more in how the stock is being rebuilt and the underlying assumptions about the stock's productivity. At higher red snapper population sizes, there could be changes in the prey and competitor population dynamics from more red snapper bycatch. Also, with increased harvest rates, there could be more gear interactions with the bottom. However, these effects are thought to be minimal.

Because **Alternatives 2 through 5** are defined to reflect various assumptions about stock productivity, possible adverse effects include economic losses associated from forgone yield if the stock is more productive than what is reflected in the chosen alternative. If, on the other hand, the stock is less productive than what is reflected in the chosen alternative, the level of F dictated by the rebuilding plan would be higher than that which would allow the stock to rebuild. The stock would then be fished at levels above F_{MSY} and would not be able to maintain B_{MSY}.

8 .5.2 Red snapper rebuilding plan alternatives

All the alternatives presented for rebuilding plans have an overall positive effect on the stock because they call for increasing the stock size. Adverse effects, which are thought to be minimal, include possible increased gear interactions with bottom as TAC is increased (**Alternatives 4 and 5**), effects on both prey and species that compete with red snapper for resources as the red snapper stock size increases, possible increases in red snapper bycatch as the stock size increases, lower economic gains where initial TACs are reduced (**Alternatives 3 and 5**), and increased regulatory actions to limit fishing effort as the red snapper population gets larger (**Alternatives 2 and 4**). However, the latter two effects would be temporary because they are constrained to the rebuilding period.

8 .5.3 Alternatives for bycatch reporting methodologies for the commercial and recreational for-hire fisheries

All the alternatives should have no or little effect on the physical and biological/ecological environments. For **Alternatives 2, 3, 5, and 6**, commercial and for-hire recreational fishermen are being asked to increase their time-burden to record information on bycatch. For **Alternative 4**, they are being asked to carry an observer onboard their vessel which could be seen as intrusive to their operations and could seen as an adverse effect. From an administrative viewpoint, these programs could be viewed as having adverse effects because they would require extra costs (particularly for electronic logbooks and observers) which would need to be evaluated with the need for other programs by NOAA Fisheries. However, if the management benefits from the bycatch data collection and management for all the alternatives outweigh the cost of data collection (both in time and in monetary cost), then these programs will be beneficial.

8 .5.4 Alternatives for bycatch reporting methodologies for the private recreational fishery

All the alternatives should have no or little effect on the physical and biological environments. **Alternatives 2 and 3** would incur costs by recreational fishermen; although, for **Alternative 3**, these costs would be voluntary. From an administrative viewpoint, these programs could be viewed as having adverse effects because they would require extra costs and would require new programs to be which would need to be budgeted for and established by NOAA Fisheries. However, if the management benefits from the bycatch data collection and management for all the alternatives outweigh the cost of data collection (both in time and in monetary cost), then these programs would be beneficial

8 .6 Relationship between short-term uses and long-term productivity

For this analysis, short term is defined as the period during which the stock is being rebuilt (2001-2032), and long term is defined as the time period after the stock has been rebuilt (2033 on). Biological reference points and status determination criteria affect short-term productivity by setting the rebuilding target would be used to set TAC and determine the status of the stock relative to overfishing and overfished conditions. It should be noted that these values will change as the stock is assessed at five-year intervals and after the stock is rebuilt, so that the rebuilding target may change with time.

Alternatives for the red snapper rebuilding plan mostly affect the short-term productivity of the stock. The plan selected will set the TAC over the rebuilding time period. As mentioned in the previous paragraph, as the stock is assessed at five-year intervals, this plan may be modified to take into account new information. As discussed in Section 4.2.1.1, the red snapper stock assessment is highly uncertain about what level the stock needs to rebuild to because information does not exist at higher population levels. As the stock rebuilds, new information will be available for the periodic assessments and the stock status will be further refined. It should be mentioned that short-term adverse effects expected from the rebuilding plan (e.g., constraints on harvest) will result in significant long-term positive effects once the stock has been rebuilt (e.g., increased TAC).

Alternatives for bycatch reporting methodologies for the various fisheries does little for red snapper productivity over the short or long term. However, the data derived from this reporting will be important to the periodic stock assessments and possible future management actions to reduce bycatch in the directed fishery.

8 .7 Irreversible and irretrievable commitments of resources

Freeman (1992) defines irreversible commitments as "those that cannot be reversed, except perhaps in the long term." These would include such instances where ore was removed from a mine or a species went extinct. Irretrievable commitments are "those that are lost for a period of time" such as when the right-of-way of a road is running through a forest is lost from timber production.

Amendment 22 would not result in any irreversible or irretrievable commitments of resources. The purpose of the amendment is to set biological reference points and status determination criteria, establish a rebuilding schedule and plan that is consistent with current fishery management standards, establish a standardized methodology to collect bycatch information in the fishery, and evaluate the practicability of additional measures to reduce bycatch and bycatch mortality in the fishery. The results of the actions proposed in this amendment should actually increase the fishery resources in the Gulf without significant adverse effects on other Gulf resources.

8 .8 Any other disclosures

CEQ guidance on environmental consequences (40 CFR §1502.16) indicate that the following elements should be considered for the scientific and analytic basis for comparisons of alternatives. These are:

a) Direct effects and their significance
b) Indirect effects and their significance.
c) Possible conflicts between the proposed action and the objectives of federal, regional, State, and local (and in the case of a reservation, Indian tribe) land use plans, policies and controls for the area concerned.
d) The environmental effects of alternatives including the proposed action.
e) Energy requirements and conservation potential of various alternatives and mitigation measures.
f) Natural or depletable resource requirements and conservation potential of various alternatives and mitigation measures.
g) Urban quality, historic and cultural resources, and the design of the built environment, including the reuse and conservation potential of various alternatives and mitigation measures.
h) Means to mitigate adverse environmental impacts

Items a, b, d, f, and h are addressed in Sections 4.1, 4.2, 4.3, 5, 8.1, 8.2, and 8.3. The other elements are not applicable to the actions taken in this document. Because this amendment concerns the management of a marine fish stock, it is not in conflict with the objectives of federal, regional, State, or local land use plans, policies, and controls. However, it should be noted that the goals of this amendment are to rebuild the Gulf red snapper stock and to enhance data collection on reef fish bycatch. These are goals that the federal government shares with regional and state management agencies (see Section 7.4).

Because this amendment addresses biological reference points and status determination criteria, rebuilding plans, standardized methodology to collect bycatch information in the fishery, and the practicability of additional measures to reduce bycatch and bycatch mortality in the fishery, energy requirements and conservation potential of various alternatives and mitigation measures is not a major factor. It is possible that as the stock size increases and the effort to harvest TAC decreases, that fishermen will require less fuel to pursue their fishery. It is also possible that they will shift their effort towards other fisheries once TAC has been harvested. Therefore, any fuel savings derived from rebuilding the red snapper resource may be lost.

Urban quality, historic and cultural resources, and the design of the built environment, including the reuse and conservation potential of various alternatives and mitigation measures is not a factor in this amendment. The actions taken in this amendment will effect a marine stock and it's fishery, and so should not affect land-based, urban environments.

9 Other Applicable Law

The MSFCMA (16 U.S.C. 1801 et seq.) provides the authority for U.S. fishery management. However, fishery management decision-making is also affected by a number of other federal statutes designed to protect the biological and human components of U.S. fisheries, as well as the ecosystems within which those fisheries are conducted. Major laws affecting federal fishery management decision making are summarized below.

9.1 Administrative Procedures Act

All federal rulemaking is governed under the provisions of the Administrative Procedure Act (APA) (5 U.S.C. Subchapter II), which establishes a "notice and comment" procedure to enable public participation in the rulemaking process. Under the APA, NOAA Fisheries is required to publish notification of proposed rules in the *Federal Register* and to solicit, consider and respond to public comment on those rules before they are finalized. The APA also establishes a 30-day waiting period from the time a final rule is published until it takes effect.

9.2 Coastal Zone Management Act

Section 307(c)(1) of the Federal Coastal Zone Management Act of 1972 encourages state and federal cooperation in the development of plans that manage the use of natural coastal habitats, as well as the fish and wildlife those habitats support. When proposing an action determined to directly affect coastal resources managed under an approved coastal zone management program, NOAA Fisheries is required to provide the relevant state agency with a determination that the proposed action is consistent with the enforceable policies of the approved program to the maximum extent practicable at least 90 days before taking final action.

The proposed changes in federal regulations governing red snapper in the EEZ of the GOM will make no changes in federal regulations that are inconsistent with the objectives of either existing or proposed state regulations. While it is the goal of the Council to have complementary management measures with those of the states, federal and state administrative procedures vary, and regulatory changes are unlikely to be fully instituted at the same time.

This plan amendment is consistent with the enforceable policies of the approved Coastal Zone Management programs of the states of Alabama, Florida, Louisiana, Mississippi and Texas to the maximum extent practicable. This determination has been submitted to the responsible state agencies under Section 307 of the Coastal Zone Management Act administering approved Coastal Zone Management programs in the states of Alabama, Florida, Mississippi, Louisiana and Texas.

9.3 Data Quality Act

The Data Quality Act (DQA) (Public Law 106-443), which took effect October 1, 2002, requires the government for the first time to set standards for the quality of scientific information and statistics used and disseminated by federal agencies. Information includes any communication or representation of knowledge such as facts or data, in any medium or form, including textual, numerical, cartographic, narrative, or audiovisual forms (includes web dissemination, but not hyperlinks to information that others disseminate; does not include clearly stated opinions).

Specifically, the Act directs the Office of Management and Budget (OMB) to issue government wide guidelines that "provide policy and procedural guidance to federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information disseminated by federal agencies." Such guidelines have been issued, directing all federal agencies to create and issue agency-specific standards to 1) ensure Information Quality and develop a pre-dissemination review process; 2) establish administrative mechanisms allowing affected persons to seek and obtain correction of information; and 3) report periodically to OMB on the number and nature of complaints received.

Scientific information and data are key components of FMPs and amendments and the use of best available information is the second national standard under the MSFCMA. To be consistent with the Act, FMPs and amendments must be based on the best information available, properly reference all supporting materials and data, and should be reviewed by technically competent individuals. With respect to original data generated for FMPs and amendments, it is important to ensure that the data are collected according to documented procedures or in a manner that reflects standard practices accepted by the relevant scientific and technical communities. Data should also undergo quality control prior to being used by the agency and a pre-dissemination review performed. Note that the pre-dissemination review was preformed, is on the record, and available from the agency.

9.4 Endangered Species Act

The Endangered Species Act (ESA) of 1973 (16 U.S.C. Section 1531 et seq.) requires that federal agencies use their authorities to conserve endangered and threatened species and that they ensure actions they authorize, fund, or carry out are not likely to harm the continued existence of those species or the habitat designated to be critical to their survival and recovery. The ESA requires NOAA Fisheries, when proposing a fishery action that "may affect" critical habitat or endangered or threatened species, to consult with the appropriate administrative agency (itself for most marine species, the U.S. Fish and Wildlife Service for all remaining species) to determine the potential impacts of the proposed action. Consultations are concluded informally when proposed actions may affect but are not likely to adversely affect" endangered or threatened species or designated critical habitat. Formal consultations, including a biological opinion, are required when proposed actions may affect and are "likely to adversely affect" endangered or threatened species or adversely modify designated critical habitat. If jeopardy or adverse modification is found, the consulting agency is required to suggest reasonable and prudent alternatives.

An April 28, 1989, biological opinion on the effects of commercial fishing activities in the Southeast Region found that mortalities of endangered and threatened species are uncommon from the hook-and-line and bottom longline gear used in the reef fish fishery and were not likely to jeopardize the continued existence of threatened or endangered species. Assessments of the level of take were not then considered a high priority. Informal Section 7 consultations have been conducted on the original Reef Fish FMP and for Amendments 1, 2, 3, 4, 5, 6, 7 ,8, 9, 11, 12, 13, 14, 15, 16A,16B, 17, 19 (Generic Tortugas Reserves Amendment), 20 (Reef fish, and associated regulatory amendments) and 21 (Madison-Swanson and Steamboat Lumps). They have also been conducted for the FMP's various regulatory amendments, including 21 regulatory amendments submitted from 1990 to 2001, and one Secretarial plan amendment. These consultations all concluded that the fishery management actions were either not likely to adversely affect any threatened or endangered species under NOAA Fisheries jurisdiction or had no effect. They also determined that FMP or amendment actions were not expected to change the prosecution of this fishery in a manner that will significantly alter the potential impacts to endangered and threatened species and their habitats previously considered. Amendments 10 and 18 are not included in the preceding list. A Section 7 consultation was initiated for Amendment 10, but that Amendment was not submitted to NOAA Fisheries. Amendment 18 is currently under development and a Section 7 consultation will be requested at the appropriate time.

9.5 Executive Orders

9.5.1 E.O. 12612: Federalism

The Executive Order on Federalism requires agencies in formulating and implementing policies that have Federalism implications, to be guided by the fundamental Federalism principles. The Order serves to guarantee the division of governmental responsibilities between the national government and the States that was intended by the framers of the Constitution. Federalism is rooted in the belief that issues that are not national in scope or significance are most appropriately addressed by the level of government closest to the people. This Order is relevant to FMPs and amendment given the overlapping authorities of NOAA Fisheries, the States, and local authorities in managing coastal resources, including fisheries, an the need for a clear definition of responsibilities. It is important to recognize those components of the ecosystem over which fishery managers have no direct control and to develop strategies to address them in conjunction with appropriate State, Tribes and local entities (international too).

No Federalism issues have been identified relative to the actions proposed in this amendment. Therefore, preparation of a Federalism assessment under Executive Order 12612 is not necessary.

9.5.2 E.O. 12866: Regulatory Planning and Review

Executive Order 12866: Regulatory Planning and Review, signed in 1993, requires federal agencies to assess the costs and benefits of their proposed regulations, including distributional impacts, and to select alternatives that maximize net benefits to society. To comply with E.O. 12866, NOAA Fisheries prepares a Regulatory Impact Review (RIR) for all fishery regulatory actions that either implement a new fishery management plan or significantly amend an existing plan. RIRs provide a comprehensive analysis of the costs and benefits to society associated with proposed regulatory actions, the problems and policy objectives prompting the regulatory proposals, and the major alternatives that could be used to solve the problems. The reviews also serve as the basis for the agency's determinations as to whether proposed regulations are a "significant regulatory action" under the criteria provided in E.O. 12866 and whether proposed regulations will have a significant economic impact on a substantial number of small entities in compliance with the RFA. A regulation is significant if it is likely to result in an annual effect on the economy of at least $100,000,000 or has other major economic effects.

9.5.3 E.O. 12630: Takings

The Executive Order on Government Actions and Interference with Constitutionally Protected Property Rights, which became effective March 18, 1988, requires that each federal agency prepare a Takings Implication Assessment for any of its administrative, regulatory, and legislative policies and actions that affect, or may affect, the use of any real or personal property. Clearance of a regulatory action must include a takings statement and, if appropriate, a Takings Implication Assessment. Such assessment will be performed prior to implementation if it is determined to be necessary.

9.5.4 E.O. 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations

This Executive Order requires that federal agencies conduct their programs, policies and activities in a manner to ensure that individuals or populations are not excluded from participation in, or denied the benefits of, or subjected to discrimination because of their race, color, or national origin. In addition, and specifically with respect to subsistence consumption of fish and wildlife, federal agencies are required to collect, maintain and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence. Impacts of commercial and recreational fishing on subsistence fishing is a concern in fisheries management.

9.5.5 E.O. 12962: Recreational Fisheries

This Executive Order requires federal agencies, in cooperation with States and Tribes, to improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities through a variety of methods including, but not limited to, developing joint partnerships; promoting the restoration of recreational fishing areas that are limited by water quality and habitat degradation; fostering sound aquatic conservation and restoration endeavors; and evaluating the effects of federally-funded, permitted, or authorized actions on aquatic systems and evaluating the effects of federally-funded, permitted, or authorized actions on aquatic systems and recreational fisheries, and documenting those effects. Additionally, it establishes a seven member National Recreational Fisheries Coordination Council responsible for, among other things, ensuring that social and economic values of healthy aquatic systems that support recreational fisheries are considered by federal agencies in the course of their actions, sharing the latest resource information and management technologies, and reducing duplicative and cost-inefficient programs among federal agencies involved in conserving or managing recreational fisheries. The Council also is responsible for developing, in cooperation with federal agencies, States and Tribes, a Recreational Fishery Resource Conservation Plan - to include a five-year agenda. Finally, the Order requires NOAA Fisheries and the U.S. Fish and Wildlife Service to develop a joint agency policy for administering the ESA.

9.5.6 E.O. 13084: Consultation and Coordination With Indian Tribal Governments

This Executive Order recognizes and reaffirms the U.S. governments responsibility for continued collaboration and consultation with tribal governments in the development of federal policies that have tribal implications. This Order relates to indigenous fishing.

9.5.7 E.O. 13089: Coral Reef Protection

The Executive Order on Coral Reef Protection requires federal agencies whose actions may affect U.S. coral reef ecosystems to identify those actions, utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and, to the extent permitted by law, ensure that actions they authorize, fund or carry out not degrade the condition of that ecosystem. By definition, a U.S. coral reef ecosystem means those species, habitats, and other national resources associated with coral reefs in all maritime areas and zones subject to the jurisdiction or control of the United States (e.g., federal, State, territorial, or commonwealth waters).

9.5.8 E.O. 13158: Marine Protected Areas

Executive Order 13158 requires federal agencies to consider whether their proposed action(s) will affect any area of the marine environment that has been reserved by federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural or cultural resource within the protected area. The broad definition of MPAs will include many sites in the U.S. EEZ as part of the National MPA System.

9.5.9 E.O. 13186: Responsibilities of Federal Agencies to Protect Migratory Birds

Executive Order 13186 directs each federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations to develop and implement a memorandum of understanding (MOU) with the (USFWS) to conserve those bird populations. The MOU will address actions taken by NOAA Fisheries that have, or are likely to have, a measurable negative effect on migratory bird populations. In the instance of unintentional take of migratory birds, NOAA Fisheries would develop and use principles, standards, and practices that will lessen the amount of unintentional take, developing any such conservation efforts in cooperation with the USFWS. Additionally, the MOU would ensure that NEPA analyses evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern.

The required MOU is currently being developed, which will address the incidental take of migratory birds in commercial fisheries under the jurisdiction of NOAA Fisheries. NOAA Fisheries must monitor, report, and take steps to reduce the incidental take of seabirds that occurs in fishing operations. The United States has already developed the U.S. National Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries, and many potential MOU components are already being implemented under that plan. Development of the plan was a collaborative effort between NOAA Fisheries, USFWS, and the Department of State, carried out in large part by the Interagency Seabird Working Group consisting of representatives from those three agencies.

9.6 Marine Mammal Protection Act

The MMPA established a moratorium, with certain exceptions, on the taking of marine mammals in U.S. waters and by U.S. citizens on the high seas, and on the importing of marine mammals and marine mammal products into the United States. Under the MMPA; the Secretary of Commerce (authority delegated to NOAA Fisheries) is responsible for the conservation and management of cetaceans and pinnipeds (other than walruses). The Secretary of the Interior is responsible for walruses, sea and marine otters, polar bears, manatees and dugongs.

Part of the responsibility that NOAA Fisheries has under the MMPA involves monitoring populations of marine mammals to make sure that they stay at optimum levels. If a population falls below its optimum level, it is designated as “depleted,” and a conservation plan is developed to guide research and management actions to restore the population to healthy levels.

In 1994, Congress amended the MMPA, to govern the taking of marine mammals incidental to commercial fishing operations. This amendment required the preparation of stock assessments for all marine mammal stocks in waters under U.S. jurisdiction, development and implementation of take~reduction plans for stocks that may be reduced or are being maintained below their optimum sustainable population levels due to interactions with commercial fisheries, and studies of pinniped-fishery interactions.

The MMPA requires a commercial fisheries to be placed in one of three categories, based on the relative frequency of incidental serious injuries and mortalities of marine mammals in each fishery. Category I designates fisheries with frequent serious injuries and mortalities incidental to commercial fishing; Category II designates fisheries with occasional serious injuries and mortalities; Category III designates fisheries with a remote likelihood or no known serious injuries or mortalities. The GOM reef fish fishery (all gear types) is listed in Category III as there have been no documented interactions between this fishery and marine mammals (68 FR 41725). Because this amendment does not change current fishing practices, the proposed actions should have no effect on marine mammal populations.

9.7 National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires all federal actions to be evaluated for potential environmental and human environment impacts, and for these impacts to be assessed and reported to the public. As it applies to the formulation of fishery management plans, the NEPA process should ensure that the potential environmental ramifications of actions determined necessary to manage a fishery are fully considered. Thus, proposed regulations that may set size or bag limits, limits on the number of permits or vessels, quotas, allowable gears, closed seasons or areas and any other measure is reviewed for its potential affect on the broader marine environment, in addition to its affect on the specific fishery being managed.

Councils initially conduct an Environmental Assessment (EA), which is a concise statement that determines whether the FMP (and subsequently any proposed amendment to the plan) will have a significant impact on the environment. If there is no potential significant impact, a “Finding of No Significant Impact,” or FONSI, is issued. In the case of the initial regulatory amendment to set a red snapper rebuilding plan through 2032, the Council submitted an EA. However, NOAA Fisheries determined that there were significant impacts and that an SEIS was needed. In this determination, the Council must consider the context and intensity of the SFA criteria and the rebuilding plan for both short and long term effects, impacts that may be beneficial or adverse, and effects on locality and society as a whole. Because NOAA Fisheries also determined that the red snapper SFA criteria and rebuilding plan need to be submitted as a plan amendment, a SEIS has been drafted concurrently with the plan amendment and lays out the proposed action(s), alternatives to the proposed action(s), and the environmental consequences for each alternative. The Draft SEIS was be sent to the EPA for a 45-day review period, and subsequently its availability was announced in the Federal Register. The public is afforded an opportunity to comment on it, generally concurrently with the public comment period for the plan amendment itself. The SEIS is submitted to the Secretary of Commerce along with the plan amendment for final approval.

9.8 Migratory Bird Treaty Act

Under the Migratory Bird Treaty Act (MBTA), it is unlawful to pursue, hunt, take, capture, kill, possess, trade, or transport any migratory bird, or any part, nest, or egg of a migratory bird, included in treaties between the United States and Great Britain, Mexico, Japan, or the former Union of Soviet Socialists Republics, except as permitted by regulations issued by the Department of the Interior. Violations of the MBTA carry criminal penalties; any equipment and means of transportation used in activities in violation of the MBTA may be seized by the United States government and, upon conviction, must be forfeited to it. To date, the MBTA has been applied to the territory of the United States and coastal waters extending three miles from shore. Furthermore, Executive Order 13186 (see Section 9.5.9) was issued in 2001, which directs federal agencies, including NOAA Fisheries, to take certain actions to further implement the MBTA.

9.9 National Marine Sanctuaries Act

Under the National Marine Sanctuaries Act (NMSA) (also known as Title III of the Marine Protection, Research and Sanctuaries Act of 1972), as amended, the Secretary of Commerce is authorized to designate National Marine Sanctuaries to protect distinctive natural and cultural resources whose protection and beneficial use requires comprehensive planning and management. The National Marine Sanctuary Program is administered by the Sanctuaries and Reserves Division of the NOAA. The Act provides authority for comprehensive and coordinated conservation and management of these marine areas. The National Marine Sanctuary Program currently comprises 13 sanctuaries around the country, including sites in American Samoa and Hawaii. These sites include significant coral reef and kelp forest habitats, and breeding and feeding grounds of whales, sea lions, sharks, and sea turtles. A complete listing of the current sanctuaries and information about their location, size, characteristics, and affected fisheries can be found at http://www.sanctuaries.nos.noaa.gov/oms/oms.html.

9.10 Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.) regulates the collection of public information by federal agencies to ensure that the public is not overburdened with information requests, that the federal government's information collection procedures are efficient, and that federal agencies adhere to appropriate rules governing the confidentiality of such information. The PRA requires NOAA Fisheries to obtain approval from the Office of Management and Budget before requesting most types of fishery information from the public.

If bycatch reporting measures above status quo are implemented through this amendment, NOAA Fisheries will submit any reporting requirements and burdens to the Office of Management and Budget for review.

9.11 Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) of 1980 (5 U.S.C. 601 et seq.) requires federal agencies to assess the impacts of regulatory actions implemented through notice and comment rulemaking procedures on small businesses, small organizations, and small governmental entities, with the goal of minimizing adverse impacts of burdensome regulations and record-keeping requirements on those entities. Under the RFA, NOAA Fisheries must determine whether a proposed fishery regulation will have a significant economic impact on a substantial number of small entities. If not, a certification to this effect must be prepared and submitted to the Chief Counsel for Advocacy of the Small Business Administration. Alternatively, if a regulation is determined to significantly impact a substantial number of small entities, the act requires the agency to prepare an initial and final Regulatory Flexibility Analyses to accompany the proposed and final rule, respectively. These analyses, which describe the type and number of small businesses affected, the nature and size of the impacts, and alternatives that minimize these impacts while accomplishing stated objectives, must be published in the Federal Register in full or in summary for public comment and submitted to the chief counsel for advocacy of the Small Business Administration. Changes to the RFA in June 1996 enable small entities to seek judicial court review of an agency's compliance with the Act's provisions.

9.12 Small Business Act

The Small Business Act of 1953, as amended, Section 8(a), 15 U.S.C. 634(b)(6), 636(j), 637(a) and (d); Public Laws 95-507 and 99-661, Section 1207; Public Laws 100-656 and 101-37 is administered by the Small Business Administration. The objectives of the act are to foster business ownership by individuals who are both socially and economically disadvantaged; and to promote the competitive viability of such firms by providing business development assistance including, but not limited to, management and technical assistance, access to capital and other forms of financial assistance, business training and counseling, and access to sole source and limited competition federal contract opportunities, to help the firms to achieve competitive viability. Because most businesses associated with fishing are considered small businesses, NOAA Fisheries, in implementing regulations, must make an assessment of how those regulations will affect small businesses.

9.13 Essential Fish Habitat

The amended MSFCMA included new EFH requirements, and as such, each existing, and any new, FMPs must describe and identify EFH for the fishery, minimize to the extent practicable adverse effects on that EFH caused by fishing, and identify other actions to encourage the conservation and enhancement of that EFH. In 1999, a coalition of several environmental groups brought suit challenging the agency's approval of the EFH FMP amendments prepared by the Gulf of Mexico, Caribbean, New England, North Pacific, and Pacific Fishery Management Councils (American Oceans Campaign et al. v. Daley et al., Civil Action No. 99-982(GK)(D.D.C. September 14, 2000). The court found that the agency's decisions on the EFH amendments were in accordance with the MSFCMA, but held that the EAs on the amendments were in violation of the NEPA and ordered NOAA Fisheries to complete new, more thorough NEPA analyses for each EFH amendment in question.

Consequently, NOAA Fisheries entered into a Joint Stipulation with the plaintiff environmental organizations that called for each affected Council to complete EISs rather than EAs for the action of minimizing adverse effects of fishing to the extent practicable on EFH. See AOC v. Evans/Daley et al., Civil No. 99-982 (GK)(D.D.C. December 5, 2001). However, because the court did not limit its criticism of the EAs to only efforts to minimize adverse fishing effects on EFH, it was decided that the scope of these EISs should address all required EFH components as described in section 303 (a)(7) of the MSFCMA.

To address these requirements the Council has, under separate action, drafted an EIS to analyze within each fishery a range of potential alternatives to: (1) describe and identify Essential Fish Habitat (EFH) for the fishery; (2) identify other actions to encourage the conservation and enhancement of such EFH; and (3) identify measures to minimize to the extent practicable the adverse effects of fishing on such EFH. Depending on the preferred alternatives identified in this EIS the Gulf Council FMPs may require amendments to comply with the guidelines articulated in the EFH Final Rule to implement the EFH provisions of the MSFCMA (See 50 CFR Part 600, Subpart J). NOAA Fisheries published the Draft EIS on August 29, 2003 and a Record of Decision is expected by the end of July 2004.

10 List of Preparers

This document was prepared by the Gulf of Mexico Fishery Management Council and National Marine Fisheries Service staff. Much of the material in Section 9 (Affected Environments) was written by MRAG Americas, Tampa, Florida, originally as part of the draft SEIS being prepared for Draft Reef Fish Amendment 18. The primary staff members responsible for compiling this document are:

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11 List of Agencies, Organizations, and Persons to Whom Copies of the Statement Are Sent

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Alabama Cooperative Extension Service
Alabama Department of Conservation and Natural Resources, Marine Resources Division
Florida Department of Environmental Protection
Florida Fish and Wildlife Conservation Commission
Florida Sea Grant
Louisiana Cooperative Extension Service
Louisiana Department of Wildlife and Fisheries
Mississippi Cooperative Extension Service
Mississippi Department of Marine Resources
National Marine Fisheries Service Southeast Regional Office
National Marine Fisheries Service Southeast Fisheries Science Center
National Marine Fisheries Service Washington Office
National Marine Fisheries Service Law Enforcement
Texas Cooperative Extension Service
Texas Parks and Wildlife Department
United States Fish & Wildlife Service
United States Coast Guard

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14 Glossary

B. Biomass, measured in terms of spawning capacity (weight) or other appropriate units of production.

B_{MSY}. Long-term average biomass that would be achieved if fishing at a constant fishing mortality rate equal to F_{MSY}.

BRP (biological reference point). Benchmarks against which the abundance of the stock or the fishing mortality rate can be measured, in order to determine its status. BRPs can be categorized as limits or targets, depending on their intended use.

Control Rule. Describes a plan for pre-agreed management actions as a function of variables related to the status of the stock. For example, a control rule can specify how F or yield should vary with B. In the NSGs, the MSY control rule is used to determine the limit fishing mortality, MFMT. Control rules are also known as “decision rules” or “harvest control laws” in some of the scientific literature.

F. Instantaneous fishing mortality rate. Measures the effective fishing intensity for a given partial recruitment pattern.

F_{MSY}. Fishing mortality rate, which, if applied constantly, would result in MSY.

Limit Reference Points. Benchmarks used to indicate when harvests should be constrained substantially so that the stock remains within safe biological limits. The probability of exceeding the limits should be low. In much of the NSGs, limits are referred to as thresholds. In much of the international literature (e.g., FAO documents), “thresholds” are used as buffer points that signal when a limit is being approached.

M. Instantaneous natural mortality rate.

MFMT (maximum fishing mortality threshold). Status determination criteria (SDC) for determining if OVERFISHING is occurring. It will usually be equivalent to the F corresponding to the MSY control rule.

MSST (minimum stock size threshold). The greater of: (a) 1/2BMSY, or (b) the minimum stock size at which rebuilding to BMSY will occur within 10 years of fishing at the MFMT. MSST should be measured in terms of spawning biomass or other appropriate measures of productive capacity.

MSY (maximum sustainable yield). The largest long-term average yield (catch) that can be taken from a stock or stock complex under prevailing ecological and environmental conditions. Any estimate of MSY depends on the population dynamics of the stock, the characteristics of the fisheries, e.g., gear selectivity, and the control rule used. In much of the traditional fisheries literature, MSY is estimated with a control rule in which F is independent of stock size. In the language of NSGs, estimates of MSY will change depending on the shape of the control rule, but B_{MSY} and F_{MSY} pertain only to a constant-F control rule.

NSGs (national standard guidelines). Advisory guidelines developed by NOAA Fisheries, based on the National Standards of the Magnuson-Stevens Fishery Conservation and Management Act.

Overfished. MSST related. A stock or stock complex is considered overfished when its size falls below the MSST. According to the NSGs, an overfished stock or stock complex is one "whose size is sufficiently small that a change in management practices is required in order to achieve an appropriate level and rate of rebuilding." A rebuilding plan is required for stocks that are overfished.

Overfishing. MFMT related. Occurs if the MFMT is exceeded for 1 year or more. According to the NSGs, "overfishing occurs whenever a stock or stock complex is subjected to a rate or level of fishing mortality that jeopardizes the capacity of the stock or stock complex to produce MSY on a continuing basis."

OY (optimum yield). The amount of fish that will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities and taking into account the protection of marine ecosystems. MSY constitutes a "ceiling" for OY. OY may be lower than MSY, depending on relevant economic, social, or ecological factors. In the case of an overfished fishery, OY should provide for rebuilding to BMSY.

Reference Points. Values of parameters, e.g. BMSY, FMSY, F0.1, that are useful benchmarks for guiding management decisions. Biological reference points are typically limits that should not be exceeded with significant probability, e.g. MSST, or targets for management, e.g. OY.

SDC (status determination criteria). MFMT related. Objective and measurable criteria used to determine if a stock is being overfished or is in an overfished state according to NSGs.

SPR (1). Spawning output per recruit. Amount of per-capita spawning biomass (or other appropriate measure of reproductive output) obtained at a given value of F, conditional on values of partial recruitment, growth, maturity (and/or fecundity) and natural mortality.

(2). Spawning potential ratio. The expected lifetime spawning output per recruit relative to the spawning output that would be realized in the absence of fishing, often expressed as a percentage. References to this second definition are associated with a percentage (%) sign.

(3). Static SPR refers to the amount of spawning for a recruit subjected to fishing under a constant pattern of fishing mortality-at-age throughout their life span relative to the amount of spawning that would have occurred if the had not been any fishing.

(4). Transitional SPR is calculated by using actual estimates of population numbers and fishing mortalities and so is a measure of actual reproductive output of recent cohorts of the stock.

FIGURES

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number represent high levels of habitat use (from the Draft Environmental Impact Statement for the Generic Essential Fish Habitat Amendment of the GMFMC).

Figure 8.2.1. Effort changes necessary to implement Alternative 2. This alternative holds TAC constant at 9.12 mp until rebuilding is achieved. Effort was assumed to be proportional to annual catches divided by red snapper abundance, which implies that catch per unit effort is an unbiased measure of abundance. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

Figure 8.2.2. Effort changes necessary to implement Alternative 3. This alternative reduces TAC to 6 mp, holding it there until rebuilding is achieved. Effort was assumed to be proportional to annual catches divided by red snapper abundance, which implies that catch per unit effort is an unbiased measure of abundance. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

Figure 8.2.3. Effort changes necessary to implement Alternative 4. This alternative holds TAC constant at 9.12 mp until an F_{OY} policy would permit higher catch limits. Effort was assumed to be proportional to annual catches divided by red snapper abundance, which implies that catch per unit effort is an unbiased measure of abundance. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

Figure 8.2.4. Effort changes necessary to implement Alternative 5. This alternative reduces TAC to 6 mp, holding it there until an F_{OY} policy would permit higher catch limits. Effort was assumed to be proportional to annual catches divided by red snapper abundance, which implies that catch per unit effort is an unbiased measure of abundance. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

Figure 8.4.1. Gulf of Mexico essential fish habitat (EFH) for red snapper.

Figure 8.4.1. Gulf of Mexico essential fish habitat (EFH) for brown shrimp.

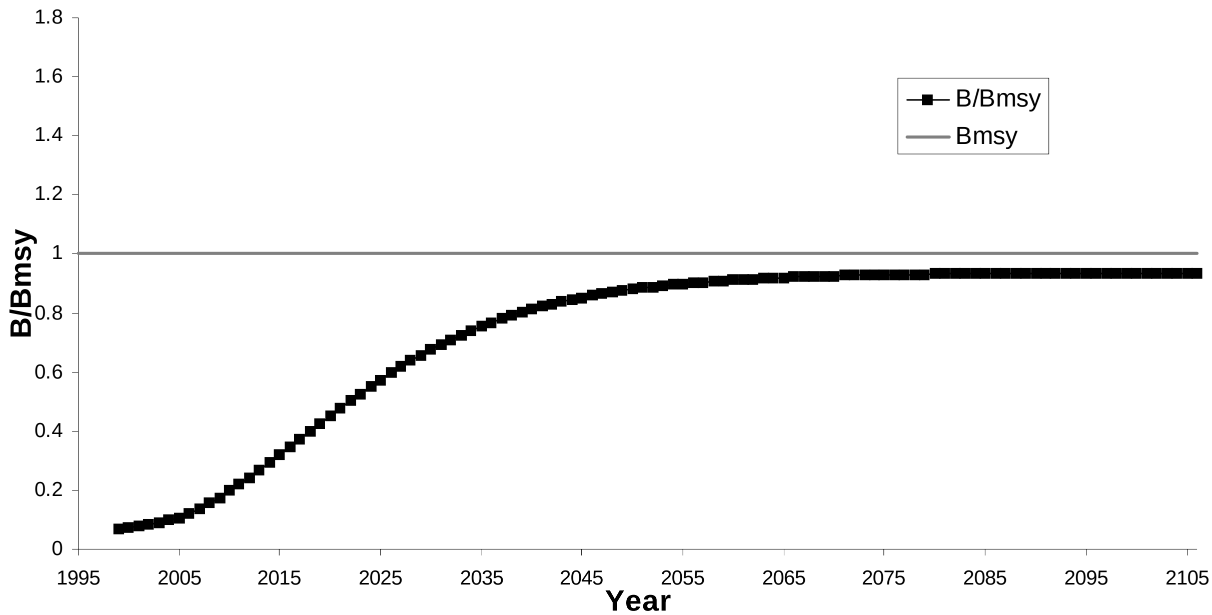

Figure 4.2.1. Biomass trajectory with no directed fishery and status quo shrimp bycatch rates. The stock never recovers to B_{MSY} levels.

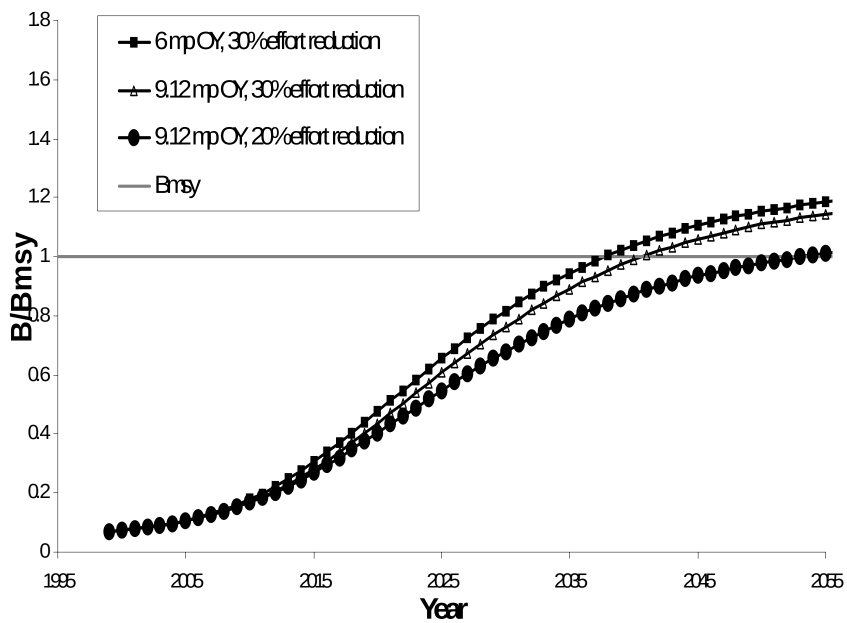

Figure 4.2.2. Recovery times with changes in directed catch levels and in bycatch rates resulting from effort reductions in the shrimp fishery. To illustrate this point, a 10 percent increase in shrimp fishing effort reduction (from 20 to 30 percent of current levels) speeds up recovery by 13 years. Reducing the directed catch from 9.12 to 6 mp annually, while holding shrimp effort reductions at 30 percent, speeds up recover by only three years.

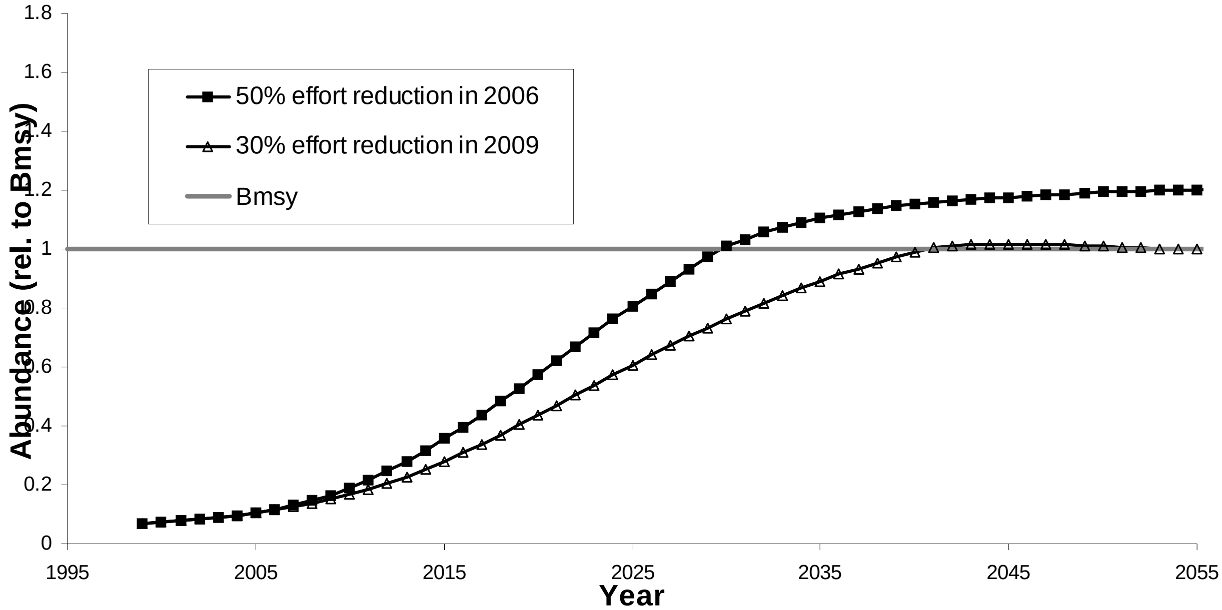

Figure 4.2.3. Biomass trajectories under rebuilding alternative 2, with a constant 9.12 mp annual TAC until rebuilding has been achieved. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

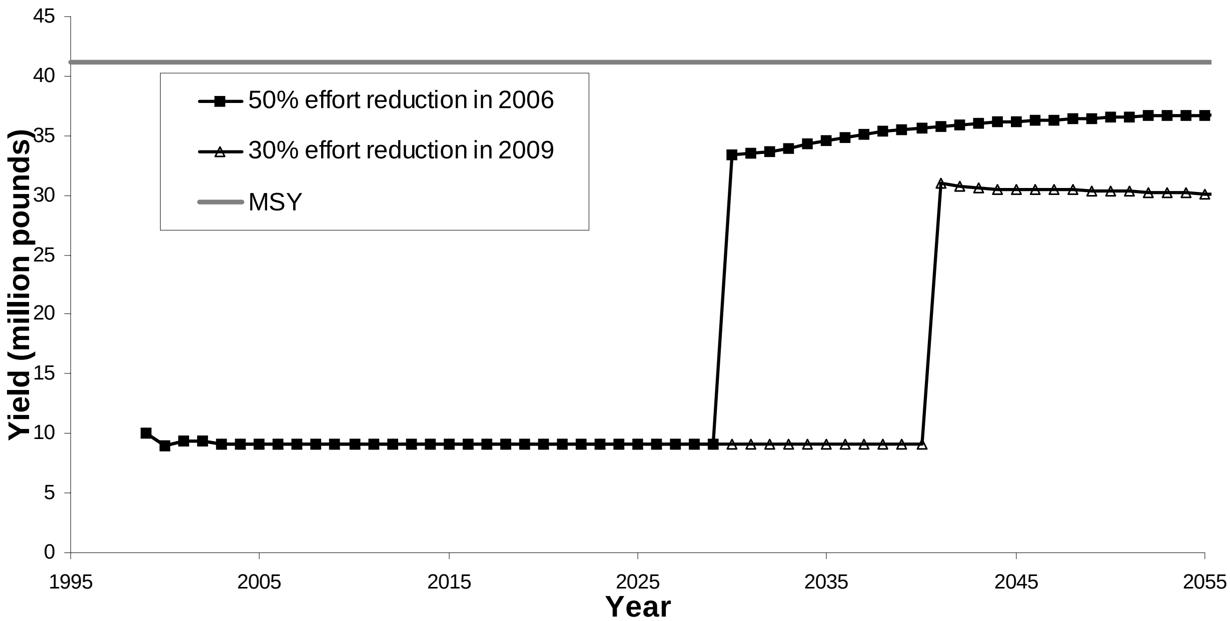

Figure 4.2.4. Catch trajectories under rebuilding alternative 2, with a constant 9.12 mp annual TAC until rebuilding has been achieved. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

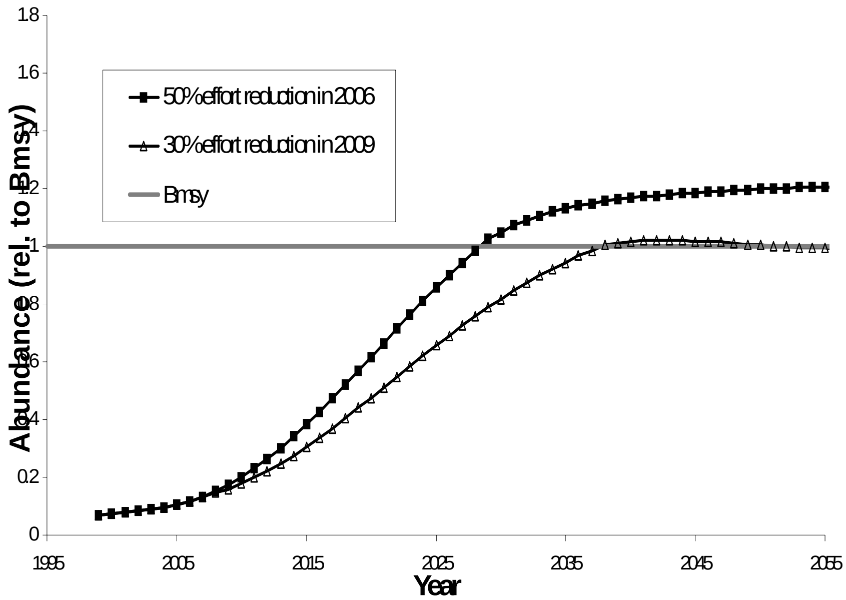

Figure 4.2.5. Biomass trajectories under rebuilding alternative 3, with a constant 6 mp annual TAC starting in 2005 and lasting until rebuilding has been achieved. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

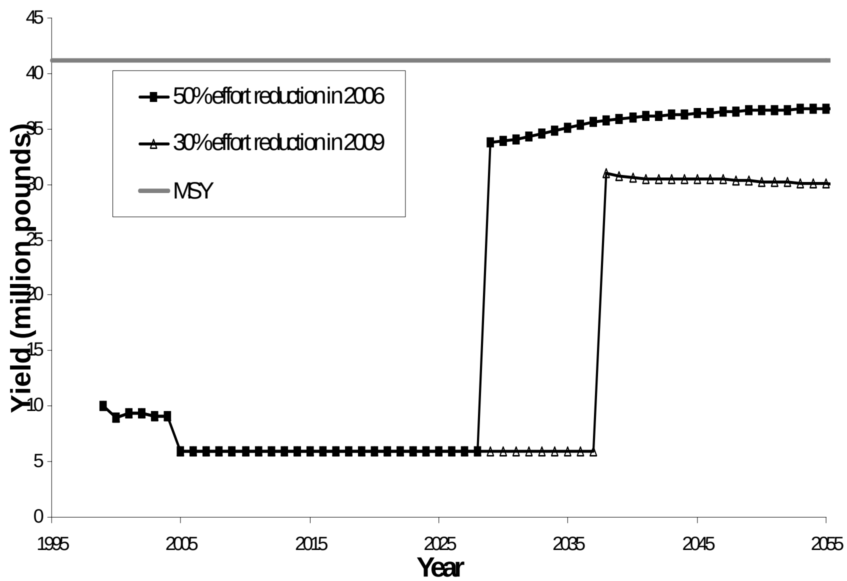

Figure 4.2.6. Catch trajectories under rebuilding alternative 3, with a constant 6 mp annual TAC starting in 2005 and lasting until rebuilding has been achieved. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

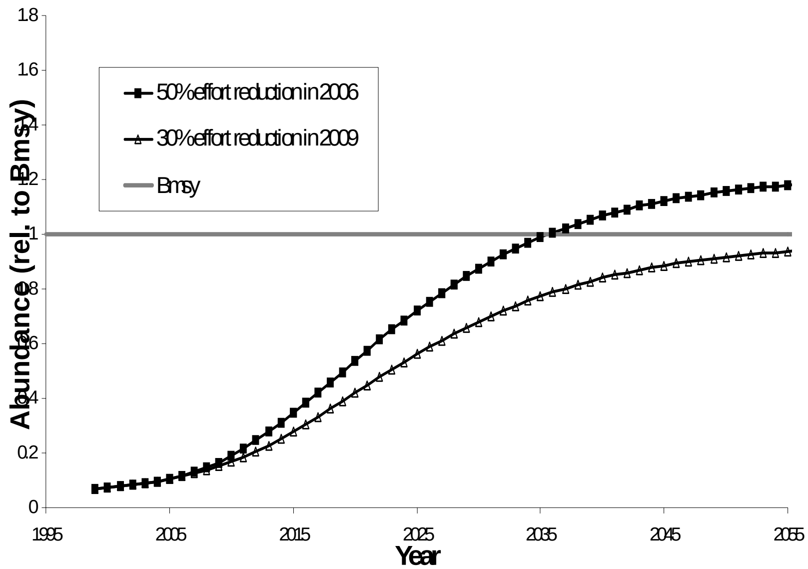

Figure 4.2.7. Biomass trajectories under rebuilding alternative 4, with a constant 9.12 mp annual TAC until a constant F_{OY} policy would provide higher limits. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

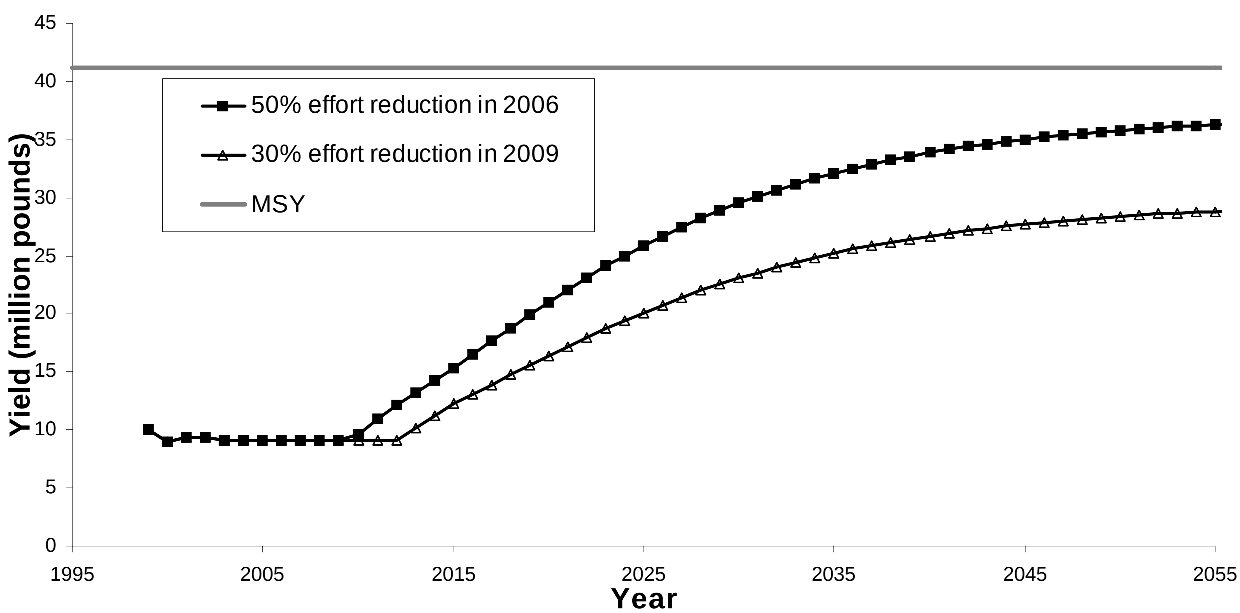

Figure 4.2.8. Catch trajectories under rebuilding alternative 4, with a constant 9.12 mp annual TAC until a constant F_{OY} policy would provide higher limits. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

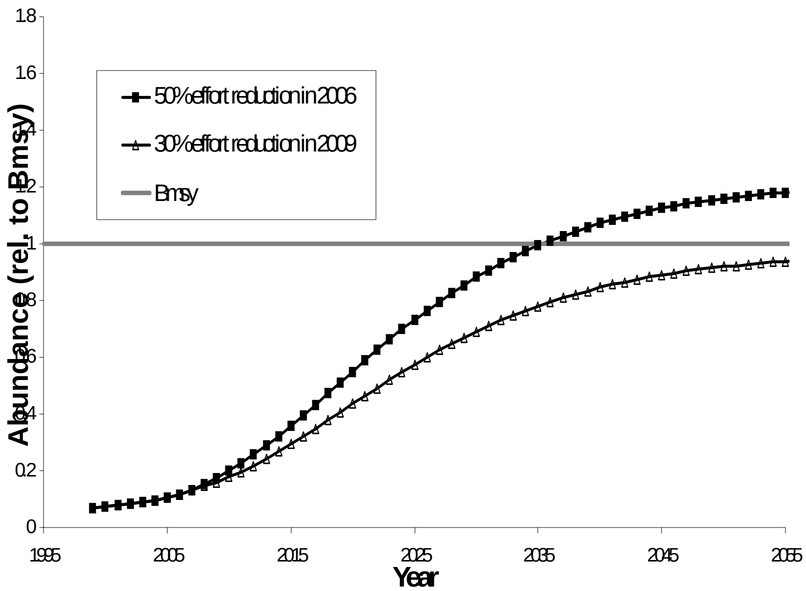

Figure 4.2.9. Biomass trajectories under rebuilding alternative 5, with a constant 6 mp annual TAC starting in 2005 and lasting until a constant F_{OY} policy would provide higher limits. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

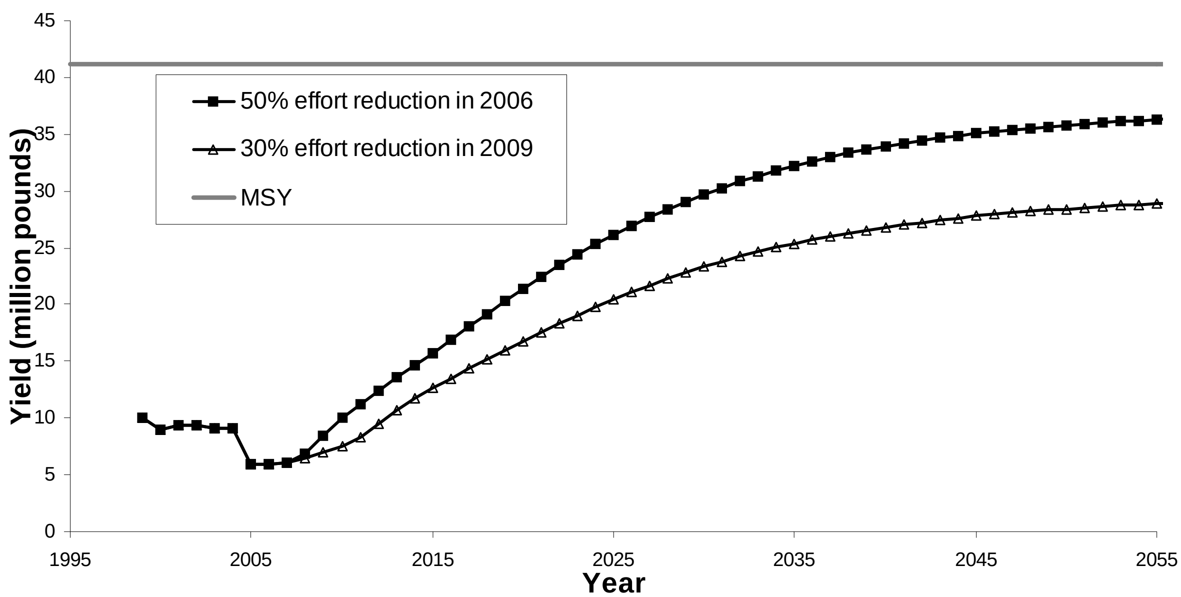

Figure 4.2.10. Catch trajectories under rebuilding alternative 5, with a constant 6 mp annual TAC starting in 2005 and lasting until a constant F_{OY} policy would provide higher limits. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

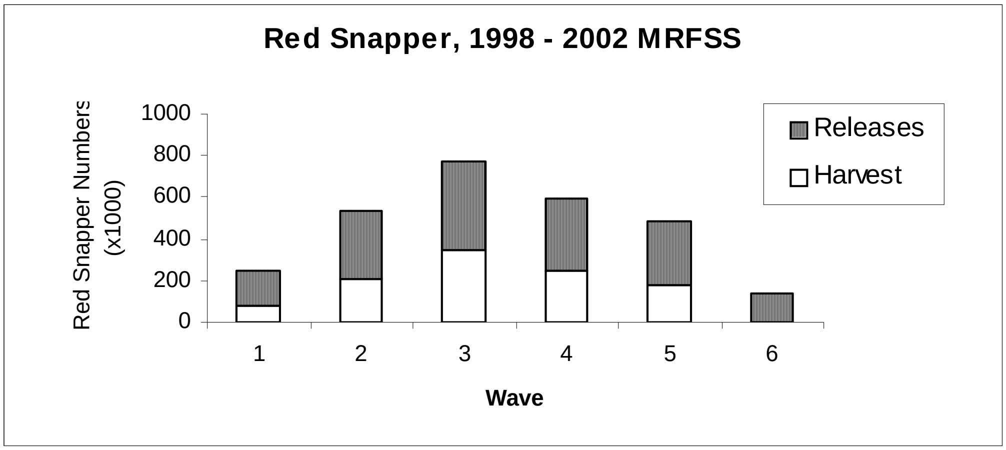

Figure 4.4.1. Average recreational red snapper harvest (A+B1) and releases (B2) for 1998 through 2002 from MRFSS.

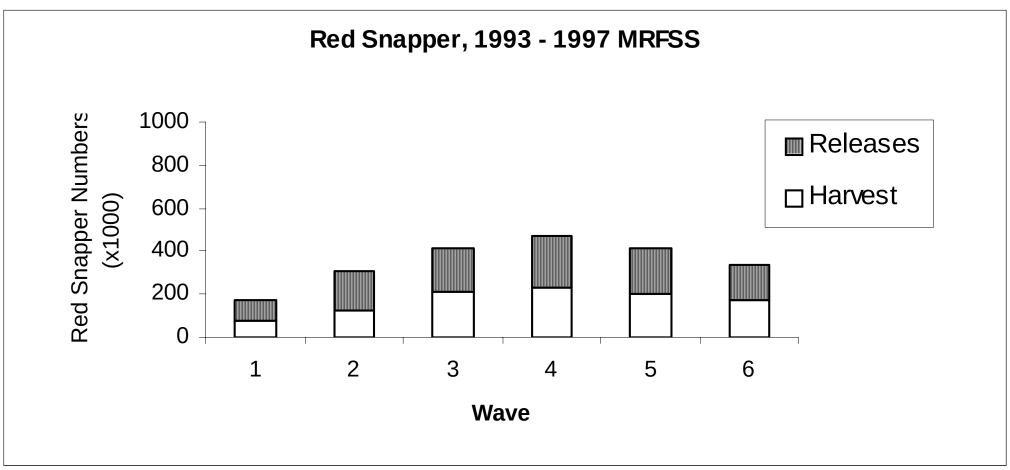

Figure 4.4.2. Average recreational red snapper harvest (A+B1) and releases(B2) for 1993 through 1997 from MRFSS.

Figure 4.4.3. Shrimp fishing effort measured in 24 hour days. Source Jim Nance, NOAA Fisheries, SEFSC, Pascagoula.

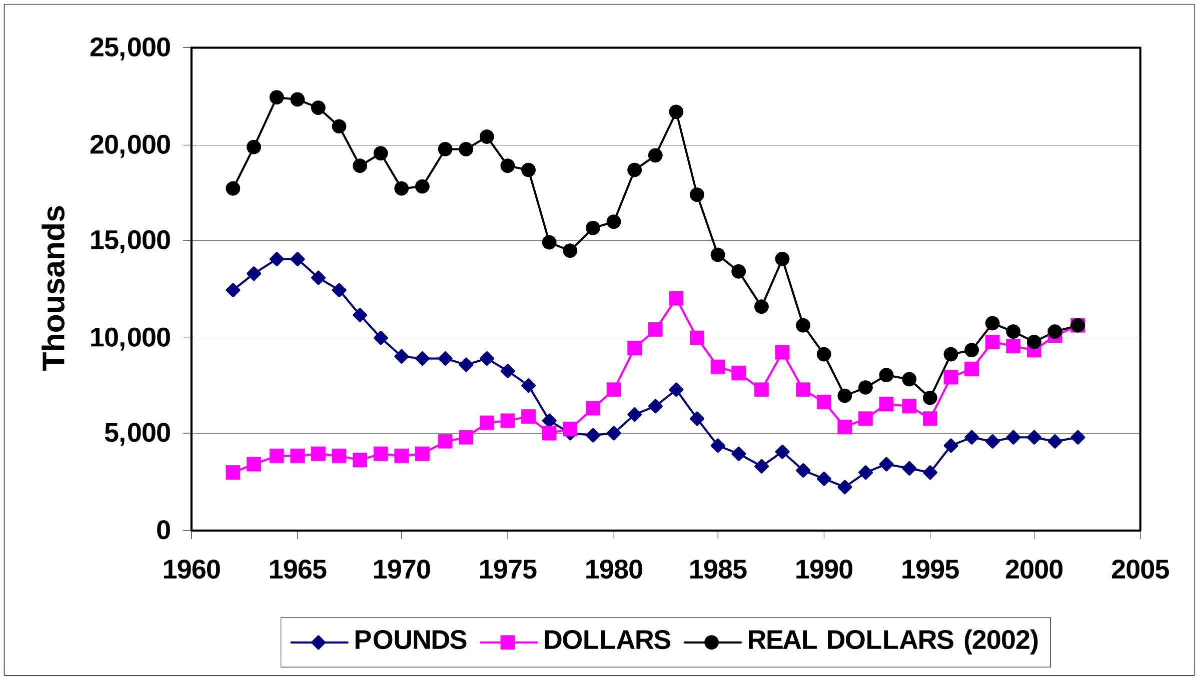

Figure 5.4.1 Commercial landings and dockside value of red snapper in the Gulf of Mexico, 1962-2002

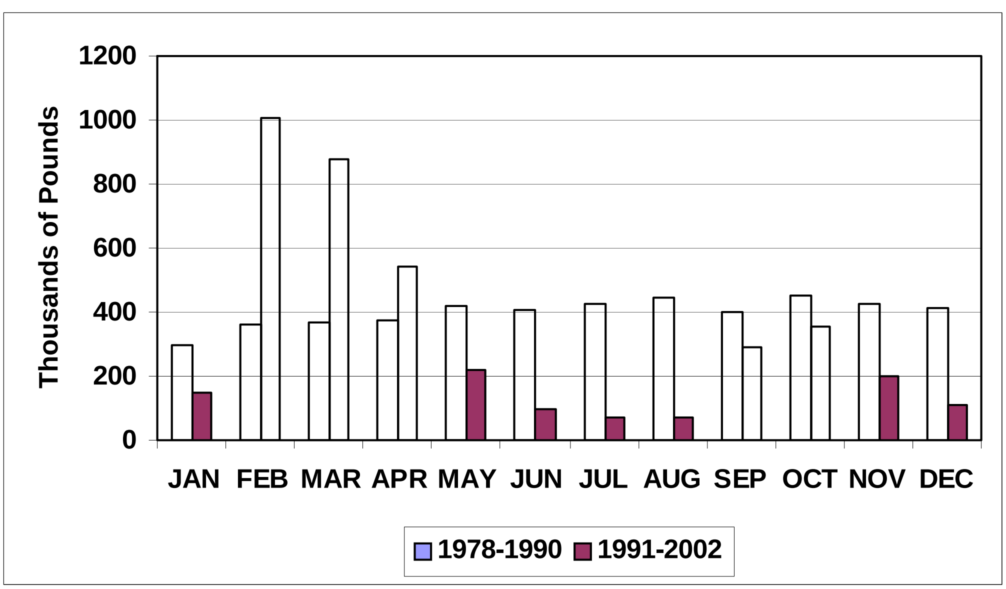

Figure 5.4.2. Average monthly landings of red snapper, 1978-2002

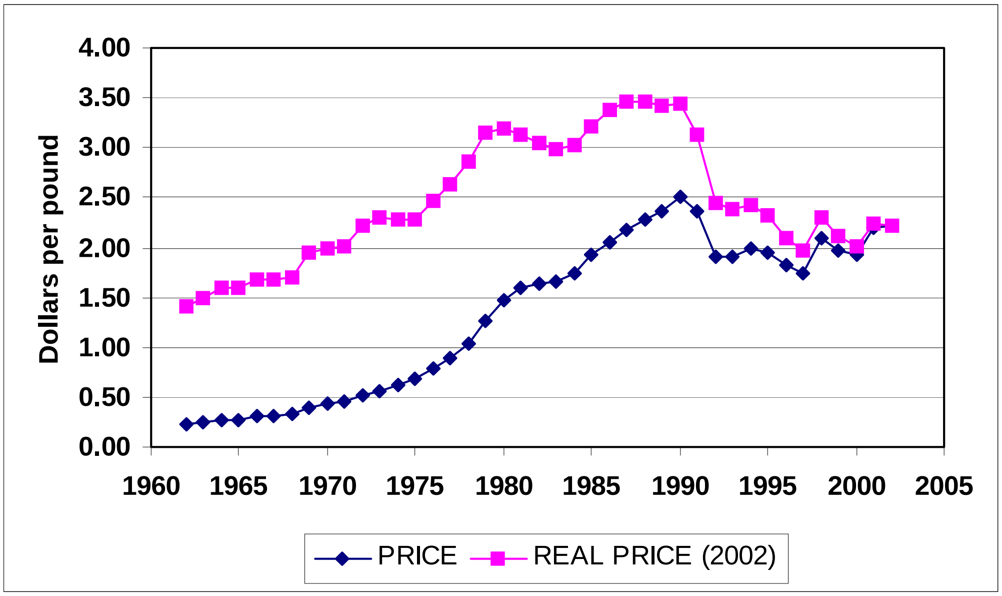

Figure 5.4.3. Red snapper: average annual dockside price vs. year.

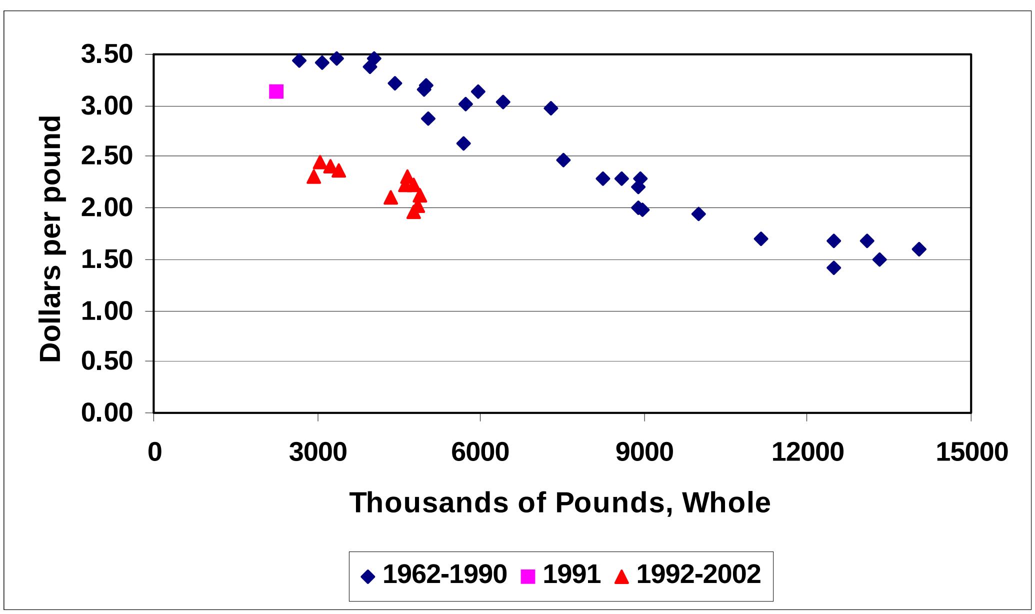

Figure 5.4.4. Red snapper: real dockside price (base year+2002) vs. landings

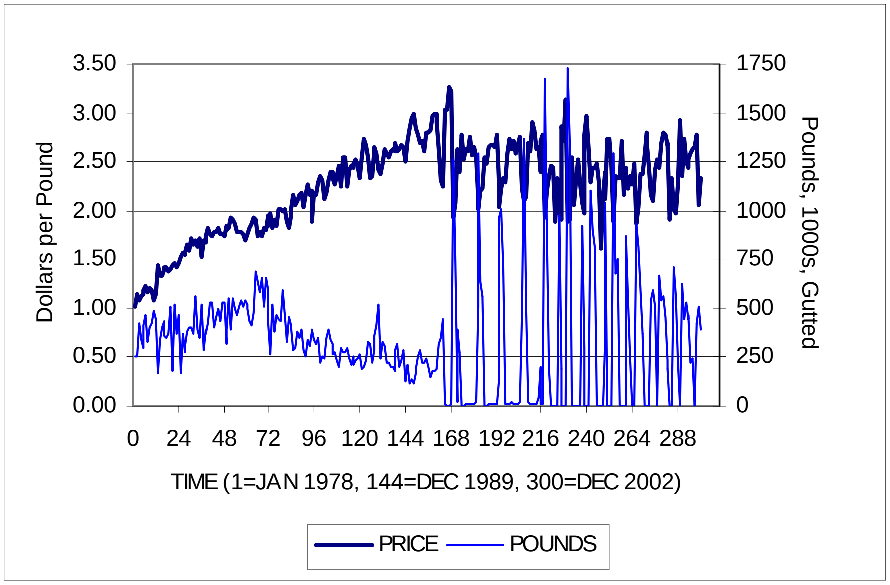

Figure 5.4.5. Average monthly dockside prices and landings vs. time (1978-2002) for red snapper.

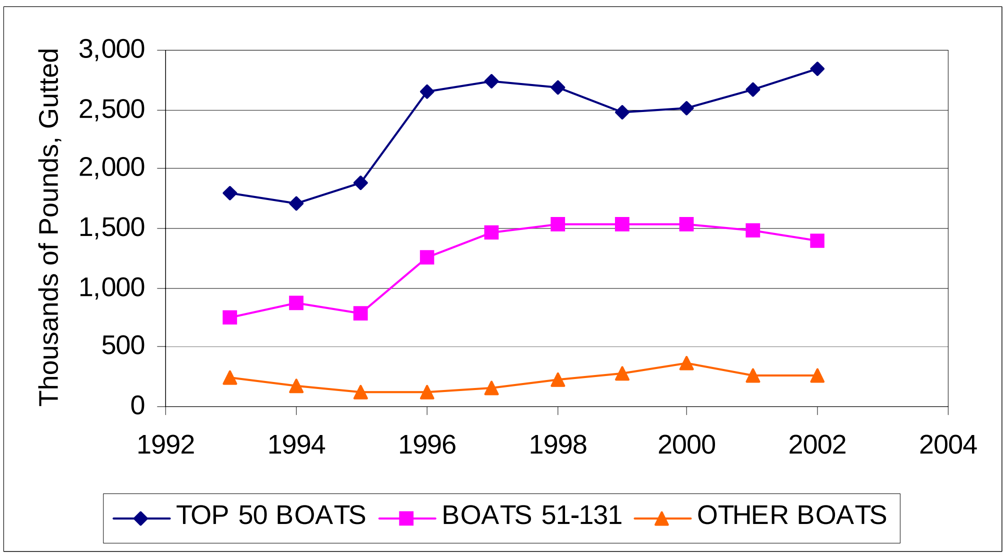

Figure 5.4.6. Total landings of red snapper.

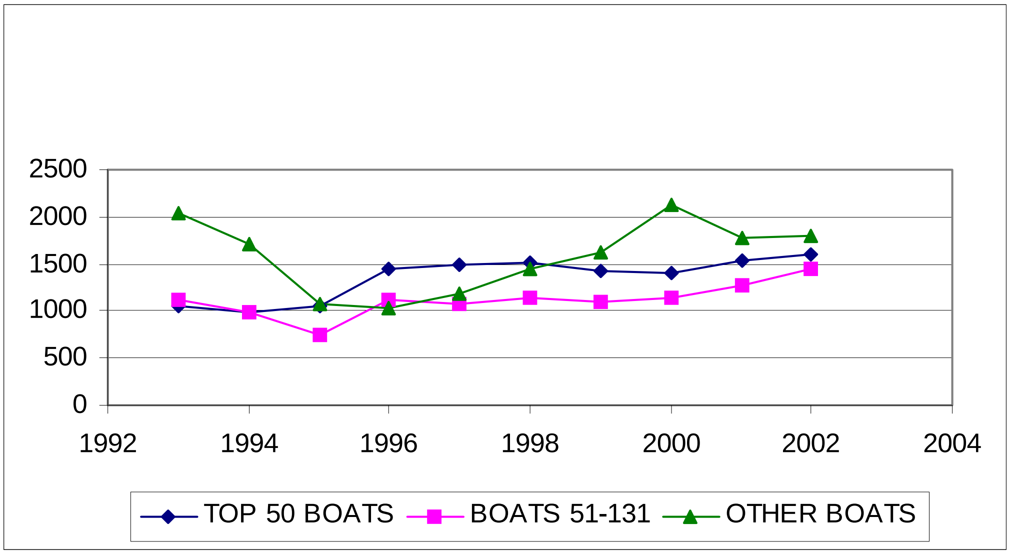

Figure 5.4.7. Number of trips per year that landed red snapper.

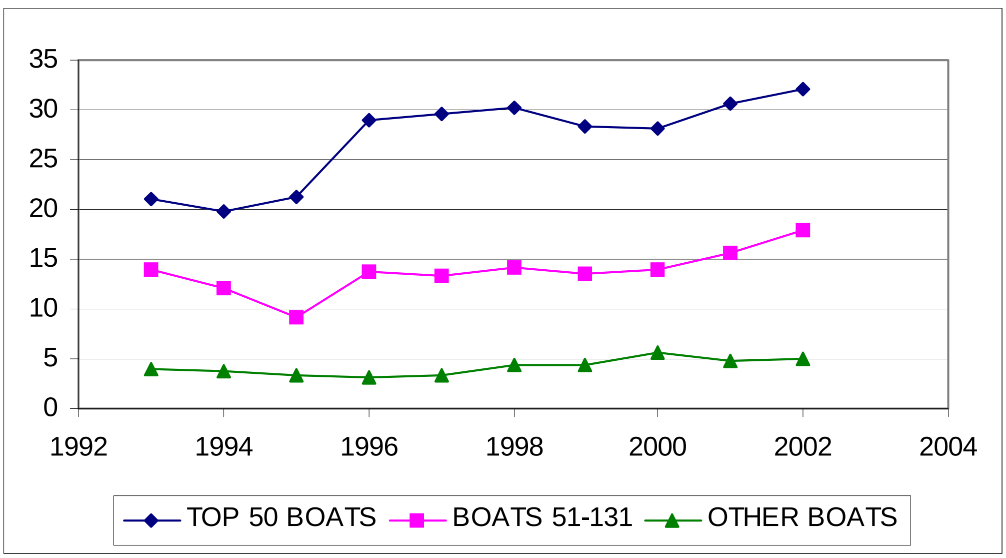

Figure 5.4.8 Number of trips per boat per year that landed red snapper.

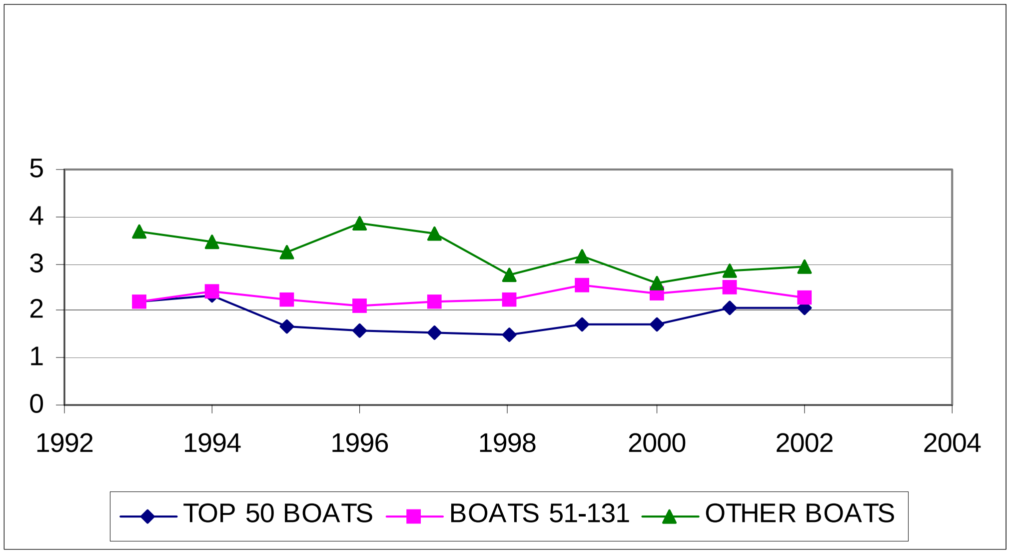

Figure 5.4.9. Number of days per trip that landed red snapper.

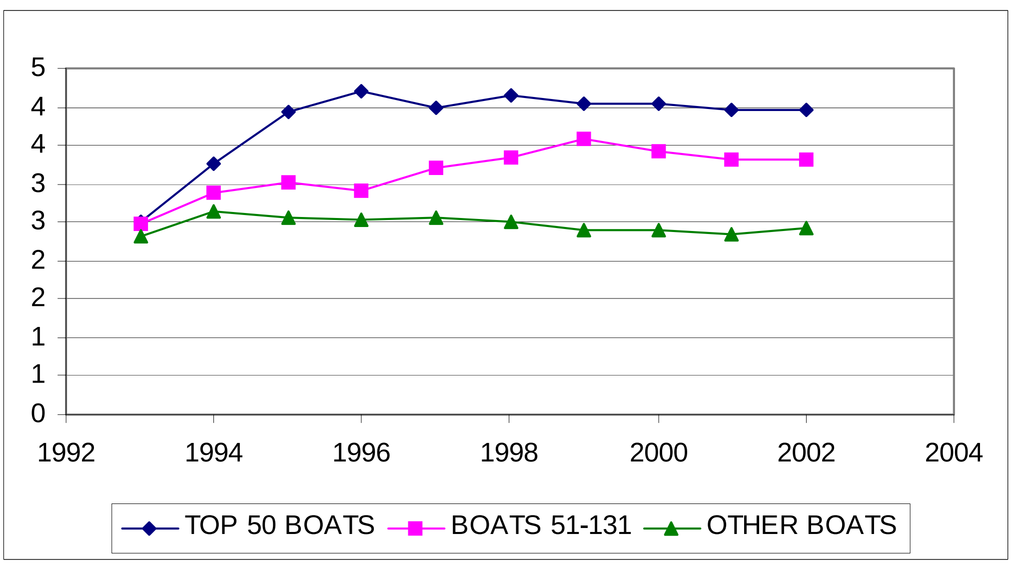

Figure 5.4.10. Number of persons aboard per trip that landed red snapper.

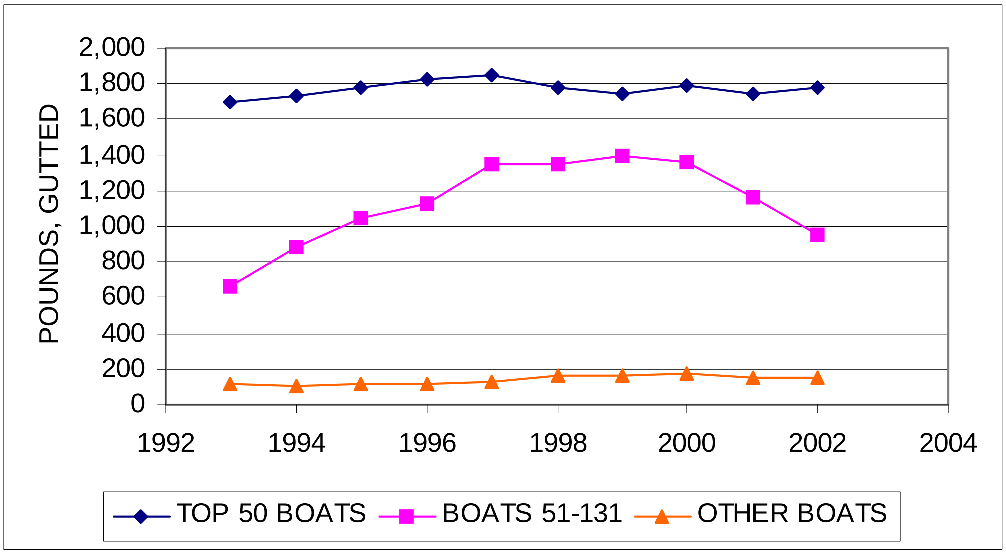

Figure 5.4.11. Average pounds of red snapper per trip.

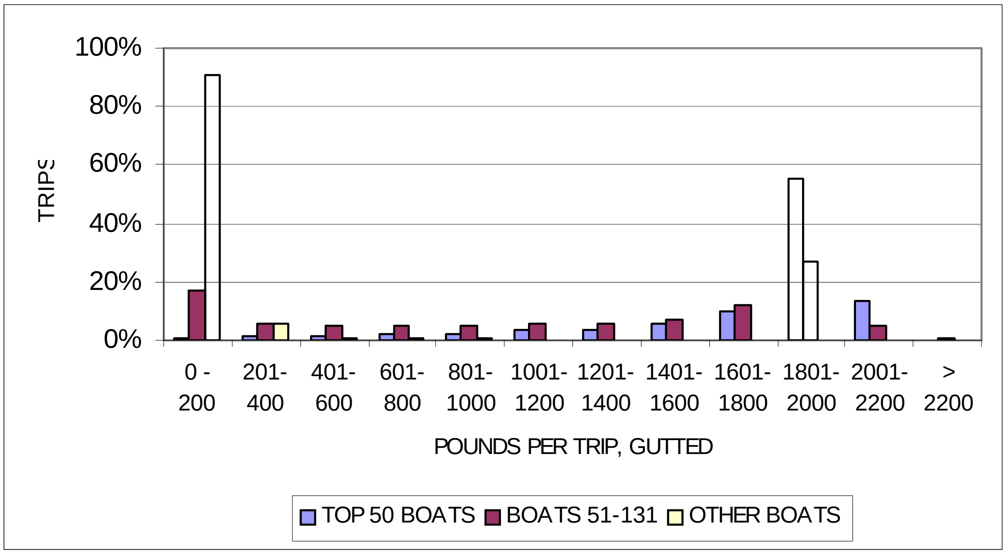

Figure 5.4.12. Distribution of pounds of red snapper per trip, 1998-2002.

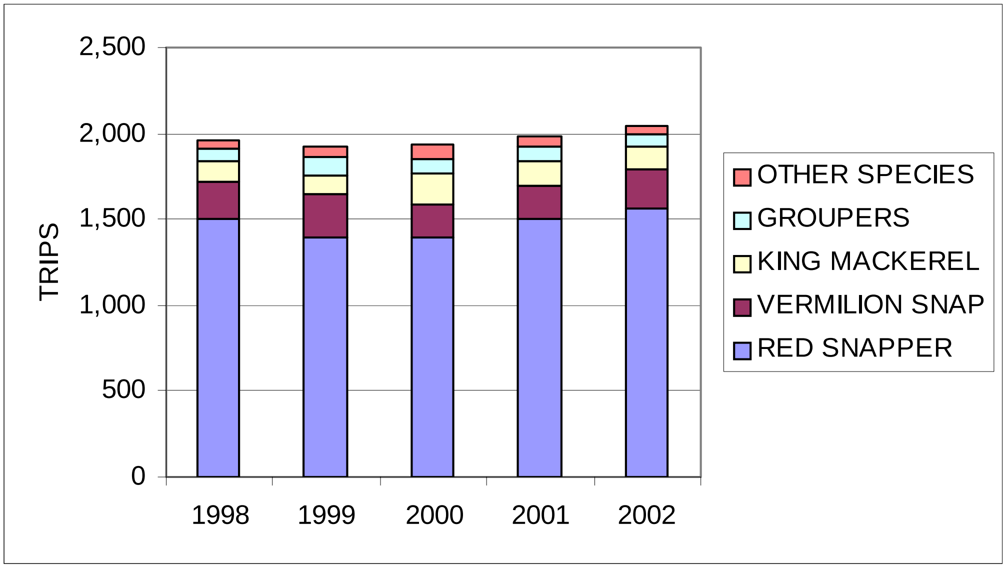

Figure 5.4.13. Number of trips for alternative main species by the top 50 boats that fished for red snapper.

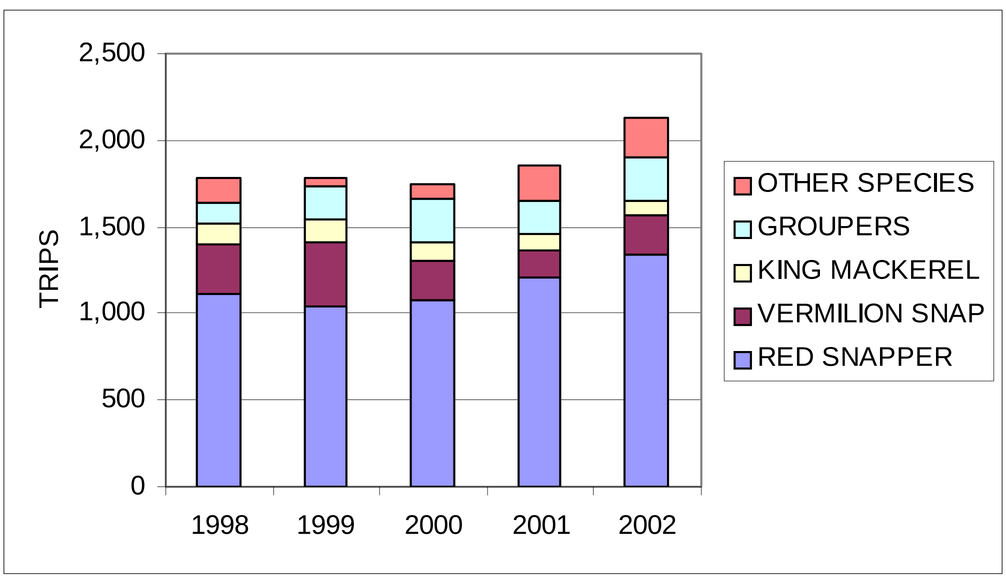

Figure 5.4.14. Number of trips for alternative main species by boats ranked 51-131 that fished for red snapper.

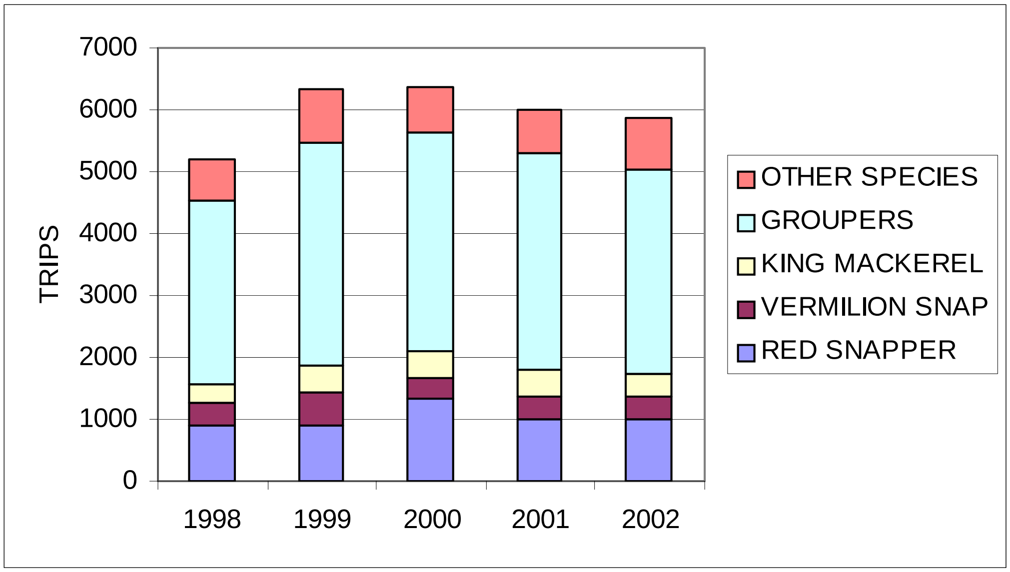

Figure 5.4.15. Number of trips for alternative main species by other boats that fished for red snapper.

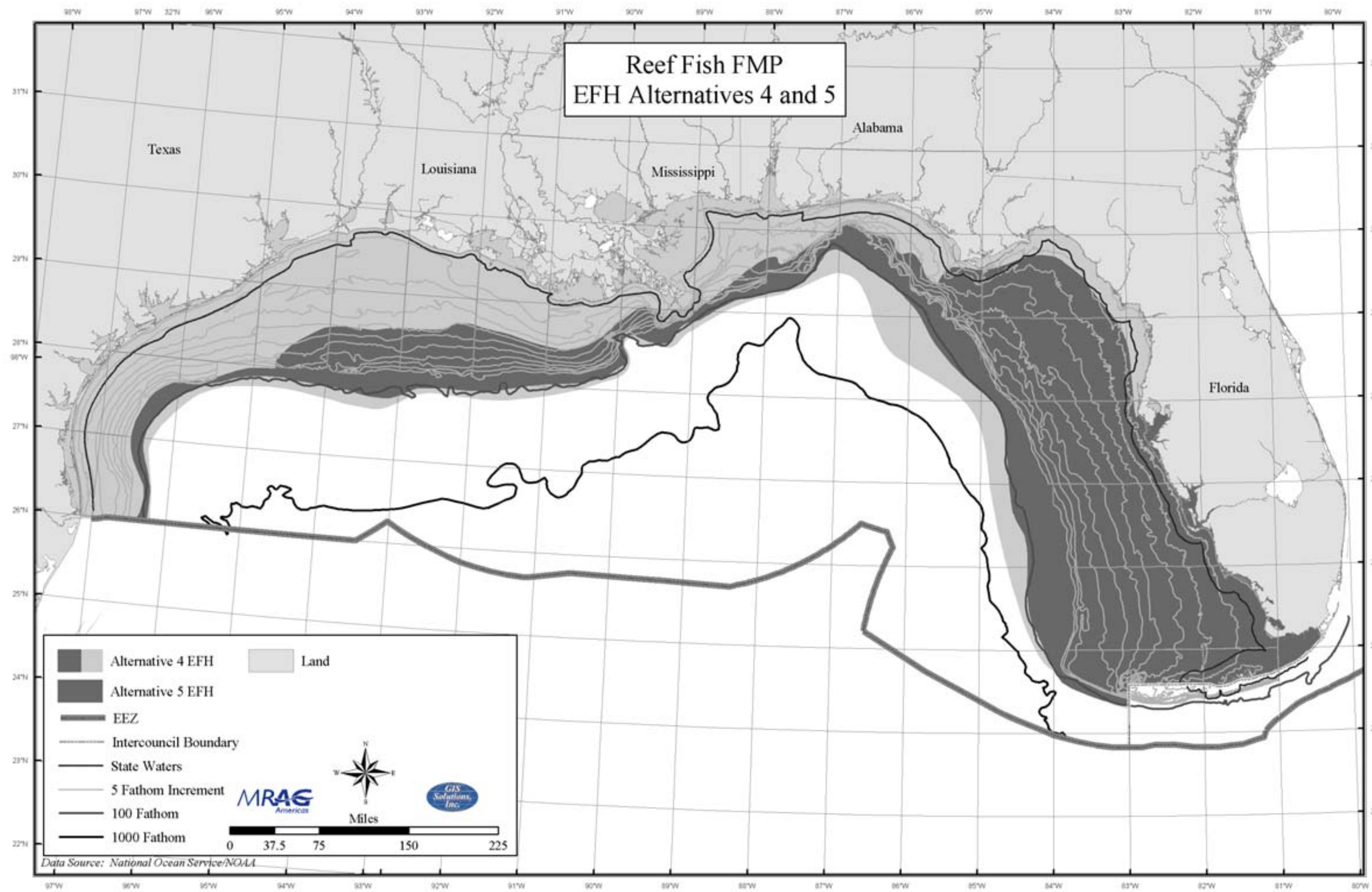

Figure 7.2.1 EFH for reef fish in the Gulf of Mexico (from the Draft Environmental Impact Statement for the Generic Essential Fish Habitat Amendment of the GMFMC).

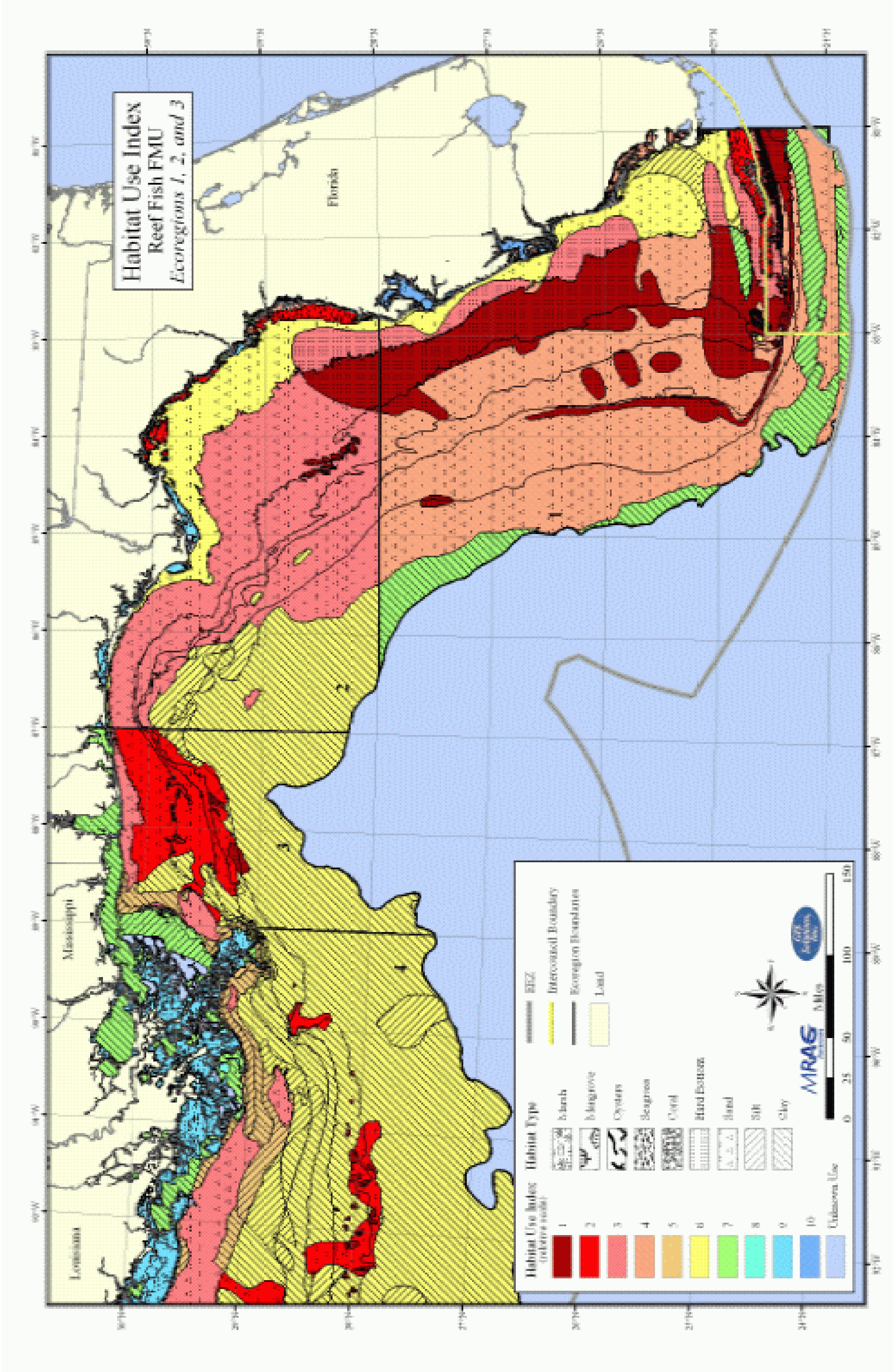

Figure 7.2.2 Habitat use by Reef Fish FMP species in the Eastern Gulf of Mexico - low index number represent high levels of habitat use (from the Draft Environmental Impact Statement for the Generic Essential Fish Habitat Amendment of the GMFMC).

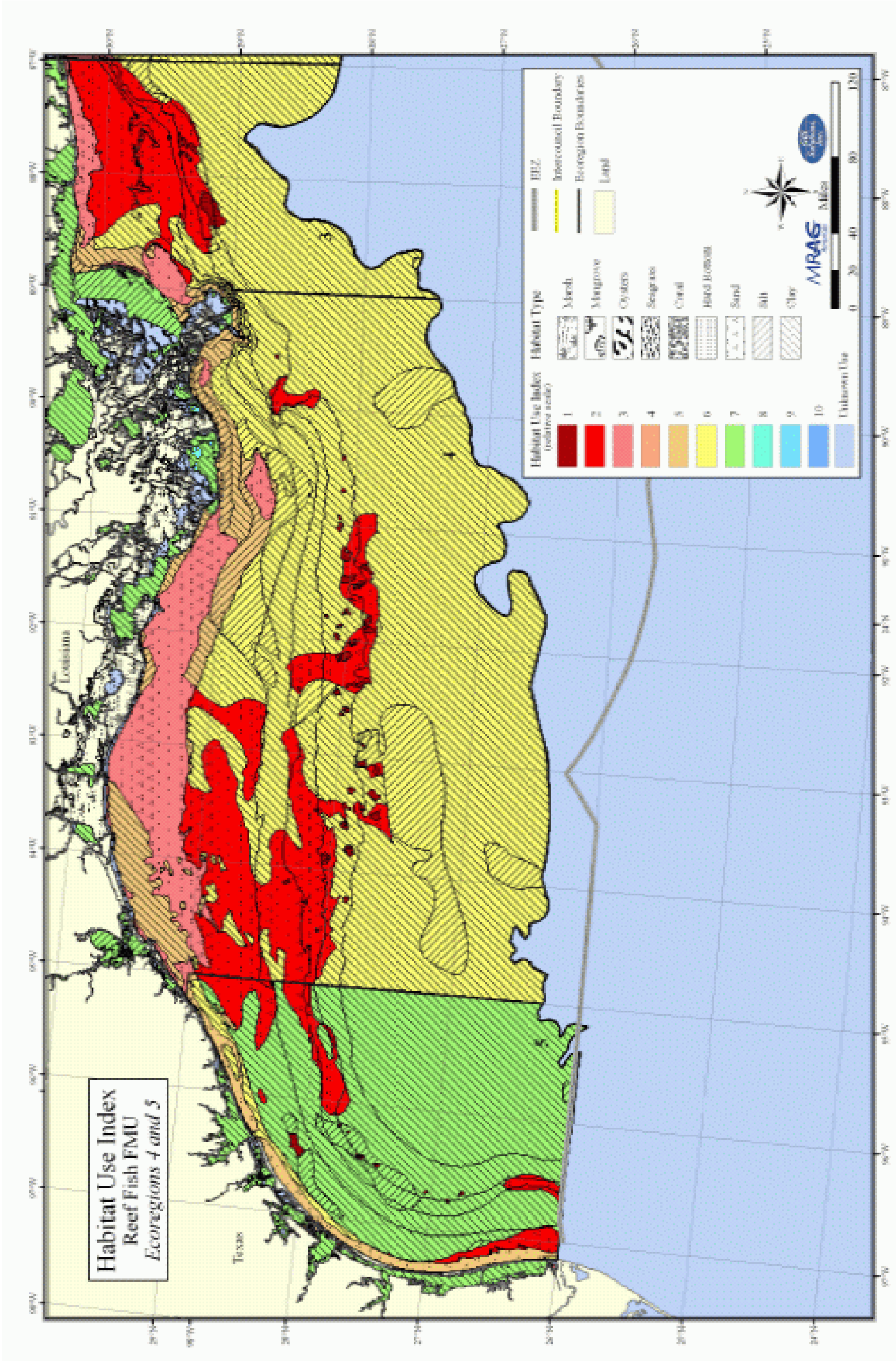

Figure 7.2.2 Habitat use by Reef Fish FMP species in the Eastern Gulf of Mexico - low index number represent high levels of habitat use (from the Draft Environmental Impact Statement for the Generic Essential Fish Habitat Amendment of the GMFMC).

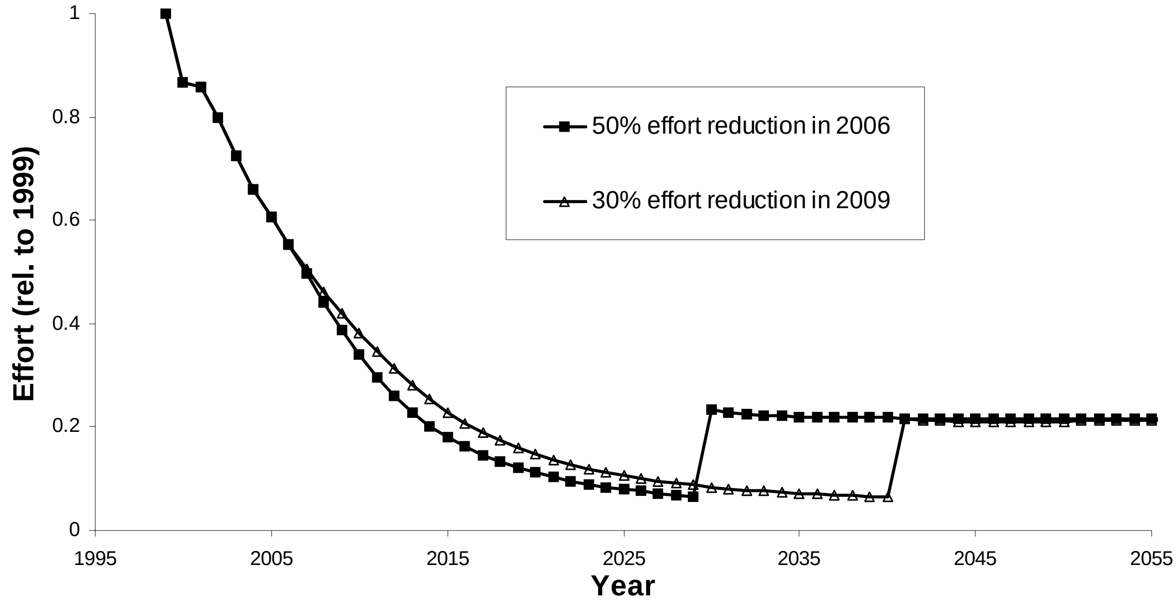

Figure 8.2.1. Effort changes necessary to implement alternative 2. This alternative holds TAC constant at 9.12 mp until rebuilding is achieved. Effort was assumed to be proportional to annual catches divided by red snapper abundance, which implies that catch per unit effort is an unbiased measure of abundance. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

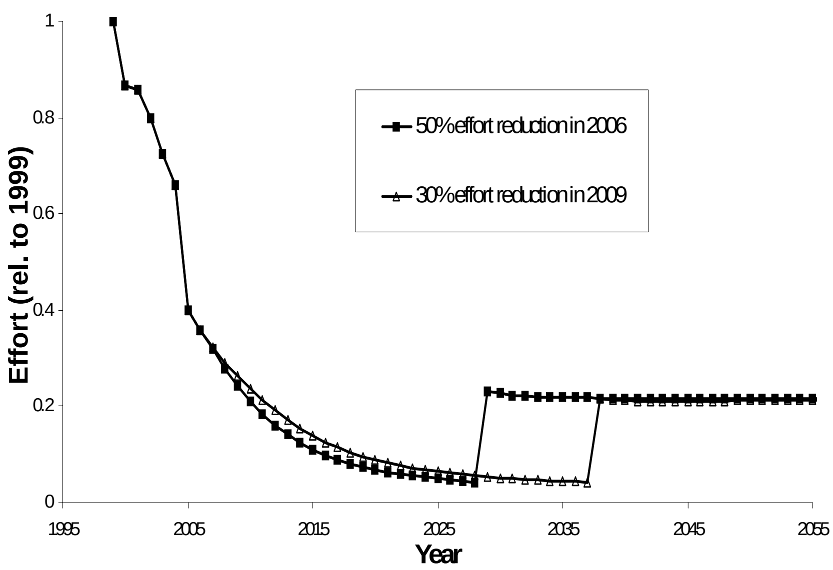

Figure 8.2.2. Effort changes necessary to implement alternative 3. This alternative reduces TAC to 6 mp, holding it there until rebuilding is achieved. Effort was assumed to be proportional to annual catches divided by red snapper abundance, which implies that catch per unit effort is an unbiased measure of abundance. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

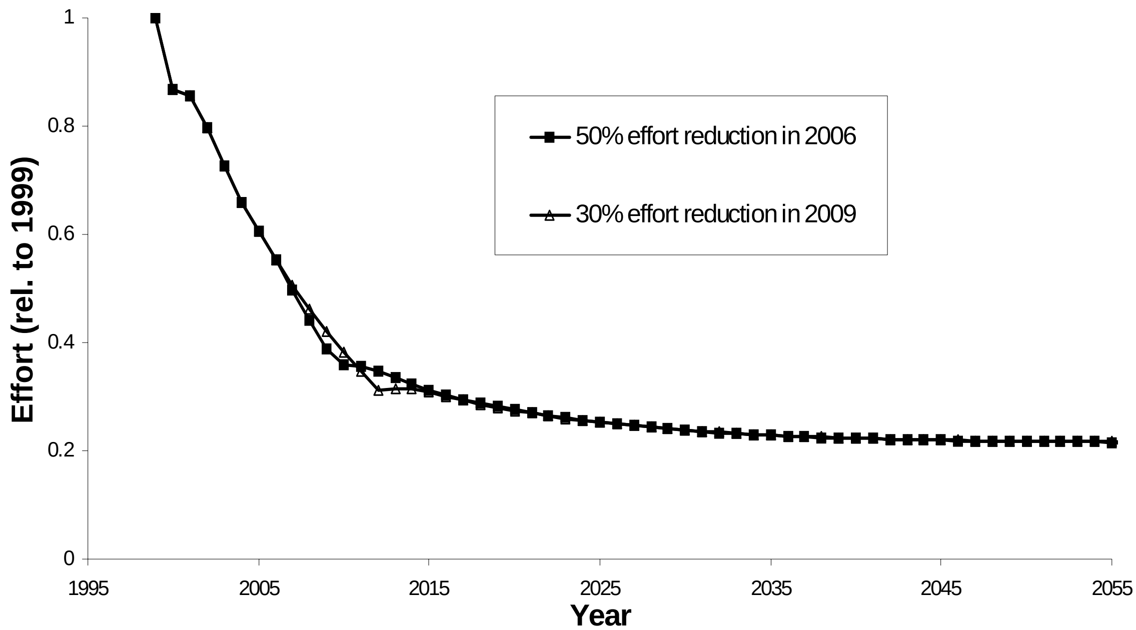

Figure 8.2.3. Effort changes necessary to implement alternative 4. This alternative holds TAC constant at 9.12 mp until an F_{OY} policy would permit higher catch limits. Effort was assumed to be proportional to annual catches divided by red snapper abundance, which implies that catch per unit effort is an unbiased measure of abundance. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

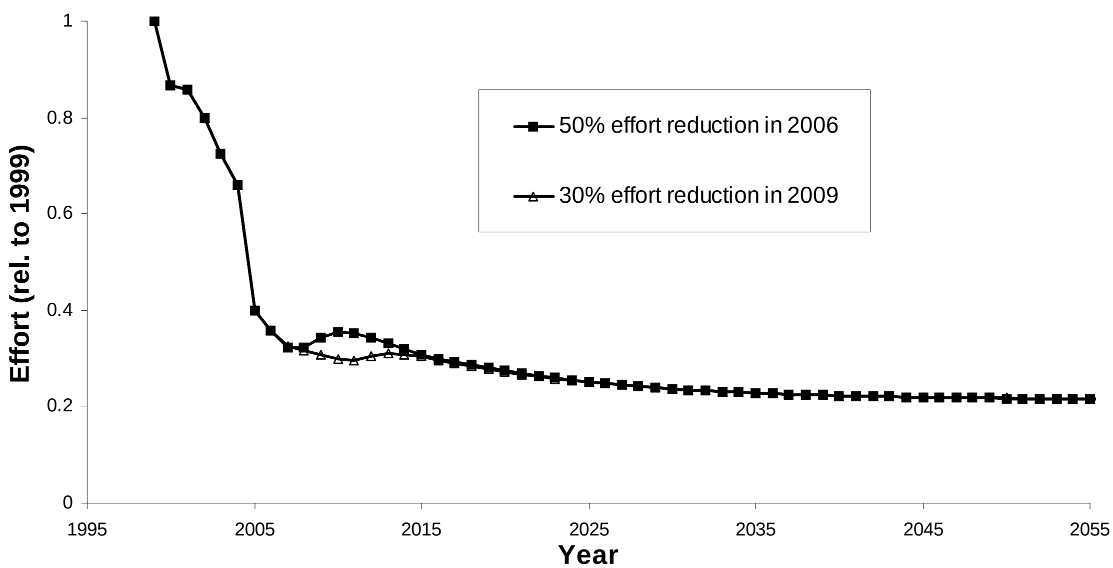

Figure 8.2.4. Effort changes necessary to implement alternative 5. This alternative reduces TAC to 6 mp, holding it there until an F_{OY} policy would permit higher catch limits. Effort was assumed to be proportional to annual catches divided by red snapper abundance, which implies that catch per unit effort is an unbiased measure of abundance. Projections ranged from a 30 percent effort reduction occurring in the shrimp fishery in 2009 to a 50 percent reduction occurring in 2006.

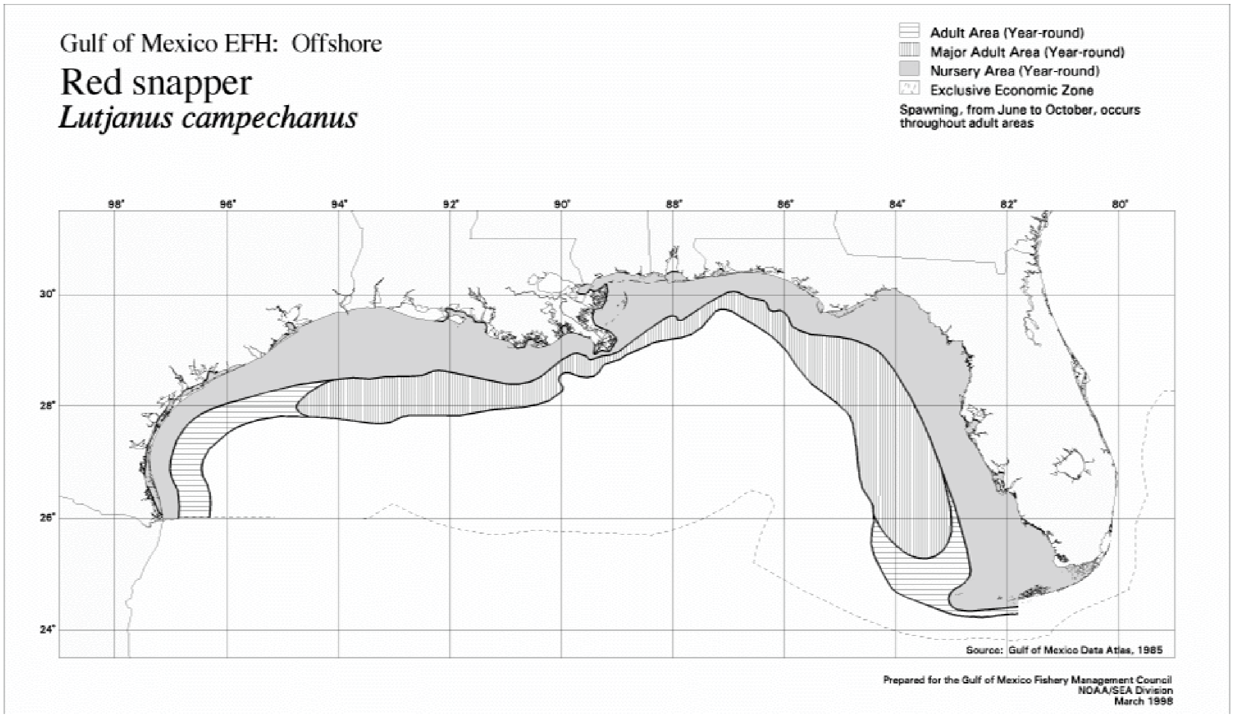

Figure 8.4.1 Gulf of Mexico essential fish habitat (EFH) for red snapper.

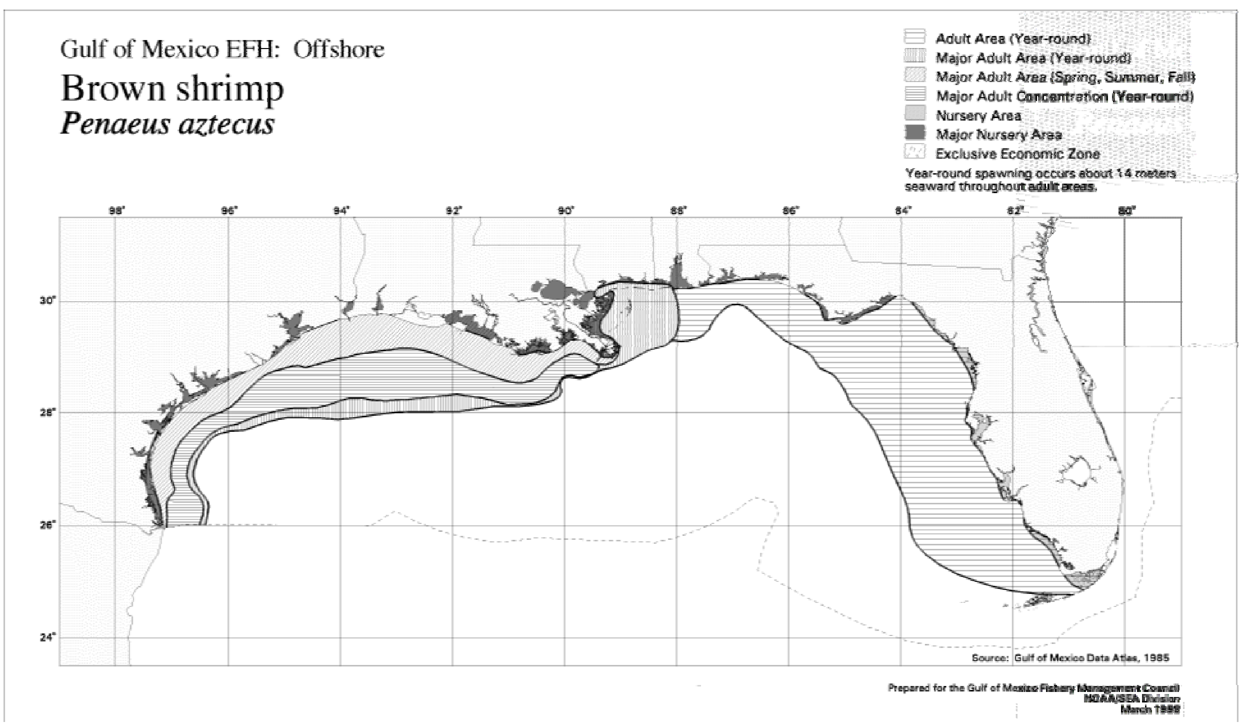

Figure 8.4.2. Gulf of Mexico essential fish habitat for brown shrimp.

APPENDIX A - ALTERNATIVES CONSIDERED BUT REJECTED

1 1 Alternatives considered but rejected

1 1.1 Biological Reference Points and Status Determination Criteria

Alternative 3: Maximum Sustainable Yield (MSY) for red snapper would be 50.41 million pounds which is yield associated with fishing at F_{MSY} using a steepness of 0.925 and the low recruitment scenario. This estimate was the second lowest estimate of MSY recommended by the Reef Fish Stock Assessment Panel (RFSAP) in September 1999.

Until recovery, OY is the yield consistent with the rebuilding strategy selected in this amendment. After achieving the rebuilding target, OY is the yield corresponding to a fishing mortality rate (F_{OY}) defined as:

A. $F_{OY} = 0.65*F_{MSY} = 0.067$
B. $F_{OY} = 0.75*F_{MSY} = 0.077$
C. $F_{OY} = 0.85*F_{MSY} = 0.087$
D. $F_{OY} = F_{MSY} = 0.103$.

Red snapper MSST shall be

E. 1-M * B_{MSY} where M = 0.1; 0.90* B_{MSY} = 2,426 mp
F. 50% of B_{MSY}; 0.50 * B_{MSY} = 1,348 mp

B_{MSY} is consistent with the stock assessment model used to select MSY.

Red snapper stocks in the Gulf of Mexico will be considered overfished if the probability that B_{CURR} is less than MSST is:

G. Greater than 50 percent.
H. Greater than 40 percent
I. Greater than 30 percent.

Red snapper MFMT is based on the F_{MSY}, or the F consistent with recovery to B_{MSY} level within the allowable rebuilding period value, and consistent with the stock assessment model run used to select MSY. The estimate of F_{MSY} associated with the second lowest MSY value from the most recent peer-reviewed stock assessment endorsed by the Reef Fish Stock Assessment Panel (RFSAP) in September 1999 was 0.103 (Steepness = 0.925 and low recruitment scenario). The red snapper stock would be considered undergoing overfishing if:

J. the probability that F_{CURR} is larger than F_{MSY} is:

1. **greater than 50 percent.**
2. **greater than 40 percent.***
3. **greater than 30 percent.***

K. F_{CURR} is larger than F_{MSY}.*
L. F_{CURR} is larger than 0.90*F_{MSY}.*
M. F_{CURR} is larger than 0.80*F_{MSY}.**

Alternative 6: Maximum Sustainable Yield (MSY) for red snapper would be 82.83 million pounds which is yield associated with fishing at F_{MSY} using a steepness of 0.925 and the high recruitment scenario. This estimate was the second highest estimate of MSY recommended by the Reef Fish Stock Assessment Panel (RFSAP) in September 1999.

Until recovery, OY is the yield consistent with the rebuilding strategy selected in this amendment. After achieving the rebuilding target, OY is the yield corresponding to a fishing mortality rate (F_{OY}) defined as:

A. $F_{OY} = 0.65*F_{MSY} = 0.070$
B. $F_{OY} = 0.75*F_{MSY} = 0.080$
C. $F_{OY} = 0.85*F_{MSY} = 0.091$
D. $F_{OY} = F_{MSY} = 0.107$.

Red snapper MSST shall be

E. 1-M * B_{MSY} where M = 0.1; 0.90* B_{MSY} = 3,625 mp

F. 50% of B_{MSY}; 0.50 * B_{MSY} = 2,014 mp

B_{MSY} is consistent with the stock assessment model used to select MSY.

Red snapper stocks in the Gulf of Mexico will be considered overfished if the probability that B_{CURR} is less than MSST is:

G. Greater than 50 percent.

H. Greater than 40 percent

I. Greater than 30 percent.

Red snapper MFMT is based on the F_{MSY}, or the F consistent with recovery to B_{MSY} level within the allowable rebuilding period value, and consistent with the stock assessment model run used to select MSY. The estimate of F_{MSY} associated with the second highest MSY value from the most recent peer-reviewed stock assessment endorsed by the Reef Fish Stock Assessment Panel (RFSAP) in September 1999 was 0.107 (Steepness = 0.925 and high recruitment scenario). The red snapper stock would be considered undergoing overfishing if:

J. the probability that F_{CURR} is larger than F_{MSY} is:

1. **greater than 50 percent.**
2. **greater than 40 percent.***
3. **greater than 30 percent.***

K. F_{CURR} is larger than F_{MSY}.*

L. F_{CURR} is larger than 0.90*F_{MSY}.*

M. F_{CURR} is larger than 0.80*F_{MSY}.**

* If this sub-alternative is chosen for MFMT, the sub-alternative D for OY would be inconsistent with this level of overfishing determination**.**

**If this sub-alternative is chosen for MFMT, the sub-alternatives C and D for OY would be inconsistent with this level of overfishing determination.

Discussion: Alternatives 3 and 6 were presented to the Council at its July meeting. After further review by NOAA Fisheries staff, it was determined that the steepness value of 0.925 which distinguished these two alternatives, was covered by the range provided by the current alternatives of 0.90 and 0.95. Therefore, the alternatives were rejected.

In addition, NOAA Fisheries staff considered an additional subalternative to set MSST equal to $B_{MSY.}$ If all other factors remained constant, this alternative would build additional conservatism into the definition of MSST by eliminating the buffer between the two parameters so that a stock would never be permitted to fall below B_{MSY} without triggering an “overfished” determination and the need to develop a rebuilding plan within one year of that determination. This alternative was rejected because it does not differ substantially from the first alternative, which would set MSST equal to 0.90*B_{MSY}.

1 1.2 Rebuilding Schedule

<u>Alternative</u> <u>1:</u> **No action. Maintain the 19-year schedule for red snapper, with the objective of rebuilding the stock by 2019.**

<u>Alternative</u> <u>2:</u> **Institute a 31-year rebuilding schedule for red snapper, with the objective of rebuilding the stock by 2032. This is the alternative considered in the regulatory amendment, and is the maximum allowable rebuilding schedule.**

<u>Alternative</u> <u>3:</u> **Institute a rebuilding schedule for red snapper in as short of time as possible by reducing F to zero.**

Alternative 4: Institute a 25-year rebuilding schedule for red snapper, with the objective of rebuilding the stock by 2026.

Discussion: The MSFCMA specifies that rebuilding plans should specify a time period for ending overfishing and rebuild the fishery. This time period should be as short as possible, taking into account the biology, ecology, and socioeconomics of the overfished fishery, as well as other factors, and should not exceed 10 years, except where biological or legal issues dictate otherwise. NOAA Fisheries' NSGs for implementing this requirement state that, if rebuilding to B_{MSY} would take 10 years or more, even in the absence of all fishing mortality, then the maximum recovery period is the rebuilding period calculated in the absence of fishing mortality plus one mean generation time.

Initially, rebuilding schedule alternatives were developed to set the time period needed for a variety of rebuilding scenarios (Section 12.4.2). However, it became evident that the rebuilding times proposed could not be achieved unless there were large reductions in red snapper bycatch in the shrimp fishery. Alternative 3 would require the closure of the both the directed and shrimp fisheries. This alternative was deemed not practical because it would close down two fisheries important to the economy. Alternatives 1 and 4 would also require not only severe reductions in the directed fishery, but also increased bycatch reductions by the shrimp fishery. This is because even with a zero TAC for the directed fishery, projections were that the red snapper stock could not recover to B_{MSY} unless bycatch reductions of greater than the current 40 percent could be achieved. Therefore, to rebuild the stock in less than the maximum 31 years, it would require even greater reductions in shrimp bycatch. With a recent economic downturn in the domestic shrimp fleet, further restrictions on shrimp harvest could have severe economic consequences. Thus, 31-year rebuilding schedule given in Alternative 2 was deemed the most practicable and was incorporated into the rebuilding plans listed in Section 4.2

1 1.3 Rebuilding Plan

Alternative 2: Institute a plan with five-year interim management goals. Set TAC for years 2001-2005 at 9.12 mp. Assume bycatch reduction at 40% (existing bycatch reduction device (BRD) requirements). Develop technological and management mechanisms to allow for increased reductions in bycatch. Use the decision tree process after the first five-year interval as follows.

For years 2006-2010:

Directed TAC defined by a constant fishing mortality rate:

- **If the B_{MSY} (stock productivity) estimate has not changed from the previous assessment and B_{2006} is less than B_{2001}, then implement increased bycatch reduction and reduce F in the directed fishery.**
- **If the B_{MSY} (stock productivity) estimate has not changed from previous assessment and B_{2006} is greater than or equal to B_{2001}, then implement up appropriate bycatch reduction to maintain stock rebuilding.**
- **If the B_{MSY} (stock productivity) estimate has changed from previous assessment, indicating that B_{2001}/B_{MSY} is better than previously thought, then adjust TAC to achieve consistency with a constant fishing mortality rate management strategy and assess the need for additional bycatch reduction.**
- **If the B_{MSY} (stock productivity) estimate has changed from previous assessment, indicating that B_{2001}/B_{MSY} is worse than previously thought, then implement increased bycatch reduction and reduce F on the directed fishery to a level appropriate to MSFCMA goals.**

For years 2011-2015 (and every five-year interval following):

Directed TAC maintained at the constant fishing mortality rate defined previously:

- **If the B_{MSY} (stock productivity) estimate has not changed from the previous assessment and B_{2011} is less than or equal to 1.5 times B_{2006}, then implement increase bycatch reduction and reduce F on the directed fishery to a level appropriate to MSFCMA goals.**

- **If the B_{MSY} (stock productivity) estimate has not changed from the previous assessment and B_{2011} is greater than 1.5 times B_{2006}, then maintain existing bycatch reduction.**
- **If the B_{MSY} (stock productivity) estimate has changed from previous assessment, indicating that B_{2006}/B_{MSY} is significantly better than previously thought, then maintain the existing bycatch reduction.**
- **If the B_{MSY} (stock productivity) estimate has changed from previous assessment, indicating that B_{2006}/B_{MSY} is worse than previously thought, then implement increased bycatch reduction and reduce F on the directed fishery to a level appropriate to MSFCMA goals.**

The rebuilding targets and thresholds associated with this alternative are based on the preferred alternatives selected in Section 4.1. MSY, OY, MFMT (overfishing), and MSST (overfished) Alternatives for Red Snapper.

<u>Alternative</u> <u>3:</u> Institute a plan with five-year interim management goals. Maintain TAC for years 2001-2005 at 9.12 mp. Current estimates of bycatch reduction of 40% [existing bycatch reduction device (BRD) require a 44 percent reduction]. Develop technological and management mechanisms to allow for increased bycatch reduction over the next 10 years. Use the decision tree process after the first five-year interval as follows.

For years 2006-2010:

Directed TAC defined by a constant fishing mortality rate where:

- **If the most recent stock assessment indicates that the stock biomass is equal to or less than the biomass expected within the rebuilding plan (the estimated B_{2006} is 1.35 - 1.45 times B_{2000}), then implement the appropriate level of bycatch reduction and adjust TAC to transition to a constant F rebuilding strategy during the 2006-2010 time period.**
- **If the most recent stock assessment indicates that the stock biomass has not improved as expected within the rebuilding plan (the estimated B_{2006} is < 1.35 times B_{2000}), then adjust TAC to achieve consistency with a constant fishing mortality rate management strategy and implement the appropriate level of bycatch reduction necessary to rebuild the stock within the rebuilding time period.**
-
- **If the most recent stock assessment indicates that the stock biomass is greater than the biomass expected within the rebuilding plan (the estimated B_{2006} is >1.45 times B_{2000}), then adjust TAC to achieve consistency with a constant fishing mortality rate management strategy and assess the need for additional bycatch reduction.**

For years 2011-2015 (and every five-year interval following):

Directed TAC maintained at the constant fishing mortality rate defined previously:

1 If the most recent stock assessment indicates that B_{CURR} is equal to $B_{rebuild}$, then maintain existing bycatch reduction.

2 If the most recent stock assessment indicates that B_{CURR} is less than $B_{rebuild}$, then implement increased bycatch reduction and reduce F on the directed fishery to a level appropriate to MSFCMA goals to rebuild the fishery to B_{MSY}.

3 If the most recent stock assessment indicates that B_{CURR} is greater than $B_{rebuild}$, then adjust TAC to achieve consistency with a constant fishing mortality rate management strategy, assess the need for additional bycatch reduction, and evaluate if the stock should be rebuilt within a shorter rebuilding period.

The rebuilding targets and thresholds associated with this alternative are based on the preferred alternatives selected in Section 4.1. MSY, OY, MFMT (overfishing), and MSST (overfished) Alternatives for Red Snapper.

<u>Alternative</u> <u>4:</u> Institute a plan with five-year interim management goals that rebuilds

the Gulf of Mexico red snapper stock to B_{MSY} within the rebuilding period listed in Section 4.2. If the rebuilding schedule chosen is 31 years, then maintain TAC at 9.12 mp until the current fishing mortality rate is estimated to be less than F_{MSY}. Once this is achieved, if the most recent stock assessment projects further increases in stock biomass while fishing at F_{MSY}, then maintain F at or below F_{MSY} and allow TAC to increase to 15 mp (or some other value selected by the Council). After 15 mp (or some other value) has been achieved while fishing at or below F_{MSY}, either cap the TAC at 15 mp or transition to a harvest level based on $F_{rebuild}$ until the stock is rebuilt.

After each five-year interval, evaluate the stock condition in terms of biomass and fishing effort through an iterative process. Causal factors for the current stock condition are evaluated (Stock status and causal factors table) and management actions to maintain the rebuilding plan are identified and implemented through framework (Management action table).

Management Action Tables

Stock status and causal factors table

	$B_{current}/B_{rebuild} < 1$	$B_{current}/B_{rebuild} = 1$	$B_{current}/B_{rebuild} > 1$
$F_{current}/F_{rebuild} > 1$	**Effort controls ineffective.** • Average or low recruitment failed to offset overfishing • Growth lower than expected. • Bycatch reduction less than expected • Directed fishery quota exceeded	**Effort controls ineffective.** • Strong recruitment may have offset overfishing • Bycatch reduction working better than expected	**Effort controls ineffective.** • Very strong recruitment • High growth • Lowered M and/or discards. • Bycatch reduction working much better than expected
$F_{current}/F_{rebuild} = 1$	**Effort controls effective.** • Below average recruitment led to below average biomass. • Natural or discard mortality increased • Bycatch reduction less than expected	**Effort controls effective.** • Recruitment at average projected level. • No evidence to reject basis for forecasting approach	**Effort controls effective.** • Strong (above projected) recruitment. • High growth • Lowered M and/or discards. • Bycatch reduction working much better than expected
$F_{current}/F_{rebuild} < 1$	**Effort control more effective than expected.** • Recruitment or growth well below average • Natural or discard mortality increased • Bycatch reduction working much less than expected.	**Effort controls more effective than expected.** • Lower than average recruitment may offset lower F	**Effort control more effective than expected.** • Average to strong recruitment.

Management action table:

	$B_{current}/B_{rebuild} < 1$	$B_{current}/B_{rebuild} = 1$	$B_{current}/B_{rebuild} > 1$
$F_{current}/F_{rebuild} > 1$	**Reduce F to $F_{rebuild}$** • Consider basis for poor biomass performance • Extra measures will be needed because present measures ineffective • Increase or maintain bycatch reduction	**Reduce F to $F_{rebuild}$** • Extra measures will be needed because present measures ineffective. • Identify causes—e.g., strong recruitment offset overfishing? • Increase bycatch reduction to level appropriate to maintain rebuilding	**Reduce F to $F_{rebuild}$, re-consider B_{MSY}, F_{MSY}** • Reconsideration should come before reduction in F. • Identify causes—strong recruitment offset overfishing?
$F_{current}/F_{rebuild} = 1$	**Maintain F at $F_{rebuild}$; and/or re-estimate B_{MSY}, F_{MSY} as appropriate** • Consider regime changes, multispecies effects, changes in vital rates • Extra measures will be needed because present measures ineffective • Increase or maintain bycatch reduction	**Maintain F at $F_{rebuild}$** • Proceed with plan. • Consider revising $F_{rebuild}$ if current value is greater than previous value • Increase or maintain bycatch reduction to level appropriate to maintain rebuilding	**Maintain F at F_{MSY} or below** • Depends on expected trajectory from $B_{current}$ to B_{2031} at Fmsy • Reevaluate bycatch reduction needed to maintain rebuilding plan • Evaluate if rebuilding period should be shortened
$F_{current}/F_{rebuild} < 1$	**Consider basis, re-estimate B_{MSY}, F_{MSY} as appropriate** • Consider regime changes, multispecies effects, and changes in vital rates • Increase or maintain bycatch reduction	**Maintain $F_{current}$ if that effort will follow rebuilding plan to B_{MSY}** 1 Increase or maintain bycatch reduction to level appropriate to maintain rebuilding	**Maintain F </= F_{MSY} re-consider B_{MSY},** 2 Reconsider time frame for rebuild and if period should be shortened (No penalty for early victory) 3 Re-evaluate F_{MSY} (too low?) 4 Reevaluate bycatch reduction needed to maintain rebuilding plan

The rebuilding targets and thresholds associated with this alternative are based on the preferred alternatives selected in Section 4.1. MSY, OY, MFMT (overfishing), and MSST (overfished) Alternatives for Red Snapper.

<u>Alternative</u> <u>5:</u> **Institute a plan with five-year interim management goals that rebuilds the Gulf of Mexico red snapper stock within the rebuilding period listed in Section 4.2. If the rebuilding schedule chosen is 31 years, then no changes in current TAC until $F = F_{MSY}$ (likely to occur by 2007), and then allow TAC to be the yield associated with F_{MSY} until TAC becomes 15 mp. After this point, cap TAC at 15 MP until the stock is rebuilt. After each 5-year interval, evaluate the stock condition in terms of biomass and fishing effort through the iterative process described in Alternative 4. The rebuilding targets and thresholds associated with this alternative are based on the preferred alternatives selected in Section 4.1. MSY, OY, MFMT (overfishing), and MSST (overfished) Alternatives for Red Snapper.**

<u>Alternative</u> <u>6:</u> **Use interim management goals other than five-year increments throughout the rebuilding period. These increments will be:**

- **A. annual increments;**
- **B. three-year increments;**
- **C. ten-year increments.**

The rebuilding plan by which these interim rules will be applied to is that described in;

- **D. Alternative 2;**
- **E. Alternative 3;**
- **F. Alternative 4;**
- **G. Alternative 5.**

The rebuilding targets and thresholds associated with this alternative are based on the preferred alternatives selected in Section 4.1. MSY, OY, MFMT (overfishing), and MSST (overfished) Alternatives for Red Snapper.

<u>Alternative</u> <u>7:</u> **Maintain the red snapper TAC at status quo, 9.12 mp (4.65 million pound commercial quota; 4.47 million pound recreational quota), utilizing a constant catch strategy. TAC will be set pending an annual or biannual review of the red snapper assessment. The rebuilding targets and thresholds associated with this alternative are based on the preferred alternatives selected in Section 4.1. MSY, OY, MFMT (overfishing), and MSST (overfished) Alternatives for Red Snapper.**

<u>Alternative</u> <u>8:</u> **Reduce the TAC (to as low as 2.0 mp) to conform with a constant F rebuilding strategy. TAC will be set pending an annual or biannual review of the red snapper assessment. The rebuilding targets and thresholds associated with this alternative are based on the preferred alternatives selected in Section 4.1. MSY, OY, MFMT (overfishing), and MSST (overfished) Alternatives for Red Snapper.**

<u>Alternative</u> <u>9:</u> **Reduce current TAC to 7.46 mp, utilizing a constant catch strategy. That value is the mid-point of the range of maximum ABC values (5.8-9.12 mp) recommended by the RFSAP under the constant catch rebuilding strategy. The rebuilding targets and thresholds associated with this alternative are based on the preferred alternatives selected in Section 4.1. MSY, OY, MFMT (overfishing), and MSST (overfished) Alternatives for Red Snapper.**

Discussion: Alternatives 2-9 were included in an initial draft of this document that was presented to the Council at their July 2002 meeting in Naples, Florida. These alternatives were considered, but then rejected as better information became available for developing rebuilding schedules. The schedules that the above alternative plans were based on provided that 60 to 80 percent bycatch reduction was needed to rebuild the stock. However, there were no specific provisions as to how this bycatch reduction would be implemented. Much of the reductions banked on gains derived from BRDs in the hope that BRD technology would improve. However, new information (described in Section 4.2) became available on the current status of the shrimp fishery indicating that reductions in shrimp fishery effort are occurring in response to economic changes in that fishery. The predicted reductions in effort are thought to be around 30 to 50 percent. Based on these predictions, new rebuilding plan alternatives were devised based on the new information. These plans are based on the best available information on bycatch reduction and shrimp effort reduction. Therefore, the current Alternatives 2-5 described in Section 4.2 were substituted for the above alternatives. Because projections of shrimp fishery effort showed that needed reductions in shrimp bycatch mortality could be achieved to allow rebuilding of the stock, other management measures such as closed areas were considered but rejected. Measures that could reduce bycatch in the shrimp fishery such as bycatch quotas and time/areas closures were not considered in the amendment and need to be considered in the Shrimp FMP.

Alternative 8 which uses a constant F rebuilding strategy was not carried over to the current document. To institute a constant F rebuilding strategy, initial harvest would have needed to be reduced to at least 2 million pounds, if not lower. It was felt that the consequence of a reduction of this magnitude would have a severe adverse effect on the directed fishery, and therefore, was impractical.

APPENDIX B - SCOPING DOCUMENT

RED SNAPPER REBUILDING AMENDMENT
SCOPING DOCUMENT

The Gulf of Mexico Fishery Management Council (Council) is preparing to amend the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico to establish a red snapper rebuilding plan that is based on biomass-based stock rebuilding targets and thresholds. In May 2001, the Council submitted to the National Marine Fisheries Service (NOAA Fisheries) a regulatory amendment to the Reef Fish FMP that modified the current rebuilding plan and was consistent with NOAA Fisheries guidelines. NOAA Fisheries has consequently determined that the actions taken by the Council warrant the preparation of a draft supplemental environmental impact statement (DSEIS), rather than the environmental assessment that accompanied the Council's regulatory amendment.

Thus, the Council will develop a DSEIS to evaluate alternative biomass-based stock rebuilding targets and thresholds for red snapper, and to consider various rebuilding schedules, consistent with the legal mandate provided by § 304(e)(4) of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) to rebuild overfished stocks in as short a time period as possible, taking into account other factors, including the status and biology of the overfished stock and the needs of fishing communities. The DSEIS will also consider various alternatives to achieve the rebuilding goal based on a constant catch scenario and/or a constant fishing mortality rate scenario. The Council is soliciting public input on the range of alternatives to be considered in the DSEIS and on the significant issues related to the actions considered.

This scoping document describes the legal requirements related to specifying stock status determination criteria and to ending overfishing and rebuilding overfished stocks, and provides a list of potential alternatives for meeting those requirements. Listed alternatives are meant to initiate discussion for scoping purposes only, and may not represent the full range of alternatives that will be evaluated in the DSEIS for the red snapper rebuilding amendment.

STOCK STATUS DETERMINATION CRITERIA

The MSFCMA § 303(a)(10) requires that *"Any fishery management plan which is prepared by any Council, or by the Secretary, with respect to any fishery, shall – specify objective and measurable criteria for identifying when the fishery to which the plan applies is overfished (with an analysis of how the criteria were determined and the relationship of the criteria to the reproductive potential of stocks of fish in that fishery)."*

The MSFCMA, as amended by the Sustainable Fisheries Act (SFA) of 1996, provides new requirements for marine fisheries managed by the Gulf Council and other regional fishery management councils. The Gulf Council responded to these new requirements by developing a Generic SFA Amendment that included among other actions, the specification of higher standards for overfishing and overfished criteria that would restore fishery stocks to maximum sustainable yield (MSY) levels. However, after the Generic SFA Amendment was submitted to NOAA Fisheries, the agency determined that biomass-based proxies for MSY, optimum yield (OY), and minimum stock size threshold (MSST) were superior to the fishery mortality-based reference points, such as spawning potential ratio (SPR), that were used in the Council's amendment. Therefore, NOAA Fisheries disapproved the Council's SPR-based reference points of MSY, OY, and MSST. The agency approved the SPR-based thresholds that the Council chose to define overfishing - the maximum fishing mortality thresholds (MFMT).

In order to understand how overfishing and overfished criteria are developed, it is important to understand MSY. According to the National Standard Guidelines (NSGs) developed by NOAA Fisheries, MSY is defined as the "largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions." Associated with MSY is a stock size (biomass at MSY or B_{MSY}) that is the "long term average size of the stock or stock complex, measured in terms of spawning biomass or other appropriate units, that would be achieved under an MSY control rule in which the fishing mortality rate (F) is constant." The MSY control rule means a harvest strategy that would be expected to result in a long-term average catch approximating MSY and to maintain the stock at B_{MSY}.

The MSST and the MFMT are two important parameters dictated by the NSGs for use in the MSY control rules regarding overfished and overfishing status for a stock. If the current stock size is below MSST, then the stock is overfished. If the current F is above MFMT, then overfishing is occurring on the stock. In selecting an MSST, the NSGs advise that "to the extent possible, the stock size threshold should be equal to whichever of the following is greater: one-half the MSY stock size (B_{MSY}), or the minimum stock size at which rebuilding to the MSY level would be expected to occur with 10 years if the stock or stock complex were exploited at the MFMT."

NOAA Fisheries technical guidance for the precautionary approach to the setting of OY recommends setting MSST so that is related to the natural mortality rate (M) of a stock. This guidance suggests that MSST should be equal to $0.5*B_{MSY}$ or $(1-M)*B_{MSY}$ - whichever yields the largest MSST. The theory behind using M as an indicator of at what level to set MSST is that a stock fished at F_{MSY} (the F that will achieve MSY) should fluctuate around B_{MSY} on a scale related to M (i.e., populations with small values for M are generally more stable, but less productive than populations that have higher values of M).

As an example of how these measures could be applied, the Gulf of Mexico red snapper stock has an estimated value of M equal to 0.1 (Schirripa and Legault 1999). Therefore, the MSST value recommended by NOAA Fisheries technical guidance would be 1-M or $0.90*B_{MSY}$ because this MSST level is greater than $0.5*B_{MSY}$. For a species like dolphin where M is greater than 0.5 (estimated M between 0.68 and 0.80), the MSST value recommended by NOAA Fisheries technical guidance would be $0.5*B_{MSY}$.

The other parameter needed for the status determination of a stock is MFMT. This is a fishing mortality threshold that should not exceed F_{MSY}. Fishing at a level above MFMT for a period of one or more years would constitute overfishing. In general, MFMT is set at F_{MSY} or some proxy of F_{MSY}. The MFMT values established by the Council in the SFA Generic Amendment were approved by NOAA Fisheries and were associated with the F that would generate a yield associated with a certain SPR level thought to approximate MSY. For Gulf of Mexico red snapper, the MFMT value is the F value needed to maintain a population at 26 percent static SPR ($F_{26\%\ SPR}$).

The SFA also requires that the Council establish an OY reference point. The OY is a target reference point that should be set no higher than MSY (a limit reference point). This value could be set through either an analysis of the risk associated with various yield levels and selecting the appropriate risk averse strategy, or by selecting a particular yield level where the probability of exceeding the limit (or MSY) is below some level. One method recommended in NOAA Fisheries Technical Guidance is to set OY at the yield corresponding to the F value that is 75 percent of F_{MSY} (i.e., $0.75*F_{MSY}$) (Restrepo et al. 1998).

An analysis of the corresponding OY associated with fishing at this F value found that OY would be 94 percent or better of MSY once the stock has achieved equilibrium. Because F refers to the proportion of fish that are removed by fishing each year, the proportion of fish being removed from the stock at F_{OY} ($0.75*F_{MSY}$) is less than the proportion removed at F_{MSY}. At this lower harvest rate, the stock size could increase above B_{MSY}. Thus, OY could be more than 75 percent of MSY because the stock has a chance to rebuild to a level higher than B_{MSY} [B_{OY} was estimated to between 125-131 percent of B_{MSY} in Restrepo et al.'s (1998) analyses].

The following are potential alternatives for defining MSY, OY, MSST, and MFMT for red snapper. These alternatives are based on the range of alternatives considered in the May 2001 regulatory amendment to the reef fish FMP to modify the red snapper rebuilding plan. They are included in this document for discussion purposes only and may change in response to comments received during the scoping and/or preliminary analytical process.

1. Maximum sustainable yield (MSY)

Alternative 1: Red snapper MSY, F_{MSY}, B_{MSY} shall be the range of values considered by the Reef Fish Stock Assessment Panel (RFSAP) in September 1999, based on the most recent red snapper stock assessment (Schirripa and LeGault 1999) (maximum recruitment equal to the low recruitment scenario, with steepness of 0.90 and 0.95):

- MSY: 41.13 - 66.03 mp
- F_{MSY}: 0.092 - 0.116 (33-36% static SPR)
- B_{MSY}: 2.64 - 2.73 billion pounds

Alternative 2: Red snapper MSY, F_{MSY}, B_{MSY} shall be the values considered by the RFSAP in September 1999, based on the most recent snapper stock assessment (Schirripa and LeGault 1999), for a spawner-recruitment steepness of 0.9 (low recruitment scenario):

- MSY: 41.13 mp
- F_{MSY}: 0.092
- B_{MSY}: 2.73 billion pounds

Alternative 3: Red snapper MSY, F_{MSY}, and B_{MSY} shall be the values considered by the RFSAP in September 1999, based on the most recent snapper stock assessment (Schirripa and LeGault 1999), for a spawner-recruitment steepness of 0.95, (low recruitment scenario):

- MSY: 66.03 mp
- F_{MSY}: 0.116
- B_{MSY}: 2.64 billion pounds

Alternative 4: Red snapper MSY, F_{MSY}, and B_{MSY} shall be the values considered by the RFSAP in September 1999, based on the most recent snapper stock assessment (Schirripa and LeGault 1999),

for a spawner-recruitment steepness of 0.925 (low recruitment scenario):
- MSY: 50.41 mp
- F_{MSY}: 0.103
- B_{MSY}: 2.70 billion pounds

Alternative 5: No action.

2. Optimum Yield (OY)

Alternative 1: From 2001-2005, OY = 9.12 mp. From 2006-recovery, OY is the yield defined by a constant fishing mortality rate strategy consistent with rebuilding to B_{MSY} within the allowable rebuilding period. And, after achieving the rebuilding target, OY is the yield corresponding to a fishing mortality rate (F_{OY}) defined as: $F_{OY} = 0.75*F_{MSY}$.

Alternative 2: From 2001-2005, OY = 6 mp. From 2006-recovery, OY is the yield defined by a constant fishing mortality rate strategy consistent with rebuilding to B_{MSY} within the allowable rebuilding period. And, after achieving the rebuilding target, OY is the yield corresponding to a fishing mortality rate (F_{OY}) defined as: $F_{OY} = 0.75*F_{MSY}$.

Alternative 3: From 2001-recovery, OY is the yield defined by a constant fishing mortality rate strategy consistent with rebuilding to B_{MSY} within the allowable rebuilding period. And, after achieving the rebuilding target, OY is the yield corresponding to a fishing mortality rate (F_{OY}) defined as: $F_{OY} = 0.75*F_{MSY}$.

Alternative 4: No action.

3. Minimum Stock Size Threshold (MSST)

Alternative 1: Red snapper MSST shall be 90% (1-M where M = 0.1) of B_{MSY}. Existing estimates of B_{MSY} are not considered reliable. However, all available scientific information indicates that B_{CURR} is << (1-M)*B_{MSY}. Red snapper stocks in the Gulf of Mexico will be considered overfished if the probability that B_{CURR} is less than MSST is:

A. Greater than 50 percent.
B. Greater than 40 percent
C. Greater than 30 percent.

Alternative 2: Red snapper MSST shall be 50% of B_{MSY}. Existing estimates of B_{MSY} are not considered reliable. However, all available scientific information indicates that B_{CURR} is << (1-M)*B_{MSY}. Red snapper stocks in the Gulf of Mexico will be considered overfished if the probability that B_{CURR} is less than MSST is:

A. Greater than 50 percent.
B. Greater than 40 percent
C. Greater than 30 percent.

Alternative 3: No Action.

3. Maximum Fishing Mortality Threshold (MFMT)

Alternative 1: Red snapper MFMT shall be F_{MSY}, or the F consistent with recovery to the MSY level in no more than 31 years. The red snapper stock would be considered undergoing overfishing if the probability that F_{CURR} is larger than F_{MSY} is:

A. Greater than 50 percent.
B. Greater than 40 percent
C. Greater than 30 percent.

Alternative 2: Red snapper MFMT shall be the current (as of 1997) fishing mortality rate as considered by the RFSAP (September 1999) based on the most recent red snapper stock assessment (Schirripa and LeGault, 1999), or the F consistent with recovery to the MSY level in no more than 31 years.

(A) for a spawner-recruitment steepness of 0.95 (low recruitment scenario) i.e., MFMT = F_{CURR} = (0.432); The red snapper stock would be considered undergoing overfishing if the probability that F_{CURR} (0.432) is larger than F_{MSY} is:

A. Greater than 50 percent.
B. Greater than 40 percent
C. Greater than 30 percent.

(B) for a spawner-recruitment steepness of 0.90 (low recruitment scenario) i.e., MFMT = F_{CURR} = (0.259);The red snapper stock would be considered undergoing overfishing if the probability that F_{CURR} (0.259) is larger than F_{MSY} is:

A. Greater than 50 percent.
B. Greater than 40 percent
C. Greater than 30 percent.

Alternative 3: Red snapper MFMT shall be 80% of F_{MSY} or the F consistent with recovery to the MSY level in no more than 31 years.

(A) for a spawner-recruitment steepness of 0.95 (low recruitment scenario) i.e., MFMT = 80% of F_{MSY} = (0.092); The red snapper stock would be considered undergoing overfishing if the probability that $F_{80\%FMSY}$ (0.092) is larger than F_{MSY} is:

A. Greater than 50 percent.
B. Greater than 40 percent
C. Greater than 30 percent.

(B) for a spawner-recruitment steepness of 0.90 (low recruitment scenario) i.e., MFMT = 80% of MSY = (0.073);The red snapper stock would be considered undergoing overfishing if the probability that $F_{80\%FMSY}$ (0.073) is larger than F_{MSY} is:

A. Greater than 50 percent.
B. Greater than 40 percent
C. Greater than 30 percent.

Alternative 4: Red snapper MFMT shall be F_{MAX} as a proxy for F_{MSY} as considered by the RFSAP (September 1999) based on the most recent red snapper stock assessment (Schirripa and LeGault, 1999), or the F consistent with recovery to the MSY level in no more than 31 years.

(A) for a spawner-recruitment steepness of 0.95 (low recruitment scenario) i.e.,MFMT = F_{MAX} = 0.122; The red snapper stock would be considered undergoing overfishing if the probability that F_{MAX} (0.122) is larger than F_{MSY} is:

A. greater than 50 percent.
B. greater than 40 percent
C. greater than 30 percent.

(B) for a spawner-recruitment steepness of 0.90 (low recruitment scenario) i.e., MFMT = F_{MAX} = 0.101; The red snapper stock would be considered undergoing overfishing if the probability that F_{MAX} (0.101) is larger than F_{MSY} is:

A. greater than 50 percent.
B. greater than 40 percent
C. greater than 30 percent

Alternative 5: No action.

REBUILDING SCHEDULE

The MSFCMA § 304(e)(4)(A) requires that *"For a fishery that is overfished, any fishery management plan, amendment, or proposed regulations prepared …for such fishery shall – specify a time period for ending overfishing and rebuilding the fishery that shall -- (i) be as short as possible, taking into account the status and biology of any overfished stocks of fish, the needs of fishing communities, recommendations by international organizations in which the United States participates, and the interaction of the overfished stock of fish within the marine ecosystem; and (ii) not exceed 10 years, except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the United States participates dictates otherwise."*

The MSFCMA specifies that rebuilding plans should specify a time period for ending overfishing and rebuild the fishery. This time period should be as short as possible, taking into account the biology, ecology, and socioeconomics of the overfished fishery, as well as other factors, and should not exceed 10 years, except where biological or legal issues dictate otherwise. NOAA Fisheries' NSGs for implementing this requirement state that, if rebuilding to B_{MSY} would take 10 years or more, even in the absence of all fishing mortality, then the maximum recovery period is the rebuilding period calculated in the absence of fishing mortality plus one mean generation time.

For red snapper, the time to recover in the absence of fishing mortality is 12 years (greater than 10 years) and the mean generation time is estimated to be 19.6 years. Therefore, the maximum rebuilding period allowed for this species is 31.6 years (12 years plus 19.6 years). The recovery plan adopted by the Council under the new guidelines in 2001 and outlined in the May 2001 regulatory amendment to the reef fish FMP would have the stock reach its recovery target during the year 2032 or earlier. Rather than use the existing target of 20 percent SPR by 2019, the rebuilding plan proposed by the Council uses biomass-based rebuilding targets and thresholds that, if achieved, would rebuild the stock by 2032.

The following are potential alternatives for defining rebuilding schedules for red snapper. They are included in this document for discussion purposes only and may change in response to comments received during the scoping and/or preliminary analytical process.

Alternative 1: Institute a 31-year rebuilding schedule for red snapper, with the objective of rebuilding the stock by 2031. This is the alternative considered in the regulatory amendment, and is the maximum allowable rebuilding schedule.

Alternative 2: Institute a 12-year rebuilding schedule for red snapper, with the objective of rebuilding the stock by 2012. This is the minimum possible rebuilding schedule.

Alternative 3: Institute a 25-year rebuilding schedule for red snapper, with the objective of rebuilding the stock by 2025.

Alternative 4: No action. Maintain the 19-year schedule for red snapper, with the objective of rebuilding the stock by 2019.

REBUILDING PLAN

The MSFCMA § 303(a)(10) requires that *"Any fishery management plan which is prepared by any Council, or by the Secretary, with respect to any fishery, shall – in the case of a fishery which the Council or the Secretary has determined is approaching an overfished condition or is overfished, contain conservation and management measures to prevent overfishing or end overfishing and rebuild the fishery."* In addition, § 304(e)(3) of the Act requires that *"Within one year of an identification…or notification…, the appropriate Council…shall prepare a fishery management plan, plan amendment, or proposed regulations for the fishery to which the identification or notice applies – (A) to end overfishing in the fishery and to rebuild affected stocks of fish; or (B) to prevent overfishing from occurring in the fishery whenever such fishery is identified as approaching an overfished condition."* And § 304(e)(4)(B) of the Act requires that *"For a fishery that is overfished, any fishery management plan, amendment, or proposed regulations prepared …for such fishery shall – allocate both overfishing restrictions and recovery benefits fairly and equitably among sectors of the fishery."*

The following rebuilding plan alternatives for red snapper are based on one of the three following NOAA Fisheries-recommended rebuilding strategies:

1. Constant catch strategy. [Holds catch at a constant level so that over the length of the rebuilding period, enough fish escape the fishery and add to the stock size until it reaches B_{MSY}.]
   This method is advantageous in that the initial total allowable catch (TAC) set for the rebuilding plan is higher than that set in other strategies. However, as the stock increases in size, the catch-per-unit-effort (CPUE) may increase to a level where the TAC could be filled within a very short time period and the fishery would need to be closed. Additionally, as the stock size increases, the participants in the fishery may want an increase in TAC because fish are seen to be very abundant and they may wish regulations to be relaxed.

2. Constant F strategy. [Holds F constant at a level that will allow a stock to rebuild within the required time period. Under this strategy, TAC is set as a constant proportion of the stock that can be removed.]
   Unlike the constant catch strategy, with this strategy, as the stock size increases, so could the TAC (i.e., as the stock size approaches B_{MSY}, TAC will be approaching OY). The main disadvantage to this strategy is that, early in the rebuilding plan, TAC may need to be set at very low levels and possibly at a point where the economic viability of a fishery is severely affected.

3. Combination of constant catch and constant F strategy. [Catch is initially held constant until a point where any decrease in TAC to get to a constant F strategy is minimized.]
   This strategy would cause less of a financial hardship on the fishery. The advantage of this type of strategy is that it would minimize the initial effect on the fishery early in the rebuilding program (as can occur in the constant F strategy) and would allow the fishery to increase the biomass taken later in the rebuilding period as the stock size increases.

The alternatives were taken from the Council's May 2001 regulatory amendment to the reef fish FMP to modify the red snapper rebuilding plan. Each is based on a 31-year rebuilding schedule. If the Council decides to continue with these alternatives, an additional subset of alternatives will need to be considered for each related to what constitutes a significant or insignificant change in the B_{MSY} estimate that would trigger additional management action upon three-, four-, five-, or ten-year reviews (i.e., plus or minus 5, 10 or X%; +/- a standard deviation). The Council may also consider alternatives to the 60% and 80% bycatch reduction goals (i.e., bycatch reduction goals that are proportional to stock status, rather than discrete). If current regulations are determined to be insufficient to maintain commercial and recreational catches within established limits, and those limits are determined to be key to the Council's ability to achieve its rebuilding goal, the Council may consider various alternatives to reduce/constrain fishing effort, such as increased size limits, decreased bag limits, trip limits, reduced seasons, area closures, etc. The Council could also consider an alternative that required that future TAC be adjusted to account for overages and for TAC that was allocated but not landed.

Alternative 1: Institute a plan with five-year interim management goals. Set TAC for years 2001-2005 at 9.12 mp. Assume bycatch reduction at 40 percent (existing bycatch reduction device (BRD) requirements). Develop technological and management mechanisms to allow for up to a 60 percent reduction in bycatch after five years and up to an 80 percent reduction in bycatch after ten years. Use the decision tree process after the first five-year interval as follows.

For years 2006-2010:

Directed TAC defined by a constant fishing mortality rate:

- If the B_{MSY} (stock productivity) estimate has not significantly changed from previous assessment and B_{2006} is less than B_{2001}, then implement up to an 80 percent bycatch reduction.
- If the B_{MSY} (stock productivity) estimate has not significantly changed from previous assessment and B_{2006} is greater than or equal to B_{2001}, then implement up to a 60 percent bycatch reduction.
- If the B_{MSY} (stock productivity) estimate has significantly changed from previous assessment, indicating that B_{2001}/B_{MSY} is significantly better than previously thought, then adjust TAC to achieve consistency with a constant fishing mortality rate management strategy and assess the need for additional bycatch reduction.
- If the B_{MSY} (stock productivity) estimate has significantly changed from previous assessment, indicating that B_{2001}/B_{MSY} is significantly worse than previously thought, then implement up to an 80 percent bycatch reduction and reduce F on the directed fishery to a level appropriate to MSFCMA goals.

For years 2011-2015 (and every five-year interval following):

Directed TAC maintained at the constant fishing mortality rate defined previously:

- If the B_{MSY} (stock productivity) estimate has not significantly changed from previous assessment and B_{2011} is less than or equal to 1.5 times B_{2006}, then implement up to an 80 percent bycatch reduction and reduce F on the directed fishery to a level appropriate to MSFCMA goals.
- If the B_{MSY} (stock productivity) estimate has not significantly changed from previous assessment and B_{2011} is greater than 1.5 times B_{2006}, then maintain existing bycatch reduction if greater than 60 percent.
- If the B_{MSY} (stock productivity) estimate has significantly changed from previous assessment, indicating that B_{2006}/B_{MSY} is significantly better than previously thought, then maintain the existing bycatch reduction.
- If the B_{MSY} (stock productivity) estimate has significantly changed from previous assessment, indicating that B_{2006}/B_{MSY} is significantly worse than previously thought, then implement up to an 80 percent bycatch reduction and reduce F on the directed fishery to a level appropriate to MSFCMA goals.

The rebuilding targets and thresholds associated with this alternative are listed as alternatives under the stock status determination criteria heading and include MSY Alternative #1, OY Alternative #1, MFMT Alternative #1, and MSST Alternative #1.

Alternative 2: Institute a plan with five-year interim management goals. Set TAC for years 2001-2005 at 6 mp. Assume bycatch reduction at 40 percent (existing BRD requirements). Develop technological and management mechanisms to allow for up to a 60 percent reduction in bycatch after five years and up to an 80 percent reduction in bycatch after ten years. Use the decision tree process after the first five-year interval as follows.

For years 2006-2010:

Directed TAC defined by a constant fishing mortality rate:

- If the B_{MSY} (stock productivity) estimate has not significantly changed from previous assessment and B_{2006} is less than B_{2001}, then implement up to an 80 percent bycatch reduction.
- If the B_{MSY} (stock productivity) estimate has not significantly changed from previous assessment and B_{2006} is greater than or equal to B_{2001}, but less than 1.5 times B_{2001}, then implement up to a 60 percent bycatch reduction.
- If the B_{MSY} (stock productivity) estimate has not significantly changed from previous assessment and B_{2006} is greater than or equal to 1.5 times B_{2001}, then maintain the existing (at least 40 percent) bycatch reduction.
- If the B_{MSY} (stock productivity) estimate has significantly changed from previous assessment, indicating that B_{2001}/B_{MSY} is significantly better than previously thought, then maintain the existing (at least 40 percent) bycatch reduction.
- If the B_{MSY} (stock productivity) estimate has significantly changed from previous assessment, indicating that B_{2001}/B_{MSY} is significantly worse than previously thought, then implement up to an 80 percent bycatch reduction and reduce F on the directed fishery to a level appropriate to MSFCMA goals.

For years 2011-2015 (and every five-year interval following):

Directed TAC maintained at the constant fishing mortality rate defined previously:

1 If the B_{MSY} (stock productivity) estimate has not significantly changed from previous assessment and B_{2011} is less than or equal to B_{2006}, then implement up to an 80 percent bycatch reduction and reduce F on the directed fishery to a level appropriate to MSFCMA goals.

2 If the B_{MSY} (stock productivity) estimate has not significantly changed from previous assessment and B_{2011} is greater than B_{2006} and less than 1.5 times B_{2006}, then implement up to a 60 percent bycatch reduction.

3 If the B_{MSY} (stock productivity) estimate has not significantly changed from previous assessment and B_{2011} is greater than 1.5 times B_{2006}, then maintain existing (at least 40 percent) bycatch reduction.

4 If the B_{MSY} (stock productivity) estimate has significantly changed from previous assessment, indicating that B_{2006}/B_{MSY} is significantly better than previously thought, then maintain the existing (at least 60 percent) bycatch reduction.

5 If the B_{MSY} (stock productivity) estimate has significantly changed from previous assessment, indicating that B_{2006}/B_{MSY} is significantly worse than previously thought, then implement up to an 80 percent bycatch reduction and reduce F on the directed fishery to a level appropriate to MSFCMA goals.

The rebuilding targets and thresholds associated with this alternative are listed as alternatives under the stock status determination criteria heading and include MSY Alternative #1, OY Alternative #2, MFMT Alternative #1, and MSST Alternative #1.

Alternative 3: Reject the five-year rebuilding interim management goals and continue to specify TAC on an annual or biennial basis; rebuilding targets and thresholds to remain the same as specified in Rebuilding Plan Alternative #1.

Alternative 4: Use three- or four-year interim management goals, rather than five-year increments throughout the rebuilding period; rebuilding targets and thresholds to remain the same as specified in Rebuilding Plan Alternative #1.

<u>Alternative</u> <u>5:</u> Use ten-year interim management goals, rather than five-year increments throughout the rebuilding period; rebuilding targets and thresholds to remain the same as specified in Rebuilding Plan Alternative #1.

<u>Alternative</u> <u>6:</u> Maintain the red snapper TAC at status quo, 9.12 mp (4.65 mp commercial quota; 4.47 mp recreational quota), utilizing a constant catch strategy. TAC will be set pending an annual or biannual review of the red snapper assessment. The rebuilding targets and thresholds associated with this alternative are listed as alternatives under the stock status determination criteria heading and include MSY Alternative #1, OY Alternative #3, MFMT Alternative #1, and 4A.

<u>Alternative</u> <u>7:</u> Reduce the TAC (to as low as 2.0 mp) to conform with a constant F rebuilding strategy. TAC will be set pending an annual or biannual review of the red snapper assessment. The rebuilding targets and thresholds associated with this alternative are listed as alternatives under the stock status determination criteria heading and include MSY Alternative #1, OY Alternative #3, MFMT Alternative #1, and MSST Alternative #1.

Other rebuilding plan alternatives could include:

<u>Alternative</u> <u>8:</u> Phased reduction in TAC in steps over two or three years (RSFAP recommendation).

<u>Alternative</u> <u>9:</u> No changes in current TAC, but capping long-term yields at historical values of 15-20 mp (RSFAP recommendation).

<u>Alternative</u> <u>10:</u> Reduce current TAC to 7.46 mp, utilizing a constant catch strategy. That value is the mid-point of the range of maximum ABC values (5.8-9.12 mp) recommended by the RFSAP under the constant catch rebuilding strategy.

<u>Alternative</u> <u>11:</u> No action.

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Schirripa, M.J. and C.M. Legault. 1999. Status of the red snapper in U.S. waters of the Gulf of Mexico: updated through 1998. Contribution: SFD-99/00-75. National Marine Fisheries Service, Southeast Fisheries Science Center, Sustainable Fisheries Division, Miami, Florida.

APPENDIX C - SUMMARY OF SCOPING HEARINGS

Brownsville, Texas
Monday, August 26, 2002
7:30 p.m.

23 Members of the Public

Matt Murphy - He felt that the current information was incorrect. He related that in 1991 rebuilding of red snapper began and the fish became more plentiful. He believed that most fishermen do not know where to go to find the fish and when they find out where the fish was they fish them all out. He stated that NOAA Fisheries should have more information about the fishery in order to protect it. He did not agree with closures or size limits and felt these were unnecessary management measures. He opined that spawners should not be targeted.

Mr. Osburn asked what shape the red snapper fishery was in. Mr. Murphy believed it was better than ever.

Patrick Murphy - He agreed that the data was incorrect. He related that red snapper spawned in the summer thus they were being caught when spawning. He stated that Texas had a deep-water fishery that Florida did not have; therefore, there should be regulations with those facts in mind.

Mr. Osburn asked if Mr. Murphy noticed a change in his clientele. Mr. Murphy responded yes and stated that most of his customers wanted to catch red snapper.

Ramona Murphy - She felt strongly that the Council should implement a bag limit not a size limit. She related that because of the implementation of a size limit, NOAA Fisheries had killed 3/4 of the red snapper fishery. She stated that once most fishermen found a spot they fished it out not thinking of conservation.

Harris Lasseigne - He felt that BRDs and turtle excluder devices (TEDs) did not reduce bycatch. He added that they were a waste of the fisherman's money.

Max Reid - He questioned whether the state of Florida had seen an increase in red snapper.

Dr. Leard related that had not been determined yet.

George Gonzales - He believed inaccurate data were being used and that NOAA Fisheries should re-evaluate the fishery.

Charles Burnell - He questioned whether there was any way to track recreational effort.

Mr. Osburn responded that there were several different methods, i.e. surveys.

Palacios, Texas
Tuesday, August 27, 2002
7:00 p.m.

20 Members of the Public

Gary Graham - He gave a written statement for the record. He felt that the Council should wait for the 2004 stock assessment before implementing any major regulations in the fishery.

Galveston, Texas
Wednesday, August 28, 2002
7:15 p.m.

37 Members of the Public

Robert McFarlane - He gave a written statement for the record. He did not believe that there was a direct connection between a reduction in bycatch and subsequent fish population sizes. He added that effort peaked at 394,000 days fished in 1989 then declined as much as 43 percent at 225,000 days fished in 1996. He related that if bycatch declined in a similar fashion it would represent a substantial decrease in fishing mortality of red snapper. He stated that the reliance on bycatch reduction to increase red snapper stock levels was unlikely to succeed. He was opposed to any sort of buyback program and felt the only permits retired would be those of the least efficient fishermen.

Ed Schroeder - Owner of a partyboat. He related that in order to reach a 20 percent spawning potential ratio (SPR) by 2009 the fishery would be close to reaching its goal. He disagreed with changing the date to 31 years from now. He felt that size limits and closures had no benefit to the fishery. He stated that the Socioeconomic Panel Report never contained pertinent data but 50 CFR required that it should.

Benny Gallaway - He gave a written statement for the record. He disagreed with taking any action before reviewing the 2004 stock assessment. He pointed out that in order to reach a spawning stock size of between 2.6 to 2.7 billion pounds by 2031, the biomass must increase by a factor of about 34 to 54 fold, or an 81 percent reduction in overall fishing mortality. He commented that all the data based on the 1999 stock assessment were outdated. He felt that the current model being used was not the problem but, rather, the many assumptions, i.e., compensatory mortality and natural mortality, and actual data, i.e., bycatch magnitude and age composition, used as inputs into the model that were the problem. He stated that NOAA Fisheries had consistently used an ultra-conservative management plan which the Council had always followed except for raising the directed TAC to 9.12 mp. He asked that the Council wait to hear the results of a review of by the National Academy of Sciences before taking any action.

Johnny Strimple - He was concerned because there were no spawning sanctuaries available for red snapper. He felt that the Corps of Engineers were destroying the shrimp industry.

New Orleans, Louisiana
Monday, September 23, 2002
6:00 p.m.

2 Members of the Public

Chris Dorsett - Gulf Restoration Network. Provided a written statement (attached).

Biloxi, Mississippi
Tuesday, September 24, 2002
6:00 p.m.

0 Members of the Public

Panama City, Florida
Monday, September 30, 2002
6:00 p.m.

20 Members of the Public

George Eller - Charter operator, Destin, Florida. He believed that TAC should remain status quo. He noted that the stock had improved due to recent regulations, i.e. consistent bag and size limits and closed seasons. He stated that the new charter boat moratorium also had the potential to help improve the stock. He was not sure that the charter boat industry could sustain a reduced season or TAC, or a reduction in bag limits.

Bob Zales - President of Panama City Boatmen's Association**.** He noted that the stock appeared to be recovering under the current TAC based on recent stock assessments and surveys. He related that the 1999 Reef Fish Stock Assessment Panel (RFSAP) report suggested a high degree of uncertainty about the stock, but even so the 9.12 MP TAC was acceptable under a constant catch scenario. He noted that the RFSAP had also been concerned regarding hardships associated with moving to a constant F in a single year, and suggested a phased reduction in TAC in steps over 2 to 3 years. He noted that BRDs had been in place in shrimp trawls since 1998 and had contributed to the rebuilding of the stock. He report that fishing mortality had decreased in the recreational sector according to charter boat surveys. He agreed that the charter boat moratorium was designed to cap effort, and believed that would also help to reduce harvest of the fishery and rebuild the fishery. He strongly suggested that no action be taken until the next stock assessment was completed.

Benji Kelley - represented his family charter boat business in Panama City. He supported status quo for red snapper TAC. He stated that the industry could not withstand a shorter season.

Mike Eller - charter boat owner/operator in Destin, Florida. He noted that he would be speaking on behalf of the president and membership of the Destin Charter boat Association. He supported the 5-year rebuilding plan. He stated that it was important that the TAC remain at 9.12 MP. He stated that they did not support the charter boat moratorium; however, they had accepted it in order to maintain current seasons and TAC. He stressed the need to see the results of the moratorium. He noted that there had been a significant socioeconomic impact on the charter boat industry since the season had been shortened to 6 months. He stated that it was very difficult to book trips before April 21. He pointed out that the shrimp industry now had BRDS and believed that time should be allowed for that regulation to work. He noted that the economy had impacted the shrimp industry and felt that the stock would continue to improve through attrition of the shrimp fleet. He recommended that the Council wait for the results of the next stock assessment before taking any action.

Bill Archer - charter boat operator in Panama City, Florida. He agreed with the other speakers. He noted that weather conditions and the economy were not factored into the model and believed they should be. He supported status quo for TAC and the 5-year rebuilding plan.

Claire Pease - charter boat owner/operator in Panama City, Florida. She stated that 824 permits would most likely not be reissued under the charter boat moratorium and believed this would make an impact on the rebuilding. She felt that any new information should be included in the model.

Henry Hunt - charter boat owner/operator Lynn Haven, Florida. He favored status quo for TAC. He stated that there would be significant economic and social impacts on the community if TAC or bag limits were reduced. He believed that if the stock was not there the quotas would not be met by either sector.

Gary Jarvis - charter boat owner/operator. He stated that he also held a Class I red snapper permit. He stressed the need for the agencies making regulations to remember the personal impact those regulations had on the fishermen and their families. He noted that everyone was interested in protecting the resource. He pointed out that management tools were already in place and believed that they should be given a chance to work.

James Page - charter boat owner/operator. He agreed with the statements that had already been made. He supported status quo for TAC. He noted that the industry was unstable but believed that the charter boat moratorium would provide stability. He recommended that the Council wait to take action until after the next stock assessment.

Chuck Gilford - charter boat owner/operator and represented the Mexico Beach Charter boat Association. He expressed concern regarding the validity of the data used in the model. He stated that weather was a large factor affecting red snapper catch. He supported status quo for TAC and believed that the stock was increasing. He supported the use of BRDs on shrimp vessels and felt they had a good effect on mortality. He recommended that the Council make no changes in management tools based on the current available data.

Wendell Sauls - He believed that the quota system worked and that the stock had greatly improved. He recommended that the Council remove the minimum size limit to decrease morality. He reported that he had been involved in tagging programs in the past with a low return rate of tagged fish (1-2 percent). He supported the need for a quota but opposed size limits.

Apalachicola, Florida
Tuesday, October 1, 2002
6:00 p.m.

2 Members of the Public

There were no comments.

Tampa, Florida
Wednesday, October 3, 2002
7:30 p.m.

5 Members of the Public

Sal Versaggi - Versaggi Shrimp Corporation. He asked Dr. Leard when the red snapper plan went into effect and if they had noted any improvements since its inception.

Dr. Leard responded by saying that the plan went into effect in 1990 and while most believed there had been improvement, they could not confirm it until the 2004 assessment was complete.

Mr. Versaggi continued by expressing his concern for the great many myriad of regulations that he believed made it difficult to pinpoint which regulation actually contributed to an improvement, if any. He expressed that while he was not best qualified to comment on the population dynamics of the red snapper fishery, he was concerned about the bycatch impact on the shrimp industry. He mentioned having seen research numbers that contributed ½ of 1 percent of the red snapper bycatch of shrimping and these figures did not justify impairment to the shrimp industry. He pointed out that impairing a $600 million dollar shrimp industry to address bycatch problems for a $6 million dollar red snapper industry was not a justifiable economical impact tradeoff. He pointed out that red snapper was not targeted by shrimp fishermen, that they did not fish in areas of red snapper and expressed that their gear was not even designed to work in the red snapper habitat. He was strongly opposed to any action which would address the red snapper bycatch issue by shutting down the shrimp industry once the targeted fishery reached a certain level.

Marianne Cufone - The Ocean Conservancy (OC). She advised that she had previously forwarded a written statement to the Council and summarized these statements for the record. She pointed out that red snapper had been an issue in the Gulf since before 1988 and believed it to have been overfished for quite some time. She felt that while rebuilding plans had been required for a number of years, they had not been placed successfully and thus the fishery had not been rebuilt. She stated that the OC strongly believed that the 9.12 mp TAC, in accordance with the best available science, was very inflated. She contributed a previous year's congressional mandated review of red snapper that indicated the 9.12 mp TAC was far too high based on the bycatch reduction. She stated that the review assumed a bycatch reduction rate of 50 percent for red snapper by the year 2000, which according to NOAA Fisheries, had not yet been reached. She indicated that OC had recommended a number of alternatives for this plan, one being lower the TAC. She did not think it logical to believe that an 80 percent bycatch reduction could be achieved in years to come, if the projected 50 percent bycatch reduction had not been realized in 2002. She cautioned that the 2004 stock assessment could yield a major TAC crash and did not feel that it was wise management to wait until then to take action, especially when the fishery had been grossly overfished for the past 7 years. She felt that it would be easier to shift to a strategy upfront that took into consideration rebuilding the population now versus five years from now. She felt that the Council should no longer rely only on bycatch reduction but should consider other measures as well. She expressed the importance of developing and implementing a standardized reporting methodology for all fisheries.

Geoffrey C. Lane - recreational red snapper fisherman. He considered himself to be an expert on bycatch reduction and agreed with Ms. Cufone that achieving a 80 percent reduction was not a realistic goal. He did not believe the equipment could achieve such a task and believed that by 2011, the goal still would be unmet. He felt that the best way to manage the bycatch reduction issue and rebuild stock would be to eliminate the recreational fishery altogether. While he realized taking such an extreme measure would cause discord amongst the recreational sector, he felt that it was the better tradeoff because of the difficulty in controlling the vast recreational sector through regulatory measures and law enforcement. He did not feel that the imposed size and bag limits had been effective. He felt that unlike the recreational fishery, the commercial fishery provided service to the general public in ensuring that red snapper was available.

APPENDIX D - WRITTEN COMMENTS

APPENDIX E - COMMENTS ON THE DSEIS AND AGENCY RESPONSES

NOAA Fisheries responses to comments on the DSEIS

The only comments received by NOAA Fisheries on the DSEIS associated with Reef Fish Amendment 22 were submitted by the Environmental Protection Agency (EPA). The key issues highlighted in the EPA comment letter relate to: 1) The reliability of the data and the level of precaution underlying alternative biological reference points and status determination criteria (Section 4.1); 2) The limiting influence of bycatch mortality in the penaeid shrimp trawl fishery on red snapper recovery strategies (Section 4.2), and 3) The availability of the funds required to implement the Council's preferred bycatch reporting methodology (Section 4.3).

Overall, the EPA supports the DSEIS associated with Reef Fish Amendment 22. The document received a Lack of Objections rating based on the finding that "the considered red snapper issues seem adequately addressed and that minimizing the overall red snapper bycatch [including bycatch of red snapper in the penaeid shrimp trawl fishery] is largely outside the scope for this SEIS and [Reef Fish] FMP." The specific comments and recommendations provided by the EPA are summarized in below and followed by NOAA Fisheries' response.

Specific recommendations provided by the EPA are summarized below. Each item is followed by NOAA Fisheries' response, and is addressed to the extent practicable in the Final SEIS.

EPA-1 The EPA recognizes the need to define biological reference points and status determination criteria for the red snapper stock, but finds it unfortunate that these reference points could not be formed from stock assessment data expected in 2004. The EPA recommends that the FEIS discuss the timing of the 2004 stock assessment, as well as the process (and environmental review documents) that would be used to incorporate information from that assessment into the Reef Fish FMP.

Response: The 2004 red snapper stock assessment workshop is scheduled for August 16-20, 2004. The assessment review workshop is scheduled for October 25-28, 2004. The 2004 assessment will incorporate a great deal of new data collected over recent years. Since 1998, NOAA Fisheries has expended over 20 million dollars internally to study red snapper, and has provided nearly 6 million dollars to academic and independent research organizations towards red snapper research. These new data could result in substantially different estimates of the management reference points adopted in this amendment to assess stock status and to define rebuilding goals. Section 4.2.1.2 (pp. 47-51) describes the various processes that could be used to refine and revise the red snapper rebuilding plan adopted in this amendment to incorporate new data and information from this and from future assessments. In summary, the Council could make such an adjustment through a plan amendment, a regulatory amendment, or through an emergency or interim rule. The process determined to be most appropriate will depend on the scope and urgency of any needed adjustments.

EPA-2 The EPA supports recent (Amendment 10 to the Shrimp FMP) and current (Amendment 14 to the Shrimp FMP) council actions to reduce bycatch in the penaeid shrimp fishery. The EPA encourages additional regulatory action to further reduce bycatch in the shrimp fishery, as opposed to relying on potential effort reductions resulting from predicted attrition.

Response: NOAA Fisheries has shared this recommendation with the Gulf Council and will consider the need for additional regulatory action to reduce bycatch when working with the Council to identify priority items for future amendments to the Shrimp FMP.

EPA-3 The EPA defers to the Council and NOAA Fisheries in defining biological reference points and status determination criteria, but generally favors alternatives that do not allow social and economic factors to compromise the sustainability of the managed stock. The EPA believes that definitions of such management reference points should reflect precautionary levels that are reduced from maximum yield, and should be reviewed frequently to support adaptive management.

Response: Fishery targets and thresholds are limited by the definition of MSY—a biological parameter that is based on the concept of sustainability. MSY is defined by Restrepo et al. (1998) as the largest long-term average yield (catch) that can be taken from a stock or stock complex under prevailing ecological and environmental conditions. None of the parameters, OY, MFMT, or MSST, can be defined at a level that would allow the fishing mortality rate to exceed that which would produce MSY. Consequently, none of the alternative biological reference points and status determination criteria evaluated in Section 4.1 would be expected to compromise stock sustainability to provide short-term social and economic benefits.

Some alternatives are more precautionary than others, in terms of how far they would reduce the allowable harvest below MSY to ensure the stock's ability to produce MSY on a continuous basis. The preferred alternatives selected by the Council are generally intermediate to the other alternatives in terms of the level of precaution they embody. They incorporate social, economic, biological, and ecological factors, but give first priority to preventing overfishing and rebuilding overfished stocks, as required by the MSFCMA.

EPA-4 The EPA defers to the Council and NOAA Fisheries regarding the final selection of a rebuilding alternative in Section 4.2. The EPA typically favors the use of direct harvest reductions to rebuild overfished stocks; but recognizes that the socioeconomic costs of such an approach might not be warranted in this case because of the uniquely limiting influence of shrimp bycatch on the recovery of red snapper. Rebuilding Plan Alternative 3 (with its reduced TAC) is predicted to have the same recovery time as Rebuilding Plan Alternative 2 (with its constant TAC). The EPA questions the viability of Rebuilding Plan Alternatives 4 and 5, which would allow the red snapper stock to rebuild over a time period that is longer than that recommended in NOAA Fisheries NSGs.

Response: NOAA Fisheries wishes to clarify that reducing TAC to six million pounds under Rebuilding Plan Alternative 3 could end overfishing up to four years earlier and rebuild the stock up to three years earlier compared to Rebuilding Plan Alternative 2 (see Table 4.2.5; page 54). NOAA Fisheries believes that the predicted, small benefits to the stock and surrounding ecosystem associated with the shorter rebuilding schedule do not warrant the large socioeconomic costs associated with a three million pound reduction in TAC.

NOAA Fisheries also believes that the uniquely limiting influence of red snapper bycatch in the shrimp fishery on red snapper recovery makes it appropriate to consider rebuilding schedules that extend beyond the maximum time frame recommended in the NSGs. The NSGs provide guidance that, when drafted, was believed to be appropriate in the majority of circumstances. However, this one-size-fits-all approach to calculating alternative rebuilding schedules might not be appropriate for red snapper, the recovery of which is largely dependent on bycatch reduction in a non-directed fishery.

EPA-5 The EPA recognizes the need to report red snapper and other bycatch taken in the reef fish fishery, and supports an observer program as the preferred bycatch reporting methodology for the commercial and recreational for-hire fisheries (Section 4.3, Alternative 4), assuming that federal funds are available to implement the program and that the program will not unfairly burden larger, observer-friendly vessels. The EPA suggests that an observer program is a reasonable and feasible bycatch reporting alternative only if funding for such a program is reasonably ensured in the FSEIS.

Response: NOAA Fisheries cannot ensure funding for a reef fish observer program in this FSEIS associated with Reef Fish Amendment 22. The MSFCMA bycatch reporting mandate represents a great challenge to NOAA Fisheries because it is a resource intensive mandate that applies to all federally managed fisheries. In response to this mandate, the agency has drafted a National Fisheries Bycatch Strategy to identify priority needs and funding requirements. Additionally, the agency has developed a framework to install an observor program if funding does become available. NOAA Fisheries supports the Council's identification of Bycatch Reporting Alternative 4 as the preferred bycatch reporting methodology for the Gulf of Mexico reef fish fishery because (1) an observer program will supplement current bycatch data collection methods, and (2) the status quo bycatch collection efforts described in Section 4.3.2 will remain in effect.

Current bycatch collection methods will continue regardless of whether an observer program is funded. Bycatch data for the commercial fishery is presently collected by using a supplemental form sent to a stratified, random sample of 20 percent of the commercial reef fish permit holders. Because this reporting is mandatory, it is considered useful in estimating bycatch (Anonymous, 2004). The current MRFSS data collection program provides adequate bycatch coverage for the recreational fishery for red snapper, and includes the charterboat sector. A percent standard error of 20 percent is generally considered acceptable in fisheries data (Van Vorhees et al., 2001). For red snapper, the percent standard error for fish released by the recreational fishery has generally been below 10 percent in recent years.

EPA-6 The EPA highlights the need to identify a preferred alternative for collecting bycatch data on the private recreational fishery, and supports Alternative 2 as the most reasonable of the alternatives presented.

Response: The Gulf Council has selected Bycatch Reporting Alternative 1 as the preferred alternative to collect bycatch information from the private recreational sector. The current MRFSS data collection program provides adequate bycatch coverage for the recreational fishery for red snapper. AS mentioned in the response to EPA-5 above, a percent standard error of 20 percent is generally considered acceptable in fisheries data (Van Vorhees et al., 2001). For red snapper, the percent standard error for fish released by the recreational fishery has generally been below 10 percent in recent years.

EPA-7 The EPA suggests that the FSEIS associated with Amendment 22 to the Reef Fish FMP should address vermilion snapper and any other fished species similar to the red snapper that may have been included in the management of red snapper

Response: Species potentially affected by the proposed actions in Reef Fish Amendment 22, including vermilion snapper, are described in Sections 7.2.2 and 7.2.3. The potential direct, indirect, and cumulative effects of the proposed actions on these species are described in Section 8.1 and 8.2. As stated in Section 8.1.2, "Red snapper prey on other fishes (Moran, 1988), and may compete with other predators, such as red grouper, greater amberjack, and vermilion snapper, which have a similar diet (Nelson 1988; Bullock and Smith, 1991; Andaloro and Pipitone, 1997). Consequently, it is possible that forage species and competitor species could decrease in abundance in response to an increase in abundance of red snapper. Conversely predators of red snapper could in response to an increase in abundance of red snapper. However, the relationships among species in marine ecosystems are complex and poorly understood. As a result, the nature and magnitude of ecological effects are difficult to predict with any accuracy." There are models being developed to help model the ecosystem red snapper are a part of (e.g., Ecopath). However, these models are still in their early development and their precision is low.

EPA-8 The EPA suggests that language be clarified to indicate that the red snapper stock cannot be rebuilt within ten years in the absence of fishing mortality due to the bycatch impacts of the shrimp fishery on juvenile red snapper.

Response: NOAA Fisheries has revised text, as needed, throughout the document to clarify that the most recent red snapper stock assessment indicates that the red snapper stock cannot rebuild to B_{MSY} within ten years due to the limiting influence of bycatch mortality in the shrimp fishery. If all fishing mortality, including mortality from the directed fishery and as bycatch from the shrimp fishery, were to be halted, the stock is estimated to rebuild in 12 years. As stated in Section 4.2, even with BRDs attaining a 40 percent reduction in bycatch mortality for the shrimp fishery, the stock could not rebuild even if TAC for the directed fishery was set at zero. Therefore, only if further bycatch reduction is achieved, can the stock rebuild within the minimum time period and allow for a directed fishery. This reduction is anticipated to be achieved by reductions in shrimp effort caused by changing economic conditions in the shrimp fishery.

EPA-9 The EPA questions whether foreign fishing could be partially responsible for the poor condition of the red snapper stock, and whether international laws regulate fishing pressure in Caribbean waters

Response: NOAA Fisheries believes that foreign fishing pressure has a minimal effect on the Gulf of Mexico red snapper stock because red snapper are not common in most Caribbean waters. However, the relationship between the red snapper captured in U.S. and Mexican waters is unknown. The U.S. does interact with Mexico on fisheries management through the United States-Mexico Fisheries Cooperation Program even though there is no formal instrument establishing this entity. NOAA Fisheries and the predecessor agency to the Mexican Secretaría de Mexico Ambiente, Recursos Naturales, y Pesca (SEMARNAP) informally agreed in 1983 to meet annually to review the broad range of issues involved in the bilateral fisheries relationship. NOAA Fisheries and PESCA normally meet annually where the nations discuss priority fishery issues. Recent meetings have included discussions on management, enforcement, recreational fisheries, marine mammals and endangered species. The meetings help to inform participants of national programs affecting the other country. The participants in recent years have widened the scope of some research projects to include coordinated management and other issues.

EPA-10The EPA suggests that the FSEIS associated with Reef Fish Amendment 2 discuss the practicality and merits of implementing a bycatch quota system to reduce red snapper bycatch in the Gulf of Mexico penaeid shrimp fishery.

Response: NOAA Fisheries believes analyzing the pros and cons of implementing a bycatch quota program in the Gulf of Mexico penaeid shrimp fishery is beyond the scope and charge of Amendment 22 to the Reef Fish FMP. The practicability of this bycatch reduction alternative will be evaluated in more detail in Amendment 14 to the Shrimp FMP.

EPA-11 The EPA questions whether the red snapper fishery is still regulated using minimum size limits and, if so, whether other management techniques (e.g., hook size, preferred bait, traps, area closures) could more selectively catch legal sized [mature] fish without resulting in discard mortalities.

Response: Minimum size limits result in regulatory discards and, consequently, some losses due to discard mortality. Specific hook sizes, bait, etc., have not been shown to be effective at reducing discards by targeting different size classes. Because discard mortality rates generally increase with depth, area closures could theoretically reduce discard mortality by prohibiting fishing in deeper waters. However, the multispecies nature of the red snapper fishery, and the limited effects of discard mortality in the directed fishery, make that an impractical alternative.

Discard mortality rates estimated for the red snapper fishery are 20 percent for the recreational sector and 33 percent for the commercial sector. NOAA Fisheries views these rates as acceptable when considered in the context of the benefits provided by minimum size limits. Reducing regulatory discards is a desirable goal. But decreasing the current minimum size limits could adversely affect reproduction and recruitment by allowing the fishery to capture immature fish. Additionally, deaths due to discard mortality are accounted for in stock assessments.

EPA-12 The EPA notes that the structure of Reef Fish Amendment 22 has incorporated comments from EPA review, and that the document is more readable and user-friendly.

Response: NOAA Fisheries has been working to improve the readability of FMPs and FMP amendments. We appreciate the EPA's input on this subject.

EPA-13 The EPA notes a mistake in the list of acronyms.

Response: The mistake has been corrected.

EPA-14 The EPA recommends additional action to further reduce bycatch in the shrimp fishery.

Response: NOAA Fisheries has shared this recommendation with the Gulf Council and will consider the need for additional regulatory action to reduce bycatch when working with the Council to identify priority items for future amendments to the Shrimp FMP.