DRAFT COMPREHENSIVE CONSERVATION PLAN AND ENVIRONMENTAL ASSESSMENT

LAGUNA CARTAGENA NATIONAL WILDLIFE REFUGE

Lajas, Puerto Rico

U.S. Department of the Interior
Fish and Wildlife Service

Southeast Region
Atlanta, Georgia

February 2011

TABLE OF CONTENTS

SECTION A. DRAFT COMPREHENSIVE CONSERVATION PLAN

I. Background 1

Introduction 1
Purpose And Need For The Plan 1
Fish and Wildlife Service 1
National Wildlife Refuge System 2
Legal and Policy Context 3
National and International Conservation Plans and Initiatives 4
Relationship To State Wildlife Agency 6

II. Refuge Overview 7

Introduction 7
Refuge History and Purpose 7
Background Information 7
Special Designations 8
Ecosystem Context 11
Regional Conservation Plans and Initiatives 12
Ecological Threats and Problems 12
Physical Resources 13
Climate 13
Geology and Topography 14
Soils 17
Hydrology and Water Quality 18
Biological Resources 20
Habitat 20
Wildlife 26
Cultural Resources 27
Socioeconomic Environment 27
Refuge Administration and Management 28
Land Protection and Conservation 28
Visitor Services 28
Personnel, Operations, and Maintenance 29

III. Plan Development 31

Summary of Issues, Concerns, and Opportunities 31

IV. Management Direction 35

Introduction 35
Vision 35
Goals, Objectives, and Strategies 35
Fish and Wildlife Population Management 36
Habitat Management 41
Resource Protection 45
Visitor Services 47
Refuge Administration 50

V. Plan Implementation **55**

Introduction 55
Proposed Projects 55
Funding and Personnel 59
Partnership/Volunteers Opportunities 60
Step-Down Management Plans 60
Monitoring and Adaptive Management 62
Plan Review and Revision 62

SECTION B. ENVIRONMENTAL ASSESSMENT

I. Background **63**

Introduction 63
Purpose and Need for Action 63
Decision Framework 64
Planning Study Area 64
Authority, Legal Compliance, and Compatibility 64
Compatibility 65
Public Involvement and the Planning Process 65
Formulation of Alternatives 69
Description of Alternatives 69
Alternative A – (Current Management - No Action) 69
Alternative B – Wildlife Diversity and Habitat Restoration (proposed alternative) 69
Alternative C – Wetland Restoration Emphasis 69
Features Common to all Alternatives 69
Comparison of the Alternatives by Issue 71
Alternatives Considered But Eliminated From Further Analysis 95

IV. Environmental Consequences **97**

Overview 97
Effects Common to All Alternatives 97
Environmental Justice 97
Climate Change 97
Other Management 98
Land Acquisition 98
Cultural Resources 98
Refuge Revenue-Sharing 99
Other Effects 99
Summary of Effects by Alternative 99
Unavoidable Impacts and Mitigation Measures 133
Water Quality from Soil Disturbance and Use of Herbicides 133
Wildlife Disturbance 133
Vegetation Disturbance 134
User Group Conflicts 134
Effects on Adjacent Landowners 134
Land Ownership and Site Development 134
Cumulative Impacts 135
Direct and Indirect Effects or Impacts 135
Short-term Uses versus Long-term Productivity 135

V. Consultation and Coordination **137**
Overview 137

APPENDICES

Appendix A. Glossary **139**

Appendix B. References and Literature Citations **149**

Appendix C. Relevant Legal Mandates and Executive Orders **155**

Appendix D. Public Involvement **169**
Summary Of Public Scoping Comments 169

Appendix E. Appropriate Use Determinations **171**

Appendix F. Compatibility Determinations **183**

Appendix G. Intra-Service Section 7 Biological Evaluation **197**

Appendix H. Wilderness Review **205**

Appendix I. Refuge Biota **207**

Appendix J. Budget Requests **235**
Refuge Operating Needs System (RONS) 235
Maintenance Management System Needs 236

Appendix K. List of Preparers **237**

LIST OF FIGURES

Figure 1. Location of Laguna Cartagena National Wildlife Refuge 9
Figure 2. Approved Boundary of Laguna Cartagena national Wildlife Refuge 10
Figure 3. Geology of Laguna Cartagena National Wildlife Refuge 15
Figure 4. Topography of Laguna Cartagena National Wildlife Refuge 16
Figure 5. Soil Types of Laguna Cartagena National Wildlife Refuge 19
Figure 6. Surface Hydrology of Laguna Cartagena National Wildlife Refuge 21
Figure 7. Landcover Vegetation of the Laguna Cartagena National Wildlife Refuge 25
Figure 8. Proposed organizational chart for Laguna Cartagena National Wildlife Refuge 61

LIST OF TABLES

Table 1. Summary of Projects 59
Table 2. Step-down management plans 60
Table 3. Comparison of alternatives by management issues for Laguna Cartagena National Wildlife Refuge 71
Table 4. Summary of Environmental Effects by Alternative for Laguna Cartagena NWR 101

SECTION A. DRAFT COMPREHENSIVE CONSERVATION PLAN

I. Background

INTRODUCTION

The Fish and Wildlife Service (Service) has prepared this Draft Comprehensive Conservation Plan and Environmental Assessment (Draft CCP/EA) for Laguna Cartagena National Wildlife Refuge (NWR), to guide management actions and direction for the refuge. Fish and wildlife conservation will receive first priority in refuge management; wildlife-dependent recreation will be allowed and encouraged as long as it is compatible with, and does not detract from, the mission of the refuge or the purposes for which it was established.

A planning team developed a range of alternatives that best met the goals and objectives of the refuge and that could be implemented within the 15-year planning period. This Draft CCP/EA describes the Service's proposed alternative, as well as other alternatives considered and their effects on the environment. The Draft CCP/EA will be made available to state and federal government agencies, conservation partners, and the general public for review and comment. Comments from each entity will be considered in the development of the final CCP.

PURPOSE AND NEED FOR THE PLAN

The purpose of the Draft CCP/EA is to develop a proposed action that best achieves the refuge purpose; attains the vision and goals developed for the refuge; contributes to National Wildlife Refuge System (Refuge System) mission; addresses key problems, issues and relevant mandates; and is consistent with sound principles of fish and wildlife management.

Specifically, the Draft CCP/EA is needed to:

- Provide a clear statement of refuge management direction;
- Provide refuge neighbors, visitors, and government officials with an understanding of Service management actions on and around the refuge;
- Ensure that Service management actions, including land protection and recreation/education programs, are consistent with the mandates of the Refuge System; and
- Provide a basis for the development of budget requests for operations, maintenance, and capital improvement needs.

FISH AND WILDLIFE SERVICE

The Service traces its roots to 1871 and the establishment of the Commission of Fisheries involved with research and fish culture. The once-independent commission was renamed the Bureau of Fisheries and placed under the Department of Commerce and Labor in 1903.

The Service also traces its roots to 1886 and the establishment of a Division of Economic Ornithology and Mammalogy in the Department of Agriculture. Research on the relationship of birds and animals to agriculture shifted to delineation of the range of plants and animals so the name was changed to the Division of the Biological Survey in 1896.

The Department of Commerce, Bureau of Fisheries, was combined with the Department of Agriculture, Bureau of Biological Survey, on June 30, 1940, and transferred to the Department of the Interior as the Fish and Wildlife Service. The name was changed to the Bureau of Sport Fisheries and Wildlife in 1956 and finally to the Fish and Wildlife Service in 1974.

The Service, working with others, is responsible for conserving, protecting, and enhancing fish and wildlife and their habitats for the continuing benefit of the American people through federal programs relating to migratory birds, endangered species, interjurisdictional fish and marine mammals, and inland sport fisheries (142 DM 1.1).

As part of its mission, the Service manages more than 540 national wildlife refuges covering over 95 million acres. These areas comprise the National Wildlife Refuge System, the world's largest collection of lands set aside specifically for fish and wildlife. The majority of these lands, 77 million acres, is in Alaska. The remaining acres are spread across the other 49 states and several United States territories. In addition to refuges, the Service manages thousands of small wetlands, national fish hatcheries, 64 fishery resource offices, and 78 ecological services field stations. The Service enforces federal wildlife laws, administers the Endangered Species Act, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat, and helps foreign governments with their conservation efforts. It also oversees the Federal Aid program that distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state fish and wildlife agencies.

NATIONAL WILDLIFE REFUGE SYSTEM

The mission of the National Wildlife Refuge System, as defined by the National Wildlife Refuge System Improvement Act of 1997 is:

> "...to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

The National Wildlife Refuge System Improvement Act of 1997 (Improvement Act) established, for the first time, a clear legislative mission of wildlife conservation for the Refuge System. Actions were initiated in 1997 to comply with the direction of this new legislation, including an effort to complete comprehensive conservation plans for all refuges. These plans, which are completed with full public involvement, help guide the future management of refuges by establishing natural resources and recreation/education programs. Consistent with the Improvement Act, approved plans will serve as the guidelines for refuge management for the next 15 years. The Improvement Act states that each refuge shall be managed to:

- Fulfill the mission of the Refuge System;
- Fulfill the individual purposes of each refuge;
- Consider the needs of wildlife first;
- Fulfill requirements of comprehensive conservation plans that are prepared for each unit of the Refuge System;
- Maintain the biological integrity, diversity, and environmental health of the Refuge System; and
- Recognize that wildlife-dependent recreation activities including hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation are legitimate and priority public uses; and allow refuge managers authority to determine compatible public uses.

The following are just a few examples of your national network of conservation lands. Pelican Island National Wildlife Refuge, the first refuge, was established in 1903 for the protection of colonial nesting birds in Florida, such as the snowy egret and the brown pelican. Western refuges were established for American bison (1906), elk (1912), prong-horned antelope (1931), and desert bighorn sheep (1936) after over-hunting, competition with cattle, and natural disasters decimated once-abundant herds. The drought conditions of the 1930s Dust Bowl severely depleted breeding populations of ducks and geese. Refuges established during the Great Depression focused on waterfowl production areas (i.e., protection of prairie wetlands in America's heartland). The emphasis on waterfowl continues today but also includes protection of wintering habitat in response to a dramatic loss of bottomland hardwoods. By 1973, the Service had begun to focus on establishing refuges for endangered species.

Recreational visits to national wildlife refuges are an important component of this economic activity. In FY 2006, 34.8 million people visited refuges in the lower 48 states for recreation, mostly to observe wildlife in their natural habitats. Their spending generated almost $1.7 billion of sales in regional economies. As this spending flowed through the economy, nearly 27,000 people were employed and $542.8 million in employment income was generated. About 82 percent of total expenditures are generated by non-consumptive activities on refuges. Fishing accounted for 12 percent and hunting 6 percent. Local residents accounted for 13 percent of expenditures, while visitors coming from outside the local area accounted for 87 percent. Refuge recreational spending generated about $185.3 million in tax revenue at the local, county, state and federal level (Carver and Caudill 2007).

Volunteers continue to be a major contributor to the success of the Refuge System. In 2002, volunteers contributed more than 1.5 million hours on refuges nationwide, a service valued at more than $22 million.

The wildlife and habitat vision for national wildlife refuges stresses that wildlife comes first; that ecosystems, biodiversity, and wilderness are vital concepts in refuge management; that refuges must be healthy and growth must be strategic; and that the Refuge System serves as a model for habitat management with broad participation from others.

The Improvement Act stipulates that comprehensive conservation plans be prepared in consultation with adjoining federal, state, and private landowners and that the Service develop and implement a process to ensure an opportunity for active public involvement in the preparation and revision (every 15 years) of the plans.

All lands of the Refuge System will be managed in accordance with an approved comprehensive conservation plan that will guide management decisions and set forth strategies for achieving refuge unit purposes. The plan will be consistent with sound resource management principles, practices, and legal mandates, including Service compatibility standards and other Service policies, guidelines, and planning documents (602 FW 1.1).

LEGAL AND POLICY CONTEXT

Legal Mandates, Administrative and Policy Guidelines, and Other Special Considerations

Administration of national wildlife refuges is guided by the mission and goals of the Refuge System, congressional legislation, presidential executive orders, and international treaties. Policies for management options of refuges are further refined by administrative guidelines established by the Secretary of the Department of the Interior and by policy guidelines established by the Director of the Fish and Wildlife Service. Select legal summaries of treaties and laws relevant to administration of the Refuge System and management of the Laguna Cartagena NWR are provided in Appendix C.

Treaties, laws, administrative guidelines, and policy guidelines assist the refuge manager in making decisions pertaining to soil, water, air, flora, fauna, and other natural resources; historical and cultural resources; research and recreation on refuge lands; and provide a framework for cooperation between Laguna Cartagena NWR and other partners, such as the Puerto Rico Department of Natural and Environmental Resources (Puerto Rico DNER), and private landowners, etc.

Lands within the Refuge System are closed to public use unless specifically and legally opened. No refuge use may be allowed unless it is determined to be compatible. A compatible use is a use that, in the sound professional judgment of the refuge manager, will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge. All programs and uses must be evaluated based on mandates set forth in the Improvement Act. Those mandates are to:

- Contribute to ecosystem goals, as well as refuge purposes and goals;
- Conserve, manage, and restore fish, wildlife, and plant resources and their habitats;
- Monitor the trends of fish, wildlife, and plants;
- Manage and ensure appropriate visitor uses as those uses benefit the conservation of fish and wildlife resources and contribute to the enjoyment of the public; and
- Ensure that visitor activities are compatible with refuge purposes.

The Improvement Act further identifies six priority wildlife-dependent recreational uses. These uses are: hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation. As priority public uses of the Refuge System, they receive priority consideration over other public uses in planning and management.

Biological Integrity, Diversity, and Environmental Health Policy

The Improvement Act directs the Service to ensure that the biological integrity, diversity, and environmental health of the Refuge System are maintained for the benefit of present and future generations of Americans. The policy is an additional directive for refuge managers to follow while achieving refuge purpose(s) and the Refuge System mission. It provides for the consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on refuges and associated ecosystems. When evaluating the appropriate management direction for refuges, refuge managers will use sound professional judgment to determine their refuges' contribution to biological integrity, diversity, and environmental health at multiple landscape scales. Sound professional judgment incorporates field experience, knowledge of refuge resources and the refuge's role within an ecosystem, applicable laws, and best available science, including consultation with others both inside and outside the Service.

NATIONAL AND INTERNATIONAL CONSERVATION PLANS AND INITIATIVES

Multiple partnerships have been developed among government and private entities to address the environmental problems affecting regions. There is a large amount of conservation and protection information that defines the role of the refuge at the local, national, international, and ecosystem levels. Conservation initiatives include broad-scale planning and cooperation between affected parties to address declining trends of natural, physical, social, and economic environments. The conservation guidance described below, along with issues, problems, and trends, was reviewed and integrated where appropriate into this Draft CCP/EA.

This Draft CCP/EA supports, among others, the Partners-in-Flight Plan, the North American Waterfowl Management Plan, the Western Hemisphere Shorebird Reserve Network, and the National Wetlands Priority Conservation Plan.

North American Bird Conservation Initiative. Started in 1999, the North American Bird Conservation Initiative is a coalition of government agencies, private organizations, academic institutions, and private industry leaders in the United States, Canada, and Mexico, working to ensure the long-term health of North America's native bird populations by fostering an integrated approach to bird conservation to benefit all birds in all habitats. The four international and national bird initiatives include the North American Waterfowl Management Plan, Partners-in-Flight, Waterbird Conservation for the Americas, and the U.S. Shorebird Conservation Plan.

North American Waterfowl Management Plan. The North American Waterfowl Management Plan is an international action plan to conserve migratory birds throughout the continent. The plan's goal is to return waterfowl populations to their 1970s levels by conserving wetland and upland habitat. Canada and the United States signed the plan in 1986 in reaction to critically low numbers of waterfowl. Mexico joined in 1994, making it a truly continental effort. The plan is a partnership of federal, provincial/state and municipal governments, non-governmental organizations, private companies, and many individuals, all working towards achieving better wetland habitat for the benefit of migratory birds, other wetland-associated species, and people. Plan projects are international in scope, but implemented at regional levels. These projects contribute to the protection of habitat and wildlife species across the North American landscape.

Partners-in-Flight Bird Conservation Plan. Managed as part of the Partners-in-Flight Plan, the Laguna Cartagena NWR's freshwater wetland physiographic area represents a scientifically based land bird conservation planning effort that ensures long-term maintenance of healthy populations of native land birds, primarily non-game land birds. Non-game land birds have been vastly under-represented in conservation efforts, and many are exhibiting significant declines. This plan is voluntary and non-regulatory, and focuses on relatively common species in areas where conservation actions can be most effective, rather than the frequent local emphasis on rare and peripheral populations.

U.S. Shorebird Conservation Plan. The U.S. Shorebird Conservation Plan is a partnership effort throughout the United States to ensure that stable and self-sustaining populations of shorebird species are restored and protected. The plan was developed by a wide range of agencies, organizations, and shorebird experts for separate regions of the country, and identifies conservation goals, critical habitat conservation needs, key research needs, and proposed education and outreach programs to increase awareness of shorebirds and the threats they face.

Northern American Waterbird Conservation Plan. This plan provides a framework for the conservation and management of 210 species of waterbirds in 29 nations. Threats to waterbird populations include destruction of inland and coastal wetlands, introduced predators and invasive species, pollutants, mortality from fisheries and industries, disturbance, and conflicts arising from abundant species. Particularly important habitats of the Southeast Region include pelagic areas, marshes, forested wetlands, and barrier and sea island complexes. Fifteen species of waterbirds are federally listed, including breeding populations of wood storks, Mississippi sandhill cranes, whooping cranes, interior least terns, and Gulf Coast populations of brown pelicans. A key objective of this plan is the standardization of data collection efforts to better recommend effective conservation measures.

RELATIONSHIP TO STATE WILDLIFE AGENCY

A provision of the Improvement Act, and subsequent agency policy, is that the Service shall ensure timely and effective cooperation and collaboration with other state fish and game agencies and tribal governments during the course of acquiring and managing refuges. State wildlife management areas and national wildlife refuges provide the foundation for the protection of species, and contribute to the overall health and sustainment of fish and wildlife species in the Commonwealth of Puerto Rico.

The Puerto Rico DNER provides management and protection for the commonwealth's fish and wildlife resources. Their mission is:

To implement public policy and programs related to sustainable ecological development, utilization, exploitation, management, conservation and protection of the natural, environmental, and energy resources of Puerto Rico for present and future generations.

II. Refuge Overview

INTRODUCTION

REFUGE HISTORY AND PURPOSE

In 1984, the U.S. Congress directed the Service to acquire and manage lands at Laguna Cartagena in order to rehabilitate the lagoon for resident and migratory water birds, and to provide for increased wildlife-dependent public use. After several years of negotiations, 773 acres were acquired by the Puerto Rico Land Administration, and on Augst 8, 1989, the Service signed a 50-year lease agreement, renewable for another 50 years, but with no fee title ownership. In 1996, an additional 270 acres were acquired with fee title transfer to the Service from the USDA Farm Service Agency. The refuge was established "…for the development, advancement, management, conservation, and protection of fish and wildlife resources…" 16 U.S.C. 742f (a) (4) and "…for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant or condition of servitude…" 16 U.S.C. 742f (b) (1) (Fish and Wildlife Act of 1956). Date Established: 1989 (1,043 acres)

Refuge Objectives:

- To restore and maintain this locally important wetland ecosystem for the benefit of endangered species and migratory birds.
- To protect and restore remnants of the subtropical dry forest.

To date, 164 species of birds have been recorded in the area, including 25 first-records for Puerto Rico.

BACKGROUND INFORMATION

Laguna Cartagena is a freshwater, depressional wetland fed mainly by precipitation runoff (Graves 1991). Because the wetland is shaped like a shallow bowl, when pool levels are high more area is covered by water and the excess flows over the lip of the bowl. When pool levels recede, the area the water occupies decreases, and water ceases flowing out of the bowl. The water that remains trapped occupies a surface area (the dead area) and a volume (the dead volume). The dead area at Laguna Cartagena NWR measures approximately 75-125 acres. It is part of what once was a much larger wetland system in the Lajas Valley that included Laguna de Guánica and the Anegado to the east.

The distinct seasonality and variability of precipitation naturally resulted in a wide range of water levels throughout the year. Floodwaters could flow out relatively quickly, reducing the size of the pool from over 400 acres to its dead area in less than a month. This variability encouraged a mosaic of habitats, including open water in the center of the wetland, a fringe of patchy cattails, and a diverse assemblage of plant species requiring slightly drier soils occupying higher elevations. Subtropical dry forest historically surrounded the wetland.

By the 1920s, the majority of arable land had been converted to agriculture, and water from the wetland was used to irrigate crops. Aerial photos suggest that inlet and outlet canals had been constructed by 1936, followed by a valley-wide irrigation and drainage system constructed in the 1950s. This large agricultural project drained the other Lajas Valley wetlands, leaving Laguna Catagena and a commonweath wildlife refuge downstream of Laguna Cartagena. The central drainage canal was plumbed into Laguna Cartagena, which introduced fertilizer-laden irrigation runoff

on a regular basis, thereby maintaining higher water levels throughout the year and reducing variability of the hydroperiod. Higher, more regular water levels combined with introduced nutrients allow cattail (*Typha domingensis*) to dominate and competitively exclude other plant species, and is the major reason for development of a thick layer of peat. Aerial photos show cattail grew to cover more than 90 percent of the open water area in less than 20 years.

The Service in 1989 acquired 816 acres of the wetland and surrounding uplands under long-term lease. An additional 270 acres of uplands were added under fee title transfer to the Service in 1996. The draft Laguna Cartagena Restoration Plan includes specific information on habitat goals, wildlife population goals, and steps in the restoration process.

Agricultural practices of the last 50 years resulted in eutrophication of Laguna Cartagena's waters, leading to the spread of a floating mat of cattails greater than 80 percent of the surface area. Historically, the most important wetland in Puerto Rico for waterfowl and many other waterbirds, a typical survey of Laguna Cartagena now reveals <10 ducks.

The decline of agriculture in the last 20 years has resulted in improved water quality, but the floating mat of vegetation remains. In 2010, the refuge plans to conduct prescribed burns in conjunction with application of herbicide to remove the majority of the cattail, and follow this with mechanical removal of the floating mat. Previous burns and clearing resulted in remarkable numbers of ducks and other waterbirds using the lagoon. Surveys will track changes in avian abundance with the change in the wetland. Also, we have received funding to construct a bypass canal and irrigation system for restoration of the dry forest.

SPECIAL DESIGNATIONS

Designated Critical Habitat for the Yellow-shouldered Blackbird

The endemic yellow-shouldered blackbird (YSBB) was listed as an endangered species and critical habitat was designated in 1976, pursuant to the Endangered Species Act of 1973, as amended (P.L. 93-205). The entire refuge is part of the more extensive designated critical habitat for this species. Under the law, critical habitat is defined as "an area essential to the conservation of a listed species, though the area need not actually be occupied by the species at the time it is designated." This designation is the most strict conservation measure the Service can provide to the habitat of any federally listed wildlife species.

The YSBB has been recorded infrequently during the Christmas bird counts in Sierra Bermeja and it is very likely to find it on La Tinaja land tract as a protected area of the Sierra. It is unclear how often or how many individuals use Sierra Bermeja, but it is likely it serves as an important corridor for the safe movements of flocks of this endangered species and may regularly serve as their feeding grounds. Sierra Bermeja might become more important for this species in the future if more land in the surrounding area falls into rural or urban development (Aukema et.al 2006). Interestingly, the highest peat of the Sierra is named Cerro Mariquita (Mariquita Peak) which honors the Spanish name of the YSBB, which is "Mariquita."

Figure 1. Location of Laguna Cartagena National Wildlife Refuge

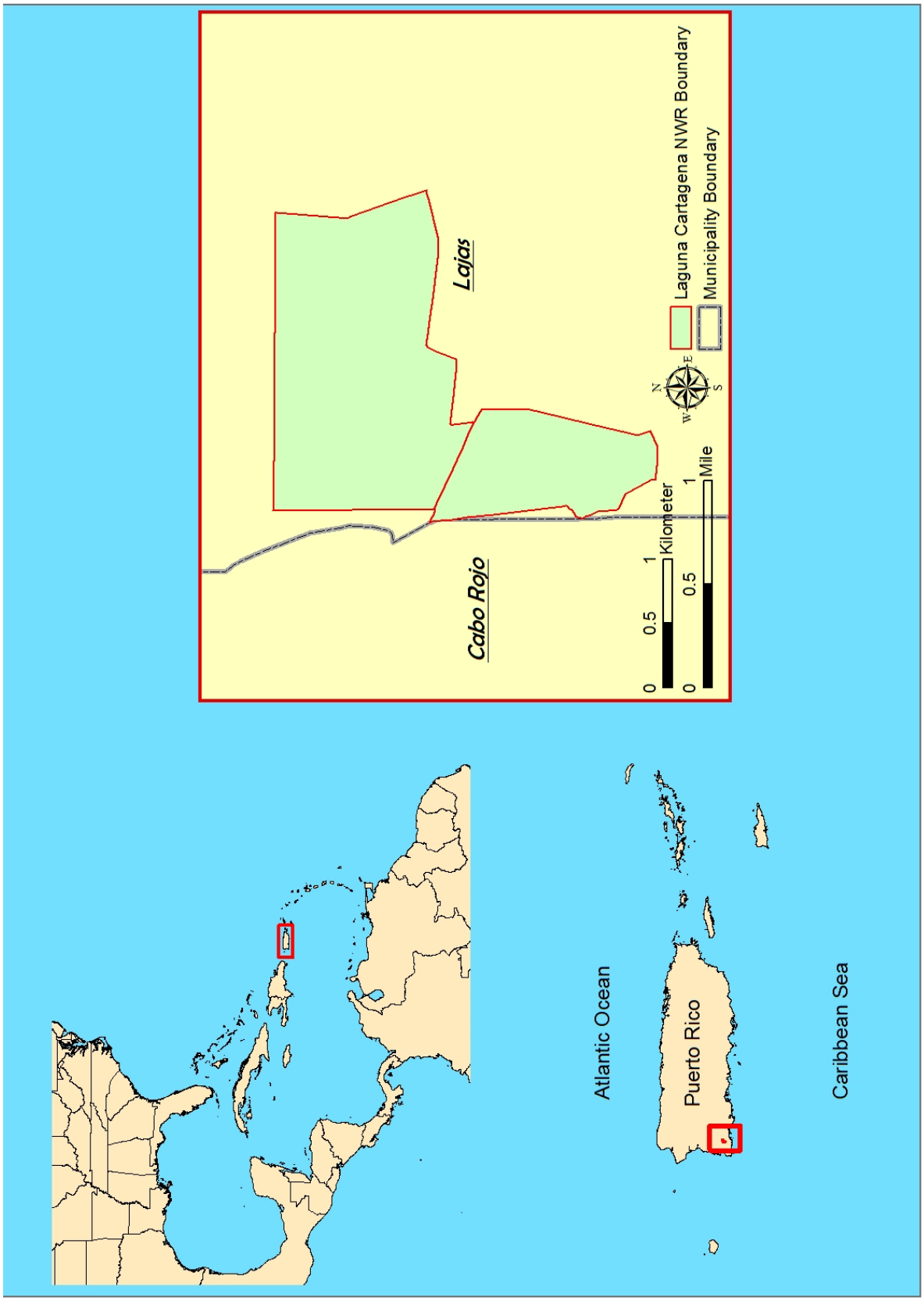
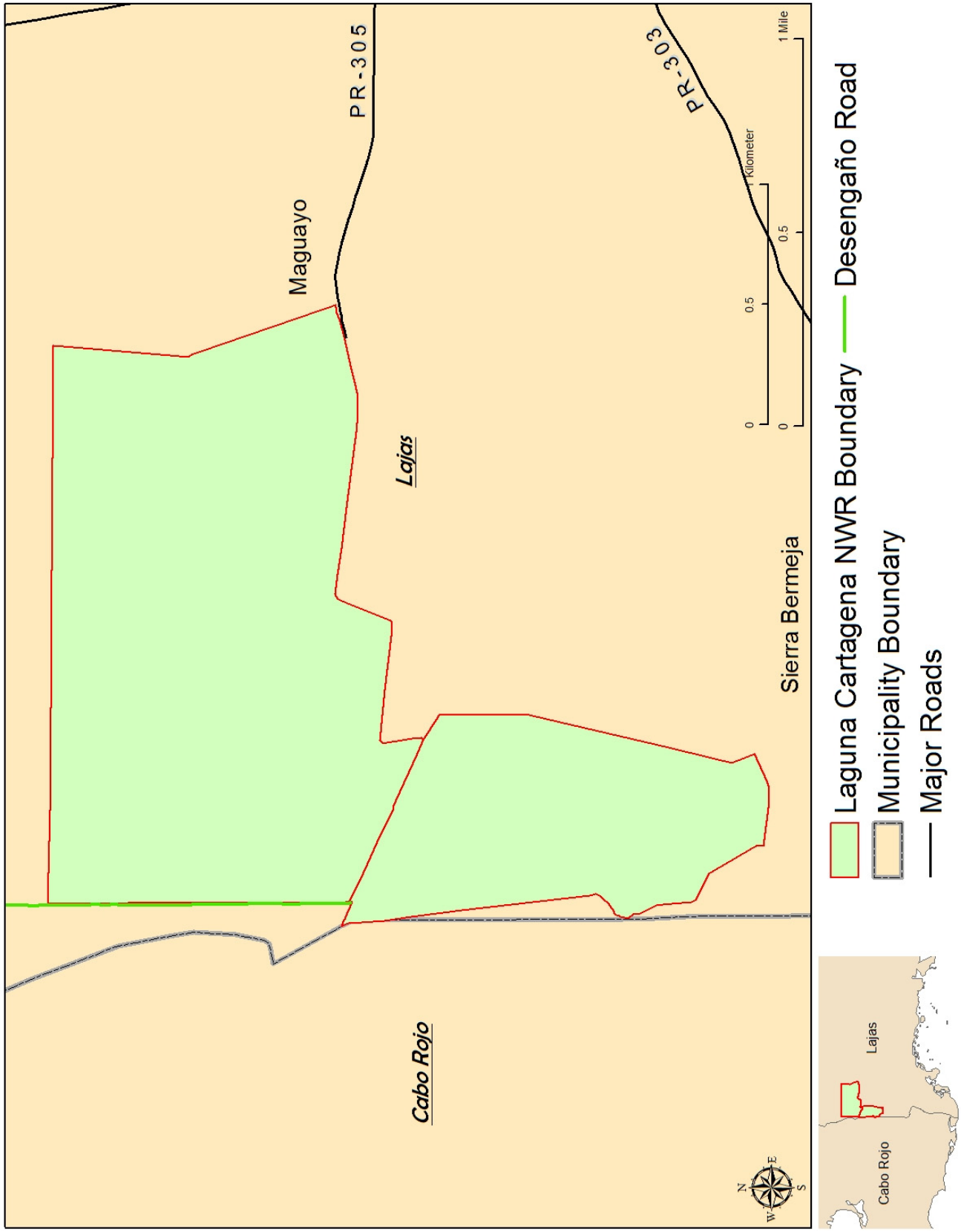


Figure 2. Approved Boundary of Laguna Cartagena national Wildlife Refuge



Important Bird Area (IBA), BirdLife International, October 2007

The entire refuge is part of the IBA named "Laguna Cartagena and Sierra Bermeja" (2009) Important Bird Area fact sheet: Suroeste, Puerto Rico (to USA). The IBA Programme of BirdLife International aims to identify, monitor, and protect a global network of IBAs for the conservation of the world's birds and other biodiversity. IBAs are key sites for conservation – small enough to be conserved in their entirety and often already part of a protected-area network. They do one (or more) of three things: (1) Hold significant numbers of one or more globally threatened species; (2) are one of a set of sites that together hold a suite of restricted-range species or biome-restricted species; and (3) have exceptionally large numbers of migratory or congregator species. On this IBA, 18 endemic species and subspecies of birds are reported; two of them federally listed as critically endangered species.

Puerto Rico Critical Wildlife Areas, Puerto Rico Department of Natural and Environmental Resources 2005

A significant portion (approximately 74 percent) of the Laguna Cartagena NWR is recognized as Important Critical Wildlife Area (CWA). The recognition of CWAs fulfills one of the most fundamental responsibilities of the Puerto Rico DNER: to provide comprehensive information on important wildlife and habitat resources in Puerto Rico and associated islands. The Puerto Rico DNER imparts important wildlife and habitat information to local governments, state and federal agencies, private landowners, and consultants for land use planning purposes. CWAs are recognized by the Puerto Rico DNER as areas to be protected and preserved from degradation from incompatible land use in or adjacent to the areas. The present lagoon is a remnant of what was once a large open expanse of water and one of the most important freshwater habitats for migrating waterfowl and aquatic birds in Puerto Rico. Due to agricultural practices, about 90 percent of the lagoon is covered with cattail. Despite this condition, Cartagena Lagoon is still one of the most important natural systems in southwest Puerto Rico (Toro and Chabert 1986).

More than half of Puerto Rico's bird species have been recorded at one time or another from the lagoon area and the adjacent Sierra Bermeja. Actually, there are reports of the presence of 144 bird species. Historically, this lagoon was said to have supported the largest population of ducks in the entire Island (Cardona and Rivera 1988). Danforth (1926) describes the lagoon as "the most important breeding ground for the resident waterfowl as well as the most important refuge for migrant waterbirds in Porto Rico. It also supplies food for thousands of other birds which are not primarily marshbirds. There is probably no other spot in the Island where so large an assemblage of birds of so many species can be found."

ECOSYSTEM CONTEXT

The Caribbean Islands National Wildlife Refuge Complex (Complex) supports and protects wildlife and ecosystems found nowhere else in the United States. Many of these species are endemic to the Commonwealth of Puerto Rico, the U.S. Virgin Islands, and Navassa. Presently encompassing nine existing national wildlife refuges, the Complex collectively supports significant recovery opportunities for a large number of federally listed endangered and threatened species. Particularly notable, the Complex presently supports, or could in the near future, as much potential to recover more threatened and endangered species than any other national wildlife refuge in the Southeast Region. Many migratory birds depend on habitat found within the Complex, including a large number of Fish and Wildlife Service Birds of Conservation Concern. Particularly notable are (1) endemic species, (2) species spending part of the year in the Neotropics, and (3) species that have unique breeding site requirements, making them extremely vulnerable to decline (e.g., colonially nesting seabirds, waterfowl, marshbirds, and shorebirds).

The Complex supports present and future opportunities to restore and manage several ecosystems that are highly endangered today, including (1) subtropical dry forest, (2) coral reefs, and (3) seagrass beds and adjacent beaches used by nesting threatened and endangered sea turtles. Within the U.S. Caribbean, the most important habitats for migrating shorebirds, and an increasing number of sites supporting emergent wetlands and mangroves, as well as nesting seabirds, are now under management and protection of national wildlife refuges.

REGIONAL CONSERVATION PLANS AND INITIATIVES

Comprehensive conservation plans are being prepared for the refuges that make up the Caribbean Islands NWR Complex. The plans will provide refuge managers with a 15-year strategy and broad direction to conserve wildlife and their habitats; to achieve refuge purposes; and, to contribute toward the mission of the Refuge System. In addition, the plans identify wildlife-dependent opportunities available to the public, including opportunities for hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation.

Puerto Rico DNER's efforts are guided by the Puerto Rico Comprehensive Wildlife Conservation Strategy (CWCS), which was completed in 2005. The Strategy lists the following as major threats to Puerto Rico's biodiversity: habitat loss, poaching and over-exploitation, and invasive exotic species. The main goals of Puerto Rico's CWCS are:

- To identify and address the greatest conservation needs of Puerto Rico's fish and wildlife.
- To prioritize efforts on species with the greatest conservation needs.
- To allow Puerto Rico DNER to work independently and in partnership to conserve, enhance, and protect Puerto Rico's diverse, but not necessarily rare or at risk, fish and wildlife species and habitats.
- To improve Puerto Rico DNER's ability to address present and future challenges and opportunities to conserve fish and wildlife species and their habitats.
- To integrate monitoring and management of hunted and non-hunted species.

The commonwealth's participation and contribution throughout this planning process will provide for ongoing opportunities and open dialogue to improve the sustainable management of fish and wildlife, and their dependent habitat, in the Commonwealth of Puerto Rico. An essential part of comprehensive conservation planning is integrating common mission objectives where appropriate.

ECOLOGICAL THREATS AND PROBLEMS

The principal threats to the refuge come from invasive exotic plants and animals. The refuge was seriously degraded of native habitat, and especially upland trees, through its history of being used as farmland. While these efforts have been on-going they have been conducted on a limited basis (as per volunteer and budget availability) and will require additional years of effort to be fully successful.

The refuge suffers from the presence of numerous invasive, exotic, and feral domestic fauna that threaten the populations of several key bird species through nest predation. Species that are a particular problem include the African Patas Monkey, mongooses, iguanas, cats, and dogs. The magnitude of the threat on bird populations in not precisely known as detailed monitoring surveys have yet to be undertaken.

Over 500 species of plants have been documented in the wetland and surrounding uplands (Weaver and Chinea 2003). The vegetation community near the project site has been altered by deforestation and conversion to agriculture. Modifications to the wetland itself included pumping water out of the lagoon for irrigation in the 1920s, construction of dikes and canals as part of the irrigation drainage canal system in the 1950s, and increased water volume entering the wetland due to presence of the canal system and runoff of excess irrigation waters. The Lajas Valley irrigation project is a complex system of five lakes that divert water from a west coast watershed (Añasco River) through two southern watersheds to the irrigation system greatly increasing the potential amount of water that may pass through Laguna Cartagena during flood releases from the Loco Dam.

Stabilization of the water levels and high nutrient levels encouraged the monotypic growth of cattail and reduced relative abundance of other plant species. These conditions, combined with Puerto Rico's subtropical climate, allow cattail to grow year-round, with new shoots (produced asexually from rhizomes) mature plants, and standing dead stems visible during any month. Dead cattails that fall into water decompose slower than the next standing crop grows, resulting in accumulation of the peat layer. Some areas of the wetland now have peat as thick as 1 meter.

Cattail coverage has been reduced temporarily due to a combination of extending dikes and canals to drain more water from the wetland, a drought, and a fire in July 2003. This reduction resulted in numerous interrelated changes. The increased open water area and more diverse habitat attracted more species and more individuals of birds. The open water allowed for more wind mixing, thus increasing dissolved oxygen and improving habitat for macro-invertebrates fed upon by birds.
The major types of vegetation that occur in and adjacent to Laguna Cartagena NWR include: mesquite and semi-evergreen woodland; coastal shrub or thorn woodland; deciduous woodland; agricultural lands, including pastures; and residential areas and roadside trees. The littoral woodland still contains numerous tree species that were part of the original vegetation. In contrast, pastures, agricultural lands, and residential areas are the most modified landscapes. The remaining vegetation types contain exotic and native species in compositions that differ from the original vegetation (McKenzie and Noble 1991).

Currently, the Laguna Cartagena NWR sites are highly disturbed by human activity and occupied by secondary vegetation, including numerous exotics.

PHYSICAL RESOURCES

CLIMATE

The climate is mild year-round, with an average high temperature of 89°F and an average low temperature of 71°F. Summers and winters are both dry, while consistent and occasionally heavy rains occur during the wet season from September through November. This is also the period when hurricanes occur. Puerto Rico has been struck by nine hurricanes since 1893. Rainfall of over 10" in 24 hours occurred in November 2003, and in association with Hurricane Georges in September 1998. Additional, sometimes torrential, rains usually occur in April or May. Rains of over 10" in 24 hours occurred during the month of May in both 2001 and 2003. The 17-year average rainfall on the refuge is 36 inches, with a low in 1997 of 15 inches, and a high of 58 inches, corresponding to the passage of Hurricane Georges in 1998.

Trade winds vary between the northeast and southeast; during January-April wind velocities exceed 15 knots for extended daily periods. Winter storms cause winds to change to a northerly direction. For much of the year, winds are calm in the morning, increasing to a high of 10-20 knots during the day, and becoming calm again in the evening.

Hurricanes

Portions of the hurricane section of this document were taken directly from Weaver, Peter L.; Schwagerl, Joseph J. 2009. U.S. Fish and Wildlife Service Refuges and Other nearby Reserves in Southwestern Puerto Rico, General Technical Report IITF-40. San Juan, PR: U.S. Department of Agriculture Forest Service, International Institute of Tropical Forestry, 110p.

Since 1700, Puerto Rico has experienced hurricane force winds at least 33 times. Twenty hurricanes had trajectories over much of the island (type A hurricane) and thirteen had trajectories over a portion of the island, or immediately offshore (type B hurricane) (Neumann et. al 1988, Quinones 1992, Salvia 1972). Local effects from more distant storms or hurricanes (type C storms) were also experienced more than 50 times. Since hurricane size, duration, and wind speed vary considerably, estimating trajectories and classifying storm types before the 20th century is a matter of conjecture.

Four hurricanes damaged southwest Puerto Rico since the end of the 19th century. San Ciriaco of 1899 and San Felipe II of 1928 passed to the northeast, and Georges of 1998 to the north. San Ciriaco, with sustained winds around 180 km/hr, and San Felipe with winds at 250 km/hr, were major storms, the latter perhaps being the most powerful on record for Puerto Rico. Hortense in 1996, a category 1 hurricane on the Saffir-Simpson Scale, passed directly over the refuge (Monzón 1996). With sustained winds of 135 km/hr and rainfall averaging between 75 and 125 mm in the southwest, Hortense caused flooding, uprooted trees, and damaged buildings and electrical lines. Its short time over Puerto Rico, poorly defined center, and generally low winds, prevented more damage. Georges in 1998, a category 3 hurricane with sustained winds of 180 km/hr, flooded the Lajas Valley and damaged the refuge. There have been several tropical storms or out of season storms (Three Kings Day rain, and an unusual rain in March – late 1990s) that flooded the valley, Cartagena, and the Anegado/Guanica Lagoon area. Tropical storms are more common, dump a lot of rain, and flood the lagoon with more frequency than hurricanes.

GEOLOGY AND TOPOGRAPHY

The geology and topography section of this document was taken directly from Weaver, Peter L.; Schwagerl, Joseph J. 2009. U.S. Fish and Wildlife Service Refuges and Other nearby Reserves in Southwestern Puerto Rico, General Technical Report IITF-40. San Juan, PR: U.S. Department of Agriculture Forest Service, International Institute of Tropical Forestry, 110p.

The southwestern part of Puerto Rico is characterized by long ridges, such as the Sierra Bermeja, separated by parallel valleys like Lajas that extend eastward for many kilometers from the Mona Passage (Meyeroff 1933). The ridges contain rocks of marine Cretaceous sediments such as ashy shales, massive limestone, and agglomerates. The valleys, in contrast, are partly covered with alluvial deposits of recent origin underlain by consolidated carbonate and clastic strata (sedimentary rock) of Cretaceous and Tertiary age (Bonnet and Tirado Sulsona 1950, Graves 1991). These, in turn, are underlain by igneous rocks at depths of 165 to 265 m.

The 1,500-ha Sierra Bermeja is the oldest and among the most interesting mountain ranges on the Caribbean plate. The Bermeja Complex is composed of basalt (volcanic origin), amphibolites and serpentinites (metamorphic rocks), and chert (formed by organisms in deep marine waters). The

Figure 3. Geology of Laguna Cartagena National Wildlife Refuge

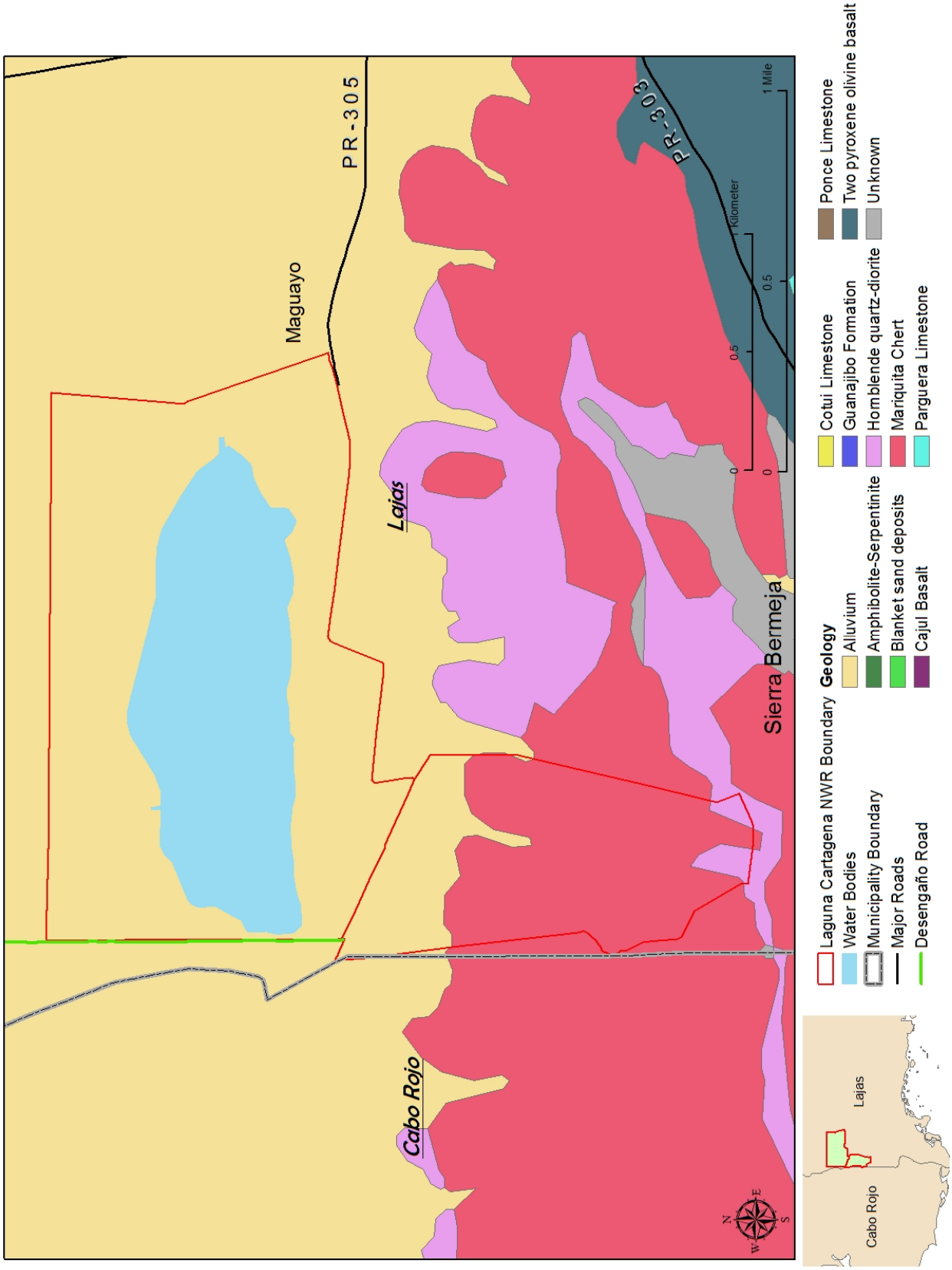
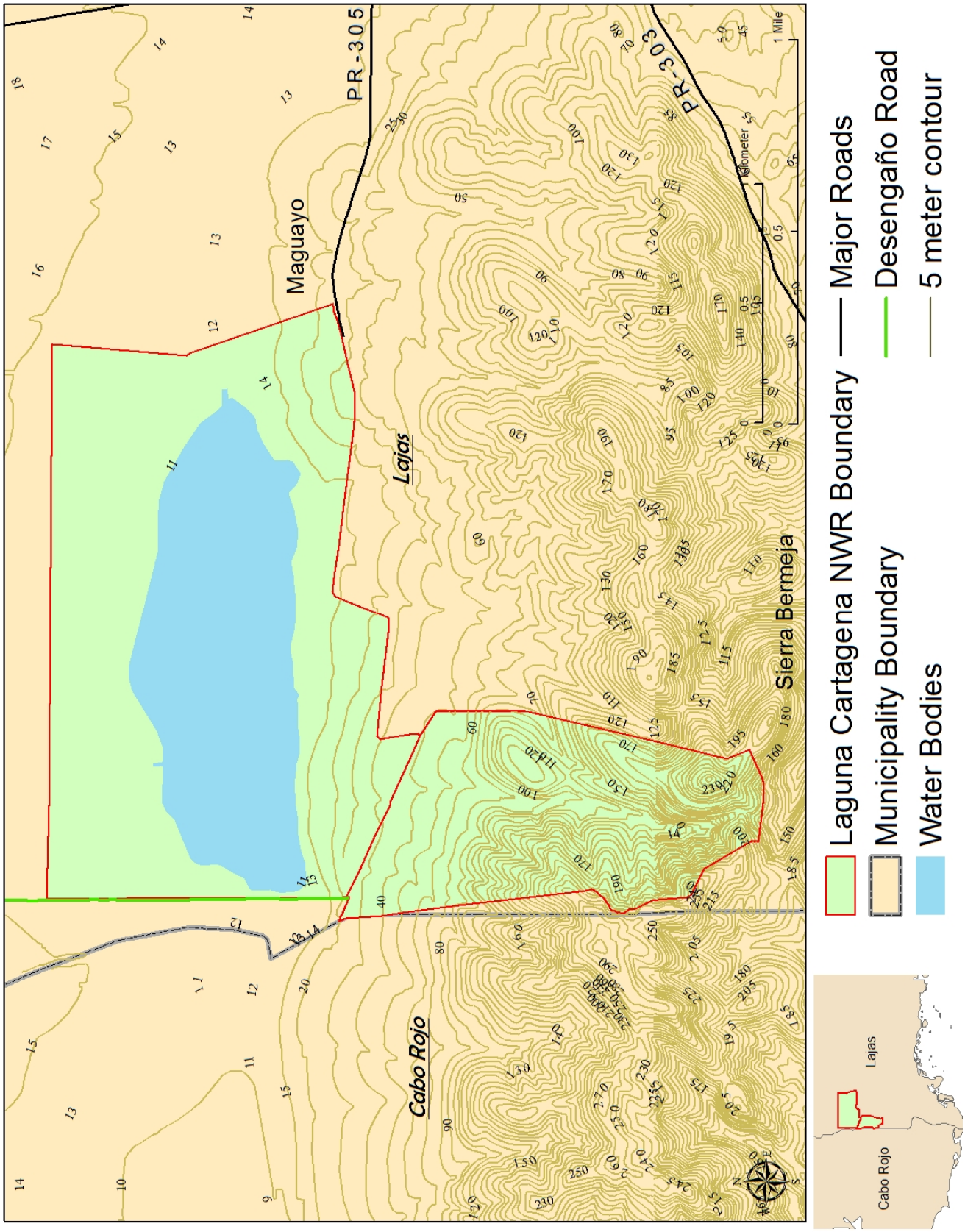


Figure 4. Topography of Laguna Cartagena National Wildlife Refuge



complex contains radiolarian (amoeboid protozoan) fossils in chert that date to 195 million years ago (Montgomery et al 1994, Pindell and Barrett 1990). The Lower Juraissic radiolarian signature is older than the Caribbean Sea and establishes the Pacific origin of the Caribbean plate.

The Yauco- Boquerón anticlinal valley (Lajas Valley) is about 30 km long by 5 km at its widest point (Graves 1991). During the Tertiary period, the Lajas Valley was eroded by a large stream with its source in the mountains near the town of Yauco. Subsequently, the Rio Guanajibo extended its headwaters and pirated streams flowing into the Lajas Valley (Michtell 1922).

More than 80 percent of the Laguna Cartagena NWR is covered by alluvium and nearly 20 percent by Mariquita chert; the remainder is Maguayo porphory (Bawiec 2001, Volckmann 1984). Alluvium dominates in the valley, merging with colluvium at lowest levels along the valley walls. Mariquita chert covers the refuge from mid- to high-level elevations. At the highest elevations, Maguayo porphyry, the only geological feature not discussed above, covers a small area.

SOILS

The soils section of this document was taken directly from Weaver, Peter L.; Schwagerl, Joseph J. 2009. U.S. Fish and Wildlife Service Refuges and Other nearby Reserves in Southwestern Puerto Rico, General Technical Report IITF-40. San Juan, PR: U.S. Department of Agriculture Forest Service, International Institute of Tropical Forestry, 110p.

Soils in the Lajas Valley exhibit certain characteristics in common (Lugo-Lopez et al. 1959). Lajas Valley soils are very deep with high, nearly uniform clay content. The top soil is usually 30 cm, but in places approaches 60 cm deep. The small pores conduct water rather well in the top soil but show very slow hydraulic conductivity in the subsoil. The soils are low in organic matter and nitrogen and generally high in soluble salts and exchangeable sodium, notably below 60 cm. The taxonomy of Puerto Rican soils, including those of the Lajas Valley, was outlined according to the new soils classification system (Lugo-López and Rivera 1977).

At Laguna Cartagena NWR, the soils situated in the Lajas Valley are distinct from those in the Sierra Bermeja. The fertile, alluvial soils of the Lajas Valley are deep, heavy, difficult to drain, and often affected by salt, particularly in previously irrigated areas (Koening 1953, Picó 1974, Willardson 1958). In contrast, the steep slopes of the Sierra Bermeja are shallow, stony, well-drained, and dry. Twelve soil types occupy the refuge, including three types of clay, two types of silty clay, two gravelly clay loams, two cherty clay loams, one silty clay loam, sand, and volcanic rock. Slightly more than one-quarter of the lagoon tract is occupied by the Cartagena Lagoon (i.e., about 20 percent of the entire refuge).

- Ag -- Aguirre clays are deep, level or nearly level, poorly-drained soils on alluvial fans. They are sticky and plastic when wet, highly calcareous, and of medium natural fertility.
- AmB -- Amelia-Maguayo gravelly clay loams are series that occur together. They are characterized by deep, well-drained acid soils in alluvium and colluvium, occurring on the gentle foot slopes of hills. The mixture is about 60 to 70 percent Amelia, and 30 to 40 percent Maguayo.
- AmC2-- Amelia-Maguayo gravelly clay loams are a series that occur together. They are characterized by deep, well-drained acid soils in alluvium and colluviums, occurring on eroded, gentle foot slopes of hills. The mixture is about 60 to 70 percent Amelia, and 30 to 40 percent Maguayo.

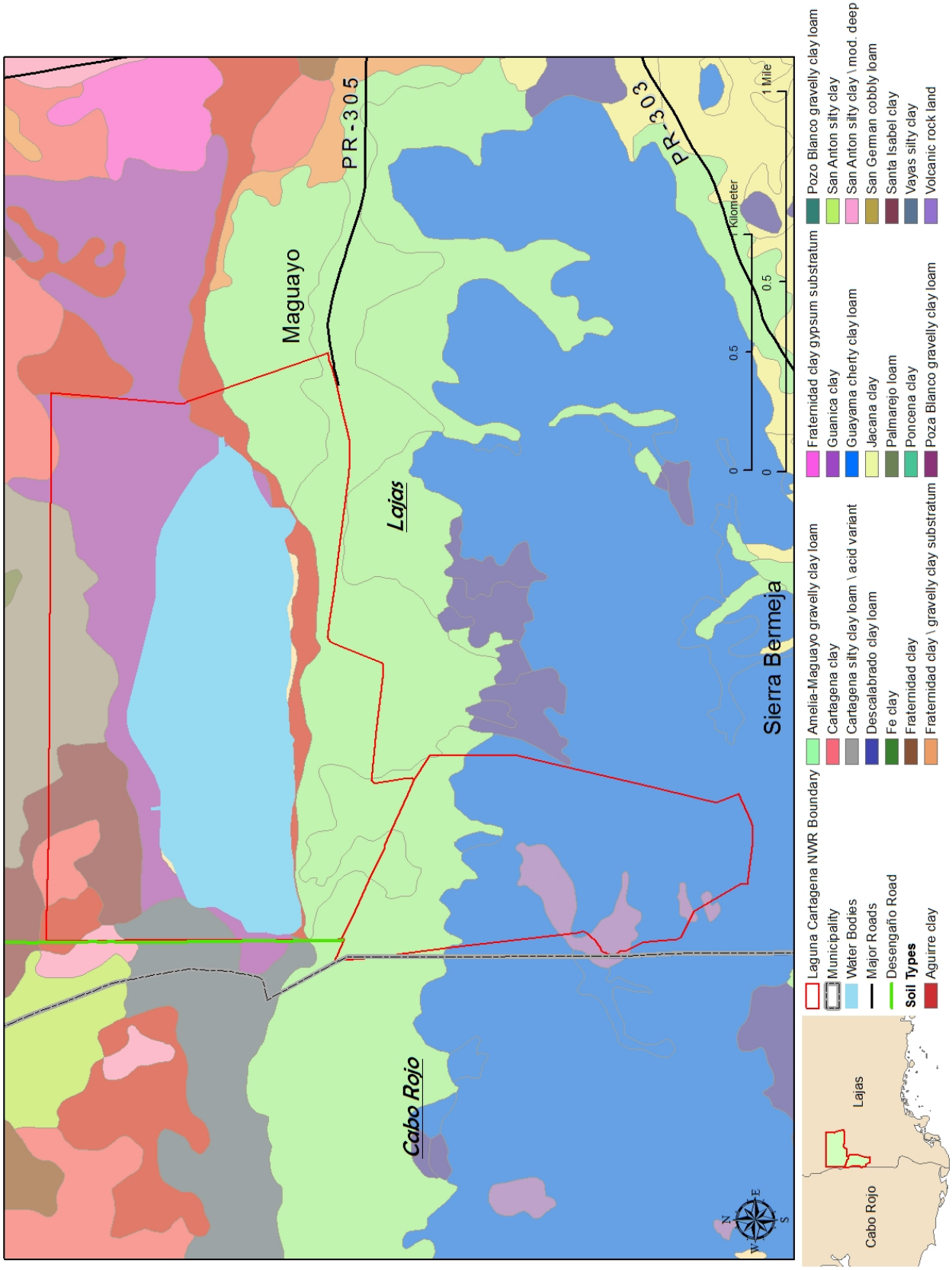
- Ca -- Cartagena clays are level to nearly level, somewhat poorly drained, and slightly aline-to-moderatley aline soils on alluvial fans. When wet, they are slightly sticky and plastic throughout the profile. They have a perched water table at depth of 60cm or greater.
- Cc -- Cartagena silty clay loams, acid variant are level, somewhat poorly drained, and slightly saline soils on alluvial fans. They have a slightly coarser textured surface layer than Cartagena clays. They shrink and crack when dry, and swell when wet, and are of medium natural fertility.
- Gc -- Guánica clays are deep, nearly level, slowly permeable, calcareous, and with medium natural fertility. They have a high shrink-swell potential, and crack when dry.
- GuD -- Guayama cherty clay loarns are shallow, well-drained soils on the steep slopes of Sierra Bermeja. The soils are acid and medium in natural fertility.
- GuF -- Guayama cherty clay loarns are a steeper variant of the former.
- Sc -- San Antón silty clays (moderately deep) are moderately deep, well-drained, nearly level alluvial soils on flood plains adjacent to streams. They are slightly acid to mildly calcareous, and moderately permeable, with a firm heavy clay substratum. They are high in natural fertility.
- Sn -- Santa Isabel clays are deep, moderately well-drained soils on nearly level terrain in valleys. High in fertility, they shrink and swell with changes in moisture.
- Va -- Vayas silty clays are nearly level, poorly drained soils on flood plains. They have a high water table, and are neutral to mildly alkaline above and saline at lower levels.
- Vo -- Volcanic rock lands are characterized by acid volcanic rock outcrops that cover more than one-half of the mapping area. Areas not covered by outcrops are covered by stony or gravelly clay loams or clays.

HYDROLOGY AND WATER QUALITY

The hydrology section of this document was taken directly from Weaver, Peter L.; Schwagerl, Joseph J. 2009. U.S. Fish and Wildlife Service Refuges and Other nearby Reserves in Southwestern Puerto Rico, General Technical Report IITF-40. San Juan, PR: U.S. Department of Agriculture Forest Service, International Institute of Tropical Forestry, 110p.

The western part of the Lajas Valley rises from sea level at Bahía Boquerón to about 13 m in elevation at Puerto Rico Route 303. The highway runs along the drainage divide that separates the eastern and western parts of the valley (Graves 1991). The principal aquifer of the Lajas Valley consists of alluvial deposits. Consolidated sedimentary rocks with different hydraulic characteristics underlie the deposits and could be considered as a distinct aquifer (Graves 1991). The principal aquifer is recharged by rainfall and stream flow, most of which occurs through coarse grain alluvial fans along the valley's edges. Seasonal changes of 0.6-m are apparent in the altitude of the potentiometric surface, which averages about 15 m at the northern and southern boundaries of the valley, and 4 m in the middle. Discharge of ground water occurs through pumping, evapotranspiration, and subsurface seepage.

Figure 5. Soil Types of Laguna Cartagena National Wildlife Refuge



The Laguna Cartagena Lagoon tract ranges in elevation from 40 m on the south side bordering the slopes of Sierra Bermeja to 11 m at the shoreline of the Cartagena Lagoon. To the north, the property is flat, rising to 12 m at the border with private holdings. At the time of discovery, Cartagena Lagoon was once part of a system of 50 freshwater lagoons throughout Puerto Rico (Colón 1982). Within the Lajas Valley, it was part of a series of wetlands that extended from Laguna Guánica westward for about 30 km through Ciénaga El Anegado and the Cartagena Lagoon to Laguna Rincón on the west coast (Ramírez Toro and Minnigh 1997). Cartagena Lagoon was a landlocked water body maintained by runoff from the surrounding mountains; however, heavy rainfall caused ephemeral streams to raise the water level in the lagoon which then overflowed, draining westward 7 km through the Rio Boquerón (i.e., today the Drainage Canal) to a mangrove swamp along Bahía Boquerón (Danforth 1926). The water level of the lagoon varied seasonally, rising during the fall with heavy rainfalls and declining during the warm summer months. The size of the lagoon could fluctuate from 0 to 140 ha and its depth from 0 to 1.5 m. The lagoon's dynamic nature provided a variety of habitats -- open water for the foraging of resident and migratory waterfowl, emergent vegetation with nesting areas for resident aquatic birds, and foraging habitat for wading birds during the seasonal change in depth.

Agricultural development subsequently wrought dramatic changes to the lagoon's water regimen. Cartagena Lagoon remains today, but by the early 1980s, it had lost 95 percent of its open water and some of its wildlife. This was due to a host of activities such as deforestation around the lagoon, pumping water for irrigation, eutrophication and pollution, canal construction, the growth of weedy plants, cattle grazing, and the concentration of hunters at the only remaining lagoon in the Lajas Valley. Today, water enters the Lajas Valley from the east via the Irrigation Canal and flows to the Cartagena Lagoon through the Margara Canal. This gravity-fed aqueduct extends 37 km from Lago Loco, passing north of the town of Maguayo, through the Cartagena Lagoon, and west to Bahía Boquerón. The aqueduct supplies about 5,670,000 m3 (4,600-acre-feet) of water per month (Graves 1991). The Tinaja Tract, contiguous with the lagoon property, lies about 0.5-km south of Cartagena Lagoon. The tract measures approximately 0.8 by 1.6 km (upslope), and ranges from 20 to 290 m in elevation. The highpoint of the Sierra Bermeja is Cerro Mariquita at 301 m. It lies about 50 m upslope to the west. The tract is dissected by two major arroyos that carry water towards the Cartagena Lagoon during heavy downpours.

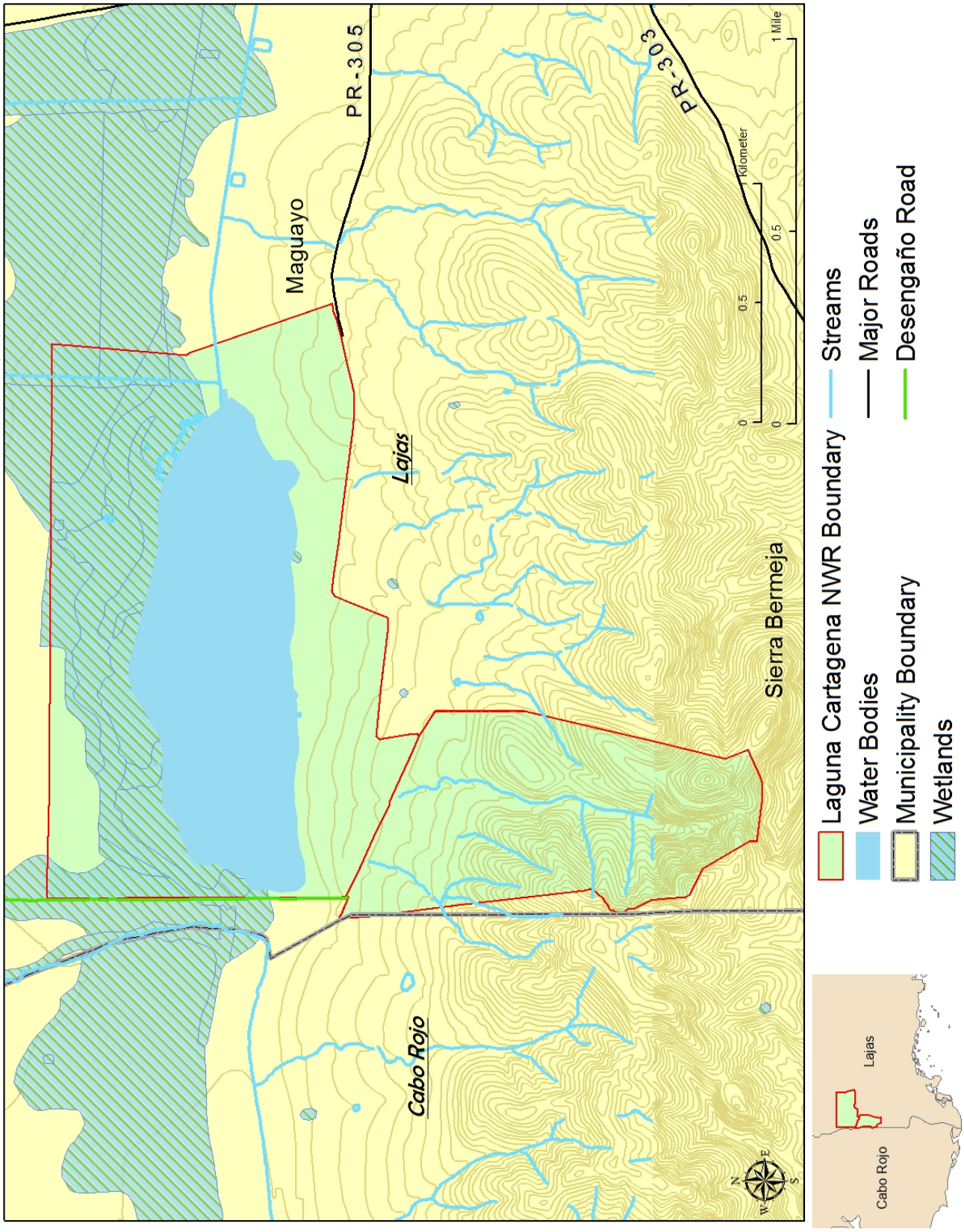
Physical and chemical conditions of the lagoon were assessed, including pH, temperature, dissolved oxygen, nutrients, and heavy metals (Delíz-Quiñones 2005). Lagoon conditions, vegetation, and insect populations all varied during the year. Ammonia and phosphate were at high levels, and dissolved oxygen at lagoon depth showed significant fluctuations.

BIOLOGICAL RESOURCES

HABITAT

The habitat section of this document was taken directly from Weaver, Peter L.; Schwagerl, Joseph J. 2009. U.S. Fish and Wildlife Service Refuges and Other nearby Reserves in Southwestern Puerto Rico, General Technical Report IITF-40. San Juan, PR: U.S. Department of Agriculture Forest Service, International Institute of Tropical Forestry, 110p.

Figure 6. Surface Hydrology of Laguna Cartagena National Wildlife Refuge



"Puerto Rico was originally mantled by forests from the level of the sea to the summit of its mountains" (Hill 1899) and the dominant vegetation in southwestern Puerto Rico at the time of Columbus' arrival was forest (Murphy 1916). Mangroves probably covered about 12,000 ha of Puerto Rico's shorelines, declining to nearly one-half by 1938 (Carrera and Lugo 1978). The dry, rocky slopes along the south coast were covered by woodland and cactus (Wadsworth 1950, 1962). Prominent tree species included Amyris elemifera, Bucida buceras, Bursera simaruba, Ceiba pentandra, Colubrina arborescens, Exostema caribaeum, Guaiacum officinale, Pictetia'aculeata, and Tabebuia hetrophylla.

The flora of Puerto Rico, ranging from coastal areas through the mountainous interior, was studied in detail during the 1920s (Britton and Wilson 1923-1930; Gleason and Cook 1927; Cook and Gleason 1928). Britton, the founder and first director of NewYork's Botanical Garden, helped carry out the first systematic inventory of natural history in the Caribbean (Sastre and Santiago-Valentín 1996). Many of his expeditions included sites in southwestern Puerto Rico. Major environmental concerns at that time included the island's loss of forest cover, and the need for forest policy and reforestation.

Pterocarpus officinalis, associated with the landward side of mangroves and swamps, probably grew around Cartagena Lagoon at the time of the island's discovery. Subsequently, during colonization and settlement, trees were cut for construction, fuel, and agriculture. At the beginning of the 20th century, the deciduous forests, ranging from Patillas in southeastern Puerto Rico along the south coast to Hormigueros near Mayagüez, were recurrently burned and grazed (Murphy 1916).

In the early 1900s, aside from locally grown fruit trees, the most conspicuous trees of the southwestern coastal areas were the natives Cassine xylocarpa, Ceiba pentandra, Hippomane mancinella, Hymenaea courbaril, Manilkara bidentata, and the exotics Delonix regia and Tamarindus indica (Hill 1899). Other native trees observed during the early 1900s were Acacia famesiana, Andira inermis, Bucida buceras, Guazuma ulmifolia, Inga laurina, Inga vera, Pictetia aculeata, Randia aculeata, Stahlia monosperma, and the exotic Haematoxylum campechianum (Gleason and Cook 1927, Murphy 1916). Pasture land, if unattended, would soon revert to a thorn thicket characterized by Capparis flexuosa, Parkinsonia aculeata, Pilosocereus royenii, and Pithecellobium unguis-cati among other species (Gleason and Cook 1927).

The Great Depression and World War II forced most islanders to utilize available land for pasture and crops. During the late 1940s, all but 6 percent of Puerto Rico was in natural forest. After the mid-1980s, however, much of the agricultural land had been abandoned and secondary forests occupied about one-third of the island, including much of the southwest (Birdsey and Weaver 1982, Franco et. al 1997). Occasional remnants of past forest cover, for example, the large Hymenaea courbaril along the jeep road in Tinaja, show that the largest trees in the original dry forest attained diameters of at least 1 m and heights approaching 20 to 25 m.

All of Puerto Rico's native tree species and many introduced exotics have been described and illustrated in local publications (Francis and Liogier 1991, Francis and Lowe 2000, Little and Wadsworth 1964, Little et. al 1974). Moreover, taxonomic descriptions of the flora (grasses, trees, and vines) are available for Puerto Rico and other islands in the Caribbean (Acevedo-Rodríguez and Woodbury 1985; Hitchcock 1936; Howard 1979, 1988-1989; Liogier 1985-1997; Liogier and Martorell 1982, 2000). Eight common species of grasses have also been illustrated in a field guide (Mas and Garcia 1990). Plant nomenclature in this report has followed Liogier.

Recently, all of Puerto Rico's forest type and land cover types were mapped (Helmer et. al 2002). Mapping zones encompassing the refuges and protected areas of the southwest were designated as dry-alluvial and dry-volcanic/sedimentary/limestone areas. The vegetation formations included lowland dry semi-deciduous forest or woodland/shrub land, tidal and semi-permanently flooded evergreen sclerophyllous forest, lowland dry semi-deciduous forest or woodland/shrub land, and lowland dry mixed evergreen drought-deciduous shrub land with succulents. The major land use of much of the southwest is pasture.

The Laguna Cartagena NWR is partitioned into two major tracts -- Lagoon and Tinaja. The Lagoon Tract has three distinct areas: the lagoon, centrally located, with its aquatic vegetation; a recently abandoned sugar cane plantation, now largely planted with trees lying to the north; and, an abandoned pasture with naturally occurring trees and several patches of planted trees, lying to the south (Weaver and Schwagerl 2005). The lagoon itself consists of open water and areas with cattails (Díaz -Soltero 1990).

The Tinaja Tract also has three distinct areas. The lower, gentler slopes were grazed and recurrently burned through 1996 when the Service acquired the property. At that time, the lower slopes had the appearance of savanna-like grassland with scattered native and exotic trees. Today, in the absence of grazing and fire, numerous trees have regenerated, principally the exotic *Leucaena leucocephal* (Weaver and Schwagerl 2004). The mid-slopes are covered with secondary vegetation, some dating back at least to the mid-1930s when it was visible in aerial photographs (Weaver and Chinea 2003). The upper slopes around Cerro Mariquita are very steep, rocky, and heavily eroded by past grazing. Much of the vegetative cover is short, yet of considerable ecological value due to the presence of rare and endangered plant species. The partially forested Tinaja Tract is important to Cartagena Lagoon as a source of unpolluted water.

Mesquite and semi-evergreen woodland: Land clearing for pasture and agriculture in the lowlands between the salt flats and nearby mountains has modified the original forest dominated by *Bucida buceras* (Cook and Gleason 1928) into an association with grass and scattered *Prosopis juliflora,* resembling a savanna (Garcia-Molinari 1952). Other common trees include the natives *Bucida buceras, Guaicum officinale,* and *Pisonia albida,* along with numerous understory species. Common exotics are *Leucaena leucocephala, Pithcellobium dulce,* and Deciduous woodland - The major tree species in the deciduous woodland are *Bourreria succulenta, Bucida buceras, Bursera simaruba, Clusia rosea, Coccolobia diversifolia, Colubrina arborescens, Colubrina elliptica, Erothroxylum aerolatum, Guazuma ulmifolia, Pisonia albida, Rauvolfia nitida, Thouinia striata var. portoricensis, Zanthoxylum martincense, Zanthoxylum monophyllum, and Ziziphus reticulata.* Occasionally, *Guaicum offincinale* is found. Other vegetation types are solely the result of human activities and are maintained in a highly modified state by regular tending, at least for a period of time. Agricultural lands and pastures: Agricultural lands often contain *Carica papaya, Persea americana,* and ground crops such as melons, peppers, pineapples, pumpkin, and yucca. Pastures are occupied by about 15 species of native and introduced grasses. Secondary regeneration of native tree species and planted *Prosopis juliflora* and *Swietenia mahagoni* are seen in the vicinity of the refuges.

Residential and roadside trees: Selected for shade, ornament, and fruit, or regenerated naturally, several species of trees survive around private homes, along fence lines, and scattered in fields. The most common trees planted for shade or as ornamental are *Delonix regia, Swietenia mahagoni, Tabebuia heterophylla, Tecoma stans, and Tectona grandis.* Among the most common fruit trees are *Tamarindus indica.*

Forest tree plantings (plantations): Forest trees are planted for a variety of purposes, usually timber production. In Puerto Rico's dry southwest, however, timber production was not a priority (Birdsey and Weaver 1982) although experimental work with timber species was attempted more than 60 years ago (Marrero 1950; Wadsworth 1943,1990). During the past 25 years, at least 80 tree species have been planted on refuge lands to stimulate native forest regeneration and to restore wildlife habitat.

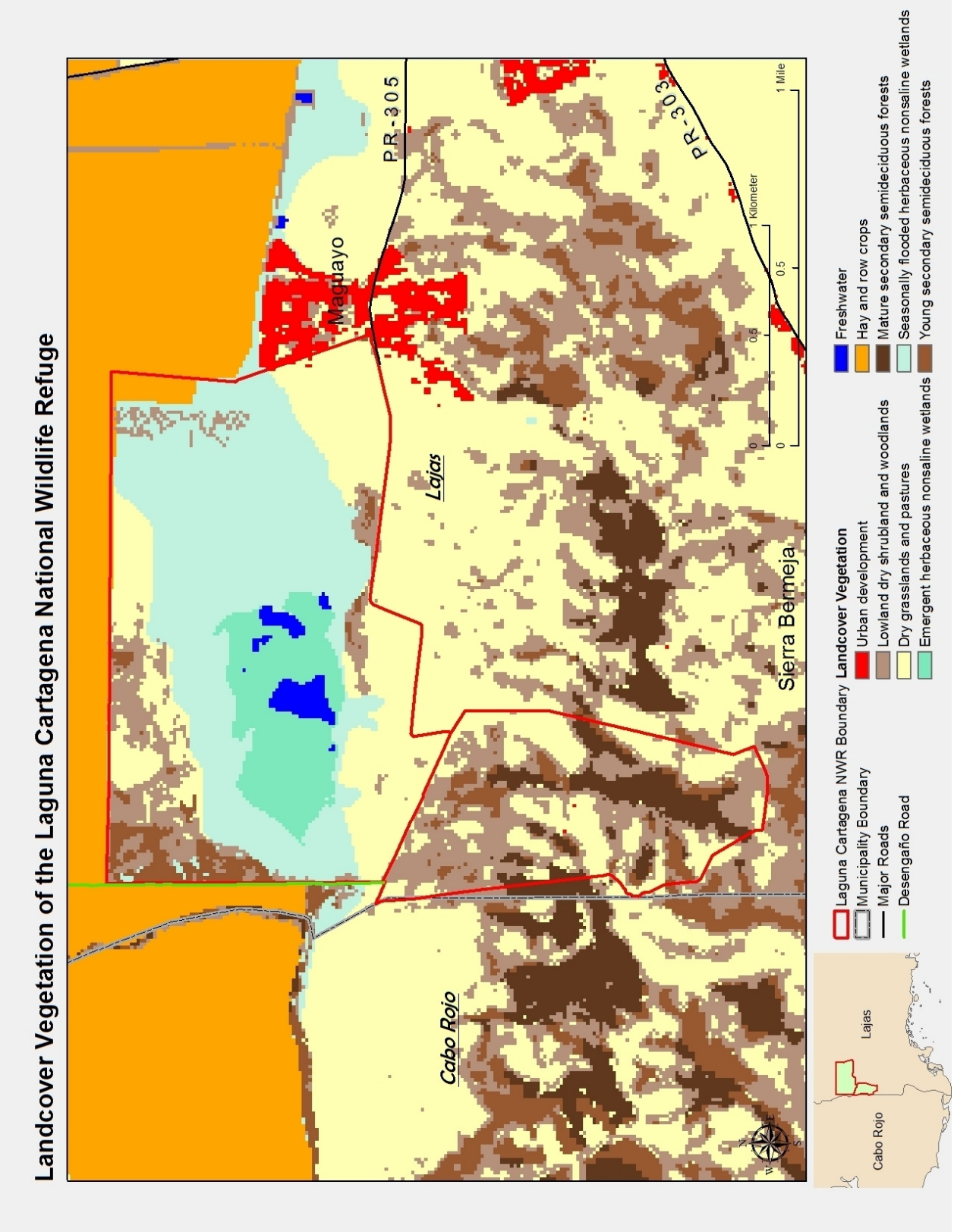
Frequent fires, heavy grazing, and continuous cropping, mainly in sugar cane, characterized the past use of the refuge. Soil erosion and sedimentation were rampant. During this period, native plants were severely reduced in numbers and several exotics increased in aerial extent. Today, the refuge is covered with pasture interspersed with native and exotic trees, patches of secondary forest, and tree plantings of various species.

Vegetative surveys have been carried out at both Cabo Rojo NWR (McKenzie 1986) and Laguna Cartagena NWR (Proctor 1996). The identified plants include: 7 ferns, 1 gymnosperm, 47 monocotyledons, and 308 dicotyledons.

Among the monocots are 1 aroid, 2 bromeliads, 1 spiderwort, 4 sedges, 36 grasses, 2 orchids, and 1 climbing shrub. The dicots include 64 families. Eleven families had nearly 60 percent of the species: 18 *Boraginaceae*, 8 *Cactaceae*, 16 *Compositae*, 11 *Convolvulaceae*, 21 *Euphorbiaceae*, 49 *Leguminosae*, 8 *Malphighiaceae*, 18 *Malvaceae*, 8 *Myrtaceae*, 13 *Rubiaceae*, and 12 *Verbenaceae*. The Tinaja Tract also has six endangered plant species.

At the present time a total of 49 plants are listed as threatened or endangered in Puerto Rico and the U.S. Virgin Islands. Of these, 10 are known to occur on refuges within the Complex and an additional 4 are known to occur on lands adjacent to the refuges. Recovery of a number of these species may depend on actions occurring within refuge land.

Figure 7. Landcover Vegetation of the Laguna Cartagena National Wildlife Refuge



WILDLIFE

A complete biota list can be found in Appendix I.

Endangered, Threatened, and Rare Biota on Laguna Cartagena NWR

	Federal (1)	State (2)
BIRDS		
Least Grebe-*Trachybactus dominicus dominicus*		DD
Brown Pelican-*Pelecanus occidentalis occidentalis*	E	EN
White-cheeked Pintail- *Anas bahamensis*		VU
West Indian Whistling Duck-*Dendrocygna arborea*		CR
Duck Masked -*Nomonix dominica*		EN
Yellow -breasted Crake-*Porzana flaviventer*		DD
Caribbean Coot -*Fulica caribaea*		VU
Ruddy Duck- *Oxyura jamaicensis*		VU
White-cheeked Pintail-*Anas bahamensis*		VU
Puerto Rican Nightjar- ***Caprimulgus noctiterus***	E	EN
Peregrine Falcon-*Falco pergrinus tundrius*	E	CR
Yellow-shouldered Blackbird-***Agelaius xanthomus xanthomus***	E	EN
Puerto Rican Oriole-***Icterus dominicensis portoricenis***		DD
White-crowned Pigeon-*Patagioenas leucocephala*		DD
Puerto Rican Vireo- ***Vireo latimeri***		LR
Grasshopper Sparrow-***Ammodramus savannarum borinquensis***		DD
REPILES AND AMPHIBIANS		
Puerto Rican Slider-***Trachemys stejnegeri***		DD
CRUSTACEANS **DD**		
Land crab-*Cardisoma guanhumi*		LR
MAMMALS		
Brazilian free-tailed bat *Tadarida brasiliensis*		LR

PLANTS		
Lyonia truncata, var. proctorii	EN	CR
Aristida chaseae	E	EN
Aristida portorricensis	E	CR
Vernonia proctorii	E	CR
Cóbana Negra-*Stahlia monosperma*	E	VU
Eugenia woodburyana	E	CR
Goetzea elegans -planted	E	E
Crescentia portorricensis -planted	E	CR
Higo Chumbo – ***Harrisia portorricensis*** –not presently on refuge, but within the historic range. Candidate for reforestation	E	VU

1/ Federal: Listed species under the U.S. Endangered Species Act (ESA) 1973, as amended. E=Endangered; T=Threatened
2/ State: Listed species under the Puerto Rico Commonwealth Department of Natural and Environmental Resources (DNER).
Regulation 6766, Feb 11, 2004. CR=Critically Endangered; EN= Endangered species designated by the Secretary of DNER; EF= Designated endangered by the Federal Government; DD=Deficient data; EX=Extinct; ESS= Extinct on the wild;
LR=Less Risk; VF=Designated vulnerable by the Federal Government; VU=Vulnerable.
Endemic species on boldface

CULTURAL RESOURCES

No cultural resources are known or have been found in the Laguna Cartagena wetland area.

SOCIOECONOMIC ENVIRONMENT

The municipality of Lajas is located in the southwestern part of Puerto Rico. It borders the municipality of San German in the north, The Caribbean Sea in the south, Guánica and Sabana Grande in the east, and the municipality of Cabo Rojo in the west. It is composed of 11 neighborhoods (barrios). Its area covers approximately 60.1 square miles. It is among the first 16 municipalities of the major territorial expansion in Puerto Rico. The population of Lajas by 2000 was 26,261 people, with a density of 167.8 people per-square-mile. The 1982 Census of Agriculture indicates the utilization of 31,291 acres of land. They are principally used for pastures, sugar cane, pineapples, and small fruit. Approximately 20 percent of the total area is urbanized.

Estimated unemployment rate is 13.2 percent, per capita income is $7,535, and there are approximately 45 percent of the families living under the poverty level Standard. (The latest was summarized from the Selected Economic Characteristics; Data Set 2006-2008 American Community Survey 3 year estimates; U.S. Census Bureau, 2000.)

In summary, the municipality of Lajas is an economically depressed area with a limited tax base. The Service pays refuge revenue sharing to the Commonwealth government to replace lost taxes on fee title lands. Once Laguna Cartagena is fully restored, it should provide increased recreation opportunities and attract tourism dollars to the area.

REFUGE ADMINISTRATION AND MANAGEMENT

LAND PROTECTION AND CONSERVATION

The refuge consists of 1,059 acres. The present lagoon is a remnant of what was once a large open expanse of water and one of the most important freshwater habitats for migrating waterfowl and aquatic birds in Puerto Rico. Due to agricultural practices, about 90 percent of the lagoon is covered with cattail. In addition to the lagoon, there are uplands that include pastureland, abandoned sugar cane fields, and 263 acres in the foothills of the Sierra Bermeja. These hills, geologically the oldest in the Caribbean, protect native forests with many endemic plant species. Management tools include water management, forestry, law enforcement, invasive/exotic plant control and removal, and environmental education.

VISITOR SERVICES

The Improvement Act and Executive Order 12996 emphasize the importance of providing compatible wildlife-dependent educational and recreational opportunities on national wildlife refuges. A variety of public use opportunities is available on Laguna Cartagena NWR.

Fishing is a priority public use on national wildlife refuges as identified in the Improvement Act. It has been a traditional activity on Laguna Cartagena long before the refuge was established in 1989. Refuge lands have been opened year-round to the public since they were acquired. The public access the lagoon through public dirt roads maintained by the municipality of Lajas. Once on the refuge, the public uses trails, dikes, and dirt roads to access their fishing sites. Anglers have been observed fishing right in front of the water control structure and along the western and eastern canals. Boats or any types of floating platforms are not permitted to accommodate fishing at the present time.

Hunting is not currently allowed on the refuge due to low numbers of hunting species and hunting safety issues.

The staff provides both on- and off-site environmental education programs for the local community schools during the school year. A non-formal agreement between the refuge and the local elementary schools is being developed to assign an area within refuge lands to be used by schools as an outdoor classroom. The refuge does not have a contact station. Two interpretive kiosks are located at each main access point (Desengaño road and Maguayo gate) with panels on birds, plants, rules and regulations, and an aerial refuge picture. No official trail system exists but maintenance roads and fire brakes are often used as trails by visitors to access the public use facilities.

Wildlife observation, photography, and interpretation seek to increase awareness, enjoyment, and understanding of the refuge's wildlife and plant resources. Wildlife observation and photography, notably of birds, occurs at any location where access is allowed. An observation tower right in front of the lagoon and a photo blind at the west side dike along with a boardwalk provide for wildlife observation and photography during visiting hours. Visitors view displays and observe and photograph wildlife at their own pace.

Access to both the Lagoon and La Tinaja Tracks is allowed throughout the year during daylight hours when the refuge is open to the public, or after dark on a case-by-case basis, as authorized by the refuge manager. All refuge lands have been opened to the public since they were acquired.

PERSONNEL, OPERATIONS, AND MAINTENANCE

Laguna Cartagena NWR is part of the Caribbean Islands NWR Complex, which administers nine wildlife refuges. The refuge headquarters is located in Boquerón, Puerto Rico. There are 25 full-time Complex staff members of which 6 are assigned duties on Laguna Cartagena NWR. The staff is responsible for maintaining assets including roads, parking lots, a fleet of heavy equipment, dikes, gates, fences, passenger vehicles, fishing platforms, observation towers, visitor contact stations, water control structures, and small equipment on Laguna Cartagena NWR. The Complex budget supports all activities and staff on Cabo Rojo, Laguna Cartagena, Desecheo, Vieques, Culebra, Sandy Point, Green Key, Buck Island, and Navassa NWRs. In Fiscal Year 2008, the budget for the Complex totaled $2,700,000.

III. Plan Development

SUMMARY OF ISSUES, CONCERNS, AND OPPORTUNITIES

The planning team identified a number of issues, concerns, and opportunities related to fish and wildlife protection, habitat restoration, recreation, and management of threatened and endangered species. Additionally, the planning team considered federal and state mandates, as well as applicable local ordinances, regulations, and plans. The team also directed the process of obtaining public input through public scoping meetings, planning team meetings open to the government, distribution of comment packets, and personal contacts. All public and advisory team comments were considered; however, some issues important to the public fall outside the scope of the decision to be made in this planning process. This Draft CCP/EA attempts to balance the competing opinions regarding important issues.

This chapter summarizes the most significant issues related to refuge management that emerged as a result of refuge meetings, scoping meetings, and other consultations. It also lists the meetings that have been held with the various agencies, organizations, and individuals who were consulted in the preparation of this Draft CCP/EA.
`

PUBLIC INVOLVEMENT AND THE PLANNING PROCESS

Preplanning activities for the Laguna Cartagena NWR Draft CCP/EA began in November 2007, with activities such as gathering data and information, meeting with refuge staff, meeting with intergovernmental partners, visioning, and preparing for the public scoping phase. As a group, the core planning team prioritized the most critical issues to be addressed by the refuge over the 15-year life of the final CCP. The core planning team involved staff from Cabo Rojo NWR, Puerto Rico, and a staff from the Complex. This team was the primary decision-making team for the development of this Draft CCP/EA. Key tasks of the team involved defining and refining the vision; identifying, reviewing, and filtering issues; defining the goals; and outlining the alternatives.

SUMMARY OF MEETINGS AND CONTACTS

The process to develop the refuge's management plan has involved a series of meetings with staff and key constituencies, including holding a public scoping meeting with neighboring communities, interested non-governmental organizations, local business leaders, community and political leaders, and other interested parties. The key events in this process have included:

- Notice of intent published: a notice of intent to prepare a comprehensive conservation paln and environmental document was published in the Federal Register, with a request for comments. March 12, 2007
- Preplanning meeting: a list of key issues identified in a preplanning meeting with refuge staff. November 2007
- Public scoping meeting held for Laguna Cartagena NWR: March 27, 2008, 5:00-9:00 p.m., Maguayo Community Center
- Meeting to review public scoping comments and identify goals, alternative management options, and objectives and strategies. June 2008

- In addition, refuge manager Oscar Diaz held a number of one-on-one meetings with key stakeholders over the planning period. This included a meeting with the municipality legislature of Lajas on March 25, 2008.

Members of the Service's core planning team met periodically to review public comments, data, and information collected to write this Draft CCP/EA. Professional reviews of the refuge were conducted to determine the status, trends, and conditions of refuge resources and facilities. The information garnered from this review helped the planning team analyze and develop recommendations for this Draft CCP/EA. The Service will seek comments on this Draft CCP/EA as the next stage of public involvement. Adjustments, as necessary, will be made in preparation for the final CCP.

SUMMARY OF ISSUES AND CONCERNS

The significant issues are divided into three categories: species and habitat; public use; and refuge outreach and management. The following list is a summary of key issues that emerged from internal refuge meetings and public scoping meetings.

Wildlife and Habitat Conservation

- Manage and monitor Laguna Cartagena NWR water levels and water quality, primarily for use by water birds. Explore opportunities for collaboration with National Oceanic Atmospheric Administration (NOAA) on water quality monitoring.
- Rehabilitate and manage the lagoon's water control structure (monitor impact on habitat and species).
- Establish a plan for exotic species removal and conservation of plant species important to migratory birds.
- Increase open water, including managing and reducing cattails (burn and flood as opportunity allows).
- Improve the lagoon's drainage system, including cleaning and maintaining canals.
- Monitor changes in habitat/species resulting from water management and from upland reforestation.
- Conduct monthly survey of marsh birds (and other birds in lagoon).
- Reduce cattails/exotic species – to provide better habitat and more open water. Use fire opportunistically to mange cattails and improve habitat
- Monitor endangered plant populations.
- Monitor/re-initiate upland bird surveys.
- Continue reforestation of native vegetation
- Build and manage nesting boxes for West Indian whistling ducks (monitor population).

Public Use

- Promote refuge as a hiking/bird watching destination.
- Expand and maintain trails, including from parking area to observation tower along the edge of the lagoon.
- Provide education to the community on how to protect the watershed of the lagoon and minimize surface water contamination.
- Improve signage, including directional signs.
- Add information kiosks (possibly by observation tower).
- Clarify relationship with neighboring community (Maguayo), particularly on issues of horse and cattle grazing use and the use and maintenance of parquesito (small fenced area set aside for community/school use).
- Develop a partnership with Lajas Municipality to increase use and promotion of refuge, including possible kayak use.
- Continue to work with Sociedad Ornitológica Puertorriqueña Inc., on bird monitoring and habitat restoration.
- Establish more recreation facilities, including: fishing boardwalk, fishing dock and boat access. Establish recreation activities in the lagoon that could be managed by volunteers or friends group of the community to promote tourism and sources of income for the residents. Explore possibility of opening to fishing but make sure water quality is safe for fish consumption.

Refuge Outreach and Management

- Establish a cooperative agreement between the Municipality of Lajas and the Laguna Cartagena NWR to: 1) develop a maintenance plan for the drainage canal that flows though the Maguayo community, and its part of the lagoon drainage basin; 2) provide transportation services of local students to the refuge to promote environmental education and conservation; 3) provide maintenance of the municipal roads around the refuge and the Maguayo community; and 4) improve security of the refuge and surrounding areas.
- Improve security of the refuge and surrounding areas.
- Present the fire management plan of the Laguna Cartagena NWR to the communities adjacent to the refuge.
- Use better promotion methods of information to make the community aware of volunteer opportunities.

Wilderness Review

Refuge planning policy requires a wilderness review as part of the comprehensive conservation planning process. While there is no land within the Laguna Cartagena NWR that qualifies as wilderness, the results of the wilderness review are nevertheless included in Appendix H.

IV. Management Direction

INTRODUCTION

The Service manages fish and wildlife habitats considering the needs of all resources in decision-making. But first and foremost, fish and wildlife conservation assumes priority in refuge management. A requirement of the Improvement Act is for the Service to maintain the ecological health, diversity, and integrity of refuges. Public uses are allowed if they are appropriate and compatible with wildlife and habitat conservation. The Service has identified six priority wildlife-dependent public uses. These uses are: hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation.

Described below is the proposed comprehensive conservation plan for managing the refuge over the next 15 years. This proposed management direction contains the goals, objectives, and strategies that will be used to achieve the refuge vision.

Three principal categories of "alternatives" were considered for managing the refuge. These alternatives included: A) Current Management/no action alternative; B) Wildlife Diversity and Habitat Restoration, and C) Wetland Restoration Emphasis. Each of these alternatives is described in the Alternatives section of the EA. Alternative B – Wildlife Diversity and Habitat Restoration – is the proposed alternative.

VISION

The Laguna Cartagena National Wildlife Refuge is managed, in partnership with the community and other resource management agencies to: (1) protect and restore freshwater wetlands and resident and migratory water birds (e.g., marsh birds, waterfowl, and shore birds); 2) protect and restore subtropical dry forest; and 3) provide wildlife-dependent recreational opportunities.

GOALS, OBJECTIVES, AND STRATEGIES

The goals, objectives, and strategies presented are the Service's response to the issues, concerns, and needs expressed by the planning team, the refuge staff and partners, and the public and are presented in hierarchical format. Chapter V, Plan Implementation, identifies the projects associated with the various strategies.

These goals, objectives, and strategies reflect the Service's commitment to achieve the mandates of the Improvement Act, the mission of the Refuge System, and the purposes and vision of Laguna Cartagena NWR. The Service intends to accomplish these goals, objectives, and strategies within the next 15 years.

Goals

The following six goals were developed for the Laguna Cartagena NWR Draft CCP/EA:

Goal 1: Monitor, protect, and recover species of management interest.

Goal 2: Conserve, enhance, and restore native plant communities and wetland habitat.

Goal 3: Protect natural, historical, and cultural resources to maintain ecological integrity.

Goal 4: Provide opportunities for appropriate and compatible public use.

Goal 5: Provide sufficient staff, volunteers, facilities, and equipment and foster partnerships to implement a comprehensive refuge management program.

Goal 6: Understand the impacts of climate change on refuge resources to plan for and adapt management as necessary to protect the wildlife and habitat of Laguna Cartagena NWR.

FISH AND WILDLIFE POPULATION MANAGEMENT

Goal 1: Monitor, protect, and recover species of management interest.

Objective 1.1: Develop an Inventorying and Monitoring Plan by 2015.

Discussion: This is a required step-down plan that will be developed to guide the development, use, and protocols for collecting biological information on species of interest.

Strategy:

- Produce an inventorying and monitoring plan.

Objective 1.2: Within 3 years of CCP approval, develop and implement a strategy to sustain a refuge-resident population of West Indian whistling ducks (WIWDs). A sustainable population is 25 breeding pairs.

Discussion: The WIWD's range is restricted to the northern West Indies and is one of the rarest ducks in North America. The WIWD's numbers have been reduced due to habitat loss, over hunting, and predation from rats and mongoose. The WIWD is listed as endangered and it is believed there are fewer than 100 individuals left in Puerto Rico. There are several pairs of resident WIWDs on the refuge, but numbers are likely limited to not more than 12-15 pairs. The refuge will work to protect WIWD habitat, reduce predators, and build nesting boxes to help develop a sustainable refuge-resident population of WIWDs.

Strategies:

- Use students pursuing master's degree and volunteers to install, monitor, and maintain 15 WIWD nesting boxes.
- Hire bio-tech for long-term banding program to monitor WIWDs (or partner with Puerto Rico DNER biologist).

Objective 1.3: Within 1 year of CCP approval, begin a process to review and analyze existing and future waterbird census data for better management decisions.

Discussion: The refuge will conduct a formal review of existing waterbird data to determine its usefulness and limitations. Based on this analysis, an improved census data collection and analysis plan will be developed.

Strategy:

- Hire a bio-tech or contract expertise to conduct monthly surveys for numbers of waterfowl and secretive marshbirds.

Objective 1.4: Within the life of the CCP, propagate plant, monitor, and protect threatened and endangered plant species within refuge uplands.

Discussion: The refuge will survey the population of existing threatened and endangered plant species and develop a plan to protect existing populations and plant and protect additional plants. This effort will mainly take place on the refuge, but support will also be provided to plant threatened and endangered species on neighboring farms.

Strategies:

- Work with private landowners adjacent to the refuge to protect threatened and endangered plant species.
- Hire a bio-tech (or partner with ES biologist/universities) to conduct threatened and endangered vegetation surveys and conduct monitoring.
- Incorporate the data from field surveys of threatened and endangered species into a GIS database.
- Identify seed sources of threatened and endangered plant species within Laguna Cartagena NWR and from adjacent areas.
- Expand propagation and planting of threatened and endangered plants such as *Lyonia truncata* var*. proctorii, Vernonia proctorii, Stahlia monosperma,* and *Eugenia woodburyana.*
- Expand propagation and planting of threatened and endangered plants such as *Lyonia truncate var. proctorii, Vernonia proctorii,* and *Eugenia woodburyana.*
- Construct a new plant nursery at Laguna Cartagena NWR.
- Exclude domestic animals that may adversely affect the populations.

Objective 1.5: Over the first 5 to 10 years of the CCP, maintain and protect the current known population numbers of *Aristida chaseae and Aristida portoricensis* on the refuge.

Discussion: Aristida chaseae and Aristida portoricensis are perennial grasses that are restricted in distribution to southwestern Puerto Rico. The grasses are known to occur in few areas: Cabo Rojo NWR, Cerro Las Mesas in Mayaguez, Peñones de Melones in Cabo Rojo, and the range of hills known as the Sierra Bermeja, including on the Laguna Cartagena NWR. These species are classified as endangered and are threatened by wildfires and by agricultural, residential, and general development/land conversion uses. *Aristida chaseae* is also threatened by competition from introduced grass species. During this strategy period, the refuge will work to maintain existing *Aristida chaseae and Aristida portoricensis* populations.

Strategies:

- Survey appropriate areas on the La Tinaja section of the refuge to determine species presence and monitor known locations.
- Conduct trials of propagation of *Aristida chaseae* and if successful, plant at localities on the refuge with similar soil characteristics.
- Continue hay harvesting plus expand existing *Aristida* population.
- Search for individuals of both *Aristida* species on adjacent locations within the Sierra Bemeja.
- Define, prioritize and support the most needed scientific research on the reproductive biology of these two species (*Aristida chaseae and Aristida portorricensis)*.

Objective 1.6: Within the 15-year life of the CCP, coordinate with partners to conduct research on threatened and endangered species in refuge uplands.

Discussion: The refuge will coordinate with local universities to solicit students to become involved in efforts to conduct surveys and research on threatened and endangered species. This work will be useful for developing and monitoring species management efforts and will help to efficiently use limited refuge staff and funding resources.

Strategy:

- Conduct university outreach to increase student involvement with threatened and endangered species and coordinate research with Puerto Rico DNER and other appropriate agencies/organizations.

Objective 1.7: Within the 15-year life of the CCP, initiate threatened and endangered bird surveys to acquire information for better management decisions (e.g., data on population, habitat needs, and breeding).

Discussion: The refuge will initiate threated and endangered bird surveys as a basis for developing management strategies to better promote species population maintenance and recovery.

Strategies:

- Hire a bio-tech (or coordinate with others) to conduct Puerto Rican Nightjar nesting survey.
- Hire a bio-tech (or coordinate with others) to conduct breeding bird survey for rare waterfowl.
- Coordinate and assist state with yellow-shouldered blackbird surveys and management actions, including mapping of habitat use areas.
- Hire a bio-tech (or coordinate with others) to conduct short-eared owl survey and management program, to include grasshopper sparrow.

Objective 1.8: Within 2 years of CCP approval, initiate upland bird surveys/research to gain information for better management decisions on La Tinaja Tract. This would involve data on population, habitat needs, and breeding.

Discussion: The refuge would initiate upland bird surveys as a basis for developing management strategies to better promote species population maintenance and recovery.

Strategies:

- Conduct surveys/research (for upland birds) through staff and/or other partnerships.
- Conduct mist nest surveys (for migratory and resident birds).
- Initiate breeding and point count surveys, including continuation of Christmas bird count.

Objective 1.9: Within 2 years of CCP approval, initiate waterbird surveys/research to gain information for better management decisions on wetland species. This would involve data on population, habitat needs, and breeding.

Discussion: The refuge would initiate waterbird surveys as a basis for developing management strategies to better promote species population maintenance and recovery.

Strategies:

- Conduct surveys/research for wetland birds through staff and/or other partnerships.
- Initiate breeding and population surveys, including continuation of Christmas bird count and monthly waterbird surveys, which include marshbird surveys.
- Maintain and annually update species lists.

Objective 1.10: Within 2 years of CCP approval, provide, maintain, and monitor nesting structures for raptors (e.g., kestrels, ospreys, and other hawks); add 10 to 15 structures adjacent to wetland areas.

Strategies:

- Build and install nesting boxes and platforms.
- Initiate nest box surveying/monitoring plan.

Objective 1.11: Within the 15-year life of the CCP, acquire better information for raptor management such as species composition and relative abundance.

Discussion: The refuge would initiate raptor surveys as a basis for developing management strategies to better promote species population maintenance and recovery.

Strategies:

- Build and install nesting boxes and platforms.
- Initiate nest box survey/monitoring plan.

Objective 1.12: Within the 15-year life of the CCP, acquire better information for reptile and amphibian management (e.g. habitat use, relative abundance, species composition and malformation).

Strategies:

- Continue raptor surveys and possibly initiate research.
- Conduct surveys/research for reptiles and amphibians through staff and/or other partnerships.

Objective 1.13: Within the 15-year life of the CCP, acquire better information for aquatic species management (e.g. habitat use, relative abundance, and species composition).

Strategy:

- Update species list and re-initiate surveys.

Objective 1.14: Within the 15-year life of the CCP, determine the presence of native fish and macroinvertebrates in the refuge lagoon.

Strategies:

- Conduct surveys for species presence.
- Re-introduce native fish species if appropriate.
- Update species list and re-initiate surveys, including a list of macroinvertebrates.
- Improve lagoon water quality to support native fish populations by:
  - Diverting run-off surface water coming from the uplands (e.g., La Tinaja Track) into the lagoon.
  - Reducing the amount of sediment (i.e., load carry) entering the lagoon during heavy rains by planting native vegetation along the water canals.
  - Maintaining the dikes and canals.

Objective 1.15: Within 2 years of CCP approval, gain information for better management decisions for bats species (e.g., feeding, nesting and roosting sites, habitat use, relative abundance, and species composition).

Strategies:

- Initiate bat survey/research (e.g., mist nest and sound frequency) through staff and/or other partnerships, such as Bat Conservancy International.
- Install bat boxes, if determined appropriate.

Objective 1.16: Develop and implement an invasive species management plan to control and, when possible, eradicate invasive animals (e.g., monkeys, mongooses, iguanas, dogs, cats, *Cactoblastis,* and *Harrisia* mealy bugs) on the refuge.

Discussion: There are a number of exotic animals on the refuge that are a threat to the bird populations as a result of predation. The most damaging species are thought to be dogs, cats, iguanas, mongooses, and monkeys. The refuge currently undertakes periodic opportunistic efforts to reduce exotic animal populations but would like to increase the effort and systematically target those predators that are most prevalent and are causing the most damage.

Strategies:

- Initiate surveys/research, develop strategies, and implement actions to control invasive animal species through staff and/or other partnerships [e.g. Puerto Rico DNER cooperation on monkey removal and possibly partner with Animal Plant and Health Inspection Services (APHIS) on *Cactoblastis* and *Harrisia* mealy bug].
- Conduct outreach with local communities to prevent/reduce grazing by domestic animals.
- Take law enforcement actions to reduce illegal use of refuge by domestic animals.

HABITAT MANAGEMENT

Goal 2: Conserve, enhance, and restore native plant communities and wetland habitat.

Objective 2.1: Develop a habitat management plan by the year 2014.

Discussion: This is a required step-down plan that will be developed to guide management and development practices in the refuge's upland and wetland areas.

Strategy:

- Produce a habitat management plan.

Objective 2.2: Enhance, restore, and protect sub-tropical dry forest in Laguna Cartagena uplands, with a restoration target of 5 to 10 acres/year.

Discussion: There are virtually no large tracts of dry forest still standing anywhere on the planet. If this habitat is to be maintained into the future, it has to be protected and expanded. Restoration ecology and habitat management are the only solutions. These upland areas provide feeding and nesting habitat for the yellow-shouldered blackbird and the Puerto Rican nightjar. The refuge has been opportunistically planting native vegetation to expand the upland forest area and would like to continue and expand this effort. This effort is implemented in conjunction with refuge efforts to control invasive and exotic vegetation and replace such with native subtropical dry forest.

Strategies:

- Operate seasonal reforestation projects to plant 2,000 native trees, including monitoring.
- Continue propagation of native and endemic trees and expand tree nursery; increase number and variety of species propagated to 15 - 25 species.
- Use prescribed fire to prepare site for reforestation.

- Continue dry forest restoration research and expand opportunities for new research.
- Continue existing reforestation partner's project and expand partners to assist with native tree propagation with Puerto Rico DNER, non-governmental organizations, and universities.
- Work with Partners program to expand reforestation on neighboring lands.
- Develop a GIS layer that includes upland restoration.

Objective 2.3: Within 5 years of CCP approval, evaluate grassland acreage needs based on habitat requirements of key grassland species and maintain select existing grasslands related to reforestation efforts.

Discussion: The refuge would conduct an analysis and develop a strategy for the portion and acreage of the refuge that should be maintained as grassland. The analysis would take into consideration the conservation status and foraging and habitat needs of grassland-dependent species and balance those needs against the habitat requirements of other refuge species of management interest. Based on this analysis, a determination would be made as to how much grassland should be maintained and in which areas.

Strategies:

- Evaluate grassland acreage needs based on habitat requirements of key grassland species.
- Contract hay harvesting to maintain grasslands.
- Evaluate the possibility of using prescribed burns for grassland areas.

Objective 2.4: Over the 15-year life of the CCP, manage the fire program to prevent and suppress wildfires on and adjacent to refuge.

Discussion: The refuge has one full-time fire staff and has an active program of cooperation and training with the local fire department, which would be continued. The refuge would also explore the possibility of conducting controlled burns to reduce fuel loads and support habitat development, although at the current time prescribed burns are not conducted. There are generally several fires a year that occur on the refuge and a number of these fires are thought to be deliberately set. Additional outreach concerning the purpose of the refuge and the negative effects of fire may help to reduce the incidence of intentionally set and accidental fires.

Strategies:

- Continue on-going mechanical fuel reduction practices.
- Provide outreach to neighboring communities on the impacts of fire and need for fire prevention.
- Hire a forestry technician (Fire).

Objective 2.5: Within 2 years of CCP approval, implement improvements to reduce soil erosions into the Cartagena Lagoon.

Discussion: In order to improve water quality, the refuge would undertake actions to reduce soil erosion into the Cartagena Lagoon. Actions to be undertaken would likely include improvements to the dirt road surrounding the refuge, stream bank stabilization, and possibly increased buffer zone vegetation planting, including in the adjacent uplands.

Strategies:

- Restore/rebuild Tinaja road and install water bars.
- Implement stream bank stabilization activities/reforestation.

Objective 2.6: Within 2 years of CCP approval, develop a plan to detect and control or eradicate invasive exotic plants, including mesquite and guinea grass.

Discussion: The refuge would continue to review efforts to reduce the area of land that is covered with exotic grass species while at the same time increasing the coverage of native grasses, particularly *Aristida chaseae.*

Strategies:

- Continue to remove mesquite and expand the removal to other species (e.g., *Parkinsonia aculeataisonia)*.
- Increase the mowing frequency of guinea grass.
- Conduct GIS mapping on land cover for future management/monitoring.
- Continue to implement herbicide applications along bridges, dikes, and roads and add limited herbicide treatment for Brazilian jasmine.

Objective 2.7: Within 3 years of CCP approval, expand and improve wetland habitat conditions.

Discussion: The Cartagena Lagoon is currently overgrown with cattails and this reduces the amount of open water, which is needed to attract additional waterfowl. The refuge periodically clears some of the cattails, but opportunities are limited by water levels and weather conditions. In addition, there are few deep water pools within the lagoon, which are useful for fish concentration during periods of low water and also helpful for attracting waterfowl. Over the strategy period, the refuge would work to increase open water in the lagoon by reducing cattails and adding deep water pools and building nesting islands.

Strategies:

- Create additional wetland ponds.
- Build nesting islands.
- Expand mechanical and chemical removal of cattails and begin use of prescribed burning.
- Improve the drainage system feeding into lagoon (coordinate with Puerto Rico Energy Power Administration (PREPA) Division of Irrigation).
- Expand partnership with municipality and PREPA to clean and restore dikes.

- Gather experts in hydrology and waterfowl and marshbird ecology to develop long-term plan for restoration objectives and identify equipment and financial needs to accomplish specific tasks.
- Establish a plot of native trees like endemic Puerto Rican Royal Palm Roystonea bonquenalis that will supply food and nesting sites for WIWD and white crowned pigeon.

Objective 2.8: Over the 15-year life of the CCP, initiate a program to improve water management and flow in the lagoon.

Discussion: Currently, lagoon water levels are controlled by a single outflow gate. Under this strategy the refuge will install water gauges to better measure and monitor water levels and work with neighboring land owners to develop/redevelop adjacent wetlands. This should improve the quality of water in the lagoon through better filtration and reduced sedimentation and increase the information needed to better manage flow levels. In addition, the refuge will work with the USGS to install and operate a long-term water monitoring station. The station will be used to measure water flow and water quality and will be helpful to enacting an improved lagoon water management system.

Strategies:

- Promote the development/redevelopment of wetlands on adjacent lands.
- Install gauges to measure water flow and water levels.
- Evaluate data and develop plan to improve water quality.
- Work with U.S. Geological Survey (USGS) researchers to develop a long-term monitoring station.
- Work with university and USGS on water quality of point source and lagoon sources.

Objective 2.9: Over the 15-year life of the CCP, reduce and, if possible, eliminate invasive species in the wetlands.

Discussion: The principal focus on efforts to reduce invasive species in the lagoon will be to reduce cattails and increase open water.

Strategies:

- Cut cattails when water levels are low and begin to use fire as an additional control measure.
- Control water levels to manage cattails.
- Institute control techniques for invasive plants through limited herbicide use and mechanical removal, with a focus on water hyacinth and water lettuce.
- Increase awareness of exotic and invasive species by educating the public.

RESOURCE PROTECTION

Goal 3: Protect natural, historical, and cultural resources to maintain ecological integrity.

Objective 3.1: Over the 15-year life of the CCP, manage the law enforcement program to provide for resource protection, visitor safety, and facilities security.

Discussion: The Cabo Rojo NWR currently has one full-time law enforcement officer, who provides coverage to Laguna Cartagena NWR on an as-needed basis and who also conducts periodic patrols. The officer patrols the refuge, provides outreach services and assists Puerto Rico DNER officials in off-refuge hunts during hunting season peak times. The law enforcement officer has an active program of cooperation with Puerto Rico DNER and municipal and commonwealth police; however, these arrangements have never been formalized under a memorandum of understanding or common operational procedures.

Strategies:

- Employ two full-time law enforcement officers (split between Cabo Rojo and Laguna Cartagena NWRs) to work cooperatively with other local law enforcement agencies, Puerto Rico DNER, and local police.
- Develop and formalize interagency memorandums of understanding with other law enforcement agencies.

Objective 3.2: Over the 15-year life of the CCP, inventory, protect, and interpret cultural and historical resources.

Discussion: There has not been a cultural or historical inventory conducted on the refuge. The refuge hopes to conduct such an assessment and, once completed, would then outline the steps required to protect important resources, depending on the findings of the assessment. To the best of the staff's knowledge, there are no important cultural or archaeological resources on the refuge.

Strategies:

- Conduct a historical and archaeological resource survey of entire refuge.
- Develop a comprehensive historical account of the refuge.

Objective 3.3: Within 2 years of CCP's approval, initiate a containments study on the refuge.

Discussion: The Cartagena Lagoon is located downstream of many agricultural operations and the Lajas Valley has a long history of intensive commercial agriculture, including cattle farming and sugar cane production. It is thought that there is a reasonable probability that the lagoon contains chemical containments, but an analysis has never been undertaken. A study would be undertaken to determine the levels and types of containments in fish and crustaceans in the Cartagena Lagoon. This would be helpful for developing fishing guidelines and for better determining management actions related to containments, if any.

Strategy:

- Conduct containments analysis for fish and crustaceans to determine the presence and levels of agricultural pesticides.

Objective 3.4: Within 2 years of CCP approval, clarify opportunities for expanding refuge boundaries and protecting additional lands key to the lagoon's health and viability.

Discussion: The refuge is relatively small and opportunities would be explored for potential expansion, either through acquiring additional land under a minor expansion plan or through the acquisition of easements. Both upland and upstream riverine areas would be reviewed for potential inclusion as part of the refuge.

Strategies:

- Investigate the potential for acquisition of additional land (i.e., potential for minor expansion plan).
- Investigate the potential for acquisition of easements.

Objective 3.5: Over the 15-year life of the CCP, clarify and secure long-term access rights to the refuge.

Discussion: There is one road, the Desengaño Road, which cuts across a portion of the refuge. The road is not currently open to the public, nor has it been since the refuge has been in operation. However, the ownership status/use rights of the road are uncertain. The refuge would explore the rights associated with this road and take action to ensure that general public access can remain indefinitely restricted.

Strategy:

- Clarify the status of Desengaño road and refuge access rights.

Objective 3.6: Enhance Birds of Conservation Concern and potential candidates' habitat on private lands adjacent to the Cabo Rojo and Laguna Cartagena NWRs.

Strategies:

- Identify and map appropriate areas for habitat enhancement activities on private lands.
- Identify potential landowners and inform them about the different habitat restoration programs and incentives available from the Service and other federal and commonwealth agencies to implement voluntary habitat restoration projects on their lands.

VISITOR SERVICES

Goal 4: Provide opportunities for appropriate and compatible public use.

Objective 4.1: Within 2 years of CCP approval, update the visitor services plan.

Discussion: As per Service requirements, the refuge would develop a step-down visitor services plan once the CCP has been approved. The plan would provide operational guidance for managing a visitor services program.

Strategies:

- Establish an annual monitoring system to review the visitor services program.
- Hire one park ranger/environmental educator to implement the plan.
- Hire a STEP/volunteer to provide a welcoming presence on Laguna Cartagena NWR.

Objective 4.2: During the 15-year life of the CCP, ensure that the refuge is welcoming, safe, and accessible. Provide visitors with clear information that promotes the refuge and the Service.

Discussion: The refuge currently receives about 300 visitors a year, but it is expected that the number of visitors would increase if infrastructure was improved or developed and more activities were offered. This objective would focus on improving directional signs and parking facilities, providing a refuge brochure and video, and updating the website.

Strategies:

- Improve and maintain the main refuge parking area, including exploring involvement of local school and others; improve the second parking area near the water control structure.
- Maintain six existing directional road signs and add a directional road sign east of the refuge; add directional signs to Laguna Cartagena NWR from Cabo Rojo NWR.
- Improve, update, and maintain website (section for Laguna Cartagena NWR) and develop a Spanish version.
- Create a new visitor contact kiosk for refuge, including a restroom and trash cans.
- Establish volunteer program at the refuge to provide a presence.
- Create a refuge-specific brochure for Laguna Cartagena NWR.
- Periodically update the refuge bird list.
- Update Laguna Cartagena NWR's fact sheet periodically.
- Add an automated phone system with features to include refuge information.
- Produce a refuge video.

Objective 4.3: Over the 15-year life of the CCP, work to increase wildlife photography and observation opportunities for refuge visitors.

Discussion: Work in this area would focus on maintaining the existing trail and adding a new uplands trail, maintaining the photo blind, adding an additional photo blind, and improving signs and maps. The refuge would also work to promote photo opportunities on the refuge by sponsoring an annual photography contest.

Strategies:

- Develop a trail system (including upland La Tinaja and dike trails) to include directional signs and maps.
- Maintain existing photo blind and develop an additional photo blind; add a photo platform at La Tinaja.
- Host an annual photography workshop/contest.
- Maintain and add a spotting scope and bird identification panel.

Objective 4.4: Over the 15-year life of the CCP, continue to expand the environmental education program to increase understanding of habitat restoration and wildlife diversity (targeted to public schools).

Discussion: The Complex has two full-time visitor services staff stationed at Cabo Rojo NWR who work closely with the local community and the local Friends Group (the Caborrojeños). This work includes providing environmental education activities to local school groups, mainly on an on-demand basis. Under this strategy, the refuge would work to develop a curriculum-based environmental education program in partnership with local schools. The development of a curriculum-based environmental education program would be managed by visitor staff located at the Cabo Rojo NWR and would be initially developed in partnership with the public schools in the Lajas and Cabo Rojo municipalities.

Strategies:

- Increase on-site environmental education programs for schools at the Cabo Rojo NWR Visitor Center and outdoor classrooms.
- Develop a curriculum-based environmental education program.

Objective 4.5: Over the 15-year life of the CCP, expand the environmental interpretation program to increase the public's understanding of habitat restoration and wildlife diversity.

Discussion: The emphasis under this objective would be to create better and more accessible information about the refuge and the ecological processes it supports. This would include adding a number of interpretive displays on the refuge. Interpretive information would emphasize the importance and functions of wetlands and explain the wetland work the refuge is undertaking for the Cartagena Lagoon.

Strategies:

- Maintain an additional kiosk at the observation tower and add an interpretive panel at the fishing platform; the interpretive information would emphasize wetland ecology, fire, fish, and invasive species.
- Add a bird identification panel at the observation tower and photo blind.
- Expand community interpretive programs such as off-site school programs.

Objective 4.6: During the 15-year life of the CCP, increase recognition of the refuge and associated management activities for local communities.

Discussion: The purpose of this objective is to increase the refuge's profile in the neighboring communities. This would include raising awareness of the refuge and its purpose and functions. In addition to helping to build environmental awareness in the neighboring communities, it is expected this would also help to foster greater cooperation between refuge staff and neighboring communities. Building better community relations may potentially have a benefit in reducing conflict and increasing cooperation, particularly around issues such as fire management, grazing, and recreational use.

Strategies:

- Continue to participate in eight to ten community events per year (e.g., University of Puerto Rico annual event and establish an annual environmental fair at Laguna Cartagena NWR).
- Conduct a survey of local communities to determine the perceived value of the Service and the refuge.
- Establish an annual photography contest/photography club on the refuge.
- Develop and distribute *Firewise* magazine in Spanish.
- Develop news articles/information on fire information for the community (e.g., radio and newsletters).
- Create fire level information signs to inform the public of the daily fire threat (expand to national program).
- Add a kiosk and environmental program in area adjacent to school in Maguayo.
- Use the website to disseminate refuge information, press releases, and other public information.

Objective 4.7: Over the 15-year life of the CCP, evaluate the potential to provide quality hunting on the refuge.

Discussion: Hunting has never been allowed on the refuge as there are few species of huntable game birds. In addition, the refuge is small and it is thought that hunting would have a negative impact on the refuge's endangered species. However, during this management period, the refuge would formally review whether hunting should be allowed.

Strategy:

- Conduct hunting assessment.

Objective 4.8: Within 5 years of CCP approval, develop a plan that would define permissible fishing opportunities on the lagoon.

Discussion: There is currently no formal fishing program on the refuge. During this time period, fishing program guidelines would be developed. This would include developing regulations and guidance, designating fishing areas, and studying fish containment levels to determine if fish consumption is safe. In addition, the refuge plans to reintroduce native fish species to the Cartagena Lagoon and the reintroduction program would be considered in the development of program regulations.

Strategies:

- Conduct a fish containments analysis for fish/crustaceans (for agricultural pesticides) and determine safety issue related to fishing.
- Develop and post fishing regulations.
- Create an additional fishing platform near the observation tower.
- Develop and host an annual youth fishing derby.

Objective 4.9: Over the 15-year life of the CCP, consider additional public uses that are appropriate and compatible with the refuge's purpose.

Discussion: Additional public uses on the refuge would be considered as per interest. Initially, the refuge would conduct appropriate use and compatibility determinations for canoeing and biking. Currently, there is not a canoeing or biking program; however, it is possible that biking could be conducted on some of the refuge's trails and canoeing could be undertaken once some of the cattails were removed and the lagoon's open water increased.

Strategy:

- Conduct compatibility and appropriate use determinations for other public uses, including canoeing/kayaking and biking.

REFUGE ADMINISTRATION

Goal 5: Provide sufficient staff, volunteers, facilities, and equipment and foster partnerships to implement a comprehensive refuge management program.

Objective 5.1: Over the 15-year life of the CCP, continue to support and expand existing partnerships.

Discussion: The refuge engages a wide array of partners in the management of the refuge. The refuge has partnerships in the areas of reforestation, visitor services, fire suppression, law enforcement, and research. The refuge would make efforts to strengthen existing partnerships and look to add new partners for future cooperation.

Strategies:

- Existing inter-governmental partnerships include: (1) Law Enforcement (existing cooperation with Puerto Rico DNER/Law Enforcement); (2) fire management partnerships (existing cooperation with municipal fire company); (3) USDA/International Institute of Tropical Forestry; and (4) Lajas Municipality to work on water drainage issues.

- Encourage the involvement of Caborrojeños in support of the refuge and look for opportunities to develop a Friend's group for Laguna Cartagena NWR.

- Develop new partnerships with municipality of Lajas to enhance coordination and cooperation on resource management and visitor service issues, local school groups, and other organizations.

- Develop a formal partnership and Cooperative Agreement with the Ornithological Society of Puerto Rico (SOPI). Develop other partnerships as appropriate (e.g., University of Puerto Rico and Inter-American University).

Objective 5.2: During the 15-year life of the CCP, maintain and expand the volunteer program and focus on promoting wildlife diversity and habitat restoration.

Discussion: The refuge currently uses volunteers on an *ad hoc* basis to support tree planting. The refuge would like to increase the use of volunteers but is currently constrained from doing so due to limited budgets and the lack of support infrastructure (especially housing) and personnel. Ideally, the refuge would like to hire a full-time volunteer coordinator (to be shared with the Cabo Rojo NWR) and develop adequate support facilities to enable an expansion of the program. This would include building new housing facilities for use by volunteers. The housing facilities would be located at the Cabo Rojo NWR, but would support volunteers who would also provide services at the Laguna Cartagena NWR.

Strategies:

- Work with partners to provide volunteer services that contribute to the refuge's goals and objectives.
- Develop housing for volunteers (to be located at Cabo Rojo NWR).
- Provide training opportunities for new volunteers.
- Hire a full-time park ranger/environmental educator to serve as volunteer coordinator.

Objective 5.3: Over the 15-year life of the CCP, develop and formalize agreements with universities and research institutes to focus on refuge research priorities.

Discussion: The Refuge System has not developed an active research program on the Laguna Cartagena NWR. There are, however, a number of research areas that could benefit from collaboration with local and national universities. Research studies could include topics such as the management of endangered species, including plants as *Aristida chaseae*; bird and fish research; and understanding of the knowledge, views, and expectations of local communities regarding the refuge and its place in the community. In order to ensure that future research studies would address

the priority needs of the refuge, the refuge plans to develop research priorities, produce terms of reference/guidance for these studies, and then solicit partners to undertake the studies. Future studies are expected to focus on both biological and social issues.

Strategy:

- Develop and formalize agreements with universities and research institutes to focus on refuge priorities.

Objective 5.4: Hire additional staff to fully implement the final CCP.

Discussion: This strategy calls for increased activity in several key areas, including visitor services; environmental education; and habitat management, restoration, and research. A number of additional staff will be required as presented below. As Laguna Cartagena NWR is managed as a satellite refuge of Cabo Rojo NWR, a number of staff would be shared between the two refuges. Laguna Cartagena NWR is currently unstaffed although some staff from Cabo Rojo NWR dedicate a portion of their time to supporting the refuge, including the refuge manager and law enforcement and fire personnel.

Strategies:

- Hire the following additional staff: biologist, biological technician, engineering equipment operators (2), park ranger/environmental educator; forestry technician (fire), GIS specialist (to be shared with the Complex), and law enforcement officer.
- Expand the Youth Conservation Corps (YCC) program to include a separate Laguna Cartagena NWR program; the appropriate number of YCC volunteers would be twelve.

Objective 5.5: Construct new facilities to enable the full implementation of the final CCP.

Discussion: This strategy requires additional use of volunteers and the development of improved visitor support facilities at the refuge (e.g., kiosks, directional signs, and observation decks). Undertaking these activities would require the development of new infrastructure.

Strategy:

- Develop operational and visitor facilities at refuge headquarters and construct the following new facilities: volunteer housing (located on Cabo Rojo NWR but shared with Laguna Cartagena NWR volunteers); new/expanded greenhouse at Cabo Rojo NWR; visitor contact station; kiosk and signs; fishing platform; photo blind; observation deck; and dikes and culverts.

Objective 5.6: Over the 15-year life of the CCP, maintain existing facilities.

Discussion: Staff and funds would be required to maintain existing refuge facilities (as outlined in RONS). Existing facilities that would require significant upgrading or repairs during this period would include fence removal and replacement and replacement of gates.

Strategy:

- Implement the following infrastructure improvements: replace (or repair) two bridges; remove cross fencing and replace boundary fencing; and replace gates as needed.

Objective 5.7: Over the 15-year life of the CCP, maintain existing equipment.

Discussion: Funds and staff would be required to maintain existing equipment and some new equipment would be required.

Strategy:

- Additional equipment needs include a water truck, augur, tractor, and a Jon boat and motor.

Goal 6: Understand the impacts of climate change on refuge resources to plan for and adapt management as necessary to protect the wildlife and habitat of Laguna Cartagena NWR.

Objective 6.1: During the 15-year life of the CCP, coordinate with researchers and partners to identify climate change research needs, investigating the impacts of climate change on fish and wildlife, listed species, vegetative communities, water quality and quantity, and other resources.

Strategy:

- Follow Refuge System guidance and initiatives to determine effects of climate change on refuge resources.

V. Plan Implementation

INTRODUCTION

Refuge lands are managed as defined under the Improvement Act. Congress has distinguished a clear legislative mission of wildlife conservation for all national wildlife refuges. National wildlife refuges, unlike other public lands, are dedicated to the conservation of the Nation's fish and wildlife resources and wildlife-dependent recreational uses. Priority projects emphasize the protection and enhancement of fish and wildlife species first and foremost, but considerable emphasis is placed on balancing the needs and demands for wildlife-dependent recreation and environmental education.

To accomplish the purpose, vision, goals, and objectives contained in this Draft CCP/EA for Laguna Cartagena NWR, this section identifies projects, funding and personnel needs, volunteers, partnerships opportunities, step-down management plans, a monitoring and adaptive management plan, and plan review and revision.

PROPOSED PROJECTS

Listed below are the proposed project summaries and their associated costs for fish and wildlife population management, habitat management, resource protection, visitor services, and refuge administration over the next 15 years. This proposed project list reflects the priority needs identified by the public, planning team, and refuge staff based upon available information. These projects were generated for the purpose of achieving the refuge's objectives and strategies. The primary linkages of these projects to those planning elements are identified in each summary.

Project 1. Science-based inventorying and monitoring program

Science-based inventorying and monitoring of plant and animal populations are critical to ensuring the biological integrity of the refuge. Information collected would serve as the basis for developing habitat management plans and would influence all refuge management activities. Standardized census and survey techniques would be employed and all data compiled into databases including GIS for spatial analysis. All data would be shared with appropriate state, federal, and local partners in an effort to further strategic habitat management.

Wildlife Objectives: 1.1-16
Habitat Objectives: 2.1-9
Resource Protection Objectives: 3.3, 3.5
Visitor Services Objectives: 4.4
Refuge Administration Objectives: 5.1-4
Climate Change Objectives: 6.1

Project 2. Geographic Information System (GIS)

The use of GIS has become widespread as a valuable tool in developing and implementing habitat management plans. To better organize, understand, and make inferences regarding habitat management, a comprehensive GIS database is needed. Once established, the geographic layers would incorporate all refuge programs. This would help ensure compatibility and productivity. This project would develop a data management, storage, and retrieval system; obtain spatial information

from appropriate sources; develop geographical layers for refuge management programs; and facilitate spatial analysis and creation of maps.

Wildlife Objectives: 1.1-16
Habitat Objectives: 2.1-9
Resource Protection Objectives: 3.2-5
Visitor Services Objectives: 4.4
Refuge Administration Objectives: 5.1-4
Climate Change Objectives: 6.1

Project 3. Increase Native Fishes

Native fish species in Laguna Cartagena are currently unknown. This project would include conducting surveys to determine species presence, updating current species lists, and re-introducing native fish species. This project would also include working to improve lagoon water quality by diverting run-off surface water coming from the uplands, reducing the amount of sediment by planting native vegetation along water canals, and maintaining the dikes and canals.

Wildlife Objectives: 1.1, 1.4, 1.14
Habitat Objectives: 2.1, 2.5, 2.8-9
Resource Protection Objectives: 3.3-5
Visitor Services Objectives: 4.4
Refuge Administration Objectives: 5.1-4
Climate Change Objectives: 6.1

Project 4. Invasive Species Control

Invasive plant species are present in both uplands and wetlands on the refuge. This project would include removing mesquite and expanding the removal of other species such as *Parkinsonia aculeata*, increasing the mowing frequency of guinea grass, mapping invasive species occurrence, and implementing herbicide applications along bridges, dikes, and roads. Invasive species management in the lagoon would focus primarily on reducing cattails and increasing open water to benefit wildlife species such as the endangered WIWD. This project would include introducing prescribed fire, managing water levels, using herbicides and mechanical removal, and increasing public awareness on exotic and invasive species.

Wildlife Objectives: 1.1-7, 1.12-14, 1.16
Habitat Objectives: 2.1-9
Resource Protection Objectives: 3.1-6
Visitor Services Objectives: 4.4-6
Refuge Administration Objectives: 5.1-4, 5.7
Climate Change Objectives: 6.1

Project 5: Reforestation

There are few large tracts of dry forest remaining in Puerto Rico. If this habitat is to be maintained into the future, it has to be protected and expanded. These uplands areas provide feeding and nesting habitat for the yellow-shouldered blackbird and the Puerto Rican nightjar. The refuge has been opportunistically planting native vegetation to expand the upland forest area and would like to continue and expand this effort. This project would include operating seasonal reforestation projects to plant 2,000 native trees (including monitoring), propagation of trees, constructing a new nursery,

using prescribed fire for site preparation, rebuilding La Tinaja Road and installing water bars, stream bank stabilization, and developing a GIS layer. The project would also include working with the reforestation Partner's project and expanding opportunities for new research.

Wildlife Objectives: 1.1, 1.4, 1.6-8, 1.10-12, 1.15-16
Habitat Objectives: 2.1, 2.2, 2.6
Resource Protection Objectives: 3.4-5
Visitor Services Objectives: 4.4-6
Refuge Administration Objectives: 5.1-4, 5.7
Climate Change Objectives: 6.1

Project 6. Lagoon Restoration

The Cartagena Lagoon was once one of the most important freshwater habitats for migratory waterfowl in Puerto Rico, but is currently overgrown with cattails, reducing the amount of open water. This project would include creating additional wetland ponds, building nesting islands, expanding the mechanical and chemical removal of cattails, introducing prescribed burning, improving drainage system feeding into the lagoon, establishing a plot of native trees in support of future whistling-duck nesting sites, and installing gauges to measure water flow and water levels. This project would also include expanding partnerships with municipality and PREPA to clean and restore dikes, working with USGS researchers to develop a long-term monitoring station, and working with university and USGS on water quality of point source and lagoon sources.

Wildlife Objectives: 1.1-4, 1.9, 1.12-14, 1.16
Habitat Objectives: 2.1, 2.5, 2.7-9
Resource Protection Objectives: 3.1, 3.3-5
Visitor Services Objectives: 4.3-8
Refuge Administration Objectives: 5.1-4, 5.6-7
Climate Change Objectives: 6.1

Project 7. Fire Management

Control burns are not currently conducted on the refuge. There are several fires that occur annually on the refuge that appear to be deliberately or accidentally set. This project would include acquiring heavy equipment to fully implement the Fire Management Plan, exploring introduction of prescribed fire to reduce fuel loads, controlling or removing invasive or exotic species, and expanding fire training. This project would also include initiating additional outreach to local communities concerning positive and negative effects fire can have on the refuge which may result in reducing intentional or accidental fires, developing *Firewise* magazine in Spanish, creating fire level information signs, and developing new articles on fire information for the community.

Wildlife Objectives: 1.1
Habitat Objectives: 2.1, 2.4, 2.7, 2.9
Resource Protection Objectives: 3.1, 3.5
Visitor Services Objectives: 4.2-6, 4.8
Refuge Administration Objectives: 5.1-4, 5.7
Climate Change Objectives: 6.1

Project 8. Expand Visitor Services Program

The refuge hosts around 300 visitors per year. If infrastructure is developed, the visitor use numbers are expected to increase. Wildlife-dependent recreation opportunities are offered at the refuge. Balancing visitor use with our mission to protect wildlife and habitat should be central to all decisions regarding expanding recreation opportunities. This project would include developing a Visitor Services Plan, improving the main parking area, adding directional signs to Laguna Cartagena NWR from Cabo Rojo NWR, improving outreach material, updating websites, establishing a volunteer program, producing a refuge video, developing a trail system, adding a photo blind and platform, conducting a hunt assessment, developing fishing regulations, creating an additional fishing platform, hosting a youth fishing day, and adding a spotting scope. This project would also include adding on-site environmental education programs for schools and developing a curriculum-based environmental education program. Outreach programs would increase through participation in 8-10 events per year, establishing an annual photography contest, adding a kiosk and an environmental program in area adjacent to the school in Maguayo, and using the website to disseminate refuge information, press releases, and other public information.

Habitat Objectives: 2.2, 2.9
Resource Protection Objectives: 3.1-2, 3.5
Visitor Services Objectives: 4.1-9
Refuge Administration Objectives: 5.1-7
Climate Change Objectives: 6.1

Project 9. Cultural Resources Survey

There is not a lot known about the cultural and historical resources on the refuge. This project would include the completion of a cultural resources survey, whose results would be incorporated into the refuge's GIS database. An integrated cultural resources plan and a cultural resources overview for the refuge would be developed as a part of this project, with guidance and assistance from the Regional Archaeologist.

Resource Protection Objectives: 3.1-2, 3.4
Visitor Services Objectives: 4.4
Refuge Administration Objectives: 5.1-4
Climate Change Objectives: 6.1

Project 10. Climate Change

Global climate change poses risks to human health and to terrestrial and aquatic ecosystems. This project would provide research funding to assess potential changes to refuge resources associated with climate change, and evaluate the changes in habitat or species diversity that may be irreversible. It would provide funding for potential management activities that could mitigate or minimize the impacts to the refuge, as well as to develop strategies that could be implemented to assist key species in adapting to climate change.

Wildlife Objectives: 1.1-16
Habitat Objectives: 2.1-9
Resource Protection Objectives: 3.3, 3.5-6
Visitor Services Objectives: 4.4-5
Refuge Administration Objectives: 5.1-4
Climate Change Objectives: 6.1

Project 11. Refuge Administration

The Complex has 25 full-time employees of which 6 are assigned duties between Cabo Rojo NWR and Laguna Cartagena NWR. This project would provide for additional staff to accomplish the goals and objectives of this CCP. Personnel priorities would include employing a biologist, a biological technician, engineering equipment operators (2), a park ranger/environmental educator, a GIS specialist (to be shared with the Complex), a forestry technician (Fire), and a law enforcement officer (to be shared with Cabo Rojo NWR). This increase in budget and staff would better enable Cabo Rojo NWR to meet the obligations of wildlife stewardship, habitat management, public use, resource protection, and refuge administration. This project would also include replacing two bridges, removing cross fencing, replacing boundary fencing, and replacing gates. Equipment needed for this project would include a water truck, auger, tractor, and a Jon boat with motor.

Wildlife Objectives: 1.1-16
Habitat Objectives: 2.1-9
Resource Protection Objectives: 3.1-6
Visitor Services Objectives: 4.1-9
Refuge Administration Objectives: 5.1-7
Climate Change Objectives: 6.1

FUNDING AND PERSONNEL

Implementation of the final CCP will require increased funding and personnel support that will come from a variety of internal and external sources. New projects and maintenance needs for existing facilities and projects are identified through the Service Asset Maintenance Management System (SAMMS). Figure 8 identifies the proposed Laguna Cartagena NWR organization chart and staffing required to help achieve the goals, objectives, and strategies outlined in this Draft CCP/EA. Table 1 lists the proposed projects described above, their costs, and associated staffing. The CCP, when final, would not constitute a commitment (from Congress) for staffing increases, operational and maintenance increases, or funding for future land acquisition, but represents wildlife resource needs based on sound biological science and input from the public.

Table 1. Summary of Projects

PROJECT NUMBER	PROJECT TITLE	FIRST YEAR COST	RECURRING ANNUAL COST	STAFF (FTE'S)
1	Science-based Inventorying and Monitoring Program	43,000	32,000	.7
2	GIS	20,000	15,000	.2
3	Increase Native Fishes	43,000	32,000	.7
4	Invasive Species Control	70,000	62,000	1.2
5	Reforestation	42,000	36,000	.5
6	Lagoon Restoration	168,000	116,000	1.4

PROJECT NUMBER	PROJECT TITLE	FIRST YEAR COST	RECURRING ANNUAL COST	STAFF (FTE'S)
7	Fire Management	20,000	22,000	.5
8	Expand Visitor Services Program	530,000	90,000	1.2
9	Cultural Resources Survey	50,000	12,000	.25
10	Climate Change	30,000	Contract	Contract
11	Refuge Administration	380,000	310,000	6.7

PARTNERSHIP/VOLUNTEERS OPPORTUNITIES

A key element of the CCP, when final, is to establish partnerships with local volunteers, landowners, private organizations, and state and federal natural resource agencies. In the immediate vicinity of the refuge, opportunities exist to establish partnerships with SOPI, municipality of Lajas, and the University of Puerto Rico. At regional and state levels, partnerships may be established or enhanced with organizations such NRCS, Puerto Rico DNER, Inter-American University, USGS, PREPA, Land Administration, Puerto Rico Tourism Company, the municipal fire and police departments, local community leaders, and USDA Forest Service.

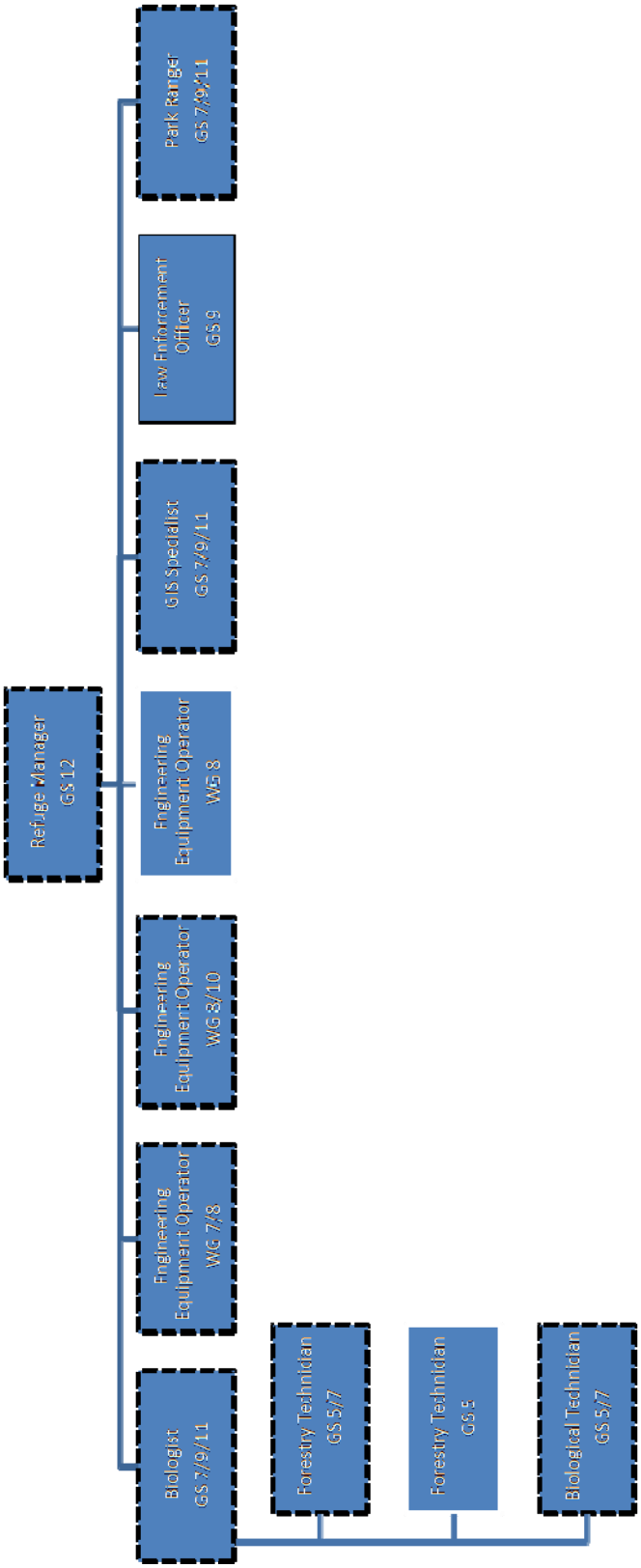
STEP-DOWN MANAGEMENT PLANS

A CCP is a strategic plan that guides the direction of the refuge. A step-down management plan provides specific guidance on activities, such as habitat, fire, and visitor services. These plans (Table 2) are also developed in accordance with the National Environmental Policy Act, which requires the identification and evaluation of alternatives and public review and involvement prior to their implementation.

Table 2. Step-down management plans

Step-down Management Plans	Completion Date
Inventorying and Monitoring	2015
Habitat Management	2014
Law Enforcement	2015
Visitor Services	2014
Cultural Resources	2020
Fire Management	2015

Figure 8. Proposed organizational chart for Laguna Cartagena National Wildlife Refuge



MONITORING AND ADAPTIVE MANAGEMENT

Adaptive management is a flexible approach to long-term management of biotic resources that is directed over time by the results of ongoing monitoring activities and other information. More specifically, adaptive management is a process by which projects are implemented within a framework of scientifically driven experiments to test the predictions and assumptions outlined within a plan.

To apply adaptive management, specific surveying, inventorying, and monitoring protocols would be adopted for the refuge. The habitat management strategies would be systematically evaluated to determine management effects on wildlife populations. This information would be used to refine approaches and determine how effectively the objectives are being accomplished. Evaluations would include ecosystem team and other appropriate partner participation. If monitoring and evaluation indicate undesirable effects for target and non-target species and/or communities, then alterations to the management projects would be made. Subsequently, the CCP would be revised. Specific monitoring and evaluation activities would be described in the step-down management plans.

PLAN REVIEW AND REVISION

The final CCP would be reviewed annually as the refuge's annual work plans and budgets are developed. It would also be reviewed to determine the need for revision. A revision would occur if and when conditions change or significant information becomes available, such as a change in ecological conditions or a major refuge expansion. The final CCP would be augmented by detailed step-down management plans to address the completion of specific strategies in support of the refuge's goals and objectives. Revisions to the final CCP and the step-down management plans would be subject to public review and NEPA compliance.

SECTION B. ENVIRONMENTAL ASSESSMENT

I. Background

INTRODUCTION

The Service prepared this Environmental Assessment (EA) for Laguna Cartagena NWR in compliance with NEPA and the Improvement Act. The Improvement Act requires the development of comprehensive conservation plans for all refuges. Following a public review and comment period on the Draft CCP/EA, a final decision will be made by the Service that will guide Laguna Cartagena NWR management actions and decisions over the next 15 years, provide understanding about the refuge and management activities, and incorporate information and suggestions from the public and refuge partners.

The Draft CCP/EA proposes a management direction, which is described in detail through a set of goals, objectives, and strategies. The Draft CCP/EA addresses current management issues, provides long-term management direction and guidance for the refuge, and satisfies the legislative mandates of the Improvement Act. While the Draft CCP/EA provides general management direction, subsequent step-down plans would provide more detailed management direction and actions.

The EA determines and evaluates a range of reasonable management alternatives. The intent is to support informed decision-making regarding future management of the refuge. Each alternative presented in this EA was generated with the potential to be fully developed into a final CCP. The predicted biological, physical, social, and economical impacts of implementing each alternative are analyzed in this EA. This analysis assists the Service in determining if the alternatives represent no significant impacts, thus requiring the preparation of a Finding of No Significant Impact, or if the alternatives represent significant impacts, thus requiring more detailed analysis through an Environmental Impact Statement and a Record of Decision. Following public review and comment, the Service would select an alternative to be fully developed for this refuge.

The CCP is needed to address current management issues, to provide long-term management direction for the refuge, and to satisfy the legislative mandates of the Improvement Act, which requires the preparation of a CCP for all national wildlife refuges.

PURPOSE AND NEED FOR ACTION

The purpose of the EA is to meet the purpose(s) of the refuge and the goals identified in the Draft CCP (for which we evaluate each alternative). The final CCP's purpose is to ensure that the Laguna Cartagena NWR is managed in partnership with the community and other resource management agencies to: (1) protect and restore freshwater wetlands and resident and migratory water birds (marsh birds, waterfowl, and shore birds); (2) protect and restore subtropical dry forest; and (3) provide wildlife-dependent recreational opportunities. The need of the EA is to adopt a 15-year management plan that provides guidance for future management and that meets the mandates of the Improvement Act.

DECISION FRAMEWORK

Based on the assessment described in this document, the Service will select an alternative to implement the CCP for Laguna Cartagena NWR. The final CCP will include a Finding of No Significant Impact (FONSI), which is a statement explaining why the selected alternative will not have a significant effect on the quality of the human environment. This determination is based on an evaluation of the Service and Refuge System mission, the purpose(s) for which the refuge was established, and other legal mandates. Assuming no significant impact is found, implementation of the CCP will begin and will be monitored annually and revised when necessary.

PLANNING STUDY AREA

The Laguna Cartagena NWR was established in 1989 (1,043 acres) to rehabilitate the lagoon for resident and migratory water birds, and to provide for increased wildlife-related public use. After several years of negotiations, 773 acres were acquired by the Puerto Rico Land Administration and the Service signed a 50-year lease agreement, renewable for another 50 years, on August 8, 1989. In 1996, an additional 270 acres were acquired with fee title from the USDA Farm Service Administration. The Laguna Cartagena Lagoon tract ranges in elevation from 40 m on the south side bordering the slopes of Sierra Bermeja to 11 m at the shoreline of the Cartagena Lagoon. To the north, the property is flat, rising to 12 m at the border with private holdings.

An additional 270 acres of uplands were added under fee title in 1996 – known as the La Tinaja Tract. The La Tinaja tract, contiguous with the lagoon property, lies about 0.5-km south of Cartagena Lagoon. The tract measures approximately 0.8 by 1.6 km (upslope), and ranges from 20 to 290 m in elevation. The highpoint of the Sierra Bermeja is Cerro Mariquita at 301 m. It lies about 50 m upslope to the west.

This EA will identify management on refuge lands, as well as those lands proposed for acquisition by the Service.

AUTHORITY, LEGAL COMPLIANCE, AND COMPATIBILITY

The Service developed this Draft CCP/EA in compliance with the Improvement Act and Part 602 of the Fish and Wildlife Service Manual (National Wildlife Refuge System Planning). The actions described within this Draft CCP/EA also meet the requirements of NEPA. The refuge staff achieved compliance with NEPA through the involvement of the public and the incorporation of this EA, with a description of the alternatives considered and an analysis of the environmental consequences of the alternatives. When fully implemented, the CCP will strive to achieve the vision and purposes of Laguna Cartagena NWR.

When final, the CCP's overriding consideration will be to carry out the purposes for which the refuge was established. The laws that established the refuge and provided the funds for acquisition state the purposes. Fish and wildlife management is the first priority in refuge management, and the Service allows and encourages public use (i.e., wildlife-dependent recreation) as long as it is compatible with, or does not detract from, the refuge's mission and purposes.

COMPATIBILITY

The National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, states that national wildlife refuges must be protected from incompatible or harmful human activities to ensure that Americans can enjoy Refuge System lands and waters. Before activities or uses are allowed on a national wildlife refuge, the uses must be found to be compatible. A compatible use "...will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge." In addition, "wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety."

An interim compatibility determination is a document that assesses the compatibility of an activity during the period of time the Service first acquires a parcel of land to the time a formal, long-term management plan for that parcel is prepared and adopted. The Service has completed an interim compatibility determination for the six priority general public uses of the Refuge System, as listed in the Improvement Act. These uses are hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation.

PUBLIC INVOLVEMENT AND THE PLANNING PROCESS

In accordance with Service guidelines and NEPA recommendations, public involvement has been a crucial factor throughout the development of the Draft CCP/EA for Laguna Cartagena NWR. This plan has been written with input and assistance from interested citizens, conservation organizations, and employees of local and state agencies. The participation of these stakeholders and their ideas has been of great value in setting the management direction for Laguna Cartagena NWR. The Service, as a whole, and the refuge staff, in particular, are very grateful to each one who has contributed time, expertise, and ideas to the planning process. The staff remains impressed by the passion and commitment of so many individuals for the lands and waters administered by the refuge.

The process to develop the refuge's management plan has involved a series of meetings with staff and key constituencies, including holding a public scoping meeting with neighboring communities, interested non-governmental organizations, local business leaders, community and political leaders, and other interested parties. The key events in this process have included:

- Preplanning Meeting: A list of key issues identified in a preplanning meeting with refuge staff in November 2007;
- A public scoping meeting was held at the Maguayo Community Center in Lajas, Puerto Rico, on March 27, 2008
- A meeting to review public scoping comments and identify goals, alternative management options, objectives, and strategies was held at the Cabo Rojo NWR in June 2009.

A complete summary of the issues and concerns is provided in Appendix D.

II. Affected Environment

For a description of the affected environment, see Section A, Chapter II, Refuge Overview.

III. Description of Alternatives

FORMULATION OF ALTERNATIVES

Alternatives are different approaches or combinations of management objectives and strategies designed to achieve the refuge's purpose and vision, and the goals identified in this Draft CCP/EA; the priorities and goals of the Cabo Rojo/Laguna Cartagena NWR Ecosystem Team; the goals of the Refuge System; and the mission of the Service. Alternatives are formulated to address the significant issues, concerns, and problems identified by the Service and the public during public scoping.

The three alternatives identified and evaluated represent different approaches to provide permanent protection, restoration, and management of the refuge's fish, wildlife, plants, habitats, and other resources, as well as compatible wildlife-dependent recreation. Refuge staff assessed the biological conditions and analyzed the external relationships affecting the refuge. This information contributed to the development of refuge goals and, in turn, helped to formulate the alternatives. As a result, each alternative presents different sets of objectives for reaching refuge goals. Each alternative was evaluated based on how much progress it would make and how it would address the identified issues related to fish and wildlife populations, habitat management, resource protection and conservation, visitor services, and refuge administration. A summary of the three alternatives is provided in Table 3.

DESCRIPTION OF ALTERNATIVES

Serving as a basis for each alternative, a number of goals and sets of objectives were developed to help achieve the refuge's purpose and the mission of the Refuge System. Objectives are desired conditions or outcomes that are grouped into sets and, for this planning effort, consolidated into three alternatives. These alternatives represent different management approaches for managing the refuge over a 15-year time frame while still meeting the refuge purposes and goals. The three alternatives are summarized below. A comparison of each alternative follows the general description.

Alternative A – (Current Management - No Action)
Alternative B – Wildlife Diversity and Habitat Restoration (proposed alternative)
Alternative C – Wetland Restoration Emphasis

FEATURES COMMON TO ALL ALTERNATIVES

Although the alternatives differ in many ways, there are similarities among them as well. These common features are listed below to reduce the length and redundancy of the individual alternative descriptions.

ALTERNATIVE A – NO ACTION (CURRENT MANAGEMENT DIRECTION)

Under this alternative, existing refuge management practices and uses would continue. All refuge management actions would be directed towards achieving the refuge's primary purposes, which are to: (1) restore and enhance native wildlife and plants, particularly the endangered yellow-shouldered blackbird; (2) increase the level of environmental awareness among residents and visitors; and (3) protect one of the most important shorebird habitats in the Caribbean.

Refuge staff would continue to restore and maintain existing sub-tropical dryland forests, the Cartagena Lagoon, and grassland habitats. Management programs would continue to be developed and implemented with limited baseline biological information. Active habitat wetland management would be implemented by continuing water level management of the lagoon and conducting opportunistic removal of cattails to try and create more open water. Current visitor facilities, which are somewhat limited, would be maintained but no additional facilities would be added, except for perhaps a new information kiosk. Law enforcement of refuge regulations and for protection of wildlife and visitors would continue at current levels, which is done through sharing the resource of a single law enforcement officer who is based at Cabo Rojo NWR.

ALTERNATIVE B – WILDLIFE DIVERSITY AND HABITAT RESTORATION (PROPOSED ALTERNATIVE)

Under this alternative, the emphasis would be on improving refuge resources for wildlife.

As with Alternative A, management efforts would focus on achieving the refuge's primary purposes. The refuge would provide greater enhancement and management of all habitats and associated plant communities for the greater benefit of wildlife. It would work to re-introduce native fish to the lagoon and actively help to support birds that are threatened, endangered, or of management interest, including the WIWD and kestrels.

Specific activities that would be expanded, or introduced, under this alternative would include: actively managing endangered plant populations, including *Aristida chaseae;* increasing native vegetative planting in the uplands; reducing the occurrence of exotic species; and better managing the lagoon's water quality and open-water restoration effort. In addition, visitor services programs, information, and facilities would be expanded.

Additional staff would be required to implement this alternative. Such staff would likely include a biologist; a biological technician; two engineering equipment operators; a forestry technician (fire) ; a park ranger or environmental education specialist; a GIS specialist (to be shared with the Complex); and a law enforcement officer (to be shared with Cabo Rojo NWR).

ALTERNATIVE C – WETLAND RESTORATION EMPHASIS

Under this alternative, the emphasis would be concentrated on improving the lagoon's water quality and habitat, and less emphasis would be placed on upland restoration and management and general visitor services. As with Alternatives A and B, management efforts would focus on achieving the refuge's primary purposes.

Under Alternative C, management would provide focused support for the lagoon's rehabilitation and management. Priority activities (in and adjacent to the wetlands) would include invasive species management (particularly cattail clearing), water quality monitoring and management, water flow management, and creating improved wetland habitat conditions and opportunities.

Additional staff would be required to implement this alternative. Such staff would likely include a biologist; a biological technician; two engineering equipment operators; a forestry technician (fire) ; a park ranger or environmental education specialist; a GIS specialist (to be shared with the Complex) and a law enforcement officer (to be shared with Cabo Rojo NWR).

COMPARISON OF THE ALTERNATIVES BY ISSUE

Table 3. Comparison of alternatives by management issues for Laguna Cartagena National Wildlife Refuge

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Goal 1: Monitor, protect, and recover species of management interest.		
Inventorying and Monitoring Plan	Produce updated Inventorying and Monitoring Plan	Same as B
Issue 1.1: Threatened, endangered, and rare species management (plants and animals)		
Nest box program - West Indian whistling duck (WIWD)	Long-term monitoring of nest boxes	Same as B
WIWD - no current banding program	Initiate banding program	Same as B
Conduct monthly waterbird census	Review and analyze data (through a bio-tech position)	Same as B
Mapping threatened and endangered (T&E) plants	Monitor and protect documented T&E plants	Same as A
Propagating and planting of T&E plant species (federal- and state-listed)	Construct a new plant nursery	No action

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
	Expand propagation and planting	No action
Existing small population of A*ristida*	Expand existing *Aristida* population	No action
Coordinate with partners to conduct T&E research	Conduct university outreach to increase student involvement (w/ T&E species)	Same as B
No current action	Conduct Puerto Rican nightjar nesting survey	No action
No current action	Conduct breeding bird survey for rare waterfowl	Same as B
No current action	Coordinate and assist state with yellow-shouldered black bird (YSBB) surveys and management actions	No action

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
No current action	Initiate short-eared owl survey and management program (and grasshopper sparrow)	No action
Issue 1.2: Upland birds		
Coordinate with partners to conduct research	Conduct university outreach to increase student involvement (for upland birds)	No action
	Conduct mist nest surveys (for migratory and resident birds)	No action
Maintain species list	Initiate breeding and point count surveys	No action
Conduct Christmas bird count	Continue Christmas bird count	No action

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 1.3: Waterbirds, shorebirds, and marshbirds		
Coordinate with partners to conduct research	Initiate breeding surveys	Same as B
Conduct Christmas bird count	Continue Christmas bird count	Same as B
Conduct monthly waterbird surveys, including marshbird survey	Same as A	Increased/more intensive surveying, including assessment of species composition
Maintain species list	Update species list annually	Same as B
Issue 1.4: Raptors		
Conduct monthly survey	Same as A	Same as A
No current nest box or platform program	Install nesting platforms for osprey and hawks	Same as B
	Install and monitor kestrel nest boxes	No Action

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 1.5: Reptiles and amphibians		
Maintain species list	Update species list and re-initiate surveys	Same as B
No current research for reptiles and amphibians	Encourage university research on reptile and amphibian malformation.	Same as B.
Issue 1.6: Aquatics and invertebrates		
Maintain species list	Update species list and re-initiate surveys	Same as B
A list of macro-invertebrates has been developed	Update species list and re-initiate surveys	Same as B
No current fish stocking program	Evaluate initiation of a fish stocking program (for native fish)	Same as B
Issue 1.7: Bats		
No current management	Initiate bat survey (mist nest and sound frequency); install bat boxes (if warranted)	No action
No current management	Partner with university/researchers to survey and define feeding, nesting and roosting sites	No action

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 1.8: Invasive animal management		
No current formal plan	Develop an invasive species management plan	No action
Opportunistic iguana removal	Expand the iguana removal program	No action
No formal survey for invasive reptiles and amphibians	Initiate survey for invasive reptiles and amphibians.	Same as B
Coordinate with state on monkey removal	Same as A	No action
Prevent grazing by domestic and feral animals	Same as A	No action
Cactoblastis - discovered on refuge	Work with partners to develop a strategy to control/eradicate *Cactoblastis* (possibly APHIS)	No action
Limited removal of African hybrid bee hives	Improved control/removal of hybrid bees	No action
Goal 2: Conserve, enhance, and restore native plant communities and wetland habitat.		
No formal plan	Develop a Habitat Management Plan	Same as B

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 2.1: Upland management		
a: Upland management: Native sub-tropical dry forest restoration		
Seasonal reforestation projects to replant native trees (including monitoring)	Same as A, but expand effort	No action
Propagation of native tree species	Same as A, and expand tree nursery	No action
No use of prescribed fire in reforestation	Use prescribed fire for site preparation for reforestation	No action
Dry forest restoration research (Int'l Institute of Tropical Forestry, Forest Service)	Expand opportunities for research	No action
Continue existing reforestation partners project	Expand partners (to help with native tree propagation with DNR, NGOs, universities etc.)	No action

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
	Work with FWS/Partners (and refuge programs) program to expand reforestation on neighboring lands	No action
b: Upland management: Grasslands		
Hay harvesting (contracted to maintain grasslands)	Same as A, plus evaluate possibility of use of prescribed burns for grassland areas	No action
c: Upland management: Fire management		
Continue hay harvesting program (to reduce fuel loads)	Partner with local neighbors to help with hay harvesting (reduce fire fuel loads on fire breaks)	No action
Maintain fire breaks to protect native forest	Partner with local neighbors to help with hay harvesting (reduce fire fuel loads on fire breaks)	No action

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
d: Upland management: Erosion control		
Continue program to install culverts and low-water crossings	Same as A, plus install water bars for La Tinaja road; restore and rebuild the road	Same as A
	Same as A, plus implement stream bank stabilization activities/reforestation	Same as B
e: Upland management: Invasive species		
Removal of invasive species - primarily mesquite	Same as A, plus expand removal effort to include other species, e.g. *Parkinsonia aculeate*	No action
Hay harvesting (contracted to reduce guinea grass)	Increase the mowing frequency of guinea grass	No action
Maintain current invasive species list	Conduct GIS mapping on land cover for future management/monitoring	No action
Herbicide application along fences, dikes and roads	Continue and add limited herbicide treatment for Brazilian jasmine	No action

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 2.1: Wetland Management		
a. Create new wetland habitat/ponds		
Continue with limited development of ponds	Same as A, plus create additional wetland ponds	Create multiple/larger scale pond environment in northern portion of refuge
No current action	Build nesting islands	Same as B
b. Increase open water		
Mechanical and chemical removal of cattails	Expand mechanical and chemical removal and begin use of prescribed burning	Same as B
Maintain feeder canals and dikes	Need to improve lagoon drainage system feeding into lagoon - coordinate with PREPA (Division of Irrigation)	Same as B
Repair and restore existing canals and dikes	Expand partnership with municipality and PREPA to clean and restore dikes	Same as B, plus explore opportunity to establish a maintenance schedule that supports the management needs of the refuge (and improves coordination of management actions)

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
c. Water management		
Restoration of drainages to feed lagoon	Same as A	Develop lagoon restoration plan to specify depth requirements/pools (access expertise as required)
No current action	Promote the development/redevelopment of wetlands on adjacent lands	Use Partners Funds, and other funds, to create wetlands on adjacent lands
Maintain new water control structure for lagoon outflow	Same as A, plus install gauge to measure water flow	Same as B
Conduct seasonal water draw-downs	Establish water measurement staff gauges	Same as B (add additional staff gauges as needed)
d. Water quality monitoring		
No current action	Evaluate data and develop plan to improve water quality	Same as B, plus implement the plan and build water retention ponds to improve water quality
No current action	Work with USGS researchers to develop a long-term monitoring station	Same as B, and review for opportunities for additional monitoring measures

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Continue work with university and USGS on water quality of point source and lagoon sources	Same as A, and expand as per progress/recommendations	Same as B
e. Invasive species management		
Cutting cattails when water levels are low	Use of fire to control cattails	Same as B
Control water levels to manage cattails	Same as A	Same as A
Limited management of other invasive plants (limited herbicide use and mechanical removal) - water hyacinth, water lettuce, cat claw mimosa	Same as A, plus expand to include more areas and species	Same as B
No current program to educate public/visitors on exotic/invasive species	Increased public awareness/education on exotic/invasive species	Same as B

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Goal 3: Protect natural, historical, and cultural resources to maintain ecological integrity.		
Issue 3.1: Provide adequate law enforcement coverage		
2 FT LE Officers (split between CR and LC refuges) - who work cooperatively with other local law enforcement agencies, DNER, local police	Same as Alternative A, but develop and formalize interagency MOUs with other law enforcement agencies	Same as B, plus may need increased LE coverage to control illegal hunting/fishing
Issue 3.2: Protect cultural and historic resources		
No active current program (potential cultural resources may exist, but are unknown) -- currently engaged in active consultation with Service's regional archaeologist and state historic preservation office (SHPO)	Conduct historical/archaeological resources survey of entire refuge	Same as A
Currently developing historic profile of refuge, including a natural history profile	Conduct historical/archaeological resources survey of entire refuge	Same as A

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 3.2: Containments		
No current management	Conduct containments analysis for fish/crustaceans (for agricultural pesticides)	Same as B
Issue 3.2: Refuge acquisition boundary		
No current acquisition boundary	Establish acquisition boundary and investigate potential for acquisition of additional land (potential to develop a Minor Expansion Plan)	Same as B
Issue 3.2: Easements		
No current acquisition boundary	Investigate potential for acquisition of easements	Same as B
Issue 3.2: State-owned access road		
Two kiosks and public parking areas	Same as A, plus clarify the status of Desengaño road and refuge access rights	Same as B

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Goal 4: Provide opportunities for appropriate and compatible public use.		
Issue 4.1: Visitor Service Plan		
Visitor Service Plan (2002/03), and a review was conducted	Produce updated Visitor Service Plan	Same as B
Issue 4.2: Welcome and orient visitors		
One public parking area	Improve and maintain parking area, including exploring involvement of local school/others; improve the second parking area near the water control structure	Same as A
Six entrance/welcome signs	Same as A, plus add additional directional road signs (east end); signs from CR to get to LC	Same as A
Website for CNWR Complex includes LC refuge overview section	Improve, update and maintain website (section for LC) and develop a Spanish version	Emphasize wetland restoration

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
New visitors center at CR NWR to open 2009; no visitor center at LC NWR	Create a new visitor contact station for refuge and include outhouse/rest room, trash cans, and establish volunteer presence at refuge	Same as A
No official refuge specific brochure	Create a refuge-specific brochure	Same as A
LC NWR bird list brochure	Update bird list periodically	Same as A
Refuge fact sheet	Update fact sheet periodically	Update to emphasize wetland restoration
Automated phone system includes staff directory information only	Add automated phone system features to include refuge information	Same as B
No current refuge-specific video	Produce a refuge video to focus on wildlife diversity and habitat restoration.	Produce a video that emphasizes the role of the wetlands and the refuge's restoration effort

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 4.2: Wildlife Observation and photography		
No designated trails	Develop a trail system (including upland La Tinaja and dike trails), and include directional signs and maps	Same as B – but excluding upland trails
Maintain existing bird photo blind (will include bird interpretive panels)	Same as A, plus develop an additional photo blind; add a photo platform at La Tinaja	Same as B
No current action	Host an annual photography workshop/contest	Same as B
Maintain existing observation tower and boardwalk	Same as A, plus add a spotting scope and bird identification panel	Same as B
Issue 4.3: Environmental education and interpretation		
On-request environmental education program with schools (mostly at schools)	Increase on-site refuge EE programs for schools (to be provided at Cabo Rojo Visitor Center)	Develop EE program emphasizing wetland ecology/restoration
No current program	Develop a curriculum-based EE program	Same as A

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Two kiosks with interpretive panels	Same as A, plus maintain and add an additional kiosk at tower & at fishing platform, including particular themes, e.g. invasive species, fire, fish. Add bird identification panels at observation tower and photo blind.	Add a kiosk focusing on wetland restoration
On a request basis, provide community interpretive programs	Expand community interpretive programs	Develop increased emphasis on wetland ecology/restoration
Issue 4.4: Public outreach		
Continue refuge participation in 8/10 community events per year, e.g. UPR annual event	Same as A, plus establish an annual environmental fair at the LC NWR	Focus fair on wetland issues/restoration
No current action	Conduct survey of local communities to determine value of FWS and the refuge.	Same as B
No current action	Establish an annual photography contest/photography club (for LC)	Same as B

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
No current action	Develop and distribute *Firewise* magazine in Spanish	Same as B
No current action	Develop news articles/information on fire information for the community; e.g., radio, newsletters.	Same as B
No current action	Create fire level information signs to inform public of daily fire danger (expand to national program)	Same as B
No current action	Add kiosk and environmental program in area adjacent to school in Maguayo	Same as B
No current action	Use website to disseminate refuge information, press releases, etc.	Including materials that focus on wetland restoration

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 4.5: Hunting		
No current hunting allowed due to limited land base and diminished hunting populations; also endangered resident ducks are mixed in with potentially huntable species	Evaluate hunting as part of public use	Same as B
Issue 4.6: Fishing		
No formal fishing program	Develop formal fishing program, including listing in Federal Register and developing regulations	Same as B
Maintains one fishing dock	Same as A, and create an additional fishing platform near observation tower	Same as B
No current program	Add annual youth fishing derby	Same as B

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 4.7: Other public uses		
Kayaking/canoeing: No current use	Conduct compatibility/appropriate use determination	Same as B
Biking: no current biking program	Conduct compatibility/appropriate use determination	Same as B
Goal 5: Provide sufficient staff, volunteers, facilities, and equipment and foster partnerships to implement a comprehensive refuge management program		
Issue 5.1: Foster partnerships		
Existing inter-governmental partnerships: 1) LE (existing cooperation with DNER/Law Enforcement); 2) Fire mgmt partnerships (existing cooperation with municipal fire company); 3) USDA/ International Institute of Tropical Forestry; 4) Lajas Municipality to work on water drainage issues.	Same as Alternative A, plus: 1) Encourage involvement of Caborrojeños in LC NWR support and look for opportunities to develop a Friend's group for LC; and 2) develop new partnerships.	Same as B

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Existing cooperation with non-governmental partners: 1) SOPI - ornithological society to use office space and help with surveys and other work; 2) Maguayo elementary school.	Develop formal partnerships and develop a Cooperative Agreement with SOPI. Develop other partnerships as appropriate, e.g. UPR and Inter-American University.	Same as B
Issue 5.2: Manage volunteer program		
Manage existing volunteer program	Expand and formalize volunteer program, with a focus on wildlife diversity and habitat restoration (Inter-American University/Department of Biology, National Guard/Challenge Program)	Expand and formalize volunteer program, with a focus on wetland restoration
	Develop housing for volunteers (to be located at CR NWR)	Same as B
	Provide training opportunities for new volunteers	Same as B
Issue 5.3: Promote scientific research		
On-going special use permit process to allow several special on-going studies; e.g., salt flat microbial beds study	Develop and formalize agreements with universities and research institutes to focus on refuge needs/priorities	Same as Alternative B, with emphasis on public use services

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 5.4: Refuge staffing		
Unstaffed refuge - managed part-time by Manager responsible for Cabo Rojo and Laguna Cartagena. Other support roles filled by staff from CNWR Complex on a part-time basis (who are located at Cabo Rojo Refuge)	Additional staff as follows: 1) One Biologist; 2) One Bio-technician; 3) Two engineering equipment operators; 4) forestry technician (fire); 5) One EE/Park Ranger staff; 6) One Law Enforcement Officer (shared); 7) GIS specialist (shared)	Additional staff as follows: 1) One Biologist; 2) Forestry Tech; 3) Two maintenance staff; 4) One Law Enforcement Officer (shared); 5) One EE staff; 6)GIS specialist(shared)
Current YCC program for CR and LC NWRs - 12 persons	Expand YCC Program to include a separate LC program; 12 person staff for LC	Expand YCC Program to include a separate LC program; 6 person staff for LC
Issue 5.5: New facilities		
CRNWC New Visitor Center at CR NWR (which serves LC)	Volunteer housing (located on CR but shared with LC volunteers); new/expanded greenhouse (at CR); visitor contact station; kiosk and signs; fishing platform; photo blind; observation deck; dikes and culverts.	Same as B -- minus greenhouse

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 5.6: Existing facilities		
Maintain existing facilities	Two bridges (may need replaced); remove cross fencing and replace boundary fencing; replace gates as needed.	Same as B
Issue 5.7: Equipment		
Maintain existing equipment	Additional equipment needs: water truck; augur; tractor; jon boat and motor.	Same as B - minus water truck, plus excavator
Goal 6: Understand the impacts of climate change on refuge resources to plan for and adapt management as necessary to protect the wildlife and habitat of Laguna Cartagena NWR.		
Current management is out-of-date Sea Level Assessment Management (SLAMM) report	Add a weather monitoring station	Same as B
	Coordinate with researchers and partners to identify climate change research needs, investigating the impacts of climate change on fish and wildlife, listed species, vegetative communities, water quality and quantity and other resources.	Same as B

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER ANALYSIS

The alternatives development process under NEPA and the Improvement Act is designed to allow consideration of the widest possible range of issues and potential management approaches. During the alternatives development process, many different solutions were considered. The following alternative components were considered but not selected for detailed study in this Draft CCP/EA for the reason(s) described.

Actions and alternatives that are infeasible or that may cause substantial harm to the environment are usually not considered in an environmental assessment. Similarly, an action or an alternative containing the action should generally not receive further consideration if it is illegal; it does not fulfill the mission of the Refuge System; it does not relate to or achieve one of the goals of the refuge; or its environmental impacts have already been evaluated in a previously approved NEPA document.

During the process of developing alternatives, the planning team considered a wide variety of potential actions on the refuge. The actions were ultimately rejected and excluded from the alternatives proposed because they did not achieve refuge purposes or were incompatible with one or more goals. Hunting is not currently allowed and the refuge has no current plan to allow hunting; however, the refuge has decided to undertake an analysis to determine if any hunting should be permissible on the refuge.

IV. Environmental Consequences

OVERVIEW

This section analyzes and discusses the potential environmental effects or consequences that can be reasonably expected by the implementation of each of the three alternatives described in Chapter III of this EA. For each alternative, the expected outcomes are portrayed through the 15-year life of the CCP.

EFFECTS COMMON TO ALL ALTERNATIVES

A few potential effects will be the same under each alternative and are summarized under seven categories: environmental justice, climate change, other management, land acquisition, cultural resources, refuge revenue-sharing, and other effects.

ENVIRONMENTAL JUSTICE

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" was signed by President Clinton on February 11, 1994, to focus federal attention on the environmental and human health conditions of minority and low-income populations, with the goal of achieving environmental protection for all communities. The order directed federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The order is also intended to promote nondiscrimination in federal programs substantially affecting human health and the environment, and to provide minority and low-income communities with access to public information and opportunities for participation in matters relating to human health or the environment.

None of the management alternatives described in this EA will disproportionately place any adverse environmental, economic, social, or health impacts on minority and low-income populations. Implementation of any action alternative that includes public use and environmental education is anticipated to provide a benefit to the residents residing in the surrounding communities.

CLIMATE CHANGE

The Department of the Interior issued an order in January 2001 requiring federal agencies under its direction that have land management responsibilities to consider potential climate change impacts as part of long-range planning endeavors.

The increase of carbon within the earth's atmosphere has been linked to the gradual rise in surface temperatures commonly referred to as global warming. In relation to comprehensive planning for national wildlife refuges, carbon sequestration constitutes the primary climate-related impact to be considered in planning. The U.S. Department of Energy's *Carbon Sequestration Research and Development* (U.S. Department of Energy 1999) defines carbon sequestration as "...the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere."

The land is a tremendous force in carbon sequestration. Terrestrial biomes of all sorts—grasslands, forests, wetlands, tundra, perpetual ice, and desert—are effective both in preventing carbon emissions and in acting as a biological "scrubber" of atmospheric carbon monoxide. The conclusions of the Department of Energy's report noted that ecosystem protection is important to carbon sequestration and may reduce or prevent the loss of carbon currently stored in the terrestrial biosphere.

Conserving natural habitat for wildlife is the heart of any long-range plan for national wildlife refuges. The actions proposed in this Draft CCP/EA would conserve or restore land and water, and would thus enhance carbon sequestration. This, in turn, contributes positively to efforts to mitigate human-induced global climate changes.

OTHER MANAGEMENT

All management activities that could affect the refuge's natural resources, including subsurface mineral reservations, utility lines and easements, soils, water and air, and historical and archaeological resources, would be managed to comply with all laws and regulations. In particular, any existing and future oil and gas exploration, extraction, and transport operations on the refuge would be managed identically under each of the alternatives. Thus, the impacts would be the same.

LAND ACQUISITION

Funding for land acquisition from willing sellers within the approved acquisition boundary of Laguna Cartagena NWR would come from the Land and Water Conservation Fund, the Migratory Bird Conservation Fund, Corps of Engineers mitigation programs or donations from conservation and private organizations. Conservation easements and leases can be used to obtain the minimum interests necessary to satisfy refuge objectives if the refuge staff can adequately manage uses of the areas for the benefit of wildlife. The Service can negotiate management agreements with local, state, and federal agencies, and accept conservation easements. Some tracts within the refuge acquisition boundary may be owned by other public or private conservation organizations. The Service would work with interested organizations to identify additional areas needing protection and provide technical assistance if needed. The acquisition of private lands is entirely contingent on the landowners and their willingness to participate.

CULTURAL RESOURCES

All alternatives afford additional land protection and low levels of development, thereby producing little negative effect on the refuge's cultural and historic resources. Potentially negative effects could include logging, construction of new trails or facilities, and development of water impoundments. In most cases, these management actions would require review by the Service's Regional Archaeologist in consultation with the Commonwealth of Puerto Rico Historic Preservation Office, as mandated by Section 106 of the National Historic Preservation Act. Therefore, the determination of whether a particular action within an alternative has the potential to affect cultural resources is an on-going process that would occur during the planning stages of every project.

Service acquisition of land with known or potential archaeological or historical sites provides two major types of protection for these resources: protection from damage by federal activity and protection from vandalism or theft. The National Historic Preservation Act requires that any actions by a federal agency which may affect archaeological or historical resources be reviewed by the State Historic Preservation Office, and that the identified effects must be avoided or mitigated. The Service's policy is to preserve these cultural, historical, and archaeological resources in the public trust, and avoid any adverse effects wherever possible.

Land acquisition, within the current acquisition boundary, by the Service would provide some degree of protection to significant cultural and historic resources. If acquisition of private lands does not occur and these lands remain under private ownership, the landowner would be responsible for protecting and preserving cultural resources. Development of off-refuge lands has the potential to destroy archaeological artifacts and other historical resources, thereby decreasing opportunities for cultural resource interpretation and research.

REFUGE REVENUE-SHARING

Annual refuge revenue-sharing payments to the local municipality (Lajas) would continue at similar rates under each alternative. If lands are acquired and added to the refuge, the payments would increase accordingly.

OTHER EFFECTS

Each of the alternatives would have similar effects or minimal to negligible effects on soils, water quality and quantity, noise, transportation, human health and safety, children, hazardous materials, waste management, aesthetics and visual resources, and utilities and public services.

SUMMARY OF EFFECTS BY ALTERNATIVE

The following section describes the environmental consequences of adopting each refuge management alternative. Table 4 summarizes and addresses the likely outcomes for the specific issues, and is organized by broad issue categories.

Alternative A – Current Management – No Action Alternative
Current refuge management would continue under Alternative A. All management actions would be oriented toward achieving the refuge's primary purposes as resources are available.

Current programs would meet with limited success in achieving refuge goals and objectives with regard to habitat and wildlife populations, primarily because of limited ability to actively manage habitats. The same is true of the program to eradicate exotic plants and animals – existing opportunistic efforts would continue, but could not be expanded due to financial and personnel limitations.

Alternative B – Wildlife Diversity and Habitat Restoration (Proposed Alternative)
Alternative B would provide for an increase in wildlife and habitat surveying and monitoring activities. There would be an increase in surveying and monitoring rare, threatened, and endangered plants and animals such as the West Idian whistling duck, Puerto Rican nightjar, yellow-shoulderd black bird, short-eared owl, and populations of *Aristida* on the refuge. Surveys would be initiated and coordinated through partnerships to focus on upland birds, waterbirds, shorebirds, marshbirds, and raptors, as well as initiation of a nest box program for osprey, hawks, and kestrels. Surveys would be reinitiated for aquatic species and invertebrates. Bat surveys would be initiated on the refuge. Under Alternative B, the refuge would develop an invasive species management plan, focusing on expanding the iquana removal program, developing a strategy to control *Cactoblastis*, and improving control of hybrid bees, increasing opportunities for native species. Under Alternative B, refuge management would provide restoration and management of habitats to the greater benefit of wildlife. In particular, the reforestation of upland dry subtropical forests would be accelerated as would the management and removal of exotic species. The reforestation activity would be supported by the establishment of a new and larger on-site nursery to propagate native tree species. Other restoration actions would include increasing wetlands on the refuge and improving water quality monitoring. More exotic and invasive species control would be conducted in the wetlands, and the refuge would

improve habitat management for native species. An archaeological survey would also be undertaken to determine if there were any cultural resources present that require protection. Management would also evaluate the impacts of climate change on the refuge. Under this alternative, wildlife-dependent recreation would be enhanced with developing a trail system on the refuge; adding more photo blinds and photo platforms; and providing enhanced wildlife viewing opportunities, including adding spotting scopes and bird identification panels to the observation tower and boardwalk. These activities would enhance visitor opportunities to view wildlife and improve the quality of wildlife viewing opportunities. Environmental education programs would increase through on-site programs. The refuge would develop a formal fishing program with regulations and create an additional fishing platform.

In order to manage an expanded array of habitat restoration and monitoring activity, the refuge would like to increase its use of volunteers and partnerships. This alternative calls for expanding and formalizing the volunteer program, with a focus on using the volunteers to conduct wildlife and habitat management activities.

Alternative C – Wetland Restoration Emphasis

Under this alternative, the emphasis would be on improving wetland restoration on the refuge. The refuge would seek to create a multiple/larger-scale pond environment on the northern portion of the refuge. This alternative would also increase removal of aquatic invasive and exotic species to benefit native species. The refuge would focus wildlife management on wetland bird species. As with Alternative B, surveys would be conducted on aquatic species and invertebrates. Invasive species removal would remain the same as Alternative A except for increasing surveys for invasive reptiles and amphibians. Under Alternative C, management would be minimal in the sub-tropical dry forest where some native vegetation may become displaced. The visitor services program would emphazie wetland restoration efforts. Increasing partnerships and volunteers would remain the same as Alternative B.

Table 4. Summary of Environmental Effects by Alternative for Laguna Cartagena NWR

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Goal 1: Monitor, protect, and recover species of management interest.		
Inventorying and Monitoring Plan **Stable**	Produce updated Inventorying and Monitoring Plan **Increasing biological and habitat quality**	Same as B **Increasing biological and habitat quality**
Issue 1.1: Threatened, endangered, and rare species management (plants and animals)		
Continue nest box program - West Indian whistling duck (WIWD) **Stable**	Long-term monitoring of nest boxes **Increasing biological and habitat quality**	Same as B **Increasing biological and habitat quality**
WIWD - no current banding program **Stable**	Initiate banding program **Increasing biological quality**	Same as B **Increasing biological quality**
Conduct monthly waterbird census **Stable**	Review and analyze data (through a bio-tech position) **Increasing biological quality**	Same as B **Increasing biological quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Mapping threatened and endangered (T&E) listed plants **Stable**	Monitor and protect document T&E plants **Increasing biological and habitat quality**	Same as A **Stable**
Propagating and planting of T&E plant species (federal and state listed) **Increasing biological and habitat quality**	Construct a new plant nursery **Increasing biological and habitat quality**	No action **Stable**
	Expand propagation and planting **Increasing biological and habitat quality**	No action **Stable**
Existing small population of *Aristida* maintained **Stable**	Expand existing *Aristida* population **Increasing biological and habitat quality**	No action **Decreasing biological quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Coordinate with partners to conduct T&E research **Stable**	Conduct university outreach to increase student involvement (w/ T&E species) **Increasing quality**	Same as B **Increasing quality**
No current action **Stable**	Conduct Puerto Rican nightjar nesting survey **Increasing biological quality**	No action **Stable**
No current action **Stable**	Conduct breeding bird survey for rare waterfowl **Increasing quality**	Same as B **Increasing quality**
No current action **Stable**	Coordinate and assist state with YSBB surveys and management actions **Increasing biological quality**	No action **Stable**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
No current action **Stable**	Initiate short-eared owl survey and management program (and grasshopper sparrow) **Increasing biological quality**	No action **Stable**
Issue 1.2: Upland birds		
Coordinate with partners to conduct research **Stable**	Conduct university outreach to increase student involvement (for upland birds) **Increasing quality**	No action **Stable to decreasing quality (as less research is conducted)**
	Conduct mist nest surveys (for migratory and resident birds) **Increasing quality**	No action **Stable**
Maintain species list **Stable**	Initiate breeding and point count surveys **Increasing quality**	No action **Stable to decreasing quality (as less is known about species presence)**
Conduct Christmas bird count **Stable**	Continue Christmas bird count **Stable**	No action **Stable**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 1.3: Waterbirds, shorebirds and marshbirds		
Coordinate with partners to conduct research **Stable**	Initiate breeding surveys **Increasing biological quality**	Same as B **Increasing biological quality**
Conduct Christmas bird count **Stable**	Continue Christmas bird count **Stable**	Same as B **Stable**
Conduct monthly waterbird surveys, including marshbird survey **Stable**	Same as A **Stable**	Increased/more intensive surveying, including assessment of species composition **Increasing biological quality**
Maintain species list **Stable**	Update species list annually **Increasing biological quality**	Same as B **Increasing biological quality**
Issue 1.4: Raptors		
Conduct monthly survey **Stable**	Same as A **Stable**	Same as A **Stable**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
No current nest box or platform program **Stable**	Install nesting platforms for osprey and hawks **Increasing biological and habitat quality**	Same as B **Increasing biological and habitat quality**
	Install and monitor kestrel nest boxes **Increasing biological and habitat quality**	No Action **Increasing biological and habitat quality**
Issue 1.5: Reptiles and amphibians		
Maintain species list **Stable**	Update species list and re-initiate surveys **Increasing biological quality**	Same as B **Increasing biological quality**
No current research for reptiles and amphibians **Stable**	Encourage university research on reptile and amphibian malformation. **Increasing biological quality**	Same as B **Increasing biological quality**
Issue 1.6: Aquatics and invertebrates		
Maintain species list **Stable**	Update species list and re-initiate surveys **Increasing biological quality**	Same as B **Increasing biological quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
A list of macro-invertebrates has been developed **Stable**	Update species list and re-initiate surveys **Increasing biological quality**	Same as B **Increasing biological quality**
No current fish stocking program **Stable**	Evaluate initiation of a fish stocking program (for native fish) **Increasing biological quality**	Same as B **Increasing biological quality**
Issue 1.7: Bats		
No current management **Stable**	Initiate bat survey (mist nest and sound frequency); install bat boxes (if warranted) **Increasing biological and habitat quality**	No action **Stable**
No current management **Stable**	Partner with university/researchers to survey and define feeding, nesting and roosting sites **Increasing biological and habitat quality**	No action **Stable**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 1.8: Invasive animal management		
No current formal plan **Stable**	Develop an invasive species management plan **Increasing biological quality**	No action **Stable**
Opportunistic iguana removal **Stable**	Expand the iguana removal program **Increasing biological and habitat quality**	No action **Stable**
No formal survey for invasive reptiles and amphibians **Stable**	Initiate survey for invasive reptiles and amphibians **Increasing biological quality**	Same as B **Increasing biological quality**
Coordinate with state on monkey removal **Stable**	Same as A **Stable**	No action **Decreasing biological quality** (could lead to expanded population)
Prevent grazing by domestic and feral animals **Stable**	Same as A **Stable**	No action **Stable to decreasing biological quality** (could lead to expanded grazing on refuge)

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Cactoblastis - discovered on refuge **Decreasing biological quality**	Work with partners to develop a strategy to control/eradicate *Cactoblastis* (possibly APHIS) **Increasing biological and habitat quality**	No action **Decreasing biological quality**
Limited removal of African hybrid bee hives **Stable**	Improved control/removal of hybrid bees **Increasing biological quality**	No action **Stable to decreasing environmental quality** (depending on the extent of bee population increase)
Goal 2: Conserve, enhance and restore native plant communities and wetland habitat		
No formal plan **Stable**	Develop a Habitat Management Plan **Increasing biological and habitat quality**	Same as B **Increasing biological and habitat quality**
Issue 2.1: Upland management		
a: Upland management: Native sub-tropical dry forest restoration		
Seasonal reforestation projects to replant native trees (including monitoring) **Increasing biological and habitat quality**	Same as A, but expand effort **Increasing biological and habitat quality** (at a faster rate than alternative A)	No action **Decreasing biological quality** (native vegetation will become displaced)

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Propagation of native tree species Increasing biological and habitat quality	**Same as A, and expand tree nursery** Increasing biological and habitat quality (native species will increase at a faster rate than alternative A)	**No action** Stable
No use of prescribed fire in reforestation **Stable**	Use prescribed fire for site preparation for reforestation **Increasing biological and habitat quality**	No action **Stable**
Dry forest restoration research (Int'l Institute of Tropical Forestry, Forest Service) **Stable**	Expand opportunities for research **Increasing quality**	No action **Stable**
Continue existing reforestation partners project	Expand partners (to help with native tree propagation with DNR, NGOs, universities etc.) **Increasing quality**	No action **Stable**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Increasing biological and habitat quality	Work with FWS/Partners (and refuge programs) program to expand reforestation on neighboring lands **Increasing biological and habitat quality** (at a faster rate than alternative A)	No action **Stable/ Decreasing biological quality** (native vegetation will become displaced)
b: Upland management: Grasslands		
Hay harvesting (contracted to maintain grasslands) **Stable**	Same as A, plus evaluate possibility of use of prescribed burns for grassland areas **Increasing biological and habitat quality**	No action **Stable to decreasing biological quality** (depending on specific grassland maintenance objectives)
c: Upland management: Fire management		
Continue hay harvesting program (to reduce fuel loads) **Stable**	Partner with local neighbors to help with hay harvesting (reduce fire fuel loads on fire breaks) **Stable**	No action **Stable to decreasing biological quality** (depending on specific grassland maintenance objectives)

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Maintain fire breaks to protect native forest **Stable**	Partner with local neighbors to help with hay harvesting (reduce fire fuel loads on fire breaks) **Stable**	No action **Decreasing biological quality**
d: Upland management: Erosion control		
Continue program to install culverts and low-water crossings **Increasing environmental quality**	Same as A, plus install water bars for La Tinaja road; restore and rebuild the road **Increasing environmental quality**	Same as A **Increasing environmental quality**
	Same as A, plus implement stream bank stabilization activities/reforestation **Increasing environmental quality**	Same as B **Increasing environmental quality**
e: Upland management: Invasive species		
Removal of invasive species - primarily mesquite **Increasing environmental quality**	Same as A, plus expand removal effort to include other species, e.g. *Parkinsonia aculeata* **Increasing environmental quality**	No action **Decreasing quality** (as invasive species are likely to increase)

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Hay harvesting (contracted to reduce guinea grass) **Stable**	Increase the mowing frequency of guinea grass **Increasing environmental quality**	No action **Decreasing quality** (as grassland acreage is likely to decrease)
Maintain current invasive species list **Stable**	Conduct GIS mapping on land cover for future management/monitoring **Increasing environmental quality**	No action **Stable**
Herbicide application along fences, dikes, and roads **Stable**	Continue,and add limited herbicide treatment for Brazilian jasmine **Increasing environmental quality**	No action **Decreasing quality** (as invasive species are likely to increase)
Issue 2.1: Wetland Management		
a. Create new wetland habitat/ponds		
Continue with limited development of ponds **Stable/Increasing environmental quality**	Same as A, plus create additional wetland ponds **Increasing biological and habitat quality**	Create multiple/larger scale pond environment in northern portion of refuge **Increasing biological and habitat quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
No current action **Stable**	Build nesting islands **Increasing environmental quality**	Same as B **Increasing biological and habitat quality**
b. Increase open water		
Mechanical and chemical removal of cattails **Stable**	Expand mechanical and chemical removal and begin use of prescribed burning **Increasing environmental quality**	Same as B **Increasing environmental quality**
Maintain feeder canals and dikes **Stable**	Need to improve lagoon drainage system feeding into lagoon - coordinate with PREPA (Division of Irrigation) **Increasing environmental quality**	Same as B **Increasing environmental quality**
Repair and restore existing canals and dikes **Stable**	Expand partnership with municipality and PREPA to clean and restore dikes **Increasing environmental quality**	Same as B, plus explore opportunity to establish a maintenance schedule that supports the management needs of the refuge (and improves coordination of management actions) **Increasing environmental quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
c. Water management		
Restoration of drainages to feed lagoon **Stable**	Same as A **Stable**	Develop lagoon restoration plan to specify depth requirements/pools (access expertise as required) **Increasing environmental quality**
No current action **Stable**	Promote the development/redevelopment of wetlands on adjacent lands **Increasing environmental quality**	Use Partners Funds, and other funds, to create wetlands on adjacent lands **Increasing environmental quality**
Maintain new water control structure for lagoon outflow **Stable**	Same as A, plus install gauge to measure water flow **Increasing environmental quality**	Same as B **Increasing environmental quality**
Conduct seasonal water draw-downs **Stable**	Establish water measurement staff gauges **Increasing environmental quality**	Same as B (add additional staff gauges as needed) **Increasing environmental quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
d. Water quality monitoring		
No current action **Stable**	Evaluate data and develop plan to improve water quality **Increasing environmental quality**	Same as B, plus implement the plan and build water retention ponds to improve water quality **Increasing environmental quality**
No current action **Stable**	Work with USGS researchers to develop a long-term monitoring station **Increasing environmental quality**	Same as B, and review for opportunities for additional monitoring measures **Increasing environmental quality**
Continue work with university and USGS on water quality of point source and lagoon sources **Stable**	Same as A, and expand as per progress/recommendations **Increasing environmental quality**	Same as B **Increasing environmental quality**
e. Invasive species management		
Cut cattails when water levels are low **Stable**	Use of fire to control cattails **Increasing environmental quality**	Same as B **Increasing environmental quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Control water levels to manage cattails **Stable**	Same as A **Stable**	Same as A **Stable**
Limited management of other invasive plants (limited herbicide use and mechanical removal) - water hyacinth, water lettuce, cat claw mimosa **Stable**	Same as A, plus expand to include more areas and species **Increasing environmental quality**	Same as B **Increasing environmental quality**
No current program to educate public/visitors on exotic/invasive species **Stable**	Increased public awareness/education on exotic/invasive species **Increasing environmental quality**	Same as B **Increasing environmental quality**
Goal 3: Protect natural, historical, and cultural resources to maintain ecological integrity.		
Issue 3.1: Provide adequate law enforcement (LE) coverage		
Two (2) full-time LE Officers (split between CR and LC refuges) - who work cooperatively with other local law enforcement agencies, DNER, local police **Stable**	Same as Alternative A, but develop and formalize interagency MOUs with other law enforcement agencies **Stable**	Same as B, plus may need increased LE coverage to control illegal hunting/fishing **Increasing quality** (and resource protection)

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 3.2: Protect cultural and historic resources		
No active current program (potential cultural resources may exist, but are unknown) -- currently engaged in active consultation with FWS regional archaeologist and state historic preservation office (SHPO) **Stable**	Conduct historical/archaeological resources survey of entire refuge **Stable**	Same as A **Stable**
Currently developing historic profile of refuge, including a natural history profile **Stable**	Conduct historical/ archaeological resources survey of entire refuge **Stable**	Same as A **Stable**
Issue 3.2: Containments		
No current management **Stable**	Conduct containments analysis for fish/crustaceans (for agricultural pesticides) **Increasing quality**	Same as B **Increasing quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 3.2: Refuge acquisition boundary		
No current acquisition boundary **Stable**	Establish acquisition boundary and investigate potential for acquisition of additional land (potential to develop a Minor Expansion Plan) **Increasing quality** (due to potential to expand resource protection)	Same as B **Increasing quality** (due to potential to expand resource protection)
Issue 3.2: Easements		
No current acquisition boundary **Stable**	Investigate potential for acquisition of easements **Increasing quality** (due to potential to expand resource protection)	Same as B **Increasing quality** (due to potential to expand resource protection)
Issue 3.2: State-owned access road		
Two kiosks and public parking areas **Stable**	Same as A, plus clarify the status of Desengaño road and refuge access rights **Stable**	Same as B **Stable**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Goal 4: Provide opportunities for appropriate and compatible public use		
Issue 4.1: Visitor Service Plan		
Visitor Service Plan (2002/03), and a review was conducted **Stable**	Produce updated Visitor Service Plan **Increasing quality**	Same as B **Increasing quality**
Issue 4.2: Welcome and orient visitors		
One public parking area **Stable**	Improve and maintain parking area, including exploring involvement of local school/others; improve the second parking area near the water control structure **Increasing quality**	Same as A **Stable**
Six entrance/welcome signs **Stable**	Same as A, plus add additional directional road signs (east end); signs from CR to get to LC **Increasing quality**	Same as A **Stable**
Website for Complex includes LC refuge overview section **Stable**	Improve, update, and maintain website (section for LC) and develop a Spanish version **Increasing quality**	Emphasize wetland restoration **Increasing quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
New visitors center at CR refuge to open 2009; no visitor center at LC refuge **Stable**	Create a new visitor contact station for refuge and include restroom and trash cans; establish volunteer presence at refuge **Increasing quality**	Same as A **Stable**
No official refuge-specific brochure **Stable**	Create a refuge-specific brochure **Increasing quality**	Same as A **Stable**
LC refuge bird list brochure **Stable**	Update bird list periodically **Increasing quality**	Same as A **Stable**
Refuge fact sheet **Stable**	Update fact sheet periodically **Increasing quality**	Update to emphasize wetland restoration **Increasing quality**
Automated phone system includes staff directory information only **Stable**	Add automated phone system features to include refuge information **Increasing quality**	Same as B **Increasing quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
No current refuge-specific video **Stable**	Produce a refuge video to focus on wildlife diversity and habitat restoration **Increasing quality**	Produce a video that emphasizes the role of the wetlands and the refuge's restoration effort **Increasing quality**
Issue 4.2: Wildlife observation and photography		
No designated trails **Stable**	Develop a trail system (including upland La Tinaja and dike trails), and include directional signs and maps **Increasing quality**	Same as B – but excluding upland trails **Increasing quality**
Maintain existing bird photo blind (will include bird interpretive panels) **Stable**	Same as A, plus develop an additional photo blind; add a photo platform at La Tinaja **Increasing quality**	Same as B **Increasing quality**
No current action **Stable**	Host an annual photography workshop/contest **Increasing quality**	Same as B **Increasing quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Maintain existing observation tower and boardwalk **Stable**	Same as A, plus add a spotting scope and bird identification panel **Increasing quality**	Same as B **Increasing quality**
Issue 4.3: Environmental education (EE) and interpretation		
On-request environmental education program with schools (mostly at schools) **Stable**	Increase on-site refuge EE programs for schools (to be provided at Cabo Rojo Visitor Center) **Increasing quality**	Develop EE program emphasizing wetland ecology/restoration **Increasing quality**
No current program **Stable**	Develop a curriculum-based EE program **Increasing quality**	Same as A **Stable**
Two kiosks with interpretive panels **Stable**	Same as A, plus maintain and add an additional kiosk at tower at fishing platform, including particular themes; e.g., invasive species, fire, and fish. Add bird identification panels at observation tower and photo blind. **Increasing quality**	Add a kiosk focusing on wetland restoration **Increasing quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
On a request basis, provide community interpretive programs **Stable**	Expand community interpretive programs **Increasing quality**	Develop increased emphasis on wetland ecology/restoration **Increasing quality**
Issue 4.4: Public outreach		
Continue refuge participation in 8 to 10 community events per year; e.g., UPR annual event **Stable**	Same as A, plus establish an annual environmental fair at the LC refuge **Increasing quality**	Focus fair on wetland issues/restoration **Increasing quality**
No current action **Stable**	Conduct survey of local communities to determine value of FWS and the refuge **Increasing quality**	Same as B **Increasing quality**
No current action **Stable**	Establish an annual photography contest/photography club for LC refuge **Increasing quality**	Same as B **Increasing quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
No current action **Stable**	Develop and distribute *Firewise* magazine in Spanish **Increasing quality**	Same as B **Increasing quality**
No current action **Stable**	Develop news articles/information on fire information for the community; e.g., radio, newsletters. **Increasing quality**	Same as B **Increasing quality**
No current action **Stable**	Create fire level information signs to inform public of daily fire danger (expand to national program) **Increasing quality**	Same as B **Increasing quality**
No current action **Stable**	Add kiosk and environmental program in area adjacent to school in Maguayo **Increasing quality**	Same as B **Increasing quality**
No current action **Stable**	Use website to disseminate refuge information, press releases, etc. Increasing quality	Including materials that focus on wetland restoration **Increasing quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 4.5: Hunting		
No current hunting allowed due to limited land base and diminished hunting populations; also endangered resident ducks are mixed in with potentially huntable species **Stable**	Evaluate hunting as part of public use **Stable**	Same as B **Stable**
Issue 4.6: Fishing		
No formal fishing program **Stable**	Develop formal fishing program, including listing in Federal Register and developing regulations **Increasing quality**	Same as B **Increasing quality**
Maintain one fishing dock **Stable**	Same as A, and create an additional fishing platform near observation tower **Increasing quality**	Same as B **Increasing quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
No current program **Stable**	Add annual youth fishing derby **Increasing quality**	Same as B **Increasing quality**
Issue 4.7: Other public uses		
Kayaking/canoeing: No current use **Stable**	Conduct compatibility/appropriate use determination **Increasing quality**	Same as B **Increasing quality**
Biking: no current biking program **Stable**	Conduct compatibility/appropriate use determination **Increasing quality**	Same as B **Increasing quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Goal 5: Provide sufficient staff, volunteers, facilities, and equipment and foster partnerships to implement a comprehensive refuge management program.		
Issue 5.1: Foster partnerships		
Existing inter-governmental partnerships: (1) LE (existing cooperation with Puerto Rico DNER/Law Enforcement); (2) Fire management partnerships (existing cooperation with municipal fire company); (3) USDA/International Institute of Tropical Forestry; (4) Lajas Municipality to work on water drainage issues. **Stable**	Same as Alternative A, plus: (1) Encourage involvement of Caborrojeños in LC refuge support and look for opportunities to develop a Friend's group for LC refuge; and (2) develop new partnerships. **Increasing quality**	Same as B **Increasing quality**
Existing cooperation with non-governmental partners: (1) SOPI - ornithological society to use office space and help with surveys and other work; (2) Maguayo elementary school. **Stable**	Develop formal partnerships and develop a Cooperative Agreement with SOPI. Develop other partnerships as appropriate; e.g., UPR and Inter-American University. **Increasing quality**	Same as B **Increasing quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 5.2: Manage volunteer program		
Manage existing volunteer program **Stable**	Expand and formalize volunteer program, with a focus on wildlife diversity and habitat restoration (Inter-American University/Departmemt of Biology, National Guard/Challenge Program) **Increasing quality**	Expand and formalize volunteer program, with a focus on wetland restoration **Increasing quality**
	Develop housing for volunteers (to be located at CR refuge) **Increasing quality**	Same as B **Increasing quality**
	Provide training opportunities for new volunteers **Increasing quality**	Same as B **Increasing quality**
Issue 5.3: Promote scientific research		
On-going special use permit process to allow several special on-going studies; e.g., salt flat microbial beds study **Stable**	Develop and formalize agreements with universities and research institutes to focus on refuge needs/priorities **Increasing quality**	Same as B, with emphasis on public use services **Increasing quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 5.4: Refuge staffing		
Unstaffed refuge - managed part-time by manager responsible for CR and LC Cartagena refuges. Other support roles filled by staff from Complex on a part-time basis (who are located at CR refuge) **Stable**	Additional staff as follows: One biologist; one bio-technician; two maintenance staff; heavy equipment operator; one EE/park ranger; one LE officer **Increasing quality**	Additional staff as follows: One biologist; heavy equipment operator; two maintenance staff; one LE Officer; one EE staff **Increasing quality**
Current YCC program for CR and LC refuges - 12 persons **Stable**	Expand YCC Program to include a separate LC refuge program; 12-person staff for LC refuge **Increasing quality**	Expand YCC Program to include a separate LC refuge program; 6-person staff for LC refuge **Increasing quality**
Issue 5.5: New facilities		
New visitor center at CR refuge (which serves LC refuge) **Stable**	Volunteer housing (located on CR refuge but shared with LC refuge volunteers); new/expanded greenhouse at CR refuge; visitor contact station; kiosk and signs; fishing platform; photo blind; observation deck; dikes and culverts **Increasing quality**	Same as B – minus greenhouse **Increasing quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
Issue 5.6: Existing facilities		
Maintain existing facilities **Stable**	Two bridges (may need replaced); remove cross fencing and replace boundary fencing; replace gates as needed. **Increasing quality**	Same as B **Increasing quality**
Issue 5.7: Equipment		
Maintain existing equipment **Stable**	Additional equipment needs: water truck; augur; tractor; Jon boat and motor. **Increasing quality**	Same as B – minus water truck, plus excavator **Increasing quality**
Goal 6: Understand the impacts of climate change on refuge resources to plan for and adapt management as necessary to protect the wildlife and habitat of Laguna Cartagena NWR.		
Current management is out-of-date and will need to consider Sea Level Assessment Management (SLAMM) report **Stable/Decreasing environmental quality** as required impacts and actions have not yet been identified or addressed	Add a weather monitoring station **Increasing quality**	Same as B **Increasing quality**

Alternative A: Current Management (No Action)	Alternative B: Wildlife Diversity and Habitat Restoration (Proposed Alternative)	Alternative C: Wetland Restoration Emphasis
	Coordinate with researchers and partners to identify climate change research needs, investigating the impacts of climate change on fish and wildlife, listed species, vegetative communities, water quality and quantity and other resources. **Increasing quality**	Same as B **Increasing quality**

UNAVOIDABLE IMPACTS AND MITIGATION MEASURES

Under Alternative A—the no-action alternative—there are numerous unavoidable impacts, including law enforcement that is not adequate for protecting any significant visitor use; continued degradation of the biological functions of native plant communities and wildlife habitat due to the invasion of exotic plants and nuisance animals; and a continued decrease in biodiversity. Over time, if these issues are not addressed, they would continue to impact refuge resources.

Alternative B, the proposed alternative, also has some unavoidable impacts. These impacts are expected to be minor and/or short-term in duration. However, the refuge would attempt to minimize these impacts whenever possible. The following sections describe the measures the refuge would employ to mitigate and minimize the potential impacts that would result from implementation of the proposed alternative.

Unavoidable impacts for Alternative C would be similar to those of Alternative B. With the emphasis of these alternatives placed on one habitat type and other wildlife populations and habitats could suffer.

WATER QUALITY FROM SOIL DISTURBANCE AND USE OF HERBICIDES

Soil disturbance and siltation due to water management activities; road and levee maintenance; and the construction of observation towers, boat ramps, and a headquarters and visitor center is expected to be minor and of short duration. To further reduce potential impacts, the refuge would use best management practices to minimize the erosion of soils into water bodies.

Foot traffic on new and extended foot trails is expected to have a negligible impact on soil erosion. To minimize the impacts from public use, the refuge would include informational signs that request trail users to remain on the trails, in order to avoid causing potential erosion problems.

Long-term herbicide use for exotic plant control could result in a slight decrease in water quality in areas prone to exotic plant infestation. Through the proper application of herbicides, however, this is expected to have a minor impact on the environment, with the benefit of reducing or eliminating exotic plant infestations.

WILDLIFE DISTURBANCE

Disturbance to wildlife is an unavoidable consequence of any public use program, regardless of the activity involved. While some activities such as wildlife observation may be less disturbing than others, all of the public use activities proposed under the proposed alternative would be planned to avoid unacceptable levels of impact.

The known and anticipated levels of disturbance from the proposed alternative are not considered to be significant. Nevertheless, the refuge would manage public use activities to reduce impacts. Providing access for fishing opportunities allows the use of a renewable natural resource without adversely impacting other resources. Hunting would also be managed with restrictions that ensure minimal impact on other resources. General wildlife observation may result in minimal disturbance to wildlife. If the refuge determines that impacts from the expected additional visitor uses are above the levels that are anticipated, those uses would be discontinued, restricted, or rerouted to other less sensitive areas.

VEGETATION DISTURBANCE

Negative impacts could result from the creation, extension, and maintenance of trails that require the clearing of nonsensitive vegetation along their length. This is expected to be a minor short-term impact.

Increased visitor use may increase the potential for the introduction of new exotic species into areas when visitors do not comply with boating regulations at the boat ramps and other access points, or with requests to stay on trails. The refuge would minimize this impact by enforcing the regulations for access to the refuge's water bodies, and by installing informational signs that request users to stay on the trails.

USER GROUP CONFLICTS

As public use increases, unanticipated conflicts between different user groups could occur. If this should happen, the refuge would adjust its programs, as needed, to eliminate or minimize any public use issues. The refuge would use methods that have proven to be effective in reducing or eliminating public use conflicts. These methods include establishing separate use areas, different use periods, and limits on the numbers of users in order to provide safe, quality, appropriate, and compatible wildlife-dependent recreational opportunities.

EFFECTS ON ADJACENT LANDOWNERS

Implementation of the proposed alternative is not expected to negatively affect the owners of private lands adjacent to the refuge. Positive impacts that would be expected include higher property values, less intrusion of invasive exotic plants, and increased opportunities for viewing more diverse wildlife.

However, some negative impacts that may occur include a higher frequency of trespass onto adjacent private lands, and noise associated with increased traffic. To minimize these potential impacts, the refuge would provide informational signs that clearly mark refuge boundaries; maintain the refuge's existing parking facilities; use law enforcement; and provide increased educational efforts at the visitor center.

LAND OWNERSHIP AND SITE DEVELOPMENT

Land acquisition efforts by the Service could lead to changes in land use and recreational use patterns. However, most of the non-Service-owned lands within the refuge's approved acquisition boundary are currently undeveloped. If these lands are acquired as additions to the refuge, they would be maintained in a natural state, managed for native wildlife populations, and opened to wildlife-compatible public uses, where feasible.

Potential development of the refuge's buildings, trails, and other improvements could lead to minor short-term negative impacts on plants, soils, and some wildlife species. When building the observation towers, efforts would be made to use recycled products and environmentally sensitive treated lumber. The visitor center would be constructed to be aesthetically pleasing to the community and to avoid any additional impacts to native plant communities. All construction activities would comply with the requirements of Section 404 of the Clean Water Act; the National Historic Preservation Act; Executive Order 11988, Floodplain Management; and other applicable regulatory requirements.

CUMULATIVE IMPACTS

A cumulative impact is defined as an impact on the natural or human environment, which results from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of which agency (federal or non-federal) or person undertakes such other actions (40 Code of Federal Regulations, 1508.7).

Cumulative impacts are the overall, net effects on a resource that arise from multiple actions. Impacts can "accumulate" spatially, when different actions affect different areas of the same resource. They can also accumulate over the course of time, from actions in the past, the present, and the future. Occasionally, different actions counterbalance one another, partially canceling out each other's effect on a resource. But more typically, multiple effects add up, with each additional action contributing an incremental impact on the resource. In addition, sometimes the overall effect is greater than merely the sum of the individual effects, such as when one more reduction in a population crosses a threshold of reproductive sustainability, and threatens to extinguish the population.

A thorough analysis of impacts always considers their cumulative aspects, because actions do not take place in a vacuum: there are virtually always some other actions that have affected that resource in some way in the past, or are affecting it in the present, or will affect it in the reasonably foreseeable future. So any assessment of a specific action's effects must in fact be made with consideration of what else has happened to that resource, what else is happening, or what else will likely happen to it.

The refuge is not aware of any past, present, or future planned actions that would result in a significant cumulative impact when added to the refuge's proposed actions, as outlined in the proposed alternative.

DIRECT AND INDIRECT EFFECTS OR IMPACTS

Direct effects are caused by an action and occur at the same time as the action. Indirect effects are caused by an action but are manifested later in time or further removed in distance, but still reasonably foreseeable.

The actions proposed for implementation under the proposed alternative include facility development, wildlife and population management, resource protection, public use, and administrative programs. These actions would result in both direct and indirect effects. Facility development, for example, would most likely lead to increased public use, a direct effect; and it, in turn, would lead to indirect effects such as increased littering, noise, and vehicular traffic.

Other indirect effects that may result from implementing the proposed alternative include minor impacts from siltation due to the disturbance of soils and vegetation while expanding the water control structures, as well as expanding or creating new foot trails; construction of the observation tower and visitor center; and providing greater visitor access through improvements to the boat ramps.

SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY

The habitat protection and management actions proposed under the proposed alternative are dedicated to maintaining the long-term productivity of refuge habitats. The benefits of this plan for long-term productivity far outweigh any impacts from short-term actions, such as the construction of observation towers and a visitor center, or creation of new trails. While these activities would cause short-term negative impacts, the educational values and associated public support gained from the improved visitor experience would produce long-term benefits for the refuge's entire ecosystem.

The key to protecting and ensuring the refuge's long-term productivity is to find the threshold where public uses do not degrade or interfere with the refuge's natural resources. The plans proposed under the proposed alternative have been carefully conceived to achieve that threshold. Therefore, implementing the proposed alternative would lead to long-term benefits for wildlife protection and land conservation that far outweigh any short-term impacts.

V. Consultation and Coordination

OVERVIEW

This chapter summarizes the consultation and coordination that has occurred to date in identifying the issues, alternatives, and proposed alternative, which are presented in this Draft CCP/EA. It lists the meetings that have been held with the various agencies, organizations, and individuals who were consulted in the preparation of this Draft CCP/EA.

The following meetings, contacts, and presentations were undertaken by the Service:

VISITOR SERVICES REVIEW

A Visitor Services Review was conducted for the Complex in June 2003

Participants included Complex staff as well as:
Garry Tucker, FWS, Regional Office
Ray Paterra, White River NWR
Gisella Burgos, Okefenokee NWR

BIOLOGICAL REVIEW

A Biological Review was conducted for the Complex on January 14-25, 2002.

The review team included:
Cal Garnett, FWS, Regional Office (Retired)
Chuck Hunter, FWS, Regional Office
Margaret Miller, Coral Reef Scientist, NOAA
Keith Watson, FWS, Migratory Bird Office
Craig Watson, FWS, South Atlantic Working Group

Staff of Caribbean Ecological Services Field Office:
Felix Lopez, Contaminants Specialist
Leopoldo Miranda, Private Lands Biologist
Marelisa Rivera, Endangered Species Biologist
Ana Román, Habitat Conservation Biologist
Jorge Saliva, Endangered Species Biologist
Beverly Yoshioka, Habitat Conservation Biologist

Staff of Caribbean Islands NWR Complex:
Oscar Díaz, Refuge Manager, Vieques
Stephen Earsom, Refuge Biologist/Pilot
Mike Evans, Refuge Manager, St. Croix
Claudia Lombard, Biologist
Amy Mackay, Biologist
Joseph Schwagerl, Deputy Project Leader
Susan Silander, Project Leader
Teresa Tallevast, Refuge Manager, Culebra

CORE PLANNING TEAM MEMBERS

The core planning team involved staff from Laguna Cartagena NWR, a staff from the Caribbean Islands NWR Complex, a regional planner, and a contractor (MSI). This team was the primary decision-making team for the CCP's development. Key tasks of the team involved defining and refining the vision; identifying, reviewing, and filtering issues; defining the goals; and outlining the alternatives. The team members included:

Susan Silander, Project Leader, Caribbean Islands NWR Complex
Joseph Schwagerl, Deputy Project Leader, Caribbean Islands NWR Complex
Oscar Díaz, Planning Team Leader, Refuge Manager, Cabo Rojo and Laguna Cartagena NWRs
William Hernández, GIS Specialist, Caribbean Islands NWR Complex
David Bocanegra, Outreach Specialist, Caribbean Islands NWR Complex
Beverly Yoshioka, Biologist, Ecological Services Office, Boquerón, PR.
David Callihan, MSI- Management Systems International
Laura Housh, Regional Planner, FWS

Summary of Meetings and Contacts

The process to develop the refuge's management plan has involved a series of meetings with staff and key constituencies, including holding a public scoping meeting with neighboring communities, interested non-governmental organizations, local business leaders, community and political leaders, and other interested parties. The key events in this process have included:

- A notice of intent to prepare a CCP and environmental document was published in the Federal Register, with a request for comments. March 12, 2007
- List of key issues identified in a preplanning meeting with refuge staff. November 2007
- Public scoping meeting held on March 27, 2008, 5:00-9:00 p.m., Maguayo Community Center
- Meeting to review public scoping comments and identify goals, alternative management options, and objectives and strategies. June 2008
- In addition, refuge manager Oscar Díaz held a number of one-on-one meetings with key stakeholders over the planning period. This included a meeting with the Municipal Legislature of Cabo Rojo on March 25, 2008.

Appendix A. Glossary

Adaptive Management: Refers to a process in which policy decisions are implemented within a framework of scientifically driven experiments to test predictions and assumptions inherent in a management plan. Analysis of results helps managers determine whether current management should continue as is or whether it should be modified to achieve desired conditions.

Alluvial: Sediment transported and deposited in a delta or riverbed by flowing water.

Alternative: 1. A reasonable way to fix the identified problem or satisfy the stated need (40 CFR 1500.2). 2. Alternatives are different sets of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the Refuge System mission, and resolving issues (Service Manual 602 FW 1.6B).

Anadromous: Migratory fishes that spend most of their lives in the sea and migrate to fresh water to breed.

Biological Diversity: The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur (Service Manual 052 FW 1. 12B). The System's focus is on indigenous species, biotic communities, and ecological processes. Also referred to as biodiversity.

Carrying Capacity: The maximum population of a species able to be supported by a habitat or area.

Categorical Exclusion: A category of actions that does not individually or cumulatively have a significant effect on the human environment and have been found to have no such effect in procedures adopted by a federal agency pursuant to the National Environmental Policy Act (40 CFR 1508.4).

CFR: Code of Federal Regulations.

Compatible Use: A proposed or existing wildlife-dependent recreational use or any other use of a national wildlife refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purpose(s) of the national wildlife refuge [50 CFR 25.12 (a)]. A compatibility determination supports the selection of compatible uses and identifies stipulations or limits necessary to ensure compatibility.

Comprehensive Conservation Plan:	A document that describes the desired future conditions of a refuge or planning unit and provides long-range guidance and management direction to achieve the purposes of the refuge; helps fulfill the mission of the Refuge System; maintains and, where appropriate, restores the ecological integrity of each refuge and the Refuge System; helps achieve the goals of the National Wilderness Preservation System; and meets other mandates (Service Manual 602 FW 1.6 E).
Concern:	See Issue
Cover Type:	The present vegetation of an area.
Cultural Resource Inventory:	A professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Inventories may involve various levels, including background literature search, comprehensive field examination to identify all exposed physical manifestations of cultural resources, or sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in 36 CFR 60.4 (Service Manual 614 FW 1.7).
Cultural Resource Overview:	A comprehensive document prepared for a field office that discusses, among other things, its prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement on how program objectives should be met and conflicts resolved. An overview should reference or incorporate information from a field office's background or literature search described in Section VIII of the Cultural Resource Management Handbook (Service Manual 614 FW 1.7).
Cultural Resources:	The remains of sites, structures, or objects used by people in the past.
Designated Wilderness Area:	An area designated by the U.S. Congress to be managed as part of the National Wilderness Preservation System (Draft Service Manual 610 FW 1.5).
Disturbance:	Significant alteration of habitat structure or composition. May be natural (e.g., fire) or human-caused events (e.g., aircraft overflight).
Ecosystem:	A dynamic and interrelating complex of plant and animal communities and their associated non-living environment.
Ecosystem Management:	Management of natural resources using system-wide concepts to ensure that all plants and animals in ecosystems are maintained at viable levels in native habitats and basic ecosystem processes are perpetuated indefinitely.

Endangered Species (Federal):	A plant or animal species listed under the Endangered Species Act that is in danger of extinction throughout all or a significant portion of its range.
Endangered Species (State):	A plant or animal species in danger of becoming extinct or extirpated in the state within the near future if factors contributing to its decline continue. Populations of these species are at critically low levels or their habitats have been degraded or depleted to a significant degree.
Environmental Assessment (EA):	A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action, alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).
Environmental Impact Statement (EIS):	A detailed written statement required by section 102(2)(C) of the National Environmental Policy Act, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).
Estuary:	The wide lower course of a river into which the tides flow. The area where the tide meets a river current.
Finding of No Significant Impact (FONSI):	A document prepared in compliance with the National Environmental Policy Act, supported by an environmental assessment, that briefly presents why a federal action will have no significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared (40 CFR 1508.13).
Goal:	Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (Service Manual 620 FW 1.6J).
Habitat:	Suite of existing environmental conditions required by an organism for survival and reproduction. The place where an organism typically lives.
Habitat Restoration:	Management emphasis designed to move ecosystems to desired conditions and processes, and/or to healthy ecosystems.
Habitat Type:	See Vegetation Type.
Improvement Act:	The National Wildlife Refuge System Improvement Act of 1997.
Informed Consent:	The grudging willingness of opponents to “go along” with a course of action that they actually oppose (Bleiker).

Issue:	Any unsettled matter that requires a management decision [e.g., an initiative, opportunity, resource management problem, threat to the resources of the unit, conflict in uses, public concern, or other presence of an undesirable resource condition (Service Manual 602 FW 1.6K)].
Management Alternative:	See Alternative
Management Concern:	See Issue
Management Opportunity:	See Issue
Migration:	The seasonal movement from one area to another and back.
Mission Statement:	Succinct statement of the unit's purpose and reason for being.
Monitoring:	The process of collecting information to track changes of selected parameters over time.
National Environmental Policy Act of 1969 (NEPA):	Requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision-making (40 CFR 1500).
National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57):	Under the Refuge Improvement Act, the Fish and Wildlife Service is required to develop 15-year comprehensive conservation plans for all national wildlife refuges outside Alaska. The Act also describes the six public uses given priority status within the Refuge System (i.e., hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation).
National Wildlife Refuge System Mission:	The mission is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.
National Wildlife Refuge System:	Various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife, including species threatened with extinction; all lands, waters, and interests therein administered by the Secretary as wildlife refuges; areas for the protection and conservation of fish and wildlife that are threatened with extinction; wildlife ranges; game ranges; wildlife management areas; or waterfowl production areas.

National Wildlife Refuge:	A designated area of land, water, or an interest in land or water within the Refuge System.
Native Species:	Species that normally live and thrive in a particular ecosystem.
Noxious Weed:	A plant species designated by federal or state law as generally possessing one or more of the following characteristics: aggressive or difficult to manage; parasitic; a carrier or host of serious insect or disease; or non-native, new, or not common to the United States. According to the Federal Noxious Weed Act (P.L. 93-639), a noxious weed is one that causes disease or had adverse effects on man or his environment and therefore is detrimental to the agriculture and commerce of the United States and to the public health.
Objective:	A concise statement of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work. Objectives derive from goals and provide the basis for determining strategies, monitoring refuge accomplishments, and evaluating the success of strategies. Making objectives attainable, time-specific, and measurable (Service Manual 602 FW 1.6N).
Plant Association:	A classification of plant communities based on the similarity in dominants of all layers of vascular species in a climax community.
Plant Community:	An assemblage of plant species unique in its composition; occurs in particular locations under particular influences; a reflection or integration of the environmental influences on the site such as soils, temperature, elevation, solar radiation, slope, aspect, and rainfall; denotes a general kind of climax plant community.
Preferred Alternative:	This is the alternative determined (by the decision-maker) to best achieve the refuge purpose, vision, and goals; contributes to the Refuge System mission, addresses the significant issues; and is consistent with principles of sound fish and wildlife management.
Prescribed Fire:	The application of fire to wildland fuels to achieve identified land use objectives (Service Manual 621 FW 1.7). May occur from natural ignition or intentional ignition.
Priority Species:	Fish and wildlife species that require protective measures and/or management guidelines to ensure their perpetuation. Priority species include the following: (1) State-listed and candidate species; (2) species or groups of animals susceptible to significant population declines within a specific area or statewide by virtue of their inclination to aggregate (e.g., seabird colonies); and (3) species of recreation, commercial, and/or tribal importance.
Public Involvement Plan:	Broad long-term guidance for involving the public in the comprehensive conservation planning process.

Public Involvement:	A process that offers impacted and interested individuals and organizations an opportunity to become informed about, and to express their opinions on Service actions and policies. In the process, these views are studied thoroughly and thoughtful consideration of public views is given in shaping decisions for refuge management.
Public:	Individuals, organizations, and groups; officials of federal, state, and local government agencies; Indian tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have indicated an interest in service issues and those who do or do not realize that Service decisions may affect them.
Purposes of the Refuge:	"The purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge sub-unit." For refuges that encompass congressionally designated wilderness, the purposes of the Wilderness Act are additional purposes of the refuge (Service Manual 602 FW 106 S).
Recommended Wilderness:	Areas studied and found suitable for wilderness designation by both the Director of the Fish and Wildlife Service and the Secretary of the Department of the Interior, and recommended for designation by the President to Congress. These areas await only legislative action by Congress in order to become part of the Wilderness System. Such areas are also referred to as "pending in Congress" (Draft Service Manual 610 FW 1.5).
Record of Decision (ROD):	A concise public record of decision prepared by the federal agency, pursuant to NEPA, that contains a statement of the decision, identification of all alternatives considered, identification of the environmentally preferable alternative, a statement as to whether all practical means to avoid or minimize environmental harm from the alternative selected have been adopted (and if not, why they were not), and a summary of monitoring and enforcement where applicable for any mitigation (40 CFR 1505.2).
Refuge Goal:	See Goal
Refuge Purposes:	See Purposes of the Refuge
Songbirds: (Also Passerines)	A category of birds that is medium to small, perching landbirds. Most are territorial singers and migratory.
Step-down Management Plan:	A plan that provides specific guidance on management subjects (e.g., habitat, public use, fire, and safety) or groups of related subjects. It describes strategies and implementation schedules for meeting CCP goals and objectives (Service Manual 602 FW 1.6 U).

Strategy:	A specific action, tool, technique, or combination of actions, tools, and techniques used to meet unit objectives (Service Manual 602 FW 1.6 U).
Study Area:	The area reviewed in detail for wildlife, habitat, and public use potential. For purposes of this CCP, the study area includes the lands within the currently approved refuge boundary and potential refuge expansion areas.
Threatened Species (Federal):	Species listed under the Endangered Species Act that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.
Threatened Species (State):	A plant or animal species likely to become endangered in the state within the near future if factors contributing to population decline or habitat degradation or loss continue.
Tiering:	The coverage of general matters in broader environmental impact statements with subsequent narrower statements of environmental analysis, incorporating by reference, the general discussions and concentrating on specific issues (40 CFR 1508.28).
U.S. Fish and Wildlife Service Mission:	The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people.
Unit Objective:	See Objective
Vegetation Type, Habitat Type, Forest Cover Type:	A land classification system based upon the concept of distinct plant associations.
Vision Statement:	A concise statement of what the planning unit should be, or what we hope to do, based primarily upon the Refuge System mission and specific refuge purposes, and other mandates. We will tie the vision statement for the refuge to the mission of the Refuge System; the purpose(s) of the refuge; the maintenance or restoration of the ecological integrity of each refuge and the Refuge System; and other mandates (Service Manual 602 FW 1.6 Z).

Wilderness Study Areas: Lands and waters identified through inventory as meeting the definition of wilderness and undergoing evaluation for recommendation for inclusion in the Wilderness System. A study area must meet the following criteria:

- Generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;
- Has outstanding opportunities for solitude or a primitive and unconfined type of recreation; and
- Has at least 5,000 contiguous roadless acres or is sufficient in size as to make practicable its preservation and use in an unimpaired condition (Draft Service Manual 610 FW 1.5).

Wilderness: See Designated Wilderness

Wildfire: A free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands (Service Manual 621 FW 1.7).

Wildland Fire: Every wildland fire is either a wildfire or a prescribed fire (Service Manual 621 FW 1.3

ACRONYMS AND ABBREVIATIONS

APHIS	Animal Plant and Health Inspection Services
BCC	Birds of Conservation Concern
BRT	Biological Review Team
CCP	Comprehensive Conservation Plan
CFR	Code of Federal Regulations
CFS	Cubic feet per Second
CINWR	Caribbean Islands National Wildlife Refuge Complex (the Complex)
CRNWR	Cabo Rojo National Wildlife Refuge
CWA	Critical Wildlife Area
CWCS	Comprehensive Wildlife Conservation Strategy
DNER	Department of Natural and Environmental Resources
DOI	Department of the Interior
DU	Ducks Unlimited
EA	Environmental Assessment
EE	Environmental Education
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
FR	Federal Register
FTE	Full-time equivalent
FY	Fiscal Year
FWS	U.S. Fish and Wildlife Service (also Service)
GIS	Geographic Information System
LE	Law Enforcement
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NGO	Non-government Organization
NOAA	National Oceanic Atmospheric Administration
NEPA	National Environmental Policy Act
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System

PFT	Permanent Full Time
PREPA	Puerto Rico Energy Power Administration
PUNA	Public Use Natural Area
RM	Refuge Manual
RNA	Research Natural Area
ROD	Record of Decision
RONS	Refuge Operating Needs System
RRP	Refuge Roads Program
SOPI	Sociedad Ornitológica Puertorriqueña Inc. or Ornithological Society of Puerto Rico
SUP	Special Use Permit
TFT	Temporary Full Time
USC	United States Code
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
WIWD	West Indian Whistling Duck
YCC	Youth Conservation Corps
YSBB	Yellow-shouldered Blackbird

Appendix B. References and Literature Citations

Acevedo-Rodríguez, Pedro; Woodbury, Roy O. 1985. Los bejucos de Puerto Rico. Gen. Tech. Rep. SO–58. Río Piedras, PR: U.S. Department of Agriculture Forest Service, International Institute of Tropical Forestry. 331 p. In Spanish.

Aukema, J.E.; T.A. Carlo; A.G. Tossas and V. Anadón-Irizarry, 2006. A Call to Protect Sierra Bermeja for Future Generations. Sociedad Ornitológica Puertorriqueña, San Juan, Puerto Rico

Bawiec, W.J. 2001. Geology, geochemistry, geophysics, mineral occurrences, and mineral resource assessment for the Commonwealth of Puerto Rico. US Geological Survey Open-File Report 98-38.

Birdlife International. 2009. Edited by David C Wege and Veronica Anadon-Irizarry. Important Bird Areas of the Caribbean: key sites for conservation. 348 p.

Birdsey, Richard A.; Weaver, Peter L. 1982. The forest resources of Puerto Rico. Resour. Bull. SO–85. New Orleans: U.S. Department of Agriculture Forest Service, Southern Forest Experiment Station. 59 p.

Bonnet, J.A., Tirado, Sulsona, 1950. Soil Studies in the Lajas Valley. Bulletin No. 86. University of Puerto Rico Experimental Station. Rio Piedras, Puerto Rico.

Britton, N.L.; Wilson, Percy. 1923–30. Botany of Porto Rico and the Virgin Islands: Spermatophyta and Ptridophyta. In: Scientific survey of Porto Rico and the Virgin Islands. New York: New York Academy of Sciences: 5(1–4): 1–626; 6(1–4): 1–663.

Cardona, J. E. and M. Rivera. 1988. Critical Coastal Wildlife Areas of Puerto Rico. Commonwealth of Puerto Rico. Department of Natural Resources. Puerto Rico Coastal Zone Management Program. Scientific Research Area. San Juan, Puerto Rico. 173 pp.

Carrera, Carlos J. and Lugo, Ariel E. 1978. The System of Mangroves in Puerto Rico. Department of Natural Resources. San Juan, Puerto Rico.

Carver, Erin and James Caudill. 2007. Banking on Nature 2006: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation. Division of Economics, U.S. Fish and Wildlife Service. Washington, DC.

Colón, H.E. 1980. Los Vertebrados de la Laguna Cartagena. Unpublish, paper. University of Puerto Rico, Mayagüez, 74 pp.

Colón, Hector E., 1982. The Importance of the Cartagena Lagoon to Threatened Species in Puerto Rico. Department of Natural resources, San Juan.

Cook, Melville T.; Gleason, Henry A. 1928. Ecological survey of the flora of Puerto Rico. Journal of the Department of Agriculture of Porto Rico. 12(1–2): 3–139 + photos and maps.

Danforth, Stuart T. 1926. An Ecological Study of Cartagena Lagoon, Puerto Rico, with Special Reference to Birds. The Journal of Agriculture, Puerto Rico. 10: 1-30.

Del Castillo, C; P. Torres-Báez and S. Matos. 1985. Estudio Ecológico de la Laguna Cartagena, PR. Unbublish. paper. University of PR, Mayaguez. 56 pp.

Deliz Quiñones, Katherine Y. 2005. Water quality assessment of a tropical freshwater marsh using aquatic insects. Mayagüez, PR: University of Puerto Rico. 127 p. M.S. thesis.

Díaz-Soltero, Hilda. 1990. Laguna Cartagena National Wildlife Refuge: Restoration, Development and Management Plan. University of Puerto Rico, Mayagüez.

Department of Natural and Environmental Resources (DNER). 2005. Comprehensive Wildlife Conservation Strategy. San Juan, PR.

Department of Natural and Environmental Resources (DNER), 2006. Puerto Rico Critical Wildlife Areas, Puerto Rico.

Endangered Species Act of 1973 as amended (P.L. 93-205).

Francis, John K.; Liogier, Henri A. 1991. Naturalized and exotic tree species of Puerto Rico. Gen. Tech. Rep. SO–62. New Orleans: U.S. Department of Agriculture Forest Service, Southern Forest Experiment Station. 12 p.

Francis, John K.; Lowe, Carol A. 2000. Bioecología de árboles nativos y exóticos de Puerto Rico y las Indias Occidentales. Reporte Técnico General IITF–15. Río Piedras, PR: Departamento de Agricultura de los Estados Unidos, Servicio Forestal, Instituto Internacional de Dasonomia Tropical. 582 p. In Spanish.

Franco, Peter A., Weaver, Peter L. and Eggen-McIntosh, Susan. 1997. Forest Resources of Puerto Rico. US Department of Agriculture, Forest Service. Asheville, NC.

García-Molinari Ovidio. 1952. Grasslands and Grasses of Puerto Rico. University of Puerto Rico Agricultural Experiemental Station. Piedras, Puerto Rico.

Gleason, H.A. and Cook, Mel T. 1927. Scientific Survey of Puerto Rico and the Virgin Islands: Plant Ecology of Puerto Rico. New York Academy of Sciences. New York.

Graves, Robert P. 1991. Groundwater Resources in the Lajas Valley, Puerto Rico. Water Resources Investigation Report. US Geological Survey.

Helmer, E.H.; Ramos, O.; Del M. López, T. [and others]. 2002. Mapping the forest type and land cover of Puerto Rico, a component of the Caribbean biodiversity hotspot. Caribbean Journal of Science. 38(3–4): 165–183.

Hill, Robert T. 1899. The forest conditions of Porto Rico. Bull. 25. Washington, DC: Government Printing Office, U.S. Department of Forestry, Division of Forestry. 48 p.

Hitchcock, A.S. 1936. Manual of the grasses of the West Indies. Misc. Publ. 243. Washington, DC: U.S. Department of Agriculture. 439 p

Howard, Richard A. 1979. Flora of the Lesser Antilles, Leeward and Windward Islands. Monocotyledonaceae. Jamaica Plain, MA: Harvard University, Arnold Arboretum. 586 p. Vol. 3.

Howard, Richard A. 1988–1989. Flora of the Lesser Antilles, Leeward and Windward Islands. Dicotyledonaceae. Pts. 1, 2, and 3. Jamaica Plain, MA: Harvard University, Arnold Arboretum. 673 p. Vol. 4; 1,262 p. Vol. 5.

IBA named “Laguna Cartagena and Sierra Bermeja” (2009) Important Bird Area fact sheet: Suroeste, Puerto Rico (to USA).

Koenig, Nathan, 1953. A Comprehensive Agricultural Program for Puerto Rico. US Department of Agriculture. Washington, D.C.

Liogier, Henri Alain. 1985–1997. Descriptive flora of Puerto Rico and adjacent islands—Spermatophyta. San Juan, PR: Editorial de la Universidad de Puerto Rico. 352 p. Vol. 1; 481 p. Vol. 2; 461 p. Vol. 3; 617 p. Vol 4; 436 p. Vol 5.

Liogier, Henri Alain; Martorell, Luis F. 1982. Flora of Puerto Rico and adjacent islands: a systematic synopsis. Río Piedras, PR: Editorial de la Universidad de Puerto Rico. 343 p.

Liogier, Henri Alain; Martorell, Luis F. 2000. Flora of Puerto Rico and adjacent islands: a systematic synopsis. 2d ed., rev. San Juan, PR: Editorial de la Universidad de Puerto Rico. 382 p.

Little, Elbert L., Jr.; Wadsworth, Frank. H. 1964. Common trees of Puerto Rico and the Virgin Islands. Agric. Handb. 249. Washington, DC: U.S. Department of Agriculture. 548 p.

Little, Elbert L., Jr.; Woodbury, Roy O.; Wadsworth, Frank H. 1974. Trees of Puerto Rico and the Virgin Islands. Agric. Handb. 449. Washington, DC: U.S. Department of Agriculture. 1,024 p.

Lugo-Lopez, M.A. and Rivera, Louis H. 1977. Updated Taxonomic Classification of the Soils of Puerto Rico. Rio Piedras Agricultural Station, Bulletin 258. Puerto Rico.

Mas, Edwin G. and García, Molinari O. 1990. Illustrated Guide of Puerto Rico Herbal Communities. University of Puerto Rico, Mayagüez.

Marrero, J. 1950. Resultados de la repoblación forestal en los bosques insulares de Puerto Rico. Caribbean Forester. 11(3): 151–195. In Spanish.

McKenzie, Paul M. 1986. Critical plants found on the Cabo Rojo National Wildlife Refuge. Boquerón, PR: U.S. Fish and Wildlife Service. 8 p. Unpublished report. On file with: U.S. Fish and Wildlife Service, Carretera 301, Km 5.1, P.O. Box 491, Boquerón, PR 00622.

McKenzie, PM and Noble, RE. 1991. Habitat Use, Movements and Behavior of Shiny Cowbirds in Southwestern Puerto Rico. US Fish and Wildlife Service. Boquerón, Puerto Rico.

Meyerhoff, Howard. 1933. Geology of Puerto Rico. Monographs of the University of Puerto Rico. University of Puerto Rico.

Mitchell, G.J. 1922. Geology of the Ponce District. Scientific Survey of Puerto Rico and the Virgin Islands. New York Academy of Sciences. New York.

Montgomery, Homer; Pessago, Emile A., Jr.; Lewis, John F.; Schellekens, Johannes. 1994. Paleogeography of jurassic fragments in the Caribbean. Tectonics. 13(2): 725–732.

Murphy, Louis S. 1916. Forests of Porto Rico: past, present, and future, and their physical and economic environment. Bull. 354. Washington, DC: U.S. Department of Agriculture. 99 p.

New Employee Handbook. U.S. Fish and Wildlife Service.

Picó, Raffael. 1974. The geography of Puerto Rico. Chicago: Aldine Publishing Co. 439 p.

Pindell, James L. and Barrett, Stephen F. 1990. Geological Evolution Off the Caribbean region: a Plate Tectonic Perspective. Geological Society of America. Boulder, Colorado.

Proctor, George R. 1994. Vieques mangrove forest manual. San Juan, PR: Departamento de Recursos Nturales y Ambientales. 72 p. English section.

Ramírez Toro, G.I.; Minnigh, H.A. 1997. Drainwaters: biological responses to water quality. San Juan, PR: Asociacíon Interamerican de Ingeniería y Ambiental. 7 p. Unpublished report. On file with: U.S. Fish and Wildlife Service, Carretera 301, Km 5.1, P.O. Box 491, Boquerón, PR 00622.

Sastre-D.J., Ines; Santiago-Valentín, E. 1996. Botanical explorations of Puerto Rico by N.L. Britton and E.G. Britton: their significance in plant conservation, horticulture, and education. Brittonia. 48(3): 322–336.

Toro McCown, J. and J. L. Chabert. 1986. Suplemento Técnico para la Designación de la Reserva Natural de Laguna Cartagena. Departamento de Recursos Naturales. Área de Investigaciones Científicas. División de Asesoramiento Técnico. 69 pp.

U.S. Department of Commerce, Bureau of the Census. 2000 Census.

USFWS. Caribbean Islands Wildlife Refuge Complex, Biological Review, January 2002. Note: Text in the section on flora is drawn directly from this document.

Volckmann, Richard P. 1984b. Geologic map of the San German quadrangle, southwest Puerto Rico. Misc. Invest. Ser., Map I–1556. San Juan, PR: Department of the Interior, U.S. Geological Survey; Commonwealth of Puerto Rico, Department of Natural Resources.

Wadsworth, Frank H. 1943. The Las Cobanitas campeche plantation. Caribbean Forester. 4(3): 140–143.

Wadsworth, Frank H. 1950. Notes on the climax forests of Puerto Rico and their destruction and conservation prior to 1950. Caribbean Forester. 11: 38–47.

Wadsworth, Frank, H. 1962. The Forests of Puerto Rico. Revista de Agricultura de Puerto Rico.

Wadsworth, Frank, H. 1990. Plantation Forests in the State Forest of Guánica. Acta Científica.

Weaver, Peter L., Chinea, J Danilo. 2003. Secondary Subtropical Dry Forest at the La Tinaja Tract of the Laguna Cartagena National Wildlife Refuge. Caribbean Journal of Science.

Weaver, Peter L. and Schwagerl, Joe. 2005. Early Recovery of Subtropical Dry Forest in the Absence of Grazing and Fire. Proceedings of the Caribbean Foresters in Puerto Rico.

Weaver, Peter L. and Schwagerl, Joe. 2004. Tree Planting in the National Wildlife Refuges of Southwestern Puerto Rico. Proceedings of the 7th Annual Caribbean Urban Forestry Conference, Caribbean Foresters Meeting. St. Croix, US Virgin Islands Cooperative Extension Service.

Weaver, Peter L.; Schwagerl, Joseph J. 2009. U.S. Fish and Wildlife Service Refuges and Other nearby Reserves in Southwestern Puerto Rico, General Technical Report IITF-40. San Juan, PR: U.S. Department of Agriculture Forest Service, International Institute of Tropical Forestry, 110p.

Willardson, Lymann S., 1958. Lajas Valley Drainage Problems. University of Puerto Rico Agricultural Experiment Station. San Juan, Puerto Rico.

Appendix C. Relevant Legal Mandates and Executive Orders

STATUTE	DESCRIPTION
Administrative Procedures Act (1946)	Outlines administrative procedures to be followed by federal agencies with respect to identification of information to be made public; publication of material in the Federal Register; maintenance of records; attendance and notification requirements for specific meetings and hearings; issuance of licenses; and review of agency actions.
American Antiquities Act of 1906	Provides penalties for unauthorized collection, excavation, or destruction of historic or prehistoric ruins, monuments, or objects of antiquity on lands owned or controlled by the United States. The Act authorizes the President to designate as national monuments objects or areas of historic or scientific interest on lands owned or controlled by the Unites States.
American Indian Religious Freedom Act of 1978	Protects the inherent right of Native Americans to believe, express, and exercise their traditional religions, including access to important sites, use and possession of sacred objects, and the freedom to worship through ceremonial and traditional rites.
Americans With Disabilities Act of 1990	Intended to prevent discrimination of and make American society more accessible to people with disabilities. The Act requires reasonable accommodations to be made in employment, public services, public accommodations, and telecommunications for persons with disabilities.
Anadromous Fish Conservation Act of 1965, as amended	Authorizes the Secretaries of Interior and Commerce to enter into cooperative agreements with states and other non-federal interests for conservation, development, and enhancement of anadromous fish and contribute up to 50 percent as the federal share of the cost of carrying out such agreements. Reclamation construction programs for water resource projects needed solely for such fish are also authorized.
Archaeological Resources Protection Act of 1979, as amended.	This Act strengthens and expands the protective provisions of the Antiquities Act of 1906 regarding archaeological resources. It also revised the permitting process for archaeological research.
Architectural Barriers Act of 1968	Requires that buildings and facilities designed, constructed, or altered with federal funds, or leased by a federal agency, must comply with standards for physical accessibility.

STATUTE	DESCRIPTION
Bald and Golden Eagle Protection Act of 1940, as amended	Prohibits the possession, sale or transport of any bald or golden eagle, alive or dead, or part, nest, or egg except as permitted by the Secretary of the Interior for scientific or exhibition purposes, or for the religious purposes of Indians.
Bankhead-Jones Farm Tenant Act of 1937	Directs the Secretary of Agriculture to develop a program of land conservation and utilization in order to correct maladjustments in land use and thus assist in such things as control of soil erosion, reforestation, conservation of natural resources and protection of fish and wildlife. Some early refuges and hatcheries were established under authority of this Act.
Cave Resources Protection Act of 1988	Established requirements for the management and protection of caves and their resources on federal lands, including allowing the land managing agencies to withhold the location of caves from the public, and requiring permits for any removal or collecting activities in caves on federal lands.
Clean Air Act of 1970	Regulates air emissions from area, stationary, and mobile sources. This Act and its amendments charge federal land managers with direct responsibility to protect the “air quality and related values” of land under their control. These values include fish, wildlife, and their habitats.
Clean Water Act of 1974, as amended	This Act and its amendments have as its objective the restoration and maintenance of the chemical, physical, and biological integrity of the Nation’s waters. Section 401 of the Act requires that federally permitted activities comply with the Clean Water Act standards, state water quality laws, and any other appropriate state laws. Section 404 charges the U.S. Army Corps of Engineers with regulating discharge of dredge or fill materials into waters of the United States, including wetlands.
Coastal Barrier Resources Act of 1982 (CBRA)	Identifies undeveloped coastal barriers along the Atlantic and Gulf Coasts and included them in the John H. Chafee Coastal Barrier Resources System (CBRS). The objectives of the act are to minimize loss of human life, reduce wasteful federal expenditures, and minimize the damage to natural resources by restricting most federal expenditures that encourage development within the CBRS.

STATUTE	DESCRIPTION
Coastal Barrier Improvement Act of 1990	Reauthorized the Coastal Barrier Resources Act (CBRA), expanded the CBRS to include undeveloped coastal barriers along the Great Lakes and in the Caribbean, and established "Otherwise Protected Areas (OPAs)." The Service is responsible for maintaining official maps, consulting with federal agencies that propose spending federal funds within the CBRS and OPAs, and making recommendations to Congress about proposed boundary revisions.
Coastal Wetlands Planning, Protection, and Restoration (1990)	Authorizes the Director of the Fish and Wildlife Service to participate in the development of a Louisiana coastal wetlands restoration program, participate in the development and oversight of a coastal wetlands conservation program, and lead in the implementation and administration of a national coastal wetlands grant program.
Coastal Zone Management Act of 1972, as amended	Established a voluntary national program within the Department of Commerce to encourage coastal states to develop and implement coastal zone management plans and requires that "any federal activity within or outside of the coastal zone that affects any land or water use or natural resource of the coastal zone" shall be "consistent to the maximum extent practicable with the enforceable policies" of a state's coastal zone management plan. The law includes an Enhancement Grants Program for protecting, restoring, or enhancing existing coastal wetlands or creating new coastal wetlands. It also established the National Estuarine Research Reserve System, guidelines for estuarine research, and financial assistance for land acquisition.
Emergency Wetlands Resources Act of 1986	This Act authorized the purchase of wetlands from Land and Water Conservation Fund moneys, removing a prior prohibition on such acquisitions. The Act requires the Secretary to establish a National Wetlands Priority Conservation Plan, required the states to include wetlands in their Comprehensive Outdoor Recreation Plans, and transfers to the Migratory Bird Conservation Fund amounts equal to import duties on arms and ammunition. It also established entrance fees at national wildlife refuges.
Endangered Species Act of 1973, as amended	Provides for the conservation of threatened and endangered species of fish, wildlife, and plants by federal action and by encouraging the establishment of state programs. It provides for the determination and listing of threatened and endangered species and the designation of critical habitats. Section 7 requires refuge managers to perform internal consultation before initiating projects that affect or may affect endangered species.

STATUTE	DESCRIPTION
Environmental Education Act of 1990	This Act established the Office of Environmental Education within the U.S. Environmental Protection Agency to develop and administer a federal environmental education program in consultation with other federal natural resource management agencies, including the Fish and Wildlife Service.
Estuary Protection Act of 1968	Authorized the Secretary of the Interior, in cooperation with other federal agencies and the states, to study and inventory estuaries of the United States, including land and water of the Great Lakes, and to determine whether such areas should be acquired for protection. The Secretary is also required to encourage state and local governments to consider the importance of estuaries in their planning activities relative to federal natural resource grants. In approving any state grants for acquisition of estuaries, the Secretary was required to establish conditions to ensure the permanent protection of estuaries.
Estuaries and Clean Waters Act of 2000	This law creates a federal interagency council that includes the Director of the Fish and Wildlife Service, the Secretary of the Army for Civil Works, the Secretary of Agriculture, the Administrator of the Environmental Protection Agency and the Administrator for the National Oceanic and Atmospheric Administration. The council is charged with developing a national estuary habitat restoration strategy and providing grants to entities to restore and protect estuary habitat to promote the strategy.
Food Security Act of 1985, as amended (Farm Bill)	The Act contains several provisions that contribute to wetland conservation. The Swampbuster provisions state that farmers who convert wetlands for the purpose of planting after enactment of the law are ineligible for most farmer program subsidies. It also established the Wetland Reserve Program to restore and protect wetlands through easements and restoration of the functions and values of wetlands on such easement areas.
Farmland Protection Policy Act of 1981, as amended	The purpose of this law is to minimize the extent to which federal programs contribute to the unnecessary conversion of farmland to nonagricultural uses. Federal programs include construction projects and the management of federal lands.
Federal Advisory Committee Act (1972), as amended	Governs the establishment of and procedures for committees that provide advice to the federal government. Advisory committees may be established only if they will serve a necessary, nonduplicative function. Committees must be strictly advisory unless otherwise specified and meetings must be open to the public.

STATUTE	DESCRIPTION
Federal Coal Leasing Amendment Act of 1976	Provided that nothing in the Mining Act, the Mineral Leasing Act, or the Mineral Leasing Act for Acquired Lands authorized mining coal on refuges.
Federal-Aid Highways Act of 1968	Established requirements for approval of federal highways through national wildlife refuges and other designated areas to preserve the natural beauty of such areas. The Secretary of Transportation is directed to consult with the Secretary of the Interior and other federal agencies before approving any program or project requiring the use of land under their jurisdiction.
Federal Noxious Weed Act of 1990, as amended	The Secretary of Agriculture was given the authority to designate plants as noxious weeds and to cooperate with other federal, State and local agencies, farmers' associations, and private individuals in measures to control, eradicate, prevent, or retard the spread of such weeds. The Act requires each Federal land-managing agency, including the Fish and Wildlife Service, to designate an office or person to coordinate a program to control such plants on the agency's land and implement cooperative agreements with the states, including integrated management systems to control undesirable plants.
Fish and Wildlife Act of 1956	Establishes a comprehensive national fish, shellfish, and wildlife resources policy with emphasis on the commercial fishing industry but also includes the inherent right of every citizen and resident to fish for pleasure, enjoyment, and betterment and to maintain and increase public opportunities for recreational use of fish and wildlife resources. Among other things, it authorizes the Secretary of the Interior to take such steps as may be required for the development, advancement, management, conservation, and protection of fish and wildlife resources including, but not limited to, research, development of existing facilities, and acquisition by purchase or exchange of land and water or interests therein.
Fish and Wildlife Conservation Act of 1980, as amended	Requires the Service to monitor non-gamebird species, identify species of management concern, and implement conservation measures to preclude the need for listing under the Endangered Species Act.
Fish and Wildlife Coordination Act of 1958	Promotes equal consideration and coordination of wildlife conservation with other water resource development programs by requiring consultation with the Fish and Wildlife Service and the state fish and wildlife agencies where the "waters of a stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted…or otherwise controlled or modified" by any agency under federal permit or license.

STATUTE	DESCRIPTION
Improvement Act of 1978	This act was passed to improve the administration of fish and wildlife programs and amends several earlier laws, including the Refuge Recreation Act, the National Wildlife Refuge System Administration Act, and the Fish and Wildlife Act of 1956. It authorizes the Secretary to accept gifts and bequests of real and personal property on behalf of the United States. It also authorizes the use of volunteers on Service projects and appropriations to carry out volunteer programs.
Fishery (Magnuson) Conservation and Management Act of 1976	Established Regional Fishery Management Councils comprised of federal and state officials, including the Fish and Wildlife Service. It provides for regulation of foreign fishing and vessel fishing permits.
Freedom of Information Act, 1966	Requires all federal agencies to make available to the public for inspection and copying administrative staff manuals and staff instructions; official, published and unpublished policy statements; final orders deciding case adjudication; and other documents. Special exemptions have been reserved for nine categories of privileged material. The Act requires the party seeking the information to pay reasonable search and duplication costs.
Geothermal Steam Act of 1970, as amended	Authorizes and governs the lease of geothermal steam and related resources on public lands. Section 15 c of the Act prohibits issuing geothermal leases on virtually all Service-administrative lands.
Lacey Act of 1900, as amended	Originally designed to help states protect their native game animals and to safeguard U.S. crop production from harmful foreign species, this Act prohibits interstate and international transport and commerce of fish, wildlife or plants taken in violation of domestic or foreign laws. It regulates the introduction to America of foreign species.
Land and Water Conservation Fund Act of 1948	This Act provides funding through receipts from the sale of surplus federal land, appropriations from oil and gas receipts from the outer continental shelf, and other sources for land acquisition under several authorities. Appropriations from the fund may be used for matching grants to states for outdoor recreation projects and for land acquisition by various federal agencies, including the Fish and Wildlife Service.

STATUTE	DESCRIPTION
Marine Mammal Protection Act of 1972, as amended	The 1972 Marine Mammal Protection Act established a federal responsibility to conserve marine mammals with management vested in the Department of the Interior for sea otter, walrus, polar bear, dugong, and manatee. The Department of Commerce is responsible for cetaceans and pinnipeds, other than the walrus. With certain specified exceptions, the Act establishes a moratorium on the taking and importation of marine mammals, as well as products taken from them.
Migratory Bird Conservation Act of 1929	Established a Migratory Bird Conservation Commission to approve areas recommended by the Secretary of the Interior for acquisition with Migratory Bird Conservation Funds. The role of the commission was expanded by the North American Wetland Conservation Act to include approving wetlands acquisition, restoration, and enhancement proposals recommended by the North American Wetlands Conservation Council.
Migratory Bird Hunting and Conservation Stamp Act of 1934	Also commonly referred to as the “Duck Stamp Act,” requires waterfowl hunters 16 years of age or older to possess a valid federal hunting stamp. Receipts from the sale of the stamp are deposited into the Migratory Bird Conservation Fund for the acquisition of migratory bird refuges.
Migratory Bird Treaty Act of 1918, as amended	This Act implements various treaties and conventions between the United States and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Except as allowed by special regulations, this Act makes it unlawful to pursue, hunt, kill, capture, possess, buy, sell, purchase, barter, export or import any migratory bird, part, nest, egg, or product.
Mineral Leasing Act for Acquired Lands (1947), as amended	Authorizes and governs mineral leasing on acquired public lands.
Minerals Leasing Act of 1920, as amended	Authorizes and governs leasing of public lands for development of deposits of coal, oil, gas, and other hydrocarbons; sulphur; phosphate; potassium; and sodium. Section 185 of this title contains provisions relating to granting rights-of-way over federal lands for pipelines.
Mining Act of 1872, as amended	Authorizes and governs prospecting and mining for the so-called “hardrock” minerals (i.e., gold and silver) on public lands.

STATUTE	DESCRIPTION
National and Community Service Act of 1990	Authorizes several programs to engage citizens of the U.S. in full- and/or part-time projects designed to combat illiteracy and poverty, provide job skills, enhance educational skills, and fulfill environmental needs. Among other things, this law establishes the American Conservation and Youth Service Corps to engage young adults in approved human and natural resource projects, which will benefit the public or are carried out on federal or Indian lands.
National Environmental Policy Act of 1969	Requires analysis, public comment, and reporting for environmental impacts of federal actions. It stipulates the factors to be considered in environmental impact statements, and requires that federal agencies employ an interdisciplinary approach in related decision-making and develop means to ensure that unqualified environmental values are given appropriate consideration, along with economic and technical considerations.
National Historic Preservation Act of 1966, as amended	It establishes a National Register of Historic Places and a program of matching grants for preservation of significant historical features. Federal agencies are directed to take into account the effects of their actions on items or sites listed or eligible for listing in the National Register.
National Trails System Act (1968), as amended	Established the National Trails System to protect the recreational, scenic, and historic values of some important trails. National recreation trails may be established by the Secretaries of Interior or Agriculture on land wholly or partly within their jurisdiction, with the consent of the involved state(s), and other land managing agencies, if any. National scenic and national historic trails may only be designated by Congress. Several national trails cross units of the National Wildlife Refuge System.
National Wildlife Refuge System Administration Act of 1966	Prior to 1966, there was no single federal law that governed the administration of the various national wildlife refuges that had been established. This Act defines the National Wildlife Refuge System and authorizes the Secretary of the Interior to permit any use of a refuge provided such use is compatible with the major purposes(s) for which the refuge was established.
National Wildlife Refuge System Improvement Act of 1997	This Act amends the National Wildlife Refuge System Administration Act of 1966. This Act defines the mission of the National Wildlife Refuge System, establishes the legitimacy and appropriateness of six priority wildlife-dependent public uses, establishes a formal process for determining compatible uses of Refuge System lands, identifies the Secretary of the Interior as responsible for managing and protecting the Refuge System, and requires the development of a comprehensive conservation plan for all refuges outside of Alaska.

STATUTE	DESCRIPTION
Native American Graves Protection and Repatriation Act of 1990	Requires federal agencies and museums to inventory, determine ownership of, and repatriate certain cultural items and human remains under their control or possession. The Act also addresses the repatriation of cultural items inadvertently discovered by construction activities on lands managed by the agency.
Neotropical Migratory Bird Conservation Act of 2000	Establishes a matching grant program to fund projects that promote the conservation of neotropical migratory birds in the united States, Latin America, and the Caribbean.
North American Wetlands Conservation Act of 1989	Provides funding and administrative direction for implementation of the North American Waterfowl Management Plan and the Tripartite Agreement on wetlands between Canada, the United States, and Mexico. The North American Wetlands Conservation Council was created to recommend projects to be funded under the Act to the Migratory Bird Conservation Commission. Available funds may be expended for up to 50 percent of the United States' share cost of wetlands conservation projects in Canada, Mexico, or the United States (or 100 percent of the cost of projects on federal lands).
Refuge Recreation Act of 1962, as amended	This Act authorizes the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use, when such uses do not interfere with the area's primary purposes. It authorizes construction and maintenance of recreational facilities and the acquisition of land for incidental fish and wildlife-oriented recreational development or protection of natural resources. It also authorizes the charging of fees for public uses.
Partnerships for Wildlife Act of 1992	Establishes a Wildlife Conservation and Appreciation Fund to receive appropriated funds and donations from the National Fish and Wildlife Foundation and other private sources to assist the state fish and game agencies in carrying out their responsibilities for conservation of non-game species. The funding formula is no more that 1/3 federal funds, at least 1/3 foundation funds, and at least 1/3 state funds.
Refuge Revenue Sharing Act of 1935, as amended	Provided for payments to counties in lieu of taxes from areas administered by the Fish and Wildlife Service. Counties are required to pass payments along to other units of local government within the county, which suffer losses in tax revenues due to the establishment of Service areas.
Rehabilitation Act of 1973	Requires nondiscrimination in the employment practices of federal agencies of the executive branch and contractors. It also requires all federally assisted programs, services, and activities to be available to people with disabilities.

STATUTE	DESCRIPTION
Rivers and Harbors Appropriations Act of 1899, as amended	Requires the authorization by the U.S. Army Corps of Engineers prior to any work in, on, over, or under a navigable water of the United States. The Fish and Wildlife Coordination Act provides authority for the Service to review and comment on the effects on fish and wildlife activities proposed to be undertaken or permitted by the Corps of Engineers. Service concerns include contaminated sediments associated with dredge or fill projects in navigable waters.
Sikes Act (1960), as amended	Provides for the cooperation by the Departments of Interior and Defense with state agencies in planning, development, and maintenance of fish and wildlife resources and outdoor recreation facilities on military reservations throughout the United States. It requires the Secretary of each military department to use trained professionals to manage the wildlife and fishery resource under his jurisdiction, and requires that federal and state fish and wildlife agencies be given priority in management of fish and wildlife activities on military reservations.
Transfer of Certain Real Property for Wildlife Conservation Purposes Act of 1948	This Act provides that upon determination by the Administrator of the General Services Administration, real property no longer needed by a federal agency can be transferred, without reimbursement, to the Secretary of the Interior if the land has particular value for migratory birds, or to a state agency for other wildlife conservation purposes.
Transportation Equity Act for the 21st Century (1998)	Established the Refuge Roads Program, requires transportation planning that includes public involvement, and provides funding for approved public use roads and trails and associated parking lots, comfort stations, and bicycle/pedestrian facilities.
Uniform Relocation and Assistance and Real Property Acquisition Policies Act (1970), as amended	Provides for uniform and equitable treatment of persons who sell their homes, businesses, or farms to the Service. The Act requires that any purchase offer be no less than the fair market value of the property.
Water Resources Planning Act of 1965	Established Water Resources Council to be composed of Cabinet representatives including the Secretary of the Interior. The Council reviews river basin plans with respect to agricultural, urban, energy, industrial, recreational and fish and wildlife needs. The act also established a grant program to assist States in participating in the development of related comprehensive water and land use plans.

STATUTE	DESCRIPTION
Wild and Scenic Rivers Act of 1968, as amended	This Act selects certain rivers of the nation possessing remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values; preserves them in a free-flowing condition; and protects their local environments.
Wilderness Act of 1964, as amended	This Act directs the Secretary of the Interior to review every roadless area of 5,000 acres or more and every roadless island regardless of size within the National Wildlife Refuge System and to recommend suitability of each such area. The Act permits certain activities within designated wilderness areas that do not alter natural processes. Wilderness values are preserved through a "minimum tool" management approach, which requires refuge managers to use the least intrusive methods, equipment, and facilities necessary for administering the areas.
Youth Conservation Corps Act of 1970	Established a permanent Youth Conservation Corps (YCC) program within the Departments of Interior and Agriculture. Within the Service, YCC participants perform many tasks on refuges, fish hatcheries, and research stations.

EXECUTIVE ORDERS	DESCRIPTIONS
EO 11593, Protection and Enhancement of the Cultural Environment (1971)	States that if the Service proposes any development activities that may affect the archaeological or historic sites, the Service will consult with Federal and State Historic Preservation Officers to comply with Section 106 of the National Historic Preservation Act of 1966, as amended.
EO 11644, Use of Off-road Vehicles on Public Land (1972)	Established policies and procedures to ensure that the use of off-road vehicles on public lands will be controlled and directed so as to protect the resources of those lands, to promote the safety of all users of those lands, and to minimize conflicts among the various uses of those lands.
EO 11988, Floodplain Management (1977)	The purpose of this Executive Order is to prevent federal agencies from contributing to the "adverse impacts associated with occupancy and modification of floodplains" and the "direct or indirect support of floodplain development." In the course of fulfilling their respective authorities, federal agencies "shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains."
EO 11989 (1977), Amends Section 2 of EO 11644	Directs agencies to close areas negatively impacted by off-road vehicles.
EO 11990, Protection of Wetlands (1977)	Federal agencies are directed to provide leadership and take action to minimize the destruction, loss of degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands.
EO 12372, Intergovernmental Review of Federal Programs (1982)	Seeks to foster intergovernmental partnerships by requiring federal agencies to use the state process to determine and address concerns of state and local elected officials with proposed federal assistance and development programs.
EO 12898, Environmental Justice (1994)	Requires federal agencies to identify and address disproportionately high and adverse effects of its programs, policies, and activities on minority and low-income populations.

EXECUTIVE ORDERS	DESCRIPTIONS
EO 12906, Coordinating Geographical Data Acquisition and Access (1994), Amended by EO 13286 (2003). Amendment of EOs and other actions in connection with transfer of certain functions to Secretary of DHS.	Recommended that the executive branch develop, in cooperation with state, local, and tribal governments, and the private sector, a coordinated National Spatial Data Infrastructure to support public and private sector applications of geospatial data. Of particular importance to comprehensive conservation planning is the National Vegetation Classification System (NVCS), which is the adopted standard for vegetation mapping. Using NVCS facilitates the compilation of regional and national summaries, which in turn, can provide an ecosystem context for individual refuges.
EO 12962, Recreational Fisheries (1995)	Federal agencies are directed to improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities in cooperation with states and tribes.
EO 13007, Native American Religious Practices (1996)	Provides for access to, and ceremonial use of, Indian sacred sites on federal lands used by Indian religious practitioners and direction to avoid adversely affecting the physical integrity of such sites.
EO 13061, Federal Support of Community Efforts Along American Heritage Rivers (1997)	Established the American Heritage Rivers initiative for the purpose of natural resource and environmental protection, economic revitalization, and historic and cultural preservation. The Act directs Federal agencies to preserve, protect, and restore rivers and their associated resources important to our history, culture, and natural heritage.
EO 13084, Consultation and Coordination With Indian Tribal Governments (2000)	Provides a mechanism for establishing regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications.
EO 13112, Invasive Species (1999)	Federal agencies are directed to prevent the introduction of invasive species, detect and respond rapidly to and control populations of such species in a cost effective and environmentally sound manner, accurately monitor invasive species, provide for restoration of native species and habitat conditions, conduct research to prevent introductions and to control invasive species, and promote public education on invasive species and the means to address them. This EO replaces and rescinds EO 11987, Exotic Organisms (1977).

EXECUTIVE ORDERS	DESCRIPTIONS
EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds. (2001)	Instructs federal agencies to conserve migratory birds by several means, including the incorporation of strategies and recommendations found in Partners in Flight Bird Conservation plans, the North American Waterfowl Plan, the North American Waterbird Conservation Plan, and the United States Shorebird Conservation Plan, into agency management plans and guidance documents.

Appendix D. Public Involvement

SUMMARY OF PUBLIC SCOPING COMMENTS

COMPREHENSIVE CONSERVATION PLANNING FOR THE LAGUNA CARTAGENA NATIONAL WILDLIFE REFUGE

Public Listening Session. March 27, 2008. 5:00-9:00 p.m., Maguayo Community Center.
Lajas, Puerto Rico

Components of the Plan

These are the public comments on the proposed comprehensive conservation planning process for the Laguna Cartagena NWR based on the recording at the public listening session. These comments were obtained in Spanish and translated in English. The comments are organized based on the number of people that addressed the same issue within the topic selected, arranged from the item most commented on to topics which received the fewest comments. The number of times a topic was mentioned is indicated in parentheses.

TOPICS:

Wildlife and Habitat

- Restoration of the habitat and open water of the Laguna Cartagena NWR through a water management plan. (4 comments)
- Establish a plan for exotic species removal and conservation of plant species important to migratory birds. (2 comments)

Public Recreation and Outreach

- Maintain the trails and roads access in good condition for public use. (4 comments)
- Provide education to the community on how to protect the watershed of the lagoon and minimize surface water contamination. (4 comments)
- Improve signs and public information of the refuge regarding: rules and regulations, laws and penalties, entrances, attractions, compatible uses of the refuge and recommendations on how to use the facilities. (4 comments)
- Establish various entrances to the refuge. (3 comments)
- Establish recreation activities in the lagoon that could be managed by volunteers or friends group of the community to promote tourism and sources of income for the residents. (2 comments)
- Establish more recreation facilities that include: fishing boardwalk, fishing dock, and boat access. (2 comments)
- Improve or create facilities that are handicapped accessible. (2 comments)

Partnerships and Friends group

- Establish a cooperative agreement between the municipality of Lajas and the Laguna Cartagena NWR to: (1) Develop a maintenance plan for the drainage canal that flows though the Maguayo community, and its part of the lagoon drainage basin; (2) provide transportation services of local students to the refuge to promote environmental education and conservation; (3) provide maintenance of the municipal roads around the refuge and the Maguayo community; and (4) improve security of the refuge and surrounding areas. (4 comments)
- Improve coordination and communication between the Maguayo community and the Laguna Cartagena NWR regarding project development that could impact the adjacent community and the refuge. (2 comments)

Law Enforcement

- Improve security of the refuge and surrounding areas. (3 comments)

Volunteers

- Use better promotion methods of information for volunteer recruitment. (3 comments)

Fire Management

- Present the fire management plan of the Laguna Cartagena NWR to the communities adjacent to the refuge. (1 comment)

Others

- Recompile and document the historical uses of the lagoon and the adjacent community. Record oral history of citizens of the Maguayo community, as an important part of the history of the refuge. (2 comments)

Appendix E. Appropriate Use Determinations

Laguna Cartagena National Wildlife Refuge Appropriate Use Determinations

An appropriate use determination is the initial decision process a refuge manager follows when first considering whether or not to allow a proposed use on a refuge. The refuge manager must find that a use is appropriate before undertaking a compatibility review of the use. This process clarifies and expands on the compatibility determination process by describing when refuge managers should deny a proposed use without determining compatibility. If a proposed use is not appropriate, it will not be allowed and a compatibility determination will not be undertaken.

Except for the uses noted below, the refuge manager must decide if a new or existing use is an appropriate refuge use. If an existing use is not appropriate, the refuge manager will eliminate or modify the use as expeditiously as practicable. If a new use is not appropriate, the refuge manager will deny the use without determining compatibility. Uses that have been administratively determined to be appropriate are:

- Six wildlife-dependent recreational uses - As defined by the National Wildlife Refuge System Improvement Act of 1997, the six wildlife-dependent recreational uses (hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation) are determined to be appropriate. However, the refuge manager must still determine if these uses are compatible.

- Take of fish and wildlife under state regulations - States have regulations concerning take of wildlife that includes hunting, fishing, and trapping. The Service considers take of wildlife under such regulations appropriate. However, the refuge manager must determine if the activity is compatible before allowing it on a refuge.

Statutory Authorities for this policy:

National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, 16 U.S.C. 668dd-668ee. This law provides the authority for establishing policies and regulations governing refuge uses, including the authority to prohibit certain harmful activities. The Act does not authorize any particular use, but rather authorizes the Secretary of the Interior to allow uses only when they are compatible and “under such regulations as he may prescribe.” This law specifically identifies certain public uses that, when compatible, are legitimate and appropriate uses within the Refuge System. The law states “. . . it is the policy of the United States that . . .compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System . . .compatible wildlife-dependent recreational uses are the priority general public uses of the System and shall receive priority consideration in refuge planning and management; and . . . when the Secretary determines that a proposed wildlife-dependent recreational use is a compatible use within a refuge, that activity should be facilitated . . . the Secretary shall . . . ensure that priority general public uses of the System receive enhanced consideration over other general public uses in planning and management within the System . . . .” The law also states “in administering the System, the Secretary is authorized to take the following actions: . . . issue regulations to carry out this Act.” This policy implements the standards set in the Act by providing enhanced consideration of priority general public uses and ensuring other public uses do not interfere with our ability to provide quality, wildlife-dependent recreational uses.

Refuge Recreation Act of 1962, 16 U.S.C. 460k. The Act authorizes the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use, when such uses do not interfere with the area's primary purposes. It authorizes construction and maintenance of recreational facilities and the acquisition of land for incidental fish and wildlife oriented recreational development or protection of natural resources. It also authorizes the charging of fees for public uses.

Other Statutes that Establish Refuges, including the Alaska National Interest Lands Conservation Act of 1980 (ANILCA) (16 U.S.C. 410hh - 410hh-5, 460 mm - 460mm-4, 539-539e, and 3101 - 3233; 43 U.S.C. 1631 et seq.).

Executive Orders. The Service must comply with Executive Order 11644 when allowing use of off-highway vehicles on refuges. This order requires the Service to designate areas as open or closed to off-highway vehicles in order to protect refuge resources, promote safety, and minimize conflict among the various refuge users; monitor the effects of these uses once they are allowed; and amend or rescind any area designation as necessary based on the information gathered. Furthermore, Executive Order 11989 requires the Service to close areas to off-highway vehicles when it is determined that the use causes or will cause considerable adverse effects on the soil, vegetation, wildlife, habitat, or cultural or historic resources. Statutes, such as ANILCA, take precedence over executive orders.

Definitions:

Appropriate Use
A proposed or existing use on a refuge that meets at least one of the following four conditions:

1) The use is a wildlife-dependent recreational use as identified in the Improvement Act.
2) The use contributes to fulfilling the refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the Improvement Act was signed into law.
3) The use involves the take of fish and wildlife under state regulations.
4) The use has been found to be appropriate as specified in section 1.11.

*Native American***.** American Indians in the conterminous United States and Alaska Natives (including Aleuts, Eskimos, and Indians) who are members of federally recognized tribes.

Priority General Public Use. A compatible wildlife-dependent recreational use of a refuge involving hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation.

Quality. The criteria used to determine a quality recreational experience include:

- Promotes safety of participants, other visitors, and facilities.
- Promotes compliance with applicable laws and regulations and responsible behavior.
- Minimizes or eliminates conflicts with fish and wildlife population or habitat goals or objectives in a plan approved after 1997.
- Minimizes or eliminates conflicts with other compatible wildlife-dependent recreation.
- Minimizes conflicts with neighboring landowners.
- Promotes accessibility and availability to a broad spectrum of the American people.
- Promotes resource stewardship and conservation.

- Promotes public understanding and increases public appreciation of America's natural resources and the Service's role in managing and protecting these resources.
- Provides reliable/reasonable opportunities to experience wildlife.
- Uses facilities that are accessible and blend into the natural setting.
- Uses visitor satisfaction to help define and evaluate programs.

Wildlife-Dependent Recreational Use. As defined by the Improvement Act, a use of a refuge involving hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Laguna Cartagena National Wildlife Refuge_ _____

Use: _All-terrain Vehicles

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	X	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?		X
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		X
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?		X
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		X
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		X

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with Territorial fish and wildlife agency. **Yes _X_ No ___**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate_X_ **Appropriate ____**

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.
If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.
If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor:_____ Date:_____

A compatibility determination is required before the use may be allowed.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Laguna Cartagena National Wildlife Refuge

Use: Camping (associated with Environmental Education and Interpretation and Conservation Projects)

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	X	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. **Yes _X_ No __**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate_____ **Appropriate __X__**

Refuge Manager:_____ Date:_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.
If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.
If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor:_____ Date:_____

A compatibility determination is required before the use may be allowed.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Laguna Cartagena National Wildlife Refuge_ _____

Use: _Geocaching

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	X	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		X
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?		X
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		X
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		X

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with Territorial fish and wildlife agency. **Yes _X_ No ___**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate_X_ **Appropriate ____**

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.
If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.
If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor:_____ Date:_____

A compatibility determination is required before the use may be allowed.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Laguna Cartagena National Wildlife Refuge_ _____

Use: Research Studies, Wildlife Surveys and Monitoring, and Scientific Collections

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	x	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	x	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	x	
(d) Is the use consistent with public safety?	x	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	x	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	x	
(g) Is the use manageable within available budget and staff?	x	
(h) Will this be manageable in the future within existing resources?	x	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	x	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	x	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with Territorial fish and wildlife agency. **Yes X No ___**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate_____ **Appropriate __X__**

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.
If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.
If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor:_____ Date:_____

A compatibility determination is required before the use may be allowed.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Laguna Cartagena National Wildlife Refuge

Use: Horseback Riding

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	X	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be use be manageable in the future within existing resources?		X
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		X
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		X

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with Territorial fish and wildlife agency. **Yes X No ___**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate X **Appropriate ____**

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.
If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.
If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor:_____ Date:_____

A compatibility determination is required before the use may be allowed.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Laguna Cartagena National Wildlife Refuge_ _____

Use: Non Commercial Plants and Fruits Collection

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	X	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be use be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with Territorial fish and wildlife agency. **Yes _X_ No ___**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate **Appropriate_X_**

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.
If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.
If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor:_____ Date:_____

A compatibility determination is required before the use may be allowed.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Laguna Cartagena National Wildlife Refuge

Use: Haying

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	X	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be use be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with Territorial fish and wildlife agency. **Yes** X **No** ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate **Appropriate** X

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.
If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.
If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor:_____ Date:_____

A compatibility determination is required before the use may be allowed.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Laguna Cartagena National Wildlife Refuge_ _____

Use: Canoeing and Kayaking

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	X	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?		X
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?		X
(h) Will this be use be manageable in the future within existing resources?		X
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with Territorial fish and wildlife agency. **Yes _X_ No ___**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate_X_ **Appropriate ____**

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.
If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.
If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor:_____ Date:_____

A compatibility determination is required before the use may be allowed.

Appendix F. Compatibility Determinations

Laguna Cartagena National Wildlife Refuge Compatibility Determination

Uses: The following uses were found to be appropriate and evaluated to determine their compatibility with the mission of the Refuge System and the purposes of the refuge.

1. Wildlife Observation, Wildlife Photography, Environmental Education, and Interpretation
2. Fishing
3. Non-commercial Harvesting of Wild Tropical Fruits and Plants
4. Haying
5. Research Studies, Wildlife Surveys and Monitoring, and Scientific Collections
6. Camping (associated with Environmental Education and Interpretation and Conservation Projects)

Refuge Name: Laguna Cartagena National Wildlife Refuge

Date Established: August 8, 1989.

Establishing and Acquisition Authority(ies): Establishing and Acquisition Authorities: The refuge was established when approximately 773 acres were acquired by the Puerto Rico Land Administration and the Service signed a 50-year lease agreement, renewable for another 50 years. In 1996, an additional 270 acres were acquired in fee title from the USDA Farm Service Agency.

Refuge Purpose: "…for the development, advancement, management, conservation, and protection of fish and wildlife resources…" 16 USC 742f(a)(4) AND "…for the benefit of the USFWS, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant or condition of servitude…" 16 USC 742f(b)(1) (Fish and Wildlife Act of 1956).

National Wildlife Refuge System Mission:

The mission of the Refuge System, as defined by the National Wildlife Refuge System Improvement Act of 1997, is:

> *... to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.*

Other Applicable Laws, Regulations, and Policies:

Antiquities Act of 1906 (34 Stat. 225)
Migratory Bird Treaty Act of 1918 (15 U.S.C. 703-711; 40 Stat. 755)
Migratory Bird Conservation Act of 1929 (16 U.S.C. 715r; 45 Stat. 1222)
Migratory Bird Hunting Stamp Act of 1934 (16 U.S.C. 718-178h; 48 Stat. 451)
Criminal Code Provisions of 1940 (18 U.S.C. 41)
Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d; 54 Stat. 250)
Refuge Trespass Act of June 25, 1948 (18 U.S.C. 41; 62 Stat. 686)
Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j; 70 Stat.1119)

Refuge Recreation Act of 1962 (16 U.S.C. 460k-460k-4; 76 Stat. 653)
Wilderness Act (16 U.S.C. 1131; 78 Stat. 890)
Land and Water Conservation Fund Act of 1965
National Historic Preservation Act of 1966, as amended (16 U.S.C. 470, et seq.; 80 Stat. 915)
National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd, 668ee; 80 Stat. 927)
National Environmental Policy Act of 1969, NEPA (42 U.S.C. 4321, et seq; 83 Stat. 852)
Use of Off-Road Vehicles on Public Lands (Executive Order 11644, as amended by Executive Order 10989)
Endangered Species Act of 1973 (16 U.S.C. 1531 et seq; 87 Stat. 884)
Refuge Revenue Sharing Act of 1935, as amended in 1978 (16 U.S.C. 715s; 92 Stat. 1319)
National Wildlife Refuge Regulations for the Most Recent Fiscal Year (50 CFR Subchapter C; 43 CFR 3101.3-3)
Emergency Wetlands Resources Act of 1986 (S.B. 740)
North American Wetlands Conservation Act of 1990
Food Security Act (Farm Bill) of 1990 as amended (HR 2100)
The Property Clause of the U.S. Constitution Article IV 3, Clause 2
The Commerce Clause of the U.S. Constitution Article 1, Section 8
The National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57, USC668dd)
Executive Order 12996, Management and General Public Use of the National Wildlife Refuge System. March 25, 1996
Title 50, Code of Federal Regulations, Parts 25-33
Archaeological Resources Protection Act of 1979
Native American Graves Protection and Repatriation Act of 1990

Compatibility determinations for each description listed were considered separately. Although for brevity, the preceding sections from “Uses” through “Other Applicable Laws, Regulations and Policies” and the succeeding section, “Approval of Compatibility Determinations” are only written once within the plan, they are part of each descriptive use and become part of that compatibility determination if considered outside of the comprehensive conservation plan.

Description of Use: Wildlife Observation, Wildlife Photography, and Environmental Education and Interpretation

The National Wildlife Refuge System Improvement Act of 1997 and Executive Order 12996 emphasize the importance of providing compatible wildlife-dependent educational and recreational opportunities on national wildlife refuges. A variety of public use opportunities are available at Laguna Cartagena NWR.

Environmental education activities seek to increase public knowledge and understanding of wildlife and contribute to the conservation of such wildlife. Activities include traditional environmental education activities (teacher-led or staff-led on-site field trips, teacher and student workshops), off-site programs in classrooms, nature study, and interpretation of the wildlife resources and support facilities such as interpretive trails, interpretive kiosks, and contact stations. Environmental education activities on the refuge also include the use of the refuge as an outdoor classroom for nearby schools, teachers, and students.

Wildlife observation, wildlife photography, and interpretation seek to increase awareness, enjoyment, and understanding of the refuge’s wildlife and plant resources. Interpretive signing is located at several locations on refuge trails and public use facilities such as observation tower, boardwalk, blind, and interpretive kiosks. Visitors view displays and observe and photograph wildlife at their own pace.

Access to both the Lagoon and La Tinaja land tracks of the refuge is allowed throughout the year during daylight hours when the refuge is open to the public, or after dark on a case-by-case basis, as authorized by the refuge manager. All refuge lands have been opened to the public since they were acquired.

Fishing is a priority public use on national wildlife refuges as identified in the Improvement Act. It has been a traditional activity on Laguna Cartagena NWR long before it was established as a refuge. Refuge lands have been opened year-round to the public since they were acquired. Members of the public access the lagoon through public dirt roads maintained by the municipality of Lajas. Once on the refuge, the public uses trails, dikes, and dirt roads to access fishing sites. Anglers have been observed fishing right in front of the water control structure and along the western and eastern canals. Fishing from boats or any other type of floating platform is not used and it's not permitted at the present time.

Availability of Resources: The existing staff and budget have provided marginal resources to manage current uses. We anticipate that the public use program will increase as additional trails are opened, the types of recreational use increase, community and school outreach programs increase, and media attention and web-site information about the refuge expand.

Anticipated Impacts of the Use: These priority uses may impose minor negative impacts on specific physical resources such as trails, roads, and designated parking areas, and on natural resources such as vegetation and wildlife. Access for these types of activities is typically by individuals or small groups. Almost all public uses described herein occur in specific footprints on the refuge, and the fact that the uses are generally confined to such areas, overall impacts are not broad nor do they impact the greater refuge. Within the designated routes of travel and in established parking lots, there are barriers to prevent vehicles from driving onto the foot trails, wetlands, lagoon, or environmentally sensitive areas. To avoid harassment of wildlife or destruction of habitat, and based on biological data and conservation management plans, the refuge manager may restrict the use or close some areas to public use. The staff will monitor the foot trails and wildlife observation areas opened to pedestrian use to minimize disturbance that could occur in these sensitive areas. If the staff identifies unacceptable levels of disturbance at any time, the sites will be closed to public entry. Some minimal trampling of vegetation also may occur as well as erosion, especially during excessive rainfall events. Waters structures and dikes have been constructed in erosion prone areas to lessen these impacts and additional areas are being identified for future treatment.

Public Review and Comment: This draft compatibility determination is available for review and comment during the 30-day public review and comment period established for the Laguna Cartagena NWR Draft Comprehensive Conservation Plan and Environmental Assessment. All comments will be addressed in the final CCP.

Determination (check one below):

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: These priority public uses are encouraged on Laguna Cartagena NWR and have been incorporated into the refuge's management program. These uses are allowed to continue and expand based on the following stipulations, mechanisms, and regulations that will help to ensure compatibility with the refuge purposes.

- Day use only to decrease the disturbance to wildlife;
- Limiting use to specific areas of refuge, such as trails, to limit overall disturbance to refuge habitats and wildlife;
- Special use permits with appropriate conditions;
- Refuge signing and information brochures;
- Posting of refuge rules and regulations;
- Monitoring by refuge staff, volunteers, and partners;
- Promoting the "Leave No Trace" philosophy;

Justification: The Improvement Act identified wildlife observation, wildlife photography, and environmental education and interpretation as activities that the Service should provide and expand upon on national wildlife refuges. Clearly, wildlife-dependent uses on refuges contribute significantly to public education and support of national wildlife refuges. The refuge uses partnerships and environmental education to motivate citizens of all ages to action and understanding in protecting a healthy ecosystem. Partnerships and environmental education are tools used to build a land ethic, develop political support, and lessen vandalism, littering, and poaching. Visitors come to the refuge to see, enjoy, and learn about wildlife and their habitats. Wildlife observation, photography, and education opportunities along refuge boundaries are wildlife-dependent activities which are compatible with refuge purposes. The minor impacts to vegetation and wildlife which may occur are worthwhile trade-offs for informing visitors about the refuge wildlife and providing an opportunity for active land stewardship.

With the stipulations noted in special use permit conditions, access trails, and posted regulations, activities will be compatible with the refuge purposes, while providing opportunities for visitors to use and learn about refuge resources. The priority public uses in this determination will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purpose of this refuge.

NEPA Compliance for Refuge Use Description: *Place an X in appropriate space.*

_____ Categorical Exclusion without Environmental Action Statement
_____ Categorical Exclusion and Environmental Action Statement
__X__ Environmental Assessment and Finding of No Significant Impact
_____ Environmental Impact Statement and Record of Decision

Mandatory 15-year Re-evaluation Date:

Description of Use: Fishing

Fishing has been a traditional activity conducted by the local residents living nearby the refuge for centuries. In the past, where wildlife was more abundant and diverse, and the water quality of the lagoon was significantly better, it is very likely that fishing was a common activity and provided an excellent source of protein for the local people.

The present condition of fish resources in the lagoon is not known. Few inventories have reported fishes. Danforth (1926) reported five species of fish. Eleven species were reported in 1980 (Colón 1980) and 9 species were reported in 1985 (Del Castillo et. al 1985). No recent fish inventories have been conducted on the refuge. Only three species (two *Tilapia spp*. and the introduced armored sailfin catfish, *Liposarcus multiradiatus*) have been commonly observed from the western dike during the last two years (Oscar Diaz, Refuge Manager; pers. comm.). People fish and eat the two species of *Tilapia,* but the catfish is considered a pest.

Availability of Resources: Refuge lands have been opened to the public since they were acquired. The public roads providing access to the refuge are maintained by the municipality of Lajas. Trails, dikes, parking lots, signs, information kiosks, and other infrastructure on the refuge, as well as staff to enforce regulations and maintain these facilities, have been provided by the Service.

Anticipated Impacts of the Use: Fishing will not cause negative impacts on this resource or other wildlife and plant species. Fishing is typically an individual or small group activity. No adverse effect by this use is anticipated on the access roads, trails, and dikes that visitors use to access their fishing sites. Better fishing opportunities are likely to increase with the ongoing efforts to restore the lagoon.

Public Review and Comment: This draft compatibility determination is available for review and comment during the 30-day public review and comment period established for the Laguna Cartagena NWR Draft Comprehensive Conservation Plan and Environmental Assessment. All comments will be addressed in the final CCP.

Determination (check one below):

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

- No boats are permitted
- Persons engaging in this use must comply with all state and refuge fishig regulations.

Justification: The Improvement Act identified fishing, among other wildlife-dependent uses, as a use that the Service should provide and expand on refuges. Clearly, wildlife-dependent uses on refuges contribute significantly to public education and support of national wildlife refuges. It is expected that fishing will again become a great recreational use as restoration efforts conducted by the Service improve the overall health of the lagoon.

NEPA Compliance for Refuge Use Description: *Place an X in appropriate space.*

_____ Categorical Exclusion without Environmental Action Statement
_____ Categorical Exclusion and Environmental Action Statement
__X__ Environmental Assessment and Finding of No Significant Impact
_____ Environmental Impact Statement and Record of Decision

Mandatory 15-year Re-evaluation Date:

Description of Use: Non-commercial Harvest of Wild Tropical Fruits and Plants

Laguna Cartagena NWR is surrounded by economically depressed communities dating back to the 18th Century. Picking of wild fruits and edible plants has been a traditional subsistence activity of many generations of local residents. Some of the edible tropical fruits present are oranges, lemons, papayas, quenepas, parchas (passion fruit), and others. Included among edible plants are wild oregano, pumpkins, arrowroot, and yams.

Before the refuge was established in 1989, hunting was common and many locals used to harvest the eggs of many species of waterfowl, mostly from species like the common gallinule and Caribbean coot, whose numbers were in the thousands. This practice is totally prohibited and today wildlife violations are extremely rare. However, some locals still visit the refuge to pick up edible fruits and plants in season.

Availability of Resources: The refuge boundaries are fenced and posted but access has been allowed to the public since these lands were acquired. Roads that provide access to the refuge are owned and maintained by the municipality of Lajas. Once on the refuge, roads, trails, parking lots, signs, and other infrastructure, as well as staff to enforce regulations and maintain these facilities, are provided by the Service. A contract to replace all boundary fence and installation of new gates on Service roads has been awarded and the project is expected to be completed by 2011.

The restoration of the lagoon is an ongoing project which includes improving parking areas, dikes, and roads. The continuation of this use will not require a significant increase in additional maintenance or enforcement staff expenditures.

Anticipated Impacts of the Use: Littering along trails and roads is an expected negative impact, but is unlikely it will increase in the future. Maintenance of these accesses is a common activity by refuge staff. This use is becoming less common over time. There are still a few local residents who use the lagoon as their backyard, to provide an additional staple food they can eat.

Short-term negative impacts are insignificant and no future increase of this use is expected.

Public Review and Comment: This draft compatibility determination is available for review and comment during the 30-day public review and comment period established for the Laguna Cartagena NWR Draft Comprehensive Conservation Plan and Environmental Assessment. All comments will be addressed in the final CCP.

Determination (check one below):

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: The Service will continue to monitor this use, and law enforcement patrol will continue to provide for public safety and resources conservation.

Justification: This traditional subsistence use has been occurring for many generations by people residing in the communities around the refuge. For most of these people, getting into the refuge to pick fruits and edible plants is part of their way of life and perhaps their only type of outdoor recreation. Conducting this incursion into the refuge provides them with a great sense of solitude and the opportunity to observe wildlife. They are and can become the most important part of weaving strong and necessary connections with the nearby communities to support refuge conservation efforts.

NEPA Compliance for Refuge Use Description: *Place an X in appropriate space.*

_____ Categorical Exclusion without Environmental Action Statement
_____ Categorical Exclusion and Environmental Action Statement
__X__ Environmental Assessment and Finding of No Significant Impact
_____ Environmental Impact Statement and Record of Decision

Mandatory 10-year Re-evaluation Date:

Description of Use: Haying

Haying, as a method of cutting and removing grasses, is an effective habitat management tool at Laguna Cartagena NWR. It serves to reduce the excessive amount of the non-native and invasive grasses, mostly Guinea grass (*Urochloa maxima*). Haying also serves as an effective method of preparing the site for reforestation with native trees. Haying is also used effectively to reduce the fuel loads, avoiding mayor damages to reforested areas in case of accidental fires.

Haying can also be practiced along trails, roads, and boundary lines to reduce vegetation loads and keep these routes open. Under special use permits, local farmers can benefit from this use and reduce the significant amount of time and work the refuge staff dedicates to the maintenance of these areas.

Availability of Resources: Roads that provide access to the refuge are owned and maintained by the municipality of Lajas. Once on the refuge, roads, trails, parking lots, signs, and other infrastructure, as well as staff to enforce regulations and maintain these facilities, are provided by the Service. No additional fiscal resources are needed to conduct this use. The additional time needed to coordinate this use with interested persons is relatively minor and can be done within the existing resources.

Anticipated Impacts of the Use: Mechanical cutting of grasses can result in short-term disturbance to people observing and photographing birds. It can also cause minor disturbance to wildlife, but most birds easily become accustomed to the noise of tractors. No significant negative impacts are expected if this use is permitted under a well-planned program and coordinated with maintenance and fire staff.

Public Review and Comment: This draft compatibility determination is available for review and comment during the 30-day public review and comment period established for the Laguna Cartagena NWR Draft Comprehensive Conservation Plan and Environmental Assessment. All comments will be addressed in the final CCP.

Determination (check one below):

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

- The Service will conduct this use under a special use permit.
- Haying will be done only on designated and well-marked areas.
- All trees and facilities will be protected
- Law enforcement patrol will continue to provide for public safety and resource conservation.

Justification: This use can be easily managed by refuge staff and is determined to be beneficial for the wildlife and refuge operation needs.

NEPA Compliance for Refuge Use Description: *Place an X in appropriate space.*

_____ Categorical Exclusion without Environmental Action Statement
_____ Categorical Exclusion and Environmental Action Statement
__X__ Environmental Assessment and Finding of No Significant Impact
_____ Environmental Impact Statement and Record of Decision

Mandatory 10-year Re-evaluation Date:

Description of Use: Research Studies, Wildlife Surveys, and Monitoring and Scientific Collections

Research studies, wildlife surveys, and monitoring and scientific collections are conducted by local, state, or federal agencies; local schools, technical colleges, and universities; nonprofit organizations; and private, for profit research companies on the refuge when the refuge acts solely in an administrative role. The access and assistance provided by the refuge may range from minimal to substantial, depending on the benefits to the Service. This includes data gathering for hypothesis testing, modeling, monitoring, and surveying. This use also includes permitting the collection of animals, fish, plants, soils, and water for monitoring and research purposes. The research and collection activities will vary in scope and duration to satisfy the requirements of the research project or survey. Projects may involve everything from a limited one-time sampling or survey to long-term study projects.

The refuge receives annually several requests from local and foreign graduate students and scientists to do work on the refuge. At the present time, six research studies are running at different stages of progress. Due to the refuge's location (less than a half-hour drive from three main universities on the island), it has become an excellent laboratory for field work and for short- and

long-term scientific research projects. Monthly bird surveys have been conducted continuously for the last 7 years. Two new bird records for Puerto Rico have been reported recently; the Eurasian Harrier and the Aplomado Falcon (*Falco ferrugineous*)

Scientific research studies will be accommodated for the purpose of properly administering the refuge, supporting the refuge's establishing purpose, advancing the mission of the National Wildlife Refuge System, and protecting the health, biological integrity, diversity of ecosystems, and the health and safety of the public. The objective of authorizing this use is to gain better knowledge of our natural resources and improve methods to manage, monitor, and protect refuge resources and the public.

All animal research will follow the best scientific practices and standards established by respected scientific societies, as well as the Service's policies and guidelines for scientific collecting and research.

All research studies will be evaluated and if deemed beneficial, a special use permit will be issued as an agreement between the researcher and the refuge. The permit will outline the guidelines that the researcher must follow while conducting research on the refuge. In addition to the general conditions and requirements of the special use permits, specific conditions may be added as appropriate.

Availability of Resources: The refuge boundaries are fenced and posted but access has been allowed to the public since these lands were acquired. Roads that provide access to the refuge are owned and maintained by the municipality of Lajas. Once on the refuge, roads, trails, parking lots, signs, and other infrastructure, as well as staff to enforce regulations and maintain these facilities, are provided by the Service. A contract to replace all boundary fence and installation of new gates on Service roads has been awarded, and the project is expected to be completed by 2011.

The restoration of the lagoon is an ongoing project which includes improving of parking areas, dikes, and roads.

The refuge is administered from the Service headquarters located on the Cabo Rojo NWR. Since the Service's Ecological Services Field office and NOAA's National Marine Fisheries are co-located with the Service headquarters, scientists and investigators can benefit from the scientific staff located on Cabo Rojo NWR, just 3 miles away. A new building for the Service headquarters in Puerto Rico and the Caribbean will be inaugurated during Fiscal Year 2010. These uses do not require a significant increase in additional maintenance and law enforcement staff expenditures.

Anticipated Impacts of the Use:

Short-term impacts:
There should be no significant adverse impacts from scientific research because each proposal will be reviewed when received, before the researcher is issued a special use permit. Factors such as project purpose, data collection methods, number of researchers, transportation, project duration, and location of access points will determine the extent of effects on the refuge. For long-term research projects, appropriateness and consistency with the Service's policies and regulations will be conducted annually. The knowledge gained from the research activities will provide information towards improving management techniques for trust resource species. Impacts such as trampling vegetation, removal of small numbers of plants and/or animals, and temporary disturbance to wildlife could occur, but should not be significant.

Long-term impacts:
Long-term benefits associated with species' population trends and improved management techniques would outweigh any negative impacts which may occur.

Public Review and Comment: This draft compatibility determination is available for review and comment during the 30-day public review and comment period established for the Laguna Cartagena NWR Draft Comprehensive Conservation Plan and Environmental Assessment. All comments will be addressed in the final CCP.

Determination (check one below):

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

Each request for any of these uses on the refuge would be examined on its individual merits. A Service official will determine if the requested proposal contributes to the refuge purposes and could be best conducted on the refuge without significantly affecting the resources. If so, the researcher would be issued a special use permit that would clearly define allowable activities under general and/or special conditions. Progress would be monitored through annual reports. The success and usefulness of the data would be evaluated through final reports, and chronicles in publications derived from the research.

The following stipulations apply to special use permits issued for scientific research. Monitoring authorized research activities would ensure compliance with the permit's general and special conditions.

The permittee is responsible for ensuring that all employees, party members, and any other persons working for the permittee and conducting activities allowed by the permit are familiar with and adhere to the conditions of the permit.

The permit may be cancelled or revised at any time by the refuge manager in case of emergency, unsatisfactory compliance, or determination of incompatibility with the purpose of the refuge.
In accordance with the Archaeological Resources Protection Act (16 U.S.C. 470aa), the removal or disturbance of archaeological or historic artifacts is prohibited. The excavation, disturbance, collection, or purchase of historical, ethnological, or archaeological specimens or artifacts are prohibited.

All waste materials and markers must be removed from the refuge upon the permittee's departure. Construction of temporary structures is prohibited unless prior approval is obtained.

All animals and fish shall be captured, handled, released, and collected following the best scientific practices and standards established by respected scientific societies, as well as the Service's policies and guidelines for scientific collecting and research.

Justification:

The benefits derived from scientific research provide a better understanding of resources on the refuge and surrounding area. This knowledge becomes valuable in managing natural systems, establishing thresholds, identifying threats, and better understanding the species and the environmental communities present on the refuge. Research projects would be designed to minimize impacts and disturbance.

NEPA Compliance for Refuge Use Description: *Place an X in appropriate space.*

_____ Categorical Exclusion without Environmental Action Statement
_____ Categorical Exclusion and Environmental Action Statement
__X__ Environmental Assessment and Finding of No Significant Impact
_____ Environmental Impact Statement and Record of Decision

Mandatory 10- year Re-evaluation Date:

Description of Use: Camping (associated with Environmental Education and Interpretation and Conservation Projects)

Camping has been allowed historically on the refuge when it is associated with conservation projects or environmental education and interpretation activities. These can be Boy or Girl Scouts small groups (15-25 participants) traveling from far away that are working toward the fulfillment of advance ranks (Eagle Scouts projects and merit badges) or are doing volunteer work to help on conservation projects (e.g., planting trees, trails maintenance, painting and reconditioning structures) on the refuge. Most of this use occurs during long weekends or during off school seasons (December; mid-May to mid-August). Requests for this use are evaluated and conducted when the Service determines the beneficial result of the proposed activity through a special use permit.

Availability of Resources: Refuge lands have been opened to the public since they were acquired. Thus, roads, access trails, parking lots, signs, and other infrastructure, as well as staff to enforce regulations and maintain these facilities, have been provided by the Service.

Camping is only allowed on a small area distant from the general visiting public. This use does not require a significant increase in additional maintenance and law enforcement staff expenditures. Existing staff can administer permits and monitor use as part of routine refuge management duties.

Anticipated Impacts of the Use: Impacts that could occur may involve some violation of refuge regulations such as deliberate disturbance of wildlife or plants, littering, or vandalism, but they are very unlikely to occur since these groups are environmentally aware of the importance and value of the resources on the refuge. Short-term impacts to facilities such as roads and structures should be minimal.

No long-term or cumulative negative impacts are anticipated, however, programs may be modified in the future to mitigate unforeseen negative impacts.

Public Review and Comment: This draft compatibility determination is available for review and comment during the 30-day public review and comment period established for the Laguna Cartagena NWR Draft Comprehensive Conservation Plan and Environmental Assessment. All comments will be addressed in the final CCP.

Determination (check one below):

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: Camping will be allowed only with a special use permit and will be restricted to a specific and clearly delineated small area behind the cactus garden. Visitors will be greeted by a service official who will discuss with them the general and specific conditions of the special use permit In order to be issued a special use permit, these groups will have to perform a designated service project, such as planting trees, cleaning/clearing hiking trails, posting boundaries, fence repairs, and any other conservation project on the refuge. The project will be determined by the refuge staff in conjunction with group leader.

Justification: Camping has been determined to be an appropriate use on the refuge when it is associated with a conservation project that requires an extended period of time on the refuge. Volunteers, boy scouts, and other conservation groups assist refuge staff on facilities maintenance, habitat management, and species monitoring and inventorying projects. Some of these projects are conducted during weekends (when people can volunteer) and most of the work is done in early morning or late afternoon when the heat is not so extreme. It's often more efficient and convenient that people stay overnight on the refuge to finish a project, instead of coordinating with staff and volunteers for another visit, especially when the group is coming from far away. People coming from the metropolitan area of San Juan (where half of the population on the island lives) are about two and a half hours drive from the refuge. Camping will only be permitted when this use is associated with a particular conservation project and will be approved on a case-by-case by the refuge manager.

NEPA Compliance for Refuge Use Description: *Place an X in appropriate space.*

_____ Categorical Exclusion without Environmental Action Statement
_____ Categorical Exclusion and Environmental Action Statement
__X__ Environmental Assessment and Finding of No Significant Impact
_____ Environmental Impact Statement and Record of Decision

Mandatory 10- year Re-evaluation Date:

Approval of Compatibility Determinations

The signature of approval is for all compatibility determinations considered within the Comprehensive Conservation Plan for Laguna Cartagena National Wildlife Refuge. If one of the descriptive uses is considered for compatibility outside of the comprehensive conservation plan, the approval signature becomes part of that determination.

Refuge Manager: _____
(Signature/Date)

Regional Compatibility Coordinator: _____
(Signature/Date)

Refuge Supervisor: _____
(Signature/Date)

Regional Chief, National Wildlife Refuge System, Southeast Region: _____
(Signature/Date)

Appendix G. Intra-Service Section 7 Biological Evaluation

Originating Person: Oscar Diaz
Telephone Number: 787/851-7258, ext. 250
E-Mail: oscar-diazr@fws.gov
Date: August 24, 2009

Project Name: Laguna Cartagena National Wildlife Refuge Comprehensive Conservation Plan

I. Service Program:
___ Ecological Services
___ Federal Aid
___ Clean Vessel Act
___ Coastal Wetlands
___ Endangered Species Section 6
___ Partners for Fish and Wildlife
___ Sport Fish Restoration
___ Wildlife Restoration
___ Fisheries
_X_ Refuges/Wildlife

II. State/Agency: Puerto Rico/Fish and Wildlife Service

III. Station Name: Laguna Cartagena National Wildlife Refuge

IV. Description of Proposed Action (attach additional pages as needed): Implementation of the Comprehensive Conservation Plan for the Laguna Cartagena National Wildlife Refuge by adopting the proposed alternative that will provide guidance, management direction, and operation plans for the next 15 years.

V. Pertinent Species and Habitat:

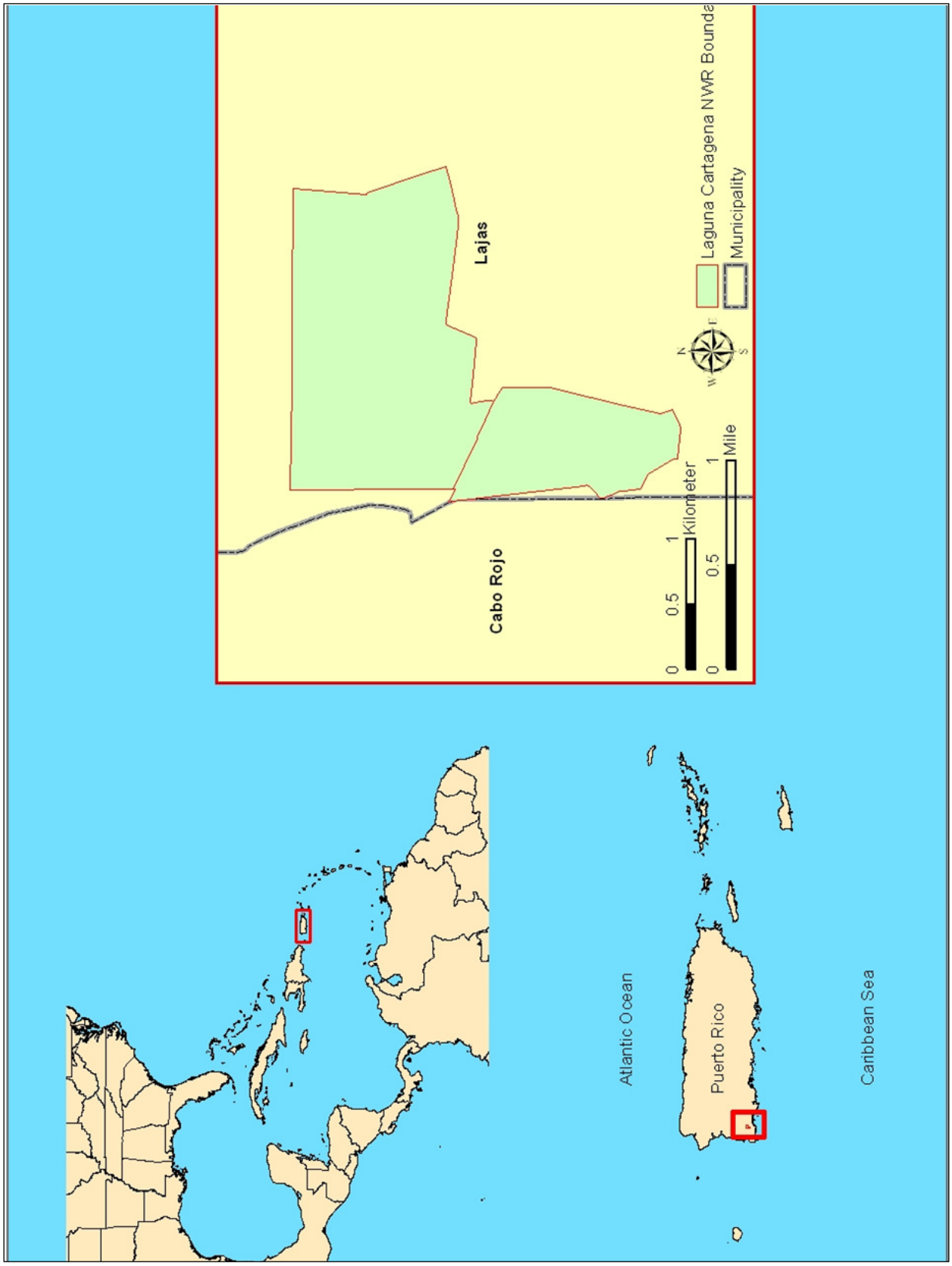
A. Include species/habitat occurrence map:

SPECIES/CRITICAL HABITAT	STATUS[1]
Yellow-Shouldered Blackbird	Endangered
Puerto Rican Nightjar	Endangered
Brown Pelican	Endangered

SPECIES/CRITICAL HABITAT	STATUS[1]
Aristida portoricensis	Endangered
Aristida chaseae	Endangered
Lyonia truncata var. proctorii	Endangered
Vernonia proctorii	Endangered
Eugenia woodburyana	Endangered
Goetzea elegans	Endangered
Stahlia monosperma	Threatened

[1]STATUS: E=endangered, T=threatened, PE=proposed endangered, PT=proposed threatened, CH=critical habitat, PCH=proposed critical habitat, C=candidate species

VI. Location (attach map):



A. Ecoregion Number and Name: Caribbean

B. County and State: Lajas, Puerto Rico

C. Section, township, and range (or latitude and longitude): LatitudeN18º01' and Longitude W67º06'.

D. Distance (miles) and direction to nearest town: 13 Km. (8 miles) SW of Lajas, PR

E. Species/habitat occurrence: Details of species occurrence and habitat are provided in text of the comprehensive conservation plan. The following is a summary of occurrence:

Yellow-shouldered blackbird. - Present on Sierra Bermeja and very likely present specifically on La Tinaja land track. The species has been recorded mostly during the Christmas Bird Counts. The main population of this species breeds on the nearby Boquerón State Forest, but it's very likely that the refuge uplands serve as important foraging habitat.

Puerto Rican Nightjar - The species presence have been detected during their breeding season mostly on the north facing slopes of Cajul Creek on La Tinaja land track of the refuge. Although nesting has not been documented, but it's very likely the species breeds on the refuge.

Brown Pelican - This species is a casual visitor to the lagoon where it feeds and rest.

Aristida portorricensis. - At present, only two small populations of this grass are known; one on Sierra Bermeja and another one in Cerro Las Mesas, in Mayagüez. The species is present specifically on the upper portion of La Tinaja track of the refuge although the size of these populations extends beyond the refuge boundaries.

Aristida chaseae. - Only two populations are known of this grass; one on the Cabo Rojo NWR and the other one in Sierra Bermeja. The population on Sierra Bermeja includes La Tinaja tack of Laguna Cartagena NWR.

Lyonia truncata var. proctorii - This very rare species is endemic to Sierra Bermeja and is known to occur within the refuge boundaries on La Tinaja Track.

Vernonia proctorii. - Only known from Sierra Bermeja and known to occur within refuge boundaries on La Tinaja track.

Eugenia woodburyana. - Species known to occur on La Tinaja track of the refuge.

Goetzea elegans. - Some trees have been planted in recent years on low lands of the refuge as part of the reforestation efforts.

Stahlia monosperma - Several mature trees are known to exist on the lowlands. They have been planted as part of the reforestation efforts to restore the subtropical dry forest. The species is within its geographical range, and it's very likely naturally occurring mature trees existed before the area became a national wildlife refuge.

VII. Determination of Effects:

A. Explanation of effects of the action on species and critical habitats in item V. B (attach additional pages as needed).

SPECIES/ CRITICAL HABITAT	IMPACTS TO SPECIES/CRITICAL HABITAT
Yellow-shouldered Blackbird	No adverse effects anticipated. Beneficial effects include providing additional nesting habitat as reforestation efforts on refuge continue and as objectives and strategies described under Goal 1 get implemented. Other beneficial effects include monitoring programs, feral animal control, and education/outreach activities.
Puerto Rican Nightjar	No adverse effects anticipated. Beneficial effects include providing additional nesting habitat as reforestation efforts on refuge continue and as objectives and strategies described under Goal 1 get implemented. Other beneficial effects include monitoring programs, feral animal control, and education/outreach activities.
Brown Pelican	No effects anticipated.
Aristida portoricensis	No adverse effects anticipated. Beneficial effects include coordinate with partners to conduct research of this species, mapping and protecting existing grasses and the propagation and establishment or enhancement of populations.
Aristida chaseae	No adverse effects anticipated. Beneficial effects include coordinate with partners to conduct research of this species, mapping and protecting existing grasses and the propagation and establishment or enhancement of populations.
Lyonia truncata var. proctorii	No adverse effects anticipated. Beneficial effects include coordinate with partners to conduct research of this species, mapping and protecting existing grasses and the propagation and establishment or enhancement of populations.
Vernonia proctorii	No adverse effects anticipated. Beneficial effects include coordinate with partners to conduct research of this species, mapping and protecting existing grasses and the propagation and establishment or enhancement of populations.
Eugenia woodburyana	No adverse effects anticipated. Beneficial effects include coordinate with partners to conduct research of this species, mapping and protecting existing grasses and the propagation and establishment or enhancement of populations.
Goetzea elegans	No adverse effects anticipated. Trails, roads, and structures will be located so as to avoid impacts to the species. Beneficial effects include mapping and protecting existing trees and the propagation and establishment or enhancement of populations.

SPECIES/ CRITICAL HABITAT	IMPACTS TO SPECIES/CRITICAL HABITAT
Stahlia monosperma	No adverse effects anticipated. Trails, roads, and structures will be located so as to avoid impacts to the species. Beneficial effects include inventories to locate additional populations and the propagation and the establishment or enhancement of populations.

VIII. Effect Determination and Response Requested:

SPECIES/ CRITICAL HABITAT	DETERMINATION[1]			RESPONSE[1]
	NE	NA	AA	
Yellow-shouldered Blackbird		X		
Puerto Rican Nightjar		X		
Brown Pelican	X			
Aristida portoricensis		X		
Aristida chaseae		X		
Lyonia truncate var.proctorii		X		
Vernonia proctorii		X		
Eugenia woodburyana		X		
Goetzea elegans		X		
Stahlia monosperma		X		

[1]DETERMINATION/RESPONSE REQUESTED:
NE = no effect. This determination is appropriate when the proposed action will not impact directly, indirectly, or cumulatively, either positively or negatively, any listed, proposed, candidate species or designated/proposed critical habitat. Response Requested is optional but a Concurrence is recommended for a complete Administrative Record.

NA = not likely to adversely affect. This determination is appropriate when the proposed action is not likely to adversely impact any listed, proposed, candidate species or designated/proposed critical habitat or there may be beneficial effects to these resources. Response Requested is a Concurrence.

AA = likely to adversely affect. This determination is appropriate when the proposed action is likely to adversely impact any listed, proposed, candidate species or designated/proposed critical habitat. Response Requested for listed species is Formal Consultation. Response Requested for proposed or candidate species is Conference.

_____ _____

Signature (originating station) **Date**

_____

Title

IX. Reviewing Ecological Services Office Evaluation:

A. Concurrence _____ Non concurrence _____
B. Formal consultation required _____
C. Conference required _____
D. Informal conference required _____
E. Remarks (attach additional pages as needed):

_____ _____

Signature **Date**

_____ _____

Title **Office**

Appendix H. Wilderness Review

The Wilderness Act of 1964 defines a wilderness area as an area of federal land that retains its primeval character and influence, without permanent improvements or human inhabitation, and is managed so as to preserve its natural conditions and which:

1. generally appears to have been influenced primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;
2. has outstanding opportunities for solitude or primitive and unconfined types of recreation;
3. has at least 5,000 contiguous roadless acres or is of sufficient size to make practicable its preservation and use in an unimpeded condition; or is a roadless island, regardless of size;
4. does not substantially exhibit the effects of logging, farming, grazing, or other extensive development or alteration of the landscape, or its wilderness character could be restored through appropriate management at the time of review; and
5. may contain ecological, geological, or other features of scientific, educational, scenic, or historic value.

The lands within Laguna Cartagena NWR were reviewed for their suitability in meeting the criteria for wilderness, as defined by the Wilderness Act of 1964. No lands in the refuge were found to meet these criteria. Therefore, the suitability of refuge lands for wilderness designation is not further analyzed in this plan.

Appendix I. Refuge Biota

BIRDS

GREBES	SP	S	F	W
Least Grebe* *Tigua*	c	c	c	c
Pied-billed Grebe* *Zaramago*	o	o	o	-

PELECANIDAE	SP	S	F	W
Brown Pelican *Pelicano*	o	o	o	o

FRIGATEBIRDS	SP	S	F	W
Magnificent Frigatebird *Tijereta*	o	o	o	-

HERONS AND BITTERNS	SP	S	F	W
Great Blue Heron *Garzón cenizo*	c	c	c	c
Little Blue Heron *Garza azul*	c	u	c	c
Cattle Egret *Garza ganadera*	a	a	a	a
Snowy Egret *Garza blanca*	c	c	c	c
Tricolored Heron *Garza pechiblanca*	c	c	c	c
Black-crowned Night-Heron *Yaboa real*	u	u	u	u
Yellow-crowned Night-Heron *Yaboa común*	o	o	o	o
Least Bittern *Martinetito*	u	u	u	u
American Bittern *Yaboa americana*	o	o	o	o

IBISES	SP	S	F	W
Glossy Ibis *Cocó prieto*	o	o	o	o

DUCKS	SP	S	F	W
Fulvous Whistling-Duck *Chiriría achocolatada*	r	r	r	r
West Indian Whistling-Duck* *Chiriría antillana; Yaguaza*	c	c	c	c
Black-bellied Whistling Duck *Chiriría pinta*	-	-	x	x
White-cheeked Pintail* *Pato quijada colorada*	r	-	r	-
Green-winged Teal *Pato aliverde*	r	-	c	c
Blue-winged Teal *Pato zarcel*	c	-	c	c
American Wigeon *Pato cabeciblanco*	-	-	r	r
Northern Shoveler *Pato cuchareta*	r	-	r	r
Ring-necked Duck *Pato acollarado*	r	-	r	r
Lesser Scaup *Pato pechiblanco*	-	-	r	r
Ruddy Duck* *Pato chorizo*	c	c	c	c
Masked Duck* *Pato dominico*	u	u	u	u

AMERICAN VULTURES	SP	S	F	W
Turkey Vulture *Aura tiñosa*	a	a	a	a

HAWKS AND HARRIER	SP	S	F	W
Red-tailed Hawk* *Guaraguao*	u	u	u	u
Northern Harrier *Gavilán de ciénaga*	r	-	r	r
Osprey *Aguila pescadora*	o	o	o	o

FALCONS	SP	S	F	W
Merlin *Falcón migratorio*	o	-	o	o
American Kestrel* *Falcón común*	c	c	c	o
Peregrine Falcon *Falcón peregrino*	o	-	o	o
Aplomado Falcon *Falcón aplomado*	-	-	-	x

JUNGLEFOWL AND QUAIL	SP	S	F	W
Red Junglefowl *Gallina y gallo*	o	o	o	o

GUINEAFOWL	SP	S	F	W
Helmeted Guineafowl (Domestic) *Guinea*	c	c	c	c

RAILS, GALLINULES AND COOTS	SP	S	F	W
Clapper Rail *Pollo de mangle*	-	-	r	-
Sora *Gallito*	u	-	u	u
Yellow-breasted Crake *Gallito amarillo*	u	-	-	-
Black Rail *Gallito negro*	r	r	r	r
Purple Gallinule* *Gallareta azul*	r	r	r	r
Common Moorhen* *Gallareta común*	a	a	a	a
American Coot *Gallinazo americano*	u	-	u	u
Caribbean Coot* *Gallinazo antillano*	c	c	c	c
Red Junglefowl *Gallina caribeña*	o	o	o	o

PLOVERS	SP	S	F	W
Semipalmated Plover *Playero acollarado*	u	-	u	u
Wilson's Plover *Playero marítimo*	u	u	u	u
Killdeer* *Playero sabanero*	c	c	c	u
American Golden-Plover *Playero dorado*	r	-	r	-
Black-bellied Plover *Playero cabezón*	o	-	o	o

STILTS AND AVOCETS	SP	S	F	W
Black-necked Stilt *Viuda*	c	o	o	c

TURNSTONES, SNIPES AND SANDPIPERS	SP	S	F	W
Common Snipe *Becasina*	c	-	c	c
Spotted Sandpiper *Playero coleador*	u	-	a	c
Lesser Yellowlegs *Playero guineilla menor*	a	u	a	a
Greater Yellowlegs *Playero guineilla mayor*	c	u	c	c
Solitary Sandpiper *Playero solitario*	o	-	c	u
Willet *Playero aiiblanco*	r	-	-	-
Least Sandpiper *Playerito menudo*	r	-	-	-
White-rumped Sandpiper *Playero rabadilla blanca*	o	-	u	-
Pectoral Sandpiper *Playero manchado*	o	-	c	u
Semipalmated Sandpiper *Playerito gracioso*	u	o	c	c

Western Sandpiper *Playerito occidental*	u	o	c	c
Stilt Sandpiper *Playero zancudo*	r	-	-	-

GULLS, TERNS AND ALLIES	SP	S	F	W
Laughing Gull *Gaviota gallega*	r	r	-	-
Gull-billed Tern *Gaviota piquigordo*	r	r	r	r
Sandwich Tern *Gaviota piguiaguda*	r	-	-	-
Black Tern *Gaviota ceniza*	r	-	-	-

PIGEONS AND DOVES	SP	S	F	W
White-crowned Pigeon *Paloma cabeciblanca*	x	-	-	-
Mourning Dove *Tórtola rabiche*	u	-	-	-
Zenaida Dove* *Tórtola cardosantera*	c	c	-	-
White-winged Dove *Tórtola aliblanca*	c	c	c	c
Key West Quail Dove *Geotrygon chrysia*	-	-	-	x
Common Ground-Dove* *Rolita*	a	a	a	a

CUCKOOS AND ANIS	SP	S	F	W
Mangrove Cuckoo *Pájaro bobo menor*	u	u	u	u
Yellow-billed Cuckoo *Pájaro bobo picoamarillo*	u	u	u	u
Smooth-billed Ani* *Judío*	a	a	a	a

TYPICAL OWLS	SP	S	F	W
Short-eared Owl* *Múcaro real*	o	o	o	o

GOATSUCKERS	SP	S	F	W
Antillean Nighthawk *Querequequé antillano*	c	c	u	-
Puerto Rican Nightjar^# *Guabairo de Puerto Rico*	u	u	u	u
Chuck-will's Widow *Guabairo mayor*	x	-	-	x

HUMMINGBIRDS	SP	S	F	W
Puerto Rican Emerald^* *Zumbadorcito de Puerto Rico*	o	o	o	o
Antillean Mango *Zumbador dorado*	c	c	c	o
Green Mango^* *Zumbador verde*	r	-	r	-

TODIES	SP	S	F	W
Puerto Rican Tody^* *San Pedrito*	c	o	o	o

KINGFISHERS	SP	S	F	W
Belted Kingfisher *Martín pescador*	c	-	c	c

PICIDAE	SP	S	F	W
Puerto Rican Woodpecker^*	c	c	c	c

TYRANT FLYCATCHERS	SP	S	F	W
Gray Kingbird* *Pitirre*	a	a	a	a
Loggerhead Kingbird^* *Clérigo*	u	u	u	o
Puerto Rican Flycatcher^* *Juí de Puerto Rico*	c	c	c	c
Lesser Antillean Pewee^* *Bobito antillano menor*	c	c	u	u
Caribbean Elaenia* *Juí blanco*	c	c	c	c

SWALLOWS AND MARTINS	SP	S	F	W
Caribbean Martin* *Golondrina de iglesias*	r	-	-	-
Bank Swallow *Golondrina parda*	c	c	a	a
Barn Swallow *Golondrina de horquilla*	c	-	a	a
Cave Swallow *Golondrina de cuevas*	a	a	a	a

THRUSHES	SP	S	F	W
Red-legged Thrush *Zorzal de patas coloradas*	r	r	-	-

MOCKINGBIRDS AND THRASHERS	SP	S	F	W
Northern Mockingbird* *Ruiseñor*	a	a	a	a
Pearly-eyed Thrasher* *Zorzal pardo*	r	r	r	r

VIREOS	SP	S	F	W
Puerto Rican Vireo^* *Bien-te-veo*	r	r	r	r
Black-whiskered Vireo* *Julián chiví*	o	o	o	o

EMBERIZIDS	SP	S	F	W
Black-and-white Warbler *Reinita trepadora*	u	-	u	u
Northern Parula *Reinita pechidorada*	c	-	c	c
Yellow Warbler *Canario de mangle*	o	-	o	o
Magnolia Warbler *Reinita manchada*	r	-	r	r
Cape May Warbler *Reinita tigre*	u	-	c	c

Yellow-rumped Warbler *Reinita coronada*	u	-	c	u
Adelaide's Warbler^* *Reinita mariposera*	c	c	o	o
Blackpoll Warbler *Reinita rayada*	o	-	c	o
Prairie Warbler *Reinita galana*	o	-	c	c
Ovenbird *Pizpita dorada*	r	-	r	r
Northern Waterthrush *Pizpita de mangle*	c	-	c	c
Louisiana Waterthrush *Pizpita de río*	u	-	c	c
Mourning Warbler *Reinita enlutada*	x	-	-	-
Common Yelowthroat *Reinita pica tierra*	u	-	u	u
Hooded Warbler *Reinita de capucha*	o	-	o	o
American Redstart *Candelita*	c	-	c	c
Bananaquit* *Reinita común*	a	a	a	a
Antillean Euphonia *Jilguero*	c	c	c	c
Puerto Rican Spindalis^* *Reina mora de Puerto Rico*	u	u	u	u
Puerto Rican Bullfinch* *Come ñame de Puerto Rico*	o	o	o	o
Yellow-faced Grassquit* *Gorrión barba amarilla*	c	c	c	c
Black-faced Grassquit* *Gorrión negro*	a	a	a	a
Grasshopper Sparrow *Gorrión chicharra*	o	o	o	o
Shiny Cowbird *Tordo lustroso*	c	c	c	c

Greater Antillean Grackle* *Mozambique, Chango*	r	c	c	c
Greater Antillean Oriole *Calandria*	r	-	-	-
Troupial* *Turpial*	c	c	c	c
Yellow-shouldered Blackbird^ *Mariquita*	r	r	r	r
WEAVER FINCHES	SP	S	F	W
Pin-tailed Whydah+ *Viuda colicinta*	c	c	c	c
Yellow-crowned Bishop+ *Napoleón tejedor*	r	r	-	-
Red Bishop+* *Obispo rojo*	c	c	c	c
WAXBILLS AND ALLIES	SP	S	F	W
Orange-checked Waxbill *Veterano mejillianaranjado*	c	o	o	o
Black-rumped Waxhill *Veterano orejicolorado*	r	-	-	-
Red Avadavat (Strawberry Finch)+ *Chamorro fresa*	r	r	r	r
Warbling Silverbill+ *Gorrión picoplata*	c	c	c	c
Bronze Mannikin+* *Diablito*	a	a	a	a
Nutmeg Mannikin+ *Gorrión canela*	o	o	o	o
Chestnut Mannikin+* *Monja tricolor*	u	u	u	u

Symbols on the preceding checklist represent the following:

Seasonal appearance/*Estaciones*:
Sp - Spring/*Primavera* (March - May)
S - Summer/*Verano* (June - August)
F - Fall/*Otoño* (September- November)
W - Winter/*Invierno* (December- February)
Seasonal abundance/*Abundancia Por Estaciones*:
a - abundant/*seguro de observarse* — a common species which is very numerous
c - common/*sequro de observarse en habitat apropiado* — certain to be seen in suitable habitat
u - uncommon/*presente, pero posiblemente no se observe* — present but not certain to be seen
o - occasional/*observado algunas veces durante la estación* — seen only a few times during a season
r - rare/*observado solo cada 2 a 5 anos* — seen at intervals of 2 to 5 years
x - accidental/*observado solo una o dos veces* — seen only once or twice
z - abundance unknown/*abundancia no conocida*
Status:
^ - Endemic
# - Endangered
+ - Exotic
* - Nesting

MAMMALS

Native - Bats

Artibeus jamaicensis	Jamaican fruit-eating bat
Molossus molossus fortis	Velvety free-tailed bat
Noctilio leporinus	Greater bulldog bat
Nyctinomus murinus [e]	Brazilian free-tailed bat

Introduced - Various

Erythrocebus patas	Patas monkey
Macaca mulatta	Rhesus monkey
Herpestes auropunctatus	Mongoose
Mus musculus	House mouse
Rattus norvegicus	House rat
R. rattus	Roof rat

REPTILES

Lizards

Ameiva exsul	Puerto Rican ground lizard
A. wetmorei	Blue tailed ground lizard
A. cristatellus	Puerto Rican crested anole
A. ponsensis	Ponce's garden lizard
A. pulchellus	Grass anole
A. stratulus	Spotted lizard

Geckos

Sphaerodactylus macrolepsis	Common gecko
S. nicholsi nicholsi	Nichols' dwarf gecko

Turtles

Trachemys stejnegeri	West Indian slider

Snakes

Alsophis portoricenis	Puerto Rican racer
Typhlops richardi	Blind snake

AMPHIBIANS

Bufo marinus	Marine toad
Eleutherodactylus antiliensis	Puerto Rican red-eyed frog
E. coqui	Coqui
Leptodactylus albilabris	White-lipped frog
Rana catesbiana	Bull frog

FISH

Anguilla rostraca	Eel
Awaous taiasica	Striated river goby
Bathygobius soporator	Frillfin goby
Caranx latus	Horse eye jack
Centropomus parallelus	Fat snook
Dormitator maculatus	Fat sleeper
Eleotris pisonis	Spiny cheek sleeper
Gobiomorus dormirtor	Bigmouth sleeper
Hypostomus plecostamus	Plecostomus
Ictalurus nebulosus	Brown bullhead
Lepomis gibbosus	Pumpkin seed
L. macrochirus	Bluegill
Liposarcus multiradiatus [g]	Armored sailfin catfish
Megalops atlanticus	Tarpon
Poecilia reticulata	Guppy
P. vivipara	Top minnow
Tilapia aurea	Tilapia
T. mossambica	Tilapia

PLANTS

PTERIDOPHYTES

AZOLLACEAE	*Azolla caroliniana*
LOMARIOPSIDACEAE	*Nephrolepis brownii*
MARSILEACEAE	***Marsilea ancylopoda***
	Marsilea berteroi
POLYPODIACEAE	*Nephrolepis biserrata*
	Nephrolepis brownii
	Campyloneurum brevifolium
	Campyloneurum phyllitidis
	Polypodium phyllitidis
	Microgramma heterophylla
	Polypodium heterophyllum
	Pecluma plumula
	Polypodium plumula
	Phlebodium aureum
	Polypodium aureum
	Pleopeltis polypodioides
	Polypodium polypodioides
PTERIDACEAE	*Acrostichum danaeifolium*
	Cheilanthes microphylla
	Doryopteris pedata
	Hemionitis palmata
	Notholaena trichomanoides
	Pityrogramma austroamericana
	Pityrogramma calomelanos

GYMNOSPERMS

ZAMIACEAE	*Zamia portoricensis*

ANGIOSPERMS

ACANTHACEAE	**Barleria prionitis*
	Blechum pyramidatum
	Justicia comata
	Justicia periplocifolia
	Justicia sessilis
	Ruellia coerulea
	Ruellia tuberosa
	**Thunbergia alata*
AGAVACEAE	*Agave minor*
ASPHODELACEAE	*Aloe vera*
AIZOACEAE	*Trianthema portulacastrum*
ALISMATACEAE	*Echinodorus berteroi*
	Sagittaria lancifolia
	Sagittaria intermedia
AMARANTHACEAE	*Achyranthes aspera*
	Centrostachys indica
	Alternanthera pungens
	Amaranthus crassipes
	Amaranthus spinosus
	Alternanthera paronychioides

	Alteranthera sessilis
	Amaranthus dubius
	Amaranthus viridis
ANACARDIACEAE	*Comocladia dodonaea*
	**Mangifera indica*
	Spondias mombin
ANNONACEAE	*Annona glabra*
	**Annona muricata*
	**Annona reticulata*
APIACEAE	*Hydrocotyle umbellata*
	Hydrocotyle verticillata
APOCYNACEAE	*Asclepias curassavica*
	**Calotropis procera*
	Cryptostegia madagascariensis
	Matelea maritima
	Metastelma linearae
	Plumeria alba
	Rauvolfia nitida
	Rauvolfia tetraphylla
	Rauvolfia viridis
	Rauvolfia lamarckii
AQUIFOLIACEAE	*Ilex krugiana*
	Ilex nitida
ARACEAE	*Anthurium crenatum*
	Philodendron hederaceum
	Philodendron scandens
	Lemna aequinoctialis
	Lemna perpusilla
	Lemna polyrhiza
	Pistia stratiotes
	Spirodela polyrhiza
	Wolffia spp.
	**Xanthosoma brasiliense*
ARECACEAE	*Acrocomia media*
	**Cocos nucifera*
	Roystonea borinquena
	Thrinax morrisii
ASTERACEAE	*Acanthospermum hispidum*
	Bidens alba
	Bidens cynapiifolia
	Bidens pilosa
	Chromolaena odorata
	Eupatorium odoratum
	Chromolaena sinuata
	Eupatorium sinuatum
	Cyanthillium cinereum
	Lepidaploa proctorii
	Vernonia proctorii
	Pectis linearis
	Pectis linifolia
	Piptocoma antillana

	Porophyllum leiocarpum
	Pterocaulon virgatum
	Synedrella nodiflora
	Tridax procumbens
	Wedelia calycina
	Wedelia lanceloata
	Vernonia cinerea
	Conyza laevigata
	Erigeron laevigatus
	Conyza apurensis
	Leptilon chinense
	Eclipta prostrata
	Eclipta alba
	Verbesina alba
	Verbesina prostrata
	Emilia fosbergii
	Lagascea mollis
	Melanthera nivea
	Bidens nivea
	Melanthera aspera
	Mikania micrantha
	Parthenium hysterophorus
	Pluchea odorata
	Pluchea purpurascens
	Symphyotrichum expansum
	Synedrella nodiflora
	**Tridax procumbens*
	Vernonia cinerea
	Cyanthillium cinereum
	Senecioides cinerea
BASELLACEAE	**Anredera vesicaria*
BIGNONIACEAE	**Crescentia cujete*
	Crescentia cujete x *linearifolia*
	Crescentia portoricensis (planted)
	Crescentia linearifolia
	Distictis lactiflora
	Macfadyena unguis-cati
	Batocydia unguis
	Tabebuia heterophylla
BORAGINACEAE	*Bourreria baccata*
	Bourreria succulenta
	Bourreria virgata
	Bourreria domingensis
	Cordia alliodora
	Cerdana alliodora
	Cordia collococca
	Cordia glabra
	Cordia curassavica
	Cordia stenophylla
	Varronia angustifolia
	Cordia dentata

	Cordia alba
	Cordia globosa
	Cordia laevigata
	Cordia nitida Vahl
	Cordia obliqua
	*Cordia ricksecker*i
	Cordia polycephala
	Varronia corymbosa
	Cordia sulcata
	Heliotropium angiospermum
	Heliotropium curassavicum
	Heliotropium indicum
	Heliotropium procumbens
	Heliotropium ternatum
	Rochefortia acanthophora
	Tournefortia hirsutissima
	Tournefortia volubilis
	Tournefortia microphylla
BRASSICACEAE	*Lepidium virginicum*
	Rorippa portoricensis
	Radicula portoricensis
BROMELIACEAE	*Bromelia pinguin*
	Hohenbergia antillana
	Pitcairnia angustifolia
	Tillandsia polystachya
	Tillandsia recurvata
	Tillandsia usneoides
	Tillandsia utriculata
BURSERACEAE	*Bursera simaruba*
	Tetragastris balsamifera
	Elaphrum simaruba
CACTACEAE	*Hylocereus trigonus*
	Leptocereus quadricostatus
	Melocactus intortus
	**Opuntia cochenillifera*
	Nopalea cochenillifera
	Opuntia repens
	Opuntia rubescens
	Opuntia stricta
	Opuntia dillenii
	Pilosocereus royenii
CAMPANULACEAE	**Sphenoclea zeylanica*
CANELLACEAE	*Canella winterana*
CANNABACEAE	*Celtis iguanaea*
	Celtis trinervia
CAPPARACEAE	*Capparis amplissima*
	Capparis baducca
	Capparis cynophallophora
	Capparis portoricensis
	Capparis flexuosa
	Capparis hastata

	Capparis indica
CLEOMACEAE	*Arivela viscosa*
	Cleome stenophylla
	Cleoserrata speciosa
	Cleome speciosa
	Gynandropsis gynandra
	Cleome gynandra
	Tarenaya spinosa
	Cleome spinosa
CERATOPHYLLACEAE	*Ceratophyllum demersum*
CLUSIACEAE	*Clusia rosea*
	Clusia minor
	Garcinia portoricensis
COMBRETACEAE	*Bucida buceras*
COMMELINACEAE	*Callisia repens*
	Commelina diffusa
	Commelina longicaulis
	Commelina erecta
	Commelina elegans
CONVOLVULACEAE	*Convolvulus nodiflorus*
	Jacquemontia nodiflora
	Cuscuta americana
	Cuscuta globulosa
	Cuscuta indecora
	Cuscuta umbellata
	Evolvulus convolvuloides
	Evolvulus nummularius
	Evolvulus sericeus
	Ipomoea nil
	**Ipomoea ochracea*
	Ipomoea quamoclit
	Quamoclit quamoclit
	Ipomoea steudelii
	Ipomoea tiliacea
	Ipomoea triloba
	Jacquemontia cumanensis
	Jacquemontia pentanthos
	Jacquemontia tamnifolia
	Merremia aegyptia
	Merremia quinquefolia
	Merremia umbellata
	Ipomoea polyanthes
CRASSULACEAE	**Kalanchoe pinnata*
	Bryophyllum pinnatum
CUCURBITACEAE *	*Cucumis anguria*
	Cucumis melo
	**Momordica charantia*
	Momordica zeylanica
CYPERACEAE	*Bulbostylis antillana*
	Cyperus aggregatus
	Cyperus articulatus

	Cyperus croceus
	Cyperus nanus
	Cyperus rotundus
	Cyperus urbanii
	Cyperus compressus
	Cyperus digitatus
	Cyperus elegans
	Cyperus esculentus
	Cyperus giganteus
	Cyperus iria
	Cyperus laevigatus
	Cyperus ligularis
	Cyperus ochraceus
	Cyperus odoratus
	Torulinium odoratum
	Cyperus polystachyos
	Cyperus rotundus
	Cyperus surinamensis
	Eleocharis cellulosa
	Eleocharis fallax
	Eleocharis geniculata
	Eleocharis interstincta
	Eleocharis mutata
	Fimbristylis cymosa
	Fimbristylis complatana
	Rhynchospora ciliata
	Rhynchospora nervosa
	Scleria lithosperma
ERYTHROXYLACEAE	*Erythroxylum areolatum*
	Erythroxylum brevipes
EUPHORBIACEAE	*Acalypha portoricensis*
	Acalypha setosa
	Adelia ricinella
	Ricinella ricinella
	Argythamnia candicans
	Argythamnia fasciculata
	Caperonia palustris
	Croton asteroides
	Croton betulinus
	Croton flavens
	Croton lobatus
	Croton lucidus
	Euphorbia cyanthophora
	Euphorbia hirta
	Chamaesyce hirta
	Euphorbia hypericifolia
	Chamaesyce hypericifolia
	Chamaesyce glomerifera
	Euphorbia glomerifera
	Euphorbia hyssopifolia
	Chamaesyce hyssopifolia

Chamaesyce nutans
Dalechampia scandens
Euphorbia lasiocarpa
Euphorbia lacteal
Euphorbia heterophylla
Euphorbia serpens
Chamaesyce serpens
Gymnanthes lucida
Chamaecrista glandulosa
Caesalpinia pulcherrima
Jatropha curcas
Jatropha gossypifolia
Adenoropium gossypiifolium
Ricinus communis
Tragia volubilis

FABACEAE-CAESALPINIOIDEAE **Bauhinia* sp.
**Cassia fistula*
Chamaecrista glandulosa
Chamaecrista swartzii
Chamaecrista lineata
†*Chamaecrista nictitans*
Cassia swartzii
Hymenaea courbaril
**Parkinsonia aculeata*
Senna obtusifolia
Cassia obtusifolia
Emelista tora
Senna occidentalis
Cassia occidentalis
Ditremexa occidentalis
Senna siamea
Senna polyphylla
Cassia polyphylla
Peiranisia polyphylla
Stahlia monosperma
**Tamarindus indica*

FABACEAE-FABOIDEAE **Abrus precatorius*
Abrus abrus
Aeschynomene americana
Aeschynomene rudis
Aeschynomene sensitiva
Alysicarpus vaginalis
Andira inermis
**Cajanus cajan*
Centrosema virginianum
Bradburya virginiana
**Clitoria ternatea*
Crotalaria incana
Crotalaria pallida
Crotalaria falcata
Crotalaria lotifolia

†*Crotalaria pallida*
Crotalaria striata
Crotolaria retusa
**Dalbergia sissoo*
Desmodium glabrum
Desmodium incanum
Desmodium triflorum
Desmodium procumbens
Erythrina eggersii
Galactia dubia
Galactia striata
Gliricidia sepium
Indigofera suffruticosa
Lonchocarpus domingensis
Macroptilium lathyroides
Phaseolus lathyroides
**Phaseolus vulgaris*
Pterocarpus officinalis
Pictetia aculeata
Piscidia carthagenensis
Poitea paucifolia
Rhynchosia minima
Dolicholus minimus
Rhynchosia reticulata
Stylosanthes hamata
Sesbania emerus
Sesban emerus
Sesbania sp.
Stylosanthes hamata
Tephrosia cinerea
Tephrosia senna
Vigna luteola
Zornia reticulata

FABACEAE-MIMOSOIDEAE

Acacia sp.
**Albizia lebbeck*
Desmanthus pernambucanus
Desmanthus virgatus
Inga laurina
**Leucaena leucocephala*
Leucaena glauca
Mimosa ceratonia
**Mimosa pigra*
Mimosa púdica
Neptunia plena
Pithecellobium dulce
Pithecellobium unguis-cati
Prosopis juliflora
Prosopis pallida
**Samanea saman*
Senegalia riparia

	Acacia retusa
	Acacia westiana
	**Vachellia farnesiana*
	Acacia farnesiana
	Zapoteca portoricensis
HYDROCHARITACEAE	*Najas guadalupensis*
	Zapoteca portoricensis
KRAMERIACEAE	*Krameria ixina*
ICACINACEAE	†*Ottoschulzia rhodoxylon*
LAMIACEAE	*Hyptis capitata*
	Hyptis pectinata
	Leonotis nepetifolia
	Ocimun campechianum
	Petitia domingensis
	Vitex divaricata
LAURACEAE	*Cassytha filiformis*
	Nectandra coriacea
	Licaria parvifolia
LORANTHACEAE	*Dendropemon purpureus*
	Phthirusa purpurea
LYTHRACEAE	*Ammannia coccinea*
	Ammannia latifolia
	Ginoria rohrii
MALPIGHIACEAE	*Byrsonima crassifolia*
	Heteropterys laurifolia
	Heteropterys purpurea
	Stigmaphyllon emarginatum
	Stigmaphyllon periplocifolium
	Stigmaphyllon floribundum
	Stigmaphyllon tomentosum
MALVACEAE	*Sida pyramidata*
	†*Allosidastrum pyramidatum*
	Bastardia viscosa
	Ceiba pentandra
	Corchorus aestuans
	Corchorus hirtus
	Guazuma ulmifolia
	Guazuma guazuma
	Guazuma tomentosa
	Hibiscus phoeniceus
	Helicteres jamaicensis
	Malachra alceifolia
	Malachra capitata
	†*Malachra urens*
	Malvastrum corchorifolium
	Malvastrum coromandelianum
	Melochia nodiflora
	Melochia pyramidata
	Melochia spicata
	Melochia villosa
	Melochia tomentosa

	Moluchia tomentosa
	Pseudabutilon umbelllatum
	Pavonia spinifex
	Sida abutifolia
	Sida acuta
	Sida carpinifolia
	Sida ciliaris
	Sida glomerata
	Sida salviifolia
	Sida spinosa
	Sida urens
	Sidastrum multiflorum
	Thespesia grandiflora
	Montezuma grandiflora
	Montezuma speciosissima
	Thespesia populnea
	Triumfetta semitriloba
	Urena lobata
	Waltheria indica
	Wissadula hernandiodes
	Wissadula amplissima
	Wissadula periplocifolia
	Waltheria indica
MARTYNIACEAE	*Martynia annua*
MELIACEAE	*Myrsine cubana*
	Ardisia obovata
	Guarea guidonia
	Guarea guara
	**Melia azedarach*
	**Toona ciliata*
	Trichilia hirta
MENYANTHACEAE	*Nymphoides indica*
	Nymphoides humboldtiana
MOLLUGINACEAE	*Mollugo verticilliata*
MORACEAE	†*Ficus americana*
	Ficus sintenisii
	Ficus citrifolia
MORINGACEAE	**Moringa oleifera*
	Moringa moringa
MYRSINACEAE	*Myrsine cubana*
	Ardisia obovata
MYRTACEAE	*Eugenia biflora*
	Eugenia axillaris
	Eugenia foetida
	Eugenia ligustrina
	Eugenia monticola
	Eugenia sessiliflora
	Eugenia procera
	Eugenia pseudopsidium
	Eugenia woodburyana
	Myrcia citrifolia

	Myrciaria myrtifolia
	Myrciaria borinquena
	Myrciaria floribunda
NYCTAGINACEAE	*Boerhavia coccinea*
	Boerhavia diffusa
	Boerhavia erecta
	Commicarpus scandens
	Boerhavia scandens
	Guapira fragrans
	Neea buxifolia
	Pisonia albida
	Pisonia subcordata
NYMPHAEACEAE	*Nymphaea amazonum*
	Nymphaea ampla
	**Nymphaea odorata*
	Nymphaea pulchella
OCHNACEAE	*Ouratea littoralis*
OLACACEAE	*Ximenia americana*
OLEACEAE	*Chionanthus domingensis*
	Forestiera segregata
	Jasminum fluminense
ORCHIDACEAE	*Oeceoclades maculata*
	Prosthechea cochleata
	Epidendrum cochleatum
	Encyclia cochleata
	Psychilis krugii
	Tetramicra canaliculata
	Vanilla barbellata
	Vanilla claviculata
OLEACEAE	*Jasminum fluminense*
	Jasminum azoricum
ONAGRACEAE	*Ludwigia erecta*
	Jussiaea erecta
	Ludwigia leptocarpa
	Jussiaea leptocarpa
	Ludwigia octovalvis
	Jussiaea angustifolia
	Ludwigia peploides
	Jussiaea peploides
	Jussiaea repens
PAPAVERACEAE	*Argemone mexicana*
PASSIFLORACEAE	*Passiflora suberosa*
PHYLLATHACEAE	*Flueggea acidoton*
	Phyllanthus amarus
	Savia sessiliflora
PHYTOLACCACEAE	*Petiveria alliacea*
	Rivina humilis
	Trichostigma octandrum
PICRAMNIACEAE	*Picramnia pentandra*
PIPERACEAE	*Peperomia humilis*
PLANTAGINACEAE	*Bacopa monnieri*

	Bramia monnieri
	Bacopa stricta
	Plantago major
	Scoparia dulcis
PLUMBAGINACEAE	*Plumbago scandens*
POACEAE	***Aristida portorricensis***
	Asistida chaseae
	**Bambusa vulgaris*
	**Bothriochloa pertusa*
	Bouteloua americana
	Bouteloua repens
	Brachiaria subquadripara
	Brachiaria purpurascens
	Brachiaria fasciculata
	**Cenchrus ciliaris*
	Cenchrus echinatus
	Chloris inflata
	Chloris paraguaiensis
	**Cynodon dactylon*
	**Dactyloctenium aegyptium*
	Digitaria bicornis
	Digitaria insularis
	**Digitaria sanguinalis*
	**Echinochloa colona*
	†**Echinochloa crus-galli*
	Echinochloa crus-pavonis
	Echinochloa polystachya
	Eleusine indica
	**Eragrostis ciliaris*
	Eragrostis hypnoides
	†*Eragrostis secundiflora*
	Eragrostis beyrichii
	Eriochloa polystachya
	Eriochloa punctata
	Heteropogon contortus
	Hymenachne amaplexicaulis
	Ichnanthus pallens
	**Megathyrsus maximus*
	Urochloa maxima
	**Oryza sativa*
	Paspalidium geminatum
	Panicum geminatum
	Panicum laxum
	Panicum fasciculatum
	Panicum muticum
	Panicum barbinode
	Paspalum conjugatum
	Paspalum distichum
	Paspalum fasciculatum
	Paspalum millegrana
	Paspalum notatum

	Paspalum virgatum
	Pennisetum purpureum
	Pharus lappulaceus
	**Rottboellia cochinchinensis*
	Rottboellia exaltata
	**Saccharum officinarum*
	**Setaria barbata*
	Setaria rariflora
	Setaria setosa
	**Sorghum arundinaceum*
	†**Sorghum bicolor*
	Sorghum saccharatum
	†*Sporobolus indicus*
	Sporobolus jacquemontii
	Steinchisma laxa
	Urochloa distachya
	Urochloa subquadripara
	Urochloa fusca
	Urochloa fasciculata
	Urochloa mutica
	Urochloa subquadripara
	Urochloa reptans
	**Zea mays*
POLYGALACEAE	***Polygala cowellii***
	Phlebotaenia cowellii
	Polygala penaea
	Badiera penaea
	Securidaca virgata
POLYGONACEAE	*Coccoloba diversifolia*
	Coccoloba microstachya
	Coccoloba uvifera
	Coccoloba venosa
	Persicaria acuminata
	Persicaria ferruginea
	Polygonum ferrugineum
	Persicaria glabra
	Polygonum glabrum
	Polygonum densiflorum
	Persicaria portoricensis
	Persicaria punctata
	Polygonum punctatum
	Persicaria segeta
	Polygonum segetum
PONTEDERIACEAE	**Eichhornia crassipes*
	**Eichhornia diversifolia*
	Piaropus diversifolus
PORTULACACEAE	*Portulaca oleracea*
	Portulaca quadrifida
	Portulaca pilosa
POTAMOGETONACEAE	*Potamogeton nodosus*
	Potamogeton fluitans

	Ruppia maritima
RANUNCULACEAE	*Clematis polygama*
RHAMNACEAE	*Colubrina arborescens*
	Colubrina elliptica
	Colubrina verrucosa
	Gouania lupuloides
	Krugiodendron ferreum
	Reynosia uncinata
	Ziziphus reticulata
RUBIACEAE	*Borreria ocymifolia*
	†*Catesbaea parviflora*
	Chiococca alba
	Diodia apiculata
	Exostema caribaeum
	Faramea occidentalis
	Guettarda elliptica
	Guettarda odorata
	Machaonia portoricensis
	Hamelia patens
	Guettarda scabra
	Exostema caribaeum
	Faramea occidentalis
	Guettarda elliptica
	Guettarda odorata
	Machaonia portoricensis
	Hamelia patens
	Guettarda scabra
	Rondeletia inermis
	Spermacoce ocymifolia
	Spermacoce confusa
	Scolosanthus versicolor
	Psychotria brownei
	Psychotria nervosa
	Psychotria microdon
	Spermacoce verticillata
	Spermacoce apiculata
	Diodia rigida
	Hamelia patens
	Hamelia erecta
	Randia aculeata
	Spermacoce confusa
	Spermacoce verticillata
	B*orreria verticillata*
RUSCACEAE	**Sansevieria trifasciata*
RUTACEAE	*Amyris elemifera*
	Citrus × aurantiifolia
	Citrus × jambhiri
	Citrus limon
	Citrus limonia
	Citrus limonum
	Citrus × sinensis

	Zanthophyllum punctatum
	Zanthoxylum martinicense
	Zanthoxylum flavum
	Zanthoxylum monophyllum
SALICACEAE	*Casearia aculeata*
	Casearia sylvestris
	Casearia guianensis
	Prockia crucis
	Samyda dodecandra
	Xylosma buxifolium
SANTALACEAE	*Phoradendron dipterum*
	Phoradendron tetrapterum
	Phoradendron quadrangulare
SAPINDACEAE	*Cardiospermum halicacabum*
	Cupania americana
	**Melicoccus bijugatus*
	Meliococca bijuga
	Paullinia pinnata
	**Sapindus saponaria*
	Serjania polyphylla
	Thouinia striata
	Thouinia portoricensis
SAPOTACEAE	*Manilkara bidentata*
	Sideroxylon foetidissimum
	Masticodendron foetidissimum
	Sideroxylon obovatum
	Bumelia obovata
SCROPHULARIACEAE	*Capraria biflora*
SOLANACEAE	*Capsicum frutescens*
	**Datura inoxia*
	**Datura stramonium*
	***Goetzea elegans* - planted**
	Physalis angulata
	Solanum americanum
	Solanum nigrum
	Solanum americanum
	Solanum campechiense
	Solanum guanicense
	Solanum bahamense
	Solanum persicifolium
	Solanum racemosum
	Solanum torvum
TALINACEAE	*Talinum fruticosum*
	Talinum triangulare
	Talinum paniculatum
THEOPHRASTACEAE	*Jacquinia arborea*
	Bonellia umbellata
	Jacquinia berteroi
TURNERACEAE	*Piriqueta racemosa*
	Turnera diffusa

TYPHACEAE	*Typha domingensis*
	Typha angustifolia
URTICACEAE	*Pilea microphylla*
VERBENACEAE	*Bouchea prismatica*
	Citharexylum spinosum
	Citharexylum fruticosum
	Lantana camara
	Lantana involucrata
	Lantana reticulata
	Lippia micromera
	Phyla fruticosa
	Lippia nodiflora
	Lippia reptans
	Lippia strigulosa
	Phyla nodiflora
	Lippia nodiflora
	Lippia nodiflora
	Priva lappulacea
	Stachytarpheta jamaicensis
	Valerianoides jamaicense
	Stachytarpheta x hybrida
	Stachytarpheta strigosa
	Tamonea boxiana
	Ghinia spinosa
	Tamonea spinosa
	Valerianoides jamaicense
	Stachytarpheta x hybrida
	Stachytarpheta strigosa
	Tamonea boxiana
	Ghinia spinosa
	Tamonea spinosa
VITACEAE	*Cissus trifoliata*
	Cissus verticillata
	Cissus sicyoides
ZYGOPHYLLACEAE	*Guaiacum officinale*
	Kallstroemia maxima

*Note: species on bold are endemic species of the Commonwealth of Puerto Rico. + indicates that species have been excluded from the flora. * indicated the species is introduced. This list should be cited as: 2010 . Breckon, Gary J. A Preliminary Checklist of the Flora of the National Wildlife Refuge at Laguna Cartagena, Unpublished publication located at the Caribbean Islands National Wildlife Refuge Complex, Boquerón, PR*

Appendix J. Budget Requests

Provided in the final CCP

REFUGE OPERATING NEEDS SYSTEM (RONS)

Appendix K. List of Preparers

Susan Silander, Project Leader, Caribbean Islands NWR Complex

Joseph Schwagerl, Deputy Project Leader, Caribbean Islands NWR Complex

Oscar Díaz, Refuge Manager, Cabo Rojo and Laguna Cartagena NWRs

William Hernández, GIS Specialist, Caribbean Islands NWR Complex

David Bocanegra, Outreach Specialist, Caribbean Islands NWR Complex

Beverly Yoshioka, Biologist, USFWS Boquerón Ecological Service

David Callihan, Consultant, Management Systems International

Laura Housh, Regional Planner, Okefenokee National Wildlife Refuge

Monica Harris, Planner, USFWS

Evelyn Nelson, Editor, USFWS Southeast Regional Office

Randy Musgraves, Graphics, USFWS Southeast Regional Office

Rose Hopp, Planning Chief, USFWS Southeast Regional Office