

Final Report
Investigations of Mitigation
for Coral Reef Impacts
in the U.S. Atlantic:
South Florida and the Caribbean



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TABLE OF CONTENTS

EXECUTIVE SUMMARY	6
I. INTRODUCTION.....	8
A. U.S. Atlantic Coral Reef Habitat.....	9
Caribbean Reef Systems	9
Southern Florida Atlantic Reef Systems	10
B. Coral Reef Study Project History.....	11
C. Similarities and Differences between the Pacific and Atlantic Studies	13
D. Report Organization.....	14
II. METHODOLOGY	14
A. Scope of Study	14
B. Project File Selection	16
C. Determination of Project Impacts.....	16
Project Footprint	16
Alternative, Avoidance, and Minimization of Impacts.....	17
Compensatory Mitigation	17
Monitoring and Mitigation Success	18
III. RESULTS	19
A. CARIBBEAN (Puerto Rico and the U.S. Virgin Islands)	20
Selection of Project Files for Review	20
Impacts to Coral Reef Habitats	23
Mitigation for Impacts to Coral Reef Habitats	24
Compensatory Mitigation Required.....	25
Project and Compensatory Mitigation Monitoring.....	26
B. SOUTHERN FLORIDA (Indian River County south through Monroe County)	27
Selection of Project Files for Review	28
Compensatory Mitigation Recommended	30
Compensatory Mitigation Required.....	31
Required Compensatory Mitigation Completed	32
Project and Required Compensatory Mitigation Monitoring	33
IV. DISCUSSION	34

A. Impact evaluation for Corps Planning Projects or Regulatory Permits	34
Baseline Data	34
Alternatives, Avoidance, and Minimization	35
Impact Trends over Time	36
Impacts by Project Type and Activity	37
B. Trends in Compensatory Mitigation	41
Recommendations, Requirements, and Compliance.....	41
Caribbean Mitigation Summary	42
Florida Mitigation Summary	42
Caribbean, Florida, and the Pacific Mitigation	43
C. Monitoring	45
Trends in Requirements and Compliance for Mitigation Monitoring	45
Pre-project Site Visit and Monitoring of Project Construction	46
Intra- and Inter-agency Information Sharing	47
V. RECOMMENDATIONS.....	48
VI. LITERATURE CITED	50
APPENDIX A. Scope of Study and Project Worksheet.....	54
APPENDIX B. Project Information Tables.....	57
APPENDIX C. General Legislative Authorities and Service Mitigation Policy	72
APPENDIX D. Historic Impact Overview (Pre 1985) for the Caribbean	75
APPENDIX E. Agency Comments and Service Responses.....	78

LIST OF TABLES

Table 1.	Summary of Coral Reef Impacts in the Study Area.
Table 2.	Selected projects by type, and Corps permit instrument.
Table 3.	Acres of Impacts by major work type.
Table 4.	Coral habitat impacts by project type (numbers and acreage).
Table 5.	Percent of projects with avoidance or minimization, recommended mitigation, required mitigation, and accomplished mitigation (per project file review).
Table 6.	Results of compensation by project number
Table 7.	Approximate Percent of projects where monitoring was required and completed.
Table 8.	Approximate Acres of Impacts by work type.
Table 9.	Coral habitat impacts by project type (numbers and approximate acreage)
Table 10.	Number of Projects and Number of Acreage with Avoidance or Minimization, Recommended Compensation, Required Compensation, and Accomplished Compensation (per project file review)
Table 11.	Percent of projects where monitoring was required and completed.

LIST OF FIGURES

Figure 1.	Atlantic Coral Reef Study Areas
Figure 2.	NOAA Benthic Habitat Maps of Puerto Rico and the U.S. Virgin Islands with RAMS Project Locations.
Figure 3.	Example of a typical beach renourishment project, Palm Beach County, Florida.
Figure 4.	Aerial photograph of limestone artificial reef.
Figure 5.	Lovango Cay undisturbed reef and barge scour impacted reef.
Figure 6.	Artificial reef modules and deployment. Left showing colonized module, and right showing an aerial photo of a more recently deployed limestone rock compensation reef.
Figure 7.	<i>Acropora cervicornis</i> thicket creation at 2 months and 2 years.
Figure 8.	Benthic map of Dade County, Miami Port project planning.

EXECUTIVE SUMMARY

The U.S. Fish and Wildlife Service (Service) has completed a cooperative file review study of mitigation for federally funded or permitted projects that impact coral reefs in the South Atlantic and Caribbean, in response to Resolution 4 from the 8th Coral Reef Task Force meeting held on October 2-3, 2002, in San Juan, Puerto Rico. This review focuses on mitigation for U.S. Army Corps of Engineers' (Corps) projects from 1985 to the present to provide information and recommendations for consideration. The Corps, EPA, NOAA Fisheries, State of Florida, Commonwealth of Puerto Rico, US Virgin Islands, and Palm Beach County provided information from their databases for review and/or comments to the draft report submitted in February, 2004 at the Task Force meeting in Washington, D.C. Agency comments and Service responses are included.

The geographic area of the review encompassed the southeastern Atlantic seaboard of Florida, from Indian River County south to the Dry Tortugas, and the U.S. Caribbean. Coral reef habitat included in the study is defined as actively accreting coral reef and coral colonized hardbottom. Seagrass beds, mangroves, and soft substrate were specifically excluded unless they were directly mixed with coral reef habitat.

Over 2,000 Corps' Regulatory Division permits and Planning Division civil works project files were screened, resulting in 28 projects from the Caribbean and 26 from Florida (16 completed and 10 pending construction) with adequate information for a more detailed review. Impacts from these completed and currently proposed projects total 264 acres: 47 in the Caribbean and 217 in Florida. Compensatory mitigation acreage for Florida projects consists mostly of the placement of artificial or natural substrate and is expected to total 113 acres: 43 acres for completed and, to date, 70 acres for pending projects. Mitigation for Caribbean projects has been almost exclusively transplantation of corals from the impact area to other reef sites, and calculated at approximately 5 acres. Mitigation success, as judged from compliance with permit conditions when possible, was variable, but has shown improvement over the years.

Completed projects involving filling and dredging for beach nourishment and port development have caused the most impacts to coral reef habitats in South Florida since 1985. The anticipated impacts for pending projects are also expected to result from dredging for port development, followed by beach nourishment, with moderate impacts expected from sedimentation. In the Caribbean, the major coral impacts were from dredging and filling for pipeline trenching and port development projects. There are no projects pending.

The information in this report suggests that compensatory mitigation recommendations, requirements, and compliance have improved over time. However, the expected impacts planned for the 10 pending projects in South Florida exceed the known impacts from the 16 completed projects of the last 20 years, with mitigation requirements still being evaluated. The number of projects and the acreage of impacts have decreased over time in the Caribbean, and some of the decrease can be attributed to increased attention to avoidance and

minimization.

Resource agencies, such as the Service, are consulted by the Corps to provide mitigation recommendations for projects with impacts to coral resources. To better address this responsibility, the report recommends the establishment of technical advisory team and/or regional interagency teams to provide consistent evaluation of project impacts, analysis of more effective coral reef mitigation techniques, and the development of appropriate protocols for mitigating unavoidable impacts, monitoring project construction, and complying with mitigation conditions. Increased intra- and inter-agency collaboration, particularly sharing monitoring and report information, would improve mitigation efforts for all agencies concerned with coral reef impacts.

I. INTRODUCTION

Coral reefs are among the most ancient and diverse ecosystems on earth. They support more species per unit area than any other marine environment, including about 4,000 species of fish, 800 species of hard corals, and hundreds of other species. Coral reefs provide actively growing fishery habitat and unparalleled shoreline and harbor protection in tropical and subtropical waters of the Pacific, Atlantic, and Indian Oceans, as well as associated seas.

For many years the scientific community and government agencies have expressed concern over the increasing deterioration of the world's coral reefs. Studies in the mid 1990's indicated that 10 percent of coral reefs were degraded beyond recovery, and another 20 to 30 percent would be in peril within 20 years (Crosby *et al.*, 1995). Amid the growing concern, the International Coral Reef Initiative was formed to reduce human impacts on coral reefs. Recent cooperative research continues to show the magnitude of loss. For example, estimates of live coral cover in the Atlantic indicate a spatial decrease of 80 percent over the past 30 years (Gardner *et al.*, 2003).

Coastal ecosystems in general, and coral reefs in particular, have proven to be highly vulnerable to a variety of human impacts, most notably when these impacts are combined (Jackson *et al.*, 2001). Human stressors that harm reef systems include over-fishing, mechanical damage (dredging, filling, ship groundings, blasting), and degraded nearshore water quality. The latter are largely due to nutrient, sediment, chemical, and other pollutant runoff from human activities. Natural stressors include storm waves (Rogers *et al.*, 1993), and increased sea temperatures (Glynn, 1984) during large-scale events such as El Niño.

This report includes evaluation of impacts to coral reef habitat, including actively accreting coral reefs dominated by stony corals and coral colonized hardbottoms which are prevalent along Florida's east coast, and common in the Caribbean. Coral colonized hardbottom are typically dominated by a sponge and soft coral (alcyonarian or gorgonian) community, with hard corals also present (Goldberg, 1970; Raymond and Antonius, 1977), and are sometimes referred to as "gorgonid reefs." Although these coral colonized hardbottoms do not produce the substantial reef base structure of more actively growing coral reefs, they provide similar habitat functions. The Caribbean and Florida, while having a relatively low diversity of hard corals compared to the Pacific, have a higher diversity of gorgonians and sponges.

The intention of this report is to document specific information existing in agency files, particularly those of the Service and the Corps, for projects that have impacted coral habitat and the processes followed for avoiding, reducing, and compensating (compensatory mitigation) for those impacts. This report does not make assumptions or conclusions about these actions on the general status or health of coral reefs in these waters.

A. U.S. Atlantic Coral Reef Habitat

Caribbean Reef Systems

Coral reef habitat in Puerto Rico and the U.S. Virgin Islands is restricted to the insular shelf, which is quite narrow in some areas, and the shallows (less than 150 feet in depth) associated with the offshore islands (Mona, Desecheo, Buck Island, Culebra, Vieques, etc.). The coral reef ecosystem area for the Caribbean was delineated for 5,009 square kilometers in Puerto Rican waters and 485 square kilometers in Virgin Islands waters, coinciding with the shelf areas. Of these, 756 square kilometers (15.1% of the total) in Puerto Rico and 298 square kilometers (61 percent of the total) in the U.S. Virgin Islands were mapped and classified as coral reef or coral colonized hardbottom (Kendall *et al.*, 2001). Seagrass beds (often associated with coral reefs) accounted for 625 square kilometers (12.5 percent of the total) in Puerto Rico, and 160 square kilometers (33 percent of the total) in the U.S. Virgin Islands (Turgeon *et al.*, 2002). Mangroves, macro-algal communities, and uncolonized hardbottom habitat account for the remainder. These estimates may not include some of the shallower ridges lying between St. Thomas and St. Croix which were not included in the original benthic mapping but lie within Federal or Territorial waters, and deeper portions of the insular shelf due to limitations in photographic interpretation with depth.

Actively growing coral reef development in Puerto Rico is more prevalent on the east, south, and west coasts than on the north coast as they are limited by physical (heavy wave), climactic (heavy rains causing land and river runoff), and oceanic conditions (Turgeon, *et al.*, 2002). The north coast shelf is very narrow, dropping off quickly to the deepest depths in the Atlantic Ocean (Puerto Rico Trench). North coast coral habitat is dominated by coral colonized hardbottom with high proportions of sponges and algae. In Puerto Rico, the shelf edge reefs, lying in depths of 45 to 100 feet, have been noted to be some of the best developed and least studied reefs on the island (Goenaga *et al.*, 1979; Turgeon *et al.*, 2002). The offshore islands, Mona, Desecheo, Culebra, Vieques, Caja del Muerto, and the smaller cays of the Cordillera, lying between the main island and Culebra, have the best developed shallower reefs, with areas of continuous reef from the shallows to the shelf edge. Desecheo Island National Wildlife Refuge (NWR), Culebra NWR, and the newer Vieques NWR have areas of steep shoreline where the protection afforded to these watersheds provides critical protection to the coral reefs, although the subtidal areas are not under the NWR jurisdictions. The Puerto Rico Commonwealth Department of Natural and Environmental Resources designated the waters around Desecheo and parts of Culebra as Marine Reserves with the intention of managing these areas as no-take zones.

In the U.S. Virgin Islands, the drier climate results in less sediment and nutrient runoff, promoting extensive coral habitat development. Nevertheless, there is concern regarding sedimentation impacts due to the development of steep slopes with highly erodible soils. Upland development and the construction of piers and barge landing facilities are particularly sensitive issues on some of the smaller associated privately owned cays proposed for or currently under development. These still have fringing patch reefs in prime condition. Most shallow submerged lands are under the jurisdiction of the Territorial Government. The

National Park Service (NPS) has jurisdiction over submerged lands adjacent to St. Johns National Park, Buck Island National Monument, and Salt River Bay National Historic Park and Ecological Preserve, in conjunction with the Territorial Government. The National Oceanic and Atmospheric Administration (NOAA) works with the Caribbean Fisheries Management Council and the Territorial Government to manage commercial fisheries.

Over 93 coral taxa, including 43 reef building scleractinian (stony) coral, 42 octocoral (gorgonian), 4 antipatharian (black coral), and 4 hydrocoral (fire and pink corals) have been reported from the Caribbean. Many more ahermatypic (non-reef building) stony corals occur, but are not included here. Over 242 reef associated fish species, 25 large motile invertebrates (lobsters, crabs, sea urchins, sea cucumbers), and myriads of smaller attached and motile invertebrates, are known from the reefs and many more occur in the associated seagrass beds and mangroves (Turgeon *et al.*, 2002). Sponge diversity in the Caribbean is particularly high and these are often the dominant habitat formers and occupiers of hard substrate, along with the soft corals or gorgonians (sea whips, sea plumes, sea fans) on coral colonized hardbottom.

Southern Florida Atlantic Reef Systems

The coastal ecosystems of Florida support a variety of coral reef habitats, including the only tropical coral reef in the continental United States, which occurs extensively offshore of the Florida Keys in Monroe County. In terms of species composition and physiography, the coral reefs of the Florida Keys resemble the tropical reefs of the Caribbean and Bahamas (Jaap and Hallock, 1990). It is well-established that coral reefs are inhabited by an extremely high diversity of species, and the coral reefs of the Florida Keys are no exception. There are thousands of species associated with it, including 80 species of algae, 120 sponges, 42 octocorals, 63 scleractinian corals, 500 crustaceans, 450 polychaetes, 1200 molluscs, 75 echinoderms, 450 fish, and 40 birds (Jaap and Hallock, 1990).

North of the Florida Keys, along the east coast, water clarity and temperature decline, as does the presence of tropical reef species. More than 7,000 years ago, ocean temperatures along the southeast coast of Florida were warmer. During the present day, colder water and pronounced temperature fluctuations prohibit active reef growth north of Miami. The relic reef ridge north of Miami now hosts mostly soft corals, sponges, and scattered coral heads (Lighty *et al.*, 1978).

From Miami to Palm Beach, corals do not build three-dimensional reefs and hard-bottom communities are dominated by octocorals (Jaap, 1984; Goldberg, 1973). However, the staghorn coral (*Acropora cervicornis*) thickets offshore of Broward County represent the largest extant *A. cervicornis* population in the continental United States (Vargas-Angel *et al.*, 2003). In the area between Palm Beach and Stuart, the subtropical climate zone transitions into the temperate zone. Species composition reflects this change, resulting in a transitional community of *Oculina* bank species and the hardiest tropical reef species able to survive at the northern limits of their range (Jaap, 1984). North of Stuart, the warm waters of the Gulf Stream are farther offshore, octocorals are fewer, and other hard bottom communities become

more important. These communities include sponges, small ahermatypic hard corals, tunicates, bryozoans, algae, and sabellariid worms. Similar to other reef habitat, these areas serve as, and are used as, breeding and juvenile fish habitat for a variety of commercially and recreationally important fish species.

Florida's most common marine communities include live bottom (hardbottom habitat) assemblages that occur from the subtidal zone east to the continental shelf edge (Jaap and Hallock, 1990). Because they do not construct reefs, hardbottom communities require hard substrate, such as limestone and rocky outcrops, to provide attachment sites. Visually dominant inhabitants include scleractinian corals, octocorals, sponges, and algae, which also contribute to habitat structure (Jaap and Hallock, 1990).

Sabellariid worms (*Phragmatopoma lapidosa*) form a unique, reef associate known as "worm reef." This is composed of loosely cemented sand particles that are held together by a mucus secreted by the worms when building their casing, which over time become hardened and provide substrate for corals and other sessile organisms. Worm reefs occur from Cape Canaveral to Key Biscayne in water up to 10 meters deep, with best development occurring off St. Lucie and Martin Counties (Jaap and Hallock, 1990). They are most often formed in high-energy surf zones (Kirtley and Tanner, 1968), and probably provide shoreline protection by reducing wave energy on the beach.

B. Coral Reef Study Project History

In response to the growing recognition of coral reef deterioration, Presidential Executive Order 13089 on Coral Reef Protection (EO) was issued on June 11, 1998, (64 FR 32701). The EO directed Federal agencies to identify their actions affecting coral reef ecosystems in the United States, and resulted in the creation of a Federal Coral Reef Task Force (CRTF). The CRTF is co-chaired by the Department of the Interior and Department of Commerce, and has directed these agencies to develop the National Action Plan to Conserve Coral Reefs (March 2, 2002).

The Coastal Development and Shoreline Modification section of the Action Plan lists seven recommendations with specific actions including:

"Assess the effectiveness of recent coral reef mitigation projects for Section 404 projects in Puerto Rico, USVI (U.S. Virgin Islands), and Hawaii and provide technical guidance for future mitigation activities related to permitting actions."

The Service, with additional funding from the Environmental Protection Agency (EPA), responded to this by initiating a study of compensatory mitigation for unavoidable impacts required by Corps' permit or civil works projects in the Pacific. A draft report was presented at the 8th Task Force meeting, held in San Juan, Puerto Rico, on October 2-3, 2002. The "Final Report: Compensatory Mitigation for Coral Reef Impacts in the Pacific Islands," was presented at the October, 2003 Coral Reef Task Force meeting and copies are now available at http://pacificislands.fws.gov/worg/orghc_envrev.html.

The October, 2002 Task Force meeting resulted in seven resolutions, the fourth of which strongly encouraged:

“...the applicable agencies, including the Fish and Wildlife Service, EPA, the National Oceanic and Atmospheric Administration (NOAA), Corps, and local jurisdictions in the Pacific to continue to coordinate in gathering data on the effectiveness of compensatory mitigation from federally funded and permitted activities. Included should be the analysis of which mitigation actions are most successful and recommendations for improving and identifying successful mitigation by the next Task Force meeting. The model of this analysis should be applied and evaluated in the Atlantic/Caribbean also and reported back to the Task Force next year.” (Resolution 4.)

This report was developed in response to Resolution 4. Information for this report was coordinated in the Caribbean with an informal interagency working group that included local representatives of the Service, NOAA Fisheries, Corps, and EPA. Territorial and Commonwealth agencies reviewed and provided comments on an earlier draft of this report. In Florida, the project was coordinated directly with the Corps' Jacksonville District Office, and with other Federal, State, and local agencies through correspondence and individual meetings. The report could not have been accomplished without the assistance of the Corps in providing file lists from their database, access to or information from their project files, and assistance in selecting projects for review. Further review of this draft by all the above parties is recommended and requested.

It should be noted here, that many Corps of Engineer's permits are authorized under the Rivers and Harbors Act, not under Section 404 of the Clean Water Act (CWA). Those often not addressed include projects that consist of dredging where no subsequent fill is involved, although few would argue that the impacts of dredging, as well as increased sedimentation, and turbidity should be considered to meet NEPA requirements. The 1990 MOA between the Corps and EPA, determining mitigation guidelines, was also specific to Section 404 of the CWA. The 2002 Regulatory Guidance Letter (RGL-02-2), extended consideration for compensatory mitigation guidance for aquatic resource impacts to the Rivers and Harbors Act of 1899. Therefore, this report includes activities from civil works projects or Corps Section 10 permitted projects with impacts to coral reefs.

Civil works projects have requirements under the Fish and Wildlife Coordination Act (FWCA) for early and close coordination with the Federal resource agencies on impacts resulting from these projects throughout the project development phases. Corps Planning addresses project impacts through NEPA, not through the Corps Regulatory Division. While the process provides for close coordination throughout the project development, continued improvement in coordination would be beneficial, and there is no mechanism for the resource agencies to elevate specific project issues on civil works projects as there is under the 1993 MOAs between the Corps and the resource agencies.

It is important to clarify that “mitigation” is an all-inclusive term that refers to the step-wise process of project impact avoidance, minimization, and lastly compensation for unavoidable impacts. Often times, the term mitigation is used interchangeably with compensatory mitigation, which is the final step to be taken for impacts that could not be avoided or minimized. The mitigation policy of the Service, and as it is defined by CEQ for NEPA, call for examination of the project alternatives, avoidance, minimization, and finally compensation for unavoidable impacts. This report attempts to document for each project: 1) whether or not impact avoidance and minimization measures were developed and implemented; 2) the extent of direct and indirect impacts; and 3) whether or not compensation for impacts to coral habitat was required and implemented.

C. Similarities and Differences between the Pacific and Atlantic Studies

Although this Atlantic Study was modeled after the Pacific Study previously mentioned, there are several differences and other distinctions that must be understood. The most important include a limited definition of coral reef excluding plant dominated habitat, a shorter time frame, and the inclusion of information on avoidance, minimization, and monitoring where available.

Due to the extensive nature of the plant-dominated habitats, it was not in the best interest of this effort to include all “coral reef ecosystems” as defined by the Coral Reef Action Strategy. As a part of meeting the goals of the Action Plan, NOAA developed a National Coral Reef Action Strategy (June 2002). The definition of coral reef under this strategy includes any reefs or shoals composed primarily of corals. Corals were further defined to include all Cnidarian species of the Anthozoan orders, Antipatharia (black corals), Scleractinia (stony corals), Gorgonacea and Alcyonacea (soft corals), Stolidinifera (organpipe corals and others), and Coenothecalia (blue coral); as well as all species of Hydrocorallina (fire corals and hydrocorals) from the class Hydrozoa. This definition includes actively accreting coral reefs, and coral or gorgonian colonized hardbottom.

Although the definition of coral reef habitat under the Action Plan includes seagrass beds and mangroves associated with coral reefs, the geology of the Florida continental shelf and the insular shelf of Puerto Rico and the U.S. Virgin Islands promotes extensive bay areas with unvegetated soft-bottom or large expanses of seagrass beds and coastal mangroves not directly associated with coral reefs. A review of all projects with plant dominated habitats including seagrass and/or mangrove impacts, particularly in south Florida, would have confused and overshadowed the coral impacts. Therefore, only coral reefs and coral-colonized hardbottom impacts, as defined above, were examined for this study unless impacts on adjacent coral areas could be established from the location or type of project. This is not meant to imply that impacts to vegetated coastal areas have no effect on coral reefs. The impact of Federal projects and mitigation on these plant-dominated habitats is worthy of separate efforts for both the Pacific and the Atlantic.

Both the Pacific and Atlantic studies focus on compensatory mitigation requirements for unavoidable coral reef impacts for projects either falling under the Corps’ regulatory or civil

works project authorities. The Pacific study evaluated projects with completion dates from around 1980 to 2001, while the Atlantic study is limited to the period from 1985 to 2003. It was determined that this period would provide reasonably accurate information for the geographic area under review. During the permitting process, the Corps and resource agencies in the Atlantic typically incorporated some level of avoidance and minimization, and effort was made to capture this information where it was documented in the project files, which is a similar process in the Pacific.

Finally, although Resolution 4 is not specific to projects authorized by the Corps, the focus of this report remains on compensatory mitigation requirements for unavoidable coral reef impacts for projects either falling under the Corps regulatory or civil works project authorities as examined in the Pacific Study. The scientific literature suggests that human induced reef impacts result more from secondary and indirect impacts, such as reduced water quality from point and non-point land-based sources and overfishing of important reef inhabitants (Jackson *et al.*, 2001), rather than direct impacts from water-related construction projects.

D. Report Organization

This report is organized to include the information gained from investigation of written and digital files and personal communications to determine mitigation for impacts to coral habitats from Corps' civil works projects or permitted projects in the U.S. Atlantic including southeastern Florida and the U.S. Caribbean. An effort was made to coordinate both areas of investigation into this single Atlantic study document.

The report describes in detail the methodology for the determination of project scope, project file selection, and analysis of mitigation and impacts. The results of the file review are reported separately to retain project and area specifics for each of the two study areas. A combined discussion section details the differences and similarities found in impact evaluation, trends in compensatory mitigation, monitoring requirements or compliance, and further discussion of the issues associated with these processes. Finally, recommendations for improvements for compensatory mitigation to coral reef impacts are provided and a literature citation is given. The actual raw data, specific project information, and working documents are provided in Appendices A and B, and agency comments on the draft document and Service responses are included in Appendix E.

II. METHODOLOGY

A. Scope of Study

The scope of this study was developed to determine, by examining various agency files and information, the impacts and subsequent compensatory mitigation to coral reef habitat from Corps' civil work projects or regulatory actions. File information such as project geographic location, type of action, type of development project or action, time period of project occurrence, mitigation requirements, and mitigation success was used to determine the applicability of the project and the data to the study. An Atlantic Scope of Study and Project

Worksheet (Appendix A) was developed to maintain consistency in data gathering between the Service offices. The Project Worksheet lists the specific information sought from Corps or Service office files. Only projects that met the criteria outlined in the Scope of Study were considered for this report. Rationale for the project limits were based on the predominant geographic areas with coral reef habitat (see Figure 1 showing project boundaries).



Figure 1. Atlantic Coral Reef Study Areas

In Florida, the geographic area of study consists of the east coast Atlantic seaboard from Indian River County south through the Florida Keys. Project files were selected from projects known to occur within these coral reef habitats. The Caribbean includes Puerto Rico and the U.S. Virgin Islands (St. Thomas, St. John, and St. Croix) as well as smaller islands under the jurisdiction of these islands (Vieques, Culebra, Mona, and a number of small cays around the U.S. Virgin Islands).

As discussed above, only those projects impacting coral reefs and coral-colonized hardbottom habitats were examined for this study unless impacts on adjacent coral areas from projects outside of the defined area could be established. For example, seagrass beds mixed with patch reefs, or offshore mangroves lying directly adjacent to fringing reef, would be considered as part of the impacted coral system. Likewise, a dredging project might impact nearby reefs, while docks or shoreline riprap probably would not. A review of all projects with seagrass and/or mangrove impacts warrants a separate study, particularly in south Florida. The results would have overshadowed this effort to focus on coral reef and hardbottom impacts. Similarly, residential and commercial dock impacts in Florida were not considered for analysis at this time, though some impacts to coral-colonized hardbottom are expected in the Florida Keys. Many thousands of docks have been built in the Keys and

southern Florida since 1985.

After examination of the available agency data, it was determined that there was a low probability of collecting accurate information from the files prior to 1985. Therefore, 1985 to the present was established as the time frame for the study. In addition, this timeframe equates to generally the same period that the current Federal mitigation process were in effect. It is clear, however, that many impacts to coral reefs occurred prior to 1985. For the Caribbean, older projects with known footprints were superimposed over the NOAA benthic maps to estimate impacts of these older projects. These consisted of older port projects and a runway extension. This information is included in Appendix D in order to give an historic picture of impacts, but not included in the study statistics.

B. Project File Selection

In the Caribbean, an initial list of projects was developed through discussions with an interagency working group. The Jacksonville District Corps Regulatory Analysis Management System (RAMS) database proved useful as a screening tool, but was limited with respect to selecting projects and was not designed to retrieve habitat specific information. Where provided, points were mapped using the location latitude/longitude and superimposed as a GIS layer on the Caribbean NOAA benthic maps. This allowed screening for projects actually falling on areas mapped as coral habitat.

Florida staff performed a computer database search of letters, reports, and other documents, to identify regulatory and Federal project files associated with marine and estuarine activities potentially affecting coral reefs and coral-colonized hardbottom. The Corps cooperated with the Service in these efforts through meetings, sharing of their RAMS database, and review of the project spreadsheet. Assistance with data compilation and validation was also rendered by the Florida Department of Environmental Protection, Florida Fish and Wildlife Conservation Commission, county and local governments, and other organizations. Since the Corps' RAMS database did not have the capability to extract detailed information relative to our review from the thousands of single-family dock projects in southeast Florida and the Keys, it was decided to exclude docks from this review. The potential for large cumulative impacts from private dock installation might be a suitable topic of review for a local working group in the future.

For each office, selected project files were reviewed in detail, and information was recorded and compiled into comprehensive Project Spreadsheets, located in Appendix B. Project or permit number, project name, location, project type, and dates were listed. Where available, information collected included original and subsequent permitted project footprints, direct and indirect coral reef or hardbottom impacts, avoidance and minimization, compensatory mitigation, and project mitigation monitoring.

C. Determination of Project Impacts

Project Footprint

The aerial extent of project impacts to coral reef habitats was determined from project files and examination of aerial photography if file information was unavailable. However, the project footprint did not necessarily equal the exact area of habitat impact. For example, the total area of dredging activities may have been 3 acres, but only 1 of those acres included hardbottom habitat. The actual area of coral habitat impact is noted in the appropriate column of the Project Spreadsheet. Acreage of project impacts was difficult to ascertain for reoccurring or multiple projects in and adjacent to previous dredge/fill footprints such as some beach nourishment and port dredging projects. If possible, multiple projects were distinguished as separate entries and impacts for each project were noted. When the impacts from each of multiple projects were difficult to distinguish, the multiple projects were combined into one entry and the impacts and mitigation for each of the projects were consolidated into the one entry.

Coral reef coverage and hardbottom colonization was categorized as either greater than or less than 5 percent, in an effort to indicate coral density in the area of the impact. This determination was derived from the file, personal knowledge of the area, or assumed from the general geographic location. In Florida, density primarily relates to: (1) the trend of coral coverage becoming less diverse and less prominent in the sessile biota associated with hardbottom as one moves north along the southeast Florida coast, and (2) coral colonies becoming less diverse and more scarce in near shore high energy environments. While it was not documented in the records, similar differences in coral communities occur in the Caribbean. For example, a high wave energy coast such as the north shore of Puerto Rico typically has relatively lower coral coverage than the lower energy south coast.

Alternative, Avoidance, and Minimization of Impacts

In an effort to highlight the use of the mitigation sequencing procedure, alternatives, avoidance and minimization of impacts to coral habitat were quantified where possible. Linear projects, such as utility lines, commonly identify minimization or avoidance measures as those where the initial selection of a route is made in areas of lower coral density or where construction techniques such as diver directed cable lays were employed to reduce or avoid impacts. In these cases, the avoidance/minimization details are included in the comments sections of the project summary worksheets Appendix B). If the actual acreage of minimization was not identified in the project files or known, the worksheet would simply note that measures were taken to avoid or minimize impacts, and no area of minimization was provided. This does not imply that these measures were ineffective.

Compensatory Mitigation

Issued permit conditions and accompanying mitigation plans were used as the basis for evaluation of compensatory mitigation. Compensation was considered “on-site” if it occurred adjacent to or within one mile of the project and within the same reef system. Compensation was considered “in-kind” if it involved: (1) coral or hardbottom restoration usually involving transplantation from the impact site to a recipient restoration site; (2)

artificial reef material such as limestone rock or marine modules; or (3) if it included protection of common anchorage areas in corals through the placement of low-impact moorings. Limestone rock and modules were considered in-kind, whereas ordinary concrete was not, based on agency experience with artificial reef types.

The amount of compensatory mitigation required by the Corps or the State was recorded in the spreadsheet if available in the file data. Furthermore, the term “mitigation complete” refers to any and all compensatory mitigation completed for a project, whether the mitigation was required by the State or Federal government. This explains why more mitigation may have been recorded than was “required.” For instance, if the Corps only required 2 acres of compensatory mitigation, but the county deployed 3 acres, the 3 acres were noted and differentiated when possible. This scenario most often occurs related to repetitive fill projects, such as beach nourishment in Florida, to compensate for unanticipated reef impacts, which were identified during constructing monitoring or post-construction monitoring of the previous project.

Compensation for Caribbean projects has been almost exclusively transplantation of corals from the impact area to other reef sites, and was quantified as number of colonies transplanted and survival rates. To make a rough estimate of acreage, full acreage credit (impacts equal to compensation) were given for those projects scoring 4 or above on the project ratings (see Appendix B Tables).

Monitoring and Mitigation Success

Where monitoring plans were required by State or Federal agencies, compliance with providing monitoring reports was recorded on the worksheet with a simple “yes or no” response. Monitoring may have addressed construction compliance (avoidance and minimization measures) as well as compensatory mitigation compliance. For this reason, some projects included monitoring to ensure avoidance where no compensation was required, or where requirements for compensatory mitigation were contingent upon the assessment of impacts during and following construction. A deficiency of monitoring information was encountered in both Service office project files, as there is no specific requirement for the Corps or the project proponent to provide monitoring reports or information to the Service. For most projects, therefore, information from the Corps and other agencies was used for assessment and documentation of monitoring activities and mitigation success.

Compensatory mitigation success was determined by comparing the available compensation information with the criteria developed in the mitigation plan accepted for the project. For the purposes of comparison in this report, mitigation success was roughly determined on a scale of 0 to 5, based on monitoring results in terms of compliance with agreed upon mitigation plan conditions and success criteria. Mitigation was deemed successful if monitoring scored a 4 or higher according to the following scale:

- 0-no documented effort
- 1-documented effort with no success;
- 2-documented effort, minor success;

- 3-documented effort, appreciable success;
- 4-documented effort, major success; and
- 5-documented effort, full success or exceeded expectations.

The numeric score and additional comments were noted on the project worksheets found in Appendix B. Note that compensation “success” was not based on whether there was a “net loss” of coral habitat, but on the project developer’s compliance with the accepted project mitigation plan. In Florida, this was generally quantifiable in acres since compensation consisted mostly of artificial reef structures (modules or limestone rock). In the Caribbean, transplantation success (number of colonies and survival) was used as the measure of compensation success. Rough estimates of acreage of compensation for transplantation projects are based solely on assuming full acreage replacement for projects scoring 4 or higher.

III. RESULTS

Several thousand Corps Regulatory Division permits and Planning Division civil works projects were screened, resulting in 28 projects from the Caribbean and 26 from Florida (16 completed and 10 pending construction) with adequate information for more detailed review (see Table 1). All of the Caribbean projects are under construction or have been completed; there are no pending projects at this time. Actual and anticipated coral reef habitat impacts realized and anticipated total 264 acres: 47 acres in the Caribbean and 217 acres in Florida. Compensation acreage for Florida projects consists mostly of the placement of artificial or natural substrate and is expected to total 113 acres: 43 acres for completed and 70 acres for incomplete projects, thus far. Compensation for Caribbean projects has been almost exclusively transplantation of corals from the impact area to other reef sites, and was quantified as number of colonies transplanted and survival rates. To make a rough estimate of acreage, full acreage credit (impacts equal to compensation) were given for those projects scoring 4 or above on the project ratings (see Appendix B Tables). Compensation success (as judged from compliance with permit conditions) was variable, but has shown improvement.

Table 1. Summary of Coral Reef Impacts in the Study Area.

Location	Acres of Impact	Acres of Compensation	Number of Projects	Number of Projects (%)			
				Avoidance/Minimization	Compensation Recommended	Compensation Required	Required Compensation Completed
Florida (completed)	103	43	16	14 (88%)	13 (81%)	14 (88%)	13 (93%)
Florida (pending)	114	70	10	8 (80%)	6 (60%)	5 (50%) ¹	pending
Caribbean (1985-1994)	42	0	16 (15) ²	4 (25%)	4 (27%)	2 (13%)	2 (100%) ³
Caribbean (1995-2003)	5	4.6 ⁴	12	8 (67%)	9 (75%)	10 (83%)	10 (100%)
TOTAL	264	118	54	34 (63%)	32 (60%)	31 (59%)	25 (81%)

- 1 Five projects are still awaiting finalization by the Corps or FERC; mitigation not decided.
- 2 One of the original 16 projects avoided impacts as a result of the permitting process.
- 3 One of the two projects requiring compensation eliminated the project impacts post-permitting, therefore didn't require compensation.
- 4 Acreage credit based on transplant success.

Filling, sedimentation, and dredging (in decreasing order) for beach nourishment and port expansion caused the most impacts in completed projects in South Florida. The anticipated impacts for uncompleted projects are attributed to dredging activities associated with port expansion and beach nourishment projects, with moderate impacts expected from sedimentation as a result of these activities. In the Caribbean, the major impacts were from dredging and filling for pipeline trenching and for port development.

The results of the file information gathered suggest that compensatory mitigation recommendations, requirements, and compliance have been improving over time. Nevertheless, total mitigation acreage in Florida, so far, was slightly more than half the amount of the impact acreage (complete and pending). Acreage figures for the Caribbean were estimated as described above. Coral reef impacts have decreased over time in the Caribbean. However, the cumulative effects of projects in Florida, if constructed as planned, are expected to exceed coral reef impacts from projects completed since 1985.

Compilation and analysis of the files and project information revealed differences and similarities between the two study areas and are outlined in the following section. Although the number of projects can be compared, compensation acreage comparisons between the two areas should be made with caution because of the assumptions made in estimating compensation to impact acreage in the Caribbean for transplantation. In Florida, compensation primarily consists of reef construction, which could be quantified reliably as acreage (when this information was available) and compared to the impact area.

Other differences found in the data between the two study areas can be attributed to available tools, file retrieval methods, types of projects, methods of addressing mitigation, and agency interactions between the two areas. Because of these, comparisons between the areas are difficult and may suggest inaccurate conclusions. Therefore, the results of the study are reported separately to retain project specifics, area distinctions, and integrity of the information.

A. CARIBBEAN (Puerto Rico and the U.S. Virgin Islands)

Selection of Project Files for Review

A number of projects were identified for inclusion into the study through discussions within a Caribbean coral reef working group that included representatives from the Caribbean offices of the Service, the Corps, the EPA, and NOAA Fisheries. Corps' Planning Division projects included: the Aguadilla breakwater port development, the Arecibo Harbor Maintenance Dredging, and the San Juan Harbor maintenance dredging. Approximately 15 additional projects were identified from the Corps' Regulatory Division that included port

developments, pipelines, and communication or power cables. There are no pending projects in the Caribbean at this time.

The file search within the Corps' RAMS database yielded 1,846 potential projects based on very broad "project type" categories, of which 485 had no specific location coordinates. Those without coordinates were filtered using project type, general location, and proponent name, leaving 32 projects with some likelihood of impacting coral reef habitat. Fifteen of these were Commonwealth or Territorial resource agency low-impact mooring buoy projects, and one was a Navy artificial reef project. These projects are expected to have positive rather than negative impacts. Therefore, while noted here, they are not addressed further in this review. Information could not be found for 10 projects, leaving 6 projects without coordinates for hard file review, and these were among the projects pre-selected by the workgroup.

The remaining projects with discrete latitude/longitude coordinates were mapped on a GIS layer superimposed over the existing NOAA Benthic Habitat Maps of Puerto Rico and the U.S. Virgin Islands (Figure 2), to select those falling on coral reef or coral colonized hardbottom. These 69 projects were further screened using project type, proponent name, and in many cases, a brief review of the files. This screening left 39 files for further review. Of these 39 projects, 14 had sufficient information for a full hard file review, 12 were for Halas-mooring buoy projects, 3 projects were for fish attracting devices or artificial reefs, and one was for oil spill clean-up activities. Information was not available for 9 projects, either requiring nationwide or general permits (Table 2).

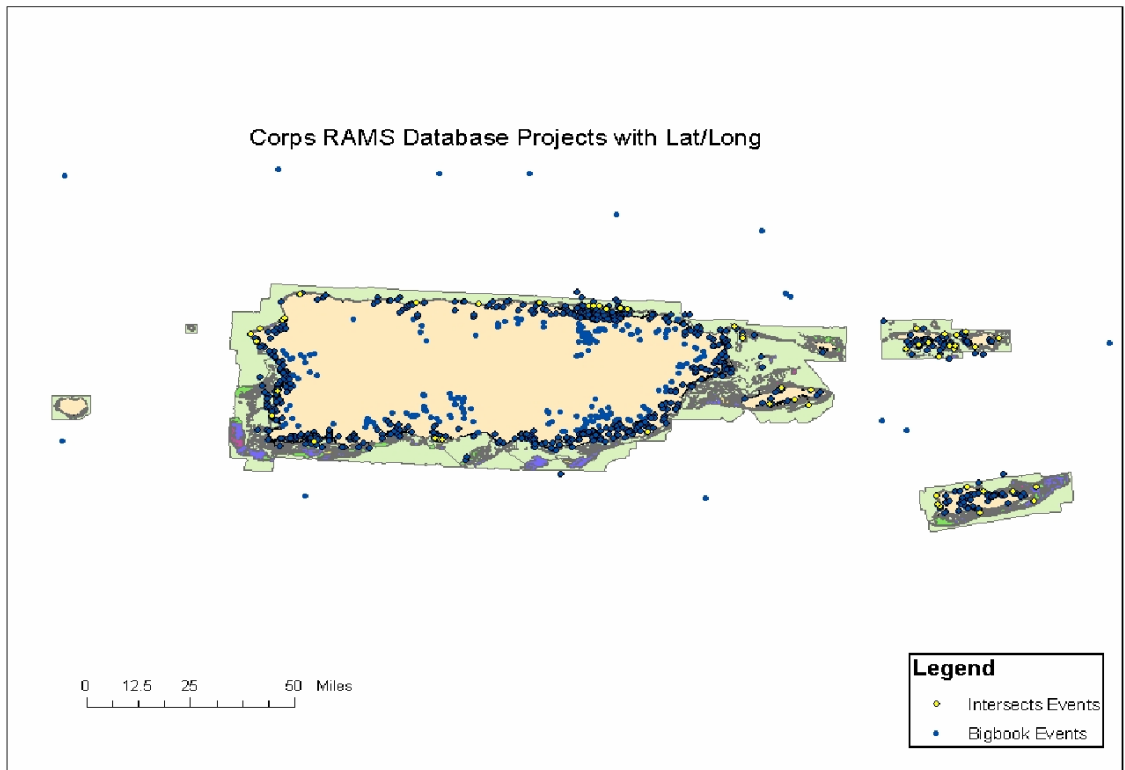


Figure 2. NOAA Benthic Habitat Maps of Puerto Rico and the U.S. Virgin Islands with RAMS Project Locations.

Table 2. Selected projects by type, and Corps permit instrument.

Projects without Coordinates (32 projects)	Corps Permit	Total
Beneficial - Halas-mooring buoy projects	5 GP, 2 NW, 6 LP, 2 unknown	15
Beneficial - Artificial Reef	1 GP	1
Remaining Projects, inadequate information	1 IP, 4 LP, 2 GP, 3 NW	10
Projects with Coral Reef Impacts, adequate information	4 IP, 1 LP, 1 NW	6
Projects with Coordinates (39 projects)		
Beneficial -Halas-mooring buoy projects	8 NW, 3 LP, 1 GP	12
Beneficial - Fish Attracting Dev., Artificial Reefs, Other	2 GP, 2 NW	4
Remaining Projects, inadequate information	5 NW, 4 GP	9
Projects with Coral Reef Impacts, adequate information	6 IP, 8 LP	14
Total Projects selected from file review		20

IP-Individual Permit, LP-Letter of Permission, NW-Nationwide Permit, GP-General Permit

The 20 projects, with adequate information from the file screening, were added to

approximately 10 more selected through the work group or in-house file review. Of the three Corps civil works projects initially selected, however, only one was reviewed in detail (Aguadilla Breakwater). The Arecibo Harbor maintenance dredging project was not reviewed as it was in litigation for coral reef impacts from the improper disposal of dredge spoil; and the San Juan Harbor channel improvement's project file only had information on impacts to an algal shoal within the bay although there was minor removal of hardground at the mouth of the bay. One of the screened coordinate projects, Christiansted channel improvements, was eliminated since it was not built.

As a means of examining trends over time, the remaining 28 projects were divided into two periods: those occurring from 1985 through 1994, and those from 1995 to the present. This resulted in 16 projects in the 1985-1994 group, and 12 projects in the 1995-2003 group. For a summary table on the 28 projects and brief project summaries see Appendix B. These projects represent the range of project types under the Corps' jurisdiction that impacted coral habitat in the Caribbean during the selected time period. The estimated impacts are conservative due to the lack of information on secondary or indirect impacts from sedimentation or construction method. Impacts from power and communication cables were estimated as one foot times the length of the cable over hardbottom (either given in the permit file, or estimated using the NOAA benthic maps).

Impacts to Coral Reef Habitats

Total coral reef impacts for the 28 projects examined were determined to be about 47 acres, with 42 acres of impacts occurring from 1985 through 1994, and 5 acres from 1995 to 2003 (Table 3). It should be noted that the large difference in impacts between the two periods is partially attributable to one project, the Ponce Regional Wastewater Treatment Plant outfall pipe construction. This project was reported to affect 28 acres of coral habitat. Nevertheless, discounting this project, coral reef impacts prior to 1995 were over twice those from 1995 to 2003. The greatest effects on coral reefs were from dredging and filling.

Table 3. Acres of Impacts by major work type.

	Number of Projects	Dredge	Fill	Sediment*	Shading*	Total
1985-1994	16	22	20	<1	<1	42
1995-2003	12	3	2	<1	<1	5
Total	28	25	22	<1	<1	47

* With few exceptions, impacts from sedimentation were not evaluated or monitored.

Private docks, port development, and power or communication lines were the most common projects, followed by water and sewer pipelines and private ports or marinas (see Table 4). Shoreline protection and beach nourishment were the least common project types in the Caribbean. The private dock impacts to coral reefs occurred in the U.S. Virgin Islands, particularly on the smaller associated cays. Port development and linear pipelines, particularly wastewater outfalls which are gravity flow, must be trenched through high relief

reef and caused the largest area impacts. Linear cables (communication and power) initially impact a very limited area due to the narrow footprint, but require periodic replacement causing repeated impacts. The majority of the coral reef impacts for port development projects occurred in the dredging footprint for the entrance channels with the exception of the Eco-Electrica pier where the pier caused shading impacts to a mixed seagrass and gorgonian dominated patch reef.

Table 4. Coral habitat impacts by project type (numbers and acreage).

Code	Project Type(s)	Number of Projects			Acreage of Impact		
		'85-'94	'95-'03	Total	'85-'94	'95-'03	Total
1a	linear outfall/water line	3	1	4	28	1	29
1b	linear power/com. cable	2	4	6	<1	<1	<1
2	Beach renourishment	1	0	1	3	0	3
3	Shoreline Protection	3	1	4	2	<1	2
4	Harbor and Port	3	3	6	6	4	10
5	Marina, docks, basin	3	1	4	2	<1	2
6	Private dock	4	3	7	<1	<1	<1

Mitigation for Impacts to Coral Reef Habitats

Alternatives, Avoidance, and Minimization of Impacts

The lack of documented alternatives, avoidance and minimization for some projects does not imply that the stepwise process of alternatives, avoidance and minimization prior to compensation was not followed. For the purpose of this review, it was assumed that alternative sites were examined when this was feasible. For the 1985 to 1994 time period, one fourth (4 out of 16) of the projects had some documented evidence of avoidance or minimization in the project files (see Table 5). The project responsible for the greatest acreage reduction (Ponce Wastewater Treatment Plant Outfall) estimated approximately 28 acres of coral reef impact minimization based upon halving the originally estimated 56 acre construction corridor by side-casting to one side of the trench, rather than both. Compliance with this condition was never verified. From 1995 to 2003, two thirds (8 out of 12) of the project files documented some avoidance or minimization measures. Virtually all of these were based on alignment variations and/or construction conditions to minimize impacts. The specific area of impact reduction was not quantified. In a current case, St. Thomas to St. John power cable replacement, impacts are to be avoided completely by altering the cable corridor to avoid coral reef or hardbottom.

Compensatory Mitigation Recommended

From 1985 to 2003, compensatory mitigation was recommended by one or more resource agency 48 percent of the time (see Table 5). Prior to 1995, documentation that compensatory mitigation was recommended was found for only 4 out of 15 cases. The sixteenth project, Inner Brass Key, lacked compensatory mitigation recommendations because the permit was denied. The applicant built an unauthorized dock and landed barges causing shading and scouring to shallow coral fringing and patch reef. The dock was removed, but nor further restoration was required. In another case, Schooner Channel, impacts to seagrass beds, not coral reefs, were anticipated and proposed to be compensated through an out-of-kind mitigation. Changes in the channel alignment, due to encountering hard basement rock during construction, impacted Round Reef near the outer portion of the channel. From 1995 through 2003, mitigation was recommended in 9 out of 12 (75 percent) of the projects. In the three cases where mitigation was not recommended, one proposed a change (which was not followed) in the pipeline alignment to avoid impacts to coral reefs, one was for a dock that had no anticipated coral impacts (but resulted in impacts through unauthorized changes), and one was the reconstruction of an existing dock with very small corals colonizing older parts of the dock that were left in place.

Compensatory Mitigation Required

Mitigation was required for 12 of the 28 projects (43 percent) for the entire period (Table 5). Prior to 1995, mitigation was required for only 2 of 15 projects (13 percent) although mitigation had been recommended by resource agencies for 4 of the projects (27 percent). From 1995 through 2003, mitigation was required for 10 of the total 12 projects (83 percent). In one case where recommended mitigation was not required, the original permit application was withdrawn, later reapplied for under a letter of permission as a dock reconstruction, and impacted coral from unauthorized changes (see Lovango Cay comments, Appendix B).

Required Compensatory Mitigation (Completed or in Progress)

Overall, compensatory mitigation has been completed or is underway for all projects that required compensation (see Table 5). Prior to 1995, the Fredericksted pier reconstruction and expansion made inadequate effort at meeting the compensatory mitigation. The other project, the West Indies Company cruise ship dock improvements and marina, eliminated the marina, eliminating coral reef impacts and the need for compensation. From 1995 through 2003, ten mitigation efforts (100 percent) have been completed or are under way, however, one project (ARCOS 1 communication cable) failed to employ the avoidance and minimization measures, and had no information available on proposed transplants, resulting in a low success rating.

Table 5. Percent of projects with avoidance or minimization, recommended mitigation, required mitigation, and accomplished mitigation (per project file review).

Time period	Percent Avoidance/Minimization	Percent Compensation Recommended	Percent Compensation Required	Percent Required Compensation Completed or In Progress
1985-1994 (16)	25%	27% ¹	13%	100%
1995-2003 (12)	67%	75%	83% ²	100% ³
Total (28)	43%	48%	43%	100%

1. Mitigation was not recommended for Inner Brass Key dock & private port because the permit was denied, but applicant built a dock without authorization and landed barges, causing scour in coral reef habitat.

2. Two projects have developed after-the fact mitigation plans for unauthorized impacts to coral reefs, one of these originally had not anticipated coral reef impacts.

3. Of the seven mitigations done, one had only 1 post-construction report, one was completed recently, and the other has no information. Some projects are still being constructed, but initial transplantation is essentially complete, and regular monitoring reports are being submitted.

Compensation for unavoidable impacts predominantly required the transplants of coral colonies from the impact areas or corridor to nearby locations. The Fredericksted cruise ship pier reconstruction (before 1995) had three elements to the mitigation: transplants of corals and sponges from the old pilings to the new pier, use of the pier construction debris in an authorized artificial reef site, and the installation of two ship moorings in areas that lacked coral reef. Only the transplant portion was successful. The compensations performed from 1995 through 2003, have all been coral transplants with the exception of one artificial reef project. Below (Table 6) are the results of compensation by project number. For more details on each of these projects see the individual project tables in Appendix B.

Table 6. Results of compensation by project number

Proj #	Transplant	Colonies	Artificial Reef	#Modules	Other	Kind	Location	Rating*
8	Yes	No Information	Yes	Pier Debris	Anchorage Sites	In Kind, Out of Kind	On Site, Off Site	2
17	Yes	200			Experiment	In Kind	On Site	5
18	>90%	2023				In Kind	On Site	5
19	79%	24				In Kind	On Site	2
21	Yes	13				In Kind	On Site	4
22	>99%	4854				In Kind	On Site	5
25	Yes	No Information				In Kind	On Site	2
26			Yes	12		In Kind	Off Site	5
27	Yes	3046				In Kind	Off Site	4

*See Methods, Page 15 for the criteria used for rating the projects.

Project and Compensatory Mitigation Monitoring

Monitoring requirements are generally included in the permit conditions and may address

avoidance, minimization, and compensatory mitigation. Monitoring requirements also usually include a project timetable for completion of the project, the mitigation, and reporting requirements. Construction monitoring may be required even when compensatory mitigation is considered unnecessary. Typically monitoring of compensatory mitigation is required from two to five years in the Caribbean. Below (Table 7) is the available information on monitoring for the project files examined. The percentages of required monitoring increased following 1994, as did the monitoring that was actually done as recorded in files or mitigation reports. For some projects, lack of monitoring information prior to 1995 may be due to lapses in the files.

Table 7. Approximate Percent of projects where monitoring was required and completed.

Time Periods Total projects (n)	Monitoring Required	Required Monitoring Performed
1985-1994 (16)	38%	67%
1995-2003 (12)	83%	90%
Total (28)	57%	81%

According to file information for projects prior to 1985, 6 out of 16 (38 percent) required monitoring and there was evidence of monitoring available for only 4 out of those 6 projects (67 percent). One of the projects requiring monitoring, the West Indies Company marina, dropped the marina portion of the project that was expected to impact coral habitat, so the monitoring was also dropped. Another project (AT&T St. Croix) did not require monitoring due to drilling methods used that were to avoid impacts. However, unexpected impacts resulted, monitoring of the clean-up and restoration was required, and the case involved protracted litigation.

Ten of the 12 projects (83 percent) from 1995 to 2003 required monitoring, and nine of these (90 percent) have submitted some evidence of monitoring. Two of the projects are recent violations under investigation by the Corps. Both projects involve piers and barge landings for private cays off St. Thomas and St. John, Lovango Cay and Little St. James Island. One was not expected to have coral reef impacts, hence no recommendations for mitigation. The other had a complex application history. Both proponents built additional unauthorized structures, impacting coral reefs, and were issued notices of noncompliance and cease and desist orders. Compensation and monitoring for one project is being required through an after-the-fact permit (but has not started), and the other is requiring restoration (removal of some of the unauthorized structures).

For the overall study period of 1985 to 2003, approximately 57 percent of the total projects with impacts (16/28) were required to monitor mitigation or construction activities. Of these monitoring requirements, there is evidence that monitoring was done or is in underway for 81 percent of the total number of projects.

B. SOUTHERN FLORIDA (Indian River County south through Monroe County)



Figure 3: Example of a typical beach renourishment project, Palm Beach County, Florida. (Photo provided by Palm Beach County Department of Environmental Resources Management).

Selection of Project Files for Review

Searches in the Service’s computer database and in over 20 years of hard copy files produced an initial list of 208 projects possibly affecting coral reefs or coral colonized hardbottom on the southeastern Atlantic coast. These project files were screened using the Scope of Study criteria outlined in Appendix A, resulting in a list of 60 possible projects with impacts for review. Examination of these 60 project files, along with additional relevant projects from the Corps’ RAMS database and input from other agencies, led to the final selection of 26 projects having sufficient information to be included in this study. Sixteen of the 26 projects have been completed and 10 remain in planning stages but provided enough information of the expected reef or hardbottom habitat impact and compensatory mitigation requirements to be included in this study. Tables A-1 to A-4 in Appendix B present information on the 16 completed and 10 proposed projects for Florida. Project types include port dredging, dredging and filling for beach nourishment, and natural gas pipeline installation.

Impacts to Coral Reef Habitats

The information for the 16 completed projects identified approximately 103 acres of direct

project impact to coral reef and coral colonized hardbottom habitat. A total of 15 acres of habitat were directly impacted from port channel expansion activities; 49 acres of habitat were filled as a result of beach nourishment activities; another 25 acres were subject to long term impacts from sedimentation as a result of dredge pipeline leaks or rupture; and approximately 14 acres of habitat were incurred as a result of hydraulic dredge pipeline placement or anchor cable damage (see Table 8). Six of the completed projects are believed to have had greater than five percent hard coral coverage within the project footprint, and 10 of the completed projects had less than five percent hard coral coverage within the project footprint. In addition to these direct impacts, an additional 10 acres of habitat are anticipated from short term and indirect impacts to nearshore hardbottom reef from turbidity and sedimentation for the Ocean Ridge beach nourishment and Indian River County beach restoration projects. These indirect impacts are not included in the tables.

Table 8. Approximate Acres of Impacts by work type.

	Number of Projects	Dredge	Fill	Sediment	Mechanical Damage	Total
Completed	16	15	49	25	14	103
Proposed	10	83	18	1	12	114
Total	26	98	67	26	26	217

The additional 10 proposed projects are anticipated to directly impact approximately 114 acres of coral reef and coral colonized hardbottom habitat. A total of 83 acres of habitat are expected to be directly impacted from port dredging; 18 acres are proposed to be filled; 12 acres are anticipated to be impacted during gas pipeline construction; and 1 acre is anticipated to be impacted by sedimentation. Seven of the proposed projects have greater than five percent hard coral coverage within the project footprint, and three of the proposed projects have less than five percent coral coverage within the project footprint. Of the 114 acres impacted by the proposed projects, 65 acres were previously impacted by past projects. An additional 3 acres of indirect impacts are expected from the Tractebel Calypso Pipeline Project and are not included in the calculations below (Table 9).

Table 9. Coral habitat impacts by project type (numbers and approximate acreage)

Project Type(s)	Frequency			Approximate Acreage		
	Completed	Proposed	Total	Completed	Proposed	Total
Gas Pipeline		3	3		12	12
Beach renourishment	12	4	16	75	19	94
Port Expansion	3	2	5	28	83	111
Private docks *	unknown	unknown	unknown	unknown	unknown	unknown

*Private dock impacts were not included in file review for Florida.

Mitigation of Impacts to Coral Reef Habitats

Alternatives, Avoidance, and Minimization of Impacts

Of the 16 projects that have been completed, there is record of 14 projects performing an alternatives analysis and no information regarding alternatives analysis for the Jupiter Inlet District dredging and the City of Boca Raton beach renourishment (south) projects. There is indication that 14 of the projects avoided or minimized impacts, for a reduction of impacts to approximately 17 acres of coral reef and hardbottom habitat, primarily through limiting the scope of beach nourishment and inlet channel dredging. The Jupiter Inlet District maintenance dredging is an ongoing project that has been depositing sand on the beach immediately south of the inlet on a semi-regular basis for years. Currently, there are no practical alternatives to the project design that could further avoid or minimize impacts. Documentation was insufficient for one other project to determine use of avoidance or minimization of impacts.

Of the 10 proposed projects in the South Florida area, there is record of 8 projects having performed alternatives analyses and no information regarding alternatives analyses for 2 projects. Seven of the projects proposed avoidance or minimization of impacts, for a reduction of impacts of approximately 22 acres of habitat, primarily through limiting the scope of beach nourishment. One project, the City of Boca Raton Beach Renourishment Project (north), did not appear to avoid or minimize impacts, and no information was found for two of the projects regarding avoidance or minimization (see Table 10).

Compensatory Mitigation Recommended

Compensatory mitigation was recommended by the Service and other resource agencies for 13 (81 percent) of the 16 completed projects. Recommended compensation for these projects totaled approximately 52 acres, or 50 percent of the 103 acres of habitat directly lost to project impacts. (Table 10). Recommended mitigation for hardbottom loss was not part of initial consultation by the Service for one project, the 1993 Miami Harbor deepening, because the project design did not anticipate loss to such habitat. However, unanticipated hardbottom impacts occurred and were addressed with after project construction mitigation. Information was not found for two of the completed projects regarding recommended mitigation.

Mitigation was recommended by the Service and other resource agencies for 6 of the 10 currently proposed projects. Information was not found for 4 of the 10 projects regarding recommended mitigation due to either lack of information in the project file or the preliminary status of the project. Recommended mitigation for the six projects having information totals 82 acres of the 100 acres of habitat is anticipated to be lost to project impacts by those 6 projects. A total of 114 acres of coral habitat is expected to be lost from all 10 of the projects. Note that the 50 acres of recommended mitigation for the Port Everglades Navigation Project is for the 31 acres of impacts (15 acres of new impacts plus 16 acres of previously impacted habitat). In comparison, 9 acres of recommended mitigation for

the Miami Harbor Maintenance Dredging and Expansion Project is only for the 3 acres of new impacts, which does not include mitigation for the 49 acres of previously impacted habitat to be dredged, out of the 52 total acres of impacts (Appendix B).

Table 10. Number of Projects and Number of Acreage with Avoidance or Minimization, Recommended Compensation, Required Compensation, and Accomplished Compensation (per project file review) (Appendix B).

Projects	Avoidance/ Minimization	Compensation Recommended	Compensation Required	Required Compensation Completed or in negotiation
Completed % (# of Projects) (Total=16) % (# of Acres) (Total =103)	14 projects (88%) 17 acres (17%)	13 projects (81%) 52 acres (50%)	14 projects (88%) 49 acres (48%)	13 projects (93%) 43 acres (88%)
Proposed % (# of Projects) (Total=10) % (# of Acres) (Total=114)	8 projects (80%) 22 acres (19%)	6 projects (60%) 82 acres (72)%	5 projects (50%) 70 acres (61%)	10 projects in negotiation 10 acres **
Overall % (# of Projects) (Total=26) % (# of Acres) (Total=217)	22 projects (85%) 39 acres (18%)	19 projects (73%) 134 acres (61%)	19 projects (73%) 119 (54%)	pending* pending*

*Currently, project final impacts and compensation are under negotiation, only 1 of 10 projects has been constructed,

**1 project constructed a 10-acre artificial reef prior to permit issuance.

Compensatory Mitigation Required

Compensatory mitigation required by the Corps and other permitting entities was found for 14 (88 percent) of the 16 projects that have been completed. The 49 acres of mitigation actually required for these 14 projects accounted for 48 percent of the 103 acres of habitat directly lost to project impacts. Furthermore, two of the projects for which mitigation that were recommended did not have information regarding required mitigation, and one of the projects for which mitigation was required did not have information regarding recommended mitigation.

Mitigation requirements from the Corps and other permitting entities were found for 5 of the 10 proposed projects. Required mitigation for these 5 projects totaled approximately 70 acres, or 72 percent, of the 97 acres of habitat anticipated to be directly lost to project impacts for those 5 projects, or 61 percent of the total proposed impact. Again, the 50 acres of required mitigation for the Port Everglades Navigation project is for the 31 acres of impacts (15 acres of new impacts plus 16 acres of previously impacted habitat). In comparison, 6 acres of required mitigation for the Miami Harbor Maintenance Dredging and Expansion project is only for the 3 acres of new impacts, which does not include mitigation

for the 49 acres of previously impacted habitat, out of the 52 total acres of impacts. Information was not available for 5 of the projects regarding required mitigation.

Required Compensatory Mitigation Completed

Of the 49 acres of mitigation required by these 14 completed projects, approximately 43 acres (88 percent) has been implemented. Artificial reefs using limestone boulders or concrete modules were the prevalent types of mitigation (Figure 4). Seven projects completed the amount of mitigation required, two completed more than was required, two completed less than was required, and three projects have performed no required mitigation. Of the two projects that completed less mitigation than required, one project, the Juno Beach Restoration Project, is due to begin construction for the remaining amount of mitigation in 2004. For the three projects that did not complete any mitigation, the Indian River County Beach Restoration project, is to begin mitigation reef construction in the summer of 2004. For the two projects that did not have information regarding required mitigation, both completed some mitigation for a total of approximately 2 acres.

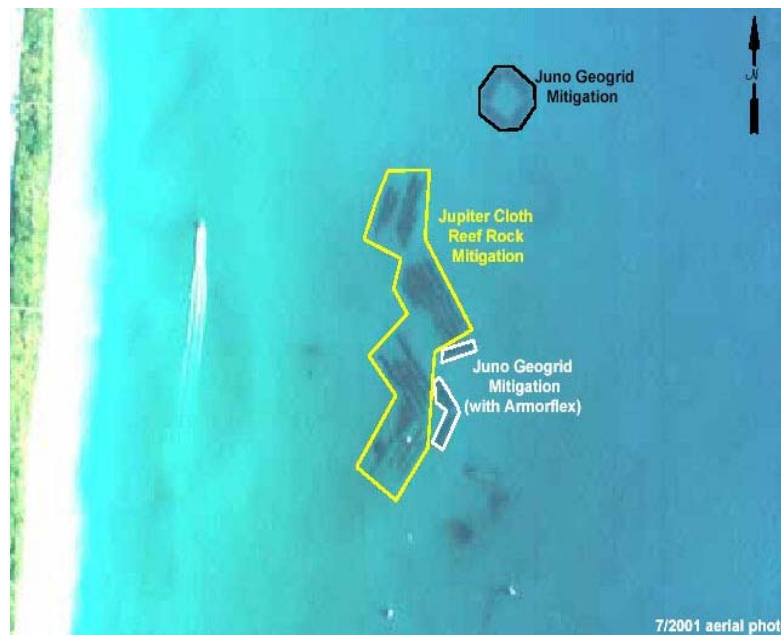


Figure 4. Aerial photograph of limestone artificial reef.

Overall, mitigation was implemented by 13 (93 percent) of the 14 projects and 43 acres of the 49 acres (88 percent) in which it was required (Table 10). This resulted in only 41 percent replacement of the total 101 acres of habitat directly lost to project impacts. In addition, over 3 of the 4 acres of artificial reef for the Ocean Ridge Beach Nourishment Project settled into, or were covered by sand and are no longer functional; and a little more than 1 acre of concrete rubble for the Jupiter-Carlin project settled into sand and is no longer functional.

Thirteen projects completed some level of mitigation, 3 (23 percent) constructed mitigation on-site, 7 (54 percent) constructed mitigation off-site, and 3 (23 percent) constructed

mitigation both on-site and off-site. Furthermore, for these 13 projects, 9 (70 percent) constructed mitigation that was considered in-kind, 2 (15 percent) constructed out-of-kind mitigation, and 2 projects (15 percent) constructed both in-kind and out-of-kind mitigation. Two (15 percent) of the 13 projects also transplanted coral colonies out of the impact area prior to nourishment activity. One project, the Hillsboro Inlet navigation improvement project, did not implement required mitigation but did transplant coral colonies and sponges out of the impact area prior to dredging activity.

Seventy acres of required mitigation is pending for the 5 of the 10 proposed projects, and 10 acres of on-site, in-kind mitigation has been constructed. The Broward County beach nourishment project also plans to transplant coral colonies measuring 15 centimeters or more. The remaining four proposed projects have no present mitigation requirements are proposing to transplant coral colonies out of the impact area before activity begins, and 3 of those projects are also proposing to remove tires from the existing reef tract area. All 10 pending projects require mitigation monitoring.

Project and Required Compensatory Mitigation Monitoring

Monitoring the mitigation to measure the development of this desired replacement of habitat function was varied in both approach and design. Monitoring, if performed, generally consisted of underwater surveys conducted by experienced biologists. These surveys typically included location and structural stability documentation and qualitative characterizations of associated marine biota. More complete surveys included quantitative inventories of fish and other motile marine life, as well as colonizing encrusting sessile organisms such as sponges and corals. Monitoring did not, in most cases, include strict performance standards for success measurement or rededication plans in the event of failure.

Twelve completed projects required mitigation monitoring and no information was found in the project files regarding mitigation monitoring requirements for the remaining 4 completed projects. Monitoring reports could be found for only 5 (42 percent) of the 12 projects that required submitted monitoring reports. Two projects, the Miami Harbor Deepening Project and the Fort Pierce Harbor Navigation Improvement Project, did not monitor the artificial reefs constructed for project mitigation. Information regarding submitted monitoring reports was not found for the remaining 5 projects that required monitoring reports. Out of the 5 projects that submitted monitoring reports, 1 project scored 3, and 4 projects scored 4 for their mitigation “success.” Although it was not possible to ascertain mitigation requirements for the Ocean Ridge Beach Renourishment Project, the project submitted a monitoring report that scored 2 for mitigation success. Overall, some form of mitigation monitoring occurred in 6 (46 percent) of the 13 completed projects that implemented mitigation (see Table 11).

Table 11. Percent of projects where monitoring was required and completed.

Projects	Monitoring Required	Monitoring Performed
Completed	75%	46%
Proposed	100%	pending*
Total	85%	46%*

*Some projects still in construction phase.

Mitigation “success” was evaluated for projects where mitigation was implemented; therefore, the percentage of mitigation implemented did not factor in the rating. For example, the Sunny Isles beach projects only implemented 0.33 (less than one acre) of the 3 acres of required mitigation. The success rating for mitigation was not lowered because only a small percentage of the required mitigation was actually implemented. The success rating was based solely on the 0.33 acre of mitigation that was implemented. Four of the 6 (67 percent) projects that implemented some form of mitigation monitoring scored 4 or above on “mitigation success” and were determined to have adequately mitigated for project impacts. Two of the 6 (33 percent) projects scored 3 and were determined to have less than adequately mitigated for project impacts. Monitoring for the 10 proposed projects has been required or is expected to be required.

IV. DISCUSSION

This section addresses the predominant project and permitting impacts and mitigation issues that were identified from the results of this study. The issues are divided into impacts (including alternatives, avoidance and minimization), compensatory mitigation, and monitoring.

A. Impact evaluation for Corps Planning Projects or Regulatory Permits

Baseline Data

The initial evaluation of coral reef resources within a project area is typically done by locating the project area on a benthic map. This is a critical first step in evaluating the potential impacts of a project, and appropriate ways to avoid or minimize these impacts. The NOAA benthic habitat maps serve as a very useful screening tool to determine if a project is likely to impact coral habitat, but not adequate for determining actual project impacts. Detailed benthic maps are critical for large projects likely to impact coral or seagrass habitat. This baseline information can provide the necessary information for addressing avoidance and minimization through project design as well as provide a basis for compensatory mitigation requirements. The techniques selected for characterizing the benthos should include scientifically reproducible methods that can be used to estimate the resource characteristics at the impact site, and the selected compensatory mitigation site. The compensatory mitigation site should also meet criteria to help guarantee success of the compensation (appropriate water quality, substrate characteristics, and physical

environment).

This baseline information has not always been available in the Caribbean. In Florida, this information is often available for review by Federal resource agencies since the Florida Department of Environmental Protection (DEP) requires that the applicant or project sponsor submit the baseline data described above. Baseline data is also included for monitoring and mitigation plans for dredge and fill projects that occur in Florida State Waters, which may have negative impacts to coral reef habitat. However, the quality and level of detail provided is often insufficient to determine the extent of impacts and mitigation success and could be improved by standardization of procedures for pre- and post-project monitoring and compensatory mitigation reporting requirements. Because the baseline information was often not available or missing in the project files, acreage of impacts and compensatory mitigation were determined on aerial photography or by laying the footprint of the project or impact on the benthic map.

Alternatives, Avoidance, and Minimization

As previously discussed, Service mitigation policies, other agency mitigation policies established for the Service (see Appendix C), and the 404 (b)(1) guidelines established in the MOA between the Corps and EPA, were all derived from CEQ determined regulations to address NEPA. The step-wise process of evaluating alternatives to address avoidance and minimization are the first and most critical steps in the process, and should be fully addressed before compensation is considered. Early or pre-application consultation is critical to finding reasonable means of avoiding and minimizing impacts before a great deal of time and money has been spent on the initial project design and planning, precluding the possibility or likelihood of examining less damaging alternatives. For Corps civil works projects, the Fish and Wildlife Coordination Act provides for early and repeated coordination with the Service early in the planning process. The Service's Fish and Wildlife Coordination Act Reports often provide the Corps with a detailed evaluation of the anticipated resource impacts of the various alternatives under consideration, and scientifically valid recommendations to avoid and minimize impacts, as well as possible compensation options for unavoidable impacts. A major difference from the Corps regulatory program process is that there is no outside oversight or appeal process as provided for in the 404 (q) MOAs between the Corps and EPA or other resource agencies.

For the Caribbean, the Service is often consulted by the Puerto Rico Planning Board or the U.S. Virgin Islands Department of Planning and Natural Resources (DPNR) on the potential impacts of proposed projects that have applied for siting permits or Coastal Zone Consistency Certification. The siting permits are often the earliest steps in the process, usually requiring a local Environmental Assessment or Impact Statement with detailed resource information, and providing invaluable opportunities to avoid or minimize impacts. In Florida, the DEP typically requests technical assistance from the Service during the early planning stage, particularly for large-scale projects. These early technical assistance opportunities can save project applicants significant time and money by informing them early on of Service trust resource concerns, allowing them to incorporate these concerns in their

project planning and environmental documentation.

Service involvement in these early stages may be verbal or informal technical assistance over an extended period of time, making it difficult to quantify the amount of project or acreage that was minimized or avoided. Even in the Corps permit process, much of the added value of early involvement or pre-project consultation is simply not recorded or quantified. Therefore, evaluations of resource agencies' recommendations for avoidance and minimization, as well as the measures taken during the Corps' permitting or planning process, were difficult to capture from file reviews in terms of reduced impacts.

Lack of avoidance and/or minimization information in the files does not necessarily indicate that a sequential mitigation process was not followed. It is possible that measures to avoid and minimize impacts were considered but not implemented since they were found to be impractical or there were no reasonable opportunities or alternatives. In addition, projects could have "no avoidance and/or minimization" when impacts are authorized or permitted "after-the-fact," in which case the damage is already done and restoration and/or compensatory mitigation are negotiated as a result of a cease and desist order and subsequent public notice to legalize the unauthorized activity.

It is clear that recommendations for avoidance and minimization have increased over time for both Florida and the Caribbean. For the Caribbean, this is at least partially due to the increased use of detailed benthic maps of the proposed site during the application process to better identify natural resource requirements. The NOAA benthic habitat maps, while not an appropriate scale for individual project impact evaluation, serve as a screening tool for the likelihood that projects lie within a mapped coral habitat unit. Florida has required detailed benthic maps to evaluate projects at least since 1985. Nevertheless, in Florida where beach nourishment projects recur, there is disagreement as to whether the repeated projects cause additional impacts that were not mitigated by the original projects.

Impact Trends over Time

Florida and the Caribbean have experienced some net loss of coral habitat over the selected time period. The overall loss of coral habitat since 1985 for the Caribbean was determined to be 47 acres. Compensatory mitigation was only required for about 46 percent of the 26 projects producing these impacts. The actual acreage of mitigation replacement area could not be determined but was assumed to be 100% for the 5 acres of impacted coral habitat that required and completed transplantation mitigation. From the 16 completed projects, Florida has lost 103 acres for which 48 acres were required (43 acres were actually constructed). Based on the current status for 10 pending projects, an additional 114 acres is expected to be impacted or lost. The initial recommended acreage of mitigation for 5 of the 10 projects is 70 acres. The other 5 projects are still under negotiation. Most of the required mitigation from the completed projects was implemented, but only about 8 acres have been confirmed successful with monitoring reports. Monitoring reports and State or Corps' files, have been requested for further verification.

The comparison of impact trends over time, in both the numbers of projects and acreage of coral habitat impacts, between the two study areas is difficult. For the Caribbean, both the number of projects and the acreage of impacts has decreased over time, but the perception of very high impacts prior to 1995 is largely based on the impacts of one project, the Ponce wastewater treatment plant outfall. Nevertheless, at least some of the decreases in impacts can be attributed to increased attention to avoidance and minimization as well as better baseline information. For Florida, some types of projects, particularly beach renourishment, are repeated on a regular basis, and the port improvements are being driven by increased cargo ship size. Consequently, acreage of impacts for the 10 currently proposed Florida projects is higher than the impacts from the 16 completed projects since 1985.

Impacts by Project Type and Activity

Harbor and port development and/or improvements were among the more frequent project types noted in both the Caribbean and Florida and are responsible for a large number of impacts in the earlier projects. Additionally, harbor and port improvements are found to cause the greatest coral reef impacts for the more recent Caribbean projects (1995-2003) and the proposed projects in Florida. Impacts to coral habitat from these projects are mostly in the outer channels and include dredging, filling (often from side-casting), and sedimentation (turbidity is included under this overall impact). The recent interest in port improvements to accommodate ever larger cargo and passenger ships exceeding the dimensions for the Panama canal, referred to as Post- or Superpost-Panamax vessels in the shipping trade, is expected to cause severe impacts. It is important to understand or address the implication of these projects on a more regional basis, examining project purpose and need more thoroughly before improving every port to these specifications. In Puerto Rico, port improvements to two bays were reduced to one site, greatly reducing seagrass bed impacts.

Sand placement on Florida's eroding beaches occurs through shoreline protection projects, inlet sand bypassing, and the beneficial use of dredged material during channel maintenance projects. These projects are collectively referred to as beach nourishment and occur at regular intervals, some projects as frequently as annually. These activities are much more common, both federally partnered and federally regulated, in Florida than in the Caribbean. The cumulative impacts of repeated burial of nearshore habitats and the elevated sedimentation and turbidity resulting from beach fill and off-shore dredging are not well understood. Until recently, the extent of nearshore reefs in south Florida was virtually unknown. The Florida DEP (1997) coordinated an effort to consolidate the known information and to map solid substrate on the northeast and east-central coast of Florida. This effort has resulted in the first reef atlas for that area.

With the absence of historical data, the health of Florida's reef system is uncertain. Lindeman (1997) estimates that in southeast Florida alone, approximately 48 million cubic yards of offshore sediment have been deposited in the nearshore area in the last 36 years. Unknown acreage of nearshore reef habitat has been buried by this practice and many more acres may have been degraded by chronic long-term turbidity and sedimentation increases. At least 80 million cubic yards are proposed to be deposited on the beaches of southeast Florida in the next 50 years based on nourishment intervals (U.S. Army Corps of Engineers

1996, Lindeman 1997).

Persistent long-term turbidity caused by beach nourishment projects may have profound biological consequences which are, as yet, unknown. Increased turbidity reduces light penetration which is critical to corals and algae that already may be stressed from sedimentation and turbid conditions. Under these conditions, chronic turbidity can be expected to stress organisms, reduce growth, and, in extreme conditions, may cause death. Telesnicki and Goldberg (1995) have demonstrated that adverse effects can take place in hard corals even with turbidity levels below the State threshold. Dodge and Vaisnys (1977) and Bak (1978) have also demonstrated adverse effects in corals. Similar effects may occur in related species.

Chronic turbidity from resuspension of fine sediments from the beach and near the borrow site may result in sub-lethal effects, such as reduced feeding or reproduction, producing long-term consequences for species survival. Increased turbidity from resuspension of sediments may continue for years after dredging has stopped (Levin, 1970; Courtenay *et al.*, 1975; Dodge and Vaisnys, 1977). In one instance, project-induced turbidity was reported to persist for as many as 7 years (Courtenay *et al.*, 1980). While the State of Florida's DEP requires that turbidity levels remain below 29 Nephelometric Turbidity Units (NTU) above background during dredging and filling for beach construction, the effects of this level of turbidity on reef communities have been poorly studied.

In addition to the effects of turbidity, deposition of suspended sediments may also occur when the sediments which cause turbidity fall out of the water column. Griffin (1974) has recommended that the rate of sediment deposition from dredging operations not exceed 200 mg/cm²/day during any 7 day period; otherwise stress to reef building coral could result. One-fourth of the coral species tested by Rogers (1983) were damaged when exposed to this deposition rate for 38 days. These sediments may also decrease populations of fish and echinoderms (Brock *et al.*, 1965, 1966), inhibit feeding of shellfish (Brehmer 1965), harm fish eggs (Wickett 1959), reduce photosynthetic production in plants, and trap phytoplankton carrying them to the bottom (Bartsch 1960).

Once the locations of nearshore and midshelf reefs areas are known, and the project is designed to minimize burial and degradation due to turbidity and sedimentation, quantitative biological surveys of the epifauna and motile component of the projected impact area should be conducted to determine the population densities of key species prior to impact. As mitigation, an artificial reef should be designed to maximize habitat values for those species, with a clear defined purpose, specific design, and construction materials. The approach to artificial reef construction using scrap and discarded rubble (McGurrin *et al.*, 1989) may be inadequate to provide suitable habitat for targeted species.

The primary direct threat to the health of Florida's nearshore reef system is the deposition of beach fill (U.S. Fish and Wildlife Service, 1999). Rock outcrops within the beach fill areas are buried, the epifaunal organisms associated with those outcrops are smothered, and the habitat which the reef provides to motile fishes and invertebrates is lost. The zone of direct

burial increases in time as the fill material relaxes or is washed seaward by wave action and is transported to adjacent areas by littoral drift. Impacts often extend beyond the fill zone when the fill material contains high amounts of silt and clay. Suspended fine material not only reduces light penetration but eventually settles to the bottom, potentially degrading reef areas seaward of the direct impact site. Midshelf reefs can similarly be affected by turbidity and sedimentation when the borrow site contains fine material. Midshelf reefs may also be damaged by direct contact with the dredge and dredge-related equipment.

Monitoring around proposed impact zones is an important consideration for determining actual final mitigation needs. More importantly, problems can be discovered and actions taken to avoid these secondary impacts and any ensuing mitigation. With regard to turbidity monitoring during and after dredging projects, we question the use of NTU's as a standard in areas of coral colonization. To our knowledge, this standard was not developed adequately to protect corals and sensitive marine resources. The use of NTU as a measure of the sediment loads being placed on adjacent reef systems from dredging operations has not been validated. Based on a study in Broward County, Florida, Telesnicki and Goldberg (1995) concluded that adherence to Florida's standard of 29 NTU above background may result in short-term stress and long-term decline in some coral species (i.e., *Dichocoenia stokesii* and *Meandrina meandrites*). Based on this research, a value less than 15 NTU is a more appropriate threshold, if it is to be used, in southeast Florida. In recent projects, such as the Broward County Beach Nourishment Project, sedimentation monitoring is becoming increasingly important to evaluating impacts and triggering re dedication (including dredge cessation or movement). Using a 1.5 mm average daily depth sedimentation threshold based on experiments by S.E. Kolemäinen (1978), a monitoring program has been designed to measure the amount and duration of sedimentation on reef habitat and includes observation of biological stress indicators from silt accumulation. Histological coral tissue analysis will be conducted concurrently by Nova Southeastern University to provide a mechanism to judge the effectiveness of this process. (Dodge, personal communication, 2003.)

In Florida, the DEP and southeast Florida coastal county environmental departments have programs which are active in the regulation and planning of projects affecting marine resources. Corps' civil works projects, for which a Federal permit is not needed, must go through the DEP's environmental permitting process, which involves rigorous review of impacts and compensation. Non-civil works projects are subject to this process, also, as well as Corps regulation. For all projects, the aforementioned counties are actively involved in project and mitigation planning, implementation, and in-water monitoring. Mitigation and monitoring are typically the responsibility of the counties, as local sponsors in Federal projects. Additionally, in the Florida Keys, the Florida Keys National Marine Sanctuary staff is well apprised of projects and issues involving the Keys reef systems, and has authority to affect project activities.

The placement of utility lines was the most common project type observed in the Caribbean. Because of differences in deployment and resulting impacts, these projects were divided into pipelines (potable water supply or wastewater outfall pipes) and power or communication cables. Pipelines, particularly wastewater outfall lines that are gravity flow and must follow

a decreasing elevation gradient, are often trenched through high relief areas, reefs in this case. Pipeline projects, both treated wastewater outfalls and water mains, were responsible for major impacts to coral habitat in the Caribbean. The Ponce wastewater treatment was estimated by the applicant to cause major impacts, particularly to the shelf edge reef, although neither the impact area nor the minimization of these impacts has been verified in the field. Similar trenches through reefs are visible on Florida LIDAR imagery maps of the bottom off the Florida coast. These projects, however, were constructed prior to 1985 and not included in this study. The Vieques-Culebra water pipeline in Puerto Rico was permitted to avoid coral reef impacts but the project did not follow the selected alignment resulting in coral reef impacts at both the Vieques and Culebra landfalls.

Linear communication or power cable projects usually have a small impact footprint, as they are laid on the bottom without dredging. Minimization is usually achieved by designating a lower coral density corridor, and requiring either diver directed deployment or cable adjustment around corals immediately following deployment. Both Florida and the Caribbean have been improving protocols for cable placement. For Florida, it is possible that not all linear communication or power cables were addressed under Corps permitting as some submerged power, gas, or oil lines have been managed by the Federal Energy Regulatory Commission.

Private docks and attendant structures were not included in the Florida review because of the enormous numbers of these and difficulty in determining which might have been responsible for coral habitat impacts. In the Caribbean, small docks and associated structures were responsible for impacts to very shallow fringing reef in the U.S. Virgin Islands. Most of these involved access for personnel and construction supplies to small offshore islands. The largest impacts resulted from not having appropriate landing facilities for barges bringing construction materials and equipment to these islands (Inner Brass Key and Lovango Cay). In these cases, the major damage was caused by barge grounding and prop wash, activities not regulated by the Corps (See Figure 5 Lovango Cay). This illustrates the importance of including all port elements in Corps permit applications for the development of offshore cays.

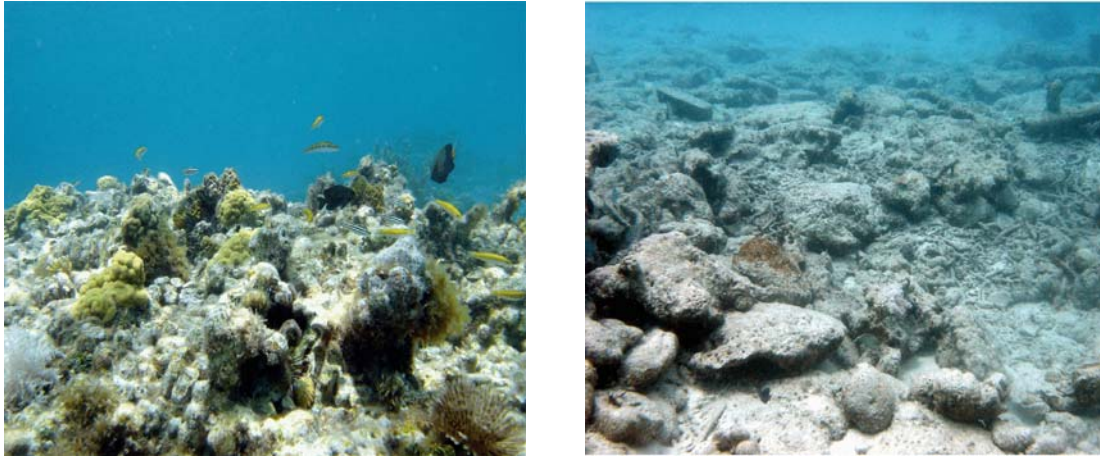


Figure 5. Lovango Cay undisturbed reef (left) and barge scour impacted reef (right).

In addition to aerial impact analysis, the compensatory mitigation procedures used by the Agencies does not address the loss of habitat and habitat function over time. When a habitat is impacted there is a lag time in the functional replacement of that habitat even if fully compensated by restoration or relocation. This lag time in recovery represents a temporal loss of the use of the coral habitat by dependent and temporarily eliminates reproductive members of the coral community from contribution to the larger coral populations through reproduction. This may be particularly critical for slow growing organism such as most corals and coral ecosystems.

B. Trends in Compensatory Mitigation

Recommendations, Requirements, and Compliance.

The percentage of projects impacting coral habitat where mitigation was recommended by resource agencies, required by the Corps, and completed (or in progress) has greatly improved over time for the Caribbean. The increased number of recommendations is due, in part, to improved baseline information for the sites, as well as stronger resource agency focus on coral habitat impacts. Likewise, the increase in required mitigation is the result of an increased willingness and efficiency of the Corps' Antilles Regulatory Office to fully address coral and wetland habitat impacts. Florida agencies recommended, required, and conducted mitigation for a high percentage of the completed projects. The low percentages for proposed projects may be partially due to these projects still being in the permitting or civil works planning processes. In the case of some Federal projects, the low mitigation percentage, such as the Port of Miami expansion, is a result of reoccurring impacts in an area that was not mitigated for the original coral reef losses.

This study shows that the increased focus toward addressing and mitigating for unavoidable coral habitat impacts was occurring prior to the Executive Order and other legislation specifically addressing coral reefs, but these laws and the creation of a Coral Reef Initiative and Task Force have provided additional impetus to the protection of coral habitat. The

Service considers coral habitat to be Resource Category II under the Service Mitigation Policy (Appendix C). Both the Service and NMFS consider coral habitat to be Aquatic Resources of National Importance. The Corps considers coral reefs as Special Aquatic Sites under their regulations as cited in 40 CFR 230.3(q-1). NMFS includes coral habitat as Essential Fish Habitat under the Magnuson-Stevens Fishery Conservation and Management Act. In short, the willingness and attention to addressing coral reef impacts have improved for national and local resource agencies and the Corps, but given the resource value, it merits increased attention.

Caribbean Mitigation Summary

Caribbean efforts at coral habitat mitigation have, with the exception of one artificial reef project, consisted entirely of coral transplants. The survival rates of these transplants has been very high (80 to 90% in most cases, but the efficacy of this technique in replacing lost area of coral habitat is questionable. These mitigation projects achieved a high ranking for this report based on the high survival rates and compliance with the mitigation and monitoring plan, however, there is still a net loss of coral (hard surface) habitat. Although these transplants could be viewed as “enhancement” of existing coral habitat at the recipient site, they may also replace other attached coral habitat biota. Other habitat forming biota (sponges, tunicates, soft corals) may not have been included in the transplant efforts, although effort was made to include these in the U.S. Virgin Islands transplants. Further, the actual area of impact was not always quantified, rather it was estimated for this report based on the project area and what is known about the area’s density of coral habitat. The compensatory mitigation is not quantified in a way that can be directly compared to the total hardbottom or reef impact area. There has also been no effort to account for temporal loss of reef (lag time in compensation area development).

Florida Mitigation Summary

Florida has, for some time, concentrated coral reef mitigation efforts on the placement of large areas of artificial reef structures consisting of limestone rock placed to simulate the lost habitat characterized as either high or low relief (see Figure 6, artificial reef module deployment). Over time, recommendations for materials appropriate for artificial reefs have evolved. The Service, NOAA Fisheries, and the Florida resource agencies no longer accept most construction debris or ordinary cement as appropriate for artificial reefs. Florida has also been utilizing a modification of procedures used by NOAA to assess impacts from oil spills or groundings that includes a lag time for natural recovery of impacted habitat. This is used to determine the ratio of the impact area to the artificial substrate area to be included in the mitigation. Transplantation of corals from the impact site was often a secondary mitigation requirement seen as an impact minimization rather than compensation, and survival information was not reported.



Figure 6. Artificial reef modules and deployment. Left showing colonized module, and right showing an aerial photo of a more recently deployed limestone rock compensation reef.

Caribbean, Florida, and the Pacific Mitigation

The island areas (e.g.; the Caribbean and Pacific) have a high percentage of mitigation projects that transplant corals from the project impact area to another coral habitat recipient site, while Florida efforts have concentrated on some ratio of acreage for acreage replacement using artificial or natural (limestone rock) substrate. This option may be quite limited for island areas where the choice of materials is more limited. Even where limestone rock is available (e.g.; Puerto Rican karst), the valuable upland habitat destruction that could result from mining this material would preclude its use. The same is likely to be true of the Pacific islands. Artificial reef modules have been used for one compensatory mitigation project in Puerto Rico, and reef ball modules are being heavily promoted in the Caribbean for reef improvements.

Florida has developed techniques and considerations for the placement of artificial reefs that can serve as a guide to the Caribbean and Pacific regions. Further, they have procedures for determining mitigation ratios that might also prove useful. Considerations for placement of artificial reefs include finding sites of suitable depth and wave energy level that lack existing coral or seagrass habitat, and that are underlain by hard substrate that will support the structures.

Both the Pacific and Caribbean areas have lacked mitigation types and methodology appropriate for comparing impacts with the compensatory mitigation. The monitoring reports on some of the U.S. Virgin Islands transplant projects indicate that large pieces of rock, as well as live corals, were generally moved to the recipient site and attributed with high survival rates. However, the area of material moved was not quantified. Given the high rates of survival for transplanted corals in the Caribbean mitigation projects, Florida could benefit from increased attention to coral transplantation, preferably onto some of the artificial reef structures, to speed up the reef development process. Transplantation to reef modules has proved highly successful in some experimental artificial reef structures in Puerto Rico (not placed for mitigation).

Other potential reef mitigation projects might include creation of staghorn or finger coral thickets, and low-impact mooring buoy installations and maintenance. The relatively fast growing branching corals have proved amenable to reef restoration through the creation of new thickets or patch reefs. Successful techniques for the creation of staghorn (*Acropora cervicornis*) or finger coral (*Porites* spp.) beds are currently in use in the Caribbean for reef restoration projects not associated with mitigation (Figure 7, *Acropora* thicket creation). This technique might be particularly desirable in areas like the U.S. Virgin Islands where staghorn coral populations have seriously declined, and could potentially be adapted for a number of Pacific branching corals. Other possible mitigation options include the placement of low impact (Halas-type) mooring buoys on heavily visited reef sites to reduce the anchoring impacts of recreational boaters and divers. Arrays of these have been used in Florida and are also being placed in the Caribbean, and they require maintenance. The “restoration” area of these can be calculated using a reasonable radius from the buoy as a measure.

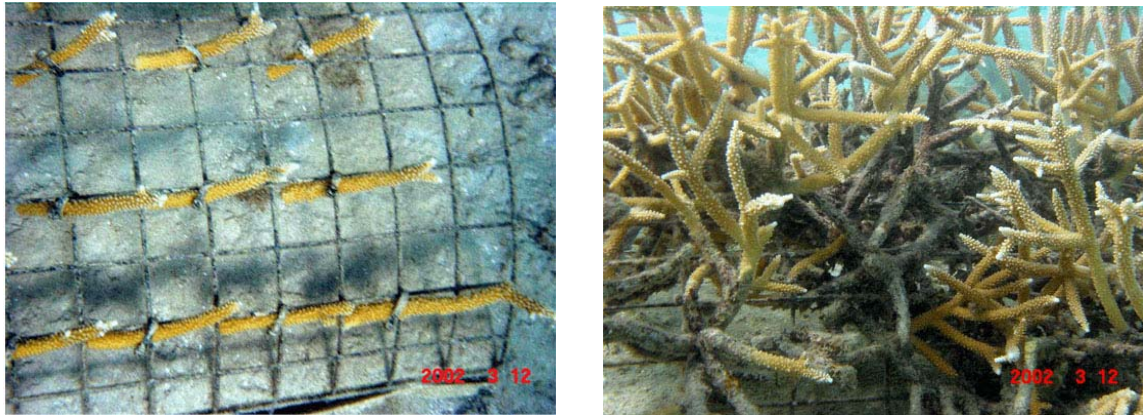


Figure 7. *Acropora cervicornis* thicket creation at 2 months (left) and 2 years (right).

The Pacific region (Bentivoglio, 2003) has included the creation of Marine Protected Areas (MPAs) as mitigation, with mixed success. Similar to wetland impacts, this may be viewed by some as the less desirable “preservation” option under normal wetland mitigation procedures. However, it may be viewed as the more highly desirable “restoration” if it can be managed to result in the reduction of known impacts by being designated as an MPA. Unfortunately, this option may only be available for state, commonwealth, or territorial government projects where the authority to designate the area lies with the project proponent. Procedures for the designation of these MPAs require public hearings and may be controversial due to the restrictions placed on certain uses. Based on the experiences in the Pacific with designating and managing these areas, acceptance of this option should be contingent upon the completion of the designation and a management plan with dedicated resources prior to the project construction.

Effort should be made to match the mitigation to the kind of impact (temporary, permanent, small area, large area, etc.) and the impacted coral habitat type (high relief, low relief,

inshore, offshore, etc.). Mitigating small impacts within sparse patch reef areas by transplanting corals and rocks out of the impact area to nearby unoccupied area may be appropriate. Mitigation using low impact mooring buoys to reduce anchor impacts might be very appropriate for mitigating relatively short-term impacts from cable deployment. Neither of these mitigation methods should be considered appropriate or adequate for mitigating permanent dredging impacts to high relief, coral reef. Decisions on whether compensatory mitigations were “in-kind” for this report were liberal. Interpretation of “on-site” vs. “off-site” compensation was also liberal to include different interpretations in the two areas. The decision to use very close “on-site” compensation must also be balanced with the expected future conditions and impacts in the project area. More stringent efforts to match coral habitat loss to the compensation type should be a goal of resource and regulatory agencies.

C. Monitoring

Trends in Requirements and Compliance for Mitigation Monitoring

The requirements for monitoring as well as submission of monitoring reports have improved over time, but the information is often not readily accessible or included in project files. The older projects in the Caribbean supplied very sparse and general information on the habitat(s) within the project area, and post-construction follow-up information to determine the actual mitigation compliance. In recognition of this, the Antilles Regulatory Office is requiring as-built verifications from project proponents. Florida has a history of providing detailed information on the impact site. Corps' civil works projects generally include this along with benthic maps dividing the area into different habitat types. (See Figure 8, benthic map of Dade County, Florida.) However, there is need for consistent and detailed information on the project impact site as a baseline for the mitigation requirements, compliance, and success.

In evaluating and monitoring impacts and mitigation for coral habitat, it would be beneficial to use survey techniques that could be applied to both before-project and after-project conditions that are reproducible and relatively fast evaluation methods. Coral habitats are diverse, patchy, and naturally variable making consistent reef observations difficult. There is guidance on coral reef monitoring techniques (Rogers *et al.*, 1994, 2001) in English and Spanish. Important survey information would include:

1. Clear benthic maps that characterize the habitat(s) to be impacted, preferably broken down by habitat type and quantified by area.
2. A species list, including hard and soft corals, anemones, sponges, algae and other major sessile organisms that includes some measure of abundance by species or group (sponges, etc).
3. A measure of live coral cover and other sessile organism cover (sponges in particular). Usually this is reported as a percentage cover of the overall area.
4. Some measure of colony density and size distribution (size frequency, median and range of colony diameters, etc.) to help determine reef age and disturbance.
5. A measure of reef rugosity to give information on reef complexity.
6. Fish surveys using standard, repeatable methods.

7. Measures of critical water quality and site parameters within short spatial ranges, including turbidity.

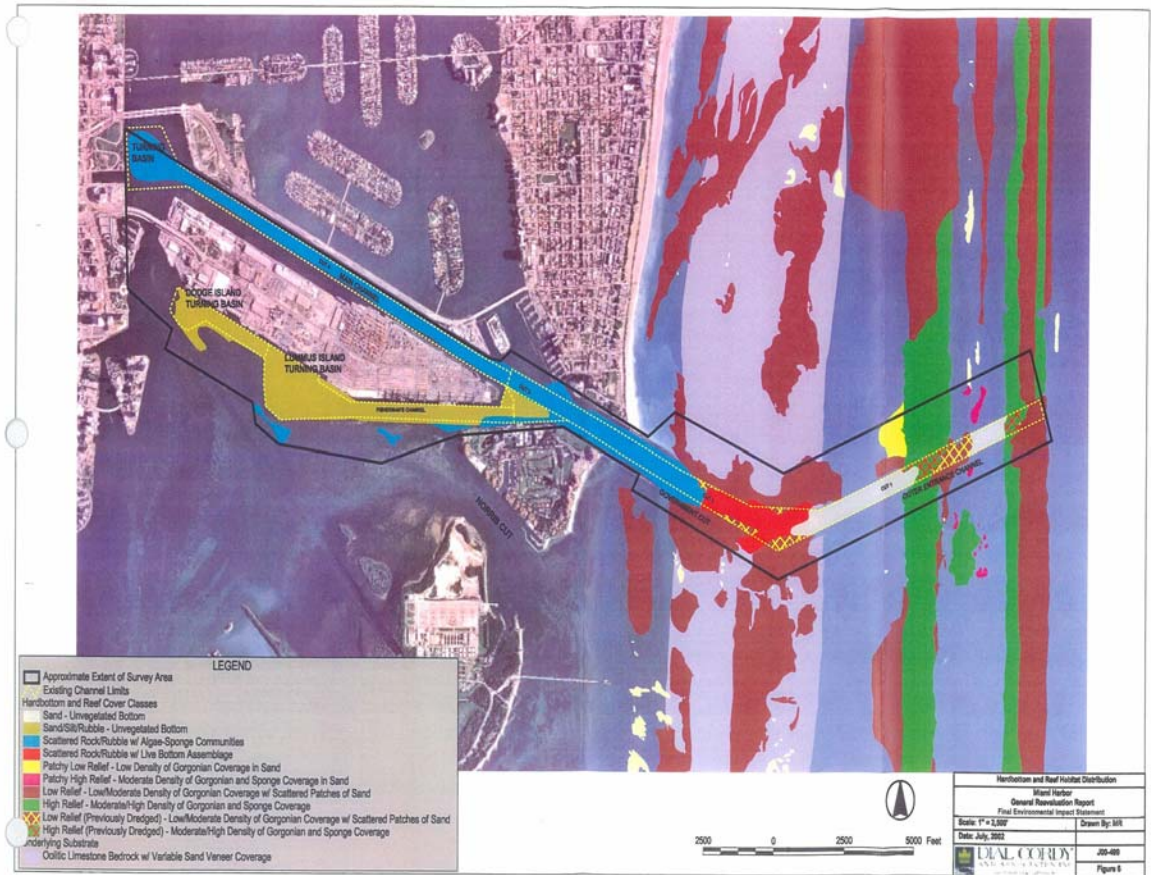


Figure 8. Benthic map of Dade County, Miami Port project planning.

In addition, Florida has the longest history of placing artificial reef structures as compensatory mitigation reefs, fish attracting reefs, and dive sites. Some of these artificial reefs have almost two decades of development. Monitoring, however, typically stops after five years. The variety of types of structures used coupled with the long term development of these artificial reefs provides a unique opportunity to assess their ability to develop into coral habitat. Such a study could provide valuable long-term information for the restoration and mitigation of coral impacts.

Pre-project Site Visit and Monitoring of Project Construction

It is important to emphasize that the results of this study were based on file reviews, not site inspections. Pre-project site visits and monitoring during the project construction usually improve compliance with avoidance and minimization measures as conditioned in the permit or project plans. In Florida, emphasis on the pre-project environmental monitoring,

including multi-agency meetings and project site visits, ensure that the extent of the impacts to fish and wildlife resources are accurately determined prior to construction. The ability to participate in such site visits allows for a better understanding of site specific conditions and more valuable specific mitigation recommendations. However, the Service rarely participates in monitoring visits during construction or post-construction because of workload concerns.

For coral habitat projects, the ability to determine if the permit conditions are followed or the mitigation measures fully implemented are hampered because the projects are sub-tidal, usually require SCUBA, and require considerable effort to visit. In addition, none of the Corps' project managers in the Antilles office are authorized to conduct underwater inspections (even for shallow water skin-diving). Florida similarly has few personnel in their Regulatory Division authorized for underwater inspections. Both Service and NOAA Fisheries can still conduct site inspections using skin-diving gear, but few are authorized by their agencies to utilize SCUBA. The cost of maintaining agency personnel with appropriate biological expertise authorized for diving (under the safety constraints of their agencies) has greatly increased. Compliance with permit conditions in the Caribbean relies almost entirely on the integrity of the applicant and/or the consultant, or diver and recreational groups. Project construction monitoring is many times done only when there is a third party or resource agency complaint. Follow-up by the Corps on notices of non-compliance and cease and desist orders has sometimes been lacking.

Intra- and Inter-agency Information Sharing

Based on experience with wetland as well as coral habitat permit actions, there is a definite need to share more information on the issued permits, particularly those with special conditions, mitigation, or monitoring plans, as well as the subsequent monitoring reports. The option of electronic transmission of the permit, and possibly monitoring report information, is now available to alleviate part of this problem and should be used more. The Corps' Civil Works Planning process provides opportunity for Service comments through Planning Aid and Coordination Act Reports, however, earlier coordination is key to impact minimization, and resource recommendations are not mandatory. The expense of recommended minimization and compensatory mitigation is often the major or only substantive objection given for not following Service mitigation recommendations.

The establishment of local working groups could help determine protocol for how to manage information. Tracking the progress, completion, and mitigation monitoring of projects could be accomplished through periodic working group meetings. This could offer the opportunity to create a central repository of information on projects and mitigation results to improve future mitigation projects and provide better public service.

On a larger scale, sharing information between the various Service and NOAA Fisheries offices that deal with coral habitat issues would be invaluable to improving monitoring and mitigation efforts, as well as evaluating new mitigation options. This would encourage consistency between agencies and geographic regions for the management of our coral reef

trust resources. An intra or inter agency interactive website focusing on coral habitat management and specific “on-the-ground” techniques would enhance this effort. In addition, it is clear that the development of these reports, in both the Pacific and the Atlantic, has resulted in the first productive exchange of information on coral reef mitigation issues between the Service offices in both regions working on these issues.

V. RECOMMENDATIONS

While the existing approach by Federal agencies to adequately address marine construction impacts and mitigation for unavoidable losses to coral reef habitat in the Caribbean and Florida has improved over time, the process could be considerably improved. The Service recommends the establishment of Local Interagency Teams comprised of Federal and State resource and regulatory agencies to develop better strategies to address coral habitat impacts, and provide mutually agreeable protocols regarding avoidance, minimization, appropriate compensation, monitoring, mitigation performance measures and success criteria. A similar approach is already in progress in Hawaii. The intent is to foster uniform data collection and reporting methods that are scientifically valid, but are general enough to accommodate project-specific needs and site-specific variations.

At a higher level, consideration should be given to examining the existing laws, regulations, and interagency memorandums of agreement with respect to their adequacy in addressing coral reef resources. As an example, for marine construction projects, dredging is one of the major impacting activities, but does not usually receive the same consideration for impacts as the placement of fill. Likewise, secondary or indirect impacts such as shading or turbidity may be very high for coral reefs, but are often not addressed thoroughly.

The following specific recommendations would provide some groundwork for greatly improving the mitigation process. Implementing these recommendations would require specific, targeted funding.

1. Databases to track the full mitigation process for projects affecting coral reefs should be developed. Improved documentation of whether project alternatives, avoidance and minimization have been thoroughly examined prior to considering compensation is needed. In addition to documenting the mitigation process, the database should serve as a repository for project baseline information and monitoring reports for the projects.
2. Assessment methods need to be developed to relate unavoidable project impacts to compensation. This could be in the format of a functional assessment, but should be grounded in scientifically valid and repeatable measurements that can be applied to the impact and compensation sites. Developing appropriate assessment methods is the key to developing appropriate performance standards for compensatory mitigation.
3. Monitoring reports and other studies should be provided to the resource agencies. These are not currently being provided on a regular basis. This information is not only crucial to evaluating the success of a particular compensation project, but is one of the best means of

improving resource agency recommendations for new or existing compensation options.

4. New strategies should be developed for restoration and compensation work for coral reef impacts. Compensating for impacts to these sensitive marine resources has often proved very costly and provided questionable results. Strategies might include measures that are highly dependent upon local policies and project proponents such as Marine Protected Areas, protected shorelines or uplands, and low-impact mooring buoys. Working with local stakeholders to develop compensation options appropriate for the area is critical.

5. The impacts of repetitious construction activities (maintenance dredging, beach nourishment, pipeline replacement) should be evaluated with respect to the direct and indirect impacts, and reasonable and appropriate measures to compensate for these impacts should be developed.

6. The long-term results of some of the existing compensatory mitigations for reef impacts should be evaluated. Both Atlantic coral reef areas and the Pacific have a history of different types of compensation projects, yet there is no long-term evaluation of the results of these efforts. Typically monitoring does not extend beyond five years. The variety of artificial reef structures placed in Florida waters over the years (for fish habitat or as reef impact compensation) offers a unique opportunity to gather long-term information on the success of these structures in recruiting corals and related biota, and replacing natural coral reef functions. Likewise, transplantation has been used extensively in the Pacific and the Caribbean, and longer term information on the survival and growth of these transplants would be invaluable in evaluating their success.

7. A mechanism should be developed for continued exchange of information for federal and local agencies dealing with coral reef impacts and mitigation. This report resulted in the first such exchange of information between Service field offices commenting on coral reef resource impacts, and opened communication between the Service, sister Federal agencies, and local agencies. Sharing information on the successes and failures would streamline the process, and widen the options available for addressing the impacts.

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APPENDIX A.

Scope of Study and Project Worksheet

Scope of Study

- A. Agencies: Service, Corps Planning and Regulatory, NOAA Fisheries, EPA
 - 1. Florida – State agencies and the coastal counties also
 - 2. Caribbean-some information in CZM Commonwealth or Territorial agencies
- B. Geographic
 - 1. Florida: Atlantic coastline from Indian River County through Florida Keys
 - 2. Puerto Rico (including Mona, Culebra, Vieques & small offshore cays), U.S. Virgin Islands (including smaller islands & cays)
- C. File Searches
 - 1. Service
 - 2. NOAA Fisheries
 - 3. EPA
 - 4. Corps
 - 5. Coast Guard (bridges)
 - 6. State & County Offices
- D. Types of Actions:
 - 1. Corps Public Notices
 - 2. Corps Planning Projects
 - 3. Corps Enforcement Actions
 - 4. NPDES (limited to large marine discharge)
- E. Types of projects: Marine/Estuarine
 - 1. Submarine utility pipelines, communications and power cables
 - 2. Beach nourishment
 - 3. Shoreline protection (breakwaters, groins)
 - 4. Harbor & port development, dredging & filling (public works)
 - 5. Basin & channel dredging (private)
 - 6. Airport development or expansion
 - 7. Private docks & other structures within coastal waters
 - 8. Bridges & Causeways
 - 9. Artificial Reefs
 - 10. Moorings
 - 11. Ship groundings
 - 12. Public piers
 - 13. Private piers
 - 14. Marinas
- F. Habitats: coral reefs & associated habitats (where there is a direct association with coral reefs or coral colonized hardgrounds)
 - 1. Colonized hardgrounds (all)
 - 2. The following will not be quantified:
 - a. *Mangroves (within 200 meters of coral reef)*
 - b. *Seagrass beds (interspersed with reef or within 200 meters)*
 - c. *Salt marshes, salt ponds, salt flats (within 200 meters of coral reefs)*
- G. Date to research: 1985 – present

Project Worksheet

Project Permit Number
Project Name
State/Commonwealth/Territory
Type of Activity
Project or permit Authority (Sect. 10, Sect. 404, NPDES, WRDA, unauthorized)
Date of Initial Project Planning
Date of Public Notice (if any)
Date Permit was Issued
Project Footprint in Acres
Date Project was Finished
Area of coral habitat impacted
 Acres Dredged
 Acres Filled
 Acres Sedimented
 Acres Otherwise impacted (collateral damage, etc)
NEPA alternatives analysis? (yes/no)
Impacts avoided/minimized, if yes, quantify if possible
Compensatory mitigation recommended
Mitigation Required
Mitigation Done
Location of Mitigation relative to impact (On-site, Off-site)
Type of Mitigation (In kind/out of kind), elaborate:
Transplant (number of colonies, average size)
Fish Aggregation Devices (Type, Area)
Artificial Reef Created (Material used, Area)
Reef Enhancement/Restoration (Type)
Preservation: Marine Protected Area Created:
 If yes, quantify reduction of impacts acres from original proposal
 Acres of Water
 Acres of Land (if terrestrial areas associated with MPA)
Other (i.e. seagrass, mangrove, other habitat type)
Monitoring Plan Required (yes/no), if yes answer the following:
Monitoring Plan Used (yes/no)
Monitoring Reports submitted (yes/no)
Monitoring Plan results (rating from 0-5 based on achievement of criteria established in
 the mitigation plan, if present)
 0-no documented effort
 1-documented effort with no success
 2-documented effort, minor success
 3-documented effort, appreciable success
 4-documented effort. success at least 2/3 of criteria
 5-documented effort, full success or exceeded expectations
Comments:

APPENDIX B.

Project Information Tables

Tables A-1 through A-3 Florida

Tables B-1 through B-3 Caribbean

Table A-1: Coral-colonized hardbottom reef impacts associated with projects in southeast Florida completed between 1985 and 2004.

Project Type, name, Corps #.	Project Information			Direct Impacts			< or > 5% Coral Coverage	Comments
	County	Year	Project Length (miles)	Dredge/ Fill (acres)	Pipeline (acres)	Mechanical (acres)		
Beach Renourishment								
Indian River County Sect 1&2 (200091872)	Indian River	2003	2.5	3.8	N/A	N/A	<	Mitigation reef constructed in 2004. Approximately 6.7 acres of hardbottom reef located up to 1.7 miles downdrift may be indirectly affected by turbidity.
Fort Pierce Shore Protection (Federal Project)	St. Lucie	1999	1.3	7.9	N/A	N/A	<	Renourishment on-going
Martin County Renourishment (199501665)	Martin	2002	4.0	1.4	N/A	N/A	<	Full project length constructed in 1996; partial in 2002 with renourishment on-going.
Jupiter/Carlin Park Shore Protection (199900902)	Palm Beach	2002	1.1	8.0	N/A	N/A	<	Post-project mitigation constructed 1998-2000. Mitigation ratio 0.5:1 as some impacts was unrelated to renourishment. Most of concrete reef settled and no longer visible.
Jupiter Inlet Sand Bypassing (Jupiter Inlet Tax District)	Palm Beach	1995	0.2	4.0	N/A	N/A	<	1.16 acres of limestone reef constructed at Tequesta in 2003/2004 to compensate for inlet sand bypassing impacts
Juno Beach Shore Protection (199706559)	Palm Beach	2000	2.4	3.77	N/A	N/A	<	Limestone and geogrid successful. Concrete "reef" settled. Additional 2.25 acres limestone reef constructed in 2003/2004.
Ocean Ridge Shore Protection (199301576)	Palm Beach	1998	1.42	6.4	N/A	2.9	<	Overall mitigation ratio 0.7:1 required. Mitigation constructed 3-4 years pre-construction. Over 3 acres of reef completely settled. Expected that 2 acres will be re-exposed as sand bar migrates.
North Boca Raton Shore Protection	Palm Beach	1997	1.45	4.0	N/A	+3.0	<	First mitigation plan for a State of Florida renourishment project. Masters thesis investigated mitigation reef success. Eight limestone modules and a concrete/limestone module were constructed as compensation.
South Boca Raton Shore Protection (199401196)	Palm Beach	2002	0.95	2.38	N/A	N/A	<	Mitigation reef constructed in 2003
Beach Renourishment (continued)								
Bal Harbor	Miami-	2003	0.9	0	24.7	0.05	>	Impacts to reefs adjacent to borrow source occurred in 1990. Modules and boulders

Project Type, name, Corps #.	Project Information			Direct Impacts			< or > 5% Coral Coverage	Comments
	County	Year	Project Length (miles)	Dredge/ Fill (acres)	Pipeline (acres)	Mechanical (acres)		
BEC&HP (Federal Project)	Dade				pipeline rupture			placed off-site. Limestone boulders placed in multi-layer formation. Monitoring on-going since 1990.
Sunny Isles BEC&HP (Federal Project)	Miami-Dade	2001	2.5	0	0.03 pipeline leak	3.1	>	Mechanical impacts as a result of dredge cutterhead and damage during pipeline placement.
63 rd Street BEC&HP (Federal Project)	Miami-Dade	2002	0.53	0	N/A	0.08	>	Mitigation to be constructed as part of the Sunny Isles Design modification project (DEP permit 012852-002-JC 11/2000). Mechanical damage occurred during dredge pipeline placement.
Surfside and Miami Beach BEC&HP (Federal Project)	Miami-Dade	1999	1.3	0	N/A	0.07	>	Mitigation for pipeline damage
TOTAL				41.65	24.73	9.2		
Navigation Improvements								
Fort Pierce Harbor Deepening	St. Lucie	1995	N/A	8.1 (Fill) 14.0 dredge	N/A	N/A	<	8.1 acres of nearshore reef filled when dredged material placed on beach. No mitigation for the nearshore reef loss. The placement of concrete rubble in a borrow pit south of inlet did not constitute in-kind replacement of the limestone ledges of the previous channel.
Hillsboro Inlet Navigation Improvement (199301995)	Broward	2002	N/A	0.85	N/A	N/A	>	none
Miami Harbor Deepening	Miami-Dade	1993	5.5	N/A	N/A	4.92 (anchor)	>	Reef impacts associated with dredge anchor cables were not anticipated during initial consultation. Mitigation constructed after the fact.
TOTAL				22.95	N/A	4.92		
Combined (Beach/Navigation) Totals				64.6	24.73	14.12		
Total Impacts			103.45					

BEC&HP- Beach Erosion Control and Hurricane Protection TBD= information to be determined N/A= information not available or unknown.
N/A= information not available or unknown.

Table A-2: Summary of compensatory mitigation for completed projects in southeast Florida between 1985 and 2004.

Project Type Name Corps' #	Florida County	Mitigation											Monitoring	
		Avoid & Minimize	Reduced Impacts(acres)	Recommend Acres	Required Acres	Constructed Acres	Location	Type (in/out of kind)	Coral Colonies Transplant (number)	Material & Acreage	Deployed (acres)	Acres Exposed	Report Submitted	Effectiveness Scale
													Yes	No
Beach Renourishment														
Indian River County, Sec 1&2 (200091872)	Indian River	Yes	7.2	10.5	5.2	TBD	Offsite	In	N/A	Limestone	TBD	TBD	Yes	
Fort Pierce Shore Protection (Federal Project)	St. Lucie	Yes	N/A	5.0	5.0	5.0	Onsite	In	N/A	Limestone	5.0	N/A	No	N/A
Martin County Renourishme nt (199501665)	Martin	Yes	.38	N/A	1.4	5.0	Onsite	Out	N/A	Concrete	5.0	N/A	No	N/A
Jupiter/Carlin Park Shore Protection (199900902)	Palm Beach	Yes	N/A	4.0	4.0	4.0	Offsite	In & Out	N/A	Limestone 3.25 Concrete 0.75	4.0	N/A	Yes	4
Jupiter Inlet Sand Bypassing	Palm Beach	No	N/A	2.32	N/A	1.16	Offsite	In	N/A	Limestone	1.16	N/A	No	N/A
Juno Beach Shore Protection (1997066559)	Palm Beach	Yes	Reduced fill & length	4.47	4.47	2.22	On and Offsite	In	N/A	Limestone	2.22	2.22	Yes	N/A
Ocean Ridge	Palm	Yes	5.9	4.55	4.55	4.55	On and	In &	N/A	Limestone	4.1	Stone –	Yes	3

Mitigation														
Project Type Name Corps' #	Florida County	Avoid & Minimize	Reduced Impacts(acres)	Recommend Acres	Required Acres	Constructed Acres	Location	Type (in/out of kind)	Coral Colonies Transplant (number)	Material & Acreage	Deployed (acres)	Acres Exposed	Monitoring	
													Report Submitted	Effectiveness Scale
Shore Protection (199301576)	Beach						Offsite	Out		2.1 Concrete 2.0		-0.1 Module -0.05		
North Boca Raton Shore Protection	Palm Beach	Yes	0.2	N/A	0.16	0.16	Offsite	In	526 hard, 310 octo. 6 sponge	Limestone .07 Modules 0.09	0.16	N/A	Yes	4
South Boca Raton Shore Protection (199401196)	Palm Beach	Yes	N/A	2.38	2.38	3.0	Offsite	In	N/A	Limestone	3.0	3.0	No	N/A

Beach Renourishment														
Bal Harbor BEC&HP (Federal Project)	Miami- Dade	N/A	N/A	0.8	N/A	0.48	Offsite	In	N/A	Limestone 0.26 Modules 0.22	0.48	N/A	Yes	4
Sunny Isles BEC&HP (Federal Project)	Miami- Dade	Yes	N/A	3.13	3.13	0.33	Onsite & Offsite	In	N/A	Limestone 0.19 Modules 0.14	0.33	N/A	Yes	4
63 rd Street BEC&HP (Federal Project)	Miami- Dade	Yes	N/A	0.08	0.08	0	Offsite	In	N/A	Limestone	N/A	N/A	No	N/A
Surfside and Miami Beach	Miami- Dade	Yes	0.005	0.07	0.07	0.07	Offsite	In	Some	Limestone	0.07	N/A	No	N/A

BEC&HP (Federal Project)														
TOTAL			13.69	36.58	30.44	25.97			842	9.07	25.52			
Navigation Improvements														
Fort Pierce Harbor Deepening	St. Lucie	Yes	2.25	15.0	4.0	4.0	Offsite	Out	N/A	Concrete 4.0	N/A	N/A	No	N/A
Hillsboro Inlet Navigation Improvement (199301995)	Broward	Yes	1.25	0.8	0.8	0	Onsite	In	1,821 hard 2,228 soft 368 sponge	Limestone 0	N/A	N/A	No	N/A
Miami Harbor Deepening	Miami- Dade	No	0	N/A	13.5	13.5	Onsite	In	N/A	Limestone N/A Modules 0.6	N/A	N/A	No	N/A
TOTAL:			3.5	15.8	18.3	17.5			4,417	4.6	N/A			
Combined (Beach/Nav) Totals			17.19	52.38	48.74	43.47			5,259	13.67	25.52			

Table A-3: Summary of impacts anticipated for proposed projects in southeast Florida currently under review.

Project name, and Corps' number.	Project Information			Anticipated Impacts				Comments
	County	Project Type	Project Length (miles)	Dredge/ Fill (acres)	Pipeline (acres)	Mechanical (acres)	< or > 5% Hard Coral Coverage	
Phipps Park Shore Protection (200000380)	Palm Beach	Beach renourishment	1.9	3.1	N/A	N/A	<	Pre-project mitigation constructed in spring 2004. Construction may begin winter 2004.
Central Boca Raton Shore Protection (200200200)	Palm Beach	Beach renourishment	2.25	0.32	2.00	N/A	<	Mitigation and monitoring plan was to be developed by interagency team. Draft plan states mitigation will be provided for unanticipated impacts, if occur.
Broward County Shore Protection (199905545)	Broward	Beach renourishment	11.5	13.5	N/A	N/A	>	Project authorization is pending. Segments will be constructed independently. Mitigation for segment III has been initiated (10.1 acre reef). Segment III will be monitored for 18 months before Segment II is authorized to commence.
Alternate Test Beach 63 rd St. BEC&HP (Federal Project)	Miami-Dade	Beach renourishment	1.5	N/A	N/A	0.8 dredge pipeline	>	Impacts minimized by utilizing a previously designated pipeline corridor.
Port Everglades Expansion (Federal Project)	Broward	Navigation improvement-dredging	432.12 acres	15.1 new* 15.5 existing*	N/A	N/A	>	Total dredge acres 432.12. * New impacts refer to impacts outside existing channel; existing impacts refers to resources within the existing channel.
Port of Miami Expansion (Federal Project)	Miami-Dade	Navigation improvement-dredging	5.5	3.3 new* 48.8 existing*	N/A	rock-rubble	>	* New impacts refer to impacts outside existing channel; existing impacts refers to resources within the existing channel.
Key West Harbor (20030203)	Monroe	Navigation improvement-dredging	N/A	N/A	N/A	N/A	>	Total dredge acres includes 465.4.
Seafarer, Inc. Gas Pipeline	Palm Beach	Natural gas pipeline	N/A	N/A	N/A	N/A		Consultation has just begun. Service has agreed to be a cooperating agency.
Ocean Express Gas	Broward	Natural gas	43	N/A	7.03	N/A	>	NOAA Fisheries considers coral relocation to be impact

Project name, and Corps' number.	Project Information			Anticipated Impacts				Comments
	County	Project Type	Project Length (miles)	Dredge/Fill (acres)	Pipeline (acres)	Mechanical (acres)	< or > 5% Hard Coral Coverage	
Pipeline (2001065555)	d	Pipeline						avoidance/minimization; not mitigation.
Tractebel/Calypso Gas Pipeline (200102775)	Broward	Natural gas pipeline	36	N/A	4.57	N/A	>	NOAA Fisheries considers coral relocation to be impact avoidance/minimization; not mitigation.
Sub-Total				99.6	13.6	0.8		
Total Direct Impacts				114.00				

Table A-4: Summary of compensatory mitigation anticipated for proposed projects in southeast Florida currently under review.

Project name and Corps' number.	Florida County	Avoided & Minimized	Reduced Impacts (acres)	Recommended Acres	Required or proposed Acres	Constructed Acres	Location	Type (in or out of kind)	Coral Colonies Transplant (number)	Material & Acreage	Monitoring Reports Required
Phipps Park Shore Protection (200000380)	Palm Beach	Yes	N/A	3.1	N/A	N/A	Onsite	In-kind	N/A	Limestone	Yes
Central Boca Raton Shore Protection (200200200)	Palm Beach	No	N/A	0.32	0.32	N/A	Offsite	In	N/A	Limestone	N/A
Broward County Shore Protection (199905545)	Broward	Yes	22	13.5	13.5	10.1	Onsite	In-kind	TBD	Limestone	Yes
Alternate Test Beach 63 rd St. BEC&HP (Federal Project)	Miami-Dade	Yes	N/A	0.08	0.08	0	Offsite	In-kind	N/A	Limestone	Yes
Port Everglades Expansion (Federal Project)	Broward	Yes	N/A	49.58	49.58	Project pending	Onsite & Offsite	In- & Out of kind	TBD	Limestone & Tire removal	Yes
Port of Miami Expansion (Federal Project)	Miami-Dade	Yes	N/A	15.94	6.2	Project pending	Offsite	In-kind	TBD	Limestone	Yes
Key West Harbor (20030203)	Monroe	Yes	N/A	N/A	N/A	TBA	N/A	N/A	TBD	N/A	Yes
Seafarer, Inc. Gas Pipeline	Palm Beach	Yes	TBD	N/A	N/A	Project pending	N/A	In- & Out of kind	TBD	N/A	Yes
Ocean Express Gas Pipeline (2001065555)	Broward	Yes	TBD	N/A	N/A	Project pending	Onsite & Offsite	In- & Out of kind	TBD	Tire removal	Yes
Tractebel/ Calypso Gas Pipeline (200102775)	Broward	Yes	TBD	N/A	N/A	Project pending	Onsite & Offsite	In- & Out of kind	TBD	Tire removal	Yes
TOTAL				82.52	69.68						

Table B-1. Caribbean Coral Habitat Impacts associated with projects built from 1985-2003.

Project Number	Project Name Corps Number(s)	Commonwealth/ Territory	Island/ Municipality	Project Type(s) Impact Type(s)	Permit Authority	Project Date(s)	Project Footprint	Coral Impact Area
Project 1985 - 1994								
1	El Morro Shoreline 84F2328, 199201673	PR	San Juan	Shoreline Protection Fill	10/404	1985	3.44 ac	0.17 ac
2	Estate Grapetree South 198500470	VI	St. Croix	Shoreline Protection Fill	10/404	1985	1.7 ac	1.7 ac
3	Michael Torf pier 85LP-500016	VI	St. Croix	Private pier Fill, Shading	10	1985	0.01 ac	0.01ac
4	Private resort 86IPB-20388	VI	St. Croix	Dock,Beach Nourishment, Dredge, Fill	10/404	1986	2.7 ac	2.7 ac
5	Schooner Channel 86IPB-20388	VI	St. Croix	Small Ship channel Dredge, Sediment	10/404	1986 1988	37 ac	7.8 ac
6	Coakley Bay Marina 87IPB20863	VI	St. Croix	Marina Dredge, Fill, Shading	10/404	1987	0.06 ac	0.06 ac
7	Alcome Realty 87IPB-20523	VI	St. Croix	Shoreline Protection, Dock Dredge	10	1987	0.18 ac	0.18 ac
8	Fredericksted Pier 199003912	VI	St. Croix	Commercial Pier Fill	10/404	1990 1992	2.4 ac	0.15 ac
9	Aguadilla Breakwaer	PR	Aguadilla	Harbor/Port Development Fill	Civil Works	1982, 1990 1995	1.8 ac	0.5 ac
10	West Indian Company 199150208-IP	VI	St. Thomas	Cruise Ship Harbor, Marina Fill, Dredge	10/404	1991	7.9 ac	0 ac
11	Inner Brass Key, 199150203IP, 199150204IP, 199250149	VI	St. Thomas	Barge Landing/Dock Shading, scour (prop dredging)	10/404	1991 1994	0.04 ac	0.04
12	St. Thomas/St. John power cable, 199150224IP	VI	St. Thomas/ St. John	Power cable Fill	10	1991	0.4 ac 3.3 mi	Not quantified
13	St John Sewer Pipe 199150284IP	VI	St. John	Pipeline and Sewer Outfall Dredge, Fill, Sediment	10/404 (NPDES)	1991 1992	0.24 ac 0.5 mi	0.12 ac
14	Ponce Sewer Pipe 199350122IP	PR	Ponce	Pipeline and Sewer Outfall Dredge, Fill	10/404 (NPDES)	1993, 1995	52 ac 4.3 mi	28 ac
15	Vieques-Culebra Pipeline 199301928IP	PR	Vieques/ Culebra	Potable Water Pipeline Dredge, Fill	10/404	1993	6.2 ac 12.9 mi	0.07 ac
16	AT&T St. Croix	VI	St. Croix	Communication Cable	10/404	1994	0.02 ac	0.01 ac

Project Number	Project Name Corps Number(s)	Commonwealth/ Territory	Island/ Municipality	Project Type(s) Impact Type(s)	Permit Authority	Project Date(s)	Project Footprint	Coral Impact Area
	199402839LP			Fill, Sediment			0.19 mi	
Total Acreage 1983 - 1994								42 ac
Projects 1995 - 2003								
17	Eco-Electrica 199505825IP	PR	Guayanilla Peñuelas	Liquid Natural Gas Pier Fill, Shading	10/404	1995, 1996	1.19 ac	0.05 ac
18	Enighed Pond Cargo Terminal 199604748IP	VI	St. John	Cargo Port Dredge, Sedimentation, Fill	10/404	1999	6.8 ac	2.7 ac
19	PREPA Power Cable 199708451IP	PR	PR/Vieques/ Culebra	Power Cable, PR-Vieques, Culebra Fill	10/404	2001, 2002	1.5 ac 12.5 mi	Not quantified
20	Lovango Cay Pier/Landing 199706308LP	VI	St. John	Private pier, barge landing Fill, Sedimentation, Shading	10/404	1998, 2003	0.02 ac	0.02 ac 0.25 ac
21	Global Crossing 199900169IP	VI	St. Croix	Communication Cable Fill	10	1999, 2000	0.048 ac	0.05 ac
22	Mangrove Lagoon Sewer Outfall 199902656IP	VI	St. Thomas	Pipeline, sewer outfall Fill, Dredge (NPDES)	10/404	1999, 2001	11.58 ac	1.2 ac
23	Little St. James Island dock 199903354 LP	VI	St. Thomas	dock, barge landing, shoreline rip-rap, Fill, Shading	10/404	1999	0/04 ac	0.1 ac
24	St. Thomas/St. John water pipeline, 200005691IP	VI	St. Thomas/ St. John	potable water pipeline dredge, fill	10	2001, 2002	1.6 ac 3.31 mi	No Impact
25	ARCOS-1 Fiber Optic Cable 200002344IP	PR	Carolina	Communication cable Fill	10	1999, 2001	0.617 ac	Not quantified
26	SAM I 200000159	PR	Carolina	Communication cable Fill	10/404	2000	0/48 ac 4 mi	0.01 ac
27	Crown Bay Pier Expansion 200002970IP	VI	St. Thomas	Industrial Pier Expansion Dredge	10/404	2002	0.4 ac	0.4 ac
28	Estate Nazareth, A. Scheidle pier 200201162LP	VI	St. Thomas	private pier repair	10	2002	NQ	NQ
Total Acreage 1995 - 2003								4.8 ac

Table B-2. Caribbean Projects: Coral Impacts and Mitigation.

Project Number	Project Name	Coral Impacts		Mitigation								
		Coral Impact Area (ac) Distance (mi)	Coral Coverage	Alternatives Analysis: Yes (Y) No (N)	Avoidance (A) Minimization (M)	Compensation Recommended	Compensation Required	Compensation Done	On-Site (OnS) Off-Site (OfS)	In-Kind (InK) Out-of-Kind (OuK)	Type: Transplant (T) Artificial Reef (AR)	Number Colonies (C) or Modules (M)
Projects 1985-1994												
1	El Morro Shoreline Protection	0.17 ac	<5%	N	N	N	N	-	-	-	-	
2	Estate Grapetree South Rock	1.7 ac	-	N	N	N	N	-	-	-	-	
3	Michael Torf, Private Pier	0.01 ac	-	N	N	N	N	-	-	-	-	
4	Floating Docks & beach nourishment	2.7 ac	-	N	N	N	N	-	-	-	-	
5	Schooner Channel	7.8 ac	-	Y	N	N	N	-	-	-	-	
6	Coakley Bay Marina	0.06 ac	-	N	N	N	N	-	-	-	-	
7	Alcome Realty-Remove	0.18 ac	>5%	N	N	N	N	-	-	-	-	
8	Fredericksted Pier Reconstruction	0.15 ac	<5%	Y	N	Y	Y	Y	OnS/ OfS	IK	T, AR, Other	294 C
9	Aguadilla Breakwater	0.5 ac	>5%	Y	N	Y	N	-			-	
10	West Indian Company Port	0 ac	-	Y	A	-	-	-	-	-	-	-
11	Inner Brass Key Dock & Landing	0.04 ac	-	N	N	Y	N	-	-	-	-	-
12	St. Thomas-St. John Power Cable	No Inf.	-	Y	A?	N	N	-	-	-	-	-
13	St. John WWTP Outfall	0.12 ac	5-20%	Y	A/M?	N	N	-	-	-	-	-
14	Ponce Regional WWTP Outfall	28 ac	>5%	Y	M?	N	N	-	-	-	-	-
15	Vieques-Culebra water pipeline	0.07 ac	> 5%	Y	N	N	N	-	-	-	-	-

Project Number	Project Name	Coral Impacts		Mitigation								
		Coral Impact Area (ac) Distance (mi)	Coral Coverage	Alternatives Analysis: Yes (Y) No (N)	Avoidance (A) Minimization (M)	Compensation Recommended	Compensation Required	Compensation Done	On-Site (OnS) Off-Site (OfS)	In-Kind (InK) Out-of-Kind (OuK)	Type: Transplant (T) Artificial Reef (AR)	Number Colonies (C) or Modules (M)
16	AT&T St. Croix Communication	0.01 ac	-	Y	N	N	N*	-	-	-	-	-
Projects 1995 - 2003												
17	Eco-Electrica LNG dock	0.05 ac	<5%	Y	M	Y	Y	Y	OnS	InK	T	200 C
18	Enighed Pond Marine Terminal	2.7 ac	5-20%	Y	A/M	Y	Y	Y	OnS	InK	T	2000 C
19	PREPA Power Cable PR-Vieques-Culebra	0.01 ac	-	Y	A/M	Y	Y	Y	OnS	InK	T	24 C
20	Lovango Cay dock, moorings, landing	0.02 ac	>5%	Y	N	Y	Y	P				
21	Global Crossing St. Croix	0.05 ac	-	Y	M	Y	Y	Y	OnS	InK	T	13 C
22	Mangrove Lagoon WWTP Outfall	1.2 ac	>>5%	Y	A/M	Y	Y	Y	OnS	InK	T	4854 C
23	Little St. James Dock/shore Protectio	0.1 ac	-	N	N	N	N	N	-	-	-	-
24	St. Thomas-St. John Water Pipeline	-	-	Y	A	-	-	-	-	-	-	-
25	ARCOS-1 Fiber Optic Cable	0.01 ac	>5%	Y	A/M	Y	Y	Y?	OnS	InK	T	?
26	SAM I, Communication	0.01 ac	>5%	Y	M	Y	Y	Y	OfS	InK	AR	12 M
27	Crown Bay Pier Expansion	0.4 ac	-	N	N	Y	Y	Y	OfS	InK	T	3003 C
28	Estate Nazareth dock reconstruction	-	-	N	N	N	N	-	-	-	-	-

Table B-3. Projects Requiring Compensation and/or Monitoring

Project Number	Project Name	Compensations Type	# Colonies (C) Modules (M)	Monitoring Required	Monitoring Done	Compensation/Monitoring Results	Comments
8	Fredericksted Pier	T AR	294 Debris	Y	Y	2	Transplants survived, Pier Debris deposited outside of designated site Only one ship anchorage/mooring compensation area was established, and it was on a coral reef. Anchorage exclusion areas may need approval by the Coast Guard.
14	Ponce Regional WWTP	-	-	Y	Y?	1	Monitoring was for construction minimization (halving acreage from 56 to 28 acres. Compensation was not required (removing primary sewage discharge from inshore waters considered in lieu of other compensation). Never provided required as-built information to verify minimization.
15	Vieques-Culebra Water Pipeline	-	-	Y	Y?	1	Project was to completely avoid coral reef impacts, but pipe landfall missed the trench and lies on fringing reef. Monitoring was required, but reports were not submitted and corrections were not made. A required seagrass mitigation failed. Corps sent notice of non-compliance, but there has been no follow-up.
17	Eco-Electrica	T	200 C	Y	Y	5	Impacts mostly to seagrass beds and only considered for piling footprints. A required monitoring study confirmed seagrass and coral growth shading impacts. Transplants had >80% survival
18	Enighed Pond Marine Terminal	T	2003 C	Y	Y	5	Construction and compensation monitoring required. Construction strictly phased to minimize turbidity impacts. Project under construction and nearly two years of monitoring reports on transplants with >90% survival.
19	PREPA Power Cable, PR-Vieques-Culebra	T	24 C	Y	Y	2	Cable was laid over hard bottom, but post-lay adjustments were made. Some corals were transplanted, but survival was <80% after the first monitoring report. No further reports submitted, PREPA sent notice of non-compliance by the Corps
20	Lovango Cay pier and landing	T O	-	Y	P	P	Dock not in compliance with permit, impacted corals, lack of defined barge landing impacted large fringing reef/patch reef area. Mitigation and monitoring required after-the-fact, but pending.

Project Number	Project Name	Compensations Type	# Colonies (C) Modules (M)	Monitoring Required	Monitoring Done	Compensation/ Monitoring Results	Comments
21	Global Crossing St. Croix, communication cable	T	13 C	Y	Y	4	Construction and compensation monitoring required. Lay was to avoid corals, impacted approximately 13 which were transplanted. Permitted in 2000, constructed recently, only one monitoring report.
22	Mangrove Lagoon WTP	T	4854 C	Y	Y	5	Pre-project benthic survey greatly underestimated number of corals at a few hundred. 4854 were transplanted, monitoring reports for 2 years plus with >99% survival.
24	St. Thomas-St. John water pipeline	-	-	Y	N		Recently constructed, route was to completely avoid coral impacts. Construction monitoring was required, monitoring report not yet seen—not rated.
25	ARCOS-I Communication Cable	T	-	Y	Y	2	Construction monitoring was to avoid high density coral areas, but did not. Transplantation was to be required, but no information on number or survival. Extra compensation required on their next cable lay.
26	SAM-I	AR	12 M	Y	Y	5	Construction monitoring and compensation (for project 25 also) required. Diver directed cable lay used very low-impact corridor. Twelve cement modules were placed at an off-site location. Last monitoring report found 11 with significant sponge colonization. One module may have sunk in soft sediment (no requirements for pre-placement substrate tests).
27	Crown Bay Pier Expansion	T	3003 C	Y	Y	4	Project still under construction. Corals transplanted to nearby Water Island. Survival >90%, some mortality among <i>Agaricia</i> colonies. Score provisional to the results of additional monitoring reports. Water quality sampling was discontinued early.

APPENDIX C.

General Legislative Authorities and Service Mitigation Policy

General Legislative Authorities

In general, the Corps initiates consultation with the Service with respect to the possible adverse impacts to fish and wildlife resources, including federally listed species, as a result of projects proposed for the authorization through the Corps' regulatory program pursuant to Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) and Section 404 of the Clean Water Act (33 U.S.C. 1344), as well as, the Corps' civil works projects, which are authorized by Congress pursuant to the Water Resources Development Act (Public Law 101-640).

In response, the Service provides comments and recommendations to the Corps regarding the potential impacts to fish and wildlife resources, such as coral reef habitat, as a result of the proposed action pursuant to the Fish and Wildlife Coordination Act of 1958, as amended (48 Stat. 401; 16 U.S.C. 661 *et. seq.*) and the Endangered Species Act (ESA) of 1973, as amended (87 Stat. 884; 16 U.S.C. 1531 *et seq.*), if informal or formal consultation under the ESA was requested, and compliance review of the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321-4347).

In addition to the Service, the Corps will typically initiate formal consultation with the National Marine Fisheries Commission, Habitat Conservation Division (NOAA Fisheries) regarding potential impacts to Essential Fish Habitat (EFH) as described in the Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), as well as, the Environmental Protection Agency pursuant to the Clean Water Act.

The Service's Mitigation Policy

In reviewing and evaluating project impacts, mitigation, and monitoring programs, the Service relies on the definitions contained in the Service's Mitigation Policy (Federal Register 46 (15), Pg. 7656). The policy states that in general, mitigation can include:

1. avoiding the impact all together by not taking a certain action or parts of an action;
2. minimizing impacts by limiting the degree of magnitude of the action and its implementation;
3. rectifying the impacts by repairing, rehabilitating, or restoring the affected environment;
4. reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
5. compensating for the impact by replacing or providing substitute resources or environments.

This definition recognizes mitigation as a stepwise process that incorporates both careful project planning and compensation for unavoidable losses and represents the desirable sequence of steps in the mitigation planning process. Initially, project planning should attempt to ensure that adverse effects to fish and wildlife resources are avoided or minimized as much as possible. In

many cases, however, the prospect of unavoidable adverse effects will remain in spite of the best planning efforts. In those instances, compensation for unavoidable adverse effects is the last step to be considered and should be used only after the other steps have been exhausted.

The Service's Mitigation Policy focuses on the mitigation of fish and wildlife habitat values, and it recognizes that not all habitats are equal. Thus, four resource categories, denoting habitat type of varying importance from a fish and wildlife resource perspective, are used to ensure that the mitigation planning goal will be consistent with the importance of the fish and wildlife resources involved. These categories are based on the habitat's value for the fish and wildlife species in the project area (evaluation species) and the habitat's scarcity on a national, regional or local basis. Resource Category 1 is of the highest value and Resource Category 4, the lowest. Mitigation goals are established for habitats in each resource category.

The mitigation goal for Resource Category 1 habitats is no loss of habitat value since these unique areas cannot be replaced. The goal for Resource Category 2 habitats is no net loss of in-kind habitat value. Thus, a habitat in this category can be replaced only by the same type of habitat (i.e., in-kind mitigation). The mitigation goal for Resource Category 3 habitats is no net loss of overall habitat value. In-kind replacement of these habitats is preferred, but limited substitution of different types of habitat (out-of-kind mitigation) perceived to be of equal or greater value to replace the lost habitat value may be acceptable. The mitigation goal for Resource Category 4 habitats (considered to be of marginal value) is to avoid or minimize losses, and compensation is generally not required.

APPENDIX D.

Historic Impact Overview (Pre 1985) for the Caribbean

Historic Impact Overview (Pre 1985) for the Caribbean

Puerto Rico and the Virgin Islands were colonized by European civilization 500 years ago, and a number of coastal modifications date back at least 100 years (since Puerto Rico became U.S. territory). While estimates of coral impacts cannot be carried back that far, an effort was made to capture some of the likely impacts that occurred from about 1950 to 1985. During that period of time, there was significant harbor development for industry and cargo as well as an airport runway expansion in St. Thomas, Virgin Islands. Large projects affecting coral reef habitat in Puerto Rico were limited to a few port developments.

Krause Lagoon, on the south coast of St. Croix was a small enclosed bay with extensive mangrove areas. Limetree Bay was a relatively open coastal bay just to the east of Krause Lagoon with a mixture of seagrass beds, hardgrounds, and coral reef habitat. The two areas have become a large industrial port complex serving Hess Oil, Alcoa aluminum, the U.S. Virgin Islands Rum Industry, the island's power plant, and other commercial and industrial enterprises. The nearshore shoal areas were a mixture of seagrass beds and coral reefs, while the offshore shelf consists of various categories of coral reef. Estimated impacts of the port on areas mapped as reef were limited to outer portions of the two major channels, part of the basin of the eastern channel, and the long groin/breakwater just east of the eastern channel. Similarly, the St. Thomas airport runway extension impacted reef colonized pavement along the shoreline for the proximal third of the extension.

Estimated Impacts prior to 1985 directly attributable to port or airport development.

Project	Location	Estimated Impact
Krause Lagoon/Limetree Bay Port	St. Croix, VI, south coast	80 - 107 acres
St. Thomas Airport Expansion	St. Thomas, VI, southwest coast	27 acres
San Juan Bay Entrance (both sides)	Puerto Rico, northeast	1 acre
Boca de Cangrejos	Puerto Rico, northeast	1 acre
Arecibo Harbor	Puerto Rico, northwest	1 acre
Las Mareas	Puerto Rico, south east coast	< 1 acre

Puerto Rico historically had deep water ports and harbors in San Juan and bays on the south and west coasts. Although extensive dredging and fill have been required within the bays for turning basins, channels, and berthing areas, the habitats most frequently affected were mangroves and seagrass beds. Some of the larger open bays, such as the outer portions of Guayanilla and San Juan Bays, contain old coral rubble on shoals within these areas, indicating that they once supported shallow patch reefs. Ponce and Mayaguez Bays are protected by reefs on the seaward

side that are highly deteriorated with very little live coral cover. Impacts to these could not be estimated due to the lack of information on prior reef condition, and the likelihood that existing impacts are due to other factors such as water quality deterioration from increasing land and river sediment and nutrient runoff, and treated wastewater discharges. Impacts for Puerto Rican ports were estimated in the same manner as those for the U.S. Virgin Islands, that is, only impacts for the channel dredging or breakwater protection in the mouths of bays or coastal areas that still show adjacent reef coverage on the NOAA maps were used. The estimated impacts noted below were mostly for projects built during the 1950s to 1970s, however, some of these areas had a long history of commercial port use, and probably had earlier impacts to coral reef areas not addressed here.

APPENDIX E.

Agency Comments and Service Responses



DEPARTMENT OF THE ARMY
 JACKSONVILLE DISTRICT CORPS OF ENGINEERS
 P. O. BOX 4970
 JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
 ATTENTION OF

Regulatory Division

Ms. Cindy Dohner
 Assistant Regional Administrator for Ecological Services
 U.S. Fish and Wildlife Service
 1875 Century Boulevard
 Atlanta, GA 30345

Dear Ms. Bohner:

Please consider this letter a response to the Draft "Investigations of Compensatory Mitigation for Coral Reef Impacts in the U.S. Atlantic: South Florida and the Caribbean", dated January 2004. The U.S. Army Corps of Engineers has reviewed the document and feels that the document adequately demonstrates the effectiveness of the Corps in mitigating impacts to coral resources. In general, the Corps agrees with the report's central theme, that we are doing better with protection and mitigation, but that continued improvement is warranted because of the high ecological value of these aquatic resources.

The U.S. Fish and Wildlife Service (Service) used a very limited data set for this evaluation. The Corps recommends that the Service obtain more information on the cases omitted from the evaluation and include them in the study. Additionally, the Corps recommends that updated information be incorporated into the report. The Corps is willing to assist the Service in the collection of this additional data, to provide for a more complete study. If this is not feasible, the report should explain the limited dataset used in the report and the reasons for this lack of data. The Corps recognizes that this issue is addressed later in the report in the section entitled, "Selection of Project Files for Review", however, if further investigations are not undertaken to provide a more encompassing dataset, this needs to be explained upfront in the Executive Summary.

The Executive Summary should point out that although construction projects have the potential to adversely impact these important hardbottom resources, other impacts are continuing to occur. These other impacts include eutrophication and sedimentation from point and non-point discharges, land based erosion, vessel discharges and groundings, and recreational uses such as diver handling and anchor damage.

1) Cases where where information was available in our files were not excluded from the study with the exception of small dock projects in Florida. The reasons for this are explained in the cited section in the report and would require too much detail for an executive summary. The results of small docks actually affecting coral reefs would not be likely to overshadow the large impacts resulting from beach nourishment or port development in Florida. There were no reliable tools to separate the RAMS database docks likely to impact coral habitat from the possible hundreds of thousands of docks not likely to impact coral resources. The Caribbean section of the study was able to utilize the lat/long coordinates in conjunction with the NOAA benthic survey and personal knowledge to assist in this purpose. The project information was coordinated with the Corps Antilles and Jacksonville offices prior to circulating the draft report with a request for additions or corrections to the information or projects used, and the Service received no response to this inquiry. It would be useful to have additional information, however, we do not believe it would change the fundamental results of this study. The Corps is welcome to conduct a study of the cumulative impacts of small docks to coral reefs.

2) We have added a paragraph to the executive summary to address this concern.

Although the tables provide insight into how the Service arrived at the conclusions, the tables are confusing in their presentation. An example of this is in Table 1, page 4, the column title indicates that the number represents a percent, however three numbers are presented in each entry. Also, Table 6, on page 21, is quite confusing. The reader is not able to determine what is meant by "X" or by "?". Table 9 on page 24 indicates that private dock impacts were not included for the Florida data. If private docks were excluded from the Florida data, then private docks should be excluded from the Caribbean data for consistency.

The section on mitigation success appears to have evaluated success based only upon the portion of mitigation completed. The report sites an example of a project in which one-ninth of the mitigation was completed and evaluated the success of the portion completed. It is misleading to assume success on one-ninth of what was required when such a small portion of what was required was actually constructed. Success should be treated from a compliance standpoint, requiring both the completion of the mitigation required and adequate utilization of the habitat created. Looking more broadly, the project referenced would not have been successful, as it would not have adequately offset the impacts associated with the authorized project.

The report acknowledges violations under investigation by the Corps and the EPA in the section entitled "Monitoring of Compensatory Mitigation", but does not indicate that typically restoration and mitigation are required as a result of enforcement actions. The Service should either identify the final outcomes of the enforcement actions, or elaborate on the goals and requirements of such actions.

In the section entitled "Mitigation of Impacts to Coral Reef Habitats", the report identifies three projects in which "There is no indication that ... the projects avoided or minimized impacts..." The Corps is not empowered to mitigate past impacts; however, the Corps incorporates strict environmental protection provisions into contracts issued and incorporates strict environmental protection conditions into all permits issued for maintenance work. Furthermore, the final plan that was chosen for the Miami Harbor deepening project avoided over 20 acres of seagrass impacts and avoided impacts to the 2nd offshore reef tract in the entrance channel.

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3) The tables have been modified to address the comments.

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4) We concur with this comment. The Caribbean mitigations were rated to include an evaluation of the proportion of the agreed mitigation completed. The Florida mitigations have been reevaluated to take this into consideration.

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5) The descriptions on the individual projects state that restoration and monitoring has been required for the recent violations noted in the study, however, restoration generally consists of removing unauthorized fill and conducting some sort of post-project mitigation. The impact is still realized, and mitigation possibilities may be more limited. The quality of after-the-fact mitigation has been improving, partly as a result of increased coordination with the resource agencies.

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The report does not adequately acknowledge the avoidance of impacts. In Southeast Florida, several hundred small single family projects per year propose impacts to coral and hardbottom resources, however, impacts are avoided through the relocation of the proposed structures to areas without such resources, or in extreme cases, where the potential for success exists, the resources themselves may be relocated. The cumulative impacts of these large numbers of small projects pose a serious threat to hardbottom resources in this fragile marine environment. In Puerto Rico and the U.S. Virgin Islands, many projects each year avoid impacts to coral and hardbottom resources. This avoidance is a result of pre-application meetings with applicants, consultants, and agents, and Inter-Agency meetings, which serve to discuss proposed projects. The Draft report focuses on projects that required compensatory mitigation and does not adequately recognize projects that through the NEPA process, were completely redesigned to avoid impacts to hardbottom resources.

The Corps agrees with the intent of the recommendations presented in Section V, entitled "Recommendations". However, recommendation number two indicates that "The Team should refine and identify agency roles and responsibilities for addressing coral reef impacts and compensatory mitigation recommendations in (to) ensure complete coverage of coral issues." The Corps agrees with establishing a working level interagency group in South Florida; however, the group would be invited to make recommendations, but would not be able to change agency authority, as suggested in the document. A similar group has proven to be successful in Puerto Rico and the U.S. Virgin Islands.

The Corps remains concerned about the datasets used for the report, however, the general result of the analysis adequately demonstrates that earlier efforts in permitting and mitigation did not adequately offset impacts to important hardbottom resources. Current permits have demonstrated a much better effort to avoid, minimize, and mitigate proposed impacts to these resources. Much of these efforts have not been sufficiently recorded, however, the new Corps database is currently collecting data on impacts proposed during pre-application meetings, impacts proposed at the time of application, and on impacts authorized through permit documents. This additional data should prove beneficial for similar reports in the future. The Corps regulatory program is making progress in improving efforts to avoid, minimize, and adequately mitigate the remaining impacts authorized by permit decisions. The Corps remains committed to the continued protection of all important coral and hardbottom resources.

7) Avoidance and minimization were very difficult to verify and quantify, and often depended upon individual biologist recollection of a particular permit process since it often is not detailed in a project file. This is particularly true for small structures, which may be authorized under nationwide or other general permits that are not coordinated with the resource agencies. If the potential impacts and avoidance to actual coral habitat are as large as the Corps suggests (several hundred per year), we recommend that the Corps conduct a specific evaluation of projects authorized under nationwides, general permits, or letters of permission (with shorter resource agency comment periods). For the Caribbean, many small projects were identified as a result of being able to overlay the project coordinates on the NOAA benthic maps. As noted in the section on selection for project files for review section for the Caribbean, a number of these projects were actually for low impact moorings or artificial reef considered beneficial to the marine environment. For Florida, our initial scoping for the project suggested that small private projects (docks, shoreline protection, and moorings) were likely to occur in projects on the outside shorelines (not bays or channels) of the Florida Keys or on outlying cays, but not north of the Keys. This information was not available in Service files, and the Corps did not provide comments on the projects chosen or provide information on additional projects to evaluate as requested by the Service during the file review process.

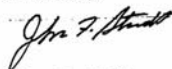
8) We concur with this comment which was also made by DPNR Virgin Islands. The recommendation has been reworded.

9) We are very interested in the new Corps database, and suggest that it might be a possible tracking method to be evaluated by the interagency team to serve the recommendations for interagency sharing and tracking recommended by this report. We understand that use of this tracking method by the Corps is not in question in such an evaluation, just a starting point to serve the need for tracking coral impacts and the full mitigation process (avoidance, minimization, and compensation for unavoidable impacts by concerned Federal and State (Territorial or Commonwealth) agencies. The inability to fully capture avoidance and minimization efforts, as well as the importance of doing so to avoid unnecessary impacts was clearly illustrated in this report

-4-

The Corps appreciates the opportunity to comment on this report and looks forward to seeing these recommendations implemented. If you have any questions or would like further clarification, please contact me at 904-232-1177 or Penny Cutt at 561-472-3505.

Sincerely,



for: John R. Hall
Chief, Regulatory Division

cc: Cindy Dohn, FWS, Atlanta, GA
Trish Adams, FWS, Vero Beach, FL



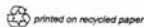
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February 26, 2004

Ms. Cynthia Dohner, Assistant Regional Director
Ecological Services
U.S. Fish & Wildlife Service
1875 Century Blvd., Ste. 200
Atlanta, GA 30345

Dear Ms. Dohner:

SUBJECT: COMMENTS

We have completed review of the draft report, *Investigations of Compensatory Mitigation for Coral Reef Impacts in the U.S. Atlantic: South Florida and the Caribbean* and found it to be interesting reading and a worthwhile effort. Here are our comments:

- The focus of the report is evaluation of "coral reef" impacts. "Coral reef" is defined as "...actively accreting....coral colonized hardgrounds..". In Palm Beach County, the nearshore reef environment that is impacted by beach nourishment projects does not fit this definition. With the exception of *Siderastrea radians*, hard corals generally are not present on the nearshore reefs. The report correctly describes the reef environments of the areas, specifically for this county, but multiple statements thereafter refer to "coral reef impacts". The impacts to nearshore hardbottom versus those to true coral reefs should not be lumped together; they are two very different habitats. This is especially important in the statement on p. 30 that says "Florida has lost...200 acres of coral habitat..."
- Overall trends: Table 1 shows increasing numbers of projects and impacted acreages for Florida as opposed to the numbers for the Caribbean that decrease. The report text states that the overall numbers are decreasing which conflicts with the data contained in Table 1 when taking into account the number of proposed projects currently in the planning stages.
- Monitoring: In addressing monitoring reports, it should be made clear as to the type of monitoring that is being evaluated or compared. In the earlier projects, required "monitoring" only consisted of construction verification; (e.g.,

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FWS Responses/Comments

1) The CRTF broadly defined coral habitat to include actively accreting coral reefs and coral colonized hard bottom. It is understood that there are various coral habitats, and it was not the purpose of this report to attempt to distinguish between all of them. It is understood, that there are differences, and compensatory mitigation generally attempts to address the type of habitat lost.

2) This has been corrected. The decreasing impacts are for the Caribbean. Projected impacts in Florida are expected to be greater than the past impacts documented within the scope of this report.

3) Monitoring may apply exclusively to construction impacts (which accounts for cases where monitoring was noted, but mitigation was not required), or it may be required for both construction and monitoring. The comment that early monitoring was not biological (only ensuring compliance with the construction design) may apply to some of the earlier projects. The "typical" time period for monitoring mentioned follows Corps permit conditions, where monitoring was required—although compliance with monitoring conditions included in Caribbean permits were not always followed or enforced (see Appendix II tables). Construction monitoring in the Caribbean and Florida has been conducted with the intent to avoid and minimize impacts, particularly in cable laying projects in the Caribbean. In these cases, the need for and extent of mitigation may have been contingent upon the success of impact avoidance during the construction phase.

was it built?) It is unclear what is referred to in the statement "typically monitoring is required from 2 to 5 years". It would seem that this statement really describes projects within the recent past. To compare monitoring of earlier projects, when biological monitoring was not required, to more recent projects where biological monitoring is required would skew any comparison over time. Biological monitoring only has been required for our projects since 2001. It is significant to note in Table 7 that in the 1985-1994 window when only 38% of the projects had required monitoring almost double that number actually provided monitoring.

- As to monitoring of artificial reefs, there is significantly more monitoring data available in Florida. The State's Artificial Reef Program (Florida Fish & Wildlife Conservation Commission; Contact Bill Horn) has compiled an extensive amount of biological and physical monitoring data for artificial reefs for a number of years.
- In the "Trends Over Time" section (p. 32) other factors, such as temperature and nutrients (particularly those associated with oceanic sewage outfall pipes), should be included as additional impacts to the reefs.
- Turbidity: In the discussion relating to turbidity, it should discuss the differences in short-term turbidity (from construction) versus long-term impacts (from fill material). Long-term turbidity impacts could have more severe impacts. It is important to acknowledge that long-term turbidity impacts have been reduced in more current beach projects compared to earlier projects. For instance, Palm Beach County uses a target of 2% silt/clay fraction during planning and design, and this value number is significantly lower than early projects from the 1980s. Reducing the percent of fines through a thorough evaluation of borrow material characteristics and rejecting those materials that contain excessive amounts of fines is another example of minimization of impacts.
- We agree with the statements that question the use of NTUs as the standard for turbidity, but we also think that 15 NTUs is too high when sensitive resources are nearby. Turbidity monitoring stations should be located based on a specific distance to sensitive resources (reefs, seagrasses, etc.) rather than defining a fixed distance mixing zone from the discharge point. The research by Nova Southeastern University that is gathering information on tolerance limits of reefs for varying amounts and durations of sedimentation appears to be a more appropriate avenue for redefining turbidity standards for Southeast Florida nourishment projects.
- Mitigation: The myriad problems associated with the "like for like" mitigation requirement for the shallow nearshore zones (areas within the active beach profile) should be elucidated in this report. Problems, such as burial by shifting sand bars,

3 4) One of the recommendations of this report is to conduct an evaluation of different types of compensatory mitigation artificial structures in Florida to better understand success or shortcomings of the compensation over time. The effectiveness and potential impacts of artificial reefs, and what they actually do for the resources is highly controversial, and some reviewers expressed strong concern about their use. Although the recommendation is directed at structures placed as compensation for impacts, broadening the scope to include artificial reefs placed for other resource purposes would be useful in providing better information to improve compensatory mitigation recommendations. The first step in such a study should be collection of existing monitoring information, so we appreciate the offer in providing such data.

4 5) The report and this section were limited to addressing the trends in impacts and compensation resulting from Corps civil works or regulatory actions. The scientific literature suggests that marine construction impacts are not the primary human impacts to coral habitat subject to federal regulation. One of our recommendations is for an interagency team to determine what other Federal activities should be addressed such as ocean out-falls for reducing impacts to coral habitats. Evaluating and addressing the impacts to corals from impaired water quality due to point and non-point source discharges is complex with respect to determining the impacts, and state/federal agency responsibility for water quality (see 6 and 7 below).

6 6) The Service acknowledges the efforts of Palm Beach County to minimize secondary affects of sedimentation and turbidity on hardbottom resources. The text has been modified to expand the discussion regarding sedimentation and turbidity.

7 7) We concur that 15 NTUs is too high for such sensitive resources. Standards above what is required by Federal authorities are determined by the state, subject to periodic review and approval by EPA. Hawaii, for instance, has extremely restrictive standards for NTUs for coastal waters with sensitive resources. Discussion and strategies for dealing with these issues would be good topics for local teams working with coral habitat impacts to deal with and share with others working with coral resources. We look forward to reviewing the results of NOVA's study.

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lack of sufficient substrate, structural stability, etc., are more prevalent in the nearshore compared to slightly deeper (e.g., 25 ft.) areas. These problems account for why we have had reduced successes (in terms of reefs remaining exposed) with shallow mitigation reefs and trying to simulate the nearshore environment. In addition, if "like for like" is the goal of mitigation, how would "success" of an ephemeral reef be measured? Stability in this respect could be considered a detriment. At this point the definition of "success" of an ephemeral mitigation reef has not really been established. Also, mitigation credit should be calculated by combining acreage with relief. Acreage alone is not a sufficient standard.

- We disagree with the statement on page 14, "Modules were considered in-kind, whereas ordinary concrete was not, because of their superior ability to recruit marine organisms." Again on page 36, "specially formulated concrete" is attributed as having a "superior ability" to recruit larval marine organisms compared to regular concrete or concrete construction debris. We have constructed a number of artificial reefs with limerock boulders and concrete construction debris (e.g., bridges) rather than with prefabricated modules made from "specially formulated concrete", and our reefs provide excellent habitat and recruit organisms quickly. This data is available. Our preference is for limerock boulders as they perform excellently as long-lasting habitat for marine organisms and fish and show a faster rate of development. In fact, Figure 5, illustrating deployment of reefballs, should not be shown as or implied to be typical or preferred mitigation reefs. A photo of limerock boulders should be shown instead since it is more representative of typical successful mitigation reefs (at least in southeast Florida). We have many photographs (and videos) of limerock reefs, predeployment, deployment, in place with marine organisms attached, etc., we'd be happy to lend you.
- Recommendations Section: Information sharing is very important and was brought up by a number of consultants and industry representatives in a recently-held Technical Advisory Committee meeting of the SEFAST Land-based Sources of Pollution subgroup. All submitted reports should be posted on a web page clearinghouse to promote information sharing.
- Another recommendation would be to resolve the problem that prevents federal agency permitting staff from diving the sites that they are expected to evaluate. Alternatively, the field inspections could be performed by an impartial contractor (university?) so that federal staff can receive better information on resources and mitigation results.
- When the Corps of Engineers performs their cost/benefit analysis for mitigation in their feasibility studies, currently they only consider the costs of building the

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8-9) Two comments addressed the "in-kind" or "like for like" issue of mitigation, from the aspects of feasibility and kinds of material used to be considered "in-kind". We acknowledge that the "in-kind" issue is subject to various interpretations. Since the report addressed both Florida (where limestone rock is preferred and available), and the Caribbean (where limestone rock may not be available for this use), the field offices decided to include either limestone rock or modules shown to easily colonize with corals. The use of construction debris for artificial reefs or mitigation has been more questionable in the Caribbean. Therefore, construction debris was not included as "in kind" mitigation. Material selection criteria and long-term monitoring information on successfully colonized and stable construction debris reef creation would be welcome, and should be included in the recommended study of Florida artificial reef development for mitigation purposes.

10) We welcome support of the recommendation for information sharing. Using web-page posting for reports would be extremely helpful in sharing available information, particularly monitoring reports, etc. However, there needs to be agreement between agencies to share this information, funding for managing such a web posting, , and a responsible entity to manage the information. This may be an issue that can be addressed through a local team.

11) While this was not included in the recommendations, it was discussed in the section entitled "Pre-project Site visit and Monitoring of Project Construction". The ability to conduct underwater site visits is complicated due to workload, available funding, and other issues. Using contractors to conduct site visits remains a possibility, but fails to maintain regulatory and resource agency personnel with hands-on knowledge of resources they are addressing, and the results (feasibility, success, or failure) of their recommendations. Regardless, agency staff needs to maintain their ability to ground truth and verify the information presented for review. Independent scientific assessment may provide more detailed information on the condition of the resources, but may fail to evaluate possible solutions that are feasible for a particular project

or proponent.

Ms. Cynthia Dohner
February 26, 2004
Page 4

mitigation reef, with no consideration for the economic and recreational value of the reef and its associated biota that will be buried. Our reefs have a value that has been recently shown to translate to a significant monetary benefit to SE Florida. This information was clearly illustrated in the recently-completed Socioeconomic Study of the Reefs of Southeast Florida. The benefits realized from a wider beach, i.e., more towel space, are included in the cost/benefit calculations but not the value of the recreational and environmental benefits of the reef that will be impacted. Including an accurate valuation of the reefs in a cost/benefit analysis is likely to provide a significant incentive to beach nourishment project planners to avoid and minimize impacts.

12


• Individual projects Table:

- p. 28: The Ocean Ridge project was scored as a "3" in the table, not a "2" as shown on this page. Also, the data in the table and correspondence with state and federal agencies shows clearly that mitigation was required; we do not understand the "...not possible to ascertain mitigation requirements." statement.
- Table: The Juno project had both in-kind AND out of kind mitigation.
- The Comments section for the Central Boca project does not appear to reflect the most recent information in that the project was reduced in size to minimize direct impacts to Red Reef Park.

13

Thank you for allowing us to review this document. It contained a lot of excellent information. If you have any questions or wish to discuss our comments further, please call Janet Phipps of this office, 561-233-2513.

Sincerely,


Richard E. Walesky
Director

REW:jp

T:\coastalreefs\FWS comp mitigation report REVletter.doc

12) We concur that the cost (loss) of impacted resources should be included in a cost/benefit analysis. This problem is common with public works projects. We believe that the cost/benefit analysis should also consider the costs for project maintenance, or limit the life-span of the project benefits to the few years between maintenance or re-nourishment needs. Maintenance costs are often ignored since they may be responsibilities of the local sponsor. For repetitive projects, the loss of re-colonized habitat following construction impacts should also be considered.

13) The table has been corrected to reflect that both in-kind and out-of-kind mitigation was provided. The Service welcomes any updated information regarding the Central Boca Project .



Department of Environmental Protection

Jeb Bush
Governor

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000
Deputy Secretary for Land and Recreation
Office of Coastal and Aquatic Managed Areas
Mail Station 235
(850) 245-2094; SC 205-2094
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David B. Struhs
Secretary

February 12, 2004

Ms. Cynthia Dohner, Assistant Regional Director
Ecological Services
1875 Century Blvd., Room 200
Atlanta, Georgia 30345

RE: Report entitled "Investigations of Compensatory Mitigation for Coral Reef Impacts in the U.S. Atlantic: South Florida and the Caribbean."

Dear Ms. Dohner:

The Florida Department of Environmental Protection (DEP) has reviewed the above titled report developed by the U.S. Fish and Wildlife Service, Southeast Region (USFWS), and offer the following comments:

1. Page 41, Intra- and Inter-agency Information Sharing: It should be mentioned that DEP along with Miami-Dade, Broward, Palm Beach, and portions of Martin Counties have recent LADS data that gives us a good indication of areas of relief and can be used as a starting point to determine whether a proposed project will impact coral reefs. This data should be shared with USFWS, Army Corps of Engineers, and NOAA.
2. Page 42, "Recommendations" #4: We agree that an appropriate methodology needs to be developed and standardized. Our recent experience with the Habitat Equivalency Analysis (HEA), has not been too good or convincing. The data put into the HEA formula was easily manipulated by applicants to indicate that the project impacts were minor and little to no mitigation would be required based upon the analysis of HEA. Serious concerns were raised and did not support the use of HEA for the oceanic gas pipeline projects.
3. Appendix B, "Table XX" Project Spreadsheet (permitted projects for Florida): - The data concerning the fiber optic cable projects is incomplete. All of these projects with the exception of the 2003 Cable Bahamas II Project are installed. The permitted impacts as well as the permitted mitigation could be supplied to USFWS if necessary.

"Protect, Conserve and Manage Florida's Environment and Natural Resources"

FWS Response/Comments

1) We concur that this is a highly significant screening tool that is already being used for evaluation of impact area and habitat type for some projects. It was not, however, available for use in screening past projects for the likelihood of coral impacts as the NOAA benthic maps were used in the Caribbean.

2) The NOAA Habitat Equivalency Analysis was mentioned as it is being used to some degree in Florida, although it may not be the best means of addressing the problem of quantifying the impact area and compensation. We are aware that these and other functional assessment tools have similar drawbacks even in less diverse and structurally complex systems such as wetlands.

3) It would be useful to have an evaluation of the cable impacts and how they are being managed to compare with the Caribbean. While this may not be incorporated into this report, it should be dealt with as an issue for types of impacts in addressing guidance or strategies for avoidance, minimization, and compensation as cable placement will continue to be an issue with respect to coral reef impacts.

We appreciate very much the opportunity to comment on this report. If you have any questions, please do not hesitate to contact Paula L. Allen in the Office of Coastal and Aquatic Managed Areas at (850) 245-2094 or Paula.Allen@dep.state.fl.us.

A handwritten signature in black ink, appearing to read "Paula L. Allen". The signature is written in a cursive style with a large, sweeping initial "P" that loops back over the rest of the name.



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Atención: Carlos Díaz
USFW

6 de febrero de 2004

De: Aileen T. Velazco Dominguez
Coordinadora
Programa de Arrecifes de Coral

P/C Ramón Martínez
Director
Negociado de Pesca y Vida Silvestre

Craig Lilyestrom
Director
División de Recursos Marinos

Celso Rosay Torres
Secretario Auxiliar
Área de Planificación Integral

Vida Martínez Medina
Directora
División de Patrimonio Natural

Vicente Quevedo Bonilla
Jefe
Sección de Estudios y Análisis de Datos

Luis D. Beltrán Burgos
Planificador Ambiental
Sección de Estudios y Análisis de Datos

"INVESTIGATION OF COMPENSATORY MITIGATION FOR CORAL REEF IMPACTS IN THE U.S. ATLANTIC: SOUTH FLORIDA AND THE CARIBBEAN"

Introducción

Atendemos su petición con fecha del día 28 de enero de 2004, de comentarios al documento cuyo título se indica arriba. El documento en cuestión presenta los resultados de una evaluación de la manera en la que se aplican medidas de mitigación compensatoria de la pérdida de arrecifes de coral, en las áreas arrecifales en jurisdicción del gobierno federal en las costas Este y

P.O. Box 9006600 P.O. Box 9006600, San Juan, P.R. 00906-6600
Tel. 724-8774 Fax 724-4255

FWS Responses/Comments

The communication from PRDNER is in the form of an internal memorandum provided to the Service. The reviewer was tasked with summarizing the study for the purpose of in-house review. We have summarized the major points in the paragraphs in English under the numbered entries below, and provided our responses at the end of this English summary.

1) The Introduction in this memorandum briefly describes the report and how it came about, and clarify that the comments are restricted to sections reporting on or discussing Puerto Rico and its surrounding islands.

Much of the information in the comments section of the letter reiterates or summarizes information from the report. In most cases, the following comments simply summarize what was expressed in the particular paragraph.

Aileen T. Velazco Domínguez
 "...COMPENSATORY MITIGATION FOR CORAL REEF IMPACTS..."
 6 de febrero de 2004
 Página 2

Sur del estado de Florida¹ y en la unidad política estadounidense compuesta para fines de estudio por Puerto Rico y las Islas Virgenes de los Estados Unidos (excluyente de la isla de Navassa). El documento responde a lo que dispone la Resolución Número 4, adoptada durante la reunión del Grupo Federal de Trabajo Sobre Arrecifes de Coral (*U.S. Coral Reef Task Force, USCRTF*) en San Juan, Puerto Rico (2 y 3 de octubre de 2002), a los fines del levantamiento de información sobre la efectividad de la mitigación compensatoria sobre los impactos de las acciones permitidas o sufragadas (o ambas) por el gobierno federal; este levantamiento de información incluye el análisis de acciones exitosas de mitigación y recomendaciones para el mejoramiento de dichas acciones.

Aclaremos que dentro de lo que nos permite el tiempo del que disponemos, el ámbito de los siguientes comentarios se limita únicamente a los hallazgos y recomendaciones pertinentes a los arrecifes de coral en las costas de Puerto Rico y sus islas y cayos circundantes.

Comentarios

De acuerdo con el documento ante nuestra atención, un grupo de trabajo compuesto por representantes del Cuerpo de Ingenieros del Ejército (USACE), la Agencia Federal de Protección Ambiental (EPA) y otras agencias federales representadas en el ámbito objeto del presente memorando,² identificó para fines de estudio algunos proyectos de desarrollo con impactos sobre los arrecifes de coral. Dicho ejercicio recurrió a la búsqueda de los datos almacenados en la base de datos de análisis regulatorio y manejo del USACE (conocida como RAMS, por sus siglas en inglés); sin embargo, se ha dicho que esa base de datos no registra información sobre la cabida y funciones de los sistemas ecológicos perdidos y recuperados en acciones autorizadas mediante permiso del USACE, por lo que se han hecho recomendaciones dirigidas a la futura incorporación de esa información (National Research Council, 2001, páginas 121 y 122).

El ejercicio del referido grupo de trabajo federal resultó en la selección de 28 proyectos bajo la jurisdicción del USACE que impactaron 47 acres (19 hectáreas) de arrecifes de coral en el Caribe; 16 de los proyectos examinados se desarrollaron entre 1985 y 1994, mientras que los 12 proyectos restantes se desarrollaron desde 1995 hasta 2003. Los proyectos seleccionados incluyen la construcción de rompeolas (por ejemplo, el rompeolas municipal de Aguadilla), dragados de mantenimiento (como los de los muelles de Arecibo y San Juan), y otros proyectos de desarrollo portuario, tuberías para la transferencia de derivados del petróleo, y líneas submarinas de transmisión eléctrica y de comunicaciones. Excluyentes de los efectos resultantes de la construcción de muelles privados en los cayos circundantes a las Islas Virgenes de los Estados Unidos, y la poco frecuente utilización de la arena para la alimentación de playas, los principales impactos identificados por ese grupo sobre los arrecifes de coral en Puerto Rico son aquellos generados por los proyectos portuarios (mayormente la profundización del calado en los canales de entrada) y los de la

¹ Esta unidad del área de estudio abarca la plataforma continental en la costa este de Florida, desde el Condado Indian River hacia el Sur, hasta los Cayos de Florida (página 12 del documento).

² Las otras agencias representadas son el Servicio Federal de Pesca y Vida Silvestre (FWS) y la División de Pesquerías de la Administración Nacional Oceánica y Atmosférica (NOAA), situada bajo el Departamento Federal de Comercio.

1

2) The comments note that the RAMS database does not record the specific data on the area and functions of the lost ecosystems, and note this as a reason for incorporating this information as recommended by the National Resource Council (2001). We concur that better information is needed in the database, but note that adequate review of a project will still require examination of more detailed individual file information.

2

3) This paragraph reiterates some of the study results with respect to the types of projects that resulted in impacts to coral reefs, noting that the largest impacts were from the port development (principally the dredging of port entrance channels), and the placement of tubes, outfall pipes and communication or power lines.

3

colocación de tuberías, emisarios submarinos, y líneas eléctricas y de comunicaciones.

Del análisis de los proyectos examinados, el documento ante nuestra atención indica que la mayor parte de los impactos ocurrieron en el periodo de estudio de 1985—1994, cuando se afectaron unos 42 acres (17 hectáreas) de arrecifes en el ámbito de nuestro interés. El documento atribuye la mayor parte de ese impacto a la construcción del emisario submarino para la planta regional de tratamiento de aguas de Ponce, que impactó unos 28 acres (11 hectáreas) de arrecifes; otras acciones que tuvieron efectos significativos durante el mismo periodo estudiado fueron el dragado de fondo y la colocación de relleno. En cuatro de los 16 proyectos examinados para ese periodo se había documentado (en alguna forma) la adopción de medidas para evitar o aminorar los impactos sobre los arrecifes de coral, mientras que para el periodo ulterior (1995—2003) se documentaron dichas medidas en ocho de los 12 proyectos examinados. De nuevo se destaca en ese sentido la construcción del emisario submarino para la planta regional de tratamiento de aguas de Ponce, en la cual se aprovechó uno de los lados de la trinchera excavada en el corredor del proyecto para colocar allí el material excedente de la construcción³ y disminuir a la mitad la huella de impacto de esa acción.

Por otra parte, se evalúan en el documento ante nuestra atención la manera en la que se mitigaron impactos como los mencionados en el párrafo anterior. En ese sentido, los preparadores del documento consideraron si la mitigación era consecuente con la normativa aplicable a la mitigación de impactos ambientales, entre la que se destaca un memorando de acuerdo, firmado el día 15 de noviembre de 1989 entre el USACE y la EPA.⁴ Ese memorando acoge la secuencia de mitigación establecida por la normativa federal,⁵ a los fines de que se siga la misma en la consideración de solicitudes de permiso bajo la Sección 404 de la *Ley Federal de Agua Limpia*,⁶ la cual regula la colocación de material de relleno sobre las aguas de los Estados Unidos de América.⁷ En el memorando se establece la preferencia de las agencias firmantes por la mitigación que conlleva el reemplazo del recurso impactado con un recurso de su mismo valor funcional (*in kind*), ubicar el recurso de reemplazo en la vecindad del recurso impactado (*on site*) y que la mitigación que se

4) This paragraph summarizes more information about the results and discussion section of the report, particularly the high impacts caused by the Ponce Waste Wastewater Treatment Plant Outfall, and the minimization methods used to halve the project impacts.

5) This paragraph and most of the footnotes summarize the procedures and laws used to develop the avoidance, minimization, and compensation protocols for mitigation. Footnote 3 refers to the term "side-casting", clarifying that it refers to the placement of excavated material to the side of a trench (commonly used construction term).

³ A fin de que esto se entienda mejor, en el documento que nos ocupa se utiliza la palabra compuesta *side-casting*. El suscriptor hizo una búsqueda de esta palabra en la Internet, en la cual encontró la palabra *side-cast*. Esta última se define como aquel material de construcción de carreteras que no se usa como relleno y que se empuja hacia o se coloca sobre el lado de la vía pendiente abajo; dicho material puede viajar largas distancias pendiente abajo, antes de llegar al punto donde reposará finalmente. (FUENTE: <http://highway.com/usa/education/>.) Se presume que la palabra original objeto de la búsqueda se refiere a la acción de colocar dicho material, de la misma manera que se hace en la construcción de carreteras.

⁴ *Memorandum of Agreement Between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines.*

⁵ Esta secuencia conlleva evitar completamente el impacto mediante la no realización de una acción o algunos de sus elementos; limitar la intensidad o magnitud de la acción propuesta, con el fin de aminorar su impacto; rectificar el impacto mediante la reparación, rehabilitación o restauración del ambiente afectado; disminuir o eliminar el impacto mediante preservación o mantenimiento, durante la vida útil de la acción; y compensar el impacto de la acción mediante el reemplazo o sustitución con recursos o ambientes equivalentes (40 CFR 1508.20).

⁶ Título IV de la Ley Pública 92-500 de 1972, según enmendada.

⁷ A los fines de la reglamentación federal, aguas de los Estados Unidos de América son todas las aguas en uso actualmente, usadas en el pasado, o susceptibles de usarse en el futuro en el comercio interestatal o extranjero. Se incluyen en esta definición las aguas sujetas al flujo y reflujo de la marea, todas las aguas interestatales, algunas aguas intrastatales (por ejemplo, lagos, ríos y aguas similares) cuya degradación o destrucción pudiera afectar adversamente el comercio interestatal o extranjero, los embalses o tributarios de todas estas aguas, los mares territoriales y los humedales adyacentes a todas las aguas anteriores (33 CFR 328.3(b)).

Aileen T. Velazco Domínguez
 "...COMPENSATORY MITIGATION FOR CORAL REEF IMPACTS..."
 6 de febrero de 2004
 Página 4

practique conlleve la restauración del recurso impactado, en preferencia a la nueva creación del recurso (véase también FWS, 1981).

La mitigación de los impactos documentados para los arrecifes de coral en el Caribe constó principalmente del trasplante de las colonias de coral (aparentemente con exclusión de esponjas, moluscos y otros organismos arrecifales), desde los lugares impactados por las obras propuestas a localidades en las cercanías de los mismos; ello no necesariamente cumple con el criterio antes mencionado de que la mitigación se produzca en el mismo lugar del recurso afectado, como lo indican los resultados presentados en el documento ante nuestra atención. A pesar de que parece haber sido exitosa en su sentido cualitativo, se alega en el documento que la efectividad de esta medida de mitigación no puede ser cuantificada, en lo referente a determinar la caída de áreas arrecifales creada por unidad de caída impactada. En muchos de los 28 proyectos examinados en ambos periodos, se requirió el monitoreo de las acciones de mitigación o de construcción. Este monitoreo se hizo más evidente en el periodo 1995—2003; de los 12 proyectos evaluados para ese periodo, se requirió monitorear nueve, de los cuales se había completado el monitoreo de ocho al final del periodo de estudio.

En la discusión de los hallazgos, el documento ante nuestra atención señala la falta de información fundamental (*baseline information*) que permita anticipar razonablemente la posibilidad de impactos ambientales significativos de las acciones de desarrollo sobre áreas arrecifales en el Caribe, y que dichos impactos puedan ser mitigados según lo que establece la normativa a esos fines. Según lo indica el documento que nos ocupa, esto conlleva la preparación de mapas béticos (es decir, del fondo) a mayor precisión que la de los mapas béticos actualmente disponibles,⁸ que sean útiles en la evaluación de posibles impactos de desarrollos prospectivos de mayor magnitud. No obstante, se infiere que la información disponible en estos momentos ha permitido recomendar las medidas para mitigar adecuadamente muchos de los impactos ambientales previstos.

Conclusión

Nuestra División considera aceptables las conclusiones obtenidas del documento federal ante nuestra atención, particularmente en lo referente al aparente éxito de las recientes medidas de mitigación de impactos sobre arrecifes de coral en Puerto Rico y las Islas Vírgenes de los Estados Unidos. No obstante, es menester que se mejore el levantamiento de información por parte de las agencias federales que tienen a su cargo la concesión de permisos para acciones que puedan afectar significativamente los arrecifes de coral. A esos fines, consideramos que se debe requerir de cualquier solicitante de permiso que proponga medidas claras y específicas de manejo adaptativo y mitigación, que contribuyan a promover la integridad biológica y ecológica de los arrecifes de coral y sus comunidades asociadas. Estas mitigaciones deben realizarse de manera tal que provean la mayor contribución posible al ecosistema marino que se beneficiará de la misma. También deben considerarse las decisiones que se tomen, tanto de permitir o auspiciar económicamente la acción propuesta, como

⁸ NOAA. 2001. *Benthic Habitats of Puerto Rico and the U.S. Virgin Islands*. CD-ROM. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, National Centers for Coastal Ocean Science Biogeography Program, Silver Spring, MD.

6) This paragraph notes the discrepancy between the no-net loss policy procedures discussed in the previous paragraph, and the inability to relate the mitigation results directly to the impacts realized. It also summarizes the results relating the number of projects where monitoring was or was not done.

7) This paragraph summarizes some of the discussion regarding the need for detailed benthic surveys, particularly to evaluate large projects to adequately determine the impacts. It misinterprets the report to infer that there is adequate available information to recommend mitigation measures adequate to address impacts to coral reefs. One of the points of the document is that there is a need for information sharing and to establish better mitigation measures and monitoring criteria to improve mitigation recommendations, compliance, and monitoring.

8) This paragraph states that the reviewers Division (within DNER) finds the conclusions of the report acceptable, but makes some recommendations regarding requiring clear conditions on a permittee to ensure success of mitigation, and the use of adaptive management for mitigation that would allow mitigation to address other existing impacts (erosion control in areas shown to have serious problems is mentioned). Finally, the reviewer suggest that the Federal agencies establish scientific studies of areas subject to existing mitigation to improve the future recommendations. And again refers to the National Research Council 2001 report (Compensating for Wetland Losses Under the Clean Water Act.

Alleen T. Velazco Domínguez
"...COMPENSATORY MITIGATION FOR CORAL REEF IMPACTS..."
6 de febrero de 2004
Página 5

de mitigar los impactos que resulten de la misma, dentro de un contexto geográfico más amplio (por ejemplo, un permiso que se otorgue para movimiento de terreno, pero que mediante la erosión y sedimentación del material expuesto pueda afectar las áreas arrecifales a la distancia) y a mayor plazo. Finalmente, al igual que se ha propuesto para los humedales, sería beneficioso para la evaluación de la mitigación de impactos ambientales sobre arrecifes de coral que el USACE y otras agencias federales con ingerencia establezcan un programa para el estudio e investigación de las áreas arrecifales en las que se están llevando a cabo acciones de mitigación, que permita determinar las prácticas de manejo que permitan lograr la mitigación exitosa de impactos sobre arrecifes de coral a largo plazo (recomendaciones adaptadas de National Research Council, 2001, páginas 167—168).

Literatura Citada

FWS. 1981. U.S. Fish and Wildlife Service Mitigation Policy. *Federal Register*, volumen 46, páginas 7644—7663.

National Research Council. 2001. *Compensating for Wetland Losses Under the Clean Water Act*. National Academy Press, Washington, D.C.

LDB/ldb

Additional Response to the Comments

We concur with the need to conduct field evaluation of past mitigations to improve the recommendations. It should be noted that the report is based only on a file review, with no actual field verification of the mitigations and how they were accomplished. The results of mitigations were largely based upon reviewing monitoring reports submitted by the project proponent to the Corps.

In the Caribbean, the majority of mitigation has involved transplantation of coral and other sessile organisms to other existing reef areas. Most of the recent projects have been done in the Virgin Islands. Several of these projects merit field evaluation by the agencies, and establishing a better means of quantifying the replacement value of these transplantations for impacted coral habitat.

Based on this review, in Puerto Rico, field inspections of the actual construction impacts would be extremely useful in providing information on whether avoidance and minimization conditions were actually followed to improve recommendations for avoiding and minimizing impacts. The most pertinent projects for this would be the Ponce Wastewater Treatment Plant Outfall, the Vieques/Culebra pipeline, and a set of communication or power cable placements or replacements.

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GOVERNMENT OF THE VIRGIN ISLANDS OF THE UNITED STATES

DEPARTMENT OF PLANNING AND NATURAL RESOURCES

DIVISION OF FISH AND WILDLIFE
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February 3, 2004

Mr. Carlos A. Diaz
USFWS
Boqueron Field Office
P.O. Box 491
Boqueron, PR 00622

Dear Mr. Diaz:

This is in response to your January 28, 2004 letter to Dr. Robert Uwate regarding the draft coral reef mitigation report.

My comments are attached.

Sincerely,

A handwritten signature in black ink, appearing to read "K. Roger Uwate".

K. Roger Uwate, Ph.D.
Chief of Fisheries

Attachment: comments on the draft coral reef mitigation report.

**COMMENTS ON THE DRAFT REPORT TITLED,
"INVESTIGATIONS OF COMPENSATION MITIGATION FOR CORAL
REEF IMPACTS IN THE U.S. ATLANTIC: SOUTH FLORIDA AND THE
CARIBBEAN", JANUARY 2004 DRAFT.**

In general, the report appears to be well written. However, many general statements are made throughout the body of the report that are not supported by references. It may be clear to the writer where these generalities came from, but it is not clear if the general statements come from the writer (as personal knowledge or speculation), or a separate reference, or elsewhere.

It would be extremely useful to provide a flow chart of how coral impacting projects (and projects in general) are developed and implemented specifying where each federal agency gets involved. To the lay reader of this report and to the lay Army Corps of Engineer (ACOE) permit applicant, the ACOE permit process is rather like a black hole. It would be good to have a flow chart regarding the permit process (what is the review process).

In addition, to the lay reader, it is unclear who has responsibility for what. Does the ACOE send all permit application materials to both USFWS and NOAA-Fisheries? What are the mandates of each reviewing agency and reviewer? Are there time constraints for review and comment?

Based on this report, it appears that reporting requirements for ACOE permits are not consistent. For example, it seems that the amount of coral restoration is measured in various units (acres or numbers of corals transplanted). This needs to be standardized, and can be specified in the reporting form.

Also, it was not clear if there was follow-up on the report requirements. Are there any checks to determine if the reporting requirements were met? Who has responsibility for this? What are the penalties for not reporting?

At the end of this report, a new interagency body is suggested. However, it may be more appropriate to develop better lines of communication between existing organizations and provide more resources to them so that they can do their job. Making a new organization without adequate resources, or taking resources of existing over-extended agencies makes no sense. Much more consideration is needed on this proposal.

Specific comments are listed below.

1. Acronyms – Need a list of acronyms up front next to the index.
2. NMFS - I thought that NMFS was officially replaced by NOAA-Fisheries. These terms are mixed and used throughout the report.

FWS Responses/Comments

- 1) References were added to the report, and some information was modified.
- 2) We concur that the Corps civil works and permit processes are complex, but providing details on these processes is beyond the scope of this report.
- 3) Corps regulations require the Corps to emit a public notice once very basic information is provided by the applicant. Effort is made to request additional information from an applicant, but it may not be provided. Additionally, large documents (EA or EIS) are often not distributed unless they are Federal NEPA documents. We concur that provision of these documents to the resource agencies would help streamline the process.
- 4) Standardization and appropriate quantification of impact and compensation results is difficult, even with much more simplified freshwater or intertidal wetland impacts. While there needs to be some standardization, there also needs to be flexibility in what is considered to be appropriate mitigation for different areas and types of impacts.
- 5) The Corps has responsibility for seeing that permit conditions have been met, but may lack the expertise to assess the quality of the reports. The Resource agencies have argued for some time for access to monitoring reports to track the results and evaluate the efficacy of their recommendations.
- 6) Achieving the recommendations here should require input from federal and local agencies with interest in or jurisdiction over these resources. For the Caribbean, a small federal working group was initiated by the Corps at the start of this review. Hawaii has created a working group, and is conducting workshops to recommend better mitigation options and measures to evaluate mitigation results.

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3. Shorthand reference to agencies - Throughout the text there is reference to "the Service", "the Agencies", etc. For the lay reader, the agency associated with these terms is not clear. It would be appropriate to define these up front or use a common acronym for them throughout the text.
4. Page 4, table - The percentages don't make sense when compared with the fraction next to it. For example, under % required mitigation completed, 79% (11/16) is indicated. 11/16 equals 69%, not 79%. There is no definition of the numbers in brackets, but these are logically the number of projects that fit a criteria divided by the total number of projects.
5. Page 5, para 2, 4th line - "spacial" should be "spatial"? Same with page 5, last line.
6. Page 5, Introduction, para 1 - Missing references.
7. Page 6, para 4 - Need references for the area estimates stated.
8. Page 7, para 2 - I don't think that the northern coast of the USVI is "protected". What is the reference here? Also, NPS in St. John includes submerged lands. Need to mention about the 2 new national monuments (submerged land areas).
9. Page 7, para 3 - Need references here.
10. Page 21, table 6 - Need a note about the meaning of the ratings column.
11. Page 42, para 1 - An interagency technical advisory team (ITAC) is proposed by the authors with specific mandates that are listed. It would be inappropriate for the ITAC to identify agency roles. That is up to the mandate of each agency.
12. Page 42-43 - It is not clear who will pay for the ITAC. Budgets of most federal and state agencies are extremely limited. Current staff can't even keep up with the current mandates for these offices. Without additional resources (financial and staff), how can existing agencies send people to ITAC meetings, or how can the ITAC members do any real work?

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7) Minor editorial comments, correction of the percentages, and reference additions were made. The ratings for compensatory mitigation are explained in the methodology section (see Section II.C.).

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8) See response (6) above relative to the "ITAC". Funding for effective teams to meet to develop strategies or guidelines for coral mitigation may be required in order to meet the recommendations in this study. Hawaii is already conducting workshops for this purpose, and several of the Pacific territories have requested similar efforts in their areas.