4 Description and comparison of alternatives

The alternatives described in this section to achieve the purpose and satisfy the needs stated in Section 3.0 are grouped under the following seven categories of actions:

1. Defining fishery management units and sub-units;
2. Specifying biological reference points and stock status determination criteria;
3. Regulating fishing mortality;
4. Rebuilding overfished fisheries;
5. Conserving and protecting yellowfin grouper;
6. Achieving the MSFCMA bycatch mandates; and
7. Achieving the MSFCMA EFH mandates.

Alternatives identified by the Council as preferred are noted. The summary impact analysis following each suite of alternatives is based on the more detailed analysis provided in Section 6.0, with the exception of those alternatives in Section 4.7. The alternatives in Section 4.7 are the preferred alternatives identified in the EFH EIS. The summary comparison of those alternatives is based on the detailed analyses in the EFH EIS (CFMC 2004), which are summarized herein.

4.1 Fishery management units and sub-units

4.1.1 Defining fishery management units and sub-units

The fishery management unit (FMU) defined by each Council FMP identifies the specific fishery (or that portion thereof) that is relevant to the FMP's management objectives. 50 CFR §600.320(d)(1) provides that FMUs may be organized around biological, geographic, economic, technical, social, or ecological goals. Decisions about the composition of FMUs are an integral part of the plan development process, as FMUs define the specific species that are to be the target of conservation and management. A species may be included in an FMU for data collection purposes only if the Council determines there is not enough information available to specify biological reference points and/or management measures for that species (50 CFR §600.320(d)(2)).

In some cases, the FMUs of the Council FMPs have been subdivided into sub-units to facilitate conservation and management efforts. For example, the Coral FMP currently recognizes aquarium trade species as a sub-unit of the Caribbean coral reef resource FMU, and the Reef Fish FMP recognizes reef fish and aquarium trade species as sub-units of the Caribbean reef fish FMU. As currently defined, FMUs do not distinguish between managed versus data collection-only species.

4.1.1.1 Alternative 1. No action. Retain the current FMUs designated by the original FMPs.

The FMUs defined by the Council under its four FMPs are described in 50 CFR Part 622.2 and associated appendices under the definitions "Caribbean spiny lobster," "Caribbean conch resource," "Caribbean reef fish," and "Caribbean coral reef resource." These FMUs are defined, respectively by the Spiny Lobster FMP, the Queen Conch FMP, the Reef Fish FMP, and the Coral FMP.

The FMUs include virtually all finfish and invertebrates that are known or are believed to be captured by commercial, recreational, and/or subsistence fishermen for food and/or for the aquarium and ornamental trades, as well as plants and invertebrates that support the development and survival of those species. The Caribbean spiny lobster FMU is composed of a single species, *Panulirus argus*, that is taken in the directed fishery. The Caribbean conch resource FMU (Table 2), Caribbean coral reef resource FMU (Table 4), and Caribbean reef fish FMU (Table 3) are composed of multiple species that may be taken directly or incidentally in multi-species fisheries.

4.1.1.2 Alternative 2 (Preferred). Redefine the FMUs and FMU sub-units in Council FMPs as detailed in Table 8. Delete from the Caribbean Conch Resource FMU the Caribbean helmet, *Cassis tuberosa*; Caribbean vase, *Vasum muricatum*; flame helmet, *Cassis flammea*; and whelk (West Indian top shell), *Cittarium pica*, leaving nine other species detailed in Table 2.

The FMUs and FMU sub-units defined under this alternative are detailed in Table 8. This alternative deletes four species from the Caribbean conch resource FMU to narrow the definition of that FMU to include only those species that occur in federal waters.

Additionally, this alternative divides species in the Caribbean reef fish FMU into 21 sub-units to facilitate conservation and management efforts. These sub-units, described in Table 8, were delineated based on comments, guidance, and input from staff of the Council, the NMFS' Southeast Regional Office (SERO) and Southeast Fisheries Science Center (SEFSC), the USVI and Puerto Rico fisheries management agencies, and several environmental non-governmental organizations represented on the Council's SFA Working Group, with minor adjustments made at the 110th Council meeting to reflect current knowledge of how species are primarily marketed in the region (e.g., for food fish versus for the aquarium trade). As illustrated in Table 8, most of these sub-units are based by taxonomic groupings. In the case of the grouper and snapper sub-units, these are based on additional rationale; in particular, they are grouped largely because they frequent the same habitat and depth range, and, therefore, they are harvested together.

Lastly, this alternative divides the Caribbean coral reef resource FMU into either an aquarium trade category or a prohibited corals and marine plants category, both of which are detailed in

Table 8. Additional alternatives for this coral reef resource category are discussed in Section 4.1.2.

Generally, these groupings are based on taxonomic families or subfamilies, modified by biological, geographic, economic, technical, social, and/or ecological criteria as provided for by 50 CFR 600.320(d). In particular, effort was directed at grouping species caught in similar habitats with similar gear and whose ecologies and current status were thought to be similar. Although much remains to be learned about these various components of Caribbean fisheries, managers have a better understanding of both species and fishery operations than they did when FMUs were first defined. For example, although fishery-dependent catch and permit (aquarium trade) data recorded by state govemments still do not adequately distinguish catches in federal and state waters, they have provided additional information on how species are captured and marketed. Scientific data from published and gray literature have provided insight into the biology and ecology of many managed species. Both types of information were considered in defining species that would best be managed together as sub-units.

Landings and export data were used to make initial determinations about which species were utilized in the aquarium trade and which were important food fish. This information was then ground-truthed through state agency staff, industry representatives, and others who serve on the Council. Data on the depth distribution of species and the composition of landings by gear type were used to define complexes of food fish that are captured in similar depth ranges and with similar fishing gear.

4.1.1.3 Alternative 3. With the exception of the aquarium trade species sub-units in the Coral and Reef Fish FMPs, redefine the FMUs and FMU sub-units in Council FMPs to be consistent with those specified in Table 8. Redefine the aquarium trade species sub-units to comprise those aquarium trade species recognized and managed by state governments, and that are not otherwise included in other sub-units of any FMU.

With the exception of the Caribbean reef fish and Caribbean coral reef resource FMUs, the FMUs defined under this alternative would be consistent with the status quo. This alternative modifies the composition of the aquarium trade species sub-units within the Caribbean reef fish and Caribbean coral reef resource FMUs. The modification would not result in any additions to the current list of aquarium trade species. It would, however, result in a number of deletions. Species that would be deleted from the aquarium trade species sub-units of the Caribbean reef fish and coral reef resource FMUs if this alternative were to be adopted are identified in Tables 3 and 4, respectively.

4.1.1.4 Alternative 4. Delete the aquarium trade species from the Caribbean reef fish resource FMU.

This alternative modifies the definition of the Caribbean reef fish FMU to exclude all species that are currently recognized as aquarium trade species in the Reef Fish FMP (Table 3).

4.1.1.5 Comparison of the environmental effects of alternative definitions of FMUs and FMU sub-units

None of the alternatives to amend the FMUs and sub-units would have a direct environmental effect. However, selection of a particular alternative to amend the FMUs could have subsequent indirect impacts. Alternative 1introduces administrative impacts and would not permit effective resource management, as, in some cases, numerous biologically diverse species are grouped together (e.g., reef fish FMU). This would complicate the designation of stock status parameters and could inhibit the identification and management of overfished species. Alternative 2 offers a more ideal situation, in that it groups species in sub-units to facilitate management, as well as deleting several species that do not even occur in federal waters. Alternative 3 refines the management of aquarium trade species (Tables 3 and 4), the harvest of which largely occurs in state waters. However, Puerto Rico has yet to implement pending legislation that would better manage and conserve these species. Alternative 4 could allow unregulated exploitation of the aquarium trade species in federal waters, to a greater extent than Alternative 3. Since there are few restrictions currently in place, compounded with the fact that the majority of harvest of aquarium trade species occurs in state waters, it would appear that the environmental impact of both Alternatives 3 and 4 would not be significant. Due to the need for more refined management and to mitigate administrative impacts when establishing stock status parameters, the Council selected Alternative 2 as the preferred alternative.

4.1.2 Additional options for aquarium trade species

As noted in Section 4.1.1, FMUs defined by Council FMPs do not currently distinguish between managed versus monitored species. 50 CFR §600.320(d)(2) provides the authority to make such a distinction when there is not enough information available to specify biological reference points and/or management measures for one or more stocks. The Council is considering the following alternatives for moving aquarium trade species in the Caribbean reef fish and Caribbean coral reef FMUs to a data collection category as a means to better reflect the Council's role in meeting the management needs of those species.

4.1.2.1 Alternative 1. No action. Continue to manage aquarium trade species.

This alternative maintains the status quo. Aquarium trade species would be retained in the Caribbean reef fish and coral reef resource FMUs as managed species, and would be subject to existing and future regulation in federal waters of the U.S. Caribbean.

4.1.2.2 Alternative 2 (Preferred). Move aquarium trade species to a data collection only category.

This alternative mandates the collection of data on aquarium trade species under the Reef Fish and Coral FMPs, but removes these species from the purview of federal regulations. Consequently, existing regulations defining a marine aquarium fish as “a Caribbean reef fish that

is smaller than 5.5 inches (14.0 cm) TL" and restricting the harvest of a marine aquarium fish to hand-held dip nets or hand-held slurp guns (50 CFR 622.41§(b) will be eliminated if this action is approved and implemented. The regulation prohibiting the harvest and possession of butterflyfish and seahorses from federal waters of the U.S. Caribbean (50 CFR §622.32(b)(1)(ii)) also will be eliminated if this alternative were implemented. Tables 1 and 2 of Appendix A to 50 CFR 622 will also be revised to identify species in the aquarium trade sub-units of the Caribbean reef fish and coral reef resource FMUs. The definition of these FMU sub-units is consistent with those adopted by the Council in Section 4.1.1 of this amendment. Furthermore, inclusion in a data collection only category results in no specification of MSY, OY, or other stock status determination criteria for these species due to no real need for federal conservation and management of these species. Therefore, they are excluded from discussion in those sections.

4.1.2.3 Comparison of the environmental effects of alternative options for managing aquarium trade species

Neither alternative would likely have a significant environmental impact. Given the reality that the harvest of these species occur largely in state waters, and the levels of harvest are not significant for many of the species in the coral reef and reef fish FMUs, Alternative 1 would present significant administrative issues since it would require the Council to develop stock status parameters for numerous biologically diverse species that are in the aquarium trade. While Alternative 2 would remove several regulations pertaining to aquarium trade species, it is not expected to result in any environmental impact. For example, the current aquarium trade definition encompasses all reef fish under 5.5 inches. The harvest and possession of butterflyfish still occurs in state waters (i.e., Puerto Rico), and since the majority of this species' habitat occurs in state waters, the effect of the current prohibition is most likely negligible. The presence or absence of a gear restriction for aquarium trade species does not really have any impact, since aquarium trade dealers are already limited to this gear in order to be able to harvest the species without placing unwanted stress on the specimen. Further, the use of explosives and poisons is already prohibited under other MSFCMA regulations. Due to the administrative impacts that could result in attempting to specify stock status criteria for the aquarium trade species, and because there is no current need for conservation of these species in federal waters, the Council selected Alternative 2 as the preferred alternative.

4.1.3 Additional options for Caribbean conch resources

The Council also is considering the following alternatives to move select species in the Caribbean conch resource FMU to a data collection category.

4.1.3.1 Alternative 1. No action. Continue to manage Caribbean conch resources.

This alternative maintains the status quo. All conch species comprising the Caribbean conch resource FMU would be subject to regulation in federal waters of the U.S. Caribbean.

4.1.3.2 Alternative 2 (Preferred). Move all species in the Caribbean conch resource FMU, with the exception of queen conch, to a data collection only category.

This alternative mandates the collection of data on all species comprising the Caribbean conch resource FMU under the Queen Conch FMP, but would remove all species, with the exception of queen conch, from the purview of other federal regulations on allowable fishing practices. Consequently, existing regulations requiring that all species in the Caribbean conch resource FMU taken from the U.S. EEZ be maintained with meat and shell intact (50 CFR §622.38(f)) would no longer apply to these species, and would instead only apply to queen conch. Furthermore, inclusion in a data collection only category would result in no specification of MSY, OY, or other stock status determination criteria for these species due to no real need for federal conservation and management of these species. Therefore, they are excluded from discussion in those sections.

4.1.3.3 Comparison of the environmental effects of alternative options for managing Caribbean conch resources

The environmental effects for these two alternatives are similar to those discussed in Section 4.1.2.3. The harvest of other conch species does not appear to occur in significant levels, and largely occurs in state waters due to the species' habitat requirements. The retention of the other conch species in Alternative 2 would allow for continued monitoring of landings and other biological information, and would facilitate management should the need ever arise. Due to the administrative impacts that could result in attempting to specify stock status criteria for the aquarium trade species, and because there is no current need for conservation of these species in federal waters, the Council selected Alternative 2 as the preferred alternative.

4.2 Biological reference points and stock status determination criteria

The MSFCMA requires that each FMP define management reference points in the form of maximum sustainable yield (MSY) and optimum yield (OY). MSY is the greatest amount or yield of a species that can be sustainably harvested under prevailing environmental conditions, while OY is the amount or yield of a species that "will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems..." (16 U.S.C. §1802(28)).

While economic and social factors are to be considered in defining the OY for each fishery, OY may not be defined as an amount of fish that would compromise a stock's ability to produce MSY (i.e., OY can not be established in excess on MSY). OY must prevent overfishing, which occurs when fishing mortality exceeds the level at which fishing produces MSY. In the case of an overfished fishery, OY must provide for rebuilding to a stock biomass level that is consistent with that which would produce MSY (50 CFR §600.10).

The MSFCMA requires that each FMP specify objective and measurable criteria for identifying when a species is overfished. Status determination criteria are defined by 50 CFR §600.310 to include a minimum stock size threshold (MSST) and a maximum fishing mortality threshold (MFMT). The MSST represents the biomass level below which a species or species complex would not be capable of producing MSY. A species or species complex with a biomass below the MSST is considered to be overfished. The MFMT represents the maximum level of fishing mortality that a species or species complex can withstand, while still producing MSY on a continuing basis. A fishery experiencing a fishing mortality rate that exceeds the MFMT is considered to be undergoing overfishing.

Together, these four parameters are intended to provide fishery managers with the means to measure the status and performance of each species or sub-unit in the FMU. By evaluating annual catches, species biomass (B_{CURR}) and fishing mortality rates (F_{CURR}) in relation to MSY, OY, MSST, and MFMT, fishery managers can determine the status of a fishery at any given time and assess whether management measures are achieving established goals. The primary goal of federal fishery management, as described in National Standard 1 of the MSFCMA, is to conserve and manage U.S. fisheries to "...prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry" (16 U.S.C. §1851(a)(1)).

The National Standard Guidelines direct regional fishery management councils to use reasonable proxies when data are insufficient to provide direct estimates of biological reference points and status determination criteria for species under their jurisdiction. NMFS provides guidance at 50 CFR §600.310 and in Restrepo *et al.* (1998) on various proxies that could be used for MSY, MSST, and MFMT in data-poor situations.

This section describes the alternative proxies considered by the Council for the species comprising each FMU. These proxies are applied to the FMU sub-units defined by the Council's preferred FMU Alternative, described in Section 4.1.1.2. These sub-units are generally composed of species with taxonomic, biological, and ecological similarities, and/or species that co-occur and, thus, are often captured together. Also described in this section are target control rules, or pre-agreed upon strategies for managing catches to achieve a long-term average catch approximating OY. A target control rule should not specify a level of catch that would exceed that associated with fishing at the MFMT because the MFMT is defined by an MSY control rule, and OY cannot exceed MSY according to the MSFCMA.

4.2.1 Maximum sustainable yield (MSY)

4.2.1.1 Alternative 1. No action. Retain current definitions of MSY (if any).

This alternative retainsthe status quo definitions of MSY included in Council FMPs. The definitions of MSY that are currently in place for species under the Council's jurisdiction are detailed in Table 9 under the column "MSY Alt 1."

4.2.1.2 Alternative 2. In the absence of MSY estimates, the proxy for MSY will be derived from recent average catch (C), and from estimates of the current biomass (B_{CURR}/B_{MSY}) and fishing mortality (F_{CURR}/F_{MSY}) ratios as: MSY = C / [(F_{CURR}/F_{MSY}) x (B_{CURR}/B_{MSY})]; where C is calculated based on commercial landings for the years 1997-2001 for Puerto Rico and 1994-2002 for the USVI, and on recreational landings for the years 2000-2001[1].

This alternative is preferred for the Caribbean queen conch, spiny lobster, and all reef fish, excluding those species retained for data collection purposes.

This alternative defines MSY proxies based on average catch (C), and on the relationships between current biomass and biomass at MSY (B_{CURR}/B_{MSY}) and between the current fishing mortality rate and the fishing mortality rate at MSY (F_{CURR}/F_{MSY}).

50 CFR §600.310(c)(3) provides that, when data are insufficient to estimate MSY directly, the long-term average catch can be used to approximate MSY. Generally, it is best to average catches over as long a time series as possible to capture the fishery's response to changing conditions. But equally important is the need to base the average on years for which reliable catch data exist. This alternative would calculate average catch using commercial landings data for the years 1997-2001 for Puerto Rico, average catch of most species complexes and sub-units from 1994-2002 for the USVI, and recreational landings data for the years 2000-2001 because these represent the longest time periods in which data were considered to be relatively reliable, as determined by the SFA Working Group.

Commercial catch data would be derived from trip ticket reports collected by the state governments. Similar data do not exist for recreational fisheries. However, the Marine Recreational Fisheries Statistics Survey (MRFSS) provides data on recreational catches landed in Puerto Rico in 2000 and 2001. MRFSS obtains standardized and comparable estimates of participation, effort, and catch by recreational anglers in the marine waters of the United States *via* a telephone survey of households in coastal counties and an intercept survey of anglers at fishing access sites. Since MRFSS coverage does not currently extend to the USVI, recreational landings of finfish in the USVI would be derived by assuming the same commercial-recreational relationship as that for Puerto Rico (recreational catches averaging 43.77% of commercial catch levels). Thus, the total annual commercial catch of finfish landed in the USVI from 1994-2002 would be multiplied by 0.4377 to derive the total annual recreational catch during that same period of time.

The MRFSS data from Puerto Rico would also be used to estimate the composition of catches taken in USVI recreational finfisheries. In this case, it would be assumed that species were captured in the USVI at the same relative frequencies as they were in Puerto Rico, as measured in the MRFSS data. Recreational catches of queen conch and spiny lobster landed in the USVI

[1] The exact process utilizing commercial and recreational landings in determining MSY is explained in Section 6.2.1.2.

would be assumed to be 50% of the USVI commercial landings based on information from Valle-Esquivel (pers. comm.). Recreational catches for all these species are defined to include both subsistence catches and more conventional recreational catches.

If we were to equate MSY to the average catch over a select period of time, we would be making the assumption that both the biomass and the fishing mortality rate associated with that catch period were consistent with that able to produce MSY. It is safe to make this assumption if the time period over which catches are averaged is sufficient to observe any trends in the fishery, if the catch data are reliable, and if the catch history does not show a pattern of decline (Restrepo *et al.* 1998).

Since the data for the U.S. Caribbean do not support these assumptions, we incorporated two additional terms into the definition of MSY: (1) the biomass, or B, ratio (current biomass (B_{CURR}) divided by biomass at MSY (B_{MSY})), and (2) the fishing mortality rate, or F, ratio (current fishing mortality rate (F_{CURR}) divided by the fishing mortality rate associated with MSY (F_{MSY})). This enables us to consider alternative definitions of MSY that reflect situations when biomass and/or fishing mortality rates are above or below the level needed to produce MSY during the defined catch period. Alternative B and F ratios evaluated by the Council are described in Section 4.2.2.

The MSY values that would result from this alternative if the Council's preferred definition of B and F ratios were to be adopted are detailed in Table 9 under the column "MSY Alt 2."

4.2.1.3 Alternative 3. Set MSY = 0.

This alternative is preferred for all species in the Coral Reef FMP, excluding those species retained for data collection purposes.

This alternative sets MSY equal to zero, indicating that no amount of harvest could be sustained over the long term.

4.2.1.4 Alternative 4. Set MSY equal to long-term average catch based on commercial landings data from 1983-2001 and on recreational data provided by MRFSS for the years 2000-2001.

This alternative defines MSY proxies based on average catch (C), calculated strictly using commercial landings data for the years 1983-2001 and recreational landings data for the years 2000-2001. Commercial catch data would be derived from trip ticket reports collected by the state governments. Recreational data would be derived from the MRFSS program. The MRFSS provides data on recreational catches landed in Puerto Rico in 2000-2001. Recreational landings of finfish in the USVI would be derived by assuming the same commercial-recreational relationship as that for Puerto Rico (recreational catches averaging 43.77% of commercial catch levels). Thus, the total annual commercial catch of finfish landed in the USVI from 1983-2001

would be multiplied by 0.4377 to derive the total annual recreational during that same period of time.

The MRFSS data from Puerto Rico would also be used to estimate the composition of catches taken in USVI recreational fisheries (excluding queen conch and spiny lobster). In this case, it would be assumed that species were captured in the USVI at the same relative frequencies as they were in Puerto Rico, as measured in the MRFSS data. Recreational catches of queen conch and spiny lobster landed in the USVI would be assumed to be 50% of the USVI commercial landings based on information from Valle-Esquivel (pers. comm.). Recreational catches for all these species are defined to include both subsistence catches and more conventional recreational catches.

Table 9, under the column "MSY Alt 4," presents the specific MSY values associated with this alternative for each stock or complex.

4.2.1.5 Comparison of the environmental effects of alternative MSY definitions

Defining MSY does not directly affect the biological, ecological, social, or economic environment in a positive or negative way because this parameter simply provides fishery managers with a biological reference point to use in assessing fishery status and performance. However, defining this target reference point will indirectly affect the biological, ecological, social, and economic environment by influencing the development of fishery management measures, which directly affect Caribbean fisheries.

In general, the lower the choice of MSY the greater these constraints will be, leading to more restrictions in the short-run and greater assurance of sustained benefits in the long-run. However, these constraints would only apply to federal waters, which make up a small portion of the fishable area in the U.S. Caribbean. Due to a lack of a long time series for recreational landings (i.e., more than two years), there is no difference in the use of that data between Alternatives 2 and 4. Likewise, there is a paucity of data regarding commercial exploitation on the aquarium trade complex on a long time scale, thus there is no difference in the data utilized on those sub-units between Alternatives 2 and 4. Alternative 3 leads to a prohibition on further fishing for the resource, resulting in significant benefits for the resource, and severe economic impacts to fishermen and related industries (with the exception of corals, the harvest of which is already prohibited). Overall, the use of a longer time series (Alternative 4) results in lower estimates of MSY (Table 9), although some would be higher under Alternative 4 than Alternative 2. The use of B and F ratios in Alternative 2 provides greater flexibility to produce MSY estimates that were tailored to the specific perceived conditions facing each stock or FMU sub-unit. Therefore, the Council selected Alternative 2 as the preferred alternative for those FMUs and FMPs indicated. Likewise, the Council selected Alternative 3 as the preferred alternative for coral species to reflect the importance of those species as EFH.

4.2.2 Fishing mortality (F) and biomass (B) ratios

In order to determine many of the stock status parameters for Caribbean FMU sub-units, most of which lack formal stock assessments and discrete data on current fishing mortality rates and biomass levels, assumptions on the perceived fishing mortality rates and relative biomass of managed species are required. These assumptions are not determinations on the official stock status (i.e., overfished, overfishing). For a species to be classified as overfished as outlined in the MSFCMA, a species biomass would have to fall below its MSST; this is addressed in Section 4.2.4.

The F ratio, or fishing mortality rate ratio, is the current fishing mortality rate (F_{CURR}) divided by the fishing mortality rate associated with MSY (F_{MSY}). Likewise, the B ratio, or biomass ratio, is the current biomass (B_{CURR}) divided by biomass at MSY (B_{MSY}). In general and all things being equal, a healthy stock would have a low fishing mortality rate (F) and a high relative biomass (B). Conversely, an unhealthy stock would have a high fishing mortality rate and a low biomass.

The fishing mortality and biomass status of each sub-unit (i.e., those that lack a stock assessment) was determined by the SFA Working Group, a Council-advisory group, which consisted of staff from the Council, the NMFS SERO and SEFSC, the USVI and Puerto Rico fisheries management agencies, and several environmental non-governmental organizations. As stated in Restrepo *et al.* (1998), "in cases of severe data limitations, qualitative approaches may be necessary, including expert opinion and consensus-building methods." More information on the composition of the SFA Working Group can be found in Section 11.3. Refinements to these determinations were made at the 117th Council meeting, which were largely based on public comment and anecdotal information.

The fishing mortality and biomass status determinations made by the SFA Working Group were based on best professional judgement, informed by available scientific and anecdotal information on a variety of factors (e.g., Appeldoorn *et al.* 1992), including the anecdotal observations of fishermen as reported by fishery managers, life history information, and the status of individual species as evaluated in other regions. For example, some snapper and grouper species are generally long-lived, are heavily targeted by fishermen, and are documented to spawn in aggregations that make them vulnerable to local overexploitation. This would likely translate to a high potential fishing mortality rate and a low potential relative biomass, possibly indicating an unhealthy condition. Therefore, applying a precautionary approach, these species (i.e., FMU sub-units) would be candidates for being determined to be potentially "at risk" of overfishing or potentially being overfished by the SFA Working Group, as illustrated in Table 8. Again, it should be pointed out that this is not an official determination that an overfished or overfishing condition exists per the MSFCMA, but simply an assumption on the current fishing mortality and relative biomass rates. A high fishing mortality rate and low relative biomass could lead to an overfished or overfishing condition if other factors (e.g., low natural mortality rate indicating a species is slow to recover to B_{MSY}) existed; this is discussed further in Sections 4.2.4 and 4.2.5. Conversely, if a species was felt to have a low fishing mortality rate and a high relative biomass,

the SFA Working Group would determine that it was healthy and not to be "at risk" of overfishing or potentially being overfished. If there was insufficient information to make an informed judgement on the fishing mortality rate and/or relative biomass of a species or sub-unit, the default status of "unknown" was selected. Formal stock assessments do exist for queen conch, Nassau grouper, and goliath grouper, and they concluded that each of these species was overfished. Therefore, this official "overfished" status was utilized throughout the SFA Amendment for these three species. The discussion resulting in these determinations took place at the October 23-24, 2002 meeting of the SFA Working Group in Carolina, Puerto Rico. Notice of the meeting location, date, and agenda was provided in the *Federal Register* (67 FR 63622).

The resulting determinations made for each FMU sub-unit, following the methodology outlined above, are presented in Table 8 under the "Status" column. The exact values for the fishing mortality rate and relative biomass (i.e., F and B ratios) are offered in the following alternatives and are detailed in Table 9.

4.2.2.1 Alternative 1. No action. Do not define F and B ratios for managed stocks.

This alternative is preferred for all species in the Coral Reef FMP, excluding those species retained for data collection purposes.

This alternative leaves B and F ratios undefined.

4.2.2.2 Alternative 2. For each FMU sub-unit for which B_{CURR}/B_{MSY} and F_{CURR}/F_{MSY} have not been estimated through a stock assessment or other scientific exercise (i.e., stock status unknown), the following estimates will be used for the B_{CURR}/B_{MSY} and F_{CURR}/F_{MSY} proxies: 1) For species that are not believed to be "at risk" based on the best available information, the F_{CURR}/F_{MSY} proxy is estimated as 0.75 and the B_{CURR}/B_{MSY} proxy is estimated as 1.25; 2) For species for which no positive or negative determination can be made on the status of their condition, the default proxies for F_{CURR}/F_{MSY} and B_{CURR}/B_{MSY} are estimated as 1.00; and 3) For species that are believed to be "at risk" based on the best available information, the F_{CURR}/F_{MSY} proxy is estimated as 1.50 and the B_{CURR}/B_{MSY} proxy is estimated as 0.75.**

This alternative is preferred for Caribbean queen conch, spiny lobster, and all reef fish, excluding those species retained for data collection purposes.

Because proper (formal) stock assessments are not available for most FMU sub-units, this alternative requires making an informed qualitative judgement about their condition. Restrepo *et al.* (1998) notes that "in cases of severe data limitations, qualitative approaches [to determining stock status and fishery status] may be necessary, including [the use of] expert opinion and consensus-building methods." This alternative defines B_{CURR}/B_{MSY} and F_{CURR}/F_{MSY} based on anecdotal information, observations (e.g., large decreases in catch rates, decrease in average

individual size, more fishing effort needed to maintain historical landings), and other informed judgements on the condition of specific stocks and complexes. The F and B ratios that would result from this alternative are based on the perceived condition of stocks as determined by the SFA Workgroup, and are detailed in Table 9. Information on the SFA Workgroup is provided in Sections 11.3.

4.2.2.3 Alternative 3. For each FMU sub-unit for which B_{CURR}/B_{MSY} and F_{CURR}/F_{MSY} have not been estimated through a stock assessment or other scientific exercise (i.e., stock status unknown), the following estimates will be used for the B_{CURR}/B_{MSY} and F_{CURR}/F_{MSY} proxies: 1) For species that are not believed to be "at risk" based on the best available information, the F_{CURR}/F_{MSY} proxy is estimated as 0.75 and the B_{CURR}/B_{MSY} proxy is estimated as 1.25; 2) For species for which no positive or negative determination can be made on the status of their condition, the default proxies for F_{CURR}/F_{MSY} and B_{CURR}/B_{MSY} are estimated as 1.00; and 3) For species that are believed to be "at risk" based on the best available information, the F_{CURR}/F_{MSY} proxy is estimated as 1.50 and the B_{CURR}/B_{MSY} proxy is estimated as 0.50.

This alternative is similar to the Preferred Alternative 2, and also requires making an informed qualitative judgement about the condition of each species or FMU sub-unit. However, it would set the B ratio at 0.50, rather than 0.75, for species that are believed to be "at risk" based on the best available information. The F and B ratios that would result from this alternative, given the perceived condition of species as determined by the SFA workgroup, are presented in Table 9.

4.2.2.4 Alternative 4. For each FMU sub-unit for which B_{CURR}/B_{MSY} and F_{CURR}/F_{MSY} have not been estimated through a stock assessment or other scientific exercise (i.e., stock status unknown), the following estimates will be used for the F_{CURR}/F_{MSY} and B_{CURR}/B_{MSY} proxies: 1) The default proxies for F_{CURR}/F_{MSY} and B_{CURR}/B_{MSY} are estimated as 1.00; 2) For species that are believed to be "at risk" based on the best available information, the F_{CURR}/F_{MSY} proxy is estimated as 1.33 and the B_{CURR}/B_{MSY} proxy = c, whereas c is equal to the natural mortality rate (M) or 0.50, whichever is smaller; and 3) For species that overfished, the F_{CURR}/F_{MSY} proxy is estimated as 2.0 and the B_{CURR}/B_{MSY} proxy = 0.67c, whereas c is equal to the natural mortality rate (M) or 0.50, whichever is smaller.

This alternative is similar to Alternatives 2 and 3 in that it requires making an informed qualitative judgement about the condition of each FMU sub-unit. It differs from Alternatives 2 and 3 in that it would define more conservative (e.g., less optimistic) B and F ratios for those stocks that are determined to be healthy. Additionally, this alternative attempts to adjust the B and F ratios of stocks believed to be "at risk" using a formula that takes into account the natural mortality rate (M) of the individual species. Table 8 lists the M defined for each species utilizing the best available scientific information (i.e., most recent published literature or FishBase). In

the case of a sub-unit with multiple M values (e.g., Snapper Unit 3), the lowest documented M value would be used in this formula to reduce the risk that the most vulnerable species in a particular sub-unit would be overexploited. The F and B ratios that would result from this alternative, given the perceived condition of stocks as determined by the SFA workgroup, are presented in Table 9.

4.2.2.5 Comparison of the environmental effects of alternative F and B ratio definitions

Defining F and B ratios does not directly affect the biological, ecological, social, or economic environment in a positive or negative way because these parameters simply provide fishery managers with numerical values that could be used to calculate MSY. However, using F and B ratios in MSY calculations would result in indirect environmental biological, ecological, social, and economic effects because the numerical value used would influence the definition of MSY, and thus the development of fishery management measures, which directly affect Caribbean fisheries.

Because the status of the majority of the reef fish management sub-units is "unknown" (i.e., as determined by the SFA Working Group), there is no difference between Alternatives 2-4 in regard to those species. For species considered to be "at risk" (i.e., as determined by the SFA Working Group), Alternative 3 assumes the species' biomass is more depressed when compared to Alternative 2, and would generate a higher MSY value. In some instances, Alternative 4 would increase MSY past both Alternatives 2 and 3 (e.g., triggerfish unit), while in some situations it would be less than Alternative 3, but more than Alternative 4 (e.g., Snapper Unit 1). For species considered to be "at risk," Alternative 4 would support the lowest fishing mortality rate relative to Alternatives 2 and 3 when stock biomass was below B_{MSY}. This could result in more severe short-term social and economic effects in the short term if management measures are required to end overfishing and/or rebuild overfished stocks, as necessary.

A decision to define (Alternatives 2-4) or not define (Alternative 1) F and B ratios could directly affect the administrative environment if such ratios are needed to calculate MSY and/or other management reference points. Alternative 1 (no action) would result in significant administrative impacts as the MSY Preferred Alternative 2 requires an F and B ratio to generate the MSY proxy.

Therefore, the Council selected Alternative 2 as the preferred alternative for those FMUs and FMPs indicated as it represented an effective approach to address species considered to be "at risk" without potentially introducing more significant socioeconomic impacts (as compared to Alternative 4).

Because the status quo for coral species is the complete prohibition of harvest (i.e., F equal to zero), and because it would be problematic to estimate a biomass ratio due to the biological diversity of the numerous managed coral species and due to the influence of other environmental factors that influence coral biomass, the Council selected Alternative 1 as the preferred

alternative for species in the Coral FMP, excluding those species retained for data collection purposes.

4.2.3 Optimum yield (OY)

As noted in Section 4.2, OY is defined as the amount of fish that "will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems; is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery" (16 U.S.C. §1802(28)).

4.2.3.1 Alternative 1. No action. Retain current definitions of OY (if any).

The definitions of OY that are currently in place for species under the Council's jurisdiction are presented in Table 9.

4.2.3.2 Alternative 2. Set OY = 0.75(MSY).

This alternative sets OY equal to a proportion (75%) of the MSY defined for a stock or stock complex. The specific OY values that would result from this alternative if the preferred MSY alternatives were to be adopted are presented in Table 9.

4.2.3.3 Alternative 3. Set OY = 0.

This alternative is preferred for all species in the Caribbean coral reef resource FMU, excluding those species retained for data collection purposes.

This alternative sets OY equal to zero, indicating that maximum benefit to the Nation would be derived from prohibiting the take of the affected species or species complex.

4.2.3.4 Alternative 4. Set OY equal to the average yield associated with fishing on a continuing basis at F_{OY}; where $F_{OY} = 0.75F_{MSY}$.

This alternative is preferred for Caribbean queen conch, spiny lobster, and all reef fish, excluding those species retained for data collection purposes.

This alternative is derived from the technical guidance provided by Restrepo *et al.* (1998), which recommends that the target fishing mortality rate (F_{OY}) be set equal to the average yield available on a continuing basis from fishing at 75% of F_{MSY}. Studies using Mace's deterministic model (Mace 1994) indicate that, when a stock is at equilibrium, fishing at this level would result in yields equal to or greater than about 94% of MSY. The approximate OY values that would result

from this alternative if the preferred MSY alternatives were to be adopted are presented in Table 9.

4.2.3.5 Comparison of the environmental effects of alternative OY definitions

Defining OY would not directly affect the biological, ecological, social, or economic environment in a positive or negative way because this parameter simply provides fishery managers with a defined target to use in assessing fishery status and performance. However, defining this target reference point will indirectly affect the biological, ecological, social, and economic environment by influencing the development of fishery management measures, which directly affect Caribbean fisheries.

A decision to redefine (Alternatives 2-4) or not define (Alternative 1) OY directly affects the administrative environment. The selection of Alternative 3 results in an OY of zero, thereby requiring additional alternatives that restrict catch to zero for those species. In regard to corals, as this is a preferred alternative for those species, this OY alternative is consistent with currently existing harvest prohibitions and results in no net environmental effect. Alternatives 2 and 4 differ in the amount of conservatism in the OY values; Alternative 4 sets a goal fairly close to MSY levels, whereas OY alternative 2 sets a more conservative goal for the fishery.

Therefore, the Council selected Alternative 4 as the preferred alternative for those FMUs and FMPs indicated as it would be more conservative and risk aversive than fishing at MSY, it would be consistent with the Technical Guidelines, and would not result in potentially overly-restrictive catch limits as a result of the subsequent selection of a control rule alternative. Furthermore, the Council selected Alternative 3 as the preferred alternative for coral species to reflect the importance of those species as EFH.

4.2.4 Minimum stock size threshold (MSST)

As noted in Section 4.2, the MSST defines the level below which a species would be considered overfished (i.e., B_{CURR} < MSST = overfished). 50 CFR §600.310(d)(2)(ii) specifies that "to the extent possible, the stock size threshold should equal whichever of the following is greater: One-half the MSY stock size, or the minimum stock size at which rebuilding to the MSY level would be expected to occur within ten years if the stock or stock complex were exploited at the maximum fishing mortality threshold...."

4.2.4.1 Alternative 1. No action. Do not define MSST for managed species.

This alternative is preferred for all species in the Coral Reef FMP, excluding those species retained for data collection purposes.

This alternative leaves MSST undefined.

NMFS is considering revisions to the National Standard 1 Guidelines, in particular to §600.310(d)(2). The proposed revisions would provide additional flexibility regarding the requirement for MSSTs for data-poor stocks. Depending on the publication of a Final Rule for such revisions, the Council may choose, in the future to re-evaluate its designations of MSST for some or all Caribbean stocks if it is determined that the available data are inadequate or insufficient for providing a defensible and meaningful estimate.

4.2.4.2 Alternative 2. Set MSST = B_{MSY}(1-c); where c = the natural mortality rate (M) or 0.50, whichever is smaller.

This alternative is preferred for the Caribbean queen conch, spiny lobster, and all coral and reef fish species, excluding those species retained for data collection purposes.

This alternative is based on the default proxy recommended by Restrepo *et al.* (1998). It defines MSST as a function of the equilibrium biomass expected when fishing constantly at F_{MSY}. The M of a species provides an indication about its productivity, such that a species with a low M generally is not as productive, or capable of recovering to B_{MSY} as quickly, as a species with a high M. By setting c equal to 0.5 or M, whichever is smaller, this formula ties MSST to the productivity of a stock, such that MSST would be set further below B_{MSY} for those stocks that are highly productive and capable of recovering to B_{MSY} more quickly. But it would prevent MSST from being set at less than one-half the MSY level even for highly productive stocks to reduce the risk that stock biomass could decrease without warning to a level from which it would be difficult to rebuild the stock to B_{MSY} within ten years.

Table 8 lists the M defined for each species utilizing the best available scientific information (i.e., most recent published literature or FishBase). In the case of a sub-unit with multiple M values (e.g., Snapper Unit 3), the lowest documented M value would be used in this formula to reduce the risk the most vulnerable species in a particular sub-unit would be overexploited. The specific MSST values that would be defined by this alternative in accordance with the preferred MSY alternatives are presented for each stock or complex in Table 10 .

4.2.4.3 Alternative 3. Set MSST = B_{MSY}(0.50).

This alternative sets MSST equal to one-half B_{MSY} regardless of the productivity of the stock. The specific MSST values defined by this alternative in accordance with the preferred MSY alternatives are presented for each stock or complex in Table 10 .

4.2.4.4 Alternative 4. Set MSST = B_{MSY}.

If all other factors remained constant, this alternative builds additional conservatism into the definition of MSST by eliminating the buffer between MSST and B_{MSY} so that a stock would never be permitted to fall below B_{MSY} without triggering an "overfished" determination and the need to develop a rebuilding plan within one year of that determination. The specific MSST

values defined by this alternative in accordance with the preferred MSY alternatives are presented for each stock or complex in Table 10 .

4.2.4.5 Comparison of the environmental effects of alternative MSST definitions

Defining MSST does not directly affect the biological, ecological, social, or economic environment in a positive or negative way because this parameter simply provides fishery managers with a defined threshold to use in assessing the status of the stocks. However, defining this biomass threshold will indirectly affect the biological, ecological, social, and economic environment because the MSST adopted by the Council will prescribe the amount of each sub-unit that should be left in the water and this, in turn, will assist fishery managers in determining the amount of each sub-unit that can be harvested. In general, Alternative 2 establishes an MSST that is more conservative than Alternative 3, but less conservative than Alternative 4, which sets MSST equal to B_{MSY} and represents the most conservative alternative available to the Council. A decision to define (Alternatives 2-4) or not define (Alternative 1) MSST directlys affect the administrative environment. Alternative 2 appears to provide a compromise relative to the other alternatives in that it sets realistic goals for stock rebuilding without frequently (or unnecessarily) burdening the administrative environment. The MSST definition provided by Alternative 3 could make it more difficult to rebuild a stock from MSST to B_{MSY} within ten years while fishing at MFMT, particularly if the stock was not very productive. MSST Alternative 4 provides the greatest assurance of all the MSST alternatives that an overfished stock could be rebuilt to B_{MSY} within ten years, however, it could excessively burden the administrative environment by frequently triggering overfishing definitions and unnecessarily restricting fishing effort.

Therefore, the Council selected Alternative 2 as the preferred alternative for those FMUs and FMPs indicated as it represents a moderate management approach

4.2.5 Maximum fishing mortality threshold (MFMT), and limit and target control rules.

As discussed in Section 4.2, the MFMT represents the maximum fishing mortality rate that an FMU sub-unit can withstand while still producing MSY on a continuing basis. A fishery operating at a level that exceeds the MFMT is considered to be experiencing overfishing. The MFMT is defined by a MSY (limit) control rule – a predefined catch strategy that is designed to achieve MSY on a continuing basis. The catch levels calculated from the control rule represent the allowable biological catch (ABC) that is consistent with achieving MSY. The MFMT calculated from the control rule represents the fishing mortality rate (proportion of the existing population caught by the fishery) that would achieve the ABC.

The OY (target) control rule is used to calculate the level of catch that would be consistent with achieving OY on a continuing basis. Because OY cannot exceed MSY, the target control rule should not allow a level of catch exceeding the MFMT.

Alternative target control rules were combined with alternative MFMT/MSY control rules in this section to avoid the potential to select incompatible MFMT/MSY control rules and target control rules.

4.2.5.1 Alternative 1. No action. Do not define MFMT or control rules for FMU sub-units.

This alternative leaves MFMT and the control rules undefined. The MFMT and ABCs associated with this alternative are specified for each sub-unit in Tables 10 and 11 .

4.2.5.2 Alternative 2.

A) Specify an MSY control rule to define MFMT and ABC as follows: 1) If $B_{CURR}/B_{MSY} < B_{MIN}$, then ABC = 0; 2) If B_{CURR}/B_{MSY} 1, then ABC = MSY; and 3) If B_{CURR}/B_{MSY} is between B_{MIN} and 1, then ABC = $(MSY/(1-B_{MIN}))((B_{CURR}/B_{MSY})-B_{MIN})$; where $B_{MIN} = 0.25$; and

B) Specify an OY control rule to define target catch levels such that : 1) If $B_{CURR}/B_{MSY} < B_{MIN}$, then target catch levels = 0; 2) If B_{CURR}/B_{MSY} 1, then target catch levels = OY; and 3) If B_{CURR}/B_{MSY} is between B_{MIN} and 1, then target catch levels = $(OY/(1-B_{MIN}))(B_{CURR}/B_{MSY}-B_{MIN})$; where $B_{MIN} = 0.25$.

This alternative is based on a constant catch strategy. When stock biomass is at or above B_{MSY}, the limit control rule described by this alternative defines the level of catch that would trigger an overfishing determination to be equal to MSY. This rule does not allow the limit catch level to increase in response to an increase in stock biomass above the MSY level. If stock biomass decreased below B_{MSY}, this rule decreases the limit catch level proportionately. In other words, the further stock biomass declined below B_{MSY}, the further the limit catch level would be reduced from MSY. If stock biomass decreased below the identified threshold level defined as B_{MIN}, this rule requires that catches be reduced to zero. The B_{MIN} component of the rule is defined to equal 25% of the unfished abundance level, or about 10-15% of B_{MSY}.

The target control rule described by this alternative prescribes a harvest level equal to OY when stock biomass was at B_{MSY} or higher, and would reduce target catch levels proportionately when stock biomass decreased below B_{MSY}. This rule prohibits fishing entirely if stock biomass declined below 10-15% of B_{MSY}.

Table 10 details the specific ABC and target catch levels defined by this alternative, based on the stock status determinations of the SFA workgroup. Table 11 describes the reductions in catch that would be prescribed by each rule relative to average catches from 1997-2001. The MSY and OY rules described by this alternative are illustrated in Figure 2.

4.2.5.3 Alternative 3.

A) Specify an MSY control rule to define MFMT and ABC as 0; and

B) Specify an OY control rule to define target catch levels as 0.

This alternative is preferred for all species in the Coral FMP, excluding those species retained for data collection purposes.

This alternative defines overfishing as any fishing mortality rate above zero, and therefore, prohibits any catch.

4.2.5.4 Alternative 4.

A) Specify an MSY control rule to define MFMT and ABC as follows: 1) If $B_{CURR}/B_{MSY} < B_{MIN}$, then ABC = 0; 2) If B_{CURR}/B_{MSY} 1, then ABC = $F_{MSY}(B)$; and 3) If B_{CURR}/B_{MSY} is between B_{MIN} and 1, then ABC = $(F_{MSY}(B)/(1-B_{MIN}))((B_{CURR}/B_{MSY})-B_{MIN})$; where B_{MIN} = 0.25. If F_{MSY} cannot be estimated directly, use M as a proxy; and

B) Specify an OY control rule to define target catch levels such that: 1) If B_{CURR}/B_{MSY} is less than B_{MIN}, then target catch levels = 0; 2) If B_{CURR}/B_{MSY} is equal to or greater than 1, then target catch levels = $F_{OY}(B)$; and 3) If B_{CURR}/B_{MSY} is between B_{MIN} and 1, then target catch levels = $(F_{OY}(B)/(1-B_{MIN}))((B_{CURR}/B_{MSY})-B_{MIN})$; where B_{MIN} = 0.25. If F_{OY} cannot be estimated directly, use 0.5(M) as a proxy.

This alternative is similar to Alternative 2, but is based on a constant fishing mortality rate (F) strategy rather than on a constant catch strategy. When stock biomass is at or above B_{MSY}, the limit control rule described by this alternative defines the level of catch that would trigger an overfishing determination to be equal to the yield associated with fishing at F_{MSY}. As a result, this alternative allows the limit catch level to increase in response to an increase in stock biomass above the MSY level. If stock biomass decreased below B_{MSY}, this rule decreases the limit catch level proportionately. In other words, the further stock biomass declined below B_{MSY}, the further the limit catch level is reduced from MSY. If stock biomass decreased below the identified threshold level defined as B_{MIN}, this rule requires that catches be reduced to zero. The B_{MIN} component of the rule is defined to equal 25% of the unfished abundance level, or about 10-15% of B_{MSY}.

The target control rule described by this alternative prescribes a harvest level equal to the yield associated with fishing at F_{OY} when stock biomass was at B_{MSY} or higher, and reduces target catch levels proportionately when stock biomass decreased below B_{MSY}. This rule prohibits fishing entirely if stock biomass declined below 10-15% of B_{MSY}.

Table 10 details the specific ABC and target catch levels defined by this alternative, based on the stock status determinations of the SFA workgroup. Table 11 describes the reductions in catch that would be prescribed by each rule relative to average catches from 1997-2001. The MSY and OY rules described by this alternative are illustrated in Figure 3.

4.2.5.5 Alternative 5.

A) Specify an MSY control rule to define MFMT and ABC as follows: 1) If $B_{CURR}/B_{MSY} < MSST/B_{MSY}$, ABC = 0.33MSY; 2) If B_{CURR}/B_{MSY} 1, ABC = MSY; and 3) If B_{CURR}/B_{MSY} is between $MSST/B_{MSY}$ and 1, ABC = 0.67MSY; and

B) Specify an OY control rule to define target catch levels such that: 1) If $B_{CURR}/B_{MSY} < MSST/B_{MSY}$, target catch levels = 0.25MSY; 2) If B_{CURR}/B_{MSY} 1, target catch levels = 0.75MSY; and 3) If B_{CURR}/B_{MSY} is between $MSST/B_{MSY}$ and 1, target catch levels = 0.5MSY.

Alternative 5 defines the limit and target catch levels as MSY and 75% of MSY, respectively, when stock biomass is at or above B_{MSY}. If stock biomass decreased below B_{MSY}, but remained above the overfished threshold (i.e., MSST), this rule decreases the limit and target catch levels to 67% of MSY and to 50% of MSY, respectively. The limit and target catch levels are further reduced to 33% of MSY and to 25% of MSY, respectively, if stock biomass decreased below the overfished threshold.

Table 10 details the specific ABC and target catch levels defined by this alternative, based on the stock status determinations of the SFA workgroup. Table 11 describes the reductions in catch that would be prescribed by each rule relative to average catches from 1997-2001. The MSY and OY rules described by this alternative are illustrated in Figure 4.

4.2.5.6 Alternative 6.

A) Specify an MSY control rule to define ABC = $F_{MSY}(B)$. When the data needed to determine F_{MSY} are not available, use natural mortality (M) as a proxy for F_{MSY}; and

B) Specify an OY control rule to define target catch limits such that they equal $F_{OY}(B)$.

This alternative is preferred for Caribbean queen conch, spiny lobster, and reef fish, excluding those species retained for data collection purposes.

Alternative 6 defines the limit and target catch levels as the yield associated with fishing at F_{MSY} and F_{OY}, respectively, regardless of where stock biomass is in relation to B_{MSY} and to MSST.

This rule uses M and 0.75(F_{MSY}) as proxies for F_{MSY} and F_{OY}, respectively. The constant F strategy employed by this rule allows catches to increase in response to an increase in stock biomass, but requires that catches be reduced as stock biomass decreases. Table 10 details the specific ABC and target catch levels defined by this alternative, based on the stock status determinations of the SFA workgroup. Table 11 describes the reductions in catch that would be prescribed by each rule relative to average catches from 1997-2001. The MSY and OY rules described by this alternative are illustrated in Figure 5.

4.2.5.7 Alternative 7.

A) Specify an MSY control rule to define ABC = F_{MSY}(B). When the data needed to determine F_{MSY} are not available, use a proxy for F_{MSY} calculated as a fraction of the natural mortality rate (M) as follows: 1) Use 1.00(M) as a proxy for F_{MSY} for species that are not believed to be "at risk" based on the best available information; 2) Use 0.75(M) as a proxy for F_{MSY} for species for which no positive or negative determination can be made on the status of their condition; and 3) Use 0.50(M) as a proxy for F_{MSY} for species that are believed to be "at risk" based on the best available information; and

B) Specify an OY control rule to define target catch levels equal to F_{MSY}(B)(OY/MSY). When the data needed to determine F_{MSY} are not available, use a proxy for F_{MSY} calculated as a fraction of the natural mortality rate (M) as follows: 1) Use 0.75(M) as a proxy for F_{MSY} for species that are not believed to be "at risk" based on the best available information; 2) Use 0.50(M) as a proxy for F_{MSY} for species for which no positive or negative determination can be made on the status of their condition; and 3) Use 0.25(M) as a proxy for F_{MSY} for species that are believed to be "at risk" based on the best available information.

This alternative differs from Alternative 6 only in how it would define F_{MSY} and F_{OY} when those parameters have not been estimated. It states that for sub-units determined not to be "at risk," the MFMT should be set equal to M, such that ABC = M(B), and the target catch level should be set equal to 3/4 of M multiplied by B. For sub-units for which no determination can be made, MFMT should be set equal to 2/3 of M, resulting in an ABC = 2/3M(B), while the target catch level should be set equal to 1/2 of M multiplied by B. Finally for sub-units believed to be "at risk," MFMT should be set equal to 1/2 of M, resulting in an ABC = 1/2M(B), while the target catch level should be set equal to 1/4 of M multiplied by B. Table 10 details the specific ABC and target catch levels defined by this alternative, based on the stock status determinations of the SFA workgroup. Table 11 describes the reductions in catch that would be prescribed by each rule relative to average catches from 1997-2001. The MSY and OY rules described by this alternative are illustrated in Figure 6.

4.2.5.8 Comparison of the environmental effects of alternative MFMT definitions, and limit and target control rules

The selection of Alternative 3 would require a complete prohibition on catch for those species affected by the alternative (i.e., corals). This alternative is consistent with currently existing harvest prohibitions, and result in no net environmental effect for those species.

For species whose perceived status has been determined to be unknown by the SFA Working Group, the ABC for FMU sub-units under Alternatives 2 and 4-6 would be identical due to the default selection of 1.00 for the F and B ratios. For species to be considered "at risk," Alternative 6 is the most liberal alternative, and allows fishing to continue at a higher level than all the other alternatives. Alternative 7 is the most conservative alternative (aside from Alternative 3), and results in a lower allowable catch than the other proposed options.

The potential adverse short-term socioeconomic effects associated with these alternatives range from no direct impact (Alternative 1), moderate (Alternatives 2 and 6), to significant adverse impacts (Alternatives 4 - 7). Impacts from Alternative 7 would exceed those associated with any other control rule alternative, with the exception of Alternative 3, which would require that the fishery be closed. A more conservative allowable catch could result in long-term biological benefits to species that are experiencing overfishing or are overfished. Conversely, a more liberal allowable catch could negatively impact the status of those species undergoing overfishing or that are overfished, and, in turn, lead to negative socioeconomic impacts over the long term.

Therefore, the Council selected Alternative 6 as the preferred alternative for those FMUs and FMPs indicated in order to minimize socioeconomic impacts, while still establishing effective control rule scenarios. Furthermore, the Council selected Alternative 1 as the preferred alternative for aquarium trade species retained for data collection in the Reef Fish and Coral Reef FMPs, as there is no need for conservation measures or active management of those species. Likewise, the Council selected Alternative 3 as the preferred alternative for coral species to reflect the importance of those species as EFH.

4.3 Regulating Fishing Mortality

The preferred definitions of FMUs and sub-units, biological reference points, stock status determination criteria, and control rules outlined in Sections 4.1 and 4.2 requires catches of select species to be reduced as follows to end overfishing: Grouper Unit 4 catches should be reduced by 30%, parrotfish catches by 27%, and Snapper Unit 1 catches by 23% (Limit Control Rule; Table 11). The preferred control rule alternatives require that catches of all species be reduced by 7%, on average, to achieve long-term average catches approximating OY (Target Control Rule; Table 11).

This section evaluates alternative management measures the Council could adopt to achieve various levels of reductions in fishing mortality rates in federal waters of the U.S. Caribbean.

The following alternatives are designed to achieve immediate reductions in fishing mortality, and could ultimately be replaced by, or supplemented with, other management strategies adopted in the future.

It is important to note that the reductions required by the alternative control rules evaluated in Section 4.2.5 (Table 11) reflect the amount that catches should be decreased in the entire U.S. Caribbean (e.g., in state and federal fisheries combined) to end overfishing and achieve OY as defined in this amendment. Consequently, assuming that catches are distributed evenly among fishable habitat, even a 100% reduction in fishing mortality rates in federal waters would not likely be sufficient to achieve the required reductions because only about 14% of the fishable habitat in the U.S. Caribbean occurs in federal waters (Figure 1). Recognizing this challenge, the Council is also considering administrative alternatives to promote the development of regulations in state waters compatible with the goals and objectives set forth in this amendment.

4.3.1 Alternative 1. No action. Do not adopt additional management measures.

This alternative maintains the status quo management regime, indicating that current regulations are adequate to achieve the goals and objectives adopted in Sections 4.1 and 4.2. Existing management measures regulating catches in the spiny lobster, queen conch, reef fish, and coral reef fisheries are summarized below, and are described more fully in Section 2.2.

The spiny lobster fishery is regulated by a minimum size limit, a prohibition on the retention of egg-bearing (berried) lobsters, a requirement to land lobsters whole, prohibitions on the type of gear that can be used to harvest lobster, and restrictions on the construction and use of traps.

The queen conch fishery is regulated by a minimum size limit, a requirement to land conch with meat and shell intact, a recreational bag limit, a commercial catch limit, an annual spawning season closure, and gear prohibitions.

The reef fish fishery is regulated by requirements for the construction and use of fish traps, prohibitions on some other types of gear to harvest reef fish, minimum size limits on the harvest of yellowtail snapper, a prohibition on the take or possession of Nassau and Goliath grouper, seahorses, and foureye, banded, and longsnout butterflyfishes, and seasonal and annual spawning closures.

The coral reef fishery is regulated by a prohibition on the take or possession of gorgonians, stony corals, and any species in the coral reef resource FMU if attached or existing upon live rock, a prohibition on the sale or possession of any prohibited coral unless fully documented as to point of origin, prohibitions on the type of gear that can be used to harvest coral reef resources, and a permit requirement. A year-round closure established through the Coral FMP prohibits all fishing in an area southwest of St. Thomas, USVI.

4.3.2 Alternative 2. Establish seasonal closures.

The following seasonal closure alternatives attempt to achieve any needed reductions in catches by prohibiting fishing for select species in federal waters during select months. Alternatives 2a - 2e are designed to eliminate directed fishing mortality on select snappers and groupers during their peak spawning periods, which are described in Section 5.2 and Table 12. Alternatives 2f - 2g are designed to eliminated directed fishing mortality on all Council-managed species for consecutively longer periods of time.

Generally, each alternative brackets the peak spawning periods of affected species (Table 12). Section 6.3.1.2 documents the actual impacts on affected FMU sub-unit landings based on Puerto Rico monthly landings, 1995 - 2002. The USVI does not differentiate species for snapper and grouper in their landings data, therefore, it is assumed for the purposes of the following alternatives that monthly landing patterns are similar between Puerto Rico and the USVI.

Alternative 2a (Preferred). Close the U.S. EEZ to the possession of all species except misty grouper in Grouper Unit 4 (i.e., red, black, tiger, yellowfin, and yellowedge grouper) from February 1 through April 30.

All species in Grouper Unit 4 spawn during at least a portion of the February - April closure proposed by this alternative. This captures the peak spawning period of the tiger and yellowfin groupers. Assuming that fishing pressure does not increase in the months preceding or following the closure, this alternative could reduce Grouper Unit 4 catches (excluding misty grouper) in federal waters by about 24% each year (Table 6.3.1.2a in Section 6.3.1.2.3). As misty grouper are caught in deep water (e.g., 300-400 m) beyond what is considered fishable habitat for the purposes of this document, the Council opted to exclude them from this seasonal closure. This alternative is intended to protect these species when they are spawning and likely vulnerable to fishing pressure.

Alternative 2b (Preferred). Close the U.S. EEZ off the west coast of Puerto Rico to the possession of red hind from December 1 through February 28.

For the purposes of this alternative, the delineation of the west coast of Puerto Rico would be those waters in the U.S. Caribbean EEZ west of 67° 10' W longitude. Peak spawning for red hind occurs from December - April (Table 12). Assuming that fishing pressure does not increase in the months preceding or following the closure, this alternative could reduce catches of red hind in federal waters by about 33% each year (Table 6.3.1.2b in Section 6.3.1.2.3). This alternative protects red hind spawning aggregations, which are vulnerable to fishing pressure.

Alternative 2c (Preferred). Close the U.S. EEZ to the possession of all species in Snapper Unit 1 (including the black, blackfin, vermilion, and silk snapper) from October 1 through December 31.

Species in Snapper Unit 1 have been documented to spawn throughout the year, and peak spawning appears to occur biannually for several species, such as silk, black, and blackfin snapper (Table 12). Assuming that fishing pressure does not increase in the months preceding or following the closure, this alternative could reduce Snapper Unit 1 catches in federal waters by about 23% each year (Table 6.3.1.2c in Section 6.3.1.2.3). This alternative protects these species when they are spawning and likely vulnerable to fishing pressure.

Alternative 2d. Close the U.S. EEZ to the possession of yellowtail snapper from April 1 through June 30.

The peak spawning period for yellowtail snapper occurs from March - July (Table 12). Assuming that fishing pressure does not increase in the months preceding or following the closure, this alternative would reduce catches of yellowtail snapper in federal waters by about 26% each year (Table 6.3.1.2d in Section 6.3.1.2.3). This alternative is intended to protect yellowtail snapper when they are spawning and likely vulnerable to fishing pressure.

Alternative 2e (Preferred). Close the U.S. EEZ to the possession of mutton snapper and lane snapper from April 1 through June 30.

The peak spawning period for mutton and lane snapper occurs from March - May and April - July, respectively (Table 12). Assuming that fishing pressure does not increase in the months preceding or following the closure, this alternative would reduce catches of mutton snapper and lane snapper in federal waters by about 29% each year (Table 6.3.1.2e in Section 6.3.1.2.3). This alternative protects these species when they are spawning and likely vulnerable to fishing pressure.

Alternative 2f. Close the U.S. EEZ to the possession of all Council-managed species each year from January 1 to March 31 (3-month closure).

Assuming that fishing pressure does not increase in the months preceding or following the closure, this alternative would reduce catches of all Council-managed species in federal waters by approximately 25%, and 28% specifically for reef fish species (Table 6.3.1.2f in Section 6.3.1.2.3). This period captures the peak spawning periods for many snapper, grouper, grunt, and parrotfish species, and for some goatfishes, porgies, squirrelfishes, jacks, surgeonfish, triggerfish, boxfish, and wrasses (Table 12).

Alternative 2g. Close the U.S. EEZ to the possession of all Council-managed species each year from January 1 to March 31 and from July 1 to September 30 (6-month closure).

Assuming that fishing pressure does not increase in the months preceding or following the closure, this alternative would reduce catches of all Council-managed species in federal waters by approximately 50%, and 52% specifically for reef fish species (Table 6.3.1.2f in Section 6.3.1.2.3). This seasonal closure alternative encompasses a portion of the spawning season of

most reef fish species and covers many species during their peak spawning period (Table 12), and to spread out the socioeconomic effects of the closure over two different time periods.

Alternative 2h. Close the U.S. EEZ to the possession of all Council-managed species all year round (total closure).

This alternative would reduce catches of all Council-managed species in federal waters by 100% each year. This alternative is designed to achieve the maximum amount of reduction in fishing effort possible in federal waters.

4.3.3 Alternative 3. Establish area closures.

Alternatives 3a and 3b attempt to achieve any needed reductions in fishing mortality by prohibiting fishing for all Council-managed species year round in select areas of the U.S. EEZ. Alternatives 3c and 3d could supplement an area closure (i.e., Alternative 3a or 3b) by prohibiting the catch of species other than Council-managed species, or allowing the transit of fishing vessels with properly stowed gear and harvested catch.

Each alternative is described with respect to its potential to reduce total annual fishing mortality on affected species in federal waters, based on the assumption that catches in the U.S. EEZ are distributed equally over fishable habitat in the U.S. EEZ (e.g., a closed area that encompasses 10% of fishable habitat in the U.S. EEZ is presumed to result in a 10% reduction in fishing mortality for all Council-managed stocks). In reality, this assumption is not likely to hold true, as the distribution of fishing effort is affected by multiple factors, including the availability of fish and the redistribution of effort. However, state trip ticket programs do not collect data that would allow us to more precisely describe the spatial distribution of fishing effort. Assuming total landings are divided equally throughout the U.S. EEZ allows us to evaluate the potential impact of the alternatives relative to one another and to the goals and objectives established by the preferred limit (ABC) and target control rules. Calculations defining the total percentage of fishable habitat (i.e., waters 100 fathoms or shallower) in the U.S. EEZ that would be protected by each area closure alternative recognize recent protections to fishable habitat provided by the designation of the Hind Bank MCD, located south of St. Thomas, USVI. Implemented in December 1999, the Hind Bank MCD encompasses an area about 13 nm^2, which includes approximately 11 nm^2 (approximately 3%) of fishable habitat in EEZ waters off the USVI.

Alternative 3a. Establish one or more closed areas off Puerto Rico and the USVI as identified in Figures 7 - 9, and 12 - 15.

Coordinates for the proposed areas are as follows:

Alternative 3a(1). West of Puerto Rico (PRW)
A) 18° 13.50N, 67° 27.00W
B) 18° 13.50N, 67° 23.00W

C) 18° 00.00N, 67° 23.00W
D) 18° 00.00N, 67° 27.00W

PRW (Figure 7) creates a closed area of approximately 51.46 nm^2, with 31.98 nm^2 consisting of waters 100 fathoms or shallower. This area encompasses an existing red hind seasonal spawning closure off the west coast of Puerto Rico. It covers about 28% of the fishable habitat in EEZ waters off Puerto Rico, and about 9% of the total fishable habitat in the EEZ.

Alternative 3a(2). Northeast of Puerto Rico (PRN)
A) 18° 33.50N, 65° 17.00W
B) 18° 33.50N, 65° 10.00W
C) 18° 30.00N, 65° 10.00W
D) 18° 30.00N, 65° 17.00W

PRN (Figures 8 and 9) creates a closed area of approximately 23.14 nm^2, with 20.36 nm^2 consisting of waters 100 fathoms or shallower. This area covers about 12% of the fishable habitat in EEZ waters off Puerto Rico, and about 3% of the total fishable habitat in the EEZ.

Alternative 3a(3). East of St. Croix on Lang Bank (CRX)
A) 17° 50.50N, 64° 28.50W
B) 17° 50.50N, 64° 25.00W
C) 17° 47.00N, 64° 25.00W
D) 17° 47.00N, 64° 28.50W

CRX (Figure 8) creates a closed area of approximately 11.63 nm^2, with 7.47 nm^2 consisting of waters 100 fathoms or shallower. This area encompasses most of the area protected by the existing red hind seasonal spawning closure on Lang Bank. It covers about 3% of the fishable habitat in EEZ waters off the USVI, and about 2% of the total fishable habitat in the EEZ.

Alternative 3a(4). South of St. John (JOS)
A) 18° 14.50N, 64° 47.50W
B) 18° 14.50N, 64° 44.00W
C) 18° 10.00N, 64° 44.00W
D) 18° 10.00N, 64° 47.50W

JOS (Figure 8) creates a closed area of approximately 14.94 nm^2, with 13.01 nm^2 consisting of waters 100 fathoms or shallower. This area covers about 5% of the fishable habitat in EEZ waters off the USVI, and about 4% of the total fishable habitat in the EEZ.

Alternative 3a(5). North of St. Thomas (THN)
A) 18° 14.50N, 64° 47.50W
B) 18° 14.50N, 64° 44.00W
C) 18° 10.00N, 64° 44.00W
D) 18° 10.00N, 64° 47.50W

THN (Figures 8 and 9) would create a closed area of approximately 66.12 nm^2, with 55.21 nm^2 consisting of waters 100 fathoms or shallower. This area covers about 23% of the fishable habitat in EEZ waters off the USVI, and about 16% of the total fishable habitat in the EEZ.

Alternative 3a(6). West of Puerto Rico (PRW2)
A) 18° 12.12N, 67° 27.30W
B) 18° 12.12N, 67° 25.00W
C) 18° 05.00N, 67° 25.00W
D) 18° 05.00N, 67° 27.30W

PRW2 (Figure 13) creates a closed area of approximately 15.64 nm^2, with 10.60 nm^2 consisting of waters 100 fathoms or shallower. This area encompasses a portion of the area protected by the existing red hind seasonal spawning closure off the west coast of Puerto Rico. It covers about 9% of the fishable habitat in EEZ waters off Puerto Rico, and about 3% of the total fishable habitat in the EEZ.

Preferred Alternative 3a(7). West of Puerto Rico (PRW3)
A) 18° 12.00N, 67° 27.00W
B) 18° 12.00N, 67° 23.00W
C) 18° 03.50N, 67° 23.00W
D) 18° 03.50N, 67° 27.00W

PRW3 (Figures 12 and 13) creates a closed area of approximately 32.93 nm^2, with 28.40 nm^2 consisting of waters 100 fathoms or shallower. This area encompasses an existing red hind seasonal spawning closure off the west coast of Puerto Rico. It covers about 24% of the fishable habitat in EEZ waters off Puerto Rico, and about 8% of the total fishable habitat in the EEZ.

Preferred Alternative 3a(8). North of St. Thomas and Culebra (CARIB)
A) 18° 33.50N, 65° 17.00W
B) 18° 33.50N, 65° 05.00W
C) 18° 30.00N, 65° 05.00W
D) 18° 30.00N, 65° 17.50W

CARIB (Figures 14 and 15) creates a closed area of approximately 39.74 nm^2, of which 38.24 nm^2 consists of waters 100 fathoms or shallower (~13.73 nm^2 in Puerto Rico and ~24.44 nm^2 in USVI). This area covers about 12% and 10% of the fishable habitat in EEZ waters off Puerto Rico and the USVI, respectively, and about 11% of the total fishable habitat in the EEZ.

Alternative 3b. Close the EEZ off Puerto Rico, and establish a closed area off the USVI (e.g., Alternative 3a(5), THN, or Alternative 3a(8), CARIB), as indicated in Figure 8 or 15.

This alternative closes all federal waters off Puerto Rico, and a smaller portion of federal waters off the USVI. The delineation for the closed area off Puerto Rico would be seaward of the state boundary, and westward of 65° 15'W longitude. This 116 nm^2 area encompasses 100% of the

fishable habitat in federal waters off Puerto Rico, and comprises about 33% of the fishable habitat in the U.S. EEZ. Additionally, this alternative closes one of two areas off the USVI: THN or CARIB. Both of these closed areas are described in Section 4.3.1.3.1. The total percentage of fishable habitat in the EEZ covered by this alternative is 49% if the THN alternative is selected, and 44% if the CARIB alternative is selected.

This alternative offers a different distribution of the social and economic burden associated with the implementation of closed areas. Puerto Rico has jurisdiction over marine waters extending nine nautical miles from shore while the USVI has jurisdiction over marine waters extending just three nautical miles from shore. Consequently, a greater percentage of the fishable habitat off the USVI is located in the U.S. EEZ, relative to the percentage of fishable habitat in the EEZ off Puerto Rico. Therefore, closing 40% of the fishable habitat in federal waters off the USVI would be more burdensome to fishermen in the USVI than closing 40% of the federal waters off Puerto Rico would be to fishermen in Puerto Rico.

Alternative 3c. Within any closed area alternative, prohibit all fishing for and possession of all species with the exception of HMS species.

This alternative supplements any preferred area closure (i.e., Alternatives 3a(7) and 3a(8)), and allow the harvest of HMS species such as tunas and sharks, but prohibit all other fishing activities. As with Alternatives 3a and 3b, there would be no transit provision for fishing vessels with this alternative.

Alternative 3d. Within any closed area alternative, prohibit all fishing for and possession of all species, but allow the transit of fishing vessels with properly stowed gear and catch.

This alternative supplements any preferred area closure (i.e., Alternatives 3a(7) and 3a(8)), but allow the transit of fishing vessels that have their gear and catch stowed.

4.3.4 Alternative 4. Eliminate the use of fish traps in the U.S. EEZ.

Alternative 4a. Implement an immediate prohibition on the use of fish traps in the U.S. EEZ.

Alternative 4b. Develop a program within two years of the implementation of this amendment that would phase out the use of fish traps in the U.S. EEZ over a period of (i) five years or (ii) ten years.

The alternatives attempt to achieve any needed reductions in fishing mortality by prohibiting the use of fish traps in federal waters of the U.S. Caribbean within various time limits. Theoretically, this results in an approximate reduction in fishing mortality of between 22-67%. This range is based on the fact that trap-based fisheries in Puerto Rico accounted for 22% of the overall catch in 2001 (Scharer *et al.* 2002), while 67% of USVI reef fish were landed by fish

traps based on the proportion of reported/expanded landings by species category and gear type from 1994-2002 (Valle-Esquivel and Díaz 2003). In reality, the reductions achieved from such an action would be less because a large proportion of the fish trap harvest occurs within state waters, and because any reduction in fishing mortality due to a trap prohibition in federal waters is likely to be negated to some extent due to a transfer of effort by displaced fish trappers to another gear type. These issues are discussed in more detail in Section 6.3.1.4.

Sub-alternative 4a establishes a prohibition that would become effective with the implementation of this amendment. Sub-alternative 4b implements a program to phase out the use of fish traps over a five (4b(i)) or ten (4b(ii)) year period. If sub-alternative 4b(i) or 4b(ii) were adopted, the first step in that program would be the implementation of the federal permit program described in Section 4.6.1.

4.3.5 Alternative 5. Eliminate the use of gill and trammel nets in the U.S. EEZ.

Alternative 5a. Implement an immediate prohibition on the use of gill and trammel nets in the U.S. EEZ.

Alternative 5b. Develop a program within two years of the implementation of this amendment that would phase out the use of gill and trammel nets in the U.S. EEZ over a period of (i) five years or (ii) ten years.

Alternative 5c (Preferred). Implement an immediate prohibition on the use of gill and trammel nets in the U.S. EEZ, with the exception of those nets used for catching ballyhoo, gar, and flying fish. Nets used for the harvest of these species must be tended at all times.

The alternative attempts to achieve any needed reductions in catches by prohibiting or greatly restricting the use of gill and trammel nets in federal waters of the U.S. Caribbean. Theoretically, this results in a reduction in fishing mortality for managed reef fish species of approximately 6-20%, based on the proportion of reported/expanded landings by species category and gear type in the USVI from 1994-2002 (6%; Valle-Esquivel and Díaz 2003), and from the proportion of total reported Puerto Rican landings (potentially including many non-managed species) by nets from 1998-2001 (20%; Matos-Caraballo 2002). However, it must be pointed out that the net category for the Puerto Rico estimate includes not only gill and trammel nets, but beach seines and cast nets. Therefore, it is likely that the actual percentage would be somewhat lower than 20%, but it is not possible to determine that actual reduction with any precision.

In reality, the reductions achieved from such an action are likely to be less because a large proportion of the net harvest occurs within state waters, and because any reduction in fishing mortality due to a net prohibition in federal waters is likely to be negated to some extent due to a transfer of effort by displaced netters to another gear type. These issues are discussed in more detail in Section 6.3.1.5. Sub-alternative 5a would establish a prohibition effective with the implementation of this amendment. Sub-alternative 5b implements a program to phase out the use of gill and trammel nets over a five (5b(i)) or ten (5b(ii)) year period. If sub-alternative 5b(i)

or 5b(ii) were adopted, the first step in that program would be the implementation of the federal permit program described in Section 4.6.1.

Alternative 5c allows the continued, but limited, use of gill nets to harvest non-managed species (e.g., flying fish) occurring in federal waters.

4.3.6 Alternative 6. Develop a memorandum of understanding (MOU) between NMFS and the state governments to develop compatible regulations to achieve the management objectives set forth in all Council FMPs in state and federal waters of the U.S. Caribbean

Because 86% of the fishable habitat in the U.S. Caribbean occurs in state waters (Figure 1), it is believed that most of the total catch in the U.S. Caribbean is taken in state waters. Therefore, any reductions in fishing mortality required by the implementation of the biological reference points, stock status determination criteria, and control rules selected in Section 4.2 should be applied consistently throughout the U.S. Caribbean, regardless of jurisdictional boundaries. The Council is considering this administrative alternative to initiate increased State-Federal cooperation.

The MOU would contain a defined set of actions that the state governments agree to implement within a prescribed time period to reduce fishing mortality in state waters to levels that would be consistent with achieving the goals and objectives set forth in the four Council FMPs, as amended, taking into consideration any recent state management actions that may have been implemented and that would result in reductions of fishing mortality. The MOU could parallel the same preferred management actions as implemented in the EEZ through this amendment. For example, the States could opt to ban gill and trammel nets within their jurisdiction; prohibit the filleting of fish at sea; implement, as necessary, additional area or seasonal closures to reduce fishing mortality on those species identified as overfished or undergoing overfishing; modify state (i.e., Puerto Rico) landings reports to include standardized bycatch reporting; and modify state (i.e., USVI) regulations to prohibit the harvest and possession of Nassau grouper within their jurisdiction. Development of the MOU's actual content would require subsequent discussions with the respective State's resource management representatives, Council staff, and NMFS.

4.3.7 Comparison of the environmental effects of alternative short-term management measures

Depending on the actual sub-alternatives that are selected, Alternative 3 would most likely be more conservative than Alternative 2, as it would prohibit all fishing within a specific area, while Alternative 2 would permit fishing activities to largely continue unabated and bycatch-associated mortality may impact its effectiveness. However, Alternative 3 is likely to result in more significant economic impacts than the species- or FMU-specific closures in Alternative 2. Sub-alternatives 3c would be more restrictive than 3a or 3b, as it would prohibit fishing for species

other than those managed by the Council, which could provide additional ecological benefits to non-managed species and potentially facilitate enforcement. Sub-alternative 3d simply adds a transit provision to minimize the burden to fishermen. Overall, Alternative 4 would have a more significant effect in reducing fishing mortality than Alternative 5 since fish traps are a more predominant gear type in the U.S. Caribbean. It would also have a larger economic impact compared to other gear prohibitions (e.g., Alternative 5). Regardless, it is likely either of these gear prohibition alternatives would have a greater economic impact off the USVI than Puerto Rico due to the disparity in state boundaries (i.e., 3 nm versus 9 nm, respectively). Alternative 6, if successfully implemented, could have the greatest overall impact since the majority of fishing activity occurs in state waters.

The Council selected alternative 2, specifically 2a - 2c and 2e, and alternative 5c as the preferred alternatives to effectively reduce fishing mortality and minimize socio-economic impacts. Furthermore, the elimination of gill and trammel nets in alternative 5c will reduce bycatch to the extent that it occurs with this gear type in the EEZ.

4.4 Rebuilding Overfished Fisheries

The MSFCMA mandates that all FMPs shall, "…in the case of a fishery which the Council or the Secretary has determined is approaching an overfished condition or is overfished, contain conservation and management measures to prevent overfishing or end overfishing and rebuild the fishery" (MSFCMA §303(a)(10)).

Specifically, "Within one year of an identification…or notification…, the appropriate Council…shall prepare a fishery management plan, plan amendment, or proposed regulations for the fishery to which the identification or notice applies – (A) to end overfishing in the fishery and to rebuild affected stocks of fish; or (B) to prevent overfishing from occurring in the fishery whenever such fishery is identified as approaching an overfished condition" (MSFCMA §304(e)(3)).

The MSFCMA stipulates certain mandatory provisions when rebuilding an overfished fishery. The FMP or proposed regulations shall "(A) specify a time period for ending overfishing and rebuilding the fishery that shall -- (i) be as short as possible, taking into account the status and biology of any overfished stocks of fish, the needs of fishing communities, recommendations by international organizations in which the United States participates, and the interaction of the overfished stock of fish within the marine ecosystem; and (ii) not exceed 10 years, except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the United States participates dictates otherwise; (B) allocate both overfishing restrictions and recovery benefits fairly and equitably among sectors of the fishery" (MSFCMA §304(e)(4)).

Guidance at 50 CFR §600.310 specifies that the starting point in structuring a rebuilding program is the length of time in which a stock could be rebuilt in the absence of fishing mortality on that stock, described as T_{MIN}. If that period is less than ten years, the factors in §304(e)(4)(A)(i),

including the needs of fishing communities, may be used to adjust the rebuilding period up to ten years. If the stock cannot be rebuilt within ten years because of the factors listed in §304(e)(4)(A)(ii), the factors in §304(e)(4)(A)(i) may be used to justify a schedule longer than the no-mortality period. To ensure that the rebuilding period is not indefinite, the outside limit of the rebuilding period is the no-mortality period plus one mean generation time (or equivalent period based on the species' life-history characteristics).

This section describes alternative schedules and measures that the Council is evaluating to rebuild five stocks or stock complexes, including Goliath grouper, Grouper Unit 4 (misty grouper, red grouper, tiger grouper, yellowedge grouper, and yellowfin grouper), Nassau grouper, and queen conch. Goliath grouper, Nassau grouper, and queen conch are classified as overfished in the most recent report to Congress on the status of fisheries of the United States (NMFS 2003a). Grouper Unit 4 would also be considered to be overfished if the Council's preferred definitions of FMU sub-units (Section 4.1) and stock status determination criteria (4.2) were adopted and implemented through this amendment

4.4.1 Nassau grouper

The biology and status of Nassau grouper is described in Section 5.2.1.3.33.9.

4.4.1.1 Rebuilding schedule

Fishery scientists do not have the data needed to calculate how quickly Nassau grouper could rebuild to B_{MSY} in the absence of fishing. The Council has specified a T_{MIN} proxy of ten years based on the conclusion of the NOAA SEFSC that it is unlikely that the stock could recover within ten years if all catches of this species were prohibited (CFMC 2001a). Estimates of generation time for this species range from 15 to 70 years (Porch and Scott 2001).

The rebuilding schedule alternatives the Council considered for Nassau grouper are based on the formula the National Standard Guidelines provides for stocks that cannot be rebuilt within 10 years: T_{MIN} + one mean generation time. The Council considered but eliminated from more detailed study an alternative that would have established a ten-year rebuilding schedule for this species. That schedule appears unrealistic based on the above-mentioned conclusion of the NOAA SEFSC and on the finding that Nassau grouper is still overfished more than ten years after the Council prohibited fishing for and possessing that species in federal waters. This is discussed in Section 11.2. The range of rebuilding schedule alternatives the Council considered for Nassau grouper were derived from the range of generation times estimated for this species.

4.4.1.1.1 Alternative 1. No action. Do not define a schedule/time frame for rebuilding Nassau grouper.

Although the Council has prohibited fishing for or possessing Nassau grouper since Amendment 1 to the Reef Fish FMP was implemented in December 1990, no formal rebuilding schedule has

been established for this species. This alternative maintains the status quo, thus no rebuilding schedule would be defined for Nassau grouper.

4.4.1.1.2 Alternative 2 (Preferred). Rebuild Nassau grouper to B_{MSY} in 25 years, using the formula T_{MIN} (10 years) + one generation (15 years) = 25 years.

This alternative specifies a rebuilding schedule for Nassau grouper consistent with the longest rebuilding period advised by the National Standard Guidelines, and is based on the lowest value of the range of estimated generation times for this species.

4.4.1.1.3 Alternative 3. Rebuild Nassau grouper to B_{MSY} in 52.5 years, using the formula T_{MIN} (10 years) + one generation (42.5 years) = 52.5 years.

This alternative specifies a rebuilding schedule for Nassau grouper consistent with the longest rebuilding period advised by the National Standard Guidelines, and that is based on the middle value of the range of estimated generation times for this species.

4.4.1.1.4 Alternative 4. Rebuild Nassau grouper to B_{MSY} in 80 years, using the formula T_{MIN} (10 years) + one generation (70 years) = 80 years.

This alternative specifies a rebuilding schedule for Nassau grouper consistent with the longest rebuilding period advised by the National Standard Guidelines, and that is based on the highest value of the range of estimated generation times for this species.

4.4.1.1.5 Comparison of the environmental effects of alternative rebuilding schedules.

Defining a rebuilding schedule for Nassau grouper is an administrative action and, as such, would have no direct positive or negative impacts on the biological, ecological, social, or economic environment. However, determining the time period over which rebuilding efforts can be extended could have indirect environmental effects. Shorter schedules generally require that overfished stocks be provided a greater amount of (and more immediate) relief from fishing pressure. Conversely, longer schedules generally allow overfished stocks to be fished at higher rates of fishing mortality as they rebuild.

Alternative 1 adversely affects the administrative environment because the MSFCMA mandates the definition of rebuilding schedules for overfished stocks, and the lack of a rebuilding schedule would not provide fishery administrators with concrete, measurable objectives to use in assessing fishery and management performance. The indirect biological, ecological, social, and economic effects associated with this action also could be adverse if the current moratorium on harvest were rescinded in response. While permitting the harvest of Nassau grouper provides social and economic benefits in the short term, the net effect of such action are negative if the harvest of this species compromised rebuilding efforts. But the Council is unlikely to rescind the prohibition, which has been in effect for many years despite the specification of a formal rebuilding schedule.

Alternatives 2-4 directly benefit the administrative environment by helping fishery managers to fulfill legal administrative and conservation mandates. If the Council were to use the defined schedule to determine the amount of harvest of Nassau grouper that would be permitted, the indirect biological and ecological, and net social and economic, benefits associated with these alternatives would be expected to be greatest for Alternative 2, followed by Alternative 3, then Alternative 4. Extending rebuilding efforts over a longer time frame helps to mitigate the adverse social and economic effects of rebuilding. However, such an extension also increases the risk that environmental or other factors could prevent the stock from recovering. Therefore, the Council selected Alternative 2 as the preferred alternative.

4.4.1.2 Rebuilding strategy

4.4.1.2.1 Alternative 1. No action. Rely on current regulations to rebuild the stock to B_{MSY} within the required time frame.

Current regulations in federal waters that impact the recovery of this stock are described more fully in Section 2.2.3, and include:

- A control rule of ABC = 0 (prohibition on catch in place since 1990);
- Gear construction requirements (e.g., 2-inch minimum mesh size; 2 escape panels);
- Gear prohibitions (e.g., prohibition on use of powerheads, explosives, poisons, drugs and other chemicals); and
- Area closures (e.g., a year-round area closure of the Hind Bank MCD).

4.4.1.2.2 Alternative 2 (Preferred). Prohibit the filleting of fish in federal waters of the U.S. Caribbean. Require that fish captured or possessed in federal waters be landed with heads and fins intact.

Anecdotal information suggests that Nassau grouper is still being harvested in federal waters and filleted at sea, thereby complicating the enforcement of the prohibition on catch and possession of these species. This action would prevent fishermen from landing Nassau grouper, as well as other species, in an unidentifiable form.

4.4.1.2.3 Alternative 3. Establish a seasonal or area closure to protect spawning stock.

This alternative would prohibit fishing in known Nassau grouper spawning sites either during a portion of the year or year-round. Fishery managers do not know of any unprotected sites in federal waters where Nassau grouper aggregate to spawn. The Council included this alternative in the amendment to solicit public input on this subject.

4.4.1.2.4 Alternative 4 (Preferred). Develop a memorandum of understanding (MOU) between NMFS and the USVI government to develop compatible regulations to achieve the objectives for Nassau grouper set forth in the Caribbean

Fishery Management Council's Reef Fish FMP in USVI and federal waters of the U.S. Caribbean.

The USVI does not currently regulate the take of Nassau grouper. Since much of the habitat that supports this species is located in state waters, its recovery likely depends on the implementation of more protective regulations in state waters. For this reason, the Council is considering this administrative alternative in addition to the regulatory alternatives described above.

The MOU would define one or more actions, such as working to prohibit the catch and possession of Nassau grouper in USVI waters, that the USVI government would agree to implement within a prescribed time period to assist federal fishery managers in achieving the rebuilding goal and schedule adopted for Nassau grouper in this amendment. At the 117th Council meeting, representatives from the USVI stated that they would pursue the prohibition of Nassau grouper harvest and possession in state waters.

4.4.1.2.5 Comparison of the environmental effects of alternative rebuilding measures

Alternative 1 offers no additional protections to Nassau grouper beyond current regulations, which are not believed to have improved the status of the stock. This failure to rebuild the stock despite a 14-year prohibition on harvest is attributed primarily to the lack of compatible regulations in state waters. Puerto Rico recently implemented regulations that would prohibit the harvest and possession of this species in state waters.

Alternatives 2 and 3 could directly benefit Nassau grouper, the surrounding ecosystem, and fishing communities if they served to further reduce overall mortality of the stock and if this reduction in mortality assisted in rebuilding stock biomass to a sustainable level. The prohibition on filleting fish at sea proposed in Alternative 2 is expected to reduce directed fishing mortality by curbing illegal fishing activities. The seasonal or annual spawning area closure proposed in Alternative 3 could reduce bycatch mortality of Nassau grouper if one or more spawning areas could be reliably defined.

Alternative 4 directly benefits the administrative environment. Although developing the MOU would present an administrative burden, the net administrative effects of coordinating state and federal management are expected to be positive. The MOU would be expected to provide indirect biological, ecological, social, and economic benefits by facilitating the implementation of a harvest prohibition in USVI waters, as well as other conservative measures, such as prohibiting the filleting of fish at sea throughout state and federal waters in the U.S. Caribbean. Therefore, the Council selected Alternatives 2 and 4 as preferred alternatives, in order to rebuild the species.

4.4.2 Goliath grouper

The biology and status of Goliath grouper is described in Section 5.2.1.3.33.6.

4.4.2.1 Rebuilding schedule

Fishery scientists do not have the data needed to calculate how quickly Goliath grouper could rebuild to B_{MSY} in the absence of fishing. The Council has specified a T_{MIN} proxy of ten years based on the conclusion of the NOAA SEFSC that it is unlikely that the stock could recover within ten years if all catches of this species were prohibited (CFMC 2001a). Estimates of generation time for this species range from 20 to 95 years (Porch and Scott 2001).

The rebuilding schedule alternatives the Council considered for Goliath grouper are based on the formula the National Standard Guidelines provides for stocks that cannot be rebuilt within 10 years: T_{MIN} + one mean generation time. The Council considered but eliminated from more detailed study an alternative that would have established a ten-year rebuilding schedule for this species. That schedule appears unrealistic based on the above-mentioned conclusion of the NOAA SEFSC and on the finding that Goliath grouper is still overfished ten years after the Council prohibited fishing for and possessing that species in federal waters. This is discussed in Section 11.2. The range of rebuilding schedule alternatives the Council considered for Goliath grouper were derived from the range of generation times estimated for this species.

4.4.2.1.1 Alternative 1. No action. Do not define a schedule/time frame for rebuilding Goliath grouper.

Although the Council has prohibited fishing for or possessing Goliath grouper since Amendment 2 to the Reef Fish FMP was implemented in November 1993, no formal rebuilding schedule has been established for this species. This alternative maintains the status quo, thus no rebuilding schedule would be defined for Goliath grouper.

4.4.2.1.2 Alternative 2 (Preferred). Rebuild Goliath grouper to B_{MSY} in 30 years, using the formula T_{MIN} (10 years) + one generation (20 years) = 30 years.

This alternative specifies a rebuilding schedule for Goliath grouper consistent with the longest rebuilding period advised by the National Standard Guidelines, and is based on the lowest value of the range of estimated generation times for this species.

4.4.2.1.3 Alternative 3. Rebuild Goliath grouper to B_{MSY} in 67.5 years, using the formula T_{MIN} (10 years) + one generation (57.5 years) = 67.5 years.

This alternative specifies a rebuilding schedule for Goliath grouper consistent with the longest rebuilding period advised by the National Standard Guidelines, and is based on the middle value of the range of estimated generation times for this species.

4.4.2.1.4 Alternative 4. Rebuild Goliath grouper to B_{MSY} in 105 years, using the formula T_{MIN} (10 years) + one generation (95 years) = 105 years.

This alternative specifies a rebuilding schedule for Goliath grouper consistent with the longest rebuilding period advised by the National Standard Guidelines, and is based on the highest value of the range of estimated generation times for this species.

4.4.2.1.5 Comparison of the environmental effects of alternative rebuilding schedules

Defining a rebuilding schedule for goliath grouper is an administrative action and, as such, would have no direct positive or negative impacts on the biological, ecological, social, or economic environment. However, determining the time period over which rebuilding efforts can be extended could have indirect environmental effects. Shorter schedules generally require that overfished stocks be provided a greater amount of (and more immediate) relief from fishing pressure. Conversely, longer schedules generally allow overfished stocks to be fished at higher rates of fishing mortality as they rebuild.

Alternative 1 adversely affects the administrative environment because the MSFCMA mandates the definition of rebuilding schedules for overfished stocks, and the lack of rebuilding schedules would not provide fishery administrators with concrete, measurable objectives to use in assessing fishery and management performance. The indirect biological, ecological, social, and economic effects associated with this action also could be adverse if the current moratorium on harvest were rescinded in response. While permitting the harvest of goliath grouper would provide social and economic benefits in the short term, the net effect of such action would be negative if the harvest of this species compromised rebuilding efforts. But the Council is unlikely to rescind the prohibition, which has been in effect for many years despite the specification of a formal rebuilding schedule.

Alternatives 2-4 would directly benefit the administrative environment by helping fishery managers to fulfill legal administrative and conservation mandates. If the Council were to use the defined schedule to determine the amount of harvest of goliath grouper that would be permitted, the indirect biological and ecological, and net social and economic, benefits associated with these alternatives would be expected to be greatest for Alternative 2, followed by Alternative 3, then Alternative 4. Extending rebuilding efforts over a longer time frame helps to mitigate the adverse social and economic effects of rebuilding. However, such an extension also increases the risk that environmental or other factors could prevent the stock from recovering. Therefore, the Council selected Alternative 2 as the preferred alternative.

4.4.2.2 Rebuilding strategy

4.4.2.2.1 Alternative 1. No action. Rely on current regulations to rebuild the stock to B_{MSY} within the required time frame.

Current regulations in federal waters that impact the recovery of this stock are described in full in Section 2.2.3, and include:

- A control rule of ABC = 0 (prohibition on catch in place since 1993);
- Gear construction requirements (e.g., 2-inch minimum mesh size; 2 escape panels);
- Gear prohibitions (e.g., prohibition on use of powerheads, explosives, poisons, drugs and other chemicals); and
- Area closures (e.g., a year-round area closure of the Hind Bank MCD).

4.4.2.2.2 Alternative 2 (Preferred). Prohibit the filleting of fish in federal waters of the U.S. Caribbean. Require that fish captured or possessed in federal waters be landed with heads and fins intact.

Anecdotal information suggests that Goliath grouper may still be harvested in federal waters and filleted at sea, thereby complicating the enforcement of the prohibition on catch and possession of these species. This action prevents fishermen from landing Goliath grouper, as well as other species, in an unidentifiable form.

4.4.2.2.3 Alternative 3. Establish a seasonal or area closure to protect spawning stock.

This alternative prohibits fishing in known goliath grouper spawning sites either during a portion of the year or year-round. Fishery managers do not know of any unprotected sites in federal waters where Goliath grouper aggregate to spawn. The Council included this alternative to solicit public input on this subject.

4.4.2.2.4 Comparison of the environmental effects of alternative rebuilding measures

Alternative 1 offers no additional protections to Goliath grouper beyond current regulations, which are not believed to have improved the status of the stock. This failure to rebuild the stock despite an 11-year prohibition on harvest is attributed primarily to the lack of compatible regulations in state waters in the past. Following recent rulemaking in Puerto Rico, the harvest and possession of this species is now prohibited in all state and federal waters throughout the U.S. Caribbean; harvest of Goliath grouper in USVI is prohibited.

Alternatives 2 and 3 could directly benefit Goliath grouper, the surrounding ecosystem, and fishing communities if they served to further reduce overall mortality of the stock and if this reduction in mortality assisted in rebuilding stock biomass to a sustainable level. The prohibition on filleting fish at sea proposed in Alternative 2 is expected to reduce directed fishing mortality by curbing illegal fishing activities. The seasonal or annual spawning area closure proposed in

Alternative 3 could reduce bycatch mortality of Goliath grouper if one or more spawning areas could be reliably defined. Therefore, the Council selected Alternative 2 as the preferred alternative, in order to rebuild the species.

4.4.3 Queen Conch

The biology and status of queen conch is described in Section 5.2.1.2.1.

4.4.3.1 Rebuilding schedule

Fishery scientists do not have the data needed to calculate how quickly queen conch could rebuild to B_{MSY} in the absence of fishing. However, the NOAA SEFSC has concluded that it is unlikely the stock can recover within ten years, even if all catches of this species were prohibited (CFMC 2001a). Employing two different models, Valle-Esquivel estimates a mean generation time for queen conch ranging from 4.6 years to 4.9 years (personal communication). This resulted in the specification of a generation time for that species of five years.

The rebuilding schedule alternatives the Council considered for queen conch are based on the formula the National Standard Guidelines provides for stocks that cannot be rebuilt within 10 years: T_{MIN} + one mean generation time. The Council considered but eliminated from more detailed study an alternative that would have established a rebuilding schedule for this species. Such a schedule appears unrealistic based on the above-mentioned conclusion of the NOAA SEFSC, and on the finding that queen conch fisheries closed in Florida and Bermuda since 1986 have shown little or no sign of improvement (CFMC 2001a; Deluca 2002). This is discussed in Section 11.2. The range of rebuilding schedule alternatives the Council is considering for queen conch derives from two alternative definitions of T_{MIN}.

4.4.3.1.1 Alternative 1. No action. Do not define a schedule/time frame for rebuilding queen conch.

This alternative maintains the status quo, thus no rebuilding schedule would be defined for queen conch.

4.4.3.1.2 Alternative 2 (Preferred). Rebuild queen conch to B_{MSY} in 15 years, using the formula T_{MIN} (10 years) + one generation (5 years) = 15 years.

This alternative specifies a rebuilding schedule for queen conch consistent with the longest rebuilding period advised by the National Standard Guidelines, and is based on a T_{MIN} proxy of ten years.

4.4.3.1.3 Alternative 3. Rebuild queen conch to B_{MSY} in 20 years, using the formula T_{MIN} (15 years) + one generation (5 years) = 20 years.

This alternative specifies a rebuilding schedule for queen conch consistent with the longest rebuilding period advised by the National Standard Guidelines, and is based on a T_{MIN} proxy of 15 years.

4.4.3.1.4 Comparison of the environmental effects of alternative rebuilding schedules

Defining a rebuilding schedule for queen conch is an administrative action and, as such, would have no direct positive or negative impacts on the biological, ecological, social, or economic environment. However, determining the time period over which rebuilding efforts can be extended could have indirect environmental effects. Shorter schedules generally require that overfished stocks be provided a greater amount of (and more immediate) relief from fishing pressure. Conversely, longer schedules generally allow overfished stocks to be fished at higher rates of fishing mortality as they rebuild.

Alternative 1 would adversely affect the administrative environment because the MSFCMA mandates the definition of rebuilding schedules for overfished stocks, and the lack of a rebuilding schedule would not provide fishery administrators with concrete, measurable objectives to use in assessing fishery and management performance. The indirect biological, ecological, social, and economic effects associated with this action also could be adverse if current management measures regulating the take of queen conch were rescinded in response. Allowing unregulated harvest of queen conch could provide social and economic benefits in the short term. However, the net effect of such action would be expected to be negative because unregulated harvest would likely compromise rebuilding efforts.

Alternatives 2-4 would directly benefit the administrative environment by helping fishery managers to fulfill legal administrative and conservation mandates. Using the defined schedules to determine the amount of harvest of queen conch that would be permitted, the indirect biological and ecological benefits, and adverse social and economic effects, associated with these alternatives would be expected to decrease progressively from Alternative 2 to Alternative 3. Extending rebuilding efforts over a longer time frame helps to mitigate the adverse social and economic effects of rebuilding. However, such an extension also increases the risk that environmental or other factors could prevent the stock from recovering. Therefore, the Council selected Alternative 2 as the preferred alternative.

4.4.3.2 Rebuilding strategy

4.4.3.2.1 Alternative 1. No action (maintain status quo). Rely on current regulations to rebuild the stock to B_{MSY} within the required time frame.

Current regulations in federal waters that impact the recovery of this stock are described in full in Section 2.2.2, and include:

- A nine-inch (22.9 cm) overall minimum size limit or 3/8-inch (9.5 mm) shell-lip thickness limitation on the possession of queen conch;
- A requirement that all species in the management unit be landed in the shell;
- A prohibition on the sale of undersized queen conch and queen conch shells;
- A bag limit of three queen conch/day for recreational fishermen, not to exceed 12 per boat, and 150 queen conch/day for licensed commercial fishermen;
- A July 1 through September 30 closed season;
- A prohibition on the use of HOOKAH gear to harvest queen conch; and
- Additional seasonal and area closures implemented to protect alternate species.

4.4.3.2.2 Alternative 2. Prohibit commercial and recreational catch and possession of queen conch in federal waters of the U.S. Caribbean.

This alternative prohibits commercial and fishermen from taking or possessing queen conch in the U.S. EEZ.

4.4.3.2.3 Alternative 3 (Preferred). Prohibit commercial and recreational catch, and possession of queen conch in federal waters of the U.S. Caribbean, with the exception of Lang Bank near St. Croix.

This alternative prohibits commercial and recreational fishermen from taking or possessing queen conch throughout the U.S. EEZ, with the exception of Lang Bank. For the purposes of this alternative, Lang Bank consists of federal waters east of 64° 34' W longitude.

4.4.3.2.4 Alternative 4 (Preferred). Develop a memorandum of understanding (MOU) between NMFS and the state governments to develop compatible regulations to achieve the management objectives set forth in the Caribbean Fishery Management Council's Queen Conch FMP in state and federal waters of the U.S. Caribbean.

Since much of the queen conch habitat, in particular juvenile habitat, is located in state waters, the recovery of this species is likely dependent on the implementation of compatible protective regulations in state waters.

Currently, both Puerto Rico and the USVI have consistent minimum size regulations with those in the EEZ; however, Puerto Rico does not require that conch be landed whole in the shell, as in USVI or federal waters. Both Puerto Rico and the USVI have closed seasons July 1 - September 30.

This alternative would require the Council to request the Secretary of Commerce/NMFS formalize, through an MOU, an agreement to work together to rebuild queen conch in the U.S. Caribbean. The MOU would define specific actions the state governments agree to implement, or maintain, over a prescribed time period to assist federal fishery managers in achieving the rebuilding goal and schedule adopted for queen conch in this amendment.

4.4.3.2.5 Comparison of the environmental effects of alternative rebuilding measures

Alternative 1 offers no additional protections to queen conch beyond current regulations, which have not been effective in sustaining the stock. As a result, this alternative is expected to result in the continued overexploitation of this species, which would directly adversely affect the biological, ecological, social, economic, and administrative environments. Alternatives 2 and 3 are expected to directly benefit queen conch, the surrounding ecosystem, and fishing communities by protecting the breeding populations of queen conch believed to exist in EEZ waters.

The total prohibition on queen conch harvest proposed in Alternative 2 is expected to provide greater biological and ecological benefits relative to the limited prohibition on queen conch harvest proposed in Alternative 3. However, the superiority of Alternative 2 relative to Alternative 3 is more uncertain in terms of social and economic benefits. St. Croix is relatively isolated geographically and oceanographically, and scientists do not fully understand how (if at all) the status of conch populations in that area affects (or is affected by) the overall status of the queen conch stock. Alternative 3 would provide greater net social and economic benefits relative to Alternative 2 if continued harvest in that area did not compromise stock rebuilding efforts.

Alternative 4 directly benefits the administrative environment. Although developing the MOU presents an administrative burden, the net administrative effects of coordinating state and federal management are expected to be positive. The MOU would be expected to provide indirect biological, ecological, social, and economic benefits by facilitating the implementation of compatible rebuilding goals and strategies.

Therefore, the Council selected Alternatives 2 and 4 as preferred alternatives to rebuild the species.

4.4.4 Grouper Unit 4

Grouper Unit 4 is composed of misty grouper, red grouper, tiger grouper, yellowedge grouper, and yellowfin grouper. The biology and status of these species is described in Section 5.2.1.3.33. This complex will be considered overfished if the preferred biological reference points and stock status determination criteria described in Section 4.2 are adopted. For this reason, the Council evaluated alternative rebuilding schedules and measures for this complex in this amendment.

4.4.4.1 Rebuilding schedule

Scientists have not estimated the parameters needed to calculate alternative rebuilding schedules for the Grouper Unit 4. Therefore, we used the theoretical dynamics of a population under the logistic (Graham-Schaefer) surplus-production model to calculate T_{MIN} for this stock based on the definition of the B ratio and F_{MSY} estimate that would be established by the preferred alternatives

in Section 4.2 and on the assumption that the intrinsic rate of population growth, r, equals 0.25. Using these definitions, T_{MIN} is equal to about 1.1 years. We rounded the T_{MIN} estimate to 2 years, rather than 1 year, because it is impossible to rebuild the stock in 1 year if T_{MIN} represents a zero-mortality scenario and is defined as 1.1. The range of alternative rebuilding schedules considered for Grouper Unit 4 is consistent with the guidance provided in the National Standard Guidelines, such that the shortest schedule evaluated is bounded by T_{MIN}, and the longest rebuilding schedule evaluated is bounded by ten years, since T_{MIN} is less than 10 years. The recovery plot is illustrated in Figure 10. A detailed description of the theory and equations used to generate the plot is provided in Prager (1994).

4.4.4.1.1 Alternative 1. No action. Do not define a schedule/time frame for rebuilding Grouper Unit 4.

This alternative maintains the status quo, thus no rebuilding schedule would be defined for the Grouper Unit 4 Complex.

4.4.4.1.2 Alternative 2 (Preferred). Rebuild grouper unit 4 to B_{MSY} in 10 years.

This alternative specifies a rebuilding schedule for the Grouper Unit 4 Complex that is consistent with the longest rebuilding period advised by the National Standard Guidelines: 10 years, if T_{MIN} is less than 10 years.

4.4.4.1.3 Alternative 3. Rebuild grouper unit 4 to B_{MSY} in 2 years.

This alternative requires the Council to rebuild the Grouper Unit 4 Complex in as short a time period as possible, defined as T_{MIN}, or the time the stock could rebuild to B_{MSY} in the absence of fishing.

4.4.4.1.4 Alternative 4. Rebuild grouper unit 4 to B_{MSY} in 6 years.

This alternative specifies a rebuilding schedule for the Grouper Unit 4 Complex that reflects the mid-point between T_{MIN} and the longest advisable rebuilding period of 10 years.

4.4.4.1.5 Comparison of the environmental effects of alternative rebuilding schedules

Defining a rebuilding schedule for the Grouper Unit 4 is an administrative action and, as such, would have no direct positive or negative impacts on the biological, ecological, social, or economic environment. However, determining the time period over which rebuilding efforts can be extended could have indirect environmental effects. Shorter schedules generally require that overfished stocks be provided a greater amount of (and more immediate) relief from fishing pressure. Conversely, longer schedules generally allow overfished stocks to be fished at higher rates of fishing mortality as they rebuild.

Alternative 1 adversely affect the administrative environment because the MSFCMA mandates the definition of rebuilding schedules for overfished stocks, and the lack of rebuilding schedules would not provide fishery administrators with concrete, measurable objectives to use in assessing fishery and management performance. The indirect biological, ecological, social, and economic effects associated with this alternative also could be adverse if it resulted in continued overfishing of the Grouper Unit 4 Complex.

Alternatives 2-4 directly benefit the administrative environment by helping fishery managers to fulfill legal administrative and conservation mandates. The indirect biological and ecological benefits associated with these alternatives are expected to be greatest for Alternative 3, followed by Alternative 4, then Alternative 2. Conversely, adverse social and economic effects are expected to be least for Alternative 3, followed by Alternative 4, then Alternative 2. Extending rebuilding efforts over a longer time frame potentially increases the adverse social and economic effects of rebuilding depending on the rebuilding strategy, as the rebuilding alternatives would potentially be in effect for a longer time period, unless the species or FMU sub-unit recovered sooner than expected. However, such an extension also increases the risk that environmental or other factors could prevent the stock from recovering.

4.4.4.2 Rebuilding strategy

The management measures described in Section 4.3 are designed to reduce fishing mortality rates to levels that are equal to or less than those prescribed by the Preferred MSY Control Rule described in Section 4.2.5. A preferred alternative in Section 4.3 would prohibit the possession of species in Grouper Unit 4 from February 1 - April 30, to reduce fishing mortality and protect spawning aggregations. It is expected to result in a 24% reduction in fishing mortality, which should be sufficient to end overfishing and rebuild the FMU sub-unit within the preferred rebuilding schedule. Because the Grouper Unit 4 Complex would be considered to be just slightly overfished (B_{CURR} is 91% of MSST) upon implementatin of the preferred alternatives in Section 4.2, ending overfishing should allow Grouper Unit 4 to rebuild to B_{MSY} within any of the alternative schedules evaluated above. Therefore, no additional rebuilding measures are considered in this section.

4.5 Conserving and Protecting Yellowfin Grouper

The Council considered the following regulatory measures in addition to those described in Section 4.3 to protect an identified yellowfin grouper spawning aggregation on Grammanik Bank, south of St. Thomas. These alternatives were originally being developed and evaluated in a separate amendment to the Reef Fish FMP, but were transferred to this amendment to streamline the administrative process and to reduce the amount of time before they were brought before the Council for final consideration.

4.5.1 Alternative 1. No action. Do not establish a seasonal closure of the Grammanik Bank.

This alternative leaves the Grammanik Bank open to fishing year round. Fishing in that area would continue to be managed by the regulations set forth in the four Council FMPs and described in Section 2.2.

4.5.2 Alternative 2. Close the Grammanik Bank to all fishing from February 1 to April 30 of each year. The proposed boundaries for the Grammanik Bank closed area are: 18º 12.40' N, 64º 59.00' W; 18º 10.00' N, 64º 59.00' W; 18º 10.00' N, 64º 56.10' W; and 18º 12.40' N, 64º 56.10' W.

This alternative defines an area of approximately 4.63 km (2.5 nm) by 5.09 km (2.75 nm), resulting in a 23.57 km^2 (6.88 nm^2) area in which fishing would be prohibited from February through April. The reported spawning aggregation would be positioned slightly northeast of the closed area's center.

4.5.3 Alternative 3. Close the Grammanik Bank to all fishing from February 1 to April 15 of each year. The proposed boundaries for the Grammanik Bank closed area are: 18º 13.20' N, 64º 59.00' W; 18º 13.20' N, 64º 54.00' W; 18º 09.50' N, 64º 59.00' W; and 18º 09.50' N, 64º 54.00' W.

This alternative defines an area of approximately 6.48 km (3.5 nm) by 9.26 km (5 nm), resulting in a 60 km^2 (17.5 nm^2) area in which fishing would be prohibited from February through April 15. The reported spawning aggregation would be centered within this closed area.

4.5.4 Alternative 4. Close the Grammanik Bank to all fishing from February 1 to April 15 of each year. The proposed boundaries for the Grammanik Bank closed area are: 18º 12.00' N, 64º 58.00' W; 18º 12.00' N, 64º 57.00' W; 18º 11.00' N, 64º 57.00' W; and 18º 11.00' N, 64º 58.00' W.

This alternative defines an area of approximately 1.85 km (1.0 nm) by 1.85 km (1.0 nm), resulting in a 3.42 km^2 (1.0 nm^2) area in which fishing would be prohibited from February through April 15. The reported spawning aggregation would be centered within this closed area.

4.5.5 Alternative 5. Close the Grammanik Bank to all fishing from February 1 to May 31 of each year. The proposed boundaries for the Grammanik Bank closed area are: 18º 13.20' N, 64º 59.00' W; 18º 13.20' N, 64º 54.00' W; 18º 09.50' N, 64º 59.00' W; and 18º 09.50' N, 64º 54.00' W.

This alternative defines an area of approximately 4.63 km (2.5 nm) by 3.70 km (2.0 nm), resulting in a 17.13 km^2 (5 nm^2) area in which fishing would be prohibited from February through May. The reported spawning aggregation would be centered within this closed area.

4.5.6 Alternative 6. Close the Grammanik Bank to all fishing from February 1 to May 31 of each year. The proposed boundaries for the Grammanik Bank closed area are: 18º 12.00' N, 64º 58.00' W; 18º 12.00' N, 64º 57.00' W; 18º 11.00' N, 64º 57.00' W; and 18º 11.00' N, 64º 58.00' W.

This alternative defines an area of approximately 1.85 km (1.0 nm) by 1.85 km (1.0 nm), resulting in a 3.42 km^2 (1.0 nm^2) area in which fishing would be prohibited from February through May. The reported spawning aggregation would be centered within this closed area.

4.5.7 Alternative 7 (Preferred). Close the Grammanik Bank to all fishing from February 1 to April 30 of each year. The proposed boundaries for the Grammanik Bank closed area are: 18º 11.898' N, 64º 56.328' W; 18º 11.645' N, 64º 56.225' W; 18º 11.058' N, 64º 57.810' W; and 18º 11.311' N, 64º 57.913' W.

This alternative defines an area of approximately 3.0 km (1.62 nm) by 0.5 km (0.27 nm), resulting in a 1.50 km^2 (0.44 nm^2) area in which fishing would be prohibited from February through April. The reported spawning aggregation would be centered within this closed area.

4.5.8 Alternative 8. Prohibit the harvest and possession of yellowfin grouper in the U.S. EEZ, in conjunction with the closure of the Grammanik Bank.

This alternative is encompassed by Preferred Alternative 2a proposed in Section 4.3.2.

4.5.9 Comparison of the environmental effects of alternatives

Alternatives 2-8 would all have a direct effect on the biological, socioeconomic, and administrative environment. Alternatives 2-7 all afford protection of a documented spawning aggregation, which are typically targeted by fishermen due to the fact that large spawning fish can be harvested in abundant numbers in a fairly discrete area and during a fairly predictable timeframe. Since a closed area prohibits all harvest and possession of Council-managed species within the specified coordinates, other species, including those species in the Coral FMP that are considered EFH, would benefit from the closure as well. However, as with any closed area or season, there could be negative effects associated with the proposed action. Intensified fishing before and after a closed season could reduce or negate benefits accrued during the closure. Likewise, displaced fishing activities could increase pressure on juveniles in USVI waters, or impair EFH through intensified fishing activities in waters outside the closed area. Finally, there may be some short-term economic impacts associated with the proposed action. The actual size and length of the closure would ultimately determine the extent of any socioeconomic impact. Generally, the larger the closed area (e.g., Alternative 3 versus Alternative 7) and the longer the duration (e.g., Alternative 4 versus Alternative 6), the greater the economic impact. However, there should be economic benefits in the long term, due to the rebuilding of yellowfin grouper and the establishment of a sustainable fishery.

Of the various closed area alternatives, Alternative 2 is the most conservative. It closes a sufficiently large area to protect yellowfin grouper and other species, as well as an area large

enough to facilitate enforcement, and it would be closed throughout the complete duration of the yellowfin grouper spawning period. Alternative 1 (no-action) obviously not prevent exploitation of the spawning aggregation, and would not fulfill the purpose and need of this action. Alternative 5 has a longer time period as Alternative 2, but is slightly smaller in area; even though Alternative 5 is longer in duration that Alternative 2, since yellowfin grouper are not documented to spawn in May, the benefit to the species is questionable. While Alternative 3 closes a larger area, its duration does not encompass the full spawning period of yellowfin grouper, nor does it prohibit fishing for other species for as long as a time period as Alternative 2. Alternative 7 is the smallest in size, which may not provide enough of a buffer around Grammanik Bank and the spawning aggregations, in turn potentially complicating enforcement. However, significant comment during Council meetings indicated there would be significant economic impact to other fisheries (e.g., yellowtail snapper) that are conducted near Grammanik Bank that could be prohibited if a large closed area were selected. Additionally, the Council wanted to ensure that the area pertinent to the year-round gear closure on Grammanik Bank to protect EFH (i.e., Section 4.7) would be consistent with the Grammanik Bank spawning aggregation closure. Alternative 8 further protects yellowfin grouper by prohibiting their harvest and possession during their documented spawning period, in conjunction with the closed area. This would protect undocumented spawning aggregations in federal waters of the U.S. Caribbean, as well as facilitate at-sea enforcement. However, since the Council opted to implement a seasonal closure for all species in Grouper Unit 4 during the entire yellowfin grouper spawning period, Alternative 8 would be redundant. Therefore, the Council selected Alternative 7 as the preferred alternative to further protect and conserve yellowfin grouper, which would be considered overfished based on the preferred stock status criteria alternatives in Section 4.2.

4.6 Achieving the MSFCMA Bycatch Mandates

The MSFCMA mandates that all FMPs shall "...establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority – (A) minimize bycatch; and (B) minimize the mortality of bycatch which cannot be avoided" (MSFCMA §303(a)(11)). This section describes the alternatives the Council is considering to meet these two bycatch mandates.

The MSFCMA defines bycatch as "fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards. Such term does not include fish released alive under a recreational catch and release fishery management program" (MSFCMA §3(2)). Economic discards are fish that are discarded because they are undesirable to the harvester. This category of discards generally includes certain species, sizes, and/or sexes with a low or no market value. Regulatory discards are fish that are required by regulation to be discarded, but also include fish that may be retained but not sold.

4.6.1 Bycatch reporting

4.6.1.1 Alternative 1. No action. Do not establish a standardized bycatch reporting methodology program in the U.S. Caribbean.

This alternative maintains the status quo. Currently, there is no program in place in the U.S. Caribbean to collect bycatch data.

4.6.1.2 Alternative 2. Develop and implement a federal permit system for commercial and charter boat fishermen participating in Council-managed fisheries, with an associated mandatory monthly reporting requirement.

Under this alternative, permits would be implemented for each fishery (e.g., conch permit, spiny lobster permit, reef fish permit). Permit renewal would be dependent upon submission of monthly catch reports, similar to what is currently required of USVI fishery participants. Permits would be issued to specific vessels. Initially, there would be no specific eligibility criteria required, so as to encourage issuance of permits to all vessels fishing in the EEZ.

The federal permit system for the U.S. Caribbean would be administered by NMFS SERO, or the SEFSC, or at a facility in Puerto Rico or the USVI. Although permits are typically issued on an annual basis, a renewal application is required every two years. In the interim year, renewal is automatic (without application) for a vessel owner or dealer who has met the specific requirements for the requested permit, license, or endorsement; who has submitted all reports required under the MSFCMA; and who is not subject to a sanction or denial.

The application and permitting process can be briefly summarized as follows: 1) initial mail out of applications; 2) application receipt; 3) permit data entry and issuance; 4) telephone correspondence regarding status of permits; 5) data request and questions following implementation, and 6) automatic renewal processes. Most permits are issued on the month of incorporation, or birth month of the individual, which spreads the permitting administrative workload throughout the calendar year.

A permit requirement (regardless of where that system is administered) allows implementation of a separate catch reporting requirement. Without a permit to identify and locate participating vessels, logbooks cannot easily be distributed. Permit holders will have to maintain a logbook to record their fishing activity. Logbook format and data reporting methods will be determined during the agency approval process. However, any permit-specific requirements are in addition to the following basic requirements. The permit holder must report catch, effort, and discards by species, location, time, and other factors as specified by the Council; report protected species observations; report any lost gear or damage to coral reef habitat (with no penalty); complete a daily logbook within 24 hours after completion of the fishing day; and submit reports within 30 days of returning to port. Reports would most likely be transmitted to the SEFSC for data management.

For an example permit application, see Appendix C.

4.6.1.3 Alternative 3 (Preferred). Utilize the MRFSS database to provide additional bycatch information on the recreational and subsistence sectors.

This alternative provides fishery managers a means to monitor the bycatch of individual recreational anglers and subsistence fishermen in Puerto Rico, and, if expanded, in the USVI.

4.6.1.4 Alternative 4 (Preferred). Consult with Puerto Rico and the USVI in an effort to modify the trip ticket system currently in place in the U.S. Caribbean to require standardized collection of bycatch data.

This alternative intends to implement standardized bycatch data reporting through the current trip ticket systems, which are managed at the state level. These systems were established in 1967 and 1974 in Puerto Rico and the USVI, respectively. Both programs have experienced a series of periodic lapses over the years, as well as significant under and/or misreporting, and changes in the type of data collected (Valle-Esquivel 2002). Landings in the USVI were historically reported by gear group (e.g., pot fish, net fish), while those in Puerto Rico were reported by species or species groups (e.g., Nassau grouper, grouper).

Presently, landings in both territories are recorded at the species or species-group level. Monthly commercial catch reporting is mandatory in both Puerto Rico and the USVI. Fishermen report landings in Puerto Rico and the USVI to the Puerto Rico DNER and the USVI DFW, respectively. Both state agencies are supported by NMFS through the State/Federal Cooperative Fisheries Statistics Program. Currently, Puerto Rico does not collect bycatch data, but the USVI initiated rudimentary bycatch reporting (i.e., pounds of bycatch by gear type) in 2004. Therefore, effort would be directed on modifying Puerto Rican landings reports to include consistent and standardized bycatch data.

Monthly landings data for Puerto Rico are collected from fishermen, fish buyers, and fishing associations by DNER port agents (four at the moment) and the program's principal investigator at 88 fishing centers in 42 coastal municipalities, including the islands of Vieques and Culebra. Prior to 2004, participation in the data collection program was voluntary. Currently, fishermen are required to submit monthly catch reports. Data fields on Puerto Rico's trip ticket form include fishing date; name of fish buyer, fisherman and/or helper; fishing license number; municipality; fishing center (landing area); number of trips reported; gear type; fishing effort (hours fishing); weight in pounds by species or taxonomic family; market value; depth; and fishing area (less than or greater than 10 miles from shore). Tickets use numeric codes for common names and species identification. Data are computerized by DNER and submitted to NMFS in raw form on an annual basis (Valle-Esquivel 2002).

Landings data for the USVI fisheries are mailed or delivered to DFW on a monthly basis. DFW requires that all reports for a 12-month period (July to June) be submitted before renewing a commercial fishing license. The current trip ticket form, which was expanded to the entire

territory between 1997 and 2000, requests data on family or species group harvested; gear type (hook and line, net, pot/trap, and dive); an estimate of fishing effort (the number of gear and the estimated time in hours fished during the trip); and area fished (including distance from shore (i.e., less than 3 miles, 3-200 miles, or greater than 200 miles) and location). The DFW computerizes and verifies data, and submits datasets to NMFS on an annual basis. Landings in St. Croix and St. Thomas/St. John are maintained in separate datasets (Valle-Esquivel 2002).

Both the specificity and accuracy of the data collected through the trip ticket systems is believed to have been improving in recent years. However, fishermen seldom complete the data fields that indicate what portion, if any, of their catches was taken from the U.S. EEZ. Consequently, fishery managers generally cannot distinguish between catches taken from federal and state waters (Valle-Esquivel, pers. comm.).

4.6.1.5 Comparison of the environmental effects of alternative bycatch reporting programs

Alternatives 1-4 would have a direct effect on the administrative and socioeconomic environment, and an indirect effect on the biological environment. Alternative 1 adversely affects the administrative environment because the MSFCMA mandates that a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery be established. The indirect biological, socioeconomic effects associated with this alternative also could be adverse if excessive and unreported bycatch jeopardized the sustainability of managed fisheries.

Alternatives 2-4 offer direct benefit to the administrative environment by helping fishery managers to fulfill legal administrative and conservation mandates. However, there would also be indirect negative administrative and socioeconomic impacts associated with Alternatives 2 and Alternative 3, in that a new permit system would have to be funded and established for Alternative 2, and that MRFSS would have to be expanded, which would require funding and personnel, under Alternative 3. Yet, the impacts associated with expanding the MRFSS survey to the USVI under Alternative 3 are expected to be overshadowed by the benefits provided by better recreational data, which can improve management of that fishery. The indirect biological benefits, and adverse socioeconomic effects, associated with these alternatives are expected to be greatest for Alternative 2, followed by Alternative 4, then Alternative 3. Because the USVI recently implemented mandatory bycatch reporting, Alternative 4 presents the most likely alternative that could produce beneficial commercial bycatch information within the U.S. Caribbean. Therefore, the Council selected Alternatives 3 and 4 as the preferred alternatives to establish a standardized bycatch reporting system in the U.S. Caribbean.

4.6.2 Minimizing bycatch and bycatch mortality to the extent practicable

There are scant data on commercial and recreational bycatch in the U.S. Caribbean region. Rosario (1993) estimated, based on fishery-independent data from the SEAMAP-Caribbean program collected off the west coast of Puerto Rico, that about 14% by number and 17% by

weight of the fish caught in the commercial hook and line fishery are species with low market value, including squirrel fishes, butterfly fishes, doctor fishes, puffers, filefish, and scorpion fish. However, anecdotal information suggests that the vast majority of fish harvested in the U.S. Caribbean are retained for the market or for personal use – including species with low market value. With the exception of species that are commonly believed to be ciguatoxic, economic discards in this region appear to be minimal.

Regulatory discards may potentially include the following species:

- Nassau grouper. Federal law requires that Nassau grouper landed in the U.S. EEZ be returned to the water (catches of Nassau grouper in the state waters of the USVI are not regulated);
- Goliath grouper. Federal law requires that Goliath grouper landed in the U.S. EEZ be returned to the water;
- Butterfly fish. The harvest of some species of butterfly fish (*Chaetodon spp.*) is prohibited in federal waters (butterfly fish are also a prohibited species in the state waters of Puerto Rico. The USVI has permitted the catch of a small number of these species for scientific research/educational purposes);
- Sub-adult yellowtail snapper. Federal law requires that catches of yellowtail snapper under 12 inches in fork length be returned to the water (yellowtail snapper are not regulated in the state waters of the USVI, and the minimum size in Puerto Rico waters is 10.5 inches); and
- Sub-adult and berried spiny lobster. Federal law prohibits the retention of spiny lobster under 3.5 inches in carapace length and berried spiny lobsters (similar regulations are in place in state waters of Puerto Rico and the USVI).

The extent of these regulatory discards is unknown. In the past, the regulatory requirements forcing fishermen to discard these species were difficult to enforce because regulations were generally less restrictive in state waters. So, for example, the captain/crew of a boat boarded in the U.S. EEZ could claim that any prohibited and/or undersized species onboard were captured in state waters. The mortality rates associated with commercial and recreational bycatch also are unknown, but generally increase with depth (e.g., finfish taken from deeper water generally have a lower survival rate when returned to the water).

In determining the practicability of minimizing bycatch and bycatch mortality, the National Standards provides the following guidance: "(i) A determination of whether a conservation and management measure minimizes bycatch or bycatch mortality to the extent practicable, consistent with other national standards and maximization of net benefits to the Nation, should consider the following factors:

(A) Population effects for the bycatch species;
(B) Ecological effects due to changes in the bycatch of that species (effects on other species in the ecosystem);

(C) Changes in the bycatch of other species of fish and the resulting population and ecosystem effects;
(D) Effects on marine mammals and birds;
(E) Changes in fishing, processing, disposal, and marketing costs;
(F) Changes in fishing practices and behavior of fishermen;
(G) Changes in research, administration, and enforcement costs and management effectiveness;
(H) Changes in the economic, social, or cultural value of fishing activities and nonconsumptive uses of fishery resources;
(I) Changes in the distribution of benefits and costs; and
(J) Social effects.

(ii) The Councils should adhere to the precautionary approach found in the Food and Agriculture Organization of the United Nations (FAO) Code of Conduct for Responsible Fisheries (Article 6.5)...when faced with uncertainty concerning any of the factors listed in this paragraph (d)(3)" (50 CFR §600.350(d)(3)).

According to Article 6.5 of the FAO Code of Conduct for Responsible Fisheries, using the absence of adequate scientific information as a reason for postponing or failing to take measures to conserve target species, associated or dependent species, and non-target species and their environment, would not be consistent with a precautionary approach.

This section describes alternatives considered by the Council to further minimize bycatch and bycatch mortality in federal fisheries of the Caribbean. The analysis of the practicability of these measures is provided in Section 6.6.2.

4.6.2.1 Alternative 1. No action. Rely on current management measures to minimize bycatch and bycatch mortality.

Current management measures that impact regulatory discards and discard mortality include minimum mesh size and escape vent requirements for traps. These apply primarily to species managed with minimum size limits (e.g. yellowtail snapper and spiny lobster), and do not reduce incidental catches of prohibited species (e.g., Nassau and Goliath grouper, and some species of butterfly fish), with the exception of those that are small enough to escape through the two-inch mesh. Some portion of the populations of prohibited species is likely protected by seasonal and area closures established by the Council primarily to protect mutton snapper and red hind spawning aggregations.

4.6.2.2 Alternative 2. Increase the minimum allowable mesh size for fish traps.

This alternative increases the minimum size of the mesh used in the construction of fish traps to provide for the increased escapement of juvenile fish and tropical species.

4.6.2.3 Alternative 3. Establish a minimum mesh size of two inches and a maximum mesh size of six inches, stretched mesh, for gill and trammel nets. Additionally, gill and trammel nets must be tended at all times.

This alternative establishes requirements for the construction and use of nets to increase the escapement of juvenile fishes and to decrease the occurrence of incidental catches.

4.6.2.4 Alternative 4 (Preferred). Amend current requirements for trap construction such that only one escape panel be required, which could be the door.

This alternative modifies the regulation implemented through a 1991 regulatory amendment to the Reef Fish FMP, which requires that each fish trap contains two degradable (escape) panels in addition to a self-destruct door fastening. Under this alternative, each fish trap must contain at least one degradable panel, which could be a self-destruct door fastening if the door was positioned on the side of the trap.

4.6.2.5 Comparison of the environmental effects and practicability of alternative bycatch reduction measures

It is unlikely that any of the alternatives would significantly reduce bycatch due to the nature of the Caribbean fisheries. Due to the fact that most Caribbean fishermen utilize much of what they catch, and due to the absence of fisheries that are noted for producing large amounts of bycatch (e.g., trawling), bycatch is not as a significant issue in the Caribbean compared to other regions. What little bycatch occurs is generally confined to regulatory discards, which would be minimally affected by the gear restriction alternatives evaluated here. Such discards will likely be further reduced if preferred alternatives identified in other sections of this amendment are retained and implemented (e.g., area closures, prohibition on filleting fish at sea). Therefore, the direct effects to the biological environment from any of these alternatives would be minimal.

Alternatives 2-4 result in direct, but relatively minor, effects to the socioeconomic and administrative environment, due to the required modifications of fishing gear. In general, the socioeconomic and administrative effect of Alternative 2 would be greater than those experienced by Alternatives 3-4. A larger mesh size in fish traps in Alternative 2 will likely result in reduced catch, and therefore reduced income for fishermen. In contrast, anecdotal information suggests that the only reason for large-mesh net fisheries is to illegally fish for turtles. Similarly, most trap fishermen already only employ one escape panel door. Regardless, the Council also opted to prohibit the use of gill and trammel nets in the EEZ (excluding some bait and species not managed by the FMP), primarily to reduce fishing mortality, though it will also have ancillary benefits in the reduction of bycatch.

4.7 Achieving the MSFCMA EFH mandates

The MSFCMA mandates that all FMPs shall "...describe and identify essential fish habitat for the fishery based on the guidelines established by the Secretary under section 305(b)(1)(A), minimizing to the extent practicable adverse effects on such habitat caused by fishing...." (MSFCMA §303(a)(7)). This section describes the preferred alternatives the Council is considering to meet these EFH mandates, which were developed in the EFH EIS.

4.7.1 Describe and identify EFH

4.7.1.1 Alternative 1. No action.

4.7.1.2 Alternative 2 (Preferred). Describe and identify EFH according to functional relationships between life history stages of Federally-managed species and Caribbean marine and estuarine habitats.

This alternative specifies functional relationships for life stages and habitat types that might be regarded as meriting special attention for their importance to managed species. The MSFCMA defined EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." These are the functions that marine and estuarine habitats support. Under this alternative, the distribution of species and life stages is inferred from information on these functional relationships. In particular, EFH is defined as:

- EFH for the spiny lobster fishery in the U.S. Caribbean consists of all waters from mean high water to the outer boundary of the EEZ – habitats used by phyllosome larvae – (Figure 2.2; EFH EIS) and seagrass, benthic algae, mangrove, coral, and live/hard bottom substrates from mean high water to 100 fathoms depth – used by other life stages – (Figure 2.38; EFH EIS), shown in the aggregate as Figure 2.39 (EFH EIS);
- EFH for the queen conch fishery in the U.S. Caribbean consists of all waters from mean high water to the outer boundary of the EEZ – habitats used by eggs and larvae – (Figure 2.2; EFH EIS) and seagrass, benthic algae, coral, live/hard bottom and sand/shell substrates from mean high water to 100 fathoms depth – used by other life stages – (Figure 2.40; EFH EIS), shown in the aggregate as Figure 2.39 (EFH EIS);
- EFH for the reef fish fishery in the U.S. Caribbean consists of all waters from mean high water to the outer boundary of the EEZ – habitats used by eggs and larvae – (Figure 2.2; EFH EIS) and all substrates from mean high water to 100 fathoms depth – used by other life stages – (Figure 2.41; EFH EIS), shown in the aggregate as Figure 2.39 (EFH EIS); and
- EFH for the coral fishery in the U.S. Caribbean consists of all waters from mean low water to the outer boundary of the EEZ – habitats used by larvae – (Figure 2.2; EFH EIS) and coral and hard bottom substrates from mean low water to 100

fathoms depth – used by other life stages – (Figure 2.42; EFH EIS), shown in the aggregate as Figure 2.39 (EFH EIS).

4.7.1.3 Alternative 3 (Preferred). Designate HAPCs in the Reef Fish and Coral FMPs based on confirmed spawning locations and on areas or sites identified as having particular ecological importance to managed species.

The EFH regulations encourage regional Fishery Management Councils to designate these HAPCs within areas identified as EFH in order to focus conservation priorities on specific habitat areas that play a particularly important role in the life cycles of federally managed fish species. The following HAPCs would be designated for the various FMPs:

Alternative 3a. Designate HAPCs in the Reef Fish FMP at the following areas based on the occurrence of confirmed spawning locations:

I. Puerto Rico
   - A. Tourmaline Bank/Buoy 8 (Figure 2.29; EFH FSEIS) (50 CFR 622.33(a));
   - B. Abrir La Sierra Bank/Buoy 6 (Figure 2.29; EFH FSEIS) (50 CFR 622.33(a));
   - C. Bajo de Sico (Figure 2.29; EFH FSEIS) (50 CFR 622.33(a)); and
   - D. Vieques, El Seco (Figure 2.30; EFH FSEIS).

II. St. Croix
   - A. Mutton snapper spawning aggregation area (Figure 2.29; EFH FSEIS) (50 CFR 622.33(a));
   - B. East of St. Croix (Lang Bank) (Figure 2.29; EFH FSEIS) (50 CFR 622.33(a)).

III. St. Thomas
   - A. Hind Bank MCD (Figure 2.29; EFH FSEIS) (50 CFR 622.33(b)); and
   - B. Grammanik Bank (Figure 2.29; EFH FSEIS).

Alternative 3b. Designate HAPC for the Reef Fish FMP as those EFH habitat areas or sites identified as having particular ecological importance to Caribbean reef fish species:

I. Puerto Rico
   - A. Hacienda la Esperanza, Manití (Figure 2.31; EFH FSEIS);
   - B. Bajuras and Tiberones, Isabela (Figure 2.31; EFH FSEIS);
   - C. Cabezas de San Juan, Fajardo (Figure 2.31; EFH FSEIS);
   - D. JOBANNERR, Jobos Bay (Figure 2.31; EFH FSEIS);
   - E. Bioluminescent Bays, Vieques (Figure 2.31; EFH FSEIS);
   - F. Boquerón State Forest (Figure 2.32; EFH FSEIS);
   - G. Pantano Cibuco, Vega Baja (Figure 2.31; EFH FSEIS);
   - H. Piñones State Forest (Figure 2.31; EFH FSEIS);
   - I. Río Espiritu Santo, Río Grande (Figure 2.31; EFH FSEIS);

J. Seagrass beds of Culebra Island (nine sites designated as Resource Category 1 and two additional sites) (Figure 2.31; EFH FSEIS); and
K. Northwest Vieques seagrass west of Mosquito Pier, Vieques (Figure 2.33; EFH FSEIS).

II. St. Thomas
A. Southeastern St. Thomas, including Cas Key and the mangrove lagoon in Great St. James Bay (Figure 2.34; EFH FSEIS); and
B. Saba Island/Perseverance Bay, including Flat Key and Black Point Reef (Figure 2.34; EFH FSEIS).

III. St. Croix
A. Salt River Bay National Historical Park and Ecological Preserve and Marine Reserve and Wildlife Sanctuary (Figure 2.36; EFH FSEIS);
B. Altona Lagoon (Figure 2.36; EFH FSEIS);
C. Great Pond (Figure 2.36; EFH FSEIS);
D. South Shore Industrial Area (Figure 2.36; EFH FSEIS); and
E. Sandy Point National Wildlife Refuge (Figure 2.36; EFH FSEIS)

Alternative 3c. Designate HAPC for the Coral FMP as those EFH habitat areas or sites identified as having particular ecological importance to Caribbean coral species:

I. Puerto Rico
A. Luis Peña Channel, Culebra (Figure 2.31; EFH FSEIS);
B. Mona/Monito (Figure 2.31; EFH FSEIS);
C. La Parguera, Lajas (Figure 2.32; EFH FSEIS);
D. Caja de Muertos, Ponce (Figure 2.32; EFH FSEIS);
E. Tourmaline Reef (Figure 2.32; EFH FSEIS);
F. Guánica State Forest (Figure 2.32; EFH FSEIS);
G. Punta Petrona, Santa Isabel (Figure 2.31; EFH FSEIS);
H. Ceiba State Forest (Figure 2.31; EFH FSEIS);
I. La Cordillera, Fajardo (Figure 2.31; EFH FSEIS);
J. Guayama Reefs (Figure 2.31; EFH FSEIS);
K. Steps and Tres Palmas, Rincon (Figure 2.31; EFH FSEIS);
L. Los Corchos Reef, Culebra (Figure 2.31; EFH FSEIS); and
M. Desecheo Reefs, Desecheo (Figure 2.31; EFH FSEIS)

II. St. Croix
A. St. Croix Coral Reef Area of Particular Concern, including the East End Marine Park (Figure 2.36; EFH FSEIS);
B. Buck Island Reef National Monument (Figure 2.36; EFH FSEIS);
C. South Shore Industrial Area Patch Reef and Deep Reef System (Figure 2.36; EFH FSEIS);
D. Frederiksted Reef System (Figure 2.36; EFH FSEIS);
E. Cane Bay (Figure 2.36; EFH FSEIS); and
F. Green Cay Wildlife Refuge (Figure 2.36; EFH FSEIS).

4.7.1.4 Comparison of the environmental effects and practicability of EFH identification measures

Please refer to Sections 2, 4.3, and 4.5 of the EFH EIS. To summarize, identification and designation of EFH will not have a direct effect on the biological or physical environment, but is likely to present indirect effects to the administrative environment due to consultation requirements, and result in controversy within the social environment due to differences in desired methodologies for designating EFH and HAPCs. It is expected that the identification and description of EFH and HAPCs will indirectly benefit the biological and physical environments, due to the EFH consultation requirements.

4.7.2 Minimize adverse effects on EFH

4.7.2.1 Alternative 1. No action.

4.7.2.2 Alternative 2 (Preferred). Establish modifications to anchoring techniques; establish modifications to construction specifications for pots/traps; and close areas to certain recreational and commercial fishing gears (i.e., pots/traps, gill/trammel nets, and bottom longlines) to prevent, mitigate, or minimize adverse fishing impacts in the EEZ.

The measures include the following:

- Require at least one buoy that floats on the surface on all individual traps/pots;
- Require at least one buoy at each end of trap lines linking traps/pots for all fishing vessels that fish for or possess Caribbean spiny lobster or Caribbean reef fish species in or from the EEZ under the Spiny Lobster and Reef Fish FMPs;
- Require an anchor retrieval system that insures the anchor is recovered by its crown in order to prevent the anchor from dragging along the bottom during recovery. For a grapnel hook, this could include an incorporated anchor rode reversal bar that runs parallel along the shank, which allows the rode to reverse and slip back towards the crown. For a fluke or plow-type anchor (e.g., Danforth, Delta, Fortress, etc.), a trip line consisting of a line from the crown of the anchor to a surface buoy (Figure 2.43; EFH EIS) would be required. This would apply to all commercial and recreational fishing vessels that fish for or possess Caribbean reef species in or from the EEZ; and
- Prohibit the use of pots/traps, gill/trammel nets, and bottom longlines on coral or hard bottom habitat year-round in the existing seasonally closed areas and Grammanik Bank (as defined by the preferred alternative in Section 4.5) in the EEZ under the Spiny Lobster and Reef Fish FMPs.

4.7.2.3 Comparison of the environmental effects and practicability of measures to minimize adverse effects on EFH

Please refer to Sections 2 and 4 of the EFH EIS. To summarize, this alternative may result in small benefits to the biological and physical environment by increasing biodiversity of coral through the reduction of continuous, but low-level impacts to coral. This alternative is expected to have a small effect on the biological environment due to the fact that only about 14% of fishable habitat consisting of coral reef species exists in the EEZ, where the Council and NMFS have jurisdiction. The alternative will have a direct effect on the socioeconomic environment, by requiring gear modification and changes in fisheries practices. Indirect administrative impacts are expected to be small, but in large part should be beneficial, as this alternative will allow managers to comply with MSFCMA and other conservation requirements. Additionally, the gear requirements will require enforcement to insure compliance in some cases. Alternative 2 introduces significant administrative effects due to potential difficulties in enforcement of such a small closed area specific to only certain types of gear (similar to those outlined in Section 4.5).