CHAPTER 5

ENVIRONMENTAL CONSEQUENCES

5.1 Introduction

Analysis of the environmental consequences of the proposed action and its alternatives is perhaps the most important part of an EIS. (For a summary of the alternatives see Tables 2.3a-d.) It must consider socioeconomic effects, to the degree that they are interrelated with environmental effects. In doing so, this chapter describes the projected direct, indirect and cumulative effects of the alternatives, and summarizes the planned mitigation measures. It also describes the conflicts between the effects of the alternatives and other plans and policies. The environment can be directly changed by the activities promoted by an alternative. These changes may trigger indirect effects on other components of the environment. Cumulative effects are the combined effects of past, present, and reasonably foreseeable future actions on the environment. Mitigation measures are activities planned to prevent, rectify or reduce projected adverse effects on the environment. Few of the effects can be measured in rigorous quantitative terms and many can only be described in qualitative terms.

Some elements of the EIS analysis parallel the MSFCMA requirement to include a fishery impact statement describing how the FMP will affect fishery participants and fishing communities (§303 (a)(9)). In addition, MSFCMA National Standard 8 requires that the management measures take into account the importance of fishing resources to fishing communities in order to provide for "sustained participation" by fishing communities, and "to the extent practicable, minimize adverse economic impacts on such communities." The economic and social impacts of the proposed actions and their alternatives are analyzed and discussed in the FMP Appendix A, which contains the Regulatory Impact Review (RIR) and Initial Regulatory Flexibility Analysis (IRFA). The RIR focuses on impacts to the net value of affected fisheries, as well as the non-fishery sectors that are dependent on coral reef ecosystems, including marine tourism, biodiversity, and other ecological services provided by coral reefs. The IRFA focuses on impacts to fishery participants as businesses, or as "small entities," as required by the Regulatory Flexibility Act. It focuses on the identification and minimization of increased burdens to small entities, such as commercial fishermen.

5.1.1 Consideration of the NWHI Coral Reef Ecosystem Reserve

The NWHI Coral Reef Ecosystem Reserve, established by President Clinton's Executive Orders 13178 (December 4, 2000) and 13196 (January 18, 2001), is likely to have effects cumulative with those of the CRE-FMP. Conservation measures included in the two NWHI Executive Orders (EOs) are described in FMP Section 9.2. The anticipated potential impacts of the NWHI

EOs to Hawaii fisheries could be substantially negative, depending on how aspects of the conservation measures are clarified and the outcome of President George W. Bush's Administration's review. If fully implemented, the Reserve could eliminate current and future sustainable, profitable, and environmentally sensitive commercial fishing in the NWHI, directly and through attrition. Estimated cumulative effects are discussed in Sections 5.2 through 5.12 of this EIS.

The Reserve is intended to be a temporary management regime until completion of the process to designate the NWHI as a National Marine Sanctuary. The Secretary of Commerce has stated (in a letter to the Council Chairman, June 21, 2001) that "while the sanctuary designation process and review of the NWHI EOs are underway, the Department will continue to use conservation and management measures under existing statutory authorities, including the Magnuson-Stevens Fishery Conservation and Management Act."

On January 19, 2001, the NOAA/NOS Office of National Marine Sanctuaries announced its intent to initiate the Sanctuary designation process for the Reserve pursuant to sections 303 and 304 of the National Marine Sanctuaries Act (16 U.S.C. 1433, 1434). During this process, NOAA will prepare an environmental impact statement and management plan, which will examine the management, boundary, and regulatory alternatives associated with sanctuary designation. As required, NOAA must also initiate public scoping meetings to solicit information and comments on the range and significance of issues related to sanctuary designation and management.

In designating the sanctuary, the December 4, 2000 Executive Order "directs the Secretary of Commerce to supplement or complement the existing Reserve, and ... in consultation with the Governor of the State of Hawaii, determine whether State submerged lands and waters should be included as part of the Sanctuary." How the Reserve will ultimately affect the CRE-FMP, and existing FMPs, depends on the outcome of the Administration's ongoing review of the EOs and clarification of the conservation measures that remain ambiguous. For example, the draft Reserve Operations Plan does not clarify how individual fishing caps will be determined, nor how straight-line boundaries will be drawn. Impacts of the EOs (as best estimated) would generally fit within the range of alternatives analyzed in the EIS, most closely approximating Alternative 4 "maximum additional protection to coral reef resources," where all EEZ waters 0-100 fm would be a no-take MPA. The likely cumulative effects of the NWHI CRE Reserve on specific components of the environment are preliminarily assessed below. Table 5.1 compares the main measures of the CRE-FMP (the Preferred Alternative) to the conservation measures of the EO, as best understood.

Table 5.1: Comparison between the management measures of the WPRFMC's CRE-FMP (preferred alternative) and the NWHI Coral Reef Ecosystem Reserve Executive Order.

Coral Reef Ecosystem FMP- In general, the FMP does not differentiate between commercial and recreational fishing (Alternative 3)	**EO establishing the NWHI Reserve- management measures differ for commercial vs. recreational fishers**
Effects on Existing NWHI Fisheries	
All fisheries: No-take marine protected areas (MPAs) around all NWHI and reefs from 0-10 fm and 0-50 fm around Laysan Island, French Frigate Shoals and the northern half of Midway Atoll. Limited fishing allowed under special permit for all waters designated as low-use MPAs (all federal waters 10-50 fathoms in NWHI; and 0-50 fathoms around Johnston, Palmyra and Wake Atoll, and the southern half of Midway Atoll). Vessel insurance to cover the cost of clean up and wreck removal is required when operating or transiting through MPAs; Nighttime spearfishing with scuba gear is prohibited. Fishing with poisons, explosives or intoxicating substances is prohibited.	**All fisheries:** Restricted within Reserve boundaries (50 miles around all NWHI) and Reserve Preservation Areas (RPAs). RPAs extend: (1) to a depth of 100 fathoms (fm) around Nihoa and Necker Islands, French Frigate Shoals, Gardner Pinnacles, Maro Reef, Laysan and Lisianski Islands, Pearl and Hermes Reef, and Kure Atoll, and (2) to a distance of 12 nautical miles (nm) around the first bank east of French Frigate Shoals, Southeast Brooks Bank, St. Rogatien Bank, the first bank west of St. Rogatien and east of Gardner Pinnacles, Raita Bank and Pioneer Bank. Limited commercial bottomfishing and commercial and recreational trolling for pelagics allowed in all, or portions of 10 of 15 RPAs. No new gear-types allowed.
Pelagic fisheries: Continue 50 mile closure to longline fishing gear. Pelagic fishing in low-use MPAs via special permits permitted.	**Pelagic fisheries:** Commercial and recreational trolling for pelagics permitted at previous levels for historical participants within Reserve waters outside of 25 fm (within RPAs) around Nihoa and Necker Islands, Gardner Pinnacles, Maro Reef, and Lisianski Island; outside 50 fm (within the RPAs) around Laysan Island; and within the entire RPAs around St. Rogatien Bank, the first bank west of St. Rogatien Bank and east of Gardner Pinnacles, Raita Bank, and Pioneer Bank. Longlining prohibited. Other commercial fishing for pelagics allowed only beyond RPA boundaries, but limited to an individual's take in the year preceding 12/04/00. Increase of recreational fishing effort beyond historical levels prohibited throughout the reserve.
Bottomfish fisheries: Continue closure for armorhead around Hancock Seamount. Bottomfish fishing in low-use MPAs permitted for NWHI bottomfish limited entry permit holders. Continue limited entry program. (Under the Bottomfish FMP, permits required to fish for Bottomfish Management Unit Species in NWHI).	**Bottomfish fisheries:** Commercial fishermen who held NWHI permits as of 12/04/00 will be allowed to fish at previous levels within Reserve waters, and outside of 25 fm (within RPAs) around Nihoa and Necker Islands, Gardner Pinnacles, Maro Reef, and Lisianski Island; outside 50 fm (within the RPAs) around Laysan Island; and within the entire RPAs around St. Rogatien Bank, and Pioneer Bank. Fishing allowed for 5 years at the first bank west of St. Rogatien Bank and east of Gardner Pinnacles and Raita Bank subject to continuation after review. Each permittee's annual aggregate level of take is capped at that permittee's individual average taken over the five years preceding 12/04/00.

Effects on Existing NWHI Fisheries	
Crustacean fisheries: Continue closure to 20 miles at Laysan Island, 10 fm elsewhere. Lobster fishing in low-use MPAs permitted for NWHI crustacean permit holders. Continue limited entry program with annual area specific harvest guidelines. (Under the Crustaceans FMP, permits required to fish for Crustacean management unit species in the NWHI).	**Crustacean fisheries:** No commercial fishing allowed within the RPA. Outside of RPAs, no commercial fishing is allowed because landings during the year preceding 12/04/00 were zero and the level of permitted annual aggregate take cannot exceed a permittees individual take in the year preceding 12/04/00. Recreational fishing (outside of RPAs) may continue at historical levels, which are also likely to be zero.
Precious coral fisheries: Continue closure of Refugia bed. Precious coral harvest in low-use MPAs permitted for NWHI precious coral permit holders. Continue general access program with annual bed and area harvest quotas. (Under Precious Corals FMP, permits required to fish for Precious Corals management unit species).	**Precious coral fisheries:** No commercial fishing within the RPAs. Outside of RPAs, no commercial fishery is allowed landings from the NWHI if the previous year's landings were zero. Recreational fishing (outside of PRAs) may continue at historical levels (likely to be zero).

Effects on New NWHI Fisheries	
Operators intending to target any coral reef ecosystem management unit species within low-use MPAs, and those intending to target "Potentially Harvested" management unit species anywhere in the NWHI EEZ must obtain Special CRE permits, which are issued on a case-by-case basis.	No new fisheries permitted.

Effects on Native Hawaiian Subsistence and Cultural Uses	
Allows an exemption for the harvest of live hard coral for cultural and ceremonial purposes under special permit in low-use MPAs (10-50 fm). Framework provision to designate a set percentage of low-use MPAs in NWHI for sole use by Native Hawaiians.	Non-commercial subsistence, cultural, and religious activities by Native Hawaiians may be permitted in areas determined by the Secretary (including RPAs) as long as it does not cause injury to the coral reef ecosystem and associated marine species. Areas may be revised with adequate public comment.

Effects on Gear Use and Insurance Requirements	
Nighttime spearfishing with scuba gear is prohibited. Fishing with poisons, explosives or intoxicating substances is prohibited. Only the following selective and non-destructive gear and methods are allowed: (1) hand collection; (2) hook and line, except longline; (3) rod and reel; (4) dip net; (5) scoop net; (6) slurp gun; (7) barrier nets for ornamental fish only; (8) use of spear without scuba; (9) use of spear with Scuba from 6:00 am to 6:00 pm only; (10) traps with owner identification only; (11) surround nets/seine nets attended at all times; (12) remotely operated vehicles; and (13) submersibles, manned or unmanned. Vessel removal and pollution clean up insurance required for all fishing vessels operating in or transiting through MPAs.	Fishery participants may not change gear types without Secretarial approval. No new insurance requirements.
Effects on Monitoring and Adaptive Management	
Existing fisheries will continue logbook reporting and Fishery Management Plan requirements with annual reports; NWHI CRE fisheries will report via special permits with annual report on the fishery. Establishes framework process to provide rapid implementation of new regulatory measures based on the best available scientific and commercial information.	Allows commercial bottomfishing and recreational trolling for pelagics to occur within portions of RPAs, as described above, unless otherwise determined by the Secretary with adequate public comment. The Secretary, after consultation with Interior and the State of Hawaii, public review and comment, and consideration of recommendations, may further restrict fishing activities as necessary to protect Reserve resources, or may authorize or require alternate gear types. The Secretary may conduct or authorize research or monitoring activities within any RPA that furthers the management principles of the EOs. A "Reserve Operations Plan" must be developed that provides for research, monitoring, and assessment of the Reseve, and use of vessel monitoring systems for any vessel entering or transiting the Reserve, if warranted.

Effects on Midway-based Fishing Operations	
No-take MPA 0-50 fm in northern half of Midway Atoll Refuge. Special permits required for all fishers operating in the low-use MPA located 0-50 fm in southern half of Midway Atoll Refuge.	No effect within the boundaries of the national wildlife refuge because the refuge is outside the Reserve.
Effects on New and Existing Fisheries around the Main Hawaiian Islands	
Special permits required for target of "Potentially Harvested" coral reef taxa in the EEZ.	No effect.

Effects on New and Existing Fisheries Around the PRIAs	
No-take MPAs out to 50 fm at Jarvis, Howland, Baker Islands, Kingman Reef, and Rose Atoll. Low-use MPAs out to 50 fm at Palmyra Atoll, and Johnston and Wake Islands. Recreational fishing under special permit permitted in low-use MPAs. Nighttime spearfishing with scuba gear is prohibited. Fishing with poisons, explosives or intoxicating substances is prohibited. Special permits required for target of "Potentially Harvested" coral reef taxa in the EEZ.	No effects.
Effects on New and Existing Fisheries Around American Samoa, Guam, and the CNMI	
Special permits required for target of "Potentially Harvested" coral reef taxa in the EEZ. Fishing with poisons, explosives or intoxicating substances is prohibited. Prohibits anchoring on Guam's Southern Bank by fishing vessels larger than 50 ft.	No effects.
Miscellaneous Effects	
Attempts to develop indices of ecosystem health as targets for management, as well as to encourage and promote improved surveillance and enforcement. The CRE-FMP also promotes participation, fairness, and equity in policy and management.	Prohibition throughout the Reserve on: oil, gas or mineral production; drilling into or otherwise altering the seabed; discharging or depositing any material into the Reserve except fish chum, biodegradable effluent, wash water, and cooling water; unauthorized removal or damage to Reserve resources.

Public Participation Process	
Detailed Environmental Impact Statement (EIS) prepared, published, and submitted to the Environmental Protection Agency.	No Environmental Assessment or Environmental Impact Statement to date.
48 Public Hearings and Meetings held throughout the region.	Seven Public Hearings held (six in Hawaii; one in Washington D.C.).
Published individual responses addressing public comments.	No individual responses to public comments published to date.

The potential for fishing and non-fishing activities to have environmental effects depends on how they are managed through one or more of the following control measures: creation of marine protected areas, institution of permit and reporting requirements, designation of allowable fishing gear, and other management measures.

Each of alternatives analyzed in this EIS contains these four control measures in varying degrees. These four alternatives are detailed in Section 2.3. Alternative 1 (No-action) would implement no new regulations. Alternative 2 (Minimal Additional Protection) would designate several low-use MPAs, require permits for some takes of Coral Reef Ecosystem Management Unit Species (CRE MUS, see FMP Section 1.6.2), limit takes of live rock and coral, and prohibit the use of non-selective gears to harvest CRE MUS throughout the EEZ. In addition to low-use MPAs in remote areas, Alternative 3 (Substantial Additional Protection - the Preferred Alternative) would designate several no-take MPAs, require all fishing vessels transiting MPAs to carry wreck cleanup and removal insurance, and prohibit the use of nighttime spearfishing for CRE MUS with scuba and/or hookah gear in the EEZs of the NWHI and the PRIAs. Finally, Alternative 4 (Maximum Additional Protection) would also establish no-take MPAs out to 100 fathoms around all of the region's islands and atolls. These alternatives are summarized in Table 2.3.

Sections 5.2-5.12 analyze the consequences of the four alternatives on the subject areas that were identified during scoping, as discussed in Chapter 4. Each of these subject areas are components of the human environment. By section number, these components are: 5.2-target stocks; 5.3-non-target stocks; 5.4-protected species; 5.5-national wildlife refuge resources; 5.6-coral reef habitat (live rock, coral, essential fish habitat, etc.); 5.7-ecosystem biodiversity, structure and function; 5.8-native cultures; 5.9-existing fisheries and communities; 5.10-bioprospecting and other new fisheries; 5.11-non-consumptive values and uses; 5.12-administration and enforcement of regulations.

5.2 Environmental Consequences for Target Stocks (Management Unit Species)

To date, Alternative 1 (No-action) has prevented overfishing for currently-harvested coral reef taxa in the EEZ, but it may not adequately protect coral reef resources from new harvest pressures. Council FMPs can only close federal or EEZ waters; they cannot regulate the state or territorial areas immediately surrounding most inhabited areas. Because of this jurisdictional

constraint, Alternatives 2 through 4 could redirect some fishing effort for currently-harvested resources away from no-take zones to fully exploited sub-populations in state waters. Nevertheless, all these alternatives would reduce the risk of overfishing for coral reef resources in EEZ waters.

5.2.1 Direct Effects on Target Stocks

Overfishing

Individual sub-populations of larger stocks of reef species may increase, decrease or cease to exist locally without adversely affecting an overall population. The condition of an overall population of a particular species is linked to the variability among sub-populations: the ratio of sources and sinks, their degrees of recruitment connection, and the proportion of the sub-populations with high variability in reproductive capacity.

Coral reefs in remote areas of the EEZ are not in danger of being overfished by existing fisheries for currently-harvested resources (Green 1997). Therefore, none of the alternatives to designate MPAs in remote areas of the EEZ are expected to have any effect on overfishing that is substantially different from that of Alternative 1 (No-action). However, MPAs may provide a reservoir of unexploited spawning biomass as "insurance" against recruitment failure in nearby sub-populations, so the broader designation of MPAs in Alternative 4—which would include EEZ waters around the main inhabited islands of American Samoa, Guam, the Northern Mariana Islands and Hawaii, in addition to remote reefs—would likely have a greater beneficial impact on target stocks in comparison to the No-action alternative. This is because some stocks in nearshore reef areas under island government jurisdiction have been locally overfished (Green 1997) and adjacent MPAs could be beneficial in restocking these areas.

The largest existing reef-related fisheries are hook-and-line bottomfishing in the EEZ around American Samoa, Guam, the Northern Mariana Islands, the MHI, and the NWHI, and lobster trapping around some of the NWHI. These fisheries are, and will continue to be, managed and closely monitored under separate state and federal fishery management plans in order to prevent overfishing. Therefore, none of the alternatives is likely to have significant direct effects on these stocks. Bottomfish and lobster fishing effort in the EEZ around the NWHI is controlled by limited entry permits and other measures, including boat size limits for bottomfishing vessels and annual harvest guidelines for lobster trapping. American Samoa, Guam, and CNMI EEZ fisheries for bottomfish and lobsters are currently quite small (less than $0.2M).[1]

New fisheries, such as bioprospecting, could target potentially-harvested coral reef taxa for which sustainable yields have not yet been determined. The detailed permit controls (i.e., special permits) in remote coral reef areas required under Alternatives 2-4 would be beneficial because

[1]A summary of landings and value of the region's coral reef resources is included in the description of the fishery section of the FMP. Chapter 4 of the CRE-FMP specifies MSY, OY, and overfishing, and domestic harvesting/processing capacity, as required by the MSFCMA.

proposals to take potentially-harvested resources would be carefully scrutinized before permits would be approved. The highly discretionary nature of special permit review and approval would allow specific activities to be disapproved if they are likely to bring about ecosystem or targeted stock overfishing. Issuance of permits and associated landings could be closely monitored to maintain harvests at safe levels while new resource information is acquired to estimate sustainable yields. Permit holders in other FMP-managed fisheries will continue to provide information on currently harvested resources; thus additional permit requirements for these managed fisheries will not further the objective of preventing overfishing.

The gear controls common to Alternatives 2-4 allow only selective methods of fishing and would more effectively prevent overfishing of both Currently Harvested and Potentially Harvested Coral Reef Taxa in comparison to Alternative 1 (No-action). Restrictions on the use of spear fishing with scuba under Alternatives 3 and 4 would also limit harvest rates. Most of the spawning adults of the more valuable food fish species are fully exploited in shallow waters near the major inhabited islands, and the deep portion of the spawning biomass should be conserved to prevent recruitment overfishing. Scuba-assisted fishing has the potential to harvest reproductive adults throughout their entire depth range. Because many of these species are especially vulnerable at night, prohibiting scuba-assisted fishing at night would provide a significant benefit to the deep-water portion of the spawning stocks, compared to Alternative 1 (No-action). The third alternative's prohibition of this gear at night in the NWHI and PRIA EEZs would provide substantial refuge for target stocks, while the fourth alternative's prohibition throughout the EEZ at all times would protect a wider area. However, the additional prohibition on its use during the day is not expected to make a significant difference because it is the nighttime vulnerability of these species that is of highest concern.

Measures under Alternatives 2 and 3, which would limit the commercial harvest of live rock and coral, would relieve pressure on species that are slow growing and have low turnover rates, while the fourth alternative's complete prohibition on all commercial take of live rock and coral would provide even greater protection to these species. Due to a lack of an FMP for these resources, their current EEZ harvest levels are unknown but believed to be low.

5.2.2 Indirect Effects on Target Stocks

Redirection of fishing effort

The designation of no-take MPAs in Alternatives 2-4 could displace existing fishing and redirect this effort to areas where the same stocks may be fully exploited, thereby increasing the risk of localized overfishing. The deeper seaward boundaries and broader designation of no-take MPAs under Alternative 4 could lead to the greatest redirection of fishing effort, while the inclusion of low-use MPAs (which allow limited fishing) in Alternatives 2 and 3 provide a lesser likelihood of significant redistribution of fishing effort and resultant indirect effects on target stocks.

The detailed special permit requirement in Alternatives 2-4 also has the potential to redirect effort if it proves too difficult to obtain permits for desirable resources. Given their ongoing

regulation under other FMPs, the exemption for harvest of those MUS by other FMP permit holders would be expected to safely reduce the probability that these operations would move to new areas.

Alternatives prohibiting in the EEZ popular but non-selective fishing gear regularly used to harvest CRE MUS in nearshore coral reef fisheries are much more likely to redirect fishing effort to fully exploited nearshore stocks as restrictions increase in scope from Alternative 1 (No-action) to Alternative 4. An objective of the FMP is to collaborate with other agencies and share in decision-making and monitoring to ensure redirection of fishing effort does not impact adjacent fishery resources in state waters.

Alternatives 3 and 4 will restrict any such new fishing effort to nearshore areas where scuba fishing is permitted by some island governments. If this gear is prohibited only in remote areas, where there is currently very little such fishing (Alternative 3- the Preferred Alternative), there would be no effort to redirect, so the impact would be similar to that of Alternative 1 (No-action). It is likely that Alternative 4 would have the greatest potential to redirect fishing effort into nearshore areas because it prohibits this gear at all times. In contrast, Alternative 1 (No-action) would allow this currently increasing effort to expand into the EEZ.

Recruitment

To be useful to fisheries and to promote the conservation of coral reef resources on a broad scale, MPAs should serve as sources of reproductive output to replenish larger surrounding areas. It has been suggested that linking populations among MPAs over a broad area is necessary to assure restocking. Recruitment to populations of coral reef organisms depends largely on the pathways of larval dispersal and "downstream" links. One must ask, are the connections sufficient to actually restock distant sub-populations or only enough to maintain a homogenous genetic stock? Existing information is insufficient to quantify the potential impacts of the various MPA schemes proposed in each alternative on the recruitment of target resources. However, if larger MPAs result in more recruitment, then the successively larger areas designated as MPAs in Alternatives 2-4, respectively, should result in corresponding increases in recruitment of CRE MUS, compared to Alternative 1 (No-action).

5.2.3 Cumulative Effects on Target Stocks

Cumulative effects on target stocks could occur if natural events, such as hurricanes and winter storms or increases or decreases in the nutrient flux into the coral reef system, are coupled with fishing pressures in the EEZ. A series of winter storms or an increase in sea surface temperature due to an El Niño event may cause coral reef mortality. Living coral reef is believed to support a higher level of biomass than dead reef. The amount of nutrients flowing into the coral reef ecosystem is difficult to quantify, but is directly proportional to the amount of biomass the reef will support. Any of these events will likely cause stress to stocks. When these occur in conjunction with fishing, stocks could become further depleted.

Alternative 1 (No-action) does not take into account the synergistic effects of natural stressors with fishing pressure. No mechanism would be in place to diminish fishing pressure under a naturally stressed ecosystem. The creation of low-use MPAs under Alternative 2 would allow better monitoring of fishing activity and let managers react to a changing environment. The Preferred Alternative institutes some no-take MPAs; these areas would be free from fishing pressure and could preserve some healthier stocks during periods when the reef is less productive. Alternative 4, with 100% of coral reefs throughout the region designated no-take MPAs, removes all fishing pressure so that natural population variations would occur. Both Alternatives 3 and 4 will accommodate the study of natural fluctuations in coral reef ecosystem populations, which could help managers to better understand the cumulative effects of fishing pressure and natural stressors.

Because this FMP can only regulate fishing activities in the EEZ, none of the alternatives would prevent overfishing of currently-harvested or potentially-harvested coral reef resources in nearshore areas regulated by island governments. Localized overfishing of high-value species is known to be occurring in the most accessible reef areas near island population centers (Green 1997).

Cyclical oceanographic events—which affect productivity over extensive areas and may account for large fluctuations in population abundance—are perhaps the most important factor in the population dynamics of many coral reef species and ecosystems in the NWHI, and likely elsewhere in the Western Pacific Region. In a study of recent climatic and oceanographic events and their effect on productivity in the NWHI, Polovina *et al.* (1994) found that 30-50% declines in the abundance of a number of species representing various trophic levels, from the early 1980s to the present, could be explained by a shift in oceanographic conditions. In contrast, oceanographic conditions during the late 1970s and early 1980s moved nutrient-rich deep ocean water into the euphotic zone, resulting in higher survival of reef fish, crustaceans, monk seals and birds. Specific management measures to address such environmental changes are not directly incorporated in any alternative. But the CRE-FMP (the Preferred Alternative) includes a non-regulatory framework procedure for timely and rapid adjustments based on feedback from the monitoring of fisheries and resource conditions. (Note that Alternatives 2-4 also include the monitoring component.) In addition, the requirement for special permits under Alternatives 2-4 would easily allow managers to change allowed harvest levels for most CRE MUS.

The conservation measures contained in the NWHI EOs would likely reduce all fishing activities in the NWHI with the exception of fishing based on Midway Atoll NWR, which is not part of the NWHI Reserve. The NWHI EOs caps commercial and recreational fishing at levels of effort and take of the year preceding December 4, 2000. Under the Code of Federal Register §660.12, the fishing begins on January 1, and ends on December 31. (The "year preceding December 4, 2000" as described in the EO is ultimately undefined). For commercial bottomfish permit holders, the level of effort and take will be each permitee's individual average taken over the past five years. Additionally, the NWHI EOs will allow only those fisheries that were permitted in the year preceding December 4, 2000 to continue. Before the date of the order there was no permitted NWHI coral reef fishery in operation; therefore, no such fishery would be allowed in the NWHI.

Further, no NWHI commercial crustacean or precious coral permits were active in the year preceding the initial executive order, resulting in a harvest cap of zero for those fisheries. As a result, the NWHI EOs are likely to preclude these fisheries from operating in the NWHI, which would alleviate all commercial fishing pressures on those target stocks.

Of the existing FMP fisheries permitted to operate in the NWHI, only the bottomfish fishery would be allowed to continue, with specific depth restrictions in federal waters in 10 of the 15 RPAs. It is expected that these depth restrictions would reduce the amount of suitable bottomfish habitat currently available to the fishery by nearly 60%, thus allowing these areas to be free from fishing pressure. As a result, bottomfishing effort will be shifted into more confined locations. However, should the fishery maintain a level of effort and take equal to the aggregate average taken over the past five years, it is expected that fishing pressures on target stocks in certain productive areas will increase, potentially resulting in localized depletions similar to that of the MHI.

Overall, the effects on bottomfish target stocks as a result of the NWHI EOs would be similar to that of the Preferred Alternative, with much reduced fishing pressure. For all other target stocks, the implementation of the NWHI EOs would be similar to Alternative 4 with primary effects due to natural variations.

5.2.4 Consistency with Other Plans and Policies for Target Stocks

Alternatives likely to cause substantial displacement of existing bottomfish and lobster fishing activities in the EEZ would prevent sustainable use and optimum yield of those resources, which are the main objectives of the FMPs for Bottomfish and Crustaceans.

5.2.5 Mitigation Measures for Effects on Target Stocks

If environmental fluctuations or other natural or human factors change target resource conditions so that there is a greater risk of overfishing, timely preventive action can be taken under the framework adjustment procedures included in the already-implemented bottomfish, crustaceans, and precious corals FMPs, and in the CRE-FMP (the Preferred Alternative). Future adjustments could include such actions as changes in MPA boundaries, in the number of special permits or their conditions of use, in the fishing gear that is allowed or not allowed, or designation of new MPAs.

5.3 Environmental Consequences for Non-Target Resources

Alternative 1 (No-action) adequately minimizes bycatch in fisheries for currently harvested coral reef resources in the EEZ, but it does not consider the potential for indirect effects on non-target resources through food web relationships. Alternatives 2, 3 (the Preferred Alternative), and 4 could redirect some fishing effort from no-take zones to areas where non-target resources are more fully exploited, but they would address the potential food web effects of fishing through scientific review of applications to fish potentially harvested resources.

5.3.1 Direct Effects on Non-Target Resources

Bycatch

Most of the fishing methods presently used to harvest coral reef resources around the U.S. Pacific Islands are relatively selective, and bycatch (i.e., discards) is negligible because almost all of the species taken can be eaten or sold. The principal exceptions are fish species that are considered to pose a high risk for ciguatera poisoning. The largest existing reef-related fisheries are hook-and-line bottomfishing in the EEZ around American Samoa, Guam, the CNMI, the MHI and the NWHI, and lobster trapping off some of the NWHI. These fisheries are already managed and closely monitored under separate FMPs to minimize bycatch, so none of the alternatives are likely to have direct effects significantly different from those of the No-action alternative. Bottomfish and lobster fishing effort in the EEZ around the NWHI is controlled by limited entry permits and other measures, including boat size limits for bottomfishing vessels and annual harvest guidelines for lobster trapping. Indiscriminate gears—including bottom trawls, dredges and bottom-set nets—are already prohibited by these FMPs. Lobster traps must have escape vents, which minimize bycatch. Bottomfishing vessels are often equipped with electronic navigational devices to relocate fishing areas, and sonar devices to target productive habitat and fish aggregations. This gear is relatively selective, with the ability to successfully target particular species groups, depending on the skill of the vessel captain. Experienced vessel crew have the ability to catch the desired species with little non-target catch. It is, however, impossible to completely avoid non-target species with most hook-and-line fishing methods.

The greatest potential for large unintended catch or bycatch would come from live rock collection or potential new fisheries that harvest a broader spectrum of resources than existing fisheries. Alternatives 3 and 4, which designate no-take zones in remote reef areas of the EEZ, provide a larger reservoir of unexploited spawning biomass than Alternatives 1 (No-action) and 2. These reservoirs act as "insurance" against recruitment failure in nearby sub-populations of non-target resources but the potential for actual restocking of other areas through recruitment cannot be evaluated with available scientific information. Broader designation of MPAs around the main inhabited islands of American Samoa, Guam, the CNMI and Hawaii, in addition to those around remote reefs, may have less ambiguous recruitment benefits than the No-action alternative or designating MPAs only in remote areas. Alternatives 3 and 4, which zone a larger part of MPAs as no take zones, would enlarge the reservoir of unexploited spawning biomass more than Alternatives 1 and 2, but the potential for actual restocking of other areas through recruitment cannot be evaluated with available scientific information.

Alternatives 3 and 4, which require a special permit and detailed reporting requirements to take potentially-harvested coral reef resources in some areas of the EEZ, would keep harvesting at low levels relative to natural environmental disturbance and mortality levels. More data could then be collected to estimate biological reference points and determine sustainable yields for species about which little is known. Alternative 1 (No-action) does not provide such safeguards against high levels of bycatch in new fisheries characterized by broad spectrum resource harvesting—such as bioprospecting.

Alternatives that prohibit approval of permits for commercial collection of live rock and stony coral would reduce the incidental take of other organisms, which is unavoidable when habitat is removed. Under the No-action alternative, removal of live rock and stony corals is regulated by island governments, and only in state waters.

Alternatives 2-4, which would only allow selective fishing gear in the EEZ or in parts of the EEZ, are expected to keep bycatch at lower levels than the No-action alternative. If selectivity is not a criterion in allowing gear, the impact would differ little from that of the No-action alternative. Scuba-assisted fishing is generally highly selective and has no bycatch, so none of the alternatives that control it would result in any more bycatch, compared to Alternatives 1 and 2, which do not control that practice.

5.3.2 Indirect Effects on Non-Target Resources

Food Web Effects

Coral reef ecosystems are comprised of multi-species resources that share a long co-evolutionary history. Removal of some species may cause undesirable changes in the abundance of other species through predator-prey relationships. Food web effects are poorly understood for coral reef ecosystems. Alternatives 3 and 4, which designate no-take MPAs, can compensate for this lack of understanding by holistically conserving the ecosystem. Existing levels of coral reef resources fishing in the EEZ are relatively low, however. Whether alternatives to designate MPAs in remote reef areas only would have any detectable effects different from those of Alternative 1 (No-action) is difficult to assess against the background of high natural variability in coral reef ecosystems. Alternative 4, which designates MPAs in reef areas adjacent to major inhabited island groups where fishing is heavy, is more likely to have detectable effects that differ from the No-action alternative. The removal of prey or alteration of prey assemblages by existing bottomfish and lobster fishing activities in the NWHI appears to be minimal URS Corp. in prep.), especially in comparison to the high levels of prey consumed by large jacks (Sudekum *et al.* 1991).

New fisheries, such as bioprospecting, could target potentially harvested coral reef resources whose role in the food web is poorly understood. Alternatives 2-4, which require a special permit and detailed reporting requirements in order to take potentially-harvested coral reef resources in some areas of the EEZ, would allow proposals to be carefully scrutinized before permits are approved. This could keep harvesting at low levels, relative to levels and frequency of natural environmental disturbance and mortality, while data are collected to assess possible food web effects. The highly discretionary nature of the special permit review process would allow specific activities to be disapproved if there is a risk of adverse food web effects. The No-action alternative does not provide such safeguards in new fisheries, such as bioprospecting, which may be characterized by broad spectrum resource harvesting.

5.3.3 Cumulative Effects on Non-Target Resources

Only fishing activities in the EEZ would be managed by the CRE-FMP (the Preferred Alternative). None of the alternatives would prevent high fishing mortality of non-target coral reef resources that are currently-harvested or potentially-harvested in nearshore areas regulated by island governments. The most accessible reef areas near island population centers are heavily fished (Green 1997).

Allowances for cyclical oceanographic events that affect productivity, discussed elsewhere in this chapter and in Section 3.2.1, are not directly incorporated in any alternative, but the CRE-FMP includes a framework procedure for timely and rapid regulatory adjustments based on feedback from monitoring of changing fisheries and resource conditions.

As the NWHI EOs prevent fishing for coral reef resources (previously unpermitted), impacts on non-target resources by reef-directed fisheries would be negligible. Incidental catch is rare in most Pacific Island reef fisheries because almost everything that is harvested is utilized in some way. Under the EO provisions, the crustacean and precious corals fisheries harvest levels would be capped to zero. Similarly, the bottomfish fishery would also be restricted from operating in a significant portion of the historical bottomfishing grounds. These restrictions would concurrently reduce associated incidental take of CRE MUS by these fisheries.

5.3.4 Consistency with Other Plans and Policies for Non-Target Resources

The Preferred Alternative (3) may cause some existing bottomfish and lobster vessels to be displaced from certain fishing areas, however, Alternative 4, would likely cause substantial displacement of existing bottomfish and lobster fishing activities in the EEZ. This would reduce the data that are collected about incidental catches in these fisheries under the reporting requirements of the FMPs for Bottomfish and Crustaceans. A special permit and reporting requirement, part of Alternatives 2-4 and applying to all coral reef fishing activities in the EEZ around Palmyra, Johnston and Wake Atolls and off the southern half of Midway Atoll is consistent with special permits required by the USFWS for entry and use of National Wildlife Refuge (NWR) resources associated with those islands.

5.3.5 Mitigation Measures for Effects on Non-Target Resources

The current management regime (the No-action alternative) under the FMP for Crustaceans includes mandatory trap escape vents, which reduce incidental catch of non-target resources.

If environmental fluctuations or other natural or human factors change non-target resource conditions so that fishing mortality presents a higher risk to the system, timely preventive action can be taken under the framework adjustment procedures included in the established FMPs for bottomfish, crustaceans and precious corals and in the CRE-FMP. Future adjustments could include such actions as changes in MPA boundaries, in the number of special permits or their conditions of use, in the fishing gear that is allowed or not allowed, or designation of new MPAs.

5.4 Environmental Consequences for Protected Species and Non-Endangered Marine Mammals

Alternative 1 (the No-action alternative) provides some protection to listed species present in the action area. Alternative 2 provides some additional protection by establishing low-use MPAs to a depth of 50 fm around all NWHI. The Preferred Alternative (3) reinforces existing protected species zones established under other FMPs and provides a higher level of protection by enlarging no-take zones off the two islands that are most important for breeding by the endangered Hawaiian monk seal in the NWHI. French Frigate Shoals, which provides habitat for the largest colony of monk seals and where prey availability may be a factor limiting population recovery, is one of the areas where no-take zones would extend to a depth of 50 fm offshore under the Preferred Alternative. The second largest monk seal colony occurs at Laysan Island, where the no-take zone would also be enlarged under the Preferred Alternative, compared to the No-action alternative. Alternative 4 would provide the most protection to protected species and non-endangered marine mammals by creating a no-take MPA throughout the region's EEZ in all areas shallower than 100 fm.

5.4.1 Direct Effects on Protected Species and Non-Endangered Marine Mammals

Direct interactions of Hawaiian monk seals with existing fisheries in the NWHI are rare (URS Corp. in prep). and a low level of risk would remain under all alternatives, including the No-action alternative. However, there have been three documented cases of monk seals hooked at Kure Atoll by recreational fishermen (Henderson 1998), and it is clear that the sport fishery at Midway Atoll has the potential to interact with monk seals. Alternatives 2 and 3, which require detailed permit control and reporting of existing fishing in low-use MPAs, including recreational and subsistence activities at Midway, would provide more information about interactions than provisions in the No-action alternative would. Alternative 4 would prevent direct interactions with protected species and non-endangered marine mammals by creating a no-take MPA throughout the region's EEZ in all areas shallower than 100 fm.

Direct interactions between Hawaiian monk seals and fishermen targeting bottomfish have occurred both in the NWHI and the MHI under the No-action alternative. However, accidental hookings of monk seals or other marine mammals have been reported or observed only rarely in these fisheries (Nitta 1999). In 1982, a monk seal was photographed at French Frigate Shoals with a circle hook in its mouth. This type of hook is used in numerous fisheries, including the bottomfish fishery. The seal was later seen alive without the hook (Nitta 1999). In 1989, the hook from a slide-bait rig was observed in the mouth of a female monk seal near Kauai (Nitta 1999; K. Kawamoto, pers. comm. 2000, NMFS-HL). This type of fishing gear is typically used during shoreline fishing, and is not employed in the NWHI bottomfish fishery. The hook was removed from the seal with no apparent serious after-effects (Nitta and Henderson 1993). State of Hawaii observers deployed on commercial bottomfish fishing vessels in 1981 and 1982 recorded no interactions with monk seals or other marine mammals (Nitta 1999). The NWHI bottomfish fishery was monitored by NMFS observers from October 1990 to December 1993 with about 13% vessel coverage (Nitta 1999). No Hawaiian monk seals were observed hooked or entangled in fishing gear.

In 1990, there were allegations that some fishermen were intentionally killing or injuring monk seals in order to stop them from stealing fish and bait from hooks (NMFS 1991). At that time a number of dead monk seals were observed by NMFS researchers with head injuries that did not appear to have been inflicted by sharks or other natural predators. However, there was no evidence that the fatalities were caused by bottomfish fishermen. The only documented case of an illegal killing of a Hawaiian monk seal occurred when a resident of Kauai killed an adult female in 1989 (NMFS 1996). Since 1990, no additional monk seals have been sighted with injuries suspected of being intentionally inflicted by humans (G. Antonelis, pers. comm. 2000, NMFS-HL).

The NMFS observer program for the NWHI bottomfish fishery conducted from October 1990 to December 1993 reported no interactions between sea turtles and the bottomfish fishery (Nitta 1999). Continued bottomfish fishing in the NWHI is expected to have little effect on sea turtles in the region under all alternatives (URS Corp. in prep.). The observer program also reported a moderate level of interactions between seabirds and the bottomfish fishery, characterized by attempted bait theft only when trolling for pelagic MUS. Although there is a possibility of accidental hooking, circle hooks used in the bottomfish fishery do not lend easily to snagging. No seabird injuries or mortalities were reported while fishermen were fishing for bottomfish. One interaction involving a Laysan albatross occurred while a bottomfish fishing vessel was trolling for pelagic species. The bird became hooked, but was subsequently released alive. While continued bottomfish fishing may affect a limited number of individual seabirds, it is expected to have no effect on seabird distribution, survival, or population structure. The NWHI lobster fishery does not use gear that is likely to cause any interactions with seabirds and none have been reported or are expected under any of the alternatives (URS Corp. in prep.).

Direct interactions of Hawaiian monk seals with the NWHI lobster fishery are rare. In 1986, a monk seal was entangled and drowned in the trap bridle and main lines of a string of lobster traps in the vicinity of Necker Island (Nitta and Henderson 1993). This is the only reported mortality of a monk seal associated with the lobster fishery. The low level of risk of such direct interactions would be reduced (in comparison to the No-action alternative) under alternatives that extend no-take zones off French Frigate Shoals, which provides habitat for the largest colony of monk seals in the NWHI.

There have been no reported interactions by NWHI fisheries with species of whales listed as endangered under the Endangered Species Act, but there is always a low level risk of behaviorial disturbance or vessel collision under any of the alternatives. Several species of marine mammals that are protected under the Marine Mammal Protection Act, but are not listed as threatened or endangered, occur in the areas where bottomfish fisheries operate. The NMFS observer program for the NWHI bottomfish fishery conducted from October 1990 to December 1993 reported interactions between bottlenose dolphins and the bottomfish fishery (Nitta 1999). No dolphins were observed hooked or entangled in fishing gear. Interactions were characterized by removal of fish catch from bottomfish fishing lines. Dolphins interacting with fishing operations typically stayed with vessels as long as fish were being retrieved. Analysis of observer reports determined a dolphin interaction rate of one event per 37.7 hours of fishing; however, this rate of interaction

is grossly overestimated as many bait stealing events were assumed to be taken by a monk seal and not directly observed. This estimated level of interaction between dolphins and the bottomfish fishery would continue under all alternatives. There have been no reported interactions of the NWHI lobster fishery with whales or dolphins and this is expected to continue for all alternatives (URS Corp. in prep.).

5.4.2 Indirect Effects on Protected Species

Interactions are characterized by removal of fish catch from bottomfish fishing lines. Some seals showed no fear of vessels and exhibited an apparent familiarity with certain vessels. In those areas heavily targeted by bottomfish fishing vessels, conditioning of monk seals to associate vessels with easy meals may have occurred. By analyzing observer reports, a monk seal interaction rate of one event per 67.4 hours of fishing was calculated; however, this interaction rate is grossly overestimated as observers assumed monk seals were stealing fish from the gear and did not actually observe the action. In some interactions monk seals were observed consuming discarded bottomfish, which could contain high levels of ciguatoxin or other biotoxins (Nitta and Henderson 1993; Nitta 1999). In particular, *kahala* are often discarded during bottomfish fishing operations because large specimens have a reputation for carrying worms and ciguatoxin and, consequently, are not accepted for sale in the Honolulu fish auction. However, two studies in the NWHI found that *kahala* tested positive for ciguatoxin much less frequently than shallow-water species, such as wrasses, that are known to be significant monk seal prey items (Goodman-Lowe 1998; Ito *et al.* 1983; Kimura *et al.* 1984).

Poisoning by ciguatoxin or related toxins was suspected as the primary cause of death of at least 50 monk seals at Laysan Island in 1978, and may have been a contributing factor to the high mortality of juvenile seals translocated to Midway Atoll in 1992 and 1993 (NMFS 1997). However, evidence proving that marine toxins caused or contributed to these monk seal deaths is lacking (T. Work, pers. comm.). Moreover, there is no evidence that monk seals are susceptible to ciguatoxin poisoning. Given that frequently highly ciguatoxic fish, such as moray eels and wrasses, make up a substantial portion of the diet of the Hawaiian monk seal suggests that the seals are resistant to ciguatoxin.

Alternatives 3 and 4 would enlarge no-take zones around the NWHI, providing additional buffer zones, but it is highly debatable whether this action would reduce food competition with monk seals any more than the No-action alternative. The removal of prey or alteration of prey assemblages by existing bottomfish and lobster fishing activities in the NWHI appear to be minimal (URS Corp. in prep.), especially in comparison to the high levels of prey consumed by large jacks (Sudekum *et al.* 1993). According to research on the diet of monk seals, the commonly caught species in the bottomfish fishery are a small fraction of the total number of monk seal prey items. The NWHI lobster fishery has the potential of interacting with the Hawaiian monk seal indirectly by reducing prey availability. According to NMFS, however, there are insufficient data at this time to support statements that the fishery affects any important source of prey for any species of mammal, including the monk seal (URS Corp. in prep.). The potential for indirect interaction with seabirds due to competition for prey is negligible, because

seabirds do not prey on bottomfish. In those areas heavily targeted by bottomfish fishing vessels, conditioning of dolphins to associate vessels with easy meals may be occurring. Such a food subsidy may be a positive direct impact, although consumption of fish with high concentrations of ciguatoxin could be a negative direct impact if these marine mammals are susceptible to the toxin.

The accidental grounding of fishing boats can also adversely affect coral reefs and other types of bottom habitat used by Hawaiian monk seals and sea turtles. The impact of a vessel striking the bottom can physically destroy coral colonies in the immediate area, and the possible subsequent break-up of the vessel and release of fuel and oil can result in pollution of habitat and mortality of marine life. A grounding can also lead to the introduction of alien species, such as rodents or insects, that can have an adverse impact on terrestrial native fauna and flora in the area. Fishing vessel groundings in the NWHI are relatively rare events. Only two fishing boats have run aground in the area during the past 15 years—one was a swordfish longline vessel at Pearl and Hermes Reef, and the other a lobster boat at Kure Atoll. In both cases there was localized mortality of corals crushed under the hull, but no reported effects on surrounding areas.

None of the alternatives are expected to have any indirect effects on protected seabirds or on whales and dolphins different from those of the No-action alternative. Enlargement of the no-take zone off French Frigate Shoals, with conditions for vessel passage, would provide a higher level of protection for green turtle critical nesting habitat than the No-action alternative.

5.4.3 Cumulative Effects on Protected Species

None of the alternatives is likely to add significantly to cumulative effects of reef-related (non-pelagic) fisheries on species of sea turtles or seabirds listed under the ESA. Nor would any alternative change cumulative effects on non-endangered species of whales and dolphins.

The overall status of the endangered Hawaiian monk seal may be grave. Contributing to the species' decline in the NWHI over the past four decades have been changes in oceanographic productivity, shark predation, attacks by aggressive adult male monk seals on females and immature seals of both sexes, entanglement in derelict fishing gear originating in the North Pacific, marine toxins from past DOD activities, and human disturbance. Research and recovery activities are additional sources of human disturbance to the species (see Section 3.2.4). At each colony, differing combinations of these factors likely have contributed to local trends in abundance, with the relative importance of individual factors changing over time. A systematic assessment of the relative importance of various threats to the survival of the Hawaiian monk seal has not yet been conducted. However, the available information suggests that fisheries conducted in the NWHI under established FMPs, or that could be conducted under the CRE-FMP, account for a very small proportion of the potential impacts to the Hawaiian monk seal. To date, no information suggests that current direct or indirect effects of bottomfish and lobster fishing activities (e.g., change in prey availability) would inhibit the recovery of the Hawaiian monk seal (URS Corp. in prep.). This applies both to fisheries managed under other FMPs and expected levels of new fishing activities that could occur under the CRE-FMP.

Allowances for cyclical oceanographic events that affect productivity, discussed elsewhere in this chapter and in Section 3.2.1, are not directly incorporated in any alternative, but the CRE-FMP includes a framework procedure for timely and rapid regulatory adjustments based on feedback from monitoring of changing fisheries and resource conditions.

Cumulative effects of the NWHI CRE Reserve on protected species and non-endangered mammals could result in an increased risk, due to increased tourism, educational, research, and indigenous activities promoted in the Reserve. Increased visitation, and additional boats and infrastructure planned for the area, may ultimately have a negative impact on protected species. The draft NWHI Reserve Operations Plan identifies a budget and plans to construct warehouses on French Frigate Shoals (one of the most important NWHI areas for endangered Hawaiian monk seals and threatened green turtles) and Midway Atoll (which is not part of the Reserve) for boats and related field supplies. Frequent field trips would promote the Reserve and support goals for research, development of educational materials, and cultural studies. The logistics of these field activities could potentially increase the degree and frequency of disturbance and compound the environmental impacts to protected species.

Furthermore, studies by Antonelis and Ragen (1997) concluded that Hawaiian monk seals are extremely sensitive to human disturbances. Therefore, increased field research in monk seal habitat and management activities on monk seals could also have a negative impact on seal survival (J. Henderson unpubl. info.).

The conservation and management measures of the NWHI EOs focusing on commercial and recreational fishing are similar to Alternatives 3 and 4 of the CRE-FMP, and will likely reduce all fishing activity with the exception of fishing occurring at Midway Atoll NWR. The cumulative effects of the NWHI Reserve would be negligible because commercial fishery-related interactions with protected species are already rare. However, as mentioned earlier, other non-fishing activities may potentially impact protected species in the NWHI, depending on the areas and the degree to which they are allowed to occur.

5.4.4 Consistency with Other Plans and Policies for Protected Species

The CRE-FMP is consistent with other plans and policies for recovery and conservation of the Hawaiian monk seals, including the Hawaiian Monk Seal Recovery Team (HMSRT), the Marine Mammal Research Program, and the Marine Mammal Commission. The Preferred Alternative (3), applying the precautionary principle, proposes a no-take MPA in waters surrounding French Frigate Shoals to provide increased protection to the largest breeding colony of Hawaiian monk seals. For further discussion on monk seal recovery efforts see Section 3.2.4.

The CRE-FMP is consistent with the recovery efforts for sea turtles, marine mammals, and seabirds, and the proposed action under the preferred alternative is not expected to adversely affect any endangered or threatened species.

5.4.5 Mitigation Measures for Effects on Protected Species

The FMP for bottomfish and Seamount Groundfish contains management measures intended to monitor and mitigate interactions between the fishery and Hawaiian monk seals. The NMFS RA has the authority to place federal observers on board bottomfish vessels to record interactions with monk seals or other protected species, if this action is deemed necessary. In addition, before the NMFS RA issues a Mau Zone or Ho`omalu Zone limited access permit to fish for bottomfish, the primary operator and relief operator named on the application must have completed a protected species workshop conducted by NMFS. The HMSRT has suggested that direct interactions between monk seals and existing fisheries in the NWHI managed by other FMPs can best be mitigated by continuing to educate fishermen through briefing materials and workshops.

The FMP for crustaceans contains management measures intended to mitigate and monitor interactions between the NWHI fishery and Hawaiian monk seals. The maximum size restriction for lobster trap openings helps eliminate the potential for monk seal entrapments. No fishing zones in the NWHI (0-10 fm around all islands and 20 mile radius around Laysan) mitigate direct and indirect interactions between monk seals and the lobster fishery. The current management regime (the No-action alternative) also includes lobster harvest guidelines and mandatory trap escape vents, which reduce impacts on monk seal prey distribution and abundance. The NMFS RA is authorized to place an observer aboard a permitted vessel to determine if any interactions occur. The RA also has the authority to close the fishery if a report is received indicating a mortality of a monk seal due to the fishery. At present, vessels participating in the NWHI lobster fishery are not obligated to carry NMFS scientific data collectors. Since 1997, however, most vessel owners have allowed data collectors on board their boats during the fishing season. Not only do they gather catch and effort data but they record bycatch and any fishery interactions with protected species.

Prohibitions in both FMPs on the use of nets, explosives, and chemicals reduce the potential for incidental harm to monk seals and help protect their habitat. By reducing fishing effort in the NWHI, the limited access programs for FMP-managed bottomfish and lobster fisheries lower the potential for direct interactions, as well as the risk of vessel groundings and other accidents which could result in monk seal mortality and habitat degradation. The current "retain-all" policy of lobster fishery management reduces the potential for direct impacts from monk seals approaching lobster fishing vessels and feeding on discarded lobster.

As a result of recent litigation and its effects on fisheries locally and elsewhere, individual fishermen are more conscious of the seriousness of protected species interactions to the continuation of their livelihoods. Fishermen are now more inclined to implement methods to minimize such interactions. For example, NWHI bottomfish fishermen developed and agreed to use voluntary mitigation measures when or if they encounter monk seals during fishing operations. These recommendations were reviewed and approved by the Council and its advisory bodies.

It is possible that colonies of gold coral at sub-photic depths near French Frigate Shoals (FFS) may provide foraging habitat for the endangered Hawaiian monk seal, and the future harvest of live gold coral could have an adverse effect on the monk seal population at FFS by reducing the availability of prey species (URS Corp. in prep.). This potential impact has been addressed through a regulatory adjustment to the Precious Corals FMP that would suspend the harvest of gold coral throughout the EEZ around the NWHI while additional research is conducted on the relationship between monk seal foraging behavior and gold coral.

If environmental fluctuations or other natural or human factors change resource conditions so that fishing presents a higher risk, timely preventive action can be taken under the framework adjustment procedures included in the established FMPs for bottomfish, crustaceans, and precious corals and in the CRE-FMP. Future adjustments could include such actions as changes in MPA boundaries, the number of special permits or their conditions of use, the fishing gear that is permitted or prohibited, and also the designation of new MPAs.

5.5 Environmental Consequences for National Wildlife Refuge Resources

Alternative 1 (the No-action alternative) conserves National Wildlife Refuge (NWR) resources. Alternative 2 provides some additional protection to these resources by creating a low-use MPA around the NWHI to a depth of 50 fm. The Preferred Alternative (3) reinforces the no-take status of NWR resources and provides a higher level of protection by enlarging no-take zones off two islands in the Hawaiian Islands NWR and off all NWR islands in the Pacific remote island areas. Alternative 4 would provide the most protection to NWR resources by creating a no-take MPA throughout the region's EEZ in all areas shallower than 100 fm.

5.5.1 Direct Effects on NWR Resources

The accidental grounding of fishing boats can have an adverse effect on coral reefs by physically destroying coral colonies in the immediate area of impact and possible break-up of the vessel and release of fuel and oil causing additional habitat degradation and mortality of reef life. A vessel grounding can lead to the introduction of alien species, such as rodents or insects, which can have an adverse impact on terrestrial native fauna and flora on remote islands. Fishing vessel groundings in the NWHI are relatively rare events. Only two fishing boats have run aground during the past 15 years. In both cases there was localized mortality of corals crushed under the hulls, but no reported effects on surrounding reef areas (URS Corp. in prep.). Grounding of a foreign fishing vessel at Rose Atoll in 1983, however, caused more widespread damage (Green 1997).

Designation of extensive no-take zones, and permit and vessel operational controls in MPAs would reinforce existing protection of shallow reef resources off NWR islands and, in comparison to the No-action alternative, would extend no-take zones farther offshore in the EEZ around particularly sensitive NWR in the NWHI and PRIAs. This would also minimize the

potential for the introduction of invasive species into those sensitive environments by restricting access to all coral reef habitat areas within National Wildlife Refuges.

5.5.2 Indirect Effects on NWR Resources

Existing bottomfish and lobster fishing activities managed under other FMPs would be displaced from particularly sensitive reef areas in the NWHI under Alternatives 3 and 4. These fisheries are already regulated to limit bycatch, to prohibit destructive and non-selective gears, and to conserve EFH for the target stocks. The indirect effects of displacement on NWR resources are uncertain but they would, nevertheless, be reduced in particularly sensitive areas of the NWHI from the levels under the No-action alternative.

5.5.3 Cumulative Effects on NWR Resources

Alternatives 2, 3, and 4 reinforce the protected status of shallow reef resources adjacent to National Wildlife Refuge islands in the Western Pacific Region. Some of the activities that can degrade resources, however, are not controllable through unilateral management. One of the most serious problems in the NWHI is the accumulation of marine debris, largely derelict gear lost from North Pacific fisheries. Inter-regional and international management will be necessary to find solutions to this problem.

Allowances for cyclical oceanographic events that affect productivity, discussed elsewhere in this chapter and in Section 3.2.1, are not directly incorporated in any alternative, but the CRE-FMP includes a framework procedure for timely and rapid regulatory adjustments based on feedback from monitoring of changing fisheries and resource conditions.

In the NWHI the USFWS (Department of Interior) administers the Hawaiian Islands National Wildlife Refuge, which asserts boundaries to 10 fm around the islands and atolls from Nihoa to Pearl and Hermes, and to 20 fm around Necker. It also administers the Midway Atoll NWR, which is not included as part of the NWHI CRE Reserve. These refuges encompasses waters under the jurisdiction of the State of Hawaii, the Department of Commerce, and the Department of the Interior.

The Reserve and Refuge are similar in purpose. The draft NWHI Reserve Operations Plan includes an Action Plan for the cleanup and prevention of marine debris in the Reserve. Numerous agencies are already involved in such work and the bulk of the problem relative to habitat impacts is in shallow nearshore state waters, which are not part of the Reserve. Marine debris impacts on protected species are well documented. However, impacts to coral reefs and benthic habitat from the marine debris removal have not been assessed.

The no-take MPAs in the CRE-FMP mostly parallel the Hawaiian Island NWR boundaries in the EEZ. However, the CRE-FMP is stricter than the USFWS and the NWHI EOs in terms of the no-take areas designated for Midway Atoll NWR. The CRE-FMP establishes no take MPA for the northern half of Midway Atoll from 0-50 fathoms.

The cumulative effects of the NWHI CRE Reserve on NWR resources would be expected to be low since the EO states that nothing in the order shall enlarge or diminish the jurisdiction or authority of the DOI in managing its Refuge. The NWHI EOs would considerably reduce commercial and recreational fishing activities throughout the Reserve. However, if ecotourism, restoration, research and other non-fishing activities are allowed to increase in adjacent areas under the NWHI CRE Reserve, the effects of those activities may carry over and potentially impact NWR resources.

5.5.4 Consistency with Other Plans and Policies for NWR Resources

Designation of no-take zones adjacent to NWR islands would reinforce the protected status and limited access policies for refuge resources. A special permit and reporting requirement for all coral reef fishing activities in the EEZ around Palmyra, Johnston, and Wake Atolls, and off the southern half of Midway Atoll is consistent with special permits required by the USFWS for entry into National Wildlife Refuges and use of refuge resources associated with those islands.

5.5.5 Mitigation Measures for Effects on NWR Resources

By reducing fishing effort in the NWHI, the limited access programs for FMP-managed bottomfish and lobster fisheries lower the potential for vessel groundings or other accidents that could result in habitat degradation.

If environmental fluctuations or other natural or human factors change coral reef resource conditions so that fishing presents a higher risk, timely preventive action can be taken under the framework adjustment procedures included in the established FMPs for bottomfish, crustaceans, and precious corals, and in the CRE-FMP. Future adjustments could include such actions as changing MPA boundaries or designating new MPAs, changing the number of special permits or their conditions of use, or revising the list of permitted and prohibited fishing gear.

5.6 Environmental Consequences for Live Rock, Corals, Essential Fish Habitat and Environmental Quality

Alternative 1 (the No-action alternative) adequately manages live rock and stony coral harvest in nearshore reefs under island government jurisdiction, but not in the EEZ. However, it does not prevent or mitigate ongoing degradation of reef habitats under island government management. Alternative 2 would prohibit take of live rock or live coral in low-use MPAs, except for incidental take by other FMP permit holders. Under a permit system it would also allow take by indigenous people for traditional or ceremonial use, use by aquaculture operations as seed stock, for science and management purposes, and for bioprospecting. The Preferred Alternative (3) would extend conservation measures for live rock, coral and essential fish habitat into the EEZ and would extend no-take zones to a depth of 50 fm off two islands in the NWHI and off most of the PRIAs. Alternative 4 would prohibit take of live rock and coral from all of the region's EEZ. Implementation of Alternatives 2, 3, and 4 would require consultations with NMFS and the Council for federal activities that have the potential for adverse effects on EFH.

5.6.1 Direct Effects on Coral Reef Habitat

Permit measures prohibiting commercial collection of live rock and stony coral would conserve non-renewable reef habitat on a broader scale than the No-action alternative (1). Control of fishing gear types, allowing only non-destructive methods, would also provide a higher level of habitat conservation in more areas of the EEZ than would the No-action alternative.

The accidental grounding of fishing boats can have an adverse effect on coral reefs by physically destroying coral colonies in the immediate area of impact and possible break-up of the vessel and release of fuel and oil, causing additional habitat degradation and mortality of reef life. Fishing vessel groundings in the NWHI are relatively rare events. Only two fishing boats have run aground during the past 15 years. In both cases there was localized mortality of corals crushed under the hulls but no reported effects on surrounding reef areas (URS Corp. in prep.). Grounding of a foreign fishing vessel at Rose Atoll in 1983 caused more widespread damage (Green 1997).

Designation of extensive no-take zones and restrictions on how vessels operate in these zones would reinforce the existing protection of shallow reef habitat adjacent to the NWR in the NWHI and PRIAs and extend it to broader areas of the EEZ than under the No-action alternative (1) . Alternatives 3 (the Preferred Alternative) and 4 are particularly beneficial because they add protection to French Frigate Shoals, the southern-most atoll in the NWHI and the largest coral reef area in the Hawaiian Islands. It has one of the highest diversities of stony coral species in the Hawaiian Archipelago (Grigg 1983).

Anchor damage can occur on coral reefs and other types of benthic habitat from vessels attempting to maintain position over productive fishing areas. The dropping of handline weights on coral substrate and line entanglements during normal hook-and-line fishing operations could theoretically affect benthic habitat. These impacts have not yet been assessed for bottomfish fishing activities in the NWHI, but it is likely that they are minimal. Most bottomfish fishing in the NWHI occurs at depths (100-400m) deeper than the part of the photic zone where coral reefs and reef building organisms are normally found (50-100m). When bottomfish fishing vessels fish in shallower waters for species such as *uku* they generally drift or slowly troll, rather than anchoring (URS Corp. in prep.). In addition, given the large perturbations in coral reef habitat in the NWHI that result from the action of winter storms and associated storm surge and swell (Grigg 1983), the impact of fishing activities on this habitat is likely to be relatively small. Direct effects on reef habitat by bottomfishing vessels are minimal under the No-action alternative but they would, nevertheless, be reduced in no-take MPAs around some of the NWHI, under alternatives that would displace fishing effort.

NMFS observer logs from the 1999 NWHI lobster fishery and follow-up interviews with observers reveal that both pieces of live coral and entire coral heads were caught in some lobster traps and ground line and landed onboard lobster vessels. One observer noted that "small broken pieces of coral were frequently (as many as one piece per five traps) wedged in the holes of the traps. Numerous softball-sized and a few basketball-sized whole coral heads came up stuck to

the mainline." Only a part of the damaged coral reaches the vessel to be seen by observers. Some of the damaged coral that remains on the bottom may continue growing, but others may be covered in sand or swept off the banks. The damage may vary from bank to bank. Trapping at atolls where lobster habitat is limited and coral density high may result in more coral damage than at islands with large, flat algal or sand bank areas. The observed bycatch of coral apparently came from habitats that would not usually be fished. These were areas where permit holders had been encouraged to trap experimentally during the 1999 season in an attempt to prevent fishing effort from concentrating solely on lobster populations off Necker Island. The long-term impact of lobster trapping on coral reef habitat is difficult to estimate because it is in the interest of the permit holders to avoid rugged coral bottoms and to set gear in flat areas where lobster catches have been historically higher. Nevertheless, the Preferred Alternative (3) is likely to reduce impacts in sensitive areas from levels in the EEZ around the NWHI and PRIAs experienced under the No-action alternative (1).

5.6.2 Indirect Effects on Coral Reef Habitat

Existing bottomfish and lobster fishing activities managed under other FMPs would be displaced from particularly sensitive reef areas in the NWHI under Alternatives 3 and 4. These fisheries are already regulated to prohibit destructive gears and to conserve EFH for the target stocks. Their indirect effects on coral reef habitat are uncertain but they would, nevertheless, be reduced under Alternatives 3 and 4 from the levels under the the No-action alternative.

5.6.3 Cumulative Effects on Coral Reef Habitat

Only fishing activities in the EEZ are managed by FMPs, which are monitored for possible adverse effects on EFH and management is adjusted as necessary. The majority of reefs affected by the management measures in the CRE-FMP are in remote areas that are far removed from terrestrial activities and impacts. None of the alternatives considered by the CRE-FMP would restore or prevent new degradation of EFH in nearshore reef areas managed by island governments. Nor does any alternative mitigate or prevent impacts on nearshore reef habitats that results from coastal construction, watershed management, shoreline erosion, or water pollution. The EFH consultation procedure required after implementation of the CRE-FMP will help to mitigate the future potential for adverse effects resulting from proposed federal activities, but it will not address non-federal activities or the condition of nearshore fishery stocks.

Considering the large perturbations in the NWHI and other coral reef habitats that result from large storms and associated wave action, the impact of fishing gear allowed under FMPs for bottomfish, crustaceans and precious corals and the CRE-FMP would not be significant. Researchers have observed that periodic storms in the NWHI reduce live coral cover to 10% in some areas. Coral cover eventually returns to 50% or more in areas where the disturbance cycle is infrequent (R. Grigg, comm. at June 14th, 2000 Council meeting).

Some of the activities that can degrade EFH are not controllable through unilateral management. The accumulation of marine debris, largely derelict gear lost from North Pacific fisheries, is one

of the most serious problems in the NWHI. Inter-regional and international management will be necessary to find solutions to this problem.

In 1998, global coral bleaching and die-off was unprecedented in geographic extent, depth and severity. Several studies have related bleaching to the combination of increased ultraviolet radiation and ocean warming, phenomena that may be exacerbated by human activities. Projected long-term climatic changes are likely to expose stony corals to an increasingly hostile environment and could possibly lead to another episode of mass extinctions. Stony corals damaged by acute, local stresses (e.g., hurricanes, starfish predation) have often been able to recover, as long as surrounding reefs remained healthy. Renewal of reef building following chronic, widespread stresses acting synergistically is likely to be much slower. Human uses of reefs have never been higher and there is growing concern about human impacts that could add to cumulative stresses on coral reefs in the Western Pacific Region. Allowances for such outside influences are not directly incorporated in any alternative, but the CRE-FMP includes a framework procedure for timely and rapid regulatory adjustments based on feedback from monitoring of changing fisheries and resource conditions.

The conservation measures outlined in the NWHI EOs would prohibit anchoring on any living or dead corals or altering the seabed in any way, and would also prohibit removal of living or non-living marine resources in the NWHI. However, the NWHI EOs provide for exemptions to these restrictions and promotes several resource dependent activities, such as increased restoration and monitoring programs, potential tourism, recreational and commercial activities, and education and research opportunities.

The potential impacts from NWHI CRE Reserve activities on coral reef and fish habitat have not been assessed, but they could be significant. Following over two decades of federally-managed commercial fisheries, the NWHI is still considered nearly pristine, based on extensive multi-agency surveys over the past year (e.g., NOW-RAMP 2000 Expedition). The NWHI EOs appear to promote a shift from commercial fishing to indigenous uses and tourism, both of which have little history in the NWHI. Increased visitation, and additional boats and infrastructure planned for the area, may ultimately have a negative impact on habitat (e.g., vessel groundings, anchor damage). In contrast, the CRE-FMP Preferred Alternative (3) requires all fishing vessels operating or transiting in the NWHI low-use MPA (10-50 fathoms) to have vessel insurance to cover the cost of vessel removal and clean-up; the NWHI EOs have no such comparable provision. The draft Reserve Operations Plan identifies a budget and plans to construct warehouses for boats and related field supplies on French Frigate Shoals—one of the most important NWHI areas for endangered Hawaiian monk seals—and Midway Atoll, which is not part of the Reserve. Frequent field trips would promote the Reserve and support goals for research, and development of education materials and cultural studies. The logistics of these field activities could potentially increase the degree and frequency of disturbance and compound the environmental impacts to coral reef habitats. The cumulative effects of the NWHI CRE Reserve will reduce commercial fishing activity. However, this reduction in commercial fishing activity would not significantly reduce impacts on live rock, coral reefs, and fish habitat because commercial fishing impacts on coral reefs and fish habitat are already minimal. Potential

cumulative impacts to coral reef and fish habitat may occur from other non-fishing activities identified by the NWHI EO. However, these impacts are contingent on the location of and the degree to which these activities are allowed to occur in the NWHI CRE Reserve.

5.6.4 Consistency with Other Plans and Policies for Coral Reef Habitat

The Preferred Alternative would address the MSFCMA requirement to avoid significant adverse effects on EFH more comprehensively than the No-action alternative, under which EFH is more narrowly designated for other FMP-managed fisheries. The 10-year target established by the U.S. Coral Reef Task Force to designate 20% of reefs off U.S. coasts as no-take zones will be easily met if the State of Hawaii takes consistent action for nearshore reefs adjacent to MPAs designated in the adjacent EEZ. The Preferred Alternative is also consistent with Presidential directives aimed at protecting coral reefs in the U.S. and specifically in the NWHI.

5.6.5 Mitigation Measures for Effects on Coral Reef Habitat

The current management regime (the No-action alternative) under the FMPs for bottomfish and crustaceans include prohibitions on the use of nets, explosives, and chemicals, which reduce the potential degradation of coral reef habitat.

If environmental fluctuations or other natural or human factors change habitat conditions (e.g., hurricanes, coral bleaching episodes) so that fishing mortality presents a higher risk to the ecosystem, timely preventive action can be taken under the framework adjustment procedures included in the established FMPs for bottomfish, crustaceans, and precious corals, and also in the CRE-FMP. Future amendments could include such changing MPA boundaries or designating new MPAs, changing the number of special permits or their conditions of use, or revising the list of permitted and prohibited fishing gear.

None of the alternatives would directly mitigate adverse effects on coral reef habitats and environmental quality in nearshore areas under island government jurisdiction. However, designation of EFH and implementation of the CRE-FMP would mandate EFH consultations by NMFS and the Council for any proposed federal activity that has the potential for significant adverse effects.

5.7 Environmental Consequences for Reef Ecosystem Biodiversity, Structure and Function

Alternative 1 (the No-action alternative) does not adequately conserve reef ecosystem biodiversity, structure or function. Alternative 2 would provide some additional protection over the No-action alternative by creating low-use MPAs. However, this level of protection is not considered adequate to provide the desired long-term conservation of CRE biological resources. The Preferred Alternative (3) would immediately designate no-take zones and add others through amendments that will easily meet the 20% protected reef resources target that the U.S. Coral

Reef Task Force has set for the year 2010. Another way in which the Preferred Alternative provides a higher level of ecosystem conservation is through a procedure that coordinates the plan teams who monitor different FMPs. This would also allow joint analysis and evaluation of possible adverse effects of any fishery on coral reef ecosystems. If environmental fluctuations or other natural or human factors change resource conditions so that fishing presents a higher risk, timely preventive action can be taken under the framework adjustment procedures included in the Council's already implemented FMPs and in the CRE-FMP (the Preferred Alternative). This would allow the kinds of adjustments mentioned in other sections, dealing with MPAs, permits, and permissible fishing gear.

5.7.1 Direct Effects on Reef Ecosystems

Alternatives 3 and 4, which designate no-take MPAs for reefs in remote areas of the EEZ would have a more positive impact than the No-action alternative. They would conserve a large reservoir of spawning biomass and genetic material for diverse coral reef resources, including endemic and rare species. Restrictions on vessel operation in MPAs would reduce the potential for vessel grounding, another beneficial effect. The No-action alternative (1) does not lower this risk to the same extent. Broader designation of no-take areas in Alternatives 3 and 4 could provide further benefits over those of Alternatives 1 and 2, while increasing the diversity of biotypes included in MPAs. Unlike the No-action alternative, the highly discretionary nature of the special permit process included in the Preferred Alternative (3) would allow limited harvesting, which is not likely to have adverse effects. Ongoing monitoring could then provide the new resource data needed for adaptive management of fishing.

As discussed in Section 5.6.1, alternatives that enlarge the no-take area off French Frigate Shoals provide significantly more benefit than the No-action alternative because of the high coral diversity there. Moreover, the expansive shallows enclosed by the barrier reef at FFS provides habitat for certain Indo-Pacific fish species that are rare or absent from other areas of the Hawaiian Islands (Hobson 1980). Added protection for Laysan Island also results in greater benefits, in comparison to the No-action alternative (1), because it represents a reef ecosystem type characteristic of the middle of the NWHI, and because there has been little previous human activity and disturbance of reefs there.

5.7.2 Indirect Effects on Reef Ecosystems

Restrictions on vessel operation in MPAs and the highly discretionary nature of the permit process would allow careful scrutiny of the potential for new fishing activities to introduce invasive alien marine species throughout the EEZ before harvesting is permitted. These measures would prevent loss of biodiversity better than current measures in the No-action alternative.

5.7.3 Cumulative Effects on Reef Ecosystems

Because the coral reef ecosystem is composed of multiple species with a long co-evolutionary history, removal of certain species can result in loss of biodiversity. These losses can also result in undesirable changes to ecosystem structure or function, such as a predominance of less valuable generalist species. Possible secondary effects of fishing may be overlooked in conventional management of specific target stocks. Alternatives that would designate large no-take MPAs—such as Alternatives 3 and 4—and allow for highly discretionary special permit review in adjacent low-use MPAs—as in the Preferred Alternative—would guard against cumulative effects on reef ecosystem biodiversity, structure and function, while also guarding against overfishing of potentially-harvested species. In addition, the Preferred Alternative includes a consultation procedure among plan teams for different FMPs to monitor possible ecosystem effects of all reef-related fisheries in the EEZ and adjust management as needed.

Only fishing activities in the EEZ would be managed by the CRE-FMP. None of the alternatives would prevent adverse effects on reef ecosystem biodiversity, structure, or function in the nearshore areas regulated by island governments. Nor does any alternative mitigate or prevent impacts on nearshore reef ecosystems resulting from coastal construction, watershed management, shoreline erosion, or water pollution. The EFH consultation procedure required after implementation of the CRE-FMP (the Preferred Alternative) will help to mitigate adverse effects resulting from proposed federal activities, but it will not address non-federal activities or the condition of nearshore ecosystems.

Allowances for cyclical oceanographic events that affect productivity, discussed elsewhere in this chapter and in Section 3.2.1, are not directly incorporated in any alternative, but the CRE-FMP includes a framework procedure for timely and rapid regulatory adjustments based on feedback from monitoring of changing fisheries and resource conditions.

A major effect of the CRE Reserve is to reduce commercial fishing, but NWHI reef ecosystems remain in excellent condition despite years of fishing effort. Following over two decades of federally managed commercial fisheries, the NWHI is still considered nearly pristine, based on extensive multi-agency surveys over the past year (NOW-RAMP 2000). Severe winter storms, large waves, and broad-scale shifts in oceanic productivity exert significantly greater impacts on these attributes.

Activities identified by the NWHI EOs may have the potential to impact coral reef ecosystem structure and function depending on the location and the extent to which these activities are allowed to occur. The NWHI EOs promote a shift from commercial fishing to indigenous uses and tourism. Increased visitation, additional boats, and infrastructure planned for the area may ultimately have a negative impact on habitat, due to vessel groundings or anchor damage, for example. The draft NWHI Reserve Operations Plan includes a budget and plans to construct warehouses on French Frigate Shoals and Midway Atoll for boats and related field supplies. Frequent field trips would promote the CRE Reserve and support goals for research, development of education materials, and cultural studies. The logistics of these field activities

could potentially increase the degree and frequency of disturbance and compound ecosystem impacts.

5.7.4 Consistency with Other Plans and Policies for Coral Reef Ecosystems

The Preferred Alternative (3) is consistent with the 10-year target of the U.S. Coral Reef Task Force to designate 20% of reefs off U.S. coasts as no-take marine protected areas. It also adheres to ecosystem management principles and policies recommended to Congress by the national Ecosystems Principles Advisory Panel (1999). The Preferred Alternative is also consistent with Presidential directives aimed at protecting U.S. coral reefs and specifically those in the NWHI. No-action would be inconsistent with these policies.

5.7.5 Mitigation Measures for Effects on Reef Ecosystems

The CRE-FMP (the Preferred Alternative) includes a coordination procedure for the plan teams monitoring different Council FMPs. This would allow joint analysis and evaluation of possible adverse effects of any fishery on coral reef ecosystems. As discussed elsewhere, if natural or human conditions change, framework measures, allowed under the Council's already implemented FMPs and also under the CRE-FMP, would allow rapid and effective managerial response. As mentioned, management measures—including MPA design and extent, the permit regime, and regulation of fishing gear—could be changed by amendment.

None of the alternatives would directly mitigate adverse effects on coral reef habitats and environmental quality in nearshore areas under island government jurisdiction. However, designation of EFH and implementation of the CRE-FMP would mandate EFH consultations by NMFS and the Council for any proposed federal activity that has the potential for significant adverse effects.

5.8 Environmental Consequences for Native Cultures

Under Executive Order 12898, dated February 11, 1994, federal agencies are required to address the potential for disproportionately high and adverse environmental effects of their actions on minority and low-income populations. Agencies are required to ensure that their programs and activities that affect human health or the environment do not directly or indirectly use criteria, methods, or practices that discriminate on the basis of race, color, or national origin. NEPA documents are specifically required to analyze effects of federal actions on minority and low-income populations and, whenever feasible, to develop mitigation measures to address significant and adverse effects on such communities. In addition, the Executive Order requires provision of opportunities for community input in the NEPA process. It states that the public, including minority and low-income communities, should have adequate access to public information relating to human health or environmental planning, regulation, and enforcement.

In designating no-take zones, the Preferred Alternative does not address Native Hawaiian concerns about their claims to the NWHI, but it would provide for preferential access to

indigenous zones in MPAs immediately and in the future. It would also increase indigenous participation in the coral reef management process for the EEZ around the NWHI and elsewhere. Therefore, the Preferred Alternative has less negative effects on native cultures than the No-action alternative. Alternative 4 would prohibit all fishing activities in waters shallower than 100 fm and would decrease indigenous participation in coral reef fisheries conducted in the EEZ around the NWHI and elsewhere. Therefore, Alternative 4 has greater negative effects on native cultures than Alternatives 1-3.

5.8.1 Direct Effects on Native Cultures

Any alternative that designates no-take zones in the EEZ around the NWHI (including the existing protections included in the the No-action alternative) is potentially in conflict with the lingering sovereign claim by native Hawaiians. In 1993, Congress passed the Apology Bill, which states that "...the indigenous Hawaiian people never directly relinquished their claims to their inherent sovereignty as a people over their national lands to the United States, either through their monarchy or through a plebiscite or referendum." Murakami and Freitas (1987) argue that the legal claims of Native Hawaiians to the fishery in the MHI and NWHI have never been extinguished by the U.S. government, either by condemning the fisheries granted to Hawaiian commoners and their successors and paying compensation for taking of their fishing grounds, or by exercising its public trust duties to protect the aboriginal claims to the resources of the EEZ and determining the extent of participation by Hawaiians in the revenue from resource use and in resource conservation.

Broader designation of the no-take zones in the NWHI included in Alternatives 3 and 4 would adversely affect Native Hawaiians who are owners, captains of, or deckhands on fishing vessels operating in that region, depriving them of a means of livelihood. In view of the historic and cultural importance of fishing to Native Hawaiians, this deprivation of the right to make a living at *koa* (Kahaulelio 1902, pp. 22, 24), which they have been accustomed to frequent in the NWHI, is an especially onerous penalty. The United States annexation of Hawaii exacerbates this loss of access because any U.S. citizen now has free access to these fishery resources (Kosaki 1954). This increases fishing pressure on resources customarily used by Native Hawaiians and weakens the cultural norms that controlled the proper conduct of fishing.

An alternative to reserve sub-zones of MPAs for indigenous use would be more beneficial than the No-action alternative because it would compensate for the hardship to native cultures resulting from previous closures of fishing grounds, without considering the claims of indigenous Pacific Island populations.

5.8.2 Indirect Effects on Native Cultures

For centuries, native cultures in the U.S. Pacific Islands relied on seafood as their principle source of protein. However, the availability of many traditional seafoods has been significantly diminished as a result of environmental degradation of nearshore reef areas under the jurisdiction of island governments. Localized overfishing is blamed for some of the adverse impacts. But

coastal construction, industrial discharges, and poor watershed management have damaged coral reef habitat on a massive scale near population centers. Shomura (1987) notes that between 1900 and 1986, commercial landings of coastal fish species in Hawaii declined by 80%. The drastic changes in diet that resulted from loss of access to marine fishery resources have contributed to the poor health of Native Hawaiians. Of all the racial groups living in Hawaii, Native Hawaiians are the group with the highest proportion of multiple risk factors leading to illness, disability, and premature death (Look and Braun 1995). None of the alternatives would mitigate this situation, although reservation of MPA sub-zones for indigenous use would be more beneficial than the No-action alternative.

5.8.3 Cumulative Effects on Native Cultures

Samoa, Hawaii, and the Mariana Islands were originally settled by seafaring peoples. The lack of terrestrial resources in most areas led to great dependence on fishing for food security. This dependence shaped the social organization, cultural values, and spiritual beliefs of the indigenous populations. Repeated contact with Europeans and North Americans eroded the stability of the social structures and subsistence economies created by indigenous people.

With the exception of American Samoa, and small enclaves in Guam, Hawaii, and the CNMI, the descendants of the islands' original inhabitants are dispersed as part of cosmopolitan populations. Island societies have become pluralistic, and many aspects of their economies and cultures have evolved in modern times. Nonetheless, the people descended from the original indigenous inhabitants have a particularly deep traditional, historical, and contemporary involvement with coral reef resources. Fishing not only provides food; it also cultivates intimacy and harmony with the ocean. This reinforces their sense of kinship with nature, and their relationships with places that perpetuate cultural identities and beliefs. Increasing restrictions on customary and traditional uses of marine resources are jeopardizing cultural continuity in many areas of the U.S. Pacific.

The cumulative effects of the NWHI EOs on Native Hawaiian cultures is expected to be minimal. The NWHI CRE Reserve allows Native Hawaiian non-commercial subsistence, cultural, or religious uses to continue in both the Reserve and Reserve Preservation Areas, although the specifics on the location of these activities remain to be determined. This allowance minimizes cumulative effects on native cultures. In addition, the Secretary of Commerce may also revise the areas where these activities may continue after public review and comment.

The Preferred Alternative (3) requires a special permit for the take of live rock and live coral for traditional and ceremonial uses. In comparison, the NWHI EOs do not include any such permitting provision for cultural studies and indigenous uses of NWHI marine resources. Additionally, the preferred alternative in the CRE-FMP does not allow any fishing in its no-take MPAs; it is therefore more restrictive than the NWHI Reserve in this regard.

5.8.4 Consistency with Other Plans and Policies for Native Cultures

The Preferred Alternative (3) is consistent with the Apology Bill in which Congress expressed its commitment to acknowledge the ramifications of the overthrow of the Kingdom of Hawaii. In order to provide a proper foundation for reconciliation between the U.S. and the Native Hawaiian people, a series of reconciliation hearings—attended by federal representatives, Native Hawaiians, and the general public—were conducted in Hawaii in December 1999. In July 2000, Hawaii's congressional delegation introduced a bill that clarifies U.S. policy on its relationship with Native Hawaiians. It also provides a process for the reorganization of a Native Hawaiian government, and the recognition by the U.S. of a Native Hawaiian government.

5.8.5 Mitigation Measures for Effects on Native Cultures

Some of the alternatives could partially mitigate the cumulative effects resulting in this hardship by designating sub-zones in MPAs; this would give indigenous populations preferential access to, and use of, resources.

In addition, the MSFCMA provides for the establishment of a western Pacific community development program for any fishery under Council authority. This provision was added to the Act to address concerns that communities consisting of descendants of indigenous peoples in the Council's area of authority have not adequately shared in the benefits from the area's fisheries. The Council and the Secretary of Commerce have discretion to develop and approve indigenous demonstration programs for eligible communities. Currently, the Council, in consultation with NMFS, is developing criteria for community eligibility. In 1999, the Council developed and the Secretary of Commerce approved an allocation of approximately one-fifth of the target number of Mau Zone bottomfish permits to a community development program.

5.9 Environmental Consequences for Existing Fisheries and Communities

Alternative 1 (the No-action alternative) would continue the present effects. Alternative 2 would have very little impact on existing fisheries and communities. The Preferred Alternative (3) would increase adverse impacts on existing fisheries and communities by displacing existing bottomfish and lobster fishing effort around some NWHI where the seaward boundary of no-take zones would extend to a depth of 50 fm. Alternative 4 would further increase adverse impacts on existing fisheries and communities by displacing existing bottomfish and lobster fishing effort around some NWHI where the seaward boundary of no-take zones would extend to a depth of 100 fm. Occasional bottomfishing activities off Kingman Reef may also be adversely affected by no-take designations. Permit and reporting requirements would be imposed on participants in existing recreational and subsistence fisheries at Midway, Johnston and Wake Atolls, and on developing recreational fishing at Palmyra as well. For these reasons, the Preferred Alternative has greater negative impacts than Alternatives 1 and 2, while Alternative 4 would have the greatest impact of all the alternatives.

5.9.1 Direct Effects on Existing Fisheries and Communities

Designation of no-take zones in the NWHI could result in some negative impacts on Hawaii communities by causing a loss of earning potential, investment value, and lifestyle for some bottomfish and lobster fisheries participants. Relatively few persons would be negatively impacted and the State's economy would be relatively unaffected. But this does not lessen the economic hardship that reduced earnings or loss of jobs would create for some fishermen and their families. Pooley and Kawamoto (1990) show that the net revenue of a bottomfish fishing vessel operating in the NWHI is most sensitive to the crew share percentage and to changes in total fixed costs. If closure of some NWHI bottomfishing grounds causes a reduction in net revenues, captain/owners may compensate by decreasing the pay of deckhands or laying them off. Suitable employment opportunities outside of fishing may be limited for affected deckhands.

Alternatives 3 and 4, which designate no-take zones in the EEZ, are likely to displace existing fisheries to a varying extent. If no-take zones are limited in depth and are confined to remote areas of coral reefs, such as in the Preferred Alternative, the most significant displacement would be in the NWHI bottomfish fishery, with far fewer effects on the NWHI lobster fishery. Permit holders in these fisheries would lose access to a few familiar fishing grounds, but the area closures are likely to have less adverse impact than closure of more productive areas of the NWHI. Data provided by the Council demonstrates that no-take zones with a boundary of 50 fm in the NWHI have accounted for about 10% of recent bottomfishing effort in the NWHI bottomfish fishery. Applied to recent (1994-1998) landings data (WPRFMC 1999b), this percentage represents about 36,000 lbs. of bottomfish with an ex-vessel value of $115,000. The same areas have recently accounted for about 1.2% of the total lobster harvest in the NWHI fishery. Applied to recent (1996-1999) landings data (URS Corp. in prep.), this percentage represents about 3,100 lbs. of spiny and slipper lobsters with an ex-vessel value of $16,000. It is likely that the displaced participants could recover this loss in revenue by moving to other fishing grounds. Recreational fishing activities for tourists could continue at Midway but with the exception of Palmyra Atoll, future development of other PRIAs as sportfishing destinations would be deterred.

Broader designation of no-take zones in Alternative 4, with seaward boundaries extending to the 100 fm isobath throughout the EEZ, would virtually eliminate existing bottomfish and crustacean fisheries in the NWHI, small recreational fisheries at Midway, Johnston, and Wake Atolls, and the developing recreational fishery at Palmyra. Immediate closure of the NWHI bottomfish fishery would impose an economic hardship on fishery participants. This alternative would immediately prohibit bottomfish fishing in the EEZ surrounding the NWHI. It is estimated that up to 45 fishermen would be displaced by this action, based on the current number of vessels (17) eligible to fish in the area under the limited access programs for the Mau and Ho'omalu Zones. This assumes that each Mau Zone vessel and Ho'omalu Zone vessel has a crew of two and three, respectively, and one-fourth of the vessels are not owner-operated. Based on recent landings data (1994-1998), about 360,000 lbs. of bottomfish with an ex-vessel value of about $1,152,000 would no longer be harvested from the NWHI fishery (WPRFMC 1999b).

The termination of the NWHI bottomfish fishery would force displaced fishermen to relocate their fishing activities to bottomfish grounds that are still open, shift to different fisheries, or tie up their vessels. Closure of the NWHI fishery is likely to have less of an impact on Mau Zone permit holders than Ho`omalu Zone permit holders, because most of the former tend to own smaller boats and currently use MHI bottomfish fishing grounds and/or participate in other fisheries (e.g., handlining or trolling for pelagic species). In contrast, Ho`omalu Zone vessels require larger catches to be profitable and have few, if any, viable alternative fisheries. For the owners of these vessels, closure of the fishery would represent a sunk cost of $150,000 to $250,000 per vessel. Broader designations of no-take zones in the NWHI would also displace 13 permit holders in the NWHI lobster fishery, which annually harvests 211,000-330,000 lbs. of lobsters with an ex-vessel value of $1,043,000 to $1,896,000 (URS Corp. in prep.). No such losses would be incurred under the No-action alternative.

Under Alternatives 2-4, fisheries for currently-harvested resources in low-use zones of MPAs and for potentially-harvested resources anywhere in the EEZ would face inefficiencies and higher costs as a result of special permit technical prerequisites and compliance costs. Such costs would not be incurred under the No-action alternative. The difficulty and high cost of compliance with special permit requirements is likely to favor applicants who are well financed to research and express scientific information over small-scale, low-income fishermen. Measures that allow some types of fishing methods but not others (including Alternatives 3 and 4, which control scuba-assisted spear fishing) have disproportionate effects on fishermen who use one type of gear but not others. These impacts are not incurred with the No-action alternative.

5.9.2 Indirect Effects on Existing Fisheries and Communities

Displaced fishermen who relocate to grounds that remain open may be forced to travel farther than previously, thereby making fishing more costly. In addition, competition for the remaining open fishing locations would increase and catch rates might fall, generating less revenue for the same fishing effort. Enterprises with high operating costs would be the first to feel the cost-revenue squeeze (Samples and Sproul 1988).

Transfer of effort from the NWHI to the MHI could indirectly create economic hardship in the form of reduced profitability for fishermen already engaged in the MHI fishery. Bottomfish fishing grounds in the MHI are fully utilized with few, if any, unexploited areas. Recently implemented state regulations that close certain bottomfish fishing grounds have further increased competition for fishing locations around the MHI. If NWHI fishermen were to shift their effort to the MHI, catch per unit effort and individual harvest for both displaced and resident fishermen would likely decline substantially, due to the intensified fishing pressure on bottomfish resources. Lower individual catches would mean a decrease in the incomes of part-time and full-time commercial fishermen and a reduction in the non-market value of the fishing experience to a number of recreational fishermen and charter fishing patrons. Total harvest in the MHI fishery would probably remain at current levels regardless of increased participation from displaced NWHI fishermen because nearly all MHI fishing grounds are fully utilized.

Those displaced fishermen who elect to target other species are likely to recover some part of the revenue previously generated from bottomfish fishing in the NWHI, particularly if they pursue more widely distributed species like tuna. Many Mau Zone vessels are already outfitted to participate in fisheries on other stocks, but some boat owners may not be capable of shifting into other fisheries without significant additional capital outlays. Conversion to charter fishing may be a feasible option for some vessel owners. However, the charter fishing fleets in most of Hawaii's ports are already over-capitalized (Hamilton 1998).

Given that opportunities for displaced fishermen to recover their lost harvest and income would be limited and the fishery is already characterized by limited profitability, it is likely that some displaced fishermen would be forced to sell out or retire. It is uncertain how active the Hawaii or nationwide market is for the types of vessels, gear, and other investment capital used in the NWHI bottomfish fishery, but it is possible that the Hawaii market for these assets could quickly be flooded. Closing the NWHI bottomfish fishery would probably depress the immediate resale market for bottomfish fishing equipment and vessels. It would also diminish the long-term investment value of the vessels owned by displaced fishermen who opt to continue fishing. This could create an economic hardship for fishermen that rely on money earned from selling their fishing assets to supplement their retirement funds (URS Corp. in prep.).

It is possible that closure of the NWHI fishing grounds could help rebuild stocks in the MHI and sustain or increase harvests, thereby mitigating the revenue reductions from fishing restrictions. However, the ability of closed areas to increase yields has not been demonstrated for bottomfish fisheries in Hawaii. It should also be noted that, even if a closed area and resulting fishery closure increases fish populations and fishery productivity, it may be several years before this effect to be realized. This is due to the high age of first reproduction for most bottomfish species. Given this time lag, it is unlikely that the potential economic benefits of an area closure would accrue to the current generation of bottomfish fishermen. Moreover, if fishing effort is allowed to increase in the MHI, any economic gains from a closed area will be dissipated over the long-run (URS Corp. in prep.).

Over the longer run, operations with higher fixed costs could be disadvantaged by the reduced margin of each fishing trip. Such effects could cause some fishermen to exit the NWHI fishery. For those enterprises that weather these negative effects, the long-term outlook could be brightened by a gradual increase in catch rates in response to initial effort reduction. It is possible that no-take zones could restock nearby fishing grounds and increase future harvest potential, thereby mitigating loss of revenue. However, the ability of closed areas to increase equilibrium yields has not been demonstrated for bottomfish fisheries in Hawaii (URS Corp. in prep.).

5.9.3 Cumulative Effects on Existing Fisheries and Communities

Many of the families that depend on fishing and the seafood industry in the U.S. Pacific Islands are probably already economically, socially, and psychologically stressed because of declining catch rates, increasing competition, or unstable markets. The imposition of ever more restrictive

state and federal regulations and uncertainty due to pending litigation also contributes to this stress. In just two years, a limited access program was established for the Mau Zone of the NWHI bottomfish fishery, the State of Hawaii closed some areas around the MHI to bottomfishing, and NMFS issued an emergency regulation that stopped the NWHI lobster season from opening in 2000. In addition, during this period litigation over the possible impacts to sea turtles from the Hawaii-based pelagic longline fishery led a federal judge to issue an injunction. This required NMFS to implement area closures, gear and effort restrictions, and increased observer coverage for the pelagic fishery. Undoubtedly, many fishermen in Hawaii have the sense that government regulations are "boxing them in" and reducing their ability to maintain their characteristic highly flexible fishing strategy. This flexibility is important to the economic success of many smaller and medium-sized fishing vessels because of natural variations in the availability of various types of fish. Closure of some NWHI fishing grounds would further confine fishermen and could jeopardize the long-term economic viability of their fishing operations.

In addition to potential economic losses associated with the cumulative effects of various fishery closures, there would be a loss of lifestyle, assuming that displaced fishermen cannot find an equally satisfactory alternative way of life. Some Hawaii fishermen feel a sense of continuity with previous generations of fishermen and want to perpetuate the fishing life style. A 1993 survey of participants in the NWHI bottomfish fishery found that half of the respondents who fish in the Ho'omalu Zone were motivated to fish by a long-term family tradition (Hamilton 1994). This sense of continuity is also reflected in the importance placed on the process of learning about fishing from "old timers" and transmitting that knowledge to the next generation. Hawaii's commercial fishing industry dates back nearly 200 years, and closing some fishing grounds in the NWHI would probably also negatively impact those who value the continued existence of Hawaii's maritime tradition and culture.

Just as Hawaii's fishing tradition is an integral part of the islands' heritage and character, the image of Hawaii has become linked with the consumption of some types of locally-caught seafood. The availability of seafood is also important to Hawaii's tourist industry, the mainstay of the state economy. Japanese tourists visiting Hawaii often want to enjoy the traditional foods and symbols of Japan while they vacation in Hawaii, including various types of high quality fresh fish (Peterson 1973). Hawaii tourists from the U.S. mainland and other areas where fish is not an integral part of the customary diet typically want to eat seafood because it is part of the unique experience of a Hawaii vacation. Consuming fish that is actually caught in the waters around Hawaii further enhances that experience (URS Corp., in prep.).

The impacts of the NWHI CRE Reserve on existing fisheries and communities could be considerable. Before the NWHI CRE Reserve was established, there were no existing permitted coral reef fisheries in operation. Therefore, no such fishery would be allowed in the NWHI under the conservation measures of the NWHI EOs.

NWHI bottomfish landings could be significantly reduced, depending on how areas closed to bottomfishing within the Reserve Preservation Areas are converted from fathoms to longitude-

latitude straight lines. In addition, the annual landings permitted by individual permit holders may also be reduced depending on how fishing quotas are calculated. The NWHI bottomfish fishery is a mixed fishery with vessels entering and exiting the fishery as result of opportunities in other fisheries, such as pelagic handline and trolling. It has an ex-vessel value of more than $1 million per year and provides 44% of all commercial bottomfish landed in the state. The fishery's 17 non-transferrable limited entry permits could be eliminated as they are nullified through attrition, due to the assimilation of existing annual trip and landing requirements with the allocation of individual fishing quotas as determined by the December 4, 2000 NWHI EO. The allocation of individual fishing quotas are to be determined by the NWHI CRE Reserve Council.

Apart from simply closing areas to fishing, the CRE Reserve will constrain fishing operations in adjacent open areas. Due to the high bathymetric relief of NWHI reefs and banks, the lack of accurate soundings for those reefs and banks, and current bottomfish fishing techniques, the conversion of straight-line boundary closures based on 25 or 50 fathom contours will likely have the effect of a 100-fathom contour closure. In order to successfully target bottomfish, a vessel must be able to operate on either side of the preferred target depth because the vessel may be in shallow waters while the actual lines are in much deeper waters.

The bottomfish fishery also targets *uku*, a bottomfish associated with the shallow-water species complex. During certain years, large quantities of *uku* are caught by bottomfishing and trolling in waters ranging between 15-30 fathoms. Between 1995 and 1998, *uku* contributed 18%, 20%, 11% and 17% of the total NWHI bottomfish landings respectively (WPRFMC 1999b). The NWHI Reserve's restriction of bottomfishing in waters shallower than 25 fm could considerably reduce this component of future bottomfish landings in the EEZ.

Immediate impacts of the NWHI CRE Reserve would include a redistribution of fishing effort to the remaining open bank areas, possibly leading to localized depletion. Displaced fishing vessels could also add to fishing pressure on MHI resources, some of which are believed to be depleted due to fishing pressure from more than 2,500 registered commercial and recreational bottomfish vessels.

Bottomfish species are culturally important to Hawaii residents and economically valuable to the state's visitor industry, which depends on Hawaii's regional cuisine featuring these locally-caught fish as a visitor attraction and marketing tool. Red fish are in demand locally, especially for year-end holidays. Foreign imports may increase to maintain the availability of bottomfish for local markets, which could potentially eliminate small family-owned fishing businesses and fishery support businesses dependent on the fishery.

The NWHI lobster fishery includes 15 limited entry permits and has an ex-vessel value of approximately $1 million or more per year and is the only commercial lobster fishery in the state. The NWHI CRE Reserve would have significant impacts on the NWHI lobster fishery. Caps on commercial fishing catch-and-effort at levels of the year preceding December 4, 2000, and prohibiting fishing in waters shallower than 100 fm could permanently close the NWHI limited entry lobster fishery. Reserve Preservation Areas to 100 fathoms (similar to Alternative 4) would

close all productive lobster grounds, because fishing generally takes place in 10-40 fm. The small-business permit holders are expected to incur a substantial economic loss.

The management provisions of the Crustaceans FMP and the annual harvest guidelines allow removal of only 13 percent of the total lobster population. Depending on the interpretation of the year preceding December 4, 2000, the NWHI EO may cap this fishery's harvest level at zero. As a result, the long-term effect of NWHI EO closure on the target species would be mainly a function of cyclical climate and oceanographic conditions that affect the recruitment dynamics of lobster.

With respect to precious corals, the Council has recommended adoption of a precious corals mega-reserve, which sets aside an area over 250 miles long to a depth of 750 fm—including Necker through French Frigate Shoals—where harvesting of pink, red, and gold precious coral would be banned. Harvest of gold precious coral, will also be banned throughout the entire NWHI.

The provision of the NWHI EOs to cap commercial fishing at levels of catch and effort of the year preceding December 4, 2000, could close two-thirds of the deep-water precious coral grounds (175 to 750 fm) surrounding the NWHI EEZ and likely eliminate the potential for domestic harvest in the area. The precious corals fishery is potentially worth $1 million in landed value and an additional $25 million in revenue for associated jewelry businesses (R. Grigg, pers. comm.).

Capping recreational fishing to that taken in the levels of catch and effort of the year preceding December 4, 2000 may preclude any future recreational fishing in the NWHI. There is no current permit or reporting requirement by the state or the federal government for recreational fishing in Hawaii, or in the area encompassed by the NWHI CRE Reserve. Therefore, it is unclear how the recreational fishing level in the NWHI will be determined. Under the rules promulgated under the Crustaceans FMP and the Bottomfish FMP, fishing for, retaining of, or taking of any crustacean or bottomfish management unit species in the NWHI EEZ without a limited access permit issued by PIAO is prohibited. Therefore, recreational take of bottomfish and crustaceans is also expected to be capped at zero.

5.9.4 Consistency with Other Plans and Policies for Existing Fisheries and Communities

The Preferred Alternative (3) is consistent with the requirement of the MSFCMA to define affected fishing communities and to minimize, wherever practicable, adverse economic impacts on these communities.

5.9.5 Mitigation Measures for Effects on Existing Fisheries and Communities

Displacement of existing bottomfish and lobster fishing activity from no-take zones in the NWHI, which would be created under Alternatives 3 and 4, cannot be mitigated by transferring

effort to other fisheries in Hawaii because those fisheries are becoming increasing restricted by state and federal regulations.

5.10 Environmental Consequences for Bioprospecting and Other New Fisheries

Alternative 1 (the No-action alternative) does not recognize bioprospecting as an emerging fishery. Alternative 2 would impose greater inefficiencies and higher costs than the No-action alternative to comply with restrictions on vessel operation in MPAs and other permit conditions. Alternatives 3 (the Preferred Alternative) and 4 would manage bioprospecting through permitting and reporting.

5.10.1 Direct Effects on Bioprospecting

Bioprospecting activities would not be prohibited by any of the alternatives. Even in no-take zones, bioprospecting may be conducted as "scientific research," if a permit is approved by the NMFS RA after consultation with the Council. Restrictions on vessel operation in MPAs and imposing permit and reporting requirements could create inefficiencies and add to the cost of bioprospecting. Such enterprises are generally well financed, however. Even if novel techniques are employed to collect samples for laboratory screening, unevaluated collection methods using gear not currently on the allowable gear list could be approved after evaluation of the potential for adverse effects. The effects of Alternatives 2, 3, and 4, therefore, differ little from those of the No-action alternative.

5.10.2 Indirect Effects on Bioprospecting

Alternatives 3 and 4, which broadly designate no-take zones, conserve a large reservoir of diverse genetic material of potential interest to bioprospecting operations seeking small samples of diverse organisms to screen for bioactive properties. Biodiversity may be reduced as a result of fishing activities under Alternatives 1 (No-action) and 2.

5.10.3 Cumulative Effects on Bioprospecting and Other New Fisheries

Due to the high profile of bioprospecting enterprises, advocate groups have been active in controlling this industry and protecting the rights of indigenous populations throughout the world. It has become common practice for the industry to write detailed contracts with local and indigenous groups, which strictly regulate harvest, negotiate up-front royalties for successful products, train local people to join the industry, and offer assistance in environmental protection.

The NWHI Reserve will preclude future opportunities for bioprospecting and other commercial coral reef fisheries, as none existed in the year preceding the EO. In addition, the designation of nearly all of the coral reef habitat to 100 fm as Reserve Preservation Areas would preclude future sustainable harvesting of coral reef ecosystem resources in the NWHI, with the exception of bottomfish. As a result, the potential economic gains lost to Hawaii could be significant. As an example, due to the uncertainties of the outcome of the NWHI EO and the reduction of other Hawaii based commercial fisheries due to litigation, the commercial fishing industry has not

reserved a single lease in the State of Hawaii's new $13 million dollar commercial fishing facility. Should the NWHI EO be fully implemented, it is unlikely that the commercial fishing facility will be leased by Hawaii's commercial fishing industry or its investors.
The NWHI Reserve provision to cap recreational fishing to previous year levels may preclude any future recreational fishing, an activity believed to have considerable future economic value to the State of Hawaii as a new or expanded fishery in the NWHI. State and federal governments do not have any permit or reporting requirements for recreational fishing in Hawaii. Thus, it is unclear how the year 2000 recreational fishing level in the NWHI will be determined, but it is expected that it will be capped at zero.

5.10.4 Consistency with Other Plans and Policies

The Convention on Biological Diversity, drafted at the Rio Earth Summit, recommends strong measures of protection against harmful bioprospecting, which the Council, under the Coral Reef Ecosystem FMP management regime, will be able to ensure.

5.10.5 Mitigation Measures for Effects on Bioprospecting

If environmental fluctuations or other natural or human factors change resource conditions so that harvesting presents a higher risk, timely preventive action can be taken under the framework adjustment procedures included in the established FMPs for bottomfish, crustaceans, and precious corals and in Alternatives 2, 3 (the Preferred Alternative), and 4. Changes in MPA boundaries and designations, the number of special permits or their conditions of use, or allowable fishing gears and methods could be implemented through amendments to the CRE-FMP (the Preferred Alternative), or under Alternative 2.

5.11 Environmental Consequences for Non-Consumptive Values and Uses

Alternatives 3 and 4 may provide greater opportunities for research than Alternatives 1 (No-action) and 2 because they better conserve coral reef organisms. However, opportunities for marine recreation by the general public may be somewhat limited in the new no-take zones designated under Alternatives 3 (the Preferred Alternative) and 4 because some of these zones are located in remote areas of the EEZ that are relatively inaccessible and, in some cases, off limits to the general public. On the other hand, the increased protection provided to the coral reef ecosystem in Alternatives 3 and 4 would help maintain coral reef habitats in their natural state and allow the development of ecotourism. None of the alternatives would restore or prevent new degradation of reef habitat and environmental quality in nearshore reef areas managed by island governments.

5.11.1 Direct Effects on Non-Consumptive Values and Uses

Alternatives 3 and 4, which designate no-take zones in remote areas of the EEZ, would conserve a large reservoir of relatively undisturbed coral reef resources and habitats with high non-consumptive values. However, these areas are relatively inaccessible and are generally off limits

to the public, except at Midway atoll, so there would be little change in impact from the No-action alternative. Under Alternatives 3 and 4, the opportunities for research of undisturbed coral reef baseline conditions would increase significantly above the level provided under Alternatives 1 (the No-action alternative), or Alternative 2. Broader designation of no-take zones under Alternatives 3 and 4 could emphasize underwater viewing and other non-consumptive activities in more accessible areas of the EEZ, but deeper boundaries would be well below safe scuba diving depths. The resulting benefits for non-consumptive values and uses would be greater under Alternatives 3 and 4 than those provided by Alternatives 1 and 2.

5.11.2 Indirect Effects on Non-Consumptive Values and Uses

None of the alternatives would directly mitigate adverse effects on coral reef habitats and environmental quality in nearshore areas under island government jurisdiction. However, designation of EFH and implementation of the CRE-FMP would mandate EFH consultations by NMFS and the Council for any proposed federal activity that has the potential for significant adverse effects. The consultation procedure produces greater benefits than the No-action alternative.

5.11.3 Cumulative Effects on Non-Consumptive Values and Uses

Alternatives that would affect reefs only in remote and inaccessible areas of the EEZ would contribute less to cumulative effects than Alternative 4, which affects reefs throughout the EEZ. Only fishing activities in the EEZ are managed by FMPs, which monitor for possible adverse effects on EFH and adjust management as necessary. The majority of reefs affected by management measures in the CRE-FMP are in remote areas far removed from terrestrial activities and impacts. Because of their inaccessibility, access for non-consumptive recreation is restricted. The no-take zones designated under Alternatives 3 and 4 would benefit research by allowing researchers to compare undisturbed baseline conditions with coral reefs that are heavily exploited.

Several factors already mentioned in this chapter also have cumulative effects on non-consumptive values. First, none of the alternatives apply in nearshore areas managed by state governments. These are the areas most affected by terrestrial and coastal activity. However, the CRE-FMP (the Preferred Alternative) would implement a consultation procedure for federal activities affecting EFH. This would help mitigate some impacts to fish stocks in nearshore areas.

Second, storms can reduce coral cover by as much of 10% in some parts of the NWHI (R. Grigg, comm. at June 14, 2000 Council meeting). (If storms are infrequent, coral cover can eventually increase to near normal levels.) Considering these large perturbations, the impact of fishing gear allowed under the Bottomfish, Crustaceans, and Precious Corals FMPs, and also those allowed under the Preferred Alternative (CRE-FMP) would not significantly affect non-consumptive values.

Third, allowances for cyclical oceanographic events that affect productivity (also see Section 3.2.1,) are not directly incorporated in any alternative, but the Preferred Alternative (the CRE-FMP) includes a framework procedure for timely and rapid regulatory adjustments based on feedback from monitoring of changing fisheries and resource conditions.
Finally, the stated management principles of the NWHI CRE Reserve—which include enhancing public awareness, and understanding and appreciation of the Reserve—appear to promote a shift from commercial fishing to tourism and indigenous uses. In support of these principles, the NWHI Reserve Operations Plan prioritizes the identification of potential tourism, recreational, and commercial activities in the Reserve. These activities could cause more damage to the reef habitat and protected species than commercial fishing. Possible impacts include diver damage to live corals and hooking of monk seals by recreational fishing activities. An associated increase in visitors, boats, and infrastructure could have negative impacts on habitats, resulting from vessel grounding and anchor damage, for example. The NWHI CRE Reserve has a considerable budget and plans to construct warehouses on French Frigate Shoals (one of the most important NWHI areas for endangered Hawaiian monk seals and the main nesting areas for the green sea turtle) and Midway Atoll (which is not part of the Reserve) for boats and related field supplies. On the other hand, frequent field trips would promote the NWHI CRE Reserve and support goals for research, and development of education materials and cultural studies, however, the logistics of these field activities would increase the degree and frequency of disturbance and compound the environmental impacts.

5.11.4 Consistency with Other Plans and Policies for Non-Consumptive Values and Uses

The Preferred Alternative is consistent with the 10-year target of the U.S. Coral Reef Task Force to designate 20% of reefs in U.S. waters as no-take MPAs.

5.11.5 Mitigation Measures for Effects on Non-Consumptive Values and Uses

As discussed elsewhere in this chapter, coordination of the Council's different FMP plan teams—a measure in the Preferred Alternative—would allow rapid identification of fishery-related impacts to coral reefs. The framework procedures that are part of all of the Council's FMPs, and the CRE-FMP as well, would allow rapid adjustment in response to changes in the fishery or environmental conditions. Management measures can also be adjusted through amendments to the FMPs.

5.12 Environmental Consequences for Administration and Enforcement of Regulations

Alternative 1 (the No-action alternative) would not add new responsibilities or costs to existing administration and enforcement burdens. Low-level surveillance of remote coral reef areas of the EEZ would continue. Therefore, it would be difficult to prosecute violators of island government regulations who claim that the illegal activity occurred in the adjacent EEZ. Alternatives 2, 3,

and 4 would significantly increase responsibilities and costs, but with positive conservation benefits for coral reef ecosystems.

5.12.1 Direct Effects on Administration and Enforcement

Implementation of Alternatives 2 and 3 would be technically complex because of their special permit regime, which covers fishing in low-use MPAs and catching potentially-harvested coral reef resources. The cost of administration and enforcement under these alternatives would be much greater than costs under Alternative 1 (the No-action alternative) because each permit is customized to the proposed activity. Scientists and Council members would have to evaluate all applications before special permits are approved. A large number of applications could overwhelm and delay permit review and administration. Additional responsibilities and costs for permitting would not be incurred under Alternative 1 (the No-action alternative).

The enforcement of MPA boundaries would be simpler if the boundaries were delineated by grids or centroids rather than depth limits, and if there were no-take zones rather than different zones for a range of uses. Live rock harvest controls have similar enforcement issues. A prohibition on possession is simpler to enforce than a prohibition on commercial collection or exemptions for aquaculture brood stock and indigenous use. No new responsibilities or additional costs would be incurred under Alternative 1 (the No-action alternative).

At-sea enforcement of MPA zoning is likely to require additional air and sea patrols. Additional patrols would cost as much as $100,000 per air patrol and $250,000 per surface patrol (WPRFMC 1999a). No additional costs would be incurred under Alternative 1 (the No-action alternative).

5.12.2 Indirect Effects on Administration and Enforcement

If substantial fishing activity is displaced from the NWHI as a result of broad designation of no-take MPAs under Alternatives 3 (the Preferred Alternative) and 4, administrative and enforcement costs associated with permitting, data collection, and observer coverage in the limited entry programs for FMP-managed bottomfish and lobster fisheries could be reduced below present levels (i.e., the No-action alternative). Broad designations of no-take zones in the NWHI that displace existing fishing activities would remove any incentive for fishermen to self-monitor domestic fishing activity, and such designations would also eliminate opportunities for fishermen to report illegal foreign and domestic fishing activity that may occur in the EEZ. These are both negative enforcement impacts of Alternatives 3 and 4 compared to Alternatives 1 (the No-action alternative) and 2.

EFH designations in the Preferred Alternative would be implemented through consultations by NMFS and the Council with federal agencies proposing or conducting activities with the potential for adverse impacts on EFH. Such consultations may help avoid or mitigate some of the adverse effects that are currently occurring in nearshore reef areas under Alternative 1 (the No-action alternative).

5.12.3 Cumulative Effects on Administration and Enforcement

The complexity of Alternatives 2, 3, and 4 would add significantly to cumulative responsibilities and costs of fishery administration, surveillance, and enforcement for fisheries managed by FMPs. Separate jurisdictions and competing missions could hinder implementation of alternatives designating MPAs. It is likely that the process of developing inter-agency, inter-governmental and public-private relationships needed for ecosystem-scale management of coral reefs would be time consuming and costly.

The provisions of the EO for the NWHI CRE Reserve most closely parallel Alternative 4. The complex system of prohibitions and restrictions as defined in the NWHI EOs will be an even greater enforcement burden that Alternatives 3 or 4 of the FMP. Monitoring the additional restrictions, individual fishing caps on levels of catch and effort, closed RPA boundaries, and various exemptions would be expected to further increase the burden for administration and enforcement of regulations. At present enforcement agencies are unable to develop and implement an enforcement plan for the NWHI CRE Reserve, due to ambiguity of some of the conservation measures. Existing resources of enforcement agencies are already strained.

5.12.4 Consistency with Other Plans and Policies for Administration and Enforcement

Permit Alternatives 2-4 (including the Preferred Alternative), which exempt permit holders operating under established FMPs for bottomfish, crustaceans, and precious corals, avoid a duplication of administrative and enforcement costs stemming from their implementation.

In most areas of the NWHI where MPAs would be designated, the State of Hawaii could take action to extend no-take zones from the shoreline to 3 nm offshore. The implementation of alternatives to designate MPAs within 3 nm of shore would require an unprecedented level of cooperation among agencies and levels of government that have different jurisdictions and missions.

5.12.5 Mitigation of Effects on Administration and Enforcement

High enforcement costs could be moderated through use of VMS. MPA boundaries based on depth will be extremely difficult to enforce unless VMS is required for all fishing vessels. NMFS and the USCG already operate a Honolulu-based VMS to monitor compliance in the pelagic longline and NWHI lobster fisheries. Additional costs would be incurred if the existing VMS was expanded to accommodate the additional vessel and area coverage associated with MPA designations.

The Preferred Alternative (3) includes a framework procedure for adaptive management. This could be useful in streamlining the permit process, possibly by moving away from burdensome prerequisites and conditions toward performance standards that create positive incentives for innovation to minimize potential adverse fishery impacts. Such an approach would reduce the regulatory burden on fishermen, managers and law enforcement personnel.

Fishery Management Plans for other western Pacific fisheries have often served as a catalyst for better coordinated fishery management across jurisdictional borders. An example is the deep-slope bottomfish fishery in Hawaii. A limited access program for the EEZ around the NWHI was implemented under the Bottomfish and Seamount Groundfish FMP, but no regulations were imposed on bottomfishing activity in the EEZ adjacent to the MHI because the latter area has been traditionally managed by the State of Hawaii. After monitoring of the overall fishery documented localized overfishing of two deepwater snapper populations in the MHI, the State developed and implemented an ambitious plan for area closures to rebuild local bottomfish populations around the MHI.

Data collection is a necessary part of the adaptive management procedure included in the CRE-FMP. Some of the associated costs may be reduced by involvement of the fishing industry and other parties, such as university researchers and volunteers, but the costs will still exceed those of the No-action alternative. The Council has established an education and public outreach program for all FMP-managed fisheries. The program is being expanded to raise public awareness of coral reef ecosystems and to improve compliance with regulations controlling the harvest of coral reef resources.

5.13 Summary of Impacts

5.13.1 Environmental Effects of the Alternatives

The four alternatives respond to resource issues and concerns differently, and as such, have different environmental effects. The impacts of each alternative on the environmental components likely to be affected by management activities are summarized for comparative purposes in Table 5.2.

Table 5.2: Summary and comparison of effects of alternatives.

Target Stocks	
Alternative 1 (No-action):	All species currently harvested under established FMPs are above overfishing threshold. Changing conditions and environmental fluctuations are closely monitored and management is adapted as necessary. Does not prevent overfishing of potentially-harvested resources or of nearshore stocks managed by island governments.
Alternative 2 (Minimal Additional Protection):	All species currently harvested under established FMPs are above overfishing threshold. Changing conditions and environmental fluctuations are closely monitored and management is adapted as necessary. Does not prevent overfishing of potentially-harvested resources or of nearshore stocks managed by island governments.
Alternative 3 **Preferred Alternative (Substantial Additional Protection):**	Depending on zoning plan, some NWHI bottomfishing effort may be redirected from no-take areas to fully exploited stocks elsewhere. Spawning populations in MPAs might restock other areas connected through recruitment. Does not prevent overfishing of potentially-harvested resources or of nearshore stocks managed by island governments.
Alternative 4 (Maximum Protection):	All bottomfishing and lobster trapping effort in the EEZ would be prohibited. Spawning populations in MPAs could restock other areas connected through recruitment. Does not prevent overfishing of potentially-harvested resources or of nearshore stocks managed by island governments.

Non-target Resources	
Alternative 1 (No-action):	Bycatch currently harvested is reported under established FMPs. Food web effects are unknown but overshadowed in NWHI by high level of predation by jacks. Changing conditions and environmental fluctuations are closely monitored and management is adapted as necessary. Fails to prevent overfishing of potentially-harvested resources or of nearshore stocks managed by island governments.
Alternative 2 (Minimal Additional Protection):	Bycatch currently harvested is reported under established FMPs. Food web effects are unknown but overshadowed in NWHI by high level of predation by jacks. Changing conditions and environmental fluctuations are closely monitored and management is adapted as necessary. Fails to prevent overfishing of potentially-harvested resources or of nearshore stocks managed by island governments.
Alternative 3 **Preferred Alternative (Substantial Additional Protection):**	Small reduction in fishing mortality may occur in some areas but impact may not be detectable against natural population fluctuations. Spawning populations in MPAs could restock other areas connected through recruitment. Does not prevent overfishing of potentially-harvested resources or of nearshore stocks managed by island governments.
Alternative 4 (Maximum Protection):	Elimination of fishing mortality would occur in areas shallower than 100 fm. Spawning populations in MPAs could restock other areas connected through recruitment. Does not prevent overfishing of potentially-harvested resources or of nearshore stocks managed by island governments.

Live Rock, Coral, Essential Fish Habitat (EFH), and Environmental Quality	
Alternative 1 (No-action):	Destructive gears are prohibited in existing FMP-managed fisheries. Effects on EFH are closely monitored and management is adapted as necessary. Low potential for damage to EFH or coral from existing fishing or anchoring methods. Island governments regulate live rock and stony coral collection in nearshore reef areas. Fails to prevent large-scale removal of live rock/stony coral in EEZ. Continues present level of risk of vessel grounding. Does not mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries. Fails to restore or prevent new degradation of nearshore reef habitat managed by island governments. Does not mitigate or prevent impacts from coastal construction, watershed management, shoreline erosion or water pollution.
Alternative 2 (Minimal Additional Protection):	Destructive gears are prohibited in existing FMP-managed fisheries. Effects on EFH are closely monitored and management is adapted as necessary. Low potential for damage to EFH or coral from existing fishing or anchoring methods. Island governments regulate live rock and stony coral collection in nearshore reef areas. Fails to prevent large-scale removal of live rock/stony coral in EEZ. Continues present level of risk of vessel grounding. Does not mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries. EFH consultation may help mitigate or prevent impacts from coastal construction, watershed management, shoreline erosion or water pollution.
Alternative 3 **Preferred Alternative (Substantial Additional Protection):**	Positive impact – MPAs would encompass large tracts of relatively undisturbed reef habitat in remote areas. Potential for vessel groundings or anchoring to degrade reef habitat is reduced in some areas. Fails to restore or prevent new degradation of nearshore reef habitat managed by island governments. EFH consultation may help mitigate or prevent impacts from coastal construction, watershed management, shoreline erosion or water pollution. Does not mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.

Live Rock, Coral, Essential Fish Habitat (EFH), and Environmental Quality	
Alternative 4 (Maximum Protection):	Positive impact – MPAs would encompass large tracts of reef habitat around remote and main inhabited islands. Potential for vessel groundings or anchoring to degrade reef habitat is reduced in some areas. Fails to restore or prevent new degradation of nearshore reef habitat managed by island governments. EFH consultation may help mitigate or prevent impacts from coastal construction, watershed management, shoreline erosion or water pollution. Does not mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.

National Wildlife Refuge Resources	
Alternative 1 (No-action):	Shallow reefs adjacent to National Wildlife Refuge islands would continue to function as *de facto* MPAs. Continues present level of risk of vessel grounding. Does not mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.
Alternative 2 (Minimal Additional Protection):	Provides some additional protection to these resources by creating a low-use MPA around the NWHI to a depth of 50 fm.
Alternative 3 **Preferred Alternative (Substantial Additional Protection):**	Reinforces the no-take status of NWR resources and provides a higher level of protection by enlarging no-take zones off two islands in the Hawaiian Islands NWR and off all NWR islands in the Pacific remote island areas. Does not mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.
Alternative 4 (Maximum Protection):	Provides the most protection to National Wildlife Refuge resources by creating a no-take MPA throughout the region's EEZ in all areas shallower than 100 fm. Does not mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.

Protected Species – Hawaiian Monk Seal	
Alternative 1 (No-action):	Risk of direct impact from gear in FMP-managed fisheries and indirectly from food competition in NWHI is low but remains unchanged. Fails to mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.
Alternative 2 (Minimal Additional Protection):	Risk of direct impact from gear in existing FMP-managed fisheries and indirectly from food competition in NWHI is reduced by establishing low-use MPAs to a depth of 50 fm around all NWHI.
Alternative 3 **Preferred Alternative (Substantial Additional Protection):**	Provides a higher level of protection by enlarging no-take zones off the two islands that are most important for breeding by the endangered Hawaiian monk seal in NWHI. Potential direct impacts near breeding areas and indirect food competition in NWHI would be reduced. Depending on zoning plan, potential for vessel groundings to degrade critical habitat is reduced in some areas. Fails to mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.
Alternative 4 (Maximum Protection):	Provides the highest level of protection by enlarging no-take zones off the two islands that are most important for breeding by the endangered Hawaiian monk seal in NWHI. Potential direct impacts near breeding areas and indirect food competition in NWHI would be greatly reduced. Depending on zoning plan, potential for vessel groundings to degrade critical habitat is reduced in some areas. Fails to mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.

Protected Species – Sea Turtles	
Alternative 1 (No-action):	No change in impact. Fails to mitigate large take of green turtles in main Hawaiian Islands' shoreline fishery or degradation of nesting habitat in American Samoa. Fails to mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.
Alternative 2 (Minimal Additional Protection):	Risk of direct impact from gear in existing FMP-managed fisheries in the NWHI is reduced by establishing low-use MPAs to a depth of 50 fm around all NWHI. Depending on zoning plan, potential for vessel groundings to degrade nesting habitat is reduced. Fails to mitigate large take of green turtles in main Hawaiian Islands' shoreline fishery or degradation of nesting habitat in American Samoa. Fails to mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.
Alternative 3 **Preferred Alternative (Substantial Additional Protection):**	Provides a higher level of protection from gear interactions by enlarging no-take zones. Depending on zoning plan, potential for vessel groundings to degrade nesting habitat is reduced. Fails to mitigate large take of green turtles in main Hawaiian Islands' shoreline fishery or degradation of nesting habitat in American Samoa. Fails to mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.
Alternative 4 (Maximum Protection):	Provides the highest level of protection from gear interactions by enlarging no-take zones. Depending on zoning plan, potential for vessel groundings to degrade nesting habitat is reduced in some areas. Fails to mitigate large take of green turtles in main Hawaiian Islands' shoreline fishery or degradation of nesting habitat in American Samoa. Fails to mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.

Protected Species – Seabirds	
Alternative 1 (No-action):	Low risk of hooking in NWHI and PRIA continues at same level. Fails to mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.
Alternative 2 (Minimal Additional Protection):	Low risk of hooking in NWHI and PRIA continues at same level. Fails to mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.
Alternative 3 Preferred Alternative (Substantial Additional Protection):	Low risk of hooking in NWHI and PRIA continues at same level. Fails to mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.
Alternative 4 (Maximum Protection):	Low risk of hooking in NWHI and PRIA continues at same level. Fails to mitigate marine debris impacts caused by derelict fishing gear drifting into region from North Pacific fisheries.

Protected Species – Non-endangered Marine Mammals	
Alternative 1 (No-action):	Low impact but dolphin interaction rate in hook-and-line fisheries would continue at same level.
Alternative 2 (Minimal Additional Protection):	Low impact but dolphin interaction rate in hook-and-line fisheries would continue at same level.
Alternative 3 Preferred Alternative (Substantial Additional Protection):	Low impact but dolphin interaction rate in hook-and-line fisheries would be reduced in no-take MPAs.
Alternative 4 (Maximum Protection):	Low impact but dolphin interaction rate in hook-and-line fisheries would be reduced in no-take MPAs.

Reef Ecosystem Biodiversity, Structure, and Function	
Alternative 1 (No-action):	Fails to prevent loss of biodiversity, undesirable changes in species dominance or introduction of invasive exotic species.
Alternative 2 (Minimal Additional Protection):	Slight positive impact--low-use MPAs would encompass areas of relatively undisturbed remote reef habitat. Fails to prevent the introduction of invasive alien species on derelict gear drifting into the region from the North Pacific. Fails to prevent loss of biodiversity or undesirable changes in species dominance in nearshore coral reef ecosystems managed by island governments.
Alternative 3 Preferred Alternative (Substantial Additional Protection):	Strong positive impact – low-use and no-take MPAs would encompass large tracts of relatively undisturbed remote reef habitat. A large reservoir of unexploited genetic material would be conserved. Fails to prevent the introduction of invasive alien species on derelict gear drifting into the region from the North Pacific. Fails to prevent loss of biodiversity or undesirable changes in species dominance in nearshore coral reef ecosystems managed by island governments.
Alternative 4 (Maximum Protection):	Strongest positive impact – No-take MPAs would encompass large tracts of relatively undisturbed remote reef habitat. A large reservoir of unexploited genetic material would be conserved. Fails to prevent the introduction of invasive alien species on derelict gear drifting into the region from the North Pacific. Fails to prevent loss of biodiversity or undesirable changes in species dominance in nearshore coral reef ecosystems managed by island governments.

Existing Fisheries and Communities	
Alternative 1 (No-action):	Continue present effects
Alternative 2 (Minimal Additional Protection):	Very little impact on existing fisheries and fishing communities.
Alternative 3 Preferred Alternative (Substantial Additional Protection):	No-take and low-use MPAs would increase adverse impacts on existing fisheries and fishing communities by displacing existing bottomfish and lobster fishing effort around some NWHI where the seaward boundary of no-take zones would extend to a depth of 50 fm. Existing NWHI fisheries would be displaced in some areas and fishing costs would be increased.
Alternative 4 (Maximum Protection):	No-take MPAs would greatly increase adverse impacts on existing fisheries and fishing communities by displacing existing bottomfish and lobster fishing effort around some NWHI where the seaward boundary of no-take zones would extend to a depth of 100 fm. Existing NWHI bottomfish and crustacean fisheries would be closed.

Bioprospecting and Other New Fisheries	
Alternative 1 (No-action):	No impact.
Alternative 2 (Minimal Additional Protection):	Very little impact.
Alternative 3 Preferred Alternative (Substantial Additional Protection):	New fisheries would be prohibited in some areas within the EEZ.
Alternative 4 (Maximum Protection):	New fisheries would be prohibited throughout the EEZ

Native Cultures and Environmental Justice	
Alternative 1 (No-action):	Fails to prevent decline of customary and traditional uses in nearshore areas closed to traditional fishing by island governments. Green turtles cannot be harvested for customary and traditional uses.
Alternative 2 (Minimal Additional Protection):	Fails to prevent decline of customary and traditional uses in nearshore areas closed to traditional fishing by island governments. Green turtles cannot be harvested for customary and traditional uses.
Alternative 3 **Preferred Alternative (Substantial Additional Protection):**	Would provide preferential access to indigenous zones in low-use MPAs designated immediately and in the future in the EEZ around U.S. Pacific islands. Would also increase indigenous participation in the coral reef management process for the EEZ around the NWHI and elsewhere. Therefore, less negative effects on native cultures than Alternative 1 (No-action). Financial institutions may view MPAs as creating too much risk and cost for new indigenous fishing enterprises. Green turtles cannot be harvested for customary and traditional uses.
Alternative 4 (Maximum Protection):	Would prohibit all fishing activities in waters shallower than 100 fm and would decrease indigenous participation in coral reef fisheries conducted in the EEZ throughout the Region. No-use MPAs close to main inhabited islands and in waters shallower than 100 fm would displace most customary and traditional coral reef fisheries. Therefore, has greater negative effects on native cultures than Alternatives 1, 2, or 3. Financial institutions are likely to view MPAs as creating too much risk and cost for new indigenous fishing enterprises. Green turtles cannot be harvested for customary and traditional uses.

Non-consumptive Values and Uses	
Alternative 1 (No-action):	No change in impacts. Island governments regulate live rock and stony coral collection in nearshore reef areas. Fails to prevent large-scale removal of live rock/stony coral in EEZ. Fails to restore or prevent new degradation of environmental quality in nearshore reef areas managed by island governments. Does not mitigate or prevent impacts from coastal construction, watershed management, shoreline erosion or water pollution.
Alternative 2 (Minimal Additional Protection):	Some positive impacts--low-use MPAs would encompass large tracts of relatively undisturbed reef habitat with high environmental quality. Fails to restore or prevent new degradation of environmental quality in nearshore reef areas managed by island governments. Does not mitigate or prevent impacts from coastal construction, watershed management, shoreline erosion or water pollution.
Alternative 3 **Preferred Alternative (Substantial Additional Protection):**	Strong positive impact – No-take and low-use MPAs would encompass large tracts of relatively undisturbed reef habitat with high environmental quality. Some areas may be accessible in the future for ocean recreation. Would provide undisturbed sites for surveying baseline characteristics of coral reefs. Fails to restore or prevent new degradation of environmental quality in nearshore reef areas managed by island governments. Does not mitigate or prevent impacts from coastal construction, watershed management, shoreline erosion or water pollution.
Alternative 4 (Maximum Protection):	Strongest positive impact – No-take MPAs would encompass large tracts of relatively undisturbed reef habitat with high environmental quality. Some areas may be accessible in the future for ocean recreation. Would provide undisturbed sites for surveying baseline characteristics of coral reefs. Fails to restore or prevent new degradation of environmental quality in nearshore reef areas managed by island governments. Does not mitigate or prevent impacts from coastal construction, watershed management, shoreline erosion or water pollution.

Administration and Enforcement of Regulations	
Alternative 1 (No-action):	No added responsibilities or costs. Continued low level of surveillance of remote reefs and difficulties in preventing violations of island government regulations.
Alternative 2 (Minimal Additional Protection):	Definition of seaward boundaries following 50 fm isobath complicates enforcement more than grid or circle definitions.
Alternative 3 Preferred Alternative (Substantial Additional Protection):	Definition of seaward boundaries following 50 fm isobath complicates enforcement more than grid or circle definitions.
Alternative 4 (Maximum Protection):	Definition of seaward boundaries following 100 fm isobath complicates enforcement more than grid or circle definitions.

5.13.2 Resource Tradeoffs

Short-Term Uses Versus Long-Term Productivity

Short-term uses generally determine the present quality of life for the public. In coral reef ecosystems, short-term uses include fishing and ocean recreation. The quality of life for future generations depends on continued productivity of coral reef resources, and for Pacific Island populations, the perpetuation of communities and cultures that are dependent on fishing and seafood. Long-term productivity refers to the capability of the ecosystem to provide resources on a sustainable basis. Management activities proposed by the CRE-FMP (the Preferred Alternative) could reduce the natural productivity of some coral reef areas in order to acquire new information and improve understanding and management of resources. The extent to which long-term productivity will be affected is not known because monitoring of these effects has only recently begun. However, it is known that coral reef management practices have the potential to reduce natural productivity if certain operating guidelines are not followed.

Control measures in all alternatives were specifically designed to meet the management standards of the MSFCMA and to prevent unacceptable degradation of coral reef resources. Monitoring will determine whether the control measures are effective and are being correctly applied. Alternatives 2-4 emphasize marine protected areas, gear restrictions to prevent destructive and non-selective fishing methods, and detailed permit control over new activities taking potentially-harvested resources about which little is known. These alternatives are less likely, therefore, to adversely affect long-term productivity than the No-action alternative. The framework procedure in the CRE-FMP allows managers to make rapid and timely regulatory adjustments in response to changing fisheries, resource conditions, and environmental fluctuations.

Unavoidable Adverse Effects

Implementation of any alternative may result in some adverse environmental effects that cannot be avoided. Control measures in all alternatives are intended to keep the extent and duration of these effects within acceptable levels but adverse effects cannot be completely eliminated. The following adverse environmental consequences would be associated with some of the alternatives:

- Displacement of some existing fishing effort from within no-take MPAs to areas outside such MPAs, and possible redirection of this effort to fully exploited coral reef resources elsewhere.

- Increased costs to fishermen who have to travel farther to fish in open areas, and have to comply with special permit, reporting, and insurance requirements for fishing vessel passage through MPAs.

- Increased governmental responsibilities and costs for administration, monitoring, and enforcement of proposed new federal regulations.

- Continuing degradation of essential fish habitat and adverse effects on coral reef resources in non-EEZ areas, and by non-fishing activities that cannot be directly managed under present MSFCMA authority.

Irreversible Resource Commitments

Irreversible commitments of resources are actions that disturb either a non-renewable resource—such as endangered species or cultural resources—or a renewable resource to the point that it can only be renewed over 100 years or more. (It may take slow-growing reef-building coral species this long to recover, for example). Measures to protect resources that could be irreversibly affected by other resource uses were incorporated into the Preferred Alternative. A summary of the major irreversible commitments of resources, and how they would be prevented, follows.

- Large-scale harvesting of live rock and stony corals directly removes major framework-building organisms that form coral reef habitat. Activities that damage reef habitat also cause irreversible losses because reef-building is very slow, often requiring eons to form a consolidated structure. Prohibitions on destructive fishing methods and on commercial collection of live rock and stony corals in Alternatives 3 and 4 are intended to prevent such irreversible losses.

- Loss of biodiversity and undesirable changes in ecosystem structure or function induced by human activities may also constitute irreversible resource commitments. For example, extinction of an endangered species, such as the Hawaiian monk seal, would constitute an irreversible loss. Even management activities undertaken to promote the recovery of endangered species can result in irreversible commitments of other resources. For example, management measures may deny indigenous island populations, who are dependent on fishing for cultural perpetuation, the opportunity to fish.

- Opportunities for research on undisturbed coral reef ecosystems to establish baselines are irreversibly lost once resources are harvested. Alternatives 1 and 2, which do not establish no-take zones, would have the most irreversible commitment of coral reef resources to uses other than baseline research, whereas Alternatives 3 and 4, which establish large no-take zones, would have the least impact.

- The use of fossil fuels for vessel operation and government surveillance and enforcement activities is an irreversible resource commitment. Alternatives with more activities and higher levels of surveillance and enforcement would cause higher consumption of fossil fuels.

Irretrievable Resource Commitments

An irretrievable commitment is the loss of opportunities for production or use of a renewable resource for a period of time. Almost all coral reef resource extraction activities produce varying degrees of irretrievable resource commitments. These commitments parallel the environmental

impacts for each resource summarized earlier in this section. The difference between resource levels under a given alternative and potentially higher levels that could be otherwise produced also represents an irretrievable commitment of resources. The difference in output levels is the opportunity cost, or lost production.

The major tradeoffs among resource output levels that may cause irretrievable commitments are: (1) between utilization of coral reef resources at sustainable levels and complete conservation through "no take;" (2) between multi-resource and single resource management activities; (3) between preventive management and mitigation after damage has occurred; (4) between management activities now or later; and, (5) between economic effects on potential new fisheries and effects on existing fisheries. These tradeoffs require commitments that are irretrievable because opportunities are foregone. The commitments are not irreversible, however, because they could be reversed by changing management direction. To allow for changes in management direction, the Preferred Alternative (3) includes an adaptive procedure. Rapid and timely regulatory adjustments can be made, based on changing fisheries, resource conditions, or environmental fluctuations.

5.14 Environmental Justice

Under Executive Order 12898, dated February 11, 1994, federal agencies are required to address the potential for disproportionately high and adverse environmental effects of their actions on minority and low-income populations. Agencies are required to ensure that their programs and activities that affect human health or the environment do not directly or indirectly use criteria, methods, or practices that discriminate on the basis of race, color, or national origin. NEPA documents are specifically required to analyze effects of federal actions on minority and low-income populations and, whenever feasible, to develop mitigation measures to address significant and adverse effects on such communities. In addition, the Executive Order requires provision of opportunities for community input in the NEPA process. It states that the public, including minority and low-income communities, should have adequate access to public information relating to human health or environmental planning, regulation, and enforcement. (See section 5.8.)

5.15 Significant Cumulative Effects

This section summarizes the cumulative impacts identified earlier in this chapter, in Sections 5.2-5.12. Cumulative effects occur when effects of coral reef management activities combine with effects of other activities to produce a greater net effect than either would if considered separately. Cumulative effects will occur as a result of implementing any alternative. Actions taken under Alternatives 3 and 4 are expected to moderate the cumulative effects of fishery activities. In contrast, measures in Alternatives 1 and 2 could increase cumulative effects. In all alternatives, management standards in the MSFCMA—to prevent overfishing and prevent adverse effects on essential fish habitat—will be met for those resources already being harvested by fisheries managed under the Council's already implemented FMPs. The cumulative effects on coral reef resources vary by alternative, but they depend largely on four factors:

1. The extent to which separate management activities in the EEZ can be integrated to avoid significant adverse effects on potentially-harvested resources and non-target coral reef resources, including protected species, and ecosystem structure and function.

2. The extent to which island governments in the U.S. Pacific implement management standards for state waters to avoid significant adverse effects on currently-harvested, potentially-harvested, and non-target coral reef resources.

3. The extent to which non-fishing activities in the EEZ and in state waters can be managed according to standards that prevent further adverse effects on coral reef habitat.

4. The extent to which adverse effects of fishing and non-fishing activities outside the Western Pacific Region (e.g., marine debris, introduction of invasive alien marine species) can be mitigated through inter-regional and international management.

Four factors contributing to cumulative impacts are considered: natural events, restrictions on fishing, marine debris, and the NWHI CRE Reserve Executive Orders.

In considering the cumulative impacts of the alternatives in this EIS, it is important to remember that the majority of reefs affected by the management measures in the CRE-FMP are in remote areas that are far removed from terrestrial activities and impacts. Thus, none of the alternatives would prevent overfishing of currently-harvested or potentially-harvested coral reef resources in nearshore areas regulated by island governments, nor would they prevent new degradation of EFH in these areas. (However, the EFH consultation procedure that would be implemented by the CRE-FMP will help to mitigate the future potential for adverse effects resulting from proposed federal activities.)

5.14.1 Natural Events

Natural events, such as hurricanes and winter storms or increases or decreases in the nutrient flux into the coral reef system, coupled with fishing pressure and other activities, can cumulatively impact coral reef resources. Storms can also significantly reduce coral cover. At a larger scale, cyclical oceanographic events affect productivity over extensive areas and may account for large fluctuations in population abundance. (El Niño is one example of such a cyclical event.) Coral bleaching is another natural event that can be exacerbated by human activity. Long-term environmental change could expose stony corals to an increasingly hostile environment and possibly lead to extinctions, although healthy corals in areas under less stress may contribute to recovery.

As discussed in the first part of this chapter, this variety of natural events could have a cumulative impact on target and non-target stocks in FMP-managed fisheries, protected species, National Wildlife Refuge Resources, coral reef habitats (including essential fish habitat), and coral reef ecosystems. Degradation of the coral reef ecosystem would also diminish the non-consumptive value of these resources. Alternatives with more extensive and restrictive MPAs

would generally reduce the cumulative impacts stemming from the combination of natural events and human activity. The Preferred Alternative's (CRE-FMP) framework procedure would also allow timely and rapid regulatory adjustments in response to these changes.

5.15.2 Restrictions on Fishing

Current levels of fishing under the Council's already-implemented FMPs appear sustainable. In addition, they have not had a significant impact on protected species, and other marine mammals, associated with the coral reef ecosystem. In particular, bottomfish and lobster fishing do not appear to have any direct or indirect effects that would inhibit the recovery of the Hawaiian monk seal.

Restrictions on fishing could have cumulative impacts on fishing communities and native cultures. Declining catch rates, increasing competition, and unstable markets have already affected fishermen in the region. Measures, such as those considered in the more restrictive alternatives, could reduce their ability to maintain the highly flexible fishing strategy that is important to the economic success of many smaller and medium-sized fishing vessels. Closing some NWHI fishing grounds would further could affect the viability of this strategy. The availability of seafood is important to Hawaii's tourist industry. Any reduction in the availability of locally-caught fish will impact the visitor experience to Hawaii. Not only would this result in some economic loss, resulting changes in lifestyle represent a social cost, assuming that displaced fishermen cannot find an equally satisfactory alternative way of life. Social costs extend to the sense of continuity that might be lost if fishing traditions cease. Pacific Islanders have an important connection with fishing; it cultivates their intimacy and harmony with the ocean. This reinforces their sense of kinship with nature, and their relationships with places that perpetuate cultural identities and beliefs. Increasing restrictions on customary and traditional uses of marine resources are jeopardizing cultural continuity in many areas of the U.S. Pacific.

Management measures in Alternatives 2, 3, and 4 , which restrict fishing, would add significantly to cumulative responsibilities and costs of fishery administration, surveillance, and enforcement. Separate jurisdictions and competing missions could hinder implementation of alternatives designating MPAs. It is likely that the process of developing inter-agency, inter-governmental and public-private relationships needed for ecosystem-scale management of coral reefs would be time consuming and costly.

5.15.3 The NWHI Coral Reef Ecosystem Reserve

The NWHI CRE Reserve, as implemented by Executive Orders, is expected to have cumulative effects in two areas. First, it is expected to reduce or eliminate commercial and recreational fishing in the NWHI. Second, it could increase other activities, with concomitant impacts.

The conservation measures contained in the NWHI EOs would likely reduce all fishing activities in the NWHI, as it caps commercial and recreational fishing to the level of effort and take to the year preceding December 4, 2000. The definition of the year preceding the December 4, 2000

remains undefined however, according to the Code of Federal Register §660. 13, the fishing year for Western Pacific FMP fisheries begins January 1 and ends on December 31. Of the Council's implemented FMP fisheries permitted to operate in the NWHI, only the bottomfish fishery would likely be allowed to continue, but with specific depth restrictions in federal waters in 10 of the 15 Reserve Protection Areas. (The crustacean and precious corals fisheries harvest levels would be capped to zero.) As a result, the NWHI EOs are likely to alleviate much commercial fishing pressure. However, if fishing effort and take remains at levels seen over the past five years, fishing pressure outside the Reserve Preservation Areas could increase, potentially resulting in localized depletions similar to that of the MHI. Cumulative impacts on target species could be significant, but the NWHI EOs are unlikely to have a significant impact on non-target resources. (Fishing based on Midway Atoll NWR is not expected to be affected because it is not part of the NWHI CRE Reserve.)

Apart from simply closing areas to fishing, the Reserve will constrain fishing operations in adjacent open areas. In order to successfully target bottomfish, a vessel must be able to operate on either side of the preferred target depth because the vessel may be in shallow waters while the actual lines are in much deeper waters. The NWHI CRE Reserve's restriction of bottomfishing in waters shallower than 25 fm could also considerably reduce future *uku* landings in the EEZ.

As noted, two other FMP-managed fisheries could be eliminated, even though FMP management provisions promote sustainable harvest. For example, the annual harvest guidelines under Crustaceans FMP allow removal of only 13% of the total lobster population. Closing fishing areas in the NWHI lobster fishery would affect 15 limited entry permits and a fishery with an ex-vessel value of $1 million or more per year. It is the only commercial lobster fishery in the state. Although the precious corals fishery is not yet active in the NWHI, closures could potentially eliminate $1 million in landed value and an additional $25 million in revenue for associated jewelry businesses (R. Grigg, pers. comm.). Interpretation of the NWHI EOs also suggests that recreational take of bottomfish and crustaceans will be capped at zero.

As with the precious corals fishery, the NWHI Reserve will preclude future opportunities for bioprospecting and other commercial coral reef fisheries, as none existed in the year preceding the EO. In addition, the designation of nearly all of the coral reef habitat to 100 fm as Reserve Preservation Areas would preclude future sustainable harvesting of coral reef ecosystem resources in the NWHI, with the exception of bottomfish. As a result, the potential economic gains lost to Hawaii could be significant.

The reduction and elimination of fisheries, resulting from the NWHI CRE Reserve, would have cumulative impacts on economic and social components similar to—although more severe—than those outlined above for fishing restrictions. Unlike the Preferred Alternative (3), the CRE Reserve EOs do not have any provisions for the take of live rock and live coral for cultural and ceremonial purposes. This would be a cumulative impact on native cultures.

Increased visitation, and additional boats and infrastructure planned for the NWHI CRE Reserve, may ultimately have cumulative impacts on protected species, National Wildlife Refuge

resources, coral reef habitat (including EFH), the coral reef ecosystem, and non-consumptive values. However, the cumulative effects of the NWHI CRE Reserve on NWR resources would be expected to be low because it would not impinge on DOI authority over Refuge management. Warehouses may be constructed on French Frigate Shoals (one of the most important NWHI areas for endangered Hawaiian monk seals and primary nesting ground for green sea turtles) and Midway Atoll (which is not part of the Reserve but part of the ecosystem) for boats and related field supplies. The logistics of these field activities could potentially increase the degree and frequency of disturbance and compound environmental impacts on coral reef components. Because Hawaiian monk seals are extremely sensitive to human disturbances, increased field research and management activities on monk seals and in monk seal habitat, related to Reserve operations, could reduce seal survival rates. On the other hand, frequent field trips would promote the Reserve and support goals for research, development of educational materials, and cultural studies.

The conservation measures outlined in the NWHI EOs would prohibit anchoring on any living or dead corals, altering the seabed in any way, and would also prohibit removal of living or non-living marine resources in the NWHI. However, the NWHI EOs provide for exemptions to these restrictions and promotes several resource-dependant activities.

The complex system of prohibitions and restrictions as defined in the NWHI EOs will be an even greater enforcement burden that Alternatives 3 (the Preferred Alternative) or 4 of the FMP.

5.15.4 Marine Debris

One of the most serious problems in the NWHI is the accumulation of marine debris, largely derelict gear lost from North Pacific fisheries. This debris has a cumulative impact on National Wildlife Reserve resources and coral reef habitats. Inter-regional and international management will be necessary to find solutions to this problem.