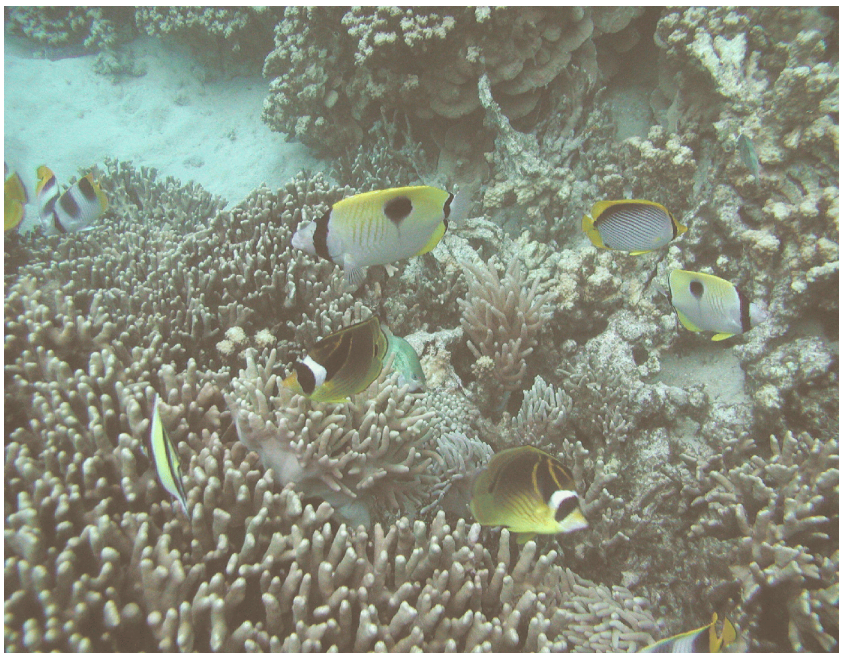

Photo by Kevin Foster, USFWS

Final Report

Compensatory Mitigation for Coral Reef Impacts in the Pacific Islands

September, 2003

Antonio Bentivoglio
United States Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, Hawaii

Table of Contents

Executive Summary i

I. Introduction 1

II. Methods 3

III. Results..... 5

IV. Discussion 8
Implementation of Compensatory Mitigation..... 9
Documentation of Anticipated Area of Impact..... 9
Assessment of Resources Anticipated to be Impacted..... 10
Correlation Between Anticipated Impacts and Compensatory Mitigation... 11
Scientific Monitoring of Compensatory Mitigation..... 12
Adequacy and Effectiveness of the Compensatory Mitigation Process..... 13

V. Conclusions 15

VI. Recommendations 16

Literature Cited 20

List of Tables

Table 1. Information retrieved from the 11 project that resulted in unavoidable impacts to coral reef ecosystems in the Pacific Islands.
Table 2. File review results of the compensatory mitigation process and effectiveness of the implemented compensatory mitigation

Appendices

A. Selected sections of Executive Order 13089 on Coral Reef Protection.
B. Integrating the Executive Order with federal laws and federal agency responsibilities and policies
C. National Research Council report recommendations
D. State of Utah report on compensatory mitigation

Executive Summary

Executive Order 13089 on Coral Reef Protection (EO) was signed on July 11, 1998, establishing the Coral Reef Task Force (Task Force) to oversee implementation of the EO and outlined Federal agency responsibilities. On March 2, 2000, the Task Force (co-chaired by Department of the Interior and Department of Commerce) published the National Action Plan to Conserve Coral Reefs (Action Plan). The Action Plan lays out a science-based road map to achieve healthy coral reefs.

In an attempt to address some of the tasks in the Action Plan, the U.S. Fish and Wildlife Service (FWS) and the U.S. Environmental Protection Agency (EPA) funded a review of completed Federal projects with unavoidable impacts to Pacific Island coral reef ecosystems and an assessment of the adequacy of the compensatory mitigation process and on-the-ground effectiveness of implemented compensatory mitigation. Projects reviewed were subject to FWS, EPA, National Marine Fisheries Service, and Army Corps of Engineers mitigation policies, which aim to avoid unnecessary impacts, minimize unavoidable impacts, and provide compensatory mitigation to replace project-related resource losses resulting from unavoidable impacts. The majority of the project information used in this review was obtained from agency files with minor additions from on-the-ground investigations. This review identified 11 Federal projects that each resulted in some measurable amount of unavoidable loss to coral reef ecosystems. Compensatory mitigation was implemented for 9 of the 11 projects (82 percent) mitigating 175.8 (98 percent) of the total 178.6 acres. In all 11 projects, anticipated impacts were generally quantified as acres impacted, but in only one project (9 percent) were the coral reef resources within the area of anticipated impacts quantitatively assessed, accounting for 4 percent of the total acres. In no cases was the project-related loss of coral reef functions lost quantitatively correlated with the amount of implemented compensatory mitigation. Valid scientific monitoring of mitigation actions occurred in seven of nine implemented projects (77 percent) accounting for 128.3 (73 percent) of the mitigated acres. Performance standards for compensatory mitigation actions were written and achieved for only two of nine projects (22 percent) accounting for 4.5 (3 percent) of the mitigated acres. Based on the criteria used in this review effectiveness was achieved in four (44 percent) of the nine projects where compensatory mitigation was implemented accounting for 116.4 (65 percent) of the mitigated acres.

Recommendations are provided to help improve the implementation and effectiveness of future coral reef mitigation efforts. These include: (1) develop a coordinated Interagency Coral Reef Mitigation Strategy; (2) develop a set of objective methodologies to estimate anticipated project-related impacts to coral reef ecosystems so the appropriate type and adequate amount of compensatory mitigation to replace losses can be identified and implemented; (3) develop systems to monitor and track the implementation of compensatory mitigation actions so the adequacy of the coral reef mitigation efforts can be determined; (4) identify and evaluate additional forms of compensatory mitigation; (5) give greater emphasis to compensatory mitigation in plans for large projects.

I. Introduction

Coral reef ecosystems are unique and among the most complex and biodiverse ecosystems on earth (U.S. Coral Reef Task Force, 2000). The United States contains an estimated 17,000 square kilometers (km^2) of coral reef habitat in Hawaii, Guam, American Samoa, Commonwealth of the Northern Mariana Islands (CNMI), Florida, Texas, U.S. Virgin Islands (USVI), and Puerto Rico (U.S. Coral Reef Task Force, 2000). The U.S. Compact States of the Republic of Palau (ROP), Federated States of Micronesia (FSM), and Republic of the Marshall Islands (RMI) contain as many as 81,500 km^2 of coral reef habitat (Holthus et al., 1993). Coral reef resources are important to humans because they provide a number of directly beneficial ecosystem functions and services, including coastal shore protection, diverse opportunities for jobs and recreation, sources of food and raw materials, and can have societal importance and cultural significance (Cesar, 2000).

However, coral reef resources have become over exploited by fishing, recreation, and other uses, and degraded by dredging and shoreline modifications, decreases in water quality, sedimentation, aquatic nuisance species or invasive native species, destructive fishing practices, vessel groundings and anchoring, disease outbreaks, and global climate change (U.S. Coral Reef Task Force, 2000). In 2000, the U.S. Coral Reef Task Force (CRTF) estimated that 10 percent of all coral reefs were degraded beyond recovery and that 30 percent were in critical condition and may die within 10 to 20 years, particularly those reefs near human populations. It was also estimated that if current pressures continue unabated, another 30 percent may perish completely by 2050 (U.S. Coral Reef Task Force, 2000).

In response to this growing global coral reef crisis, President William Jefferson Clinton issued Executive Order 13089 on Coral Reef Protection (EO) on June 11, 1998 (64 FR 32701). Through the policies set forth in the EO, Federal agencies were directed to identify their actions that may affect U.S. coral reef ecosystems, utilize their programs and authorities to protect and enhance the conditions of these ecosystems and ensure that any actions they authorize, fund, or carry out will not degrade the conditions of coral reef ecosystems. The EO defines "U.S. coral reef ecosystems" as those species, habitats, and other natural resources associated with coral reefs in all maritime areas and zones subject to the jurisdiction or control of the United States. The EO established the CRTF, which developed the National Action Plan to Conserve Coral Reefs (Action Plan), a comprehensive plan for protection, restoration, and sustainable use of U.S. coral reefs.

A major recommended item in the Action Plan is to assess the effectiveness of recent coral reef mitigation for Federal projects and provide guidance for future mitigation activities related to Federal actions. In the U.S. Pacific Islands, many such actions entail permitting by the U.S. Army Corps of Engineers (Corps) under Section 404 of the Clean Water Act (CWA) or Section 10 of the Rivers and Harbors Act or are Civil Works projects implemented by the Corps with Federal funds.

Mitigation is essentially a three part process. If a proposed project will impact marine resources, Federal agencies first attempt to modify the proposed project to avoid impacts. If after all avoidance measures have been implemented and project-related impacts still exist, Federal agencies then attempt to minimize impacts. Finally, if unavoidable impacts still exist after all attempt at avoidance and minimization, then the Federal agencies must replace the resource's lost functions through compensatory mitigation.

The EO reinforces the abilities of the Federal natural resource agencies, such as the U.S. Fish and Wildlife Service (FWS), U.S. Environmental Protection Agency (EPA), and the National Marine Fisheries Service (NMFS) to make compensatory mitigation recommendations for Federal projects that specifically impact coral reef ecosystems. Currently, each Federal resource agency follows their own internal mitigation policy when recommending mitigation for federally permitted or funded projects that impact Federal trust resources such as threatened and endangered species, marine mammals, wetlands, migratory birds, and coral reef ecosystems. For proposed projects anticipated to result in unavoidable impacts to coral reef ecosystems, all of the Federal resource agencies' mitigation policies recommend that compensatory mitigation be implemented.

To help enhance Federal agency coordination on the development of compensatory mitigation recommendations, the FWS and EPA jointly funded this review of past projects that have impacted coral reef ecosystems in the Pacific Islands (Interagency Agreement #DW-14-95548101-1). This review directly and indirectly relates to Table B.3 (Reducing Habitat Destruction) in the Action Plan. Relevant items from Table B.3 are presented below.

Table B.3: Reduce Habitat Destruction

1) Work with coastal states and territories to review and strengthen enforceable policies for reef protection.
2) Prohibit the use of CWA section 404 Nationwide Permits for activities that would directly impact coral reefs.
3) Minimize the impacts to coral reefs by Section 404 permitted projects, Corps of Engineers planning projects and proposed activities under other federal resource management statues and programs through new guidance and impact thresholds.
4) Provide technical guidance documents to federal agencies for evaluating proposed permitting actions that may affect coral reef habitats.
5) Provide guidance and procedural documents to applicants for federal and state permits on projects affecting coral reef habitats.
6) Provide guidance documents to federal permitting and regulatory agencies for avoiding and mitigating impacts of approved projects on coral reefs.
7) Assess effectiveness of recent coral reef mitigation projects for Section 404 projects in Puerto Rico, USVI, and Hawaii and provide technical guidance for future mitigation activities related to permitting actions.

The focus of this review is on U.S. Pacific island projects with unavoidable impacts to coral reef ecosystems and, therefore, projects that should have implemented some form of compensatory mitigation. The purpose of this review is to investigate the overall adequacy of the existing compensatory mitigation process, as well as the on-the-ground effectiveness of implemented compensatory mitigation actions, and to provide recommendations to improve the process and its effectiveness in the future. The objectives of the review are: (1) to examine past marine project files for information relevant to the compensatory mitigation process and, where possible, documentation of the on-the-ground effectiveness of implemented compensatory mitigation actions in replacing project-related losses to coral reef ecosystems, and (2) to develop and disseminate recommendations aimed to improve the compensatory mitigation process.

For the purposes of this review, the compensatory mitigation process was considered to be comprised of the following six components: (1) Implementation of Compensatory Mitigation; (2) Documentation of Anticipated Area of Impact; (3) Assessment of Resources Anticipated to be Impacted; (4) Correlation Between Anticipated Impacts and Compensatory Mitigation; (5) Scientific Monitoring of Compensatory Mitigation; and (6) Establishment of Performance Standards/Evaluation Criteria.

II. Methods

To begin to build a database of project information for this review, FWS, EPA, NMFS, Corps and other knowledgeable personnel were asked to recommend recently completed Federal projects with unavoidable impacts to coral reef ecosystems in Hawaii, American Samoa, Guam, CNMI, RMI, FSM, and ROP. Existing project files maintained by the FWS, NMFS, and Corps were reviewed for information on the recommended projects. During the process of locating recommended project files, additional files for projects with impacts to coral reef ecosystems were found. However, due to time, budget, and other constraints, not all existing files maintained by all agencies could be examined for applicability to the review. Nevertheless, the complement of files that are included in the review represents the major Federal projects that have occurred in the U.S. Pacific Islands in the recent past.

For a project to be included in the review, its file information had to substantiate that:

(1) the project was a Federal project (i.e., the project was either permitted or funded by the Corps); and

(2) compensatory mitigation to replace unavoidable coral reef ecosystem losses was recommended by at least one Federal resource agency.

Information contained in these files was the sole basis for determining the adequacy of the compensatory mitigation process. Accordingly, usable files were checked for information on whether:

(1) the recommended compensatory mitigation or an alternative was implemented;
(2) the area of anticipated project impact was accurately quantified;
(3) the resources anticipated to be impacted in that area were adequately assessed;
(4) the implemented compensatory mitigation was based on some correlation between the resource functions anticipated to be lost by the project and those anticipated to be gained by the mitigation effort;
(5) the implemented compensatory mitigation was monitored with scientifically valid methods, defined as (a) the collection of data by the use of scientifically accepted and repeatable methods (anecdotal observations or notes are not considered to be valid scientific data) and (b) the collection of data at survey stations that remained consistent among sampling events so valid comparisons among data sets were possible; and
(6) the monitoring data were compared against specific performance criteria established to serve as a basis upon which to conclude whether the completed mitigation effort was adequate in replacing project losses.

Project files were examined for specific documentation on whether completed compensatory mitigation efforts were considered to have replaced the lost functions of the coral reef resources impacted. For example, files were checked for monitoring reports on the implemented mitigation. Whether or not a completed compensatory mitigation project should be considered to have been effective was based on whether or not valid monitoring over some period of time demonstrated that final on-the-ground conditions replaced project-related losses. If a file contained no valid monitoring report with conclusive results (e.g., no performance criteria on which to base conclusions regarding the success of a compensatory mitigation effort), the effectiveness of the mitigation effort could not be determined.

For this review, a coral transplantation project would be considered to have been an effective compensatory mitigation effort if valid monitoring had documented greater than 50 percent transplant survival over the length of the monitoring period. In the case of Marine Protected Area (MPA) establishment, such actions would be considered to have been effective if supported by a comparison of data representing baseline conditions with data from valid periodic MPA monitoring for extended periods of time. Since implemented compensatory mitigation actions many not always be effective these criteria were developed to evaluate agency actions relative to the compensatory mitigation process.

Author's Note 1: Resources impacted were most often measured in acres and mitigation implemented was measured in acres, tons, or numbers of pieces of coral transplanted. No correlation between project impacts and mitigation were attempted other than best professional judgement. Therefore, for this review, if a project removed 1 acre of coral reef and the mitigation was creation of a 2-acre marine protected area, the area mitigated was considered to be 1 acre. Similarly, if a project removed 1 acre of coral reef and the mitigation was transplantation of 10,000 pieces of coral, the area mitigated was considered to be 1 acre.

Historically, the Federal resource agencies applied few, if any, performance standards to evaluate the adequacy of mitigation projects. First, there was no agreement or "buy in" by resources agencies on the application of a specific set of performance standards to evaluate the adequacy of mitigation actions, and second, no single agency appeared to consistently use a systematic approach to evaluate mitigation actions. Given this past insufficient attention to performance standards by the resource agencies, very liberal performance criteria were developed only for the purpose of this review. In no way is it suggested that these criteria be adopted for application by the agencies to evaluate present or future mitigation actions. Rather, these very liberal criteria were employed in this review as a means to assess the adequacy of mitigation actions when the information contained in valid monitoring reports was limited. Regardless, all relevant agencies need to collaboratively develop rigorous performance standards that are agreed upon and applied in a systematic manner.

III. Results

Based on the information contained in the project files and from discussions with various experts, 11 files provided enough project-specific information to be included in this study. Table 1 lists the 11 projects and provides relevant project-specific information available from the files. Project completion dates ranged from about 1980 to 2001. The project types include new construction or expansion/maintenance of existing airports, harbors, roads/bridges, and communication cable landings.

Implementation of Compensatory Mitigation

In nine (82 percent) of the 11 projects, compensatory mitigation was implemented as a project feature or a permit condition. Based on the files, no compensatory mitigation was implemented for two projects: Ofu-Olosega bridge in American Samoa, where the proposed marine protected area was not created; and the West Beach swim lagoons in Hawaii, where the proposed marine protected area, boat moorings, and conservation signage have not be implemented (Francis Oishi, pers. comm. July 27, 2003). Overall, the compensatory mitigation associated with the nine projects accounted for 175.8 acres (98 percent) of the total 178.6 acres of habitat that was anticipated to be directly lost within the footprints of all 11 projects (see Table 2).

Documentation of Anticipated Area of Impact

Most of the selected project files specifically identified the size of areas of anticipated direct impacts (i.e., dredged or filled area). But few project files identified the size of areas of anticipated indirect impacts. Based on the files, it was estimated that the 11 projects would directly and indirectly impact at least 193.3 acres of marine resources. This included 178.6 acres of coral reef resources anticipated to be directly impacted from project dredging and/or filling activities and an additional 14.7 acres of marine habitat anticipated to be indirectly impacted (e.g., secondary impacts from siltation, contamination, disturbance, blasting) from project construction. Post-construction quantification of acres actually impacted was not found in the project files and it appears that this kind of project-related

assessment was rarely if ever performed. The full extent of indirect or secondary impacts could not be determined due to inconsistencies of information included in the project files. Therefore, only the 178.6 acres of anticipated direct impacts could be used as a baseline to evaluate the process and effectiveness of the compensatory mitigation measures implemented.

Assessment of Resources Anticipated to be Impacted

Based on this review, only one (9 percent) of 11 project files contained a detailed assessment of the coral reef resources within the area anticipated to be directly impacted at a proposed project site. This accounted for 4 percent of the total 178.6 acres. The Fish and Wildlife Coordination Act Report for the Kawaihae Light Draft Harbor, Hawaii (USFWS, 1993) provided observations on physical features (substrate, depth, and topographic relief to delineate and qualitatively describe the existing dominant marine habitat types present) and quantitative surveys of conspicuous reef fishes, corals, and other macroinvertebrates were conducted within each habitat type.

Correlation Between Anticipated Impacts and Compensatory Mitigation

In no instances was there documentation of a process through which the anticipated loss of coral reef ecosystem functions were determined and used as a basis to develop commensurate compensatory mitigation to replace those losses. The ratio of the number of acres of MPAs created to the number of acres impacted by proposed projects was 12:1 for the Ammo Wharf and 28:1 for Saipan Harbor.

Scientific Monitoring of Compensatory Mitigation

According to the criteria used in this report, seven of the nine projects (78 percent) for which compensatory mitigation was implemented were validly monitored. These seven projects accounted for 128.3 acres (73 percent) of the 175.8 acres impacted by all nine projects. Two of the nine projects (22 percent) for which compensatory mitigation was implemented did not have valid monitoring: Kwajalein Atoll causeway, RMI (created marine habitat was not monitored; 44 acres); Outer Cove Marina, Saipan (anecdotal observations were made on transplanted coral; 3.5 acres; Marine Revitalization Corporation, 1997). These two projects accounted for 47.5 acres (27 percent) of the 175.8 acres.

Establishment of Performance Standards/Evaluation Criteria

According to the criteria used in this report, two (22 percent) of the nine projects (Piti cable landing, Project 11; Piti Underwater Observatory (PUO), Project 8; Table 2) established performance standards so that valid monitoring could demonstrate whether these standards were achieved (Environmental Services, 2001). This accounted for three percent (4.5 acres) of the 175.8 acres impacted by the nine projects.

Effectiveness of Implemented Compensatory Mitigation

Of the 11 project files included in the review, four (36 percent) contained sufficient information, based on the above criteria, to indicate that the compensatory mitigation efforts were effective in replacing project-related coral reef losses. These projects included Saipan Harbor maintenance dredging, Kaneohe Marine Corps Base storm drain installation, Kaneohe Bay Yacht Club maintenance dredging and PUO construction. Compensatory mitigation for the Saipan Harbor project included MPA designation, which occurred about ten years after project completion. The other three mitigation actions involved coral transplantation. Valid monitoring showed that greater than 50 percent of the transplanted coral at Kaneohe Marine Corps Base (98 percent survival), PUO (97 percent survival), and Kaneohe Bay Yacht Club (94 percent survival) survived for the lengths of their respective monitoring periods. The mitigation efforts for these four projects accounted for 65 percent of the total 178.6 acres.

Three (27 percent) of the files contained sufficient information, based on the above criteria, to indicate that the compensatory mitigation efforts were not effective in replacing project-related coral reef losses. These projects included the construction of the Ofu-Olosega bridge in American Samoa (1.5 acres), the construction of Kawaihai harbor in Hawaii (4.5 acres), and West Beach swim lagoons in Hawaii (1.3 acres). Recommended compensatory mitigation for the Ofu-Olosega bridge included MPA designation which was not implemented. Compensatory mitigation for Kawaihae harbor was coral transplantation. Valid monitoring showed an overall survival rate of 33 percent, which is below the 50 percent survival rate chosen for this report. The compensatory mitigation for West Beach was creation of an MPA, establishment of boat moorings, and conservation signage. None of these three compensatory mitigation aspect were implemented. These three projects accounted for 7.3 acres (4 percent) of the total 175.8 acres.

The remaining four (36 percent) files did not contain enough information to determine the effectiveness of the compensatory mitigation efforts, this accounted for 31 percent of the total acres. These projects included the Piti Cable landing in Guam, Ammo Wharf construction in Guam, Outer Cove Marina in Saipan, and the construction of the Kwajalein Atoll Causeway in RMI. Valid monitoring showed that 97 percent of the transplanted coral at the Piti Cable landing site survival after 14 weeks (Environmental Services, 2001). However, a site inspection after 14 months only located 52 percent of the transplanted coral. These remaining coral pieces had 60 percent survival (Kolinski, 2002). Because almost half of the transplanted coral was not found the effectiveness of the mitigation action was considered unknown. Baseline and continued periodic monitoring did not occur at the Haputo and Orote MPAs that were created as compensatory mitigation for the construction of the Ammo Wharf. No valid monitoring occurred for the Outer Cove Marina transplanted coral or the dredge pits created as coral reef habitat from the construction of the Kwajalein Atoll Causeway.

Table 2. File review results of the compensatory mitigation process and effectiveness of the implemented compensatory mitigation.

Components of the Compensatory Mitigation Process	Percent of Projects	Percent of Acres
Compensatory Mitigation Implemented [1]	82	98
Project Impacts Quantified [1]	100	100
Coral Reef Resources Assessed [1]	9	4
Lost Coral Reef Functions Correlated with Compensatory Mitigation [2]	0	0
Valid Scientific Monitoring [2]	77	73
Performance Standards Established [2]	22	3
Compensatory Mitigation was Effective	36 [1] or 44 [2]	65 [1] or 66 [2]

[1] Based on 11 projects and 178.6 acres

[2] Based on 9 projects and 175.8 acres

IV. Discussion

Projects dating back to the late 1960's were reviewed. In many early projects, concern was raised regarding losses to coral reefs (Honolulu Reef Runway: initiated in 1972, 763 acres impacted; Kosrae airport: initiated in 1978, 340 acres impacted; Moen, Chuuk airport: initiated in 1976, 40 acres impacted) but there was no legislation requiring compensatory mitigation until the revised CWA 404(b)(1) Guidelines were codified in 1980 (Final Rule 40 CFR 230). The 1980 Guidelines included specific language on compensatory mitigation that had been lacking to date. Subsequent legislation and guidance have further clarified and defined the protection afforded to coral reef ecosystems. See Appendix B for additional information. For this reason only projects started after 1980 were included in this review. The one exception was the Ofu-Ologea bridge project which was included because there was very specific language recommending “setting aside a rich coral area of similar value within the Ofu-Olosega fringing reef as an underwater sanctuary” (NMFS letter; May 1, 1979).

The compensatory mitigation process is not a static process. This review is a snapshot of current project conditions based on the recent past. The application of valid monitoring methods with established performance standards is urgently needed. If this does occur, the overall adequacy of the compensatory mitigation process for projects could increase. If performance standards are established and valid monitoring shows these standards are achieved, effectiveness of the compensatory mitigation effort for projects could also increase.

The most important aspect of the compensatory mitigation process is to achieve on-the-ground replacement of lost coral reef functions. However, a precisely followed compensatory mitigation process does not necessarily lead to effective compensatory mitigation. Similarly, not following a process does not necessarily lead to ineffective compensatory mitigation. Regardless, a clear compensatory mitigation process should greatly help set the stage for effective on-the-ground results to replace lost coral reef functions.

This review revealed a number of aspects related to the compensatory mitigation process in which small improvements could cumulatively yield improved adequacy of the overall compensatory mitigation process and improve the effectiveness of implemented compensatory mitigation. The significant aspects of the compensatory mitigation process are: (1) Implementation of Compensatory Mitigation; (2) Documentation of Anticipated Area of Impact; (3) Assessment of Resources Anticipated to be Impacted; (4) Correlation Between Anticipated Impacts and Compensatory Mitigation; (5) Scientific Monitoring of Compensatory Mitigation; and (6) Establishment of Performance Standards/Evaluation Criteria. Each of these areas is briefly discussed below. It will be necessary for the relevant Federal, State and Territory agencies in the Pacific to collaboratively address these areas in order to improve the overall compensatory mitigation to achieve more effective results.

Implementation of Compensatory Mitigation

Based on the project files, when recommendations for compensatory mitigation were made they were generally implemented. However, it appears that if recommendations for compensatory mitigation were rejected, alternative efforts to replace the unavoidable losses were not pursued. In such cases, efforts should be made to identify and implement reasonable mitigation alternatives that replace the losses. The review also revealed that when an implemented compensatory mitigation action was not successful (e.g., transplanted corals died), subsequent discussions determine were not held to determine whether additional mitigation actions for the project were warranted. This suggests that if a compensatory mitigation goal is not clearly defined and not pursued in an adaptive way, it will be difficult to achieve effective on-the-ground results.

Documentation of Anticipated Area of Impact

Project impacts were chosen for review partly because relevant elements can be tracked through written documentation available in agency files. In reality, most projects undergo mitigation sequencing (i.e., avoidance, minimization, compensation) during project development and emphasis is placed on avoidance and minimization of impacts to natural resources. This often occurs in meetings among agency representatives when project details (e.g., design, time frames, potential impacts etc.) and local knowledge are discussed and alternatives to avoid and minimize impacts to coral reef ecosystems are explored. Often times these discussions go undocumented. Based on the results of this review, direct impacts were documented but indirect impacts were not, and there appears to be a general lack of resource-specific documentation in project files.

In general,the primary Federal agencies involved in the review of coral reef mitigation (FWS, EPA, NMFS) had poor tracking and filing systems. The Corps tracking system appeared efficient. None of these agencies specifically tracked coral reef impacts. No one agency's files contained all the information relating to a project and dates of project initiation and completion were almost never identified in the files. Therefore, projects initiation and completion dates were difficult to determine. The inability to locate simple information (e.g., project footprint, compensatory mitigation recommended and implemented, and presence of monitoring reports), excluded many project files from the review.

A good example of insufficient project documentation is the file on the Outer Cove Marina project in Saipan (Project 7; Table 1). In this case, original engineering designs were produced for Project 7, and the anticipated impacts to coral reefs and appropriate compensation were based on these designs (Corps Public Notice Number 990100148). However, about a year later, another project (not completed, not included in Table 1) was proposed at the same site (Corps Public Notice Number 990100148). The purpose of this new project was to correct construction deficiencies that occurred in Project 7 (i.e., actual work done for Project 7 did not conform to the approved engineering designs). However, the implemented compensatory mitigation was based on the original project design and not modified to account for the revised project design. As a result the implemented compensatory mitigation did not correlate with the actual project impacts.

Assessment of Resources Anticipated to be Impacted

Before Federal resource agencies can recommend appropriate compensatory mitigation, anticipated direct and indirect impacts to the coral reef ecosystem must be quantified. This should include both a surface area estimation (e.g., acres) of the extent of direct and indirect project-related impacts and a quantitative assessment of the coral reef ecosystem resources in the impact area. This review found that direct surface area impacts (acres) were generally identified but indirect surface area impacts (acres) were rarely identified.

Pre-project quantitative assessments of biological resources anticipated to be directly and indirectly impacted by a project were rarely conducted even though valid assessment methodologies for coral reef resources are well established (line transects, Brock 1954; fish biomass estimation, Ricker 1975; see Maragos and Grober-Dunsmore 1999 for more complete monitoring information). Among the 11 projects, the most extensive pre-project resource assessments occurred in the Fish and Wildlife Coordination Act Report for the Kawaihae Light Draft Vessel Harbor (Project 9; Table 1) on the island of Hawaii (US Fish and Wildlife Service, 1993). Resource information provided for this project included qualitative descriptions of the existing dominant marine habitat types. Quantitative surveys of conspicuous reef fishes (104 species), corals (11 species) and other macroinvertebrates (12 species of molluscs, four species of crustaceans, six species of echinoderms) were conducted along transect lines randomly placed within the turning basin, entrance channel, and surrounding coral reef areas. Reef-fish abundance and coral coverage of reef substrates by species and habitat type were estimated from transect data. Additional fish surveys were conducted to more accurately document fish species

composition. These surveys provided the best qualitative and quantitative information of the marine resources in the project site and surrounding areas.

Another project in which marine surveys occurred was the U.S. Navy Ammunition Wharf relocation project, Apra Harbor, Guam (Project 2; Table 1). Direct and indirect impacts were estimated to be 7.4 acres and 7.3 acres respectively. The final Environmental Impact Statement (VTN, Pacific, 1983, p ii) describes the whole 14.7 acres as "high quality coral reef." Quantitative resource assessments occurred at seven sites in Apra Harbor for coral and benthic macroalgae (line-intercept transects), macroinvertebrates (transect line), fish (transect line using SCUBA) and physical-chemical analyses. Only one of the assessment sites (site 2) occurred in the vicinity of the proposed site for the new Ammunition Wharf. Numbers of species of coral (37), percent coral cover (37 percent reef slope, 34 percent inshore, 100 percent reef margin, reef front and upper slope), general descriptions of invertebrates, and numbers of fish species (46) were summarized at site 2. The EIS stated that this information was based on a "...rapid, but by no means thorough, way of assessing major representative species and habitats in the limited field time available" (VTN Pacific, 1983). More specifically, this survey provided information along a single transect line in the 14.7-acre impact area. More thorough and extensive pre-project surveys assessing resources in proposed project areas are needed so the amount of impacts, can be estimated with reasonable confidence. Appropriate resource assessment surveys must be done prior to a project's initiation to document pre-project resource conditions.

Correlation Between Anticipated Impacts and Compensatory Mitigation

In the past, quantitative information on impacts to coral reef function was rarely gathered. Instead common sense and best professional judgement was used to determine amounts of compensatory mitigation. For the Kaneohe Bay Yacht Club dredging, Outer Cove Marina dredging, and the Piti cable landing, the coral inside the project area was transplanted outside. For the Piti Underwater Observatory (PUO), coral was temporarily moved to create a channel for barged construction equipment. The coral was replaced once the construction was completed.

If coral reef functions in project areas are not known, there is no way to accurately determine impacts to the coral reef ecosystem. This has led to the use of "acres" as a convenient unit to use to assess anticipated impacts and "acres impacted" as a quick way to quantify the degree of impact. The two projects (Ammo Wharf and Saipan Harbor) that created MPAs (1459 total marine acres) as the mitigation action impacted a total of 112.4 acres for an overall ratio of 13:1. The use of an acreage to assess impacts and determine mitigation has been extensively used in the wetland realm over the past 20 years. The National Research Council (NRC, 2001) found that between 1993 and 2000, an average of 1.8 acres of wetlands were mitigated for every 1 acre impacted. However, despite this ratio, the NRC report found that, when assessed, the functions of the mitigation acres rarely offset the loss of the functions of the acres impacted resulting in a net loss of wetland functions. A serious concern is that this also led to an overall net loss in the quality of the nations wetlands. Similarly, the MPA ratio of 13:1 appears to provide ample

replacement acreage but to date no monitoring or management reports are available to show whether coral reef functions in the MPAs replaced the project losses.

This concern should be addressed for coral reef ecosystems when compensatory mitigation is used to replace resources lost. Without knowing the most important resource attributes of the coral reef ecosystem at both the proposed project site and mitigation site, it is impossible to determine whether the resources lost would be replaced as a result of the mitigation efforts implemented. Although it is daunting to consider how much investigation and analyses it might take to completely account for all ecosystem attributes associated with a proposed site, it is reasonable that a workable list of the most important attributes could be compiled relatively easily from scientific work already completed. A set of attributes for a specific site could be generated from the list and used to help improve the resource impact assessment for the project and as a guide in the determination of an appropriate type and amount of compensatory mitigation. Although it may not always be possible or desirable to fully replace all lost resource conditions, more meaningful measurements of significant resource conditions at the sites can only help in attempts to achieve adequate compensatory mitigation.

Mitigation should also be implemented within a certain time frame. The seven year time delay between completion of the Saipan Harbor project and the designation of the MMCA is excessive. Generally, impacts are permanent so compensatory mitigation should be built into project planning and if possible implemented before the project is completed.

Finally, if transplantation is to be used as a mitigation tool, survival ratios should be examined. Long term transplantation survival needs to be studied. If in general, only 50 percent of transplanted coral is expected to survive, then theoretically twice the number of pieces of coral should be transplanted to account for mortality. However, coral from other natural areas outside a project area should never be used as a source of transplants for a mitigation project. Therefore, if coral transplantation survival for a specific project is expected to be only 50 percent, additional mitigation actions should be identified for implementation so all anticipated resource losses can be replaced.

Scientific Monitoring of Compensatory Mitigation

In order to determine whether impacts from a project are replaced by the implemented compensatory mitigation, monitoring of the mitigation action must occur. This requires collection of baseline parameters at the new mitigation site and subsequent regular on-site monitoring of similar parameters so comparisons to the baseline can occur.

A few of the coral transplantations provided adequate baseline and follow-up monitoring. The transplanted coral at the Piti Cable Landing (Project 11; Table 1) had 97 percent survival after 14 weeks when monitoring ceased (Environmental Services, 2001). Subsequent monitoring 14 months after transplantation showed 60 percent survival, however, only 52 percent of the transplanted corals were located (Kolinski, 2002). Transplanted corals were monitored at

Kawaihae Harbor, Hawaii (Project 9; Table 1) for about two years, and showed that survivorship was close to 100 percent through about 14 weeks but then started to drop dramatically. Kawaihae Harbor coral survivorship at eight sites after about two years was 81 percent, 53 percent, 43 percent, 43 percent, 30 percent, 15 percent, 0 percent and 0 percent (Jokiel et al, 1999). When monitoring ceased, survival was on a decreasing track at four of the six remaining Kawaihae Harbor sites. Based on these results, it appears that the monitoring at the Piti Cable Landing likely occurred over too short a time frame to provide relevant data regarding the long-term survivorship of the transplanted coral. Therefore, monitoring must examine long-term survival of transplants and must be a standard component of coral transplantation projects.

Similarly, the value of scientific long-term monitoring applies to MPAs. The Orote and Haputo Ecological Reserve Areas (ERAs) were created in 1984 (U.S. Navy 1984a and 1984b) as part of the U.S. Navy Ammunition Wharf Project in Guam (Project 2; Table 1). Project baseline information was gathered in 1986 (U.S Fish and Wildlife Service, 1986a and 1986b), and only Orote was resurveyed in 1988 (U.S. Fish and Wildlife Service, 1988a). However, differences between sample sizes and monitoring methods used in 1986 and 1988 made it difficult to detect differences between years. This is illustrated by mean point-to-colony coral values from 1986 (non-random site selection, 9 transects) and 1988 (random site selection, 5 transects), which ranged from 26 to 35 with the variance for these mean values ranging from 157 to 943 (variances were always higher in the 1988 surveys). The 1988 resurvey report concluded that "this statistical analysis strengthens our general observation that coral communities of Orote appeared to change little between 1986 and 1988" (U.S. Fish and Wildlife Service, 1988a). However, these variances are so wide that they provide little statistical value to assess the change of the coral community over time.

Similarly, fish surveys at Orote identified 208 species in 1986 and 116 species in 1988, with 20 percent of these (23 species) having lower abundance in 1988 (U.S. Fish and Wildlife Service, 1988a). The report concluded that "...it is difficult to draw definitive conclusions from these observations" and "...in light of other data obtained during the 1988 re-survey, we believe that there has been little qualitative change in the health of the fish community within Orote since the summer of 1986" (no other fish data provided). Although monitoring was conducted, the results provided little usable information regarding the conditions of the ERA resources in and between the years 1986 and 1988. Scientific monitoring methods must be consistently used so comparisons can be made over time and sample size must be large enough to provide a statistical comparison with control sites over time.

Adequacy and Effectiveness of the Compensatory Mitigation Process

This review identifies some concerns in the compensatory mitigation process that need to be addressed in the future. In addition, the appropriate Federal agencies must, in some way, scientifically relate both sides of the coral reef equation (project losses and compensation) or else significant amounts of coral reef ecosystem resources may be lost.

If the extent of healthy coral reef ecosystem resources continues to decline, the downward trend may appear similar to past experiences with wetlands. The Federal Water Pollution Control Act (FWPCA), later known as the Clean Water Act (CWA), was enacted in 1948 (33 U.S.C. 1251-1376). The goal "to restore and maintain the chemical physical, and biological integrity of the Nation's waters" (this includes most wetlands) was added in the 1972 amendments (P.L. 92-500). The FWPCA became known as the CWA in 1977 (P.L. 95-217). Throughout history, wetlands have often been drained and filled for farmlands and urban development, mosquito control, and many other activities under the direction of the Federal government. In recognition of the importance of the function and value of wetlands and the realization that they were being lost at an alarming rate, the Conservation Foundation introduced a "no net loss" national wetland policy in 1988. This policy was endorsed by the Federal government in 1990 and has been supported ever since. The goal of "no net loss" was behind the Federal agencies' efforts to develop CWA section 404 guidelines that would secure compensation for permitted wetland losses. The goal was articulated by the EPA and Corps in their 1990 Mitigation Memorandum of Agreement (MOA). Restated in a 2002 Regulatory Guidance Letter (RGL 02-2), the Corps reaffirmed the "no net loss" goal as the basis for national wetland policy and other waters of the United States, consistent with the Section 404(b)(1) Guidelines.

According to the FWS, 53 percent of the conterminous U.S. pre-settlement wetland area was lost between the 1780s and the 1980s (Dahl, 1990). As stated in a National Research Council (NRC) report, average wetland loss during a 10-year period between the mid-1970s and the mid-1980s was 254,700 acres per year (NRC, 2001). Between 1986 and 1997, this loss was reduced to 58,545 acres per year (644,000 total acres over the 11-year period). This number included the number of wetland acres created as compensatory mitigation, which reduced the total number of acres lost (see p. 13-16 of the NRC report for additional interpretations and explanation of data). The results from this study indicate that despite the goal of "no net loss" as agreed upon in the 1990 MOA between the EPA and the Corps, net wetland losses continued. Appendices C and D contain recommendations for future actions to reduce wetland losses that may also have potential applicability to coral reef ecosystems.

A coherent strategy for interagency collaboration on the development and implementation of appropriate coral reef compensatory mitigation in the Pacific is urgently needed. The strategy should represent an organized effort to (a) identify the functions of coral reef resources in order to better anticipate project-related impacts, (b) employ appropriate types and amounts of compensatory mitigation to replace anticipated direct, indirect, and temporal project-related losses, and (c) track the overall performance of implemented compensatory mitigation efforts in replacing losses to coral reef ecosystems in order to determine the adequacy of the mitigation effort.

Similarly, a viable strategy should include workable means to identify the effectiveness of compensatory mitigation activities. The overall effectiveness of 65 percent found in this review may appear positive, but it also indicates net loss over time. There are clear problems associated with large projects and the timing of the implementation of the compensatory mitigation (creation

of MPAs) to replace lost resources. The recommendation to create a MPA around Managaha in 1988 and the actual creation of the MMCA in 2000 appear to be a case of implementing a proposed recommendation. However, the idea of conserving marine resources was initially proposed in the Northern Mariana Island Constitution that was adopted in 1977. Whether the 1988 recommendation for a marine reserve and the creation of the MMCA are directly related or merely coincidental is unclear. Regardless, the MMCA was created. If the MMCA was created as compensatory mitigation for the Saipan Harbor project then the timespan between the impacts from the project and the establishment of the MPA is excessive. Project-related impacts went unmitigated for seven years. If this same review had been completed prior to the creation of the MMCA in 2001, the overall effectiveness of the compensatory mitigation implemented for the projects covered in this review would have been only six percent. The agencies responsible for implementing compensatory mitigation must somehow assure that recommendations can be discussed and modified, if necessary, to ensure implementation of mitigation actions in a timely manner. This is particularly important for coral reefs, which can take years to centuries to recover, depending on how "recovery" is defined (Brown, 1997).

One of the Federal recommendations for compensatory mitigation for the West Beach swim lagoons was MPA creation. Aquatic resources in Hawaii ultimately are managed by the state. Designation of MPAs must go through public hearings where strong opposition can change these plans as happened with this proposed MPA. Ultimately, recommendations agreed upon by all Federal and State agencies may not be implemented. Such real life examples must be taken into account, and contingency plans and should be included for such cases. Significant time-lags to implement compensatory mitigation actions should also be accounted for.

For MPAs, baseline conditions must be established and periodic monitoring must occur so trends can emerge and adaptive management can be used to achieve the performance standards set for these areas. Such monitoring should have occurred at the Orote and Haputo ERAs and the dredge pits on Kwajalein, similar to what is currently being conducted at MMCA. A viable strategy must address proper pre-and post-project data collection to serve as a basis upon which conclusions can be made on the effectiveness of the compensatory mitigation actions in replacing coral reef ecosystem losses.

V. Conclusions

The ability of Federal agencies to effectively replace unavoidable impacts to Pacific coral reef ecosystems from federally funded or permitted projects is uncertain based on information contained in historical project files. On the surface, the information analyzed indicates the existence of an uneven compensatory mitigation process. However, the lack of a coherent strategy for interagency collaboration on the development and implementation of appropriate coral reef compensatory mitigation may be a major reason for this. Therefore, future efforts should be focused on improving the ability of Federal agencies to accomplish adequate compensatory mitigation for coral reef ecosystems through the development and use of such a strategy.

This strategy should focus on improvement in the following areas: (1) record keeping, (2) use of compensatory mitigation to offset unavoidable impacts, (3) identifying and compensating for secondary (indirect) impacts to coral reef ecosystems, (4) correlate project-related coral reef ecosystem losses and recommended compensatory mitigation, (5) monitoring and tracking of implemented compensatory mitigation, (6) identifying and implementing, as necessary, contingency measures (additional mitigation actions, performance bonds) for compensatory mitigation actions, and (7) appropriate follow-up monitoring to assess the effectiveness of the mitigation effort and to provide a feedback loop that will help improve future mitigation recommendations.

Continued pressure on oceanic resources from land-based and sea-based activities has contributed to a decline in the abundance and distribution of coral reefs around the world. The goal of the EO is to protect, restore, and sustain existing coral reefs in the United States. The EO directs Federal agencies to initiate this task. Past Federal agency attempts to offset impacts to Pacific coral reef ecosystems occurred without formal coordination based on a formal collaborative interagency strategy. This review revealed concerns regarding the adequacy of past Federal agency attempts at implementing compensatory mitigation in the Pacific and provides recommendations for improvement. With the issuance of the EO, Action Plan, recent Corps guidance (RGL 02-2), Federal resource agency mitigation strategies, and recent information highlighting similar problems being experienced with wetland compensatory mitigation, the difficult path to producing a better process has been initiated. Implementation of a coordinated and well thought out coral reef mitigation strategy will help provide the Corps and the Federal natural resource agencies with a greater ability to achieve the goals of the EO for federally funded and permitted projects.

VI. Recommendations

The results of this review demonstrate that the existing approach by the Federal agencies (i.e., FWS, EPA, NMFS, Corps) to replace unavoidable losses to coral reef ecosystems could and should be improved. If the goals of the EO and the Action Plan are to be met in the Pacific Islands, the Federal resource agencies must work together and with other interested parties to develop a cohesive, comprehensive, and practical interagency strategy to accomplish adequate compensatory mitigation. Once the strategy is developed all parties will need to cooperatively implement the strategy.

One of the goals of this report is to provide recommendations that could lead to an improved compensatory mitigation strategy for projects that impact U.S. Pacific coral reef ecosystems. The following recommendations are suggested starting points for future discussion. It is the intent of the FWS and the EPA to work collaboratively with the Corps, NMFS, and all relevant State and Territory partners and other stakeholders to act on these recommendations.

Recommendation 1: Develop an Interagency Coral Reef Ecosystem Mitigation Strategy.

The terminology in current resource agency mitigation policies is only partially applicable to coral ecosystems. This has hindered the use of these policies and created confusion on potential avenues to accomplish appropriate compensatory mitigation. An interagency strategy should define the overall mitigation expectation (e.g., no net loss) for coral reef ecosystems, clarify how existing Federal agency mitigation policies relate to coral reef ecosystems, and guide the agencies in carrying out the responsibilities given to them by EO 13089. It is clear that the first two steps in mitigation, avoidance and minimization, must be used to the maximum extent practicable. Steps to avoid and minimize impacts should be fully documented for projects under individual permits as well as through an alternatives analysis as required by the CWA 404(b)(1) guidelines, since often a project's anticipated impacts can be prevented or reduced to the point of not requiring compensation. If unavoidable impacts to the coral reef ecosystem are anticipated, then this strategy must provide a framework by which appropriate compensatory mitigation can be developed and successfully implemented. It is recommended that an interagency strategy should be collaboratively developed and cooperatively agreed to by the Corps, EPA, NMFS, FWS, and the relevant state, territorial and other resource management agencies. Currently, RGL 02-2 provides a strong backbone upon which a viable overall strategy could be built.

Recommendation 2: Develop a set of objective methodologies to estimate anticipated project-related impacts to coral reef ecosystems so the appropriate type and adequate amount of compensatory mitigation to replace losses can be identified and implemented.

In the past, a project's estimated footprint (direct impacts) in acres was often the only quantitative information available on the project-related loss of coral reef resources. The use of footprint size as a measure of direct impacts in this manner can be misleading since, for many projects, secondary and chronic impacts (from installation of the project) may occur over a much larger area. A way to reasonably estimate the area of secondary impacts should always be employed and this estimate should always be considered with estimates of direct impacts. In order to determine appropriate compensatory mitigation needed to replace the coral reef habitat anticipated to be lost or degraded by a project, a pre-project resource assessment of the coral reef ecosystem should be conducted. Quantitative methodologies to assess anticipated project-related loss through resource assessments of coral reef habitat are not currently used. This makes it impossible to accurately anticipate project-related losses to coral reef ecosystems and, therefore, the appropriate type and amount of compensatory mitigation needed to replace the loss. All coral reef habitats do not exhibit the same characteristics or attributes. However, even a reef flat that has no or minimal live coral has some level of importance to the overall coral reef ecosystem, which should be addressed. Whatever methodologies are collaboratively developed must be well-documented along with clear guidelines on how to best implement them. The natural resource agencies and the Corps should work collaboratively to identify workable methodologies. Ultimately, the use of the methodology must be agreed to by the agencies.

Recommendation 3: Develop a system to monitor and track the implementation of compensatory mitigation actions so the adequacy of the coral reef mitigation efforts can be determined.

In order to evaluate the adequacy of coral reef ecosystem-based compensatory mitigation actions, the effects of the actions on the ecosystem must be monitored and tracked. Monitoring of compensatory mitigation allows managers to determine how well the mitigation requirements were implemented (e.g., whether the required amounts of coral were transplanted), if the compensatory mitigation had the desired outcome (e.g., whether transplanted coral survived or provided expected functions to offset the loss), and if the underlying compensatory mitigation principles are correct (e.g., whether marine debris removal is an adequate form of compensatory mitigation). Since no organized tracking system exists or systematic monitoring occurs to evaluate long-term losses and mitigation gains for coral reef habitats, the adequacy of implemented compensatory mitigation is difficult if not impossible to determine. Through knowledge gained from the appropriate use of monitoring, the Corps and the natural resource agencies could improve their ability to offset coral reef ecosystem losses from project impacts. Quantitative methodologies to assess anticipated project-related loss through resource assessments of coral reef habitat are not currently used. This makes it impossible to accurately anticipate project-related losses to coral reef ecosystems and, therefore, the appropriate type and amount of compensatory mitigation needed to replace the loss. However, existing survey methodologies (e.g., Jokiel et al., 2001, Maragos and Gruber-Dunsmore, 1999) can be used or new methodologies (Jameson et al., 1998 and Jameson et al., in press) can be developed and used to assess coral reef conditions both before the project is initiated and over time after project completion. Appropriate mitigation monitoring should be required for each project. Very specific (and achievable) goals and objectives must be identified in mitigation monitoring plans or they may provide little information that can be used to determine the overall adequacy of implemented compensatory mitigation efforts. A local database should be established to store the monitoring data. Clear performance criteria for the monitoring data should be established along with quality assurance measures for data entry. Brief reports or periodic reviews of the system should be produced so adaptive management can occur and future improvements can be made to the system.

Recommendation 4: Identify and evaluate additional forms of compensatory mitigation.

Third party approaches to compensation (e.g., mitigation banking, in-lieu fee programs) offer some advantages over permittee-responsible mitigation. Positive and negative aspects of other approaches to compensatory mitigation are discussed by the National Research Council (2001) report. These approaches have resulted in varying degrees of success for wetlands mitigation. If supported by the resource agencies and the general public, in-lieu fee programs may offer a source of funds to complete agreed upon compensatory mitigation projects or to enhance resource protection. Funds could also be used for outreach and education purposes as a component of compensatory mitigation. Land-based activities also have adverse impacts on coral reef habitats. Specifically, unwise land management practices, water quality degradation, and pollution can

seriously impact coral reef habitats and prevent coral recolonization in areas where other aquatic threats do not occur. Forms of compensation that reduce land-based pollution, especially nutrients and sediments should be investigated.

Recommendation 5: Give greater emphasis to compensatory mitigation in plans for large projects.

To assure proper implementation of large compensatory mitigation actions, they should have adequate plans and budgets and, if appropriate, implemented concurrent with or before an authorized project is completed. The Federal resource agencies should work with the Corps in the early planning of appropriate compensatory mitigation actions to provide a clear picture of what is reasonably required of project sponsors. There should be effective legal and financial incentives for long-term site sustainability and monitoring of all coral reef compensatory mitigation projects. Project plans developed with insufficient incentives to compensate for losses to coral reef ecosystems have often resulted in single attempts at compensation that were not shown to be adequate. Incentive mechanisms including the use of performance bonds and adequate funding to prepare and implement contingency plans and adaptive management plans, should be investigated for potential use. The Corps should take the lead in working with potential project sponsors to plan for the adequate fulfillment of compensatory mitigation requirements.

VII. Literature Cited

Birkeland, C., and A. Friedlander. 2001. The need for marine reserves in Hawai'i: The importance of natural refuges to reef fish replenishment. Hawaii Audubon Society. Honolulu, Hawaii. 20 p.

Brock, V. 1954. A preliminary report on a method of estimating reef fish populations. J. Wildlife Management. Vol. 18. pp. 297-308.

Brock, R. 1994. Beyond Fisheries Enhancement: Artificial Reefs and Ecotourism. Bulletin of Marine Science. Vol. 55. No 2-3. pp. 1181-1188.

Brown, B. 1997. Disturbances to Reefs in Recent Times. *In* C. Birkeland (ed.), Life and Death of Coral Reefs, pages 354-379. Kluwer Academic Publishers, Boston, Massachusetts.

Colinvaux, P. 1993. Ecology 2. John Wiley and Sons, Inc. New York, New York. 688 p.

Dahl, T. 1990. Wetland Losses in the United States 1780's to 1980's. U.S. Department of Interior, Fish and Wildlife Service, Washington, D.C. 21 p.

Environmental Services. 2001. Final Report: Coral Transplant and Follow-up Monitoring of Transplanted Corals at Tepungan, Piti, Guam. 1 June, 2001 to 4 September, 2001. Duenas and Associates Inc., Tamuning, Guam. 147 p.

Global Coral Reef Monitoring Network (GCRMN). 2002. Status of Coral Reefs of the World: 2002. C. Wilkinson (ed). Australian Institute of Marine Science. 378 p.

Gosliner, T., D. Nehrens, and G. Williams. 1996. Coral Reef Animals of the Indo-Pacific. Animal life from Africa to Hawai'i exclusive of the vertebrates. Sea Challengers. Monterey, California. 314 p.

Halpern, B. In press. The impacts of marine reserves; do reserves work and does reserve size matter? Ecological Applications.

Hawkins, J., and C. Roberts. 1993. Effects of recreational scuba diving on coral reefs: trampling on reef-flat communities. Journal of Applied Ecology (1993) 30. pp. 25-30.

Holthus, P., P. Brennan, S. Gon, L. Honigman, and J. Maragos. 1993. Preliminary classification and inventory of ecosystems of U.S. affiliated islands of the tropical Pacific. Prepared by The Nature Conservancy, Pacific Region, for the U.S. Fish and Wildlife Service, Dept. of the Interior, Honolulu, Hawaii. 26 p.

Jameson, S, M. Erdmann, R. Gibson Jr., and K. Potts. 1998. Development of biological criteria for coral reef ecosystem assessment. Atoll Res. Bull., September 1998, No. 450. Smithsonian Institution, Washington, D.C. 102 p.

Jameson, S, M. Erdmann, R. Gibson Jr., and K. Potts. In Press. Charting a Course Toward Diagnostic Monitoring: A Continuing Review of Coral Reef Attributes and Research Strategy for Creating Coral Reef Indexes of Biotic Integrity. Bulletin of Marine Science.

Jokiel,P., E. Brown, A. Friedlander, S. Kuulei Rogers, and William Smith. 2001. Hawaii Coral Reef Initiative. Coral Reef Assessment and Monitoring Program (CRAMP). Final Report 1999-2000. 66 p.

Jokiel, P., E. Cox, F. Te, and D. Irons. 1999. Mitigation of Reef Damage at Kawaihae Harbor Through Transplantation of Reef Corals. Hawaii Institute of Marine Biology. Kaneohe, Hawaii. 21 p.

Jokiel, P., and J. Naughton. 2001. Coral reef mitigation and restoration techniques employed in the Pacific Islands: II. Guidelines. Oceans 2001 Conference Proceedings 1:313-316. Marine Technology Society 0-933957-29-7.

Kelleher, G., C. Bleakley, and S. Wells. (eds.). 1995. A Global Representative System of Marine Protected Areas. Volumes II-IV, Great Barrier Reef Marine Park Authority, World Bank and World Conservation Union (IUCN), World Bank, Washington, D.C. 452 p.

Kolinski, S. 2002. Analysis of year long success of the transplantation of corals in mitigation of a cable landing at Tepungan, Piti, Guam: 2001-2002. Honolulu, HI.

Kolinski, S., and P. Jokiel. Feasibility Study - Final Report. 1996. Coral Transplantation in Conjunction with Dredging of the Kaneohe Bay Yacht Club Harbor, Oahu, Hawaii. 2 September 1996.

Maragos, J., and R. Grober-Dunsmore. (eds.). 1999. Proceedings fo the Hawai'i Coral Reef Monitoring Workshop. June 9-11, 1998 Honolulu, Hawai'i. Department of Land and Natural Resources and East-West Center. Honolulu, Hawaii. 334 p.

Marine Research Consultants. 1999a. Coral Transplantation Monitoring at Box Drain Project Under Bracon P-268T at Marine Corps Base Hawaii (MCBH) Kaneohe Bay. Baseline B. Honolulu Hawaii. p. 6.

Marine Research Consultants. 1999b. Coral Transplantation Monitoring at Box Drain Project Under Bracon P-268T at Marine Corps Base Hawaii (MCBH) Kaneohe Bay. Post-Construction 1. Honolulu Hawaii. p. 7.

Marine Research Consultants. 1999c. Coral Transplantation Monitoring at Box Drain Project Under Bracon P-268T at Marine Corps Base Hawaii (MCBH) Kaneohe Bay. Post-Construction 1. Honolulu Hawaii. p. 7.

Marine Research Consultants. 1999d. Coral Transplantation Monitoring at Box Drain Project Under Bracon P-268T at Marine Corps Base Hawaii (MCBH) Kaneohe Bay. Post-Construction 3. Honolulu Hawaii. p. 9.

Marine Research Consultants. 1999e. Coral Transplantation Monitoring at Box Drain Project Under Bracon P-268T at Marine Corps Base Hawaii (MCBH) Kaneohe Bay. Post-Construction 4. Honolulu Hawaii. p. 9.

Marine Research Consultants. 1999f. Coral Transplantation Monitoring at Box Drain Project Under Bracon P-268T at Marine Corps Base Hawaii (MCBH) Kaneohe Bay. Post-Construction 5, Final Report. Honolulu Hawaii. p. 10.

Marine Revitalization Corporation. 1997. Outer Cove Coral Transplantation Project: 7-Month Assessment. Saipan, Commonwealth of the Northern Mariana Islands.

National Research Council. 2001. Compensating for Wetland Losses Under the Clean Water Act. National Academy Press, 2101 Constitution Ave., NW, Box 285, Washington, D.C. 267 p.

Naughton, J., and P. Jokiel. 2001. Coral reef mitigation and restoration techniques employed in the Pacific Islands: I. Overview. Oceans 2001 Conference Proceedings 1:306-312. Marine Technology Society 0-933957-29-7.

Pacific Basin Environmental Consultants Inc. 1995a. Pacific Underwater Observatory Monitoring Report 3, Month Two Survey for Coral Transplanting Phase I. Guam.

Pacific Basin Environmental Consultants Inc. 1995b. Pacific Underwater Observatory Monitoring Report One, for Coral Transplanting Phase II. Guam.

Pacific Basin Environmental Consultants Inc. 1995c. Pacific Underwater Observatory Monitoring Report One for Coral Transplanting Phase III. Guam.

Ricker, W. 1975. Computation and interpretation of biological statistics of fish populations. Bull 19. Dept Environ Fish Mar Serv, Ottawa. 207 p.

Roberts, C., J. Bohnsack, F. Gell, J. Hawkins, and R. Goodridge. 2001. Effects of Marine Reserves on Adjacent Fisheries. Science. Vol 294, 30 Nov. 2001. pp. 1920-1923.

Roberts, C., and Hawkins, J. 2000. Fully-protected marine reserves: a guide. WWF Endangered Seas Campaign, 1250 24th Street, NW, Washington, DC 20037, USA and Environment Department, University of York, York, UK. 131 p.

Rodwell, L., and C. Roberts. 2000. Economic Implications of Fully-Protected Marine Reserves for Coral Reef Fisheries. In: *Collected Essays on the Economics of Coral Reefs*. Herman S.J. Cesar (ed). CORDIO, Sweden. pp. 107-124.

Salm, R.V. 1986. Coral reefs and tourist carrying capacity; the Indian Ocean experience. UNEP Industry and Environment 1986 Jan/Feb/Mar. UNEP, Nairobi, Kenya.. pp. 11-14.

United States Coral Reef Task Force. 2000. The National Action Plan to Conserve Coral Reefs. Washington, DC. 34 p.

U.S. Fish and Wildlife Service. 1986a. Fish and Wildlife Resources of the Orote Ecological Reserve Area, September, 1986. Prepared for the Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawaii. 60 p.

U.S. Fish and Wildlife Service. 1986b. Fish and Wildlife Resources of the Haputo Ecological Reserve Area, September 1986. Prepared for the Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawaii. 86 p.

U.S. Fish and Wildlife Service. 1988. Fish and Wildlife Resources of the Orote Ecological Reserve Area, First Biannual Resurvey, June and August, 1988. Prepared for the Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawaii. 16 p.

U.S. Fish and Wildlife Service. 1993. Final Fish and Wildlife Coordination Act Report, Kawaihae Harbor for Light-Draft Vessels, Kawaihae, Hawaii, Hawaii. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Honolulu, Engineer District, Fort Shafter, Hawaii. 27 p.

U.S. Navy. 1983. Final Environmental Impacts Statement for an Ammunition Wharf in Outer Apra Harbor, Guam, Mariana Islands. Honolulu, Hawaii.

U.S. Navy. 1984a. Haputo Ecological Reserve Area Establishment Report. Pacific Division, Naval Facilities Engineering Command. Pearl Harbor, Hawaii. 31 p.

U.S. Navy. 1984b. Orote Peninsula Ecological Reserve Area Establishment Report. Pacific Division, Naval Facilities Engineering Command. Pearl Harbor, Hawaii. 33 p.

U.S. Navy. 1986a. Management Plan for the Haputo Ecological Reserve Area. Pacific Division, Naval Facilities Engineering Command. Pearl Harbor, Hawaii. 31 p.

U.S. Navy. 1986b. Management Plan for the Orote Peninsula Ecological Reserve Area. Pacific Division, Naval Facilities Engineering Command. Pearl Harbor, Hawaii. 30 p.

Utah Division of Wildlife Resources. 2001. Wetlands Program. Assessment of Section 404 Compensatory Mitigation Compliance in Northern Utah. March 2001. 21 p.

Ward, F. 1990. Florida's coral reefs are imperiled. National Geographic. July. pp. 115-132.

Wilkinson, C. 2000. Status of coral reefs of the World: 2000. Australian Institute of Marine Science. Western Australia, Australia. 363 p.

APPENDIX A: Selected Sections of Executive Order 13089 on Coral Reef Protection

Policy and Responsibilities

Executive Order 13089 (EO) established the Coral Reef Task Force (Task Force), under the joint leadership of the Departments of the Interior and Commerce, and established a new policy and Federal agency responsibilities concerning protection of coral reef ecosystems. The EO requires the Task Force to develop a comprehensive plan for protection, restoration and sustainable use of U.S. coral reefs. The EO also highlights international trade and protection of coral reef species by promoting the implementation of appropriate strategies and actions for conservation and sustainable use of coral reef resources worldwide. Section 2 of the EO establishes policy and Section 3 establishes Federal agency responsibilities. As written in the EO these are:

> Section 2. Policy.
>
> (a) All Federal agencies whose actions may affect U.S. coral reef ecosystems shall:
>
> (1) identify their actions that may affect U.S. coral reef ecosystems;
>
> (2) utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and
>
> (3) to the extent permitted by law, ensure that any actions they authorize, fund, or carry out will not degrade conditions of such ecosystems.
>
> (b) Exceptions to this section may be allowed under terms prescribed by the heads of Federal agencies:
>
> (1) during time of war or national emergency
>
> (2) when necessary for reasons of national security, as determined by the President;
>
> (3) during emergencies posing an unacceptable threat to human health or safety or to the marine environment and admitting of no other feasible solution;
>
> (4) in any case that constitutes a danger to human life or a real threat to vessels, aircraft, platforms, or other man-made structures at sea, such as cases of force majeure caused by stress of weather of other act of God.
>
> Section 3. Federal Agency Responsibilities.
>
> In furtherance of Section 2 of this order, Federal agencies whose actions affect U.S. coral reef ecosystems, shall, subject to the availability of appropriations, provide for implementation of measures needed to research, monitor, manage, and restore affected ecosystems, including, but not limited to, measures reducing impacts from pollution, sedimentation, and fishing. To the extent not inconsistent with statutory responsibilities and procedures, these measures shall be developed in cooperation with the U.S. Coral Reef Task Force and fishery management councils and in consultation with affected State, territorial, commonwealth, tribal, and local government agencies, non-government organization, the scientific community, and commercial interests.

Definition of Coral Reef Ecosystem

According to the EO, the definition of U.S. coral reef ecosystems includes, "those species, habitats, and other natural resources associated with coral reefs in all maritime areas and zones subject to the jurisdiction or control of the U.S., including reef systems in the south Atlantic, Caribbean, Gulf of Mexico, and Pacific Ocean." Depending on local conditions including currents, wave action, turbidity, temperature, and salinity, the expression of biotic communities within coral reef ecosystems may vary. Four primary types of biotic communities have developed in the shallow waters of the tropical Indo-Pacific and these include coral reefs, sea grass beds, mangrove forests, and sand flats (Gosliner et al., 1996). Coral reef ecosystems can become very large (e.g. Great Barrier Reef Marine Park covers 339,750 sq km [Wilkinson, 2000]) and take decades, centuries and even millennia to attain a climax status. Whether small or large, coral reef ecosystems may over time become increasingly populated with taxa, increasing the complexity, biodiversity, and resilience of the system. It is these complex systems with their multitude of species and species interactions, energy flows, and physical forces (Colinvaux, 1993) that are addressed in the EO.

In simple terms, human actions can destroy coral reef ecosystems. Through the direct or indirect anthropogenic effects of pollution, over-fishing and over-exploitation, destructive fishing practices, dredging and shoreline modifications, vessel groundings and anchoring, and disease outbreaks, coral reef ecosystems can be reduced in their complexity or entirely removed. These anthropogenic effects can combine with natural factors, such as global climate change, to further degrade or kill coral reef ecosystems. Once coral reefs are removed , it could take decades if not centuries for the original complexity of the coral reef ecosystem to be rebuilt (if it returns at all) since the reefs must begin the rebuilding process from scratch.

Coral Reef Task Force and the National Action Plan to Conserve Coral Reefs

The EO established the Task Force, which includes Federal agencies and State and Territory partners. Through policies set forth in the EO, the Federal government is specifically directed to strengthen its stewardship of coral reef ecosystems across the globe. To address the EO's directives, the Task Force adopted the National Action Plan to Conserve Coral Reefs (Action Plan) on March 2, 2000, to serve as the Nation's comprehensive strategy for permanently conserving coral reef ecosystems. The Action Plan contains priority recommendations for actions to be undertaken by Federal agencies and others to comprehensively meet the most pressing challenges facing coral reefs today. To better implement the recommendations, the Task Force created six Working Groups that are focused on Coastal Uses, Water and Air Quality, Mapping and Information Synthesis, Ecosystem Science and Conservation, International, and Outreach and Education. These Working Groups were charged with developing projects and strategies for specific aspects of coral reef conservation (United States Coral Reef Task Force, 2000). Appendix C in the Action Plan provides a list of action items and associated responsible agencies and working groups.

APPENDIX B: **Integration of Executive Order 13089 with Federal Laws and Federal Agency Responsibilities and Policies**

Executive Order 13089 states that the preservation and protection of U.S. coral reef ecosystems and the marine environment should be carried out in furtherance of the purposes of a variety of natural resource laws including; Clean Water Act of 1977 (33 U.S.C. 1251 *et seq*.), Coastal Zone Management Act (16 U.S.C. 1451 *et seq*.), Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 *et seq*.), National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq*.), National Marine Sanctuaries Act, (16 U.S.C. 1431 *et seq*.), National Park Service Organic Act (16 U.S.C. 1 *et seq*.), and the National Wildlife Refuge System Administration Act (16 U.S.C. 668dd-ee), and other pertinent statutes (such as the Fish and Wildlife Coordination Act [16 U.S.C. 661 *et seq*.] and the Fish and Wildlife Act [U.S.C. 742 *et seq*.]).

These laws provide guidelines for how Federal agencies will protect natural resources (including coral reef ecosystems) and allow for Federal natural resource agencies to review project proposals that may impact the natural environment. When project-related impacts to natural resources are anticipated, compensatory mitigation can be used to reduce or eliminate these impacts. The Federal natural resource agencies provide, guidelines and recommendations to help mitigate a project's impacts to coral reef ecosystems and the marine environment.

The United States Fish and Wildlife Service (FWS), United States Environmental Protection Agency (EPA), National Marine Fisheries Service (NMFS), and United States Army Corps of Engineers (Corps) have developed their own implementing regulations and/or guidance on mitigation when reviewing projects that may impact natural resources including coral reef ecosystems. In general, mitigation policies of these four agencies follow the same general approach of avoidance, minimization, and compensation.

1969 National Environmental Policy Act enacted
Requires that all Federal agencies prepare detailed environmental impact statements for major Federal actions significantly affecting the quality of the human environment. The statute requires that Federal agencies employ an interdisciplinary approach in related decision-making and develop means to ensure that unquantified environmental values are given appropriate consideration, along with economic and technical considerations (USDOI, 1992). The NEPA does not require mitigation for environmental effects but requires documentation of significant effects, with and without mitigation.

1972 Clean Water Act Section 404 enacted
Section 404 does not use the terms "mitigate" or "mitigation". Nor does Section 404 expressly authorize the Corps to require mitigation of permit applicants. Nevertheless, by virtue of the interplay between Section 404(b)(1) and 403(c), the statute does provide implicit authority for the Corps to require permit applicants to avoid and minimize impacts to waters of the United States

(National Research Council, 2001). Coral reefs are not specifically mentioned under waters of the US covered by the Clean Water Act.

1975 EPA section 404(b)(1)Guidelines promulgated (Guidelines)
The 1975 EPA's Clean Water Act Guidelines (Federal Register 40: 41292-41298) provide a mitigation framework of avoidance and minimization for adverse impacts to aquatic resources. No mention is made of restoration, enhancement, or creation as mitigation, although the guidelines state that "[c]onsideration shall be given to preservation of submerged and emergent vegetation." These guidelines require that when evaluating alternative project designs, the least environmentally damaging practicable project alternative be selected to insure the avoidance and minimization of impacts to waters of the United States (NRC, 2001).

1978 NMFS Habitat Protection Policy
NMFS adopted their Habitat Protection Policy on June 8, 1978, and revised this policy on October 25, 1991. This policy follows a general theme of avoidance, minimization, and compensation. The main emphasis of this policy is that NMFS will not recommend approval or authorization of any project or activity that will damage any existing or potentially restorable habitat of living marine, estuarine, or anadromous resources. Under circumstances where habitat resource damages can be compensated, exceptions are allowed but certain requirements must be followed. The first is that the project will incorporate all feasible modification and construction techniques to minimize adverse environmental impacts. Where there are unavoidable adverse impacts, an acceptable combination of habitat restoration, enhancement or other suitable mitigation will be adopted in the following order of preference: (a) on-site and in-kind, (b) off-site and in-kind, (c) on-site and out-of-kind, and (d) off-site and out-of-kind. Wherever the mitigation occurs, the post-project habitat value shall be equal to or greater than pre-project habitat value. The post-project habitat value will be based on the contribution of the habitat to the support of commercial and recreational fisheries, fishery resources, certain marine mammals, and/or endangered species. Finally, the policy specifically identifies examples of off-site, out-of-kind compensatory mitigation for coral reef habitats such as the deployment of artificial reefs, creation of hard substrate for coral colonization, establishment of refuge areas to protect coral reef habitat in perpetuity, and monitoring to determine the success of the mitigation.

1980 Section 404 (b)(1) Guidelines
The current Guidelines were written in 1980 (Federal Register 45: 85336-85357) and codified (40 CFR 230) changing the designation from advisory to regulatory. Included in the definition of minimization is reference to compensatory mitigation. The Guideline objectives for mitigating unavoidable impacts is to replace environmental losses. For wetlands and other "special aquatic sites" (e.g. coral reefs), such mitigation should provide, at a minimum, a one to one functional replacement ratio with an adequate margin for safety to reflect the expected degree of success associated with the mitigation plan. It should be noted that once eliminated from an area, coral reefs take years, decades or even centuries to regain similar degrees of biotic complexity and ecological function. In the absence of definitive information on the functions and values of

specific sites, a minimum of 1 to 1 acreage replacement is often used as a reasonable goal to regain lost functions and values.

1981 FWS Final Mitigation Policy

In 1974 the FWS issued a draft Mitigation Policy, this policy was finalized in 1981 (46 FR 7643). Although it was written as a general mitigation policy, the impetus for writing this policy was a nationwide decline in wetlands. This mitigation policy outlines a five-step process for reviewing projects that impact the natural environment. These five steps are: avoid unnecessary impacts altogether; minimizing unavoidable impacts; rectify unavoidable impacts by repair, rehabilitation or restoration; reduce or eliminating unavoidable impacts over time by preservation and maintenance operations; and, compensate for unavoidable impacts by replacing or providing substitute resources or environments. In practice, with the 1990 Corps/EPA Memo these steps are generally reduced to avoidance, minimization, and compensation.

In addition to this mitigation sequence, a fundamental principle of the policy is that the degree of mitigation recommended should correspond to the value and scarcity of the habitat impacted. This policy established three criteria to be used when determining various Resource Categories. These criteria are Evaluation Species, Habitat Value, and Scarcity. Types of Evaluation Species include Federal trust species, species with economic or social value, environmentally sensitive (indicator) species, species performing a key ecological role, and representative groups of species that use a common environmental resource. Habitat Value is not meant to be an absolute quantitative measure of value of importance. Rather it draws on previously published information and expertise to gauge the relative importance of the habitat in question. Scarcity is determined by whether the habitat in question is scarce on a national, ecoregional, state, or smaller scale; the demand on the habitat in question for conversion; and the overall supply or availability of the habitat in question.

Resource Category 1 is assigned when the habitat to be impacted is of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section and has a mitigation goal of no loss of existing habitat value. Resource Category 2 is assigned when the habitat to be impacted is of high value for evaluation species and is relatively scarce or becoming scarce on a national basis or in the ecoregion section and has a mitigation goal of no net loss of in-kind habitat value. Resource Category 3 is assigned when the habitat to be impacted is of high to medium value for evaluation species and is relatively abundant on a national basis and has a mitigation goal of no net loss of habitat value while minimizing loss of in-kind habitat value. Resource Category 4 is defined as habitat to be impacted is of medium to low value for evaluation species and has a mitigation goal of minimize loss of habitat value.

1986 Water Resources Development Act (PL 99-662) (WRDA)

Section 906 provides guidance on fish and wildlife mitigation. For new civil works projects, necessary mitigation measures shall be undertaken before or concurrently with project construction, as determined appropriate by the Secretary of the Army. Feasibility reports must contain specific plans to mitigate fish and wildlife losses, unless a determination is made that they

would be negligible adverse impacts. Section 906(e) provides that for any project measures recommended to enhance fish and wildlife, the first costs of such enhancement shall be a Federal cost where the benefits are determined to be national. These benefits are specifically extended in a number of cases such as; species of national economic importance, threatened or endangered species, and activities on National Wildlife Refuges. This legislation incorporated the design and cost estimates of mitigation into civil works project planning.

1990 Memorandum Of Agreement Between EPA and Corps Concerning the Determination of Mitigation under the Clean Water Act Section 404 (b)(1) Guidelines (MOA).
This MOA clarified existing policy and procedures to be used when determining the type and level of mitigation necessary to demonstrate compliance with the 404(b)(1) Guidelines in the review of standard permit applications. The Corps must make a determination that potential impacts have been avoided to the maximum extent practicable and that remaining unavoidable impacts are minimized prior to any consideration of compensatory mitigation. The MOA refers to the 404(b)(1) Guideline requirements that only the least environmentally damaging practicable alternative may be permitted. This MOA was written to provide guidance on wetland mitigation, however, the general categories of avoidance, minimization, and compensation are easily applied to coral reef ecosystems and other marine environments.

1998 Executive Order 13089 on Coral Reef Protection (EO 13089)
Directs all Federal agencies whose actions may affect U.S. coral reef ecosystems to: identify their actions that may affect U.S. coral reef ecosystems; utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and to the extent permitted by law, ensure that any actions they authorize, fund or carry out will not degrade the conditions of such ecosystems.

1999 Corps and EPA Memorandum to the Field (Memorandum) entitled Special Emphasis Given to Coral Reef Protection under the Clean Water Act, Marine Protection, Research, and Sanctuaries Act, River and Harbors Act, and Federal Project Authorities.
This Memorandum was released in response to EO 13089 and was intended to clarify and reemphasize the protection afforded the Nation's valuable coral reef ecosystems under the above mentioned authorities. Regarding Section 404 of the CWA, the Memorandum states that there shall be no discharge permitted if there is a practicable alternative available that would have less adverse environmental impacts, with the presumption that discharge at an alternate site outside of special aquatic sites (including coral reefs) is less damaging to the aquatic ecosystem. Consistent with the Guidelines, it is the permit applicant's responsibility to demonstrate that there is no practicable alternative to filling a special aquatic site. In relation to denial of permits in areas where there are coral reefs, the Memorandum states "It is important to recognize that there are circumstances where the impacts of the proposed activity are so significant that even if alternatives are determined not to be available, the permit should be denied regardless of compensatory mitigation that is proposed."

2000 National Action Plan to Conserve Coral Reefs
Lays out a carefully considered, science-based road map to healthy coral reefs. Prioritizes recommendations to be undertaken by federal, state and territorial governments, and non-government and international conservation partners.

2002 Guidance on Compensatory Mitigation Projects for Aquatic Resource Impacts Under the Corps Regulatory Program Pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act (RGL 02-2).
The RGL 02-2 was, in part, written as guidance to address concerns raised in the National Research Council report entitled "Compensating for Wetland Losses under the Clean Water Act" (National Research Council, 2001). The RGL 02-2 directs the Corps to increase the effectiveness and compliance of mitigation required for authorized impacts to the aquatic environment. This is to be accomplished through the development and implementation of detailed compensatory mitigation plans which should include the following sections: Baseline Information, Goals of the Mitigation, Mitigation Work Plan, Success Criteria, Monitoring Plan, Contingency Plan, Site Protection, Financial Assurances, and Responsible Party for Long-Term Maintenance.

Appendix C: Recommendations from the National Research Council Report on Compensating for Wetland Losses under the Clean Water Act, June, 2001.

Below are the conclusions and recommendations as presented in the NRC (2001) report.

Conclusion 1: The goal of no net loss of wetlands is not being met for wetland function by the mitigation program, despite progress in the last 20 years.

From the data, 24,000 acres of wetland fill were permitted and 42,000 acres were required as compensatory mitigation on an annual basis. Thus, 1.8 acres were supposed to be mitigated for every 1 acre permitted. The committee, however, found that the data available from the Corps was not adequate for determining the status of the required compensation wetlands. In addition, the data do not report the wetland functions that were lost due to the permitted fill. Further, the literature on compensatory mitigation suggests that required mitigation projects often are not undertaken or fail to meet permit conditions.

The NRC made the following recommendations:

1) The wetland area and functions lost and regained over time should be tracked in a national database. This database could include the Corps Regulatory Analysis and Management System database.
2) The Corps should expand and improve quality assurance measures for the entry of data into this database.
3) The Corps, in cooperation with States, should encourage the establishment of watershed organizations responsible for tracking, monitoring, and managing wetlands in public ownership or under easement.

Conclusion 2: A watershed approach would improve permit decision making.

Wetland function must be understood within a watershed framework in order to secure the purposes of the CWA. A mitigation site need to have the ability to become self-sustaining. This means that the hydrological processes that define a wetland in the ecosystem need to be present and expected to persist in perpetuity.

To aid regulators and mitigators in designing projects that will become ecologically self-sustaining, the NRC offered the following ten operational guidelines:

1) Consider the hydrogeomorphic and ecological landscape and climate
2) Adopt a dynamic landscape perspective
3) Restore or develop naturally variable hydrological conditions
4) Whenever possible, choose wetland restoration over creation
5) Avoid over-engineering the wetland's design
6) pay particular attention to appropriate planting elevation, depth, soil type, and seasonality
7) Provide appropriately heterogeneous topography

8) Pay attention to subsurface conditions, including soil and sediment geochemistry and physics, groundwater quantity and quality, and infaunal communities
9) Consider complications associated with wetland creation or restoration in seriously degraded or disturbed sites
10) Conduct early monitoring as part of adaptive management

Conclusion 3:Performance expectations in Section 404 permits have often been unclear, and compliance has often not been assured or attained.

The attainment of no net loss of wetlands through both permittee and third-party mitigation requires that performance requirements for individual compensation sites be clearly stated and that the stated requirements will be bet by the parties responsible for the mitigation.

The NRC provided the following General Goals:

1) Individual compensatory mitigation sites should be designed and constructed to maximize the likelihood that they will make an ongoing ecological contribution to the watershed; this contribution should be specified in advance.
2) Compensatory mitigation should be in place concurrent with, and preferably before, the permitted activity.
3) To ensure the replacement of lost wetland function, there should be effective legal and financial assurances for long-term site sustainability and monitoring of all compensatory wetland projects.

The NRC also provided the following Specific Recommendations:

1) Compensatory mitigation sites should receive long-term stewardship
2) The Corps and other responsible regulatory authorities should establish and enforce clear compliance requirements for permittee-responsible compensation to assure that (a) projects are initiated no later than concurrent with permitted activity, (b) projects are implemented and constructed according to established design criteria and use an adaptive management approach specified in the permit, (c) the performance standards are specified in the permit and attained before permit compliance is achieved, and (d) the permittee provides a stewardship organization with an easement on, or title to, the compensatory wetland site and a cash contribution appropriate for the long-term monitoring, management and maintenance of the site.
3) Because the particular floristic assemblage might not provide all of the functions lost, both restoration of community structure and restoration of wetland functions should be considered in setting goals and assessing outcomes. Relationships between structure and function should be better known.
4) Mitigation projects should be planned with and measured by a broader set of wetland function than are currently employed.
5) Mitigation goals must be clear, and those goals carefully specified in terms of measurable performance standards, in order to improve mitigation effectiveness. Performance standards in permits should reflect mitigation goals and be written in such a

way that ecological viability can be measured and the impacted functions replaced.
6) Impact sites should be evaluated using the same functional assessment tools as used for the mitigation site.
7) Dependence on subjective, best professional judgment in assessing wetland function should be replaced by science-based, rapid assessment procedures that incorporate at least the following characteristics: (a) effectively assess goals of wetland mitigation projects, (b) assess all recognized functions, (c) incorporate effects of position in landscape, (d) reliably indicate important wetland processes or at least scientifically-established structural surrogates of those processes, (e) scale assessment results to results from reference sites, and (f) ensure assessments are sensitive to changes in performance over a dynamic range, are iterative over space and time, and generate parametric dimensioned units, rather than non-parametric rank.
8) The Corps and other responsible regulatory authorities, should use a functional assessment protocol that recognizes the watershed perspective to establish permittee compensation requirements.
9) The Corps and other responsible regulatory authorities should take actions to improve the effectiveness of compliance monitoring before and after project construction.

Conclusion 4: Support for regulatory decision making is inadequate.

In addition to using a watershed framework, the Federal regulatory authorities can work to improve functional wetland assessment, permit compliance monitoring, staff training, research, and collaboration with State agencies.

Specific recommendations from the NRC are as follows:

1) To assist permit writers and others in making compensatory mitigation decisions, a reference manual should be developed to help design projects that will be most likely to achieve permit requirements.
2) The Corps and other responsible authorities should commit funds to allow staff participation in professional activities and in technical training programs that include the opportunity to share experience across districts.
3) The Corps and other responsible regulatory authorities should establish a research program to study mitigation sites to determine what practices achieve long-term performance for creation, enhancement, and restoration of wetlands.
4) States, with participation of appropriate federal agencies, are encouraged to prepare technical plans or initiate interagency consensus processes for setting wetland protection acquisition, restoration, enhancement, and creation project priorities on an ecoregional (landscape-watershed) basis.

Conclusion 5: Third-party compensation approaches (mitigation banks, in-lieu fee programs) offer some advantages over permittee-responsible mitigation.

The NRC evaluated several compensatory mitigation mechanisms and developed a taxonomy to evaluate their potential strengths and weaknesses. Mechanisms were characterized by the following five attributes: (1) on-site or off-site compensatory mitigation action; (2)responsible party; (3) timing of the mitigation actions; (4) whether the Mitigation Review Banking Team process is used; and (5) stewardship requirements.

Specific NRC recommendations included the following:

1) The taxonomy developed by the NRC is recommended as a reference point for discussions about compensatory mitigation. In practice, however, a compensatory mitigation mechanism may not fit neatly into one of the listed categories (e.g., mitigation bank v. in-lieu fee v. cash donation). Accordingly, it is recommended that when an agency reviews mitigation options, it is most important to focus on characteristics or attributes (e.g., who is legally responsible, when the mitigation actions would occur, whether the MBRT process is used, and whether stewardship requirements are in place).
2) Institutional systems should be modified to provide third-party compensatory mitigation with all of the following attributes: timely and assured compensation for all permitted activities, watershed integration, and assurances of long-term sustainability and stewardship for restored, created, enhanced, or preserved wetlands.
3) The Corps and EPA should work with the States to expand their permitting and watershed planning programs to fill gaps in the Federal wetland program.

CONCLUSION

The Clean Water Act Section 404 program should be improved to achieve the goal of no net loss of wetlands for both area and functions. The above recommendations will help achieve this goal. It is of paramount importance that the regulatory agencies consider each permitting decision over broader geographic areas and longer time periods by modifying the boundaries of permit decision-making in time and space.

APPENDIX D: State of Utah Report on Compensatory Mitigation

Utah Division of Wildlife Resources, 2001. Wetlands Program. Assessment of Section 404 Compensatory Mitigation Compliance in Northern Utah. March 2001. 21p.

Below is the summarization of the findings of the Utah Division of Wildlife Resources (2001) mitigation report.

Numerous studies conducted in various parts of the U.S. have found that compensatory mitigation often fails to offset wetland impacts authorized by Section 404 permits. These studies have found net losses of wetlands acreage, substitution of wetland types, and low rates of compliance with permit conditions. The recommendations of this study were: (1) improve documentation and record keeping, (2) improve assessment of existing conditions at the proposed project and mitigation sites, (3) improve guidelines for mitigation and monitoring plans, (4) encourage mitigation methods that will help meet no-net-loss goals, (5) make use of trained volunteers to assist in monitoring of mitigation sites, and (6) make use of landscape-level planning information to direct mitigation toward sites most likely to provide and sustain long-term wetland function.