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GENERIC SUSTAINABLE FISHERIES ACT AMENDMENT

TO THE FOLLOWING FMPS

- **Gulf Coral and Coral Reef Resources**
- **Coastal Migratory Pelagics**
- **Red Drum**
- **Reef Fish**
- **Shrimp**
- **Spiny Lobster**
- **Stone Crab**

(Includes Regulatory Impact Review, Initial Regulatory Flexibility Analysis and Environmental Assessment)

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ACRONYMS/ABBREVIATIONS
IN THIS AMENDMENT

ABC	acceptable biological catch
AP	advisory panel
B_{MSY}	long-term average biomass achieved fishing at F_{MSY}
BRD	bycatch reduction device
ComFIN	Commercial Fisheries Information Network
Council	Gulf of Mexico Fishery Management Council
CPUE	catch per unit effort
CSAP	Ad Hoc Crustacean Stock Assessment Panel
DEIS	draft environmental impact statement
EA	environmental assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
E.O.	Executive Order
F	instantaneous fishing mortality rate
$F_{0.1}$	fishing mortality rate at which slope of equilibrium YPR is reduced to 10% of slope at F=0
F_{MAX}	fishing mortality rate at which slope of equilibrium YPR is zero
F_{MSY}	fishing mortality rate which if applied constantly would result in MSY
FDEP	Florida Department of Environmental Protection
FL	fork length
FMFC	Florida Marine Fisheries Commission
FMP	fishery management plan
FSAP	Ad Hoc Finfish Stock Assessment Panel
GMFMC	Gulf of Mexico Fishery Management Council
GSAFDF	Gulf and South Atlantic Fisheries Development Foundation
GSMFC	Gulf States Marine Fisheries Commission
IRFA	initial regulatory flexibility analysis
LDWF	Louisiana Department of Wildlife and Fisheries
M	instantaneous natural mortality rate
MARFIN	Marine Fisheries Initiative
MFMT	maximum fishing mortality threshold, same as overfishing threshold for some stocks
MP	million pounds
MRFSS	Marine Recreational Fishery Statistics Survey
MSAP	Mackerel Stock Assessment Panel
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act)
MSST	minimum stock size threshold, same as overfished threshold for some stocks
MSY	maximum sustainable yield
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration

OY	optimum yield
RA	Regional Administrator of NMFS
RecFIN	Recreational Fisheries Information Network
RDSAP	Red Drum Stock Assessment Panel
RFSAP	Reef Fish Stock Assessment Panel
RIR	Regulatory Impact Review
SAP	stock assessment panel
SEAMAP	Southeast Area Monitoring and Assessment Program
SEFSC	Southeast Fisheries Science Center of NMFS
SEP	Socioeconomic Panel
SERO	Southeast Regional Office (NMFS)
SFA	Sustainable Fisheries Act
SPR	spawning potential ratio
SSAP	Shrimp Stock Assessment Panel
SSBR	spawning stock biomass per recruit
SSC	Scientific and Statistical Committee
TAC	total allowable catch
TL	total length
TPWD	Texas Parks and Wildlife Department
VPA	virtual population analysis
YPR	yield per recruit

TABLE OF CONTENTS

1.0 INTRODUCTION

This generic amendment serves to amend the following fishery management plans (FMPs) to comply with the provisions of the Sustainable Fisheries Act (SFA) that amended the Magnuson-Stevens Fishery Conservation and Management Act (M-MSFCMA):

- Coastal Migratory Pelagics (mackerel) FMP
- Reef Fish FMP
- Red Drum FMP
- Shrimp FMP
- Spiny Lobster FMP
- Stone Crab FMP
- Gulf Coral and Coral Reef Resources FMP

The amendment addresses principally the new provisions of Section 303(a) of the M-MSFCMA, with the exception of the provision for identifying and describing essential fish habitat, which is addressed in a separate generic amendment to the FMPs listed above. In addressing the new provisions of the M-MSFCMA, the Council finds that the management measures of all of its FMPs are already in compliance with most of the new provisions. The Council's finding in this regard is discussed in the appropriate sections of the amendment.

While the amendment addresses all the new provisions of Section 303(a) and Section 3, the principal changes to the FMPs relate to specification of overfishing criteria and rebuilding periods, and of bycatch measures. The amendment section on overfishing criteria and rebuilding periods (8.0) serves two purposes. For those stocks that National Marine Fisheries Service (NMFS) identified as overfished in 1997, the amendment includes management measures to restore those stocks and specific rebuilding periods based on the current criteria specified in each FMP as provided for in Section 304(e) of the M-MSFCMA. The section also specifies new overfishing criteria and rebuilding schedules based on the guidelines for National Standard 1 as set forth in 50 CFR 600.310. When the amendment is approved and implemented by NMFS, these new criteria will serve as the basis for the Secretary of Commerce (Secretary) to judge whether additional stocks should be classified as overfished or approaching an overfished state. Should the Secretary reach that conclusion, as provided for in Section 304(e), he will immediately notify the Council and request that action be taken to end overfishing by subsequent amendment, based on the new criteria approved in this amendment.

2.0 HISTORY OF MANAGEMENT

The Gulf of Mexico Fishery Management Council (Council/GMFMC) developed or participated in development of eleven draft FMPs principally during the period 1977-1981. Five of the draft FMPs were joint plans with the South Atlantic Fishery Management Council (SAFMC) and all were implemented, while two of the draft plans for the Gulf were not implemented (i.e., groundfish and sharks). The history of management for each of seven FMPs listed below has been routinely included in each of the amendments to those FMPs and is incorporated by reference and not restated here. The FMPs are listed in order of implementation dates below, with the most recent amendment listed as a reference for the most recent discussion of the history of management for that fishery.

FMP/DEIS	Implementation Date	Last Amendment	Implementation Date
Stone Crab	9/79	Amendment 5	3/95
Shrimp	5/81	Amendment 9	4/98
Spiny Lobster*	6/82	Amendment 4	8/95
Mackerel*	2/83	Amendment 8	4/98
Coral	7/84	Amendment 3	10/95
Reef Fish	11/84	Amendment 15	12/97
Red Drum	12/86	Amendment 3	10/92
*Joint plan with SAFMC			

3.0 PURPOSE AND NEED FOR ACTION

The purpose and need for this generic amendment are to comply with the changes to the M-MSFCMA through the passage of the SFA. Each of the aforementioned FMPs and their subsequent amendments contain statements regarding the purpose and need for the actions that were proposed.

4.0 PROBLEMS REQUIRING A PLAN AMENDMENT

As previously noted, this generic amendment was mandated by the M-MSFCMA. Primarily, the new provisions require the Council to review consistency of definitions between FMPs and the SFA (Section 6.0); address bycatch (Section 7.0); establish new definitions of "overfishing" and "overfished," with rebuilding periods (Section 8.0); consider the effects on fishing communities (Section 9.0); and review consistency with regard to reporting requirements (Section 10.0). Problems with each individual fishery are contained in the original FMP and subsequent amendments. They are cumulative to the most recent amendment (see reference table above).

5.0 SUMMARY OF PROPOSED ACTIONS

BYCATCH PROVISIONS FOR FMPs (Section 7.0)

7.2 Measures for Standardized Reporting

7.2.1 General Bycatch Reporting Measures

As part of the reporting requirements for each of the FMPs, NMFS is authorized to collect bycatch information using the most practical reporting requirements and methodology. Such reporting is mandatory for persons selected to report.

If it is determined that observers are needed to collect bycatch information, or substantiate the information collected through reporting, and if determined by the Council, it shall be mandatory that vessels selected by NMFS carry observers, consistent with Section 403 of the M-MSFCMA.

7.3 Measures to Minimize Bycatch and/or Bycatch Morality

7.3.2 Stone Crab Fishery

Adopt in the Stone Crab FMP the construction characteristics of stone crab traps set forth in Chapter 46-13.002(2)(a) of Florida law.

OVERFISHING CRITERIA AND REBUILDING PERIODS FOR STOCKS (Section 8.0)

8.1 REEF FISH

8.1.2 Maximum Sustainable Yield (MSY)

MSY is equivalent to 50 percent static SPR for Nassau grouper and jewfish.

MSY is equivalent to 30 percent static SPR for reef fish stocks under Section 8.1, except for red snapper, Nassau grouper, and jewfish.

MSY is equivalent to 26 percent static SPR for red snapper.

8.1.3 Optimum Yield (OY)

OY is equivalent to 50 percent static SPR for Nassau grouper and jewfish.

OY is equivalent to 36 percent static SPR for red snapper.

OY is equivalent to 40 percent static SPR for reef fish stocks under Section 8.1, except for red snapper, Nassau grouper, and jewfish.

8.1.4.1 Overfishing Threshold (MFMT)

Set the overfishing threshold at a fishing mortality rate equivalent to 50 percent static SPR for Nassau grouper and jewfish.

Set the overfishing threshold at a fishing mortality rate equivalent to 26 percent static SPR for red snapper.

Set the overfishing threshold at a fishing mortality rate equivalent to 30 percent static SPR for all of the reef fish stocks in Section 8.1, except red snapper, Nassau grouper, and jewfish.

8.1.4.2 Overfished Threshold (MSST)

The overfished threshold will be implemented by framework measure as estimates of B_{MSY} and MSST are developed by NMFS, the RFSAP, SSC, and the Council.

8.1.5 Rebuilding Periods

The rebuilding period for red snapper will be completed on or before year 2033.

There is insufficient scientific information to compute the rebuilding periods for Nassau grouper and jewfish.

8.2 COASTAL MIGRATORY PELAGICS (MACKERELS)

8.2.2 Maximum Sustainable Yield (MSY)

MSY is equivalent to 30 percent static SPR for the following stocks or management groups: Gulf-group king mackerel, Gulf-group Spanish mackerel, cobia, cero, dolphin (fish), bluefish, and little tunny.

8.2.3 Optimum Yield (OY)

OY is equivalent to 40 percent static SPR for the following stocks or management groups: Gulf-group king mackerel, Gulf-group Spanish mackerel, cobia, cero, dolphin (fish), bluefish, and little tunny.

8.2.4.1 Overfishing Threshold (MFMT)

Set the overfishing threshold at a fishing mortality rate equivalent to 30 percent static SPR for the following stocks or migratory groups: Gulf-group king mackerel, Gulf-group Spanish mackerel, cobia, cero, dolphin (fish), bluefish, and little tunny.

8.2.4.2 Overfished Threshold (MSST)

The overfished threshold will be implemented for each stock by framework measure as estimates of B_{MSY} and MSST are developed by NMFS, the MSAP, SSC, and the Council.

8.2.5 Rebuilding Period

The rebuilding period for Gulf-group king mackerel to MSY (30 percent static SPR) will be for 10 years, 1999 - 2009.

8.3 RED DRUM

8.3.2 Maximum Sustainable Yield (MSY)

MSY is equivalent to 30 percent static SPR.

8.3.3 Optimum Yield (OY)

OY is equivalent to 30 percent static SPR.

8.3.4.1 Overfishing Threshold (MFMT)

Set the overfishing threshold at a fishing mortality rate equivalent to 30 percent static SPR.

8.3.4.2 Overfished Threshold (MSST)

The overfished threshold will be implemented by framework measure as estimates of B_{MSY} and MSST are developed by NMFS, the RDSAP, SSC, and the Council.

8.3.5 Rebuilding Period

There is insufficient scientific information to compute the rebuilding period for red drum.

8.4 SHRIMP

8.4.1 Penaeid Shrimp

8.4.1.2 Maximum Sustainable Yield (MSY)

The proxy for the MSY spawning stock size is defined as the parent stock numbers (as indexed from current VPA procedures) for the three penaeid species of shrimp in the Gulf of Mexico at or above the following levels:

Brown Shrimp - 125 million individuals, age 7+ months during the November through February period.

White Shrimp - 330 million individuals, age 7+ months during the May through August period.

Pink Shrimp - 100 million individuals, age 5+ months during the July through June year.

8.4.1.3 Optimum Yield (OY)

Set OY equal to MSY (or proxy for MSY).

8.4.1.4.1 Overfishing Threshold (MFMT)

The overfishing threshold is defined as a rate of fishing that results in the parent stock number for any of the penaeid species being reduced below the MSY minimum levels listed below:

Brown Shrimp - 125 million individuals, age 7+ months during the November through February period.

White Shrimp - 330 million individuals, age 7+ months during the May through August period.

Pink Shrimp - 100 million individuals, age 5+ months during the July through June year.

8.4.1.4.2 Overfished Threshold (MSST)

An overfished condition would result when a parent stock number falls below one-half of overfishing definition, i.e.:

Brown Shrimp - 63 million individuals, age 7+ months during the November through February period.

White Shrimp - 165 million individuals, age 7+ months during the May through August period.

Pink Shrimp - 50 million individuals, age 5+ months during the July through June year.

8.4.2 Royal Red Shrimp

8.4.2.2 Maximum Sustainable Yield (MSY)

Set MSY at a range of 392,000 to 650,000 pounds.

8.4.2.3 Optimum Yield (OY)

Set OY equal to MSY.

8.4.2.4.1 Overfishing Threshold (MFMT)

The overfishing threshold is defined as a rate of fishing that results in landings exceeding OY.

8.4.2.4.2 Overfished Threshold (MSST)

There is insufficient scientific information to specify the threshold.

8.5 SPINY LOBSTER

8.5.2 Maximum Sustainable Yield (MSY)

MSY is defined as a harvest strategy that results in at least a 20 percent SSBR (transitional SPR).

8.5.3 Optimum Yield (OY)

OY is defined as a harvest strategy that results in achieving a 30 percent SSBR (transitional SPR).

8.5.4.1 Overfishing Threshold (MFMT)

Overfishing exists when the fishing rate results in SSBR being reduced below 20 percent.

8.5.4.2 Overfished Threshold (MSST)

The minimum stock size threshold proxy is an SSBR level of 15 percent.

8.6 STONE CRAB

8.6.2 Maximum Sustainable Yield (MSY)

MSY is defined as the harvest that results from a realized egg production per recruit at or above 70 percent of potential production. This harvest capacity is currently estimated at between 3.0 and 3.5 million pounds of claws (minimum 70 mm propodus length).

8.6.3 Optimum Yield (OY)

Set OY equal to MSY

8.6.4.1 Overfishing Threshold (MFMT)

Overfishing is defined as a harvest level (or fishing mortality rate) that would result in a realized egg production per recruit of below 70 percent of potential production (see Figure 9).

8.6.4.2 Overfished Threshold

The overfished condition would occur when the realized egg production per recruit is reduced below 40 percent of potential production.

6.0 SFA DEFINITIONS

6.1 Statement of SFA Definitions

The SFA added new definitions related to the new required provisions of plans under M-MSFCMA Section 303(a) and the new national standards under Section 301. In addition, it modified other existing definitions to be compatible with Section 2 on Congressional Findings, Purposes and Policy; the most important of these is the definition of optimum as used in optimum yield (OY).

The new definitions are as follows:

The term bycatch means 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.

The term economic discards means fish which are the target of a fishery, but which are not retained because they are of an undesirable size, sex, or quality, or for other economic reasons.

The term regulatory discards means fish harvested in a fishery which fishermen are required by regulation to discard whenever caught, or are required by regulation to retain but not sell.

The term charter fishing means fishing from a vessel carrying a passenger for hire (as defined in section 2101(21a) of title 46, United States Code) who is engaged in recreational fishing.

The term commercial fishing means fishing in which the fish harvested, either in whole or in part, are intended to enter commerce or enter commerce through sale, barter, or trade.

The term recreational fishing means fishing for sport or pleasure.

The term fishing community means a community which is substantially dependent on or substantially engaged in the harvest 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.

The term individual fishing quota means a Federal permit under a limited access system to harvest a quantity of fish, expressed by a unit or units representing a percentage of the total allowable catch (TAC) of a fishery that may be received or held for exclusive use by a person. Such term does not include community development quotas as described in section 305(I).

The term optimum with respect to the yield from a fishery, means the amount of fish which,

(A) 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;

(B) is prescribed on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant social, economic, or ecological factor; and

(C) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.

The terms overfishing and overfished mean a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis.

The term essential fish habitat means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.

6.2 Consistency of FMPs with SFA Definitions

One of the tasks carried out by the NMFS, Southeast Regional Office (SERO) in complying with the SFA, was to examine the code of regulations for the Gulf FMPs to determine if the word usage was in compliance with the new set of definitions. The initial conclusion by NMFS, SERO was that the regulations were in compliance (Rod Dalton, NMFS, personal communication). The FMPs contain other language setting forth policy and procedures under which management measures are promulgated as rules. This type of FMP language that deviates from the new definitions is addressed here, with the exception of language related to the definition of "overfishing and overfished," as interpreted by the Guidelines for National Standard 1 under 50 CFR 600.310. These definitions are addressed in Section 8.0 of this amendment.

There are some minor word usages in FMPs that differ from the definitions, such as the use of individual transferable quota (ITQ) instead of individual fishing quota (IFQ), but both terms are used with the same meaning. Some of the current FMP statements of OY, are somewhat different from but not necessarily inconsistent with the new definition of OY, as based on the definition of optimum above. Some may not be expressed quantitatively; or in some instances, they are based on relatively poor quantitative information. Examples of the first case (where OY is not expressed quantitatively) are as follows:

Brown, White, and Pink Shrimp:

OY is determined to be: All the shrimp that can be taken during open seasons, in permissible areas, in a given fishing year, with existing gear and technology. The Council has determined that, because of the annual nature of the resource, a numerical value for OY cannot be calculated for any given year until the environmental factors can be determined and evaluated. Under optimum environmental conditions and maximum effort, the maximum probable catch for brown, white, and pink shrimp is estimated to be 216 million pounds (MP) of tails. Fishing, however, will not be stopped when this numerical estimate is reached.

The Council has also determined that adjustments to OY need not be made yearly as economic, biological, and technological factors prevent the taking of sufficient shrimp during a single year to harm the next year's resource size. The Council will monitor closely the appropriate factors of the management regime established by the plan and, in particular, the environmental factors surrounding the determination of MSY. Should conditions warrant, the Council will provide the information to the Secretary of Commerce and a new MSY/OY relationship will be established through rule making.

Red Drum:

OY is defined as:

1. All red drum recreationally and commercially harvested from state waters landed consistent with state laws and regulations under a goal of allowing 30 percent escapement of the juvenile population.

2. All red drum commercially or recreationally harvested from the Primary Area of the exclusive economic zone (EEZ) under the TAC level and allocations specified under the provisions of the FMP, and a zero retention level from the Secondary Areas of the EEZ. Note: TAC has been set at zero for the EEZ since 1988.

Examples of the second case (use of poor quantitative information) are as follows:

Spiny Lobster:

Optimum yield is specified to be all lobster more than 3.0 inches carapace length or not less than 5.5 inches tail length that can be harvested by commercial and recreational fishermen given existing technology and prevailing economic conditions.

(This amount is estimated to be 9.5 MP in 1981.) (See Section 12.2 for analysis of the proposed OY and four alternatives which were not accepted). With improvement of enforcement capability and possible development of alternative baits, the amount of OY may increase to approach a maximum of 12.0 MP.

Stone Crab:

The statement of OY for stone crabs is a verbatim statement from the Fishery Conservation and Management Act of 1976 (FCMA) and needs to be modified to conform with the current definition. This statement of OY, along with all the others, are addressed in Section 8.0 of this amendment, and may be respecified in terms of a spawning potential ratio (SPR) or spawning stock biomass per recruit (SSBR) or some other aspect of spawning biomass.

Royal Red Shrimp:

The new definition of OY, based on a level of MSY "as reduced by any relevant social, economic, or ecological factor" has made the current management measures for closure of the royal red shrimp fishery inconsistent with the M-MSFCMA. That measure allows a harvest of up to 30 percent above MSY for up to two consecutive years to obtain information to respecify MSY. The Council felt that the MSY figure used as a base for annual closure of that fishery was unreliable, and likely an underestimate (see Shrimp Amendment 8 for discussion), as did the scientist developing the MSY (Richard Condrey, personal communication 7/21/95). This issue is addressed in Section 8.0 of this amendment.

No other inconsistencies have been detected with regard to the definitions in the regulatory language of the other FMPs.

7.0 BYCATCH PROVISIONS FOR FMPs

7.1 Introduction

The SFA includes as required provisions under MSFCMA Section 303(a)(11) that FMPs shall: (1) establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery; and (2) include conservation and management measures that, to the extent practicable and in the following priority, shall: (A) minimize bycatch; and (B) minimize the mortality of bycatch which cannot be avoided.

The SFA defines bycatch as fish which are harvested in the 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. Economic discards means fish which are the target of a fishery, but which are not retained because they are of an undesirable size, sex, or quality, or for other economic reasons. Regulatory discards means fish harvested in a fishery which fishermen are required by regulation to discard whenever caught, or are required to retain but not sell.

This section summarizes data available (or lack of availability of such data) on bycatch in fisheries managed by the Council. It does not include data on bycatch in the shrimp fishery for the Gulf area west of Cape San Blas, Florida, since those data are available in Shrimp Amendment 9 (GMFMC 1997), which regulates bycatch with BRDs in that area.

Spiny Lobster Fishery

Mathews, Cox, and Eaken (1995) examined the contents of 21,309 lobster traps. The traps were constructed of wood (88 percent), wire reinforced wood (9 percent), wire (2 percent), and plastic (>1 percent). Sixty-seven percent of the traps had no organisms other than lobster. They observed 15,536 individuals, including lobster, comprising 172 species of which 65 percent were stone crabs, grunts, spider crabs, and sea urchins, in that order (see Table 1). Of the 44 most abundant species listed in Table 1, 21 invertebrates and 7 finish were reported as dead. Of the 4,898 stone crab taken, 1,514 (31 percent) were undersize, regulatory discards. Of the 87 groupers taken, 90 percent were undersize, regulatory discards. Additionally, 36 (44 percent), 43 (77 percent), 25 (66 percent), and 5 (20 percent) of mutton snapper, lone snapper, gray snapper, and yellowtail snapper, respectively, were undersize, regulatory discards.

Stone Crab Fishery

There is no similar set of data for the stone crab fishery. However, the Spiny Lobster Advisory Panel (AP) and Stone Crab AP, in a joint meeting addressing bycatch (4/94), indicated that stone crab traps typically had less finfish bycatch than spiny lobster traps, partially because the traps are smaller. A likely exception to this is the wire stone crab traps used in the Big Bend area of Florida. These traps had an additional funnel constructed in the side of the traps with the longest axis oriented vertically. The AP members indicated that these traps were likely fished for finfish as well as stone crabs. Dr. Terri Bert (Florida Department of Environmental Protection [FDEP], personal communication, 4/98) indicated that since 1978 she had monitored the contents of plastic and wooden stone crab traps in the Everglades National Park, Florida Bay area and the Tampa Bay area. She indicated in her experiments that, in the great majority of trap sets there were no finfish at all, and she caught almost zero legal size fish.

Reef Fish Commercial Longline Fishery

There are two bottom longline fisheries for reef fish, one west of Cape San Blas where the gear is restricted to offshore of the 50-fathom contour and the other offshore of 20 fathoms on the Florida shelf. There are no data on bycatch in the western fishery, and likely, if regulatory discards are taken beyond 50 fathoms, the fish are dead or will die.

Pooled logbook data for longline landings in the western Gulf (Statistical Areas 9 - 21) for the years 1990 - 1997 indicated that the catch landed (30,097 pounds) was composed as follows:

Sharks	57%
Tuna	3%
Shallow-water Grouper	9%
Deep-water Grouper	7%
Snappers	4%
Amberjacks	1%
Tilefish	1%
Others	18%

NMFS (1995) monitored the longline fishery on the Florida shelf (see Figure 1 for area sampled). They sampled 311 sets (227,607 hooks). Average depth of the sets was 47.8 fathoms. Of the 5,016 fish observed, 55.9 percent were kept, 28.3 percent were released alive, 4.5 percent released dead, 9.4 percent used as bait, and 1.8 percent were discarded with fate unknown (Table 2). Survival was based on swim down observation. Of the red groupers caught, 43 percent were released alive and 6 percent dead. Considering that the average depth of trips targeting red grouper was 34.1 fathoms, mortality of fish released alive may have been higher than 33 percent. Of the deep-water grouper and tilefish, almost all (>99 percent) were either kept or used for bait. Release mortality for discards by the commercial sector would appear to be much higher than for the recreational sector. For the longline fishery, the discard rate in numbers of fish was 53 percent (Table 2). This fishery takes approximately 64 percent of the annual commercial landings, and is restricted to areas seaward of the 20-fathom contour. The NMFS (1995) observer study monitored 311 sets in water depths from 18 to 129 fathoms. Of the 236 sets targeting red grouper, fishing occurred from 18 to 65 fathoms and the average water depth fished was 34.1 fathoms (see Figure 1). The Wilson and Burns (1996) *in situ* study indicated no survival of red grouper taken from 30 to 41 fathoms and less than 33 percent survival for all groupers.

Reef Fish Fish Trap Fishery

NMFS (1995) monitored the fish trap fishery from statistical area 3 north through statistical area 7 (Figure 2). A total of 517 sets (10,654 trap hauls) were monitored, with 34 percent of sampling in the summer and the remainder essentially evenly divided over the other seasons. Depths ranged from 10 to 17 fathoms, and average soak time was 10 hours. Of the 15,148 individuals observed, 55.4 percent were released alive, 1.6 percent dead, and 0.4 percent with the fate unknown (Table 3). This study did not monitor the fishery off Monroe County, except for some sampling directly north of the Dry Tortugas, and catch likely would not be representative of the species taken near the coral reef complexes. The NMFS (1995) study probably did not proportionally sample effort in statistical area 6 where about 30 percent of the trap fishermen reside (i.e., Tarpon Springs to Cedar Key) (see Figure 2).

The fish trap fishery harvested about 10 percent of commercial red grouper landings annually, and discarded 77 percent of the number caught (Table 3). This fishery occurred in depths ranging from 10 to 23 fathoms (NMFS 1995); therefore, the survival of fish discarded should be very high. The NMFS (1995) study recorded "swim down" rates for red grouper that were very high for both fish trap and longline fisheries. The Mote Marine Laboratory studies raised questions about the survival of grouper observed swimming down when harvested from the deeper waters. The hook-and-line commercial fishery takes about 26 percent of red grouper landings. An observer study of limited scope indicated that these vessels were fishing between 8 and 56 fathoms (23 fathoms average depth) (Ms. Scott-Denton, NMFS, personal communication).

Taylor and McMichael (1983) monitored 1,694 trap hauls off Monroe County, and of the 619 released fish they observed 20 percent were dead. Their study monitored the fishery principally on the Atlantic Ocean side of the Keys (South Atlantic Council area) where most of the coral complex is located. At the time of the study, traps were left continually deployed at sea.

Fish observed by Taylor and McMichael (1983) off Monroe County, Florida, consisted of a much higher proportion of fish important to the aquarium-trade harvesters, e.g. angelfish, butterflyfish, etc., as was the case in the study of the trap fishery in the coral reef tract by Bohnsack et al. (1989). (Also see Reef Fish Amendment 5, GMFMC 1993.) The Council, through Reef Fish Amendment 16A (GMFMC 1998a) has proposed phasing-out the fish trap fishery off Monroe County by 2001, partly because of the bycatch of aquarium-trade species. This action would restrict the trap fishery to the Florida area between 25.05˚ north latitude on the south and Cape San Blas, Florida, (85˚ 30' west longitude) on the north and west (GMFMC 1996).

Reef Fish Hook-and-Line Fishery

There is very little information available on catch and discards for the bandit and other hook-and-line gear. Goodyear (1995) reported on a limited observer study during the 1995 season in which 40.7 percent of red snapper were discarded. Only 1.6 percent was discarded dead, but most of the discarded fish had eyes or stomachs protruding. For captains who recorded red snapper discards in logbooks, the discards were 31 percent in 1993, 28 percent in 1994, and 30 percent in 1995. Render and Wilson (1994) reported that 19.7 percent of the discarded red snapper were dead from 69 feet. Wilson and Burns (1996) reported good survival (86 to 100 percent) for red grouper and scamp released from water shallower than 44 m (24 fathoms). For grouper released from water deeper than 44 m, survival was poor (<33 percent). For stock assessment purposes, the release mortality of snapper and grouper by the commercial sector was assumed to average 33 percent (Goodyear, 1993).

Between 1990 and 1994, the recreational release of red snapper was estimated to range between 500 and 900 thousand fish or 40 to 60 percent of the catch (Table 4). Table 5 presents more recent data on number and percentages of red snapper released by anglers, as well as for other dominant reef fish species. Most of the releases of red snapper, groupers, and amberjack are likely due to regulations on these species for size and bag limits, and would be classified as regulatory discards. In recent years, these release levels have been on the order of 50 percent for red snapper, 80 percent for gag, 85 percent for red grouper, and 50 percent for greater amberjack. For stock assessment purposes, the release mortality levels of released snapper and grouper by the recreational sector were assumed as 20 percent (Goodyear 1993 and 1995).

Recreational anglers are discarding more than 80 percent of the gag and red grouper they catch as regulatory discards (Table 5). These discards appear to be largely in response to the 20-inch minimum size limit that was implemented in 1990, along with an aggregate bag limit of 5 fish. Holiman (1995) computed MRFSS catch and landing frequencies for red grouper and all shallow-water grouper for 1991-1993. During these years the average number of red grouper caught per angler ranged between 4.5 and 5.8 fish; and the average number landed ranged between 1.7 and 1.8 fish, indicating that the size limit was the principal reason for discarding fish. The red grouper fishery is conducted almost entirely off Florida. For the shallow-water grouper complex of which gag and red grouper are the major components, average catch ranged between 3.6 and 3.7 fish and landings between 1.3 and 1.8 fish for 1991-1993. The shallow-water grouper complex extends across the Gulf, but grouper are less abundant outside of the Florida area; therefore, average catch and landings are less. The percentage of gag discarded has increased by about 10 percent since 1990, while the percentage of red grouper has declined somewhat (Table 5). Figure 6 from the most recent stock assessment for gag (Schirripa and Legault 1997) depicts total kill, including that from release mortality of discarded gag. It illustrates that there are almost no regulatory discards of gag by the commercial sector. That is consistent with the NMFS (1995) longline observer study (Table 2), i.e., most fish encountered are of legal size. Figure 6 also illustrates that if the assumed release mortality rate (20 percent) is correct, then the kill of gag in numbers of fish by recreational discards is higher than the kill from landings for both 1994 and 1995.

Similar assumptions on release mortality (at 33 percent) were made for both recreational and commercial sectors in the 1993 red grouper stock assessment

(Goodyear and Schirripa 1993). At this rate, estimated recreational discard kill likely would exceed recreational landings kill each year since 1990. Information for red grouper indicates a significant discard rate from the commercial longline fishery. The NMFS (1995) observer study indicated that rate to be 53 percent (Table 2); however, the majority (43 percent) were observed to swim down.

The regulatory restrictions of bag and size limits and commercial quotas are necessary to manage the stocks and prevent overfishing. Relatively high levels of regulatory discards are a natural consequence of those actions. They become a concern only when the release mortality is high. For example, assuming a 20 percent release mortality rate, the size that maximizes yield per recruit (YPR) for gag is about 24 inches total length (TL) (Schirripa and Goodyear 1994, Figure 60), which is also the size that 50 percent of females are mature (Reef Fish Stock Assessment Panel [RFSAP] October 1997). At an assumed mortality rate of 33 percent, the size that maximizes YPR would be about 20 inches TL. Similar YPR analyses for red grouper indicate yield would be maximized at 20 and 18 inches TL for assumed release mortalities of 20 and 33 percent, respectively (Goodyear and Schirripa 1993, Figure 61 and 62). However, bias in the age-length data used for those computations may have affected their reliability. The only more recent information on YPR for red grouper was by Goodyear (1995a). He examined YPR for 3 minimum sizes of 30, 50, and 70 cm in relation to variations in length at age for modeled populations at $F_{0.1}$ and F_{max}. YPR was maximized at both $F_{0.1}$ and F_{max} at 50 cm (20 inches) TL. However, Goodyear (1995a) pointed out this conclusion might not hold at a finer resolution of alternate minimum sizes.

Mackerel and Coastal Migratory Pelagic Fishery

There is even less bycatch information for this commercial fishery. Harvest is largely by trolling, with the exception of a small run-around gill net fishery for mackerel in the Florida Keys. Since the fish are not removed from the net immediately, the probability of survival of released fish is probably poor. There are no known studies of catch and bycatch in the mackerel gill net or troll fisheries. Probably most of that catch, except for economic discards, is sold. The mesh size of the nets (4½ x 4½ inches) probably preclude catching most economic and regulatory discards. The troll fishery lands fish by pulling them aboard on the line and dropping them in a chill box (ice and water). This practice apparently allows them to release unwanted fish with little mortality.

Table 6 indicates the number and percentage of coastal migratory pelagic species that are released by anglers. In recent years, the release levels have been approximately 20 percent for king mackerel, 35 percent for Spanish mackerel, 60 percent for cobia, and 15 percent for dolphin. Probably most of this release is regulatory discards related to bag and size limits on these species, with the possible exception of dolphin (fish). The only regulation applying to recreational harvest of dolphin is a bag and possession limit for fish landed in Florida; however, as most of the Gulf recreational landings occur in Florida, the discards could be a result of the size limit. Data on the mortality associated with releasing the coastal migratory pelagic species is limited to two studies by Edwards (1994 and 1996). For king and Spanish mackerel, the mortality rates that he reported using sonic tagging were 18.2 and 16.7 percent, respectively.

Shrimp Fishery

The Council, through Shrimp Amendment 9, required bycatch reduction devices (BRDs) in shrimp trawls fished in the EEZ from Cape San Blas, Florida to the Mexican border (west of 85˚ 30' west longitude). The purpose of this requirement was to reduce the incidental harvest of juvenile red snapper and assist in the restoration of that stock. Most of the bycatch in the shrimp fishery are discards of no value to the vessel crew, with a limited amount being regulatory discards.

The current provisions of Shrimp Amendment 9 apply to a portion of statistical area 8 through statistical area 21. Statistical areas 1 through 7 and one-half of area 8 are not affected (see Figure 1 for area boundaries). Table 7 summarizes annual average shrimping effort for these two areas of the Gulf for the periods 1990-1993 and 1994-1995. For these two periods, 8 to 12 percent of the total annual shrimping effort occurred in statistical areas 1 through 7. In terms of total Gulf EEZ, statistical areas 1 through 7 make up more than one-third of the total area of the statistical zone because the Florida shelf is broader.

As indicated in Table 8 from Shrimp Amendment 9 addressing bycatch, the ratio of weight of finfish caught in trawls to weight of shrimp is fairly uniform (near 3 to 1) for nearshore areas (inside 10 fathoms) across the Gulf. For the offshore areas (outside 10 fathoms), it is much higher for the Louisiana area, which comprises most of the primary area for harvest of groundfish (GMFMC 1980). For the Florida area (statistical areas 1-10), the finfish/shrimp ratio by weight for the offshore areas was 3 to 1.

Table 9 summarizes the finfish to shrimp ratios for statistical areas east of Cape San Blas, Florida (i.e., statistical areas 1-8) and by water depth within those areas. This is the area for which there is currently no requirement for shrimp vessels to use BRDs. Water depths less than 5 fathoms are all within the fishery jurisdiction of the state of Florida (inshore of 9 nautical miles), and part of the depth zone 5 to 10 fathoms is within that jurisdiction in some areas. The ratios of finfish weight to shrimp weight in the EEZ range from 1 to 1 for statistical areas 1 and 2 to 4.8 to 1 for water depths greater than 15 fathoms in statistical areas 6, 7, and 8. Most of the shrimping effort off Florida is associated with the Tortugas Shrimp Grounds which includes portions of statistical areas 1 - 3, with most of the catch occurring from statistical area 2, and to a lesser extent, in the Sanibel Shrimp Grounds in statistical area 4 (see Figure 3). Therefore, information on bycatch for statistical areas 1 and 2 (Table 9) is likely more representative of the bycatch. The data set used for Table 9 included data with much higher finfish to shrimp ratios for statistical areas 9 - 10, but the number of tows sampled was only 11; therefore, the data were not used.

The species composition in shrimp trawl bycatch for statistical areas 1 - 8 (Table 10) differs significantly from that for the remainder of the Gulf (Shrimp Amendment 9, GMFMC 1997), where the catch is predominantly species of the drum family. In statistical areas 1 and 2, the dominant species groups were sea basses, searobins, pinfish, mojarras, and small species of the flounder family. In statistical areas 3 through 5, the dominant species were sea basses, searobins, grunts, lane snapper, and small species of the flounder family. In statistical areas 6 through 8, the dominant species groups were porgy, spot, sea basses, grunts, searobins, and small species of the flounder family (Table 10).

7.2 Measures for Standardized Reporting

The collection of landings data and other fisheries-dependent data is in the process of transition. Through the Gulf States Marine Fisheries Commission (GSMFC), the states have developed and are developing cooperative state-federal data collection programs (GSMFC 1998). The GSMFC currently manages and coordinates the Southeast Fishery Information Network (FIN) of which RecFIN and ComFIN are the recreational and commercial components, respectively. Over time, all or most of the fishery-dependent data will be collected under the umbrella of this program, which includes such state programs as the Florida and Louisiana trip ticket programs for collection of commercial fishery statistics. It is expected that under the RecFIN program, the states will eventually collect all or most of the intercept data for the NMFS Marine Recreational Fishery Statistics Survey (MRFSS).

The ComFIN and RecFIN(SE) are still in the developmental stages regarding a discards and protected species interactions monitoring program. The ComFIN Data Collection Work Group met in August 1997 to discuss this issue and developed some basic guidelines regarding discards and protected species interactions. For the commercial aspects, the group talked about several methods, such as an observer program, fishery-independent sampling, and some type of sampling program which randomly selects vessels to examination of discards and protected species interactions, for collecting this type of information. For the recreational aspects, the group agreed that a minimum standard data elements including quantity released dead, quantity released alive, and disposition of catch should be collected. It was agreed by the group that the type of method used to collection discards and protected species interactions information is dependent upon the fishery that is being sampled and collection of discards and protected species interactions could be implemented by special studies to address specific issues and may not be a long-term sampling program. The Atlantic Coastal Cooperative Statistics Program (ACCSP) has done a lot of work regarding the development of a discards and protected species interactions collection program, and

ComFIN and RecFIN(SE) will utilize their experiences in the development of their program.

Section 303(a)(5) of the M-MSFCMA requires the Councils to specify the fishery-dependent data that "will be reported to the Secretary with respect to commercial, recreational, and charter fishing in the fishery . . ." The Council does this by including management measures in the FMPs and in the regulations providing authority for the Science and Center Director (SCD) of the NMFS Southeast Fisheries Science Center (SEFSC) to collect these data from fishermen and dealers (for example, see Figure 4). The SCD, under the regulatory authority provided, may and does collect much of the data from existing state programs. For example, almost all of the fishery-dependent data on the commercial fisheries for spiny lobster and stone crab are collected through the Florida trip ticket system. Most of the commercial landings data for other FMP fisheries are also collected through state data collection programs. However, the mandatory data collection provisions of the FMP regulations provide authority for agents of the SCD to directly collect information, including Trip Interview Program (TIP) data on length-frequency of fish landed or in possession and weekly landings information from dealers used for monitoring quotas. Such agents include state personnel designated by the head of a state agency that has entered into a cooperative agreement with NMFS to collect fishery data.

7.2.1 General Bycatch Reporting Measures

The Council has not selected a proposed alternative for this section.

Proposed Alternative 1: As part of the reporting requirements for each of the FMPs, NMFS is authorized to collect bycatch information using the most practical reporting requirements and methodology. Such reporting is mandatory for persons selected to report.

Proposed Alternative 2: If it is determined that observers are needed to collect bycatch information, or substantiate the information collected through reporting, and if determined by the Council, it shall be mandatory that vessels selected by NMFS carry observers, consistent with Section 403 of the M-MSFCMA.

Alternatives Considered and Rejected:

Alternative 1: If it is determined that observers are needed to collect bycatch information or substantiate information collected through reporting, a voluntary observer program shall be utilized.

Alternative 2: In order to optimize the use of the available fiscal and personnel resources, bycatch information will be collected only from those fisheries for

which NMFS and the Council determine the bycatch level is adversely impacting fishery resources.

<u>**Alternative 3**</u>**: Status Quo - Do not implement one or more of the alternatives above.**

<u>**Discussion**</u>**:** Proposed Alternative 1 is similar to the reporting measures of most of the original FMPs. The Council provided NMFS with authority to collect fishery statistics from commercial, recreational, recreational for-hire vessels, and dealers, and to determine the data that would be reported and the system to be used for collection of the data. In a few instances, the Council specified the level of sampling, e.g., all the dealers, and the data to be collected. However, in the last instance, NMFS still had the authority to collect other data than that specified by the Council. This process provided NMFS with the flexibility to standardize reporting forms and to utilize the existing data collection systems of the states. The Council made all reporting mandatory, if a person was selected by the NMFS SCD to report. This mandatory requirement has been used to require that data be provided to the agents of the SCD through legal action.

Proposed Alternative 2 recognizes that for some fisheries, observers will be necessary to collect bycatch data or to periodically ground-truth data collected through reporting. For some studies to effectively use the limited observer resources, it is very important that NMFS is able to randomly select the vessels to which the observers will be assigned. This allows the data collected by the observers to be statistically representative of the fisheries being monitored. However, the Council consensus on this issue was that in most instances voluntary observer programs were likely to yield less biased information, but in certain instances the quality of the information collected may depend on random selection by NMFS; however, that decision should be by the Council, rather than NMFS. A large portion of the Council members, including state directors, have been associated with observer programs assessing the effects of BRDs and collection of bycatch information on shrimp and other fisheries at federal and state levels. For example, seven members of the Council served on the Bycatch Steering Committee for the cooperative program by NMFS, Sea Grant, industry, and states. Many of the members felt that voluntary systems yielded better and more reliable data, and that if persons are forced to carry observers against their will, the vessel operator may bias the data collection process. Other members felt that for the data to be representative of the fishery, the participants must be randomly selected and the process mandatory.

Section 403 of the M-MSFCMA, the guidelines promulgated by NMFS under that section (50 CFR 600.756), and guidelines under 50 CFR 600.506 regulate the use of observers by NMFS. For example, Section 403 provides that a vessel is not required to carry an observer if the facilities on board a vessel are inadequate for quartering the observer.

If it is determined that an observer program is necessary to collect bycatch information, Rejected Alternative 1 provides that observers will be placed only on vessels whose master agrees voluntarily to carry the observers. Many Council members feel that mandatory programs are usually ineffective and create unnecessary ill will from persons forced to carry observers.

Rejected Alternative 2 somewhat moderates the general authority provided to NMFS under Proposed Alternative 1 for collection of bycatch information under all FMPs from all fishing vessels. It recognizes that existing information indicates that there is no problem caused by the bycatch taken in many fisheries (See discussion in Section 7.1 above.). Therefore, there is no need to place a reporting burden on the fishermen or to utilize NMFS limited manpower or fiscal resources to collect and process data from these fisheries. Fisheries that currently appear to fall into this category are spiny lobster, stone crab, coral, and red drum.

Rejected Alternative 3 is the no action alternative for any of the 4 alternatives above.

Biological Impacts: There are no direct biological impacts associated with implementation of the alternatives. Proposed Alternative 1 will result in the collection of information that, when subsequently used, may eventually result in beneficial biological impacts for some stocks. Proposed Alternative 2 would have a beneficial effect on the reliability of the stock assessments or analyses in which the observer data is used. A major criticism of current observer programs and collection of other assessment data, such as length-frequency information, is that the data were not randomly collected, and therefore, is likely not representative of the fishery. The proponents of Rejected Alternative 1 feel that if an observer program is mandatory the data may be biased intentionally, because of the objections of crew members to carrying an observer.

Economic Impacts: Considering that these alternatives are provided in more general forms, the determination of their specific economic impacts cannot be assessed. Once any of the alternatives (except status quo which in principle has no impacts on fishing participants) is given more specificity, a more complete determination of its economic impacts will be conducted. At this stage, only general statements can be made about the various alternatives' economic impacts.

The SFA requirement regarding the collection of bycatch information virtually renders Rejected Alternative 3 as a non-viable alternative; thus, any of the first 4 alternatives, or combinations thereof, would have to be adopted. Each alternative differs in terms of both the information collected and the costs involved. A comparison of the benefits from having bycatch information with the associated costs is the major issue in the determination of economic impacts of each of the alternatives.

The bycatch information collected would be used to 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 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 dependent on the bycatch species and those generating the bycatch species. In addition, such benefits would have to be compared with the costs of the bycatch reduction measure, and a good part of this cost is likely be borne by the industry that generated those incidental catches. It may be noted in passing that both the bycatch and directed fisheries could be one and the same fishery. Given this caveat, it is simply assumed that among the alternatives considered in this section, the one that is likely to generate better information is judged to bring about larger benefits.

Proposed Alternative 1 and Proposed Alternative 2 only implicitly include an observer program among the various possible means of collecting bycatch information, although it may be assumed that both alternatives would not use observers, as is the current experience with Proposed Alternative 1. While logbooks and other means of generating bycatch information from fishermen's reports would provide some baseline information, the information so generated cannot be validated for consistency and accuracy. Logbooks and other reporting mechanisms dependent on fishermen's reports impose reporting burdens on fishermen, and while there may be no intent on not reporting bycatch information, fishermen's recollection of such information may be deficient considering that logbooks are generally filled at the dock. This problem would especially occur if there were no economic incentives for reporting bycatch. Under this condition, Proposed Alternative 2 and Rejected Alternative 1, both of which explicitly provide for the development of an observer program, may be adjudged superior to the other alternatives in generating bycatch information.

Proposed Alternative 2 and Rejected Alternative 1 presuppose that some means other than an observer program are first employed in generating some preliminary data on bycatch. Such preliminary information leads the way for the need to proceed further in collecting bycatch information through observers aboard fishing vessels. One of the major differences between these two alternatives is that one is voluntary and the other, mandatory. Noting the fact that it would be impractical to put observers on all vessels, sampling may have to be done. Within this context, the mandatory program is more desirable than the voluntary one insofar as it affords more flexibility in defining statistically valid sampling frame. The downside of a mandatory program, as mentioned elsewhere, is that fishermen's cooperation may be so low as to render questionable the validity of the collected information. This problem may be addressed only if there is enough pressure coming from industry associations and/or there are economic incentives provided to the sampled vessels. These incentives could be in the form of direct monetary or non-monetary awards to the participating vessels or in form of some believable benefits that participants can expect from better management of the fishery. At this stage, it is not possible to conclude one way or the other, except to point out that both mandatory and voluntary observer programs have been tried in some fisheries. The observer program in Alaska to monitor bycatch is mandatory and funded mainly by the industry. In the Gulf of Mexico, the limited observer program in the shrimp fishery has been conducted under an essentially voluntary program and funded in large part by the government.

While an observer program offers the better approach to generating bycatch information, it is also more expensive to administer. The Alaska program carries a cost of about $8 million a year. The most recent experience in the Gulf of Mexico designed to evaluate BRDs cost NMFS as much as $1.8 million, and this program was designed to cover only approximately 100 vessels over a period of 5 months. The large cost involved is definitely the major obstacle to conducting an observer program.

Environmental Consequences:

Human Environment: The alternatives will create a reporting burden on those persons selected by NMFS to report. Likely this will be a random sample of the participants from only some of the Gulf fisheries each year. The actual cost of observers, if used at all, will probably be born by the federal government rather than the vessels, since that is currently the case for all fisheries, other than those in the North Pacific region; however, other costs and burdens on the selected vessels would be expected for quartering and allowing access to catch, gear, communications, and other facilities and records.

Fishery Resources: Although the measures will have no direct impact on the fishery resources managed by the Council, the information collected on regulatory and economic discards may result in actions that do have a beneficial impact.

Other Fishery Resources: The information collected on bycatch of other fishery resources may result in actions that have a beneficial impact for some stocks.

7.3 Measures to Minimize Bycatch and/or Bycatch Mortality

The SFA added National Standard 9 to the M-MSFCMA addressing bycatch. This standard provides that “conservation and management measures shall, to the extent practicable, (A) minimize bycatch, and (B) to the extent that bycatch cannot be avoided, minimize the mortality of such bycatch.” Section 303(a)(11) restates National Standard 9 as a required provision of FMPs and indicates that a higher priority should be placed on minimizing bycatch than on minimizing the mortality of bycatch that cannot be avoided.

This section contains management alternatives to reduce bycatch in the stone crab fishery.

7.3.1 Shrimp Fishery Bycatch

The Council elected to proceed as quickly as possible to prepare an amendment to the Shrimp FMP that will address collection of bycatch data and possibly reduction of bycatch in other unregulated areas of the Gulf. The Council proposes to complete the draft amendment by July 1999, and to submit it to NMFS within 1999. This has a major advantage in that a great deal of additional information on bycatch characterization has become available during the period in which this generic amendment was being developed. This should result in additional and more reliable information to assess the bycatch and for development of alternatives for reducing bycatch. Therefore, this amendment does not contain alternatives for that purpose.

7.3.2 Stone Crab Fishery

As indicated in Section 7.1, wooden and plastic stone crab traps take very little bycatch, probably less than spiny lobster traps. However, as also noted in that section, some of the wire traps being used in the fishery in the Big Bend area of Florida appear to be designed to also capture finfish, predominantly sea bass and grunts. The Stone Crab FMP regulations require degradeable panels in traps, but do not describe the construction characteristics of legal traps used in the EEZ. This omission creates a potential for persons to use wire stone crab traps to circumvent the Council's moratorium on and phase-out of the fish trap fishery. The FMFC has promulgated rules within the last two years to specify construction characteristics of stone crab traps that would prevent this from happening in state waters and minimize finfish bycatch in wire stone crab traps.

Proposed Alternative: Adopt in the Stone Crab FMP the construction characteristics of stone crab traps set forth in Chapter 46 - 13.002(2)(a) of Florida law.

Rejected Alternative: Status Quo - no action.

Discussion: Typically, most stone crab fishermen use a trap design that they feel is most effective for harvesting stone crabs, and the traps are usually smaller than the maximum size specified by the state. Most of these traps are constructed of wooden or plastic lath material and have the funnels located in the top. In the development of the state rule, the FMFC was advised by FDEP scientists that the size, configuration, and location of the funnel regulates the egress of finfish into the traps, as does the size of the traps. All of these characteristics are addressed in the state rule that is appended to this amendment as Appendix A. The principal changes affecting finfish catch by wire stone crab traps are to require that the funnel entrance (throat) be horizontally-oriented and limit its size.

Adoption of the Proposed Alternative will probably have little effect on stone crab fishermen because most fish in both state and federal waters and are likely in compliance with the Florida rule. The only likely effect would be on the few fishermen that are targeting both stone crab and finfish with wire traps that have one or more vertically-oriented throats (funnels). Adoption of Alternative 1 would allow this practice to continue in the EEZ.

<u>Biological Impacts</u>: The Proposed Alternative would minimize the bycatch of finfish in stone crab traps to the extent practicable. Whether it would have a positive biological impact is not known, because the condition of the stocks of grunts and sea basses is not known.

<u>Economic Impacts</u>: The Proposed Alternative would affect those fishermen who target or catch both stone crabs and finfish (mostly grunts and black sea bass) using the same traps. Finfish caught by these vessels using gear types other than traps remain unaffected. Waters (1996) reported that the number of reef fish vessels engaged in stone crab fishing ranges from 69 in May to 114 in November. In their stone crab trips, high-volume vessels generated 81 percent of their revenue from stone crabs and the rest from other species while low-volume vessels earned 93 percent of their revenue from stone crabs and the rest from other species. It is not known how much of the revenues from other species were from species caught in traps or how many vessels earn part of their revenues from other species caught in traps. Nonetheless, it is quite safe to surmise that, on a per vessel basis, the adverse revenue impact of the Proposed Alternative would be relatively small. The proposed change may be expected to increase the fixed costs of the vessels affected, although such costs would be mainly a one-time expense.

One other important effect of the Proposed Alternative is that it would render fairly consistent the EEZ rules with those of the state with respect to stone crab trap specifications. To some extent, this would help in the enforcement of fish trap rules in both state and federal waters. Insofar as finfish catches in stone crab traps are minimized, occurrences of finfish exhibiting trap rash may be reduced. This condition would help in avoiding potential violations of the recent rule proposed under Reef Fish Amendment 16A regarding finfish exhibiting trap rash.

Environmental Consequences:

Human Environment: The proposed action would likely have adverse impacts on persons fishing stone crab traps that have been modified to catch more finfish by reducing their income from that source. It will probably not impact persons targeting stone crab.

Fishery Resources: The proposed action likely will have no adverse impact on the stone crab resource.

Other Fishery Resources: The Proposed Alternative will reduce bycatch; however, data are not available to assess the impact on stocks of grunts, sea basses, or other fishes, all of which can be legally harvested.

7.3.3 Finfish Regulatory Discards

In the preliminary draft of this amendment, the Council included sections with alternatives for reducing regulatory discards of red grouper and red snapper. The regulatory discards of finfish are high for some stocks, e.g., more than 80 percent for gag and red grouper (Tables 5 and 6). The Council felt that actions addressing reduction in regulatory discard mortality (see Table 12) are more appropriate when taken under the framework measure for specifying TAC at the time the stock assessment is available. The Council took such action in November 1998 for red snapper through a regulatory amendment proposing the size limit be reduced and will consider such action for red grouper in 1999 when the assessment for that stock is available. Therefore, these sections were deleted from this document.

The alternatives were to reduce the minimum size limit for red snapper taken by the commercial sector to 13 or 14 inches TL and to reduce the minimum size limit for red grouper to 18 inches TL for the commercial sector, or for both the commercial and recreational sectors. The alternatives were based on data in the preliminary draft amendment which indicated that release mortality was likely much higher than the levels assumed for stock assessment purposes, and the size limits were likely adversely affecting the stocks. Approval by NMFS of the regulatory amendment proposing a 14-inch TL minimum size limit for the red snapper commercial sector is currently pending. The Council will submit a regulatory amendment specifying TAC and other measures for red grouper in December 1999. The Council will take final action on a regulatory amendment for gag in March 1999.

8.0 OVERFISHING CRITERIA AND REBUILDING PERIODS FOR STOCKS

This section addresses Section 303(a)(10) that was added to the M-MSFCMA by the SFA. Section 303(a)(10) reads as follows:

> (10) 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) and, 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;

These overfishing criteria and rebuilding periods are to be based on the final National Standard Guidelines promulgated under 50 CFR 600.310 for National Standard 1, which addresses OY and overfishing. The proposed criteria specified in this amendment will, after public hearings and Council approval, be subject to review, approval/disapproval, and implementation by NMFS and the Department of Commerce (DOC). After approval and implementation, they will become the basis for actions under Section 304(e), Rebuilding Overfished Fisheries, as well as the basis for attaining OY and preventing overfishing through specification of TAC and other management measures.

Under Section 304(e), the Secretary will use the criteria approved in this amendment as the basis for determining the status of each fishery within the FMPs as to whether the stocks are overfished or approaching a condition of being overfished within two years. The Secretary will report annually to the Congress and to the Councils on the status of the fisheries. The Secretary will also immediately notify the appropriate Council at any time he/she determines a fishery is overfished. Upon such notice, annually or in the interim, the Council must, within one year, prepare an amendment to end or prevent overfishing within a rebuilding period acceptable to the Secretary. If the Council does not submit the amendment to the Secretary within a one-year period, the Secretary will prepare the amendment. Further, the Secretary will review the progress toward ending overfishing and rebuilding affected stocks as established under the amendment, at intervals not to exceed two years. If progress is inadequate, the Secretary will notify the Council and recommend changes to the management measures to achieve adequate progress.

In addition to being the vehicle for implementing new criteria based on the revision to the National Standard Guidelines, this amendment will also specify management measures and rebuilding periods for arresting overfishing based on current criteria in the FMPs for some stocks classified as overfished by NMFS (1997 and 1998) in its reports to Congress (see Table 13).

Use of Spawning Potential Ratio (SPR) as Overfishing Criteria:

The SPRs used in the document are based on the methodology used in computations from the most recent stock assessment. (See the sections on current status of stocks.)

As pointed out by Mace et al. (1996), SPR has been used as a standard for assessing whether stocks were overfished and whether overfishing was occurring for many years. SPR has also been used to express management targets such as OY since the SPR levels can be readily computed. The National Standard Guidelines suggest SPR could be used as a proxy for MSY.

Spawning potential ratio is an index of a population's health as measured by the biological ability of the adult fish to produce spawn or eggs. A particular estimated level of SPR is directly dependent on the estimated number of living adult fish (or females), and their longevity or number at age, which is controlled by the prevailing fishing mortality exerted on the population. This biological spawning ability can be measured in terms of total adult fish biomass (number alive x average weight), gonad biomass (number alive x average gonad weight), or eggs produced (number alive x average number of eggs spawned) for each age class of fish.

A generation of fish in a population must on average produce the same number of adult fish in the next generation for a population to persist without decline or, in other words, be in equilibrium. All populations of animals attempt to attain levels of equilibrium, however environmental fluctuations prevent this from happening in most cases. Fishing reduces the number of adults surviving from a given number of recruits by reducing their life expectancy. To prevent population collapse the egg to recruit survival probability and/or the fecundities of the survivors must rise in response to the fishing induced lowered abundance of adults (Goodyear 1989). Clearly, the above population mechanisms allow a population to be harvested without damaging its biological potential. However, as harvest pressure grows (fishing mortality increases), a point is reached where the population loses more fish through harvesting than it can replenish, and overfishing occurs. A population can also exist at an equilibrium level below its optimum level and can increase in size if fishing mortality is reduced.

Various measures of optimal fishing have been defined whereby fishing greater than the optimal level results in overfishing. The concepts of MSY and maximum yield per recruit (YPR) are the two most common measures of optimal fishing. For reasons set forth in Amendment 1, the measure of optimal fishing for reef fish was chosen to be 20 percent SPR, which in a YPR context results in management advice similar to that needed to achieve maximum YPR.

Calculation of SPR is similar to calculation of YPR, except, instead of attempting to maximize yield from a year class of fish, achieving a certain level of spawning potential is attempted. This spawning potential is estimated as the fraction or ratio of spawning ability of the species when being fished divided by the spawning ability of the species under conditions of no fishing mortality; i.e., only natural mortality occurs. The SPR of a population is then controlled by the fishing mortality exerted on each age class of fish.

The SPR estimate can be calculated as either a *transitional* or *static* SPR:

Transitional SPR is used to determine if a stock is currently in an overfished status. It provides information about the status of the stock at a point in time, but it does not provide any indication of whether a stock is declining, recovering, or remaining stable.

Static SPR is used to determine if a stock is being fished at a rate that will eventually lead to an overfished status. When a stock is in the process of declining or recovering, this is the level at which a stock will eventually stabilize if the fishing rate remains at its current level.

Under Section 8.0, the following sub-sections are included for each fishery:

- **Current Status of Stocks**
- **Maximum Sustainable Yield (MSY)**
- **Optimum Yield (OY)**
- **Overfishing Criteria**
- **Rebuilding Period (if applicable to stocks)**

The language of the SFA and the National Standard Guidelines relating to the above parameters is stated below. In the draft amendment, this language had been repeated in the sections for each fishery and has been subsequently deleted from those sections.

Maximum Sustainable Yield (MSY)

MSY serves as a maximum limit on harvest which cannot be exceeded.

The final guidelines for National Standard 1, which serve as interpretive rule for the SFA, state that each stock should have a MSY. However, where this is not possible in a mixed stock fishery, then MSY could be specified on the basis of one or more species as an indicator for the mixed stocks as a whole. The guidelines indicate that when data are insufficient to estimate MSY directly the Councils can use other measures of productive capacity as proxies for MSY, such as relative spawning per recruit. Such proxies might be based on levels of SPR or SSBR, etc. NMFS suggested that a range of spawning per recruit of 30 to 40 percent of the long-term average that would exist in the absence of fishing would be a reasonable proxy for the MSY fishing mortality rate. The SAFMC (1998) suggested that 30 percent SPR may be reasonable for short-lived stocks and 40 percent for long-lived stocks. The reef fish complex also includes fish (e.g., gag) that change sex as they age or get larger, or possibly even based on social behavior factors, e.g., too few males in the spawning aggregations or groups. This may affect the level of SPR that should be selected for MSY, OY, and overfishing thresholds. The SAFMC (1998) considered whether for such species SPR or SSBR ratios should be based on the biomass of both male and female fish, as suggested by Huntsman and Schaaf (1994).

The final guidelines define MSY 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. The "MSY control rule" means a harvest strategy which if implemented would be expected to result in a long-term average catch approximating MSY. The "MSY stock size" means 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 a MSY control rule in which the fishing mortality rate (F) is constant. Examples of MSY control rules are (1) allowing a constant catch each year; (2) removing a constant fraction of the biomass each year; and (3) allowing a constant escapement each year, where these are chosen to maximize the resulting long-term average yield. In any MSY control rule, a given stock size is associated with a given level of fishing mortality and a given level potential harvest, where the long-term average of these potential harvests provides an estimate of MSY.

Optimum Yield (OY)

OY serves as the management target limiting harvest to a level less than MSY.

The SFA modified the definition of OY to provide that it be prescribed on the basis of MSY as reduced by any relevant economic, social, or ecological factor. Previously OY could be set to result in a production level higher than MSY if there was adequate supporting rationale based on the relevant economic, social, or ecological factors. Under the amended language, OY, if expressed as numbers or weight of fish (or some proxy thereof), can be set only equal to or less than MSY. The final guidelines for National Standard 1 provide OY could be specified as a range or a single value, but specification of a numerical fixed value does not preclude the use of annual target harvest levels (TAC) that vary with stock size. OY should be translatable into an annual numerical estimate. Under a precautionary approach, the fishing mortality rate at OY would be set at a level less than the fishing mortality rate for MSY. That means if SPR levels are used as proxies for MSY and OY, the SPR for OY would be higher than that for MSY.

OY control rules may be specified similar to the MSY control rules, but they are designed to achieve OY rather than MSY. All fishing mortality must be counted against OY, including that from bycatch and fishery research. OY does not constitute an absolute ceiling, but rather a desired result. Exceeding OY does not necessarily constitute overfishing, but exceeding OY on a continual basis would violate National Standard 1. The FMP must specify how OY was determined.

Overfishing Criteria

The SFA and final guidelines for National Standard 1 define overfish to mean fishing at a rate or level that jeopardizes the capacity of the stock or stock complex to produce MSY on a continuing basis. 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. To avoid confusion, the guidelines use overfished only in the sense of describing a stock or stock complex whose size is sufficiently small that a change in management practices is required in order to achieve an appropriate level and rate of rebuilding.

The guidelines provide that each FMP must specify, to the extent possible, objective and measurable status determination criteria for each stock or stock complex and provide an analysis of how the criteria were chosen and how they relate to reproductive potential. The guidelines provide the status determination criteria must have both a maximum fishing mortality threshold (MFMT) or reasonable proxy thereof, and a minimum stock size threshold (MSST) or reasonable proxy thereof.

The maximum fishing mortality threshold may be expressed as a number or function of spawning biomass or other measure of productive capacity, but must not exceed the mortality rate associated with the relevant MSY control rule. Exceeding the fishing mortality rate for one year constitutes overfishing.

The minimum stock size threshold should be expressed in terms of spawning biomass or other productive capacity. To the extent possible the stock size threshold should equal whichever of the following is greater: one-half MSY stock size or minimum stock size at which rebuilding to MSY would be expected to occur within 10 years if the stock were exploited at the maximum fishing mortality threshold. Exceeding this threshold is considered overfishing. If NMFS determines that either of the thresholds will be reached within 2 years, it will notify the Council to take action to arrest overfishing.

Both of the status determination criteria can be expressed as a function of spawning biomass; therefore, it would appear that both could be expressed as SPR or SSBR levels.

Rebuilding Periods

The SFA added Section 304(e) on rebuilding of overfished stocks. The National Standard Guidelines addressing this section provide that the Secretary will immediately notify a Council to take remedial action when the Secretary determines that:

(1) overfishing is occurring;

(2) a stock or stock complex is overfished;

(3) the rate of fishing mortality for a stock is approaching the maximum fishing mortality threshold;

(4) a stock or stock complex is approaching its minimum stock size threshold; or,

(5) existing remedial action taken for ending overfishing or rebuilding a stock has not resulted in adequate progress.

After notification, the Council must submit to the Secretary within one year remedial action via amendment or rule (regulatory amendment) that will:

(1) end overfishing;

(2) rebuild the stock to a MSY level within an appropriate time frame;

(3) prevent the maximum fishing mortality threshold from being reached; or,

(4) prevent the minimum stock size threshold from being reached.

Where a stock is overfished, the Council action must specify a time period for rebuilding the stock that satisfies the requirements of SFA Section 304(e)(4)(A) which provides that the period shall:

(1) 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

(2) not exceed 10 years, except in cases where the biology of the stock of fish, environmental conditions, or management measures under an international agreement in which the United States participates dictate otherwise.

The guidelines provide that the time period for rebuilding be specified as follows: (1) the lower limit is determined by the status and biology of the stock and its interaction with the ecosystem, and is defined as the amount of time required for rebuilding if fishering mortality were eliminated entirely; (2) if the lower limit is less than 10 years then the rebuilding period may be adjusted upward to the extent warranted to address the needs of fishing communities, except no upward adjustment can exceed 10 years; (3) if the lower limit is 10 years or greater then the rebuilding period can be adjusted upward to address the needs of fishing communities, but cannot exceed the period calculated in the absence of fishing mortality (i.e., lower limit) plus one mean generation time or equivalent period based on the species life history characteristics.

The guidelines provide that a rebuilding program undertaken after May 1, 1998 commences when measures to rebuild the stock are implemented. Rebuilding plans in place before that date will be reviewed to determine if they are in compliance.

8.1 REEF FISH

The Reef Fish FMP, implemented in 1984, includes 14 species of snappers, 15 species of groupers, 4 species of amberjacks, as well as tilefishes, triggerfish, and hogfish. Red snapper and greater amberjack are managed as separate stocks. Groupers are managed as separate shallow-water and deep-water species-complexes. Aggregate bag limits, and in some instances size limits, apply to most of the other stocks. Many of the species are incidental (not targeted) catch in the directed fisheries for red snapper, groupers, and greater amberjack.

Fish managed under the FMP include the following species:

Snappers - Lutjanidae Family

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

Groupers - Serranidae Family

Rock hind	Epinephelus adscensionis
Speckled hind	Epinephelus drummondhayi
Yellowedge grouper	Epinephelus flavolimbatus
Red hind	Epinephelus guttatus
Jewfish	Epinephelus itajara
Red grouper	Epinephelus morio
Misty grouper	Epinephelus mystacinus
Warsaw grouper	Epinephelus nigritus
Snowy grouper	Epinephelus niveatus

Nassau grouper	Epinephelus striatus
Black grouper	Mycteroperca bonaci
Yellowmouth grouper	Mycteroperca interstitialis
Gag	Mycteroperca microlepis
Scamp	Mycteroperca phenax
Yellowfin grouper	Mycteroperca venenosa

Tilefishes - Malacanthidae (Branchiostegidae) Family

Goldface tilefish	Caulolatilus chrysops
Blackline tilefish	Caulolatilus cyanops
Anchor tilefish	Caulolatilus intermedius
Blueline tilefish	Caulolatilus microps
Tilefish	Lopholatilus chamaeleonticeps

Jacks - Carangidae Family

Greater amberjack	Seriola dumerili
Lesser amberjack	Seriola fasciata
Almaco jack	Seriola rivoliana
Banded rudderfish	Seriola zonata

Triggerfishes - Balistidae Family

Gray triggerfish	Balistes capriscus

Wrasses - Labridae Family

Hogfish	Lachnolaimus maximus

Sand Perches - Serranidae Family

Dwarf sand perch	Diplectrum bivittatum
Sand perch	Diplectrum formosam

8.1.1 Current Status of Stocks

Table 13 summarizes the current status of the stocks based on the current criteria for overfishing in the FMP, as amended.

Red snapper are seriously overfished with the most current estimate of transitional SPR at 0.5 percent (as compared to the overfishing threshold of 20 percent SPR). When the RFSAP used a value of M = 0.2 for natural mortality, the SPR value was about 4 percent. Based on additional information, the RFSAP (October 1995) concluded that the best estimate of M was 0.1, which caused the numerical value of SPR to decline to 0.4 percent, and the rebuilding period to extend to 2019 (from 2010), based on the Goodyear (1995) analysis.

Based on the NMFS stock assessment by Goodyear (1988), the Council concluded that the red snapper stock was seriously overfished and that shrimp trawl bycatch mortality was contributing to that condition. Amendment 1 (GMFMC 1989) placed severe harvest restrictions on the directed fishery, that continued as TAC was specified annually. Shrimp Amendment 9 (GMFMC 1997) required the use of BRDs in trawls, effective May 14, 1998, to reduce mortality of juvenile red snapper. Based on these actions and the assumption of a 60 percent reduction in bycatch by the year 2001, the Council concluded that the 20 percent transitional SPR level would be achieved by 2019 (GMFMC 1998).

In 1997, based on Schirripa (1996), NMFS concluded that the vermilion snapper stock would approach an overfished state within the next two years without additional regulations (Table 13). Based on a new stock assessment (Schirripa 1998) that incorporated previously unavailable recruitment data, and the recommendations of the RFSAP (August 1998), the Council concluded that the vermilion snapper stocks are stable or improving under current harvest levels, and that harvest levels will be in the range of 2.2 to 2.5 MP in 1999, which is consistent with a fishing mortality rate corresponding to a static SPR of 30 percent. The RFSAP noted that the two previous stock assessments (Schirripa 1992 and 1996) ascribed the increase in landings in 1990-1993 to increased effort, whereas the current assessment (Schirripa 1998) ascribed the increase in landings to a strong 1991 year class. The RFSAP (August 1998) noted that as this year class grew out of the fishery the stock size and landings will return to historic levels.

Based on the assessment by McClellan and Cummings (1996), the RFSAP concluded that the transitional SPR was 34 to 36 percent for greater amberjack. The Council, by amendment, had reduced the recreational bag limit to one fish (GMFMC 1995) and closed the commercial season for three months: March, April, and May (GMFMC 1997). These actions are anticipated to stabilize the greater amberjack stocks (Table 13). The Council also asked NMFS to prepare a new stock assessment for greater amberjack by October 1998, if the personnel resources were available to do so. (Note: NMFS was not able to comply with this request; however, a new assessment is expected in the near future.)

Based on the assessment by Schirripa and Goodyear (1994), the RFSAP concluded that for gag the SPR level was about 30 percent. Stock assessment results indicated that the highest fishing mortality for 1992 was 0.21 for age 5 fish (assuming M = 0.20). With available information on growth and natural mortality, the biological reference point, $F_{0.1}$ was estimated to be 0.17. The static SPR, assuming a 30 percent release mortality among undersized fish, was estimated to be 30 percent in 1992.

These results, coupled with CPUE trends which were characterized as stable, indicated that the fishery was probably not overfishing gag stocks. [The median fishing mortality rate based on the existing stock-recruitment estimates suggested that fishing mortality rates much lower than either $F_{30\%}$ or $F_{20\%}$ were needed for stock replacement (Mace et al. 1996); however, there were too few data to draw useful conclusions.] A more recent assessment by Schirripa and Legault (1997) suggested that the SPR for the stock is well below 30 percent, depending on the rate of release mortality assumed for discarded fish (see Section 7.3.3.1). The RFSAP (August 1998) determined that the static SPR ranged between 18 and 23 percent depending on which model was used. They also expressed concern over the practice of fishing on the spawning aggregation and that the minimum size was below the size at maturity. Some members of the RFSAP expressed concern about a reduction in the proportion of males in the population in recent years and possible implications for future spawning success for this hermaphroditic species, which begins life as a female, and then transitions to a male. The Council will be holding public hearings on a regulatory amendment that proposes spawning season closures, areal closures of aggregation sites, and an increase in minimum size to 24 inches TL.

Based on the assessment by Goodyear and Schirripa (1993) and subsequent analyses by Goodyear (1994a), the RFSAP concluded that current SPR levels for red grouper could not be calculated due to the discovery of bias in the growth data resulting from the combination of length-stratified sampling and the introduction of a minimum size limit in 1990. However, such bias could be corrected in the data collected prior to the minimum size limit regulation. Using pooled data from 1986 - 1989, Goodyear (1994a) found that the average transitional SPR during those years was between 20 percent and 52 percent. Goodyear and Schirripa (1993) concluded that the maximum yield-per-recruit could be obtained with a minimum size limit of 17 inches TL (Goodyear and Schirripa, 1993, also calculated that a 14-inch TL size limit would produce maximum yield-per-recruit when the most recent data and growth models were used, but that result was invalidated by the discovery of bias in the post-1990 growth data). The RFSAP felt that the SPR level since 1990 should be higher since the 20-inch TL minimum size limit is above the minimum size producing maximum yield-per-recruit, and those extra fish are probably remaining in the population and reproducing (Table 13). However, Goodyear and Schirripa (1993) noted that if release mortality exceeds 33 percent, then the conservation effect on the spawning stock could be enhanced by lowering the minimum size. Section 7.3.3.1 raises questions whether the release mortality may have prohibited the stock from recovering since the 20-inch TL minimum size limit was implemented. **Mace et al. (1996) concluded that a 20 percent SPR threshold for red grouper seems reasonable based on: (1) the life history of red grouper (protogynous hermaphrodites) which probably increases their resilience; (2) the steady historical landings of red grouper; and (3) the estimates of transitional SPR prior to the change in minimum size. It should be noted, however, that the**

question of whether hermaphroditic species are more or less resilient is heavily disputed in the scientific community, and no consensus currently exists.

Based on largely anecdotal information on the status of the jewfish stock, the Council prohibited harvest or possession of jewfish (GMFMC 1990). For consistency with the SAFMC and Caribbean Fishery Management Council (CFMC), the Council prohibited the harvest or possession of Nassau grouper in 1997 (GMFMC 1996). Both of these stocks were considered for designation as threatened species under the Endangered Species Act (ESA) by NMFS (1997, 62 FR 37560). Rebuilding periods for these stocks cannot be specified in this amendment.

8.1.2 Maximum Sustainable Yield (MSY)

The MSY in the Reef Fish FMP (1981) was computed for the entire reef fish complex using a Graham-Schaefer stock production model that yielded an estimate of 51 million pounds. No attempt was made to compute MSYs for individual stocks because the effort data could not be separated by stock. At best, this was a crude estimate to satisfy the requirement for a MSY and was based on many unsubstantiated assumptions. The recreational landings data used in computing MSY were based on the 1965 and 1970 NMFS saltwater angling surveys, which were conducted as part of the national census and which surveyed approximately 1,500 households nationally. In the survey respondents asked to recall all the fish by species that they landed during the past year. These studies have been judged to have a recall bias that significantly inflated the landings values (GMFMC & GSMFC 1984). The effort data used in the computation with the expanded recreational landings were all assumed based on trends in commercial data. Needless to say, the MSY has served no purpose.

8.1.2.1 MSY Alternatives

Proposed Alternative 1: MSY is equivalent to 50 percent static SPR for the following stocks: Nassau grouper and jewfish.

Proposed Alternative 2: MSY is equivalent to 30 percent static SPR for all the reef fish stocks under Section 8.1 , except for red snapper, Nassau grouper, and jewfish.

Proposed Alternative 3: MSY is equivalent to 26 percent static SPR for red snapper.

Alternatives Considered and Rejected:

Alternative 1: MSY is initially set equivalent to 35 percent static SPR for gag, but reverts to 30 percent SPR upon implementation of any of the following: 1) a minimum size limit of 24 inches TL or greater; or 2) a spawning season closure that includes at least the two month period of February and March.

Alternative 2: MSY is equivalent to 35 percent static SPR for gag if no increased size limit and/or spawning season closure is implemented for the stock.

Alternative 3: MSY is equivalent to 30 percent static SPR for gag if an increased size limit and/or spawning season closure is implemented for the stock.

Alternative 4: MSY is equivalent to 5 to 20 percent static SPR for the stocks for which those levels are supported by scientific documentation.

Alternative 5: MSY is equivalent to 45 percent static SPR for the following stocks or stock complexes:

Alternative 6: MSY is equivalent to 40 percent static SPR for the following stocks or stock complexes:

Alternative 7: Status quo - retain current MSY estimate of 51 million pounds for the entire reef fish complex.

Discussion: The Council feels, based on the information available to it and on the recommendations of the SAPs, that SPR has been set at the appropriate level for each stock. The use of higher SPR levels would overestimate MSY and result in more restrictive management measures than are necessary. The use of lower SPR levels would underestimate MSY and not maintain the condition of the stock at the optimum level. The MSY fishing mortality rate (F_{MSY}) will be set at these levels. The use of SPR levels to specify proxies for MSY, OY, and overfishing definitions seem appropriate for the stocks of the reef fish complex (Mace et al. 1996). The first Finfish Stock Assessment Panel (FSAP) noted the following:

> The Council asked the first FSAP to consider whether SSBR or spawning stock biomass is more appropriate than the use of SPR to gage stock status. The FSAP (July 1998) assumed that the Council was requesting guidance as to the most appropriate measure of a stocks

ability to replenish itself over time. First, the FSAP clarified that SPR is simply a general term that refers to the proportion of a spawning stock remaining under fished conditions to that of an unfished stock. Ideally annual egg production should be used in the calculation of SPR. However, egg production is not always available and biomass of mature females is used as a proxy. The use of biomass in the calculation of SPR was historically referred to as SSBR. Currently, either the use of eggs or biomass is referred to as SPR.

At this time, the first FSAP did not recommend one method over another. They felt it should be the purview of the stock assessment panels to decide the best method used based upon the available data. However, they suggested that if the Council wishes to adopt a method that best reflects management measures imposed, the use of SPR is the appropriate measure to use.

The first FSAP (July 1998) suggested that for species with natural mortality rate/von Bertalanffy growth coefficient (M/K) <1.0, e.g., red drum, red snapper, greater amberjack, the SPR at $F_{30\%SPR}$ probably is a good proxy for SPR at F_{MSY}. However, for species with M/K ratios >1.0, e.g., vermilion snapper, king mackerel, Spanish mackerel, red grouper; fishing mortality rates corresponding to $F_{30\%SPR}$ may exceed F_{MSY} and, thus, the SPR proxies should be increased to values corresponding to SPR at $F_{35\%SPR}$. For those species where M/K >1.5, e.g., gag and white grunt, SPRs corresponding to $F_{40\%SPR}$ (or higher) may be the best proxies of SPR at F_{MSY} (see Table 14).

The second FSAP (August 1998), as well as many members of the first FSAP, did not agree that the M/K ratio was useful as a scalar for determining resilience because of variability observed in estimates of M and K. They indicated that in general longer-lived species that mature at an early age relative to their life-span are perceived to be relatively more resistant to overfishing than shorter-lived species with few spawning year classes. That is because species with numerous year-classes can still maintain themselves if several of those year-classes are lost or reduced. Whereas the panel defined resilience as the ability of a stock to recover from an overfished condition. Long-lived species although resistant to overfishing are slow to recover once they have become overfished because of the large numbers of age-classes that must be rebuilt and thus generally have a lower resiliency. Conversely, short-lived species with very high fecundity may be able to recover quickly from an overfished condition. The panel cautioned that the above are generalizations and may not be applicable in all situations.

The second FSAP (August 1998) recommended the Council establish a MSY proxy of 40 to 60 percent static SPR for jewfish and Nassau grouper for the following reasons:

> Jewfish and Nassau grouper species have been fully protected by the Gulf Council with ABCs at zero harvest. These fisheries were closed due to concerns that they were especially susceptible to overfishing because their populations were small in size and at depressed levels as the result of fishermen being able to easily find and target large sedentary individuals, as well as, spawning aggregations. These species are, therefore, generally believed to be neither very resistant nor resilient to overfishing.

The second FSAP had the following recommendations for gag:

> Stock assessments for gag have been available since 1994. It is currently estimated the gag population is at a transitional SPR level of 21 percent being prosecuted at a fishing mortality rate between 18 to 23 percent SPR (FSAP July 1998). The panel noted that concern existed about the lack of resistance of gag to overfishing because it forms large spawning aggregations that are easily targeted by fishermen. Some biologists fear that the decreasing percentage of males in the population during the past two decades may be negatively impacting reproductive productivity.
>
> The data are not available to estimate MSY or B_{MSY} directly and the only available recruitment index represents too short a time series for use in estimating MSY or B_{MSY}. Therefore, the best available MSY proxy is SPR. The panel recommends that the MSY SPR proxy should be 35 to 40 percent if no action is taken by the Gulf Council to further protect mature fish through an increased size limit and/or a spawning season closure when they are aggregated. However, if protection of spawning fish is implemented, then the panel believes a MSY SPR proxy of 30 percent is appropriate for the gag population because specific protection of the mature stock improves the population’s resistance to overfishing. Although two scenarios for MSY proxies are presented, the panel feels that the preferred scenario should be the one that protects mature fish and spawning aggregations through an increased size limit and spawning season closure.

The Council will take a regulatory amendment for specifying TAC for gag to public hearings with proposals for seasonal closures, spawning aggregation areal closures, and increasing the minimum size limit up to 24 inches TL. Final action will be taken on the regulatory amendment when final action is taken on this amendment.

The panel recommended that the MSY proxy for red snapper be set at 30 percent static SPR. Scientists employed by Texas Shrimp Association presented analyses for red snapper that used the relationships in Mace and Sissenwine (1993), and suggested that the SPR levels should be less than 20 percent. Those analyses were reviewed by the RFSAP and independent scientists.

The RFSAP (1998) found that the analyses by Gazey and Gallaway (1998) calculated maximum excess recruits (MER) rather than MSY. At low stock levels, a higher survival rate of recruits per spawner may occur due to a lack of density-dependent mortality. While this is beneficial to recovery of the stock, it does not correspond to the MSY level. Nevertheless, the RFSAP felt that attaining the MER level over a five year time period could be an appropriate intermediate step en route to the ultimate target of MSY.

The RFSAP (1998a) recommended that the MSY proxy be set at 26 to 30 percent static SPR. Mace (Personal Communication to Dr. Kemmerer, 11/9/98) indicated the 26 percent static SPR level was an appropriate level for red snapper. The Council, therefore, set the MSY proxy at 26 percent SPR for red snapper.

The second FSAP also recommended the following default MSY proxy for other species:

> Based on the finding by Mace (1994) that, when the age of 50 percent maturity is less than the age of 50 percent recruitment to the fishery, $F_{35\%SPR}$ will generally exceed $F_{0.1}$, the panel recommends that the other Gulf finfish species under the jurisdiction of the Gulf Council be managed with an MSY and B_{MSY} SPR proxy level of 30 percent, provided there is a minimum size limit of at least the size at 50 percent maturity, unless certain life history characteristics or management strategies warrant a more precautionary approach.

There are currently 11 reef fish species with minimum size limits. Amendment 16B, which is pending implementation by NMFS, will include minimum size limits for 9 additional reef fish species. For some of the species usually caught from deeper waters a minimum size limit would serve no purpose as the fish are usually killed by embolism. These include the five species of tilefish, speckled hind, misty grouper, warsaw grouper, snowy grouper, and scamp in some geographical areas. From the available literature on fraction of females mature by size, which is limited, it appears all the snappers with minimum size limits, except Cubera snapper, reach the 50 percent maturity level. Red snapper, which has a minimum size limit of 15 inches TL, are 50 percent mature at 11.8 inches and 100 percent mature at 13.2 inches (Goodyear 1995, Figure 19). The other snappers with 12-inch limits are shorter-lived and faster growing. Eighty percent of vermilion snapper (size limit 10 inches TL) are mature at 8.3 inches (Hood and Johnson, 1999). The size limits for red grouper and yellowfin grouper, and the proposed size limit for gag are at the 50 percent maturity [Amendment (GMFMC 1989), Amendment 16B (GMFMC 1999), Gag Regulatory Amendment (GMFMC 1999)]. The proposed size limit for black grouper is below the size at 50 percent maturity, but is set at the same level as for gag because many fishermen cannot distinguish between the 2 species (GMFMC, 1999 Gag Regulatory Amendment). The commercial size limit for greater amberjack of 36 inches should be near or above the 50 percent maturity level, while the recreational size limit of 28 inches is below the size at first maturity (32 inches). The proposed minimum size limit of 14 inches for lesser amberjack and banded rudderfish should be near or above the 50 percent maturity level as they live to reach only maximum sizes of 29 and 27 inches, respectively (GMFMC, Amendment 16B, 1999). Gray triggerfish (size limit 12 inches) reach 91 percent maturity at about 10 inches (Harper and McClellan, 1997; Hood and Johnson, 1997).

Biological Impacts: The current prohibition on harvest and possession and the higher standard for MSY (50 percent SPR) should have a beneficial effect on the stocks of jewfish and Nassau grouper by allowing them to be restored to a much higher biomass in the Gulf area. The MSY proxy and F_{MSY} of 30 percent static SPR basically results in raising the overfishing threshold from 20 to 30 percent for the other reef fish stocks which should have a long-term beneficial effect. The MSY proxy of 26 percent static SPR for red snapper represents a precautionary level for that stock. The higher default alternative for gag of 35 percent SPR would be implemented only if the Council does not take action to increase the minimum size limit or reduce fishing pressure on the spawning aggregations as expected.

Economic Impacts: The specification of MSY has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. Pending more concrete measures designed to achieve or maintain an MSY level, it is only instructive to note some of the general economic implications of specifying MSY in terms of SPR.

First, all alternatives (except Alternative 7) specify MSY in terms of a single SPR level or a range of SPR levels. This specification of MSY has strong biological rationale, as discussed elsewhere, but its economic significance is somewhat indeterminate. The important economic specification of MSY is in terms of poundage of harvestable stock. Understandably, this particular specification is not possible for most of the reef fish stocks due mainly to the absence of a reasonably estimated stock-recruit curve. In the case of red snapper for example, all the known data points of recruitment are scattered over a narrow range of stock levels in a heavily exploited stock. Unless a yield level is specified corresponding to the chosen SPR proxy for MSY, economic values associated with any chosen MSY cannot be determined. It goes without saying that any yield level also has to be translated into economic terms via some estimated functions that describe the underlying economic relationships within and between the commercial and recreational sectors of the subject fisheries, including the bycatch fisheries.

Second, while there is good biological basis to assume that the higher the SPR level is specified to correspond to MSY, the more likely it would represent the long-term sustainability of the stock. However, a higher SPR level does not always correspond to higher level of poundage that would be available for harvest. Goodyear (1994) has shown that a narrow range of SPR levels could correspond to a very wide range of harvest yields, depending on fishing selectivities. This condition only complicates the determination of net economic benefits over a long period of time. Consider the following scenario. At a higher the SPR level specified to correspond to MSY, more restrictive short-term measures would be imposed. A necessary condition for such measures to be economically justified is a larger harvest yield in the future. Without assurance that a higher SPR level corresponds to higher harvest yield in the future, the possibility exists that net economic results could be negative despite achieving a high SPR level.

<u>Environmental Consequences</u>:

Human Resources: The elevation of the overfishing criteria to a higher level based on the new proxies for MSY may, in the short-term, result in some additional stocks being classified as overfished and the necessity to reduce harvest levels. However, these restrictions should be of rather short duration and, in the long-term, the harvest levels should be enhanced resulting in a positive benefit. For the stocks of jewfish and Nassau grouper the prohibition of harvest would be extended many additional years by the new standards. However, that has no immediate impact, in that harvest is currently prohibited.

Fishery Resources: The higher standards should benefit the reef fish stocks by maintaining the stock biomass at or above MSY.

Other Fishery Resources: The proposed actions likely will have a beneficial effect on other stocks.

8.1.3 Optimum Yield (OY)

The current statement of OY for the reef fish complex is as follows:

> *The primary objective and definition of OY for the Reef Fish Fishery Management Plan is to stabilize long-term population levels of all reef fish species by establishing a certain survival rate of biomass into the stock of spawning age to achieve at least 20 percent spawning potential ratio (SPR).*
>
> *OY can be achieved with annual TAC specifications for each species or species group. The Council has established a framework procedure to attain the management goal of OY where, on an annual basis, a scientific stock assessment panel will establish an acceptable biological catch (ABC) range and the Council will set a TAC and prescribe fishing restrictions (to attain the management goal of OY) for implementation by the Regional Director of NMFS prior to the beginning of a fishing year.*

This statement makes OY any level of SPR greater than that describing overfishing. The Council recognized that for restoration of stocks and preventing overfishing, OY should be specified at a more conservative level. Through Amendment 11 (GMFMC 1995), the Council proposed the following definition:

> *Set OY for each stock based on a SPR level corresponding to $F_{0.1}$ until an alternative operational definition that optimizes ecological, economic, and social benefits to the Nation has been developed by RFSAP, Socioeconomic Panel (SEP), Statistical and Scientific Committee (SSC), and AP and approved by the Council.*

The discussion in the amendment provided the following information:

> For the reef fish species for which stock assessments have been prepared, under current management conditions, SPR at $F_{0.1}$ is approximately 34 percent for red snapper, 46 percent for red grouper, and 48 percent for gag. The RFSAP has recommended using $F_{0.1}$ as a reference point for OY for fisheries that are not overfished (RFSAP 1993).

The NMFS disapproved the proposed OY definition and recommended that OY be defined as a fixed SPR above the overfished level of 20 percent.

The Council resubmitted Amendment 11 (GMFMC 1997) with a proposed definition that OY be set at a yield level that would result in at least a 30 percent SPR for that stock, with authority for the RFSAP to set the level higher than 30 percent SPR depending on the characteristics of the stock. The RFSAP had recommended a level of 35 percent SPR for reef fish.

The recommendations of the RFSAP from their report (1995) are as follows:

> Optimum Yield should be based on MSY as reduced by economic and social considerations. When OY, or the biological target of MSY, cannot be calculated reliably, as is generally the case, the Panel recommends that the Council also adopt the findings of the SPR Report which states that:
>
>> It is suggested that equilibrium (static) SPR levels in the range of 30-40 percent be used as surrogates for F_{MSY}. In general, the low end of the range should be used for resilient species and the high end for species that have low fecundity and/or are slow growing, late maturing, or long-lived. This range is based on values in the scientific literature that suggest $F_{35\%}$ as a reasonable surrogate for F_{MSY} over a wide range of life history characteristics.
>
> The RFSAP considers this to be sound advice based on the best available information. In addition, because it is likely that a stock will experience near maximum production at $F_{35\%}$ the Panel recommends that $F_{35\%}$ be adopted by the Council to be a good surrogate for F_{MSY} and/or F_{OY} until the Council has explicitly determined OY for a stock."

The NMFS disapproved the proposed definition based on a determination that those species that change sex may be less resilient to overfishing. The NMFS recommended that the OY definition should correspond with a 40 percent SPR.

8.1.3.1 OY Alternatives

Proposed Alternative 1: OY is equivalent to 50 percent static SPR for the following stocks: Nassau grouper and jewfish.

Proposed Alternative 2: OY is equivalent to 40 percent static SPR for all of the reef fish stocks under Section 8.1, except red snapper, Nassau grouper, and jewfish.

Proposed Alternative 3: OY is equivalent to 36 percent static SPR (i.e., SPR at $F_{0.1}$) for red snapper.

Alternatives Considered and Rejected:

Alternative 1: OY is initially set equivalent to 35 percent static SPR for gag, but reverts to 30 percent SPR upon implementation of any of the following: 1) a minimum size limit of 24 inches TL or greater; or 2) a spawning season closure that includes at least the two month period of February and March.

Alternative 2: OY is equivalent to 35 percent static SPR for gag if no increased size limit and/or spawning season closure is implemented for the stock.

Alternative 3: OY is equivalent to 30 percent static SPR for gag if an increased size limit and/or spawning season closure is implemented for the stock.

Alternative 4: OY is equivalent to 5 to 20 percent static SPR for stocks for which these levels are supported by scientific documentation.

Alternative 5: OY is equivalent to 45 percent (or higher) static SPR for the following stocks or stock complexes:

Alternative 6: OY is equivalent to 40 percent (or higher) static SPR for the following stocks or stock complexes:

Alternative 7: OY is set equivalent to MSY (in pounds) for the following stocks or stock complexes:

<u>Alternative 8</u>: Status quo - retain current statement of OY.

<u>Discussion</u>: OY must be set lower than or equal to MSY if specified as a harvest level or fishing mortality rate. In terms of SPR levels, OY would equate to a SPR higher than or equal to the SPR for MSY. It is not at all unusual for OY to be set at MSY since that is the largest long-term average yield that can be obtained from the stock. Under a precautionary or risk-adverse approach OY would be set lower (higher SPR) than MSY. OY becomes the target used for stocks for which a TAC is set to specify the ABC range and its probabilities of achieving OY. NOAA (1998), in its "Technical Guidance on the Use of Precautionary Approaches to Implementing National Standard 1 of the M-SFMCA," recommend using this risk averse approach to specifying OY and other parameters and thresholds. This is consistent with the United Nations FAO agreement on managing international stocks. The intended effect of such a precautionary approach is to err on the side of conservation in management of marine resources. The Council feels, based on the information available to it and on the recommendations of the SAPs, that SPR has been set at the appropriate level for each stock. The use of higher SPR levels would overestimate OY and result in more restrictive management measures than are necessary. The use of lower SPR levels would underestimate OY and not maintain the condition of the stock at the optimum level.

<u>Biological Impacts</u>: The Council opted to set OY at a much higher SPR level as a precautionary approach. For red snapper, the effect would be that as soon as the stock had been restored to the MSY level, the management target would shift to a harvest strategy at OY (i.e., a harvest level less than that at F_{MSY}).

In as much as the OY levels for the stocks were set higher than the MSY levels for those stocks, the biological impacts should be beneficial to the stocks.

<u>Economic Impacts</u>: The specification of OY has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. Pending more concrete measures designed to achieve or maintain an OY level, it is only instructive to note some of the economic implications of the alternatives for specifying OY.

First, the general discussions made regarding the specification of MSY in terms of SPR also apply here, since all alternatives specify an SPR level as OY

Second, the obvious feature of an OY that is absent in any of the alternatives above is the consideration of economic and social factors. Understandably, the biological component needs to be specified since the SFA currently defines OY relative to a biological MSY. However, a simple specification of OY in biological terms is totally deficient, especially when management measures are developed to achieve an OY level. Given this consideration, it is assumed that the specification of OY would be revised to incorporate economic and social factors as they become available.

Third, it is understood that both in the initial stage when only the biological component of OY is specified and later when other factors are considered by the Council, OY itself corresponds to a certain level of allowable harvest. In this manner, the harvest level corresponding to OY may change as other factors are considered or as more information on the fishery become available. Measures designed to achieve such level of harvest are the ones that have direct effects on fishing participants.

Fourth, the presence of an overfishing definition (specified below) invariably implies that the biological component of OY must be one that maintains the fish stocks above the overfishing threshold. In the meantime, while the economic and social factors are not considered, measures adopted to achieve OY would then be governed by the need to achieve the biological target. There is a strong possibility that the level of harvest allowed under such condition may not be coincident with the level demanded by economic or social factors. In such a situation, the alternatives considered in this section could force the fishing participants to forgo economic or social benefits. That is, if the measures later adopted are very restrictive, short-run benefits may be forgone although the long-term status of the fish stock may be preserved. Measures less restrictive than those that may be required for social and economic reasons are very unlikely.

Fifth, the process of incorporating social and economic factors in the determination of OY may involve more than a determination of a fixed or variable harvest level. The process could involve adoption of a management regime that would enable achievement of OY at some harvest levels. In determining OY, the economic process involves, among others, the translation of sustainable harvests into consumer and producer surpluses. One way of doing this is to perform a constrained optimization exercise whereby consumer and producer surpluses are maximized over time subject to a minimum level of SPR or an attribute of the minimum SPR level. For example, if the stock is not overfished, the binding constraint could be a specific level of SPR, say the overfishing threshold. If the stock is overfished, the binding constraint could be an attribute of the chosen level of SPR, such as the direction, absolute magnitude, or rate of change of the SPR. A similar exercise of constrained optimization may be performed incorporating social factors. As the process continues, OY that incorporates social and economic factors would be measurable. It may be noted, however, that while the process discussed may determine the level of harvest corresponding to OY, achieving that level of harvest with the highest possible economic and social benefits may require certain type of management regimes, such as ITQ or some other effort limitation programs. In the absence of this management regime, constraining the harvest level and more importantly the SPR to one that was determined to correspond to OY may not achieve OY itself when this latter is defined to incorporate economic or social factors.

Sixth, there is a very high likelihood that a satisfactory incorporation of economic and social factors in the determination of OY would take several years. In the meantime, the biological component may be the overriding concern, but as long as the Council through its various advisory groups, including the general public, is able to infuse social and economic factors in designing measures to achieve OY, significant adverse consequences to the fishing participants in the short run may be minimized.

Environmental Consequences:

Human Resources: The setting of OY at a higher level of SPR than MSY will in the long-term benefit the participants in the fishery by assuring the stocks will be maintained at a biomass level at or above MSY. However, in the short-term, it may adversely affect fishermen for some stocks because a more restrictive management regime may be necessary.

Fishery Resources: The setting of OY at a higher level of SPR than MSY will benefit the condition of the stock by maintaining the biomass at or above MSY. This should stabilize to some extent the effect of natural fluctuations in recruitment.

Other Fishery Resources: The effects on *other fishery resources* are expected to be beneficial to other stocks that are targeted by fishermen.

8.1.4 Overfishing Criteria

The following are the definitions of overfishing and overfished contained in the Reef Fish Fishery FMP:

1. A reef fish stock or stock complex is overfished when it is below the level of 20 percent [transitional] SPR.

2. When a reef fish stock or stock complex is overfished, overfishing is defined as harvesting at a rate that is not consistent with a program that has been established to rebuild the stock or stock complex to the 20 percent [static] SPR level.

3. When a reef fish stock or stock complex is not overfished, overfishing is defined as a harvesting rate that if continued would lead to a state of the stock or stock

complex that would not at least allow a harvest of optimum yield on a continuing basis.

8.1.4.1 Overfishing Threshold Alternatives (MFMT)

Proposed Alternative 1: Set the overfishing threshold at a fishing mortality rate equivalent to 50 percent static SPR ($F_{50\%SPR}$) for the following stocks: Nassau grouper and jewfish.

Proposed Alternative 2: Set the overfishing threshold at a fishing mortality rate equivalent to 30 percent static SPR ($F_{30\%SPR}$) for all of the reef fish stocks under Section 8.1, except red snapper, Nassau grouper, and jewfish.

Proposed Alternative 3: Set the overfishing threshold at a fishing mortality rate equivalent to 26 percent static SPR ($F_{26\%SPR}$) for red snapper.

Alternatives Considered and Rejected:

Alternative 1: The overfishing threshold is initially set equivalent to 35 percent static SPR for gag, but reverts to 30 percent SPR upon implementation of any of the following: 1) a minimum size limit of 24 inches TL or greater; or 2) a spawning season closure that includes at least the two month period of February and March.

Alternative 2: Set the overfishing threshold at a fishing mortality rate equivalent to 30 percent static SPR ($F_{30\%SPR}$) for gag, if an increased size limit and/or spawning season closure is implemented for the stock.

Alternative 3: Set the overfishing threshold at a fishing mortality rate equivalent to 35 percent static SPR ($F_{35\%SPR}$) for gag, if no increased size limit and/or spawning season closure is implemented for the stock.

Alternative 4: Set the overfishing threshold at a fishing mortality rate equivalent to 5 to 20 percent static SPR ($F_{5\text{-}20\%SPR}$) for stocks for which those levels are supported by scientific documentation.

Alternative 5: Status Quo - no action, retain the current definitions.

Alternative 6: Set the overfishing threshold at a fishing mortality rate equivalent to 25 percent static SPR ($F_{25\%SPR}$) for the following stocks or stock complexes:

<u>Alternative 7</u>: Set the overfishing threshold at a fishing mortality rate equivalent to 40 percent SPR ($F_{40\%SPR}$) for the following stocks or stock complexes:

<u>Discussion</u>: The final guidelines suggest that long-term average fishing mortality rate equivalent to a 30-40 percent level of spawning per recruit may be a reasonable proxy for the MSY fishing mortality rate. The analyses by the first and second FSAP (1998) support those levels (Appendices C and D). (See discussion under MSY.)

The overfishing alternatives represent the maximum fishing mortality threshold (MFMT) and should be specified at the SPR levels set for MSY in Section 8.1.2.1. The Council feels, based on the information available to it and on the recommendations of the SAPs, that SPR has been set at the appropriate level for each stock. The use of higher SPR levels would overestimate MFMT and result in more restrictive management measures than are necessary. The use of lower SPR levels would underestimate MFMT and not maintain the condition of the stock at the optimum level.

<u>Biological Impacts</u>: The current prohibition on harvest and possession and the higher standard for the overfishing threshold (50 percent SPR) should have a beneficial effect on the stocks of jewfish and Nassau grouper by allowing them to be restored to a much higher biomass in the Gulf area. The MSY proxy and F_{MSY} of 30 percent SPR basically results in raising the overfishing threshold from 20 to 30 percent for the other reef fish stocks, which should have a long-term beneficial effect. The F_{MSY} of 26 percent SPR for red snapper is considered a precautionary approach.

<u>Economic Impacts</u>: The specification of an overfishing threshold has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. It is only instructive to note that the higher the SPR level specified to correspond to an overfishing threshold, the more restrictive would be the short-term measures adopted. These measures would be more restrictive the further the current status of any stock is to the specified threshold level.

<u>Environmental Consequences</u>:

Human Resources: The elevation of the overfishing criteria to a higher level based on the new proxies for MSY may, in the short-term, result in some additional stocks being classified as overfished and the necessity to reduce harvest levels. However, these restrictions should be of rather a short duration and, in the long-term, the harvest levels should be enhanced, resulting in a positive benefit. For the stocks of jewfish and Nassau grouper, the prohibition on harvest would be extended many additional years by the new standards. However, that has no immediate impact, in that harvest is currently prohibited.

Fishery Resources: The higher standards should benefit the reef fish stocks by maintaining the stock biomass at or above MSY.

Other Fishery Resources: The proposed actions likely will have a beneficial effect on other stocks.

8.1.4.2 <u>Overfished Threshold Alternatives</u>

The national standard guidelines provide that the overfished threshold be a minimum stock size threshold (MSST) which should be expressed in terms of spawning biomass or other measure of productive capacity. The guidelines also provide that this threshold should equal whichever of the following is greater: (1) one-half of MSY or (2) the minimum stock size at which rebuilding to the MSY level is expected to occur within 10 years.

The first FSAP (July 1998) provided the following discussion and suggestion on computing the MSST:

> The ideal value of MSST depends on the resiliency of the stock, which in the case of the stocks examined in this report, is not well established. The FSAP believes that the most appropriate strategy to address this issue would be through analyses by the respective stock assessment panels for each FMP. In the interim, the FSAP recommends that MSST be set equal to the stock size associated with the maximum fishing mortality threshold multiplied by the greater of 1 minus the natural mortality rate (M) or 0.5. Such a rule of thumb for MSST is intuitively appealing because one would expect stocks with a higher M to recover faster, on average, than stocks with a lower M.

The intent of the first FSAP in using the multiplier of 1.0-M was that it should be related to restoration of the stock that becomes overfished within the 10-year period. That is because longer-lived fish tend to have lower rates of M and restoration of such a stock takes longer. It also creates a relatively narrow range between the overfishing threshold and overfished threshold. For example, for red snapper, with M=0.1 and the overfishing threshold at 30 percent SPR, the overfished threshold would be 27 percent, i.e., 90 percent of the overfishing threshold.

The second FSAP (August 1998) recommended that proxies for B_{MSY} for reef fish stocks be set at levels of 30 to 50 percent transitional SPR. Subsequent to that time the NMFS SERO hosted a workshop to discuss technical guidance on the use of precautionary approaches to implementing national standard 1 (NOAA 1998). The consensus reached at that meeting was that transitional SPRs were not appropriate as a proxy for B_{MSY} and that B_{MSY} and especially MSST (overfished threshold) must be expressed in terms of biomass. The conclusion of the Councils and NMFS was as follows:

> Evaluation of stock status for southeastern FMP species have generally relied on per recruit estimates of spawning potential (transitional SPR), thus estimates of biomass at MSY (B_{MSY} or proxies thereof) and of current biomass are generally not available. Where the information for calculating (B_{MSY}) is available in the Stock Assessment Panel reports, as they are for red snapper and mackerel, B_{MSY} can be estimated. For many other stocks, an estimate of B_{MSY} (or proxy thereof) can be obtained as the product of the amount of expected spawning biomass per recruit at the MSY fishing mortality (F_{MSY}) and an estimate of expected recruitment levels at B_{MSY} and estimates of current biomass require further evaluation of the available data. These evaluations will take place within the year.

Therefore, the Council's Proposed Alternative is that the overfished threshold (or MSST) will be implemented for each stock by framework measure as estimates of B_{MSY} and MSST are developed by NMFS, the RFSAP, and Council.

Alternatives Considered and Rejected:

Alternative 1: Set the overfished threshold (MSST) at a transitional SPR level equivalent to 50 to 70 percent of the SPR level for the MSY proxy.

Alternative 2: Set the overfished threshold (MSST) at a transitional SPR level equivalent to 1.0-M times the SPR level for the MSY proxy.

Alternative 3: Set the overfished threshold (MSST) at a transitional SPR level equivalent to the SPR level for the MSY proxy.

Discussion: While NMFS has suggested the MSST be stated only in terms of biomass, the fact remains that that type of estimate is not currently available for most Gulf stocks. For example, the NMFS stock assessment personnel (Schirripa, Personal Communication) indicated for red snapper it will require at least 10 years of additional data on the recovering fishery in order for a reliable estimate of B_{MSY} to be computed with the stock/recruit relationship. The use of the transitional SPRs as an interim statement for the MSST would seem beneficial, especially as the status of the stock in relation to this standard can be readily determined. However, SEFSC (Brown, Personal Communication, 1/8/99) pointed out that the levels of transitional SPR in the rejected alternatives are improperly used as the percentages were intended for setting levels of MSSTs in terms of biomass. Therefore, if the intent was to set the MSST at 50 percent of MSY (in biomass), the SPR proxy representing that level would not be 50 percent of the SPR MSY proxy, but likely would be much higher. This means that Rejected Alternative 3 would be the more appropriate level.

8.1.5 Rebuilding Periods

8.1.5.1 Rebuilding Period Alternatives

Reef fish stocks that have been identified as overfished by NMFS (1997) in its report to Congress include red snapper, jewfish, and Nassau grouper (Table 13). The determination that these stocks are overfished is based on the current definition of overfished in the FMP, i.e., 20 percent SPR. Section 304(e) of the SFA requires that the rebuilding period and proposed management measure for rebuilding the stock be based on the overfishing criteria in the FMP. While this amendment could serve as a vehicle for expressing rebuilding periods for all of these stocks based on the overfishing criteria of 20 percent SPR (current criteria of the FMP), it could also serve to express the rebuilding periods for the stocks based on the new overfishing criteria specified in Section 8.1.4. In that instance, the rebuilding period would start the date of implementation, probably 1999. NMFS (1998) in its report to Congress indicated while gag were not overfished, the stock was approaching an overfished state.

Red Snapper - the current rebuilding period, based on the current criteria of 20 percent SPR and 1.5 times the generation time (19.6 years) and a starting date of 1990, extends through 2019. A restoration scenario proposed by the Council in the Regulatory Amendment for 1998 Red Snapper TAC for a constant TAC of 9.12 MP and 45 percent bycatch reduction beginning in 1998 (which increases by 5 percent per year to 60 percent in 2001) would have resulted in achieving 20 percent SPR by 2019 (GMFMC 1998). Considering that the 30 mesh fisheye BRD was reported to reduce bycatch of age-0 and age-1 red snapper by 58 percent (Shrimp Amendment 9, GMFMC, 1997) this probably was not an unreasonable assumption by the Council. NMFS is assessing the assumption through an observer program.

Using the stock restoration scenario for red snapper by Schirripa (1998) in the Appendix 2 Table on page 81 of his report for no directed red snapper fishery (TAC=0) and 100 percent reduction in shrimp trawl mortality on red snapper (i.e., no fishing mortality at all), the red snapper stock would be restored to the 26 percent SPR level (F_{MSY}) by year 2013. Adding the generation time of 19.6

years, the rebuilding period would be completed by 2033 if this amendment is implemented in 1999 or 34 years.

Jewfish and Nassau Grouper - Rebuilding periods for jewfish and Nassau grouper began in 1990 and 1997, respectively, with rules preventing harvest or possession in the EEZ. The affected states implemented compatible rules. Nassau grouper are a Pan-Caribbean species that are occasionally caught off South Florida and appear to be overfished throughout their range. Legault and Eklund (1998) provided analyses of the generation times for Nassau grouper and jewfish. They provided a range of estimates of natural mortality rate (M) for the two species based on the expected percentage that would be surviving at the maximum age. The percent remaining at maximum age ranged from 0.05 percent to 5.0 percent. The maximum ages in an unfished population were assumed as 40 years and 80 years for Nassau grouper and jewfish respectively. Using both fecundity and weight at age analyses Legault and Eklund (1998) computed the relationship for generation time as a function of M for both species. Using these relationships of Legault and Eklund (1998) (Figures 4 and 5 of their report) and the midpoints of the range of M of 0.1675 and 0.1135 for Nassau grouper and jewfish, respectively, resulted in the generation times of about 17 and 24 years for each species, respectively. If the estimate of Ault et. al. (1997) of M=0.18 and M=0.08 are used for Nassau grouper and jewfish, respectively, the generation time estimates are about 12 and 28 years, respectively.

Because there are no estimates for the time required to restore these stocks in the absence of a directed fishery, it is not possible to compute a rebuilding period at this time. Because of the Pan-Caribbean distribution of Nassau grouper, data on the stock for the Gulf of Mexico will probably always be inadequate for this computation, and the current prohibition on harvest will likely have a very limited effect on restoration of that stock, i.e., only about 9,000 pounds were landed annually by Gulf commercial fishermen.

8.1.6 Procedure for Specifying TAC

The following is the framework procedure for specification of TAC, as established in Amendment 1 and modified in Amendments 11 and 14, and as modified in 1997 by regulatory amendment to comply with the requirement that the recreational red snapper fishery be managed as a quota. The specified recovery date for red snapper reflects the current recovery criteria that overfished stocks be recovered to 20 percent SPR within 1.5 generation times.

Based on the SFA and National Standard Guidelines, the procedure is modified as follows (deletions are bolded in brackets; new language is underlined and bolded):

Procedure for Specification of TAC:

1. Prior to October 1 each year, or such other time as agreed upon by the Council and RA, the NMFS Southeast Fisheries Science Center (SEFSC) and Economics and Trade Division (ETD), Southeast Regional Office (SERO) will: a) update or complete biological and economic assessments and analysis of the present and future condition of the stocks and fisheries for red snapper and other reef fish stocks or stock complexes; b) assess to the extent possible the current SPR levels for each stock; c) estimate fishing mortality (F) in relation to **F_{MSY} (MFMT)** **[$F_{20\% SPR}$]** and F_{OY}; d) **[estimate annual surplus production, F_{max} or]** other population parameters deemed appropriate; e) summarize statistics on the fishery for each stock or stock complex; f) specify the geographical variations in stock abundance, mortality, recruitment, and age of entry into the fishery for each stock or stock complex; **[and]** g) provide information for analyzing social and economic impacts of any specification demanding adjustments of allocations, quotas, bag limits or other fishing restrictions, **and h) develop estimates of B_{MSY} and MSST.**

2. The Council will convene a Scientific Reef Fish Stock Assessment Panel (RFSAP), and a Socioeconomic Assessment Panel (SEP) appointed by the Council, that will, as working groups, review the SEFSC and ETD assessments, current harvest statistics, economic, social, and other relevant data. The RFSAP will prepare a written report to the Council specifying a range of ABC for each stock or stock complex which is in need of catch restrictions for attaining or maintaining OY. The ABCs are catch ranges that will be calculated for those species in the management unit that have been identified by the Council, NMFS, or the working panels as in need of catch restrictions for attaining or maintaining OY. For overfished stocks, the range of ABCs shall be calculated so as to achieve reef fish population levels at or above **F_{MSY} at B_{MSY} within the rebuilding periods specified by the Council and approved by NMFS. The RFSAP will recommend rebuilding periods based on the provisions of the National Standard Guidelines, including generation times for the affected stocks.** **[the 20 percent SPR goal by January 1, 2000, for all reef fish except red snapper which has a January 2019 target date, or by a time period (target date), or set of time periods (target dates) specified by the RFSAP. Any time period specified by the stock assessment panel for consideration by the Council under this framework procedure cannot exceed a period equal to 1.5 times the potential generation time of the stock or such other time period as specified by plan amendment.]** Generation times are to be specified by the stock assessment panel based on the biological characteristics of the individual stocks. **The RFSAP will review the SEFSC recommendations for B_{MSY} and will recommend to the Council a B_{MSY} level and minimum stock size threshold (MSST) from B_{MSY}. The RFSAP may also recommend a more appropriate estimate of F_{MSY} for any stock. The RSAP may also recommend more appropriate levels for the MSY proxy, OY, the overfishing threshold (MFMT), and overfished threshold (MSST).**

For stock or stock complexes where data in the SEFSC reports are inadequate to compute an ABC based on the spawning stock biomass per recruit or SPR models, the RFSAP will use other available information as a guide in providing their best estimate of an ABC range that should result in **achieving the MFMT** **[at least a 20 percent SPR level]**. The ABC ranges will be established to prevent an overfished stock from further decline. To the extent possible, a risk analysis should be conducted indicating the probabilities of attaining or exceeding **the MFMT and** **[stock goal of 20 percent SPR]**, the annual transitional yields (i.e., catch streams) calculated for each level of fishing mortality within the ABC range. The SEP will examine the economic and social impacts associated with fishing restrictions required to attain those levels. The working groups reports may include recommendations on bag limits, size limits, specific gear limits, season closures, and other restrictions required to attain management goals, along with the economic and social impacts of such restrictions, and the research and data collection necessary to improve the assessments. The RFSAP may also recommend additional species for future analysis.

3. The Council will conduct a public hearing on the RFSAP and SEP reports at, or prior, to the time it is considered by the Council for action. Other public hearings may be held also. The Council will request review of the reports by its Reef Fish Advisory Panel and Scientific and Statistical Committees and may convene these groups before taking action.

4. The Council in selecting a TAC level, and a stock restoration time period (target date), if necessary, for each stock or stock complex for which an ABC range has been identified will, in addition to taking into consideration the recommendations and information provided for in (1), (2), and (3), utilize the following criteria:

   a. Set TAC within or below the first ABC range or set a series of annual TACs to obtain the ABC level within the first three years or less.

   b. Subdivide the TACs into commercial and recreational allocations which maximize the net benefits of the fishery to the nation. The allocations will be based on historical percentages harvested by each user group during the base period of 1979-1987. However, if for an overfished stock the harvest in any year exceeds the TAC due to either the recreational or commercial user group exceeding its allocation, subsequent allocations pertaining to the respective user group will be adjusted to assure meeting the specified target date for achieving **the MFMT** **[the spawning potential ratio (SPR) goal]**.

5. The Council will provide its recommendations to the NMFS Regional Administrator for any specifications in TACs and stock restoration target dates

for each stock or stock complex, **<u>estimates of B_{MSY} and MSST, estimates of MFMT</u>**, and the quotas, bag limits, trip limits, size limits, closed seasons, and gear restrictions necessary to attain the TAC, along with the reports, a regulatory impact review and environmental assessment of impacts, and the proposed regulations before October 15, or such other time as agreed upon by the Council and Regional Administrator. **<u>The Council may also recommend new levels or statements for MSY (or proxy) and OY.</u>**

6. Prior to each fishing year, or other such time as agreed upon by the NMFS Regional Administrator and Council, the Regional Administrator will review the Council's recommendations and supporting information; and, if he concurs that the recommendations are consistent with the objectives of the FMP, the Magnuson-Stevens Act National Standards, and other applicable law, he shall forward for publication notice of proposed rules for TACs and associated harvest restrictions by November 1, or such other time as agreed upon by the Council and Regional Administrator (providing up to 30 days for additional public comment). The Regional Administrator will take into consideration all public comment and information received and will forward for publication in the Federal Register the notice of final rule by December 1, or such other time as agreed upon by the Council and Regional Administrator.

7. The commercial allocations of reef fish TACs, and the recreational allocation of red snapper TAC, shall be considered to be quotas. Appropriate regulatory changes that may be implemented by proposed rule in the Federal Register include:

   a. The TACs for each stock or stock complex that are designed to achieve a specific level of ABC within the first year, or annual levels of TAC designed to achieve the ABC level within three years.

   b. Bag limits, size limits, vessel trip limits, closed seasons or areas, gear restrictions, and quotas designed to achieve the TAC level.

   c. The time period (target date) specified for rebuilding an overfished stock**<u>, estimates of B_{MSY} and MSST for overfished stocks and MFMT.</u>** **[with the restriction that a time period specified under this framework procedure cannot exceed a period equal to 1.5 times the generation time of the stock under consideration.]**

   d. **<u>New levels or statements of MSY (or proxy) and OY for any stock.</u>**

8. The NMFS Regional Administrator is authorized, through notice action, to conduct the following activities:

a. Close the commercial fishery of a reef fish species or species group that has a commercial quota or sub-quota at such time as projected to be necessary to prevent the commercial sector from exceeding its allocation for the remainder of the fishing year or sub-quota season.

b. Close the recreational red snapper fishery in the EEZ, i.e., reduce the red snapper bag limit to zero, at such time as projected to be necessary to prevent the recreational sector from exceeding its allocation for the remainder of the fishing year.

c. Reopen a commercial or recreational season that had been prematurely closed if needed to assure that an allocation can be reached.

9. If the NMFS decides not to publish the proposed rule of the recommended management measures, or to otherwise hold the measures in abeyance, then the Regional Administrator must notify the Council of his intended action within 30 days of receipt of the Council's proposal and the reasons for NMFS concern along with suggested changes to the proposed management measures that would alleviate the concerns. Such notice shall specify: 1) the applicable law with which the amendment is inconsistent, 2) the nature of such inconsistencies, and 3) recommendations concerning the actions that could be taken by the Council to conform the amendment to the requirements of applicable law.

8.2 COASTAL MIGRATORY PELAGICS (MACKERELS)

Species in the Fishery for Coastal Migratory Pelagics:

King mackerel	Scomberomorus cavalla
Spanish mackerel	S. maculatus
Cobia	Rachycentron canadum
Cero	S. regalis
Little tunny	Euthynnus alleteratus
Dolphin	Coryphaena hippurus
Bluefish (Gulf of Mexico only)	Pomatomus saltatrix

The Fishery Management Plan for Coastal Migratory Pelagic Resources of the Gulf of Mexico and South Atlantic (FMP) and Final Environmental Impact Statement (FEIS), approved in 1982 and implemented by regulations effective in February of 1983, treated king and Spanish mackerel each as one U.S. stock. Allocations were established for recreational and commercial fisheries, and the commercial allocation was divided between net and hook-and-line fishermen.

Amendment 1 and its EIS, implemented in September of 1985, provided a framework procedure for pre-season adjustment of total allowable catch (TAC), revised king mackerel maximum sustainable yield (MSY) downward, recognized separate Atlantic and Gulf migratory groups of king mackerel, and established fishing permits and bag limits for king mackerel. Commercial allocations among gear users were eliminated. The Gulf commercial allocation for king mackerel was divided into eastern and western zones for the purpose of regional allocation.

Amendment 2 with Environmental Assessment (EA), implemented in July of 1987, revised Spanish mackerel MSY downward, recognized two migratory groups, and set commercial quotas and bag limits.

The present management regime for king mackerel recognizes two migratory groups, the Gulf migratory group and the Atlantic Migratory Group. These groups seasonally mix on the east coast of Florida. For management and assessment purposes, a boundary between groups was specified as the Volusia/Flagler County border on the Florida east coast in the winter (November 1-March 31) and the Monroe/Collier County border on the Florida southwest coast in the summer (April 1-October 31). The commercial allocation for the Gulf group is currently divided at the Florida/Alabama boundary into eastern zone (Florida) and western zone (Texas through Alabama) quotas.

8.2.1 <u>Current Status of Stocks</u>

Table 13 summarizes the current status of Gulf stocks of mackerels and cobia based on current criteria for overfishing and overfished in the FMP. The status of the stocks of cero, little tunny, and Gulf bluefish is unknown.

<u>Gulf Migratory Group King Mackerel</u>

Based on the current criteria for overfishing and overfished of 30 percent SPR, Gulf group king mackerel are considered overfished with a 23 percent transitional SPR and are being fished at a rate (F) that constitutes overfishing, i.e., 21 percent static SPR (MSAP 1998). Previously, Mace et al. (1996) suggested using a level of 20 percent transitional and static SPR for the overfished and overfishing thresholds respectively; however, rebuilding should be continued until the 30 percent SPR level is achieved. The MSAP (1998) report provided the following information on the status of these stocks:

> Landings and History of Management
>
> Catches since 1981/82 have ranged from a high of 12.3 million pounds in 1982/83 to a low of 3.0 million pounds in 1987/88 (Figure **GK-1**). Since 1986/87, landings have generally increased and have exceeded TAC in most years. Preliminary estimates of 1997/98 landings are:

<u>1997/98</u>	
Commercial	3,390,000
Recreational	8,393,226 (779,319 fish)
Total	11,783,266

Estimates of Fishing Mortality Rates

Pooled F's on age 4+ adults generally declined from 1981/82 to their lowest point in 1987/88. The last peak in F was during the 1994/95 fishing year with lower, relatively stable levels since 1995 (Figure **GK-2)**. The median pooled F on ages 4+ for 1997/98 was 0.19 per year within the 10^{th} percentile to 90^{th} percentile range of 0.15 to 0.23.

Trends in Recruitment

Estimates of recruitment for ages 1-3 declined from 1981/82 to a low in 1984/85, then steadily increased to a high in 1996/97 (Figure **GK-3)**. The 1997/98 estimate is somewhat lower, as is the 1998 projection; however, recruitment is still higher than levels that existed prior to 1994.
Trends in Biomass

Biomass estimates of ages 4+ showed a steady decline from 1981/82 to 1987/88 but have since increased to the current levels that are the highest in the time series (Figure **GK-4**). Total biomass increased from 1981/82 to about 1988/89 and remained relatively stable thereafter (Figure **GK-5**). The expected biomass at the beginning of the 1998-99 season is the highest in the time series. *A note of caution is that biomass has consistently lagged recruitment with an offset of about 3 years. Since recruitment has remained level or may be declining, continued increases in biomass may not occur in the short-term.*

Acceptable Biological Catch (ABC)

For the 1998/99 fishing year, given the Gulf Council's objective not to exceed F 30 percent SPR, the Panel recommends the best estimate of TAC to be 8.7 million pounds. There is a 50 percent chance that a TAC of 8.7 million pounds will achieve a $F_{30\%}$ SPR level, a 16 percent chance that a 10.8 million pound TAC would reach a $F_{30\%}$ SPR level, and an 84 percent that a TAC of 7.1 million pounds would provide a $F_{30\%}$ SPR level.

Discussion of Stock Status

Landings of Gulf group king mackerel in the last five years have been the highest in the series since 1982/83, and total landings have exceeded TAC in every year since 1986 (Table 15). Since the 1986/87 fishing year, transitional SPR has varied between 20 and 25 percent with a slightly increasing trend since 1995 (Figure **GK-6**). Transitional SPR for the 1998/99 fishing year is estimated at 23 percent, which is below the Council's objective.

Overfishing/Overfished

Static SPR was estimated at 21 percent based on the F multiplier for 1996-97 of 1.00. Consequently, the Panel concludes that the Gulf group king mackerel fishery was overfishing the available stock because the fishing mortality rate was greater than F at 30 percent static SPR in 1996/97. If fishing mortality continues at this rate, the fishery will remain overfished and will not be able to recover above the 30 percent transitional SPR level. The Panel concludes that the Gulf migratory group of king mackerel is overfished because the transitional SPR is below 30 percent.

Gulf Migratory Group Spanish Mackerel

The MSAP (1998) concluded that this stock was not overfished (35 percent transitional SPR) nor was overfishing of the stock occurring (47 percent static SPR). The Florida net ban eliminated most of the Gulf commercial fishery.

Cobia

The MSAP (1996) evaluated the cobia stock and recommended no management changes since yield for South Atlantic and Gulf was relatively stable at MSY, i.e., 2.2 MP. They did express concern over the magnitude of shrimp trawl bycatch for the Gulf. Their report follows:

Catches of cobia from 1984 through 1995 for the Gulf were updated from Thompson (1995). As a result of the 1992 assessment, the MSY combined for the commercial and recreational sectors and the Gulf and Atlantic "groups", was increased from 1 million pounds to 2.2 million pounds. This represented the average total catch over the time series 1984-1991 for the Gulf and Atlantic, commercial and recreational combined. Although VPA analysis of cobia stocks in southeast U.S. waters now is available (Thompson 1996), the preliminary nature of the assessment due to uncertainty about several important biological parameters preclude revision of the current MSY level of 2.2 million pounds for the Gulf and Atlantic combined.

The recreational sector remains the primary source of landings and these estimates were revised over the time series 1988-1995 using MRFSS catch estimates derived from the "new" method. There is little difference between these new estimates and the "old" estimates. Total catch in weight for both sectors and the Gulf and Atlantic combined in 1991 was estimated to be well above MSY at about 3.1 million pounds; total combined landings (in millions of pounds) were about 2.6 in 1992, 1.8 in 1993, 2.5 1994, and 1.8 in 1995. While catches in the Gulf remain high and stable, the Atlantic catches demonstrate more variability and except for 1991 are low compared to Gulf catches.

Age-based assessments were completed for the Gulf and Atlantic respectively in the same way as in 1995. Age-length results from Franks and McBee (1991) and Franks (1992) were applied to develop catch at age for Gulf catches from 1984-1994. It was noted that undersized fish were included in Franks sample which came primarily from recreational anglers. Undersized age 1 fish were also in the catch at age tables. An age-length key developed using data from Mr. Joseph Smith (NMFS Beaufort Laboratory, pers. comm. 1995, accepted for publication) was applied to estimate catch-at-age for the Atlantic catches. Smith's data also included undersized fish and these were also represented in the catches-at-age. How representative samples were of the fishery is not known.

Results of ageing fish in the Gulf and Atlantic suggested that fish grow slower and live longer in the Atlantic relative to the Gulf. This result provides some biological evidence for separation of cobia into two groups, Atlantic and Gulf. However, recent but preliminary tagging studies (Franks and McBee 1994, Franks and Moxey 1996) indicate that movement between the Gulf and Atlantic is typical and seasonal; the authors caution that it is too early to determine if Gulf and Atlantic groups represent two distinct breeding sub-populations.

Included in the Gulf catches-at-age were updated estimates of bycatch of fish aged 0 (70 percent) and 1 (30 percent). Bycatch in the past two years is relatively high compared to previous years; recruitment also was high in 1993 and 1994, but declined in 1995.

Shrimp trawl bycatch probably occurs in the Atlantic but there are no quantitative data available at this time for their inclusion into the stock assessment. While there is likely bycatch, the directed catches remain low relative to Gulf catches and as indicated in the 1993 assessment, Atlantic catches probably result in very small F; with high SPR.

An assessment combining the Gulf and Atlantic catches would essentially be a Gulf assessment given the difference in magnitude of catches. Thus, an age based analysis as described by Powers and Restrepo (1992) was completed for the Gulf "group." Detailed results of the VPA are not presented because of considerable uncertainty about several of the biological parameters, especially length-at-age, fecundity-at-age, and natural mortality rate.

Briefly, using results from previous assessments, selectivities for ages 0 and 1 averaged for the period 1988-1933, with M=0.2 and M=0.4, and the catch-age-data including bycatch from Frank and colleagues, the VPA was completed. CPUE indices based on the MRFSS and headboat data were used to tune the VPA results. At M=0.2, the values of F for the fully recruited age classes (2-8+) were estimated to be 0.63 and 0.46 for 1993 and 1994, respectively, compared to current $F_{0.1}$=0.198 and F_{max}=0.289. These most recent levels of F result in an $SPR_{M=0.2}$ of about 13 percent. At M=0.4, the values of F for the fully recruited age classes (2-8+) were estimated to be 0.42 and 0.32 for 1993 and 1994, respectively, compared to current $F_{0.1}$=0.275 and F_{max}=0.432. These most recent levels of F results in an $SPR_{M=0.4}$ of about 25 percent.

Because of the uncertainty of the VPA results, the dependency of those results on the level of M, and the appearance that current yield for both areas seems to be relatively stable at MSY, the Panel recommended that no management changes be considered at this time. However, the Panel expressed concern because these preliminary results suggest that F may be at or near F_{max}, owing in large part to the magnitude of the shrimp bycatch in the Gulf, which is approximately five times the harvest of the directed fishery. It is suggested that cobia assessments continue to be done separately for the Gulf and Atlantic.

8.2.2 Maximum Sustainable Yield (MSY)

MSY for king mackerel was set within the range of 21.0 to 35.2 MP with the best point estimate of 26.2 MP. The best point estimate for Gulf group king mackerel was 14.2 MP and for Atlantic group king mackerel was 11.8 MP (Amendment 1, GMFMC/SAFMC 1985).

MSY for Spanish mackerel was respecified in Amendment 2 (GMFMC/SAFMC 1987) from within the range of 15.7 to 19.7 MP with the best point estimate of 18.0 MP. Separate estimates for Gulf and Atlantic groups were not computed.

MSY for cobia was respecified as 2.2 MP (MSAP 1992). Estimates of MSY for other stocks are not available.

8.2.2.1 MSY Alternatives

Proposed Alternative: MSY is equivalent to 30 percent static SPR for the following stocks or management groups:

Gulf-group king mackerel
Gulf-group Spanish mackerel
Cobia
Cero
Dolphin (Gulf of Mexico only)
Bluefish (Gulf of Mexico only)
Little tunny (Gulf of Mexico only)

Alternatives Considered and Rejected:

Alternative 1: MSY is equivalent to 40 percent static SPR for the following stocks or management groups:

Alternative 2: MSY is equivalent to 35 percent static SPR for the following stocks or management groups:

Alternative 3: MSY is equivalent to 25 percent static SPR for the following stocks or management groups:

Alternative 4: Retain the current estimates of MSY for the mackerels and cobia.

Alternative 5: Status quo - no action

Discussion: The Council feels, based on the information available to it and on the recommendations of the SAPs, that SPR has been set at the appropriate level for each stock. The use of higher SPR levels would overestimate MSY and result in more restrictive management measures than are necessary. The use of lower SPR levels would underestimate MSY and not maintain the condition of the stock at the optimum level. Although there is an estimate of MSY in terms of pounds for Gulf group king mackerel and for cobia, there is no estimate for Gulf group Spanish mackerel or the other species. The reliability of these estimates, which were required by the MSFCMA, and never used for any purpose, has not been determined. The original MSY estimate for king mackerel (throughout their range) in the FMP (GMFMC/SAFMC 1983) was computed by discounting the recreational landing information from the 1970 NMFS saltwater angling survey to 38 percent of that value and using commercial landings information. A time series of recreational landings was assumed based on the 1970 discounted figure. In subsequent discussions with Gerry Scott (NMFS, personal communication, 1/99), he felt that an estimate of biomass at MSY should be determined from the spawner-recruit relationship when the data allows that to be computed, i.e., data on the recovering stock over a longer period would yield a more reliable estimate. Therefore, this amendment considers proxies for MSY in terms of SPR as interim estimates.

NMFS considers 30 to 40 percent as a reasonable range for MSY and Mace et al. (1996) suggested 30 percent SPR as an appropriate MSY or OY target for the mackerels. The first FSAP noted the following:

> The Council asked the first FSAP to consider whether SSBR or spawning stock biomass is more appropriate than the use of SPR to gage stock status. The FSAP (July 1998) assumed that the Council was requesting guidance as to the most appropriate measure of a stocks ability to replenish itself over time. First, the FSAP clarified that SPR is simply a general term that refers to the proportion of a spawning stock remaining under fished conditions to that of an unfished stock. Ideally annual egg production should be used in the calculation of SPR. However, egg production is not always available and biomass of mature females is used as a proxy. The use of biomass in the calculation of SPR was historically referred to as SSBR. Currently, either the use of eggs or biomass is referred to as SPR.
>
> At this time, the first FSAP did not recommend one method over another. They felt it should be the purview of the stock assessment panels to decide the best method used based upon the available data. However, if the Council wishes to adopt a method that best reflects management measures imposed, the use of SPR is the appropriate measure to use.

> The first FSAP (July 1998) suggested that for species with M/K <1.0, e.g., red drum, red snapper, greater amberjack, the SPR at $F_{30\%SPR}$ probably is a good proxy for SPR at F_{MSY}. However, for species with M/K ratios >1.0, e.g., vermilion snapper, king mackerel, Spanish mackerel, red grouper; fishing mortality rates corresponding to $F_{30\%SPR}$ may exceed F_{MSY} and, thus, the SPR proxies should be increased to values corresponding to SPR at $F_{35\%SPR}$. For those species where M/K >1.5, e.g., gag and white grunt, SPRs corresponding to $F_{40\%SPR}$ (or higher) may be the best proxies of SPR at F_{MSY}. (See Table 14.)

The second FSAP (August 1998), as well as many members of the first FSAP, did not agree that the M/K ratio was useful as a scalar for determining resilience because variability observed in estimates of M and K. They indicated that in general longer-lived species that mature at an early age relative to their life-span are perceived to be relatively more <u>resistant</u> to overfishing than shorter-lived species with few spawning year-classes. That is because species with numerous year-classes can still maintain themselves if several of those year-classes are lost or reduced. Whereas the panel defined <u>resilience</u> as the ability of a stock to recover from an overfished condition. Long-lived species although resistant to overfishing are slow to recover once they have become overfished because of the large numbers of age-classes that must be rebuilt and thus generally have a lower resiliency. Conversely, short-lived species with very high fecundity may be able to recover quickly from an overfished condition. The panel cautioned that the above are generalizations and may not be applicable in all situations.

The second FSAP (August 1998) offered the following recommendations for Gulf-group king and Spanish mackerel:

> Stock assessments for king and Spanish mackerel have been available since 1983. Restrictive management measures were enacted in the early 1980's to correct overfishing conditions and to rebuild the stocks. As the result of these management actions, the king and Spanish mackerel populations have exhibited a high resiliency to the resulting lower fishing mortality rates; during the past decade increased spawning stock biomass (king and Spanish) and increased recruitment (king) trends have been evident. It is currently estimated the Gulf king and Spanish mackerel populations are at transitional SPR levels of 23 percent and 35 percent, respectively and being prosecuted at a fishing mortality rate equivalent to 21 percent and 47 percent static SPR, respectively.

> The data are not available to estimate MSY or B_{MSY} directly and the recruitment indices from the SEAMAP and fall groundfish surveys are too imprecise and incomplete to use for estimating MSY or B_{MSY}. **The Panel determined the best available proxy for MSY is SPR and recommends the Gulf Council establish a MSY SPR proxy of 30 percent for king and Spanish mackerel because the empirical evidence suggests these species are resilient to overfishing.**

The recommendations of the second FSAP (August 1998) of a MSY proxy at 30 percent static SPR is consistent with the recommendations of Mace et al. (1996) and the MSAP (1997) for MSY and OY for mackerels and cobia. The second FSAP recommended that the MSY proxy for other Gulf finfish species be set at 30 percent static SPR.

It should also be noted that the framework procedure for specifying TAC (Section 8.2.6) currently provides for the MSAP to recommend MSY (or proxies therefor) for the stocks as better data become available.

Biological Impacts: The use of a SPR proxy for MSY appears to have a beneficial biological impact as it provides a more reliable measure of stock status than the estimate of MSY under status quo for the mackerels and cobia. It also provides a measurable standard for the other coastal migratory pelagic stocks for which there is inadequate information to compute a biomass estimate of MSY. The Council feels, based on the information available to it and on the recommendations of the SAPs, that SPR has been set at the appropriate level for each stock. The use of higher SPR levels would overestimate MSY and result in more restrictive management measures than are necessary. The use of lower SPR levels would underestimate MSY and not maintain the condition of the stock at the optimum level.

Economic Impacts: The specification of MSY has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. Pending more concrete measures designed to achieve or maintain an MSY level, the earlier discussion of MSY alternatives for reef fish is included herein by reference.

Environmental Consequences:

Human Resources: In as much as the Proposed Alternative provides for a more reliable measure of the status of the stocks relative to MSY, it appears to have a beneficial effect, as would Alternatives 1 and 2. Because the coastal pelagic stocks are relatively short-lived with high resiliency, the Proposed Alternative seems more beneficial to the harvesters than the other alternatives, which may either overestimate or underestimate MSY.

Fishery Resources: The use of a more measurable standard for MSY through the use of this proxy for F_{MSY} should have a beneficial effect on the coastal migratory pelagic stocks because it provides a better way of monitoring the stocks in order to tailor management measures to the needs of the resource.

Other Fishery Resources: The Proposed Alternative is likely to have a beneficial effect on other stocks of fish.

8.2.3 Optimum Yield (OY)

The current statement of OY for the coastal migratory pelagics is as follows:

The SAFMC's target level or OY for mackerels is 40 percent static SPR. The GMFMC's target level or OY for mackerels is 30 percent static SPR. ABC is calculated on the target level or OY. OY for cobia is MSY.

8.2.3.1 OY Alternatives

Proposed Alternative: OY is equivalent to 40 percent static SPR for the following stocks or management groups:

Gulf-group king mackerel
Gulf-group Spanish mackerel
Cobia
Cero
Dolphin (Gulf of Mexico only)
Bluefish (Gulf of Mexico only)
Little tunny (Gulf of Mexico only)

Alternatives Considered and Rejected:

Alternative 1: OY is equivalent to 45 percent static SPR for the following stocks or management groups:

<u>Alternative 2</u>: OY is equivalent to 35 percent static SPR for the following stocks or management groups:

<u>Alternative 3</u>: OY is equivalent to 30 percent static SPR for the following stocks or management groups:

<u>Alternative 4</u>: OY is set equivalent to MSY (in pounds) for the following stocks or stock complexes:

<u>Alternative 5</u>: Status quo - retain current OY statement.

<u>Discussion</u>: OY must be set lower than or equal to MSY if specified as a harvest level or fishing mortality rate. In terms of SPR levels that would equate to a SPR higher than or equal to the SPR for MSY. It is not at all unusual for OY to be set at MSY since that is the largest long-term average yield that can be obtained from the stock. Under a precautionary or risk-averse approach OY would be set lower than MSY (higher SPR).

The Proposed Alternative takes a precautionary approach by setting OY at a higher SPR level (40 percent) than MSY. This assures, when all the stocks are restored to MSY, that harvest allowed under ABC and TAC will less than that a MSY. This provides a safe-guard that MSY will not be exceeded as a result of fluctuations in recruitment. The Council feels, based on the information available to it and on the recommendations of the SAPs, that SPR has been set at the appropriate level for each stock. The use of higher SPR levels would overestimate OY and result in more restrictive management measures than are necessary. The use of lower SPR levels would underestimate OY and not maintain the condition of the stock at the optimum level.

<u>Biological Impacts</u>: The Proposed Alternative will provide a beneficial impact to the stocks by limiting harvest to a level which should assure that the stock is maintained at a level above or at MSY.

<u>Economic Impacts</u>: The specification of OY has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. It is only instructive to note that the higher the SPR level specified to correspond to OY, the discussions regarding OY alternatives for reef fish are included herein by reference.

Environmental Consequences:

Human Resources: Maintaining an OY equivalent to MSY should benefit the harvesters by allowing the maximum permissible harvest consistent with maintaining the stock at the MSY level. A higher SPR for OY likely would result in the necessity of reducing TAC and particularly the bag limit for Gulf-group king mackerel to less than two fish until OY is achieved. This would adversely impact the charter vessel industry during that period and also the commercial fishery.

Fishery Resources: The Proposed Alternative seems to be a reasonable level for OY for the stocks (Mace et al. 1996). (See Section 8.2.1.)

Other Fishery Resources: Other fishery stocks are anticipated to benefit by the proposed actions.

8.2.4 Overfishing Criteria

The following are the definitions of overfishing and overfished contained in the Mackerel FMP:

1. A mackerel stock or migratory group and cobia are considered to be overfished when the transitional SPR is below 30 percent.

2. When a mackerel stock or migratory group is not overfished (transitional SPR equal to or greater than 30 percent), overfishing is defined as a harvesting rate that exceeds a static SPR of 30 percent.

8.2.4.1 Overfishing Threshold Alternatives (MFMT)

Proposed Alternative: Set the overfishing threshold at a fishing mortality rate equivalent to 30 percent static SPR ($F_{30\%SPR}$) for the following stocks or management groups:

Gulf-group king mackerel
Gulf-group Spanish mackerel
Cobia
Cero
Dolphin (Gulf of Mexico only)
Bluefish (Gulf of Mexico only)
Little tunny (Gulf of Mexico only)

Alternatives Considered and Rejected:

Alternative 1: Status Quo - no action, retain the current definitions.

Alternative 2: Set the overfishing threshold at a fishing mortality rate equivalent to 25 percent static SPR ($F_{25\%SPR}$) for the following stocks or management groups:

Alternative 3: Set the overfishing threshold at a fishing mortality rate equivalent to 35 percent static SPR ($F_{35\%SPR}$) for the following stocks or management groups:

Alternative 4: Set the overfishing threshold at a fishing mortality rate equivalent to 40 percent static SPR ($F_{40\%SPR}$) for the following stocks or management groups:

Discussion: The final guidelines suggest that long-term average fishing mortality rate equivalent to a 30-40 percent level of spawning per recruit may be a reasonable proxy for the MSY fishing mortality rate. The overfishing alternatives represent the maximum fishing mortality threshold (MFMT) and should be specified at the SPR levels set for MSY in Section 8.1.2.1.

The second FSAP (August 1998) recommended that the MSY proxy for mackerels and coastal migratory pelagic stocks be a 30 percent static SPR, which is the Proposed Alternative. Under the Status Quo Alternative that was the level set for king and Spanish mackerel only. The Council feels, based on the information available to it and on the recommendations of the SAPs, that SPR has been set at the appropriate level for each stock. The use of higher SPR levels would overestimate MFMT and result in more restrictive management measures than are necessary. The use of lower SPR levels would underestimate MFMT and not maintain the condition of the stock at the optimum level.

Biological Impacts: Because the coastal pelagic stocks are relatively short-lived and resilient to overfishing, the 30 percent static SPR proxy for MSY provided by the Proposed Alternative seems appropriate (see discussion under Section 8.2.2.1).

Economic Impacts: The specification of an overfishing threshold has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. It is only instructive to note that the higher the SPR level specified to correspond to an overfishing threshold, the more restrictive would be the short-term measures adopted. These measures would be more restrictive the further the current status of any stock is to the specified threshold level.

Environmental Consequences:

Human Resources: The Proposed Alternative should benefit harvesters by assuring that the stocks are restored to or maintained at a level of biomass equivalent to MSY. Also, since it represents the current goal of management for the most important species (mackerels), there should be minimal changes that would disrupt fishing activities.

Fishery Resources: The coastal migratory pelagic stocks should be maintained at or above MSY by the Proposed Alternative.

Other Fishery Resources: Some of the other fishery resources will likely benefit from maintaining the coastal pelagic stocks at MSY by reduced fishing pressure on those stocks.

8.2.4.2 Overfished Threshold Alternatives

The guidelines provide that the overfished threshold be a minimum stock size threshold (MSST) which should be expressed in terms of spawning biomass or other measure of productive capacity. The guidelines provide that this threshold should equal whichever of the following is greater: one-half of MSY or the minimum stock size at which rebuilding to the MSY level is expected to occur within 10 years.

The first FSAP (July 1998) provided the following discussion and suggestion on computing the MSST:

> The ideal value of MSST depends on the resiliency of the stock, which in the case of the stocks examined in this report, is not well established. The FSAP believes that the most appropriate strategy to address this issue would be through analyses by the respective stock assessment panels for each FMP. In the interim, the FSAP recommends that MSST be set equal to the stock size associated with the maximum fishing mortality threshold multiplied by the greater of 1 minus the natural mortality rate (M) or 0.5. Such a rule of thumb for MSST is intuitively appealing because one would expect stocks with a higher M to recover faster, on average, than stocks with a lower M.

The intent of the first FSAP in using the multiples of 1.0-M was that this should be somewhat related to restoration of the stock, that becomes overfished, within the 10-year period. That is because longer-lived fish tend to have lower rates of M and restoration of such a stock takes longer. It also creates a relatively narrow range between the overfishing threshold and overfished threshold. For example, for king mackerel, with M=0.2 and the overfishing threshold at 35 percent SPR, the overfished threshold would be 28 percent, i.e., 80 percent of the overfishing threshold.

The second FSAP (August 1998) recommended that proxies for B_{MSY} for coastal migratory pelagic stocks be set at 30 percent transitional SPR. Subsequent to that time, the NMFS SERO hosted a workshop to discuss technical guidance on the use of precautionary approaches to implementing National Standard 1 (NOAA 1998). The consensus reached at that meeting was that transitional SPRs were not appropriate as a proxy for B_{MSY}, and that B_{MSY} and especially MSST (overfished threshold) must be expressed in terms of biomass. The conclusion of the Councils and NMFS SEFSC was as follows:

> Evaluation of stock status for southeastern FMP species have generally relied on per recruit estimates of spawning potential (transitional SPR), thus estimates of biomass at MSY (B_{MSY} or proxies thereof) and of current biomass are generally not available. Where the information for calculating (B_{MSY}) are available in the Stock Assessment Panel reports, as they are for red snapper and mackerel, B_{MSY} can be estimated. For many other stocks, an estimate of B_{MSY} (or proxy thereof) can be obtained as the product of the amount of expected spawning biomass per recruit at the MSY fishing mortality (F_{MSY}) and an estimate of expected recruitment levels at B_{MSY} and estimates of current biomass require further evaluation of the available data. These evaluations will take place within the year.

Therefore, the Council has selected as its <u>Proposed Alternative</u> that the overfished threshold (or MSST) will be implemented for each stock by framework measure as estimates of B_{MSY} and MSST are developed by NMFS, the MSAP, and Council.

<u>Alternatives Considered and Rejected</u>:

<u>Alternative 1</u>: Set the overfished threshold (MSST) at a <u>transitional</u> SPR level equivalent to 50 to 70 percent of the SPR level for the MSY proxy.

<u>Alternative 2</u>: Set the overfished threshold (MSST) at a <u>transitional</u> SPR level equivalent to 1.0-M times the SPR level for the MSY proxy.

Alternative 3: Set the overfished threshold (MSST) at a transitional SPR level equivalent to the SPR level for the MSY proxy.

Discussion: While NMFS has suggested the MSST be stated only in terms of biomass, the fact remains that that type of estimate is not currently available for most, if not all, Gulf stocks. However, SEFSC will attempt to compute B_{MSY} for each stock when completing an assessment for that stock. The use of the transitional SPRs as an interim statement for the MSST would seem beneficial, especially as the status of the stock in relation to this standard can be readily determined. See Section 8.1.4.2 for additional discussion for rejecting the alternatives.

8.2.5 Rebuilding Periods

8.2.5.1 Rebuilding Period Alternatives

Currently the only migratory coastal pelagic stock classified as overfished is Gulf group king mackerel. The NMFS prepared an analyses examining SPR levels by relating 3 scenarios for recruitment (low, medium, or high) and 4 scenarios of bycatch reduction (0, 20, 40, and 60 percent) as contrasted against several levels of F for the directed fishery, including F=0 (Appendix B, MSAP 1998). In all of the scenarios for no directed fishery, including low recruitment and status quo for bycatch, a SPR level equal to or exceeding 30 percent transitional SPR was reached within 3 years.

This 3-year period would be the lower limit for rebuilding as defined in the guidelines. As specified in the guidelines, a rebuilding period of up to 10 years could be used to restore the stock above the overfishing threshold. Assuming that this rebuilding period is implemented in 1999 through this amendment, the rebuilding period would extend through 2009. The use of the entire 10-year rebuilding period is contingent on addressing the needs of the fishing communities.

Proposed Alternative: The rebuilding period for Gulf-group king mackerel to MSY (30 percent static SPR) will be for 10 years, 1999 - 2009.

Discussion: NMFS, in review of this section, requested that quantitative estimates of the time to complete the rebuilding period be provided. The most current assessment (MSAP 1998) indicates only that under the current TAC (10.6 MP) there is a 16 percent probability that $F_{30\%SPR}$ would be achieved within one year (See Section 8.2.1). Although there are projections that allow the determination of the time required to achieve a 30 percent SPR with F=0 (no fishing), there are not projections in the MSAP (1998) report or the other assessment documents on the time required to reach 30 percent SPR under the TAC. Therefore, there is no information currently available to make an estimate of the time required to rebuild the stock. In the absence of that estimate, it seems prudent to set the period at 10 years. However, at the next stock assessment (April 1999) the projection will be computed. It should also be noted that other estimates indicate the stock is being rebuilt, i.e., recruitment indices, biomass, and changes in biomass (Figures GK-3, GK-4, and GK-5, respectively).

As indicated in Section 8.2.1, the stock in 1996 - 1997 had static SPR of 21 percent; therefore, it is proposed that a 10-year period be utilized to restore the stock to the 30 percent static SPR level. This appears to be necessary to avoid irreparable harm to fishing communities. The recreational community receives 68 percent of the TAC, and the charter vessel sector harvests the majority of those landings. In the Gulf, there are about 2,400 recreational for-hire vessels that are clustered to a great extent in communities where the revenue generated by the vessels makes up a significant portion of the community's economy. (See Appendix G on Gulf fishing communities.) A reduction of the current bag limit of 2-fish is anticipated to greatly reduce the charter trips targeting king mackerel that are booked by fishermen creating the adverse impact.

Currently, the recreational bag limit is two fish per angler, and if a more rapid restoration period is selected, the bag limit would need to be reduced. The charter vessel industry has indicated that if the bag limit is reduced below two fish, a large portion of their customers will cease paying to target king mackerel, which will create serious adverse impacts on the charter sector and the coastal communities where they contribute significantly to the economy (e.g., Florida Keys with 646 recreational for-hire vessels). A reduction in TAC to restore the stock more rapidly would also adversely affect commercial fishermen in communities dependent on fishing, such as the Florida Keys; Panama City, Florida; and, Grand Isle, Louisiana.

Another factor supporting the need for the 10-year period is that landings have exceeded TAC in each year since restoration was begun in 1984. While the commercial fishery has been closed without that annual allocation being significantly exceeded, it is more difficult to estimate recreational catches. Although recreational catches have exceeded the allocation in recent years, and these constitute over two-thirds of the total catch of king mackerel, the stock has continued to rebuild. Continued rebuilding is expected in the future, albeit at a slower rate under the proposed period; but without the likelihood of adverse effects to the commercial and recreational industries.

<u>Rejected Alternative</u>: The rebuilding period for Gulf-group king mackerel will be 5 years, 1999 - 2004.

<u>Discussion</u>: Considering the above discussion of restoration scenarios that the stock could be restored in the absence of any directed fishery (TAC=0) in 3 years, it is completely unrealistic to attempt to rebuild the stock in 5 years with the current restricted fishery (TAC=10.6 MP). A more restricted fishery would have significant adverse economic effects on the recreational and commercial fishery sectors and on fishing communities.

8.2.6 <u>Procedure for Specifying TAC</u>

Based on the SFA and National Standard Guidelines, the procedure is modified as follows (Deletions are bolded in brackets; new language is underlined and bolded.):

Section 6.1.1: Mechanism for Determination of Framework Adjustments, as modified by this and previous amendments is as follows:

Section 12.6.1.1

A. An assessment panel (Panel) appointed by the Councils will normally reassess the condition of each stock or migratory group of king and Spanish mackerel and cobia in alternate (even numbered) years **<u>and other stocks when data allows</u>** for the purpose of providing for any needed preseason adjustment of TAC and other framework measures. However, in the event of changes in the stocks or fisheries, the Councils may request additional assessments as may be needed. The Councils, however, may make annual seasonal adjustments based on the most recent assessment. The Panel shall be composed of NMFS scientists, Council staff, Scientific and Statistical Committee members, and other state, university, and private scientists as deemed appropriate by the Councils.

The Panel will address the following items for each stock:

1. Stock identity and distribution. This should include situations where there are groups of fish within a stock which are sufficiently different that they should be managed as separate units. If several possible stock divisions exist, the Panel should describe the likely alternatives.

2. MSY **<u>and/or B_{MSY} (or appropriate proxies)</u>** for each identified stock. If more than one possible stock division exists, MSY **<u>and/or B_{MSY}</u>** for each possible combination should be estimated.

3. Condition of the stock(s) or groups of fish within each stock which could be managed separately. For each stock, this should include but not be limited to:

a. Fishing mortality rate relative to F_{MSY} and $F_{0.1}$ as well as **[$F_{20\%SPR}$]**, $F_{30\%SPR}$, and $F_{40\%SPR}$.

b. Spawning potential ratio (SPR).

c. Abundance relative to an adequate spawning biomass.

d. Trends in recruitment.

e. Acceptable Biological Catch (ABC) which will result in long-term yield as near MSY as possible.

f. Calculation of catch ratios based on catch statistics using procedures defined in the FMP as modified.

g. Estimate of current mix of Atlantic and Gulf migratory group king mackerel in the mixing zone for use in tracking quotas.

4. Overfishing:

a. A mackerel stock or migratory group is considered to be overfished when **[the transitional spawning potential ratio (SPR) is below 30 percent.]** **<u>the biomass is reduced below the MSST.</u>**

b. The South Atlantic Council's target level or optimum yield (OY) is 40 percent static SPR. The Gulf Council's target level or optimum yield (OY) is 30 percent static SPR. ABC is calculated based on the target level or optimum yield (SAFMC = 40 percent static SPR and GMFMC = 30 percent static SPR).

c. When a stock or migratory group is overfished **<u>(biomass is below MSST)</u>** **[(transitional SPR less than 30 percent)]**, a rebuilding program that makes consistent progress towards restoring stock condition must be implemented and continued until the stock is restored **<u>to MSY</u>** **[beyond the overfished condition]**. The rebuilding program must be designed to achieve recovery within an acceptable time frame **<u>consistent with the National Standard Guidelines, and</u>** as specified by the Councils. The Councils will continue to rebuild the stock **<u>above MSY</u>** until the stock is restored to the management target (OY) **<u>if different from MSY</u> [within an unspecified time frame]**.

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

e. The Councils have requested the Mackerel Stock Assessment Panel (MSAP) provide a range of possibilities and options for specifying **[an absolute biomass level which could be used to represent a depleted condition or state. In a future amendment, the Councils will describe a process whereby if the biomass is below such a level, the Councils would take appropriate action, including but not limited to, eliminating directed fishing mortality and evaluating measures to eliminate any bycatch mortality in a timely manner through the framework procedure.]** **<u>B_{MSY} and the MSST.</u>**

f. For species **[like cobia,]** when there is insufficient information to determine whether the stock or migratory group is overfished **[(transitional SPR)]**, overfishing is defined as a fishing mortality rate in excess of the fishing mortality rate corresponding to a default threshold static SPR of 30 percent, **<u>which is the MFMT</u>**. If overfishing is occurring, a program to reduce fishing mortality rates to at least the level corresponding to management target levels will be implemented.

5. Management options. If recreational or commercial fishermen have achieved or are expected to achieve their allocations, the Panel may delineate possible options for non-quota restrictions on harvest, including effective levels for such actions as:

a. Bag limits.
b. Size limits.
c. Gear restrictions.
d. Vessel trip limits.
e. Closed season or areas, and
f. Other options as requested by the Councils.

6. **The Panels may also recommend more appropriate levels or statements for the MSY (or proxy), OY, MFMT, and MSST for any stock, including their rationale for the proposed change.**

7. Other biological questions as appropriate.

B. The Panel will prepare a written report with its recommendations for submission to the Councils each year (even years - full assessment, odd years - mini assessments) by such date as may be specified by the Councils. The report will contain the scientific basis for their recommendations and indicate the degree of reliability which the Council should place on the recommended stock divisions, levels of catch, and options for non-quota controls of the catch.

C. The Councils may take action based on the panel report or may take action based on issues/information that surface separate from the assessment group. The steps are as follows:

1. Assessment panel report: The Councils will consider the report and recommendations of the Panel and such public comments as are relevant to the Panel's report. Public hearings will be held at the time and place where the Councils consider the Panel's report. The Councils will consult their Advisory Panels and scientific and Statistical Committees to review the report and provide advice prior to taking final action. After receiving public input, the Councils will make findings on the need for changes.

2. Information separate from assessment panel reports: The Councils will consider information that surfaces separate from the assessment group. Council staff will compile the information and analyze the impacts of likely alternatives to address the particular situation. The Council staff report will be presented to the Council. A public hearing will be held at the time and place where Councils consider the Council staff report. The Councils consult their Advisory Panels and Scientific and Statistical Committees to review the report and provide advice prior to taking final action. After receiving public input, the Councils will make findings on the need for changes.

D. If changes are needed in the following, the Councils will advise the Regional Administrator (RA) of the Southeast Region of the National Marine Fisheries

Service in writing of their recommendations, accompanied by the assessment panel's report, relevant background material, and public comment:

a. MSYs **or B_{MSY} (or proxies)**,
b. overfishing levels **(MFMT) and overfished levels (MSST)**,
c. TACs **and OY statements**,
d. quotas (including zero quotas),
e. trip limits,
f. bag limits (including zero bag limits),
g. minimum sizes,
h. reallocation of Atlantic group Spanish mackerel,
i. gear restriction (ranging from modifying current regulations to a complete prohibition),
j. permit requirements, or
k. season/area closure and reopening (including spawning closure).

Recommendations with respect to the Atlantic migratory groups of king and Spanish mackerel will be the responsibility of the South Atlantic Council, and those for the Gulf migratory groups of king and Spanish mackerel will be the responsibility of the Gulf Council. Except that the SAFMC will have responsibility to set vessel trip limits, closed seasons or areas, or gear restrictions for the northern area of the Eastern Zone (Dade through Volusia Counties, Florida) for the commercial fishery for Gulf group king mackerel. This report shall be submitted by such data as may be specified by the Councils.

For stocks, such as cobia, where scientific information indicates it is a common stock that migrates through the Gulf and South Atlantic jurisdictions, both Councils must concur on the recommendations. For other stocks, such as bluefish, cero, little tunny, and dolphin, there is no scientific information that shows they are common stocks, and each Council will separately make management recommendations for these stocks in their jurisdictions.

E. The RA will review the Councils' recommendation, supporting rationale, public comments and other relevant information, and if the RA concurs with the recommendation, the RA will draft regulations in accordance with the recommendation. The RA may also reject the recommendation, providing written reasons for rejection. In the event the RA rejects the recommendation, existing regulations shall remain in effect until resolved. However, if the RA finds that a proposed recreational bag limit for Gulf migratory group or groups of king mackerels is likely to exceed the allocation and rejects the Councils' recommendation, the bag limit reverts to one fish per person per day.

F. If the RA concurs that the Councils' recommendations are consistent with the goals and objectives of the plan, the National Standards, and other applicable law, the RA shall implement the regulations by proposed and final rules in the Federal Register prior to the appropriate fishing year or such dates as may be agreed upon with the Councils. A reasonable period for public comment shall be afforded, consistent with the urgency, if any, of the need to implement the management measure.

Appropriate regulatory changes that may be implemented by the RA by proposed and final rules in the Federal Register are:

1. **[Adjustment of the point estimates of MSY for cobia, for Spanish mackerel within a range of 15.7 million pounds to 19.7 million pounds, and for king mackerel within a range of 21.9 million pounds to 35.2 million pounds.]** Adjustment of the overfishing level **(MFMT)** for king and Spanish mackerels **and other stocks. Specification of B_{MSY} and the MSST for the stocks. Respecification of levels or statements of OY and MSY (proxy).**

2. Setting total allowable catches (TACs) for each stock or migratory group of fish which should be managed separately, as identified in the FMP provided:

   a. No TAC may exceed the best point estimate of MSY by more than 10 percent **for more than one year**.

   b. No TAC may exceed the upper range of ABC if it results in overfishing **[as defined in Section 12.6.1.1(A)(4)]**.

   c. Downward adjustments of TAC of any amount are allowed in order to protect the stock and prevent overfishing.

   d. Reductions or increases in allocations as a result of changes in the TAC are to be as equitable as may be practical utilizing similar percentage changes to allocations for participants in a fishery.

3. Adjusting user group allocations in response to changes in TACs according to the formula specified in the FMP.

4. The reallocation of Atlantic Spanish mackerel between recreational and commercial fishermen may be made through the framework after consideration of changes in the social and/or economic characteristics of the fishery. Such allocation adjustments shall not be greater than a ten percent change in one year to either sector's allocation. Changes may be implemented over several years to reach a desired goal, but must be assessed

each year relative to changes in TAC and social and/or economic impacts to either sector of the fishery.

5. Modifying (or implementing for a particular species):

   a. quotas (including zero quotas)
   b. trip limits
   c. bag limits (including zero bag limits)
   d. minimum sizes
   e. re-allocation of Atlantic group Spanish mackerel by no more than 10 percent per year to either the commercial or recreational sector.
   f. gear restriction (ranging from modifying current regulations to a complete prohibition)
   g. permit requirements, or
   h. season/area closures and re-openings (including spawning closure)

   Authority is also granted to the RA to close any fishery, i.e., revert any bag limit to zero, and close and reopen any commercial fishery, once a quota has been established through the procedure described above; and such quota has been filled. When such action is necessary, the RA will recommend that the Secretary publish a notice in the Federal Register as soon as possible.

8.3 RED DRUM

The Red Drum FMP was developed by NMFS as a result of Congressional concern over an escalating EEZ fishery targeting the adult stock with purse seines. The FMP was implemented on December 19, 1986 and prohibited a directed commercial fishery in the EEZ, but allowed an incidental catch allowance of 300,000 pounds annually by the commercial sector and an EEZ bag limit of 1 fish by the recreational sector.

The Council developed Amendment 1 that was implemented in October 1987. The amendment continued to allow the incidental catch allowance for the commercial sector and a 1-fish bag limit for the recreational sector for the EEZ off Louisiana, Mississippi, and Alabama (Primary area), but prohibited harvest or possession in the EEZ off Texas and Florida (secondary areas).

Amendment 2 implemented in 1988 prohibited retention and possession of red drum from the EEZ. This action was based on a Southeast Fisheries Science Center (SEFSC) stock assessment (Goodyear 1987), that concluded the annual F for 1986 on the juvenile population was on the order of 2.0; consequently, escapement rates to the SSB were likely less than 2.0 percent. This escapement rate would not maintain the SSB at a 20 percent SSBR relative to the unfished stock. In addition, F on the offshore stock was estimated to be about 0.25 (22 percent annually). The 1987 Red Drum Stock Assessment Panel (RDSAP) report recommended that acceptable ABC be set at zero for the EEZ and that the states increase the escapement rate from the estuaries to 20 percent. The SEFSC Stock Assessment report (Goodyear 1989) indicated that the SSBR would likely decline to 13 percent. The 1989 RDSAP recommended ABC for the EEZ be maintained at zero, and that the states increase escapement to 30 percent.

The status of the stock has been monitored approximately biennially, and the prohibition on harvest and possession of red drum from the EEZ has continued through the present. The states, independently and cooperatively, have implemented the rules for rebuilding the stock by regulating the inshore fishery to try to achieve an escapement rate to the spawning stocks of 30 percent or greater for each cohort. Table 17 illustrates the current state restrictions as compared to the restrictions in 1986 regulating the fishery.

Red drum Sciaenops ocellatus is the only species managed under the FMP.

8.3.1 Current Status of the Stock

The RDSAP (1996) reviewed the Goodyear (1996) stock assessment, the results of state stock assessments (Murphy 1996; Shepard 1996), and the data analyses provided by other states. The RDSAP (1996) report included the following assessments and recommendations:

> Virtual population analysis (VPA) techniques were used to evaluate historic fishing mortality rates. Preliminary results were consistent with previous findings that juveniles experienced high fishing mortality rates prior to the implementation of conservation actions after about 1986. Estimates of escapement rates (the probability of surviving fishing through age 4) declined from an average of about 10 percent in the early 1980s to below 1 percent in 1986 and 1987. If fishing mortality patterns existing in 1994 and 1995 (Figure 18 in Goodyear 1996) persist in the fishery, the Gulf-wide average escapement rate is expected to exceed 50 percent by 1999. If the VPA estimates are assumed to be correct and the pre-1979 fishing mortality rates were equal to those in 1979, then the unweighted transitional spawning potential ratio (SPR) would have been 13 percent in 1979. Under the same assumptions SPR declined to a low of about 6 percent in 1992. If fishing mortality remains constant at the estimated rates in 1995 then SPR will reach about 20 percent in 2001(from Figure 19 in Goodyear 1996).
>
> Based on the best available data, the Panel concludes that the spawning stock is currently below 20 percent SPR, but SPR is increasing. The SPR increase is directly related to the conservation measures implemented by the states. The projected estimate of

> Gulf-wide escapement rate may be more pessimistic than expected based on the 1993 assessment (Goodyear 1993). However, if the fishing mortality rates estimated for 1995 are held constant in the future, then the Council's SPR goal will be met in the year 2001. Given that the conservation measures are producing the desired results and that the current estimate of SPR is below the Council's definition of overfishing at 20 percent SPR, the Panel recommends that the ABC be set at zero.
>
> We wish to point out to the states and the Council that the attainment of 20 percent SPR will result in increased inshore and offshore abundances. This is expected. The states and the Council must be prepared to maintain these high levels of abundance and to resist relaxation of regulations until the Council's goal of 20 percent SPR has been met.

The assessment determination by the RDSAP (1996) is more pessimistic than that by the RDSAP in 1993. This is largely because data from state surveys compiled by Goodyear (1996) indicated that escapement rates of juveniles to the spawning stock were not as high as previously estimated, i.e., F on the juveniles was higher. The RDSAP (1993) analysis was as follows:

> Estimates of escapement through age 3 averaged about 10 percent in the early 1980s to about 1 percent in 1986/1987, increasing to above 40 percent in 1991. The transitional SPR was estimated to be about 10 percent in 1992, but it is projected to reach 20 percent by 1997 under existing regulations. The 1992 estimate of static SPR for red drum was about 44 percent. The median fishing mortality rate based on stock-recruitment estimates is higher than either $F_{30\%}$ or $F_{20\%}$, suggesting that the stock will increase in size if fishing mortality can be reduced below $F_{20\%}$.

The RDSAP (1996) also recommended that the next stock assessment be delayed until NMFS completed a tag/recapture study of the size of the offshore spawning population. That study will be useful in tuning the VPA model and should be available in 1999.

8.3.2 Maximum Sustainable Yield (MSY)

MSY for red drum was calculated considering three growth rates, three levels of inshore loss rates (Z), three levels of inshore natural mortality (M), three levels of offshore natural mortality, and three levels of migration rates from inshore to offshore groups (NMFS 1986). From this array of 243 alternatives, the best point estimate of MSY was determined to be 17.4 MP. There was an 80 percent probability that the MSY was greater than 10 MP, and 65 percent probability that MSY was between 10 and 25 MP. The reliability of the MSY figure should be reassessed by the RDSAP.

As pointed out by Mace et al. (1996), since the fishing mortality is on the subadults, MSY is lower than otherwise might be the case.

8.3.2.1 MSY Alternatives

Proposed Alternative: MSY is equivalent to 30 percent static SPR.

Alternatives Considered and Rejected:

Alternative 1: MSY is equivalent to 40 percent (or higher) static SPR.

Alternative 2: MSY is equivalent to 35 percent (or higher) static SPR.

Alternative 3: MSY is equivalent to 25 percent static SPR.

Alternative 4: MSY is equivalent to 20 percent static SPR.

Alternative 5: Retain the current estimate of MSY (in pounds) for red drum.

Alternative 6: Status quo - no action

Discussion: Mace et al. (1996) listed red drum with the mackerels and reef fish as stocks that appear to be resilient to overfishing; therefore, a 30 to 40 percent level of SSBR or SPR may be an appropriate proxy for MSY. Red drum are longlived (40+ years) like red snapper. Since the MSY computed by NMFS of 17.4 MP was based on data related to the fishery on subadult fish, it may be a more appropriate estimate of MSY for the fishery than a SPR or SSBR proxy. Figure 8 (from Goodyear 1996) shows that combined recreational and commercial landings for the period of 1979-1995 have been below that MSY estimate, except during the years of the offshore purse seine fishery. A tag and recapture study completed in 1987 estimated the size of the offshore population biomass at 123 MP. However, escapement to spawning biomass was estimated at 1 percent for 1986/87 (Mace et al. 1996).

The first FSAP (July 1998) recommended that the MSY proxy for red drum be set at 30 percent SPR level. (See SFA discussion under Sections 8.1.2.1, for reef fish, and 8.2.2.1, for mackerels.)

The second FSAP (August 1998) recommended that the MSY proxy be 20 percent SPR. Part of the rationale for this recommendation was that existing fishing is concentrated on a few year-classes, while spawning is provided by a large number of year-classes. The level of 20 percent was contingent on a 30 percent escapement level from the juvenile fishery to the spawning stock, with the escapement rate set at a higher value recognizing that some harvest of mature fish occurs in state waters. The most recent estimates by the states (Murphy 1996) (Shepard 1996) indicate escapement levels are much higher than 30 percent. The recommendation was also contingent on continuation of the moratorium on harvest of adult red drum in federal waters, which will occur under the Proposed Alternative.

The Council elected to take a more precautionary approach by selecting as their Proposed Alternative a MSY proxy of 30 percent static SPR. The Council feels, based on the information available to it and on the recommendations of the SAPs, that SPR has been set at the appropriate level for each stock. The use of higher SPR levels would overestimate MSY and result in more restrictive management measures than are necessary. The use of lower SPR levels would underestimate MSY and not maintain the condition of the stock at the optimum level.

Biological Impacts: The level selected by the Council should, over time, result in enhancement of the spawning stock and stock abundance. It should also allow the stock to rebuild to its MSY level; however, there are insufficient data to determine a timeframe for rebuilding at this time.

Economic Impacts: The specification of MSY has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. Pending more concrete measures designed to achieve or maintain an MSY level, the general discussions undertaken with respect to MSY alternatives for reef fish are included herein by reference.

The harvest or possession red drum fishery in the EEZ has been closed to both commercial and recreational fishing since 1988, so that adoption of any of alternatives for MSY would entail no immediate adverse effects on fishing participants. However, the higher the SPR level chosen, as is the case with the Proposed Alternative, the longer the fishery will be closed. Benefits in the remote future would be highly discounted, and it would have to very large in order to economically justify longer fishery closure.

Environmental Consequences:

Human Resources: The time required to restore the stock to levels above the overfishing threshold will be extended by the proposed action which will delay the harvest opportunity in federal waters, adversely affecting the commercial sector which is denied a harvest opportunity in most state waters. However, the proposed action will, over the long-term, result in higher abundance available for harvest in the federal waters when MSY is reached.

Fishery Resources: The red drum stock will benefit from the proposed action to restore the stock to a higher level of SPR.

Other Fishery Resources: Increased abundance of red drum may reduce fishing pressure on some other stocks, while other stocks of prey species may be reduced by increased predation by red drum.

8.3.3 Optimum Yield (OY)

The current statement of OY from the FMP is as follows:

1. All red drum recreationally and commercially harvested from state waters landed consistent with state laws and regulations under a goal of allowing 30 percent escapement of the juvenile population.

2. All red drum commercially or recreationally harvested from the Primary Area of the EEZ under the TAC level and allocations specified under the provisions of the FMP, and a zero retention level from the Secondary Areas of the EEZ. (Note: TAC for the EEZ has been set at zero since 1988.)

Overfishing is defined as a fishing mortality that prohibits attaining the spawning stock goal or threshold which is currently set at a 20 percent SSBR ratio.

8.3.3.1 OY Alternatives

Proposed Alternative: OY is equivalent to 30 percent static SPR.

Alternatives Considered and Rejected:

Alternative 1: OY is equivalent to 45 percent static SPR.

Alternative 2: OY is equivalent to 40 percent static SPR.

Alternative 3: OY is equivalent to 35 percent static SPR.

Alternative 4: **OY is equivalent to 20 percent static SPR.**

Alternative 5: **Maintain an escapement rate of subadults to the spawning stock of 30 (or 40) percent.**

Alternative 6: **OY is set equivalent to MSY in pounds.**

Alternative 7: **Status quo - retain the current OY statement.**

Discussion: OY must be set lower than or equal to MSY if specified as a harvest level or fishing mortality rate. In terms of SPR levels OY would equate to a SPR higher than or equal to the SPR for MSY. It is not at all unusual for OY to be set at MSY since that is the largest long-term average yield that can be obtained from the stock. Under a precautionary or risk-averse approach OY would be set lower (higher SPR) than MSY.

Mace et al. (1996) and Goodyear (personal communication on Draft National Standard Guidelines 1997) pointed out that if the fishery continues to target the juveniles or subadults (as it always has historically), then the MSY yield at an equilibrium level will be much less than if the adults were targeted. The MSY control rules (Section 8.3.2) allow a harvest strategy that would be expected to result in a long-term catch approximating MSY. One of the examples of such a rule is to allow a constant escapement each year chosen to maximize the resulting long-term average yield. That management strategy is typically used for salmon management where adequate escapement of spawners is allowed upstream before harvest of the remaining stock is allowed. As long as the spawning stock of red drum is protected by slot limits and an EEZ prohibition on harvest, that strategy may be applicable to red drum. The guidelines provide that OY control rules similar to the MSY control rules may be specified; therefore, an alternative similar to the current OY statement may be appropriate under these circumstances, i.e., allowing 30 percent (or higher) escapement to the spawning stock. If the overfishing threshold for red drum is set higher than 20 percent SSBR (or SPR) then the escapement level likely would need to be set higher than 30 percent.

The second FSAP (August 1998) suggested the Council might consider a level higher than 20 percent SPR (their recommendation for the MSY proxy) as a precautionary approach for OY. The Council instead chose to set the MSY proxy higher at 30 percent SPR as a precautionary approach and OY equal to the MSY proxy. The Council feels, based on the information available to it and on the recommendations of the SAPs, that SPR has been set at the appropriate level for each stock. The use of higher SPR levels would overestimate OY and result in more restrictive management measures than are necessary. The use of lower SPR levels would underestimate OY and not maintain the condition of the stock at the optimum level.

Biological Impacts: In as much as the ABC range is based on achieving OY, the proposed action should have a beneficial effect on the stock, provided that catch does not continue at or above the upper estimate of the ABC range.

Economic Impacts: The specification of OY has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. Pending more concrete measures designed to achieve or maintain an OY level, the general discussions on OY alternatives for reef fish are included herein by reference.

One point earlier discussed for reef fish and needs reiterating here is the absence of economic and social factors in the specification of OY. This condition assumes greater importance for the red drum fishery considering that this fishery in the EEZ has been closed for about 10 years now. A higher SPR proxy for OY entails a longer recovery period so that benefits to be derived in the remote future would have to be very large to outweigh the effects of heavy discounting.

Environmental Consequences:

Human Resources: The effect would be as indicated under the MSY section.

Fishery Resources: The red drum stock will benefit from the proposed action and from having an OY statement that is measurable in terms of stock condition.

Other Fishery Resources: The effect would be as indicated under the MSY section.

8.3.4 Overfishing Criteria

The following is the definition of overfishing contained in the Red Drum FMP:

> Overfishing is defined as a fishing mortality rate that prohibits attaining the spawning stock goal or threshold which is currently set at a 20 percent SSBR ratio.

8.3.4.1 Overfishing Threshold Alternatives

Proposed Alternative: Set the overfishing threshold at a fishing mortality rate equivalent to 30 percent static SPR ($_{F30\%SPR}$).

Alternatives Considered and Rejected:

Alternative 1: Status Quo - no action, retain the current definitions.

<u>Alternative 2</u>: Set the overfishing threshold at a fishing mortality rate equivalent to 20 percent static SPR ($F_{20\%SPR}$).

<u>Alternative 3</u>: Set the overfishing threshold at a fishing mortality rate equivalent to 25 percent static SPR ($F_{25\%SPR}$).

<u>Alternative 4</u>: Set the overfishing threshold at a fishing mortality rate equivalent to 35 percent static SPR ($F_{35\%SPR}$).

<u>Alternative 5</u>: Set the overfishing threshold at a fishing mortality rate equivalent to 40 percent static SPR ($F_{40\%SPR}$).

<u>Alternative 6</u>: Set the overfishing threshold at a fishing mortality rate on subadults that would reduce the escapement rate to the SSB below 30 (or 40) percent.

<u>Discussion</u>: The final guidelines suggest that long-term average fishing mortality rate equivalent to a 30-40 percent level of spawning per recruit may be a reasonable proxy for the MSY fishing mortality rate. The Overfishing Alternatives represent the maximum fishing mortality threshold (MFMT) and should be specified at the SPR levels set for MSY in Section 8.1.2.1.

The second FSAP (August 1998) recommended that F_{MSY} (MFMT) be set at a 20 percent static SPR (see discussion under MSY in Section 8.3.2.1). The Council elected to take a more precautionary approach and set F_{MSY} (MFMT) at 30 percent static SPR. The Council feels, based on the information available to it and on the recommendations of the SAPs, that SPR has been set at the appropriate level for each stock. The use of higher SPR levels would overestimate MFMT and result in more restrictive management measures than are necessary. The use of lower SPR levels would underestimate MFMT and not maintain the condition of the stock at the optimum level.

<u>Biological Impacts</u>: The proposed action should, over time, result in enhancement of the spawning stock and increased stock abundance.

<u>Economic Impacts</u>: The specification of an overfishing threshold has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. It is only instructive to note that the higher the SPR level specified to correspond to an overfishing threshold, the more restrictive would be the short-term measures adopted. These measures would be more restrictive the further the current status of any stock is to the specified threshold level. Given the fact that the red drum fishery in the EEZ has been closed to fishing, no immediate more restrictive measures would be imposed. Under this condition, attention should be shifted to the length of time the fishery would remain closed. An SPR level that is high, as is the case with the Proposed Alternative, implies that the fishery would most likely remain close for a good period of time. Future benefits have to be substantially large to outweigh the effects of discounting.

Environmental Consequences:

Human Resources: The effect would be as indicated under the MSY section.

Fishery Resources: The condition of the stock should improve by the proposed action, and be maintained at or above MSY.

Other Fishery Resources: The effect would be as indicated under the MSY section.

8.3.4.2 Overfished Threshold Alternatives

The guidelines provide that the overfished threshold be a minimum stock size threshold (MSST) which should be expressed in terms of spawning biomass or other measure of productive capacity. The guidelines provide that this threshold should equal whichever of the following is greater: (1) one-half of MSY or (2) the minimum stock size at which rebuilding to the MSY level is expected to occur within 10 years.

The first FSAP (July 1998) provided the following discussion and suggestion on computing the MSST:

> The ideal value of MSST depends on the resiliency of the stock, which in the case of the stocks examined in this report, is not well established. The FSAP believes that the most appropriate strategy to address this issue would be through analyses by the respective stock assessment panels for each FMP. In the interim, the FSAP recommends that MSST be set equal to the stock size associated with the maximum fishing mortality threshold (MFMT) multiplied by the greater of 1 minus the natural mortality rate (M) or 0.5. Such a rule of thumb for MSST is intuitively appealing because one would expect stocks with a higher M to recover faster, on average, than stocks with a lower M.

The intent of the first FSAP in using the multiples of 1.0-M was that this should be somewhat related to restoration of the stock, that becomes overfished, within the 10-year period. That is because longer-lived fish tend to have lower rates of M and restoration of such a stock takes longer. It also creates a relatively narrow range between the overfishing threshold and overfished threshold.

The second FSAP (August 1998) recommended that the proxy for B_{MSY} for red drum pelagic stocks be set at 20 percent transitional SPR. Subsequent to that time, the NMFS SERO hosted a workshop to discuss technical guidance on the use of precautionary approaches to implementing national standard 1 (NOAA 1998). The consensus reached at that meeting was that transitional SPRs were not appropriate as a proxy for B_{MSY}, and that B_{MSY} and especially MSST (overfished threshold) must be expressed in terms of biomass. The conclusion of the Councils and NMFS was as follows:

> Evaluation of stock status for southeastern FMP species have generally relied on per recruit estimates of spawning potential (transitional SPR), thus estimates of biomass at MSY (B_{MSY} or proxies thereof) and of current biomass are generally not available. Where the information for calculating (B_{MSY}) are available in the Stock Assessment Panel reports, as they are for red snapper and mackerel, B_{MSY} can be estimated. For many other stocks, an estimate of B_{MSY} (or proxy thereof) can be obtained as the product of the amount of expected spawning biomass per recruit at the MSY fishing mortality (F_{MSY}) and an estimate of expected recruitment levels at B_{MSY} and estimates of current biomass require further evaluation of the available data. These evaluations will take place within the year.

Therefore, the Council's Proposed Alternative is that the overfished threshold (or MSST) will be implemented for the stock by framework measure as estimates of B_{MSY} and MSST are developed by NMFS, the RDSAP, and Council.

Alternatives Considered and Rejected:

Alternative 1: Set the overfished threshold (MSST) at a transitional SPR level equivalent to 50 to 70 percent of the SPR level for the MSY proxy.

Alternative 2: Set the overfished threshold (MSST) at a transitional SPR level equivalent to 1.0-M times the SPR level for the MSY proxy.

Alternative 3: Set the overfished threshold (MSST) at a transitional SPR level equivalent to the SPR level for the MSY proxy.

Discussion: While NMFS has suggested the MSST be stated only in terms of biomass, the fact remains that that type of estimate is not available for most, if not all, Gulf stocks. The use of the transitional SPRs as an interim statement for the MSST would seem beneficial, especially as the status of the stock in relation to this standard can be readily determined. See Section 8.1.4.2 for additional rationale for rejecting the alternatives.

8.3.5 Rebuilding Periods

8.3.5.1 Rebuilding Period Alternatives

There are insufficient data to determine the rebuilding period for red drum. No estimate of the time to rebuild the stock to the 30 percent SPR level in the absence of a directed fishery is available nor is an estimate of the generation time available. When this information becomes available, the Council will specify the rebuilding period through the framework measure which has been modified for that purpose.

8.3.6 Procedure for Specifying TAC

Based on the SFA and National Standard Guidelines, the procedure is modified as follows (Deletions are bolded in brackets; new language is underlined and bolded.):

1. Prior to October 1 every other year, or at such time as agreed upon by the Council and Regional Director, the SEFSC will: a) update the stock assessment for red drum; b) reassess the MSY **and/or B_{MSY}** levels; c) specify the best estimate of the standing stock and its age composition; d) re-examine the spawning stock requirements and specify escapement levels **(ranging from 20 to 50 percent)** that are needed to achieve these requirements; e) specify the geographical variations in stock abundance, mortality, juvenile escapement and recruitment, and summarize current and historical information on migratory movements of the stock; and f) analyze social and economic data available for the fishery.

2. The Council will convene a scientific stock assessment group, appointed by the Council, that will review the SEFSC report(s), current harvest statistics, economic, social and other relevant data and who will prepare a written assessment report to the Council specifying a range of acceptable biological catch (ABC) **[for the Primary Area]**. The report will set forth a risk analysis showing the probabilities of adversely impacting the spawning stock biomass (SSB) through fishing at each level of ABC and the economic and social impacts of those levels. Such a report shall include consideration of the fishing mortality rate(s) **for F_{MSY}, $F_{0.1}$, $F_{20\%SPR}$, and $F_{30\%SPR}$** **[abundance relative to the spawning stock goal or threshold]**; trends in recruitment; and, whether overfishing is occurring for the stock as a whole or upon a portion of the stock for any geographical area. **[The specification of ABC shall separately identify that quantity of the offshore population in excess of the spawning stock goal or threshold and in excess of annual surplus production that may be harvested.]** **The Panel will review the SEFSC recommendations for B_{MSY} and recommend to the Council the derivation of the minimum stock size threshold (MSST) from B_{MSY}. The Panel will also recommend escapement rates for juvenile fish to the spawning stock. The Panel may also specify more appropriate levels or statements for MSY (or proxy), OY, and the MFMT.** This report will, when requested by the Council, include information on the levels of bag

limits, size limits, specific gear harvest limits, and other restrictions required to **[attain the escapement goal or]** prevent a user group from exceeding their allocation or quota under a TAC specified by the Council **[for the Primary Area]**, along with the economic and social impacts of such restrictions.

3. The Council will consider the report and recommendations of the assessment group and such public comment as may be relevant. A public hearing will be held at the time and place where the Council takes action on the report. Other public hearings may be held. The Council may convene its Red Drum Advisory Panel and Scientific and Statistical Committee to provide advice prior to taking action.

4. In selecting a TAC level, the Council will, in addition to consideration of the recommendations, comments, and advice provided for in (1), (2), and (3) above and the objectives of the FMP, utilize the following criteria:

   a. Set TAC from within or below the ABC range, and

   [b. Given a total specified quantity of offshore population (above annual surplus production) which is greater than a SSB necessary to optimize recruitment, the percentage of this quantity which may be included in the TAC shall be set by the Council periodically or annually.]

5. Changes in user group allocations **[for the Primary Area]**, if any, will be by subsequent plan amendment<u>**, except that estimates of B_{MSY} and MSST may be implemented by framework measure.**</u>

8.4 <u>SHRIMP</u>

Shrimp managed under the FMP consist of the following species:

Brown shrimp	<u>Penaeus</u> <u>aztecus</u>
White shrimp	<u>Litopenaeus</u> <u>setiferus</u>
Pink shrimp	<u>Penaeus</u> <u>duorarum</u>
Royal Red shrimp	<u>Hymenopenaeus</u> <u>robustus</u>

The 3 species of penaeid shrimp provide more than 99 percent of landings which are estimated to exceed 200 MP (tails) in years with favorable environmental conditions in the estuarine nursery grounds (Section 8.4.1.2). Maximum annual production of royal red shrimp has been on the order of 0.35 MP (tails). Royal red shrimp are a deep-water shrimp occurring primarily in depths of 140 to 300 fathoms. Brown shrimp provide the largest portion of annual landings, and in the northern Gulf, are commonly distributed from the Mexican border through Apalachicola Bay, Florida (GMFMC 1981). Brown shrimp are caught out to at least 50 fathoms, though most come from less than 30 fathoms. White shrimp are distributed from the Mexican border through Apalachee Bay

(Figure 11, GMFMC 1998). Typically, white shrimp are caught inshore of 15 fathoms. Pink shrimp are distributed across the northern Gulf (Figure 13, GMFMC 1998); but they are most common off southwest Florida, where they make-up most of the shrimp landings.

8.4.1 Penaeid Stocks

This section addresses the respecification of MSY, OY, and overfishing criteria for brown, white, and pink shrimp. A subsequent section addresses these parameters for royal red shrimp.

8.4.1.1 Current Status of the Stocks

Since 1991, NMFS has monitored the status of the shrimp stocks using the methodology of Nance et al. (1989), and Klima et al. (1990), as modified by the Shrimp Stock Assessment Panel (SSAP 1993) for white shrimp. Based on these monitoring reports, the Ad Hoc Crustacean Stock Assessment Panel (CSAP 1998) reached the following conclusion:

> Parent stocks for all 3 species have remained well above the MSY parent stock minimum for about 30 years. Even during the recent reduction of pink shrimp recruitment in south Florida, the stock maintained adequate spawning potential. Overfishing does not appear imminent for any of the three species of *Penaeus*.

8.4.1.2 Maximum Sustainable Yield (MSY)

MSY values were computed in the Shrimp FMP (GMFMC 1981) and presented with the following explanation:

The biological characteristics that affect sustainable yields for penaeid shrimp are unusual. They are an annual crop. Very few individuals live a year and the majority are harvested at less than six months of age. There is no demonstrable stock-recruitment relationship and recruitment overfishing, given present technology, is essentially impossible. That is, it is not economically or technically feasible to take so many shrimp that there are too few survivors to provide an adequate supply for the following year. Because of these characteristics, fishing mortality and yield in one year do not affect yield in the following year. The maximum yield in number for a given year is essentially all the shrimp available to harvest, using current technology.

Growth overfishing is caused by taking the available recruits at too small a size. If growth overfishing is occurring, allowing additional time for growth will result in a greater total yield in weight, although the total number of individuals will be less. The rapid growth rate of penaeid shrimp makes them resistant to growth overfishing until high levels of effort are reached. Effort in the fishery has been increasing rapidly (i.e., 1960 through 1978), and it is probable that the total yield of penaeid shrimp could be increased if the average size taken was larger. However, the poor quality and small amount of available data make it difficult to precisely estimate the magnitude of any increase or its effect on price.

The abundance (number of recruits) and resulting yield and CPUE, vary greatly from year to year depending on the temperature and salinity in the estuarine nursery areas. This is evident when regression coefficients for the different models are compared. For example, linear regressions of catch on effort showed that effort alone explained only 38 percent of the variation in catch of Louisiana white shrimp and 57 percent of the variation in Gulf brown shrimp catch. Multiple regressions including environmental parameters explained 89 percent and 88 percent respectively. For brown shrimp, the environmental model predicts that at a fishing effort of 100,000 units (essentially the record until 1976), annual catch would vary from 57 to 88 million pounds provided that temperature and salinity ranged within 1963-1975 levels. If environmental conditions were more favorable, a greater yield would be expected. Given environmental conditions slightly better than previously observed and high levels of effort, the maximum probable catch of brown shrimp is estimated at 116.4 million pounds tails, 37.6 percent greater than the point estimate of MSY from a Schaefer surplus production model.

Surplus production models utilize trends in catch and fishing effort over a series of years. They were designed for, and are usually applied to, species with multiple year classes, (i.e., individual animals live longer than one year). They do not consider fluctuations in recruitment controlled by the environment, but assume that environmental effects are constant. The predictive ability of these models, particularly in the range of fishing effort that might produce overfishing, is at its best for long-lived species and/or those that are not subject to large, environmentally produced fluctuations in recruitment. Because penaeid shrimp meet neither of these criteria, application of surplus production models must be made with caution and with an understanding of what is being predicted by the model. Estimates of MSY produced should be considered as long-term averages that are greatly affected by environmental conditions. They should not be considered a maximum allowable catch for a given year.

The Schaefer version of the surplus production model was chosen to estimate MSY in all three species because: (1) sufficient data were available; (2) it fit the data as well as other models which gave similar estimates of MSY; and (3) was mathematically easier to use. The estimate was calculated using only reported catch and effort from the commercial fishery. Estimates of the recreational catch, bait catch, and discarded undersized shrimp are added, for a total MSY of 165 million pounds of tails annually for the three species.

	Schaefer Commercial[1]	Recreational	Bait	Discard	Total
Brown shrimp	85	8	2	5	100
White shrimp	38	8	1	3	50
Pink shrimp	14	_	1	-	15
Total	**137**	**16**	**4**	**8**	**165**

For the three penaeid species, surplus production models indicate only a long term average yield, and not an allowable maximum. The catch in any given year can only be estimated using environmental factors and expected effort for that particular year.

A reasonable estimate of the maximum probable catch of white and pink shrimp can be estimated by applying the percentage by which the maximum probable catch of brown shrimp exceeds the Schaefer MSY estimate to all species (i.e, by 37.6 percent). Estimates of bait catch, recreational catch, and discards are then added to give a total maximum probable catch of 216 million pounds of tails.

	Schaefer Commercial Estimate	Maximum Commercial Yield Considering Environmental Factors (137.6%)	Recrea-tional	Bait	Discard	Total
Brown shrimp	85	117	8	2	5	132
White shrimp	38	52	8	1	3	64
Pink shrimp	14	19	-	1	-	20
Total	**137**	**188**	**16**	**4**	**8**	**216**

The CSAP (1998) reviewed the MSY section of the FMP and offered the following comments and recommendations:

> The definition of MSY with respect to the status of the existing fishery was a contentious issue during the original development of the shrimp FMP because the annual harvest levels upon which any point estimate of MSY was based varied by up to 30 percent, due to environmental factors affecting survival in the nursery grounds. The authors of the plan wanted to stress the dependence of harvest on the environment, but objections were raised because the plan would allow yields above any stated MSY. The plan authors, therefore, presented point estimates of MSY, the maximum probable catch under optimum environmental conditions, and an estimate of maximum effort for a sustainable fishery. With the increased experience with FMPs, it should now be recognized that shrimp harvests can exceed a long-term

[1] All weights are in millions of pounds, tail weight

average MSY for perhaps several years without damage to stock productivity, and conversely, that harvests below MSY might be excessive during periods of low recruitment. The CSAP believes that maintaining sufficient spawning stock is much more appropriate for shrimp management than comparing catches to MSY values.

8.4.1.2.1 MSY Alternatives

Proposed Alternative: The CSAP recommends that the proxy for the MSY spawning stock size be defined as the parent stock numbers (as indexed from current VPA procedures) for the three penaeid species of shrimp in the Gulf of Mexico at or above the following levels:

Brown Shrimp - 125 million individuals, age 7+ months during the November through February period.

White Shrimp - 330 million individuals, age 7+ months during the May through August period.

Pink Shrimp - 100 million individuals, age 5+ months during the July through June year.

Alternatives Considered and Rejected:

Alternative 1: Specify MSY in terms of SPR or SSBR.

Alternative 2: Status Quo - Specify MSY in terms of numerical values computed in the original FMP using the Schaefer surplus population model set forth in Section 8.4.1.2 above.

Discussion: The CSAP (1998) recommended the Proposed Alternative as the appropriate proxy for MSY use as a status determination criteria for determining when overfishing is occurring, i.e., as the MSY control rule harvest strategy which would be expected to result in a long-term average catch approximating MSY. Allowing a constant escapement each year chosen to maximize the long-term average yield is an acceptable control rule under the guidelines.

The CSAP and the drafters of the FMP cautioned against the use of the point estimates of MSY from the Schaefer surplus production models as a method of monitoring the status of the stock, i.e., the Status Quo Alternative. Discussion of these concerns is set forth in Section 8.4.1.2 above. The CSAP did not feel that SPR or SSBR levels were appropriate for shrimp since they are an annual crop, and no stock recruitment relationship based on immigration of shrimp larvae into estuaries has ever been demonstrated (GMFMC 1981). Annual production is largely dependent on survival of the post-larvae in the estuaries.

<u>Biological Impacts</u>: Because the overfishing threshold (Section 8.4.1.4) is based on a maximum fishing mortality rate associated maximizing the long-term average yield at or near MSY, the Proposed Alternative appears to be the best alternative for a proxy for MSY. This is supported because analyses for the penaeid shrimp stocks over the past 30 years have indicated that stocks maintained at a parent stock level above the minimums specified in the Proposed Alternative have always been able to produce MSY. NMFS assesses the condition of the penaeid shrimp stocks annually based on the proposed standards.

<u>Economic Impacts</u>: The specification of MSY has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. At this time, it is only instructive to note that the higher the shrimp parent stock level specified to correspond to MSY, the more restrictive would be the short-term measures adopted. These measures would be more restrictive the further below the current status of any stock is to the specified MSY level.

To date none of the shrimp species under consideration has fallen below the MSY levels specified under the Proposed Alternative, so that adoption of this alternative would not require a change in regulatory measures affecting the shrimp fishery, thus precluding any adverse impacts on fishing participants, at least over the short run.

Whereas for finfish, an argument could be made to specify MSY in yield terms, the case for the three shrimp species under consideration using parent stock size appears to be sufficient. The main reason for this is that these species are basically annual crops and that there is good reason to fish as much of the standing stock as possible provided an escapement level specified as MSY is maintained.

<u>Environmental Consequences</u>:

Human Resources: The proposed action would not alter the effects on the human resources in that it retains the harvest strategy used for the past 10 years to assure that the stocks are not overfished.

Fishery Resources: The proposed action essentially maintains the status quo and does not alter the effects on penaeid shrimp resources.

Other Fishery Resources: Other fishery resources that prey upon shrimp are benefitted by retaining the harvest strategy that assures the stocks are not overfished.

8.4.1.3 <u>Optimum Yield (OY)</u>

The current statement of OY for penaeid shrimp is as follows:

OY is determined to be: All the shrimp that can be taken during open seasons in permissible areas in a given fishing year with existing gear and technology without resulting in recruitment overfishing. The Council has determined that, because of the annual nature of the resources, a numerical value for OY cannot be calculated for any given year until the environmental factors can be determined and evaluated. However, under optimum environmental conditions and maximum effort the maximum probable catch for brown, white, and pink shrimp is estimated to be 216 million pounds of tails.

8.4.1.3.1 OY Alternatives

Proposed Alternative: Set OY equal to MSY (or proxy for MSY).

Alternatives Considered and Rejected:

Alternative 1: Set OY at some level lower than MSY (or proxy for MSY).

Alternative 2: Status Quo - Retain the current statement of OY.

Discussion: The CSAP (1998) offered no comment on the economic or social factors that could be considered in specifying OY. They provided the following recommendations:

> There are no known biological considerations that would require the setting of OYs at levels below those attaining the MSY proxies. Under current management practices, OY is actually a consequence, not a target, of the varied strategies to obtain shrimp at different desired sizes in different regions of the Gulf. Using spawning population to define overfishing has the advantage of separating the essentially economic decisions about utilization of a given recruitment from more serious biological concerns about compromising possible future recruitments.

The CSAP position supports adoption of the Proposed Alternative.

Under the guidelines, Alternative 2 would be inappropriate since OY is not translatable into a numerical estimate. The Proposed Alternative would make OY control rule essentially the same as the MSY control rule.

Biological Impacts: As indicated in the CSAP (1998) position stated above, there is no beneficial biological reason to set OY at a level different from MSY; consequently, there should be no negative biological impact from the Proposed Alternative.

<u>Economic Impacts</u>: The specification of OY has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. At this time, it is only instructive to mention two points.

First, while the specification of MSY in terms of parent stocks (under the Proposed Alternative for MSY) was considered appropriate, there appears to be no reason why OY cannot be specified in yield terms. The status quo alternative, provided recruitment overfishing is considered to occur at or below the MSY level as defined under the Proposed Alternative for MSY, appears to be closer to a more appropriate alternative for OY. As noted earlier in connection with the definition of MSY, the three species of shrimp under consideration are annual crops. As such, there exists good reason to fish as much of the standing stock as possible provided an escapement level specified as MSY is maintained. A more appropriate statement of OY would thus be any harvest level, constrained by the requirement to maintain parent stock levels specified as MSY, that maximizes net economic (and social) benefits.

Second, given the fact that all three shrimp species has not experienced any condition wherein the parent stocks fell below the specified OY (equated to MSY under the Proposed Alternative), these species must now be harvested at their OY levels.

<u>Environmental Consequences</u>:

Human Resources: The users of the penaeid shrimp resources are benefitted by selection of an OY equal to MSY (see below).

Fishery Resources: The proposed actions essentially retain the status quo harvest strategy; therefore, the penaeid stocks are not effected. There is no biological benefit for selection of an OY less than MSY.

Other Fishery Resources: Other fishery resources are not effected by the proposed action.

8.4.1.4 <u>Overfishing Criteria</u>

The following are the definitions of overfishing contained in the Shrimp FMP, as amended:

A parent stock level of 125 million shrimp is proposed to be the lower limit used to define recruitment overfishing for brown shrimp. Parent stock for brown shrimp is defined as the number of age 7+ (months) shrimp during the period of November through February (GMFMC 1991).

White shrimp recruitment overfishing is indicated when the parent stock is reduced below 330 million shrimp. Parent stock for white shrimp is defined as the number of age 7+ (months) shrimp during the period of May through August (GMFMC 1994).

A parent stock level of 100 million shrimp is proposed to be the lower limit used to define recruitment overfishing for pink shrimp. Parent stock for pink shrimp is defined as the number of age 5+ (months) shrimp during the period of July through June (GMFMC 1991).

Implement a recovery program if the parent stock for the species remains below the index for a second consecutive year.

8.4.1.4.1 Overfishing Threshold Alternatives

Proposed Alternative: The overfishing threshold is defined as a rate of fishing that results in the parent stock number for any of the penaeid species being reduced below the MSY minimum levels listed below:

Brown Shrimp - 125 million individuals, age 7+ months during the November through February period.

White Shrimp - 330 million individuals, age 7+ months during the May through August period.

Pink Shrimp - 100 million individuals, age 5+ months during the July through June year.

Response to Possible Overfishing:

If overfishing persists for 2 consecutive years, the CSAP recommended that the appropriate committees and/or panels (*e.g.* stock assessment panels, Advisory Panels, or Scientific and Statistical Committee) be convened to review changes in the parent stock size, changes in fishing effort, potential alterations in habitat or other environmental conditions, fishing mortality, and other factors that may have contributed to the decline. If excessive fishing is determined to be the source of, or a contributor to the reduced parent stock sizes, reduction in fishing pressure should be recommended.

Alternatives Considered and Rejected:

Alternative 1: Set the overfishing threshold at another level of parent stock number.

Alternative 2: Status Quo - retain same definitions.

Discussion: The CSAP (1998) agreed with the findings of Nance et al. (1989), Klima et al. 1990, and the Shrimp Stock Assessment Panel (1993) that the best way to define overfishing for the three species of *Penaeus* is in terms of spawning population size. Empirical comparisons of 30 years of landings data with the indices of spawning population size determined by VPA stock assessment were used by Nance et al. (1989), Klima et al. (1990), and the Shrimp Stock Assessment Panel (1993) to define minimum levels of spawning stock believed to be compatible with maximum productivity under current conditions. The CSAP recommended these values as the most meaningful proxy for MSY. Maintaining parent stock numbers above these levels should be sufficient to prevent overfishing. The CSAP proposed retention of the scientific review scenarios proposed by Nance et al. (1989), Klima et al. (1990), and the Shrimp Stock Assessment Panel (1993) as the proper response to reduction of parent stocks below the MSY proxies.

The Status Quo Alternative is essentially the same as the Proposed Alternative. No scientific information is available to suggest another level of parent stock number as suggested as in Rejected Alternative 1.

Economic Impacts: The specification of an overfishing threshold has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. It is only instructive to note that the higher the parent stock level specified to correspond to an overfishing threshold, the more restrictive would be the short-term measures adopted. These measures would be more restrictive the further below the current status of any stock is to the specified threshold level.

Given the fact that the parent stocks of the three shrimp species have never fallen below the threshold level, the adoption of the preferred overfishing threshold may be expected to have no adverse impacts on fishing participants.

8.4.1.4.2 Overfished Threshold Alternatives

Proposed Alternative: An overfished condition would result when a parent stock number falls below one-half of overfishing definition, i.e.:

Brown Shrimp - 63 million individuals, age 7+ months during the November through February period.

White Shrimp - 165 million individuals, age 7+ months during the May through August period.

Pink Shrimp - 50 million individuals, age 5+ months during the July through June year.

Alternatives Considered and Rejected:

Alternative 1: Set the minimum parent stock size (in number of parents) at 75 (or other) percent of the MSY proxy, rather than at 50 percent as in Alternative 1.

Alternative 2: An overfished condition would result if the parent stock level falls below 75 percent of their MSY values or falls below their MSY levels for 2 consecutive years.

Discussion: The Proposed Alternative defines overfished at a level of one-half (50 percent) of the MSY, and thus represents a MSST as proposed in the guidelines. The CSAP (1998) expressed some concern with setting values at 50 percent of the MSY target spawning population size; however, the CSAP noted that white shrimp populations in the early 1960s recovered rapidly from below one-half the MSY minimum (within 4 years, Klima et. al. 1990). Because this recovery occurred in much less than the 10-year period specified in the guidelines, the Council felt that for shrimp it was not necessary to specify an overfished threshold above the one-half MSY level as a precautionary approach.

Biological Impacts: As indicated in the discussion of the MSY alternatives (Section 8.4.1.2.1) the Proposed Alternative for the overfishing threshold will have a beneficial biological impact by setting as the MSY and OY control rules, a constant escapement level of parent stock chosen to maximize the long-term average yield. The proposed response of the Proposed Alternative to overfishing seems very appropriate in that NMFS monitors the status of each stock annually, and the guidelines provide that NMFS would notify the Council to take remedial action if overfishing has occurred for two years or the stock will reach an overfished condition in that period. Most likely the Proposed Alternative for the overfished threshold will have no biological effect because it is unlikely that the escaping parent stock numbers will drop to those levels, since that has not happened in the past 30 years. However, as intended, the overfished threshold serves as a safeguard assuring remedial action is taken should the stock biomass drop to that level.

Economic Impacts: The specification of an overfished threshold has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. It is only instructive to note that the higher the level specified to correspond to an overfished threshold, the more restrictive would be the short-term measures adopted. These measures would be more restrictive the further the current status of any stock is to the specified threshold level.

The current status of the three shrimp stocks is such that none is currently overfished so that any restrictive measures based on overfished threshold levels are unlikely to be forthcoming in the near future.

Environmental Consequences:

Human Resources: The proposed action would not alter the effects on the human resources in that it retains the harvest strategy used for the past 10 years to assure that the stocks are not overfished.

Fishery Resources: The proposed action essentially maintains the status quo and does not alter the effects on penaeid shrimp resources.

Other Fishery Resources: Other fishery resources that prey upon shrimp are benefitted by retaining the harvest strategy that assures the stocks are not overfished.

8.4.1.5 Rebuilding Periods

None of the shrimp stocks are overfished; therefore, no rebuilding periods are proposed.

8.4.2 Royal Red Shrimp Stock

In January 1996, NMFS implemented Shrimp Amendment 8 (GMFMC 1995) that modified the statement of OY and overfishing threshold as follows:

> Proposed Alternative: The Council, through a framework adaptive management procedure, may recommend that the Regional Director set a TAC (OY) for royal red shrimp no higher than MSY plus up to 30 percent for up to two consecutive years to test the resilience of the stock to fishing. NMFS will monitor catch, effort, area by capture, and other data relating to the fishery on an annual

basis for presentation to the Council. These data will be reviewed at least biennially by the Council's stock assessment panel (SAP) which will prepare a report with recommendations for ABC and MSY.

Fishing for the season will close when TAC (OY) is reached. Overfishing is defined as fishing in excess of OY.

Following recommendation of the SEP, SSC, and public comment, the Council may recommend OY, TAC, and MSY to the Regional Director who may implement the changes by regulatory amendment which will contain a regulatory impact review and an environmental assessment.

The SFA modified the definition of OY to provide that it be based on MSY as reduced by relevant economic, social, and ecological factors. The NMFS, in reviewing the compliance of FMPs with the SFA, notified the Council that this measure violated the SFA because it provided for OY to exceed MSY (Georgia Cranmore, NMFS, personal communication, January 1997).

This section, therefore, rescinds the above measure and readdresses statements of MSY, OY, and overfishing.

8.4.2.1 Current Status of the Stocks

There are no data to assess the status of the stock. Landings information by statistical grid (or area) (Table 18) indicate that the stock exists in the deep waters (140 to 300 fathoms) across the northern Gulf (~ 1,600 miles). The fishery has been sporadic in terms of landing levels and areas fished. Fishing for royal red shrimp primarily occurs when fishing success for penaeid shrimp is relatively poor. Recognizing these constraints and the inadequacy of the current point estimate of MSY, the CSAP (1998) offered the following comment:

> No annual harvests have exceeded the lower limit of MSY (at 392,000 pounds). The stock is not believed to be overfished, and overfishing is not occurring. The current fishery may be exploiting only a small part of the stock's spatial distribution.

8.4.2.2 Maximum Sustainable Yield (MSY)

The CSAP (1998) had the following comments and recommendations:

> The fishery for royal red shrimp in the Gulf of Mexico could be characterized as experimental. Fishing effort has varied greatly from year-to-year, and because of the lack of meaningful estimates of effort, the current estimate of MSY (392,000 pounds) has not been considered to be a truly realistic one. To obtain additional data upon which to calculate a more precise estimate of MSY, the Council has, in the past, proposed allowing the MSY level to be exceeded by up to 30 percent for up to two consecutive years to test the resilience of the stock to increased fishing effort (Amendment 8). Because of the current legal definitions of MSY, OY, and overfishing, a harvest level above MSY is not allowed. Additionally, although the harvest of royal red shrimp approached the MSY level in 1993 and 1994, catches have since declined, presumably with a decline in effort.
>
> Condrey (1995) re-examined the modeling decisions with regard to calculating the current MSY. He concluded that had he used a generalized surplus production model (GSPM) with a natural mortality value (M) of 0.5, which he felt was more appropriate, the estimated value of MSY for royal red shrimp would be about 650,000 pounds. He concluded, however, that based on the current data and statistical reasons there was no defensible basis to select one model over the other.
>
> MSY for royal red shrimp is best considered undetermined. The current MSY point estimate is 392,000 pounds. However, recent analyses have shown that an MSY estimate of 650,000 pounds is as scientifically defensible as 392,000 pounds (Condrey 1995). The CSAP therefore recommends that MSY be reported as a range from 392,000 to 650,000 pounds. The CSAP notes that, as discussed in Amendment 8 to the Shrimp Fishery Management Plan, a more adequate accounting of the biology and distribution of this species is needed before improvement in the quality of MSY estimates can be expected. Simply allowing catches to rise to the upper end of the MSY range may not provide sufficient information to specify MSY more accurately.

8.4.2.2.1 MSY Alternatives

Proposed Alternative: Set MSY as a range of 392,000 to 650,000 pounds.

Alternatives Considered and Rejected:

Alternative 1: Set MSY at 650,000 pounds.

Alternative 2: Status Quo - retain a MSY of 392,000 pounds.

Alternative 3: Remove royal red shrimp from management under the FMP.

Discussion: The Council proposed exceeding the point estimate of MSY for up to 2 consecutive years as a management measure in Shrimp Amendment 8 because it recognized from the spatial distribution of the stock that MSY was probably grossly underestimated. The MSY level was serving as the overfishing threshold; and landings at that time were approaching the level at which time annual harvest would cease. Since it was a developing fishery, the annual closure seemed unfair to the industry. The management measure included in Amendment 8 (GMFMC 1995) was intended to allow additional harvest to collect data so that a more reliable MSY could periodically be calculated. Since the time of the proposal in Amendment 8, landings have dropped without additional regulations. Presumably, this drop in landings was the result of economic factors related to the high cost of fishing operations.

The Proposed Alternative or Rejected Alternative 1 would allow additional harvest so MSY could be revised over time based on new landings and effort values. Rejected Alternative 3 would remove the royal red shrimp from such management constraints and allow the fishery to fully develop unrestricted over the range of the stock providing better information on sustainable yield. Royal red shrimp contribute only about 0.2 percent of annual Gulf shrimp landings. Considering the much higher cost of fishing at depths exceeding 100 fathoms and the fact that penaeid shrimp are usually more valuable in terms of ex-vessel price than royal red shrimp, it is unlikely that the stock would ever be overfished. Landings data for royal red shrimp would continue to be collected if they are removed from the FMP, so that NMFS and the Council could assess changes in the fishery and take action if necessary.

Biological Impacts: None of the alternatives is likely to have any positive or negative biological impact because the actual MSY for the stock is probably much greater and the difficulty and cost of fishing between 140 and 300 fathoms are sufficiently prohibitive that effort will increase slowly, if at all.

Economic Impacts: In general, the specification of MSY has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. In the particular case of royal red shrimp, however, some immediate effects may be forthcoming. The management experience in the royal red shrimp fishery has been to set TAC equal to MSY, or as per current rule, equal to MSY plus up to 30 percent for up to two consecutive years. The entire TAC is now allocated to the domestic fishery, which is practically a commercial fishery. Once this TAC is reached, the fishery closes. If the same management rule is maintained in the fishery, the setting of MSY in terms of yield could have direct impacts on fishing participants.

While historically the fishery has never reached the TAC of 392,000 pounds, harvests in the early 1990s reached peak levels and were very close to the TAC. Before 1993, the highest landings occurred in 1969 when there were about 15 vessels in the fishery. Landings were also relatively high in 1973 and 1974 when there were more than 15 vessels. The early 1990s appear to be different. About 10 vessels operated in the fishery, but landings reached levels higher than in the 1960s and 1970s. In the last three years, landings again dropped although not as significantly as in the 1980s. While there are other factors that may affect the level of landings, the experience in the 1990s indicates that a slight increase in either the number of vessels or effort expended by existing vessels may lead to substantial increases in landings.

The decision to enter or re-enter the royal red shrimp fishery depends on a host of factors. But the bottom line for that decision is whether the fishery offers better profit prospects than other fishing undertakings. The fishery is a deepwater fishery, and so requires larger costs than shallow water shrimp fisheries. Fishing for royal red requires larger vessels, longer distances to travel, heavier gear, and specific fishing skills. Royal red shrimp also need better handling, cooking, and overall processing procedures than penaeid shrimp. In addition to being a relatively more costly operation, royal red shrimp fishing has not been attractive on the revenue side. This species of shrimp commands lower prices than penaeid shrimp at corresponding market levels. Given such cost and revenue conditions, profitability of the fishery appears to be low. But there are compensating factors. The relatively high direct cost of operation may be mitigated by relatively low indirect costs, such as the presence of fewer rivals, absence of managed closed and open seasons, and exemption from TEDs and BRDs requirements. In addition, prices of royal red shrimp in recent years appear to be relatively higher than those in the past. It is also possible that over the last 30 years or so, some techniques in handling and cooking preparation have been developed by some buyers (restaurants and retail outlets) that they could increase their demand for royal red without sacrificing profitability. Given the foregoing, an increase in the number of participants in the fishery is not a remote possibility.

Jones et al. (1994) noted that fluctuations in landings for royal red shrimp are more likely due to market than resource availability. Given such claim, it is possible that the high landings in the more recent years reflect a relatively strong market for the species. If this relatively strong demand persists, the ten or so vessels now involved in the fishery may increase their effort to take advantage of the market demand.

Given then the possibility of an increase in the number of participants in the royal red shrimp fishery and of an increase in effort of current participants, there is a good chance that landings may be expected to increase in the near future. Such likelihood increases if there is also an increase in abundance of shrimp in known fishing areas or if new fishing areas are developed. Under this condition, closure of the fishery may eventually be required if an MSY specified under Rejected Alternative 2 is adopted. The Proposed Alternative, on the other hand, would provide enough cushion against potential fishery closure.

Closure of the fishery has both short- and long-term implications. There is no doubt that the direction of short-term effects is negative for the harvesters and for dealers and retailers, since business plans would have to be dropped or revised at some additional costs. The market for this species is not well defined yet, unlike that for the shallow-water shrimp species. If, as mentioned earlier, the record landings in the most recent years indicate a market that is still developing, any closure would stunt further development of such market. Harvesters and dealers would be forgoing profits that could increase with the expansion of the market.

The long-term benefits that can accrue from closure of the royal red shrimp fishery crucially hinge on the MSY estimate. Assuming that the estimate of MSY is accurate, restricting harvest to MSY and closing the fishery when harvest exceeds MSY would be beneficial to the fishery since the stock will be prevented from deteriorating. If overfishing continues a stock may eventually reach a level when fishing operation becomes unprofitable. Under this situation, of course, fishing would be reduced to negligible level. The stock may not recover; or if it does, it may take a long while. In the meantime, producer and consumer surpluses that could have been generated out of the fishery would be forgone. Thus restricting fishing before the stock becomes severely overfished would enable the fishery to generate long-term benefits. If in addition to having a relatively accurate estimate of MSY, the management system adopted for the fishery is conducive to the development of an efficient fishery, the most likely harvest level would be even below MSY. In this case, closure of the fishery would be a remote possibility. Hence, if the MSY estimate is such that closure prevents overfishing of the resource, future economic benefits can be expected. Otherwise, short-term economic losses would only be compounded by long-term economic losses.

Environmental Consequences:

Human Resources: The proposed action has the potential to be beneficial to the harvesters by increasing the value of MSY. That benefit would occur only if their landings exceeded 392,000 pounds, which historically it has not. Previously under status quo the fishery would have been closed when 392,000 pounds were landed.

Fishery Resources: There is no effect on the royal red shrimp resource by the alternatives as the actual MSY value for this stock is probably many times higher than stated in the alternatives.

Other Fishery Resources: There is no effect on other fishery resources by the alternatives.

8.4.2.3 Optimum Yield (OY)

Prior to the implementation of Amendment 8, OY was set equivalent to MSY and also served as the overfishing threshold (Shrimp Amendment 5, GMFMC 1991).

8.4.2.3.1 OY Alternatives

Proposed Alternative: Set OY at a biomass level equal to MSY.

Rejected Alternative: Set OY at a biomass level less than MSY.

Discussion: The Council felt that it was unnecessary to take a precautionary approach to management of this stock, considering the broad spatial distribution of the stock and the limited and sporadic distribution of the fishing effort.

Biological Impacts: Neither of the alternatives is likely to have a positive or negative biological impact.

Economic Impacts: The economic implications of these OY alternatives are similar to those of the MSY alternatives. The discussion therein is included here by reference.

Environmental Consequences:

Human Resources: By setting OY equal to MSY the effects discussed under MSY would occur.

Fishery Resources: There is no effect on the royal red shrimp resource by the alternatives.

Other Fishery Resources: There is no effect on other fishery resources by the alternatives.

8.4.2.4 Overfishing Criteria

Historically, the overfishing threshold has been set at OY (GMFMC 1991).

8.4.2.4.1 Overfishing Threshold Alternatives

Proposed Alternative: The overfishing threshold is defined as a rate of fishing that results in landings exceeding OY.

Alternatives Considered and Rejected:

Alternative 1: The overfishing threshold is defined as a rate of fishing that results in landings exceeding MSY (if different from OY).

Alternative 2: The overfishing threshold would be a rate of fishing that results in landings exceeding OY for two consecutive years.

Discussion: Under Amendment 8 (GMFMC 1995), overfishing occurred when OY had been exceeded for two consecutive years. This definition was not permissible under the SFA because OY exceeded MSY by 10 percent. If the OY target is set at a value less than MSY, either Alternative 1 or 2 could be used. The CSAP (1998) recommended the Proposed Alternative, recognizing that OY may be set at some value within the range of MSY, i.e., 392,000 to 650,000 pounds.

Biological Impacts: As indicated in the MSY discussion (Section 8.4.2.2.1), there should be no biological impacts from any of the alternatives presented.

Economic Impacts: The economic implications of the alternatives for overfishing threshold are similar to those of the MSY alternatives. The discussion therein is included here by reference.

8.4.2.4.2 Overfished Threshold Alternatives

No alternatives for an overfished threshold are specified.

Discussion: The CSAP (1998) indicated that there was insufficient data to specify an overfished threshold. A minimum stock size threshold seems inappropriate since there is no reliable information on the stock size.

Biological Impacts: There should be no additional biological effects (positive or negative) as a result of not specifying an overfished threshold.

Economic Impacts: There is expected to be no impacts on fishing participants.

Environmental Consequences:

Human Resources: By setting the overfishing threshold to be OY=MSY, the effects discussed under MSY would occur. Not specifying an overfished threshold should have no effect on users or other human resources.

Fishery Resources: There is no effect on the royal red shrimp resources by the alternatives because the actual MSY for the resource is probably much higher than the value cited under the MSY section.

Other Fishery Resources: There is no effect on other fishery resources by the alternatives.

8.4.2.5 Rebuilding Period

Since the stock is not overfished, no rebuilding period is proposed.

8.5 SPINY LOBSTER[2]

The FMP for spiny lobster, Panulirus argus, was implemented in 1982 as a joint plan regulating that stock in the jurisdiction of the GMFMC and the SAFMC. The domestic commercial fishery is principally located in the waters surrounding Monroe County, Florida, associated with the Florida Keys reef tract. Historically, in the 1960s and 1970s, large poundages of spiny lobster were landed at Florida east coast ports from the Bahamian waters. The Bahamian government prohibited U.S. vessels from participating in that fishery, beginning in the mid-1970s. Less than 10 percent of commercial harvest is taken off the east coast of Florida. Annual landings for Florida, exclusive of the Bahamian catch, have fluctuated between 4.3 and 7.9 MP.

Similarly, recreational landings are predominantly from the Florida Keys area. The Florida Marine Research Institute (FMRI) has monitored this fishery since 1991. Since 1991, the number of licenses for this fishery has remained fairly stable at about 110,000; and landings have been stable at about 1.7 million lobsters (FMRI 1997).

Spiny lobster are also found across the northern Gulf and waters off the eastern seaboard through the Carolina's, but in these areas their reduced abundance typically does not support directed fisheries. The source of primary recruitment has not been

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[2]The FMP also prohibits landing or possession of female slipper lobster, Scyllarides nodifer, with eggs attached. There are no data to determine any of the parameters, MSY, OY, overfishing, and overfished criteria, for this stock.

determined since the larvae are planktonic for about six to nine months. The origin of the larvae could be from the Caribbean Sea, Cuba, Mexico, the northern Gulf, the Florida Keys, or a combination of these potential sources.

The Florida commercial fishery has been characterized by the excessive number of traps deployed. After the closure of the Bahamian fishery, the number of traps essentially doubled to approximately 500,000 and continued to increase, reaching a peak of approximately 939,000 in 1991 (Muller et al. 1997). A trap reduction program was implemented by the state of Florida in 1993; and, by the beginning of the 1995 season, the number of traps was reduced to approximately 568,000.

8.5.1 Current Status of Stocks

Muller et al. (1997) conducted an age-structured analyses of the status of the Florida fishery and examined the effects of the trap reduction program. The number harvested, population size, fishing mortality rates, and transitional SPRs were computed by age for the seasons 1987-88 through 1995-96. These parameters were computed for females and males (excluding SPR for males) from the upper and the lower Florida Keys. The upper Keys was defined as Key Largo to Big Pine Key, and lower Keys from Big Pine Key to Dry Tortugas. The analyses included both commercial and recreational fishery statistics, and indicated that lobsters landed are primarily from 2 to 7 years of age. The estimated abundance of age-1 and older lobsters in the Keys prior to 1993 was approximately 30 million individuals, but the number increased to 33 million lobsters in subsequent years. Recruitment estimated by age-2 lobsters varied from 7.8 million to 10.7 million lobsters, and was more variable in the upper Keys. Fishing mortality rates on the fully recruited ages (age-3 in females and age-2 in males) varied two-fold. Average fishing mortality rate (F=0.59 per year) was higher in the upper Keys than the lower Keys (F=0.33 per year). Fishing mortality rates before the 1993-94 season (average F=0.47 per year) were higher than for subsequent seasons (average F=0.39 per year) for the entire Florida Keys.

Transitional SPRs based on biomass varied by season between 7 and 19 percent in the upper Keys and between 20 and 31 percent in the lower Keys. SPRs were approximately 2 to 4 percent higher when based on fecundity rather than biomass, i.e., 23 to 34 percent for the lower Keys.

The assessment by Muller et al. (1997) above indicates that the condition of the stock is much better than when Powers and Sutherland (1989) assessed the condition. However, part of the difference is due to the different growth models employed in the analyses. Powers and Sutherland (1989) did not separate sexes, and they used a composite von Bertalanffy growth curve (first year after 50 mm CL $L_\infty = 155$, $K = 0.2$ and thereafter $L_\infty = 190$, and K between 0.2 and 0.3) that estimated an average fishing mortality of approximately F=2.0 per year , i.e. spiny lobsters were mostly caught within a year of recruiting. The stochastic growth model (Muller et al. 1997) that considered sexes, time of the year, location in the Keys, and carapace length produced slower growth and lower estimated fishing mortality rates. Muller et al. (1997) also noted that landings in the upper Keys fishery were more variable because the fishery operated mostly on recruits with fluctuations in recruitment not buffered by multiple year classes in the fishery; whereas, the landings from the lower Keys fishery were more stable, and that fishery operated on more year classes.

Muller et al. (1997) indicated that since 1993 the fishing mortality rate decreased by 16 percent, even as landings increased; but, they cautioned that this may be due to natural fluctuations rather than the reduction in traps.

8.5.2 Maximum Sustainable Yield (MSY)

The MSY for the FMP (GMFMC/SAFMC 1981) was derived by using the Fox surplus yield model and the effort and landings data for the Monroe County fishery, which resulted in an estimate of 5.9 MP. That was adjusted by adding the average Florida east coast landings, estimated unreported recreational and commercial landings, and estimated mortality of sublegal lobsters, which resulted in an estimate of 12.0 MP. That was adjusted by the YPR relationship for an estimate of 12.7 MP at a carapace length (CL) of 3.5 inches. The minimum size of 3.0 inches CL was estimated to provide between 85 and 91 percent of the maximum YPR.

Beginning in 1975 after the closure of Bahamian waters to Florida fishermen, annual commercial landings of spiny lobster by Florida fishermen have been very consistent at an average of 6.4 MP with coefficient of variation of only 15%. The highest landings (7.9 MP) during this period occurred in 1996. In addition to the commercial fishery, annual surveys indicate that recreational fishermen harvest about 1.7 million lobsters with an equivalent weight of 2.0 million pounds for a combined yield of 9.9 MP. Using the methods presented in Muller et al. (1997), the associated transitional SPR in that year was 32%. A possible explanation for the stability of the landings accompanying a near doubling of traps in the fishery is that the stocks in Florida receive an influx of settling lobsters from throughout the Caribbean basin, and recruitment may not depend solely upon local production.

8.5.2.1 MSY Alternatives

Proposed Alternative: MSY is defined as a harvest strategy that results in at least a 20 percent transitional SPR (SSBR).

Alternatives Considered and Rejected:

Alternative 1: MSY is defined as a harvest strategy that results in at least a 30 percent transitional SPR (SSBR).

Alternative 2: Status Quo - retain the original MSY estimate of 12.7 million pounds based on a 3.5 inch carapace length.

Alternative 3: Recompute a MSY point estimate based on more recent data.

Discussion: Table 19, computed by Muller for the CSAP, summarizes the transitional SPRs expressed in terms of biomass (SSBR) and fecundity (SPR) for the Florida Keys population. The SSBR levels for the fishing seasons from 1987-88 through 1996-97 ranged between 24 and 36 percent. The CSAP (1998) concluded that the use of SSBR was a more appropriate measure of spawning potential than the fecundity-based estimates of SPR. That is because the larvae produced are planktonic and drift with ocean currents for six to nine months. There is no apparent correlation between numbers of larvae produced and subsequent production of adults.

The SSBR levels in Table 19 indicate that the stock is in much better condition than when measured by Powers and Sutherland (1989) in their assessment. The first issue addressed by the CSAP (1998) was the difference in fishing mortality rates between Powers and Sutherland (1989) and Muller et al. (1997). The first was that substantially different growth models were used to age the catch. Powers and Sutherland (1989) mentioned the Hunt and Lyons (1986) model of growth but used a composite von Bertalanffy growth curve for both sexes starting at 50 mm at year one and used a $L\infty$ of 155 and a K of 0.2 the next year followed by a $L\infty$ of 190 and a K of 0.2 to 0.3 for the following years. Their growth pattern had lobsters recruiting at 2.5 years and persisting in the fishery for only a year. The Muller et al. (1997) growth model calculated the probability of molting given a lobster of a certain sex, time of the year, carapace length, and location in the Keys from tagging data. If the lobster molted, then the size increment was calculated from the same parameters. The resulting growth curve had male lobsters entering the fishery at an average of 21 months and females about a year later. The lobsters spent from two to three years in the fishery, thus lowering the fishing mortality rates. Another difference between the fishing mortality rates comes from the Trap Reduction Program that began in the 1993-94 fishing season which reduced the number of traps in the fishery from 939,000 traps to 582,000 traps. Since the traps are baited with sub-legal lobsters, the elimination of over 300,000 traps spares many sub-legal lobsters that subsequently enter the fishery, which is reflected by the lower fishing mortality rates.

The question the CSAP addressed was if the fishery is as overfished as suggested in Our Living Oceans (NOAA 1995), "How can landings be so consistent?" Plots of historical commercial landings by coast from 1950 showed the development of the fishery, the expansion into Florida Bay and the Bahamas after the change of minimum size to 3.0 inches carapace length (CL) (76.2 mm) in 1968, and the closure of Bahamian waters to Florida fishermen in 1974. From 1975 to date, the fishery and its regulations have not changed, and the annual landings have varied from 4.3 MP to 7.9 MP, with an average of 6.4 MP. The highest annual landings (7.9 MP) occurred in 1996. Most of the variation in landings occurred with the middle Keys fishery that operates on the lobsters from the Florida Bay nursery. The CSAP did not expect to find a significant spawning-recruit relationship because of Panulirus argus's extensive plankton stage (6 to 9 months) prior to settlement at 6-7 mm. However, there is evidence linking the number of settling pueruli to numbers of recruits that subsequently enter the fishery. Dr. Mark Butler suggested that a better index of recruitment would be juvenile lobsters between 35 mm CL and 50 mm CL because his work with Dr. Richard Herrnkind on lobster recruitment processes showed that habitat influences the number of animals that survive from settlement to becoming juveniles. Also, the sexes of juveniles can be identified providing sex-specific indices which is important since males recruit sooner than females (Muller et al. 1997).

The CSAP considered that the concept of MSY was going to be difficult to define in this fishery because the Trap Reduction Program is reducing effort and the population is increasing in response, due to the reduction in the mortality of sub-legal lobsters. The historical landings do not provide information on the level of MSY after the fishery has had time to re-equilibrate. If that were not enough, the source of Florida's recruitment is unknown at this time. A precautionary approach is to assume that recruitment depends on local spawning even though genetic analysis has been unable to detect differences between lobsters from different sites in the Caribbean region.

The Proposed Alternative is consistent with CSAP recommendations on overfishing in that, although recent SSBR levels have been 30 percent or higher, the levels have been less than that for 4 of the previous 10 seasons. If the MSY proxy was set at 30 percent SSBR, SSBR levels would have been lower in 4 of the 10 years causing unnecessary concern over the status of the stock. Historically, the SPR level has been near 5 percent without the stock collapsing; therefore, the 20 percent SSBR level seems consistent with the precautionary approach.

Biological Impacts: The Proposed Alternative and Rejected Alternative 1 both would have a beneficial biological impact by providing a proxy for MSY that results in a higher overfishing threshold than is currently utilized (see Section 8.5.4). Thus, it provides a mechanism for remedial action to arrest overfishing sooner than the present strategy. As indicated under Section 8.5.1, the condition of the stock has been, and is, improving as the number of traps are reduced, and as the result of other management measures (e.g., requirement for live wells). As indicated in the MSY discussion above it is probably inappropriate to specify a MSY proxy at 30 percent SBBR, but it could be a good target for OY.

Economic Impacts: The specification of MSY has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. It is only instructive to note that the higher the SPR level specified to correspond to MSY, the more restrictive would be the short-term measures adopted. These measures would be more restrictive the further the current status of any stock is to the specified MSY level.

Both the Proposed Alternative and Rejected Alternative 1 would tend to raise the likelihood of imposing restrictive management measures, but the current status of the stock as shown in Table 19 appears to be in good condition that no severely restrictive management measures for the fishery would be forthcoming.

Environmental Consequences:

Human Resources: The proposed action and alternatives for MSY will have little to no effect on the human resources.

Fishery Resources: In as much as the MSY level will become the standard for the overfishing threshold, the proposed action will have a beneficial effect on the spiny lobster resource, as would Rejected Alternative 1.

Other Fishery Resources: There is no effect to a beneficial effect on other fishery resources by the Proposed Alternative.

8.5.3 Optimum Yield (OY)

The statement of OY in the FMP is as follows:

> OY is specified to be all lobster more than 3.0 inches carapace length or not less than 5.5 inches tail length that can be harvested by commercial and recreational fishermen given existing technology and prevailing economic conditions.
>
> This amount is estimated to be 9.5 MP in 1981 (see Section 12.2 for analysis of the proposed optimum yield and 4 alternatives

which were not accepted). With improvement of enforcement capability and possible development of alternative baits, the amount of OY may increase to approach a maximum of 12.0 million pounds.

8.5.3.1 OY Alternatives

Proposed Alternative OY is defined as a harvest strategy that results in achieving a 30 percent transitional SPR (SSBR).

Alternatives Considered and Rejected:

Alternative 1: Set OY equal to the MSY proxy based on SSBR.

Alternative 2: Set OY higher than the MSY proxy based on SSBR.

Alternative 3: Set OY lower than the numerical MSY (12.0 or 12.7 MP) based on pounds landed.

Alternative 4: Set OY equal to the numerical MSY based on pounds landed.

Alternative 5: Status Quo - retain the current statement of OY.

Discussion: The CSAP had no comments on OY. The Proposed Alternative and Rejected Alternatives 2 and 3 provide for a precautionary approach by setting the OY target below the MSY (i. e. at a SPR level higher than MSY). Rejected Alternatives 1 and 4 would make OY equal to MSY. The Status Quo Alternative would likely be unacceptable because OY could be higher than MSY.

Biological Impacts: By setting OY at a SPR level higher than MSY it provides a target to be achieved that will have a beneficial biological effect over the long term.

Economic Impacts: The specification of OY has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. It is instructive to note that the higher the SPR level specified to correspond to OY, the more restrictive would be the short-term measures adopted. These measures would be more restrictive the further the current status of any stock is to the specified MSY level. Long-term benefits may be expected to be higher, but only on condition that the management system adopted would tend to preserve the economic rent generated in the fishery.

The obvious feature of an OY that is absent in any of the ones specified above is the consideration of economic and social factors. Understandably, the biological component needs to be specified since the SFA currently defines OY relative to a biological MSY. However, a simple specification of OY in biological terms is totally deficient, especially when management measures are developed to achieve an OY level.

Environmental Consequences:

Human Resources: Over the long-term the higher standard for the OY target will have a beneficial effect.

Fishery Resources: Similarly, the spiny lobster resource will benefit over the long-term as the OY target is achieved.

Other Fishery Resources: There is no effect to a beneficial effect on other fishery resources by the Proposed Alternative.

8.5.4 Overfishing Criteria

Overfishing was defined by Amendment 4 (GMFMC/SAFMC 1990) as follows:

> **Definition of Overfishing:** "Overfishing exists when the eggs per recruit ratio of the exploited population to the unexploited population is reduced below five percent and recruitment of small lobsters into the fishery has declined for three consecutive fishing years. Overfishing will be avoided when the eggs per recruit ratio of exploited to unexploited populations is maintained above five percent."
>
> **Management Measures to Prevent Overfishing**: Should overfishing occur, the Councils and the state of Florida will take one or more of the following actions by regulatory amendment as authorized under this measure:
>
> - modify season length
> - increase minimum carapace length
> - limits on use of shorts
> - require escape gaps
> - reduce number of traps

Discussion (In Amendment 4): The eggs per recruit ratio should be empirically determined by sampling populations in exploited areas and the Tortugas/Fort Jefferson sanctuary following the methods of Gregory et. al. (1982), rather than being calculated as by Powers and Sutherland (1989). The average number of eggs produced over its lifetime by a lobster recruited to the fishery is defined as eggs per recruit. The ratio of the number of eggs per recruit at the present exploitation rate relative to the number with no fishing is the eggs per recruit ratio. Recruitment of small lobsters into the fishery should be monitored annually through catch statistics.

8.5.4.1 Overfishing Threshold Alternatives

Proposed Alternative: Overfishing exists when the fishing rate results in the transitional SPR being reduced below 20 percent SSBR.

Alternatives Considered and Rejected:

Alternative 1: Overfishing exists when the transitional SPR is reduced below 20 percent SSBR and the recruitment of small lobsters into the fishery has declined for 3 consecutive fishing years. Overfishing is avoided when the fishing mortality rates will not drive the stock to transitional SPR levels below 20 percent SSBR (CSAP).

Alternative 2: Set the SSBR level higher, i.e., between 20 and 30 percent.

Alternative 3: Status Quo: Retain the overfishing definition of Amendment 4 (see previous section).

Management Measures to Prevent Overfishing: Should overfishing occur, the Councils and state of Florida will take one or more of the following actions by regulatory amendment as authorized under this measure:

- modify season length
- increase minimum carapace length
- limits on use of shorts
- require escape gaps
- reduce number of traps

Discussion: The CSAP (1998) recommended Rejected Alternative 1. If the Council had set MSY above 20 percent SSBR under Section 8.5.2.1, then Rejected Alternative 2 would be more appropriate. Following the precautionary approach, the Council decided on an overfishing definition of 20 percent transitional SPR instead of the present 5 percent eggs per recruit. The value of 20 percent was chosen because the lowest transitional SPR (SSBR) for the Florida Keys in the past 10 years was 24 percent in the 1991-92 season. There were no data to determine the SPR value for the season with lowest landings (1983-84), but the CSAP assumed that it was lower than 24 percent and chose 20 percent. The CSAP recommended including a juvenile or pre-recruit index because, although the number of recruits cannot be predicted accurately from the number of spawners, the number of recruits entering the fishery can be predicted from the number of juveniles or pre-recruits. Thus the index would allow the Council to prepare the fishery for any downturns if necessary. The Council selected the Proposed Alternative without including the pre-recruit index provision.

Although there was discussion within the CSAP as to whether recruitment overfishing was possible in spiny lobster, they agreed with using SPRs as a measure of the status of the fishery but did not see any utility to using egg production over spawning biomass because the CSAP group doubted whether a meaningful spawner-recruit relationship could be demonstrated given the extensive planktonic stage (lasting between six and nine months) before lobsters settle as pueruli. Furthermore, the group thought that an index based on juveniles would be measurable and would provide information on recruitment a year in advance. Recruitment into the fishery of small lobsters should be monitored annually through on-board observers.

Economic Impacts: The specification of an overfishing threshold has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. It is only instructive to note that the higher the SPR level specified to correspond to an overfishing threshold, the more restrictive would be the short-term measures adopted. These measures would be more restrictive the further the current status of any stock is to the specified threshold level. The current status of the spiny lobster stock appears to suggest a low likelihood that severely restrictive management measures would be imposed in the near future.

8.5.4.2 Overfished Threshold Alternatives

Proposed Alternative: The minimum stock size threshold proxy is an SSBR level of 15 percent.

Alternatives Considered and Rejected:

Alternative 1: The minimum stock size threshold proxy is an SSBR level of 10 percent.

Alternative 2: The minimum stock size threshold is set at one-half the numerical level of MSY in pounds.

Discussion: Rejected Alternative 1 would be consistent with an MSY set at 20 percent SSBR, and is a precautionary approach in itself, since the fishery operated at an egg per recruit level near 5 percent previously without any long-term adverse effect (GMFMC/SAFMC 1990). Because the condition of the stock has improved, the SSBR and SPR levels have increased (Table 19), and the Council felt it was possible to increase the SSBR proxy to 15 percent, as a precautionary approach. If MSY was set in pounds, Rejected Alternative 2 would be more appropriate.

Biological Impacts: The Proposed Alternative for both the overfishing threshold and overfished threshold are precautionary approaches; therefore, they should have a beneficial biological effect.

Economic Impacts: The specification of an overfished threshold has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. It is only instructive to note that the higher the level specified to correspond to an overfished threshold, the more restrictive would be the short-term measures adopted. These measures would be more restrictive the further the current status of any stock is to the specified threshold level. The current status of the spiny lobster stock appears to suggest a low likelihood that severely restrictive management measures would be imposed in the near future.

Environmental Consequences:

Human Resources: In the long-term, the higher standard of the proposed action over status quo will be beneficial to the harvesters. It raises the overfishing threshold from a 5 percent eggs per recruit ratio to 20 percent SSBR.

Fishery Resources: The spiny lobster resource should benefit form the higher standard of the proposed action, in that the standard can be periodically raised as the effects from the trap reduction program are realized.

Other Fishery Resources: There is no effect to a beneficial effect on other fishery resources by the alternatives.

8.5.5 Rebuilding Period

Since the stock is not overfished, no rebuilding period is proposed.

8.6 STONE CRAB

The stone crab FMP was implemented in 1979 and provided for management of that stock in the EEZ off the west Florida shelf. The FMP was implemented principally to resolve a gear conflict between shrimp fishermen and stone crab fishermen off southwest Florida, and provided management only for the commercial fishery.

Menippe mercenaria is the principal species taken in the fishery. Bert (1986) indicated that in the northwest area of Florida another species occurred which was named Menippe adina. Subsequent work by Bert and Harrison (1988) described a hybrid zone from about Cedar Key, Florida, through Wakulla County, Florida, in which the hybrid of the two species was dominant. That area represented the northern terminus of the commercial fishery. The range of Menippe adina extends across the northern and western Gulf.

8.6.1 Current Status of Stock (from Muller and Bert 1997)

Landings in terms of claw weight have been increasing for more than 30 years, and annual landings fluctuate around a linear trend line. Landings for the 1981-82 and 1982-83 seasons were above the trend line; however, landings in 1983-84 and 1984-85 were below it. More recently, landings from 1990-91 through 1994-95 were above the trend line, but landings for 1995-96 and preliminarily 1996-97 were below it.

Effort, in terms of the number of traps, has increased from about 14,000 in 1962-63 to about 798,000 in 1995-96. The number of trips has also increased since 1985-86 (the first year for which trip data are available) from about 19,000 to approximately 34,000 in 1995-96. Landings have not increased commensurate with either of these measurements of effort.

As the number of traps being fished increased, catch per trap per year declined considerably, dropping from more than 20 pounds per trap in the early 1960s to less than 10 pounds in the mid-1970s and less than 5 pounds by the mid-1980s. Since the mid-1980's, catch per trap per year has remained low, and both this index and the more recently available index of standardized catch per trip per year are presently (1995-96 and 1996-97, respectively) at their lowest historical levels. Because landings have not increased with effort (in terms of catch per trap or catch per trip), the fishery appears to be operating at its maximum or slightly past the maximum.

In 1989-90, the Florida Department of Environmental Protection (FDEP) implemented a fishery-independent, juvenile monitoring project in Tampa Bay. The juvenile indices were used to predict commercial catch rates approximately 3 years later when crabs enter the fishery. Although the first year's prediction (1992-93 commercial season) did not fit the juvenile index well, juvenile catch rates from 1990 through 1993 have correlated well with catch per trap in 1993-94 to 1996-97. The study also showed that some juveniles enter the fishery at approximately 27 months after settlement (presumably males) while others do not enter the fishery until 38 months later (principally females). The 1996-97 juvenile catch rates for the samples from the Tampa Bay area were not significantly different from zero. If this index is indicative of the future adult population, there could be a serious shortage of stone crabs in the Tampa Bay area in 1999-2000. The utility of these comparisons in predicting catch rates over extended periods of time and in other areas remains to be evaluated; if valid, they could serve as an early indicator of potential problems for the fishery.

The stone crab fishery is one that harvests only the claws; the crabs are returned to the water. Claws regenerate over time, and it has been observed that approximately 10 percent of the claws sampled in fish houses have been regenerated. Male crabs grow faster than females, and the majority of the claws taken are from males.

In the opinion of the CSAP (1998), the stone crab fishery in the Gulf of Mexico is at or near full exploitation. Landings have increased since the 1960s, to a 1990-1997 average level of about 3.0-3.5 million pounds (claw weight). Effort (in number of traps) has also increased considerably, resulting in currently low catch per unit effort (CPUE) values; however, the stock does not show indications of overfishing and appears to be able to sustain the current levels of production.

8.6.2 Maximum Sustainable Yield (MSY)

The MSY computed in the FMP (GMFMC 1979), which was based on landings and effort data for the period 1962-1978 and on a generalized stock production model, yielded an estimate of 1.8 MP of claws. This estimate of MSY was done at a time when the fishery was expanding into new fishing grounds, and consequently it underestimated MSY. Currently, average landings are on the order of 3 MP of claws (Muller and Bert 1997).

The CSAP (1998) believed that an egg production per recruit ratio is a definable, quantitative measure that is appropriate for measuring stock condition, MSY values, and overfishing/overfished definitions for stone crabs. The minimum claw size regulation (70 mm propodus length [PL]), probably originally set as a market requirement, assures that female crabs spawn at least once before they are subject to harvest and results in a relatively high (~80 percent) egg production per recruit ratio. The CSAP (1998) also believed that the current claw size regulation that produces this egg production per recruit ratio can both produce an MSY harvest and provide a high level of protection against overfishing.

Therefore, MSY was defined by the CSAP (1998) as the harvest that results from a realized egg production per recruit at or above 70 percent of potential production. This harvest capacity is currently estimated at between 3.0 and 3.5 million pounds of claws (minimum 70 mm PL).

The CSAP reviewed the analyses for stone crabs from the NMFS SEFSC Overfishing Workshop, held February 12-14, 1990, and concluded that at the current minimum claw length of 70 mm PL recruitment overfishing is unlikely. This conclusion was based on the fact that, on average, males and females mature at age 2 (50 percent maturity), the male crusher and pincer claws reach legal length between age 2 and age 3, and female claws reach legal lengths one to two years later. Therefore, females spawn for at least one or more years before entering the fishery. Restrepo (1989) suggested that the egg production potential is largely independent of the male/female ratio in the population since a single copulation fertilizes a female for the season and males can copulate with several females. The fact that males enter the fishery at earlier ages and their numbers may be reduced relative to the number of females does not appear to impact the egg production potential. Females are capable of producing up to 13 batches of eggs after a single copulation (four to five batches on the average) during the reproductive season. Fecundity is linearly related to size, and large females produce upwards of 350,000 eggs per batch. At the present minimum claw length of 70 mm PL, more than 70 percent of potential egg production will be maintained over a wide range of fishing mortality rates, both higher and lower than the present mortality rate. The current fishing mortality rates produce between 3.0 and 3.5 million pounds of claws annually, and this range is considered to be the best estimate for MSY.

8.6.2.1 MSY Alternatives

Proposed Alternative: MSY is defined as the harvest that results from a realized egg production per recruit at or above 70 percent of potential production. This harvest capacity is currently estimated at between 3.0 and 3.5 million pounds of claws (minimum 70 mm propodus length).

Alternatives Considered and Rejected:

Alternative 1: MSY will be based on another computation from the generalized stock production model utilizing more recent landings and effort data.

Alternative 2: Status Quo - retain the FMP's MSY estimate.

Discussion: The CSAP (1998) recommended the Proposed Alternative. Their rationale for this recommendation is cited above. Rejected Alternative 1 would update the stock production model estimate, which likely would result in a numerical value similar to that in the Proposed Alternative. If MSY was set at 100 percent of potential egg production, then yield would be zero.

Biological Impacts: The use of 70 percent of potential egg production as a proxy for MSY and for the overfishing threshold is a very conservative precautionary approach, in that at 100 percent there is no directed fishery.

Economic Impacts: The specification of MSY has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted.

Environmental Consequences:

Human Resources: The proposed action and alternatives for MSY are anticipated to have no effect.

Fishery Resources: In as much as the MSY level is used as the basis for the overfishing threshold; the proposed action has beneficial effect by perpetuating a threshold that assures that overfishing will not occur.

Other Fishery Resources: There is no effect on other fishery resources by the alternatives.

8.6.3 Optimum Yield (OY)

The current statement of OY from the FMP is as follows:

> Optimum yield from a fishery is the amount of fish which will provide the greatest overall benefit to the Nation, with particular reference to food production and recreational opportunities, and which is prescribed as such on the basis of the maximum sustainable yield from that fishery, as modified by any relevant economic, social, or ecological factor (PL 94-265).

The CSAP (1998) recommendations on OY were as follows:

> There are no known biological considerations that would require the setting of OY at a level below MSY, and the stock is adequately protected at this level. Although overfishing should not occur under the existing minimum claw size regulation, Ehrhardt and Restrepo (1989) and Restrepo (1989) concluded that YPR in terms of weight could be increased by reducing the existing minimum claw size. Bert et al. (1986) suggested that stone crabs live to be about 6 years old. Also, females do not fully enter the fishery until age 5. Consequently, there is a potential for reducing the minimum claw size to obtain a greater YPR. On the other hand, Restrepo (1989) indicated that such a reduction may affect the reproductive capacity of the stone crab population.

Another consideration of reducing the minimum claw size is the economic impacts on the fishery. Although there would probably be an increase in pounds landed, such an increase could result in losses with regard to total ex-vessel value because there is a significant price differential between claw sizes. For example, during the 1988-89 season, the percentage of claws landed were classified as follows: 5% - jumbo, 48% - large, 25% - medium, 9% - small, and 13% - unclassified (Sutherland 1989). Ex-vessel prices per pound for the 1989-90 season were as follows: $6.55 - jumbo, $6.13 - large, and $5.49 - small. Since the small classification includes claws only slightly larger that the current minimum size limit (70 mm PL), a reduced size limit would probably create a new market classification below this size, and it would probably have a lower ex-vessel value that would have to be contrasted against the gains in poundage. On the other hand, Restrepo (1989) indicated that such a reduction may affect the reproductive capacity of the stone crab population, which could decrease long-term yields and increase the risk of recruitment overfishing.

8.6.3.1 OY Alternatives

Proposed Alternative: Set OY equal to MSY.

Alternatives Considered and Rejected:

Alternative 1: Set OY less than MSY.

Alternative 2: Status Quo - retain the FMP statement of OY.

Discussion: Under the National Standard Guidelines, the Status Quo Alternative would be unacceptable. The Proposed Alternative makes the OY statement equivalent to that for the MSY control rule, i.e., an egg production per recruit at or above 70 percent of potential production, which is a precautionary approach.

Biological Impacts: As indicated in the discussion above, the Proposed Alternative is a very conservative precautionary approach, and there is no biological benefit to setting OY less than MSY (i.e., at a higher percent of potential egg production).

Economic Impacts: The specification of OY has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. Pending more concrete measures designed to achieve or maintain an OY level, it is only instructive to point out the deficiency attendant to alternatives for OY. The obvious feature of an OY that is absent in any of the ones specified above is the consideration of economic and social factors. While OY is defined in relation to MSY, this latter term is proxied by some biological parameter. Understandably, the biological component needs to be specified since the SFA currently defines OY relative to a biological MSY. However, a specification of OY should include economic and social, in addition to biological factors.

<u>Environmental Consequences</u>:

Human Resources: The harvesters are benefitted by setting OY equal to MSY as there is no biological reason to harvest less than MSY.

Fishery Resources: It is beneficial in the management of the stone crab resource to provide for an OY standard that is measurable.

Other Fishery Resources: The effect on other fishery resources by the Proposed Alternative should be beneficial.

8.6.4 <u>Overfishing Criteria</u>

The following definition of overfishing was implemented by Amendment 4 (GMFMC 1990):

> **<u>Definition of Overfishing</u>:**: "Overfishing exists when the realized egg production per recruit is reduced below 70 percent of potential production. Overfishing will be avoided when there is a minimum claw length (length of propodus that assures survival of the crabs to achieve the 70 percent egg production per recruit potential."
>
> **<u>Management Measure to Arrest Overfishing</u>:** Should overfishing occur, the Council and State of Florida will adjust the minimum claw length or fishing mortality rate (F) by regulatory amendment as authorized under this measure to increase the egg production potential to at least 70 percent.

The CSAP (1998) provided the following comments and recommendations:

> Overfishing for the stone crab fishery is defined as a realized egg production per recruit of below 70 percent of potential production.
>
> A minimum claw length of 70 mm PL equates to an egg production per recruit ratio >70%. Catch statistics show that the stock has supported the MSY catch levels of 3.0 to 3.5 million pounds under this management rule. Minimum claw lengths below 70 mm PL would reduce egg production per recruit and would define an overfishing situation. Although overfishing will probably be avoided when there is a minimum claw length that assures survival of crabs to achieve the 70 percent egg production per recruit potential, there is an unlikely possibility that the 70 percent ratio might not be achieved due to incidental mortality of sublegal size crabs. Although the CSAP recommends a strategy

that will probably produce an egg production per recruit ratio of 70 percent or more, it is noted that this level is probably much larger than what is needed to maintain the stock. It is likely that a strategy that would produce a 40 percent level would be adequate.

8.6.4.1 Overfishing Threshold Alternatives

Proposed Alternative: Overfishing is defined as a harvest level (or fishing mortality rate) that would result in a realized egg production per recruit of below 70 percent of potential production (see Figure 9).

Alternatives Considered and Rejected:

Alternative 1: Same as Alternative 1, except the realized egg production per recruit is set between 70 to 80 percent of potential production.

Alternative 2: Status Quo - retain current definition

Discussion: The Proposed Alternative and Rejected Alternative 2 are essentially the same. Rejected Alternative 1 would be more conservative, which probably is not necessary (see the CSAP's rationale cited above).

Economic Impacts: The specification of an overfishing threshold has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. It is only instructive to note that the higher the overfishing threshold specified to correspond to an overfishing threshold, the more restrictive would be the short-term measures adopted. These measures would be more restrictive the further the current status of any stock is to the specified threshold level. Long-term economic benefits can arise from short-term restrictive measures if the long-term viability of the fishery is preserved and, more importantly, if the management system adopted is such that economic rent is not dissipated. The current move in the fishery for limited access may be seen as an initial step toward preserving the economic rent that would be generated from short-term restrictive measures.

8.6.4.2 Overfished Threshold Alternatives

Proposed Alternative: The overfished condition would occur when the realized egg production per recruit is reduced below 40 percent of potential production.

<u>Alternatives Considered and Rejected</u>:

<u>Alternative 1</u>: Same as above, except the egg production per recruit level would be set between 40 to 70 percent of potential production.

<u>Alternative 2</u>: The overfished condition would occur when the realized egg production per recruit is reduced below 35 percent of potential production.

<u>Discussion</u>: The Proposed Alternative was recommended by the CSAP (1998), who pointed out that as 40 percent may also serve as the overfishing threshold, i.e., that level could exist at all the fishing mortality rates observed in the fishery (0.7 to 4.0) (see Figure 9). The CSAP also indicated that the Council may want to specify an overfished threshold above the one-half of MSY level (Rejected Alternative 2) as a precautionary approach, as in the Proposed Alternative. Rejected Alternative 1 would provide greater conservatism in management than is presently supported by available information.

<u>Biological Impacts</u>: The use of 70 percent of potential egg production as a proxy for MSY and for the overfishing threshold standard is a very conservative precautionary approach, in that at 100 percent there is no directed fishery. The Proposed Alternative of 40 percent of potential egg production for the overfished threshold is also a very conservative approach, in that as indicated in the discussion above that level could be used for an overfishing threshold, but only if the size limit was reduced.

<u>Economic Impacts</u>: The specification of an overfished threshold has no immediate impacts on fishing participants, but the measures designed to achieve that level could have impacts on these participants. Once those measures are specified, an economic impact analysis will be conducted. It is only instructive to note that the higher the level specified to correspond to an overfished threshold, the more restrictive would be the short-term measures adopted. These measures would be more restrictive the further the current status of any stock is to the specified threshold level.

<u>Environmental Consequences</u>:

Human Resources: The proposed actions maintain the standard that has provided a very high level of assurance that the stock would not be overfished. This high standard has benefitted the harvesters not only from the basis of having a stable fishery, but also in terms of higher revenue, i.e., a lower standard would likely result in smaller legal size claws of less value.

Fishery Resources: Maintenance of the overfishing threshold and a conservative overfished standard are beneficial to the stone crab stock.

Other Fishery Resources: There is no effect on other fishery resources from the alternatives.

8.6.5 Rebuilding Period

Since the stock is not overfished, no rebuilding period is proposed.

8.7 CORAL AND CORAL REEF RESOURCES

The Coral FMP was developed as a joint FMP for the coral complexes in the jurisdiction of the GMFMC and the SAFMC, with the GMFMC as administrative lead. The Secretary provided authority in December 1994 for separate Coral FMPs for each Council's jurisdiction, and since that time each Council has independently amended the plans.

The FMP included several hundred species, some of which were described by including all species within a family or order. MSY was described for only 3 species and 6 genera in terms of $kg/m^2/year$ dry weight for very small and discrete areas where the number of colonies had been monitored (GMFMC/SAFMC 1982). The FMP prohibits any harvest or possession of stony coral and seafans, except under scientific permit. The FMP, as amended, also prohibits harvest or possession of live rock, except from sites permitted for aquaculture of live rock organisms by the Corps of Engineers and NMFS. Such aquaculture is carried out by placing identifiable substrate (principally imported from the Bahamas) on the approved sites and harvesting it two to three years later when the colonizing organisms have matured. The FMP, as amended, allows an annual harvest of 50,000 colonies of gorgonians from areas estimated to have more than 4.7 billion colonies. With the exception of the gorgonians for which harvest is significantly restricted, OY is set at zero. Therefore, this amendment does not address overfishing or overfished thresholds for these stocks.

9.0 FISHING COMMUNITIES

9.1 Introduction

The SFA amended the M-MSFCMA to provide a new national standard addressing fishing communities as follows:

Standard 8. Conservation and management measures shall, consistent with the conservation requirements of the Magnuson-Stevens Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to:

(1) Provide for the sustained participation of such communities; and

(2) To the extent practicable, minimize adverse economic impacts on such communities.

The SFA also amended Section 303(a)(9) of the M-MSFCMA. This provision provides that the fishery impact statement shall assess, specify and describe the likely effects, if any, of management measures on participants in the fishery. The amendment added "and on fishing communities affected."

The National Standard Guidelines (50 CFR 600.345) provide interpretative rule for Standard 8, as follows:

General. (1) This standard requires that an FMP take into account the importance of fishery resources to fishing communities. This consideration, however, is within the context of the conservation requirements. Deliberations regarding the importance of fishery resources to affected fishing communities, therefore, must not compromise the achievement of conservation requirements and goals of the FMP. Where the proposed alternative negatively affects the sustained participation of fishing communities, the FMP should discuss the rationale for selecting this alternative over another with a lesser impact on fishing communities. All other things being equal, where two alternatives achieve similar conservation goals, the alternative that provides the greater potential for sustained participation of such communities and minimizes the adverse economic impacts on such communities would be the proposed alternative.

(2) This standard does not constitute a basis for allocating resources to a specific fishing community nor for providing preferential treatment based on residence in a fishing community.

(3) The term "fishing community" means a community that is substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew, and fish processors that are based in such communities. A fishing community is 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 services and industries (for example, boatyards, ice suppliers, tackle shops).

(4) The term "sustained participation" means continued access to the fishery within the constraints of the condition of the resource.

Analysis. (1) FMPs must examine the social and economic importance of fisheries to communities potentially affected by management measures. For example, severe reduction of harvests for conservation purposes may decrease employment opportunities for fishermen and processing plant workers, thereby adversely affecting their families and communities. Similarly, a management measure that results in the allocation of fishery resources among competing sectors of a fishery may benefit some communities at the expense of others.

(2) An appropriate vehicle for the analyses under this standard is the fishery impact statement required by section 303(a)(9). Qualitative and quantitative data may be used, including information provided by fishermen, dealers, processors, and fisheries organizations and associations. In cases where data are severely limited, effort should be directed to identifying and gathering needed data.

(3) To address the sustained participation of fishing communities that will be affected by management measures, the analysis should first identify affected fishing communities and then assess their differing levels of dependence on and engagement in the fishery being regulated. The analysis should also specify how that assessment was made. The best available data on the history, extent, and type of participation of these fishing communities in the fishery should be incorporated into the social and economic information presented in the FMP. The analysis does not have to contain an exhaustive listing of all communities that might fit the definition; a judgement can be made as to which are primarily affected. The analysis should discuss each alternative's likely effect on the sustained participation of these fishing communities in the fishery.

(4) The analysis should assess the likely positive and negative social and economic impacts of the alternative management measures, over both the short and the long term, on fishing communities. Any particular management measure may economically benefit some communities while adversely affecting others. Economic impacts should be considered both for individual communities and for the group of all affected communities identified in the FMP. Impacts of both consumptive and non-consumptive uses of fishery resources should be considered.

(5) A discussion of social and economic impacts should identify those alternative that would minimize adverse impacts on these fishing communities within the constraints of conservation and management goals of the FMP, other national standards, and other applicable law.

9.2 Gulf Fishing Communities

This section uses existing information to attempt to identify communities in the Gulf region that appear to be dependent or partially dependent on fisheries and fishing.

The Gulf of Mexico has relatively large commercial fisheries with annual landings higher than any other region of the U.S., other than the Alaskan region. Commercial landings for 1995 and 1996 averaged about 1.5 billion pounds annually. This is below landings for the 1983-84 period (highest years) of about 2.5 billion pounds annually.

The decline reflects largely a reduction in Gulf menhaden landings, which averaged about 2.1 billion pounds in 1983 and 1984 and currently (1995 and 1996) averages about 1.0 billion pounds. This reduction in menhaden landings appears to be related to market-induced reduction in industry capacity. The number of production plants has declined from about 11 to 5, and the number of vessels dropped from about 80 to about 50 (GSMFC 1995).

During 1995 and 1996, the value of Gulf commercial landings averaged about $700 million ex-vessel annually. This represents the value at the dock, and the value to the local and national economies is much higher. For example, Kearney/Centaur (1989) estimated the Gulf shrimp industry alone contributed $2.95 billion to the Gross National Product (GNP) when the value-added was estimated to the retail level, including restaurant sales.

During 1995 and 1996, an average of about 7,100 vessels (5 net tons or greater) and 22,000 boats participated in Gulf region commercial fisheries (NMFS 1997). In 1995, there were 390 seafood processing plants in the Gulf region that seasonally employed 10,127 persons and permanently employed 9,549 persons. There were 810 wholesale seafood plants employing an average of 6,555 persons on an annual basis.

The recreational fisheries in the Gulf region are larger than other east coast regions in terms of landings and participants. During 1995 and 1996, an average of about 4.0 million persons participated in marine recreational fishing in the Gulf states (NMFS 1997) (Page Campbell, TPWD, pers. comm). They made approximately 26.7 million trips annually and landed approximately 205 million pounds of fish. Marine recreational fishermen in the Gulf states spent $3.5 billion and created an overall economic impact of $7.0 billion (ASFA, 1997).

In the Gulf region there are about 2,460 recreational for-hire boats. This includes headboats, charter boats, and smaller guide boats. The headboats and most of the charter boats typically fish offshore. Many of the guide boats fish the estuaries and tidal coastal flats. Dive boats, whose clientele harvest fish, would be required to have a charter vessel permit, while dive boats that never harvest fish would not. Therefore, there are some dive boats, particularly in the Florida Keys, that are not included in the above total number, but which are dependent on fishery resources, including coral, for their revenue. The recreational for-hire boats contribute significantly to the economies of many fishing communities.

Data are not currently available to assess and describe the effects of management measures on fishing communities as provided for under Section 303(a)(9) of the M-MSFCMA and the guidelines as set forth in the introductory discussion above. A MARFIN project completed by Dr. Charles Tolbert and associates (1998), Louisiana State University (LSU), provides a data source from the national censuses of 1970, 1980, and 1990 for coastal communities (counties and communities) in the Gulf and south Atlantic regions that provides very general social, economic, and demographic information and can be used for the purpose of describing fishing and other occupations in coastal counties of the Gulf states.

In as much as the census data from Tolbert et al. (1998) and data from other sources are inadequate for assessing the impacts of fishery management on individual communities, the data has been placed in Appendix G and serves only as an initial source for identifying fishing communities.

The deficiencies of the census data for use in communities assessments is that in collection of data on employment in industry, the census form combines employment for agriculture, fishing, and mining industries. For the census of self-employed persons, the occupations for farming, fishing, and forestry are combined. The combining of these estimates makes the data virtually useless for fishery assessments, because most Gulf coastal areas have occupation opportunities in one or more of these industries, in addition to fishing. For example, the oil and gas industry and agriculture is common in the coastal areas from Louisiana through Texas. Forestry is common in the coastal counties from Mississippi through Florida in other than metropolitan areas. Therefore, in most areas these employment figures cannot be attributed to fisheries alone, nor is there any basis to prorate them between occupations or industries.

Similar problems affect the use of data from other sources, i.e., the data is compiled on the state or county level and cannot be disaggregated to community level. The recreational fishing landings, effort, and modes of fishing are compiled on the state level. Commercial landings and processing information are compiled on state and county levels. Most of the fisheries economic studies are done on the county level. Therefore, if the social and economic impacts on communities are to be determined, community-specific studies will be required to gather the appropriate data. A MARFIN project by researchers at the University of Florida was approved in 1998 to assess and describe fishing communities in the state of Florida.

10.0 REPORTING REQUIREMENTS

The SFA amended Section 303(a)(5) of the M-MSFCMA to provide the Councils require the collection of information with respect to commercial, recreational, and charter fishing for each fishery.

The Council feels it is already in compliance with this provision. The Council did, however, with a few exceptions, allow the SEFSC of NMFS to determine what data would be required to be submitted, and who would be sampled for collection of those data. This allowed the SEFSC the option of standardizing reporting requirements for persons in multiple fisheries. All of the FMPs provided for mandatory reporting by dealers and vessels in the commercial sector if the Center Director selected those persons to report. These requirements were amended for the Stone Crab and Spiny Lobster FMPs to provide such reporting would be through the Florida trip ticket program. Data on harvest of gorgonians under the Coral FMP are also collected by Florida. None of these FMPs, or the Shrimp FMP had recreational or charter/head boat sectors operating in the EEZ and no provision was made for reporting. The Reef Fish and Coastal Migratory Pelagics (CMP) FMPs provided for mandatory reporting by charter/headboat and private recreational boat sectors. NMFS reserved the rules applying to the private recreational (not-for-hire) boats and elected to use instead the MRFSS and headboat surveys for collection of data. The Council has also required the use of logbooks by commercial reef fish and mackerel vessels. Under the Red Drum FMP all reporting was either deferred to the states or reserved until an EEZ fishery was allowed.

11.0 DESCRIPTION OF FISHING SECTORS

The SFA amended the M-MSFCMA to add a Section 303(a)(13) requiring FMPs to provide a description of the commercial, recreational, and charter sectors and to quantify trends in landings for those sectors. With the exception of the charter sector, the Council concluded this information is current for all the FMPs, except Stone Crab and Spiny Lobster. Currently the information for the charter sector is being collected for the Gulf and South Atlantic areas under MARFIN. A description of Florida's west coast stone crab fishery (Vondruska 1998) is included as **Appendix E**. A description of Florida's spiny lobster fishery (Vondruska 1998a) is included as **Appendix F**.

12.0 REGULATORY IMPACT REVIEW

12.1 Introduction

The National Marine Fisheries Service (NMFS) 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 any proposed regulations are a "significant regulatory action" under certain criteria provided in Executive Order 12866 and whether the proposed regulations will have a "significant economic impact on a substantial number of small business entities" in compliance with the Regulatory Flexibility Act of 1980 (RFA).

This RIR analyzes the probable impacts on fishery participants of the proposed generic plan amendment to the Fishery Management Plans for Gulf Coral and Coral Reef

Resources, Coastal Migratory Pelagics, Red Drum, Reef Fish Resources, Shrimp, Spiny Lobster, and Stone Crab.

12.2 Problems and Objectives

The general problems and objectives are found in the respective FMPs, as amended, and in Section 4.0 of this document. The purpose and need for the present plan amendment are found in Section 3.0 of this document. The current plan amendment addresses the following issues: 1) bycatch provisions for FMPs, 2) overfishing criteria and rebuilding periods for stocks, 3) description of fishing communities, 4) reporting requirements, and 5) description of fishing sectors.

12.3 Methodology and Framework for Analysis

This RIR assesses management measures from the standpoint of determining the resulting changes in costs and benefits to society. To the extent practicable, the net effects are stated in terms of producer surplus to the harvest sector, net profits to the intermediate sector, and consumer surplus to the final users of the resource.

In addition to changes in the surpluses mentioned above, there are public and private costs associated with the process of changing and enforcing regulations on the various FMPs affected by this amendment.

Ideally, all these changes in costs and benefits need to be accounted for and quantified in assessing the net economic benefit from changes in management of various fisheries in the Gulf. The RIR attempts to determine these changes to the extent possible.

12.4 Impacts of Proposed Alternatives

The economic impacts of the individual alternatives are discussed in the main section (Sections 7.0-8.0) of this amendment under each of the alternatives. The subsections titled "Economic Impacts" comprise the major part of this RIR and are included herein by reference.

12.5 Private and Public Costs of Regulation

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 amendment include:

Council costs of document preparation, meetings, public hearings, and information dissemination $35,000

NMFS administrative costs of document preparation, meetings and review 22,000

Law enforcement costs . . . . no new cost

Public burden associated with licenses and reporting requirements . . . . none

NMFS costs associated with licenses and reporting requirements . . . . none

TOTAL $57,000

The identified costs, all of which are one-time expenses, pertain solely to the development of this amendment. There are no expected recurring costs from the implementation of this amendment.

12.6 Summary of Expected Effects

All the proposed measures in this amendment are not expected to have immediate impacts on fishing participants. These measures mainly provide the general parameters with respect to the type of regulations that may be enacted. Once specific measures are considered, an economic analysis will be conducted to assess their impacts on fishing participants.

12.7 Determination of a Significant Regulatory Action

Pursuant to Executive Order 12866, a regulation is considered a "significant regulatory action" if it is likely to result in a rule that may: 1) 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 or communities; 2) create a serious inconsistency or otherwise interfere with an action taken or planned by another agency; 3) materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of the recipients thereof; or 4) raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

The analyses of economic impacts contained in appropriate sections of this amendment have shown that there are no immediate impacts on fishing participants that may be expected of the various measures proposed in this amendment. Item 1, thus, is not satisfied by the proposed regulation.

The proposed regulation is determined not to interfere or create inconsistency with an action of another agency, including state fishing agencies or to affect any entitlements, grants, user fees, or loan programs. However, it is deemed that the proposed alternatives pertaining to specifications of MSY, OY, overfishing threshold, and overfished threshold present novel policy issues. A good amount of controversy arose especially with the definitions of overfishing. On this basis, the regulation proposed in this amendment is considered to be a significant regulatory action.

12.8 Initial Regulatory Flexibility Analysis

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

All of the commercial harvesting business entities affected by the rule will qualify as small business entities because their gross revenues are less than $3 million annually. In addition, for-hire vessels in the Gulf affected by the proposed rule generally earn less than $5 million in annual revenues and are thus considered to be small business entities. Hence, it is clear that the criterion of a substantial number of the small business entities comprising the commercial harvesting industry and the for-hire sector being affected by the proposed rule will be met. The outcome of "significant impact" is less clear but can be triggered by any of the five conditions or criteria discussed below.

<u>The regulations are likely to result in a change in annual gross revenues by more than 5 percent.</u> The discussions under the Economic Impacts section have determined that no immediate impacts on fishing participants are forthcoming from any of the measures proposed in this amendment, except the MSY, OY, overfishing, and overfished definitions relating to the royal red shrimp. The potential impacts, however, of the Proposed Alternative would be positive and equivalent to an approximately 65 percent increased in gross vessel revenues. But considering the recent decline in landings, the potential increase in landings and revenues would not materialize, at least in the near future.

<u>Annual compliance costs (annualized capital, operating, reporting, etc.) increase total costs of production for small entities by more than 5 percent.</u> The only measure that has potential impacts on the vessel production costs is the requirement to collect bycatch information, particularly the use of observers. At this stage, the proposed measures are couched in very general terms so that, in and by themselves, they are expected to have no immediate impacts on fishing vessels.

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

Capital costs of compliance represent a significant portion of capital available to small entities, considering internal cash flow and external financing capabilities. General information available as to the ability of small business fishing firms to finance items such as a switch to new gear indicate that this would be a problem for at least some of the firms. The evidence is that the banking community is becoming increasingly reluctant to finance changes of this type, especially if the firm has a history of cash flow problems. Available information is not sufficient to estimate the number of small business entities that would be affected in this fashion, although it may be noted that the measures that would have the likely effects of the nature described pertain to the collection of bycatch information. At the moment, these measures are specific enough for impact assessment.

The requirements of the regulation are likely to result in a number of the small entities affected being forced to cease business operations. This number is not precisely defined by SBA but a "rule of thumb" to trigger this criterion would be two percent of the small entities affected. The discussion of economic impacts of the sets of measures contained in this amendment has not determined that any business entity would cease operation as a result of adopting the proposed measures of this amendment.

Considering all the criteria discussed above, the conclusion is that small businesses will not be significantly affected by the proposed rule. Hence, the determination is made that the proposed rule will not have a significant economic impact on a substantial number of small business entities, and an Initial Regulatory Flexibility Analysis (IRFA) is not required.

The full details of the economic analyses conducted for the proposed rule are contained in the Economic Impacts sections of this document. Some of the relevant results are summarized below.

Description of the reasons why action by the agency is being considered: The need and purpose of this action are set forth in Section 3 of this document.

Statement of the objectives of, and legal basis for, the proposed rule: The specific objectives of this action are enumerated in Section 4 of this document. The Magnuson-Stevens Fishery Conservation and Management Act, as amended through October 11, 1996, provides the legal basis for the rule.

Description and estimate of the number of small entities to which the proposed rule will apply: The proposed rule will apply to all commercial and recreational for-hire firms that currently participate in the various fisheries considered in this amendment.

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: The reporting, record keeping and other compliance requirements of the proposed rule are not materially different from the current practice, with the possible exception of the use of an observer program in collecting bycatch information. The public burden associated with this latter activity cannot be estimated at this time, primarily because of the specifics related to the use of observers aboard fishing vessels.

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

Description of significant alternatives to the proposed rule and discussion of how the alternatives attempt to minimize economic impacts on small entities: Several types alternatives have been considered as ways to meet the FMP objectives. They are all discussed under the appropriate sections of this document.

13.0 ENVIRONMENTAL ASSESSMENT

The purpose and need for action for this amendment are contained in Section 3.0, with additional discussion in Section 4.0. The list of proposed actions is contained in Section 5.0. The full list of alternatives considered, including rejected alternatives, is listed for each issue in the appropriate issue section (sections 7.0 and 8.0).

The description of the affected environment of the fisheries are discussed in the Generic Amendment for Addressing Essential Fish Habitat in the following FMPs of the Gulf of Mexico: Shrimp, Red Drum, Reef Fish, Coastal Migratory Pelagic Resources, Stone Crab, Spiny Lobster, and Coral and Coral Reefs (GMFMC 1998).

13.1 Effects on Physical, Human, Fishery, and Wetlands Environments

The alternatives in the amendment are anticipated to have no effects on the physical environment, flood plains, wetlands or rivers.

Discussion of the environmental consequences of the alternatives on the Human and Fishery Environments accompanies each section containing the alternatives (sections 7.0 and 8.0) and constitutes the bulk of the environmental assessment with respect to the specific alternatives. Additional information concerning human impacts is contained in the RIR (section 12.0), and in the Economic Impacts subsection under each of the sets of alternatives.

13.2 Effect on Endangered Species and Marine Mammals

A Section 7 consultation will be requested from NMFS regarding the impact of the proposed Amendment. It is not anticipated that populations of threatened/endangered species would be adversely affected by the proposed actions.

13.3 Conclusion

Mitigation measures related to the proposed action and fishery: No significant adverse environmental impacts are expected; therefore, no mitigating actions are proposed. Unavoidable adverse effects with implementation of the proposed actions and any negative net economic benefits are discussed in the Regulatory Impact Review. The only irreversible and irretrievable commitment of resources involved are the government costs related to implementation of the amendment and reporting burdens on the public associated with providing bycatch information.

13.4 Finding of No Significant Environmental Impact

In view of the analysis presented in this document, I have determined that the fishery and the proposed action in this amendment to the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico would not significantly affect the quality of the human environment with specific reference to the criteria contained in NDM 02-10 implementing the National Environmental Policy Act. Accordingly, the preparation of a Supplemental Environmental Impact Statement for this proposed action is not necessary.

Approved: ______________________________ ______________

Assistant Administrator for Fisheries Date

14.0 OTHER APPLICABLE LAW

14.1 Habitat Concerns

Fish habitats and related concerns were described in the Generic Amendment for Addressing Essential Fish Habitat in the following FMPs of the Gulf of Mexico: Shrimp, Red Drum, Reef Fish, Coastal Migratory Pelagic Resources, Stone Crab, Spiny Lobster, and Coral and Coral Reefs (GMFMC 1998). The actions in this amendment do not directly affect the habitat.

14.2 Vessel Safety Considerations

A determination of vessel safety with regard to compliance with 50 CFR 600.355(d) will be requested from the U.S. Coast Guard. Actions in this amendment are not expected to adversely affect vessel safety.

14.3 Coastal Zone Consistency

Section 307(c)(1) of the Federal Coastal Zone Management Act of 1972 requires that all federal activities which directly affect the coastal zone be consistent with approved state coastal zone management programs to the maximum extent practicable. The proposed changes in federal regulations of this amendment will make no changes in federal regulations that are inconsistent with either existing or proposed state regulations.

This amendment has been judged to be consistent with the Coastal Zone Management programs of the states of Alabama, Florida, Louisiana, Mississippi, and Texas to the maximum extent practical. This determination will be submitted for review to the responsible state agencies under Section 307 of the Coastal Zone Management Act administering approved Coastal Zone Management programs of these states.

14.4 Paperwork Reduction Act

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

The proposal to require those vessels selected to submit reports on bycatch harvested by the vessel would impose additional but relatively minimal public reporting burden. This requirement has been determined to be necessary under the SFA to improve the information available to assess the impacts of bycatch.

14.5 Federalism

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.

15.0 LIST OF AGENCIES AND PERSONS CONSULTED

The following agencies and entities were consulted on the provisions of this amendment:

Gulf of Mexico Fishery Management Council:
- Standing Scientific and Statistical Committee
- Ad Hoc Sustainable Fisheries Advisory Panel
- Law Enforcement Advisory Panel
- Ad Hoc Finfish Stock Assessment Panel
- Ad Hoc Crustacean Stock Assessment Panel

Coastal Zone Management Programs:
- Texas
- Louisiana
- Mississippi
- Alabama
- Florida

National Marine Fisheries Service:
- Southeast Regional Office
- Southeast Fisheries Science Center

16.0 PUBLIC HEARING LOCATIONS AND DATES

Public hearings for the daft Amendment were held in the following dates and locations from 7:00 p.m. to 10:00 p.m.

Monday, December 7, 1998
Holiday Inn - Fort Brown
1900 East Elizabeth Street
Brownsville, Texas 78520

Tuesday, December 8, 1998
Port Aransas Civic Center Auditorium
710 West Avenue A
Port Aransas, Texas 78373

Pier House
One Duval Street
Key West, Florida 33040

Wednesday, December 9, 1998
Texas A&M Auditorium
200 Seawolf Parkway
Galveston, Texas 77553

Thursday, December 10, 1998
New Orleans Airport Hilton &
Conference Center
901 Airline Highway
Kenner, Louisiana 70063

Ramada Airport Hotel
5303 West Kennedy Boulevard
Tampa, Florida 33609

Monday December 14, 1998
National Marine Fisheries Service
Panama City Laboratory
3500 Delwood Beach Road
Panama City, Florida 32408

Tuesday, December 15, 1998
Orange Beach Community Center
27235 Canal Road
County Road 180
Orange Beach, Alabama 36561

Wednesday, December 16, 1998
J.L. Scott Marine Education Center
& Aquarium
115 East Beach Boulevard
U.S. Highway 90
Biloxi, Mississippi 39530

Thursday, December 17, 1998
Larose Regional Park
2001 East 5th Street
Larose, Louisiana 70373

17.0 LIST OF PREPARERS

Gulf of Mexico Fishery Management Council:
- Wayne E. Swingle, Executive Director
- Antonio Lamberte, Economist
- Richard Leard, Biologist

18.0 REFERENCES

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Table 1. By-catch observed in 21,309 lobster traps during the 1993-1994 lobster season. Species are listed in order of abundance. For those species regulated by size restrictions, the number of legal and sub-legal sized individuals are presented separately.

[Table only available with printed copy.]

Table 2. Number and fate of fish caught on longline gear from April 1994 through February 1995.

[Table only available with printed copy.]

Table 3. Number and fate of fish sampled in fish traps from December 1993 through November 1994.

[Table only available with printed copy.]

Table 4. Estimates of fractions of red snapper caught and released by recreational fishermen by fishing mode and year for the period 1979-1994, based on the NMRFSS data. Note: charter boat data are included with head boats before 1986.

	Head Boats			**Charter**			**Private/Rental**			**Combined**		
Year	Kept	Rel	% Rel	Kept	Rel	% Rel	Kept	Rel	% Rel	Kept	Rel	% Rel
1979	2892	0	0.0				2490	114	4.4	5382	114	2.1
1980	2044	40	1.9				2021	40	2.0	4065	81	1.9
1981	323	6	2.0				1792	55	3.0	2115	61	2.8
1982	708	12	1.6				726	11	1.4	1433	22	1.5
1983	1053	2	0.1				1554	0	0.0	2607	2	0.1
1984	422	1	0.3				232	21	8.3	654	22	3.3
1985	621	2	0.4				503	177	26.0	1124	179	13.7
1986				580	30	4.9	247	15	5.7	827	45	5.1
1987				556	31	5.2	224	37	14.2	780	68	8.0
1988				368	27	6.8	344	166	32.5	712	193	21.3
1989				284	81	22.1	370	202	35.3	654	282	30.1
1990				137	141	50.6	203	361	64.1	340	502	59.6
1991				357	286	44.4	273	531	66.0	630	816	56.4
1992				309	259	45.6	663	663	50.0	972	923	48.7
1993				567	189	25.0	704	654	48.2	1270	843	39.9
1994				328	311	48.6	496	494	49.9	824	805	49.4
Source: Goodyear (1995a)												

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Table 5. Number (Thousands) of Fish Released by Anglers in the Gulf of Mexico and Percentage of Total Catch Released for Reef Fish Species.

	Red Snapper		Vermilion Snapper		Gag Grouper		Red Grouper		Greater Amberjack	
Year	Number Released	Percent of Catch	Number Released	Percent of Catch	Number Released	Percent of Catch	Number Released	Percent of Catch	Number Released	Percent of Catch
1990	539	58	44	7	414	71	1690	89	78	56
1991	870	58	155	15	875	77	3013	91	279	54
1992	936	49	159	20	754	74	2740	86	329	57
1993	963	39	344	31	1296	78	1708	82	225	59
1994	906	47	101	14	1815	87	1708	86	114	49
1995	768	50	286	28	2016	83	1713	84	73	57
1996*	1006	59	81	22	1150	80	1048	89	69	49

*Preliminary Data

Source: Marine Recreational Fishery Statistics Survey Data only.

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Table 6. Number (Thousands) of Fish Released by Anglers in the Gulf of Mexico and Percentage of Total Catch Released for Migratory Coastal Pelagic Species.

	King Mackerel		Spanish Mackerel		Cobia		Dolphin (fish)	
Year	Number Released	Percent of Catch	Number Released	Percent of Catch	Number Released	Percent of Catch	Number Released	Percent of Catch
1990	229	24	4281	58	171	68	46	4
1991	308	21	2462	42	456	79	695	31
1992	271	28	3301	41	218	69	101	13
1993	106	11	2028	40	131	57	205	15
1994	288	21	1295	32	232	65	254	19
1995	258	21	1113	35	153	61	474	25
1996*	332	22	1274	36	235	56	27	3

*Preliminary Data

Source: Marine Recreational Fishery Statistics Survey Data only.

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Table 7. Annual average of Total Shrimp Effort by Statistical Zones for 1990 - 1993 and 1994 - 1995 Periods (In Thousands of 24-hour Fishing Days)

Date/Location	Nearshore[1]	Offshore[2]	Total (%)
1990 - 1993			
Stat. Areas 1 - 7	3.1	14.4	17.5 (8%)
Stat. Areas 8 - 21	105.4	93.5	200.0 (92%)
1994 - 1995			
Stat. Areas 1 - 7	6.3	16.3	22.6 (12%)
Stat. Areas 8 - 21	85.2	78.2	163.4 (88%)

Source: Data provided by National Marine Fisheries Service, Galveston Laboratory.

[1]Inshore of 10 Fathoms
[2]Offshore of 10 Fathoms

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Table 8. Ratio of Finfish Poundage to each Pound of Shrimp Caught in Shrimp Trawls from the Gulf of Mexico, 1992 - 1994.

By Area		By Season	
Gulf-wide	4.2	Gulf-wide:	
Florida			
Nearshore[1]	2.9	January/April	4.9
Offshore[2]	3.1		
Alabama/Mississippi		May/August	3.3
Nearshore	3.2		
Offshore	3.6	September/December	5.1
Louisiana			
Nearshore	3.3		
Offshore	6.9		
Texas			
Nearshore	3.5		
Offshore	3.3		

Source: Gulf of Mexico Fishery Management Council, 1997, Shrimp Amendment 9 (Data provided by National Marine Fisheries Service, Galveston Laboratory.)

[1]Inshore of 10 Fathoms
[2]Offshore of 10 Fathoms

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Table 9. Ratio of Finfish Poundage for each Pound of Shrimp Caught in Trawls from Statistical Areas 1 - 8 off Florida, 1993 - 1996.

Water Depths (Fathoms)	Statistical Areas Sampled (See Figure 2)		
	1 - 2	3 - 5	6 - 8
<5	-----	7.8	4.7
5 - 10	1.1	4.1	4.1
10 - 15	1.0	1.3	2.7
>15	1.0	2.0	4.8
N[1]	330	298	374

Source: Data provided by the Gulf and South Atlantic Fisheries Development Foundation.

[1]N=Number of Tows Sampled

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Table 10. Most Common Species Groups in Shrimp Trawl Samples for Statistical Areas 1 - 8, 1993 - 1996, in Numbers of Fish Per Hour Trawled.

Statistical Areas:	1 - 2		3 - 5		6 - 8	
Depths (fathoms):	10 - 15	>15	10 - 15	>15	10 - 15	>15
Sea Basses[1]	3.0	0.4	3.3	4.5	4.6	5.3
Searobins	1.6	3.2	2.2	1.1	2.9	2.0
Pinfish	3.0	0.4	0.2	<0.1	0.4	0.2
Porgy, Longspine	0.1	----	0.1	----	29.1	64.5
Spot	0.2	<0.1	----	----	11.2	6.7
Mojarras	2.6	0.1	----	----	<0.1	----
Lane Snapper	1.0	0.3	3.1	1.0	<0.1	<0.1
Flounders by genera:						
Citharichthys	2.3	0.1	1.5	1.0	0.6	0.3
Syacium	13.9	15.5	15.6	18.5	12.5	14.2
Etropus	0.2	<0.1	5.2	23.1	1.9	52.2
Paralichthys	0.5		0.2	<0.1	0.3	<0.1
Grunts/Porgies[2]	0.2	0.7	0.7	4.1	4.7	5.1

Source: Data provided by Gulf and South Atlantic Fisheries Development Foundation.

[1]Fish of the following genera: Centropristis, Diplectrum, and Serranus

[2]Fish of the following genera: Orthoprista, Haemulon, Calamus, and Arohoaorgus

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Table 11. Number of Fish Caught Per Hour for Less Common Species or Species Groups in Bycatch Characterization and BRD Control Net Evaluations by Water Depth for Statistical Areas 1 - 5, 1993 - 1996.

Species/ Species Group	Statistical Area 1 - 2			Statistical Areas 3 - 5			
	Depth (Fathoms) 5 - 10	10 - 15	>15	Depth (Fathoms) 0 - 5	5 - 10	10 - 15	>15
Atlantic Croaker		0.27	0.04				
Bumper	0.46	0.22	0.04			0.10	0.01
Butterfish		0.07					0.01
Catfish	0.03	0.05	0.02	0.41			0.01
Cobia		0.03					
Cutlassfish		0.01				0.03	
Silver Perch	0.03				0.02		
Sharks	0.03						
Flounder		0.16	0.06				0.05
Porgy		0.09				0.10	
King Mackerel		0.01	0.01			0.02	
Spanish Mackerel		0.04				0.02	
Red Snapper			0.03				
Vermilion Snapper			0.07			0.03	0.19
Other Snapper					0.04	0.05	0.02
Spot		0.23	0.03	0.70	0.07		
Star Drum		0.08					
Seatrout		0.19	0.01				
Whiting		0.22	0.02	5.4	0.89		
Jacks	0.06	0.28	0.03				0.02
Groupers			0.02				
N[1]	21	181	127	10	66	122	100

Source: Data provided by G&SAFDF.

[1]N=Number of Tows

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Table 12 - insert Qpro table

Table 13. Updated Assessment of Overfishing Status for Gulf Stocks Based on Current Criteria in FMPs[1].

Species Stocks	Council's Overfished SPR %	Assessment Year	Data Through Year	Latest Estimated SPR %	Projected SPR % with Regulation	Overfished Determination		Approaching Overfished Condition
						NMFS	Council	
A. Reef Fish								
Red Snapper	20	1997	1996	0.4	>20[2]	yes	yes	n/a
Vermilion Snapper	20	1996	1995	20-25	<20	no	no	yes
Greater Amberjack	20	1996	1995	34-36	>40	no	no	no
Gag	20	1994[3]	1992	30	<30	unknown	no	unknown[9]
Red Grouper	20	1993	1992	30	>30	unknown	no	unknown
Shallow-water Grouper	20	1991[4]	1990	30-36	>36	n/a	no	n/a
Jewfish & Nassau Grouper	20	none				yes	yes	n/a
B. Migratory Coastal Pelagics								
Gulf-group King Mackerel	30	1998	1997	23	>23	yes	yes	n/a
Gulf-group Spanish Mackerel	30	1998	1997	35	>35	no	no	no
Cobia	20	1996	1995	13-25	unknown	no	no	no
C. Red Drum	20	1996	1995	10	>20[5]	yes	yes	n/a
D. Shrimp								
Brown Shrimp	n/a[6]	1997	1996	n/a[6]		no	no	no
White Shrimp	n/a[6]	1997	1996	n/a[6]		no	no	no
Pink Shrimp	n/a[6]	1997	1996	n/a[6]		no	no	no
Royal Red Shrimp	n/a[6]	1997	1996	n/a[6]		no	no	no
E. Spiny Lobster	5[7]	1990	1982	n/a[7]	>5	no	no	no
F. Stone Crab	70[8]	1989	1988	>70	>70	no	no	no

[1]Status of other species or stocks is unknown
[2]By year 2019
[3]More recent assessment (1997) exists but has not been analyzed by RFSAP. It suggests SPR is lower.
[4]Red Grouper assessment was used as proxy for shallow-water grouper
[5]By year 2001
[6]Surviving parent stock levels, rather than SPR, are used for Penaeid shrimp and MSY for royal red shrimp
[7]Eggs per recruit ratio measured from exploited stock as compared to stock in sanctuary
[8]Eggs per recruit ratio
[9]The 1998 NMFS report indicated gag were approaching an overfished state

TABLE 14 Summary of M/K Ratios for Gulf Finfish Stocks

Group One: M/K Ratio ≤ 1.0

Species	M	K	M/K
Black Grouper	0.15	0.160	0.94
Red Hind	0.18	0.207	0.87
Cubera Snapper	0.15	0.160	0.93
Red Snapper*	0.10	0.160	0.63
Yellowtail Snapper*	0.20	0.250	0.80
Greater Amberjack*	0.20	0.250	0.80
Red Drum*	0.20	0.367	0.55
Cobia*	0.35	0.350	1.00
Red Grouper*	0.20	0.210	0.95
Jewfish**			0.92
Nassau Grouper**			0.94

Group Two: M/K Ratio > 1.0 ≤ 1.5

Species	M	K	M/K
Coney	0.18	0.145	1.24
Rock Hind	0.25	0.191	1.31
Scamp	0.14	0.126	1.13
Snowy Grouper	0.13	0.113	1.15
Warsaw Grouper	0.08	0.054	1.48
Yellowedge Grouper	0.18	0.170	1.05
Yellowfin Grouper	0.18	0.170	1.05
Schoolmaster	0.25	0.180	1.38
Vermilion Snapper*	0.20	0.198	1.01
Mutton Snapper*	0.21	0.153	1.36
Hogfish	0.25	0.190	1.32
King mackerel*	0.20	0.170	1.18
Spanish mackerel*	0.30	0.270	1.11

Group Three: M/K Ratio > 1.5

Species	M	K	M/K
Gag*	0.20	0.150	1.63
Graysby	0.20	0.130	1.54
Speckled Hind	0.20	0.130	1.54
Yellowmouth Grouper	0.18	0.063	2.86
Black Snapper	0.30	0.097	3.09
Blackfin Snapper	0.23	0.084	2.74
Dog Snapper	0.33	0.100	3.30
Gray Snapper	0.30	0.136	2.21
Lane Snapper	0.30	0.097	3.09
Mahogany Snapper	0.30	0.097	3.09
Silk Snapper	0.23	0.092	2.50

Source: Ault, et al. (1997 (Except for species marked by *). **from Legault and Eklund (1998)

Table 15. Comparison of Gulf group king mackerel TAC and landings by fishing year (million pounds); percent of total landings and percent over allocation for recreational and commercial sectors.

[Table only available with printed copy.]

<u>Table 16</u>. Cobia U.S. Atlantic and Gulf of Mexico Catch Summary in Number and by Weight in Pounds. Year denotes calendar year. The 1995 estimates are preliminary.

Atlantic- thousands of fish				Atlantic- thousands of pounds		
Year	Commercial	Recreational	Total	Commercial	Recreational	Total
1984	1479	40750	42229	33.4	951.4	984.8
1985	1328	44204	45532	30.0	1313.6	1343.6
1986	3099	33012	36111	70.0	573.7	648.7
1987	5401	29809	35210	122.8	617.3	740.1
1988	4684	27132	31816	105.6	553.9	659.5
1989	5799	46498	52297	131.1	1339.7	1470.8
1990	5482	29085	34567	123.3	619.7	743.0
1991	5297	31554	36851	125.0	914.8	1039.8
1992	5604	54883	60487	137.3	1204.5	1341.8
1993	5627	31756	37383	123.8	684.8	808.6
1994	5410	30273	35683	126.6	671.6	798.2
1995	3739	18541	22280	97.2	521.1	618.3
US Gulf - thousands of fish				US Gulf - thousands of pounds		
Year	Commercial	Recreational	Total	Commercial	Recreational	Total
1984	10161	54160	64321	174.4	1066.9	1241.3
1985	9404	48580	57984	161.4	1115.8	1277.2
1986	10301	71875	82176	176.8	1373.4	1550.2
1987	11764	54928	66692	201.9	919.9	1121.8
1988	10488	74480	84968	180.0	1348.7	1528.7
1989	3535	44913	58448	232.3	939.9	1172.2
1990	10143	41903	52046	174.1	811.6	985.7
1991	7225	60854	68079	176.3	1218.2	1294.5
1992	8615	52142	60757	232.6	950.5	1183.1
1993	9147	57988	67135	260.7	1034.2	1294.9
1994	9276	66394	75670	262.5	1392.5	1655.0
1995	5053	52720	57773	151.6	1050.0	1201.6

Source: MSAP Report 1996.

Table 17. Gulf Red Drum Rules.

GULF RED DRUM RULES

As of April 1986

Alabama (No sale of fish from state waters)

Bag: 15/day
Size: 14 inches - 36 inches TL
(two fish over 36 inches)

Florida

Bag: None
16 inches - 32 inches TL[1]
Size: 18 inches - 32 inches TL [2]
(one fish over 32 inches)
Commercial quota: No Limit

Mississippi

Bag: 10/day - (with 5 undersize)
Size: 14 inches - 30 inches TL
(two fish over 30 inches allowed)
Commercial quota: 200,000 Pounds
Closed season: No Fishing 9/15 - 11/15

Louisiana

Bag: 50/day (red drum/spotted seatrout combined)
Size: 16 inches - 36 inches TL (commercial)
no limit (recreational)
two fish over 36 inches
Commercial quota: No limit

Texas (No sale of fish from state waters)

Bag: 5/day
Size: 18 inches - 30 inches TL
(no fish over 30 inches)

[1] Alabama To Dixie County
[2] Rest of State
TL = Total Length

As of March 1996

Alabama (Gamefish Status)

Bag: 3/day
Size: 16 inches - 26 inches TL
(one fish over 26 inches allowed)

Florida (Sale Prohibited)

Bag: 1/day
Size: 18 inches - 27 inches TL

Mississippi

Bag: 3/day
Size: 18 inches - 30 inches TL
(One fish over 30 inches allowed)
Commercial quota: 35,000 pounds

Louisiana (Game Fish Status)

Bag: 5/day
Size: 16 inches - 27 inches TL
(One fish over 27 inches allowed)

Texas (Gamefish Status)

Bag: 3/day
Size: 20 inches - 28 inches TL
(Up to two tagged fish over 28 inches annually)

Note: Off water possession limit generally twice bag limit for most states

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Table 18. Landings (pounds) of Royal Red Shrimp by Year and Statistical Grid.

[Table only available with printed copy.]

Table 18 (cont.). Landings (pounds) of Royal Red Shrimp by Year and Statistical Grid.

[Table only available with printed copy.]

Table 19. Number of spiny lobster harvested, estimated population size, fishing mortality rates, weighted fishing mortality for ages 2 - 7 by year, and transitional spawning potential ratios. The fishing mortality rates in bold represent the rate for the fully available lobsters (selectivity = 1.00). Natural mortality rate: 0.34 per year.

[Table only available with printed copy.]

APPENDIX A. Chapter 46-13 Florida Code of Law. Stone Crabs.

[Appendix only available with printed copy.]

Appendix B. Report of the Ad Hoc Crustacean Stock Assessment Panel. Prepared by the Ad Hoc Crustacean Stock Assessment Panel at the Panel Meeting held June 1-3, 1998.

CRUSTACEAN STOCK ASSESSMENT PANEL REPORT

I. INTRODUCTION

The charge of the Crustacean Stock Assessment Panel (CSAP) was to address the new provisions of the SFA that apply to National Standard 1 which provides that management measures shall prevent overfishing while achieving optimum yield (OY) from each fishery for the U.S. fishing industry. These changes require the SAP to reassess statements in the fishery management plans (FMPs) for MSY, OY, and threshold defining overfishing and overfished for each stock or stock complex. In carrying out this task, the CSAP was guided by the provisions of the National Standard Guidelines for National Standard 1 which is set forth in 50 CFR 600.310 and include the alternatives for specifying these parameters. The CSAP utilized the best available scientific information in formulating its recommendations which included, but was not limited to, those documents discussed in Section II of this report. In the case of the Spiny Lobster FMP, the CSAP deferred making recommendations until a subpanel could be convened to analyze more recent information and develop a separate report for that fishery.

II. REVIEW OF STOCK ASSESSMENT INFORMATION

The Panel reviewed the documents presented in Section IV (Review of the Literature). To fulfill its charge, the Panel paid particular attention to the existing definitions for MSY, OY, and overfishing for the 3 *Penaeus* species discussed in Amendments 5 and 7 to the Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico, United States Waters and for royal red shrimp discussed in Amendment 8. The Panel also considered the findings from a series of workshops on overfishing of shrimp from 1989 through 1993, the recent overfishing reports by the National Marine Fisheries Service (NMFS), and conclusions regarding estimates of MSY for royal red shrimp.

With regard to stone crabs, the Panel particularly reviewed the current definitions for overfishing (contained in Amendment 4 to the Fishery Management Plan for the Stone Crab Fishery of the Gulf of Mexico and current definitions of MSY. In addition to the catch, effort, and other stock assessment information available in these documents, a 1997 update of stock parameters regarding this species prepared by the Florida Department of Environmental Protection was most helpful to the Panel's review and conclusions.

As noted below, there was insufficient participation by Panel members with particular experience assessments of spiny lobster stocks for the Panel to fully address its charge with regard to this species. Additionally, a recent paper (Muller et al. 1997) was presented at the Panel meeting, and members felt that there was sufficient time to fully review the document and determine the most appropriate application of the data to the Panel's charge.

III. CRUSTACEAN STOCK ASSESSMENT PANEL RECOMMENDATIONS AND CONCLUSIONS

Shrimp Fishery Management Plan

Genus - ***Penaeus***

The three species of *Penaeus* comprising the bulk of the Gulf of Mexico shrimp fisheries are essentially annual crops. Annual harvests vary considerably due to fluctuations in environmental conditions experienced by pre-recruits. MSY estimates have been reported, based on analytical models of catch and landings. Such MSY values are near observed maximum catches. However, the Panel stresses that due to the environmental fluctuations seen to date, catches above MSY, even if persisting over several years, must not of themselves be taken as evidence of overfishing.

The Panel agrees with the findings of <<overfishing workshops>>, that the best way to define overfishing for the 3 *Penaeus* species is in terms of spawning population size. Empirical comparisons of 30 years of landings data with the indicies of spawning population size determined by VPA stock assessment were used by the <<workshops>> to define minimum levels of spawning stock believed to be compatible with maximum productivity under current conditions. The Panel recommends these values as the most meaningful proxy for MSY. Maintaining parent stock numbers above these levels should be sufficient to prevent overfishing. The Panel proposes retention of the scientific review scenarios proposed by the <<workshops>> (‘response to potential overfishing,’ below) as the proper response to reduction of parent stocks below the MSY proxy targets.

<u>Maximum Sustainable Yield (MSY)</u>:

The definition of MSY with respect to the status of the existing fishery was a contentious issue during the original development of the shrimp FMP, because the annual harvest levels upon which any point estimate of MSY was based varied by up to 30%, due to environmental factors affecting survival in the nursery grounds. The authors of the plan wanted to stress the dependence of harvest on the environment, but objections were raised because the plan would allow yields above any stated MSY. The plan authors, therefore, presented point estimates of MSY, the maximum probable catch under optimum environmental conditions, and an estimate of maximum effort for a sustainable fishery. With the increased experience with FMPs, it should now be recognized that shrimp harvests can exceed a long-term average MSY for perhaps several years, without damage to stock productivity, and conversely, that harvests below MSY might be excessive during periods of low recruitment. The Panel believes that maintaining sufficient spawning stock is much more appropriate for shrimp management than comparing catches to MSY values.

The Panel recommends that the minimum MSY spawning stock size be defined as the parent stock numbers (as indexed from current VPA procedures) for the 3 penaeid species of shrimp in the Gulf of Mexico at or above the following levels:

Brown Shrimp - 125 million individuals, age 7+ months during the November through February period.

White Shrimp - 330 million individuals, age 7+ months during the May through August period.

Pink Shrimp - 100 million individuals, age 5+ months during the July through June year.

Optimum Yield (OY):

There are no known biological considerations that would require the setting of OYs at levels below those attaining the MSY proxies. Under current management practices, OY is actually a consequence, not a target, of the varied strategies to obtain shrimp at different desired sizes in different regions of the Gulf. Using spawning population to define overfishing has the advantage of separating the essentially economic decisions about utilization of a given recruitment from more serious biological concerns about compromising possible future recruitments.

Overfishing Threshold:

Overfishing is defined as a level of fishing that results in the parent stock number for any of the penaeid species being reduced below the MSY minimum levels listed above.

Response to Possible Overfishing::

If overfishing persists for 2 consecutive years, the Crustacean SAP recommends that the appropriate panels (*e.g.* SAP, AP, SSC) be convened to review changes in the parent stock size, changes in fishing effort, potential alterations in habitat or other environmental conditions, fishing mortality, and other factors that may have contributed to the decline. If excessive fishing is determined to be the source of, or a contributer to the reduced parent stock sizes, reduction in fishing pressure should be recommended.

Overfished Threshold:

An overfished condition would be at a parent stock level below the overfishing definition. The guidelines provide that a value as low as one-half the MSY target spawning population size could be used, *i.e.*:

Brown Shrimp - 63 million individuals, age 7+ months during the November through February period.

White Shrimp - 165 million individuals, age 7+ months during the May through August period.

Pink Shrimp - 50 million individuals, age 5+ months during the July through June year.

Some concern was expressed about setting values this low, but the Panel did note that white shrimp in the early 1960s recovered rapidly from below one-half the MSY minimum. The Council may want to specify an overfished threshold above the one-half MSY level as a precautionary approach.

Current Status:

Parent stocks for all three species have remained well above the MSY parent stock minimum for about 30 years. Even during the recent reduction of pink shrimp recruitment in south Florida, the stock maintained adequate spawning potential. Overfishing does not appear imminent for any of the three *Penaeus* species.

Research Recommendations

For purposes of stock assessment, and for assessing condition relative to overfishing, current information is considered adequate. The most serious omission in data collection for assessment could be the lack of annual estimates of recreational, bait, and commercial harvest not marketed through traditional dealers. There are several contentious issues involving impacts of management actions on the shrimp fisheries that do call for further data collection and analysis, but these are not directly related to the basic stock assessments. The most important, active area for biological research on shrimp at present is in defining habitat requirements for shrimp.

Royal Red Shrimp - *Pleoticus robustus*

Maximum Sustainable Yield MSY:

MSY for royal red shrimp is best considered undetermined. The current FMP point estimate is 392,000 pounds. However, recent analyses have shown that an MSY estimate of 650,000 pounds is as scientifically defensible as 392,000. The Panel therefore recommends that MSY be reported as a range from 392,000 to 650,000 pounds. The Panel notes that, as discussed in Amendment 8 to the Shrimp Fishery Management Plan, a more adequate accounting of the biology and distribution of this species is needed before improvement in the quality of MSY estimates can be expected. Simply allowing catches to rise to the upper end of the MSY range may not provide sufficient information to specify MSY more accurately.

Optimum Yield (OY):

The Panel had no recommendations for specifying OY.

Overfishing Threshold:

Overfishing is defined as a harvest level that exceeds the Council's established level of OY, expected to be within the MSY range.

Overfished Threshold:

The Panel noted that there was insufficient data to specify an overfished level.

Current Status:

No annual harvests have exceeded the lower range limit of MSY. The stock is not believed to be overfished. The current fishery may be exploiting only a small part of the stock's spatial distribution.

Stone Crab Fishery Management Plan

In the opinion of the Panel, the stone crab fishery in the Gulf of Mexico is at or near full exploitation. Landings have increased since the 1960s, to a 1990-1997 level of 3.0-3.5 million pounds (claw weight). Effort (in number of traps) has also increased considerably, resulting in currently low catch per unit of effort (CPUE) values. However, the stock does not show indications of overfishing and appears to be able to sustain the current levels of production. The Panel believes that the egg production per recruit ratio is a definable, quantitative measure that is appropriate for measuring stock condition, MSY values, and overfishing/overfished definitions for stone crabs.

The minimum claw size regulation (70 mm), probably originally set as a market requirement, assures that female crabs spawn at least once before they are subject to harvest. This results in a relatively high (~80%) egg production per recruit ratio. The Panel believes that this level, which can produce an MSY harvest, provides a high level of protection against overfishing.

Maximum Sustainable Yield (MSY):
MSY is defined as the harvest that results from a realized egg production per recruit at or above 70% of potential production. This harvest capacity is currently estimated at between 3.0 and 3.5 million pounds of claws (70 mm minimum propodus length).

Rationale: The Panel reviewed the analyses for stone crabs from the NMFS SEFSC Overfishing Workshop and concluded that at the current minimum claw length of 70 mm recruitment overfishing is unlikely. That is because on average males and females mature at age 2 (50% maturity), the male crusher and pincher claws reach legal length between age 2 and age 3, and female claws reach legal lengths one to two years later. Therefore, females spawn for at least one or more years before entering the fishery. Restrepo (1989) suggested the egg production potential is largely independent of the male/female ratio in the population since a single copulation fertilizes a female for the season and males can copulate with several females. Therefore, the fact that males enter the fishery at earlier ages and may be reduced relative to the number of females does not appear to impact egg production potential. Females are capable of producing up to 13 batches of eggs after a single copulation (four to five batches on the average) during the reproductive season. Fecundity is linearly related to size and large females produce upwards of 350,000 eggs per batch. Therefore, at the present minimum claw length of 70 mm, more than 70% of potential egg production will be maintained over a wide range of fishing mortality rates, both higher and lower than the present mortality rate. The current fishing mortality rates produce between 3.0 and 3.5 million pounds of claws annually, and this range is considered to be the best estimate for MSY.

Optimum Yield (OY):
There are no known biological considerations that would require the setting of OY at a level below MSY, and the stock is adequately protected at this level. [*Add last 2 lines on p. 5 and the first 12 lines on p.6 from the Stone Crab Amendment 4*].

Overfishing:
Overfishing for the stone crab fishery is defined as a realized egg production per recruit of below 70% of potential production.

Rationale: A minimum claw length of 70 mm equates to an egg production per recruit ratio of 70% or over. Catch statistics show that the stock has supported the MSY catch levels of 3.0 to 3.5 million pounds under this management rule. Minimum claw lengths below 70 mm would reduce egg production per recruit and would define an overfishing situation. Although overfishing shouldl be avoided when there is a minimum claw length (length of propodus) that assures survival of crabs to achieve the 70% egg production per recruit potential, there is an unlikely possibility that the 70% ratio might not be achieved due to incidental mortality of sublegal size crabs, in which case overfishing could occur at somewhat higher egg production per recruit ratios. Although the Panel recommends a strategy that will probably produce an egg production per recruit percentage of 70% or more, it is noted that this level is probably much larger than what is needed to maintain the stock. It is likely that a strategy that would produce a 40% level would be adequate .

Overfished:
The overfished condition exists when the realized egg production per recruit is reduced below 40% of potential production. As noted above, this level might also be an overfishing threshold.

Rationale: An egg production per recruit level of 40% was chosen to represent the overfished threshold, because this represents the value of egg production per recruit that is approximately one-half the value of that at MSY. The Council may want to specify an overfished theshold above the one-half MSY level as a precautionary approach.

Current Status of the Stock:

(Executive Summary of Muller report) (Tab 20)

Research and Data Needs:

1.Expand juvenile monitoring program currently being conducted in Tampa Bay by the Florida Department of Environmental Protection (FDEP) to other areas of the fishery (e.g., Monroe-Collier and Citrus-Pasco Counties).

2. Monitor claw size composition in the commercial catch.

3.Monitor CPUE in the fishery (catch per trip, catch per trap).

4. Evaluate impact of incidental mortality of sublegal size crabs by the fishery.

5. Annual estimation of recreational catch.

Spiny Lobster Fishery Management Plan

Preface:

The CSAP examined recently available data (including the paper by Muller et al. 1997). The Panel believes that some form of stock potential value (eggs per recruit, SPR, SSBR, etc.) Is the best proxy for MSY. The Panel also believes that sufficient data exists to calculate these various levels. Once this analysis is performed, a Subgroup of the Panel should be convened to evaluate the results and recommend MSY levels, overfishing definitions, overfished criteria, and current status of the stock.

The analysis should include review of egg per recruit values from Restrepo (1979), recent SPR and SSBR values in Muller et al. 1997, and investigation of the differences in the fishing mortality rates used by Powers and Sutherland (1989) and Muller et al. (1997).

REPORT OF THE FIRST AD HOC FINFISH STOCK ASSESSMENT PANEL

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Abbreviations Used in This Document

F — Refers to an instantaneous rate of fishing mortality. This is often written with a subscript to indicate the fishing mortality rate at a given biological reference point, e.g.;

- $F_{0.1}$ — The fishing mortality rate where the slope of the yield curve has theoretically dropped to 10% of the slope at the origin.
- F_{msy} — The fishing mortality rate that theoretically produces maximum sustainable yield.
- F_{max} — The fishing mortality rate that theoretically produces maximum yield-per-recruit. Note: this is NOT the same point as F_{msy}.
- $F=M$ — The fishing mortality rate is theoretically equal to natural mortality.

FMP — Fishery Management Plan

MFMT — Maximum fishing mortality threshold (an MSY control law component)

MSST — Minimum stock size threshold (an MSY control law component)

MSY — Maximum sustainable yield

OY — Optimum yield

SPR — Spawning Potential per Recruit - the average reproductive capacity of a female recruit under exploitation as a proportion of the reproductive capacity in the absence of fishing.

OR

Spawning Potential Ratio - the average reproductive capacity or spawning stock biomass of a stock under exploitation relative to the reproductive capacity of spawning stock biomass in the absence of fishing. There are two basic types of SPR values:

- Transitional SPR — This is the SPR value at a given point in time, and may be suitable for use as a proxy for biomass levels in MSY control laws.
- Static SPR — This is the SPR that will eventually be reached if fishing mortality and all other parameters that affect SPR are held constant. This may be suitable for use as a proxy for fishing mortality rates in MSY control laws. (Also called Equilibrium SPR)

SSB — Spawning stock biomass

SSBR — Spawning stock biomass per recruit, or spawning stock biomass ratio, as a proportion of the SSB in the absence of fishing (see SPR, second definition)

Panel Members Present

Dr. James Cowan, Jr. (Chair)	University of South Alabama
Mr. Joseph Shepard (Vice-Chair)	Louisiana Dept. Of Wildlife and Fisheries
Dr. Jerald Ault	Univeristy of Miami/RSMAS
Mr. Douglas Gregory	University of Florida/Monroe County
Mr. Mike Murphy	Florida Marine Research Institute
Dr. Clay Porch	NMFS/SEFSC

Others present

Vernon Minton - Gulf Council Member
Bob Shipp - Gulf Council Member
Wayne Swingle - Gulf Council staff
Rick Leard - Gulf Council staff
Steven Atran - Gulf Council Staff
Pete Eldridge - NMFS/SERO
Chris Legault - NMFS/SEFSC
Victor Restrepo - NMFS/SEFSC
Stephen Turner - NMFS/SEFSC

INTRODUCTION

At the direction of the Gulf of Mexico Fishery Management Council (Council), the Ad Hoc Finfish Stock Assessment Panel (Panel) met in Miami, Florida on June 22-25, 1998 to review available information and provide guidance to the Council for defining appropriate maximum sustainable yield (MSY) levels or MSY proxies for finfish that could be used in setting definitions for overfished and overfishing thresholds. The Panel Also discussed control law strategies for recovery when a stock falls below defined thresholds of overfished or overfishing.

Under the Sustainable Fisheries Act of 1996, the Regional Management Councils and NMFS are required to develop new definitions of what constitutes overfishing and overfished exploited stocks, and optimum yield targets. These new definitions are to be submitted to NMFS for review and approval by October 1998. The Magnuson-Stevens Fishery Conservation and Management Act contains several points relevant to developing these new definitions:

- The terms “overfishing” and “overfished” mean a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the MSY on a continuing basis.

- National Standard 1 of the Magnuson-Stevens Act requires that conservation and management measures prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.
- The term "optimum", with respect to the yield from a fishery, means the amount of fish which : (A) 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; (B) is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and (C) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.

On May 1, 1998, NMFS published revised guidelines for several of the Magnuson-Stevens Act National Standards, including Standard 1. These guidelines called for overfishing and overfished thresholds to be defined in terms of a maximum fishing mortality threshold (MFMT) and a minimum stock size threshold (MSST), or reasonable proxies thereof. They also require the establishment of a MSY control rule that would be expected to result in a long-term average catch approximating MSY. The MFMT would be the level of fishing mortality associated with the specific MSY control rule for that stock. A fishing mortality rate in excess of the MFMT threshold for a period of 1 year or more would constitute overfishing. The MSST would be the stock size (biomass) threshold that is the greater of: 1) one half the MSY stock size, or 2) the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years.

Additional guidelines are being prepared by NMFS to assist the Councils with development of MSY control rules. These additional guidelines were not finalized in time for the Panel meeting; however, NMFS staff involved in development of these guidelines (Victor Restrepo and Clay Porch) were present at the meeting to assist the Panel in interpreting the requirements.

RATIONALE FOR SELECTION OF SPR PROXY FOR MSY

The Panel reviewed SPRs corresponding to a fish stock's life history, population dynamics, and fishing mortality rates corresponding to various biological reference points that potentially could serve as proxies for F_{MSY}. Mace (1994) reported that F_{max} always exceeds F_{msy} for a Beverton-Holt stock/recruitment function, and generally when using other functions (e.g., a Ricker function). She concluded that F_{max} was usually too high to serve as a reliable proxy for F_{MSY}, although it may be useful as a MFMT overfishing threshold. Consequently, the Panel rejected SPR corresponding to F_{max} as an F_{MSY} proxy, and discussed SPR at $F_{0.1}$ as a potentially better proxy for F_{MSY}. Although it was noted that $F_{0.1}$ was originally derived as an indicator of optimum economic yield with little attention to its biological function, the SPRs associated with $F_{0.1}$ are generally much more conservative than those for F_{max}. Additionally, Mace (1994) stated that $F_{0.1}$ often corresponded with $F_{35\%SPR}$. The third scenario for an MSY proxy reviewed by the Panel was the SPR associated with F=M. The Panel noted that at F=M, fishing rates usually correspond to static SPR levels above 40%. Since Mace (1994) recommended $F_{40\%\ SPR}$ as a surrogate for F_{msy}, the Panel concluded that this level was probably most conservative and, perhaps, could be the best estimate of F_{OY}.

Consequently, the Panel determined that static SPRs associated with either $F_{0.1}$ or F=M were acceptable proxies for F_{MSY}. At the Panel's disposal were the necessary life history and population dynamics information to estimate these values for a number of the species in the region. These were examined during the exploratory simulations described below. Ideally, a stock-recruitment function linked to information on stock age and size structure could be used to directly estimate MSY; however, adequate data for this type of analysis are not available for the majority of the stocks examined by the Panel. The proxies chosen by the Panel have a firm basis in the scientific literature. Deriso (1987) showed that an F equal to $F_{0.1}$, as estimated from equilibrium yield-per-recruit analyses, provided a catch that was close to MSY. There is also compelling evidence that MSY is attained for most stocks when fishing mortality equals natural mortality (F=M) (Gulland 1970). **Consequently, the Panel concluded that the most likely SPR corresponding with F_{MSY} would be somewhere between a SPR at F_{max} and a SPR at F=M, but perhaps closer to SPR at $F_{0.1}$.**

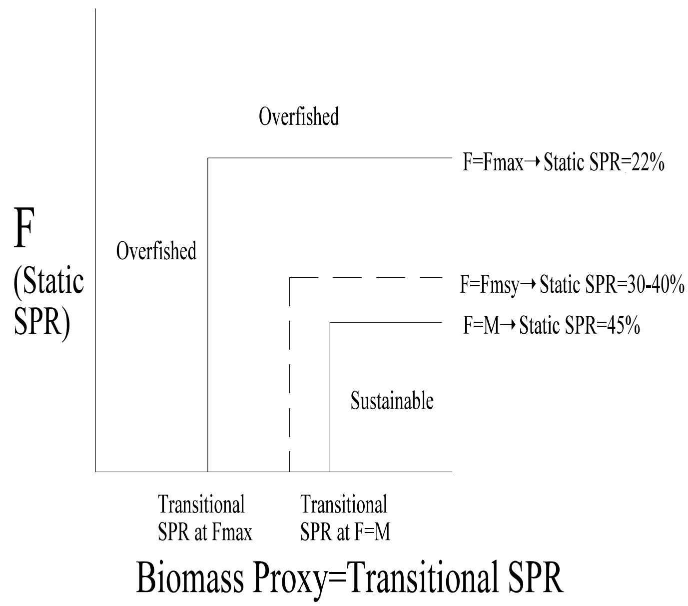

Figure 1. Theoretical argument and SPR equivalent estimates of F_{max}, F=M, and F_{msy} based upon our exploratory simulations.

The Panel used data generated in the stock simulation exercise described above to provide advice to the Council in two ways. Given that previous literature reviews on stock dynamics have led several others (e.g., Clark 1993, Mace et al.1996) to conclude that fishing mortality (F) rates consistent with static SPR values of 30-40% are good proxies for F_{msy}, The Panel first focused on learning whether or not data for several Gulf of Mexico stocks produced results consistent with these findings. While SPR estimates are highly dependent on the specific set of selectivities used to generate Table 1, the Panel could find no compelling argument to recommend a F value resulting in an SPR < 30% as a good proxy for F_{msy} for any species. The argument is summarized in Figure 1. Theory and experience from previous analyses (e.g., Deriso 1987) suggest that F_{msy} should fall between F_{max} and F=M which, based upon this simple analysis for several Gulf of Mexico stocks, corresponds to static SPR values of approximately 22% to 45% SPR, respectively (Table 1).

Table 1. Selected population characteristics used to determine the range of possible SPR values that approximate MSY. The F values and corresponding SPRs were calculated using the analytical yield model described in Ault et al. 1998.

Species	$F_{0.1}$	F_{max}	F = M	M	K	t-lambda	M/K
Red Drum	30%	11%	30%	0.2	0.367	40	0.55
Red Snapper	37%	20%	37%	0.10	0.16	50	0.63
King Mackerel	36%	22%	42%	0.20	0.17	17	1.18
Spanish Mackerel	43%	30%	39%	0.30	0.27	12	1.11
Red Grouper	42%	25%	47%	0.18	0.153	17	1.18
Gag	30%	16%	35%	0.20	0.15	13	1.34
White Grunt	43%	26%	43%	0.375	0.186	8	2.01
Vermilion Snapper	35%	18%	36%	0.23	0.206	10	1.11
Nassau Grouper	45%	19%	60%	0.18	0.145	17	1.24
Greater Amberjack				0.20	0.250		0.80
Bay Anchovy				2.53	0.22		11.5
Northern Anchovy				0.43	0.32	7	1.43

Data for white grunt and Nassau grouper is from Ault et al. 1998, for bay anchovy from Wang 1998, for northern anchovy from Ault and Olsen 1996, and for the remaining species from the appropriate stock assessments.

The fishing mortality rate, F_{max}, has been demonstrated for many stocks to exceed F_{msy}, and it is considered by the Panel to be risk prone, implying that the SPR corresponding to F_{msy} should exceed 21% (the average F_{max} SPR for those species summarized) by a significant margin. In addition, there is strong support in the literature (Deriso 1987, Clark 1993, Mace et al. 1996) for choosing either $F_{0.1}$ or F=M as acceptable proxies for F_{msy}. The Panel was divided as to which proxy was the most appropriate. Some members argued that F=M was a more conservative approach, providing a greater buffer for the stock against environmental variability. Other Panel members suggested that $F_{0.1}$ was nearly as conservative, but allowed for some additional harvest that would not be realized at F=M. For the stocks considered in Table 1, the lowest value of SPR expected at $F_{0.1}$ is 30%, and the mean SPR is approximately 38%, implying that, while 30% to 40% SPR may be an appropriate range for MSY proxies: 1) SPR at $F_{30\%SPR}$ (F_{MFMT}; see Control Rule section below) may be a reasonable proxy for SPR at F_{msy} for some species; 2) fishing mortality rates in excess of $F_{30\%SPR}$ most likely will exceed F_{msy}; and, 3) fishing mortality rates resulting in SPRs much higher than 30%, i.e., at F=M, may be appropriate for some species. It should be noted that these findings for the Gulf of Mexico are entirely consistent with those of Clark (1993), Mace et al. (1996) and others mentioned above.

Nevertheless, while the Panel recommends that SPR at $F_{30\%SPR}$ is a good minimum proxy for SPR at F_{msy} for some species, it may be risk prone for those species with less compensatory reserve and a lower potential for producing population biomass. Consequently, to scale this potential for the species in Table 1, the Panel calculated the index M/K (natural mortality rate/von Bertalanffy growth coefficient). Species with low values of M/K (high growth with respect to natural mortality) are expected, and have been shown, to be able to sustain higher yields as a fraction of spawning stock biomass than those with high M/K (high natural mortality with respect to growth) (Deriso 1987). This is largely due to the presence of multiple age classes from which spawning potential can be realized for those long-lived species with low natural mortality rates. This index is easy to calculate, and can be done so with relative confidence given knowledge of age, growth, and longevity estimates based upon otoliths, and knowledge of the relationship between natural mortality rates and longevity.

MSY PROXY RECOMMENDATIONS

The Panel suggests that for species with M/K $<$ 1.0, e.g., red drum, red snapper, greater amberjack, the SPR at $F_{30\%SPR}$ probably is a good proxy for SPR at F_{msy}. However, for species with M/K ratios $>$1.0, e.g., vermilion snapper, king mackerel, Spanish mackerel, red grouper, fishing mortality rates corresponding to $F_{30\%SPR}$ may exceed F_{msy} and thus the SPR proxies should be increased to values corresponding to SPR at $F_{35\%SPR}$. For those species where M/K$>$1.5, e.g., gag and white grunt, SPRs corresponding to $F_{40\%SPR}$ (or higher) may be the best proxies of SPR at F_{msy}.

To further clarify this approach, the Panel added M/K ratios for Chesapeake Bay bay anchovy and southern California Bight northern anchovy to Table 1. While high yields have been obtained, or can be expected, from each of these stocks, high M/K ratios imply that there is risk in reducing the SPR level below 40% given the relatively few age classes available to produce eggs (only 1 or 2 for bay anchovy). Historically, the northern anchovy stock has been able to sustain only modest fishing pressure ($\sim$F=0.1 to 0.3) before dropping to stock levels at which recruitment success became highly susceptible to adverse environmental fluctuations, leading to recruitment failures and collapse of the fishery. Simulations of fishing on bay anchovy produced similar results (Wang 1998). **It should be noted, however, that estimates of M and K**

are not without error (in fact estimates vary widely for many species, especially with regard to M). Some Panel members noted that, in general, stocks with high M values are usually more resilient than those with low M values. The Panel noted that the M/K ratios should be used in conjunction with all other information about life history characteristics that may help to define a stocks compensatory reserve.

CONTROL RULE FOR STOCK REBUILDING

Each fishery management plan (FMP) is mandated to specify overfishing criteria that include: (1) a maximum fishing mortality threshold (MFMT) that may not exceed the level associated with the proxy for F_{MSY} and (2) a minimum stock size threshold (MSST). The MSST is defined in the National Standard guidelines as the greater of "one-half the MSY stock size or the minimum biomass at which rebuilding to the MSY level would be expected to occur within 10 years if the stock were exploited at the maximum fishing mortality threshold ...". The ideal value of MSST depends on the resiliency of the stock, which in the case of the stocks examined in this report is not well established. The Panel believes that the most appropriate strategy to address this issue would be through analyses by the respective stock assessment panels for each FMP. In the interim, the Panel recommends that MSST be set equal to the stock size associated with the maximum fishing mortality threshold (B_{MFMT}) multiplied by the greater of 1 minus the natural mortality rate (M) or 0.5. With this definition the overfishing criteria (MFMT and MSST) appear as illustrated in Figure 2. Such a rule of thumb for MSST is intuitively appealing because one would expect stocks with a higher M to recover faster, on average, than stocks with a lower M.

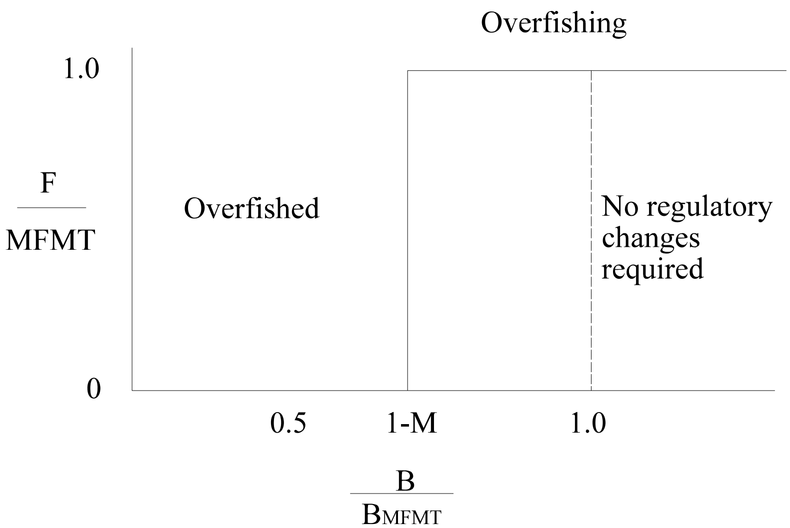

Figure 2. Hypothetical example showing the relationship between Maximum Stock Size Threshold (solid vertical line) and the Maximum Fishing Mortality Threshold (solid horizontal line) using the 1-M rule of thumb. Overfishing occurs whenever the fishing mortality rate (F) or stock size (B) is above or to the left of the solid lines. The dotted vertical line corresponds to the long-term average stock size that would be achieved by fishing at the MFMT (B_{MFMT}). Note that both F (vertical) and B (horizontal) axes are scaled by the values at F=MFMT.

Given these overfishing criteria, each FMP must also specify a rebuilding plan should the stock size fall below the MSST. This rebuilding plan will also depend on the resiliency of the stock in question. A default limit control rule that has been suggested in the past is to reduce the fishing mortality rate in proportion to the amount that the current stock size is below the MSST. Mathematically this can be expressed as:

$$F = C^{*}MFMT \qquad (1)$$

where C= B/MSST if B < MSST © = 1 otherwise) and MSST = (1-M)B_{MFMT}. This idea is illustrated in Figure 3. To the extent that a stock fished at F = MFMT is expected to fluctuate about B_{MFMT} on a scale related to M, this control rule would generally accommodate the timetables required under the guidelines for implementing National Standard 1 of the Magnuson-Stevens Act. Ideally, of course, the control rule should be tailored to the unique life history characteristics and level of depletion of the stock. Such detailed analyses were not possible within the time frame available to the Panel, but are strongly recommended for the future.

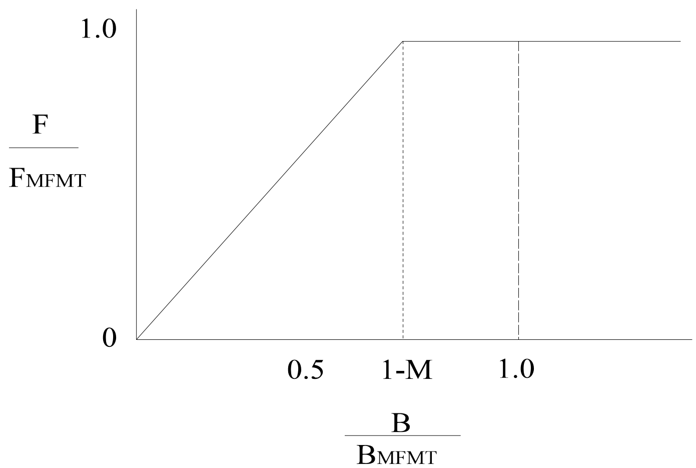

Figure 3. An example of a default limit control rule, based on the formula in Equation 1.

In practice, the fishing mortality rate will tend to occasionally deviate above the MFMT even when the MFMT control law is prosecuted effectively, owing to the randomness of the fishing process itself. Likewise, stock size will tend to occasionally deviate below B_{MFMT} about half of the time, owing to natural fluctuations in recruitment and natural mortality. (Results of computer simulations often show that constant F_{msy} policies can cause the stock to fall well below MSY (Jerry Ault. personal communication). A more conservative "precautionary" control law that has been recommended is to set a target F at 75 percent of MFMT and reduce F in proportion to the extent the current stock size is below MSST:

$$F = C*0.75*MFMT \qquad (2)$$

where C= B/MSST if B < MSST © = 1 otherwise) and MSST = (1-M)B_{MFMT}. If the stock is severely overfished (B << MSST), a more drastic reduction in F may be necessary to meet the rebuilding time requirements. This "precautionary" control law is contrasted with the earlier "limit" control law (equation 1) in Figure 4. Interestingly, simulation studies by Mace (1994) and others suggest that 75% F_{msy} generally would result in long-term yields of 94% MSY or higher while the long-term biomass levels would exceed 125% of the biomass at MSY. Thus, the use of the more precautionary control rule trades a small sacrifice in yield for a large gain in biomass.

The Panel suggests that the default limit control law (equation 1) with MFMT = F_{msy} be used to satisfy the legal requirements of the FMP and the "precautionary" control rule (equation 2) be applied operationally (Figure 4).

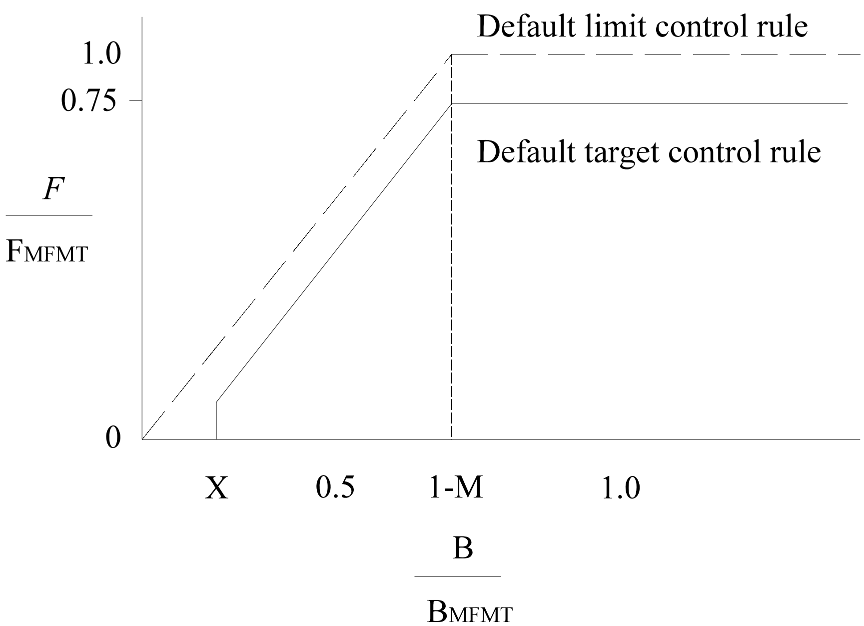

Figure 4. The recommended default "precautionary" control rule (solid lines) contrasted with the default "limit" control rule defined earlier (dashed lines). The vertical dotted line is the default MSST. The value of X is the fraction below B_{MFMT} at which no fishing will be allowed, which may or may not be below 0.5 at the Councils discretion. The default limit control rule could be submitted to satisfy the legal requirements for the overfishing criteria, whereas the precautionary control law could be used to avoid frequent excursions outside the limit control rule (which would necessitate equally frequent regulatory actions by the Council).

APPROPRIATE MSY PROXIES (SPR, SSB, SSBR)

The Council asked the Panel to consider whether spawning stock biomass per recruit (SSBR) or spawning stock biomass (SSB) is more appropriate than the use of SPR to gauge stock status. The Panel assumed that the Council was requesting guidance as to the most appropriate measure of a stocks ability to replenish itself over time.

First, the Panel wishes to clarify that SPR is simply a general term that refers to the proportion of a spawning stock remaining under fished conditions to that of an unfished stock. Ideally annual egg production should be used in the calculation of SPR. However, egg production is not always available, and thus biomass of mature females is often used as a proxy. The use of biomass in the calculation of SPR was historically referred to as SSBR. Currently, either the use of eggs or biomass is referred to as SPR.

Spawning stock biomass (SSB) measures the magnitude in weight of the mature component of the stock. Trends in SSB are driven by recruitment, fluctuations in natural mortality and growth rates, and fishing mortality rates, and do not necessarily reflect regulatory actions. A SSB management criterion would seek to maintain spawning biomass above some estimated level that would insure the population's ability to sustain itself. If a stock undergoes a period of low recruitment, then management measures to reduce fishing mortality must be implemented to maintain SSB at or above the specified critical level. In contrast, the simplest interpretation that SPR is driven by fishing mortality rates alone suggests that it directly reflects measures taken to manage a stock. Under this scenario, fluctuations in recruitment are not a factor; only the proportion of the population remaining after fishing that resulted from those recruitment levels is considered.

At this time, the Panel cannot recommend one method over another. It should be the purview of the stock assessment panels to decide the best method used based upon the available data. However, if the Council wishes to adopt a method that best reflects management measures imposed, we feel that the use of SPR is the appropriate measure to use.

The Panel also was asked to consider whether recruitment indices were appropriate for setting total allowable catch (TAC) of red snapper. There was consensus among Panel members that estimates of the magnitude of recruitment (and recruitment indices), while apparently somewhat easy to obtain, are fraught with estimation error and provide little or no information with respect to stock dynamics and fishing mortality rate. Thus, the Panel concluded that they are not appropriate for setting TACs, especially given the inherent observed variability in stock recruitment relationships.

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REPORT OF THE SECOND AD HOC FINFISH STOCK ASSESSMENT PANEL

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Abbreviations Used in This Document

B Biomass

F Refers to an instantaneous rate of fishing mortality. This is often written with a subscript to indicate the fishing mortality rate at a given biological reference point, e.g.;

$F_{0.1}$ The fishing mortality rate where the slope of the yield curve has dropped to 10% of the slope at the origin.

$F_{30\%\,SPR}$ The fishing mortality rate corresponding to a 30 percent static spawning potential ratio

F_{msy} The fishing mortality rate that theoretically produces maximum sustainable yield.

F_{max} The fishing mortality rate that produces maximum yield-per-recruit. Note: this is NOT the same point as F_{msy}.

F=M The fishing mortality rate is equal to natural mortality.

FMP Fishery Management Plan

MFMT Maximum fishing mortality threshold (an MSY control law component)

MSST Minimum stock size threshold (an MSY control law component)

MSY Maximum sustainable yield

OY Optimum yield

SPR Spawning Potential Ratio - the average reproductive capacity of a female recruit as a proportion of the reproductive capacity in the absence of fishing. There are two basic types of SPR values:

Transitional SPR This is the SPR value at a given point in time, and may be suitable for use as a proxy for biomass levels in MSY control laws.

Static SPR This is the SPR that will eventually be reached if fishing mortality and all other parameters that affect SPR are held constant. This may be suitable for use as a proxy for fishing mortality rates in MSY control laws.

SSB Spawning stock biomass

SSBR (1) Spawning stock biomass per recruit
(2) Spawning stock biomass ratio, as a proportion of the SSB in the absence of fishing

Panel Members Present

Mr. Douglas Gregory, Jr. (Acting Chair)	University of Florida/Monroe County
Dr. James Cowan, Jr.	University of South Alabama
Mr. Harry Blanchet	La. Dept. Of Wildlife and Fisheries
Dr. Mark Fisher	Texas Parks and Wildlife Department
Dr. Terry Henwood	NMFS/SEFSC - Pascagoula, MS
Dr. Joanne Lyczkowski-Shultz	NMFS/SEFSC - Pascagoula, MS
Mr. Mike Murphy	Florida Marine Research Institute
Dr. Clay Porch	NMFS/SEFSC - Miami, FL

Others present

Vernon Minton - Gulf Council Member
Bob Shipp - Gulf Council Member
Roy Williams - Gulf Council Member
Rick Leard - Gulf Council staff
Steven Atran - Gulf Council Staff
Tom McIlwain - NMFS/SERO

SUMMARY OF PANEL MSY RECOMMENDATIONS

Species	MSY Proxies	
	F_{MSY}	B_{MSY}
Red Snapper	30% static SPR	30% transitional SPR
Red Drum	20% static SPR	20% transitional SPR (minimum stock size threshold = 16% transitional SPR)
King and Spanish Mackerel	30% static SPR	30% transitional SPR
Gag	35-40% static SPR if no increased size limit or spawning season closure. 30% static SPR with increased size limit and/or spawning season closure.	35-40% transitional SPR if no increased size limit or spawning season closure. 30% transitional SPR with increased size limit and/or spawning season closure.
Jewfish and Nassau grouper	40-60% static SPR	40-60% transitional SPR
Other Gulf Finfish Species	30% static SPR	30% transitional SPR

INTRODUCTION

The previous Ad Hoc Finfish Panel report (GMFMC 1998a) recommended that the Gulf of Mexico Fishery Management Council establish maximum sustainable yield (MSY) proxies for Gulf fisheries based on levels of spawning potential ratios (SPR) between 30 and 40 percent, with specific levels based on a species relative ranking of the ratio of natural mortality rate to Brody growth coefficient (M/K). Subsequent to the report the use of the M/K ratio was questioned by some members of the Panel and of the Council. The Council, upon review of the report, expressed interest in evaluating the potential use of alternative MSY proxies in addition to SPR.

The primary charge of the Gulf of Mexico Fishery Management Council to the Second Ad Hoc Finfish Panel (see attached Memorandum from W. E. Swingle to the panel) was to:

> "...develop potential proxies for maximum sustainable yield (MSY) for at least red snapper, king mackerel, and red drum based on the empirical fishery- independent data collected in the summer SEAMAP and fall groundfish surveys, or other appropriate data sources, for juvenile fish recruitment. These proxies should be modified, as appropriate, by changes in other relevant population parameters such as fishing mortality, biomass of fishable ages, and/or biomass of all ages for a specific period of time."

Secondary charges to the panel were 1) to re-evaluate the M/K ratios as scaling factors for assigning SPR proxy levels for MSY, and 2) provide advice on alternative methods of assigning MSY SPR proxy levels for the Gulf finfish species listed in Table 14(attached).

Resilience vs Resistance

The NMFS technical guidance on the use of precautionary approaches for selection of MSY proxies (Restrepo 1998) recommend scaling the appropriate proxy for F_{msy} based on resilience of the stock to overfishing. However, the technical guidance document does not define resilience. The Panel discussed the meaning of resilience, and suggests that there are actually two related characteristics, “resistance” and “resiliency” which should be considered.

Resistance, as defined by the Panel, is the ability of a stock to withstand high levels of removals without recruitment failures occurring as a result. In general, longer-lived species that mature at an early age relative to their life-span are perceived to be relatively more resistant to overfishing than shorter-lived species with fewer spawning years. This is because species with numerous year-classes contributing to the spawning stock can still maintain themselves if several of those year-classes are lost, whether by recruitment failure or selective fishing mortality. It has been hypothesized that a large number of year classes in a spawning population could be an adaptation that ensures an adequate spawning population, even in the face of fluctuating recruitment (Murphy 1968; Leaman and Beamish 1984)

Resilience, as defined by the Panel, refers to the ability of a stock to recover from an overfished condition. Long-lived species, although resistant to overfishing, are slow to recover once they become overfished because of the large number of age-classes that must be rebuilt, and thus have generally low resiliency. Conversely, Short-lived species with very high fecundity levels may be able to compensate for high fishing mortalities by producing more offspring allowing them to recover quickly from an overfished condition.

The above definitions are generalizations, and may not be applicable in all situations. Factors other than lifespan, growth and fecundity also need to be considered. It is easy to cite counter examples such as pink shrimp, which are very resistant to overfishing despite having very few year classes, and jewfish, which are easily overfished despite having very many spawning year classes. Species with a strong aggregating behavior may be especially vulnerable to fishing and thus less resistant than nonaggregating species. Similarly, a species with a short spawning season may be more dependent on having favorable environmental conditions during a specific time period than one with a protracted spawning season. Therefore, a recovery from low stock levels within a given time period is more uncertain, perhaps making that species less resilient than one with a protracted spawning season.

M/K and Other Population Scalars

The M/K ratio has been criticized because the variability observed in available estimates of M and K estimates among species are more likely due to sampling or estimation errors than to actual interspecific differences. The difficulties in estimating M are well known. In fact, M is probably the most difficult parameter of a population to determine. The most common method of estimating M, based on maximum age observed in a fished population, may be biased by variations in harvest rates. Several Panel members noted that the estimates of M for some of the species were based on empirical regressions of K and perhaps other parameters (e.g. Pauly 1979). Therefore, the M/K ratio would tend to reflect the slope of the empirical regression equation rather than a fundamental property of the stock in question. Only M values estimated by methods independent of K would be free of this problem.

The estimation of K is difficult because growth studies may derive data from a variety of sources, and from stocks under different harvest regimes. Biases can occur from the use of fish from areas or gears that are not representative to the whole population. Variation in harvest regimes may also influence growth rates for a population, resulting in variable K.

Legault and Eklund (1998) have shown that the M and K estimates for Nassau grouper and jewfish are highly uncertain and produce M/K ratios with 80 percent confidence intervals of 0.39 to 1.27 (Nassau) and 0.30 to 1.28 (jewfish). The conventional M/K paradigm cited in the previous panel report (GMFMC 1998a) would therefore classify both species as moderately to highly resilient. Legault and Eklund (1998) pointed out that this goes against all current knowledge of these two stocks and questioned the utility of the M/K paradigm in general. Thus, while M/K ratios may provide some information on the relative resilience of a population, caution should be taken so that too much reliance is not placed on a given value of the index for any species without careful examination of all aspects of the stock and its fisheries.

The Panel discussed the potential use of other life history parameters/ratios, such as length-at-maturity to maximum length (L_{mat}/L_{∞}), age-at-maturity to maximum age (t_{mat}/t_{max}), and other compensation ratios that may be useful in providing a scaling factors for ranking the relative vulnerability of populations to overfishing, however, no scientific studies or data were available to evaluate the validity of such scaling factors. Estimation of these parameters is also subject to error/uncertainty, and may be affected by fishing on the population, as noted for M/K ratios. Therefore, at the present time, no life history scaling factor, including M/K, can be recommended for ranking populations relative to their vulnerability to overfishing.

A general characteristic of populations that seems to be emerging from population studies is that if the age or size of recruitment to the fishery is greater than the age or size at which all or most of the females have begun spawning, then yields very close to MSY are obtained for a wide range of fishing mortalities (Myers, memo, 1998). Thus, a spawn-at-least-once policy will help protect against a stock collapse if fishing mortality targets are exceeded (Myers and Mertz, 1998).

However, although a population protected by a size limit that is larger than the size of reproduction would be more resistant to overfishing than a similar population with fishing mortality exerted on both juvenile and adult fish, a post-maturity size limit or a size limit that allows spawning to occur only once before entering the fishery may not be sufficient. This relatively simple concept is also not applicable in stocks where undersize discard mortality is a significant factor or where management may prefer goals that in some instances specify harvest of juveniles over adults (e.g., red drum). In the latter case, management must be especially prudent in controlling fishing mortality rates to ensure adequate spawning stock size. The spawn-at-least-once policy must not be allowed to degenerate to a spawn-only-once policy, which would likely cause any population to collapse.

As in most situations, much of the information for this general concept is derived from temperate or boreal species, where relatively late maturity and other life history characteristics may mean that this same policy may provide more protection than in the subtropical/temperate species being considered by this Panel. It should be noted that high fishing mortality rates on spawning adults seems to be a significant issue in groupers, for instance. Very high fishing mortality rates on a long-lived, early-maturing spawning population could result in SPRs much lower than presently accepted as appropriate for most stocks. The note that a wide range of fishing mortality rates provide similar yields near MSY has long been noted as one of the dangers of management near MSY, since a production model of the stock may not indicate the true status of the fishing pressure, and its impact on spawning potential.

Direct Estimation of MSY and B_{MSY}

The necessary analyses for calculating MSY and stock biomass levels at MSY (B_{MSY}) from stock-recruit and stock production models with reasonable confidence do not exist for Gulf species. Therefore, MSY proxies are needed to fulfill the Sustainable Fisheries Act requirements, as specified in the National Standard Guidelines.

Use of Fishery Independent Data to Estimate MSY and B_{MSY}

The available fishery independent survey data for Gulf of Mexico finfish stocks are described below. Among the existing recruitment, larval, and adult surveys, the recruitment indices based on the northern Gulf groundfish trawl and SEAMAP trawl surveys are the most useful because of their longer time series, but they do not provide sufficient information on all species of interest.

Recruitment Indices

Part of the charge to the Panel was to review the potential use of juvenile fish recruitment indices that have been collected under fishery-independent data collection programs, with regard to their appropriateness for use in assessing proxies for MSY or overfishing/overfished thresholds. The Panel discussed the availability, utility, and time sequence of various databases. The Panel noted that various fishery-independent databases of recruitment are available, e.g. Summer SEAMAP and Fall Groundfish Surveys, as well as individual state surveys. However, the groundfish surveys are conducted in the central and western Gulf while many of the species of interest occur primarily in the eastern Gulf (e.g., jewfish, gag, etc.) Where they would not be sampled by the existing surveys. Furthermore, trawling gear isn't very effective in catching mackerel and other pelagic species.

The SEAMAP surveys were investigated and are discussed under the individual species sections of this report. Although not totally fishery-independent, recruitment from bycatch was also reviewed, especially with regard to the king mackerel fishery. State juvenile bag seine surveys have provided an index of red drum young-of-the-year abundance in some Gulf states for variable time periods. These indices have been incorportated into stock assessments at both the state and Gulf-wide levels. In general, the Panel felt that estimates of recruitment either were too variable or at present could not be fully evaluated as a proxy for MSY and B_{MSY}.

Larval Indices

Estimates of annual mean larval abundance or frequency of occurrence derived from fishery independent larval surveys can be used to index trends in adult stocks in the Gulf of Mexico for those species in which the larvae have been adequately described. Ichthyoplankton collections taken during SEAMAP surveys conducted in Summer and Fall, 1982 to 1995, have provided just such a data set for king mackerel (Lyczkowski-Shultz 1996; Gledhill and Lyczkowski-Shultz ms). Larval frequency of occurrence has been used as a tuning variable in the king mackerel VPA stock assessment since 1996 (GMFMC 1996a).

A larval index for red snapper has only recently been feasible because of the difficulty in distinguishing snapper larvae (Drass et al. ms). Results of an examination of snapper larvae from Gulfwide SEAMAP collections in 1992 and 1993 indicated that 53% of snapper larvae captured are larger than 3 mm and can be identified to species and/or genus levels. Use of a red snapper larval index to follow trends in population size can now be attempted based on the identifiable size fraction of lutjanid larvae in SEAMAP collections. The examination and identification of lutjanid larvae from the remaining 14 years of SEAMAP collections will be a labor intensive process. Additional manpower is required for timely completion of this work.

With respect to red drum, there are no difficulties in identifying the larvae and SEAMAP collections could provide information on relative spawning stock levels since 1986 when a Gulfwide plankton survey during the month of September was established. A first-order approximation of red drum spawner biomass in the area between the Mississippi River and Mobile Bay underestimated stock size by an order of magnitude when compared to the Nichols (1988) mark and recapture estimate (Comyns et al. 1991). Variability associated with larval catch data was the primary cause for the underestimate. Sampling effort in subsequent surveys has been tripled (from 19 to 60 stations) and the resultant annual mean estimates of red drum abundance since 1989 may provide a valid fishery independent index for red drum off east Louisiana, Mississippi and Alabama (Bruce H. Comyns, Gulf Coast Research Laboratory/University of Southern Mississippi, unpublished data). Additional information is available from the annual estimates of the abundance of red drum larvae from east Louisiana, Mississippi and Alabama coastal waters that have been monitored by Bruce Comyns of the Gulf Coast Research Laboratory/University of Southern Mississippi since 1989.

The available larval indices are valuable as an independent estimate of spawning stock size and as an abundance index to tune VPAs, but the lack of a sufficient time series over a range of stock sizes precludes their use for estimating MSY or B_{MSY}. Use of annual abundance and occurrence of the early life stages of fishes in stock assessments is dependent on our ability to identify those early stages which for many species remain undescribed.

Adult Stock Indices

Fishery independent survey data on adults are valuable for tuning VPAs and calculating other population parameters such as MSY and B_{MSY}. The NMFS/SEAMAP groundfish and larval surveys were not designed, nor could they be, to assess populations of all species of fishes inhabiting the Gulf of Mexico. The NMFS currently conducts a Gulfwide reef fish video/acoustic survey which may prove useful in future stock assessments, but unfortunately, this time series began in 1992 and is of too short a duration to be useful in estimating MSY or B_{MSY}.

Potential proxies for MSY with Fishery-Independent Data

The Panel examined several fishery-independent indices of abundance that might be used to develop proxies for MSY. The major difficulty the Panel found was that there was no way to confidently relate fishery-independent abundance indices to the yield or biomass that would be produced by the directed fishery at any given abundance level in the index. For instance, the catchability of sizes from within the directed harvest was most often different from the catchability in the fishery-independent survey. This might be due to movement to different habitats with growth, or to differences in gear efficiency. Many of the datasets considered are used in VPA analyses of the stocks. Any comparison of recruitment from an index to the estimated harvestable stock size would need to be aware of possible autocorrelation between these parameters.

Some larval and juvenile indices have been considered as fishery-independent indices of spawning stock size. While these indices may also be valuable sources of information on actual stock size and changes in stock size, the time series on most of these indices is relatively short, and the sampling program may only cover a portion of the species range. Evaluation of the accuracy and precision of these estimates must be carried out before they provide this type of information.

Species Specific Recommendations

Red Snapper

Stock assessments have been available for red snapper since at least 1988. Estimates of MSY have been made in the past but they do not appear to be reliable[3]. Current estimates of SPR show that red snapper are severely overfished. However, recent regulatory actions have reduced juvenile red snapper bycatch in shrimp trawls and these actions have coincided with increases in fishery-independent measures of recruitment.

Data are not available to directly estimate B_{MSY}. However, a likely range of estimates for the stock biomass at MSY could be calculated using the VPA-estimated abundance and a range of likely spawner-recruit relations. **The Panel requests that a stock assessment analyst responsible for red snapper perform these analyses.**

The Panel investigated the use of fishery-independent data to estimate proxies for B_{MSY}. Recruitment indices are available for red snapper from the fall groundfish surveys (since 1972) and summer SEAMAP surveys (since 1984) conducted in the northern Gulf of Mexico. A B_{MSY} proxy can be approximated as the relative biomass that the average survey recruitment index would produce over the long term if the stock were fished at F_{MSY} (or a proxy thereof such as $F_{0.1}$ or F_{max}), provided of course recruitment is largely independent of stock size. For red snapper, the age-1 recruit abundance index in terms of standardized catch-per-hour from the summer SEAMAP and Fall groundfish surveys (Table 4; Schirripa and Legault 1997) ranged from 0.82 to 14.87 during 1972-96, with a median of 5.94. Red snapper yield per recruit at F_{max} (or $F_{0.1}$) is about 1.0 kg per recruit (Goodyear 1995; Fig. 86). Therefore, it would be expected that the median recruitment of 5.94 juvenile fish per tow-hour would result in 5.94 kilograms per tow-hour of post-recruit red snapper in the survey tows when the population biomass reached the biomass associated with F_{max} or $F_{0.1}$ (F_{MSY}). The actual catch observed in the survey could then be compared to this target survey catch to determine the yield relative to the expected yield at B_{MSY}. Unfortunately, this assumes that the survey gear is just as effective at catching post-recruit red snapper as it is at catching recruits and that a relationship can be defined between the juvenile survey and the resulting harvestable biomass. The differences in catchability and availability between these size groups would need to be determined if this method is to be used effectively. **The Panel decided that a better proxy for B_{MSY} is the equilibrium biomass of the stock size at $F_{30\% SPR}$. This can be expressed in terms of an SPR proxy as a 30 percent transitional SPR at MSY.** This biomass accrues when the stock comes into equilibrium with an F approximating $F_{0.1}$. Mace (1994) stated that when the age of 50 percent maturity is less than the age of 50 percent recruitment to the fishery, $F_{35\% SPR}$ will generally exceed $F_{0.1}$. Red snapper have 50 percent maturity at about 12 inches (Goodyear 1995, figure 19) and have a 15 inch size limit, so this scenario holds true for the directed

[3] The original Reef Fish FMP estimated MSY for snapper and grouper combined to be approximately 51 million pounds, based on a Graham-Schaefer yield model (GMFMC 1981).

fishery. Therefore, $F_{0.1}$ for red snapper occurs at an SPR lower than 35 percent. On this basis, **the Panel recommends that the fishing mortality MSY proxy for red snapper be set at 30 percent static SPR**.

Summer SEAMAP age-1 recruitment indices are used to tune the red snapper VPA with very good results (Figure 13, Schrippa and Legault 1997). Estimates of age-1 snapper from the stock assessment are highly correlated with results from the fishery-independent survey, demonstrating the effect of tuning on the VPA. Estimates of F needed to compare to the B_{MSY} threshold can be made from the current stock assessment.

<u>Red Drum</u>

Historically, the bulk of the red drum harvest throughout the Gulf of Mexico was taken from state waters. Harvest from Federal waters was a small component of total harvest for most years of record (Goodyear 1996, Table 3). Present state regulations attempt to regulate harvest rates through minimum and maximum size limits, creel limits, and commercial quota, where allowed, and effectively establish nearly the entire harvest as recreational allocation, through gamefish status or prohibition on commercial harvest in Gulf states, except Mississippi. Therefore, the concept of maximum sustainable harvest for this species should consider recreational harvest opportunity along with yield in weight. This differs from the yield-per-recruit component that dominates commercial species analysis. Allowable numbers harvested, as well as the sizes allowed, may not be those that would be expected from a generalized yield-per-recruit estimation based on a constant F after initial recruitment to the fishery.

Red drum grow rapidly as juveniles, and mature relatively early in their expected lifetime. Maturity may be as early as 3 years, and Wilson and Nieland (1994) estimated 50% maturity as 4 years of age. At least 25 year-classes are represented in the spawning stock in significant numbers (Wilson and Nieland 1994, Goodyear 1996).. This life history, combined with the F profile of the existing fishery, provide a spawning stock biomass that should be relatively stable over time, and relatively resistant to overfishing. This is because existing fishing is concentrated on a few year-classes, while spawning is provided by a large number of year-classes. Yield from the fishery may be relatively variable due to the small number of year-classes exposed to the fishery, and the variability noted in recruitment indices from fishery-independent samples. However, if the stock becomes overfished, then these same life history parameters mean that stock recovery will require longer periods of rebuilding. This is because the relative contribution of a given year-class to the spawning biomass is small relative to the total.

Virtual population analyses have been used to estimate the status of the stock since 1987. Consistent findings include high fishing mortality rates on juveniles prior to implementation of conservation actions after about 1986. Estimates of escapement rates (probability of surviving fishing through age 4) declined from about 10% in the early 1980's to below 1% in 1986 and 1987. Spawning potential ratios declined from 13% in 1979 to a low of 6% in 1992 (Goodyear, 1996, GMFMC 1996b). In 1996, the Red Drum Stock Assessment Panel found that the spawning stock was below 20% SPR, but was increasing in response to conservation measures implemented by Gulf states. The projected estimate of escapement was less than expected based on the 1993 assessment, but the Red Drum Stock

Assessment Panel reported that if fishing mortality rates estimated for 1995 were held steady, then the Council's SPR goal (20%) would be met in the year 2001.

The existing overfishing definition of red drum is 20% SPR, with a management goal of 30% escapement from the juvenile fishery estimated to provide that SPR level at equilibrium. This escapement rate includes some allowance for harvest of mature fish that occurs within state waters, so that the escapement rate to the spawning stock is a higher value than the SPR produced by that escapement rate.

The actual yield corresponding to MSY is defined as: All red drum recreationally and commercially harvested from state waters landed consistent with state laws and regulations under a goal of allowing 30 percent of the escapement of the juvenile population that would have occurred under unfished conditions.

The MSY proxy for maximum fishing mortality threshold (MFMT) (the fishing mortality rate equal to F_{MSY} when biomass is at the MSY levels), is recommended to be a fishing mortality rate corresponding to 20 percent static SPR. The MSY biomass proxy relative to SPR is therefore 20 percent transitional SPR.

Lacking a stock-recruitment relationship, the minimum stock size threshold (MSST) of adult red drum required to maintain current recruitment to the inshore nursery areas is estimated to be the minimum spawning stock biomass over the 1979-92 time period. However, in order to meet the requirement that a stock be capable of being rebuilt within 10 years from the MSST, it is recommended that the minimum stock size threshold (MSST) be set as the stock size that would result at equilibrium fishing of $F_{16\%SPR}$ (i.e., 16 percent transitional SPR) based on the NMFS formula in the technical guidance document ($M \cong 0.2$, $c=(1-0.2)$, $F(B)=F_{MSY}*B/c*B_{MSY}$). This measure will require examination and refinement by the red drum stock assessment panel in order to define any trajectory in fishing mortality rates that would be required in order to achieve the rebuilding schedule from the MSST. The minimum biomass of spawning stock over the 1979-92 period may be appropriate as a short-term measure of a lower limit on spawning stock size, below which much more stringent limits on fishing rates must be applied (severely overfished, B<<MSST in the first Ad Hoc SAP report). However, consideration of habitat issues (see below) may mean that this measure may need revision in the future, The other stock size measures, being relative to fishing mortality rates, would not need revision over time.

Goodyear was unable to reconcile estimates of adult stock size with those from the NMFS tag-recapture study of Nichols (1988), so this report will not specify a specific value for MSST (or B_{MSY}) , but rather recommend that any evaluation of present condition use available comparable information from the 1979-92 time period.

It should be noted that the above recommendations are based on maximizing the benefits of a (mainly) recreational fishery that is conducted primarily on juveniles. Therefore, the recommendations are contingent upon a continuation of the moratorium of adult red drum in federal waters.

Optimum Yield for Red Drum

More precautionary SPRs might be considered for optimum yield (OY) targets, potentially with yield-per-recruit benefits. These may require substantial reductions in fishing mortality rates. The Panel noted that fishing mortality rates may be the best surrogate presently available for "recreational opportunities" in the OY definition, while yield-per-recruit may be the best surrogate for yield in terms of food production. Establishing OY targets at SPR levels higher than those required to maintain MSY allows managers to enhance some aspects of the fishery, without compromising possible recruitment..

Ecosystem Effects

The Panel notes that the nursery areas for red drum are being substantially reduced through coastal wetlands losses, especially in Louisiana. As Louisiana coastal waters provide a substantial portion of current and historic red drum harvest, it is reasonable to assume that losses of these nursery areas may eventually impact the ability of the red drum stock to maintain itself, independent of fishing mortality issues. For some estuarine-marine species, the loss of these habitats may already be impacting the ability of the stocks to maintain themselves at levels seen in recent history. These aspects of essential fishery habitat may eventually lead to re-establishment of any absolute stock size benchmarks that would more accurately reflect the ability of those habitats to sustain stocks. The result of such habitats would most directly impact the indices of recruitment to the fishery, which would be expected to decline from current levels. This would produce lower harvests with no change in the F profile. The resulting long-term adult biomass would also be expected to decline.

King and Spanish Mackerel

Stock assessments for king and Spanish mackerel have been available since 1983. Restrictive management measures were enacted in the early 1980's to correct overfishing conditions and to rebuild the stocks. As the result of these management actions the king and Spanish mackerel populations have exhibited a high resiliency to the resulting lower fishing mortality rates; during the past decade increased spawning stock biomass (king and Spanish) and increased recruitment (king) trends have been evident. It is currently estimated the Gulf king and Spanish mackerel populations are at transitional SPR levels of 23 percent and 35 percent, respectively and being prosecuted at a fishing mortality rate equivalent to 21 percent and 47 percent static SPR, respectively.

The data are not available to estimate MSY or B_{MSY} directly and the recruitment indices from the SEAMAP and fall groundfish surveys are too imprecise and incomplete to use for estimating MSY or B_{MSY}. **The Panel determined the best available proxy for MSY is SPR and recommends the Gulf Council establish a MSY SPR proxy of 30% for king and Spanish mackerel because the empirical evidence suggests these species are resilient to overfishing.**

Gag

Stock assessments for gag have been available since 1994. It is currently estimated the gag population is at a transitional SPR level of 21% and being prosecuted at a fishing mortality rate between 18 to 23% SPR (GMFMC 1998a). The Panel noted that concern existed about the lack of resistance of gag to overfishing because it forms large spawning aggregations that are easily targeted by fishermen.

Some biologists fear that the decreasing percentage of males in the population during the past two decades may be negatively impacting reproductive productivity.

The data are not available to estimate MSY or B_{MSY} directly and the only available recruitment index represents too short a time series for use in estimating MSY or B_{MSY}. Therefore the best available MSY proxy is SPR. **The panel recommends that the MSY SPR proxy should be 35-40% if no action is taken by the Gulf Council to further protect mature fish through an increased size limit and/or a spawning season closure when they are aggregated. However, if protection of spawning fish is implemented, then the panel believes a MSY SPR proxy of 30% is appropriate for the gag population because specific protection of the mature stock improves the population's resistance to overfishing.** Although two scenarios for MSY proxies are presented, the Panel feels that the preferred scenario should be the one that protects mature fish and spawning aggregations through an increased size limit and spawning season closure.

Jewfish and Nassau Grouper

Jewfish and Nassau grouper species have been fully protected by the Gulf Council with ABCs of zero harvest. These fisheries were closed due to concerns that they were especially susceptible to overfishing because their populations were small in size and at depressed levels as the result of fishermen being able to easily find and target large sedentary individuals, as well as, spawning aggregations. These species are, therefore, generally believed to be neither very resistant not resilientto overfishing. **Therefore, the Panel recommends that the Gulf Council establish a MSY SPR proxy of 40-60 percent for jewfish and Nassau grouper.**

Other Gulf Finfish Species

Based on the finding by Mace (1994) that, when the age of 50 percent maturity is less than the age of 50 percent recruitment to the fishery, $F_{35\%\ SPR}$ will generally exceed $F_{0.1}$, **the Panel recommends that the other Gulf finfish species under the jurisdiction of the Gulf Council be managed with an MSY and B_{MSY} SPR proxy level of 30%, provided there is a minimum size limit of at least the size at 50 percent maturity, unless certain life history characteristics or management strategies warrant a more precautionary approach.**

Conclusions and Recommendations

1. Future stock assessments should evaluate the utility and uncertainty of estimating MSY and B_{MSY} directly from the available stock production models and ancillary data.

2. Fishery independent surveys of larval, juvenile, and adult components of the Gulf fishery stocks need to be expanded and designed specifically to assist in stock assessments.

3. Future stock assessments should use a consistent reporting format for the following parameters to assist in the type of cross-fishery analyses needed to evaluate the relative resiliency or resistance of the Gulf populations: F, SPR, and yield levels associated with all of the commonly used biological reference points life history traits such as age and length at recruitment to the fishery, age and length of maturity, maximum age and L_{∞}, M, K, etc..

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TABLE 14 (from Generic SFA Amendment)

Summary of M/K Ratios for Gulf Finfish Stocks

Group One: M/K Ratio ≤ 1.0

Species	M	K	M/K	
Black Grouper	0.15	0.160		0.94
Red Hind	0.18	0.207		0.87
Cubera Snapper	0.15	0.160		0.93
Red Snapper*	0.10	0.160		0.63
Yellowtail Snapper*	0.20	0.250		0.80
Greater Amberjack*	0.20	0.250		0.80
Red Drum*	0.20	0.367		0.55
Cobia*	0.35	0.350		1.00
Red Grouper*	0.20	0.210		0.95
Jewfish**			0.92	
Nassau Grouper**			0.94	

Group Two: M/K Ratio > 1.0 ≤ 1.5

Species	M	K	M/K	
Coney	0.18	0.145		1.24
Rock Hind	0.25	0.191		1.31
Scamp	0.14	0.126		1.13
Snowy Grouper	0.13	0.113		1.15
Warsaw Grouper	0.08	0.054		1.48
Yellowedge Grouper	0.18	0.170		1.05
Yellowfin Grouper	0.18	0.170		1.05
Schoolmaster	0.25	0.180		1.38
Vermilion Snapper*	0.20	0.198		1.01
Mutton Snapper*	0.21	0.153		1.36
Hogfish	0.25	0.190		1.32
King mackerel*	0.20	0.170		1.18
Spanish mackerel*	0.30	0.270		1.11

Group Three: M/K Ratio > 1.5

Species	M	K	M/K	
Gag*	0.20	0.150		1.63
Graysby	0.20	0.130		1.54
Speckled Hind	0.20	0.130		1.54
Yellowmouth Grouper	0.18	0.063		2.86
Black Snapper	0.30	0.097		3.09
Blackfin Snapper	0.23	0.084		2.74
Dog Snapper	0.33	0.100		3.30
Gray Snapper	0.30	0.136		2.21
Lane Snapper	0.30	0.097		3.09
Mahogany Snapper	0.30	0.097		3.09
Silk Snapper	0.23	0.092		2.50

Source: Ault, et al. (1997 (Except for species marked by *). **from Legault and Eklund (1998)

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APPENDIX E. Florida's West Coast Stone Crab Fishery.

[Appendix only available with printed copy.]

Appendix F. Florida's Spiny Lobster Fisheries.

[Appendix only available with printed copy.]

APPENDIX G

DEMOGRAPHIC AND ECONOMIC

DATA RELATED TO

FISHING COMMUNITIES

BY STATE AND COUNTY

Introduction

Appendix G summarizes data by county or parish for each state that provide some information useful in identifying fishing communities. The authors, with guidance from state fishery personnel and advisory panel members, have identified some communities as fishing communities and have identified other that appear to be fishing communities, possibly meeting some of the criteria under Section 9.1 of the Generic Sustainable Fisheries Act (SFA) Amendment. Appendix G serves as a state by state continuation of Section 9.2 of the Generic SFA Amendment. **As discussed in more detail in Section 9.2, the data contained in this appendix are not suitable for assessing the impacts of management measures on individual fishing communities.** In order to obtain these data, economic and social studies of each community would be necessary, and it likely would be necessary to update these studies periodically.

Tables are presented under each coastal county around the Gulf of Mexico to highlight some socioeconomic characteristics pertinent to sub-areas within each county. The source of information is Tolbert et al. (1998).

While some of the areas within each county are clearly non-fishing areas, they are retained in the tables for the purpose of determining at a later time some general differences between non-fishing and fishing communities. In addition, certain areas believed to be fishing communities may not appear on the table. The data set used simply does not provide specific statistics for those communities.

Each table presents four characteristics of each sub-area for three census years (1970, 1980, and 1990). The characteristics are Total Persons, Employment in Agriculture, Fishing, and Mining Industry, Employment in Farming, Fishing, and Forestry Occupation, and Average Wage/Salary. Total Persons refers to individuals who indicated the area as their primary place of residence. The employment variables refer to the number of persons employed in agriculture, fishing, or mining industries or to the number of persons indicating their occupation in farming, fishing, or forestry. Fishing-related employment is not separated from that in agriculture and mining industries or from that in farming and forestry occupations. Comparison of employment, then, over time would have to include all three industries or three occupations. There are areas that can be considered predominantly fishing areas so that the employment characteristics would most likely be reflective of employment in fishing. Average wage/salary refers to household income from labor employment. It may be noted that some areas do not have information for the three census years, partly because of changes in area designations for census purposes.

In addition to the tabled demographic information from the censuses (Tolbert et al. 1998) referenced above, much of the other data are available only on a county or multi-city basis, rather than for specific fishing communities.

9.2.1 Florida Fishing Communities

In 1996, Florida west coast (including the Keys) commercial landings were about 94 million pounds, valued at about $151 million (NMFS 1997). About 2.25 million persons participated in marine recreational fishing in 1996. For the entire state of Florida, saltwater angler expenditures in 1996 were estimated at $2.21 billion, generating a total output of $4.11 billion, total income of $1.17 billion, and total employment of 56,278 (ASFA, 1997).

Monroe County

Both the population and economy of Monroe County grew rapidly in the 1980s and 1990s. Monroe County includes the Florida Keys. Population increased from about 63,000 in 1980 to about 81,000 in 1995. Gross sales in the county grew from $0.72 billion in 1980 to $1.75 billion in 1992. The county's economy is supported by three major sectors: recreation and tourism, commercial fishing, and retirement communities. Bell (1991) estimated these three sectors to account for over 80 percent of the local economy's export base. English et al. (1996) estimated that between June 1995 and May 1996, visitors to the county spent $1.19 billion. This spending generated total output of $1.33 billion, total income of $506 million, and total employment of 21,848 jobs. It may be noted that these numbers apply to all visitors's activities, not only those related to fishing, boating, or diving. In 1994, the commercial fishery in Monroe County produced total output and income estimated at $160 million and $101 million, respectively, and generated full time employments of 2,941 (CEMR, 1995). Bell and Sorensen (1993) estimated that in 1988, total income by place of work in the county was about $803 million, whereas total personal income by place of residence was about $1.4 billion, with the difference accounted for by transfer payments, dividends, interests, and rents. These latter income were most likely accounted for by retired people living in the county but receiving social security, pensions, and returns from investments outside the county.

In 1996, Key West was the fourth leading port in the U.S. in terms of value of commercial seafood products landed ($63 million) and 37th leading port in terms of pounds landed (24 MP). The high value products landed included shrimp, spiny lobster, and stone crab claws. Marathon is also a major landing port for spiny lobster and stone crab. There are 646 recreational for-hire boats based in the Florida Keys that include headboats, charter boats, and guide boats. There is also a very large industry catering to divers in the Keys, whose clientele participate in recreational fishing with spear guns or in observing the coral reef fauna and fishery resources. Most of the large tourist industry is based on persons who visit the Keys for water-related activities, including fishing and non-consumptive enjoyment of the fishery resources. Therefore, the entire Keys could be considered a fishing community. Principal cities for recreational fishing and diving include Key West, Marathon, Islamorada, Tavenier, and Key Largo.

Monroe County is one of the few areas where the following demographic data from the censuses on employment likely includes principally fishery-related employment. There are no agriculture or mineral extraction industries based in the Florida Keys, nor is there any forestry industries. However, there is a major agricultural area just north of the Keys in the Homestead, Florida, area, so some of the residents in the upper Keys, e.g. Key Largo area, may have commuted and worked in that area.

Key Characteristics of Census-Defined Areas in Monroe County

	1,970	1980	1990
Big Coppitt Key			
Total Persons		1,905	2,441
Emplmnt in Agri., Fishing, Min. Industry		33	60
Emplmnt in Farm, Fishing, Forestry Occupation		7	61
Average Wage/Salary ($)		14,876	31,303
Big Pine Key			
Total Persons		2,321	4,124
Emplmnt in Agri., Fishing, Min. Industry		74	195
Emplmnt in Farm, Fishing, Forestry Occupation		93	177
Average Wage/Salary ($)		16,176	29,417
Cudjoe Key			
Total Persons			1,796
Emplmnt in Agri., Fishing, Min. Industry			28
Emplmnt in Farm, Fishing, Forestry Occupation			36
Average Wage/Salary ($)			30,887
Islamorada			
Total Persons		1,482	1,293
Emplmnt in Agri., Fishing, Min. Industry		134	57
Emplmnt in Farm, Fishing, Forestry Occupation		162	65
Average Wage/Salary ($)		17,848	35,040
Key Colony Beach City			
Total Persons		1,006	958
Emplmnt in Agri., Fishing, Min. Industry		29	18
Emplmnt in Farm, Fishing, Forestry Occupation		29	18
Average Wage/Salary ($)		17,649	48,268
Key Largo			
Total Persons	2,866	7,447	11,350
Emplmnt in Agri., Fishing, Min. Industry	60	199	175
Emplmnt in Farm, Fishing, Forestry Occupation		195	174
Average Wage/Salary ($)	6,860	14,893	38,137
Key West City			
Total Persons	37,323	24,382	24,832
Emplmnt in Agri., Fishing, Min. Industry	352	589	296
Emplmnt in Farm, Fishing, Forestry Occupation	67	505	265
Average Wage/Salary ($)	6,949	15,039	32,032
Layton City			
Total Persons		75	190
Emplmnt in Agri., Fishing, Min. Industry		5	10
Emplmnt in Farm, Fishing, Forestry Occupation		5	13
Average Wage/Salary ($)		12,593	31,858
Marathon			
Total Persons	4,461	7,568	8,857
Emplmnt in Agri., Fishing, Min. Industry	217	319	379
Emplmnt in Farm, Fishing, Forestry Occupation	59	328	365
Average Wage/Salary ($)	6,745	15,495	28,608

Monroe County continued			
North Key Largo			
Total Persons		18,479	1,476
Emplmnt in Agri., Fishing, Min. Industry		96	5
Emplmnt in Farm, Fishing, Forestry Occupation		114	0
Average Wage/Salary ($)		21,018	98,845
Plantation Key			
Total Persons		2,838	4,406
Emplmnt in Agri., Fishing, Min. Industry		81	110
Emplmnt in Farm, Fishing, Forestry Occupation		61	89
Average Wage/Salary ($)		15,759	43,427
Stock Island			
Total Persons		4,482	3,560
Emplmnt in Agri., Fishing, Min. Industry		162	147
Emplmnt in Farm, Fishing, Forestry Occupation		141	152
Average Wage/Salary ($)		16,145	22,402
Tavernier			
Total Persons		1,770	2,359
Emplmnt in Agri., Fishing, Min. Industry		27	67
Emplmnt in Farm, Fishing, Forestry Occupation		21	56
Average Wage/Salary ($)		14,446	26,970

Collier County

In 1996, 3.7 MP of seafood was landed in the county. There are 162 recreational for-hire boats based in Collier County, of which a majority are probably guide boats associated with trips to the Everglades National Park. Principal cities for recreational fishing activity include Naples, Marco Island, Everglades City/Chokoloskee area, and Flamingo. Principal commercial landings ports include Naples and Everglades City. Everglades City, Chokoloskee, and Flamingo appear to be fishing communities.

Key Characteristics of Census-Defined Areas in Collier County

	1970	1980	1990
East Naples			
Total Persons	6,152	12,127	22,951
Emplmnt in Agri., Fishing, Min. Industry	127	170	367
Emplmnt in Farm, Fishing, Forestry Occupation	23	160	359
Average Wage/Salary ($)	7,971	15,647	30,550
Everglades City			
Total Persons		514	317
Emplmnt in Agri., Fishing, Min. Industry		33	10
Emplmnt in Farm, Fishing, Forestry Occupation		27	13
Average Wage/Salary ($)		11,862	41,682
Golden Gate			
Total Persons		4,327	14,148
Emplmnt in Agri., Fishing, Min. Industry		68	135
Emplmnt in Farm, Fishing, Forestry Occupation		81	130
Average Wage/Salary ($)		14,497	33,213
Immokalee			
Total Persons	3,764	11,038	14,120
Emplmnt in Agri., Fishing, Min. Industry	699	1,719	2,617
Emplmnt in Farm, Fishing, Forestry Occupation	646	1,414	2,300
Average Wage/Salary ($)	3,961	10,531	19,233
Lely			
Total Persons		1,364	3,057
Emplmnt in Agri., Fishing, Min. Industry		0	35
Emplmnt in Farm, Fishing, Forestry Occupation		0	45
Average Wage/Salary ($)		21,483	33,315
Marco			
Total Persons		4,679	9,493
Emplmnt in Agri., Fishing, Min. Industry		52	103
Emplmnt in Farm, Fishing, Forestry Occupation		57	108
Average Wage/Salary ($)		20,353	45,382
Naples City			
Total Persons	12,042	17,581	19,505
Emplmnt in Agri., Fishing, Min. Industry	248	194	178
Emplmnt in Farm, Fishing, Forestry Occupation	101	168	131
Average Wage/Salary ($)	11,475	23,269	56,515

Collier County continued			
Naples Park			
Total Persons		5,438	8,002
Emplmnt in Agri., Fishing, Min. Industry		72	134
Emplmnt in Farm, Fishing, Forestry Occupation		64	117
Average Wage/Salary ($)		16,357	31,716
North Naples			
Total Persons	3,192	7,950	13,422
Emplmnt in Agri., Fishing, Min. Industry	27	100	204
Emplmnt in Farm, Fishing, Forestry Occupation	22	110	175
Average Wage/Salary ($)	9,290	20,475	37,646
Palm River			
Total Persons			3,471
Emplmnt in Agri., Fishing, Min. Industry			51
Emplmnt in Farm, Fishing, Forestry Occupation			23
Average Wage/Salary ($)			45,421

Lee County

In 1996, 11.7 MP of seafood was landed in the county. There are 180 recreational for-hire vessels based in Lee County. Principal cities for recreational fishing activity include Boca Grande, Fort Myers Beach, Sanibel, Captiva, and St. James City. Sanibel and Captiva are major shell gathering areas and attract large numbers of shell collectors annually. Principal commercial landings ports include Fort Myers Beach, Fort Myers, St. James City, Bokeelia, and Boca Grande. Boca Grande, Sanibel, Captiva, St. James City, and Bokeelia appear to be fishing communities.

Key Characteristics of Census-Defined Areas in Lee County

	1970	1980	1990
Alva			
Total Persons			949
Emplmnt in Agri., Fishing, Min. Industry			14
Emplmnt in Farm, Fishing, Forestry Occupation			24
Average Wage/Salary ($)			21,087
Bonita Springs			
Total Persons		5,363	13,600
Emplmnt in Agri., Fishing, Min. Industry		172	161
Emplmnt in Farm, Fishing, Forestry Occupation		169	240
Average Wage/Salary ($)		13,572	28,536
Cape Coral City			
Total Persons	10,214	32,103	74,991
Emplmnt in Agri., Fishing, Min. Industry	100	201	605
Emplmnt in Farm, Fishing, Forestry Occupation	22	188	465
Average Wage/Salary ($)	8,501	17,420	32,244
Cypress Lake			
Total Persons		8,721	10,491
Emplmnt in Agri., Fishing, Min. Industry		60	94
Emplmnt in Farm, Fishing, Forestry Occupation		52	127
Average Wage/Salary ($)		19,273	31,877
Estero			
Total Persons			3,261
Emplmnt in Agri., Fishing, Min. Industry			9
Emplmnt in Farm, Fishing, Forestry Occupation			9
Average Wage/Salary ($)			35,086
Forest Island Park			
Total Persons		6,819	5,904
Emplmnt in Agri., Fishing, Min. Industry		149	53
Emplmnt in Farm, Fishing, Forestry Occupation		48	26
Average Wage/Salary ($)		19,578	39,979
Fort Myers City			
Total Persons	27,351	36,638	45,206
Emplmnt in Agri., Fishing, Min. Industry	879	609	678
Emplmnt in Farm, Fishing, Forestry Occupation	585	544	677
Average Wage/Salary ($)	7,729	16,072	28,508

Lee County continued			
Fort Myers Shores			
Total Persons		4,426	5,460
Emplmnt in Agri., Fishing, Min. Industry		48	136
Emplmnt in Farm, Fishing, Forestry Occupation		31	74
Average Wage/Salary ($)		16,681	30,823
Iona			
Total Persons			9,511
Emplmnt in Agri., Fishing, Min. Industry			126
Emplmnt in Farm, Fishing, Forestry Occupation			64
Average Wage/Salary ($)			32,833
Lehigh Acres			
Total Persons	4,394	9,604	13,611
Emplmnt in Agri., Fishing, Min. Industry	14	118	174
Emplmnt in Farm, Fishing, Forestry Occupation	9	99	124
Average Wage/Salary ($)	6,467	14,659	25,017
Lochmoor Waterway Estates			
Total Persons			4,091
Emplmnt in Agri., Fishing, Min. Industry			52
Emplmnt in Farm, Fishing, Forestry Occupation			29
Average Wage/Salary ($)			39,442
McGregor			
Total Persons			6,504
Emplmnt in Agri., Fishing, Min. Industry			38
Emplmnt in Farm, Fishing, Forestry Occupation			21
Average Wage/Salary ($)			54,592
Morse Shores			
Total Persons			3,771
Emplmnt in Agri., Fishing, Min. Industry			83
Emplmnt in Farm, Fishing, Forestry Occupation			61
Average Wage/Salary ($)			26,452
North Fort Myers			
Total Persons	8,798	22,808	30,027
Emplmnt in Agri., Fishing, Min. Industry	90	242	254
Emplmnt in Farm, Fishing, Forestry Occupation	32	224	265
Average Wage/Salary ($)	8,066	16,730	24,733
Page Park-Pine Manor			
Total Persons		4,996	5,116
Emplmnt in Agri., Fishing, Min. Industry		39	112
Emplmnt in Farm, Fishing, Forestry Occupation		16	129
Average Wage/Salary ($)		16,539	22,403
Punta Rassa			
Total Persons			1,547
Emplmnt in Agri., Fishing, Min. Industry			8
Emplmnt in Farm, Fishing, Forestry Occupation			8
Average Wage/Salary ($)			23,942
St. James City			
Total Persons		1,259	1,943
Emplmnt in Agri., Fishing, Min. Industry		7	39
Emplmnt in Farm, Fishing, Forestry Occupation		7	39
Average Wage/Salary ($)		8,900	26,861

Lee County continued			
Sanibel City			
Total Persons		3,363	5,468
Emplmnt in Agri., Fishing, Min. Industry		52	72
Emplmnt in Farm, Fishing, Forestry Occupation		43	105
Average Wage/Salary ($)		25,970	55,990
Suncoast Estates			
Total Persons		4,399	4,483
Emplmnt in Agri., Fishing, Min. Industry		79	43
Emplmnt in Farm, Fishing, Forestry Occupation		82	63
Average Wage/Salary ($)		12,071	24,492
Tice			
Total Persons	7,254	6,645	3,971
Emplmnt in Agri., Fishing, Min. Industry	77	97	43
Emplmnt in Farm, Fishing, Forestry Occupation	18	61	48
Average Wage/Salary ($)	8,029	14,680	24,083
Villas			
Total Persons	2,524	2,098	9,898
Emplmnt in Agri., Fishing, Min. Industry	0	3	81
Emplmnt in Farm, Fishing, Forestry Occupation	0	3	102
Average Wage/Salary ($)	9,816	20,899	35,357
Whiskey Creek			
Total Persons			5,061
Emplmnt in Agri., Fishing, Min. Industry			29
Emplmnt in Farm, Fishing, Forestry Occupation			5
Average Wage/Salary ($)			51,346

Charlotte County

In 1996, 2.4 MP of seafood was landed in the county. There are 54 recreational for-hire boats based in Charlotte County, most of which probably fish in the Charlotte Harbor estuary. Principal coastal cities are Placida, Charlotte Harbor, and Punta Gorda.

Key Characteristics of Census-Defined Areas in Charlotte County

	1970	1980	1990
Charlotte Harbor			
Total Persons		2,079	3,339
Emplmnt in Agri., Fishing, Min. Industry		21	35
Emplmnt in Farm, Fishing, Forestry Occupation		8	29
Average Wage/Salary ($)		15,821	25,314
Charlotte Park			
Total Persons		1,671	2,142
Emplmnt in Agri., Fishing, Min. Industry		6	6
Emplmnt in Farm, Fishing, Forestry Occupation		0	0
Average Wage/Salary ($)		14,138	27,041
Cleveland			
Total Persons		2,422	2,922
Emplmnt in Agri., Fishing, Min. Industry		48	34
Emplmnt in Farm, Fishing, Forestry Occupation		37	50
Average Wage/Salary ($)		13,083	24,548
Grove City			
Total Persons		1,903	2,415
Emplmnt in Agri., Fishing, Min. Industry		11	23
Emplmnt in Farm, Fishing, Forestry Occupation		11	39
Average Wage/Salary ($)		10,693	21,303
Harbour Heights			
Total Persons			2,511
Emplmnt in Agri., Fishing, Min. Industry			37
Emplmnt in Farm, Fishing, Forestry Occupation			29
Average Wage/Salary ($)			35,103
Manasota Key			
Total Persons		1,145	1,326
Emplmnt in Agri., Fishing, Min. Industry		12	10
Emplmnt in Farm, Fishing, Forestry Occupation		12	10
Average Wage/Salary ($)		11,727	45,972
Port Charlotte			
Total Persons	10,802	23,770	41,535
Emplmnt in Agri., Fishing, Min. Industry	69	103	343
Emplmnt in Farm, Fishing, Forestry Occupation	45	126	291
Average Wage/Salary ($)	6,456	15,444	27,659
Punta Gorda City			
Total Persons	3,749	6,797	10,878
Emplmnt in Agri., Fishing, Min. Industry	64	110	40
Emplmnt in Farm, Fishing, Forestry Occupation	34	89	73
Average Wage/Salary ($)	8,357	16,702	39,223

Charlotte County continued			
Rotonda			
Total Persons		1,473	3,535
Emplmnt in Agri., Fishing, Min. Industry		12	0
Emplmnt in Farm, Fishing, Forestry Occupation		21	16
Average Wage/Salary ($)		16,594	29,249
Solana			
Total Persons		1,342	1,080
Emplmnt in Agri., Fishing, Min. Industry		21	50
Emplmnt in Farm, Fishing, Forestry Occupation		26	72
Average Wage/Salary ($)		11,496	20,620

Sarasota County

In 1996, 308,000 pounds of seafood was landed in the county. There are 79 recreational for-hire vessels based in Sarasota County. Principal coastal cities are Sarasota, Venice, Nokomis, and Englewood.

Key Characteristics of Census-Defined Areas in Sarasota County

	1970	1980	1990
Bee Ridge			
Total Persons		3,313	6,406
Emplmnt in Agri., Fishing, Min. Industry		27	51
Emplmnt in Farm, Fishing, Forestry Occupation		33	50
Average Wage/Salary ($)		19,221	40,923
Desoto Lakes			
Total Persons		2,085	2,912
Emplmnt in Agri., Fishing, Min. Industry		48	41
Emplmnt in Farm, Fishing, Forestry Occupation		47	45
Average Wage/Salary ($)		18,171	39,005
Englewood			
Total Persons	5,011	10,227	15,094
Emplmnt in Agri., Fishing, Min. Industry	32	90	86
Emplmnt in Farm, Fishing, Forestry Occupation	12	100	100
Average Wage/Salary ($)	6,988	14,423	23,713
Fruitville			
Total Persons		3,070	9,808
Emplmnt in Agri., Fishing, Min. Industry		57	124
Emplmnt in Farm, Fishing, Forestry Occupation		55	97
Average Wage/Salary ($)		17,656	42,265
Gulf GateEstates			
Total Persons	5,739	9,248	11,622
Emplmnt in Agri., Fishing, Min. Industry	8	42	49
Emplmnt in Farm, Fishing, Forestry Occupation	0	40	65
Average Wage/Salary ($)	8,063	14,420	29,480
Kensington Park			
Total Persons	3,123	2,783	2,921
Emplmnt in Agri., Fishing, Min. Industry	0	27	74
Emplmnt in Farm, Fishing, Forestry Occupation	0	24	82
Average Wage/Salary ($)	8,050	15,741	32,507
Lake Sarasota			
Total Persons			4,117
Emplmnt in Agri., Fishing, Min. Industry			53
Emplmnt in Farm, Fishing, Forestry Occupation			24
Average Wage/Salary ($)			38,030
Laurel			
Total Persons		6,368	8,245
Emplmnt in Agri., Fishing, Min. Industry		59	136
Emplmnt in Farm, Fishing, Forestry Occupation		63	98
Average Wage/Salary ($)		14,990	31,600

Sarasota County continued			
Longboat Key Town			
Total Persons	2,828	4,811	5,904
Emplmnt in Agri., Fishing, Min. Industry	12	6	91
Emplmnt in Farm, Fishing, Forestry Occupation	7	6	45
Average Wage/Salary ($)	9,853	24,735	69,911
Nokomis			
Total Persons		3,108	3,448
Emplmnt in Agri., Fishing, Min. Industry		51	93
Emplmnt in Farm, Fishing, Forestry Occupation		62	82
Average Wage/Salary ($)		12,840	24,810
North Port City			
Total Persons		6,205	11,973
Emplmnt in Agri., Fishing, Min. Industry		31	161
Emplmnt in Farm, Fishing, Forestry Occupation		49	152
Average Wage/Salary ($)		11,765	25,652
North Sarasota			
Total Persons		5,020	6,702
Emplmnt in Agri., Fishing, Min. Industry		34	47
Emplmnt in Farm, Fishing, Forestry Occupation		74	85
Average Wage/Salary ($)		15,602	29,005
Osprey			
Total Persons		1,651	2,618
Emplmnt in Agri., Fishing, Min. Industry		34	24
Emplmnt in Farm, Fishing, Forestry Occupation		34	31
Average Wage/Salary ($)		18,409	36,315
Plantation			
Total Persons			1,795
Emplmnt in Agri., Fishing, Min. Industry			0
Emplmnt in Farm, Fishing, Forestry Occupation			0
Average Wage/Salary ($)			31,189
Ridge Wood Heights			
Total Persons	2,583	3,951	4,851
Emplmnt in Agri., Fishing, Min. Industry	17	56	48
Emplmnt in Farm, Fishing, Forestry Occupation	0	64	79
Average Wage/Salary ($)	8,429	16,732	30,409
Sarasota City			
Total Persons	40,237	48,876	50,978
Emplmnt in Agri., Fishing, Min. Industry	331	389	558
Emplmnt in Farm, Fishing, Forestry Occupation	91	337	615
Average Wage/Salary ($)	8,065	15,261	28,000
Siesta Key			
Total Persons		7,015	7,772
Emplmnt in Agri., Fishing, Min. Industry		41	17
Emplmnt in Farm, Fishing, Forestry Occupation		18	27
Average Wage/Salary ($)		21,645	50,182
Southgate			
Total Persons		7,322	7,324
Emplmnt in Agri., Fishing, Min. Industry		38	28
Emplmnt in Farm, Fishing, Forestry Occupation		63	60
Average Wage/Salary ($)		17,628	29,184

Sarasota County continued			
South Sarasota			
Total Persons		4,267	5,298
Emplmnt in Agri., Fishing, Min. Industry		51	23
Emplmnt in Farm, Fishing, Forestry Occupation		26	49
Average Wage/Salary ($)		17,234	49,966
South Venice			
Total Persons		8,075	11,951
Emplmnt in Agri., Fishing, Min. Industry		68	78
Emplmnt in Farm, Fishing, Forestry Occupation		97	83
Average Wage/Salary ($)		14,690	28,103
The Meadows			
Total Persons			3,437
Emplmnt in Agri., Fishing, Min. Industry			0
Emplmnt in Farm, Fishing, Forestry Occupation			11
Average Wage/Salary ($)			38,072
Vamo			
Total Persons		2,574	3,304
Emplmnt in Agri., Fishing, Min. Industry		0	51
Emplmnt in Farm, Fishing, Forestry Occupation		5	59
Average Wage/Salary ($)		19,113	30,820
Venice City			
Total Persons	6,648	12,153	16,922
Emplmnt in Agri., Fishing, Min. Industry	26	67	47
Emplmnt in Farm, Fishing, Forestry Occupation	0	68	35
Average Wage/Salary ($)	8,316	14,318	27,900
Warm Mineral Springs			
Total Persons			4,041
Emplmnt in Agri., Fishing, Min. Industry			8
Emplmnt in Farm, Fishing, Forestry Occupation			17
Average Wage/Salary ($)			13,233

Manatee County

In 1996, 3.2 MP of seafood was landed in the county. There are 41 recreational for-hire vessels based in Manatee County. Principal coastal cities are Bradenton, Bradenton Beach, Longboat Key, and Holmes Beach.

Key Characteristics of Census-Defined Areas in Manatee County

	1970	1980	1990
Anna Maria City			
Total Persons		1,537	1,744
Emplmnt in Agri., Fishing, Min. Industry		22	16
Emplmnt in Farm, Fishing, Forestry Occupation		21	19
Average Wage/Salary ($)		17,602	37,464
Bayshore Gardens			
Total Persons		14,894	17,062
Emplmnt in Agri., Fishing, Min. Industry		113	138
Emplmnt in Farm, Fishing, Forestry Occupation		59	174
Average Wage/Salary ($)		14,792	24,567
Bradenton City			
Total Persons	21,040	30,170	43,779
Emplmnt in Agri., Fishing, Min. Industry	326	479	775
Emplmnt in Farm, Fishing, Forestry Occupation	193	397	713
Average Wage/Salary ($)	6,422	14,300	27,946
Cortez			
Total Persons			4,509
Emplmnt in Agri., Fishing, Min. Industry			58
Emplmnt in Farm, Fishing, Forestry Occupation			54
Average Wage/Salary ($)			28,548
Ellenton			
Total Persons		1,608	2,573
Emplmnt in Agri., Fishing, Min. Industry		59	52
Emplmnt in Farm, Fishing, Forestry Occupation		34	57
Average Wage/Salary ($)		13,504	28,280
Holmes Beach City			
Total Persons	2,699	4,023	4,810
Emplmnt in Agri., Fishing, Min. Industry	10	32	98
Emplmnt in Farm, Fishing, Forestry Occupation	0	34	91
Average Wage/Salary ($)	7,891	17,107	35,640
Memphis			
Total Persons	3,229	5,501	6,760
Emplmnt in Agri., Fishing, Min. Industry	223	344	256
Emplmnt in Farm, Fishing, Forestry Occupation	183	196	215
Average Wage/Salary ($)	5,374	14,367	27,450
Palmetto City			
Total Persons	7,370	8,637	9,268
Emplmnt in Agri., Fishing, Min. Industry	242	326	415
Emplmnt in Farm, Fishing, Forestry Occupation	175	330	391
Average Wage/Salary ($)	6,234	13,736	25,946

Manatee County continued			
Samoset			
Total Persons	4,104	5,747	3,119
Emplmnt in Agri., Fishing, Min. Industry	89	116	69
Emplmnt in Farm, Fishing, Forestry Occupation	51	74	62
Average Wage/Salary ($)	6,039	14,066	25,540
South Bradenton			
Total Persons		14,285	20,398
Emplmnt in Agri., Fishing, Min. Industry		156	207
Emplmnt in Farm, Fishing, Forestry Occupation		141	167
Average Wage/Salary ($)		13,464	23,659
West Bradenton			
Total Persons		4,065	4,528
Emplmnt in Agri., Fishing, Min. Industry		48	29
Emplmnt in Farm, Fishing, Forestry Occupation		41	31
Average Wage/Salary ($)		19,133	44,794
West Samoset			
Total Persons			3,819
Emplmnt in Agri., Fishing, Min. Industry			90
Emplmnt in Farm, Fishing, Forestry Occupation			53
Average Wage/Salary ($)			22,330
Whitfield			
Total Persons		4,328	3,112
Emplmnt in Agri., Fishing, Min. Industry		15	38
Emplmnt in Farm, Fishing, Forestry Occupation		15	7
Average Wage/Salary ($)		23,765	37,788

Pinellas County

In 1996, 12.8 MP of seafood was landed in the county, and the Tampa Bay/St. Petersburg area was the 36th leading port area in the U.S. in terms of the value of commercial landings ($20 million). There are 152 recreational for-hire boats based in Pinellas County. Principal recreational fishing ports include St. Petersburg, St. Petersburg Beach, Treasure Island, Madeira Beach, Seminole, Clearwater, Clearwater Beach, Indian Rocks Beach, and Tarpon Springs. Historically, Tarpon Springs was a fishing community dependent on the sponge fishery. Principal commercial landings ports are St. Petersburg, Madeira Beach, and Tarpon Springs.

Key Characteristics of Census-Defined Areas in Pinellas County

	1970	1980	1990
Baskin			
Total Persons		126	3,834
Emplmnt in Agri., Fishing, Min. Industry		5	40
Emplmnt in Farm, Fishing, Forestry Occupation		0	52
Average Wage/Salary ($)		16,503	22,116
Bay Pines			
Total Persons		5,757	4,171
Emplmnt in Agri., Fishing, Min. Industry		44	26
Emplmnt in Farm, Fishing, Forestry Occupation		31	11
Average Wage/Salary ($)		16,247	30,068
Belleair Town			
Total Persons	3,048	3,673	3,968
Emplmnt in Agri., Fishing, Min. Industry	15	15	27
Emplmnt in Farm, Fishing, Forestry Occupation	5	14	6
Average Wage/Salary ($)	13,443	24,256	76,260
Belleair Bluffs City			
Total Persons		2,470	2,128
Emplmnt in Agri., Fishing, Min. Industry		0	4
Emplmnt in Farm, Fishing, Forestry Occupation		0	2
Average Wage/Salary ($)		18,155	32,518
Belleair Shore Town			
Total Persons		73	71
Emplmnt in Agri., Fishing, Min. Industry		0	4
Emplmnt in Farm, Fishing, Forestry Occupation		0	4
Average Wage/Salary ($)		30,762	84,825
Clearwater City			
Total Persons	51,624	85,528	98,773
Emplmnt in Agri., Fishing, Min. Industry	474	511	549
Emplmnt in Farm, Fishing, Forestry Occupation	125	496	572
Average Wage/Salary ($)	7,931	17,061	33,675
Dunedin City			
Total Persons	17,744	30,203	34,012
Emplmnt in Agri., Fishing, Min. Industry	80	161	234
Emplmnt in Farm, Fishing, Forestry Occupation	30	197	194
Average Wage/Salary ($)	7,963	15,981	31,331

Pinellas County continued			
	Feather Sound		
Total Persons			2,886
Emplmnt in Agri., Fishing, Min. Industry			0
Emplmnt in Farm, Fishing, Forestry Occupation			0
Average Wage/Salary ($)			58,134
	Gandy		
Total Persons			2,968
Emplmnt in Agri., Fishing, Min. Industry			6
Emplmnt in Farm, Fishing, Forestry Occupation			0
Average Wage/Salary ($)			27,652
	Gulfport City		
Total Persons	9,730	11,180	11,727
Emplmnt in Agri., Fishing, Min. Industry	25	59	147
Emplmnt in Farm, Fishing, Forestry Occupation	0	60	145
Average Wage/Salary ($)	6,240	12,109	24,591
	Harbor Bluffs		
Total Persons			2,643
Emplmnt in Agri., Fishing, Min. Industry			32
Emplmnt in Farm, Fishing, Forestry Occupation			32
Average Wage/Salary ($)			60,517
	Highpoint		
Total Persons	2,787	2,485	13,818
Emplmnt in Agri., Fishing, Min. Industry	74	53	135
Emplmnt in Farm, Fishing, Forestry Occupation	47	53	129
Average Wage/Salary ($)	7,377	16,684	28,626
	Indian Rocks Beach City		
Total Persons	2,750	3,717	3,963
Emplmnt in Agri., Fishing, Min. Industry	25	7	55
Emplmnt in Farm, Fishing, Forestry Occupation	0	12	59
Average Wage/Salary ($)	7,681	17,172	36,710
	Indian Shores Town		
Total Persons		977	1,405
Emplmnt in Agri., Fishing, Min. Industry		8	3
Emplmnt in Farm, Fishing, Forestry Occupation		8	5
Average Wage/Salary ($)		23,106	38,746
	Kenneth City Town		
Total Persons			4,462
Emplmnt in Agri., Fishing, Min. Industry			64
Emplmnt in Farm, Fishing, Forestry Occupation			40
Average Wage/Salary ($)			31,047
	Largo City		
Total Persons	21,956	58,977	65,690
Emplmnt in Agri., Fishing, Min. Industry	153	495	412
Emplmnt in Farm, Fishing, Forestry Occupation	55	531	428
Average Wage/Salary ($)	8,206	15,652	28,383
	Lealman		
Total Persons		19,873	21,748
Emplmnt in Agri., Fishing, Min. Industry		234	217
Emplmnt in Farm, Fishing, Forestry Occupation		198	194
Average Wage/Salary ($)		13,008	24,618

Pinellas County continued			
Madeira Beach City			
Total Persons	4,179	4,520	4,225
Emplmnt in Agri., Fishing, Min. Industry	10	40	31
Emplmnt in Farm, Fishing, Forestry Occupation	0	67	31
Average Wage/Salary ($)	6,737	15,366	29,035
North Redington Beach Town			
Total Persons		1,156	1,135
Emplmnt in Agri., Fishing, Min. Industry		6	4
Emplmnt in Farm, Fishing, Forestry Occupation		4	2
Average Wage/Salary ($)		15,547	38,435
Oldsmar City			
Total Persons		2,608	8,361
Emplmnt in Agri., Fishing, Min. Industry		22	47
Emplmnt in Farm, Fishing, Forestry Occupation		15	56
Average Wage/Salary ($)		18,261	32,939
Palm Harbor			
Total Persons		5,215	50,256
Emplmnt in Agri., Fishing, Min. Industry		104	368
Emplmnt in Farm, Fishing, Forestry Occupation		67	341
Average Wage/Salary ($)		20,370	38,976
Pinellas Park City			
Total Persons	22,235	32,811	43,426
Emplmnt in Agri., Fishing, Min. Industry	138	184	363
Emplmnt in Farm, Fishing, Forestry Occupation	29	190	342
Average Wage/Salary ($)	7,547	15,102	29,173
Redington Beach Town			
Total Persons		1,708	1,626
Emplmnt in Agri., Fishing, Min. Industry		4	7
Emplmnt in Farm, Fishing, Forestry Occupation		7	9
Average Wage/Salary ($)		17,853	48,986
Redington Shores Town			
Total Persons		2,149	2,366
Emplmnt in Agri., Fishing, Min. Industry		9	41
Emplmnt in Farm, Fishing, Forestry Occupation		8	4
Average Wage/Salary ($)		15,943	35,317
Safety Harbor City			
Total Persons	3,173	6,461	15,124
Emplmnt in Agri., Fishing, Min. Industry	43	61	95
Emplmnt in Farm, Fishing, Forestry Occupation	15	34	82
Average Wage/Salary ($)	7,277	17,322	40,295
St. Petersburg City			
Total Persons	216,067	238,647	238,629
Emplmnt in Agri., Fishing, Min. Industry	1,163	1,206	1,708
Emplmnt in Farm, Fishing, Forestry Occupation	407	1,289	1,408
Average Wage/Salary ($)	7,578	15,435	30,727
Seminole City			
Total Persons		4,586	9,251
Emplmnt in Agri., Fishing, Min. Industry		83	60
Emplmnt in Farm, Fishing, Forestry Occupation		91	51
Average Wage/Salary ($)		13,081	22,792

Pinellas County continued			
South Pasadena City			
Total Persons		4,188	5,644
Emplmnt in Agri., Fishing, Min. Industry		18	8
Emplmnt in Farm, Fishing, Forestry Occupation		13	0
Average Wage/Salary ($)		18,606	26,922
Tarpon Springs City			
Total Persons	7,081	13,251	17,906
Emplmnt in Agri., Fishing, Min. Industry	128	81	231
Emplmnt in Farm, Fishing, Forestry Occupation	51	94	221
Average Wage/Salary ($)	7,172	18,400	31,452
Treasure Island City			
Total Persons	6,100	6,316	7,266
Emplmnt in Agri., Fishing, Min. Industry	5	18	69
Emplmnt in Farm, Fishing, Forestry Occupation	5	5	76
Average Wage/Salary ($)	8,718	22,037	44,986

Hillsborough County

In 1996, 3.5 MP of seafood was landed in the county. The Port of Tampa serves as a major landing and docking facility for Gulf shrimp vessels. Tampa/Hillsborough County is a major shrimp processing area.

Key Characteristics of Census-Defined Areas in Hillsborough County

	1970	1980	1990
Apollo Beach			
Total Persons		4,014	6,025
Emplmnt in Agri., Fishing, Min. Industry		94	60
Emplmnt in Farm, Fishing, Forestry Occupation		66	35
Average Wage/Salary ($)		18,124	41,114
Bloomingdale			
Total Persons			13,912
Emplmnt in Agri., Fishing, Min. Industry			108
Emplmnt in Farm, Fishing, Forestry Occupation			93
Average Wage/Salary ($)			53,446
Brandon			
Total Persons	12,830	41,826	57,985
Emplmnt in Agri., Fishing, Min. Industry	170	416	626
Emplmnt in Farm, Fishing, Forestry Occupation	78	169	307
Average Wage/Salary ($)	10,877	22,476	40,786
Carrollwood			
Total Persons			7,195
Emplmnt in Agri., Fishing, Min. Industry			56
Emplmnt in Farm, Fishing, Forestry Occupation			17
Average Wage/Salary ($)			50,962
Carrollwood Village			
Total Persons	5,515		15,051
Emplmnt in Agri., Fishing, Min. Industry	170		97
Emplmnt in Farm, Fishing, Forestry Occupation	62		41
Average Wage/Salary ($)	6,801		55,673
Del Rio			
Total Persons		7,409	8,248
Emplmnt in Agri., Fishing, Min. Industry		36	104
Emplmnt in Farm, Fishing, Forestry Occupation		15	90
Average Wage/Salary ($)		18,627	29,432
Dover			
Total Persons		2,399	2,552
Emplmnt in Agri., Fishing, Min. Industry		156	314
Emplmnt in Farm, Fishing, Forestry Occupation		123	292
Average Wage/Salary ($)		15,706	23,571
East Lake-Orient Park			
Total Persons	5,701	5,612	6,171
Emplmnt in Agri., Fishing, Min. Industry	25	76	80
Emplmnt in Farm, Fishing, Forestry Occupation	0	26	55
Average Wage/Salary ($)	8,422	16,737	27,115

Hillsborough County continued			
Egypt Lake			
Total Persons	7,558	11,932	14,580
Emplmnt in Agri., Fishing, Min. Industry	17	97	98
Emplmnt in Farm, Fishing, Forestry Occupation	5	63	74
Average Wage/Salary ($)	9,592	17,604	31,832
Gibsonton			
Total Persons			7,706
Emplmnt in Agri., Fishing, Min. Industry			380
Emplmnt in Farm, Fishing, Forestry Occupation			356
Average Wage/Salary ($)			24,724
Greater Northdale			
Total Persons			16,318
Emplmnt in Agri., Fishing, Min. Industry			92
Emplmnt in Farm, Fishing, Forestry Occupation			95
Average Wage/Salary ($)			45,326
Lake Magdalene			
Total Persons	9,260	13,331	15,973
Emplmnt in Agri., Fishing, Min. Industry	43	64	106
Emplmnt in Farm, Fishing, Forestry Occupation	16	63	76
Average Wage/Salary ($)	9,490	20,248	37,382
Lutz			
Total Persons		5,555	10,552
Emplmnt in Agri., Fishing, Min. Industry		36	158
Emplmnt in Farm, Fishing, Forestry Occupation		43	100
Average Wage/Salary ($)		22,403	47,731
Mango			
Total Persons			8,700
Emplmnt in Agri., Fishing, Min. Industry			135
Emplmnt in Farm, Fishing, Forestry Occupation			101
Average Wage/Salary ($)			28,514
Palm River-Clair Mel			
Total Persons	8,524	14,447	13,691
Emplmnt in Agri., Fishing, Min. Industry	61	137	36
Emplmnt in Farm, Fishing, Forestry Occupation	33	84	53
Average Wage/Salary ($)	8,191	16,211	28,774
Plant City			
Total Persons	15,451	19,270	22,754
Emplmnt in Agri., Fishing, Min. Industry	745	495	610
Emplmnt in Farm, Fishing, Forestry Occupation	364	304	442
Average Wage/Salary ($)	7,243	15,775	31,956
Riverview			
Total Persons			6,478
Emplmnt in Agri., Fishing, Min. Industry			131
Emplmnt in Farm, Fishing, Forestry Occupation			77
Average Wage/Salary ($)			38,663
Ruskin			
Total Persons		5,117	6,046
Emplmnt in Agri., Fishing, Min. Industry		516	567
Emplmnt in Farm, Fishing, Forestry Occupation		427	452
Average Wage/Salary ($)		12,939	23,329

Hillsborough County continued			
Seffner			
Total Persons			5,371
Emplmnt in Agri., Fishing, Min. Industry			45
Emplmnt in Farm, Fishing, Forestry Occupation			30
Average Wage/Salary ($)			32,955
Sun City Center			
Total Persons		5,605	8,326
Emplmnt in Agri., Fishing, Min. Industry		0	8
Emplmnt in Farm, Fishing, Forestry Occupation		0	16
Average Wage/Salary ($)		12,288	16,374
Tampa City			
Total Persons	277,736	271,523	280,015
Emplmnt in Agri., Fishing, Min. Industry	1,456	2,076	2,274
Emplmnt in Farm, Fishing, Forestry Occupation	718	1,799	2,252
Average Wage/Salary ($)	7,722	16,113	31,221
Temple Terrace City			
Total Persons	7,377	11,097	16,444
Emplmnt in Agri., Fishing, Min. Industry	21	37	103
Emplmnt in Farm, Fishing, Forestry Occupation	0	54	107
Average Wage/Salary ($)	12,559	22,961	44,436
Town n'Country			
Total Persons		37,834	60,946
Emplmnt in Agri., Fishing, Min. Industry		266	353
Emplmnt in Farm, Fishing, Forestry Occupation		187	331
Average Wage/Salary ($)		19,756	36,292
University West			
Total Persons	10,009	24,514	23,760
Emplmnt in Agri., Fishing, Min. Industry	63	124	201
Emplmnt in Farm, Fishing, Forestry Occupation	43	173	231
Average Wage/Salary ($)	5,832	11,782	20,211
West Park			
Total Persons			10,347
Emplmnt in Agri., Fishing, Min. Industry			90
Emplmnt in Farm, Fishing, Forestry Occupation			88
Average Wage/Salary ($)			28,514
Wimauma			
Total Persons		1,553	2,968
Emplmnt in Agri., Fishing, Min. Industry		156	600
Emplmnt in Farm, Fishing, Forestry Occupation		136	548
Average Wage/Salary ($)		14,141	19,936

Pasco County

In 1996, 1.4 MP of seafood was landed in the county. There are 31 recreational for-hire boats based in Pasco County. Principal coastal cities are Hudson and New Port Richey.

Key Characteristics of Census-Defined Areas in Pasco County

	1970	1980	1990
Bayonet Point			
Total Persons		16,455	21,860
Emplmnt in Agri., Fishing, Min. Industry		34	81
Emplmnt in Farm, Fishing, Forestry Occupation		40	86
Average Wage/Salary ($)		12,658	21,088
Beacon Square			
Total Persons		6,513	6,265
Emplmnt in Agri., Fishing, Min. Industry		11	33
Emplmnt in Farm, Fishing, Forestry Occupation		13	33
Average Wage/Salary ($)		12,187	22,707
Dade City			
Total Persons	4,241	4,923	5,633
Emplmnt in Agri., Fishing, Min. Industry	194	376	177
Emplmnt in Farm, Fishing, Forestry Occupation	132	239	114
Average Wage/Salary ($)	6,739	15,724	27,159
Elfers			
Total Persons		11,396	12,356
Emplmnt in Agri., Fishing, Min. Industry		61	76
Emplmnt in Farm, Fishing, Forestry Occupation		59	89
Average Wage/Salary ($)		12,560	22,782
Holiday			
Total Persons		18,392	19,360
Emplmnt in Agri., Fishing, Min. Industry		41	194
Emplmnt in Farm, Fishing, Forestry Occupation		65	269
Average Wage/Salary ($)		11,446	21,375
Hudson			
Total Persons		5,799	7,248
Emplmnt in Agri., Fishing, Min. Industry		54	25
Emplmnt in Farm, Fishing, Forestry Occupation		45	43
Average Wage/Salary ($)		11,993	23,243
Jasmine Estates			
Total Persons			17,136
Emplmnt in Agri., Fishing, Min. Industry			45
Emplmnt in Farm, Fishing, Forestry Occupation			76
Average Wage/Salary ($)			22,692
Lacoochee			
Total Persons		1,719	1,985
Emplmnt in Agri., Fishing, Min. Industry		35	105
Emplmnt in Farm, Fishing, Forestry Occupation		42	109
Average Wage/Salary ($)		10,387	24,020

Pasco County continued			
Land O'Lakes			
Total Persons		4,515	7,892
Emplmnt in Agri., Fishing, Min. Industry		71	134
Emplmnt in Farm, Fishing, Forestry Occupation		54	108
Average Wage/Salary ($)		23,750	37,396
New Port Richey City			
Total Persons	6,098	11,196	14,044
Emplmnt in Agri., Fishing, Min. Industry	50	59	99
Emplmnt in Farm, Fishing, Forestry Occupation	9	69	107
Average Wage/Salary ($)	6,636	12,509	23,841
Port Richey City			
Total Persons		2,165	2,619
Emplmnt in Agri., Fishing, Min. Industry		26	28
Emplmnt in Farm, Fishing, Forestry Occupation		13	43
Average Wage/Salary ($)		12,687	28,019
St. Leo Town			
Total Persons		883	1,021
Emplmnt in Agri., Fishing, Min. Industry		16	7
Emplmnt in Farm, Fishing, Forestry Occupation		13	5
Average Wage/Salary ($)		17,965	37,659
Zephyrhills City			
Total Persons	3,369	5,742	8,126
Emplmnt in Agri., Fishing, Min. Industry	54	23	81
Emplmnt in Farm, Fishing, Forestry Occupation	20	25	30
Average Wage/Salary ($)	6,910	12,413	22,058
Zephyrhills South			
Total Persons		1,995	2,608
Emplmnt in Agri., Fishing, Min. Industry		34	21
Emplmnt in Farm, Fishing, Forestry Occupation		8	21
Average Wage/Salary ($)		11,462	18,133
Zephyrhills West			
Total Persons		3,698	4,249
Emplmnt in Agri., Fishing, Min. Industry		65	8
Emplmnt in Farm, Fishing, Forestry Occupation		38	21
Average Wage/Salary ($)		11,244	17,133

Hernando County

There are no deep channels into ports in Hernando County, and therefore, little fishing activity (e.g., no recreational for-hire boats). In 1996, 988,000 pounds of seafood was landed in the county. Coastal cities include Springhill and Bay Port.

Key Characteristics of Census-Defined Areas in Hernando County

	1970	1980	1990
Brookridge			
Total Persons		1,250	2,773
Emplmnt in Agri., Fishing, Min. Industry		7	0
Emplmnt in Farm, Fishing, Forestry Occupation		0	9
Average Wage/Salary ($)		7,940	12,719
Brooksville City			
Total Persons	4,060	5,582	7,427
Emplmnt in Agri., Fishing, Min. Industry	242	178	137
Emplmnt in Farm, Fishing, Forestry Occupation	80	59	78
Average Wage/Salary ($)	6,934	13,850	22,428
Hernando Beach			
Total Persons			1,749
Emplmnt in Agri., Fishing, Min. Industry			52
Emplmnt in Farm, Fishing, Forestry Occupation			18
Average Wage/Salary ($)			37,818
High Point			
Total Persons		1,707	2,846
Emplmnt in Agri., Fishing, Min. Industry		17	0
Emplmnt in Farm, Fishing, Forestry Occupation		17	0
Average Wage/Salary ($)		10,323	13,341
North Brooksville			
Total Persons		1,041	1,421
Emplmnt in Agri., Fishing, Min. Industry		21	59
Emplmnt in Farm, Fishing, Forestry Occupation		11	7
Average Wage/Salary ($)		12,166	23,178
Ridge Manor			
Total Persons		1,052	1,935
Emplmnt in Agri., Fishing, Min. Industry		14	9
Emplmnt in Farm, Fishing, Forestry Occupation		6	9
Average Wage/Salary ($)		14,418	25,469
South Brooksville			
Total Persons		1,231	1,637
Emplmnt in Agri., Fishing, Min. Industry		108	10
Emplmnt in Farm, Fishing, Forestry Occupation		63	10
Average Wage/Salary ($)		13,218	20,029
Spring Hill			
Total Persons		6,468	31,159
Emplmnt in Agri., Fishing, Min. Industry		43	248
Emplmnt in Farm, Fishing, Forestry Occupation		22	190
Average Wage/Salary ($)		10,764	23,880

Hernando County continued			
Timber Pines			
Total Persons			3,140
Emplmnt in Agri., Fishing, Min. Industry			0
Emplmnt in Farm, Fishing, Forestry Occupation			0
Average Wage/Salary ($)			18,923
Weeki Wachee City			
Total Persons		9	69
Emplmnt in Agri., Fishing, Min. Industry			0
Emplmnt in Farm, Fishing, Forestry Occupation			0
Average Wage/Salary ($)			16,301
Weeki Wachee Gardens			
Total Persons			1,181
Emplmnt in Agri., Fishing, Min. Industry			17
Emplmnt in Farm, Fishing, Forestry Occupation			9
Average Wage/Salary ($)			32,649

Citrus County

In 1993, commercial landings of fish in the county was valued at $6.4 million while spending for recreational fishing was estimated at $11.2 million (Bell, 1997). Since the county is mainly covered by wetlands and there is no major beach, tourism expenditures (except for recreational fishing) are negligible. In 1996, 4.1 MP of seafood was landed in the county. There are 58 recreational for-hire boats based in Citrus County, some of which fish offshore in the Middle Grounds. Crystal River is the principal port for both commercial and recreational fishing. Homosassa Springs caters to the private recreational fisherman with lodging and launching facilities. Both appear to be fishing communities.

Key Characteristics of Census-Defined Areas in Citrus County

	1970	1980	1990
Beverly Hills			
Total Persons		5,024	6,163
Emplmnt in Agri., Fishing, Min. Industry		46	27
Emplmnt in Farm, Fishing, Forestry Occupation		17	33
Average Wage/Salary ($)		8,895	14,958
Citrus Springs			
Total Persons		1,283	2,135
Emplmnt in Agri., Fishing, Min. Industry		15	10
Emplmnt in Farm, Fishing, Forestry Occupation		27	22
Average Wage/Salary ($)		10,131	23,130
Crystal River City			
Total Persons		2,878	4,044
Emplmnt in Agri., Fishing, Min. Industry		53	18
Emplmnt in Farm, Fishing, Forestry Occupation		30	13
Average Wage/Salary ($)		12,222	30,841
Floral City			
Total Persons		1,197	2,698
Emplmnt in Agri., Fishing, Min. Industry		31	28
Emplmnt in Farm, Fishing, Forestry Occupation		16	24
Average Wage/Salary ($)		17,968	18,583
Hernando			
Total Persons		1,630	2,066
Emplmnt in Agri., Fishing, Min. Industry		20	40
Emplmnt in Farm, Fishing, Forestry Occupation		11	52
Average Wage/Salary ($)		11,391	27,906
Homosassa			
Total Persons			2,170
Emplmnt in Agri., Fishing, Min. Industry			76
Emplmnt in Farm, Fishing, Forestry Occupation			58
Average Wage/Salary ($)			34,017
Homosassa Springs			
Total Persons		1,410	6,271
Emplmnt in Agri., Fishing, Min. Industry		34	135
Emplmnt in Farm, Fishing, Forestry Occupation		43	115
Average Wage/Salary ($)		13,113	20,731

Citrus County continued			
Inverness City			
Total Persons		4,095	5,797
Emplmnt in Agri., Fishing, Min. Industry		61	47
Emplmnt in Farm, Fishing, Forestry Occupation		39	57
Average Wage/Salary ($)		13,323	22,959
Lecanto			
Total Persons			1,309
Emplmnt in Agri., Fishing, Min. Industry			27
Emplmnt in Farm, Fishing, Forestry Occupation			34
Average Wage/Salary ($)			37,026
Sugarmill Woods			
Total Persons			4,016
Emplmnt in Agri., Fishing, Min. Industry			69
Emplmnt in Farm, Fishing, Forestry Occupation			44
Average Wage/Salary ($)			29,245

Levy County

In 1993, commercial landings of fish in the county were valued at $3.1 million while recreational fishing spending was estimated at $8.1 million (Bell, 1997). The absence of major beaches in the county, tourism expenditures related to beach activities are negligible. In 1996, 2.2 MP of seafood was landed in the county. There are 15 recreational for-hire boats based in Levy County, most of which probably operate out of Cedar Key. Commercial landings ports are Cedar Key and Yankeetown. Both appear to be fishing communities.

Key Characteristics of Census-Defined Areas in Levy County

	1970	1980	1990
Bronson Town			
Total Persons		882	878
Emplmnt in Agri., Fishing, Min. Industry		23	15
Emplmnt in Farm, Fishing, Forestry Occupation		13	17
Average Wage/Salary ($)		10,564	20,968
Cedar Key City			
Total Persons		671	682
Emplmnt in Agri., Fishing, Min. Industry		37	36
Emplmnt in Farm, Fishing, Forestry Occupation		44	36
Average Wage/Salary ($)		6,410	22,232
Chiefland City			
Total Persons		1,986	1,917
Emplmnt in Agri., Fishing, Min. Industry		41	41
Emplmnt in Farm, Fishing, Forestry Occupation		46	59
Average Wage/Salary ($)		17,357	19,339
Fanning Springs City			
Total Persons		296	475
Emplmnt in Agri., Fishing, Min. Industry		2	15
Emplmnt in Farm, Fishing, Forestry Occupation		2	13
Average Wage/Salary ($)		9,808	18,748
Inglis Town			
Total Persons		1,173	1,256
Emplmnt in Agri., Fishing, Min. Industry		29	30
Emplmnt in Farm, Fishing, Forestry Occupation		24	13
Average Wage/Salary ($)		14,551	22,083
Otter Creek Town			
Total Persons		164	128
Emplmnt in Agri., Fishing, Min. Industry		5	7
Emplmnt in Farm, Fishing, Forestry Occupation		7	5
Average Wage/Salary ($)		11,768	17,979
Williston City			
Total Persons		2,240	2,090
Emplmnt in Agri., Fishing, Min. Industry		53	56
Emplmnt in Farm, Fishing, Forestry Occupation		44	44
Average Wage/Salary ($)		11,350	23,619
Yankeetown Town			
Total Persons		3,168	620
Emplmnt in Agri., Fishing, Min. Industry		26	15
Emplmnt in Farm, Fishing, Forestry Occupation		12	17
Average Wage/Salary ($)		19,030	22,608

Dixie County

In 1993, the exvessel value of fish commercially landed was estimated at $2.1 million while recreational fishing spending was estimated at $5.2 million (Bell, 1997). Very much like Citrus and Levy counties, Dixie County is covered mainly by wetlands so that beach related tourist expenditures are negligible. In 1996, 1.3 MP of seafood was landed in the county. There are 20 recreational for-hire boats based in Dixie County. Ports at Steinhatchee, Suwannee, and Horseshoe Beach serve both commercial and recreational fishermen. All three ports appear to be fishing communities.

Key Characteristics of Census-Defined Areas in Dixie County

	1970	1980	1990
Cross City Town			
Total Persons		2,154	2,004
Emplmnt in Agri., Fishing, Min. Industry		18	15
Emplmnt in Farm, Fishing, Forestry Occupation		16	51
Average Wage/Salary ($)		11,226	23,632
Horseshoe Beach Town			
Total Persons		344	289
Emplmnt in Agri., Fishing, Min. Industry		42	39
Emplmnt in Farm, Fishing, Forestry Occupation		42	31
Average Wage/Salary ($)		14,219	24,689

Taylor County

In 1993, commercial fishing landings were valued at $1.3 million while recreational fishing spending was estimated at $7.3 million (Bell, 1997). Beach-related tourist expenditures are also negligible due to the absence of major beaches. In 1996, 900,000 pounds of seafood was landed in the county. There are 18 recreational for-hire boats based in Taylor County. The ports of Keaton Beach and Dekle Beach serve both recreational and commercial fishermen. Both appear to be fishing communities.

Key Characteristics of Census-Defined Areas in Taylor County

	1970	1980	1990
Perry City			
Total Persons	7,701	8,254	7,151
Emplmnt in Agri., Fishing, Min. Industry	49	48	65
Emplmnt in Farm, Fishing, Forestry Occupation	22	79	69
Average Wage/Salary ($)	7,922	17,160	27,344

Wakulla County

In 1993, the exvessel value of commercial fish landings was estimated at $2.8 million while recreational fishing spending was estimated at $5.9 million (Bell, 1997). The absence of major beaches constrains tourist spending on beach related activities to a negligible level. In 1996, 2.7 MP of seafood was landed in the county. There are 11 recreational for-hire boats based in Wakulla County. Principal ports are Panacea and St. Marks. Both appear to be fishing communities, serving both the commercial and recreational sectors.

Key Characteristics of Census-Defined Areas in Wakulla County

	1970	1980	1990
St. Marks City			
Total Persons		294	309
Emplmnt in Agri., Fishing, Min. Industry		14	12
Emplmnt in Farm, Fishing, Forestry Occupation		16	8
Average Wage/Salary ($)		14,526	26,879
Sopchoppy City			
Total Persons		463	391
Emplmnt in Agri., Fishing, Min. Industry		17	12
Emplmnt in Farm, Fishing, Forestry Occupation		19	12
Average Wage/Salary ($)		11,522	24,213

Franklin County

In 1993, commercial fish landings were valued at $12.3 million while recreational fishing spending amounted to $6.5 million (Bell, 1997). This county accounted for the largest value of commercial landings among the 13 counties from Citrus to Escambia. Beach-related tourist spending amounted to $0.7 million. Apalachicola Bay is the major oyster producing area in the state of Florida. In 1996, 6.8 MP of seafood was landed, and Apalachicola was the 47th leading port in the U.S. in terms of value of commercial seafood products landed ($14 million), with shrimp accounting for most of the value. Other commercial ports are East Point and Carrabelle. There are 34 recreational for-hire boats based in Franklin County, which operate principally out of Apalachicola. All three ports appear to be fishing communities.

Key Characteristics of Census-Defined Areas in Franklin County

	1970	1980	1990
Apalachicola City			
Total Persons	3,151	2,620	2,707
Emplmnt in Agri., Fishing, Min. Industry	219	219	48
Emplmnt in Farm, Fishing, Forestry Occupation	6	208	41
Average Wage/Salary ($)	4,523	10,931	20,780
Carrabelle City			
Total Persons		1,304	1,200
Emplmnt in Agri., Fishing, Min. Industry		79	64
Emplmnt in Farm, Fishing, Forestry Occupation		54	62
Average Wage/Salary ($)		11,070	19,422
Eastpoint			
Total Persons		1,267	1,650
Emplmnt in Agri., Fishing, Min. Industry		158	127
Emplmnt in Farm, Fishing, Forestry Occupation		185	141
Average Wage/Salary ($)		7,913	17,601

Gulf County

In 1993, commercial landings in the county were valued at $3.8 million, while recreational fishing spending was estimated at $3.7 million (Bell, 1997). Beach-related tourist spending was estimated at $2.5 million. In 1996, 3.8 MP of seafood was landed in the county. The principal coastal city is Port St. Joe, the economy of which was previously based on the manufacture of paper. However, the paper mill has closed, and Port St. Joe serves as a major landing port for commercial fish and should be considered a fishing community. There are 7 recreational for-hire vessels based in Gulf County.

Key Characteristics of Census-Defined Areas in Gulf County

	1970	1980	1990
Port St. Joe			
Total Persons	4,401	4,039	4,044
Emplmnt in Agri., Fishing, Min. Industry	43	18	42
Emplmnt in Farm, Fishing, Forestry Occupation	12	17	52
Average Wage/Salary ($)	7,995	16,527	26,979
Wewahitchka City			
Total Persons		1,742	1,779
Emplmnt in Agri., Fishing, Min. Industry		36	40
Emplmnt in Farm, Fishing, Forestry Occupation		30	31
Average Wage/Salary ($)		14,289	23,612

Bay County

In 1993, commercial landings in the county were valued at $6.7 million while recreational fishing spending was estimated at $11.0 million (Bell, 1997). Beach-related tourist spending was estimated at $59.6 million, the highest among counties in Northwest Florida. In 1996, 4.1 MP of seafood was landed in the county. There are 121 recreational for-hire boats based in Bay County. Most are based in the Panama City/Panama City Beach area and some in Mexico Beach. Panama City has historically been a major port for headboats and charter boats. Commercial fish and shrimp are principally landed in Panama City. Both Panama City and Mexico Beach appear to be a fishing communities.

Key Characteristics of Census-Defined Areas in Bay County

	1970	1980	1990
Callaway			
Total Persons	3,240	7,154	12,253
Emplmnt in Agri., Fishing, Min. Industry	15	33	77
Emplmnt in Farm, Fishing, Forestry Occupation	0	38	58
Average Wage/Salary ($)	7,547	16,255	27,004
Cedar Grove Town			
Total Persons		1,104	1,479
Emplmnt in Agri., Fishing, Min. Industry		8	16
Emplmnt in Farm, Fishing, Forestry Occupation		8	16
Average Wage/Salary ($)		13,878	21,349
Hiland Park			
Total Persons	3,677	4,763	3,865
Emplmnt in Agri., Fishing, Min. Industry	6	24	35
Emplmnt in Farm, Fishing, Forestry Occupation	0	21	39
Average Wage/Salary ($)	7,656	13,662	21,510
Laguna Beach			
Total Persons			1,700
Emplmnt in Agri., Fishing, Min. Industry			24
Emplmnt in Farm, Fishing, Forestry Occupation			24
Average Wage/Salary ($)			25,577
Lower Grand Lagoon			
Total Persons		1,616	3,388
Emplmnt in Agri., Fishing, Min. Industry		7	17
Emplmnt in Farm, Fishing, Forestry Occupation		32	27
Average Wage/Salary ($)		13,170	28,556
Lynn Haven City			
Total Persons	4,044	6,239	9,298
Emplmnt in Agri., Fishing, Min. Industry	27	28	74
Emplmnt in Farm, Fishing, Forestry Occupation	0	45	68
Average Wage/Salary ($)	7,565	16,253	31,338
Mexico Beach City			
Total Persons		573	992
Emplmnt in Agri., Fishing, Min. Industry		2	13
Emplmnt in Farm, Fishing, Forestry Occupation		0	13
Average Wage/Salary ($)		14,718	24,477

Bay County continued			
Panama City			
Total Persons	32,125	33,346	34,378
Emplmnt in Agri., Fishing, Min. Industry	182	286	230
Emplmnt in Farm, Fishing, Forestry Occupation	38	265	218
Average Wage/Salary ($)	7,236	13,995	27,506
Parker City			
Total Persons	4,212	4,298	4,598
Emplmnt in Agri., Fishing, Min. Industry	13	20	13
Emplmnt in Farm, Fishing, Forestry Occupation	0	28	27
Average Wage/Salary ($)	7,972	14,719	24,691
Pretty Bayou			
Total Persons		3,340	3,839
Emplmnt in Agri., Fishing, Min. Industry		34	22
Emplmnt in Farm, Fishing, Forestry Occupation		26	19
Average Wage/Salary ($)		20,871	38,524
Springfield City			
Total Persons		7,220	8,715
Emplmnt in Agri., Fishing, Min. Industry		43	91
Emplmnt in Farm, Fishing, Forestry Occupation		34	133
Average Wage/Salary ($)		13,221	22,295
Tyndall AFB			
Total Persons	4,338	4,601	4,318
Emplmnt in Agri., Fishing, Min. Industry	0	0	9
Emplmnt in Farm, Fishing, Forestry Occupation	0	5	13
Average Wage/Salary ($)	8,388	13,720	25,075
Upper Grand Lagoon			
Total Persons		3,317	7,796
Emplmnt in Agri., Fishing, Min. Industry		48	74
Emplmnt in Farm, Fishing, Forestry Occupation		29	73
Average Wage/Salary ($)		10,978	37,351

Walton County

In 1993, commercial landings in the county were valued at $0.1 million while recreational fishing spending was estimated at $1.5 million (Bell, 1997). Beach-related tourist spending was estimated at $5.6 million. In 1996, 123,000 pounds of seafood was landed in the county. There is one recreational for-hire vessel based in Walton County. Santa Rosa Beach and Grayton Beach are very small communities that appear to principally cater to persons engaging in swimming and other water sports.

Key Characteristics of Census-Defined Areas in Walton County

	1970	1980	1990
De Funiak Springs City			
Total Persons	4,966	5,563	5,120
Emplmnt in Agri., Fishing, Min. Industry	51	68	165
Emplmnt in Farm, Fishing, Forestry Occupation	21	74	65
Average Wage/Salary ($)	6,317	11,594	21,026
Freeport City			
Total Persons		683	848
Emplmnt in Agri., Fishing, Min. Industry		11	5
Emplmnt in Farm, Fishing, Forestry Occupation		11	10
Average Wage/Salary ($)		14,930	20,670
Miramar Beach			
Total Persons			1,639
Emplmnt in Agri., Fishing, Min. Industry			0
Emplmnt in Farm, Fishing, Forestry Occupation			9
Average Wage/Salary ($)			39,289
Paxton Town			
Total Persons		645	585
Emplmnt in Agri., Fishing, Min. Industry		10	18
Emplmnt in Farm, Fishing, Forestry Occupation		10	15
Average Wage/Salary ($)		10,584	19,556

Okaloosa County

In 1993, commercial landings in the county were valued at $6.0 million, while 1998 recreational fishing and beach-related spendings were, respectively, estimated at $10.2 million and $21.3 million (Bell, 1998). In 1996, 206 MP of seafood were landed in the county. There are 120 recreational for-hire vessels based in Okaloosa County that fish out of Destin. Destin has historically been a major port for headboats and charter boats fishing offshore. The Destin area continues its reliance on the fishing industry as a key element in the county's growing focus on the tourism segment.

A 1998 study was conducted to estimate the economic impacts of Destin Harbor to Okaloosa and Walton Counties using aggregated and annualized inputs from the business activities of charterboats and commercial fishing boats, real estate, tourism, and tournament visitors, salaries and wages, and private boats (Kastro 1998). These business activities were estimated to generate an annual economic impact of $125 million to Okaloosa and Walton Counties.

Key Characteristics of Census-Defined Areas in Okaloosa County

	1970	1980	1990
Cinco Bayou Town			
Total Persons		205	325
Emplmnt in Agri., Fishing, Min. Industry		0	5
Emplmnt in Farm, Fishing, Forestry Occupation		2	2
Average Wage/Salary ($)		10,843	21,518
Crestview City			
Total Persons	7,952	7,617	9,886
Emplmnt in Agri., Fishing, Min. Industry	25	99	137
Emplmnt in Farm, Fishing, Forestry Occupation	20	77	48
Average Wage/Salary ($)	6,895	14,115	22,498
Destin City			
Total Persons		3,689	8,080
Emplmnt in Agri., Fishing, Min. Industry		101	178
Emplmnt in Farm, Fishing, Forestry Occupation		83	194
Average Wage/Salary ($)		18,768	37,279
Eglin AFB			
Total Persons	7,769	7,574	8,347
Emplmnt in Agri., Fishing, Min. Industry	0	5	7
Emplmnt in Farm, Fishing, Forestry Occupation	0	5	7
Average Wage/Salary ($)	8,793	12,774	24,142
Fort Walton Beach City			
Total Persons	19,994	20,871	21,468
Emplmnt in Agri., Fishing, Min. Industry	97	106	108
Emplmnt in Farm, Fishing, Forestry Occupation	29	111	128
Average Wage/Salary ($)	9,450	16,999	29,028
Lake Lorraine			
Total Persons		5,418	6,777
Emplmnt in Agri., Fishing, Min. Industry		23	37
Emplmnt in Farm, Fishing, Forestry Occupation		12	22
Average Wage/Salary ($)		19,398	31,451

Okaloosa County continued			
Laurel Hill City			
Total Persons		681	569
Emplmnt in Agri., Fishing, Min. Industry		13	15
Emplmnt in Farm, Fishing, Forestry Occupation		4	15
Average Wage/Salary ($)		10,262	18,048
Mary Esther City			
Total Persons	3,137	3,530	4,139
Emplmnt in Agri., Fishing, Min. Industry	10	29	18
Emplmnt in Farm, Fishing, Forestry Occupation	7	7	33
Average Wage/Salary ($)	8,040	15,815	34,821
Niceville City			
Total Persons		8,543	10,507
Emplmnt in Agri., Fishing, Min. Industry		73	48
Emplmnt in Farm, Fishing, Forestry Occupation		35	52
Average Wage/Salary ($)		16,539	32,107
Ocean City			
Total Persons	5,267	5,582	5,422
Emplmnt in Agri., Fishing, Min. Industry	10	24	44
Emplmnt in Farm, Fishing, Forestry Occupation	10	7	46
Average Wage/Salary ($)	8,278	15,255	29,354
Shalimar Town			
Total Persons		399	343
Emplmnt in Agri., Fishing, Min. Industry		7	0
Emplmnt in Farm, Fishing, Forestry Occupation		3	0
Average Wage/Salary ($)		18,169	40,193
Valparaiso City			
Total Persons	6,504	6,142	4,672
Emplmnt in Agri., Fishing, Min. Industry	3	46	13
Emplmnt in Farm, Fishing, Forestry Occupation	3	39	14
Average Wage/Salary ($)	8,035	17,885	28,864
Wright			
Total Persons		13,011	18,945
Emplmnt in Agri., Fishing, Min. Industry		39	115
Emplmnt in Farm, Fishing, Forestry Occupation		49	110
Average Wage/Salary ($)		14,559	27,826

Santa Rosa County

In 1993, commercial landings in the county were valued at $1.2 million while recreational fishing spending was estimated at $5.1 million (Bell, 1997). Beach-related tourist spending was estimated at $22.4 million. In 1996, 350,000 pounds of seafood was landed in the county. There are six recreational for-hire vessels based in Santa Rosa County. The coastal communities are Navarre and Navarre Beach.

Key Characteristics of Census-Defined Areas in Santa Rosa County

	1970	1980	1990
Baghdad			
Total Persons		1,489	1,416
Emplmnt in Agri., Fishing, Min. Industry		0	5
Emplmnt in Farm, Fishing, Forestry Occupation		0	5
Average Wage/Salary ($)		12,847	24,076
Gulf Breeze City			
Total Persons	4,190	5,478	5,530
Emplmnt in Agri., Fishing, Min. Industry	12	28	75
Emplmnt in Farm, Fishing, Forestry Occupation	12	27	34
Average Wage/Salary ($)	12,950	22,829	46,724
Jay Town			
Total Persons		636	667
Emplmnt in Agri., Fishing, Min. Industry		17	16
Emplmnt in Farm, Fishing, Forestry Occupation		6	11
Average Wage/Salary ($)		13,920	24,580
Milton City			
Total Persons	5,360	7,206	7,216
Emplmnt in Agri., Fishing, Min. Industry	20	67	63
Emplmnt in Farm, Fishing, Forestry Occupation	0	6	42
Average Wage/Salary ($)	8,015	15,259	22,654
Pace			
Total Persons			6,318
Emplmnt in Agri., Fishing, Min. Industry			47
Emplmnt in Farm, Fishing, Forestry Occupation			45
Average Wage/Salary ($)			29,396

Escambia County

In 1993, commercial landings in the county were valued at $2.5 million while recreational fishing spending was estimated at $8.1 million (Bell, 1997). Beach-related tourist spending was estimated at $22.4 million. In 1996, 1.5 MP of seafood was landed in the county. There are 45 recreational for-hire boats based in Escambia County, most of which fish out of Pensacola. Pensacola Beach appears to cater principally to persons using the beaches. Pensacola is also a commercial landings port for shrimp and finfish. The economy was previously largely based on the U.S. Naval Air Station, but appears more diversified in recent years.

Key Characteristics of Census-Defined Areas in Escambia County

	1970	1980	1990
Bellview			
Total Persons		15,439	19,386
Emplmnt in Agri., Fishing, Min. Industry		138	67
Emplmnt in Farm, Fishing, Forestry Occupation		36	47
Average Wage/Salary ($)		17,495	28,851
Brent			
Total Persons		21,872	21,624
Emplmnt in Agri., Fishing, Min. Industry		92	169
Emplmnt in Farm, Fishing, Forestry Occupation		62	204
Average Wage/Salary ($)		15,406	24,190
Century Town			
Total Persons		520	2,202
Emplmnt in Agri., Fishing, Min. Industry		12	44
Emplmnt in Farm, Fishing, Forestry Occupation		8	21
Average Wage/Salary ($)		11,696	18,629
Ensley			
Total Persons		14,422	16,362
Emplmnt in Agri., Fishing, Min. Industry		95	80
Emplmnt in Farm, Fishing, Forestry Occupation		26	80
Average Wage/Salary ($)		16,735	26,099
Ferry Pass			
Total Persons		16,910	26,301
Emplmnt in Agri., Fishing, Min. Industry		60	123
Emplmnt in Farm, Fishing, Forestry Occupation		53	111
Average Wage/Salary ($)		18,368	31,555
Gonzalez			
Total Persons		6,084	7,669
Emplmnt in Agri., Fishing, Min. Industry		73	27
Emplmnt in Farm, Fishing, Forestry Occupation		40	8
Average Wage/Salary ($)		19,237	37,084
Goulding			
Total Persons		5,352	4,159
Emplmnt in Agri., Fishing, Min. Industry		8	16
Emplmnt in Farm, Fishing, Forestry Occupation		38	16
Average Wage/Salary ($)		12,145	15,591

Escambia County continued			
Molino			
Total Persons		1,456	1,173
Emplmnt in Agri., Fishing, Min. Industry		20	16
Emplmnt in Farm, Fishing, Forestry Occupation		17	7
Average Wage/Salary ($)		16,749	27,940
Myrtle Grove			
Total Persons	16,261	14,238	17,402
Emplmnt in Agri., Fishing, Min. Industry	37	11	147
Emplmnt in Farm, Fishing, Forestry Occupation	27	25	83
Average Wage/Salary ($)	8,697	17,768	25,412
Pensacola City			
Total Persons	59,571	57,619	58,165
Emplmnt in Agri., Fishing, Min. Industry	270	311	241
Emplmnt in Farm, Fishing, Forestry Occupation	130	231	220
Average Wage/Salary ($)	8,102	17,353	33,464
Warrington			
Total Persons	15,824	15,792	16,040
Emplmnt in Agri., Fishing, Min. Industry	56	74	165
Emplmnt in Farm, Fishing, Forestry Occupation	15	77	115
Average Wage/Salary ($)	7,402	14,962	24,420
West Pensacola			
Total Persons		24,371	22,107
Emplmnt in Agri., Fishing, Min. Industry		141	127
Emplmnt in Farm, Fishing, Forestry Occupation		124	133
Average Wage/Salary ($)		13,938	21,267

9.2.2 Alabama Fishing Communities

In 1996, Alabama commercial landings were about 27 million pounds, valued at about $38 million ex-vessel. About 260,000 persons participated in marine recreational fishing (NMFS 1997). Saltwater angler expenditures in 1996 were estimated at $0.12 billion, generating a total output of $0.24 billion, total income of $0.07 billion, and total employment of 4,084 (ASFA, 1997).

Baldwin County

In 1996, 3.8 MP of seafood was landed in the county. There are 115 recreational for-hire vessels based in Baldwin County that principally operate out of Orange Beach. The Alabama Gulf Coast Convention and Visitors Bureau (1998) estimates the boats carry about 84,000 passengers each year and contribute about $60 million to the local economy through expenditures related to these trips. Principal cities for recreational fishing activity include Orange Beach, Gulf Shores, Fairhope, and Daphne. Principal commercial landings ports include Bon Secour and Gulf Shores. Orange Beach and Bon Secour appear to be fishing communities.

Key Characteristics of Census-Defined Areas in Baldwin County

	1970	1980	1990
Bay Minette City			
Total Persons	6,727	74,455	7,168
Emplmnt in Agri., Fishing, Min. Industry	68	46	23
Emplmnt in Farm, Fishing, Forestry Occupation	51	39	35
Average Wage/Salary ($)	7,393	15,235	24,640
Daphne City			
Total Persons		3,406	11,290
Emplmnt in Agri., Fishing, Min. Industry		33	116
Emplmnt in Farm, Fishing, Forestry Occupation		25	107
Average Wage/Salary ($)		20,136	40,821
Elberta Town			
Total Persons		490	490
Emplmnt in Agri., Fishing, Min. Industry		14	26
Emplmnt in Farm, Fishing, Forestry Occupation		10	22
Average Wage/Salary ($)		11,611	23,003
Fairhope City			
Total Persons	5,720	7,299	8,555
Emplmnt in Agri., Fishing, Min. Industry	17	49	99
Emplmnt in Farm, Fishing, Forestry Occupation	17	45	85
Average Wage/Salary ($)	7,719	16,988	32,870
Foley City			
Total Persons	3,368	4,003	4,937
Emplmnt in Agri., Fishing, Min. Industry	76	75	61
Emplmnt in Farm, Fishing, Forestry Occupation	41	65	95
Average Wage/Salary ($)	6,969	15,497	22,439

Baldwin County continued			
Gulf Shores City			
Total Persons		1,349	3,029
Emplmnt in Agri., Fishing, Min. Industry		23	43
Emplmnt in Farm, Fishing, Forestry Occupation		23	18
Average Wage/Salary ($)		14,893	34,149
Loxley Town			
Total Persons		804	1,167
Emplmnt in Agri., Fishing, Min. Industry		16	23
Emplmnt in Farm, Fishing, Forestry Occupation		7	17
Average Wage/Salary ($)		13,746	25,322
Orange Beach Town			
Total Persons			2,253
Emplmnt in Agri., Fishing, Min. Industry			31
Emplmnt in Farm, Fishing, Forestry Occupation			40
Average Wage/Salary ($)			31,243
Point Clear			
Total Persons		1,799	2,055
Emplmnt in Agri., Fishing, Min. Industry		19	0
Emplmnt in Farm, Fishing, Forestry Occupation		36	20
Average Wage/Salary ($)		16,073	26,397
Robertsdale City			
Total Persons		2,306	2,404
Emplmnt in Agri., Fishing, Min. Industry		44	36
Emplmnt in Farm, Fishing, Forestry Occupation		42	30
Average Wage/Salary ($)		15,270	24,200
Silverhill Town			
Total Persons		612	553
Emplmnt in Agri., Fishing, Min. Industry		6	8
Emplmnt in Farm, Fishing, Forestry Occupation		2	7
Average Wage/Salary ($)		15,651	26,046
Spanish Fort			
Total Persons		3,415	3,732
Emplmnt in Agri., Fishing, Min. Industry		11	7
Emplmnt in Farm, Fishing, Forestry Occupation		13	7
Average Wage/Salary ($)		22,368	37,917
Summerdale Town			
Total Persons		558	553
Emplmnt in Agri., Fishing, Min. Industry		20	6
Emplmnt in Farm, Fishing, Forestry Occupation		20	3
Average Wage/Salary ($)		14,433	22,564

Mobile County

There are seven recreational for-hire vessels based in Mobile County which operate out of Dauphin Island. Dauphin Island is also a major launching site for private recreational fishing boats from Mobile County and the city of Mobile. In 1996, Bayou La Batre was the 20th leading port in the U.S. in terms of value of commercial seafood products landed ($29 million) and the 45th leading port in terms of pounds landed (20 MP). Bayou La Batre and Coden are major processing centers for shellfish (shrimp, crabs, and oysters). Bayou La Batre, Coden, and Dauphin Island appear to be fishing communities.

Key Characteristics of Census-Defined Areas in Mobile County

	1970	1980	1990
Bayou La Batre City			
Total Persons	2,664	1,990	2,456
Emplmnt in Agri., Fishing, Min. Industry	248	125	115
Emplmnt in Farm, Fishing, Forestry Occupation	10	64	72
Average Wage/Salary ($)	6,217	15,763	21,757
Chickasaw City			
Total Emplmnt	8,296	7,402	6,649
Emplmnt in Agri., Fishing, Min. Industry	0	62	10
Emplmnt in Farm, Fishing, Forestry Occupation	0	34	5
Average Wage/Salary ($)	9,461	17,763	27,887
Citronelle City			
Total Persons		2,841	3,671
Emplmnt in Agri., Fishing, Min. Industry		71	45
Emplmnt in Farm, Fishing, Forestry Occupation		4	8
Average Wage/Salary ($)		16,557	29,974
Creola City			
Total Persons		1,708	1,896
Emplmnt in Agri., Fishing, Min. Industry		10	9
Emplmnt in Farm, Fishing, Forestry Occupation		0	10
Average Wage/Salary ($)		18,166	27,820
Dauphin Island Town			
Total Persons			824
Emplmnt in Agri., Fishing, Min. Industry			17
Emplmnt in Farm, Fishing, Forestry Occupation			26
Average Wage/Salary ($)			31,751
Grand Bay			
Total Persons		3,185	3,383
Emplmnt in Agri., Fishing, Min. Industry		54	21
Emplmnt in Farm, Fishing, Forestry Occupation		36	24
Average Wage/Salary ($)		20,008	31,692
Mobile City			
Total Persons	189,986	200,396	196,278
Emplmnt in Agri., Fishing, Min. Industry	698	1,126	825
Emplmnt in Farm, Fishing, Forestry Occupation	312	17,704	30,902
Average Wage/Salary ($)	8,162	17,704	30,902

Mobile County continued			
Mount Vernon Town			
Total Persons		1,038	911
Emplmnt in Agri., Fishing, Min. Industry		6	0
Emplmnt in Farm, Fishing, Forestry Occupation		5	0
Average Wage/Salary ($)		16,325	30,951
Prichard City			
Total Persons	41,644	39,518	34,311
Emplmnt in Agri., Fishing, Min. Industry	231	223	162
Emplmnt in Farm, Fishing, Forestry Occupation	170	206	210
Average Wage/Salary ($)	6,414	12,298	20,067
Saraland City			
Total Persons	7,788	9,833	11,751
Emplmnt in Agri., Fishing, Min. Industry	45	73	60
Emplmnt in Farm, Fishing, Forestry Occupation	5	47	22
Average Wage/Salary ($)	9,584	20,640	32,210
Satsuma City			
Total Persons		3,822	5,194
Emplmnt in Agri., Fishing, Min. Industry		10	47
Emplmnt in Farm, Fishing, Forestry Occupation		10	39
Average Wage/Salary ($)		21,754	37,191
Theodore			
Total Persons		6,392	6,509
Emplmnt in Agri., Fishing, Min. Industry		115	167
Emplmnt in Farm, Fishing, Forestry Occupation		110	96
Average Wage/Salary ($)		16,188	25,774
Tillmans Corner			
Total Persons		15,941	17,988
Emplmnt in Agri., Fishing, Min. Industry		140	145
Emplmnt in Farm, Fishing, Forestry Occupation		97	126
Average Wage/Salary ($)		19,782	31,860
Wilmer Town			
Total Persons		604	494
Emplmnt in Agri., Fishing, Min. Industry		14	16
Emplmnt in Farm, Fishing, Forestry Occupation		12	8
Average Wage/Salary ($)		18,791	32,837

9.2.3 Mississippi Fishing Communities

In 1996, Mississippi commercial landings were about 177 million pounds, valued at about $33 million ex-vessel. About 230,000 persons participated in marine recreational fishing (NMFS 1997). Saltwater angler expenditures in 1996 were estimated at $0.16 billion, generating a total output of $0.29 billion, total income of $0.07 billion, and total employment of 3,988 (ASFA, 1997).

Jackson County

In 1996, Pascagoula-Moss Point was the 9th leading port in the U.S. in terms of commercial landings (148 MP). Coastal cities include Pascagoula, Moss Point, Gautier, and Ocean Springs. There are six recreational for-hire boats based in Jackson County. Moss Point, with its menhaden processing, is a fishing community. The economy of Pascagoula is primarily based on shipbuilding and also is a home port for the U.S. Navy.

Key Characteristics of Census-Defined Areas in Jackson County

	1970	1980	1990
Escatawpa			
Total Persons		5,367	3,902
Emplmnt in Agri., Fishing, Min. Industry		33	79
Emplmnt in Farm, Fishing, Forestry Occupation		37	33
Average Wage/Salary ($)		17,694	39,710
Gautier			
Total Persons		8,917	10,088
Emplmnt in Agri., Fishing, Min. Industry		83	83
Emplmnt in Farm, Fishing, Forestry Occupation		63	41
Average Wage/Salary ($)		18,475	33,564
Gulf Hills			
Total Persons		4,512	5,004
Emplmnt in Agri., Fishing, Min. Industry		36	39
Emplmnt in Farm, Fishing, Forestry Occupation		18	28
Average Wage/Salary ($)		19,427	33,534
Gulf Park Estates			
Total Persons			2,390
Emplmnt in Agri., Fishing, Min. Industry			20
Emplmnt in Farm, Fishing, Forestry Occupation			7
Average Wage/Salary ($)			30,750
Latimer			
Total Persons			3,243
Emplmnt in Agri., Fishing, Min. Industry			52
Emplmnt in Farm, Fishing, Forestry Occupation			54
Average Wage/Salary ($)			25,391
Matin Bluff			
Total Persons			1,852
Emplmnt in Agri., Fishing, Min. Industry			11
Emplmnt in Farm, Fishing, Forestry Occupation			5
Average Wage/Salary ($)			28,051

Jackson County continued			
Moss Point City			
Total Persons	19,308	18,998	17,837
Emplmnt in Agri., Fishing, Min. Industry	122	107	104
Emplmnt in Farm, Fishing, Forestry Occupation	17	161	101
Average Wage/Salary ($)	8,568	17,595	26,910
Ocean Springs City			
Total Persons	9,631	14,504	14,643
Emplmnt in Agri., Fishing, Min. Industry	46	84	148
Emplmnt in Farm, Fishing, Forestry Occupation	0	32	126
Average Wage/Salary ($)	8,983	18,680	33,609
Pascagoula City			
Total Persons	27,471	29,318	25,899
Emplmnt in Agri., Fishing, Min. Industry	85	217	167
Emplmnt in Farm, Fishing, Forestry Occupation	16	118	103
Average Wage/Salary ($)	9,348	18,424	32,186
St. Martin			
Total Persons			6,328
Emplmnt in Agri., Fishing, Min. Industry			35
Emplmnt in Farm, Fishing, Forestry Occupation			51
Average Wage/Salary ($)			31,019
Vancleave			
Total Persons		1,356	3,229
Emplmnt in Agri., Fishing, Min. Industry		12	18
Emplmnt in Farm, Fishing, Forestry Occupation		12	10
Average Wage/Salary ($)		15,169	27,523

Harrison County

Gulfport is the 40th leading port in the U.S. in terms of value of commercial seafood products landed ($18 million). There are 57 recreational for-hire boats based in Harrison County, most of which operate out of Biloxi. Coastal cities include Biloxi, Biloxi Beach, Gulfport, Long Beach, and Pass Christian. Biloxi remains a fishing community with a number of plants processing seafood harvested locally and trucked in from other states. However, gambling casinos are now the major contributors to the economy.

Key Characteristics of Census-Defined Areas in Harrison County

	1970	1980	1990
Biloxi City			
Total Persons	48,486	49,311	46,319
Emplmnt in Agri., Fishing, Min. Industry	205	305	341
Emplmnt in Farm, Fishing, Forestry Occupation	42	137	356
Average Wage/Salary ($)	6,434	14,424	24,427
D'Iberville City			
Total Persons	7,549	13,369	6,566
Emplmnt in Agri., Fishing, Min. Industry	24	152	56
Emplmnt in Farm, Fishing, Forestry Occupation	13	73	63
Average Wage/Salary ($)	7,481	15,801	25,456
Gulfport City			
Total Persons	40,787	39,676	40,775
Emplmnt in Agri., Fishing, Min. Industry	208	284	170
Emplmnt in Farm, Fishing, Forestry Occupation	36	179	121
Average Wage/Salary ($)	7,467	15,590	26,661
Long Beach City			
Total Persons	6,170	7,967	15,804
Emplmnt in Agri., Fishing, Min. Industry	20	64	95
Emplmnt in Farm, Fishing, Forestry Occupation	0	44	53
Average Wage/Salary ($)	8,715	16,866	33,156
Lyman			
Total Persons			1,034
Emplmnt in Agri., Fishing, Min. Industry			8
Emplmnt in Farm, Fishing, Forestry Occupation			8
Average Wage/Salary ($)			26,092
North Gulfport			
Total Persons		6,660	4,966
Emplmnt in Agri., Fishing, Min. Industry		30	5
Emplmnt in Farm, Fishing, Forestry Occupation		54	10
Average Wage/Salary ($)		10,688	19,376
Orange Grove			
Total Persons		13,476	15,676
Emplmnt in Agri., Fishing, Min. Industry		141	113
Emplmnt in Farm, Fishing, Forestry Occupation		32	63
Average Wage/Salary ($)		18,636	28,873

Harrison County continued			
Pass Christian City			
Total Persons	2,979	5,153	5,557
Emplmnt in Agri., Fishing, Min. Industry	47	59	66
Emplmnt in Farm, Fishing, Forestry Occupation	0	51	85
Average Wage/Salary ($)	8,560	17,009	27,944
Wool Market			
Total Persons			1,230
Emplmnt in Agri., Fishing, Min. Industry			0
Emplmnt in Farm, Fishing, Forestry Occupation			0
Average Wage/Salary ($)			25,475

Hancock County

There are five recreational for-hire boats based in Hancock County. Coastal cities include Bay St. Louis, Waveland, and Lakeshore. Oyster shucking is the primary seafood processing conducted in the county; additionally crabs and shrimp are harvested and sold locally.

Key Characteristics of Census-Defined Areas in Hancock County

	1970	1980	1990
Bay St. Louis City			
Total Persons	6,752	7,891	8,063
Emplmnt in Agri., Fishing, Min. Industry	73	51	57
Emplmnt in Farm, Fishing, Forestry Occupation	15	36	60
Average Wage/Salary ($)	7,940	15,756	27,584
Diamondhead			
Total Persons		982	2,761
Emplmnt in Agri., Fishing, Min. Industry		13	26
Emplmnt in Farm, Fishing, Forestry Occupation		5	7
Average Wage/Salary ($)		24,815	43,846
Kiln			
Total Persons			1,446
Emplmnt in Agri., Fishing, Min. Industry			17
Emplmnt in Farm, Fishing, Forestry Occupation			7
Average Wage/Salary ($)			29,996
Pearlington			
Total Persons			1,503
Emplmnt in Agri., Fishing, Min. Industry			36
Emplmnt in Farm, Fishing, Forestry Occupation			22
Average Wage/Salary ($)			33,923
Shoreline Park			
Total Persons			2,591
Emplmnt in Agri., Fishing, Min. Industry			26
Emplmnt in Farm, Fishing, Forestry Occupation			26
Average Wage/Salary ($)			21,242
Waveland City			
Total Persons	3,289	4,186	5,369
Emplmnt in Agri., Fishing, Min. Industry	19	35	113
Emplmnt in Farm, Fishing, Forestry Occupation	0	27	51
Average Wage/Salary ($)	7,473	16,044	25,329

9.2.4 Louisiana Fishing Communities

In 1996, Louisiana commercial landings were about 1.1 billion pounds valued at $293 million. About 74 percent of the Gulf commercial landings were in Louisiana ports. In 1996, commercial fishing (including marine finfish harvests, freshwater harvests, and marine shellfish harvests) generated sales of $2.1 billion, total output of $2.8 billion, and employment of 31,400 (Southwick Associates, 1997). About 493,000 persons participated in marine recreational fishing (NMFS 1997). Saltwater angler expenditures in 1996 were estimated at $0.21 billion, generating a total output of $0.40 billion, total income of $0.10 billion, and total employment of 5,627 (ASFA, 1997).

St. Tammany Parish

There are 19 recreational for-hire boats based in St. Tammany Parish. Cities with access to the estuarine water include Mandeville, Lacombe, and Slidell, all of which appear to be largely populated by persons employed in New Orleans.

Key Characteristics of Census-Defined Areas in St. Tammany Parish

	1970	1980	1990
Abita Springs Town			
Total Persons		1,072	1,296
Emplmnt in Agri., Fishing, Min. Industry		30	22
Emplmnt in Farm, Fishing, Forestry Occupation		5	12
Average Wage/Salary ($)		16,132	31,702
Covington City			
Total Persons	7,170	7,892	7,691
Emplmnt in Agri., Fishing, Min. Industry	87	111	149
Emplmnt in Farm, Fishing, Forestry Occupation	9	37	67
Average Wage/Salary ($)	7,730	17,299	35,259
Eden Isle			
Total Persons		444	3,768
Emplmnt in Agri., Fishing, Min. Industry		0	58
Emplmnt in Farm, Fishing, Forestry Occupation		2	31
Average Wage/Salary ($)		13,795	43,599
Folsom Village			
Total Persons		351	516
Emplmnt in Agri., Fishing, Min. Industry		27	6
Emplmnt in Farm, Fishing, Forestry Occupation		13	6
Average Wage/Salary ($)		14,831	19,409
Lacombe			
Total Persons		5,146	6,523
Emplmnt in Agri., Fishing, Min. Industry		113	80
Emplmnt in Farm, Fishing, Forestry Occupation		48	24
Average Wage/Salary ($)		20,050	28,335
Madisonville Town			
Total Persons		6,076	7,083
Emplmnt in Agri., Fishing, Min. Industry		145	239
Emplmnt in Farm, Fishing, Forestry Occupation		23	28
Average Wage/Salary ($)		22,630	39,669

St. Tammany Parish continued			
Mandeville City			
Total Persons		6,076	7,083
Emplmnt in Agri., Fishing, Min. Industry		145	239
Emplmnt in Farm, Fishing, Forestry Occupation		23	28
Average Wage/Salary ($)		22,630	39,669
Pearl River Town			
Total Persons		1,693	1,467
Emplmnt in Agri., Fishing, Min. Industry		11	21
Emplmnt in Farm, Fishing, Forestry Occupation		4	22
Average Wage/Salary ($)		17,056	22,772
Slidell City			
Total Persons	16,292	26,718	24,124
Emplmnt in Agri., Fishing, Min. Industry	163	678	468
Emplmnt in Farm, Fishing, Forestry Occupation	16	97	125
Average Wage/Salary ($)	10,437	24,544	37,719
Sun Village			
Total Persons		414	410
Emplmnt in Agri., Fishing, Min. Industry		24	8
Emplmnt in Farm, Fishing, Forestry Occupation		4	4
Average Wage/Salary ($)		16,507	24,823

Orleans Parish

There are 14 recreational for-hire boat based in Orleans Parish. Cities with access to riverine or estuarine waters include New Orleans. New Orleans is a major seafood processing and distribution center.

Key Characteristics of Census-Defined Areas in Orleans Parish

	1970	1980	1990
Total Persons	593,471	557,515	496,938
Emplmnt in Agri., Fishing, Min. Industry	4,940	6,719	4,505
Emplmnt in Farm, Fishing, Forestry Occupation	559	1,586	1,910
Average Wage/Salary ($)	7,906	17,374	29,734

St. Bernard Parish

There are 12 recreational for-hire boats based in St. Bernard Parish. Cities with access to riverine or estuarine waters include Shell Beach, Ysclaskey, Reggio, Hopeville, and Chalmette.

Key Characteristics of Census-Defined Areas in St. Bernard Parish

	1970	1980	1990
Arabi			
Total Persons		10,248	8,787
Emplmnt in Agri., Fishing, Min. Industry		71	33
Emplmnt in Farm, Fishing, Forestry Occupation		6	4
Average Wage/Salary ($)		20,855	28,906
Chalmette			
Total Persons		433	31,860
Emplmnt in Agri., Fishing, Min. Industry		17	293
Emplmnt in Farm, Fishing, Forestry Occupation		11	97
Average Wage/Salary ($)		11,410	30,839
Meraux			
Total Persons			8,849
Emplmnt in Agri., Fishing, Min. Industry			74
Emplmnt in Farm, Fishing, Forestry Occupation			23
Average Wage/Salary ($)			33,792
Poydras			
Total Persons		5,722	4,029
Emplmnt in Agri., Fishing, Min. Industry		129	44
Emplmnt in Farm, Fishing, Forestry Occupation		56	54
Average Wage/Salary ($)		17,901	24,359
Violet			
Total Persons		11,678	8,574
Emplmnt in Agri., Fishing, Min. Industry		113	142
Emplmnt in Farm, Fishing, Forestry Occupation		39	65
Average Wage/Salary ($)		18,250	26,642

St. Charles Parish

There are eight recreational for-hire boats based in St. Charles Parish. Des Allemands straddles the Lafourche/St. Charles Parish line. Most of it is in St. Charles Parish.

Key Characteristics of Census-Defined Areas in St. Charles Parish

	1970	1980	1990
Boutte			
Total Persons			2724
Emplmnt in Agri., Fishing, Min. Industry			34
Emplmnt in Farm, Fishing, Forestry Occupation			13
Average Wage/Salary ($)			28,148
Destrehan			
Total Persons		2,414	8,031
Emplmnt in Agri., Fishing, Min. Industry		49	117
Emplmnt in Farm, Fishing, Forestry Occupation		7	8
Average Wage/Salary ($)		27,458	50,292
Hahnville			
Total Persons		3,052	2,577
Emplmnt in Agri., Fishing, Min. Industry		56	0
Emplmnt in Farm, Fishing, Forestry Occupation		0	8
Average Wage/Salary ($)		21,656	28,329
Lone Star			
Total Persons		1,541	1,383
Emplmnt in Agri., Fishing, Min. Industry		45	7
Emplmnt in Farm, Fishing, Forestry Occupation		0	0
Average Wage/Salary ($)		29,497	36,802
Luling			
Total Persons	3,151	4,006	2,787
Emplmnt in Agri., Fishing, Min. Industry	18	5	6
Emplmnt in Farm, Fishing, Forestry Occupation	5	0	7
Average Wage/Salary ($)	9,399	21,854	31,436
Mimosa			
Total Persons			4,507
Emplmnt in Agri., Fishing, Min. Industry			34
Emplmnt in Farm, Fishing, Forestry Occupation			10
Average Wage/Salary ($)			46,467
New Sarpy			
Total Persons		2,217	2,946
Emplmnt in Agri., Fishing, Min. Industry		41	7
Emplmnt in Farm, Fishing, Forestry Occupation		4	16
Average Wage/Salary ($)		17,333	34,457
Norco			
Total Persons	4,789	4,416	3,385
Emplmnt in Agri., Fishing, Min. Industry	6	87	34
Emplmnt in Farm, Fishing, Forestry Occupation	6	5	12
Average Wage/Salary ($)	9,303	23,081	32,144
St. Rose			
Total Persons			6,259
Emplmnt in Agri., Fishing, Min. Industry			39
Emplmnt in Farm, Fishing, Forestry Occupation			16
Average Wage/Salary ($)			30,362

Plaquemines Parish

In 1996, Empire-Venice was the 2nd leading port in the U.S. in terms of pounds landed (317 MP) and the 8th leading port in the U.S. in terms of value of seafood landed ($45 million). There are 29 recreational for-hire boats based in Plaquemines Parish. The Empire-Venice-Buras area is a major launching and dockage area for recreational fishermen from New Orleans. All three ports appear to be fishing communities, although they are also major staging areas for support vessels and services for the oil and gas industry.

Key Characteristics of Census-Defined Areas in Plaquemines Parish

	1970	1980	1990
Belle Chase			
Total Persons		5,412	8,512
Emplmnt in Agri., Fishing, Min. Industry		223	233
Emplmnt in Farm, Fishing, Forestry Occupation		41	95
Average Wage/Salary ($)		23,175	34,477
Boothville-Venice			
Total Persons			2,699
Emplmnt in Agri., Fishing, Min. Industry			194
Emplmnt in Farm, Fishing, Forestry Occupation			104
Average Wage/Salary ($)			25,826
Buras-Triumph			
Total Persons	4,258	4,137	3,746
Emplmnt in Agri., Fishing, Min. Industry	459	461	382
Emplmnt in Farm, Fishing, Forestry Occupation	11	95	174
Average Wage/Salary ($)	8,971	21,576	27,980
Empire			
Total Persons	3,715		2,681
Emplmnt in Agri., Fishing, Min. Industry	0		224
Emplmnt in Farm, Fishing, Forestry Occupation	0		127
Average Wage/Salary ($)	8,337		23,618
Port Sulphur			
Total Persons	3,022	3,318	3,496
Emplmnt in Agri., Fishing, Min. Industry	322	357	190
Emplmnt in Farm, Fishing, Forestry Occupation	6	57	102
Average Wage/Salary ($)	8,609	19,051	27,167

Jefferson Parish

In 1996, Grand Isle was the 41st leading port in the U.S. in terms of value of seafood landed ($18 million) and the 54th leading port in the U.S. in terms of pounds landed (14 MP). Lafitte/Barataria is a very significant shrimp port. Westwego and Bucktown are small but significant centers of recreational and commercial fishing activity. There are 71 recreational for-hire boats based in Jefferson Parish. Grand Isle and Lafitte/Barataria are major launching areas for recreational boats and are fishing communities.

Key Characteristics of Census-Defined Areas in Jefferson Parish

	1970	1980	1990
Avondale			
Total Persons		6,699	5,813
Emplmnt in Agri., Fishing, Min. Industry		114	76
Emplmnt in Farm, Fishing, Forestry Occupation		20	67
Average Wage/Salary ($)		19,306	29,605
Barataria			
Total Persons		1,092	1,152
Emplmnt in Agri., Fishing, Min. Industry		112	119
Emplmnt in Farm, Fishing, Forestry Occupation		97	107
Average Wage/Salary ($)		15,302	19,787
Bridge City			
Total Persons			8,327
Emplmnt in Agri., Fishing, Min. Industry			95
Emplmnt in Farm, Fishing, Forestry Occupation			47
Average Wage/Salary ($)			23,794
Estelle			
Total Persons		12,724	14,091
Emplmnt in Agri., Fishing, Min. Industry		319	195
Emplmnt in Farm, Fishing, Forestry Occupation		29	26
Average Wage/Salary ($)		21,019	32,681
Grand Isle Town			
Total Persons		1,982	1,472
Emplmnt in Agri., Fishing, Min. Industry		166	82
Emplmnt in Farm, Fishing, Forestry Occupation		29	32
Average Wage/Salary ($)		17,410	23,624
Gretna City			
Total Persons	25,012	20,615	17,208
Emplmnt in Agri., Fishing, Min. Industry	508	540	195
Emplmnt in Farm, Fishing, Forestry Occupation	12	158	77
Average Wage/Salary ($)	8,329	16,882	22,943
Harahan City			
Total Persons	13,078	11,384	9,927
Emplmnt in Agri., Fishing, Min. Industry	187	153	114
Emplmnt in Farm, Fishing, Forestry Occupation	24	0	36
Average Wage/Salary ($)	10,315	23,967	36,037
Harvey			
Total Persons	6,200	22,709	21,222
Emplmnt in Agri., Fishing, Min. Industry	135	611	304
Emplmnt in Farm, Fishing, Forestry Occupation	0	37	60
Average Wage/Salary ($)	8,812	19,299	28,988
Jean Lafitte Town			
Total Persons		955	1,469
Emplmnt in Agri., Fishing, Min. Industry		57	59
Jefferson Parish continued			
Emplmnt in Farm, Fishing, Forestry Occupation		31	32
Average Wage/Salary ($)		23,655	25,504
Jefferson			
Total Persons		15,550	14,521

Emplmnt in Agri., Fishing, Min. Industry		254	177
Emplmnt in Farm, Fishing, Forestry Occupation		37	51
Average Wage/Salary ($)		17,664	28,491
Kenner City			
Total Persons	29,910	66,382	72,033
Emplmnt in Agri., Fishing, Min. Industry	274	953	906
Emplmnt in Farm, Fishing, Forestry Occupation	20	178	373
Average Wage/Salary ($)	9,203	22,057	35,666
Laffite			
Total Persons		1,324	1,498
Emplmnt in Agri., Fishing, Min. Industry		96	88
Emplmnt in Farm, Fishing, Forestry Occupation		72	49
Average Wage/Salary ($)		12,117	21,838
Marrero			
Total Persons	29,015	36,548	36,671
Emplmnt in Agri., Fishing, Min. Industry	612	685	450
Emplmnt in Farm, Fishing, Forestry Occupation	50	77	166
Average Wage/Salary ($)	8,721	19,634	28,239
Metairie			
Total Persons	134,796	164,160	149,428
Emplmnt in Agri., Fishing, Min. Industry	2,060	3,309	1,790
Emplmnt in Farm, Fishing, Forestry Occupation	112	303	460
Average Wage/Salary ($)	11,067	22,569	35,753
River Ridge			
Total Persons		17,146	14,800
Emplmnt in Agri., Fishing, Min. Industry		208	167
Emplmnt in Farm, Fishing, Forestry Occupation		56	48
Average Wage/Salary ($)		25,034	41,303
Terrytown			
Total Persons	13,823	23,548	23,787
Emplmnt in Agri., Fishing, Min. Industry	449	893	546
Emplmnt in Farm, Fishing, Forestry Occupation	0	38	64
Average Wage/Salary ($)	11,443	22,083	32,323
Timberlane			
Total Persons		11,579	12,614
Emplmnt in Agri., Fishing, Min. Industry		419	318
Emplmnt in Farm, Fishing, Forestry Occupation		34	74
Average Wage/Salary ($)		26,752	39,959
Waggaman			
Total Persons		9,004	9,405
Emplmnt in Agri., Fishing, Min. Industry		55	128
Emplmnt in Farm, Fishing, Forestry Occupation		15	103
Average Wage/Salary ($)		19,001	28,784
Westwego City			
Total Persons	11,386	12,663	11,218
Emplmnt in Agri., Fishing, Min. Industry	142	200	110
Emplmnt in Farm, Fishing, Forestry Occupation	18	87	71
Average Wage/Salary ($)	7,787	16,175	22,588

Lafourche Parish

In 1996, Golden Meadow-Leeville (including Port Forchon) was the 31st leading port in the U.S. in terms of value of seafood landed ($22 million) and the 52nd leading port in the U.S. in terms of pounds landed (14 MP). Both are fishing communities. Other cities on Bayou Lafourche include Galliano and Larose. There are 47 recreational for-hire boats based in Lafourche Parish. Most of these are likely guide boats. Des Allemands straddles the Lafourche/St. Charles Parish line. Most of it is in St. Charles Parish. Golden Meadow, Galliano, and Leeville are major centers of recreational fishing with a lot of launching, docking, and storage facilities. Leeville is becoming especially important.

Key Characteristics of Census-Defined Areas in Lafourche Parish

	1970	1980	1990
Chackbay			
Total Persons		33,847	2,250
Emplmnt in Agri., Fishing, Min. Industry		361	83
Emplmnt in Farm, Fishing, Forestry Occupation		78	40
Average Wage/Salary ($)		20,928	25,090
Cut Off			
Total Persons		5,049	5,325
Emplmnt in Agri., Fishing, Min. Industry		369	324
Emplmnt in Farm, Fishing, Forestry Occupation		66	88
Average Wage/Salary ($)		21,422	26,185
Des Allemands			
Total Persons		2,803	2,399
Emplmnt in Agri., Fishing, Min. Industry		131	85
Emplmnt in Farm, Fishing, Forestry Occupation		34	39
Average Wage/Salary ($)		19,410	26,491
Galiano			
Total Persons		5,159	4,294
Emplmnt in Agri., Fishing, Min. Industry		430	185
Emplmnt in Farm, Fishing, Forestry Occupation		214	68
Average Wage/Salary ($)		19,003	22,480
Golden Meadow Town			
Total Persons	2,681	2,282	2,049
Emplmnt in Agri., Fishing, Min. Industry	149	189	106
Emplmnt in Farm, Fishing, Forestry Occupation	0	59	22
Average Wage/Salary ($)	7,887	17,213	27,806
Larose			
Total Persons	4,399	5,234	5,772
Emplmnt in Agri., Fishing, Min. Industry	340	339	364
Emplmnt in Farm, Fishing, Forestry Occupation	7	89	103
Average Wage/Salary ($)	8,023	21,226	24,951

Lafourche Parish continued			
Lockport Town			
Total Persons		2,493	2,392
Emplmnt in Agri., Fishing, Min. Industry		101	50
Emplmnt in Farm, Fishing, Forestry Occupation		0	12
Average Wage/Salary ($)		22,959	23,782
Mathews			
Total Persons			2,930
Emplmnt in Agri., Fishing, Min. Industry			135
Emplmnt in Farm, Fishing, Forestry Occupation			0
Average Wage/Salary ($)			32,113
Raceland			
Total Persons	4,882	6,233	5,675
Emplmnt in Agri., Fishing, Min. Industry	207	187	237
Emplmnt in Farm, Fishing, Forestry Occupation	41	29	63
Average Wage/Salary ($)	8,393	18,969	29,492
Thibodaux			
Total Persons	14,922	15,810	14,035
Emplmnt in Agri., Fishing, Min. Industry	320	391	259
Emplmnt in Farm, Fishing, Forestry Occupation	24	62	87
Average Wage/Salary ($)	7,609	16,956	26,679

Terrebonne Parish

In 1996, Dulac-Chauvin was the 9th leading port in the U.S. in terms of value of seafood landed ($45 million) and the 27th leading port in terms of pounds landed (38 MP). There are 42 recreational for-hire boats based in Terrebonne Parish, most of which are probably guide boats. Both cities are primarily fishing communities, but also serve as oil and gas industry terminals. Both cities also serve as major launching and docking sites for recreational fishermen.

Key Characteristics of Census-Defined Areas in Terrebonne Parish

	1970	1980	1990
Bayou Cane			
Total Persons	9,144	15,723	15,876
Emplmnt in Agri., Fishing, Min. Industry	782	1,366	892
Emplmnt in Farm, Fishing, Forestry Occupation	7	41	45
Average Wage/Salary ($)	10,284	23,670	30,145
Chauvin			
Total Persons		3,338	3,375
Emplmnt in Agri., Fishing, Min. Industry		293	220
Emplmnt in Farm, Fishing, Forestry Occupation		42	65
Average Wage/Salary ($)		17,970	26,995
Dulac			
Total Persons		1,253	3,273
Emplmnt in Agri., Fishing, Min. Industry		58	195
Emplmnt in Farm, Fishing, Forestry Occupation		11	142
Average Wage/Salary ($)		17,843	16,423
Gray			
Total Persons			4,260
Emplmnt in Agri., Fishing, Min. Industry			185
Emplmnt in Farm, Fishing, Forestry Occupation			15
Average Wage/Salary ($)			22,536
Houma City			
Total Persons	30,893	32,608	30,495
Emplmnt in Agri., Fishing, Min. Industry	1,898	2,123	1,418
Emplmnt in Farm, Fishing, Forestry Occupation	27	157	130
Average Wage/Salary ($)	8,347	20,947	28,472
Montegut			
Total Persons			1,777
Emplmnt in Agri., Fishing, Min. Industry			110
Emplmnt in Farm, Fishing, Forestry Occupation			33
Average Wage/Salary ($)			25,944
Schriever			
Total Persons	22,557	15,113	4,958
Emplmnt in Agri., Fishing, Min. Industry	424	88	193
Emplmnt in Farm, Fishing, Forestry Occupation	148	54	49
Average Wage/Salary ($)	7,131	16,246	28,012

St. Mary Parish

In 1996, Morgan City-Berwick was the 7th leading port in the U.S. in terms of pounds landed (163 MP) and the 46th leading port in terms of value of seafood landed ($14 million). Three recreational for-hire vessels are registered in the parish. There are no real fishing communities in the parish; fishermen are scattered throughout all the cities and towns. Morgan City's economy appears to largely be based on oil and gas industry support services, although the city was a major fishing center. Offshore shrimp fishing originally developed from Morgan City.

Key Characteristics of Census-Defined Areas in St. Mary Parish

	1970	1980	1990
Amelia			
Total Persons		3,565	2,385
Emplmnt in Agri., Fishing, Min. Industry		209	66
Emplmnt in Farm, Fishing, Forestry Occupation		16	15
Average Wage/Salary ($)		20,581	23,394
Baldwin Town			
Total Persons		2,696	2,363
Emplmnt in Agri., Fishing, Min. Industry		129	79
Emplmnt in Farm, Fishing, Forestry Occupation		21	38
Average Wage/Salary ($)		19,863	26,566
Bayou Vista			
Total Persons	5,078	5,805	4,733
Emplmnt in Agri., Fishing, Min. Industry	369	328	205
Emplmnt in Farm, Fishing, Forestry Occupation	5	14	52
Average Wage/Salary ($)	10,348	22,474	23,500
Berwick Town			
Total Persons	4,168	4,466	4,437
Emplmnt in Agri., Fishing, Min. Industry	238	302	275
Emplmnt in Farm, Fishing, Forestry Occupation	0	40	69
Average Wage/Salary ($)	8,477	21,429	27,693
Charenton			
Total Persons			1,446
Emplmnt in Agri., Fishing, Min. Industry			96
Emplmnt in Farm, Fishing, Forestry Occupation			37
Average Wage/Salary ($)			20,178
Franklin City			
Total Persons	9,325	9,584	9,142
Emplmnt in Agri., Fishing, Min. Industry	322	357	239
Emplmnt in Farm, Fishing, Forestry Occupation	14	75	62
Average Wage/Salary ($)	7,459	16,710	25,778
Morgan City			
Total Persons	16,665	16,114	14,531
Emplmnt in Agri., Fishing, Min. Industry	767	786	441
Emplmnt in Farm, Fishing, Forestry Occupation	0	63	122
Average Wage/Salary ($)	8,671	22,804	28,448
Patterson City			
Total Persons	4,409	4,693	4,736
Emplmnt in Agri., Fishing, Min. Industry	294	273	227
Emplmnt in Farm, Fishing, Forestry Occupation	28	31	26
Average Wage/Salary ($)	7,963	20,248	23,949

Iberia Parish

In 1996, Delcambre was the 44th leading port in the U.S. in terms of value of seafood landed ($16 million). There are three recreational for-hire boats based in Iberia Parish. Delcambre is a fishing community.

Key Characteristics of Census-Defined Areas in Iberia Parish

	1970	1980	1990
Delcambre Town			
Total Persons		2,220	1,984
Emplmnt in Agri., Fishing, Min. Industry		180	126
Emplmnt in Farm, Fishing, Forestry Occupation		35	30
Average Wage/Salary ($)		18,397	22,728
Jeanerette City			
Total Persons	6,286	6,511	6,205
Emplmnt in Agri., Fishing, Min. Industry	256	251	269
Emplmnt in Farm, Fishing, Forestry Occupation	37	39	87
Average Wage/Salary ($)	6,527	19,237	23,870
Loreauville Village			
Total Persons		864	860
Emplmnt in Agri., Fishing, Min. Industry		67	31
Emplmnt in Farm, Fishing, Forestry Occupation		14	12
Average Wage/Salary ($)		17,410	26,829
Lydia			
Total Persons			1,236
Emplmnt in Agri., Fishing, Min. Industry			71
Emplmnt in Farm, Fishing, Forestry Occupation			8
Average Wage/Salary ($)			25,685
New Iberia City			
Total Persons	30,147	32,766	31,828
Emplmnt in Agri., Fishing, Min. Industry	1,563	1,894	1,331
Emplmnt in Farm, Fishing, Forestry Occupation	59	172	268
Average Wage/Salary ($)	7,477	18,777	25,417

Vermilion Parish

In 1996, Intercoastal City was the 6th leading port in the U.S. in terms of pounds landed (200 MP) and 59th in terms of value of seafood landed ($11 million). Intercoastal City appears to be a fishing community. There are two recreational for-hire vessels in the parish.

Key Characteristics of Census-Defined Areas in Vermilion Parish

	1970	1980	1990
Abbeville City			
Total Persons	10,996	12,391	11,187
Emplmnt in Agri., Fishing, Min. Industry	371	734	371
Emplmnt in Farm, Fishing, Forestry Occupation	33	62	111
Average Wage/Salary ($)	6,490	15,810	21,645
Erath Town			
Total Persons		2,133	2,428
Emplmnt in Agri., Fishing, Min. Industry		107	137
Emplmnt in Farm, Fishing, Forestry Occupation		11	21
Average Wage/Salary ($)		16,501	21,082
Gueydan Town			
Total Persons		1,695	1,611
Emplmnt in Agri., Fishing, Min. Industry		148	131
Emplmnt in Farm, Fishing, Forestry Occupation		34	41
Average Wage/Salary ($)		16,247	19,318
Kaplan City			
Total Persons	5,540	5,016	4,535
Emplmnt in Agri., Fishing, Min. Industry	281	180	161
Emplmnt in Farm, Fishing, Forestry Occupation	24	51	25
Average Wage/Salary ($)	6,216	11,525	19,851
Maurice Village			
Total Persons		470	430
Emplmnt in Agri., Fishing, Min. Industry		24	19
Emplmnt in Farm, Fishing, Forestry Occupation		9	2
Average Wage/Salary ($)		14,942	21,567

Cameron Parish

In 1996, Cameron was the 3rd leading port in the U.S. in terms of pounds landed (316 MP) and the 19th leading port in the U.S. in terms of value of seafood landed ($31 million). There are 26 recreational for-hire boats based in Cameron Parish. Cameron, Hackberry, and Grand Chenier appear to be fishing and farming communities.

Key Characteristics of Census-Defined Areas in Cameron Parish

	1970	1980	1990
Cameron			
Total Persons		1,732	2,003
Emplmnt in Agri., Fishing, Min. Industry		192	174
Emplmnt in Farm, Fishing, Forestry Occupation		110	89
Average Wage/Salary ($)		20,071	25,201
Hackberry			
Total Persons			1,702
Emplmnt in Agri., Fishing, Min. Industry			82
Emplmnt in Farm, Fishing, Forestry Occupation			38
Average Wage/Salary ($)			29,738

Calcasieu Parish

There are 25 recreational for-hire boats in Calcasieu Parish, most of which are probably guide boats. The principal city with access to water is Lake Charles.

Key Characteristics of Census-Defined Areas in Calcasieu Parish

	1970	1980	1990
Carlyss			
Total Persons		1,829	3,305
Emplmnt in Agri., Fishing, Min. Industry		92	30
Emplmnt in Farm, Fishing, Forestry Occupation		9	7
Average Wage/Salary ($)		22,733	30,957
De Quincy City			
Total Persons	3,448	3,966	3,474
Emplmnt in Agri., Fishing, Min. Industry	72	103	52
Emplmnt in Farm, Fishing, Forestry Occupation	0	15	29
Average Wage/Salary ($)	7,124	19,179	24,889
Iowa Town			
Total Persons		2,437	2,708
Emplmnt in Agri., Fishing, Min. Industry		98	82
Emplmnt in Farm, Fishing, Forestry Occupation		18	38
Average Wage/Salary ($)		18,101	27,851
Lake Charles City			
Total Persons	77,998	75,226	70,580
Emplmnt in Agri., Fishing, Min. Industry	1,095	2,019	788
Emplmnt in Farm, Fishing, Forestry Occupation	112	245	311
Average Wage/Salary ($)	8,316	19,361	29,427
Moss Bluff			
Total Persons		7,004	8,039
Emplmnt in Agri., Fishing, Min. Industry		222	225
Emplmnt in Farm, Fishing, Forestry Occupation		6	19
Average Wage/Salary ($)		25,165	38,582
Prien			
Total Persons		6,224	6,448
Emplmnt in Agri., Fishing, Min. Industry		178	120
Emplmnt in Farm, Fishing, Forestry Occupation		44	41
Average Wage/Salary ($)		24,422	39,517
Sulphur			
Total Persons	13,551	19,709	20,125
Emplmnt in Agri., Fishing, Min. Industry	223	479	261
Emplmnt in Farm, Fishing, Forestry Occupation	30	101	98
Average Wage/Salary ($)	9,076	23,348	33,001
Vinton Town			
Total Persons	3,286	3,631	3,154
Emplmnt in Agri., Fishing, Min. Industry	153	191	74
Emplmnt in Farm, Fishing, Forestry Occupation	28	58	26
Average Wage/Salary ($)	7,535	18,966	27,017
Westlake City			
Total Persons	4,082	5,246	5,007
Emplmnt in Agri., Fishing, Min. Industry	31	134	57
Emplmnt in Farm, Fishing, Forestry Occupation	0	8	19
Average Wage/Salary ($)	9,130	21,668	27,999

9.2.5 Texas Fishing Communities

In 1996, Texas commercial landings were about 88.5 million pounds with an exvessel value of $181.6 million (Dokken et al., 1998). Shrimp contributed 75 percent of landings and 85 percent of value. In

1996, about 860,000 persons participated in marine recreational fishing, made 10 million trips, and landed 10.9 MP of fish (Page Campbell, TPWD, pers. comm). Saltwater angler expenditures in 1996 were estimated at $0.89 billion, generating a total output of $1.99 billion, total income of $0.50 billion, and total employment of 24,802 (ASFA, 1997).

In 1996, the coastal counties in Texas, excluding Harris, Orange, and Victoria counties, had an estimated population of 1,547,007, representing 8.2 percent of the total population in Texas. In 1995, personal income for the region was about $26.1 million, representing 6.6 percent of total personal income in Texas (Dokken et al., 1998).

Jefferson County

In 1996, Port Arthur/Sabine Pass was the 23rd leading port in the U.S. in terms of value of seafood landed ($27 million) and the 58th leading port in terms of pounds landed (12 MP). Coastal cities include Sabine and Port Arthur. There are 10 recreational for-hire boats based in Jefferson County. Sabine Pass and Port Acres appear to be fishing communities.

In their socioeconomic study of Texas coastal counties, Dokken et al. (1998) reported that total population in Jefferson county grew from 239,397 in 1990 to 245,056 in 1996. The increase was accounted for by natural increases (births minus deaths) and international migration. Domestic migration was negative and largest among coastal counties. Per capita income in the county rose from $17,039 in 1990 to $20,459 in 1995. Fishery related employment (commercial fishing, seafood processing, wholesaling, retailing) decreased from 2,430 in 1990 to 2,234 in 1995, with the decrease occurring only in the commercial fishing industry. The authors also conducted a shift-share analysis[4] of employment for 1990 and 1995 using the Gulf of Mexico region, comprising the five coastal states, as the benchmark region. They found that this county had negative net relative shift in both fishery related and and non-fishery related industries, indicating that the county was growing less rapidly than the benchmark region.

[4]Shift share analysis is a technique used to measure the change in a region's performance relative to that of a benchmark region. In present case, employment prospects are the focus of analysis.

Key Characteristics of Census-Defined Areas in Jefferson County

	1970	1980	1990
Beaumont City			
Total Persons	115,965	118,102	114,323
Emplmnt in Agri., Fishing, Min. Industry	1,432	1,017	715
Emplmnt in Farm, Fishing, Forestry Occupation	189	385	430
Average Wage/Salary ($)	8,519	20,390	32,744
Bevil Oaks Town			
Total Persons		1,303	1,350
Emplmnt in Agri., Fishing, Min. Industry		14	6
Emplmnt in Farm, Fishing, Forestry Occupation		0	2
Average Wage/Salary ($)		29,932	46,366
Central Gardens			
Total Persons		14,692	4,026
Emplmnt in Agri., Fishing, Min. Industry		926	0
Emplmnt in Farm, Fishing, Forestry Occupation		68	0
Average Wage/Salary ($)		42,949	42,917
China City			
Total Persons		1,351	1,153
Emplmnt in Agri., Fishing, Min. Industry		72	41
Emplmnt in Farm, Fishing, Forestry Occupation		52	25
Average Wage/Salary ($)		19,140	26,883
Groves City			
Total Persons	18,076	17,090	16,513
Emplmnt in Agri., Fishing, Min. Industry	80	158	197
Emplmnt in Farm, Fishing, Forestry Occupation	0	51	67
Average Wage/Salary ($)	10,397	23,831	34,421
Nederland City			
Total Persons	16,812	16,855	16,192
Emplmnt in Agri., Fishing, Min. Industry	107	73	99
Emplmnt in Farm, Fishing, Forestry Occupation	23	12	34
Average Wage/Salary ($)	10,573	24,080	36,554
Nome City			
Total Persons		553	439
Emplmnt in Agri., Fishing, Min. Industry		41	23
Emplmnt in Farm, Fishing, Forestry Occupation		29	16
Average Wage/Salary ($)		17,339	28,111
Port Arthur City			
Total Persons	57,380	61,251	58,724
Emplmnt in Agri., Fishing, Min. Industry	441	590	587
Emplmnt in Farm, Fishing, Forestry Occupation	35	318	432
Average Wage/Salary ($)	7,927	18,713	26,424
Port Neches City			
Total Persons	10,874	13,944	12,974
Emplmnt in Agri., Fishing, Min. Industry	59	77	49
Emplmnt in Farm, Fishing, Forestry Occupation	0	15	27
Average Wage/Salary ($)	9,864	25,534	40,452

Orange County

In 1996, 368,000 pounds of seafood was landed in the county. There are 10 recreational for-hire boats based in Orange County. The coastal cities include Orange and Beaumont.

Key Characteristics of Census-Defined Areas in Orange County

	1970	1980	1990
Bridge City			
Total Persons	8,194	7,667	8,034
Emplmnt in Agri., Fishing, Min. Industry	88	69	57
Emplmnt in Farm, Fishing, Forestry Occupation	5	13	41
Average Wage/Salary ($)	10,006	24,386	33,582
Mauriceville			
Total Persons			2,082
Emplmnt in Agri., Fishing, Min. Industry			17
Emplmnt in Farm, Fishing, Forestry Occupation			17
Average Wage/Salary ($)			30,460
Orange City			
Total Persons	24,457	23,628	19,340
Emplmnt in Agri., Fishing, Min. Industry	140	107	107
Emplmnt in Farm, Fishing, Forestry Occupation	47	34	80
Average Wage/Salary ($)	8,760	20,560	30,171
Pine Forest City			
Total Persons		662	692
Emplmnt in Agri., Fishing, Min. Industry		12	7
Emplmnt in Farm, Fishing, Forestry Occupation		2	7
Average Wage/Salary ($)		20,354	29,675
Pinehurst City			
Total Persons		3,055	2,723
Emplmnt in Agri., Fishing, Min. Industry		22	16
Emplmnt in Farm, Fishing, Forestry Occupation		12	0
Average Wage/Salary ($)		20,357	26,124
Rose City			
Total Persons		737	573
Emplmnt in Agri., Fishing, Min. Industry		6	12
Emplmnt in Farm, Fishing, Forestry Occupation		5	10
Average Wage/Salary ($)		16,851	24,383
Vidor City			
Total Persons	9,741	12,043	10,934
Emplmnt in Agri., Fishing, Min. Industry	44	120	88
Emplmnt in Farm, Fishing, Forestry Occupation	0	17	33
Average Wage/Salary ($)	8,971	20,558	30,612
West Orange City			
Total Persons	4,858	4,610	4,187
Emplmnt in Agri., Fishing, Min. Industry	38	24	42
Emplmnt in Farm, Fishing, Forestry Occupation	0	0	18
Average Wage/Salary ($)	9,798	21,012	28,792

Chambers County

In 1996, 3.3 MP of seafood was landed in the county. There is one recreational for-hire boat based in Chambers County. Anahuac is the principal coastal city. South Port, Oak Island, and Crystal Beach are fishing communities.

In their socioeconomic study of Texas coastal counties, Dokken et al. (1998) reported that total population in Chambers county grew from 20,088 in 1990 to 22,131 in 1996. The increase was accounted for by natural increases (births minus deaths), international migration, and domestic migration. Per capita income in the county rose from $15,234 in 1990 to $19,170 in 1995. Fishery related employment (commercial fishing, seafood processing, wholesaling, retailing) decreased from 520 in 1990 to 429 in 1995, with the decrease occurring in the commercial fishing and wholesaling industries. The authors also conducted a shift-share analysis of employment for 1990 and 1995 using the Gulf of Mexico region, comprising the five coastal states, as the benchmark region. They found that this county had negative net relative shift in fishery related industries and positive net relative shift in non-fishery related industries, indicating that the county was growing less rapidly in fishery related industries and more rapidly in non-fishery related industries than the benchmark region.

Key Characteristics of Census-Defined Areas in Chambers County

	1970	1980	1990
Anahuac City			
Total Persons		1,840	1,993
Emplmnt in Agri., Fishing, Min. Industry		85	58
Emplmnt in Farm, Fishing, Forestry Occupation		38	33
Average Wage/Salary ($)		19,431	29,501
Beach City			
Total Persons		964	850
Emplmnt in Agri., Fishing, Min. Industry		15	7
Emplmnt in Farm, Fishing, Forestry Occupation		11	0
Average Wage/Salary ($)		21,376	45,738
Cove Town			
Total Persons		658	416
Emplmnt in Agri., Fishing, Min. Industry		15	10
Emplmnt in Farm, Fishing, Forestry Occupation		6	6
Average Wage/Salary ($)		24,186	36,436
Old River-Winfree Town			
Total Persons		1,034	1,233
Emplmnt in Agri., Fishing, Min. Industry		0	24
Emplmnt in Farm, Fishing, Forestry Occupation		0	9
Average Wage/Salary ($)		27,728	43,573
Stowell			
Total Persons		1,509	1,406
Emplmnt in Agri., Fishing, Min. Industry		111	46
Emplmnt in Farm, Fishing, Forestry Occupation		63	10
Average Wage/Salary ($)		16,217	27,603
Winnie			
Total Persons		2,485	2,251
Emplmnt in Agri., Fishing, Min. Industry		172	112
Emplmnt in Farm, Fishing, Forestry Occupation		51	46
Average Wage/Salary ($)		19,405	25,090

Harris County

In 1996, 4.1 MP of seafood was landed in the county. There are 79 recreational for-hire boats based in Harris County, most of which are probably guide boats fishing Galveston Bay. The Houston metropolitan area is located in Harris County.

Key Characteristics of Census-Defined Areas in Harris County

	1970	1980	1990
Aldine			
Total Persons		12,623	11,133
Emplmnt in Agri., Fishing, Min. Industry		241	205
Emplmnt in Farm, Fishing, Forestry Occupation		101	76
Average Wage/Salary ($)		20,913	29,197
Barrett			
Total Persons	2,667	3,183	2,991
Emplmnt in Agri., Fishing, Min. Industry	27	30	9
Emplmnt in Farm, Fishing, Forestry Occupation	11	31	19
Average Wage/Salary ($)	7,091	17,723	32,457
Baytown			
Total Persons	43,980	56,923	63,838
Emplmnt in Agri., Fishing, Min. Industry	417	869	815
Emplmnt in Farm, Fishing, Forestry Occupation	44	173	149
Average Wage/Salary ($)	10,277	23,323	35,885
Bellaire City			
Total Persons	19,069	14,950	13,842
Emplmnt in Agri., Fishing, Min. Industry	382	654	416
Emplmnt in Farm, Fishing, Forestry Occupation	11	50	42
Average Wage/Salary ($)	11,353	24,978	53,331
Bunker Hill Village			
Total Persons	3,977	3,750	3,391
Emplmnt in Agri., Fishing, Min. Industry	119	154	134
Emplmnt in Farm, Fishing, Forestry Occupation	0	7	10
Average Wage/Salary ($)	24,059	64,576	147,476
Channelview			
Total Persons		17,471	25,560
Emplmnt in Agri., Fishing, Min. Industry		171	460
Emplmnt in Farm, Fishing, Forestry Occupation		45	135
Average Wage/Salary ($)		23,033	37,385
Cloverleaf			
Total Persons		17,317	18,230
Emplmnt in Agri., Fishing, Min. Industry		230	228
Emplmnt in Farm, Fishing, Forestry Occupation		38	60
Average Wage/Salary ($)		24,140	64,906

Harris County continued			
Crosby			
Total Persons		1,626	1,578
Emplmnt in Agri., Fishing, Min. Industry		32	48
Emplmnt in Farm, Fishing, Forestry Occupation		24	20
Average Wage/Salary ($)		19,307	34,654
Deer Park City			
Total Persons	12,773	22,648	27,652
Emplmnt in Agri., Fishing, Min. Industry	66	193	267
Emplmnt in Farm, Fishing, Forestry Occupation	5	38	36
Average Wage/Salary ($)	11,877	27,855	47,121
El Lago City			
Total Persons		3,129	3,255
Emplmnt in Agri., Fishing, Min. Industry		52	42
Emplmnt in Farm, Fishing, Forestry Occupation		0	0
Average Wage/Salary ($)		30,647	58,342
Friendswood City			
Total Persons	5,675	10,719	22,851
Emplmnt in Agri., Fishing, Min. Industry	61	202	393
Emplmnt in Farm, Fishing, Forestry Occupation	0	35	73
Average Wage/Salary ($)	14,027	32,967	55,194
Galena Park City			
Total Persons	10,519	9,879	10,033
Emplmnt in Agri., Fishing, Min. Industry	47	120	80
Emplmnt in Farm, Fishing, Forestry Occupation	0	35	25
Average Wage/Salary ($)	9,758	21,497	28,686
Hedwig Village City			
Total Persons	3,255	2,490	2,558
Emplmnt in Agri., Fishing, Min. Industry	135	141	55
Emplmnt in Farm, Fishing, Forestry Occupation	3	12	22
Average Wage/Salary ($)	15,175	32,951	71,442
Highlands			
Total Persons	3,402	6,467	6,632
Emplmnt in Agri., Fishing, Min. Industry	24	72	97
Emplmnt in Farm, Fishing, Forestry Occupation	7	11	0
Average Wage/Salary ($)	10,450	23,708	37,554
Hilshire Village			
Total Persons		617	667
Emplmnt in Agri., Fishing, Min. Industry		15	17
Emplmnt in Farm, Fishing, Forestry Occupation		8	2
Average Wage/Salary ($)		39,268	83,967
Houston City			
Total Persons	1,232,407	1,595,167	1,630,672
Emplmnt in Agri., Fishing, Min. Industry	19,225	43,090	32,281
Emplmnt in Farm, Fishing, Forestry Occupation	1,259	4,715	8,552
Average Wage/Salary ($)		21,721	34,745
Humble City			
Total Persons	3,106	6,729	12,060
Emplmnt in Agri., Fishing, Min. Industry	117	175	174
Emplmnt in Farm, Fishing, Forestry Occupation	11	39	60
Average Wage/Salary ($)	8,723	20,741	32,238

Harris County continued			
Hunters Creek Village			
Total Persons	3,947	4,215	3,954
Emplmnt in Agri., Fishing, Min. Industry	106	102	111
Emplmnt in Farm, Fishing, Forestry Occupation	15	0	0
Average Wage/Salary ($)	26,267	74,961	146,136
Jacinto City			
Total Persons	9,563	8,953	9,343
Emplmnt in Agri., Fishing, Min. Industry	80	65	79
Emplmnt in Farm, Fishing, Forestry Occupation	0	25	37
Average Wage/Salary ($)	9,103	20,815	25,157
Jersey Village			
Total Persons		4,084	4,826
Emplmnt in Agri., Fishing, Min. Industry		129	204
Emplmnt in Farm, Fishing, Forestry Occupation		4	9
Average Wage/Salary ($)		37,765	68,696
Katy City			
Total Persons	3,083	5,656	8,130
Emplmnt in Agri., Fishing, Min. Industry	153	226	340
Emplmnt in Farm, Fishing, Forestry Occupation	81	44	106
Average Wage/Salary ($)	9,124	24,173	40,192
Kingwood			
Total Persons		16,267	37,404
Emplmnt in Agri., Fishing, Min. Industry		885	1,491
Emplmnt in Farm, Fishing, Forestry Occupation		19	73
Average Wage/Salary ($)		39,648	66,569
La Porte City			
Total Persons	7,041	14,062	27,896
Emplmnt in Agri., Fishing, Min. Industry	45	204	268
Emplmnt in Farm, Fishing, Forestry Occupation	6	56	103
Average Wage/Salary ($)	10,146	24,673	42,396
League City			
Total Persons	10,534	16,575	30,122
Emplmnt in Agri., Fishing, Min. Industry	112	304	388
Emplmnt in Farm, Fishing, Forestry Occupation	48	64	155
Average Wage/Salary ($)	11,895	25,436	47,764
Mission Bend			
Total Persons			24,945
Emplmnt in Agri., Fishing, Min. Industry			938
Emplmnt in Farm, Fishing, Forestry Occupation			59
Average Wage/Salary ($)			48,704
Missouri City			
Total Persons	4,079	24,533	36,176
Emplmnt in Agri., Fishing, Min. Industry	82	1,072	1,171
Emplmnt in Farm, Fishing, Forestry Occupation	28	74	85
Average Wage/Salary ($)	12,222	35,232	53,432
Morgan’s Point City			
Total Persons		417	355
Emplmnt in Agri., Fishing, Min. Industry		6	3
Emplmnt in Farm, Fishing, Forestry Occupation		2	3
Average Wage/Salary ($)		26,075	53,413

Harris County continued			
Nassau Bay City			
Total Persons		4,583	4,320
Emplmnt in Agri., Fishing, Min. Industry		131	36
Emplmnt in Farm, Fishing, Forestry Occupation		35	5
Average Wage/Salary ($)		31,573	64,965
Pasadena City			
Total Persons	89,316	112,560	119,363
Emplmnt in Agri., Fishing, Min. Industry	659	1,167	1,065
Emplmnt in Farm, Fishing, Forestry Occupation	59	215	402
Average Wage/Salary ($)	10,538	22,649	33,582
Pearland City			
Total Persons	6,444	13,219	18,716
Emplmnt in Agri., Fishing, Min. Industry	131	360	459
Emplmnt in Farm, Fishing, Forestry Occupation	13	22	86
Average Wage/Salary ($)	11,995	27,742	44,742
Piney Point Village			
Total Persons	2,546	2,958	3,197
Emplmnt in Agri., Fishing, Min. Industry	76	132	96
Emplmnt in Farm, Fishing, Forestry Occupation	4	8	30
Average Wage/Salary ($)	25,088	70,584	169,605
Seabrook City			
Total Persons	3,811	4,670	6,699
Emplmnt in Agri., Fishing, Min. Industry	35	73	186
Emplmnt in Farm, Fishing, Forestry Occupation	9	30	81
Average Wage/Salary ($)	12,361	24,549	38,456
Sheldon			
Total Persons		2,055	1,657
Emplmnt in Agri., Fishing, Min. Industry		35	36
Emplmnt in Farm, Fishing, Forestry Occupation		14	19
Average Wage/Salary ($)		23,806	30,361
Shoreacres City			
Total Persons		1,260	1,316
Emplmnt in Agri., Fishing, Min. Industry		17	27
Emplmnt in Farm, Fishing, Forestry Occupation		8	6
Average Wage/Salary ($)		31,633	53,436
South Houston City			
Total Persons	11,568	13,293	14,207
Emplmnt in Agri., Fishing, Min. Industry	59	136	92
Emplmnt in Farm, Fishing, Forestry Occupation	0	44	49
Average Wage/Salary ($)	9,140	19,576	27,039
Southside Place City			
Total Persons		1,366	1,392
Emplmnt in Agri., Fishing, Min. Industry		61	27
Emplmnt in Farm, Fishing, Forestry Occupation		3	0
Average Wage/Salary ($)		22,205	62,336
Spring			
Total Persons			33,111
Emplmnt in Agri., Fishing, Min. Industry			531
Emplmnt in Farm, Fishing, Forestry Occupation			38
Average Wage/Salary ($)			40,862

Harris County continued			
Spring Valley			
Total Persons	3,145	3,357	3,390
Emplmnt in Agri., Fishing, Min. Industry	99	159	125
Emplmnt in Farm, Fishing, Forestry Occupation	11	8	11
Average Wage/Salary ($)	14,221	37,165	69,688
Stafford Town			
Total Persons	2,833	4,772	8,328
Emplmnt in Agri., Fishing, Min. Industry	50	228	213
Emplmnt in Farm, Fishing, Forestry Occupation	26	105	55
Average Wage/Salary ($)	9,459	22,495	39,732
Taylor Lake Village			
Total Persons		3,669	3,394
Emplmnt in Agri., Fishing, Min. Industry		57	73
Emplmnt in Farm, Fishing, Forestry Occupation		12	42
Average Wage/Salary ($)		43,632	73,196
Tomball City			
Total Persons	2,734	3,996	6,370
Emplmnt in Agri., Fishing, Min. Industry	95	55	177
Emplmnt in Farm, Fishing, Forestry Occupation	11	25	76
Average Wage/Salary ($)	8,426	22,708	33,598
Waller City			
Total Persons		2,348	4,678
Emplmnt in Agri., Fishing, Min. Industry		28	69
Emplmnt in Farm, Fishing, Forestry Occupation		7	40
Average Wage/Salary ($)		19,505	33,988
West University Place City			
Total Persons	13,328	12,010	12,920
Emplmnt in Agri., Fishing, Min. Industry	288	477	379
Emplmnt in Farm, Fishing, Forestry Occupation	0	28	15
Average Wage/Salary ($)	10,496	29,140	87,895

Galveston County

In 1996, Galveston was the 11th leading port in the U.S. in terms of value of seafood landed ($37 million) and the 44th leading port in the U.S. in terms of pounds landed (21 MP). There are 38 recreational for-hire boats based in Galveston County, which includes large headboats. Coastal cities include Galveston, Texas City, and Port Bolivar. Port Bolivar appears to be a fishing community.

In their socioeconomic study of Texas coastal counties, Dokken et al. (1998) reported that total population in Galveston county grew from 217,399 in 1990 to 237,775 in 1996. The increase was accounted for by natural increases (births minus deaths), international migration, and domestic migration. Per capita income in the county rose from $17,552 in 1990 to $21,300 in 1995. Fishery related employment (commercial fishing, seafood processing, wholesaling, retailing) decreased from 3,135 in 1990 to 2,872 in 1995, with the decrease occurring only in the commercial fishing industry. The authors also conducted a shift-share analysis of employment for 1990 and 1995 using the Gulf of Mexico region, comprising the five coastal states, as the benchmark region. They found that this county had negative net relative shift in both fishery and non-fishery related industries, indicating that the county was growing less rapidly than the benchmark region.

Key Characteristics of Census-Defined Areas in Galveston County

	1970	1980	1990
Bacliff			
Total Persons		4,762	5,549
Emplmnt in Agri., Fishing, Min. Industry		55	117
Emplmnt in Farm, Fishing, Forestry Occupation		13	41
Average Wage/Salary ($)		22,133	31,095
Bayou Vista Village			
Total Persons			1,323
Emplmnt in Agri., Fishing, Min. Industry			18
Emplmnt in Farm, Fishing, Forestry Occupation			10
Average Wage/Salary ($)			45,281
Clear Lake Shores City			
Total Persons		758	1,096
Emplmnt in Agri., Fishing, Min. Industry		19	11
Emplmnt in Farm, Fishing, Forestry Occupation		10	9
Average Wage/Salary ($)		22,591	41,653
Dickinson City			
Total Persons	10,776	7,505	9,497
Emplmnt in Agri., Fishing, Min. Industry	101	78	135
Emplmnt in Farm, Fishing, Forestry Occupation	24	33	54
Average Wage/Salary ($)	10,620	24,272	38,324
Galveston City			
Total Persons	61,813	61,902	59,072
Emplmnt in Agri., Fishing, Min. Industry	498	792	651
Emplmnt in Farm, Fishing, Forestry Occupation	79	335	475
Average Wage/Salary ($)	7,710	17,955	29,301

Galveston County continued			
Hitchcock City			
Total Persons	5,644	6,655	5,868
Emplmnt in Agri., Fishing, Min. Industry	36	92	78
Emplmnt in Farm, Fishing, Forestry Occupation	16	19	26
Average Wage/Salary ($)	8,426	21,260	31,598
Jamaica Beach Village			
Total Persons		364	622
Emplmnt in Agri., Fishing, Min. Industry		6	4
Emplmnt in Farm, Fishing, Forestry Occupation		0	4
Average Wage/Salary ($)		23,366	44,634
Kemah City			
Total Persons		1,304	1,094
Emplmnt in Agri., Fishing, Min. Industry		45	27
Emplmnt in Farm, Fishing, Forestry Occupation		29	21
Average Wage/Salary ($)		21,659	30,942
La Marque City			
Total Persons	16,131	15,361	14,120
Emplmnt in Agri., Fishing, Min. Industry	93	109	133
Emplmnt in Farm, Fishing, Forestry Occupation	17	51	57
Average Wage/Salary ($)	10,064	21,615	33,351
San Leon			
Total Persons		1,834	3,328
Emplmnt in Agri., Fishing, Min. Industry		0	116
Emplmnt in Farm, Fishing, Forestry Occupation		8	44
Average Wage/Salary ($)		20,080	28,865
Santa Fe City			
Total Persons		6,172	8,429
Emplmnt in Agri., Fishing, Min. Industry		61	141
Emplmnt in Farm, Fishing, Forestry Occupation		8	50
Average Wage/Salary ($)		21,976	36,217
Texas City			
Total Persons	38,825	41,403	40,822
Emplmnt in Agri., Fishing, Min. Industry	220	297	400
Emplmnt in Farm, Fishing, Forestry Occupation	46	106	157
Average Wage/Salary ($)	9,545	21,895	31,585
Tiki Island Village			
Total Persons			534
Emplmnt in Agri., Fishing, Min. Industry			7
Emplmnt in Farm, Fishing, Forestry Occupation			6
Average Wage/Salary ($)			56,504

Brazoria County

In 1996, 6.1 MP of seafood was landed in the county. In 1996, Freeport was the 59th leading port in the U.S. in terms of value of seafood landed ($14 million). There are 13 recreational for-hire boats based in Brazoria County. Freeport and Brazoria appear to be fishing communities.

In their socioeconomic study of Texas coastal counties, Dokken et al. (1998) reported that total population in Brazoria county grew from 191,707 in 1990 to 216,402 in 1996. The increase was accounted for by natural increases (births minus deaths), international migration, and domestic migration. Per capita income in the county rose from $17,028 in 1990 to $19,595 in 1995. Fishery related employment (commercial fishing, seafood processing, wholesaling, retailing) decreased from 1,216 in 1990 to 995 in 1995, with the decrease occurring in the commercial fishing, seafood processing, and wholesaling industries. The authors also conducted a shift-share analysis of employment for 1990 and 1995 using the Gulf of Mexico region, comprising the five coastal states, as the benchmark region. They found that this county had negative net relative shift in both fishery and non-fishery related industries, indicating that the county was growing less rapidly than the benchmark region.

Key Characteristics of Census-Defined Areas in Brazoria County

	1970	1980	1990
Alvin City			
Total Persons	10,798	16,514	19,220
Emplmnt in Agri., Fishing, Min. Industry	252	500	507
Emplmnt in Farm, Fishing, Forestry Occupation	30	87	128
Average Wage/Salary ($)	10,320	22,064	32,370
Angleton City			
Total Persons	9,664	13,881	17,140
Emplmnt in Agri., Fishing, Min. Industry	76	216	147
Emplmnt in Farm, Fishing, Forestry Occupation	36	85	65
Average Wage/Salary ($)	9,570	23,651	35,984
Bailey’s Prairie Village			
Total Persons		401	650
Emplmnt in Agri., Fishing, Min. Industry		4	13
Emplmnt in Farm, Fishing, Forestry Occupation		2	6
Average Wage/Salary ($)		35,616	64,875
Bonney Village			
Total Persons		87	295
Emplmnt in Agri., Fishing, Min. Industry		6	9
Emplmnt in Farm, Fishing, Forestry Occupation		3	7
Average Wage/Salary ($)		19,929	35,342
Brazoria City			
Total Persons		3,025	2,764
Emplmnt in Agri., Fishing, Min. Industry		56	19
Emplmnt in Farm, Fishing, Forestry Occupation		30	5
Average Wage/Salary ($)		22,044	35,441

Brazoria County continued			
Brookside Village City			
Total Persons		1,453	1,470
Emplmnt in Agri., Fishing, Min. Industry		26	32
Emplmnt in Farm, Fishing, Forestry Occupation		14	11
Average Wage/Salary ($)		23,539	37,045
Clute City			
Total Persons	6,023	9,577	8,907
Emplmnt in Agri., Fishing, Min. Industry	54	164	91
Emplmnt in Farm, Fishing, Forestry Occupation	5	78	73
Average Wage/Salary ($)	8,437	20,223	30,714
Danbury City			
Total Persons		1,357	1,447
Emplmnt in Agri., Fishing, Min. Industry		40	43
Emplmnt in Farm, Fishing, Forestry Occupation		17	33
Average Wage/Salary ($)		23,691	41,902
Freeport City			
Total Persons	12,070	13,442	11,375
Emplmnt in Agri., Fishing, Min. Industry	262	225	175
Emplmnt in Farm, Fishing, Forestry Occupation	16	105	105
Average Wage/Salary ($)	8,841	19,785	27,101
Hillcrest Village			
Total Persons		772	677
Emplmnt in Agri., Fishing, Min. Industry		13	6
Emplmnt in Farm, Fishing, Forestry Occupation		2	0
Average Wage/Salary ($)		31,531	55,637
Holiday Lakes Town			
Total Persons			1,023
Emplmnt in Agri., Fishing, Min. Industry			12
Emplmnt in Farm, Fishing, Forestry Occupation			13
Average Wage/Salary ($)			24,548
Iowa Colony Village			
Total Persons		575	631
Emplmnt in Agri., Fishing, Min. Industry		37	20
Emplmnt in Farm, Fishing, Forestry Occupation		24	10
Average Wage/Salary ($)		23,276	36,182
Jones Creek Village			
Total Persons		2,634	2,160
Emplmnt in Agri., Fishing, Min. Industry		35	26
Emplmnt in Farm, Fishing, Forestry Occupation		15	18
Average Wage/Salary ($)		24,664	38,549
Lake Jackson City			
Total Persons	13,340	19,102	22,749
Emplmnt in Agri., Fishing, Min. Industry	69	98	119
Emplmnt in Farm, Fishing, Forestry Occupation	3	27	29
Average Wage/Salary ($)	12,259	28,705	48,646
Liverpool Village			
Total Persons		612	440
Emplmnt in Agri., Fishing, Min. Industry		14	8
Emplmnt in Farm, Fishing, Forestry Occupation		10	2
Average Wage/Salary ($)		20,030	35,168

Brazoria County continued			
Manvel City			
Total Persons		3,549	3,733
Emplmnt in Agri., Fishing, Min. Industry		172	84
Emplmnt in Farm, Fishing, Forestry Occupation		44	39
Average Wage/Salary ($)		25,482	38,551
Oyster Creek Village			
Total Persons		1,473	939
Emplmnt in Agri., Fishing, Min. Industry		25	4
Emplmnt in Farm, Fishing, Forestry Occupation		15	0
Average Wage/Salary ($)		20,276	31,574
Quintana			
Total Persons		27	73
Emplmnt in Agri., Fishing, Min. Industry			0
Emplmnt in Farm, Fishing, Forestry Occupation			0
Average Wage/Salary ($)		15,906	33,324
Richwood City			
Total Persons		2,591	2,735
Emplmnt in Agri., Fishing, Min. Industry		47	24
Emplmnt in Farm, Fishing, Forestry Occupation		40	13
Average Wage/Salary ($)		23,611	42,216
Surfside Beach City			
Total Persons		582	603
Emplmnt in Agri., Fishing, Min. Industry		6	8
Emplmnt in Farm, Fishing, Forestry Occupation		3	5
Average Wage/Salary ($)		20,845	31,325
Sweeny Town			
Total Persons	3,191	3,538	3,236
Emplmnt in Agri., Fishing, Min. Industry	94	53	45
Emplmnt in Farm, Fishing, Forestry Occupation	15	21	9
Average Wage/Salary ($)	9,150	22,918	32,526
West Columbia City			
Total Persons	3,335	4,109	4,372
Emplmnt in Agri., Fishing, Min. Industry	84	96	107
Emplmnt in Farm, Fishing, Forestry Occupation	34	28	70
Average Wage/Salary ($)	8,455	20,247	32,972
Wild Peach Village			
Total Persons		2,390	2,393
Emplmnt in Agri., Fishing, Min. Industry		63	36
Emplmnt in Farm, Fishing, Forestry Occupation		37	37
Average Wage/Salary ($)		23,061	36,190

Matagorda County

In 1996, 9.2 MP of seafood was landed in the county. In 1996, Palacios was the 25th leading port in the U.S. in terms of value of seafood landed ($25 million). There are 17 recreational for-hire boats based in Matagorda County. Palacios and Matagorda are the principal coastal cities. Palacios and Sargent appear to be fishing communities.

In their socioeconomic study of Texas coastal counties, Dokken et al. (1998) reported that total population in Matagorda county grew from 36,928 in 1990 to 38,352 in 1996. The increase was accounted for by natural increases (births minus deaths) and international migration. Net domestic migration was negative. Per capita income in the county rose from $14,688 in 1990 to $17,160 in 1995. Fishery related employment (commercial fishing, seafood processing, wholesaling, retailing) decreased from 1,915 in 1990 to 1,494 in 1995, with the decrease occurring in the commercial fishing and wholesaling industries. The authors also conducted a shift-share analysis of employment for 1990 and 1995 using the Gulf of Mexico region, comprising the five coastal states, as the benchmark region. They found that this county had negative net relative shift in both fishery and non-fishery related industries, indicating that the county was growing less rapidly than the benchmark region.

Key Characteristics of Census-Defined Areas in Matagorda County

	1970	1980	1990
Bay City			
Total Persons	11,843	17,837	18,264
Emplmnt in Agri., Fishing, Min. Industry	574	753	308
Emplmnt in Farm, Fishing, Forestry Occupation	152	239	157
Average Wage/Salary ($)	7,081	20,186	31,874
Markham			
Total Persons		1,532	1,112
Emplmnt in Agri., Fishing, Min. Industry		100	32
Emplmnt in Farm, Fishing, Forestry Occupation		24	23
Average Wage/Salary ($)		17,037	23,333
Palacios Town			
Total Persons	3,642	4,667	4,418
Emplmnt in Agri., Fishing, Min. Industry	242	190	156
Emplmnt in Farm, Fishing, Forestry Occupation	66	140	137
Average Wage/Salary ($)	6,356	16,342	26,423
Van Vleck			
Total Persons		1,083	1,481
Emplmnt in Agri., Fishing, Min. Industry		88	51
Emplmnt in Farm, Fishing, Forestry Occupation		15	19
Average Wage/Salary ($)		20,291	30,065

Victoria County

There are 15 recreational for-hire boats based in Victoria County, all of which are probably guide boats.

Key Characteristics of Census-Defined Areas in Victoria County

	1970	1980	1990
Bloomington			
Total Persons		1,904	1,881
Emplmnt in Agri., Fishing, Min. Industry		69	45
Emplmnt in Farm, Fishing, Forestry Occupation		11	27
Average Wage/Salary ($)		18,086	27,230
Inez			
Total Persons	3,661	5,436	1,447
Emplmnt in Agri., Fishing, Min. Industry	232	255	126
Emplmnt in Farm, Fishing, Forestry Occupation	6	96	31
Average Wage/Salary ($)	8,995	19,410	42,189
Victoria City			
Total Persons	41,349	50,695	55,000
Emplmnt in Agri., Fishing, Min. Industry	878	1,935	1,496
Emplmnt in Farm, Fishing, Forestry Occupation	149	189	430
Average Wage/Salary ($)	7,956	19,718	32,247

Calhoun County

In 1996, 5.1 MP of seafood was landed in the county. There are 17 recreational for-hire boats based in Calhoun County. Coastal cities include Seadrift, Port O'Connor, and Port Lavaca. All three appear to be fishing communities.

In their socioeconomic study of Texas coastal counties, Dokken et al. (1998) reported that total population in Calhoun county grew from 19,052 in 1990 to 20,569 in 1996. The increase was accounted for by natural increases (births minus deaths) and international migration. Net domestic migration was negative. Per capita income in the county rose from $14,004 in 1990 to $17,025 in 1995. Fishery related employment (commercial fishing, seafood processing, wholesaling, retailing) decreased from 1,386 in 1990 to 1,023 in 1995, with the decrease occurring in the commercial fishing and wholesaling industries. The authors also conducted a shift-share analysis of employment for 1990 and 1995 using the Gulf of Mexico region, comprising the five coastal states, as the benchmark region. They found that this county had negative net relative shift in fishery related industry and positive net relative shift in non-fishery related industries, indicating that the county was growing less rapidly in fishery related industries but more rapidly in non-fishery related industries than the benchmark region.

Key Characteristics of Census-Defined Areas in Calhoun County

	1970	1980	1990
Point Comfort City			
Total Persons		1,124	956
Emplmnt in Agri., Fishing, Min. Industry		22	18
Emplmnt in Farm, Fishing, Forestry Occupation		9	6
Average Wage/Salary ($)		23,342	32,392
Port Lavaca City			
Total Persons	10,440	10,911	10,886
Emplmnt in Agri., Fishing, Min. Industry	161	341	195
Emplmnt in Farm, Fishing, Forestry Occupation	60	148	138
Average Wage/Salary ($)	8,244	20,341	27,719
Seadrift City			
Total Persons		1,272	1,277
Emplmnt in Agri., Fishing, Min. Industry		88	86
Emplmnt in Farm, Fishing, Forestry Occupation		69	76
Average Wage/Salary ($)		14,591	22,844

Refugio County

There are four recreational for-hire boats based in Refugio County. The only coastal city is Bayside.

In their socioeconomic study of Texas coastal counties, Dokken et al. (1998) reported that total population in Refugio county decreased from 7,976 in 1990 to 7,784 in 1996. The decrease was accounted for a significant reduction in net domestic migration although natural increases (births minus deaths) and international migration were positive. Per capita income in the county rose from $15,789 in 1990 to $22,829 in 1995. Fishery related employment (commercial fishing, seafood processing, wholesaling, retailing) decreased from 73 in 1990 to 57 in 1995, with the decrease accounted for by the commercial fishing and retailing industries. The authors also conducted a shift-share analysis of employment for 1990 and 1995 using the Gulf of Mexico region, comprising the five coastal states, as the benchmark region. They found that this county had negative net relative shift in both fishery and non-fishery related industries, indicating that the county was growing less rapidly than the benchmark region.

Key Characteristics of Census-Defined Areas in Refugio County

	1970	1980	1990
Austwell City			
Total Persons		290	156
Emplmnt in Agri., Fishing, Min. Industry		17	6
Emplmnt in Farm, Fishing, Forestry Occupation		15	4
Average Wage/Salary ($)		19,775	27,825
Bayside Town			
Total Persons		396	413
Emplmnt in Agri., Fishing, Min. Industry		23	15
Emplmnt in Farm, Fishing, Forestry Occupation		6	5
Average Wage/Salary ($)		15,420	22,814
Refugio Town			
Total Persons	4,572	3,898	3,158
Emplmnt in Agri., Fishing, Min. Industry	362	361	234
Emplmnt in Farm, Fishing, Forestry Occupation	48	44	62
Average Wage/Salary ($)	7,568	16,058	25,278
Woodsboro Town			
Total Persons		1,974	1,718
Emplmnt in Agri., Fishing, Min. Industry		222	123
Emplmnt in Farm, Fishing, Forestry Occupation		74	58
Average Wage/Salary ($)		14,443	22,471

Aransas County

In 1996, 8.6 MP of seafood was landed in the county. In 1996, Rockport-Port Aransas was the 28th leading port in the U.S. in terms of value of seafood landed ($24 million). There are 94 recreational for-hire boats based in Aransas County. Rockport appears to be a fishing community. Aransas Pass is a fishing community located at the juncture of San Patrico, Aransas, and Nueces Counties and serves as a regional docking port for Gulf shrimp vessels.

In their socioeconomic study of Texas coastal counties, Dokken et al. (1998) reported that total population in Aransas county grew from 17,892 in 1990 to 21,105 in 1996. The increase was accounted for by natural increases (births minus deaths), international migration, and domestic migration. Per capita income in the county rose from $14,943 in 1990 to $17,630 in 1995. Fishery related employment (commercial fishing, seafood processing, wholesaling, retailing) decreased from 1,391 in 1990 to 1020 in 1995, with the decrease occurring in all industries, except retailing. The authors also conducted a shift-share analysis of employment for 1990 and 1995 using the Gulf of Mexico region, comprising the five coastal states, as the benchmark region. They found that this county had negative net relative shift in fishery related industries and positive net relative shift in non-fishery related industries, indicating that the county was growing less rapidly in fishery related industries but more rapidly in non-fishery related industries than the benchmark region.

Key Characteristics of Census-Defined Areas in Aransas County

	1970	1980	1990
Fulton Town			
Total Persons		696	685
Emplmnt in Agri., Fishing, Min. Industry		9	25
Emplmnt in Farm, Fishing, Forestry Occupation		0	22
Average Wage/Salary ($)		16,727	15,333
Rockport City			
Total Persons	3,738	3,686	4,831
Emplmnt in Agri., Fishing, Min. Industry	114	143	221
Emplmnt in Farm, Fishing, Forestry Occupation	7	45	105
Average Wage/Salary ($)	7,213	16,301	27,494

San Patricio County

In 1996, 8.6 million pounds of seafood was landed in Aransas Pass. In 1996 Port Aransas-Rockport was the 28th leading port in the U.S. in terms of value of seafood landed ($24 million).There are 54 recreational for-hire boats based in San Patrico County, many of which are likely guide boats. Coastal cities include Aransas Pass, Portland, and Gregory. Aransas Pass is a fishing community located at the juncture of San Patrico, Aransas, and Nueces counties, and serves as regional docking port for Gulf shrimp vessels.

In their socioeconomic study of Texas coastal counties, Dokken et al. (1998) reported that total population in San Patricio county grew from 58,749 in 1990 to 66,885 in 1996. The increase was accounted for by natural increases (births minus deaths), international migration, and domestic migration. Per capita income in the county rose from $11,980 in 1990 to $14,617 in 1995. Fishery related employment (commercial fishing, seafood processing, wholesaling, retailing) decreased from 1,325 in 1990 to 993 in 1995, with the decrease occurring in the commercial fishing and wholesaling industries. The authors also conducted a shift-share analysis of employment for 1990 and 1995 using the Gulf of Mexico region, comprising the five coastal states, as the benchmark region. They found that this county had negative net relative shift in both fishery and non-fishery related industries, indicating that the county was growing less rapidly than the benchmark region.

Key Characteristics of Census-Defined Areas in San Patricio County

	1970	1980	1990
Gregory City			
Total Persons		2,739	2,540
Emplmnt in Agri., Fishing, Min. Industry		75	89
Emplmnt in Farm, Fishing, Forestry Occupation		15	45
Average Wage/Salary ($)		14,649	22,993
Ingleside City			
Total Persons			5,696
Emplmnt in Agri., Fishing, Min. Industry			112
Emplmnt in Farm, Fishing, Forestry Occupation			85
Average Wage/Salary ($)			26,074
Lake City			
Total Persons		401	472
Emplmnt in Agri., Fishing, Min. Industry		22	8
Emplmnt in Farm, Fishing, Forestry Occupation		0	0
Average Wage/Salary ($)		21,049	25,911
Lakeside Town			
Total Persons		277	307
Emplmnt in Agri., Fishing, Min. Industry		5	7
Emplmnt in Farm, Fishing, Forestry Occupation		0	2
Average Wage/Salary ($)		18,118	26,277

San Patricio County continued			
Mathis City			
Total Persons	5,728	5,667	5,423
Emplmnt in Agri., Fishing, Min. Industry	365	243	155
Emplmnt in Farm, Fishing, Forestry Occupation	260	143	93
Average Wage/Salary ($)	4,448	11,823	17,133
Odem City			
Total Persons		2,379	2,382
Emplmnt in Agri., Fishing, Min. Industry		109	92
Emplmnt in Farm, Fishing, Forestry Occupation		65	45
Average Wage/Salary ($)		18,274	27,918
San Patricio City			
Total Persons		254	347
Emplmnt in Agri., Fishing, Min. Industry		4	14
Emplmnt in Farm, Fishing, Forestry Occupation		6	9
Average Wage/Salary ($)		16,115	27,637
Sinton City			
Total Persons	5,563	6,044	5,533
Emplmnt in Agri., Fishing, Min. Industry	167	217	214
Emplmnt in Farm, Fishing, Forestry Occupation	65	111	134
Average Wage/Salary ($)	6,732	16,283	23,413
Taft City			
Total Persons	3,274	3,768	3,247
Emplmnt in Agri., Fishing, Min. Industry	108	139	113
Emplmnt in Farm, Fishing, Forestry Occupation	64	85	84
Average Wage/Salary ($)	7,457	17,089	23,865

Nueces County

In 1996, 2.4 MP of seafood was landed in the county. There are 112 recreational for-hire boats based in Nueces County, with most at Port Aransas. Coastal cities include Corpus Christi and Port Aransas. Port Aransas is a recreational fishing community. Aransas Pass is a fishing community located at the juncture of San Patrico, Aransas, and Nueces counties, and serves as regional docking port for Gulf shrimp vessels.

In their socioeconomic study of Texas coastal counties, Dokken et al. (1998) reported that total population in Nueces county grew from 291,145 in 1990 to 313,049 in 1996. The increase was accounted for by natural increases (births minus deaths), international migration, and domestic migration. Per capita income in the county rose from $15,407 in 1990 to $18,703 in 1995. Fishery related employment (commercial fishing, seafood processing, wholesaling, retailing) increased from 1,222 in 1990 to 1,459 in 1995, with only the commercial fishing industry experiencing a decrease. The authors also conducted a shift-share analysis of employment for 1990 and 1995 using the Gulf of Mexico region, comprising the five coastal states, as the benchmark region. They found that this county had positive net relative shift in both fishery and non-fishery related industries, indicating that the county was growing more rapidly than the benchmark region.

Key Characteristics of Census-Defined Areas in Nueces County

	1970	1980	1990
Agua Dulce City			
Total Persons		934	809
Emplmnt in Agri., Fishing, Min. Industry		91	46
Emplmnt in Farm, Fishing, Forestry Occupation		7	8
Average Wage/Salary ($)		19,988	29,174
Aransas Pass City			
Total Persons	5,846	7,205	7,080
Emplmnt in Agri., Fishing, Min. Industry	278	469	193
Emplmnt in Farm, Fishing, Forestry Occupation	14	278	154
Average Wage/Salary ($)	7,597	16,819	24,946
Bishop City			
Total Persons	3,445	3,706	3,337
Emplmnt in Agri., Fishing, Min. Industry	138	182	82
Emplmnt in Farm, Fishing, Forestry Occupation	52	77	34
Average Wage/Salary ($)	8,601	19,186	28,692
Corpus Christi City			
Total Persons	204,590	231,999	257,453
Emplmnt in Agri., Fishing, Min. Industry	3,713	5,302	4,135
Emplmnt in Farm, Fishing, Forestry Occupation	456	1,137	1,302
Average Wage/Salary ($)	8,330	18,646	31,067
Driscoll City			
Total Persons		690	693
Emplmnt in Agri., Fishing, Min. Industry		34	23
Emplmnt in Farm, Fishing, Forestry Occupation		17	11
Average Wage/Salary ($)		17,157	19,445

Nueces County continued			
North San Pedro			
Total Persons		2,541	845
Emplmnt in Agri., Fishing, Min. Industry		33	17
Emplmnt in Farm, Fishing, Forestry Occupation		19	9
Average Wage/Salary ($)		11,224	18,331
Petronila City			
Total Persons			135
Emplmnt in Agri., Fishing, Min. Industry			16
Emplmnt in Farm, Fishing, Forestry Occupation			11
Average Wage/Salary ($)			16,416
Port Aransas City			
Total Persons		1,965	2,241
Emplmnt in Agri., Fishing, Min. Industry		45	82
Emplmnt in Farm, Fishing, Forestry Occupation		33	71
Average Wage/Salary ($)		16,743	28,100
Portland City			
Total Persons	7,204	12,023	12,142
Emplmnt in Agri., Fishing, Min. Industry	425	552	440
Emplmnt in Farm, Fishing, Forestry Occupation	49	23	73
Average Wage/Salary ($)	10,525	26,036	38,206
Robstown City			
Total Persons	11,217	12,100	12,957
Emplmnt in Agri., Fishing, Min. Industry	246	193	151
Emplmnt in Farm, Fishing, Forestry Occupation	126	70	112
Average Wage/Salary ($)	7,514	16,047	21,376

Kleberg County

In 1996, 820,000 pounds of seafood was landed in the county. There are eight recreational for-hire boats based in Kleberg County. Coastal cities depending on recreational fishing include Riviera, Loyola Beach, and Valtman.

In their socioeconomic study of Texas coastal counties, Dokken et al. (1998) reported that total population in Kleberg county slightly grew from 30,274 in 1990 to 30,294 in 1996. Significant negative net domestic migration was outweighed by positive natural increases (births minus deaths) and international migration. Net domestic migration was negative. Per capita income in the county rose from $11,904 in 1990 to $15,034 in 1995. Fishery related employment (commercial fishing, seafood processing, wholesaling, retailing) decreased from 397 in 1990 to 308 in 1995, with the decrease occurring in the commercial fishing industry. The authors also conducted a shift-share analysis of employment for 1990 and 1995 using the Gulf of Mexico region, comprising the five coastal states, as the benchmark region. They found that this county had negative net relative shift in both fishery and non-fishery related industries, indicating that the county was growing less rapidly than the benchmark region.

Key Characteristics of Census-Defined Areas in Kleberg County

	1970	1980	1990
Kingsville City			
Total Persons	28,605	28,808	25,276
Emplmnt in Agri., Fishing, Min. Industry	541	1,140	640
Emplmnt in Farm, Fishing, Forestry Occupation	136	257	259
Average Wage/Salary ($)	6,974	16,495	26,868

Kenedy County

There is one recreational for-hire boat based in the county. Communities with access to water include Sarita and Olmas. Baffin Bay is a recreational fishing community.

In their socioeconomic study of Texas coastal counties, Dokken et al. (1998) reported that total population in Kenedy county fell from 460 in 1990 to 436 in 1996. The decrease was accounted for negative net domestic migration. Per capita income in the county rose from $20,262 in 1990 to $21,773 in 1995. No fishery related employment (commercial fishing, seafood processing, wholesaling, retailing) information was reported, and a shift-share analysis was not conducted.

Key Characteristics of Census-Defined Areas in Kenedy County

	1970	1980	1990
Total Persons	752	543	460
Emplmnt in Agri., Fishing, Min. Industry	179	142	89
Emplmnt in Farm, Fishing, Forestry Occupation	143	114	80
Average Wage/Salary ($)	6,023	12,825	24,393

Willacy County

In 1996, 130,000 pounds of seafood was landed in the county. There are 26 recreational for-hire vessels based in the county. Port Mansfield and San Benito both appear to be fishing communities.

In their socioeconomic study of Texas coastal counties, Dokken et al. (1998) reported that total population in Willacy county grew from 17,705 in 1990 to 19,300 in 1996. The increase was accounted for by natural increases (births minus deaths) and international migration. Net domestic migration was negative. Per capita income in the county rose from $7,638 in 1990 to $10,029 in 1995. Fishery related employment (commercial fishing, seafood processing, wholesaling, retailing) fell from 87 in 1990 to 75 in 1995, with the decrease occurring in the commercial fishing industry. The authors also conducted a shift-share analysis of employment for 1990 and 1995 using the Gulf of Mexico region, comprising the five coastal states, as the benchmark region. They found that this county had negative net relative shift in fishery related industries and positive relative shift in non-fishery related industries, indicating that the county was growing less rapidly in fishery related industries but more rapidly in non-fishery related industries than the benchmark region.

Key Characteristics of Census-Defined Areas in Willacy County

	1970	1980	1990
Lyford City			
Total Persons		1,635	1,654
Emplmnt in Agri., Fishing, Min. Industry		121	69
Emplmnt in Farm, Fishing, Forestry Occupation		94	64
Average Wage/Salary ($)		12,610	19,881
Raymondville City			
Total Persons	8,167	9,493	8,921
Emplmnt in Agri., Fishing, Min. Industry	505	468	293
Emplmnt in Farm, Fishing, Forestry Occupation	421	368	200
Average Wage/Salary ($)	5,223	13,631	16,925
San Perlita City			
Total Persons		458	532
Emplmnt in Agri., Fishing, Min. Industry		50	54
Emplmnt in Farm, Fishing, Forestry Occupation		42	43
Average Wage/Salary ($)		11,578	16,113
Sebastian			
Total Persons			1,557
Emplmnt in Agri., Fishing, Min. Industry			70
Emplmnt in Farm, Fishing, Forestry Occupation			82
Average Wage/Salary ($)			13,262

Cameron County

In 1996, Brownsville-Port Isabel was the 5th leading port in the U.S. in terms of value of seafood landed ($60 million) and the 40th leading port in pounds landed (22 MP). There are 78 recreational for-hire boats based in the county, with most in the South Padre Island-Port Isabel area. Other coastal communities include Port Brownville and Port Harlingen. South Padre Island, Port Isabel, and Port Brownsville appear to be fishing communities. Communities dependent on aquaculture of shrimp include Rio Hondo and Arroyo City.

In their socioeconomic study of Texas coastal counties, Dokken et al. (1998) reported that total population in Cameron county grew from 260,120 in 1990 to 307,869 in 1996. The increase was accounted for by natural increases (births minus deaths), international migration, and domestic migration. Per capita income in the county rose from $9,770 in 1990 to $11,960 in 1995. Fishery related employment (commercial fishing, seafood processing, wholesaling, retailing) decreased from 3,760 in 1990 to 2,798 in 1995, with the decrease occurring in all, but seafood processing, industries. The authors also conducted a shift-share analysis of employment for 1990 and 1995 using the Gulf of Mexico region, comprising the five coastal states, as the benchmark region. They found that this county had negative net relative shift in fishery related industries and positive net relative shift in non-fishery related industries, indicating that the county was growing less rapidly in fishery related industries and more rapidly in non-fishery related industries than the benchmark region.

Key Characteristics of Census-Defined Areas in Cameron County

	1970	1980	1990
Bayview Town			
Total Persons		295	243
Emplmnt in Agri., Fishing, Min. Industry		30	2
Emplmnt in Farm, Fishing, Forestry Occupation		16	4
Average Wage/Salary ($)		16,632	31,309
Brownsville City			
Total Persons	52,522	84,997	97,962
Emplmnt in Agri., Fishing, Min. Industry	1,019	1,009	771
Emplmnt in Farm, Fishing, Forestry Occupation	392	706	743
Average Wage/Salary ($)	5,897	14,399	22,343
Cameron Park			
Total Persons			3,802
Emplmnt in Agri., Fishing, Min. Industry			55
Emplmnt in Farm, Fishing, Forestry Occupation			52
Average Wage/Salary ($)			12,992
Combes Town			
Total Persons		1,488	2,042
Emplmnt in Agri., Fishing, Min. Industry		26	33
Emplmnt in Farm, Fishing, Forestry Occupation		22	35
Average Wage/Salary ($)		12,501	21,927

Cameron County continued			
Encantada-Ranchito El Calaboz			
Total Persons			1,204
Emplmnt in Agri., Fishing, Min. Industry			35
Emplmnt in Farm, Fishing, Forestry Occupation			29
Average Wage/Salary ($)			21,193
Harlingen City			
Total Persons	33,515	43,243	48,735
Emplmnt in Agri., Fishing, Min. Industry	633	561	529
Emplmnt in Farm, Fishing, Forestry Occupation	519	398	461
Average Wage/Salary ($)	6,727	15,132	27,916
Indian Lake Town			
Total Persons			350
Emplmnt in Agri., Fishing, Min. Industry			3
Emplmnt in Farm, Fishing, Forestry Occupation			2
Average Wage/Salary ($)			24,416
La Feria City			
Total Persons	2,964	3,495	4,360
Emplmnt in Agri., Fishing, Min. Industry	65	61	78
Emplmnt in Farm, Fishing, Forestry Occupation	71	64	72
Average Wage/Salary ($)	5,555	11,438	18,962
Laguna Heights			
Total Persons			1,671
Emplmnt in Agri., Fishing, Min. Industry			45
Emplmnt in Farm, Fishing, Forestry Occupation			46
Average Wage/Salary ($)			16,687
Laguna Vista Village			
Total Persons		692	1,154
Emplmnt in Agri., Fishing, Min. Industry		29	27
Emplmnt in Farm, Fishing, Forestry Occupation		17	20
Average Wage/Salary ($)		22,941	29,097
Los Fresnos City			
Total Persons		2,173	2,473
Emplmnt in Agri., Fishing, Min. Industry		77	30
Emplmnt in Farm, Fishing, Forestry Occupation		71	22
Average Wage/Salary ($)		16,883	27,464
Palm Valley Town			
Total Persons		721	1,199
Emplmnt in Agri., Fishing, Min. Industry		27	21
Emplmnt in Farm, Fishing, Forestry Occupation		24	12
Average Wage/Salary ($)		14,437	57,000
Port Isabel City			
Total Persons	2,745	3,769	4,467
Emplmnt in Agri., Fishing, Min. Industry	196	111	86
Emplmnt in Farm, Fishing, Forestry Occupation	16	60	86
Average Wage/Salary ($)	4,796	12,776	16,411
Primera Town			
Total Persons		1,380	2,030
Emplmnt in Agri., Fishing, Min. Industry		49	46
Emplmnt in Farm, Fishing, Forestry Occupation		47	37
Average Wage/Salary ($)		13,372	21,358

Cameron County continued			
Rancho Viejo Town			
Total Persons			824
Emplmnt in Agri., Fishing, Min. Industry			4
Emplmnt in Farm, Fishing, Forestry Occupation			4
Average Wage/Salary ($)			52,931
Rangerville Village			
Total Persons			255
Emplmnt in Agri., Fishing, Min. Industry			8
Emplmnt in Farm, Fishing, Forestry Occupation			8
Average Wage/Salary ($)			18,426
Rio Hondo City			
Total Persons		1,673	1,793
Emplmnt in Agri., Fishing, Min. Industry		70	43
Emplmnt in Farm, Fishing, Forestry Occupation		33	37
Average Wage/Salary ($)		14,464	20,826
San Benito City			
Total Persons	15,180	17,988	20,125
Emplmnt in Agri., Fishing, Min. Industry	468	279	142
Emplmnt in Farm, Fishing, Forestry Occupation	399	226	114
Average Wage/Salary ($)	4,925	12,507	22,959
Santa Rosa Town			
Total Persons		1,889	2,223
Emplmnt in Agri., Fishing, Min. Industry		88	94
Emplmnt in Farm, Fishing, Forestry Occupation		72	90
Average Wage/Salary ($)		9,646	18,487
South Padre Island Town			
Total Persons		727	1,677
Emplmnt in Agri., Fishing, Min. Industry		15	23
Emplmnt in Farm, Fishing, Forestry Occupation		8	21
Average Wage/Salary ($)		17,147	35,325

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