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AMENDMENT NUMBER 10

TO

FISHERY MANAGEMENT PLAN FOR THE SHRIMP FISHERY

OF THE GULF OF MEXICO, U.S. WATERS

WITH

ENVIRONMENTAL ASSESSMENT

REGULATORY IMPACT REVIEW

INITIAL REGULATORY FLEXIBILITY ANALYSIS

AND SOCIAL IMPACT ASSESSMENT

JULY 2002

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ABBREVIATIONS AND ACRONYMS USED IN THIS DOCUMENT

AP	Shrimp Advisory Panel
BCR	Benefit/Cost Ratio
BRD	Bycatch Reduction Device
CPUE	Catch Per Unit Effort
CZMA	Coastal Zone Management Act
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FMP	Fishery Management Plan
GMFMC	Gulf of Mexico Fishery Management Council
HAPC	Habitat Areas of Particular Concern
IRFA	Initial Regulatory Flexibility Analysis
MMS	Mineral Management Service
MP	Million Pound
M-SFCMA	Magnuson-Steven Fishery Conservation and Management Act
MSY	Maximum Sustainable Yield
NEPA	National Environmental Policy Act
NM^2	Square Nautical Miles
NPV	Net Present Value
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
RA	Regional Administrator of NMFS
RFA	Regulatory Flexibility Analysis
RIR	Regulatory Impact Review
SEAMAP	Southeast Area Monitoring and Assessment Program

SEFSC	Southeast Fisheries Science Center of NMFS
SEIS	Supplemental Environmental Impact Statement
SLF	Shrimp Landings File
SFA	Sustainable Fisheries Act
SSAP	Shrimp Stock Assessment Panel
SSC	Scientific and Statistical Committee
TAC	Total Allowable Catch
TALFF	Total Allowable Level of Foreign Fishing
TED	Turtle Excluder Device
USCG	United States Coast Guard
YPR	Yield Per Recruit

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1.0 INTRODUCTION

General Information:

The species of shrimp managed under the fishery management plan (FMP) are as follows:

Brown shrimp	*Farfantepenaeus aztecus*
White shrimp	*Litopenaeus setiferus*
Pink shrimp	*Farfantepenaeus duorarum*
Royal Red shrimp	*Hymenopenaeus robustus*

The three species of penaeid shrimp comprise more than 99% of the landings in the Gulf of Mexico. In recent years, average annual landings have been approximately 150 million pounds (MP) (tails). Brown shrimp provide the largest portion of annual shrimp landings in the northern Gulf with average landings in the 1990's of approximately 80.0 MP. This species is distributed from the Mexican border through Apalachicola Bay, Florida (GMFMC 1981). Brown shrimp are caught out to at least 50 fathoms, though most catches are from less than 30 fathoms. White shrimp are the second most abundant species with 1998 and 1999 landings of approximately 55.0 MP and 2000 landings of over 70.0 MP. They are distributed from the Mexican border through Apalachee Bay (Figure 11, GMFMC 1998). Typically, white shrimp are caught inshore of 15 fathoms. Pink shrimp landings were approximately 19.0 MP in 1996, but dropped to only about 8.0 MP in 1999 and 7.0 MP in 2000. This species is distributed across the northern Gulf from the Florida Keys to Mexico; however, they are most common in the Tortugas and Sanibel areas off Florida (GMFMC 1980). Pink shrimp are usually taken from waters less than 25 fathoms with the majority of catch being harvested in 11 to 15 fathoms. Maximum annual production of royal red shrimp has been on the order of 337,000 pounds (tails) in 1994; however, landings in recent years (1998, 1999, and 2000) have only been around 245,000 to 299,000 pounds. Royal red shrimp are a deep-water shrimp occurring primarily in depths of 140 to 300 fathoms.

Status of the Stocks

The Gulf of Mexico Fishery Management Council (Council or GMFMC) has established an overfished level for each of the 3 penaeid species in terms of a parent stock level as follows:

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.

The National Marine Fisheries Service (NMFS) has monitored the parent stock levels for all 3 penaeid species since 1970. 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. The parent stock numbers for all 3 species have remained above the maximum sustainable yield (MSY) parent stock minimum throughout this monitoring period. Additionally, the yield from the royal red shrimp fishery has remained below the MSY yield level of 392,000 pounds throughout the history of that fishery. Consequently, the shrimp stocks of the Gulf of Mexico are not considered to be overfished or approaching an overfished state.

Considerations for further reductions in bycatch on the west coast of Florida

This amendment considers various measures to further reduce bycatch on the west coast of Florida east of Cape San Blas (85°30' W. Longitude). As discussed in the following sections trawls of various configurations such as otter, skimmer, and beam are the primary gears used in this area as well as the rest of the Gulf. Bycatch from trawls in this area and the rest of the Gulf primarily includes macroinvertebrates, including primarily crustaceans (shrimps and crabs), sponges, coelenterates, echinoderms, and molluscs, as well as fishes. This amendment focuses on 3 major sets of alternatives to reduce such bycatch: additional closed areas, additional or extended closed seasons, and the requirement of bycatch reduction devices (BRDs). Of these 3 sets of alternatives, only closed seasons and areas would be effective in reducing bycatch of macroinvertebrates because BRDs are only effective in reducing finfish bycatch. These alternatives and their impacts are discussed in following sections of this document.

Another alternative to require nontrawl gear (at least in some areas) was also considered. The only nontrawl gear that would be effective in catching shrimp would be a trap. A requirement for the use of this gear, however, was deemed to be inappropriate at this time for various reasons. First, only limited experiments with trap gear have been attempted for penaeid shrimp (brown, white, and pink) and only in nearshore waters of the states. These have also been only recreational or subsistence efforts and not geared to commercial production which is the primary component of the shrimp fishery in the Gulf. The likely reasons why trap gear have not been further explored for the commercial fishery are related to costs and efficiency. Traps in other fisheries such as spiny lobster and stone crab are expensive to buy and maintain. These gear are used, however, because these animals are much more valuable than shrimp and because they are not effectively harvested with trawls due to their habitat and biological habits (burrowing and association with hard-bottom structure). In support of the decision to reject further consideration of trap alternatives, it is noted that the Council and NMFS have been approached on at least 2 different occasions in the last 5 years by would-be entrepreneurs with plans to harvest royal red shrimp with traps. In both cases these individuals/firms did not proceed past the initial contact and perhaps obtaining an experimental permit from NMFS. This failure to proceed, even experimentally, indicates that a determination was made that such an effort would not be profitable or feasible.

2.0 HISTORY OF MANAGEMENT

A fishery management plan with an Environmental Impact Statement (EIS) for the shrimp fishery in the Gulf of Mexico were prepared by the GMFMC and implemented as federal regulation on May 15, 1981. The principal thrust of the plan was to enhance yield in volume and value by deferring harvest of small shrimp to provide for growth. Principle action included: (1) establishing a cooperative Tortugas Shrimp Sanctuary with the state of Florida to close a shrimp trawling area where small pink shrimp comprise the majority of the population most of the time; (2) a cooperative 45-day seasonal closure with the state of Texas to protect small brown shrimp emigrating from bay nursery areas; and (3) seasonal zoning of an area of Florida Bay for either shrimp or stone crab fishing to avoid gear conflict.

Amendment 1, approved later that year, provided the Regional Administrator (RA) of the NMFS with the authority (after conferring with the GMFMC) to adjust by regulatory amendment the size of the Tortugas Sanctuary or the extent of the Texas closure, or to eliminate either closure for one year.

Amendment 2 (1983) updated catch and economic data in the FMP, and Amendment 3 (1984) resolved another shrimp-stone crab gear conflict on the west-central coast of Florida.

Amendment 4, partially approved in 1988 and finalized in 1989, identified problems that developed in the fishery and revised the objectives of the FMP accordingly. The annual review process for the Tortugas Sanctuary was simplified, and the GMFMC's and RA's review for the Texas closure was extended to February 1st. Disapproved was a provision that white shrimp taken in the exclusive economic zone (EEZ) be landed in accordance with a state's size/possession regulations to provide consistency and facilitate enforcement with the state of Louisiana. This latter action was to have been implemented at such time when Louisiana provided for an incidental catch of undersized white shrimp in the fishery for seabobs. This proposed action was disapproved by the NMFS with the recommendation that it be resubmitted under the expedited 60-day Secretarial review schedule after Louisiana provided for a bycatch of undersized white shrimp in the directed fishery for seabobs. This resubmission was made in February of 1990 and applied to white shrimp taken in the EEZ and landed in Louisiana. It was approved and implemented in May of 1990.

In July 1989, the NMFS published revised guidelines for FMPs that interpretatively addressed the Magnuson Act National Standards (50 CFR Part 602). These guidelines required each FMP to include a scientifically measurable definition of overfishing and an action plan to arrest overfishing should it occur.

In 1990, Texas revised the period of its seasonal closure in Gulf waters from June 1 to July 15 to May 15 to July 15. The FMP did not have enough flexibility to adjust the cooperative closure of federal waters to accommodate this change, thus an amendment was required.

Amendment 5, approved in 1991, defined overfishing for Gulf brown, pink, and royal red shrimp and provided for measures to restore overfished stocks if overfishing should occur. Action on the definition of overfishing for white shrimp was deferred, and seabobs and rock shrimp were deleted from the management unit. The duration of the seasonal closure to shrimping off Texas was adjusted to conform with the changes in state regulations.

Amendment 6 (1993) eliminated the annual reports and reviews of the Tortugas Shrimp Sanctuary in favor of monitoring and an annual stock assessment. Three seasonally opened areas within the sanctuary continued to open seasonally, without need for annual action. A proposed definition of overfishing of white shrimp was rejected by the NMFS as not being based on the best available data.

Amendment 7, finalized in 1994, defined overfishing for white shrimp and provided for future updating of overfishing indices for brown, white, and pink shrimp as new data become available. A total allowable level of foreign fishing (TALFF) for royal red shrimp was eliminated; however, a redefinition of overfishing for this species was disapproved.

Amendment 8, submitted in 1995 and implemented in early 1996, addressed management of royal red shrimp. It established a procedure that would allow total allowable catch (TAC) for royal red shrimp to be set up to 30% above MSY for no more than two consecutive years so that a better estimate of MSY could be determined. This proposal was subsequently rejected by NMFS because the Sustainable Fisheries Act (SFA) defined exceeding MSY as overfishing.

Amendment 9, with Supplemental Environmental Impact Statement (SEIS), approved in May 1998, required the use of a NMFS certified bycatch reduction devices in shrimp trawls used in the EEZ from Cape San Blas, Florida (85°30' W. Longitude) to the Texas/Mexico border and provided for the certification of the Fisheye BRD in the 30 mesh position. The purpose of this action was to reduce the bycatch mortality of juvenile red snapper by 44% from the average mortality for the years 1984-89. This amendment exempted shrimp trawls fishing for royal red shrimp outside of 100 fathoms, as well as groundfish and butterfish trawls. It also excluded small try nets and no more than two ridged frame roller trawls that do not exceed 16 feet. Amendment 9 also provided mechanisms to change the bycatch reduction criterion and to certify additional BRDs.

3.0 PROBLEMS REQUIRING A PLAN AMENDMENT

The Magnuson-Stevens Fishery Conservation and Management Act (M-SFCMA) requires that all FMPs, amendments, and regulations be consistent with the 10 National Standards. National Standard 9 states that "conservation and management measures shall to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch." Amendment 9 to the Shrimp FMP addressed bycatch reduction of red snapper in the Gulf EEZ west of Cape San Blas, Florida (85°30' W. Longitude) through the requirement of BRDs in all shrimp trawls with the exception of: (1) royal red shrimp trawls

that are being used in depths greater than 100 fathoms, (2) groundfish and butterfish trawls, (3) a single try net with a head rope measurement of 16 feet or less, and (4) no more than 2 rigid-frame roller trawls that are 16 feet or less (see 50 CFR, Part 622 for more specific definitions of exempted vessels, boats, and gear). These exemptions were determined to have no or little impact of red snapper bycatch. Although BRDs are also effective in reducing bycatch of other species (primarily finfish), Amendment 9 did not include measures applicable in waters of the EEZ east of Cape San Blas, Florida. Consequently, the Council is proposing this amendment to further reduce bycatch and/or the mortality from bycatch to the extent practicable as required by the M-SFCMA. Because the original FMP for the shrimp fishery in the Gulf and subsequent amendments did not include a standardized bycatch reporting methodology in accordance with the required provisions of FMPs and amendments (Section 303[a][11]) of the M-SFCMA), this amendment includes alternatives to establish such a methodology.

4.0 PURPOSE AND NEED FOR ACTION

This amendment addresses the need for reducing bycatch from the shrimp trawl fishery in the EEZ off the west coast of Florida, specifically in the Gulf EEZ east of Cape San Blas (85°30' W. Longitude). As noted above, Amendment 9 to the Shrimp FMP addressed bycatch reduction of red snapper in the Gulf EEZ west of Cape San Blas, Florida; and the method that was approved was the requirement of bycatch reduction devices (BRDs) that would reduce the mortality from shrimp trawls on age 0 and age 1 red snapper by at least 44% from the average level of mortality during the period 1984-89. Because Amendment 9 did not address bycatch reduction on the west coast of Florida, east of Cape San Blas, this amendment considers the need and practicability of various alternatives for reducing bycatch from shrimp trawling in this area, including the requirement of BRDs. It also reviews the effectiveness and potential impacts of these alternatives. Finally, this amendment addresses the need to establish a standardized bycatch reporting methodology in accordance with the required provisions of FMPs and amendments (Section 303[a][11]) of the M-SFCMA) through consideration of various alternatives.

5.0 PROPOSED ACTIONS

This amendment proposes to require the installation of a NMFS-certified BRDs that reduces the bycatch of finfish by at least 30% by weight in each net used aboard vessels trawling for shrimp in the Gulf of Mexico EEZ east of Cape San Blas, Florida (85°30' W. Longitude). Exempted are vessels trawling for royal red shrimp beyond the 100-fathom contour and vessels trawling for groundfish or butterfish. A single try net with a headrope length of 16 feet or less per vessel and no more than two rigid-frame roller trawls limited to 16 feet or less, such as those used in the Big Bend area of Florida are also exempted.

This amendment also proposes to utilize the annual Summer Shrimp/Groundfish and Fall Shrimp/Groundfish Trawl Surveys as a bycatch reporting methodology to determine annual

finfish and invertebrate bycatch. Since BRDs are currently required in most areas of the Gulf EEZ and are proposed for the remaining areas of the EEZ by other actions in this amendment, estimates of finfish bycatch from these surveys would be reduced by at least 35% (the estimate of bycatch reduction from the most popular BRD in use [Fisheye BRD]). Survey data would be multiplied to convert sampled bycatch estimates for finfish and invertebrates into 24 hour (or per day) periods. These results would then be multiplied by the same year's estimates from the NMFS effort data or other effort estimates such as from Gallaway et. al (2000) in days fished to obtain annual estimates of total finfish and invertebrate bycatch.

6.0 MANAGEMENT ALTERNATIVES

6.1 Area Closures

6.1.1 Rejected Alternative - Increase the size of presently closed areas in the Gulf of Mexico EEZ east of Cape San Blas, Florida (85°30' W. Longitude) by 20% or (30%, 40%, or 50%)

6.1.2 Rejected Alternative - Permanently close the present boundaries of the Southwest Florida Seasonal Trawl Closure and the Tortugas Shrimp Sanctuary in the EEZ

6.1.3 Rejected Alternative - Enact additional area closures in areas of high bycatch, particularly Statistical Subareas 4-5 and 6-8 where there is a higher incidence of finfish bycatch

6.1.4 Proposed Alternative - Status Quo - do not increase the size or seasonal extent of presently closed areas and do not close additional areas in the Gulf of Mexico EEZ east of Cape San Blas, Florida (85°30' W. Longitude)

Discussion: The state of Florida has established various permanently closed areas to the commercial harvest of shrimp. These areas are described in Titles 68B-31.016, 68B-31.017, 68B-31.018, and 68B-38, Florida Administrative Code (Figure 1) (Appendix A). These areas are primarily nursery areas for pink shrimp; however, they also include known habitat for many of the bycatch species in the shrimp trawl fishery. There are also several areas in the EEZ off the west coast of Florida that are permanently closed to shrimp trawling, including the Madison and Swanson sites and the Steam Boat Lumps implemented through the Reef Fish FMP framework procedure in June 2000 and the Florida Middle Grounds. Other areas in federal waters of south Florida have been closed through the expansion of the Florida Keys National Marine Sanctuary boundaries and future implementation of a generic amendment to establish the Tortugas Ecological Reserve. Although closures exist and additional ones are proposed in state and federal waters, closures in state waters are much more extensive (Figure 1). There are also numerous, but unmapped, areas of hard bottom off the west coast of Florida in both state and federal waters that are not trawlable due to the potential for gear loss or damage and

minimal amounts of shrimp (GMFMC 1997). The biological, ecological, economic, and social effects of these regulatory closures and untrawlable bottom on reducing bycatch are unknown. However, for species that typically do not migrate from these areas and those that do migrate but change habitat so as to become less vulnerable to trawl gear, a reduction in their bycatch would be expected. Increasing the size of these areas and/or enacting additional permanent closures of areas that are being trawled would be expected to further reduce bycatch; however, the amount of reduction and which species would be affected would depend on the extent and location of any additional closures.

Another factor that could influence the effect of additional area closures is the potential relocation of fishing effort to open areas or cessation of trawling activities. If additional closed areas are relatively small and/or disjunct, shrimpers might increase efforts in nearby open areas. This activity would likely cause a localized increase in bycatch and possibly the mortality of bycatch. However, if these areas are sufficiently large, they might cause a broader relocation of shrimpers to other areas resulting in positive impacts with regard to bycatch reduction in such areas, but there would still be the possibility of increased bycatch in areas to which shrimpers relocate. Very large closed areas could cause some, particularly local operators, to exit the fishery, which could also have a positive impact on bycatch reduction. Smaller closed areas would be more difficult and costly to enforce, and larger closed areas would probably have more significant negative social and economic impacts to the shrimping industry due to the more substantial loss of trawlable bottoms.

Figure 2 shows the percentage of shrimp catch to total bycatch and to finfish bycatch for 3 statistical subareas off the west coast of Florida (Statistical Subareas 1-3, 4-5, and 6-8), and Figure 3 shows the Statistical Subareas 1-8. These groupings closely correspond to the area of the EEZ off the west coast of Florida in which additional bycatch reduction measures were not implemented through Amendment 9 (GMFMC 1997). Figure 2 also shows that the shrimp to bycatch ratios, in terms of both finfish and total bycatch, is much higher in Statistical Subareas 1-3 as compared to 4-5 and 6-8. Additionally, approximately 59% of the total shrimp landings for Statistical Subareas 1-8 comes from Statistical Subareas 1-3 (Table 1). Consequently, the impact on shrimp production of closing additional areas in Statistical Subareas 1-3 would be much greater than additional closures in the other subarea groupings, and larger areas would have to be closed to gain approximately the same amount of bycatch reduction when compared with the other subarea groupings. These inferences are supported by the fact that the square nautical miles (NM^2) for each of the 3 statistical subarea groupings (1-3, 4-5, and 6-8) are about the same at between 24,000 and 28,000 NM^2 (Table 2). Area closures in Statistical Subareas 4-5 would be expected to have the least impact to shrimp harvest because only about 7% of the total shrimp harvest and 9% of the effort in days fished comes from this subarea grouping. Area closures in Statistical Subareas 6-8 would be expected to have about the same percentage effect on bycatch reduction since the percentages of shrimp and bycatch are the same in both subarea groupings (Figure 2); however, because approximately 34% of the shrimp catch and 33% of the effort comes from Statistical Subareas 6-8, the impacts of additional area closures here on shrimp catch would be much greater.

Figure 1 shows there are over 3,000,000 acres (approximately 3,600 NM^2) that are permanently closed to commercial shrimping in Statistical Subareas 1-3. This amounts to approximately 12% of the total area. Permanently closed areas in Statistical Subareas 6-8 amount to nearly 900,000 acres (1,100 NM^2), or about 5% of the total area here. As shown in Figure 1, there are other, small, seasonally closed areas in Statistical Subareas 1-3 and 6-8. Closed areas in Statistical Subareas 4-5 have not been calculated, but are exceedingly small compared to the other statistical subarea groupings. As shown in Tables 1 and 3, the majority of shrimp catch and effort occurs in Statistical Subareas 1-3. As discussed above, this area grouping currently has the largest amount of closed acreage and as shown in Figure 2 additional closures here would have the greatest negative impact to shrimp production.

Alternative 6.1.1 would increase the size of currently closed areas and Alternative 6.1.2 would permanently close existing seasonally closed areas. Because these areas are already known to shrimpers and enforcement personnel, there should be less impact in terms of enforcement and violations, as opposed to implementing new closed areas. Alternative 6.1.3 could be assumed to have the greatest potential success in reducing bycatch of the closed area alternatives if such locations could be determined and matched with areas that are being trawled. However, data have only been reported for trawling trips by statistical subarea, and there could be flaws due to an individual trip consisting of trawling over more than one subarea with reports indicating only one subarea. Also, shrimpers do not always trawl in the same area. They often move from place to place using a small try net to test shrimp and bycatch concentrations, and only deploying larger commercial gear when tests show good potential catches without excessive bycatch.

Data on concentrations of bycatch have not been collected over the area being considered for further bycatch reduction, i.e. the west coast of Florida east of Cape San Blas, and a major research effort would have to be conducted to collect such data. The costs of such an effort would be exorbitant requiring trawl sampling across all statistical subareas, but particularly Statistical Subareas 4 through 8 where bycatch is higher, at various depth zones and seasons because environmental conditions often change from season to season and within a given season. Furthermore some bycatch species are known to move further offshore as they mature during a given season. If such data could be collected over many years, a predictive model might be developed. Again, such an effort would require an even more exorbitant commitment of resources, and other similar predictive ecological models have been shown to be highly variable (Browder 1983, Martinez et al. 1996).

The shrimp fishery operates in coastal areas of all five gulf states. However, the level of shrimping activity in Statistical Subareas 1 through 8 is minimal with only about 10% of the Gulf catch and 10% of the Gulf shrimp fishing effort occurring here. The greatest impact of additional closed areas would likely occur in Statistical Subareas 1-3 because about 59% of the catch and 58% of the effort occurs here. As shown in Figure 2, this subgrouping contains the smallest shrimp trawl bycatch at a ratio of approximately 1:1.77, shrimp to total bycatch. Consequently, the remaining Statistical Subareas 4-5 and 6-8 would only include the area

where approximately 4% of the Gulf catch and effort occurs. In fact, a closure of this entire area (Statistical Subareas 1-8) would not likely result in significant impacts to shrimp catch, bycatch species, or affected interests due to the low levels of harvesting activities occurring there when compared to the Gulf as a whole. For example out of approximately 13,000 shrimp boats and 4,000 shrimp vessel only approximately 900 to 1,000 fish in these areas. Consequently, only approximately 6% of the entire fleet would be impacted and as discussed herein at least some portion of these affected craft would relocate to other areas. Furthermore, this is not likely to change in either the short term or the long term.

Given that area closures would reduce bycatch and directed harvest of all trawl vulnerable species in the closed area, it would suggest only a positive impact on fishery resources in the area. However, as discussed under "Biological Impacts" reducing bycatch of a species could have impacts on other species through altering predator prey relationships or other ecosystem interactions, and such impacts are potentially adverse. Area closures would likely result in positive impacts to some fish habitat regardless of its location because there would be less impact to sessile and interstitial benthic species; however, existing trawling areas are not known to be permanently and negatively impacted by trawling. Even though additional area closures would likely be beneficial, as previously discussed, they are not likely to have a significant impact to biological stocks, but as discussed in the following, fairly severe social and economic impacts to the local shrimp industry are likely, especially if large or highly productive areas are selected for closure.

Only a minimal effect on public safety could occur, because so little fishing effort occurs in these areas. Any change such as effort shifting or traveling greater distances to trawl for shrimp would be on an extremely small scale, and therefore not significant, except in the case of very large closed areas. Also, seasonal shifts by larger vessels to the northern and western Gulf in the summer and fall currently occur without such additional area closures.

Some aspects of the geographic areas considered for closure, particularly in Statistical Subareas 1-3, are close to areas with unique characteristics, such as the Dry Tortugas Ecological Reserve and the Florida Keys National Marine Sanctuary (FKNMS). However, those specific areas and others are already closed to trawling with approximately 12% of the entire Statistical Subareas 1-3 being closed. Furthermore, the amount of trawling occurring nearby is, again, extremely low indicating that additional area closures in this area would have insignificant effects on unique characteristics of the environment in those areas.

Social and economic data on the shrimp fishery on the west coast of Florida are very limited. Consequently, a complete analysis of the social and economic impacts of additional closed areas to reduce bycatch off the west coast of Florida cannot be accomplished without additional costly research. The following "Socioeconomic Impacts" section discusses what impacts can be inferred from available information. Shrimp industry representatives have, however, testified that additional closed areas or permanent closures of seasonally closed areas would

have the greatest negative impact and be the least preferable of the other alternatives being considered.

Closing areas to fishing practices nearly always generates controversy, even when as in this instance the scale of actual effects would be minimal. Many participants and associations oppose in principle the closure of any area to any fishing activities, or to fishing activities of one sector or another such as commercial or recreational fishing. Other groups view area closures as the panacea for fishery management.

Although the effects of additional closures in these areas are known in general and qualitative terms rather than in precise detail, no indication has arisen that these effects are uncertain or implicate unique or unknown risks. As noted above, effects are expected to be beneficial in terms of bycatch reduction, but they would constitute only a minimal degree of change for the biological environment with potentially large, negative impacts to the local shrimping industry.

Area closures already exist in many contexts and to varying degrees of restriction; consequently, establishing additional closed areas would not set a precedent or represent a decision in principle about a future consideration. While it may be that closing additional areas could be interpreted by some, particularly those opposed to closures, as a statement in support of a policy of using closures, the M-SFCMA already explicitly establishes that principle (see 16 U.S.C. § 1853[b][2])

In terms of cumulative effects, the effects of additional closed areas alone, together with effects of previous closures would not amount to a significant change. If additional closures resulted in effort shifting there would likely be only a shift in impacts from one area to another. However, if the shift was to another area where bycatch was currently being impacted, the additional area closure requirement could have greater negative impacts to overall bycatch due to increased effort in the areas to which effort was shifted.

Establishing additional areas closed to shrimp trawling in the marine environment would not implicate issues relating to the National Register of Historic Places. To the extent scientific, cultural, or historical resources may exist within areas considered for closure, any effect would be protective rather than harmful. Similarly, to the extent interactions occur with species listed under the Endangered Species Act (ESA) or such species' habitat within any new closed areas under consideration, the effect of additional closures would be protective rather than adverse since it would reduce such interactions and the likelihood of takes.

Finally, additional closed areas would be consistent with other legal authorities aimed at environmental protection. The alternatives are being considered based on the requirement of the M-SFCMA to reduce bycatch and bycatch mortality to the extent practicable which is consistent with other protective legal authorities such as the National Marine Sanctuaries Act (NMSA), Coastal Zone Management Act (CZMA), and other relevant authorities.

As discussed in more detail in previous and following discussions, establishing additional closed areas east of Cape San Blas, Florida is not a practicable measure for minimizing bycatch and bycatch mortality. As noted above, population effects of most bycatch species are unknown with precision, but generally to the extent an effect occurs from closing additional areas in Statistical Subareas 1-8, one would expect positive effects for individual populations that may be adversely affected by shrimp trawling here.

Similarly, ecosystem interactions are difficult to predict; however, as discussed in the "Biological Impacts" section below, effects could be positive or negative depending on whether an individual bycatch species is or becomes a predator or prey of other species. As previously discussed there are already established closed areas off the west coast of Florida, and such closures do not appear to have significantly changed biological diversity here. Consequently, additional closures, even rather large ones are not likely to have any significant ecological impacts.

Closing these statistical subareas or some portion of them is not likely to result in a significant change in the bycatch species, nor therefore to trigger population or ecosystem effects as a result, primarily because they would afford additional protection for the present species diversity. Also, as previously discussed closed areas are already in place in some areas, and for state waters out to 9 nautical miles only BRDs are required. Tables 4 and 5, and Amendment 9 (GMFMC 1997), indicate bycatch species by area to the extent the information is available. No information suggests species composition would be significantly altered in areas open to trawling by closing them, thus any potential changes to species composition are likely to be minimal.

Interactions between shrimp trawlers and marine mammals and birds are not known to occur, therefore no effects would be anticipated. Shrimp trawl gear is pulled along the sea floor, making it unlikely that birds would fly or swim deep enough for an interaction, and operate at sufficiently slow speeds to virtually preclude interaction with marine mammals.

As indicated in the discussion of "Socioeconomic Impacts" the costs of additional closures would be greater in Statistical Subareas 1-3 than in Subareas 6 - 8, although lost profits may be greater in Statistical Subareas 6 - 8. Statistical Subareas 4-5 involve less shrimping effort and less bycatch than the other subareas, so costs and lost profits would likely be less there as well. Effort shifting would be likely to occur and would offset total losses, but would certainly increase costs, as discussed in the following analysis. The practicability of increasing costs and lost profits for what appear to be minimal gains in bycatch reduction by the use of additional area closures seems dubious.

Additional area closures would likely result in additional research, enforcement, and administration costs and a reduction in management effectiveness. Additional closed areas would also be more difficult and expensive to monitor. Sections 6.1.1 and 6.1.2 would expand upon existing closed areas and would probably have a reduced impact to the shrimp fishery and

the aforementioned costs in terms of enforcement and voluntary compliance, as opposed to new closed areas because they are known to the industry and enforcement personnel. Furthermore, they only require an expansion of the existing enforcement presence, as opposed to requiring an enforcement presence in additional areas for some time period that would likely result from the choice of Section 6.1.3. Any of these choices for additional closed areas would be more difficult to enforce when compared to seasonal closures or BRD alternatives, and they are the least preferred options by industry. Consequently, they would likely foster non-compliance through the ease of evasion and resentment of fishery participants. Research efforts may also be thwarted as a result of disgruntled fishermen not willing to assist researchers either voluntarily or under contract. These effects weigh against a determination that additional closed areas would be practicable, particularly in light of the minimal gains to be achieved in reducing bycatch and bycatch mortality previously discussed.

As discussed in the "Socioeconomic Impacts" section additional closed areas could have significant economic impacts depending on their size and location among the Statistical Subareas 1-8. They would also have negative social impacts for shrimpers that are required to travel farther or restricted to less productive areas. Some recreational fishermen and charter operators fish recreationally near shrimp trawlers, finding that trawling activities can contribute to their success; consequently, the economic, social and cultural value of their recreational fishing activity would be lessened in any additional closed areas. The impacts would likely be very small as would any benefits to recreationally targeted species from such closed areas because of the minimal shrimp trawling that occurs in these subareas and the fact that as shown in Tables 4 and 5 the predominant bycatch species are not typically targeted by recreational fishermen. Nonconsumptive uses such as scuba diving may experience some very minor benefit from additional area closures, but these activities typically occur on or near hard-bottom reefs that are not trawled due to the potential damage to gear.

Changes in the distribution of costs and benefits that could result from additional closed areas would likely occur only among those participating in the shrimp fishery in these areas. As discussed above and in the "Biological Impacts" and "Socioeconomic Impacts" sections, the benefits of additional bycatch reduction to be gained from additional closed areas on the west coast of Florida seems low in comparison to the level of costs that would accrue to participants. On balance, consideration of this factor does not favor a determination that additional closed areas would be practicable.

As discussed above and in the "Socioeconomic Impacts" section, social effects would vary depending on the size and location of any additional area closures. Although from an overall Gulf shrimp fishery perspective, these effects would be minor regardless of the size of additional area closures. However, from a local perspective they could be rather significant to participants with little impact to overall bycatch reduction. Consequently, from a potential social effects perspective, additional area closures would not be deemed practicable.

Biological Impacts:
Additional closed areas could be developed to further reduce bycatch; however, the amount of additional area in terms of NM^2 and its preferable location cannot be determined at this time. Present data on the life histories of and interactions between bycatch species are insufficient to conduct a complete analysis of the likely biological affects of area trawling closures on such species. Given that many bycatch species move in and out of areas subject to closures at different stages throughout their life histories, it is not possible to evaluate potential biological impacts without a complete picture of how all species use each option for areas subject to closure. Further, reducing bycatch of one species may have unforseen positive or negative impacts on other species, such as increased predation on other species, thus a complete picture of ecosystem interactions would also be required for accurate analysis. Such an analysis would be a tremendous undertaking for which there exists neither the scientific capability nor the funding to accomplish, therefore potential effects must be evaluated using theoretical approaches in analyzing existing information.

As shown in Tables 4 and 5, the species diversity changes by Statistical Subareas 1 through 8, depth, and season. Depending on the location and size of additional closed areas, different populations could be affected, as well as their ecological relationships with other species. Consequently, the only available approach to assessing the potential biological impacts of additional closed areas is through the use of these existing relevant data on bycatch, summarized in Tables 4 and 5, to make general predictions about potential biological impacts to bycatch species. Although general, these predictions find support in the analogy provided by past experience in other areas of the Gulf of Mexico, as represented by the record underlying and reflected by Amendment 9 (GMFMC 1997). To use these existing data requires an assumption of an even distribution of such species over these closed areas and potential additional areas, as well as equal trawlability. Such assumptions are likely to be erroneous based on present knowledge; consequently, the analysis is largely qualitative in nature. Using this assumption, additional area closures would reduce bycatch by species and amount proportionally to the areas, seasons, and depths described in Tables 4 and 5 by number and weight, respectively. Table 5 contains limited data on the percent composition of species caught in shrimp trawls by weight per unit effort. It contains an "other species" category, which is often a substantial percentage of overall shrimp trawl harvest from Statistical Subareas 1 through 8, making the task of estimating biological impacts of closed areas from the data less precise. This "other species" category is, however, inclusive of a very small number of numerous species; consequently, any impacts to individual species in this category would be small and insignificant. As previously discussed, additional area closures in Statistical Subareas 1-3 would have the greatest impact on shrimp harvest with the least benefit to finfish bycatch, but they would have the highest benefit to nonfinfish catch (Figure 2). Thus, while area closures in these subareas would result in bycatch reduction, particularly for nonfinfish species, as previously discussed, they would also result in the loss of some of the most efficient shrimp harvesting areas. This loss could potentially increase overall effort to compensate for lost harvest eventually resulting in increased biological impacts elsewhere, particularly in Statistical Subareas 4-5 and 6-8 that have higher bycatch rates. As previously

discussed and as derived from Tables 4 and 5, additional area closures in Statistical Subareas 4-5 and 6-8 would have the greatest potential to benefit finfish stocks in deeper waters.

Socioeconomic Impacts:
Since the intent of any area closure is to reduce shrimp trawl bycatch, it only stands to reason that the particular areas considered for closure should be characterized by at least two features, namely, areas where shrimping actually occurs (preferably intensively) and where bycatch is relatively highest. Alternative 6.1.3 directly addresses these two features while Alternative 6.1.1 may do so depending on the areas chosen for closure. Alternative 6.1.2 specifies a shrimping area but the level of bycatch in the area needs to be determined.

As discussed above, there is little information that can be used to determine the biological benefits of area closures for the purpose of reducing bycatch in shrimp trawls. Given this uncertainty on the biological aspects, the resulting economic and social benefits from area closures to reduce bycatch cannot be properly evaluated. However, there are some issues on the benefit side that need mentioning. In general, area closures can provide protection to fish stocks, enhance the long-term viability of the subject species, and increase the abundance of fish in and around the closed areas. Closures are considered to be especially important for protecting spawning aggregations in subject areas. But the effectiveness of an area closure can be partly negated if a good amount of fishing pressure is still allowed in the closed area. This is especially true in the present case where area closure is made to apply only to fishing effort coming from shrimp trawls. There is then some possibility that any benefits that may be derived from area closures would be partially offset by an increase in fishing pressure from sources other than shrimp trawls. This would depend on whether there is substantial direct and incidental harvest of affected species by other gear types.

A direct effect of any area closure is to compel shrimpers to shift fishing-displaced effort to open areas. Considering that most trawlable areas, if not already subject to seasonal or permanent closure, are now being exploited, displaced fishing craft may not be able to offset their harvest and revenue reductions by shifting effort to other areas. Fishing craft already fishing in the open areas would also be faced with further competition, and this may reduce their harvest and revenues as well. Any effort shift is also likely to increase the cost of fishing, since vessels may either have to travel farther, fish harder, or at least develop skills to fish in a new area. A reduction in vessel profitability can then be expected from any effective area closure. In addition, shifting of displaced fishing effort can give rise to conflicts among shrimpers and other gear users, thus creating social costs above and beyond private costs that shrimp fishing craft would incur.

The described double squeeze on profitability is likely to disproportionately affect displaced fishing craft. Larger fishing craft are likely to be more able than smaller ones in cushioning the impacts of an area closure by fishing in other areas. Depending on the size of the closed area and the area's importance to their harvest of shrimp, smaller vessels/boats may not be able

to successfully shift their operations to other areas and thus would have to exit the fishery to minimize cost.

Figure 2 shows the ratio of shrimp catch to bycatch in various statistical subarea groupings in 3 subareas off the west coast of Florida. Regardless of whether only finfish bycatch or total bycatch is considered, it appears that Statistical Subareas 4-5 and 6-8 are the two subareas where bycatch is relatively high compared to shrimp catch. On the other hand, Table 1 and Table 3 indicate that the greatest amount of shrimp catch and effort in terms of trips and hours fished occur in Statistical Subareas 1-3 and 6-8. Consequently, it would be expected for bycatch to be higher in these two subarea groupings than in Statistical Subareas 4-5, thus additional area closures in Statistical Subareas 1-3 or 6-8 would appear to yield greater bycatch reduction than in Statistical Subareas 4-5. Thus, these two subareas may be considered prime candidates for closure in order to reduce bycatch in a more effective way.

It is likely that of the two prime subarea groupings for closure the cost of closure, in terms of harvest and revenue/profit reductions to shrimp fishing craft, would be higher if the closed areas were in Statistical Subareas 1-3 than if they were in Statistical Subareas 6-8 because shrimp harvest and revenues are, on average, greater in Statistical Subareas 1-3 (59% as opposed to 34% in landings and 61% as opposed to 31% in ex-vessel revenues [see Table 1])[1]. However, it is possible that the cost of closure, in terms of profits, may be higher in Statistical Subareas 6-8 than in Statistical Subareas 1-3. Currently, there is no routine costs and returns data collection done for any commercial fishery in the Gulf, but some approximations may be made. Travis (2001), using results from a study by Funk (1998), estimated vessel profits by vessel length for 1998 and 1999 in Statistical Areas 1-8. Table 6 shows that while revenues are higher in Statistical Subareas 1-3 than those in Statistical Subareas 6-8, the reverse is true for profits. Profits for Statistical Subareas 6-8 were about $3.2 million and $1.6 in 1998 and 1999, respectively; the corresponding profit figures for Statistical Subareas 1-3 were $2.6 million and $1.4 million in 1998 and 1999, respectively.

In terms of minimizing shrimp loss for a given bycatch reduction or maximizing bycatch reduction for a given shrimp loss, it appears that Statistical Subareas 6-8 is a better choice than Statistical Subareas 1-3. The shrimp to bycatch ratio is higher in Statistical Subareas 1-3 than in Statistical Subareas 6-8, implying that for any given amount of shrimp reduction the bycatch reduction in Statistical Subareas 6-8 would be higher than that in the other area, or conversely that for any given bycatch reduction the shrimp loss in Statistical Subareas 6-8 would be lower

[1]Fluctuations in landings and revenues can reduce the difference in proportional catch and revenues from each area; however, the relative ranking of each area in catch and revenue importance may not necessarily change. For example, Statistical Subareas 1-3 accounted for 54.2% of total landings in Statistical Areas 1-8 in 1999 but only 48.9% in 1998. The share for Statistical Subareas 6-8 was 37.4% in 1999 but was higher in 1998 at 48%. In both years, Statistical Subareas 1-3 accounted for a higher percentage to total catch, although in 1998, the two major subareas were about the same in percentage share to total landings.

than that in the other area. Given this scenario, it is possible to achieve the same bycatch reduction via a smaller closed area in Statistical Subareas 6-8 than in Statistical Subareas 1-3. This contention, of course, assumes that the shrimp to bycatch ratio indicated in Figure 2 uniformly holds throughout each of the subareas for the entire fishing season.

Although the assumption of uniform shrimp to bycatch ratio throughout each subarea grouping may be questionable, it can be used as a starting point for estimating the economic effects of any area closure. The information in Table 1, showing 1991-2000 average landings and revenues (values), may be interpreted as the potential "maximum" loss in harvest and revenues (Table 6 for profits) if any additional areas in the three subarea groupings is closed to shrimping. The term "maximum" is used here in restricted form to signify the fact that landings and revenues fluctuate from year to year and that a closure could also affect the harvest by shrimp trawls of non-shrimp species. If, for example, under Alternative 6.1.3 the entire area comprising Statistical Subareas 6-8 were closed to shrimping, the resulting loss to shrimp vessels would be about 4.2 MP of shrimp valued at $13.7 million. Fluctuations in abundance and market conditions, not reflected in and captured by average landings and revenues, can mitigate or exacerbate the adverse impacts of an area closure. For example, total shrimp landings in Statistical Subareas 1-8 were approximately 21.8 million in 1998, but fell precipitously in 1999 to approximately 9.3 MP. The corresponding ex-vessel revenues fell from approximately $74.5 million in 1998 to approximately $37.6 million in 1999, and profits fell from $6.3 million in 1998 to $3.3 million in 1999. In the particular case of Statistical Subareas 6-8, revenues fell from $29.7 million in 1998 to $12.7 million in 1999 while profits fell from $3.2 million to $1.6 million. If the closure in this area coincides with the type of economic performance in the fishery experienced in 1999, the resulting reductions in harvest and revenue/profit will only exacerbate the economic conditions of those affected, including the communities dependent on the subject area's harvest of shrimp. On the other hand, a much improved economic performance, as in 1998, would cushion the adverse impacts of the closure.

Considering that the number of shrimp fishing craft trips in Statistical Subareas 6-8 averaged about 3,610 annually, a total closure of this subarea is unlikely to result in effectively shifting effort to other areas. A partial closure of this subarea would force a shift in effort most likely to open locations within the same subarea, but the resulting shrimp harvest from such effort shift may be expected to not fully offset the loss from the closed area as those areas would likely be less productive than the closed area. In addition, fishing cost may increase, giving rise to the double squeeze on fishing craft profit mentioned earlier.

Tables 7a, 7b, and 7c provide information on fishing craft harvesting shrimp in Statistical Subareas 1-8. These are the fishing craft that would be affected by any area closure designed to reduce bycatch. As with Table 6, which contains revenues and profits, only two years are considered, but these two years appear to be sufficient to show the potential impacts on fishing craft operation. A total of 1,106 fishing craft harvested shrimp in Statistical Areas 1-8 in 1998 but dropped to 967, or by 139, in 1999. This reduction in the number of fishing craft is closely

related to the significant decline in landings, revenues, and profits from 1998 to 1999, as noted above.

There are more fishing craft in Statistical Subareas 6-8 than in either of the two other subareas. Most vessels operate in Statistical Subareas 1-3 and 6-8 while most boats operate in Statistical Subareas 4-5 and 6-8 (Table 7a). In all subareas, there are more large fishing craft (greater than 60 feet in length) than either small (less than 45 feet) or medium size (45 to 60 feet) classes (Table 7b). This is especially true for Statistical Subareas 1-3 and 4-5 where the number of large fishing craft exceeds the sum of small and medium fishing craft. In Statistical Subareas 6-8, the number of large fishing craft is about the same as the sum of small and medium fishing craft, and there are more small fishing craft than medium size ones.

It is not a surprise that there are more fishing craft homeported in Florida than in any other state, although there is significant participation from Texas and Alabama (Table 7c). Fishing craft from Florida and Alabama concentrate in Statistical Subareas 6-8 while those from Texas, in Statistical Subarea 1-3. It should be noted, however, that there are more Florida fishing craft than those from Texas and Alabama combined in all three major statistical subarea groups.

A fishing closure in any of the areas in Statistical Subareas 1-8 would directly or indirectly affect 967 to 1,106 fishing craft, based on 1998 and 1999 total number of fishing craft. Closures in Statistical Subareas 6-8 would directly affect 698 fishing craft, of which 629 are vessels and 69 are boats if based on 1999 fishing year or 593 fishing craft, of which 476 are vessels and 117 are boats if based on 1998 fishing year (see Table 7a). Closures in Statistical Subareas 1-3 would directly affect 574 vessels and 8 boats, for a total of 582 fishing craft based on 1998 data, or 443 vessels and 7 boats, for a total of 450 fishing craft based on 1999 data. Closures in Statistical Subareas 4-5 would directly affect 307 vessels and 65 boats, for a total of 372 fishing craft based on 1998 data, or 223 vessels and 53 boats, for a total of 276 fishing craft based on 1999 data. Although as discussed above, a closure in Statistical Subareas 6-8 would potentially effect a larger bycatch reduction than a similar closure in Statistical Subareas 1-3, it would do so by affecting more fishing craft. Additionally, more small and medium sized fishing craft would be adversely affected than if the closures were in Statistical Subareas 1-3 (see Table 7b). Moreover, while more Florida fishing craft than those of any other state would be affected by any closure, a closure in Statistical Subareas 6-8 would affect more Florida fishing craft than a closure in Statistical Subareas 1-3. Considering Alabama and Texas only since more fishing craft come from these states than from any other state, except Florida, a closure in Statistical Subarea 6-8 would affect more Alabama fishing craft while a closure in Statistical Subareas 1-3 would affect more Texas fishing craft. It would appear then that a closure in Statistical Subareas 6-8 than one in Statistical Subareas 1-3 would effect more bycatch reduction, but the accompanying economic cost would be larger.

Table 7d presents additional insight into the impacts of area closures on various fishing craft that may be considered highly dependent on shrimp operations in Statistical Subareas 1-8. It shows the number of vessels, by size category, from each homeport state fishing exclusively

in each major statistical subarea grouping[2]. A closure in Statistical Subareas 1-3 would affect more larger than smaller vessels. This is particularly true for vessels homeported in Texas, with 114 of 116 vessels (72 of 73 vessels in 1999) fishing exclusively in the subject area are larger vessels. On the other hand, closures in Statistical Subarea 6-8 would affect more smaller vessels than larger ones. This time Florida fishing craft would be hit hard as about 90 of 92 fishing craft (298 of 345 fishing craft in 1999) fishing exclusively in the subject area are smaller fishing craft.

The potential impacts of any closure can also be seen from the standpoint of revenues and profits derived from fishing in Statistical Subareas 1-8. Table 7e presents fishing craft revenues by area fished and homeport state of fishing craft. Table 7f presents similar tabulation of profits. Due to the confidentiality nature of the data when too few fishing craft are homeported in some states, only a few totals by major statistical subareas are calculated. Both revenue and profit figures show the predominance of fishing craft from Alabama, Florida, and Texas fishing in Statistical Subareas 1-8. This situation is directly a function of the number of fishing craft from these 3 states fishing in the subject areas. Among the 3 states, Florida accounts for the greatest revenues and profits in all major subarea grouping. In terms of revenues and profits, Florida fishing craft would be hit hard if closures were enacted for Statistical Subareas 1-3 and 6-8. A similar type of impacts can be said of Alabama fishing craft. Texas would be hit hard if closures were in Statistical Subareas 1-3. This nature of impacts follows closely the impacts described above when considering only the number of fishing craft affected.

Any reduction in vessel/boat revenues would translate to reduction in income of the crew. Crew shares may be approximated as 1/3 of vessel/boat gross revenues (Travis 2001). Using information from the vessel operating units file and Coast Guard data, Travis (2001) estimated that crew size would be about 2.1, 2.5, and 3.5, respectively, for fishing craft below 45 feet, 45 to 60 feet and greater than 60 feet. Using Tables 6 and 7b and assuming that state registered boats are below 45 feet in length, area closures would affect 2,031 crew members and income of $9.9 million in Statistical Subareas 6-8, 1,147 crew members and income of $2.3 million in Statistical Subareas 4-5, and 1,978 crew members and income of $12.6 million in Statistical Subareas 1-3[3]. A closure in Statistical Subareas 1-3 would affect a larger amount of crew income but fewer individuals than a corresponding closure in Statistical Subareas 6-8. To the

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[2]It should be noted that some of these vessels fish in areas other than in Statistical Subareas 1-8, particularly those fishing craft homeported outside of Florida or those larger vessels homeported in Florida.

[3]Total crew size should be interpreted more in terms of full-time or part-time equivalent employment, since some individuals may serve in more than one fishing craft. This is especially borne out by the fact that given the crew size and crew income, income per person would turn out to be significantly low. It should also be noted that persons may serve on various fishing craft fishing in different areas.

extent that larger vessels are likely more able to offset their landings/revenues reductions than smaller ones, it is likely that a closure in Statistical Subareas 6-8, which would affect more smaller sized vessels/boats, would eventually result in affecting more crew income and individuals than a corresponding closure in Statistical Subareas 1-3.

Another group of entities that would be affected by any closure are the dealers/wholesalers that purchase shrimp caught in Statistical Subareas 1-8. Table 7g provides some information on dealers that purchased shrimp caught from Statistical Subareas 1-8 in 1998 and 1999. There were 84 dealers in 1998; the number dropped to 76 in 1999. In 1998, the dealers were located in the following counties/ports: Monroe - 5, Lee - 7, Hillsborough - 4, Pinellas - 4, Franklin - 10, Bay - 3, Levy - 4, Mobile - 11, Brazoria - 3, Port Isabel - 10, and Brownsville - 5. In addition, 14 dealers were distributed among the following counties/parishes/ports: Gulf, Okaloosa, Escambia, Charlotte, Manatee, Citrus, Hernando, Baldwin, Jackson, Harrison, LaFource, East Cameron, Kemah, Galveston, and Palacios. In 1999, a decline of one shrimp dealer purchasing shrimp from Statistical Subareas 1-8 occurred in each of the following ports/counties: Monroe, Gulf, Levy, Baldwin, Galveston, and Palacios. The decrease in Mobile was 3 dealers, while a decrease of 2 dealers was seen in Port Isabel and Jackson. However, this was partially offset by increases in the number of dealers purchasing shrimp from these zones in Franklin (1), Escambia (1), East Cameron (1), and Kemah (2). A decline in the number of purchasing dealers was particularly noticeable from Statistical Subarea 8 (from 34 to 23), but also occurred from Statistical Subareas 6 and 2, thereby explaining the decreases in their respective subareas. An increase was actually seen in the number of dealers purchasing shrimp from Statistical Subarea 4, from 23 to 26.

Dealers in all three major area groups are very dependent on shrimp catches from Statistical Subareas 1-8, with the largest dependence being among dealers purchasing shrimp caught in Statistical Subarea 6-8. In 1998, 60 of the 84 dealers purchased about 52% of their entire gulfwide shrimp purchases from these areas, although a slight decline to about 49% occurred in 1999. One observation that can be inferred from this information is that a closure in Statistical Subareas 6-8 would impact more dealers and dealers that are highly dependent on catches of shrimp in these areas than a similar closure in Statistical Subareas 1-3. A closure in these latter areas would directly affect 42 to 48 dealers that purchased about 1/4 of their gulfwide shrimp purchases from shrimp caught in these areas.

Also affected by area closures are fishing communities dependent on the harvest of shrimp in Statistical Subareas 1-8. Jacob et al. (2002) recently completed a study of Florida fishing communities whose major objective was to develop a definition of fishing dependent communities and a protocol for identifying such places. Using their general cutoff level of dependence as 15% of employment in a distinct geographic area derived from fishing, they identified five commercially (fishing) dependent communities in Florida based on 1996 data: Steinhatchee, Apalachicola, Panama City, Ochopee/Everglades City, and Panacea. The authors also identified 7 recreationally dependent communities, but noted the lack of confidence in the recreational indicators used. Whether this definition of fishing dependence becomes a standard

is still too early to determine, although there appears from the study's characterization of the five commercial fishing communities that these communities are highly likely to be true fishing communities. A draft Supplemental Environmental Impact Statement accompanying a previously considered Amendment 18 to the Gulf Reef Fish Fishery Management Plan employed five criteria in an initial attempt at designating grouper fishery-dependent communities: (1) the area is associated with commercial vessel reef fish permit holders using longlines, spears, traps, or vertical lines; (2) the area is associated with greater than 10 charter, party, or headboat reef fish permit holders; (3) the area is in the top 20 locations for grouper sales in the Gulf; (4) the area is identified as a fishing community or activity center by a previous study; and, (5) the area has more than 20,000 private anglers holding licenses. Using these criteria 38 cities/ports were designated as fishing communities. From available information, it appears that, with the possible exception of the five fishing communities so designated by the Jacob et al. (2002) study, there is currently no clear delineation of various fishing communities throughout the Gulf. For this reason, only general statements are made regarding the possible locations of fishing communities that may be affected by shrimp harvest closures of areas in Statistical Subareas 1-8.

Table 8 provides a distribution, by counties/ports, of revenues from shrimp harvest in Statistical Subareas 1-8. Except for Lee and Monroe counties in Florida, shrimp caught in Statistical Subareas 1-8 and landed in Florida mostly came from Statistical Subareas 6-8. Outside of Florida, only Mobile accounted for most shrimp landings from Statistical Subareas 6-8. Brownsville, Port Isabel, and other ports in Texas, Mississippi, and Louisiana were more dependent on shrimp catches from Statistical Subareas 1-3. A closure then in Statistical Subareas 6-8 would affect more fishing communities located in Florida (except those in Lee and Monroe counties) and Baldwin and Mobile counties in Alabama. On the other hand, a closure in Statistical Subareas 1-3 would affect more fishing communities in Lee and Monroe counties in Florida and those in Louisiana, Mississippi, and Texas, although in the case of fishing communities in Mississippi and Louisiana, a relatively significant impact would also be felt by a closure in Statistical Subareas 6-8. A closure in Statistical Subareas 4-5 would have some relatively significant effects on fishing communities in Hillsborough, Lee, and Pinellas counties.

Within the various counties listed in Table 8, certain areas, or at least subareas, appear to be highly dependent on shrimp landings and may potentially be considered fishing communities. The following areas are: Key West and/or Stock Island in Monroe County, FL; Fort Myers Beach in Lee County, FL; Tampa in Hillsborough County, FL; Tarpon Springs and St. Petersburg in Pinellas County, FL; Yankeetown in Levy County, FL; Appalachicola and Carabelle in Franklin County, FL; Panama City in Bay County, FL; Bon Secour in Baldwin County, AL; and Bayou La Batre in Mobile, AL.

Alternative 6.1.2 considers permanent closure of the Tortugas Shrimp Sanctuary and the Southwest Florida Seasonal Trawl Closure boundaries. The Tortugas Shrimp Sanctuary is located in Statistical Subareas 1, 2 and 3. On average, these areas generated 7.5 MP of shrimp

valued at $27 million (Table 1). In 1998 and 1999, ex-vessel revenues from harvest of shrimp in these areas were $37.8 million and $21.4 million, respectively. Profits were $2.6 million and $1.4 million in 1998 and 1999, respectively. Previous estimates on the effects of the sanctuary indicated that it enabled an increase in the yield of pink shrimp by about 1.0 MP (GMFMC 1981). More recent estimates are not available. The sanctuary is permanently closed to shrimping, except for three small areas in the EEZ portion of the sanctuary. These three small areas totaling 63 square miles and located in Statistical Subareas 1 and 2 are open for shrimping on a seasonal basis. These areas comprise about 5% of the federal portion and 1% of the total area of the sanctuary (GMFMC 1992). In the absence of information on the amount of catch from the three small areas, the economic cost of the closure as in Alternative 6.1.2 cannot be ascertained. However, certain general insights on the economic consequences of such closure may be made.

Permanently closing the now seasonally open three areas in the Tortugas Shrimp Sanctuary, as in Alternative 6.1.2, would directly affect fishing craft that fish in Statistical Subareas 1 and 2 (possibly also Subarea 3). In 1998, there were 582 fishing craft, of which 574 were vessels and 8 were boats, that fished in Statistical Subareas 1-3. In 1999, the numbers dropped to 443 vessels and 7 boats, or a total of 450 fishing craft (see Table 7a). While most of the fishing craft were from Florida, a good number also came from Texas and Alabama. By considering only those fishing craft that fish exclusively in Statistical Subarea 1-3, a permanent closure of the three areas in the Tortugas Shrimp Sanctuary would affect more Texas fishing craft than those from Florida. As shown in Table 7d, 116 fishing craft out of 241 total fishing craft exclusively in these areas are homeported in Texas. In 1999, shrimp caught in Statistical Subareas 1, 2 and 3 were landed in 6 counties in Florida, namely, Charlotte, Franklin, Hillsborough, Lee, Monroe, and Pinellas and in ports in other states, especially Baldwin and Mobile counties in Alabama, Port Isabel and Brownsville in Texas. Of these areas, Hillsborough, Lee, and Monroe counties in Florida, Baldwin and Mobile counties in Alabama, and Port Isabel and Brownsville in Texas would likely shoulder most of the negative economic effects based on landings and revenues in these counties from shrimp catches in Statistical Subareas 1, 2 and 3 (Table 8). The magnitude of impacts would depend on the amount of the shrimp landings for these counties that come from the three subject areas in the sanctuary. In terms of bycatch reduction, it appears that closing these areas would not reduce bycatch by any significant amount. As can be inferred from Figure 2 showing the shrimp to finfish bycatch ratio, a 1-pound reduction in shrimp catch would reduce finfish bycatch by only 1.14 pounds. Hence, unless a very large amount of landings come from the subject three areas in the sanctuary, the resulting bycatch reduction would be very small.

One other point worth noting with Alternative 6.1.2 is that the main reason for opening the three areas in the sanctuary starting in 1988 was to alleviate the plight of those fishing around the area who suffered economically due to the reduced productivity of the Tortugas pink shrimp fishery. This fishery produced an average of 10 MP until 1985, but thereafter pink shrimp production in the Tortugas fishery dropped dramatically and in the last few years has hovered around 6 to 7 MP. Clearly, the rationale used to open the three small areas in the

sanctuary still holds especially when set against the backdrop of large declines in landings and revenues from 1998 to 1999. Thus permanently closing these areas would only worsen the economic conditions of fishermen in the area, especially when taking into account the newly proposed closed area in Statistical Subarea 2 under the auspices of the Tortugas marine reserves. Closure of the Tortugas marine reserves to shrimping has been estimated to reduce shrimp harvests in Statistical Subarea 2 by about 45,000 pounds, with the possibility of offsetting this reduction by shifting effort to other areas determined to be unlikely. It is, however, worth noting that in terms of potential community impacts, Texas ports would be affected more than ports in other areas since more Texas fishing craft fish exclusively at least in Statistical Subareas 1-3.

Another area for permanent closure specified under Alternative 6.1.2 is the Southwest Florida Seasonal Trawl Closure. This area is located in Statistical Subareas 1, 3, and 4 and its seaward boundary generally straddles between the 5- and 10-fathom contour lines. The area is closed to shrimping from January 1 through May 20. Data from the Shrimp Landings File (SLF) indicate that in 1999 shrimp harvest in Statistical Subareas 1, 3, and 4 for depths below 10 fathoms totaled 107,000 pounds valued at $429,000 during the months of June through December (see Table 9 for monthly catches by water depths in Statistical Subareas 1, 3, and 4). Most of the catch were from Statistical Subarea 4 from depths of 6 to 10 fathoms and thus most likely would not be from the subject area. In addition, catches are recorded for months when the subject area is supposedly closed to shrimp trawl fishing. In a sense then, these numbers may represent the maximum loss if a year round closure of the subject area is effected as proposed under Alternative 6.1.2. If the areas closed are located in Statistical Subareas 1 and 3, the number of fishing craft affected would be at the most 383 based on 1998 fishing season or 290 based on 1999 fishing season. Mostly larger vessels would be affected by the closure in the subject areas.

There are several combinations of closed areas that can be done under Alternative 6.1.1 or 6.1.3. In order to reduce bycatch by a significant amount, but with lesser reduction in shrimp catch, most of the closed areas would have to be in Statistical Subareas 4-5 and 6-8. Again, the numbers in Table 1 and Table 6 may be considered the potential maximum reduction in shrimp landings and revenues (Table 1) and profits (Table 6) if a total closure of these areas is imposed. Any percentage of these areas closed to shrimping would possibly translate to an equivalent reduction in shrimp landings, revenues, and profits. At the maximum, 1,070 fishing craft, of which 134 are boats, operated in Statistical Subareas 4-5 and 6-8 based on 1998 data, or 869 fishing craft, of which 170 are boats, based on 1999 data. Fishing craft fishing exclusively in Statistical Subareas 4-5 and 6-8 totaled 30 in 1998 and 19 in 1999.

Although in principle, there are long-term biological and economic benefits from area closures, these benefits cannot be properly estimated. The discussions then attempted here have been conducted to determine likely bycatch reduction and associated socioeconomic costs. Of the two prime areas for closure to reduce bycatch, it appears that closures of areas in Statistical Subareas 6-8 would be more effective than a similar closure in Statistical Subareas 1-3.

However, the associated socioeconomic costs of area closures in Statistical Subareas 6-8 would likely be higher than similar closures in Statistical Subareas 1-3.

6.2 Seasonal Closures

6.2.1 Rejected Alternative - Extend the Southwest Florida Seasonal Trawl Closure by one month before and one month after (or some lesser period) the present closed period (currently January 1 to May 20)

6.2.2 Rejected Alternative - Extend the present seasonal closures of the three small areas of the Tortugas Shrimp Sanctuary by one month before and one month after (or some lesser period) the present closed periods (current open periods vary by area between April 11 and September 30)

6.2.3 Rejected Alternative - Enact additional seasonal closures in areas of high bycatch, particularly Statistical Subareas 4-5 and 6-8 where there is a higher incidence of finfish bycatch

6.2.4 Proposed Alternative - Status Quo - do not extend the present closed seasons and do not enact additional closed seasons.

Discussion:
As discussed below, seasonal closures to shrimp trawling off the west coast of Florida, particularly in the EEZ, have mainly been adopted to prevent or ameliorate conflicts with other fisheries and their gears. Other seasonal closures, particularly in state waters, have been implemented to allow shrimp to grow to a more optimum harvest size.

The Southwest Florida Seasonal Trawl Closure (Figure 4) was implemented to resolve a violent gear conflict between stone crab and shrimp fishermen that occurred in 1978. The conflict arose as a result of shrimp vessels that fished at night for pink shrimp. During such time, they harvested, moved, and destroyed stone crab traps set by fishermen who fished in daylight. The concrete-weighted traps frequently damaged shrimp trawls. The shrimp vessels involved in the conflict were not locally based vessels and most were from out-of-state. Therefore, they had no prior knowledge of where stone crab fishermen set their traps. When violence between vessels began to occur the U.S. Coast Guard intervened and negotiated a temporary line of separation shoreward of which shrimp fishing was prohibited. Having resolved the armed conflict, the U.S. Coast Guard reported that they lacked authority to implement a permanent solution. Therefore, the Council rapidly developed an FMP to provide such authority and in that development period the Council convened the Stone Crab and Shrimp Advisory Panels (APs) to negotiate a permanent solution that was presented at public hearings and implemented in 1979.

As with the temporary U.S. Coast Guard line, the shrimp vessels were prohibited from fishing inshore of the line of separation (Figure 4) from January 1 to one hour past sunset on May 20. However, stone crab fishermen were not prohibited from setting traps seaward of the line, but would be subject to loss of traps if they did so. As shown in Figure 1 and Appendix A, the state of Florida also closed portions of its waters north of the Tortugas Shrimp Sanctuary seasonally to food shrimp trawling from October 1 to May 31.

As shown in Figure 5, 5 areas off Citrus and Hernando Counties on the west coast of Florida were seasonally and cooperatively closed to all shrimp trawling to avoid conflicts with stone crab gear. Zones I, II, and III are closed from October 5 to May 20. Zone IV is closed to shrimping from December 2 through April 1. Federal waters of Zone V are closed to shrimping from December 1 through March 15; however, state waters of Zone V are closed to shrimping from October 5 through November 30 of a given year and from March 16 through May 20 of the following year. Additional alternatives to expand seasonal closures in this area were not considered due to their complexity and variations between state and federal waters.

At the request of the shrimp industry based in the Florida Keys, the Council allowed vessels to fish in three small areas within the Tortugas Shrimp Sanctuary during the late spring and summer. Resource assessment information on the sanctuary indicated that pink shrimp were usually above the 36 count standard that maximizes yield per recruit (YPR) during that period. The three small areas are depicted as areas 1, 2, and 3 on Figure 6. Area 1 (25 square miles) is open April 11 through September 30, Area 2 (5 square miles) is open April 11 through July 31, and Area 3 (33 square miles) is open May 26 through July 31. The opening dates are related to the closure dates for spiny lobster (March 31) and stone crab (May 15) fisheries because traps are also fished in these small shrimping areas.

As with area closures, additional seasonal closures or extensions of present closures could be adopted to potentially reduce bycatch. As discussed in Amendment 9 (GMFMC 1997), juvenile red snapper are distributed over shrimping grounds for approximately 14 months; consequently, seasonal closures would have little effect on bycatch reduction for this species or for other species with similar life histories. For other species, the effectiveness of closed seasons would depend on whether these bycatch species are only seasonally available to shrimp trawl gear during a chosen closed season. Where this is the case, some reduction in bycatch from the existing seasonal closures would be expected, and further reductions could occur with additional or extended seasonal closures under the same assumed circumstances. On the other hand, short-lived species tend to have higher natural mortality rates. Consequently, any perceived biological benefits from seasonal closures may be offset by natural mortality.

As discussed under area closures, there are limited data on the most often encountered bycatch species on the west coast of Florida, and their seasonal distribution throughout this area is largely unknown. As with area closures, to fully evaluate the effect of existing or additional seasonal closures would require additional research that cannot be attempted at this time. However, as previously discussed the likely impacts of the use of seasonal closures would be

relatively insignificant because of the minimal amount of catch and effort that occurs throughout this entire area when compared to the overall Gulf shrimp fishery. As previously mentioned only approximately 6% of the entire fleet would be affected. Some of these vessels might relocate to other areas during additional or extended seasonal closures or use such time to perform maintenance.

Alternatives 6.2.1 and 6.2.2 would likely have the least impact on catch, bycatch, and participants. Alternative 6.2.1 would impose only a 2-month extension of an existing closed season within a relatively small area. Alternative 6.2.2 would include an additional 2-month closure for an extremely small (63 square nautical miles) area, and this choice would also force a change in the spiny lobster and stone crab seasons to prevent gear conflicts. Alternative 6.2.3 would have the greatest potential of the additional seasonal closure options to impact catch, bycatch, and participants depending on their location, area, and duration. However, as discussed under "Area Closures", there would be only minimal impacts from closing the entire area; consequently, any choice of seasonal closures would have even less impacts.

As discussed, area closures would reduce bycatch and directed harvest of all trawl vulnerable species within a given closed area, and the same would be expected of additional seasonal closures; however, as discussed under the "Biological Impacts," the impacts would likely be less for seasonal closures than permanent closures because some species remain in the area throughout the year, thus they would be vulnerable once the season reopened. Also, all impacts may not be positive because reducing bycatch of one species could have negative impacts on other species through altering predator/prey relationships or other ecosystem interactions. Additional seasonal closures would have minimal if any positive impacts to fish habitat regardless of their location because any impact to sessile and interstitial benthic species would only be forgone until the season reopened in such area. However, as previously discussed, existing trawling areas are not known to be permanently and negatively impacted by trawling. Additional seasonal closures would likely have minimal benefit to bycatch species, as previously discussed, but social and economic impacts to the local shrimp industry are likely to be more severe but less than permanent area closures.

Public safety would probably not be affected by additional seasonal closures, except in the case that Alternative 6.2.2 were approved without a corresponding change in the seasons for stone crab and spiny lobster. In such case, minimal gear conflicts could occur, but there is probably little fishing effort in these 3 small areas. Since this is not the proposed alternative, conflicts are not expected. Effort shifting or traveling great distances to trawl for shrimp would probably not occur, unless in the case of Alternative 6.2.3 large areas are closed for lengthy periods. Such a condition would have less impact than area closures that were deemed to be insignificant. Additionally, seasonal shifts currently occur without additional area closures because many larger vessels move fishing operations to the northern and western Gulf in the summer and fall to fish for brown and white shrimp. Furthermore, this alternative is not being proposed.

Seasonal closures under Alternative 6.2.1 and 6.2.2 are in Statistical Subareas 1-3, and are close to areas with unique characteristics, such as the Dry Tortugas Ecological Reserve and the Florida Keys National Marine Sanctuary. However, a 2-month expansion of these seasonally closed areas would have insignificant effects on unique characteristics of the environment here because current trawling is not known to be affecting such sites and an additional 2 months fishing is not likely to change this condition.

As previously discussed, social and economic data on the shrimp fishery on the west coast of Florida are sparse; therefore, a thorough analysis of the social and economic impacts of additional closed seasons to reduce bycatch off the west coast of Florida cannot be completed without additional costly research. The following "Socioeconomic Impacts" section discusses what impacts can be inferred from available information. Shrimp industry representatives have also testified against additional seasonal closures, and such closures appear to have the least promise for reducing bycatch of all the alternatives considered.

Seasonal closures in any fishery can generate controversy, if they interrupt existing fishing practices, and even when, as with the shrimp fishery on the west coast of Florida, the effects are minimal. Although the effects of additional seasonal closures in these areas are known only in general and qualitative terms, there is no indication that their effects are uncertain or implicate unique or unknown risks. As discussed, any effects are likely to be minimal, except in the case of large areas being closed for long periods of time. In such a case there would still be only minimal effects on the biological environment, but there could be more severe and negative impacts to the local shrimping industry.

Seasonal closures are already used as a management tool in the shrimp fishery and other fisheries. Consequently, additional or extended seasonal closures would not set a precedent or represent a decision in principle. It is simply an alternative that is being considered for potentially reducing bycatch and bycatch mortality at this time.

In terms of cumulative effects, the effects of additional closed seasons or extensions of existing ones would not amount to a significant change. Only in the case of large, extended seasonal closures would there be the possibility of effort shifting that would potentially shift impacts from one area to another, and as previously discussed create the potential for greater negative impacts if the bycatch in the area to which effort was shifted was already experiencing negative impacts.

Additional or expanded seasonal closures to shrimp trawling in the marine environment would not implicate issues relating to the National Register of Historic Places. Scientific, cultural, or historical resources may exist within areas considered for additional seasonal closures, but unless the closures were permanent, there would be no additional impacts, positive or negative.

Similarly, to the extent interactions occur with species listed under the ESA or such species' habitat within any new or existing closed seasons, any effect would likely be minimal. If large,

extended closed seasons were implemented, the effect could be similar to additional closed areas and may afford some additional protection to such species and their habitat.

The alternatives for additional seasonal closures are being considered based on the requirement of the M-SFCMA to reduce bycatch and bycatch mortality to the extent practicable which is consistent with other protective legal authorities such as the NMSA, CZMA, and other relevant authorities. Implementation of additional seasonal closures would complement such authorities, but would likely have little effect.

As discussed herein, establishing additional or expanded closed seasons east of Cape San Blas, Florida would not be a practicable measure for minimizing bycatch and bycatch mortality. As previously stated, population effects of most bycatch species are largely unknown, but there would be little if any impact to bycatch species from a 2-month extension of existing closed seasons. Only if large, extended closed seasons, tantamount to closed areas, were implemented would there be a potential for positive effects to such bycatch populations.

Ecosystem interactions are also mostly unknown, and as discussed in the "Biological Impacts" section of Section 6.1, they "could be positive or negative depending on whether an individual bycatch species is or becomes a predator or prey of other species." As previously discussed, there would probably be no, or very little, impacts of extending existing closed seasons by 2-months. Large, extended closed seasons would have the potential for greater impacts, but large closed areas are currently in effect, and they do not appear to have altered the biological diversity on the west coast of Florida. Consequently, even large, extended closed seasons are not likely to have any significant ecological impacts.

Additional or expanded closed seasons are not likely to produce a change in the bycatch species or cause population or ecosystem effects. They are basically temporary and would only provide additional protection for species that are susceptible to trawling only during the time of such closures. Closed seasons are currently used in state and federal waters in this area, and there is no information that suggests that species diversity has been altered by such closures or would be altered by additional or expanded seasonal closures.

As stated under Section 6.1, interactions between shrimp trawlers and marine mammals and birds are not known to occur, therefore no effects of additional or expanded seasonal closures would be anticipated. Shrimp trawl gear is pulled along the sea floor, making it unlikely that birds would fly or swim deep enough for an interaction, and operate at sufficiently slow speeds to virtually preclude interaction with marine mammals.

As indicated in the discussion of "Socioeconomic Impacts" the costs of an additional 2-month closure as indicated in Alternatives 6.2.1 and 6.2.2 would be minimal, but the potential for bycatch reduction would be even less because in these areas the ratio of shrimp to bycatch is approximately 1:1.77. Closures would have a greater negative impact on shrimp catch in Statistical Subareas 4-5 if they were implemented in the months of January through June. In

Statistical Subareas 6-8, impacts would be about the same regardless of the months chosen. Obviously, the longer the closure (regardless of months) the greater the impacts would be. Effort shifting could offset losses if seasonal closures are short; however, losses from longer closures are not likely to be compensated. One would probably not deem it to be practicable to incur increasing costs and lost profits for extremely little gains in bycatch reduction that would only occur if closures were of large areas for lengthy durations.

A 2-month extension of the present seasonal closures as in Alternatives 6.2.1 and 6.2.2 would probably have only minimal impacts to research, enforcement, and administration costs and a reduction in management effectiveness. Additional closed seasons, especially if they are large and extended, would have greater impacts, proportionally. Sections 6.2.1 and 6.2.2 would add a 2-month extension of existing closed seasons and would probably have little impact to the shrimp fishery and the aforementioned costs in terms of enforcement and voluntary compliance, as opposed to new closed areas because they are known to the industry and enforcement personnel. Furthermore, they only require an expansion of the existing enforcement presence, as opposed to requiring an enforcement presence in new areas for some time period that would likely result from the choice of Section 6.2.3. Although such closed seasons may be easier to enforce and require reduced costs when compared to permanent area closures, they would still have greater impacts than the choice of requiring BRDs. Like area closures, additional seasonal closures were not supported by the shrimp industry; consequently, they would likely foster non-compliance. Again, disgruntled fishermen may not be willing to assist researchers either voluntarily or under contract if additional seasonal closures are implemented, thereby hampering research efforts. It would not appear practicable to incur the increased management and enforcement costs coupled with the potential for compromising some research efforts for extremely minimal potential reduction in bycatch and bycatch mortality from additional seasonal closures.

As discussed in the "Socioeconomic Impacts" section additional closed seasons would only have the potential for significant economic impacts if they are large and closed for extended periods of time. Under such conditions they would also have negative social impacts for shrimpers that would be required to shift effort to other areas or cease trawling during the closed season. As discussed for "Area Closures" some recreational fishermen and charter operators fish recreationally near shrimp trawlers to increase their success; consequently, the economic, social, and cultural value of their recreational fishing activity would be lessened by extended closed seasons or additional closed seasons in other areas. The impacts would likely be smaller than for permanent closures of areas previously discussed. Nonconsumptive uses such as scuba diving would probably not experience any impacts from seasonal closures.

Changes in the distribution of costs and benefits that could result from additional or extended closed seasons would likely occur only among those participating in the shrimp fishery, and they would probably not be significant unless additional, large and extended closed seasons were established. As discussed herein, any potentially significant benefits in the form of additional bycatch reduction from additional, large and extended closed seasons would

probably result in high costs to participants. The likelihood of such costs when compared to the potential for only minimal increases in bycatch reduction appears to indicate that this alternative is not practicable.

As discussed above and in the "Socioeconomic Impacts" section, social effects would vary depending on the choice of alternatives for additional or extended closed seasons. Any social effects would be very minimal for the 2-month extensions of existing closed seasons as described in Sections 6.2.1 and 6.2.2 and be more localized to the west coast of Florida. Effects would increase with size and length of closure for any additional closed seasons, and they would likely effect more participants from other areas of the Gulf. Although from an overall Gulf shrimp fishery perspective, these effects would be minor regardless of the size or length of additional seasonal closures. From a potential social effects perspective compared to potential bycatch reduction, additional or extended seasonal closures would not be deemed practicable.

Biological Impacts:
Additional or extended closed seasons could be established to further reduce bycatch on the west coast of Florida; however, the biological impacts of existing seasonal closures and possible additional seasonal closures on various bycatch stocks have not been evaluated. Furthermore, there is insufficient data to evaluate the location and duration of additional seasonal closures to optimize bycatch reduction with minimal impacts to shrimping. Present data on the life histories of many bycatch species in this area are insufficient to fully evaluate impacts. As such, it is not known which species may be distributed over the shrimp grounds off the west coast of Florida throughout the trawling season and which species are only seasonally available. For species, like red snapper as discussed in Amendment 9 (GMFMC 1997), seasonal closures would not be effective in reducing their bycatch. If they are only found on the shrimp grounds during a portion of the season or are more abundant during some period, closed seasons could be effective in reducing their bycatch. Also, as discussed above, the effect of any reduction in bycatch from seasonal closures on the health and size of a given stock or species group has not been determined, but it could have positive or negative impacts on other species due to changes in predator/prey relationships, thus a complete picture of ecosystem interactions would also be needed for accurate analysis. Such an analysis would be a tremendous undertaking for which there exists neither the scientific capability nor the funding to accomplish, therefore potential effects must be evaluated using theoretical approaches in analyzing existing information. Intuitively, seasonal closures would be expected to have a lesser impact on bycatch reduction than permanent closures because some species are likely to remain in a given area after the seasonal closure ends, thus only delaying their being subject to trawling.

Tables 4 and 5 provide the only available data on potentially impacted species from which general predictions about potential biological impacts to bycatch species can be made. Although general, these predictions find support in the analogy provided by past experience in other areas of the Gulf of Mexico, as represented by the record underlying and reflected by

Amendment 9 (GMFMC 1997). As with area closure options in Section 6.1, using these data requires an assumption of an even distribution of these species over these statistical subareas as stratified, as well as equal trawlability. As previously stated, such an assumption is likely erroneous based on present knowledge; consequently, the analysis is largely qualitative in nature. As previously stated, Table 5 contains limited data on the percent composition of species caught in shrimp trawls by weight per unit effort. The "other species" category constitutes a substantial percentage of overall shrimp trawl harvest in most of these data for Statistical Subareas 1 through 8, making the task of estimating biological impacts of closed areas or seasons from the data less precise. This "other species" category is, however, inclusive of a very small number of numerous species; consequently, any impacts to individual species in this category would be small and probably insignificant. Using this assumption, additional 2-month seasonal closures of the existing areas as described in Sections 6.2.1 and 6.2.2 and shown in Figures 4 and 6 would reduce bycatch by species and amount proportionally to the areas, seasons, and depths described in Tables 4 and 5 by number and weight, respectively, provided that such species are available in these areas at these times and the amount of trawling that would be expected to occur during these periods. Extension of the existing Tortugas Shrimp Sanctuary Closure by 2-months (Section 6.2.2) would probably have hardly any impact on reducing bycatch because: (1) this area is extremely small (63 square nautical miles); (2) the additional closures would extend into the summer (May and September) and the fall (October), and the shrimp fishery in this area primarily operates in the winter (December and January); and (3) in Statistical Subareas 1-3, where these areas are located, the shrimp to bycatch ratio is approximately 1:1.77, thus there is very little bycatch when compared to the other Statistical Subareas 4-8 where the shrimp to bycatch ratio is approximately 1:5.6 (Figure 2). The 2-month extension of the Southwest Florida Seasonal Trawl Closure would also have very little biological impact because only the December month extension would coincide with a major effort period, and again, this closure is mostly in Statistical Subareas 1-3 where the amount of bycatch is small. As with area closures, additional seasonal closures would have to be rather large and prolonged to have any potentially significant biological impacts, and as previously discussed this is not likely to happen. As previously discussed, if such measures were implemented, there could be positive or negative impacts to individual bycatch species. Also, if they caused effort to be shifted to other areas, the potential for negative biological impacts would be increased due to increased effort.

Socioeconomic Impacts:

Previous discussions noted that the area currently subject to Southwest Florida Seasonal Trawl Closure generated about 107,000 pounds of shrimp valued at $429,000 during the months of June through December. Of this amount, about 34,000 pounds valued at $152,000 are accounted for by the months of June and December. These would be the potential losses to the shrimp vessels if the seasonal closure is extended by one month before (December) and one month after (June) the closure, as proposed under Rejected Alternative 6.2.1. Fishing craft operating in Statistical Subareas 1 and 3, where the subject areas are located, totaled 383 based

on 1998 fishing season or 290 based on 1999 fishing season. Mostly larger vessels would be affected by the closure in the subject areas.

Since even the total catch, much less the seasonal catch, from the three small areas considered under Alternative 6.2.2 is not known, the economic impacts of this alternative cannot be quantified. It may only be worthwhile recalling that in an earlier discussion the most likely negative impacts of closing these three areas would fall on vessels fishing in Statistical Subareas 1-3. In 1999, there were 450 fishing craft that fished in these areas, of which 7 were boats (Table 7a). In 1999, shrimp catches from these two areas were landed in 6 counties in Florida, namely, Charlotte, Franklin, Hillsborough, Lee, Monroe, and Pinellas and in ports in other states, especially Baldwin and Mobile counties in Alabama and Port Isabel and Brownsville in Texas. Of these areas, Hillsborough, Lee, and Monroe counties in Florida, Baldwin and Mobile counties in Alabama, and Port Isabel and Brownsville in Texas would likely shoulder most of the negative economic effects based on landings in these counties from shrimp catches in Statistical Subareas 1-3 (Table 8). The magnitude of impacts would depend on how much of the shrimp landings for these counties comes from the three subject areas in the sanctuary during the two months proposed to be closed. In terms of bycatch reduction, it appears that closing these three areas by an additional two months would not reduce bycatch by any significant amount. As can be inferred from Figure 2 showing the shrimp to finfish bycatch ratio, a 1-pound reduction in shrimp catch would reduce finfish bycatch by only 1.14 pounds. Hence, unless a very large amount of landings come from the subject three areas in the sanctuary, the resulting bycatch reduction would be very small.

Rejected Alternative 6.2.3 presents several combinations for seasonal closures of the two sub-areas. Some general insights into the potential economic impacts of additional seasonal closures in Statistical Subareas 4-5 and Statistical Subareas 6-8 may be gained from an examination of the seasonal distribution of catches from these two sub-areas. Table 10 shows the 1999 monthly distribution of catches and values by areas (Statistical Subareas 4-5 and Statistical Subareas 6-8).

In Statistical Subareas 4-5, the concentration of shrimp catches occurs in the months of January through June. On the other hand, catches in Statistical Subareas 6-8 are about evenly distributed throughout the year although there are months, such as January-February, May-July, and November, when catches exceed 1.0 MP. If bycatch in both subarea groupings were about evenly distributed throughout the year, it would appear that for Statistical Subareas 4-5, larger negative economic impacts would occur if closure were for any months January through June. For Statistical Subareas 6-8, the choice for closed months that would generate relatively smaller (or larger) negative economic impacts is not as clear. It would appear though that relatively smaller negative economic impacts would ensue if the months chosen for closure were either March-April or August-October. The negative economic impacts can be alleviated if effort can be successfully shifted to the open months, but then harvesters would have to contend with potentially lower prices as more shrimp than usual, at least in the short term, would be landed in the open months.

6.3 Bycatch Reduction Devices

6.3.1 Rejected Alternative - Require the installation of BRDs in each net used aboard vessels trawling for shrimp in the Gulf of Mexico EEZ east of Cape San Blas, Florida (85°30' W. Longitude) that are approved in Rule 68B-31.0045, Florida Administrative Code under authority of Section 370.027(2), Florida Statutes. Exempted are vessels trawling for royal red shrimp beyond the 100-fathom contour and vessels trawling for groundfish or butterfish. A single try net with a headrope length of 16 feet or less per vessel and no more than two rigid-frame roller trawls limited to 16 feet or less, such as those used in the Big Bend area of Florida are also exempted.

6.3.2 Rejected Alternative - Require the installation of NMFS-certified BRDs in each net used aboard vessels trawling for shrimp in the Gulf of Mexico EEZ east of Cape San Blas, Florida (85°30' W. Longitude). Exempted are vessels trawling for royal red shrimp beyond the 100-fathom contour and vessels trawling for groundfish or butterfish. A single try net with a headrope length of 16 feet or less per vessel and no more than two rigid-frame roller trawls limited to 16 feet or less, such as those used in the Big Bend area of Florida are also exempted.

6.3.3 Proposed Alternative - Require the installation of NMFS-certified BRDs that meet or exceed the bycatch reduction criteria established by the Council in each net used aboard vessels trawling for shrimp in the Gulf of Mexico EEZ east of Cape San Blas, Florida (85°30' W. Longitude). Exempted are vessels trawling for royal red shrimp beyond the 100-fathom contour and vessels trawling for groundfish or butterfish. A single try net with a headrope length of 16 feet or less per vessel and no more than two rigid-frame roller trawls limited to 16 feet or less, such as those used in the Big Bend area of Florida are also exempted. Bycatch reduction criteria shall be as follows:

Proposed Option a.	**BRDs must reduce the bycatch of finfish by at least 30% by weight**
Rejected Option b.	**BRDs must reduce the bycatch of finfish (by number or weight) by at least 20% or (30%, 40%, or 50%)**
Rejected Option c.	**BRDs must reduce the bycatch of all species (by number or weight) by at least 20% or (30%, 40%, or 50%)**
Rejected Option d.	**No bycatch reduction criteria are specified**

6.3.4 Rejected Alternative - Require the use of BRDs as specified in Sections 6.3.1 or 6.3.2 above, only in areas of the EEZ north of 26° N. Latitude (the dividing line between Statistical Subareas 3 and 4)

6.3.5 Rejected Alternative - Require the use of BRDs as specified in Sections 6.3.3 above, only in areas of the EEZ north of 26° N. Latitude (the dividing line between Statistical Subareas 3 and 4)

6.3.6 Rejected Alternative - Require the use of BRDs as specified in Sections 6.3.1, 6.3.2, or 6.3.3 above, only in areas of the EEZ north of 28° N. Latitude (the dividing line between Statistical Subareas 5 and 6)

6.3.7 Rejected Alternative - Status Quo - do not require BRDs in shrimp trawls used aboard vessels trawling for shrimp in the Gulf of Mexico EEZ east of Cape San Blas, Florida (85°30' W. Longitude)

Discussion:
Currently, there are various areas along the west coast of Florida from Cape San Blas to the Florida Keys that are closed either permanently or seasonally (see discussions above). As noted, the effects of these closed areas on bycatch reduction have not been determined (but would be minimal when compared with overall bycatch in the Gulf), and data on the species involved are very limited. In addition to closed areas and seasons, the state of Florida enacted additional restrictions on the shrimp fishery in 1996. These restrictions include a reduction in the amount and type of allowable gear in various areas (basically no more than 500 square feet of net within 3 miles of shore) and the requirement of BRDs in state waters. Although the effects of these changes in gear on bycatch reduction have not been adequately evaluated, several research efforts have been conducted in both inshore bay areas and Florida state waters to determine the effects of BRDs and to characterize bycatch. Coleman et al. (1992) tested various BRDs using small otter trawls in Pensacola Bay, Choctawhatchee Bay, Apalachicola Bay, St Andrews Bay, St. Johns River, Tampa Bay, and Charlotte Harbor. The results of these studies were highly variable (bycatch ranging from a 2% increase to over a 75% reduction, and 0shrimp catch ranging from a 17% increase to about a 47% reduction). The variation in these results is probably due to the small sample sizes and using different types of BRDs.

Steele et al. (2002) tested the efficiency of the Florida Fisheye and Large Mesh Extended Funnel BRDs in small otter trawls in Tampa Bay. They concluded that these BRDs significantly reduced bycatch of finfish with no significant shrimp loss. The top 10 species encountered (by number) included: leopard searobin, silver jenny, gafftopsail catfish, hardhead catfish, tonguefish, southern kingfish, sand seatrout, silver perch, pinfish, and spadefish. Interestingly, the number of leopard searobin and tonguefish increased in most nets equipped with either of these BRDs when compared to control nets with only a turtle excluder device (TED), and results were also highly variable.

Table 11 shows possible shrimp loss and finfish bycatch reduction estimates for 5 different BRDs used in tests covering Statistical Subareas 1-8 (NMFS unpublished data). As shown, shrimp loss ranged from 0% to 10%, and bycatch reduction ranged from 7% to 40%. These data came from very few tests, and most were in Statistical Subareas 1-3. Possible shrimp loss and finfish bycatch reduction estimates from BRD studies in other areas of the Gulf and South Atlantic where there is considerably more data available over a broader area are provided in Table 12. As shown, the potential finfish bycatch reduction ranges from 31% to 58%. The most commonly used BRD in the Gulf to reduce bycatch of red snapper (Fisheye) was shown to reduce overall finfish bycatch by an average of approximately 35%. Although data in Table 12 show that the Jones/Davis BRD is capable of achieving a 58% reduction in finfish bycatch with only a 4% shrimp loss, this BRD is not preferred by the vast majority of shrimpers due to its complexity and cost when compared with the Fisheye BRD. Additionally, the currently certified Jones/Davis BRD includes large holes in the net for escapement of finfish, and most shrimpers fear that these large holes will allow more shrimp loss, be more costly and time consuming to repair, and in general have other perturbations as opposed to the Fisheye.

Table 4 shows the top 10 species caught in shrimp trawls in numbers stratified by area, depth, and season (where data are available) (NMFS unpublished data). Table 5 provides this information based on weight in kilograms.

Bycatch of crustaceans and other invertebrates is not effectively reduced by BRDs. This fact is significant in that a large portion of the bycatch in terms of numbers and weight for Statistical Subareas 1-3 are made up of invertebrates (Tables 4 and 5, Figure 2). Many of these species do not, however, suffer bycatch mortality. Many of the invertebrate species are hardier than the small finfish species that are caught in shrimp trawls, thus more come aboard alive. Many of the crab species are able to walk across the deck and fall back into the water. Other species such as starfish, sponges, sand dollars, and unwanted shrimp species are sturdy enough to survive until culled overboard. Consequently, although invertebrates may not be effectively excluded by BRDs, bycatch mortality is less for many of these species.

Based on these studies, the potential reduction in bycatch from requiring BRDs in the EEZ east of Cape San Blas, Florida would vary depending on the type of BRD used; the type of shrimp-trawl gear used; the species involved; and the season, area, and depth of fishing. It would also be contingent on the amount of shrimping effort over statistical subareas and in the EEZ versus state waters. These data are currently not available; however, inferences from existing data are used in the following discussion.

To estimate the effects of requiring BRDs in the EEZ east of Cape San Blas, the effects of current requirements must first be evaluated. As previously stated, Florida currently requires the use of BRDs in state waters. Table 13 shows average shrimp catches, trips, and effort in days fished by depth for 1991-2000 from Statistical Subareas 1-8 with subgroupings of 1-3, 4-5, and 6-8 and percentages of the total. Table 2 shows the average depth along the Florida state-federal boundary, and Table 1 shows shrimp catches by individual statistical subarea. As

shown in these tables and Table 3, the majority of catch, trips, and effort (88%, 95%, and 86%, respectively) from Statistical Subareas 1-3 comes for the 11-20 fathom depth range. Tables 1 and 3 show that the majority of the catch, trips, and effort in Statistical Subareas 1-3 (75%, 79%, and 71%, respectively) come from Statistical Subarea 2. Table 2 shows that the average depth along the state-federal boundary of Statistical Subarea 2 is 20.5 fathoms. Consequently, based on these data, the majority, approximately 70%, of the catch and trawling effort from Statistical Subareas 1-3 comes from state waters. (Note: anecdotal information from some fishermen and others involved with the shrimp industry indicates that there is greater fishing effort in federal waters than would be indicated by these data). Based on these and other data, the requirement of BRDs in Statistical Subareas 1-3 would have a minimal effect on bycatch reduction because: (1) only 41% of the bycatch from this area is finfish (Figure 2), and invertebrates are not effectively excluded by BRDs; (2) only about 30% of the trawling effort occurs in the EEZ of this area, consequently only about 12% of the finfish bycatch is currently not effected by a BRD requirement; and (3) BRDs are generally less than 50% effective in reducing finfish bycatch, consequently there would only be about a 6% reduction in finfish bycatch from requiring BRDs in the EEZ of Statistical Subareas 1-3.

For Statistical Subareas 4-5, only approximately 1.5% of the shrimp catch and effort occur in state waters. There is also a larger finfish component of the bycatch (66%). As such, BRDs would probably be effective in the EEZ of this area; however, this statistical subarea grouping has only about 9% of the total shrimping effort for Statistical Subareas 1-8. Consequently, the BRD requirement would have a minimal effect here.

In Statistical Subareas 6-8, the finfish component of the bycatch is also 66% (Figure 2). Additionally, only about 11% of the shrimp catch and effort occurs in state waters of Statistical Subareas 6 and 7.

In Statistical Subarea 8, average depth along the state-federal boundary is about 11.5 fathoms, and about 28% of the shrimping effort for Statistical Subareas 6-8 occurs in this subarea. Assuming that 28% of the effort occurs in Statistical Subarea 8 and 48% of the total effort for Statistical Subareas 6-8 occurs inside of 10 fathoms, then a rough estimate of approximately 13% of the total effort for Statistical Subareas 6-8 occurs inside state waters of Statistical Subarea 8. Additionally, BRDs are currently required in a portion of the EEZ of Statistical Subarea 8.

Based on these data, the effectiveness of BRDs in the EEZ of Statistical Subareas 6-8 would be expected to be greater than in the other statistical subareas or subarea groupings on the west coast of Florida. This statement assumes that there is a similar distribution of bycatch species that would be susceptible to catch in shrimp trawls and effectively excluded by BRDs.

With regard to the alternatives, Rejected Alternative 6.3.1 would allow the use of any BRD that is certified by Florida law for use in state waters. Currently, all BRD designs that are certified for use in the EEZ of the Gulf are also certified for Florida state waters. Additionally, the

Extended Funnel BRD is also certified for Florida waters, but not in other areas of the Gulf because it does not meet the criterion for reduction of red snapper as approved in Amendment 9 (GMFMC 1997). Selection of this alternative would preclude vessels from having to change BRDs when moving shrimping operations from state waters to federal waters, if there are differences in designs allowed. Rejected Alternative 6.3.2 would allow the use of any BRD certified by the NMFS for federal waters of the Gulf and South Atlantic. The criteria for these certifications are based on bycatch reduction of red snapper and weakfish for the Gulf and South Atlantic, respectively, and currently include all designs that are certified in Florida state waters. Proposed Alternative 6.3.3 would allow the Council to set a bycatch reduction criterion for the west coast of Florida south and east of Cape San Blas with the Proposed Option of a 30% reduction in finfish catch by weight. Choice of this proposed alternative would include all currently certified BRDs under Rejected Alternatives 6.3.1 and 6.3.2. Furthermore, it would provide a criterion for approving future new BRD designs that may be developed and that potentially could have lower shrimp loss rates and higher bycatch reduction percentages. Rejected Alternatives 6.3.4, 6.3.5, and 6.3.6 provide options for exempting certain areas and are tied to the choice of either Rejected Alternatives 6.3.1 and 6.3.2, as well as the Proposed Alternative 6.3.3. Rejected Alternatives 6.3.4, 6.3.5, and 6.3.6 include options for exempting Statistical Subareas 1-3 and 1-3 plus 4-5 due to data indicating that: (1) in Statistical Subareas 1-3 bycatch reduction would be minimal because the shrimp to finfish ratio of the catch is 1:1.14: (2) most of the shrimping effort occurs in state waters where BRDs are already required; and (3) the shrimp loss in this area has been estimated at approximately 10% from the Fisheye BRD. The exemption option for BRDs in Statistical Subareas 4-5 (Rejected Alternative 6.3.6) is based on previous discussions of a low amount of shrimping effort in this area (Table 3) which would translate into minimum benefits. Rejected Alternative 6.3.7 would not require BRDs in the EEZ off the west coast of Florida east of Cape San Blas.

As shown in Tables 4 and 5, there are very few shrimp trawl encounters with managed species, particularly mackerels and reef fish, off the west coast of Florida; and the amount of their catch in either pounds or numbers is also small. Additionally, most such catches occur in water depths >20 fathoms. The amount of shrimping effort in depths >20 fathoms ranges between 1.5% and 5% for the 3 statistical subarea groupings (Table 13). Consequently, the potential catch of managed species is minimal.

Personal communication with some commercial shrimpers with larger vessels indicated that they no longer fish in Florida state waters, primarily due to the 500 square feet gear restriction on trawls used inside of 3 miles. Based on available data, shrimp trawl encounters with managed species primarily occur in the EEZ because state waters typically extend only to approximately 4 to 8 fathoms in Statistical Subareas 1-8, with the exception of Statistical Subareas 2 and 8 where the EEZ begins at approximately 20.5 and 11.5 fathoms, respectively (Table 2). These shrimpers also indicated that most of these vessels were currently using BRDs. To the extent that BRDs are not being used in the EEZ, the requirement of BRDs would probably reduce the bycatch of both managed and unmanaged finfish species, as discussed above. Possible percentages are presented in Tables 11 and 12, assuming that the

reduction rates are applicable to all finfish catch. If most trawlers in the EEZ off Florida are already using BRDs, there would be only minor benefits to bycatch reduction from requiring these devices; however, the requirement would result in potential increases in enforcement costs or redirection of some enforcement efforts.

There should be little or no effect on public safety from requiring BRDs off the west coast of Florida because these devices are already required in other areas of the Gulf and many, if not most, of the same vessels that fish in the EEZ off Florida also fish in the northern and western Gulf, thus they already use BRDs at least part of the time. Furthermore, this requirement would not likely cause vessels to change their current fishing behavior because such was not the case when BRDs were required in the EEZ west of Cape San Blas, Florida where approximately 90% of the catch and effort in the shrimp fishery occurs.

Some geographic areas off the west coast of Florida have unique characteristics, primarily coral reefs, such as the Dry Tortugas Ecological Reserve, the Florida Keys National Marine Sanctuary, and the Florida Middle Grounds. However, those specific areas and others are already closed to trawling. The amount of trawling occurring near these areas is extremely low due to the potential for gear damage, and the requirement of BRDs would not change current trawling operations, thus there would be insignificant effects on unique characteristics of the environment in those areas.

As previously discussed, social and economic data on the shrimp fishery on the west coast of Florida are generally lacking; consequently, a comprehensive analysis of the social and economic impacts of requiring BRDs to reduce bycatch off the west coast of Florida cannot be completed without additional costly research. The following "Socioeconomic Impacts" section discusses what impacts can be inferred from available information. Shrimp industry representatives have, however, testified against an additional requirement of BRDs in this area.

The effects of BRDs on reducing bycatch would likely be similar to their effects in other areas as discussed herein, and there is no indication that they would implicate unique or unknown risks. As shown in Tables 11 and 12, BRDs would probably produce a bycatch reduction for finfish of 35% to 40% with only a 4% shrimp loss. Their use would likely constitute only a minimal change for the biological environment with the least amount of loss in terms of social and economic impacts to the local and Gulfwide shrimping industry of all the bycatch reduction alternatives considered.

Bycatch reduction devices are already required in other areas of the Gulf EEZ and in state waters of Texas and Florida; consequently, requiring BRDs east of Cape San Blas, Florida or some portion of that area would not set a precedent. Furthermore, in terms of the cumulative effects, the requirement of BRDs in the EEZ off the west coast of Florida would not represent a significant change because as previously mentioned they are already required in the EEZ of the rest of the Gulf where approximately 90% of the catch and effort occurs, and many of the same vessels fish both areas.

Requiring BRDs in the EEZ off the west coast of Florida would have no implications relating to the National Register of Historic Places. To the extent scientific, cultural, or historical resources may exist in the Gulf, the requirement to place a BRD in each trawl would not create a change from the current status.

Similarly, to the extent interactions occur with species listed under the ESA, the requirement of BRDs could be positive if BRDs exclude such species and reduce any mortality. However, the requirement of TEDs has had the greatest beneficial impact on reducing mortality of endangered sea turtles. Other impacts of trawls on ESA species that would likely be affected by the requirement of BRDs are not known to occur. The M-SFCMA's requirements to reduce bycatch and bycatch mortality to the extent practicable is consistent with other protective legal authorities such as the NMSA, CZMA, and other relevant authorities.

As discussed in more detail in previous and following discussions, the requirement of BRDs in shrimp trawls used in the EEZ is the only potentially practicable measure for minimizing bycatch and bycatch mortality. As previously stated, the data on percent bycatch reduction for most species by BRDs that have been tested are sparse for the west coast of Florida. Furthermore, the data are insufficient to determine whether the bycatch of managed species, particularly reef fish and mackerels is sufficiently large that the requirement of BRDs would effect total mortality, recruitment, or stock size. Available data indicate that the bycatch of these managed species is insignificant. It is, however, likely that many of the BRD designs reported in Tables 11 and 12 would reduce bycatch of finfish. Additionally, to accomplish a given reduction in bycatch (e.g. 30%), the shrimp loss from requiring BRDs would probably be less than through the use of area closures or seasonal closures as discussed in Sections 6.1 and 6.2. As previously mentioned, the determination of the amount of bycatch reduction achievable from the requirement of BRDs in this area would require additional study and would vary depending on the type of BRD used; the type of shrimp-trawl gear used; the species involved; and the season, area, and depth of fishing. Such a study would require an extensive and costly research effort. Furthermore, such a study may not be necessary to the management choice of whether to require BRDs to reduce bycatch on the west coast of Florida. Table 12 includes all data from evaluations of BRDs by NMFS in the South Atlantic and Gulf. It also includes the limited data from the west coast of Florida reported in Table 11. As shown in Table 12 and based on the data from various geographic areas, all BRD designs currently certified are capable of reducing finfish bycatch by at least 30%. It is therefore likely that these BRD designs would also produce at least a 30% reduction in finfish bycatch from the west coast of Florida. However, in Statistical Subareas 1-3, there would likely be as much as a 10% reduction in shrimp harvest with a minimal reduction in finfish bycatch. Also, as previously discussed, the overall impact of total finfish reduction in this statistical subarea grouping from the use of BRDs would probably be much less than the groupings in other areas, and the cost in terms of shrimp loss would probably be high.

As discussed, ecosystem interactions are difficult to predict; however, as discussed in the "Biological Impacts" section below, effects could be positive or negative depending on

whether an individual bycatch species is or becomes a predator or prey of other species. As previously discussed, BRDs are already required in other areas of the Gulf, and their requirement does not appear to have significantly changed biological diversity. Consequently, the requirement of BRDs off the west coast of Florida would probably not cause any significant ecological impacts.

Although as previously discussed, the ecological impacts of the requirement of BRDs off the west coast of Florida cannot be precisely determined, in other areas they do not appear to have caused a significant change in the bycatch species, nor therefore to trigger population or ecosystem effects. Tables 4 and 5, and Amendment 9 (GMFMC 1997), indicate bycatch species by area to the extent the information is available. No information suggests that species composition would be significantly altered by requiring BRDs, thus any potential changes to species composition, are likely to be minimal.

Interactions between shrimp trawlers and marine mammals and birds are not known to occur, therefore no effects would be anticipated. Shrimp trawl gear is pulled along the sea floor, making it unlikely that birds would fly or swim deep enough for an interaction, and operate at sufficiently slow speeds to virtually preclude interaction with marine mammals.

As indicated in the discussion of "Socioeconomic Impacts" the costs of requiring BRDs would be greater in Statistical Subareas 1-3 than in Statistical Subareas 6-8, although lost profits may be greater in Statistical Subareas 6-8. Statistical Subareas 4-5 involve less shrimping effort and less bycatch than the other subareas, so costs and lost profits would likely be less there as well. The requirement of BRDs is, however, not expected to change fishing or fishermen's behavior nor would it be expected to alter processing, disposal, or marketing costs. The practicability of increasing costs and lost profits for what appear to be minimal gains in bycatch reduction from requiring BRDs in Statistical Subareas 1-3 would seem questionable, but it could ease enforcement burdens due to the fact that BRDs are required in Florida state waters and in the EEZ of the South Atlantic..

Requiring BRDs would likely cause only minor changes in additional research, enforcement, and administration costs, as well as management effectiveness. Research efforts may be slightly hindered if disgruntled fishermen are not willing to assist researchers either voluntarily or under contract; however this is less likely to occur when compared to alternatives to close additional areas or seasons. The enforcement burden is also likely to be minimal in comparison to the other bycatch reduction alternatives. It may even be somewhat lessened because of the current discrepancy wherein BRDs are required in state waters but not in federal waters off Florida, and west of Cape San Blas but not east. Administrative costs would be limited to the costs of preparation and implementation of regulations and would be minimal. Furthermore, there are no anticipated changes in management effectiveness.

As discussed above and in the "Socioeconomic Impacts" section the requirement of BRDs would have some negative social and economic impacts depending on which devices are

allowed and where they are required (statistical subareas) off the west coast of Florida. As previously discussed, impacts would be greater in Statistical Subareas 1-3 than in Statistical Subareas 6-8, although lost profits may be greater in Statistical Subareas 6-8. There would probably be no impact on the cultural value of fishing or nonconsumptive uses such as scuba diving.

The distribution of costs and benefits is not likely to be affected by the requirement of BRDs because as previously discussed the industry's behavior is not likely to change. (No appreciable changes have been observed due to this requirement in other areas.) However, they would probably be reduced proportionately to the amount of shrimp loss incurred. This reduction is estimated at about 4% (Table 12).

As discussed above and in the "Socioeconomic Impacts" section, social effects would probably be minimal. It is not likely that vessels would exit the fishery or be required to relocate as a result of the required use of BRDs. Furthermore, as previously discussed, fishermen and other aspects of the industry are not likely to change their behavior; however, if it is economically feasible, fishermen may fish harder to make up for lost income due to shrimp loss.

Biological Impacts:
The biological impacts of requiring BRDs in the EEZ east of Cape San Blas, Florida are largely unknown, primarily because very little is known about the biology (life histories) of most species involved. Many of these species are relatively short-lived, forage species that typically have high natural mortality rates. For species such as most of the invertebrates that are not effectively excluded by BRDs, there would be little if any effects, positive or negative. This perceived lack of impacts is based on the fact that many of these species do not suffer bycatch mortality. As previously discussed, many of the invertebrate species are hardier than the small finfish species that are caught in shrimp trawls, thus more come aboard alive. Many of the crab species are able to walk across the deck and fall back into the water. Other species such as starfish, sponges, sand dollars, and unwanted shrimp species are sturdy enough to survive until culled overboard. Consequently, although invertebrates may not be effectively excluded by BRDs, bycatch mortality is less for many of these species. Furthermore, their relative abundance in the bycatch is mostly limited to Statistical Subareas 1-3. For finfish stocks that are excluded, there would be positive benefits to at least some species, provided that the mortality presently encountered by trawls is not merely offset by natural mortality. There may also be negative impacts to other species due to this increased survival of some stocks. In order to determine the biological impacts of requiring BRDs, additional research is needed to understand these ecological relationships. As previously discussed the costs for such a study in terms of time and funding would be exorbitant.

Also, as previously discussed, such a study may not be necessary to a reasoned choice of whether to require BRDs to further reduce bycatch on the west coast of Florida. BRDs are currently required in state waters off Florida (since 1998) and in federal waters on the east coast of Florida. They are also required in federal waters west of Cape San Blas, Florida (since

1998). Although some changes in ecological relationships may have occurred in the last 4 years, there is no information that would indicate that significant changes in biological diversity have occurred. Additionally, shrimp catches have been generally above average for the past 3 years, although this phenomenon is more likely a product of favorable environmental conditions. As previously mentioned, existing, certified BRD designs have been shown to reduce finfish bycatch by at least 30% in overall studies. It is logical to assume that the same would be the case for the west coast of Florida. However, in Statistical Subareas 1-3, there would likely be as much as a 10% reduction in shrimp harvest with a minimal reduction in finfish bycatch. Also, as previously discussed, the overall impact of total finfish reduction in this statistical subarea grouping from the use of BRDs would probably be much less than the groupings in other areas.

The state of Florida is currently involved with an Ecopath Modeling effort to identify ecological relationships in some areas off the west coast of Florida. To date, this effort has not included scenarios for ecological impacts of bycatch reduction. Martinez et al. (1996) (Appendix B) reviewed scenarios for ecological impacts of bycatch reduction in the northern Gulf of Mexico. These model results have not been tested since the requirement of BRDs in 1998. Furthermore, it is unlikely that they could be adequately evaluated without an extensive study over many years. It is also unknown whether these results would be applicable off the west coast of Florida, east of Cape San Blas, partly because of differences in the array of species encountered. The following is an excerpt from Amendment 9 (GMFMC 1997) to the Shrimp FMP that contains a discussion of potential ecological impacts as presented by Martinez et al. (1996):

> Although the requirement for using BRD's is expected to have positive biological impacts of increasing the biomass of numerous finfish species, their ecological effects may have a negative impact on shrimp biomass. The following is a summary of these ecological effects. Appendix B provides a more detailed discussion.
>
> The Southeast Fisheries Science Center (SEFSC) examined the food habits of 161 species of bottomfish, reef fish, and pelagic fish. Of these, only 14 species were identified as predators on shrimp at some time in their life. Table 1 (of Appendix B) lists these in order of their importance as predators. The top three were sand seatrout, spotted seatrout, and Atlantic croaker.
>
> Mandating the use of BRDs could have a negative effect on the shrimp population based on results of the NMFS ecological modeling of bycatch reduction. Martinez, et al. (1996) projected that the effect of requiring BRDs could be a reduction in the biomass of shrimp by as much as 11%, but more likely between 5.9 and 8.2%. These estimates are based on increased predation that could result from an increase in abundance of bottomfish predators and decreased recycling of nutrients if finfish bycatch biomass is reduced by 50% (see Appendix B). Their model examined the effects of predation and recycling of organic nitrogen resulting from the reduction of bycatch. Four types of scenarios were

examined. The first of these was the general effect of various levels of reduction in biomass of bottomfish (principally groundfish) on the biomass of shrimp from increased predation and reduced organic nitrogen. This scenario provided a standard by which probable effects could be evaluated depending on the reduction of bottomfish biomass achieved by various BRD designs that might be certified in the future. The model predicted that a 10% reduction in bycatch of finfish would result in a 0.8% decline in shrimp stock biomass, and declines of 5.5% and 10.7% were predicted for reductions in bycatch of 25 and 50%, respectively. The predicted reduction in shrimp stock biomass resulted from predation as the bottomfish nitrogen pool increased due to bycatch reduction. With the current BRD designs being considered, the reduction of bycatch biomass would be approximately 25% with a resultant reduction in shrimp stock biomass of 5.8% (see following discussion on BRDs). The scenario, however, assumed all finfish were released at equivalent rates.

The second scenario examined the reduction in bycatch by .... three BRD models and used data on the selective release of finfishes by each model recognizing the fact that BRDs do not release all finfish at equivalent rates. (Some finfish are released at higher rates and some are not released at all.) The reductions in catch-per-unit-of-effort (CPUE) (by weight of all fish excluded) averaged 30.6% for the 30 mesh position fisheye BRD, 29.6% for the 45 mesh position fisheye BRD, and 34% for the extended funnel BRD ....). The model estimated these BRDs would reduce the shrimp stock biomass by 6.7, 5.9, and 8.2%, respectively. Factors that would affect these estimates include the areas where BRDs are used .... and seasonal closures .... This scenario is probably more accurate because finfish are probably not excluded at an equivalent rate for all species.

The two other scenarios examined (Appendix B) assumed that as finfish biomass increased through the use of BRDs, the size and age structure of these excluded stocks could also change. Additionally, as these fish attain a larger size, and predation rates and prey may change for species that feed on shrimp. These scenarios examined assumptions that: (1) Larger fish would consume more shrimp, and some fish that are currently too small to prey on shrimp might grow large enough to utilize shrimp; and (2) Larger fish would target prey larger than shrimp (e.g., other fish), and predation rates on shrimp may decline. There are currently insufficient data available to predict the effects on predation through growth in size of fish for the populations of predator species through use of the model. A sensitivity analysis, however, showed that the shrimp stock could be reduced by as much as 16.7% from an increase in predation by 50%. A reduction in predation had smaller effects on the shrimp stock biomass; however, a 50% reduction showed an increase in shrimp stock biomass of 4.7%. Figure 7 of Appendix B presents these relationships in terms of predation rates and increases or decreases in shrimp biomass (expressed as organic nitrogen).

Sufficient information to utilize the model to examine effects of bycatch reduction on other predators, such as birds and marine mammals is not available. Large numbers of

birds prey on the discarded bycatch while it floats on the surface, and there is some conjecture that they may have developed a dependence on this source of food. Earlier versions of a trophic ecological model (Browder 1983 and Sheridan et al. 1984, Appendix B) indicated that if 50% bycatch was removed from the ocean (e.g., landed and utilized on shore) the shrimp biomass would decline by 25%. If birds were harvesting a significant percentage of the bycatch biomass, a similar effect should have occurred, but it would be smaller in magnitude because bird guano and the tissues of dead birds would be recycled and contribute to the organic nitrogen pool. Whether bycatch reduction will have an adverse impact on bird populations is unknown (see discussion under section 6).

Martinez, et al., (1996) (Appendix B) pointed out that the model predicted the effects on the shrimp stock biomass and not yield from the fishery. Information to assess the relation between the model results and catch by fishermen is not available, and any negative effects of increased predation could be "masked" by annual fluctuations in recruitment and landings.

In summary, there is currently insufficient information to accurately determine the biological impacts of requiring BRDs on the west coast of Florida east of Cape San Blas. Positive impacts to one species that may accrue due to exclusion may result in negative impacts to other species. Additionally as reported by Martinez et al. (1996), the impacts to shrimp biomass could be either positive or negative. Ecological modeling has not been attempted off the west coast of Florida, and it is unknown whether results of such efforts would be similar. Impacts would likely vary based on the type of BRD used by area, season, and depth. Existing data indicate that there would probably be minimal impacts to shrimp populations and species diversity. Furthermore, there could be significant (30% or more) reduction in finfish bycatch from requiring BRDs in this area with the exception of Statistical Subareas 1-3. The overall impacts on bycatch reduction for the Gulf as a whole would probably be minimal, affecting 3% or less of the shrimp fishing effort.

Socioeconomic Impacts:

In Amendment 9 to the Shrimp FMP, it was shown that the adoption of BRDs by shrimp fishing craft in areas west of Cape San Blas, Florida would help rebuild the red snapper stock and provide short-term and eventually long-term increases in allowable catch of red snapper. Economic benefits would result from such increases in allowable catch. Extending the BRD requirement to fishing craft operating east of Cape San Blas, Florida does not have similar distinct economic benefits, primarily because of insufficient information to assess the biological and ecological effects on managed and non-managed species from the use of BRDs. In addition, discussions above noted that shrimp trawl bycatch of managed species, particularly reef fish and mackerel, in west Florida appear to be insignificant. With this uncertainty surrounding the biological and ecological effects of bycatch reduction in west Florida, the associated economic benefits cannot be properly evaluated. Some type of economic benefits may be estimated, even in the absence of the biological/ecological information, if at the very least the market importance of major species incidentally caught in shrimp trawls can be

ascertained. But a highly specialized study has to be conducted to generate the necessary information. The succeeding discussions mainly attempt to determine the socioeconomic costs of the various alternatives for requiring the use of BRDs.

Tables 11 and 12 show the shrimp and finfish bycatch reduction from various types of BRDs. Table 11 has particular relevance as this table contains results of BRD tests that were conducted in Statistical Subareas 1-8. This table shows that BRDs would effect a bycatch reduction from 7% to 40% and shrimp losses from 0% to 10%. Of the BRDs tested in Statistical Subareas 1-8, the Kiffe Version 4 BRD performed the best in terms of shrimp loss but it only reduced bycatch by 17%. The highest shrimp loss of 10% was recorded for the 12x5 Fisheye BRD, with only a slight improvement in bycatch reduction (22%) over the Kiffe Version 4. In terms of balancing shrimp loss and bycatch reduction, both the New Extended Funnel and the 3/5 Extended Funnel BRDs appear to be the best among the BRDs tested in Statistical Subareas 1-8, with the proportion of bycatch reduction significantly higher relative to shrimp loss.

Since the percent loss in shrimp through the use of a BRD may not necessarily translate to an actual reduction in shrimp catch as overall effort may increase to compensate for the shrimp loss per tow, the percentages in shrimp loss found in Tables 11 and 12 may be considered near the maximum potential loss in shrimp catch relating to the use of a specific BRD. As such, the potential loss in shrimp catch can range from zero (4x7 Fisheye BRD) to 10% (12x5 Fisheye BRD), with actual percentage loss being determined by the required minimum bycatch reduction.

From the standpoint of reduction in shrimp catch, revenues, and profits, Rejected Alternative 6.3.1, Rejected Alternative 6.3.2, and Proposed Alternative 6.3.3, Rejected Option (d) may be considered to have the same impacts. Each of these alternatives would result in either no shrimp and revenue loss (using 4x7 Fisheye BRD) or a shrimp and revenue loss by as much as 10%, or 1.3 MP valued at $4.4 million, based on 1991-2000 averages (using 12x5 Fisheye BRD). Naturally, catches and particularly revenues and profits fluctuate from year to year. For example, a 10% revenue loss would amount to $7.4 million ($6.3 million in profits) if based on the 1998 fishing year or $3.8 million ($3.2 million in profits) if based on the 1999 fishing year. With no specific requirement for minimum bycatch reduction percentage, it is reasonable to expect fishermen to use "approved" BRDs with the lowest shrimp loss which in this case would be the 4x7 Fisheye BRD. Naturally, such choice of a specific BRD has to be balanced by the associated costs of a BRD.

If under Proposed Alternative 6.3.3, Rejected Options (b) and (c) the minimum bycatch reduction required is 20%, all BRDs in Table 12 and Table 11, except the 4x7 Fisheye and Kiffe Version BRDs, would potentially qualify. Shrimp losses from these BRDs would range from zero (12x5 BRD in the 2.6 Meter Position or Extended Funnel Device) to 10% (12x5 Fisheye BRD). Losses in shrimp catch and revenues would range from zero to 1.3 MP valued at zero to $4.4 million, based on 1991-2000 averages. Again, the upper bound of these losses

may be expected to fluctuate year to year, e.g., from $7.4 million ($6.3 million in profits) in 1998 to $3.8 million ($3.2 million in profits) in 1999. In effect then, these alternatives would have the same impacts as Rejected Alternatives 6.3.1, 6.3.2 and Proposed Alternative 6.3.3, Rejected Option (d). Among the "approved" BRDs that meet the minimum bycatch reduction requirement and for a given BRD cost, the one with the lowest shrimp loss (i.e., zero) is likely to be employed by the fishermen.

Proposed Alternative 6.3.3, Proposed Option (a), that requires a minimum bycatch reduction of 30%, would result in a shrimp loss of zero to 7%. Losses in shrimp catch and revenues would range from zero to 880,000 pounds valued at zero to $3.1 million, based on 1991-2000 averages. Again, the upper bound of the loss in terms of catch, revenues, and profits would fluctuate from year to year. Based on 1998 and 1999 data, the revenue reductions would be from $ 2.6 million to $5.2 million and profit reductions would be from $229,000 to $444,000.

If the minimum bycatch reduction under Proposed Alternative 6.3.3, Rejected Options (b) and (c) is set at 40%, only 3 of the BRDs listed in Tables 11 and 12 (New Extended Funnel, 12x5 Fisheye BRD in the 2.6 Meter Position, and Jones/Davis BRD) would potentially qualify. Each of these three BRDs would reduce shrimp catch by 4% or 500,000 pounds valued at $1.8 million, based on 1991-2000 averages. Using data for 1998 and 1999, the reductions would fluctuate from about $3.0 million in revenues, or $253,000 in profits, to $1.5 million in revenues, or $130,000 in profits. Of the three, the Jones/Davis BRD is unlikely to be the choice due to its relatively high cost, but this would be the only BRD that would potentially qualify if the bycatch reduction percentage were set at 50%.

Rejected Alternatives 6.3.4 and 6.3.5 would have similar impacts provided that the minimum required bycatch reduction for the latter alternative is no more than 20%. Shrimp reductions would range from zero to 10% of the catch from Statistical Subareas 4 through 8. At the higher end of this range, shrimp losses would amount to 5.1 MP valued at $17.5 million, based on 1991-2000 averages. Based on 1998 data, the revenue and profit reductions would be $3.7 million and $369,000, respectively; based on 1999 data, the reductions would be $1.6 million in revenues and $182,000 in profits. Again, it is likely that, for a given BRD cost, fishermen would deploy BRDs with the lowest possible shrimp loss which in this case would be zero. If the minimum bycatch reduction is set at 40% under Rejected Alternative 6.3.5, fishermen would lose flexibility in the choice of BRDs, since only three BRDs would potentially qualify under the 40% minimum bycatch reduction. Fishermen would stand to lose as much as 4% of their catch from Statistical Subareas 4 through 8, or about 200,000 pounds valued at $700,000, based on 1991-2000 averages. Again, yearly fluctuations in losses can be expected: revenue and profit reductions would be about $1.5 million in revenues and $148,000 in profits, based on 1998 data, or $651,000 in revenues and $73,000 in profits, based on 1999 data.

In general, Rejected Alternative 6.3.6 would have the lowest negative impacts among the alternatives requiring the use of BRDs, mainly because it would require BRD use only in Statistical Subareas 6-8. If the minimum bycatch reduction is no more than 20%, this

alternative would reduce shrimp catch from Statistical Subareas 6-8 from zero to 10%. At the higher end of this range, shrimp losses would amount to 4.2 MP valued at $1.4 million, based on 1991-2000 averages. Revenue and profit reductions would be about $3.0 million and $316,000, respectively, based on 1998 data, or about $1.3 million and $155,000, respectively, based on 1999 data. If the minimum bycatch reduction were set at 40%, fishermen would be limited to choice of three BRDs, each of which would result in a 4% shrimp loss, or 169,000 pounds valued at $549,000. Based on 1998 and 1999 data, revenue losses would fluctuate from $1.2 million to $507,000 and profits would fluctuate from $126,000 to $62,000.

There are approximately 967 to 1,106 fishing craft operating in Statistical Subareas 1 through 8, with many fishing in more than one statistical subarea (Table 7a). All these fishing craft would be directly affected by Rejected Alternative 6.3.1, Rejected Alternative 6.3.2, and Proposed Alternative 6.3.3. All the other alternatives would directly affect only a subset of these fishing craft or none in the case of Rejected Alternative 6.3.7, Status Quo. In particular, Rejected Alternatives 6.3.4 and 6.3.5 would directly affect 276 to 372 fishing craft in Statistical Subareas 4-5 and 593 to 698 fishing craft in Statistical Subareas 6-8. Note that these fishing craft are not additive since some fish in both areas. Rejected Alternative 6.3.6 would directly affect 593 to 698 fishing craft. The impacts would be relatively greater on those that fish exclusively in the affected areas. Rejected Alternative 6.3.1, Rejected Alternative 6.3.2, and Proposed Alternative 6.3.3 would have particularly larger impacts on 90 to 175 fishing craft, of which 61 to 90 fishing craft are homeported in Florida, 7 to 28 are homeported in Alabama, 18 to 29 are homeported in Texas, and the rest in various other states (see Table 7d). Rejected Alternatives 6.3.4 and 6.3.5 would have larger effects on 19 to 30 fishing craft that exclusively fish in Statistical Subareas 4-5 and 6-8 while Rejected Alternative 6.3.6 would affect 397 to 411 fishing craft that exclusively fish in Statistical Subarea 6-8, of which 296 to 345 are homeported in Florida, 47 to 68 are homeported in Alabama, 5 to 9 are homeported in Texas, and the rest in other states (see Table 7d).

Although the level of shrimp reduction is important in distinguishing one alternative from another, it appears that as they currently stand, the alternatives become more distinguishable from one another when evaluated from the standpoint of how many vessel/boats would be affected. For a given level of shrimp reduction, Rejected Alternative 6.3.6 would result in least economic adverse impacts than all the other alternatives, except status quo, followed by Rejected Alternatives 6.3.4 and 6.3.5.

Based on landings and revenues by landing area, Rejected Alternative 6.3.1, Rejected Alternative 6.3.2, or Proposed Alternative 6.3.3 would affect Charlotte, Franklin, Hernando, Hillsborough, Lee, Manatee, Monroe, and Pinellas counties in Florida, Baldwin and Mobile counties in Alabama, and Port Isabel and Brownsville in Texas as these areas account for most of the landings of shrimp caught in Statistical Subareas 1-8 (Table 8). Under Rejected Alternatives 6.3.4 and 6.3.5, each of which requires the use of BRDs only in Statistical Subareas 4 through 8, the counties likely to experience the most negative impacts would be Charlotte, Franklin, Gulf, Hernando, Hillsborough, Lee, Manatee, and Pinellas counties in

Florida and Baldwin and Mobile counties in Alabama, since most of the shrimp landings in these counties are caught in Statistical Subareas 4-8. Under Rejected Alternative 6.3.6, which requires BRDs in Statistical Subareas 6 through 8, the landing areas most likely to incur the most negative impacts would be the same as those in Rejected Alternatives 6.3.4 and 6.3.5, except Manatee county in Florida. All other areas have either relatively less shrimp landings overall or less landings of shrimp caught in Statistical Subareas 6-8.

As noted in Section 6.1, some of the counties are dominated by some ports in terms of shrimp landings and revenues. The landing ports that may be potentially considered fishing communities are: Key West in Monroe County, FL; Fort Myers Beach in Lee County, FL; Tampa in Hillsborough County, FL; Tarpon Springs and St. Petersburg in Pinellas County, FL; Yankeetown in Levy County, FL; Appalachicola and Carabelle in Franklin County, FL; Panama City in Bay County, FL; Bon Secour in Baldwin County, AL; Bayou La Batre in Mobile County, AL. Port Isabel and Brownsville in Texas may also fit into the fishing community category.

Any harvest and revenue reductions from the use of BRDs would also adversely affect dealers in various ports around the Gulf. Earlier discussions on the effects on dealers also apply here. In particular, Rejected Alternative 6.3.1, Rejected Alternative 6.3.2, or Proposed Alternative 6.3.3 would potentially affect dealers in Charlotte, Franklin, Hernando, Hillsborough, Lee, Manatee, Monroe, and Pinellas counties in Florida, Baldwin and Mobile counties in Alabama, and Port Isabel and Brownsville in Texas as these areas account for most of the landings of shrimp caught in Statistical Subareas 1-8 (Table 8). Under Rejected Alternatives 6.3.4 and 6.3.5, each of which requires the use of BRDs only in Statistical Subareas 4 through 8, the dealers likely to experience the most negative impacts would be those located in Charlotte, Franklin, Gulf, Hernando, Hillsborough, Lee, Manatee, and Pinellas counties in Florida and Baldwin and Mobile counties in Alabama, since most of the shrimp landings in these counties are caught in Statistical Subareas 4-8. Under Rejected Alternative 6.3.6, which requires BRDs in Statistical Subareas 6 through 8, the landing areas most likely to incur the most negative impacts would be the same dealers as those in Rejected Alternatives 6.3.4 and 6.3.5, except Manatee county in Florida. All other areas have either relatively less shrimp landings overall or less landings of shrimp caught in Statistical Subareas 6-8, and thus would not substantially affect dealers in those areas.

As with the area closure alternatives, the various BRD alternatives would also affect crew income. The general discussions in Section 6.1 also apply here.

One other cost item that accompanies the BRD requirement is the cost of the BRD itself and of the required maintenance. In Amendment 9 to the Shrimp FMP (GMFMC 1997), available information led to the assumption that a typical shrimp vessel would incur a $200 expense for the use of 4 BRDs. Recent information indicates that costs for BRDs range from $25 each for a Fisheye BRD to $300 each for a Jones-Davis BRD (Jamir, personal communication 2001). Also, smaller boats typically use 2 nets and therefore 2 BRDs while larger vessels use 4 nets

and therefore 4 BRDs, and each fishing craft may be assumed to carry a spare BRD for each net used (Travis, personal communication 2002). The number of BRDs then that shrimp fishing craft would have to purchase would range from 2 to 4, and could be as many as 4 to 8. The cost of the equipment would increase the fixed cost of operation, and while this cost may not be significant relative to the potential shrimp revenue forgone, it could be substantial relative to the fixed cost of operating smaller fishing craft.

In order to provide additional insights into the economic effects of BRDs, the same bioeconomic model that was used in Amendment 9 (GMFMC 1997) but adapted to the shrimp fishery in the west coast of Florida was run (Ward, personal communication, 2002). Adapting this model to the Florida fishery is done by mainly reconfiguring the vessels to those characteristic of the Florida boats. Other parts of the model, such as the demand function for shrimp and cost structure, have not been modified. This adaptation is definitely leaves plenty to be desired, but the model provides some results that may add to the understanding of the economic implications of requiring BRDs in the west coast of Florida.

Table 14 contains results for some bioeconomic indicators. The BRD types, bycatch reduction, and shrimp reduction are those found in Tables 11 and 12. The resulting indicators used to illustrate the effects of BRDs are change in fleet size, change in net present value (NPV), and benefit/cost ratio (BCR). A negative sign for change in fleet size and NPV indicate a reduction in those values. A BCR greater than one indicates that benefits exceed costs. A basic assumption used in the modeling is that a BRD would be required of every boat/vessel fishing in Statistical Subareas 1-8.

Information from Table 14 indicates that a BRD that results in shrimp reductions of 4% or more would result in reductions in fleet size, reductions in NPV and BCRs of less than unity. A 4% reduction in shrimp results in 4% to 5% reduction in NPV, and a 7% reduction in shrimp catch results in double or a 14% reduction in NPV. However, a 10% reduction in shrimp catch results in more than double or a 25% reduction in NPV. These results indicate that a 7% to 10% reduction in shrimp catch would have significant economic impacts on fishing craft operation. A 1% or less reduction in shrimp catch would slightly increase the NPV. This could be partly interpreted to mean that such level of shrimp reduction when compensated for by an increase in effort and harvest would result in an increase in revenue exceeding the corresponding increase in cost. A 4% reduction in shrimp catch, which results in about equivalent reduction in NPV, is probably not that significant as the accompanying CBR is not too far from unity.

6.4 Rejected Alternative - Status Quo - do not implement further bycatch reduction requirements on the west coast of Florida

Discussion:
In approving this alternative, the Council would be concluding that bycatch reduction in the shrimp trawl fishery has already been achieved to the extent practicable in accordance with

National Standard 9 under Section 301 of the M-SFCMA. Making this determination from the data and analyses previously presented concludes that the present management measures, including closed areas, closed seasons, and the requirement of BRDs in state waters of Florida and Texas, as well as previous actions in Amendment 9 to the Shrimp FMP (GMFMC 1997) to require BRDs in shrimp trawls used west of Cape San Blas, Florida and other considerations such as untrawlable bottoms, have reduced bycatch to the extent practicable. The no action alternative would have no National Environmental Policy Act (NEPA) implications and would not require a practicability analysis.

Biological Impacts:
There would be no additional biological impacts from taking no action to implement additional bycatch reduction measures. As previously discussed, biological impacts of additional bycatch reduction measures could be quite variable depending on where, when, how, and what types of additional measures are chosen, and such impacts cannot be quantified at this time. As previously discussed, some action, primarily the requirement of BRDs is likely to increase survival of some bycatch species for which there would likely be some positive biological impact. However, increased survival of one species could have negative biological impacts to other species. In summary, however, there would be no additional impacts from the status quo alternative.

Socioeconomic Impacts:
Choice of the status quo alternative under area closures, seasonal closures, and BRD requirements is equivalent to choosing Rejected Alternative 6.4, and would have no short-run economic impacts on the shrimp fishery participants. Maintaining the status quo for area closures, seasonal closures, and BRD requirement, or choosing Rejected Alternative 6.4 is tantamount to concluding that additional bycatch reduction in the Gulf EEZ east of Cape San Blas, Florida is not practicable.

6.5 Bycatch Reporting Requirements

6.5.1 Proposed Alternative - Utilize the annual Summer Shrimp/Groundfish and Fall Shrimp/Groundfish Trawl Surveys to determine finfish and invertebrate bycatch as opposed to commercial shrimp catches on a per hour basis. Since BRDs are currently required in most areas of the Gulf EEZ and are proposed for the remaining areas of the EEZ, reduce these estimates of finfish bycatch by at least 35% (the estimate of bycatch reduction from the most popular BRD in use [Fisheye BRD]). Multiply to convert these bycatch estimates for finfish and invertebrates into 24 hour (or per day) periods. Multiply these results by the same year's estimates from the NMFS effort data or the effort estimates from Gallaway et. al 2000 in days fished to obtain annual estimates of total finfish and invertebrate bycatch.

6.5.2 Rejected Alternative - With the implementation of Amendment 11 to the Shrimp FMP (expected in early summer 2002) that will require federal vessel permits on all shrimp vessels harvesting shrimp in the Gulf EEZ, develop a standardized bycatch logbook reporting form and require as a condition of each permit's renewal that the form be completed and submitted to NMFS under such conditions that the NMFS may require. The NMFS will annually compile the results from these logbook forms to determine total finfish and invertebrate bycatch.

6.5.3 Rejected Alternative - With the implementation of Amendment 11 to the Shrimp FMP (expected in early summer 2002) that will require federal vessel permits on all shrimp vessels harvesting shrimp in the Gulf EEZ, develop a random selection procedure for determining vessels that will be required to carry observers in order to collect bycatch information. In selecting vessels that will be required to carry observers, the NMFS will consider the suitability of the vessel for such purpose and insure that vessels included are representative of all statistical subzones in the Gulf. The NMFS will use total effort estimates to extrapolate observer data into overall estimates of total annual finfish and invertebrate bycatch estimates.

6.5.4 Rejected Alternative - Status Quo - do not establish a bycatch reporting methodology for the shrimp fishery of the Gulf of Mexico.

Note: In specifying the Proposed Alternative 6.5.1, the Council intends that NMFS would use the best available estimate of effort in the shrimp fishery on an annual basis.

Discussion:
The Proposed Alternative would utilize fishery-independent trawl survey data that are collected by NMFS in cooperation with the 5 Gulf states under the Southeast Area Monitoring and Assessment Program (SEAMAP) to analyze the amount and type of annual bycatch from the shrimp fishery of the Gulf of Mexico. These studies have been standardized since 1987 and collect data on shrimp catch and bycatch of all species during the summer and fall periods. Additionally, these periods correspond with the highest shrimp production and effort. SEAMAP data are collected from randomly selected stations in the Gulf using 40-foot trawls (in most areas), similar to those used by the offshore commercial shrimp vessels, typically using 10 to 60 minute tow times.

To estimate total bycatch, the bycatch from SEAMAP data would first be standardized into bycatch by hour and then into bycatch per day because NMFS measures effort in the shrimp fishery in days fished. Then bycatch would be separated into finfish bycatch and other because the existing and proposed use of BRDs would reduce the finfish bycatch by approximately 35%, and the SEAMAP trawls do not use BRDs. After reducing the daily finfish bycatch data

by 35% to account for BRD use, a simple multiplication using the NMFS' total shrimp effort data yields estimates of finfish and other bycatch on an annual basis.

Although logbooks have been used in other fisheries, primarily reef fish and mackerel in the Gulf, as a means of determining bycatch, they would likely not be feasible for the shrimp fishery in the Gulf for several reasons. First, the hook-and-line finfish fisheries encounter considerably less bycatch in terms of species and amount (weight/number). Almost all of it is finfish, and some of the so called "bycatch" is used as bait, therefore it is not bycatch. Consequently, based on the magnitude of shrimp catch and bycatch, it would be practically impossible for a captain and crew to identify and measure bycatch while still maintaining a viable shrimping operation. Second, there are far fewer participants (vessels) in these finfish fisheries as opposed to the shrimp fishery (about 4,000 mackerel and reef fish commercial and for-hire vessels); consequently, there are fewer records to be evaluated in order to estimate bycatch. With nearly 4,000 offshore shrimp vessels and 13,000 inshore boats (some percentage of which fish sporadically in the EEZ), there would be considerably more logbook records from which bycatch would have to be calculated. Third, most of these fisheries operate in daylight hours where bycatch can be viewed and identified; whereas most of the shrimp fishery occurs at night. This fact coupled with the large number of species taken in a given trawl tow would make estimation of bycatch by captains and crew extremely difficult. Furthermore, these individuals are not trained biologist and would not be able to accurately identify many species consistent with accepted taxonomy without additional training.

The use of trained observers in a random sampling programs to estimate bycatch would be a preferred method over logbooks; however, no such program is currently in place. Such a program would have to be designed and funded before it could be implemented, and funding is currently not available. Additionally, a significant number of observer trips would have to be scheduled across the Gulf and stratified by statistical subarea and season because the brown and white shrimp fisheries primarily operate in the northern and western Gulf in the summer and fall while the pink shrimp fishery is predominantly in south Florida in the winter and spring months. Such an ongoing study would be extremely costly to implement and maintain. Furthermore, observer data would still have to be annually extrapolated to the entire shrimp fleet by the same multiplication process using the NMFS effort data as with the proposed alternative. Consequently, because it is unlikely that enough observer trips could be funded to generate a significantly better sample of bycatch than the proposed alternative to use SEAMAP data, the additional expense would not be justified by a significantly better estimate of total bycatch.

Although the no action alternative is included, Section 303 (a)(11) requires the establishment of such a methodology as a mandatory provision of fishery management plans. Even if such a provision were not mandated, there is a need to assess bycatch and the impacts of various management measures that have been implemented to reduce bycatch, i.e., BRDs. Also, the need for present or future regulations cannot be ascertained without the ability to measure their impacts on bycatch. The Proposed Alternative appears to include the most practicable means

of annually assessing bycatch; however, the amount of bycatch is generally known from previous studies. For Statistical Subareas 1-8, these amounts are reflected in the bycatch to shrimp ratios previously mentioned and as shown in Figure 2. For the rest of the Gulf similar information is available, and the overall bycatch to shrimp ratio has been estimated at approximately 4.2:1. Consequently, a general estimate of bycatch can be ascertained by simply multiplying annual shrimp catch by approximately 4.2. Although these estimates may vary annually, they could be used in lieu of setting up an additional reporting methodology. However, the Proposed Alternative would appear to provide a better estimate without appreciably increasing management or other burdens.

The type of data collection program contained in the Proposed Alternative would not have direct beneficial or adverse consequences on fishery resources and user groups, since the program would simply make use of existing information collected from existing data collection programs. Since there are no additional actions undertaken, except the evaluation of bycatch data, this alternative would have no consequence on public health or safety or on unique characteristics of geographic areas where shrimping occurs. It would not cause any controversial effects on the human environment nor create any uncertain, unknown, or unique risks. If the bycatch data generated under the Proposed Alternative is deemed insufficient or necessitates further evaluation, other bycatch data collection programs may be instituted. Thus, adoption of this alternative would not create a precedent for not collecting bycatch information through other means. Since there are no impacts associated with using data that are currently collected, there would be no cumulative impacts. Other resources such as districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places would likewise not be affected. There would be no impacts to endangered or threatened species and their habitat, and there would be no implications to other environmental laws or regulations from such a data collection program.

Establishing a logbook reporting program would not have immediate direct beneficial or adverse consequences on fishery resources, but as discussed in the "Socioeconomic Impacts" section, there could be rather significant impacts to users. Management would have to develop logbooks and a training program for vessel captains and crew. Vessel operators and crew would be required to receive training in order to properly identify bycatch species as well as how to fill out logbooks. The time required to complete these tasks could be extensive and costly. Furthermore, it is estimated that at least 15 minutes per trawl would be required to complete logbooks which may be complicated by inclimate weather conditions and the fact that most trawling activity occurs at night. As discussed in the "Socioeconomic Impacts" section and in the following practicability analysis, there could be other social and economic impacts due to lost trawling time and the probability that at least some captains and crew would be unwilling to participate in a logbook program.

The logbook alternative would have no consequence on public health or safety or on unique characteristics of geographic areas where shrimping occurs. As previously discussed and as further discussed in the "Socioeconomic Impacts" section there would likely be controversial

effects on the human environment due to the imposition of a logbook requirement due to the complications previously mentioned.

A requirement of logbooks would not impose any uncertain, unknown, or unique risks, but there would be unknown impacts. For example, it is unknown whether some participants in the shrimp fishery would be able to complete training that would allow them to accurately identify many of the bycatch species. If not, their continued participation in the fishery could be at risk.

The requirement of logbooks for the shrimp fishery would also set a precedence for this fishery because they are currently not required. Logbooks are required in other fisheries in the Gulf, however, including the reef fish fishery and the coastal migratory pelagics fishery.

As previously noted there would be no biological impacts from requiring any form of standardize bycatch reporting methodology indicated in the above alternatives; however, there would be social and potentially economic impacts from the requirement of logbooks. Consequently, the cumulative impacts would be the same as those discussed for the socioeconomic impacts herein and in the "Socioeconomic Impacts" section.

Other resources such as districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places would not be affected by the choice of logbooks to report bycatch. There would also be no impacts on endangered species or other environmental laws and regulations because only reporting of data would be required.

Establishing an observer program as contemplated in Rejected Alternative 6.5.3 would not have immediate direct beneficial or adverse consequence on fishery resources, but as discussed in the "Socioeconomic Impacts" section and under the practicability analysis there could be rather significant impacts to users. These costs would come in the form of liability and potential fear that confidentiality of data may not be maintained. This cost would only increase if the industry has to bear part of the direct cost of an observer program. An observer program would also be extremely costly for management with an estimated annual cost of $13 to $19 million at the low end, or $50 to $57 million at the high end, for only a 5% observer coverage; consequently, bycatch would have to be extrapolated for the remaining 95% of the shrimping effort.

Since the action contemplated is merely to collect bycatch information, this alternative would have no consequence on public health or safety or on unique characteristic of geographic areas where shrimping occurs.

Although not as severe as the logbook alternative, a requirement of observers would have controversial effects on the human environment. Typically, fishermen do not like to take observers onboard for various reasons. Some may fear liability for the safety of observers and others feel that they are simply a nuisance because they are "in the way." In the particular case

of health and safety, an observer program would expose shrimp fishermen to the risk that their fishing craft may not be adequately equipped to carry an extra person, although this may be partly addressed by the requirement imposed under Section 403 (a) of the M-SFCMA regarding the health and safety of observers. Others do not trust that observer information can be kept confidential.

A requirement of observers would probably not impose any uncertain, unknown, or unique risks, but there may be some implications. There may be additional risks to observers, although such risks have been encountered in other fisheries in other regions. There may also be unknown or uncertain impacts from requiring observers because they have only been used to a limited extent, primarily in research programs.

Adoption of an observer program in the shrimp fishery could set a precedent for similar actions in other fisheries in the Gulf because observers are currently not required in any Gulf fisheries.

As previously noted there would be no biological impacts from requiring an observer program; however, there would be social and probably extreme economic impacts. Consequently, the cumulative impacts would be the same as those discussed for the socioeconomic impacts herein and in the "Socioeconomic Impacts" section.

Other resources such as districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places would not be affected by the choice of an observer program as a standardized bycatch reporting methodology. There would also be no impacts on endangered species or other environmental laws and regulations because only reporting of data would be required.

Among the choices for collecting bycatch data, the Proposed Alternative is the most practicable as basic data are already available and bycatch information can be generated without additional cost to the industry and only minimal cost to the government. The use of observers in a fully functional program would provide slightly better information on individual catches and trips because such data would be collected from actual commercial shrimping operations. However, it is not practicable to fund enough trips to preclude the need for extrapolation using the same effort statistics as included in the Proposed Alternative. Consequently, this alternative would not be deemed to be significantly better than the Proposed Alternative in terms of identifying and quantifying bycatch. There would be no population effects or ecological effects resulting from any of the alternatives for a bycatch reporting methodology because they merely are methods of counting existing bycatch without imposing additional capture. For the same reason, these alternatives would not cause any change in bycatch or other ecosystem impacts. These types of data collection have no consequence on the bycatch of marine mammals and birds, as previously discussed because these animals are not impacted by shrimp trawling and these reporting requirements would also not cause any effect. Since the Proposed Alternative would not effect any new initiative, except on the part of the government to estimate and analyze bycatch information, no effects can be expected on the operations of the industry.

Thus, fishing, processing, disposal, and marketing costs, as well as fishermen's behavior would remain unaffected.

The alternatives for logbooks or observers would, however, cause additional impacts to the industry. Rejected Alternative 6.5.2, which requires logbook reporting of bycatch information, could provide potentially broader information than the Proposed Alternative; however, it is based on self-reporting by vessel operators and its dependability is based on the accuracy and selectivity of vessel operator's recollection. Also, in the case of logbooks, the vessel captains and crew would have to receive training in order to accurately identify bycatch species. Furthermore, they would have to spend a great deal of additional time filling out logbooks that would reduce fishing time and effort. This data collection system would impose direct cost outlay on the part of the government to develop and manage the system. Although it would not require an actual cost outlay on fishermen, logbook reporting would impose additional burden on fishermen, with an estimated burden of 15 minutes per trawl haul. Although these costs in terms of fishing, processing, disposal, and marketing costs may not be accurately measured, it is safe to say that fishermen's behavior would be significantly altered, and there would be negative costs.

The alternative for observers would also have negative impacts to shrimp fishing operations although less than logbooks. Observers would have to be quartered in some fashion, and many shrimp boats do not have available space. Additionally, there are issues of liability and confidentiality that could cause owners to be reluctant to carry observers. Again, these impacts may not be accurately measured, but fishing, processing, disposal, and marketing costs would likely be affected, and fishermen's behavior would probably be altered.

Under any of the alternatives for this section, there would be some changes in research and administration to the extent that some resources would have to be devoted to the evaluation of bycatch data and using it to establish bycatch estimates. The costs would be minimal for the Proposed Alternative, somewhat greater for the logbook alternative, and very significant for the observer alternative.

The Proposed Alternative for using SEAMAP data would not affect the economic, social, or cultural value of fishing activities and non-consumptive uses of fishery resources. The distribution of costs and benefits would remain unaffected by this alternative as well because use of existing data collected by scientists would have no implications to fishing or aesthetic uses of marine resources.

Economic, social, or cultural value of fishing activities, as well as changes to the costs and benefits would be expected from the choice of either logbooks or observers for the reasons previously stated above. However, the Proposed Alternative would neither change fishing practices and behavior of fishermen nor affect the economic, social, or cultural value of fishing activities and non-consumptive uses of fishery resources. Although the changes and costs cannot be quantified, they are likely to be very significant for logbooks due to the anticipated

amount of additional time and training required to implement such a program. The burden time to be borne by the industry would be directly proportional to the size of fishing operation. These changes and impacts would be lessened by the choice of observers, but still likely significant as discussed above.

No social effects, including the relationship between fishermen and fishery managers can be expected from the Proposed Alternative because the industry would not be involved with developing these estimates. However, the choices of logbooks or observers would be expected to generate social impacts. Captains and crew may not be willing to accept training in identification of bycatch species or to fill out logbooks accurately. Without some ability to enforce such a requirement, could preclude it being effectively implemented. Furthermore, even with the ability to potentially sanction vessel permits for noncompliance, some captains and crew may be expected to exit the fishery. In the case of fleet owned vessels, this could cause social and potentially economic impacts to owners that would be required to find willing captains.

The major social effects resulting from a logbook program involves the relationship between fishermen and fishery managers. Since logbook reporting would be used as one of the conditions for permit renewal and future fishing regulations, potential misunderstandings can arise between the two groups with respect to the compliance with the logbook requirement and the fishery managers' interpretation of the collected information. Experience from logbook requirements in the reef fish and mackerel fisheries indicates that such misunderstandings would be not serious, although some problems with the shrimp fishery may arise if the logbook requirement is administered to a sample of fishermen but extrapolated to the entire industry for management purposes.

Similar, but probably less severe, social impacts could be expected from observers because captains may be unwilling to accept the liability or risk to observers or to allow observers to learn preferred fishing grounds for fear that such information may not be kept confidential. There are no enforcement costs that would ensue from adoption of any of the bycatch reporting requirement alternatives. Since bycatch information would be generated, management of the fishery can be improved as stock assessment information is generated with the use of the estimated bycatch data.

Rejected Alternative 6.5.3 that requires an observer program to collect bycatch information can provide somewhat better information than the Proposed Alternative or Rejected Alternative 6.5.2. As a data collection activity, all three alternatives would not have direct consequence on the bycatch of marine mammals and birds.

An observer program would impose direct cost outlay on the part of the government to develop and manage the system. It may also require an actual cost outlay on fishermen, depending on how the cost of an observer program is shared by the government and the industry. As noted in the "Socioeconomic Impact" section, the cost can be substantially higher than the $1.8

million estimated for a study to evaluate BRDs that covered only 100 vessels over a 5-month period. Most recent estimates for offshore trips would carry an annual cost of $13 to $19 million at the low end, or $50 to $57 million at the high end, for a 5% coverage of total shrimping effort. There are also potential liabilities that the industry may have to bear attendant to the carrying of an additional person on board. The government cost for a logbook program would not be as high as that for an observer program, and noted in the Socioeconomic Impacts" section, could range annually from $200,000 to $240,000, exclusive of the cost for training in species identification and logbook recording. A logbook program would impose additional labor work to identify and record the numerous bycatch species. Considering that many crew members are not trained biologists and that a trawl hauls include many varying species of fish, some form of training for species identification and logbook recording would have to be administered to them. The cost of this training could be shared by the vessel owner/operator and the government or could be fully borne by either entity. The Proposed Alternative would not impose these type of costs on the vessel owner, operator, crew, or the government.

If the industry were made to share part of the cost of an observer program, fishing costs would increase and could be too burdensome especially for smaller vessel operations. Processing, disposal, and marketing costs would likely remain unaffected, considering that most vessels, especially those independently owned, do not have the leverage to bargain with processors and dealers for purposes of passing on the increased fishing costs to these entities, especially if the current low price levels for shrimp remain for an extended duration. However, these costs cannot be calculated based on present data. A logbook program would not directly affect fishing cost, but would require additional labor time that could have been expended for fishing. The Proposed Alternative would not affect fishing, processing, disposal, and marketing costs, since it would not impose any additional requirement on the industry.

An observer program would likely change fishing practices and behavior of fishermen especially if the industry did not have strong participation in the design of the program or remained unconvinced of the economic benefits of the program to the industry. If fishing costs become too high relative to ordinary fishing costs, some vessels may cease fishing entirely or during the times they are selected to carry observers. Some fishermen may also alter their fishing practices and/or fish in other areas during times they are required to carry observers just to keep observers, who could become shrimp fishermen or operators themselves, from learning how, when, and where to fish for shrimp. A logbook program can also change fishing practices, since fishermen have to compensate for time lost in identifying and recording bycatch. The nature and extent of this change cannot be determined. The Proposed Alternative would not impose any additional requirement so that it would have no effect on fishing practices and behavior of fishermen.

There would ensue some changes in research under all the bycatch data collection alternatives, although this would be more in terms of using the collected information and potentially on future research projects that may be undertaken to address deficiencies in data collection in the

shrimp and other fisheries. Although there has been some experience in the administration of an observer program, such experience is relatively limited in scope. An observer program that costs at least $13 to $19 million annually would require the establishment of a team that would oversee and manage the program on a full time basis. A logbook program would not entail a major change in administration, except probably in the area of training fishermen to identify and record the various bycatch species. There are no enforcement costs that would directly ensue from any of the bycatch data collection alternatives, since these alternatives would not impose regulations that would have to be followed by fishermen at sea or in the dock. Since bycatch information would be generated, management of the fishery may be somewhat enhanced by the use of the estimated bycatch data. The better and more complete the bycatch information collected, the better would generally be any stock assessments and subsequent management strategies. An observer program may generate the best information, but it is unlikely to be complete unless more coverage of shrimping effort is targeted, albeit at a much higher cost. A logbook program may not generate better information than an observer program, but it can be designed to cover more fishing trips at a relatively lower cost. The Proposed Alternative is the least costly and can approximate the coverage of effort under either an observer or logbook program. It may, however, generate bycatch information that is not better than that under the other alternatives.

In general, a data collection program would not have direct effects on the economic, social and cultural value of fishing activities. Such valuation is more dependent on personal and community preferences for fishing; access to the fishery resources; and presence of economic, social and cultural infrastructures, such as fishing support industries, fishing organizations, fishing related social events and powwows, and historical significance of an area to fishing. Among the three alternatives, logbook reporting is the one most likely to have some effects on such valuation but mainly to the extent that fishermen may have to spend more time at sea to compensate for the time lost due to logbook recording or to spend time attending training seminars to identify bycatch. Time spent on such activities may interfere with ordinary activities performed by fishermen, such as attending fishing-related social events. Indirectly, however, any of the bycatch data collection alternatives would affect the mentioned valuation, if regulations subsequently formulated based on bycatch information would restrict fishing activities of shrimpers. On the other hand, such implementation of additional regulations may benefit non-consumptive users of the bycatch species in twofold ways. First, these users would feel assured that species that may be vital to the whole ecosystem are protected. Secondly, their concern that bycatch species may be "wasted" would be addressed.

The cost of an observer program would be borne disproportionately to the size of fishing operations. Smaller vessel operations would not have as much flexibility as larger ones in absorbing the additional fishing costs, particularly with respect to the liabilities vessels may face for carrying an extra person on board. To a lesser extent, a logbook program would impose a disproportional cost on the various sizes of fishing operations in the shrimp fishery in the sense that larger operations have the better capability in compensating for the loss of shrimping effort due to the effort expended on identifying and recording bycatch species. Also,

larger operations have more resources than smaller ones in spending time and/or money for the training of crew members in identifying and recording bycatch species. The Proposed Alternative would not affect the distribution of cost. The distribution of benefits, if any, to the shrimp industry from the collection of bycatch information would not be altered by any of the alternatives to collect bycatch information. Any information or management enacted to enhance shrimp operations would be shared by all participants in the shrimp fishery. Very likely, however, fisheries other than the shrimp fishery, would benefit from a better management of bycatch species, and this would change the distribution of benefits from the utilization of shrimp and other fishery resources, including non-consumptive use of other fishery resources.

An observer program is an intrusive data collection system, and thus is likely to create adverse social effects. In particular, an observer program can give rise to some friction between fishermen and fishery managers. A mandatory observer program would only worsen the situation. In addition, fishermen do not like to take observers on board for reasons mentioned above and in the "Socioeconomic Impact" section. A logbook program, though less intrusive than an observer program, would still result in adverse social effects, particularly in the relationship between fishermen and fishery managers. Since logbook reporting would impose additional labor work that could have been devoted to fishing, the vessel captain may decide to put less labor in logbook reporting so as to be inaccurate in reporting bycatch. Fishery managers, upon examination of some logbooks, may observe certain patterns of inaccuracies and would require more work from fishermen. Such additional requirement may be viewed by fishermen as another obstacle from possibly renewing their permits (assuming logbook reporting as a condition for permit renewal). Additionally, fishermen may resist training in species identification and logbook recording (assuming such training is mandatory), since it would only take time away from fishing or other personal activities. These potential social effects would be absent under the Proposed Alternative.

Biological Impacts:
There would be no direct biological impacts from establishing a standardized reporting methodology to estimate bycatch in the shrimp fishery of the Gulf of Mexico. The alternatives discussed above would only establish various means of determining the amount and type of bycatch that is occurring in the shrimp fishery on an annual basis. To the extent that any of these alternatives provides a better understanding of the bycatch, it may prove useful in conjunction with future biological and ecological research regarding the relationships of bycatch species, as well as potentially improving stock assessments for managed species. It is, however, unlikely that any of these alternatives would provide data with sufficient precision that they would provide better indices than those currently used in stock assessments for the managed finfish stocks.

Socioeconomic Impacts:
The Sustainable Fisheries Act (SFA) requirement regarding the collection of bycatch information virtually renders Rejected Alternative 6.5.4 as a non-viable alternative; thus, any

of the first 3 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 socioeconomic impacts of each of the alternatives.

The bycatch information collected would be used to help devise conservation and management measures that would minimize bycatch or minimize the mortality of bycatch which cannot be avoided. The better the information, the more effective would likely be the bycatch reduction measures developed. But whether or not an effective bycatch reduction measure generates more benefits depends materially on the type of measures adopted, including the overall management strategy governing both the fisheries that are dependent on the bycatch species and those generating the bycatch. In addition, such benefits would have to be compared with the costs of the bycatch reduction measure. A good part of this cost would likely be borne by the shrimp industry that generated those incidental catches. Given such considerations, it is simply assumed that among the alternatives considered, the one that is likely to generate better information is judged to bring about larger benefits. A similar presumption on costs cannot be made, although in principle it may be expected that better information can be collected at relatively higher costs.

The Proposed Alternative is basically a combination of a fishery-dependent and a fishery-independent bycatch data collection system. The fishery-independent part collects, among others, bycatch information through the use of agency trawl vessels while the fishery-dependent part collects, among others, commercial shrimp vessel effort data. Both data collection systems have been in place for quite some time. This approach would only indirectly provide bycatch information and may or may not represent actual bycatch depending on how closely agency trawl vessels approximate actual commercial shrimp vessel harvest operations and on the assignment of bycatch weights to the various strata (season, area, size of vessel, etc.) of shrimp effort. The extent to which this approach depends on fishermen's reports relates only to the reporting of fishing effort. Rejected Alternative 6.5.2 requires logbooks as a means of generating bycatch information. Logbooks 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 out at the dock. In addition, species incidentally caught in shrimp trawls are too numerous for proper identification and reporting. This problem may especially occur if there are no economic incentives for reporting bycatch. Electronic logbooks filled out while the vessel is in operation can partially address the reporting deficiency via logbooks, but there are complications with such an activity as presented in the "Discussion" section. Rejected Alternative 6.5.3 requires the use of observers for collecting bycatch information. An observer program is probably the best alternative to validate the accuracy and consistency of bycatch information collected. In this manner, Rejected Alternative 6.5.3 may be adjudged superior to the other alternatives in generating bycatch information; however, these data would still have to be extrapolated using the NMFS effort data which would be considerably less certain.

In terms of the cost of bycatch data collection, the Proposed Alternative is the least costly and involves no additional burden on the shrimp industry. The government's cost for this system is also minimal as all basic data would already have been collected as part of existing data collection programs.

A logbook program would impose minimal cash outlay on the industry but would require potentially many hours of reporting burden. Reporting burden for logbook purposes is estimated at 15 minutes per trawl haul. But this time burden can substantially increase due to the numerous bycatch species that would have to be identified and reported by fishermen. The government cash outlay includes the cost for form development and printing, labor for sight review and data entry, and program management. The level of cost outlay depends on the number of fishing craft that would be required to submit logbooks, or on the number of trips targeted to be covered by a logbook system. In an earlier investigation on the level of shrimp effort as part of the red snapper bycatch study, a logbook program was administered to the shrimp fleet in the western Gulf. This logbook program was limited in coverage (2,100 trips) and duration (4 months). In addition, the information requested was very limited, with the level of effort being the main target. Burden time was estimated at 10 minutes per form to complete each daily log, or a total burden time of 1,670 hours for the industry. Government cost outlay was estimated at $16,250. A bycatch data collection, even if added to a general logbook program for the shrimp fishery, would undoubtedly entail a much higher cost, noting that the estimated burden time is about 15 minutes per trawl haul as mentioned above. A better analogy in terms of the cost involved would be the bycatch data collection in relatively simple fisheries in the southeast. A bycatch data collection requirement has recently been initiated (November 2001) involving approximately 500 vessels in the commercial reef fish and coastal migratory pelagic fisheries. The estimated cost of this bycatch data collection program to the Federal government is $25,000 to $30,000 annually (SEFSC 2001). If a logbook program is initiated in the shrimp fishery and bycatch data collection is added on to it, the potential cost of the bycatch data collection portion alone could range from $200,000 to $240,000 annually. Such cost level, however, is expected to be still much less than that of an observer program that covers the same number of vessels.

The Alaska program carries a cost of about $8 million a year. In a recent experience in the Gulf of Mexico, designed to evaluate BRDs in the shrimp fishery, 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 cost would definitely escalate if an observer program were expanded to cover 3,000 to 5,000 shrimp vessels. Most recently, an observer program has been estimated to cost $800 to $900 per sea day for offshore trips, and this covers the phases from data collection itself through analysis (Nance, personal communication 2002). In 2001, there were about 42,000 offshore trips, and assuming the average of 30 days per trip and a 5% coverage of total sea days (63,000), an observer program would cost $50 to $57 million annually. There's a good possibility that economies of scale can develop, and if in addition the observer program is made mandatory, the cost per sea day could go down to $200 to $300 (Nance, personal communication 2002). At these lower numbers, an observer program at the 5%

coverage can range from $13 to $19 million annually. This cost may be shared by the government and the industry or fully borne by either entity.

Potentially affected by any bycatch data collection are 3,000 to 5,000 shrimp fishing craft (a more exact number may be derived once the federal shrimp permitting requirement becomes effective)[4]. These fishing craft vary in size and extent of operations. As mentioned earlier, the Proposed Alternative would not entail additional cost on these vessels. Rejected Alternative 6.5.2 may be expected not to impose significant differential impacts on the cost of the various fishing craft's operations as the cost outlay would be minimal and the reporting burden would be about proportional to the size of the operations. But this does not mean that crew time spent on species identification and logbook recording would be minimal. An observer program, on the other hand, has the potential to create disparity in impacts on the operations of the various classes of fishing craft, particularly if the industry shares part of the cost of the observer program. This cost may come in the form of outright cash expense and/or in the form of liability associated with carrying an observer on board the fishing craft. Larger operations, such as some fleet operations in the shrimp fishery, may be able to absorb the potential costs, but smaller operations would be placed at a strong disadvantage. These costs would have to be explicitly determined in designing an observer program.

There are other potential costs attendant to logbook and observer program alternatives for collecting bycatch information. In the case of logbooks, management would have to develop logbooks and a training program for vessel captains and crew. Vessel operators and crew would likely be required to receive training in order to properly identify bycatch species as well as how to fill out logbooks. The time required to complete these tasks could be extensive and costly. Furthermore, it is estimated that at least 15 minutes per trawl would be required to complete logbooks which may be complicated by inclimate weather conditions and the fact that most trawling activity occurs at night. In addition, logbook reporting, which for purposes of accuracy needs to be completed at sea, would demand time on the crew that have been spent trawling or doing routine tasks on the vessel and equipment. Also, there is a probability that at least some captains and crew would be unwilling to participate in a logbook programs, and thus would promote ill harbor toward fishery managers that could later translate in inaccurately reporting bycatch. Fishery managers, upon examination of some logbooks, may observe certain patterns of inaccuracies and would require more work from fishermen. Such additional requirement may be viewed by fishermen as another obstacle from possibly renewing their permits (assuming logbook reporting as a condition for permit renewal).

An observer program is an intrusive data collection system, and thus is likely to create adverse social effects. In particular, an observer program can give rise to some friction between fishermen and fishery managers. A mandatory observer program would only worsen the

[4]It should be noted that license files from various states show that there are about 13,163 shrimp fishing craft in the Gulf (GMFMC 2001) so that the number of permitted shrimp fishing craft may be more than estimated here.

situation. In addition, fishermen do not like to take observers on board for a variety of reasons. Some may fear liability for the safety of observers and others feel that they are simply a nuisance because they are "in the way." In the particular case of health and safety, an observer program would expose shrimp fishermen to the risk that their fishing craft may not be adequately equipped to carry an extra person, although this may be partly addressed by the requirement imposed under Section 403 (a) of the M-SFCMA regarding the health and safety of observers. Others do not trust that observer information can be kept confidential.

7.0 REGULATORY IMPACT REVIEW AND INITIAL REGULATORY FLEXIBILITY ANALYSIS

7.1 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 the proposed regulations are a "significant regulatory action" under the criteria provided in Executive Order (EO) 12866 and provides some information that may be used in conducting an analysis of impacts on small business entities pursuant to the Regulatory Flexibility Act (RFA). This RIR analyzes the probable impacts that the alternatives in this plan amendment to the Shrimp FMP would have on the commercial shrimp industry.

7.2 Problems and Issues in the Fishery

The specific problems addressed by this proposed plan amendment are enumerated and discussed in Section 3 and are incorporated here by reference. Section 3 notes that the major issues identified for this plan amendment are whether bycatch has been reduced to the extent practicable as required by the M-SFCMA, and if not what additional measures are needed and feasible. Alternatives considered in order to reduce shrimp trawl bycatch are: (1) area closures; (2) seasonal closures; and (3) bycatch reduction devices. Alternatives for establishing a standardized bycatch reporting methodology are also included.

7.3 Objectives

Section 4 of this document discusses the specific need for this plan amendment and is incorporated here by reference. As noted the need for this amendment is based on whether bycatch in the shrimp fishery of the Gulf has been reduced to the extent practicable, and if not

what are the most appropriate ways to further reduce this bycatch. Furthermore, it addresses the M-SFCMA requirement to establish a standardized bycatch reporting methodology.

7.4 Description of the Fishery

A general description of the fishery is found in Section 8. Additional features of the fishery are discussed in Section 6 and Section 7.8.

7.5 Impacts of Management Measures

The discussions under the "Socioeconomic Impacts" sub-heading under each of the alternatives in Section 6 comprise the bulk of the social and economic impact analysis for RIR purposes. Readers should review these sections for more detailed information on such impacts. It is worth noting here that the status quo, i.e., no additional bycatch reduction, is considered a viable alternative in each set of alternatives considered in this amendment. It may not be a viable option for the statutory requirement of establishing a standardized bycatch reporting methodology. The following summarizes the general results of the analyses conducted in Section 6.

There are 4 sets of measures considered in this amendment, namely, area closures, seasonal closures, BRD requirements, and bycatch reporting methodology. The Council's proposed alternatives are to impose no additional area closures; to impose no additional seasonal closures; to require the use of BRDs; and, to use existing information to estimate bycatch in the shrimp fishery.

The mandate pursuant to M-SFCMA is to minimize, to the extent practicable, bycatch and mortality of bycatch that cannot be avoided. The general rationale for this goal is that bycatch precludes better utilization of the species in question. The bycatch species may play an important role in the ecosystem so that their mortality can disrupt the proper functioning of the system or may be important to the directed fisheries so that their restricted use in those fisheries would reduce overall benefits to the nation. In addition, the incidence of bycatch may reduce the ability of scientists to determine the true status of the bycatch species for purposes of setting overfished, overfishing, MSY and optimum yield (OY) parameters. The bycatch issue in the shrimp fishery west of Cape San Blas, Florida was addressed in Amendment 9 (GMFMC 1997), with the major intent of protecting and reducing the mortality of juvenile red snapper, which is a highly sought species in the directed commercial and recreational fisheries. Addressing the bycatch issue in areas east of Cape San Blas, Florida lacks the focused approach that was adopted for Amendment 9. This lack of focus precludes estimation of potential benefits from a bycatch reduction program east of Cape San Blas, Florida. This condition limited the analysis of benefits to a more qualitative approach and concentrated more on the effectiveness of the various alternatives to reduce bycatch. A more expanded discussion was devoted to determining the potential costs of the various bycatch reduction alternatives.

In general, area closures can provide protection to fish stocks, enhance the long-term viability of the bycatch and other species inhabiting in the subject areas, and increase the abundance of bycatch and non-bycatch fish in and around the closed areas. Area closures are particularly effective for protecting spawning aggregations. Available data, however, cannot provide guidance on specific areas that would be targeted for closures to achieve the described benefits. One important negating factor of area closures is the non-prohibition of other (than shrimp) fishing in the subject areas. Among the potential areas for closure in Statistical Subareas 1-8, areas in Statistical Subareas 1-3 and 6-8 are prime candidates from the standpoint of effectively reducing bycatch in shrimp trawls, but closures in Statistical Subareas 1-3 would impose a relatively large cost that would likely not be outweighed by the potential benefits.

Seasonal closures offer the same type of benefits as area closures, but the magnitude of benefits as viewed from the standpoint of effectively reducing bycatch would likely be less than those for permanent closure alternatives. The attendant costs of seasonal closures would also be less than those of area closures.

The potential benefits and costs of requiring BRDs are more susceptible to estimation than those for area and seasonal closures. Bycatch reduction required under the proposed alternative is set at a minimum of 30% of finfish bycatch by weight. Of the potentially 11 BRDs that have currently been tested, only 2 types would not qualify under the 30% minimum requirement. The attendant reduction in shrimp harvests, and consequently revenues and profits, ranges from 0% to 10%. This described condition allows flexibility among fishermen to choose a BRD type they think are more appropriate for their operations. As the technology for BRDs is improved over the years, potentially higher bycatch reductions and lower shrimp loss may be achieved.

In summary, the choice of BRDs over area and seasonal closures provides at least a first approach to reducing bycatch in areas east of Cape San Blas, Florida at a relatively known cost to the industry. Area and seasonal closures need to be evaluated more to determine their effectiveness in reducing bycatch and their attendant economic benefits and costs.

Among the alternatives for a bycatch reporting methodology, the proposed alternative is the least costly and the one that can be implemented immediately. However, potentially better bycatch information may be generated by the logbook and observer programs, although at a relatively higher costs. The cost is especially substantial with the use of an observer program. Logbooks would also be very burdensome on the crew considering the numerous species that are incidentally caught in shrimp trawls and may not be practical to implement.

7.6 Private and Public Costs

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

Council costs of document preparation, meetings, public hearings, and information dissemination	$45,000
NMFS administrative costs of document preparation, meetings, and review	$30,000
Industry cost of BRDs	$193,400 - $221,200
Law enforcement costs	unknown
TOTAL	$268,400 - $296,200

The Council and NMFS costs of document preparation are based on staff time, travel, printing, and any other relevant items where funds would be expended directly for this specific action. Industry BRD cost refers only to the cost of the equipment. The total industry cost is estimated using BRD cost of $50 (from Amendment 9) and assuming 4 trawls per vessel/boat of the 967 to 1,106 fishing craft that may be affected by this amendment. Actual BRD costs may vary from the one presented here depending on the type of BRD used, number of BRDs per fishing craft, and the number of fishing craft affected. Current information indicates each BRD costs around the range of $25 for Fisheye, $50 for Extended Funnel, $200 for Kiffe, and $300 for Jones-Davis (Jamir, personal communication, 2001). Boats may use only two nets and thus two BRDs while vessels may use four nets and thus four BRDs, and in addition, each fishing craft may have spare BRDs on board equal to the number of BRDs installed in nets. There are expected to be no additional data collection costs at the federal level with this plan amendment, since the bycatch reporting proposal makes use of data from existing data collections programs. Enforcing closures or the use of BRDs would be part of the routine enforcement tasks, although this would mean some reallocation of enforcement activities. It should be recalled here that, in their review of Amendment 11 to the Shrimp FMP, the Council's Law Enforcement Advisory Panel advised that there are undetermined enforcement costs associated with any additional regulations that reduce efficiency and contacts. A more in-depth study is thus needed to determine these costs.

7.7 Determination of a Significant Regulatory Action

Pursuant to EO 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 EO 12866.

Any of the alternatives considered in this amendment, except for the bycatch reporting methodology, would affect the business operations related to the harvest of shrimp in Statistical Subareas 1 through 8. As shown in Table 1, the 1991-2000 average total value of landings of shrimp caught in these areas is $44.5 million. It may be noted, however, that catch and revenues fluctuate from year to year. For example, in 1998 revenues from the harvest of shrimp in Statistical Subareas 1-8 was $74.5 million but in 1999 fell to $37.6 million. There is a possibility that if the wholesale level is considered, the revenues involved may reach or exceed $100 million during a very good fishing year, such as the one experienced in 1998. But since any of the closure or BRD alternatives would reduce only a certain percentage of shrimp harvest and revenues (maximum of 10%), any of the alternatives considered in this amendment would not meet the $100 million annual impact criterion.

The costs to federal government agencies of formulating and implementing closures or BRD requirements are estimated to be about $75,000. If BRDs are required, industry costs may total from $193,400 to $221,200 for the equipment alone. There are no expected cost increases to be borne by state and other local governments from implementing any of the alternatives in this amendment, since the measures considered would likely affect only vessel operations in the EEZ. It is likely that if a relatively high percentage reduction in shrimp landings is effected, the price of shrimp may increase in areas that are highly dependent on shrimp caught in the subject area. To the extent that the shrimp market is essentially dominated by imports, a significant increase in price may be deemed unlikely. It is not known whether some shrimp vessels/boats would exit the fishery as a result of adopting certain measures in this amendment. In the event that a substantial number of vessels/boats exit the fishery, there would ensue some adverse effects on competition, investment, productivity, and innovation, or on the competitive status of the domestic fishery, vis-a-vis its foreign rivals. The significance of this effect cannot be determined.

None of the closure, BRD or bycatch reporting methodology alternatives considered in this amendment would create a serious inconsistency or otherwise interfere with an action taken or planned by another agency. In fact, the BRD alternatives would complement Florida's BRD requirement in state waters and the current BRD requirement west of Cape San Blas, Florida in the EEZ and state waters.

None of the alternatives considered in this amendment are expected to impact entitlements, grants, user fees, or loan programs or the rights and obligations of the recipients thereof. These items would continue to be in effect whether or not any of the alternatives in this amendment is implemented. Closures or BRDs are not novel in the Gulf fishery management programs, considering that there are now in effect various closures for shrimping as well as requirements for the use of BRDs.

It is, therefore, determined that any of the alternatives considered in this amendment, or any combination thereof, would not constitute a significant regulatory action as stipulated under EO 12866.

7.8 Initial Regulatory Flexibility Analysis

Introduction

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

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

Description of the reasons why action by the agency is being considered: The need and purpose of the actions are set forth in Section 4 of this document. This particular section is included herein by reference. As noted the need for this amendment is based on whether bycatch in the

shrimp fishery of the Gulf has been reduced to the extent practicable as required by the M-SFCMA, and if not what are the most appropriate ways to further reduce this bycatch. This amendment is also needed to establish a standardized bycatch reporting methodology as required by the M-SFCMA.

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. This section is included herein by reference. As noted the objectives of this amendment are based on whether bycatch in the shrimp fishery of the Gulf has been reduced to the extent practicable, and if not what are the most appropriate ways to further reduce this bycatch. The M-SFCMA, as amended, provides the legal basis for this consideration and a proposed rule, as well as the need to establish a standardized bycatch reporting methodology.

Description and estimate of the number of small entities to which the proposed rule will apply: There are about 3,500 to 5,000 shrimp vessels and 13,000 shrimp boats in the Gulf, of which about 967 to 1,106 fishing craft may be directly affected by the proposed action in this amendment to the extent that they fish in the EEZ of Statistical Subareas 1 through 8. For the 1991-2000 period, these vessels/boats made an average of 6,761 annual trips totaling about 26,000 hours in Statistical Subareas 1-8. Additional descriptions are noted below in the discussion of the substantial number of small entities criterion.

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: This amendment does not require additional reporting requirements in that the bycatch reporting methodology is based on currently collected data by the NMFS.

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. In fact the actions in this amendment related to BRD requirements would place the shrimp fishery in the subject area on par with the shrimp fishery in state waters of Florida and Texas, as well as the shrimp fishery in the EEZ west of Cape San Blas, Florida and in the EEZ and waters of the EEZ under the jurisdiction of the South Atlantic Fishery Management Council. The proposed bycatch reporting methodology makes use of information collected as part of existing data collection programs.

Substantial Number of Small Entities Criterion

Generally, a fish-harvesting business is considered a small business if it is independently owned and operated and not dominant in its field operation, and if it has annual receipts not in excess of $3.5 million. Although there are several fleet operations in the shrimp fishery, their actual number is not known. Considering the low likelihood that these operations are dominant in the harvesting sector of the shrimp fishery, the gross receipts criterion may be used to define small business in the shrimp fishery.

Of the possible 3,500 vessels and 13,163 boats fishing for shrimp in the Gulf, approximately 967 to 1,106 fishing craft would be directly or indirectly affected by measures in this amendment. Of these fishing craft, 792 to 966 are vessels and 140 to 175 are boats. While vessels versus boats are generally distinguished in the shrimp fishery, a finer classification by length is also available and may be used here to further describe the characteristics of the affected shrimp fishing craft. These fishing craft may be categorized into three: (1) less than 45 feet in length, (2) 45 to 60 feet in length, and (3) greater than 60 feet in length. The average crew size, including captains for these categories of fishing craft are: 2.1 for vessels/boats less than 45 feet in length, 2.5 for vessels between 45 to 60 feet in length, and 3.5 for vessels greater than 60 feet in length. Using 1998 and 1999 data, the following are the number of fishing craft in the three categories within three major statistical subareas (see Table 7b for more details):

Statistical Subarea	Less than 45 feet	45 to 60 feet	Greater than 60 feet
1-3	19 - 21	28 - 30	403 - 531
4-5	77 - 91	16 - 28	183 - 253
6-8	215 - 251	91 - 111	251 - 372

Source of basic data: Travis (2001).

Average revenues per fishing craft across all vessel categories and areas fished were $67,342 in 1998 and $38,927 in 1999. The drop in revenues per fishing craft from 1998 to 1999 reflects the decline in overall harvest and revenues from Statistical Subareas 1-8 of participating vessels/boats. The following provides a more detailed summary of revenues per fishing craft, by size categories and areas fished, for 1998 and 1999:

Statistical Subarea	Less than 45 feet	45 to 60 feet	Greater than 60 feet
1998			
1-3	$40,053	$25,183	$68,095
4-5	$2,733	$9,580	$25,722
6-8	$18,346	$24,908	$61,803
1999			
1-3	$18,266	$10,151	$51,438
4-5	$1,308	$12,285	$17,969
6-8	$9,427	$15,661	$35,476

Source of basic data: Travis (2001).

It should be noted in the revenue information above that only the operations of vessels/boats in Statistical Subareas 1-8 are considered. Some of these vessels/boats may also fish in other areas in the Gulf or in the Atlantic for those coming from other states or east coast of Florida, or they may be deriving income from sale of species other than shrimp. It is very likely, however, that boats from Florida derive most of their harvest and revenues from fishing in Statistical Subareas 1-8.

Fishing craft harvesting shrimp in Statistical Subareas 1-8 are homeported in eight states in the southeastern United States. Most fishing craft have Florida as their homeport state, although there are also significant numbers coming from Alabama and Texas. The following provides a summary of vessels/boats by homeport states and areas fished:

Statistical Subarea	AL	FL	GA	LA	MS	NC	SC	TX
1-3	45 - 63	238 - 267	11 - 16	11 - 17	12 - 20	8 - 15	2 - 5	123 - 179
4-5	20 - 43	205 - 269	4 - 5	0 - 2	0 - 3	0 - 1	0 - 2	44 - 50
6-8	80 - 135	453 - 466	8 - 9	3 - 13	10 - 19	1 - 2	1 - 2	36 - 53

Source of basic data: Travis (2002).

The following provides a summary of total revenues per fishing craft, by homeport of fishing craft. Again, revenues per fishing craft refer only to a fishing craft's operations in the various areas in Statistical Subareas 1-8. Note that fishing craft revenues in some homeport states are not provided due to the possibility of disclosing some confidential information.

Statistical Subarea	AL	FL	GA	LA	MS	NC	SC	TX
1998								
1-3	$81,952	$69,461	$23,375	$52,411	$49,850	$19,533	$44,800	$51,765
4-5	$24,116	$18,372	$7,600			0	0	$18,080
6-8	$60,593	$39,903	$35,333	$23,385	$20,316			$32,509
1999								
1-3	$37,956	$52,126	$12,727	$16,727	$34,667	$32,250		$50,772
4-5	$9,550	$13,078	$9,000	0	0			$14,796
6-8	$19,463	$21,728	$8,125		$8,200			$25,778

Source of basic data: Travis (2002).

Considering the information above, it is clear that the $3.5 million threshold would not be met, and all shrimp vessel/boat operations affected by this amendment may be considered small business entities. To the extent that all fishing craft may be at least indirectly affected by measures in this amendment, the substantial number criterion is adjudged to be met.

Significant Economic Impact Criterion

The outcome of "significant economic impact" can be ascertained by examining two issues: disproportionality and profitability.

Disproportionality: Do the regulations place a substantial number of small entities at a significant competitive disadvantage to large entities?

All the commercial entities potentially affected by the proposed rule are considered small entities so that the issue of disproportionality does not arise in the present case. Within these small entities, there are significant variations among fishing operations in terms of revenues by size of fishing craft and areas fished, as noted above.

Profitability: Do the regulations significantly reduce profit for a substantial number of small entities?

Average profit per fishing craft across all vessel categories and areas fished were $5,730 in 1998 and $3,380 in 1999. The drop in profits per fishing craft from 1998 to 1999 follows the decline in overall harvest and revenues from Statistical Subareas 1-8 of participating vessels/boats. The following provides a more detailed summary of profits per fishing craft, by size categories and areas fished, for 1998 and 1999:

Statistical Subarea	Less than 45 feet	45 to 60 feet	Greater than 60 feet
1998			
1-3	$12,336	$4,760	$4,222
4-5	$842	$1,811	$1,595
6-8	$5,651	$4,708	$3,832
1999			
1-3	$5,626	$1,919	$3,189
4-5	$403	$2,322	$1,114
6-8	$2,904	$2,960	$2,199

Source of basic data: Travis (2001).

As with the caveat earlier noted with respect to revenues, the profit figures above consider only shrimp operations of vessels/boats in Statistical Subareas 1-8. Some of these vessels/boats may also fish in other areas in the Gulf or in the Atlantic for those coming from other states or east coast of Florida, or they may be deriving income from sale of species other than shrimp.

It is very likely, however, that boats from Florida derive most of their harvest, revenues, and profits from fishing in Statistical Subareas 1-8.

Some of the alternatives in this amendment (e.g., a BRD requirement that would potentially reduce shrimp catch by 10%, in some areas, or area closure that would increase the areas closed to shrimping by 20% or more) result in a fair amount of reduction in shrimp landings, and thus would likely significantly reduce revenues and profits of fishing craft, particularly those of smaller fishing operations. Considering that low profitability characterizes several fishing craft regardless of size (again with the caveat that only fishing operations in Statistical Subareas 1-8 are considered), a 10% to 20% reduction in shrimp harvest and revenues would likely result in significant reductions in profits.

As it currently stands, this amendment contains the Council's proposed alternatives of maintaining status quo for area and seasonal closures, requiring BRDs that reduce finfish bycatch by at least 30% (Proposed Alternative 6.3.3) throughout Statistical Subareas 1-8, and using existing data collection programs to estimate bycatch. All proposed alternatives, except the BRD requirement, would have no impacts on the profits of small entities. The BRD proposed alternative provides fishermen with the flexibility of choosing a number of BRDs (see Tables 11 and 12). Shrimp losses from these BRDs would range from 0% to 10%, and at the higher end of this range the reduction in profit to shrimp fishing craft would be significant. It is very likely, however, that fishermen would choose BRDs that have lower shrimp reductions, but this choice would depend on availability of BRDs that meet the bycatch reduction criteria and costs of these BRDs.

With respect to the use of BRDs, fishing craft would have to incur additional costs for equipment and maintenance. As described in the previous sections, each fishing craft is assumed to use 4 BRDs at a total cost of $200. Some BRDs cost more than this and can comprise a significant contribution to the cost of operating a shrimp vessel/boat. In addition, each fishing craft would have to have a spare BRD equal to the number of BRDs used in the nets. It is likely then that a BRD requirement can significantly affect the profitability of some fishing craft. Based on the profit information above and cognizant of the caveat noted, even a $200 cost of using a BRD can significantly reduce the profits of many fishing craft, particularly those fishing in Statistical Subareas 4-5. The cost of the BRDs themselves could wipe out the profits of some small vessels fishing in Statistical Subarea 4-5.

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

Regarding area and seasonal closures, the Council's proposed alternatives are for maintenance of status quo. These proposed alternatives would provide the least adverse economic impacts on small entities among the alternatives considered for area or seasonal closures. With respect to the BRD requirement, the Council's preferred alternative provides for a good amount of flexibility in the choice of BRDs, and among the potentially allowed BRDs, four provide for

a zero reduction in shrimp catch. Rejected Alternatives 6.3.4 and 6.3.5 would restrict the requirement of BRDs to Statistical Subareas 4-8, and thus would cushion the impacts of requiring BRDs that may effect greater than zero shrimp loss. Rejected Alternative 6.3.6 would restrict further the areas in which BRDs are required and would then effect lesser negative impacts on small business entities. On the other hand, certain alternatives (e.g., Rejected Options (b) and (c) under Proposed Alternative 6.3.3) would potentially result in higher shrimp losses, particular if a higher bycatch reduction criterion, such as 40% or 50%, were imposed. As regards the bycatch reporting methodology, viable alternatives to the proposed alternative are logbooks and an observer program. Logbooks would impose a considerable reporting burden on shrimp fishing craft, especially that numerous species are incidentally caught in trawl nets. The identification alone of those species would demand significant labor burden on the crew of shrimp fishing craft. An observer program would be very expensive to establish and manage, with the cost totaling to as high as $50 to $57 million annually to cover about 5% of total sea days for offshore trips. Even if the full cost outlay is borne by the government, shrimp fishing craft may still be liable for the health and safety of an additional person on board.

Conclusion

Some of the alternatives considered in this amendment would possibly result in a significant economic impact on a substantial number of small entities. One such alternative is the use of a BRD that would effect a 10% reduction in shrimp catch. The data that produced this large shrimp loss were from a limited number of tests of the large 12X5 Fisheye BRD on the west coast of Florida (Table 11), and most tests were conducted in Statistical Subareas 1-3. Exempting this area and allowing greater flexibility in their choice of a BRD, would significantly reduce the potential adverse impact on small entities. Additionally, in other areas this BRD design and other designs have been shown to create only a 4% or less shrimp loss (Table 12).

8.0 DESCRIPTION OF FISHERY

The Final Environmental Impact Statement (FEIS) for the original Shrimp FMP and the FMP as revised in 1981 contain a description of the Gulf shrimp fishery. In its appendix, the FEIS of February 1981 includes the Habitats, Distribution, and Incidental Capture of Sea Turtles. This material is incorporated by reference and is not repeated here in detail. Amendment 9 (GMFMC 1997) with SEIS updated this information.

As an overview, the management unit of this FMP consists of brown, white, pink, and royal red shrimp. Seabobs and rock shrimp occur as incidental catch in the fishery.

Brown shrimp is the most important species in the U.S. Gulf fishery with principal catches made from June through October. Annual commercial landings in recent years range from 70 to 100 MP of tails depending on environmental factors that influence natural mortality. The fishery extends offshore to about 40 fathoms.

White shrimp, second in value, are found in nearshore waters to about 20 fathoms from Texas through Alabama. There is a small spring and summer fishery for overwintering individuals, but the majority are taken from August through December. Recent annual commercial landings are about 50 MP of tails.

Pink shrimp are found off all Gulf states but are most abundant off Florida's west coast and particularly in the Tortugas grounds off the Florida Keys. Most landings are made from October through May with annual commercial landings of about 10 MP. In the western Gulf states, pink shrimp are landed mixed with browns. Most catches are made within 30 fathoms.

The commercial fishery for royal red shrimp has expanded in recent years with the development of local markets. This deep-water species is most abundant on the continental shelf from about 140 to 275 fathoms east of the Mississippi River. Thus far, landings have not reached the MSY, OY, and TAC estimate of 392,000 pounds of tails in any year.

The three principal species (penaeids) are short-lived and provide annual crops; however, royal red shrimp live longer, and several year classes may occur on the grounds at one time. The condition of each shrimp stock is monitored annually, and none has been classified as being overfished.

Brown, white, and pink shrimp are subjected to fishing from inland waters and estuaries, through the state-regulated territorial seas, and into federal waters of the EEZ. Royal red shrimp occur only in the EEZ. Management measures implemented under the M-SFCMA apply only to federal waters in the EEZ. Cooperative management occurs when state and federal regulations are consistent. Examples are the seasonal closure off Texas, the Tortugas Shrimp Sanctuary, and the shrimp/stone crab seasonally closed zones off Florida.

The NMFS has classified commercial shrimp vessels comprising the nearshore and offshore fleet into size categories from under 25 feet to over 85 feet. More than half fall into a size range from 56 to 75 feet.

Federal permits for shrimp vessels are currently not required, and state license requirements vary. Many vessels maintain licenses in several states because of their migratory fishing strategy. The number of vessels in the fishery at any one time varies due to economic factors such as the price and availability of shrimp and cost of fuel. The NMFS maintains two types of vessel files, both of which are largely dependent on port agent records. One is for vessels that are recorded as landing shrimp, the shrimp landings file (SLF); the other is the vessel operating units file (VOUF) that lists vessels observed at ports. The number of commercial vessels participating in the Gulf shrimp fishery is not known but is believed to be between about 3,500 and 5,000.

The NMFS estimates fishing effort independently from the number of vessels fishing. The NMFS uses the number of hours actually spent fishing from interview data with vessel captains to develop reports as 24-hour days fished. These estimates have been controversial and not well understood because the effort reported does not necessarily reflect the number of active vessels in the fleet.

A recreational shrimp trawl fishery occurs seasonally and almost entirely in the inside waters of the states. There are about 8,000 small boats participating using trawls up to 16 feet in width. About half the boats are licensed in Louisiana.

Bait landings of juvenile brown, pink, and white shrimp, occur in all states and are not routinely included in the NMFS statistics. Estimates from the original FMP suggest landings of about 5 MP (whole weight) in 1980.

Various types of gear are used to capture shrimp including but not limited to cast nets, haul seines, stationary butterfly nets, wing nets, skimmer nets, traps, and beam trawls. The otter trawl with various modifications, is the dominant gear used in offshore waters. A basic otter trawl consists of a heavy mesh bag with wings on each side designed to funnel the shrimp into the codend or tail. A pair of otter boards or trawl doors positioned at the end of each wing hold the mouth of the net open by exerting a downward and outward force at towing speed.

The two basic otter-trawl designs used by the Gulf shrimp fleet are the flat and the semi-balloon trawls (Klima and Ford 1970). The mouth of the flat trawl is rectangular in shape, whereas the mouth of the semi-balloon design forms a pronounced arch when in operation.

Try nets are small otter trawls about 12 to 16 feet in width that are used to test areas for shrimp concentrations. These nets are towed during regular trawling operations and lifted periodically to allow the fishermen to assess the amount of shrimp and other fish and shellfish being caught. These amounts in turn determine the length of time the large trawls will remain set or whether more favorable locations will be selected.

Until the late 1950s, most shrimp vessels pulled single otter trawls ranging from 80 to 100 feet in width (Idyll, 1963). Double-rig trawling was introduced into the shrimp fleet during the late 1950s. The single large trawl was replaced by two smaller trawls, each 40 to 50 feet in width, towed simultaneously from stoutly constructed outriggers located on the port and starboard sides of the vessels. The port trawl was towed about 150 feet in back of the starboard trawl to prevent fouling. The advantages of double-rig trawling include: (1) increased catch per unit of effort, (2) fewer handling problems with the smaller nets, (3) lower initial gear costs, (4) a reduction in costs associated with damage or loss of the nets, and (5) greater crew safety (Idyll, 1963).

In 1972, the quad rig was introduced in the shrimp fishery, and by 1976 it became widely used in the EEZ of the western Gulf. The quad rig consists of a twin trawl pulled from each

outrigger. One twin trawl typically consists of two 40-foot trawls connected to a center sled and spread by two outside trawl doors. Thus, the quad rig with two twin trawls has a total spread of 160 feet versus the total spread of 110 feet in the old double rig of two 55-foot trawls. The quad rig has less drag and is more fuel efficient. For some designs, a lower opening reduces fish bycatch (David Harrington, personal communication).

Although the industry continuously works to develop more efficient gear designs and fishing methods, the quad rig is still the primary gear used in federal waters. In recent years, the skimmer trawl has become a major gear in the inshore shrimp fishery in the northern Gulf.

9.0 ENVIRONMENTAL ASSESSMENT

This section reviews and discusses the effects of the proposed actions on the biological, physical, and human environment of the shrimp fishery of the Gulf of Mexico. These reviews and discussions have been developed to determine whether there is a significant environmental impact that would result in the need to develop a SEIS.

9.1. Biological Environment

The Shrimp FMP (with FEIS), Amendment 9 (with SEIS), and the Generic Essential Fish Habitat (EFH) Amendment provide a review of the biology and habitat of shrimp, and they are incorporated here by reference. As discussed, the life cycle of penaeid species (brown, white, and pink shrimp) is typical of many species in the Gulf. They are estuarine-dependent with spawning occurring in offshore waters followed by movement of larvae into nearshore nursery areas. Juveniles and subadults gradually move from estuaries as they grow to maturity and subsequently move offshore to spawn and complete the cycle. No new information that would appreciably change these discussions is available. Furthermore, since shrimp production has been relatively stable over the past 40 years, these environments appear to be stable.

The biological impacts of the proposed and rejected actions are discussed immediately following each set of alternatives in Section 6.0 herein and are incorporated here by reference. As discussed in this section, the composition of the bycatch from shrimp trawls in the area south and east of Cape San Blas is poorly understood because there have been very limited sampling efforts to characterize the bycatch composition by species. As shown in Tables 4 and 5, it varies considerably by season, depth, and area; and from available data, few managed species are encountered. Furthermore, as discussed in Section 6.0, the ecological relationships of these bycatch species are largely unknown, but some inferences are made based on available data.

This document considers 3 methods to further reduce bycatch: closed areas, closed seasons, and the requirement of BRDs. As discussed in Section 6.0, additional, cost prohibitive, research would be needed to accurately determine the biological impacts of each method. Although these impacts are presently unknown, they would likely vary depending on the

preferred method and options chosen. As discussed, additional closures or areas and seasons would probably have the greatest negative impacts with the least promise for bycatch reduction when compared to the alternative of requiring BRDs. Any method that produces additional bycatch reduction may be beneficial in the sense of increasing the survival of a given species. However, that species' survival may reduce the survival of other species that are part of the food web. Because the identity of these species is poorly understood and their ecological relationships are unknown, "winners" and "losers" cannot be accurately determined. Consequently, overall impacts, positive or negative, cannot be completely understood. As discussed in Section 6.0, however, the overall amount of shrimping effort in Statistical Subareas 1-8 is minimal when compared to the overall Gulf. Consequently, impacts, either positive or negative, are expected to be minimal. Furthermore, based on the fact that BRDs have been required in other areas with little apparent effect on biodiversity, there would likely be minimal effects in this area with the greatest potential for additional bycatch reduction, albeit small from a Gulfwide perspective.

The requirement of a standardized bycatch reporting methodology would have no biological impacts. These data are currently being collected, and the preferred alternative would only affect the way the data are compiled and used.

9.2 Physical Environment

The alternatives proposed in this amendment will not have a negative impact on the physical environment. A BRD requirement for additional bycatch reduction from shrimp vessels in the shrimp fishery would have immeasurable effect on the physical environment because BRDs have been required in federal waters of most of the Gulf since 1998 (Amendment 9 to the Shrimp FMP) and are now required in state waters of Florida and Texas. This statement is supported by the fact that brown shrimp catches were the fourth highest and white shrimp catches were the second highest on record in 2000. To the extent that additional areas are closed permanently or seasonally, some positive benefits to the bottom environment might occur due to reducing or eliminating trawling. Any such benefits could not be quantified without further research, but any benefits are likely to be insignificant unless such areas were very large and permanently closed. Continuing studies have provided no new information beyond that already contained in the FMP, as amended, that would change the aforementioned determination. The relationship between penaeid shrimp stocks and their habitats, including the physical requirements, are contained in the Shrimp FMP, as amended, the original EIS, the SEIS in Amendment 9, and in the Councils' Generic EFH Amendment. These documents note that shrimp are generally associated with bottom substrates and most often with soft, mud and sand areas into which they most often burrow, except when feeding, during which time they opportunistically graze the bottom for food. They also move offshore as they grow to maturity and spawn. Additionally, subsequent studies have not provided new or different information that could be used to further define the physical environment for shrimp or the relative importance of each physical component to spawning, growth, feeding, behavior, etc. that would

alter the descriptions and discussions in the aforementioned documents. These documents, accompanying discussions, and conclusions are incorporated here by reference.

9.2.1 Effect on Wetlands: Based on a review of the documents listed in Section 9.2 and the discussions in Section 6.0, it has been determined that the proposed and rejected alternatives regarding shrimp trawl bycatch reduction will have no effect on flood plains, rivers, creeks, or other streams and tributaries to the marine environment or their associated wetlands because no actions are proposed in these areas.

9.2.2 Effect on Essential Fish Habitat: The documents listed above in Sections 9.2 describe EFH for the managed shrimp species in the Gulf. Based on a review of these documents, it has been determined that the proposed action will have no effect on EFH. A BRD requirement for additional bycatch reduction from shrimp trawling in the EEZ east of Cape San Blas would probably have no measurable effect on the environment or on EFH because BRDs have been required in federal waters of most of the Gulf since 1998 (Amendment 9 to the Shrimp FMP) and are now required in state waters of Florida and Texas. To date, no measurable impacts have been observed, and as previously discussed near record shrimp harvests occurred in 2000. As discussed in Section 6.3 herein, bycatch reduction and reduction of bycatch mortality may alter fish stock structures; however, a complete assessment of such changes cannot be made without additional research. As discussed, such a research effort would be costly in terms of time and funding, neither of which is currently available. To the extent that additional areas are closed permanently or seasonally, some positive benefits to the bottom environment might occur. Any such benefit could not be quantified without further research. As discussed in Sections 6.1 and 6.2, there is insufficient data to fully assess biological and socioeconomic impacts of permanently or seasonally closed areas. To determine possible benefits to the bottom environment from such closed areas would require an additional study to characterize bottom types along the west coast of Florida. Such a study would take many years and millions of dollars to complete. For example, the NMFS, United States Geological Survey (USGS), and Mineral Management Service (MMS) have spent 3 years just to map a small area of reef bottom south of Apalachicola, Florida. The costs of a complete mapping study for the entire west coast of Florida would, consequently, be exorbitant. Furthermore, any results would have to be compared with known shrimping areas which would require an additional observer study. Since the shrimping effort often changes seasonally and within seasons such a study would have to be ongoing, exacerbating costs. It can be inferred, however, that additional permanent area closures would have the greatest potential for protecting sessile benthic and interstitial organisms and their habitats. Additional seasonal closures would likely have less effect, and the BRD requirement would likely create no change from the present condition. None of these alternatives is likely to have a significant impact on the physical environment because the area is small with numerous areas of untrawlable bottom, much of it is currently permanently or seasonally closed to trawling, and there is very little shrimping effort occurring here. Furthermore, in the rest of the Gulf EEZ where BRDs have been required since 1998, there have been no observed impacts, positive or negative to EFH.

9.2.3 Mitigating Measures: Based on a review of documents listed in Section 9.2, it has been determined that no mitigating measures related to the proposed action are necessary because the management alternatives to reduce shrimp trawl bycatch that are listed will not cause any additional impacts on the environment, and some (permanent closures) could have benefits, albeit insignificant. As previously mentioned, closing additional areas either permanently or seasonally can only provide additional protection to the physical environment from potential impacts from shrimp trawl gear. The requirement of BRDs would also not be expected to cause any additional impacts because these devices are simply added to the existing trawl gear and do not change the way the gear interacts with the physical environment.

9.2.4 Unavoidable Adverse Affects: Based on a review of documents listed in Section 9.2, and as discussed in Section 6.0 herein, it has been determined that the proposed action does not create unavoidable adverse affects on the environment because, no adverse impacts on the environment will occur as a result of implementing additional closed areas, closed seasons, or requiring BRDs. In fact, no significant impacts of any kind are expected.

9.2.5 Irreversible and Irretrievable Commitments of Resources: There are no irreversible commitments of resources other than costs of administering and enforcing the proposed rule resulting from implementation of this amendment. BRDs, area closures, and seasonal closures would increase the cost and reduce the revenues of affected vessels/boats, and any changes in BRD and closure regulations would change the cost and revenue configurations of affected vessels/boats. The commitment of resources to comply with BRD and closure regulations does not involve huge financial considerations that need to be fully recouped over a certain period of time. Furthermore, it is likely that many of the vessels fishing in the area under consideration are already using BRDs, at least when fishing other areas of the Gulf, thus they have already committed resources for this requirement.

9.2.6 Relationship Between Short-Term Uses and Long-Term Productivity: These relationships cannot be determined at this time. Depending on the method of additional bycatch reduction that is chosen, there could be some benefits to the long-term productivity. None of these fisheries are overfished or undergoing overfishing, and there are no allocations of the resources involved. BRDs, area closures, and seasonal closures would impair both the short-term and long-term productivity of shrimp fishing craft. However, long-term productivity for other fisheries may occur. Both effects are likely to be insignificant.

9.2.7 Impacts on Other Fisheries: Based on a review of the alternatives proposed in this amendment as compared with other fisheries and as discussed in Section 6.0, any effects on other fisheries cannot be fully determined at this time. There should be very little if any impacts to managed species in the EEZ because they are seldom encountered in trawls from the areas being addressed. Also, very few of the most frequently encountered

species are a component of any fishery in state or federal waters. Some portion of the bycatch is forage species for managed species; consequently, any bycatch reduction of such forage species could translate into greater availability of a food source for fishery species. However, as previously discussed the ecological relationships among these forage species and other species including fishery species are unknown. Furthermore, as previously discussed in Section 6.0, the costs required to determine these relationships and impacts would be exorbitant and not practicable at this time. Lastly, any impacts are likely to be insignificant because they have not been observed in other areas of the Gulf where BRDs are currently required and where the majority of shrimp fishing effort occurs.

9.3 Human Environment

9.3.1 Description of the Fishery: The original FMP and subsequent Amendments 1 through 9, including accompanying EIS, SEIS or Environmental Assessments (EA) along with Section 8.0 herein describe the shrimp fishery in the Gulf. See Section 2.0 herein for an overview of the management actions taken in the original Shrimp FMP and Amendments 1 through 9. Review Section 8.0 for a synopsis of the fishery and how it operates. Additional description of the shrimp fishery in Statistical Subareas 1-8 is embedded in the socioeconomic impacts sections of this document.

9.3.2 History of Management: See Section 2.0 herein for a review of the management history of the shrimp fishery in the Gulf of Mexico.

9.3.3 Economic and Social Assessment: The economic and social effects of this amendment are discussed in detail in the discussions following each set of alternatives in Sections 6.0, 7.0, and 9.0. These effects are specific for each set of management alternatives being considered.

10.0 FINDING OF NO SIGNIFICANT ENVIRONMENTAL IMPACT (FONSI)

The Gulf of Mexico Fishery Management Council (Council) is submitting the attached Amendment 10 (Amendment) to the Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico, U.S. Waters (FMP) for Secretarial review under procedures of the Magnuson-Stevens Fishery Conservation and Management Act. Amendment 10 was developed as an integrated document that includes an EA, RIR, and a determination of the need for an IRFA. Copies of the Amendment are available from the Council at the following address:

Gulf of Mexico Fishery Management Council
The Commons at Rivergate
3018 U.S. Highway 301 North
Suite 1000
Tampa, Florida 33619

Amendment 10 reviews the following alternatives:

- requirement of additional closed areas off the west coast of Florida east of Cape San Blas to shrimp trawling to reduce bycatch in the Gulf of Mexico EEZ,

- requirement of additional closed seasons to shrimp trawling off the west coast of Florida east of Cape San Blas to reduce bycatch in the Gulf of Mexico EEZ, and

- requirement of BRDs in shrimp trawls used in the Gulf of Mexico EEZ off the west coast of Florida east of Cape San Blas to reduce bycatch, and

- requirement of a standardized bycatch reporting methodology.

The EA considers information contained in the EIS associated with the original Shrimp FMP, a SEIS associated with Amendment 9 to the Shrimp FMP, as well as the Generic EFH Amendment. The NMFS has reviewed these actions as well as the comprehensive analyses of alternatives in Amendment 10 and supportive analyses are herein incorporated by reference.

Based on the following summary of effects, I have determined that implementation of the proposed and approved alternatives will not have a significant effect on the human environment.

Summary of Effects - Rationale

Closed Areas and Seasons: The closure of additional areas to shrimp trawling would likely result in additional bycatch reduction, albeit minimal. Sections 2.0, 6.0, 7.0, 8.0, and 9.0 herein review the environmental impacts of the various alternatives to further reduce bycatch on the west coast of Florida. Season and area closures have been adopted in previous amendments to both the Reef Fish FMP and the Shrimp FMP for purposes unrelated to bycatch reduction, and these discussions are included in the referenced sections. As noted, such closures could have positive benefits to the physical and biological environments, if trawling is causing negative impacts; however, such has not been established in previous research and data collecting efforts. The impacts of further bycatch reduction on ecological relationships has likewise not been fully determined, but they are likely minimal. Further closures would likely have greater negative impacts to shrimpers, particularly if additional closures include productive shrimp grounds either on a seasonal or permanent basis. Users have also testified that such closures would have more severe impacts than the alternative for requiring BRDs.

Requirement of BRDs: BRDs are currently required in most areas of the Gulf, and their impacts were assessed in the SEIS to Amendment 9 to the Shrimp FMP. Through the implementation of Amendment 9, it was determined that there would be no significant impacts to the physical environment. This document reiterates this finding as well as the finding that ecological impacts of requiring BRDs are unknown, but likely minimal. To the extent that the requirement of BRDs reduces shrimp catch there would be a negative impact on users

(currently estimated at approximately 4%). This negative impact was discussed extensively in the SEIS for Amendment 9 and in Section 6.3 herein. Furthermore, it primarily resulted from Amendment 9's requirement of BRDs west of Cape San Blas, effectively encompassing the area where approximately 90% of the trawling effort and 90% of the catch occurs. Consequently, the impacts of the requirement of BRDs in this limited area of the EEZ off Florida would probably be insignificant, and they are currently required in state waters of Florida and Texas.

Very limited studies have shown that in Statistical Subareas 1-3 there is approximately a 10% shrimp loss from the use of BRDs which may be deemed significant for that portion of participants' catch, but it would only amount to approximately 0.6% of the overall Gulf shrimp catch. Exempting this area from the requirement of BRDs and allowing flexibility in the choice of BRDs would likely mitigate any significant impacts here due to the fact that approximately 59% of the shrimp catch comes from this subarea grouping, as opposed to the groupings of Statistical Subareas 4-5 and 6-8, and the limited studies showed lower shrimp losses from requiring BRDs in Statistical Subareas 4-8.

Conclusion

Section 1508.27(b) of the implementing regulations for the Council for Environmental Quality identifies 10 concepts for evaluation of significance. They are discussed below in conclusive form for all bycatch reduction alternatives; however evaluations of significance using these concepts for each of the sets of alternatives (closed areas, closed seasons, BRDs, and a standardized bycatch reporting methodology) are discussed under each subsection of Section 6.0.

(1) Beneficial and Adverse Impacts: Precise impacts of requiring additional bycatch reduction measures in the shrimp trawl fishery of the Gulf of Mexico EEZ or status quo cannot be determined without additional research. Testimony of users indicates that greatest adverse impacts would result from additional area or seasonal closures. Although there was very little support for an additional BRD requirement by the industry, BRDs have been required in the EEZ west off Cape San Blas, Florida since 1998 and more recently in state waters of Florida and Texas. Although there may be some adverse impacts to shrimp catchability and profits, the shrimp fishery continues to operate in these areas with near record catches in 2000. From an ecological perspective, beneficial impacts may accrue to some species from measures to further reduce bycatch due to increased survival; however, this increased survival for a given species may reduce survival of other species depending on ecological relationships that are currently unknown. Adverse impacts could accrue to shrimpers if such measures result in significantly reduced catches of shrimp or reduced efficiency, thereby increasing costs. A standardized bycatch reporting methodology would provide a means of measuring bycatch on an ongoing basis, which would be beneficial to management.

(2) Public Safety: Implementation of additional bycatch reduction measures would have no effect on public safety because the general public is not associated with trawling activities. Additionally, as demonstrated through the implementation process for Amendment 9, there would be no vessel safety issues with regard to requiring BRDs, seasonal closures, or area closures, other than potentially positive, albeit small, effects from the latter two alternatives. There would be no public safety implications from a standardized bycatch reporting methodology.

(3) Unique geographic areas: The proposed and rejected alternatives regarding additional bycatch reduction measures would not affect park lands, prime farmlands, wetlands, or wild and scenic rivers because those resources are onshore or nearshore, not in the EEZ. To the extent that additional areas are closed to shrimp trawling adjacent to sensitive areas such as the Florida Middle Grounds Habitat Area of Particular Concern (HAPC), Dry Tortugas Ecological Reserve, or the FKNMS, a greater buffer zone would be created to enhance protection of these unique habitats. Shrimp trawlers typically avoid these rocky and coral areas as well as other structures and artificial reefs to prevent potential gear loss. If historic or cultural resources or sites currently exist or are designated in the EEZ, it is unlikely that shrimp vessels would damage these sites because shrimp vessels would avoid those structures. There would be no impacts to unique geographic areas from a standardized bycatch reporting methodology.

(4) Controversial effects on Human Environment: The proposed and rejected alternatives would probably be controversial because many in the shrimp fishing community perceive that these actions would impact the quality of the human environment. Any requirement of additional bycatch reduction measures in the EEZ has been opposed by fishery participants who believe that the Council and NMFS have already reduced bycatch to the extent practicable as required by the M-SFCMA. Furthermore, they believe that additional measures are unnecessary and would pose an additional economic burden to the industry. Others believe that the additional requirement of BRDs would further reduce bycatch without substantial burden to the industry because BRDs are currently required in the EEZ west of Cape San Blas and in state waters of Florida and Texas where over 90% of the Gulf shrimp production occurs. There would be no controversial effects from the proposed standardized bycatch reporting methodology because the industry would not be involved. There would be additional controversry from a requirement of logbooks or observers to collect bycatch data; however, these are rejected alternatives.

(5) Uncertain, Unknown, or Unique Risks: The requirement of additional bycatch reduction measures does not pose any uncertain, unknown, or unique risks to the shrimp industry or others, other than potential economic and social impacts as discussed in previous sections. However, the ecological impacts are unknown; consequently, risks to individual species that compose the bycatch are likewise unknown, but they are likely to be minimal due to the limited effort and relatively small area being considered. There would be no risks associated with the proposed requirement of a standardized bycatch reporting methodology. Additional risks

would probably accrue to both vessel owners and observers from a requirement of observers to gather bycatch data; however, this is a rejected alternative.

(6) *Precedence*: The proposed actions do not establish new precedence. Regulations including closed areas, closed seasons, and BRDs are already in effect for other areas of the Gulf for various purposes as previously discussed. The proposed alternative for a standardized bycatch reporting methodology would set a precedence in that data currently being collected would be used for an alternative purpose, i.e. to estimate bycatch. The alternatives for logbooks and observers would also set precedence for the shrimp industry and would likely involve significant impacts to management and to the shrimp industry; however, these are rejected alternatives.

(7) *Cumulative impacts*: The alternatives to add a new requirement for bycatch reduction in an area of the EEZ where such requirements are currently not in effect could cause direct, cumulative impacts to the biological or physical environment. The nature of such impacts, positive or negative, cannot be determined without further research, which as discussed in Section 6.0, the costs for such research would be exorbitant and take many years to complete. Although these impacts may not be precisely known, they are likely to be minimal given the small area and limited amount of shrimping effort that occurs here. There would be no cumulative impacts from the proposed alternative to establish a standardized bycatch reporting methodology; however, as previously discussed there would likely be significant impacts to management and the shrimp industry from requiring logbooks or observers to gather these data.

(8) Adverse effects on resources: The effects of the proposed and rejected alternatives regarding bycatch reduction from shrimp trawling in the Gulf of Mexico EEZ east of Cape San Blas would not apply to any sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or cause loss or destruction of significant scientific, cultural, or historical resources. Should such structures or resources be located in the EEZ near shrimping grounds additional closed areas would afford greater protection. However, shrimp vessels are not known to be impacting these resources and typically avoid areas containing structure to avoid potential gear loss. There should be no adverse effects on other resources due to a requirement of a standardized bycatch reporting methodology.

(9) Endangered Resources: An informal Section 7 consultation may be conducted by NMFS Office of Protected Resources regarding the proposed and rejected alternatives as to their impact on threatened or endangered species. The action to require BRDs would modify existing fishing methods through the requirement of this additional gear; however, it is unlikely that BRDs would have any impact on endangered species. Furthermore, as stated in the most recent biological opinion, management actions, including status quo, are not likely to jeopardize the continued existence of any endangered species. Alternatives for closed areas or seasons could reduce fishing effort in areas where endangered resources (primarily marine turtles) are known to exist thereby providing an additional level of protection: however, any benefits would likely be very insignificant since shrimp trawls are already required to have a

TED installed. There should be no adverse effects on endangered resources due to a requirement of a standardized bycatch reporting methodology.

(10) Other environmental laws: The effects of the proposed and rejected alternatives regarding bycatch reduction in the EEZ would not have an impact on state or local regulations outside the EEZ, and would not create a conflict with any other federal law or regulation applicable to the EEZ. Alternatives for closed areas, closed seasons, and BRDs, to the extent that they provide additional protection for marine resources, would only compliment state and federal laws that likewise provide protection. There should be no implications to other environmental laws from a requirement of a standardized bycatch reporting methodology.

Based on the analyses and discussions in this document, including its EA, and in the other referenced documents and sections herein, I have determined that the proposed action will not significantly affect the physical or human environment, including EFH, and that preparation of a supplemental environmental impact statement is not required by Section 102(2)(c) of NEPA or its implementing regulations.

Approved:_____ _____
Assistant Administrator for Fisheries Date

11.0 OTHER APPLICABLE LAW

11.1 Vessel Safety

The proposed alternatives do not impose requirements for use of unsafe (or other) gear nor do they direct fishing effort to periods of adverse weather conditions. Seasonal or area closures could actually cause a reduction in fishing effort and the potential for accidents and encounters with inclimate weather. Since BRDs are already required throughout most of the EEZ in the Gulf of Mexico, the addition of the area east of Cape San Blas would not have any additional impacts, and the same is true for the status quo alternative. There should be no implications to vessel safety from a requirement of a standardized bycatch reporting methodology.

11.2 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, its collection, and record keeping 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 proposed actions are not expected to increase paperwork requirements; however, rejected alternatives to require logbooks or observers as a means of establishing a standardized bycatch reporting methodology would be expected to increase paperwork burdens for the shrimp industry and the NMFS.

11.3 Coastal Zone Management Consistency

The Council has determined that actions to reduce bycatch or maintain status quo on the west coast of Florida, as well as implement a standardized bycatch reporting methodology would not have any impact on the coastal zone management programs of the 5 Gulf states. Consequently, the proposed action will be implemented in a manner that is consistent to the maximum extent practicable with the approved coastal zone management programs of the Gulf states. This determination is being submitted for review and concurrence by the Gulf states under Section 307 of the Coastal Zone Management Act (CZMA).

11.4 Effect on Endangered Species and Marine Mammals

Amendment 9 contains a list of endangered and threatened species in the Gulf, as well as a detailed account of the Section 7 consultations and biological opinions that have been issued for the shrimp fishery in the Gulf since 1980. These consultations and opinions generally concluded that the management actions that have effected the shrimp fishery were not likely to jeopardize the continued existence of any endangered species, and they are incorporated here by reference. The proposed actions to require additional bycatch reduction measures in the relatively small area off the west coast of Florida and to implement a standardized bycatch reporting methodology are not likely to alter these conclusions.

11.5 Scientific Data Needs

The actions proposed do not directly create the need for additional data collection efforts. There continues to be a need to study the impacts of bycatch reduction on managed species and ecological relationships among both managed and unmanaged species. Furthermore, if additional closed areas are imposed, there is additional opportunity to compare biodiversity between closed and open shrimp trawling areas; however, as previously discussed this opportunity currently exists (if funding were available) because there are over 3,000,000 acres of currently closed areas off the west coast of Florida. Additional study of the effectiveness of various BRDs is also needed and should be stratified geographically across the west coast of Florida. Such data could be collected if BRDs are required or through scientific research or both. The implementation of a standardized bycatch reporting methodology as proposed would be a scientific data collection effort in itself, utilizing existing data collection efforts of the SEAMAP program to estimate total bycatch from the shrimp fishery.

11.6 Federalism

This proposed amendment does not contain policies with federalism implications sufficient to warrant preparation of a federalism assessment under EO 12612.

12.0 LIST OF PREPARERS

Dr. Richard L. Leard, Senior Fishery Biologist
Dr. Antonio Lamberte, Economist

13.0 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE AMENDMENT/ENVIRONMENTAL ASSESSMENT ARE SENT

Gulf of Mexico Fishery Management Council
Law Enforcement Advisory Panel
Shrimp Advisory Panel
Standing Scientific and Statistical Committee (SSC) and Special Shrimp SSC

Coastal Zone Management Offices
Alabama, Mississippi, Louisiana, Florida, Texas

Other Agencies, Organizations, and Persons
Alabama Cooperative Extension Service
Alabama Department of Conservation and Natural Resources, Marine Resources Division
Center for Marine Conservation
Coastal Conservation Association
Environmental Defense Fund
Florida Department of Environmental Protection
Florida Fish and Wildlife Conservation Commission
Florida Sea Grant
Gulf Restoration Network
Gulf and South Atlantic Fisheries Foundation, Inc.
Louisiana Cooperative Extension Service
Louisiana Department of Wildlife and Fisheries
Mississippi Cooperative Extension Service
Mississippi Department of Marine Resources
Monroe County Commercial Fishermen's Association
Monroe County Cooperative Extension Service
National Marine Fisheries Service Southeast Regional Office
National Marine Fisheries Service Southeast Fisheries Center
National Marine Fisheries Service Washington Office
National Marine Fisheries Service Law Enforcement
National Fisheries Institute

Organized Fishermen of Florida
Recreational Fishing Alliance
ReefKeeper International
Southeastern Fisheries Association
Southern Offshore Fishermen's Association
Texas America Vietnamese Association
Texas Cooperative Extension Service
Texas Parks and Wildlife Department
Texas Shrimp Association
United States Fish & Wildlife Service
United States Coast Guard

14.0 PUBLIC HEARING LOCATIONS AND DATES

The following public hearings were held beginning at 7:00 p.m. Public testimony was accepted at the Council meeting in Biloxi, Mississippi, on December 12, 2001, and additional public testimony was accepted at the Council meeting on March 13, 2002 meeting in Mobile, Alabama, and at the Council meeting on May 15, 2002 meeting in San Destin, Florida.

Tuesday, August 14, 2001
Laguna Madre Learning Center
Port Isabel High School
Highway 100
Port Isabel, TX 78578
956-943-0052

Wednesday, August 15, 2001
Palacios Recreation Center
2401 Perryman
Palacios, TX 77465
361-972-2387

Monday, August 20, 2001
Holiday Inn Beachside
3841 North Roosevelt Boulevard
Key West, FL 33040

Tuesday, August 21, 2001
Edison Community College
Lee Campus
Room K143
8099 College Parkway
Fort Myers, FL 33919

Thursday, August 23, 2001
Tampa Airport Hilton
2225 Lois Avenue
Tampa, FL 33607

Tuesday, August 28, 2001
Franklin County Courthouse
33 Market Street
Apalachicola, FL 32320

15.0 REFERENCES

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GMFMC. 1998. Generic amendment for addressing essential fish habitat requirements. Gulf of Mexico Fishery Management Council, 3018 U.S. Highway 301 N., Suite 1000, Tampa, Florida 33619. 157 pp +tables, figures, and appendices.

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16.0 TABLES

Table 1. Average annual shrimp catch (all species)and value by statistical subareas and subarea groupings for 1991 through 2000.

STATISTICAL SUBAREA (SS)	POUNDS	VALUE
1	383,372	1,272,149
2	5,619,096	19,974,495
3	1,455,258	5,730,226
SS SUBTOTAL	**7,457,726**	**26,976,870**
4	427,706	1,836,331
5	454,350	1,955,658
SS SUBTOTAL	**882,056**	**3,791,989**
6	1,416,478	4,484,858
7	1,734,326	5,760,776
8	1,075,543	3,484,747
SS SUBTOTAL	**4,226,347**	**13,730,381**
TOTALS	**12,566,129**	**44,499,240**

Source: NMFS (unpublished data)

Table 2. Square nautical mile (nm2) calculations for statistical subareas off the west coast of Florida from Key West to Panama City, Florida and average depth in fathoms (fm) along the state-federal boundary.

Area	Description	State nm^2	Federal nm^2	Total nm^2	Avg. Depth (fm)
1	Key West (middle-lower Keys; Gulf waters)	300	960	1,260	7.5
2	Dry Tortugas	250	9,950	10,200	20.5
3	Everglades (Naples-Florida Bay)	864	17,466	18,330	4
4	Fort Myers (Charlotte Harbor-Naples)	650	13,960	14,610	8
5	Tampa Bay (to N. of Charlotte Harbor)	610	9,770	10,380	6
6	Crystal River-Tarpon Springs	560	7,540	8,100	4
7	Apalachee Bay (Apalachicola-Crystal River)	1,341	4,739	6,080	5
8	Panama City-Apalachicola	540	9,030	9,570	11.5

Source: Anderson (unpublished data); Brown (2001)

Table 3. Average annual trips and effort (days fished) by statistical subareas and subarea groupings for 1991 thorough 2000.

STATISTICAL SUBAREA (SS)	TRIPS	EFFORT
1	95	1,289.3
2	2,078	10,772.6
3	467	3,171.0
SS SUBTOTAL	**2,640**	**15,232.9**
4	322	1,285.6
5	189	1,060.2
SS SUBTOTAL	**511**	**2,345.8**
6	1,993	2,764.8
7	1,266	3,512.6
8	351	2,395.1
SS SUBTOTAL	**3,610**	**8,672.5**
TOTALS	**6,761**	**26,251.3**

Source: NMFS (unpublished data)

Table 4. Most frequently caught species by area, depth, and season for the Florida west coast (numbers per hour).

StatGr	DepthGr	SeasonGr	Scientific Name	Common Name	NCPUE	Percent
Area 1-3	0-10 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	918.92	70.94
Area 1-3	0-10 fm	Pre-Summer	*Solenocera sp*	Shrimp, Humpback	48.66	3.76
Area 1-3	0-10 fm	Pre-Summer	*Lagodon rhomboides*	Pinfish	36.01	2.78
Area 1-3	0-10 fm	Pre-Summer	*Trachypenaeus sp*	Shrimp, Sugar/Blood	31.70	2.45
Area 1-3	0-10 fm	Pre-Summer	*Eucinostomus gula*	Jenny, Silver	29.51	2.28
Area 1-3	0-10 fm	Pre-Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	27.46	2.12
Area 1-3	0-10 fm	Pre-Summer	*Portunus spinimanus*	Crab, Blotched Swimming	26.86	2.07
Area 1-3	0-10 fm	Pre-Summer	*Squilla sp*	Shrimp, Mantis	19.09	1.47
Area 1-3	0-10 fm	Pre-Summer	*Eucinostomus argenteus*	Mojarra, Spotfin	16.95	1.31
Area 1-3	0-10 fm	Pre-Summer	*Eucinostomus sp*	Mojarra sp	13.70	1.06
Area 1-3	0-10 fm	Pre-Summer		Other Species	126.54	9.77
Area 1-3	11-20 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	430.48	45.97
Area 1-3	11-20 fm	Pre-Summer	*Syacium gunteri*	Flounder, Shoal	81.72	8.73
Area 1-3	11-20 fm	Pre-Summer	*Portunus sp*	Crab, Portunus	75.62	8.07
Area 1-3	11-20 fm	Pre-Summer	*Portunus spinimanus*	Crab, Blotched Swimming	56.05	5.98
Area 1-3	11-20 fm	Pre-Summer	*Scorpaena sp*	Scorpionfish	47.10	5.03
Area 1-3	11-20 fm	Pre-Summer	*Squilla sp*	Shrimp, Mantis	29.32	3.13
Area 1-3	11-20 fm	Pre-Summer	*Trachypenaeus sp*	Shrimp, Sugar/Blood	24.03	2.57
Area 1-3	11-20 fm	Pre-Summer	*Eucinostomus sp*	Mojarra sp	15.20	1.62
Area 1-3	11-20 fm	Pre-Summer	*Loligo pealeii*	Squid, Longfin	14.77	1.58
Area 1-3	11-20 fm	Pre-Summer	*Synodus foetens*	Lizardfish, Inshore	10.94	1.17
Area 1-3	11-20 fm	Pre-Summer		Other Species	151.28	16.15
Area 1-3	11-20 fm	Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	100.09	22.73
Area 1-3	11-20 fm	Summer	*Syacium papillosum*	Flounder, Dusky	98.28	22.31
Area 1-3	11-20 fm	Summer	*Portunus spinimanus*	Crab, Blotched Swimming	48.35	10.98
Area 1-3	11-20 fm	Summer	*Squilla sp*	Shrimp, Mantis	23.29	5.29
Area 1-3	11-20 fm	Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	22.24	5.05
Area 1-3	11-20 fm	Summer	*Bothus sp*	Flounder	20.58	4.67
Area 1-3	11-20 fm	Summer	*Scorpaena calcarata*	Scorpionfish, Smoothead	14.77	3.35
Area 1-3	11-20 fm	Summer	*Synodus foetens*	Lizardfish, Inshore	12.17	2.76
Area 1-3	11-20 fm	Summer	*Loligo pealeii*	Squid, Longfin	10.47	2.38
Area 1-3	11-20 fm	Summer	*Sicyonia brevirostris*	Shrimp, Brown Rock	10.38	2.36
Area 1-3	11-20 fm	Summer		Other Species	79.79	18.12
Area 1-3	>20 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	271.51	32.97
Area 1-3	>20 fm	Pre-Summer	*Portunus spinicarpus*	Crab, Longspine Swimming	92.72	11.26
Area 1-3	>20 fm	Pre-Summer	*Syacium gunteri*	Flounder, Shoal	78.27	9.50
Area 1-3	>20 fm	Pre-Summer	*Portunus spinimanus*	Crab, Blotched Swimming	74.19	9.01
Area 1-3	>20 fm	Pre-Summer	*Bothus robinsi*	Flounder, Twospot	49.35	5.99
Area 1-3	>20 fm	Pre-Summer	*Synodus foetens*	Lizardfish, Inshore	24.08	2.92

Table 4 (continued)

Area 1-3	>20 fm	Pre-Summer	*Loligo pealeii*	Squid, Longfin	22.61	2.75
Area 1-3	>20 fm	Pre-Summer	*Sphoeroides spengleri*	Pufferfish, Bandtail	21.02	2.55
Area 1-3	>20 fm	Pre-Summer	*Scorpaena calcarata*	Scorpionfish, Smoothead	19.86	2.41
Area 1-3	>20 fm	Pre-Summer	*Lagodon rhomboides*	Pinfish	19.41	2.36
Area 1-3	>20 fm	Pre-Summer		Other Species	150.57	18.28
Area 1-3	>20 fm	Summer	*Syacium papillosum*	Flounder, Dusky	164.89	29.65
Area 1-3	>20 fm	Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	116.41	20.93
Area 1-3	>20 fm	Summer	*Portunus spinimanus*	Crab, Blotched Swimming	34.51	6.21
Area 1-3	>20 fm	Summer	*Squilla sp*	Shrimp, Mantis	26.43	4.75
Area 1-3	>20 fm	Summer	*Bothus sp*	Flounder	26.36	4.74
Area 1-3	>20 fm	Summer	*Sicyonia brevirostris*	Shrimp, Brown Rock	21.97	3.95
Area 1-3	>20 fm	Summer	*Sphoeroides nephelus*	Pufferfish, Southern	20.69	3.72
Area 1-3	>20 fm	Summer	*Scorpaena calcarata*	Scorpionfish, Smoothead	19.31	3.47
Area 1-3	>20 fm	Summer	*Synodus foetens*	Lizardfish, Inshore	17.13	3.08
Area 1-3	>20 fm	Summer	*Portunus spinicarpus*	Crab, Longspine Swimming	13.57	2.44
Area 1-3	>20 fm	Summer		Other Species	94.86	17.06
Area 4-5	0-10 fm	Pre-Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	256.81	21.66
Area 4-5	0-10 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	184.67	15.57
Area 4-5	0-10 fm	Pre-Summer	*Squilla sp*	Shrimp, Mantis	156.12	13.17
Area 4-5	0-10 fm	Pre-Summer	*Prionotus scitulus*	Searobin, Leopard	115.60	9.75
Area 4-5	0-10 fm	Pre-Summer	*Eucinostomus havana*	Mojarra, Big Eye	103.58	8.74
Area 4-5	0-10 fm	Pre-Summer	*Diplectrum formosum*	Perch, Sand	59.76	5.04
Area 4-5	0-10 fm	Pre-Summer	*Citharichthys macrops*	Whiff, Spotted	55.02	4.64
Area 4-5	0-10 fm	Pre-Summer	*Haemulon sciurus*	Grunt, Bluestriped	42.26	3.56
Area 4-5	0-10 fm	Pre-Summer	*Portunus spinimanus*	Crab, Blotched Swimming	25.46	2.15
Area 4-5	0-10 fm	Pre-Summer	*Lagodon rhomboides*	Pinfish	17.40	1.47
Area 4-5	0-10 fm	Pre-Summer		Other Species	169.12	14.26
Area 4-5	0-10 fm	Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	495.12	36.75
Area 4-5	0-10 fm	Summer	*Eucinostomus havana*	Mojarra, Big Eye	238.12	17.67
Area 4-5	0-10 fm	Summer	*Prionotus scitulus*	Searobin, Leopard	146.80	10.90
Area 4-5	0-10 fm	Summer	*Squilla sp*	Shrimp, Mantis	130.40	9.68
Area 4-5	0-10 fm	Summer	*Citharichthys macrops*	Whiff, Spotted	58.44	4.34
Area 4-5	0-10 fm	Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	53.15	3.94
Area 4-5	0-10 fm	Summer	*Portunus spinimanus*	Crab, Blotched Swimming	35.56	2.64
Area 4-5	0-10 fm	Summer	*Diplectrum formosum*	Perch, Sand	27.09	2.01
Area 4-5	0-10 fm	Summer	*Haemulon plumieri*	Grunt, White	17.72	1.31
Area 4-5	0-10 fm	Summer	*Etropus crossotus*	Flounder, Fringed	16.13	1.20
Area 4-5	0-10 fm	Summer		Other Species	128.85	9.56
Area 4-5	11-20 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	127.21	24.38
Area 4-5	11-20 fm	Pre-Summer	*Syacium gunteri*	Flounder, Shoal	67.59	12.96
Area 4-5	11-20 fm	Pre-Summer	*Portunus spinimanus*	Crab, Blotched Swimming	34.76	6.66
Area 4-5	11-20 fm	Pre-Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	32.03	6.14

Table 4 (continued)

Area 4-5	11-20 fm	Pre-Summer	*Loligo pealeii*	Squid, Longfin	28.34	5.43
Area 4-5	11-20 fm	Pre-Summer	*Squilla sp*	Shrimp, Mantis	26.47	5.07
Area 4-5	11-20 fm	Pre-Summer	*Scorpaena calcarata*	Scorpionfish, Smoothead	21.89	4.20
Area 4-5	11-20 fm	Pre-Summer	*Eucinostomus sp*	Mojarra sp	19.10	3.66
Area 4-5	11-20 fm	Pre-Summer	*Synodus foetens*	Lizardfish, Inshore	16.70	3.20
Area 4-5	11-20 fm	Pre-Summer	*Sicyonia brevirostris*	Shrimp, Brown Rock	13.97	2.68
Area 4-5	11-20 fm	Pre-Summer		Other Species	133.66	25.62
Area 4-5	11-20 fm	Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	163.42	22.68
Area 4-5	11-20 fm	Summer	*Syacium gunteri*	Flounder, Shoal	60.73	8.43
Area 4-5	11-20 fm	Summer	*Syacium papillosum*	Flounder, Dusky	46.47	6.45
Area 4-5	11-20 fm	Summer	*Sicyonia brevirostris*	Shrimp, Brown Rock	43.80	6.08
Area 4-5	11-20 fm	Summer	*Etropus sp*	Flounder sp	43.27	6.00
Area 4-5	11-20 fm	Summer	*Loligo pealeii*	Squid, Longfin	36.79	5.10
Area 4-5	11-20 fm	Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	36.62	5.08
Area 4-5	11-20 fm	Summer	*Synodus foetens*	Lizardfish, Inshore	27.50	3.82
Area 4-5	11-20 fm	Summer	*Portunus spinicarpus*	Crab, Longspine Swimming	27.24	3.78
Area 4-5	11-20 fm	Summer	*Squilla sp*	Shrimp, Mantis	24.43	3.39
Area 4-5	11-20 fm	Summer		Other Species	210.39	29.19
Area 4-5	>20 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	430.81	47.00
Area 4-5	>20 fm	Pre-Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	111.36	12.15
Area 4-5	>20 fm	Pre-Summer	*Squilla sp*	Shrimp, Mantis	49.66	5.42
Area 4-5	>20 fm	Pre-Summer	*Haemulon aurolineatum*	Tomtate	42.55	4.64
Area 4-5	>20 fm	Pre-Summer	*Portunus spinimanus*	Crab, Blotched Swimming	31.30	3.41
Area 4-5	>20 fm	Pre-Summer	*Syacium gunteri*	Flounder, Shoal	22.06	2.41
Area 4-5	>20 fm	Pre-Summer	*Diplectrum formosum*	Perch, Sand	16.42	1.79
Area 4-5	>20 fm	Pre-Summer	*Rhomboplites aurorubens*	Snapper, Vermilion	14.18	1.55
Area 4-5	>20 fm	Pre-Summer	*Etropus sp*	Flounder sp	13.66	1.49
Area 4-5	>20 fm	Pre-Summer	*Loligo pealeii*	Squid, Longfin	13.66	1.49
Area 4-5	>20 fm	Pre-Summer		Other Species	171.04	18.66
Area 4-5	>20 fm	Summer	*Etropus sp*	Flounder sp	498.13	32.51
Area 4-5	>20 fm	Summer	*Scorpaena calcarata*	Scorpionfish, Smoothead	185.03	12.07
Area 4-5	>20 fm	Summer	*Etropus crossotus*	Flounder, Fringed	113.31	7.39
Area 4-5	>20 fm	Summer	*Syacium papillosum*	Flounder, Dusky	102.30	6.68
Area 4-5	>20 fm	Summer	*Sicyonia brevirostris*	Shrimp, Brown Rock	93.65	6.11
Area 4-5	>20 fm	Summer	*Syacium gunteri*	Flounder, Shoal	68.15	4.45
Area 4-5	>20 fm	Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	67.61	4.41
Area 4-5	>20 fm	Summer	*Bellator militaris*	Searobin, Horned	61.85	4.04
Area 4-5	>20 fm	Summer	*Loligo pealeii*	Squid, Longfin	56.59	3.69
Area 4-5	>20 fm	Summer	*Haemulon aurolineatum*	Tomtate	38.36	2.50
Area 4-5	>20 fm	Summer		Other Species	247.49	16.15
Area 6-8	0-10 fm	Pre-Summer	*Peprilus burti*	Butterfish, Gulf	228.58	19.27
Area 6-8	0-10 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	88.24	7.44

Table 4 (continued)

Area 6-8	0-10 fm	Pre-Summer	*Stellifer lanceolatus*	Drum, Star	80.91	6.82
Area 6-8	0-10 fm	Pre-Summer	*Squilla sp*	Shrimp, Mantis	70.22	5.92
Area 6-8	0-10 fm	Pre-Summer	*Ovalipes ocellatus*	Crab, Lady (w/specks)	65.93	5.56
Area 6-8	0-10 fm	Pre-Summer	*Diplectrum formosum*	Perch, Sand	61.71	5.20
Area 6-8	0-10 fm	Pre-Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	60.68	5.12
Area 6-8	0-10 fm	Pre-Summer	*Prionotus scitulus*	Searobin, Leopard	42.63	3.59
Area 6-8	0-10 fm	Pre-Summer	*Leiostomus xanthurus*	Spot (Flat Croaker)	36.99	3.12
Area 6-8	0-10 fm	Pre-Summer	*Prionotus tribulus*	Searobin, Bighead	33.86	2.86
Area 6-8	0-10 fm	Pre-Summer		Other Species	416.17	35.09
Area 6-8	0-10 fm	Summer	*Prionotus scitulus*	Searobin, Leopard	283.44	17.83
Area 6-8	0-10 fm	Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	226.89	14.27
Area 6-8	0-10 fm	Summer	*Sicyonia brevirostris*	Shrimp, Brown Rock	211.07	13.27
Area 6-8	0-10 fm	Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	132.60	8.34
Area 6-8	0-10 fm	Summer	*Stenotomus caprinus*	Porgy, Longspine	73.59	4.63
Area 6-8	0-10 fm	Summer	*Echinoidea*	Echinoderm (Class)	73.53	4.62
Area 6-8	0-10 fm	Summer	*Lolliguncula brevis*	Squid, Atlantic Brief	64.53	4.06
Area 6-8	0-10 fm	Summer	*Ovalipes floridanus*	Crab, Florida Lady	48.70	3.06
Area 6-8	0-10 fm	Summer	*Diplectrum formosum*	Perch, Sand	39.20	2.47
Area 6-8	0-10 fm	Summer	*Trachypenaeus sp*	Shrimp, Sugar/Blood	38.23	2.40
Area 6-8	0-10 fm	Summer		Other Species	398.21	25.04
Area 6-8	11-20 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	145.82	31.82
Area 6-8	11-20 fm	Pre-Summer	*Syacium gunteri*	Flounder, Shoal	54.07	11.80
Area 6-8	11-20 fm	Pre-Summer	*Loligo pealeii*	Squid, Longfin	51.94	11.33
Area 6-8	11-20 fm	Pre-Summer	*Portunus spinicarpus*	Crab, Longspine Swimming	37.14	8.10
Area 6-8	11-20 fm	Pre-Summer	*Diplectrum formosum*	Perch, Sand	20.28	4.43
Area 6-8	11-20 fm	Pre-Summer	*Sicyonia brevirostris*	Shrimp, Brown Rock	16.77	3.66
Area 6-8	11-20 fm	Pre-Summer	*Synodus foetens*	Lizardfish, Inshore	15.82	3.45
Area 6-8	11-20 fm	Pre-Summer	*Raja eglanteria*	Skate, Clearnose	12.91	2.82
Area 6-8	11-20 fm	Pre-Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	12.46	2.72
Area 6-8	11-20 fm	Pre-Summer	*Scorpaena calcarata*	Scorpionfish, Smoothead	11.86	2.59
Area 6-8	11-20 fm	Pre-Summer		Other Species	79.19	17.28
Area 6-8	11-20 fm	Summer	*Portunus spinicarpus*	Crab, Longspine Swimming	512.72	25.73
Area 6-8	11-20 fm	Summer	*Etropus crossotus*	Flounder, Fringed	280.96	14.10
Area 6-8	11-20 fm	Summer	*Sicyonia brevirostris*	Shrimp, Brown Rock	217.84	10.93
Area 6-8	11-20 fm	Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	214.38	10.76
Area 6-8	11-20 fm	Summer	*Etropus sp*	Flounder sp	155.88	7.82
Area 6-8	11-20 fm	Summer	*Scorpaena calcarata*	Scorpionfish, Smoothead	57.60	2.89
Area 6-8	11-20 fm	Summer	*Syacium gunteri*	Flounder, Shoal	50.22	2.52
Area 6-8	11-20 fm	Summer	*Lolliguncula brevis*	Squid, Atlantic Brief	46.93	2.35
Area 6-8	11-20 fm	Summer	*Loligo pealeii*	Squid, Longfin	40.49	2.03
Area 6-8	11-20 fm	Summer	*Synodus poeyi*	Lizardfish, Offshore	40.29	2.02
Area 6-8	11-20 fm	Summer		Other Species	375.52	18.84
Area 6-8	>20 fm	Post-Summer	*Stenotomus caprinus*	Porgy, Longspine	759.12	34.99
Area 6-8	>20 fm	Post-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	548.01	25.26
Area 6-8	>20 fm	Post-Summer	*Etropus crossotus*	Flounder, Fringed	305.45	14.08
Area 6-8	>20 fm	Post-Summer	*Syacium papillosum*	Flounder, Dusky	157.21	7.25
Area 6-8	>20 fm	Post-Summer	*Prionotus scitulus*	Searobin, Leopard	62.88	2.90
Area 6-8	>20 fm	Post-Summer	*Sicyonia brevirostris*	Shrimp, Brown Rock	49.41	2.28

Table 4 (continued)

Area 6-8	>20 fm	Post-Summer	*Loligo pealeii*	Squid, Longfin	44.91	2.07
Area 6-8	>20 fm	Post-Summer	*Micropogonias undulatus*	Croaker, Atlantic	40.43	1.86
Area 6-8	>20 fm	Post-Summer	*Bellator militaris*	Searobin, Horned	31.44	1.45
Area 6-8	>20 fm	Post-Summer	*Halieutichthys aculeatus*	Batfish, Pancake	26.95	1.24
Area 6-8	>20 fm	Post-Summer		Other Species	143.69	6.62

Source: NMFS (unpublished data)

Table 5. Most frequently caught species by area, depth, and season for the Florida west coast (kilograms per hour).

StatGr	DepthGr	SeasonGr	Scientific Name	Common Name	WCPUE	Percent
Area 1-3	0-10 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	8.55	43.06
Area 1-3	0-10 fm	Pre-Summer	*Lagodon rhomboides*	Pinfish	1.55	7.79
Area 1-3	0-10 fm	Pre-Summer	*Portunus spinimanus*	Crab, Blotched Swimming	0.94	4.73
Area 1-3	0-10 fm	Pre-Summer	*Eucinostomus gula*	Jenny, Silver	0.91	4.59
Area 1-3	0-10 fm	Pre-Summer	*Diplectrum formosum*	Perch, Sand	0.74	3.74
Area 1-3	0-10 fm	Pre-Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	0.45	2.27
Area 1-3	0-10 fm	Pre-Summer	*Eucinostomus sp*	Mojarra sp	0.44	2.23
Area 1-3	0-10 fm	Pre-Summer	*Eucinostomus argenteus*	Mojarra, Spotfin	0.44	2.19
Area 1-3	0-10 fm	Pre-Summer	*Etropus crossotus*	Flounder, Fringed	0.36	1.83
Area 1-3	0-10 fm	Pre-Summer	*Porifera*	Sponge (Phylum)	0.36	1.83
Area 1-3	0-10 fm	Pre-Summer		Other Species	5.11	25.74
Area 1-3	11-20 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	5.10	28.70
Area 1-3	11-20 fm	Pre-Summer	*Portunus spinimanus*	Crab, Blotched Swimming	2.39	13.46
Area 1-3	11-20 fm	Pre-Summer	*Portunus sp*	Crab, Portunus	1.91	10.77
Area 1-3	11-20 fm	Pre-Summer	*Syacium gunteri*	Flounder, Shoal	1.49	8.36
Area 1-3	11-20 fm	Pre-Summer	*Scorpaena sp*	Scorpionfish	0.60	3.36
Area 1-3	11-20 fm	Pre-Summer	*Sphoeroides spengleri*	Pufferfish, Bandtail	0.49	2.77
Area 1-3	11-20 fm	Pre-Summer	*Diplectrum formosum*	Perch, Sand	0.49	2.74
Area 1-3	11-20 fm	Pre-Summer	*Eucinostomus sp*	Mojarra sp	0.47	2.63
Area 1-3	11-20 fm	Pre-Summer	*Synodus foetens*	Lizardfish, Inshore	0.38	2.15
Area 1-3	11-20 fm	Pre-Summer	*Lagodon rhomboides*	Pinfish	0.31	1.75
Area 1-3	11-20 fm	Pre-Summer		Other Species	4.14	23.31
Area 1-3	11-20 fm	Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	2.45	19.53
Area 1-3	11-20 fm	Summer	*Syacium papillosum*	Flounder, Dusky	2.36	18.78
Area 1-3	11-20 fm	Summer	*Portunus spinimanus*	Crab, Blotched Swimming	1.89	15.07
Area 1-3	11-20 fm	Summer	*Lactophrys quadricornis*	Cowfish, Scrawled	0.72	5.74
Area 1-3	11-20 fm	Summer	*Lutjanus synagris*	Snapper, Lane	0.61	4.84
Area 1-3	11-20 fm	Summer	*Synodus foetens*	Lizardfish, Inshore	0.56	4.45
Area 1-3	11-20 fm	Summer	*Bothus sp*	Flounder	0.36	2.85
Area 1-3	11-20 fm	Summer	*Diplectrum bivittatum*	Perch, Dwarf Sand	0.33	2.60
Area 1-3	11-20 fm	Summer	*Sphoeroides spengleri*	Pufferfish, Bandtail	0.31	2.46
Area 1-3	11-20 fm	Summer	*Sphoeroides nephelus*	Pufferfish, Southern	0.30	2.39
Area 1-3	11-20 fm	Summer		Other Species	2.67	21.29
Area 1-3	>20 fm	Pre-Summer	*Portunus spinimanus*	Crab, Blotched Swimming	3.52	16.91
Area 1-3	>20 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	3.35	16.11
Area 1-3	>20 fm	Pre-Summer	*Syacium gunteri*	Flounder, Shoal	2.20	10.59
Area 1-3	>20 fm	Pre-Summer	*Syacium papillosum*	Flounder, Dusky	1.08	5.18
Area 1-3	>20 fm	Pre-Summer	*Sphoeroides spengleri*	Pufferfish, Bandtail	1.07	5.16
Area 1-3	>20 fm	Pre-Summer	*Lagodon rhomboides*	Pinfish	1.04	4.97
Area 1-3	>20 fm	Pre-Summer	*Bothus robinsi*	Flounder, Twospot	0.95	4.55
Area 1-3	>20 fm	Pre-Summer	*Upeneus parvus*	Goatfish, Dwarf	0.68	3.28
Area 1-3	>20 fm	Pre-Summer	*Synodus foetens*	Lizardfish, Inshore	0.60	2.86
Area 1-3	>20 fm	Pre-Summer	*Portunus spinicarpus*	Crab, Longspine Swimming	0.53	2.57
Area 1-3	>20 fm	Pre-Summer		Other Species	5.79	27.81

Table 5 (continued)

Area 1-3	>20 fm	Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	3.06	21.98
Area 1-3	>20 fm	Summer	*Syacium papillosum*	Flounder, Dusky	2.50	18.00
Area 1-3	>20 fm	Summer	*Portunus spinimanus*	Crab, Blotched Swimming	1.73	12.43
Area 1-3	>20 fm	Summer	*Sphoeroides nephelus*	Pufferfish, Southern	0.90	6.44
Area 1-3	>20 fm	Summer	*Lactophrys quadricornis*	Cowfish, Scrawled	0.80	5.76
Area 1-3	>20 fm	Summer	*Synodus foetens*	Lizardfish, Inshore	0.62	4.46
Area 1-3	>20 fm	Summer	*Bothus sp*	Flounder	0.47	3.36
Area 1-3	>20 fm	Summer	*Scorpaena calcarata*	Scorpionfish, Smoothead	0.42	3.00
Area 1-3	>20 fm	Summer	*Lutjanus synagris*	Snapper, Lane	0.33	2.37
Area 1-3	>20 fm	Summer	*Sphoeroides spengleri*	Pufferfish, Bandtail	0.31	2.23
Area 1-3	>20 fm	Summer		Other Species	2.78	19.97
Area 4-5	0-10 fm	Pre-Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	5.04	16.29
Area 4-5	0-10 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	4.52	14.59
Area 4-5	0-10 fm	Pre-Summer	*Eucinostomus havana*	Mojarra, Big Eye	2.61	8.43
Area 4-5	0-10 fm	Pre-Summer	*Diplectrum formosum*	Perch, Sand	2.44	7.89
Area 4-5	0-10 fm	Pre-Summer	*Squilla sp*	Shrimp, Mantis	1.89	6.11
Area 4-5	0-10 fm	Pre-Summer	*Prionotus scitulus*	Searobin, Leopard	1.69	5.47
Area 4-5	0-10 fm	Pre-Summer	*Haemulon sciurus*	Grunt, Bluestriped	1.39	4.48
Area 4-5	0-10 fm	Pre-Summer	*Lactophrys quadricornis*	Cowfish, Scrawled	0.96	3.10
Area 4-5	0-10 fm	Pre-Summer	*Citharichthys macrops*	Whiff, Spotted	0.91	2.93
Area 4-5	0-10 fm	Pre-Summer	*Portunus spinimanus*	Crab, Blotched Swimming	0.76	2.46
Area 4-5	0-10 fm	Pre-Summer		Other Species	8.74	28.23
Area 4-5	0-10 fm	Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	9.38	30.35
Area 4-5	0-10 fm	Summer	*Eucinostomus havana*	Mojarra, Big Eye	5.42	17.54
Area 4-5	0-10 fm	Summer	*Prionotus scitulus*	Searobin, Leopard	2.07	6.70
Area 4-5	0-10 fm	Summer	*Squilla sp*	Shrimp, Mantis	1.77	5.72
Area 4-5	0-10 fm	Summer	*Diplectrum formosum*	Perch, Sand	1.49	4.81
Area 4-5	0-10 fm	Summer	*Portunus spinimanus*	Crab, Blotched Swimming	1.08	3.50
Area 4-5	0-10 fm	Summer	*Synodus foetens*	Lizardfish, Inshore	0.97	3.13
Area 4-5	0-10 fm	Summer	*Citharichthys macrops*	Whiff, Spotted	0.94	3.03
Area 4-5	0-10 fm	Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	0.81	2.63
Area 4-5	0-10 fm	Summer	*Lactophrys quadricornis*	Cowfish, Scrawled	0.70	2.26
Area 4-5	0-10 fm	Summer		Other Species	6.29	20.34
Area 4-5	11-20 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	2.85	14.66
Area 4-5	11-20 fm	Pre-Summer	*Syacium gunteri*	Flounder, Shoal	1.94	9.97
Area 4-5	11-20 fm	Pre-Summer	*Portunus spinimanus*	Crab, Blotched Swimming	1.48	7.62
Area 4-5	11-20 fm	Pre-Summer	*Synodus foetens*	Lizardfish, Inshore	1.23	6.31
Area 4-5	11-20 fm	Pre-Summer	*Lactophrys quadricornis*	Cowfish, Scrawled	1.02	5.27
Area 4-5	11-20 fm	Pre-Summer	*Lutjanus synagris*	Snapper, Lane	0.86	4.40
Area 4-5	11-20 fm	Pre-Summer	*Eucinostomus sp*	Mojarra sp	0.73	3.78
Area 4-5	11-20 fm	Pre-Summer	*Haemulon aurolineatum*	Tomtate	0.69	3.55
Area 4-5	11-20 fm	Pre-Summer	*Diplectrum formosum*	Perch, Sand	0.63	3.25
Area 4-5	11-20 fm	Pre-Summer	*Lagodon rhomboides*	Pinfish	0.60	3.09
Area 4-5	11-20 fm	Pre-Summer		Other Species	7.41	38.11

Table 5 (continued)

Area 4-5	11-20 fm	Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	3.35	15.96
Area 4-5	11-20 fm	Summer	*Synodus foetens*	Lizardfish, Inshore	1.86	8.85
Area 4-5	11-20 fm	Summer	*Syacium papillosum*	Flounder, Dusky	1.86	8.84
Area 4-5	11-20 fm	Summer	*Syacium gunteri*	Flounder, Shoal	1.73	8.26
Area 4-5	11-20 fm	Summer	*Portunus spinimanus*	Crab, Blotched Swimming	1.00	4.77
Area 4-5	11-20 fm	Summer	*Lactophrys quadricornis*	Cowfish, Scrawled	0.96	4.57
Area 4-5	11-20 fm	Summer	*Raja eglanteria*	Skate, Clearnose	0.71	3.39
Area 4-5	11-20 fm	Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	0.67	3.18
Area 4-5	11-20 fm	Summer	*Diplectrum formosum*	Perch, Sand	0.63	3.00
Area 4-5	11-20 fm	Summer	*Haemulon aurolineatum*	Tomtate	0.62	2.94
Area 4-5	11-20 fm	Summer		Other Species	7.61	36.24
Area 4-5	>20 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	7.56	24.73
Area 4-5	>20 fm	Pre-Summer	*Haemulon aurolineatum*	Tomtate	3.85	12.62
Area 4-5	>20 fm	Pre-Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	2.04	6.69
Area 4-5	>20 fm	Pre-Summer	*Lutjanus synagris*	Snapper, Lane	2.02	6.62
Area 4-5	>20 fm	Pre-Summer	*Synodus foetens*	Lizardfish, Inshore	1.44	4.71
Area 4-5	>20 fm	Pre-Summer	*Diplectrum formosum*	Perch, Sand	1.42	4.66
Area 4-5	>20 fm	Pre-Summer	*Rhomboplites aurorubens*	Snapper, Vermilion	0.99	3.25
Area 4-5	>20 fm	Pre-Summer	*Syacium gunteri*	Flounder, Shoal	0.96	3.13
Area 4-5	>20 fm	Pre-Summer	*Squilla sp*	Shrimp, Mantis	0.89	2.90
Area 4-5	>20 fm	Pre-Summer	*Lagodon rhomboides*	Pinfish	0.87	2.84
Area 4-5	>20 fm	Pre-Summer		Other Species	8.51	27.86
Area 4-5	>20 fm	Summer	*Etropus sp*	Flounder sp	7.52	20.16
Area 4-5	>20 fm	Summer	*Syacium papillosum*	Flounder, Dusky	4.60	12.33
Area 4-5	>20 fm	Summer	*Scorpaena calcarata*	Scorpionfish, Smoothead	3.36	9.02
Area 4-5	>20 fm	Summer	*Synodus foetens*	Lizardfish, Inshore	2.38	6.39
Area 4-5	>20 fm	Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	2.24	6.02
Area 4-5	>20 fm	Summer	*Syacium gunteri*	Flounder, Shoal	1.70	4.57
Area 4-5	>20 fm	Summer	*Etropus crossotus*	Flounder, Fringed	1.65	4.42
Area 4-5	>20 fm	Summer	*Sicyonia brevirostris*	Shrimp, Brown Rock	1.53	4.10
Area 4-5	>20 fm	Summer	*Portunus spinimanus*	Crab, Blotched Swimming	1.38	3.69
Area 4-5	>20 fm	Summer	*Loligo pealeii*	Squid, Longfin	1.00	2.67
Area 4-5	>20 fm	Summer		Other Species	9.94	26.64
Area 6-8	0-10 fm	Pre-Summer	*Peprilus burti*	Butterfish, Gulf	4.62	11.90
Area 6-8	0-10 fm	Pre-Summer	*Leiostomus xanthurus*	Spot (Flat Croaker)	2.53	6.52
Area 6-8	0-10 fm	Pre-Summer	*Diplectrum formosum*	Perch, Sand	2.21	5.69
Area 6-8	0-10 fm	Pre-Summer	*Archosargus probatocephalus*	Sheepshead	2.15	5.54
Area 6-8	0-10 fm	Pre-Summer	*Stellifer lanceolatus*	Drum, Star	2.14	5.51
Area 6-8	0-10 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	2.00	5.15
Area 6-8	0-10 fm	Pre-Summer	*Gymnura micrura*	Ray, Smooth Butterfly	1.34	3.46
Area 6-8	0-10 fm	Pre-Summer	*Menticirrhus americanus*	Kingfish, Southern	1.33	3.42
Area 6-8	0-10 fm	Pre-Summer	*Dasyatis americana*	Stingray, Southern	1.11	2.87
Area 6-8	0-10 fm	Pre-Summer	*Squilla sp*	Shrimp, Mantis	0.97	2.50

Table 5 (continued)

Area 6-8	0-10 fm	Pre-Summer		Other Species	18.42	47.43
Area 6-8	0-10 fm	Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	5.21	15.16
Area 6-8	0-10 fm	Summer	*Prionotus scitulus*	Searobin, Leopard	3.38	9.84
Area 6-8	0-10 fm	Summer	*Sicyonia brevirostris*	Shrimp, Brown Rock	2.90	8.44
Area 6-8	0-10 fm	Summer	*Aluterus schoepfi*	Filefish, Orange	2.07	6.03
Area 6-8	0-10 fm	Summer	*Portunus gibbesii*	Crab, Iridescent Swimming	1.96	5.70
Area 6-8	0-10 fm	Summer	*Diplectrum formosum*	Perch, Sand	1.82	5.28
Area 6-8	0-10 fm	Summer	*Porifera*	Sponge (Phylum)	1.31	3.80
Area 6-8	0-10 fm	Summer	*Synodus foetens*	Lizardfish, Inshore	0.80	2.33
Area 6-8	0-10 fm	Summer	*Ogcocephalus radiatus*	Batfish, Polkadot	0.76	2.22
Area 6-8	0-10 fm	Summer	*Lolliguncula brevis*	Squid, Atlantic Brief	0.74	2.16
Area 6-8	0-10 fm	Summer		Other Species	13.42	39.05
Area 6-8	11-20 fm	Pre-Summer	*Raja eglanteria*	Skate, Clearnose	10.95	35.90
Area 6-8	11-20 fm	Pre-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	2.44	7.99
Area 6-8	11-20 fm	Pre-Summer	*Aluterus schoepfi*	Filefish, Orange	2.03	6.64
Area 6-8	11-20 fm	Pre-Summer	*Syacium gunteri*	Flounder, Shoal	1.89	6.19
Area 6-8	11-20 fm	Pre-Summer	*Diplectrum formosum*	Perch, Sand	1.76	5.78
Area 6-8	11-20 fm	Pre-Summer	*Raja texana*	Skate, Roundel	1.58	5.18
Area 6-8	11-20 fm	Pre-Summer	*Syacium papillosum*	Flounder, Dusky	1.14	3.74
Area 6-8	11-20 fm	Pre-Summer	*Synodus foetens*	Lizardfish, Inshore	1.10	3.60
Area 6-8	11-20 fm	Pre-Summer	*Paralichthys albigutta*	Flounder, Gulf	1.06	3.47
Area 6-8	11-20 fm	Pre-Summer	*Ogcocephalus radiatus*	Batfish, Polkadot	1.04	3.40
Area 6-8	11-20 fm	Pre-Summer		Other Species	5.52	18.11
Area 6-8	11-20 fm	Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	5.01	13.97
Area 6-8	11-20 fm	Summer	*Sicyonia brevirostris*	Shrimp, Brown Rock	2.40	6.70
Area 6-8	11-20 fm	Summer	*Raja eglanteria*	Skate, Clearnose	2.39	6.67
Area 6-8	11-20 fm	Summer	*Portunus spinicarpus*	Crab, Longspine Swimming	2.07	5.77
Area 6-8	11-20 fm	Summer	*Synodus foetens*	Lizardfish, Inshore	1.89	5.26
Area 6-8	11-20 fm	Summer	*Etropus crossotus*	Flounder, Fringed	1.59	4.44
Area 6-8	11-20 fm	Summer	*Syacium gunteri*	Flounder, Shoal	1.36	3.79
Area 6-8	11-20 fm	Summer	*Diplectrum formosum*	Perch, Sand	1.29	3.60
Area 6-8	11-20 fm	Summer	*Etropus sp*	Flounder sp	1.19	3.33
Area 6-8	11-20 fm	Summer	*Aluterus schoepfi*	Filefish, Orange	1.19	3.31
Area 6-8	11-20 fm	Summer		Other Species	15.49	43.18
Area 6-8	>20 fm	Post-Summer	*Stenotomus caprinus*	Porgy, Longspine	41.80	45.38
Area 6-8	>20 fm	Post-Summer	*Farfantepenaeus duorarum*	Shrimp, Pink	12.23	13.28
Area 6-8	>20 fm	Post-Summer	*Syacium papillosum*	Flounder, Dusky	6.88	7.47
Area 6-8	>20 fm	Post-Summer	*Etropus crossotus*	Flounder, Fringed	5.61	6.09
Area 6-8	>20 fm	Post-Summer	*Raja eglanteria*	Skate, Clearnose	5.09	5.53
Area 6-8	>20 fm	Post-Summer	*Micropogonias undulatus*	Croaker, Atlantic	3.95	4.28
Area 6-8	>20 fm	Post-Summer	*Prionotus scitulus*	Searobin, Leopard	2.80	3.04
Area 6-8	>20 fm	Post-Summer	*Leiostomus xanthurus*	Spot (Flat Croaker)	2.29	2.49
Area 6-8	>20 fm	Post-Summer	*Mellita quinquiesperforata*	Urchin, Keyhole (sanddollar)	2.03	2.21

Table 5 (continued)

Area 6-8	>20 fm	Post-Summer	*Diplectrum formosum*	Perch, Sand	1.53	1.66
Area 6-8	>20 fm	Post-Summer		Other Species	7.91	8.58

Source: NMFS (unpublished data)

Table 6. Estimated revenues and profits, by area and vessel length, 1998 and 1999.

Statistical Area	Vessel Length (feet)	Revenues ($)		Profits ($)	
		1998	1999	1998	1999
1	< 45	15,555	31,512	4,791	9,706
1	45-60	10,234	9,643	1,934	1,822
1	> 60	1,314,902	737,860	81,524	45,747
2	< 45	780,518	315,552	240,400	97,190
2	45-60	643,975	201,026	121,711	37,994
2	> 60	28,138,766	14,983,600	1,744,603	928,983
3	< 45	45,048		13,875	
3	45-60	101,289	73,568	19,144	13,904
3	> 60	6,704,865	5,008,294	415,702	310,514
Sub-Total		**37,755,152**	**21,361,055**	**2,643,684**	**1,445,860**
4	< 45	111,560	48,300	34,361	14,877
4	45-60	68,280	45,072	12,905	8,518
4	> 60	2,370,745	1,730,633	146,987	107,299
5	< 45	137,180	52,460	42,251	16,158
5	45-60	199,962	151,488	37,793	28,631
5	> 60	4,137,053	1,557,702	256,497	96,578
Sub-Total		**7,024,780**	**3,585,655**	**530,794**	**272,061**
6	< 45	2,019,052	862,856	621,868	265,760
6	45-60	764,290	399,515	144,451	75,508
6	> 60	7,304,958	3,457,275	452,907	214,351
7	< 45	1,253,534	1,074,848	386,089	331,053
7	45-60	1,278,010	552,436	241,544	104,410
7	> 60	7,166,663	3,353,266	444,333	207,903
8	< 45	671,819	428,604	206,920	132,010
8	45-60	722,515	473,270	136,555	89,448
8	> 60	8,519,306	2,093,974	528,197	129,826
Sub-Total		**29,700,147**	**12,696,044**	**3,162,864**	**1,550,269**
TOTAL		74,480,079	37,642,754	6,337,342	3,268,190

Source: Travis (2001).

Table 7a. Shrimp fishing craft fishing in statistical areas 1-8, 1998 and 1999.

Statistical Subarea	Vessels	Boats	Total Fishing Craft
1998			
1	195	2	197
2	536	6	542
3	186	0	186
1-3	**574**	**8**	**582**
4	172	61	233
5	188	5	193
4-5	**307**	**65**	**372**
6	304	5	309
7	345	44	389
8	237	29	266
6-8	**629**	**69**	**698**
1-8	**966**	**140**	**1,106**
1999			
1	121	4	125
2	418	3	421
3	165	0	165
1-3	**443**	**7**	**450**
4	174	47	117
5	111	6	219
4-5	**223**	**53**	**276**
6	191	28	219
7	278	59	337
8	164	36	200
6-8	**476**	**117**	**593**
1-8	**792**	**175**	**967**

Source: Travis (2002).

Note: Vessels and boats are not additive across statistical subareas, because some fish in more than one subarea, but fishing craft in statistical subareas 1-3, 4-5, and 6-8 are unique vessels/boats in those subareas.

Table 7b. Shrimp fishing craft fishing in statistical subareas 1-8, by length, 1998 and 1999

Statistical Subarea	Less than 45 feet (Small)	45-60 feet (Medium)	Greater than 60 feet (Large)	Total
1998				
1	6	7	184	197
2	15	30	497	542
3	1	7	178	186
1-3	**21**	**30**	**531**	**582**
4	85	15	133	233
5	8	15	170	193
4-5	**91**	**28**	**253**	**372**
6	79	13	197	309
7	110	81	198	389
8	59	47	160	266
6-8	**215**	**111**	**372**	**698**
1-8	**317**	**135**	**654**	**1,106**
1999				
1	6	6	113	125
2	12	26	383	421
3	1	7	157	165
1-3	**19**	**28**	**403**	**450**
4	70	12	129	211
5	7	9	101	117
4-5	**77**	**16**	**183**	**276**
6	91	28	100	219
7	126	58	153	337
8	70	45	85	200
6-8	**251**	**91**	**251**	**593**
1-8	**341**	**113**	**513**	**967**

Source: Travis (2002).

Table 7c. Shrimp fishing craft fishing in statistical subareas 1-8, by homeport state, 1998 and 1999.

Statistical Subarea	AL	FL	GA	LA	MS	NC	SC	TX	Total
1998									
1	21	120	8	1	7	8	2	30	197
2	56	246	15	15	17	14	5	174	542
3	13	130	1	1	1	0	1	39	186
1-3	**63**	**267**	**16**	**17**	**20**	**15**	**5**	**179**	**582**
4	14	193	1	1	1	0	0	23	233
5	31	114	4	2	2	0	0	40	193
4-5	**43**	**269**	**5**	**2**	**3**	**0**	**0**	**50**	**372**
6	34	228	5	3	4	1	0	34	309
7	87	253	5	5	15	2	1	21	389
8	84	145	2	7	10	1	0	17	266
6-8	**135**	**466**	**9**	**13**	**19**	**2**	**1**	**53**	**698**
1-8	**145**	**673**	**21**	**27**	**29**	**16**	**5**	**190**	**1,106**
1999									
1	18	73	3	1	7	2	0	21	125
2	41	221	9	10	10	7	2	121	421
3	4	114	1	1	2	1	0	42	165
1-3	**45**	**238**	**11**	**11**	**12**	**8**	**2**	**123**	**450**
4	12	170	3	0	0	1	1	34	211
5	8	82	2	0	0	0	1	24	117
4-5	**20**	**205**	**4**	**0**	**0**	**1**	**2**	**44**	**276**
6	15	181	3	0	1	0	1	18	219
7	46	257	5	2	9	1	1	16	337
8	43	143	0	1	3	1	1	8	200
6-8	**80**	**453**	**8**	**3**	**10**	**1**	**2**	**36**	**593**
1-8	**103**	**671**	**14**	**14**	**19**	**9**	**4**	**133**	**967**

Source: Travis (2002).

Table 7d. Shrimp fishing craft fishing exclusively in certain subareas, by homeport state, 1998 and 1999.

Vessel Size Class	AL	FL	GA	LA	MS	NC	SC	TX	Total
1998									
Statistical Subarea 1-3									
Less than 45 feet	1	14	0	0	0	1	0	1	17
45 - 60 feet	0	7	2	1	0	0	0	1	11
Greater than 60 feet	6	44	9	13	10	13	4	114	213
Total	**7**	**65**	**11**	**14**	**10**	**14**	**4**	**116**	**241**
Statistical Subarea 4-5									
Less than 45 feet	0	82	1	0	0	0	0	0	83
45 - 60 feet	1	8	0	0	0	0	0	0	9
Greater than 60 feet	1	2	0	0	0	0	0	2	5
Total	**2**	**92**	**1**	**0**	**0**	**0**	**0**	**2**	**97**
Statistical Subarea 6-8									
Less than 45 feet	12	192	1	0	0	0	0	3	208
45 - 60 feet	19	58	1	4	6	0	0	1	89
Greater than 60 feet	37	46	3	6	2	1	0	5	100
Total	**68**	**296**	**5**	**10**	**8**	**1**	**0**	**9**	**397**
1999									
Statistical Subarea 1-3									
Less than 45 feet	1	14	0	1	0	1	0	0	17
45 - 60 feet	0	8	2	1	0	0	0	1	12
Greater than 60 feet	15	63	3	9	9	6	1	72	178
Total	**16**	**85**	**5**	**11**	**9**	**7**	**1**	**73**	**207**
Statistical Subarea 4-5									
Less than 45 feet	0	71	1	0	0	0	0	0	72
45 - 60 feet	1	5	0	0	0	0	0	0	6
Greater than 60 feet	4	1	0	0	0	0	1	3	9
Total	**5**	**77**	**1**	**0**	**0**	**0**	**1**	**3**	**87**
Statistical Subarea 6-8									
Less than 45 feet	8	236	1	0	1	0	0	0	246
45 - 60 feet	10	62	1	1	3	0	1	0	78
Greater than 60 feet	29	47	0	2	3	1	0	5	87
Total	**47**	**345**	**2**	**3**	**7**	**1**	**1**	**5**	**411**

Source: Travis (2002).

Table 7d. Shrimp fishing craft fishing exclusively in certain subareas, by homeport state, 1998 and 1999. (Cont'd)

Vessel Size Class	AL	FL	GA	LA	MS	NC	SC	TX	Total
1998									
Statistical Subareas 1-3 and 4-5									
Less than 45 feet	0	2	0	0	0	0	0	0	2
45 - 60 feet	0	4	0	0	0	0	0	0	4
Greater than 60 feet	1	44	0	0	0	0	0	19	64
Total	**1**	**50**	**0**	**0**	**0**	**0**	**0**	**19**	**70**
Statistical Subareas 1-3 and 6-8									
Less than 45 feet	1	1	0	0	0	0	0	0	1
45 - 60 feet	0	3	0	0	4	0	0	0	7
Greater than 60 feet	27	39	1	1	3	1	1	15	88
Total	**27**	**43**	**1**	**1**	**7**	**1**	**1**	**15**	**96**
Statistical Subareas 4-5 and 6-8									
Less than 45 feet	0	5	0	0	0	0	0	0	5
45 - 60 feet	2	5	0	0	0	0	0	0	7
Greater than 60 feet	10	8	0	0	0	0	0	0	18
Total	**12**	**18**	**0**	**0**	**0**	**0**	**0**	**0**	**30**
1999									
Statistical Subareas 1-3 and 4-5									
Less than 45 feet	0	0	0	0	0	0	0	0	0
45 - 60 feet	0	4	0	0	0	0	0	0	4
Greater than 60 feet	2	51	0	0	0	1	0	21	75
Total	**2**	**55**	**0**	**0**	**0**	**1**	**0**	**21**	**79**
Statistical Subareas 1-3 and 6-8									
Less than 45 feet	0	0	0	0	0	0	0	0	0
45 - 60 feet	0	4	0	3	0	0	0	0	7
Greater than 60 feet	20	31	3	0	0	0	0	11	65
Total	**20**	**35**	**3**	**3**	**0**	**0**	**0**	**11**	**72**
Statistical Subarea 4-5 and 6-8									
Less than 45 feet	0	4	0	0	0	0	0	0	4
45 - 60 feet	0	1	0	0	0	0	0	0	1
Greater than 60 feet	6	6	0	0	0	0	0	2	14
Total	**6**	**11**	**0**	**0**	**0**	**0**	**0**	**2**	**19**

Source: Travis (2002).

Table 7d. Shrimp fishing craft fishing exclusively in certain subareas, by homeport state, 1998 and 1999.
(Cont'd)

Vessel Size Class	AL	FL	GA	LA	MS	NC	SC	TX	Total
1998									
Statistical Subarea 1-8									
Less than 45 feet	0	1	0	0	0	0	0	0	1
45 - 60 feet	0	5	0	0	1	0	0	2	8
Greater than 60 feet	28	103	4	2	2	0	0	27	166
Total	**28**	**109**	**4**	**2**	**3**	**0**	**0**	**29**	**175**
1998									
Statistical Subarea 1-8									
Less than 45 feet	0	0	0	0	0	0	0	0	0
45 - 60 feet	0	2	1	0	0	0	0	2	5
Greater than 60 feet	7	59	2	0	0	0	1	16	18
Total	**7**	**61**	**3**	**0**	**0**	**0**	**1**	**18**	**90**

Source: Travis (2002).

Table 7e. Vessel revenues from shrimp fishing in statistical subareas 1-8, by homeport state, 1998 and 1999.
(Thousand Dollars)

Statistical Subarea	AL	FL	GA	LA	MS	NC	SC	TX
1998								
1	515	580	8	dp	dp	3	dp	21
2	4,170	13,055	366	dp	dp	290	dp	7,826
3	478	4,911	0	dp	dp	0	dp	1,419
1-3	**5,163**	**18,546**	**374**	**891**	**997**	**293**	**224**	**9,266**
4	361	1,968	dp	dp	dp	0	0	220
5	676	2,974	dp	dp	dp	0	0	684
4-5	**1,037**	**4,942**	**38**	**dp**	**dp**	**0**	**0**	**904**
6	649	8,348	dp	127	dp	dp	0	694
7	1,858	7,129	dp	21	dp	dp	dp	357
8	5,673	3,118	dp	156	dp	dp	0	672
6-8	**8,180**	**18,595**	**318**	**304**	**386**	**dp**	**dp**	**1,723**
1999								
1	121	439	dp	dp	dp	dp	0	138
2	1,513	8,181	dp	dp	dp	dp	dp	4,989
3	73	3,786	dp	dp	dp	0	0	1,118
1-3	**1,707**	**12,406**	**140**	**184**	**416**	**258**	**dp**	**6,245**
4	52	1,358	dp	0	0	dp	dp	379
5	140	1,323	dp	0	0	0	dp	272
4-5	**192**	**2,681**	**36**	**0**	**0**	**dp**	**dp**	**651**
6	261	3,939	32	0	dp	0	dp	416
7	594	3,960	32	dp	dp	dp	dp	321
8	702	1,944	0	dp	dp	dp	dp	191
6-8	**1,557**	**9,843**	**64**	**dp**	**82**	**dp**	**dp**	**928**

Source: Travis (2002).

Note: dp=disclosure problem; too few fishing craft reporting.

Table 7f. Vessel profits from shrimp fishing in statistical subareas 1-8, by homeport state, 1998 and 1999.
(Thousand Dollars)

Statistical Subarea	AL	FL	GA	LA	MS	NC	SC	TX
1998								
1	35	38	1	dp	dp	0.2	dp	1
2	323	988	31	dp	dp	23	dp	583
3	30	326	0	dp	dp	0	dp	90
1-3	**388**	**1,352**	**32**	**66**	**94**	**23.2**	**16**	**674**
4	23	156	dp	dp	dp	0	0	15
5	47	234	dp	dp	dp	0	0	49
4-5	**70**	**390**	**3**	**dp**	**dp**	**0**	**0**	**64**
6	48	1092	dp	8	dp	dp	0	51
7	173	815	dp	3	dp	dp	dp	37
8	407	373	dp	11	dp	dp	0	45
6-8	**628**	**2,280**	**28**	**22**	**60**	**dp**	**dp**	**133**
1999								
1	11	32	dp	dp	dp	dp	0	10
2	108	565	dp	dp	dp	dp	dp	326
3	4	242	dp	dp	dp	0	0	69
1-3	**123**	**839**	**12**	**15**	**34**	**20**	**dp**	**405**
4	4	98	dp	0	0	dp	dp	26
5	10	109	dp	0	0	0	dp	21
4-5	**14**	**207**	**3**	**0**	**0**	**dp**	**dp**	**47**
6	24	500	2	0	dp	0	dp	26
7	52	554	3	dp	dp	dp	dp	22
8	50	275	0	dp	dp	dp	dp	11
6-8	**126**	**1,329**	**5**	**dp**	**dp**	**dp**	**dp**	**59**

Source: Travis (2002).

Note: dp=disclosure problem; too few fishing craft reporting.

Table 7g. Distribution of dealers purchasing shrimp caught in statistical subareas 1-8 and percentage of gulfwide shrimp purchases from various subareas, 1998 and 1999.

Statistical Subarea	Number of Purchasing Dealers	Percent of Gulfwide Shrimp Purchases
1998		
1	14	3.2
2	43	21.6
3	18	11.5
1-3	**48**	**24.6**
4	23	20.2
5	25	12.7
4-5	**32**	**24.5**
6	37	23.7
7	39	35.0
8	34	25.7
6-8	**60**	**51.9**
1-8	**84**	
1999		
1	16	4.4
2	38	19.9
3	15	15.2
1-3	**42**	**25.2**
4	26	19.3
5	21	10.0
4-5	**31**	**23.0**
6	29	28.9
7	37	31.3
8	23	23.8
6-8	**52**	**48.9**
1-8	**76**	

Source: Travis (2002).

Table 8. Ex-vessel revenues (dollars), by statistical area and landing county/port, for shrimp trawl trips in statistical subareas 1-8, 1999.

County/Port	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8	TOTAL
Bay							782	169,520	**170,302**
Franklin	44,555	60,963			34,912	64,422	3,195,992	26,430	**3,427,274**
Hillsborough.	220,140	778,668	355,247	448,635	1,226,812	1,773,652	413,545		**5,216,699**
Lee		6,324,356	4,118,243	714,751	61,197	2,996	28,414		**11,249,957**
Levy						611,153	188,973		**800,126**
Monroe	86,769	5,805,572	393,002	62,103	5,057		84,305		**6,436,808**
Pinellas	123,833	519,813	130,543	394,709	100,126	1,558,234	432,416		**3,259,674**
Other Fl. W.		9,845		24,810	111,430	504,689	21,257	1,369,500	**2,041,531**
Baldwin	118,394	104,765		47,788	4,328	1,736	208,146	77,639	**562,796**
Mobile	110,159	269,313	70,917	108,883	217,788	182,111	311,192	1,310,425	**2,580,788**
MS/LA	75,164	18,144	13,911				23,768	33,668	**164,655**
Port Isabel		493,204		22,327					**515,531**
Brownsville		1,108,840				20,653	1,577		**1,131,070**
Other TX		6,714					70,183	8,637	**85,534**
TOTAL	**779,014**	**15,500,197**	**5,081,863**	**1,824,006**	**1,761,650**	**4,719,646**	**4,980,550**	**2,995,819**	**37,642,745**

Source: Travis (2001).

Table 8 (cont'd). Ex-vessel revenues (dollars), by statistical area and landing county/port, for shrimp trawl trips in statistical subareas 1-8, 1998.

County/Port	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8	**TOTAL**
Bay							4,845	207,133	**211,978**
Franklin		87,014	31,772	31,074	40,295	270,857	5,595,413	32,358	**6,088,783**
Hillsborough.	43,527	1,723,645	317,778	196,956	1,704,817	2,750,188	195,265		**6,932,176**
Lee		7,733,427	4,853,769	1,482,161	323,514	681,145	176,564	73,315	**15,323,895**
Levy						1,105,204	397,018		**1,502,222**
Monroe	275,709	14,360,579	576,629	63,811			95,134		**15,371,862**
Pinellas	347,887	691,025	96,528	65,563	1,379,765	3,271,205	1,378,811	9,091	**7,239,875**
Other Fl. W.		117,673	10,194	145,953	148,944	1,180,400	126,151	1,777,200	**3,506,515**
Baldwin	237,714	206,793		80,755	75,816	157,420	691,200	474,058	**1,923,756**
Mobile	203,986	889,795	891,675	480,324	689,348	655,142	973,400	7,033,673	**11,817,343**
MS/LA	226,144	2,942	49,507	3,989		16,753	50,777	157,296	**507,408**
Port Isabel		1,926,370			66,136				**1,992,506**
Brownsville		1,801,477	23,350		5,560			27,524	**1,857,911**
Other TX	5,724	22,559					13,629	122,021	**163,933**
TOTAL	**1,340,691**	**29,563,299**	**6,851,202**	**2,550,586**	**4,434,195**	**10,088,314**	**9,698,207**	**9,913,669**	**74,440,163**

Source: Travis (2001).

Table 9. Monthly shrimp landings and revenues for water depths of 10 fathoms or less, by selected statistical subareas.

Month	Statistical Area 1		Statistical Area 3		Statistical Area 4		Total	
	Pounds	Revenues ($)	Pounds	Revenues ($)	Pounds	Revenues ($)	Pounds	Revenues ($)
January	19,731	73,247	5,370	14,598	19,987	85,658	45,088	173,503
February					14,106	60,593	14,106	60,593
March	13,601	48,992			13,393	49,151	26,994	98,143
April	7,448	20,218			9,154	47,407	16,602	67,625
May	7,115	17,165			22,325	121,072	29,440	138,237
June					13,368	57,918	13,368	57,918
July	653	2,351			21,573	76,606	22,226	78,957
August	88	289			17,017	67,989	17,105	68,278
September					5,799	27,285	5,799	27,285
October					10,019	33,915	10,019	33,915
November					17,282	69,017	17,282	69,017
December	10,810	44,555			9,993	49,300	20,803	93,855

Source: Travis (2001).

Table 10. Monthly shrimp catches and values from two sub-areas, 1999.

Month	Statistical Subareas 4-5				Statistical Subareas 6-8			
	Pounds	Percent	Values	Percent	Pounds	Percent	Values	Percent
January	73,594	9.5	344,907	9.6	312,366	9.0	1,320,335	10.2
February	117,368	15.2	547,237	15.3	313,565	9.0	1,296,732	10.0
March	104,585	13.5	532,588	14.9	229,073	6.6	901,919	6.9
April	99,405	12.9	515,733	14.4	254,916	7.3	984,498	7.6
May	73,484	9.5	371,565	10.4	358,688	10.3	1,286,663	9.9
June	76,612	9.9	280,628	7.8	372,191	10.7	1,257,726	9.7
July	43,862	5.7	150,451	4.2	318,044	9.1	1,048,451	8.1
August	50,196	6.5	203,271	5.7	248,878	7.1	726,909	5.6
Sept.	25,340	3.3	124,523	3.5	175,078	5.0	476,245	3.7
Oct.	30,617	4.0	129,644	3.6	282,085	8.1	902,579	6.9
Nov.	31,642	4.1	132,714	3.7	406,605	11.7	1,599,430	12.3
Dec.	46,744	6.0	252,395	7.0	210,174	6.0	894,556	6.9
Total	773,449		3,585,656		3,481,663		12,696,043	

Source: Travis (2001).

Table 11. Reduction rate estimates of various BRDs on the west coast of Florida (Statistical Subareas 1-8).

Species	n	Reduction Rate (%)	P - Value	95% C.I. (%)
New Extended Funnel BRD				
Shrimp (wt)	22	4	0.25	-3 to 10
Total Fish (wt)	22	40	0	32 to 48
3/5 Extended Funnel BRD				
Shrimp (wt)	72	1	0.54	-2 to 4
Total Fish (wt)	68	33	0.01	15 to 52
12x5 Fisheye BRD				
Shrimp (wt)	20	10	0.06	0 to 19
Total Fish (wt)	19	22	0.05	6 to 38
4x7 Fisheye BRD				
Shrimp (wt)	21	0	0.91	-8 to 7
Total Fish (wt)	21	7	0.23	-4 to 18
Kiffe Version 4 BRD				
Shrimp (wt)	24	0	0.90	-5 to 4
Total Fish (wt)	24	17	0	9 to 24

Source: NMFS (unpublished data)

Table 12. Reduction rate estimates of various BRDs and one TED for the Gulf of Mexico and South Atlantic.

Species	n	Reduction Rate (%)	P - Value	95% C.I. (%)
12x5 Fisheye BRD				
Shrimp (wt)	157	4	0.16	--
Total Fish (wt)	141	35	0	30 to 39
12x5 Fisheye BRD in the 2.6 Meter Position				
Shrimp (wt)	105	4	0.17	--
Total Fish (wt)	98	44	0	38 to 49
12x5 Fisheye BRD in the 3.8 Meter Position				
Shrimp (wt)	35	-1*	0.78	--
Total Fish (wt)	35	31	0	24 to 37
Extended Funnel Device				
Shrimp (wt)	299	0	0.74	--
Total Fish (wt)	280	38	0	32 to 44
Jones/Davis BRD				
Shrimp (wt)	33	4	0.07	0 to 9
Total Fish (wt)	31	58	0	53 to 63
Parker TED				
Shrimp (wt)	68	7	0.00	4 to 10
Total Fish (wt)	67	32	0.00	28 to 36

*Negative values represent a nominal increase.

Source: NMFS (unpublished data)

Table 13. Average annual shrimp catch (all species), value, trips, and effort (days fished) by depth for three statistical subarea groupings, 1991-2000, and percent of total.

Subgroup	FMGroup	Pounds	Percent	Value	Percent	Trips	Percent	Effort	Percent
1-3	0-5	171,822	2.3	370,586	1.4	14	0.5	880.128	5.8
1-3	6-10	642,809	8.6	1,920,912	7.1	85	3.2	1,113.180	7.3
1-3	11-20	6,577,292	88.2	24,410,355	90.5	2,518	95.4	13,033.241	85.6
1-3	> 20	65,804	0.9	275,017	1.0	23	0.9	206.394	1.4
SS Subtotal		7,457,727	100.0	26,976,870	100.0	2,640	100.0	15,232.943	100.0
4-5	0-5	13,585	1.5	39,568	1.0	31	6.0	27.165	1.2
4-5	6-10	365,524	41.3	1,532,661	40.3	274	53.1	1,038.431	44.3
4-5	11-20	501,808	56.6	2,213,172	58.1	209	40.5	1,160.081	49.5
4-5	> 20	4,996	0.6	21,091	0.6	2	0.4	120.182	5.1
SS Subtotal		885,913	100.0	3,806,492	100.0	516	100.0	2,345.859	100.0
6-8	0-5	484,835	11.4	1,493,781	10.9	1,146	31.7	986.227	11.4
6-8	6-10	1,369,003	32.3	4,497,479	32.7	1,676	46.4	3,197.786	36.9
6-8	11-20	2,262,260	53.4	7,423,274	53.9	772	21.4	4,283.859	49.4
6-8	> 20	122,498	2.9	350,941	2.5	17	0.5	204.677	2.4
SS Subtotal		4,238,596	100.0	13,765,475	100.0	3,611	100.0	8,672.549	100.0
TOTAL		**12,582,236**		**44,548,837**		**6,767**		**26,251.351**	

Source: NMFS (unpublished data)

Table 14. Bioeconomic modeling results of various types of BRDs.

BRD Type	Percent Bycatch Reduction	Percent Shrimp Reduction	Percent Change in Fleet Size	Percent Change in Net Present Value	Benefit to Cost Ratio
New Extended Funnel	40	4	-1.7	-4.9	0.95
3/5 Extended Funnel	33	1	0.4	1.6	1.02
12x5 Fisheye (Table 8)	22	10	-5.7	-25.0	0.75
4x7 Fisheye	7	0	0	3.2	1.03
Kiffe Version 4	17	0	0	3.2	1.03
12x5 Fisheye (Table 9)	35	4	-1.7	-5.0	0.95
12x5 Fisheye (2.6 Meter)	44	4	-1.7	-5.0	0.95
12x5 Fisheye (3.8 Meter)	31	-1	0.4	4.6	1.05
Extended Funnel Device	38	0	0	3.2	1.03
Jones/Davis	58	4	-1.7	-5.0	0.95
Parker	32	7	-3.5	-14.0	0.86

Source: Ward (2002).

17.0 FIGURES

Figure 1. Permanent and seasonally closed areas to the commercial harvest of shrimp on the west coast of Florida.

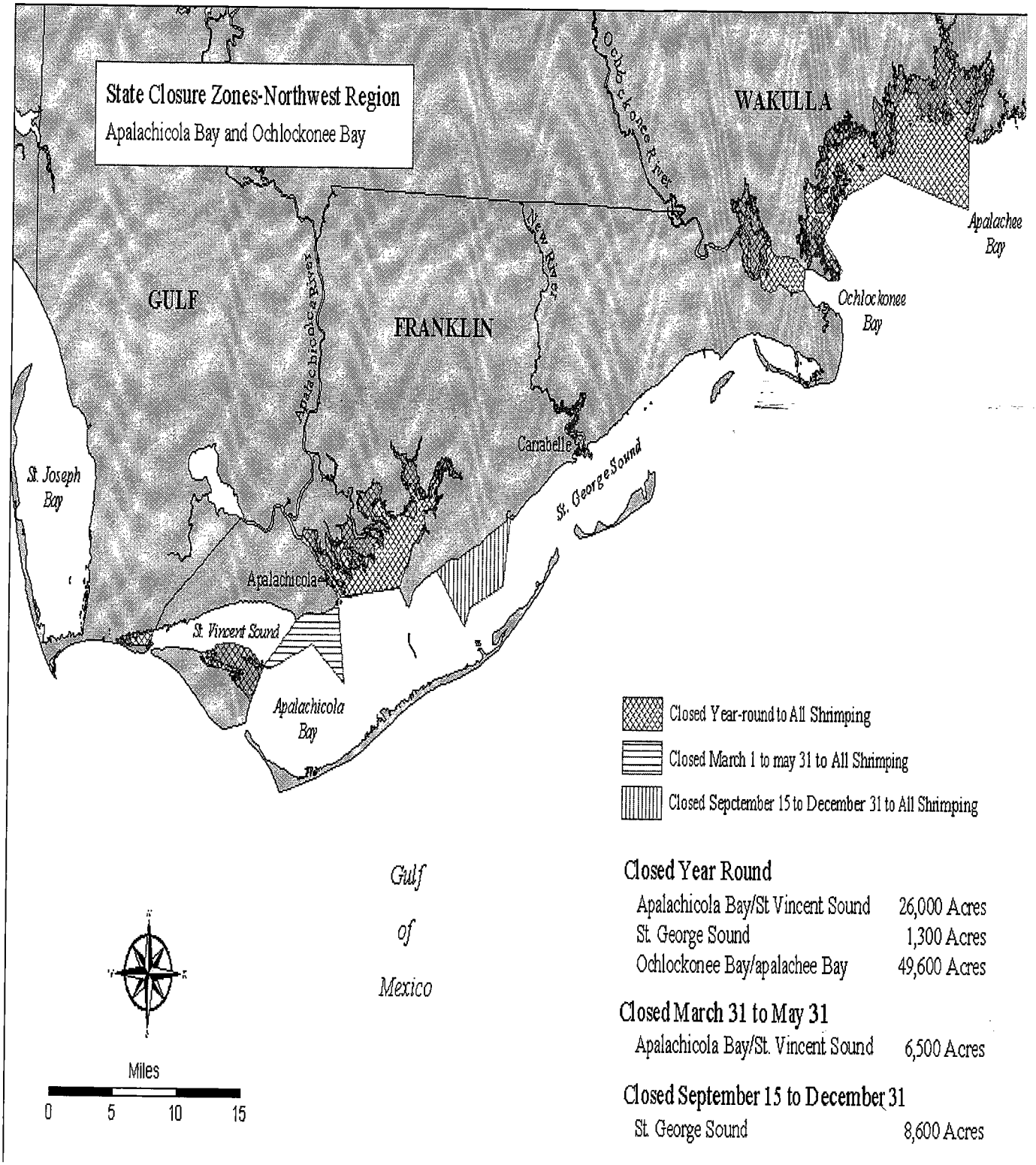


Figure 1. Continued.

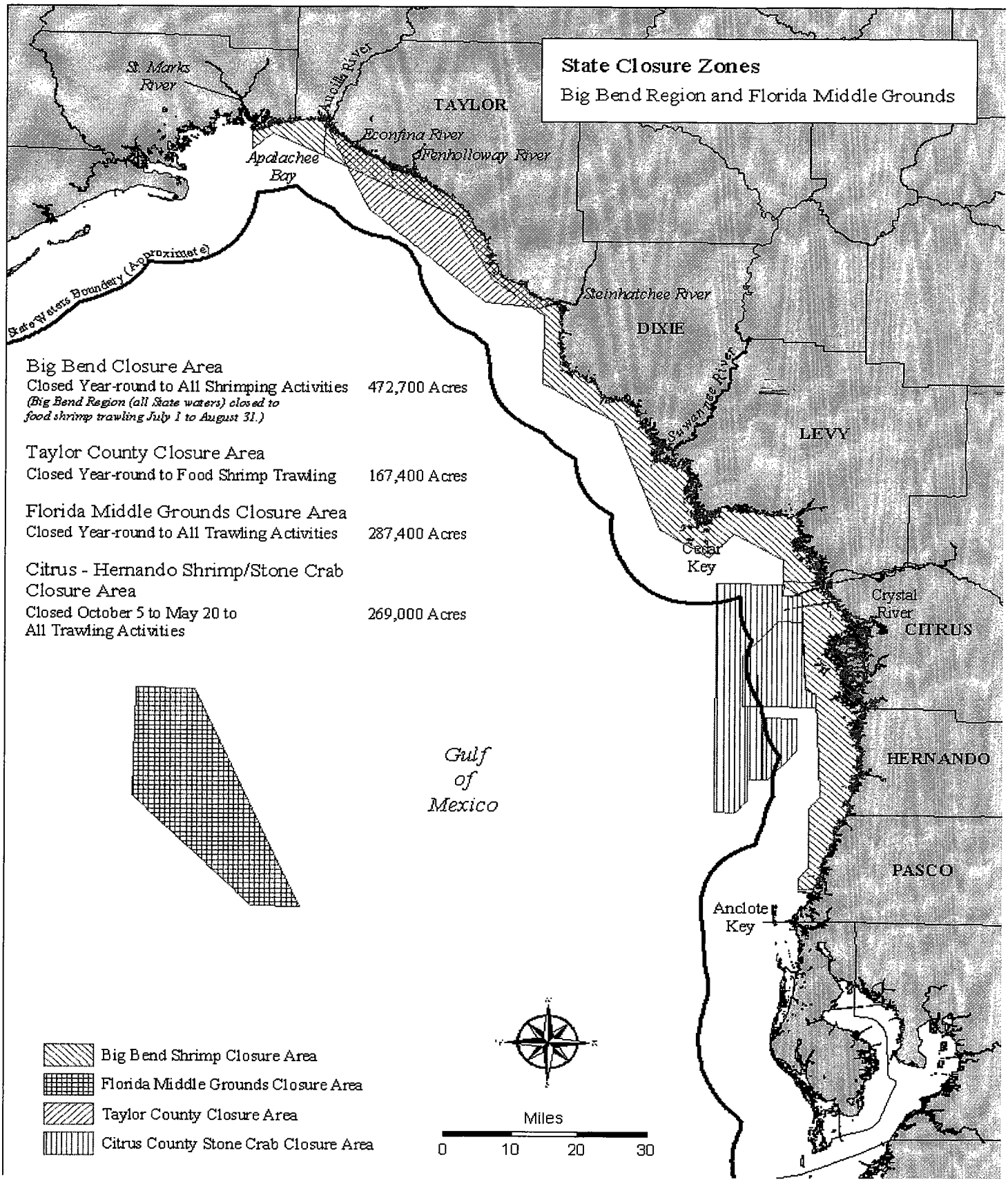


Figure 1. Continued.

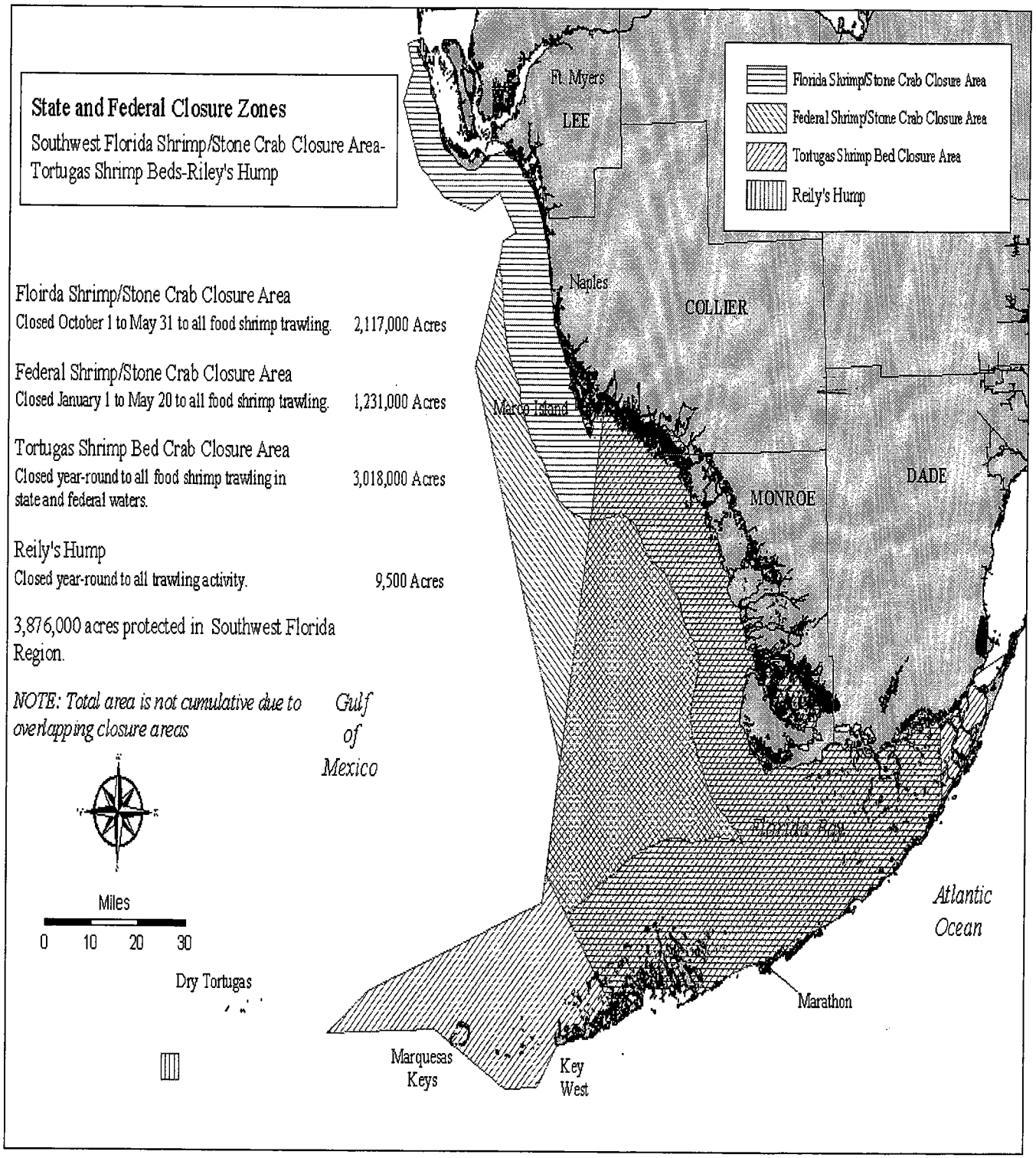
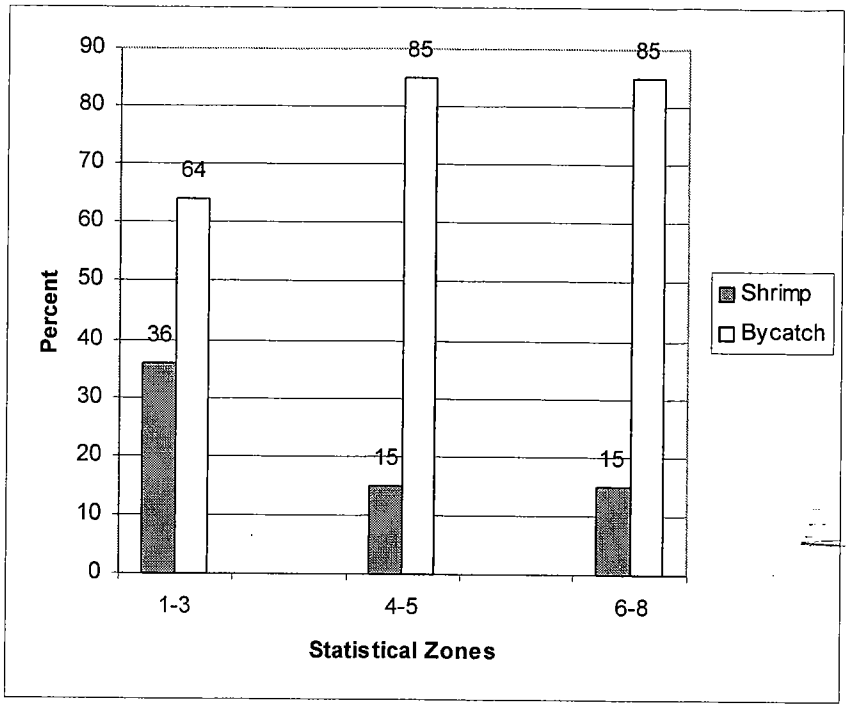


Figure 2. Percentage of catch weights (kilograms per hour) for shrimp to all bycatch and shrimp to finfish bycatch in 3 statistical subarea groupings off the west coast of Florida. (Source: NMFS, unpublished data)



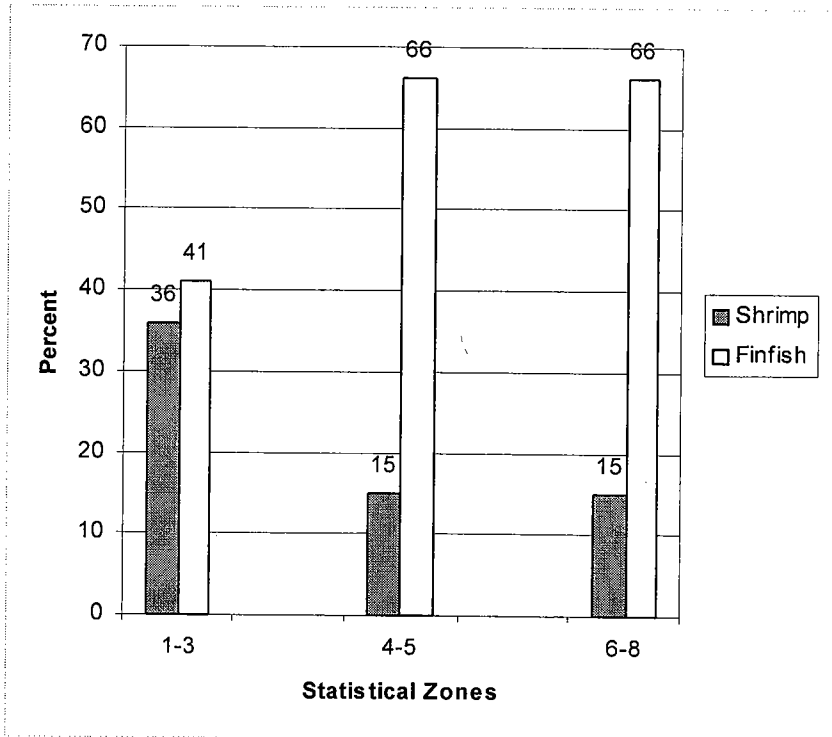


Figure 3. Statistical subareas 1-8.

Figure 4. Southwest Florida seasonal trawl closure.

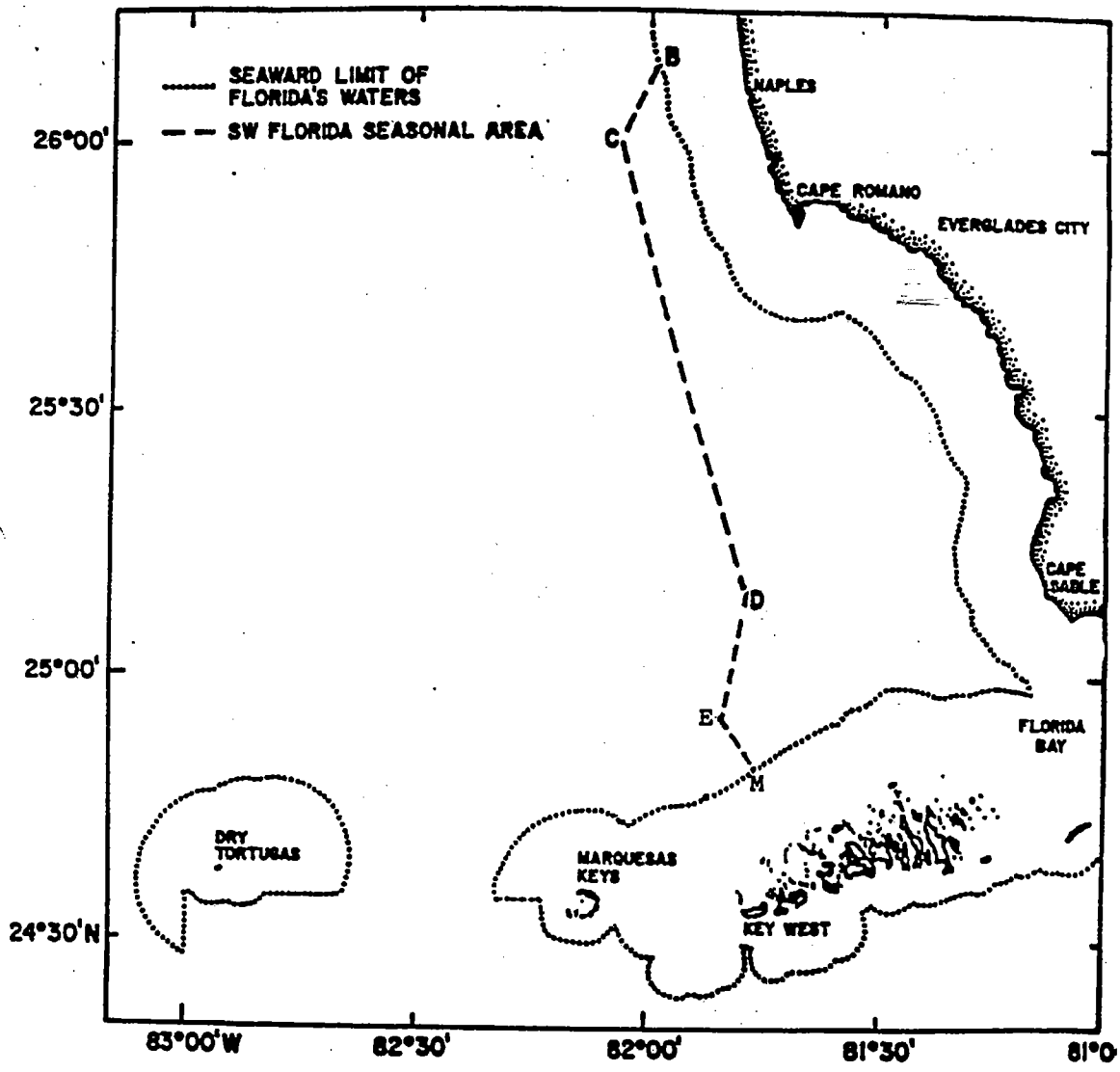


Figure 5. Citrus-Hernando shrimping and stonecrabbing closed areas.

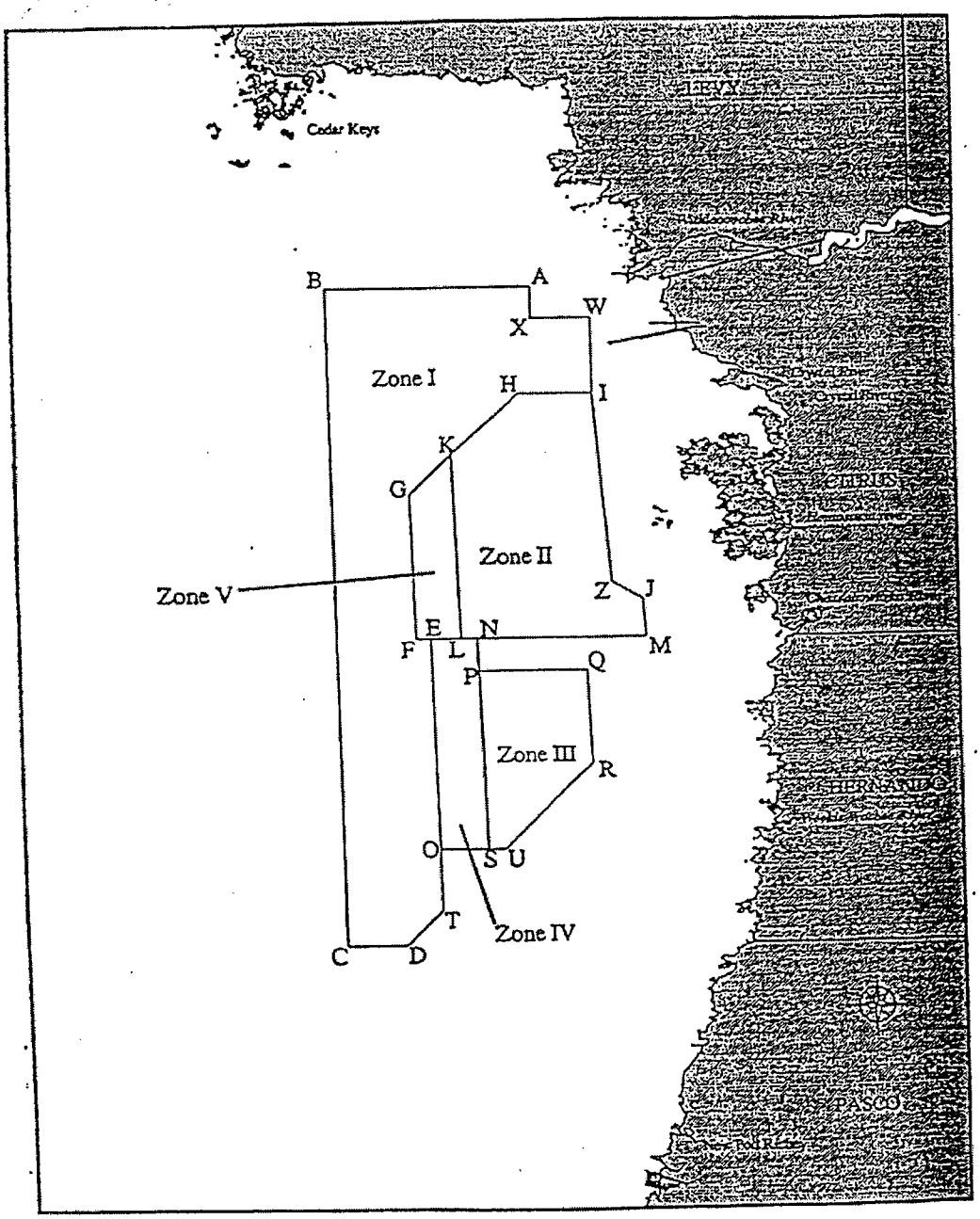
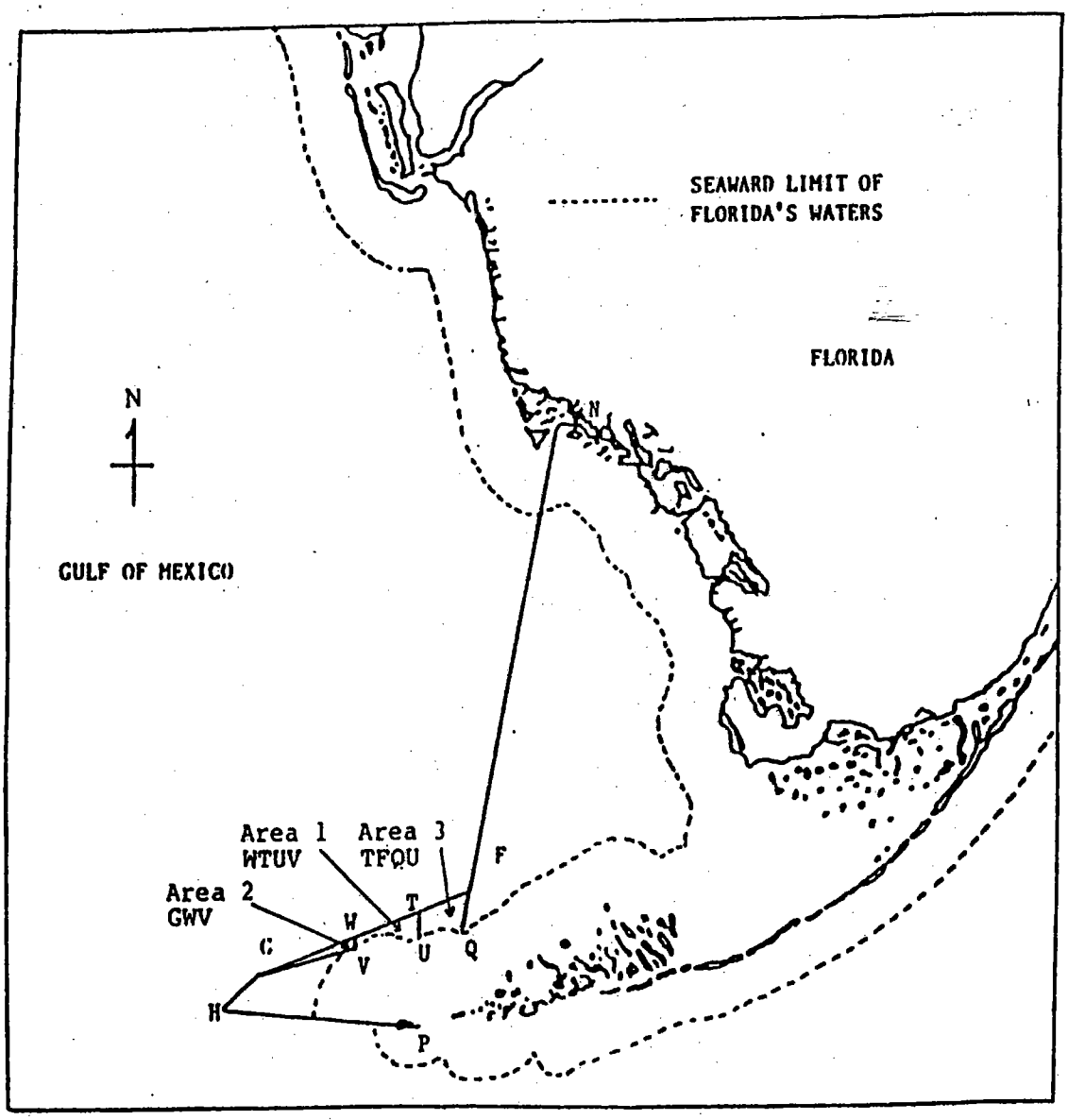


Figure 6. Tortugas shrimp sanctuary.



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