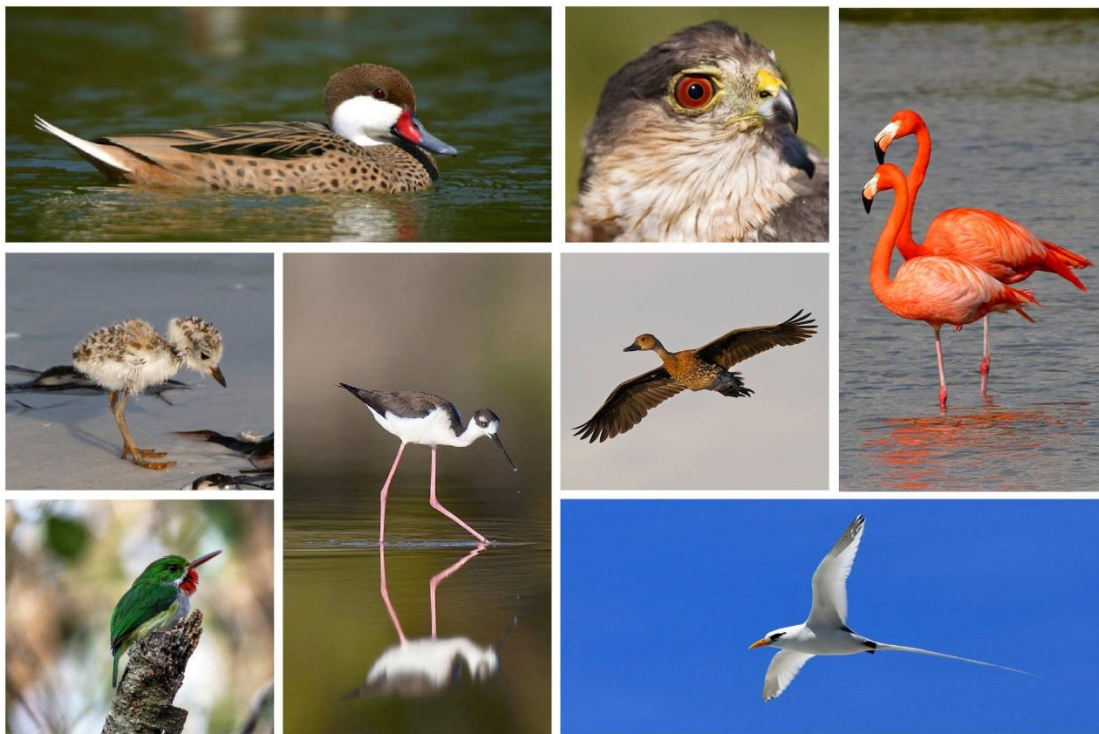


Avian Conservation Planning Priorities for Puerto Rico and the U.S. Virgin Islands (BCR 69)

February 2015



PROJECT AFFILIATES:

US Fish and Wildlife Service

Atlantic Coast Joint Venture

Caribbean Landscape Conservation Cooperative



Atlantic Coast Joint Venture



Caribbean
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DEDICATION

We dedicate this conservation planning document to Jorge E. Saliva (1963-2012). Jorge was a tireless advocate for avian conservation in Puerto Rico, the US Virgin Islands, and the rest of the Caribbean. Seabirds were his passion, particularly terns, and he spent countless hours in the field documenting their status while relishing their beauty. The breadth of his knowledge also led him to advance endangered species conservation, research, and conservation planning. Indeed, this plan reflects many of his contributions about aquatic and terrestrial avian species throughout the region. We honor Jorge by building upon his legacy and continuing his commitment to conservation.

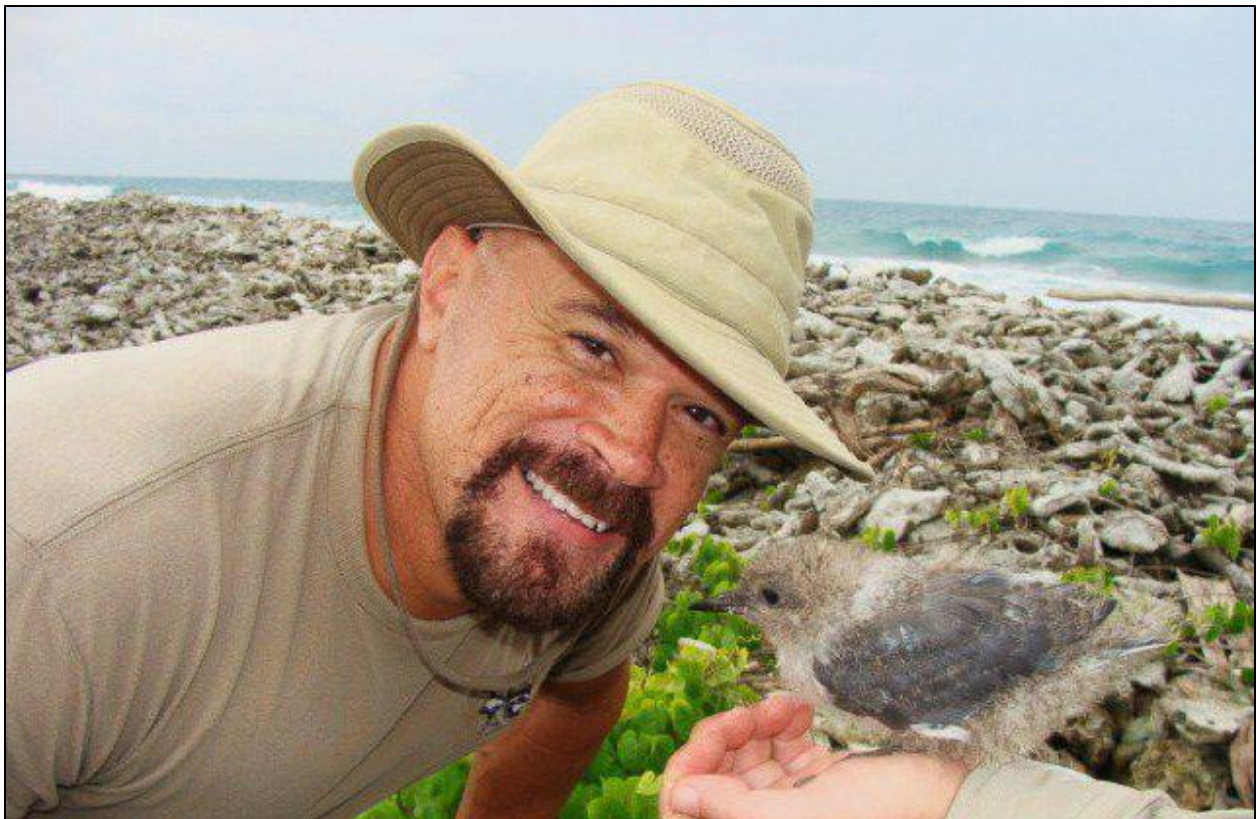


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LIST OF ABBREVIATIONS AND ACRONYMS

ACJV – Atlantic Coast Joint Venture
ACP – Area of Conservation Priority
Bah – Greater Antilles-Bahamas
BBA – Breeding Bird Atlas
BCR – Bird Conservation Region
BD – Breeding Distribution
BH – Biodiversity Health
C – Controlled
CC – Continental Concern
CDSS – Caribbean Decision Support System
CE – Critically Endangered
CR (Partners in Flight)– Critical Recovery
CR (Comprehensive Wildlife Conservation Strategy) – Critically Endangered
CWA – Critical Wildlife Area
CWAP – Clean Water Action Plan
CWCS – Comprehensive Wildlife Conservation Strategy
CX – subset of CR, when no populations are presently known
DD – Data Deficient
DNER – Department of Natural and Environmental Resources
DPNR – Department of Planning and Natural Resources
EN – Endangered
EPA – Environmental Protection Agency
EYNF – El Yunque National Forest
GA – Greater Antilles
GAP – Gap Analysis Project
Ha – hectare
Hisp – Hispaniola
IBA – Important Bird Area
IITF – International Institute of Tropical Forestry
IM – Immediate Management
IUCN – International Union for Conservation of Nature
LA – Lesser Antilles
LC – Least Concern
LR – Low Risk
ND – Non-breeding Distribution
NGO – Non-governmental organization
NHP – National Heritage Program
NT – Near-Threatened
P – Peripheral
PC – Large scale Population Control/Suppression
PCL – Local Population Control
PIF – Partners in Flight
PR – Planning and Responsibility
PR – Puerto Rico

PRCCC – Puerto Rico Climate Change Council
PRCT – Puerto Rico Conservation Trust
PS – Population Size
PT – Population Trend
RC – Regional Concern
RCS – Regional Combined Score
RD – Relative Density
S – Stewardship
SC – Special Concern
SOPI – Sociedad Ornitológica Puertorriqueña Inc.
TB – Threats to Breeding
TN – Threats to Non-breeding
TNC – The Nature Conservancy
UNEP – United Nations Environment Programme
US – United States
USDA – United States Department of Agriculture
USFS – United States Forest Service
USFWS – United States Fish and Wildlife Service
USVI – United States Virgin Islands
VU – Vulnerable
WFA – Waterfowl Focus Area
WI – West Indies

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FOREWORD

The idea that conservation of natural resources is best accomplished as a collaborative process is well accepted by scientists, planners and practitioners. There is a long history of this concept that goes back to the early days of the conservation movement in the United States. In the mid-1800s, society was aware that natural resources had limits and human activity had pushed some of these resources to the brink. Loss of game, diminishing forest resources, and soil erosion were seen as consequences of poorly managed human activity. Congressman George Marsh, in one of his speeches, noted the feedbacks between human activity and climate – recognizing that climate influences productivity in natural and managed landscapes and indicating a fundamental understanding of the sometimes indirect connectivity of human actions to natural resources. He concluded with the statement that farming, ranching, and industry have a common interest in maintaining a balance in the use of natural resources:

“The herdsman, the ploughman and the mechanic are fellow laborers, not indeed competitors, but coworkers in a common cause, and every measure that tends to elevate any one of them at the expense of another, must in the end infallibly prove detrimental to the best interests of them all.” — George P. Marsh, Sept. 30, 1847 in an address delivered before the Agricultural Society of Rutland County, VT.

The next half century saw an increasing awareness of the value of natural landscapes and wildlife, the initiation of the United States Department of the Interior, the establishment of the National Park Service, and the establishment of the Division of Forestry in the Department of Agriculture. At the end of the century the German biologist Ernst Haeckel introduced the term “ecology” and by the early 1900s writer John Muir championed the concept of connectivity in natural systems.

“When we try to pick out anything by itself, we find it hitched to everything else in the Universe.” — John Muir, 1911 in *My First Summer in the Sierra*, Riverside Press, Cambridge, MA.

The idea of shared interests in conservation and the connectivity of resources have been around for a long time, but it is only recently that collaborative networks for conservation of large landscapes and multiple resources have emerged. The Migratory Bird Joint Ventures were established in 1987 to serve as a framework for developing partnerships among agencies, organizations, and individuals to conserve habitat for priority bird species. The Landscape Conservation Cooperatives, patterned in part after the Migratory Bird Joint Ventures, were initiated in 2009 to collaboratively define conservation priorities and to sustain natural and cultural resources in light of climate change. These conservation frameworks promote action based on shared priorities and the best available science. The Caribbean Landscape Conservation Cooperative will benefit greatly from this report. The work represents an enormous effort to observe, document, compile, and synthesize information about birds and their habitats in Puerto

Rico and the U.S. Virgin Islands (USVI). It will serve as a foundation for conservation planning and action for many of the stakeholders with interest in bird conservation in the Caribbean. It also represents the persistence of the authors and their supporting agencies to provide the best science for conservation planning and action. It is a collaborative effort in the compilation and writing, and in that the source information comes from a wide range of agency, university, and individual efforts to understand the distribution of resident and migratory species and the habitat resources they depend on in Puerto Rico and the USVI. The dedication and expertise of the authors is just what is needed to improve our record of science delivery, and make sure that new knowledge reaches managers and decision makers to derive the greatest good from publically supported science.

William A. Gould
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Tropical Forestry, and
Coordinator, Caribbean Landscape Conservation Cooperative

ACKNOWLEDGMENTS

This conservation planning project for the birds of Puerto Rico and the US Virgin Islands began more than a decade ago, sponsored by the US Fish and Wildlife Service. Over the course of the last fifteen years it has evolved in geographic and analytical scope, and incorporated a multitude of Stateside and island-based project collaborators. The data which have been used in its preparation have been collected over a much longer period of time by a diversity of natural resource professionals, including ornithologists, biologists, ecologists, conservationists, land managers, and planners.

We would like to offer our gratitude to all of the partner institutions and individuals whose support and contributions made this work possible. We are especially grateful to Jaime Collazo of the North Carolina State University Cooperative Fish and Wildlife Research Unit for his guidance and coordination efforts throughout the process of creating this report. Likewise, William Gould and Ariel Lugo of the USDA Forest Service International Institute of Tropical Forestry, Craig Watson of the Atlantic Coast Joint Venture, Sergio Colón of the Puerto Rico Ornithological Society, Claudia Lombard of the US Fish and Wildlife Service in the US Virgin Islands, and Frank Wadsworth all provided detailed comments and suggestions that greatly improved this manuscript.

In addition, we would like to thank Mariano Solórzano and Gary Potts of the USDA Forest Service International Institute of Tropical Forestry; Stefani Melvin of the USDA Forest Service in Idaho; Alcides Morales Pérez, Verónica Anadón, and Verónica Méndez of the Puerto Rico Ornithological Society; Judy Pierce of the US Fish and Wildlife Service in the US Virgin Islands; Ricardo Colón-Merced, José Cruz Burgos, Oscar Díaz, Rafael González, Iván Llerandi, Silmarie Padrón, Marelisa Rivera, and Jorge Saliva of the US Fish and Wildlife Service in Puerto Rico; Daniel Dávila Casanova, Miguel Garcia, Ricardo Lopez, Alexis Martínez, Alberto Puente Rolón, and Eduardo Ventosa of the Puerto Rico Department of Natural and Environmental Resources; Francisco Vilella of the USGS Cooperative Fish and Wildlife Research Unit at Mississippi State University; Frank Rivera of the US Fish and Wildlife Service in Maryland; Soledad Gaztambide, Glorimar Toledo, and Yoganí Govender of the Puerto Rico Conservation Trust; Alexis Dragoni of the Center for Landscape Conservation; Barry Grand of the Alabama Cooperative Fish and Wildlife Research Unit at Auburn University; the North Carolina Cooperative Fish and Wildlife Coop Unit at North Carolina State University; and the US Fish and Wildlife Service in Atlanta who provided funding. We also appreciate the images of regional avifauna contributed by Alcides Morales Pérez, Mike Morel, and Julio Salgado Vélez.

This report has been submitted to the US Fish and Wildlife Service as specified in work contract no. F12PX02389.

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EXECUTIVE SUMMARY

Puerto Rico and the US Virgin Islands (USVI) have a combined total of 364 bird species, including natives, exotics, vagrants, and fossils. Currently, 284 species are known to occur in the region, 17 of which (including one genus) are endemics (i.e., species found nowhere else), in addition to several introduced species. The community includes roughly equal percentages of native birds and Neotropical migrants that occupy a variety of forested, wetland, grassland, and coastal habitats. Human land use practices, particularly deforestation and demands on environmental resources caused by continuous population growth, have negatively impacted some native species, while other native land birds have survived well the historical effects of forest conversion. Habitat loss resulted in the recent extinction of the Culebra race of Puerto Rican Parrot (*Amazona vittata gracilipes*) and the Puerto Rican Parakeet (*Aratinga chloroptera maugeri*), as well as the extirpation of the White-necked Crow (*Corvus leucognaphalus*), and the near-extirpation of the Limpkin (*Aramus guarauna*). Another 25 species are considered vulnerable or endangered at regional or global scales. The extent of the effects of habitat destruction on the migratory birds has not yet been determined. Human activities have also resulted in the creation of anthropogenic habitats with bird conservation values ranging from inferior and resource deficient (e.g., in some, but not all, urban areas) to mostly beneficial (e.g., shade coffee and mixed forest plantations). Notably, extensive habitat conversion has facilitated many exotic birds to become established, resulting in novel biotic communities. Such communities may play useful conservation roles, but they may also advance deleterious interactions, including nest parasitism, increased potential for competition, propagation of foreign diseases, and depredation by introduced mammals. Further investigation of inter-species interactions in both natural and constructed environments is paramount.

In this report we discuss historical and present habitat threats, conservation opportunities, and management strategies to protect important native and migratory birds in Puerto Rico and the USVI. Based on the Partners in Flight (PIF) prioritization process we assigned priority rankings to 144 bird species (131 species for Puerto Rico, 104 species for the USVI, and 90 species common to both PR and the USVI), and then used habitat requirements and available biological information to establish specific bird population objectives to be achieved or surpassed in the next 20 to 25 years. We subsequently analyzed Gap Analysis Project (GAP) predicted species distribution and stewardship management data for 125 bird species associated with 11 distinct habitat types. We then synthesized our findings with recommendations from several relevant conservation reports in order to identify priority habitat areas and establish conservation objectives. While this document is not itself a comprehensive plan, the conclusions within are aimed at guiding island-wide and regional avian conservation planning priorities.

For the PIF prioritization, summary results of the number of species per conservation tier and action level (see Section 3 for detailed descriptions) are as follows:

For Puerto Rico

- Tier 1
 - Critical Recovery -- 19 species
 - Immediate Management – 13 species
 - Management Attention – 33 species
 - Planning and Responsibility – 8 species
- Tier 2
 - Planning and Responsibility – 20 species
- Tier 3
 - None
- Tier 4
 - Planning and Responsibility – 20 species
- Tier 5
 - Generic Population Control – 2 species
 - Local Population Control – 3 species
- No tier – 13 species

For the US Virgin Islands

- Tier 1
 - Critical Recovery -- 20 species
 - Immediate Management – 10 species
 - Management Attention – 11 species
 - Planning and Responsibility – 6 species
- Tier 2
 - Planning and Responsibility – 1 species
- Tier 3
 - Planning and Responsibility – 9 species
- Tier 4
 - Planning and Responsibility – 19 species
- Tier 5
 - Generic Population Control – 2 species
 - Local Population Control – 3 species
- No tier – 19 species

For the GAP-based habitat analysis, summary results reveal the following:

In Puerto Rico

- About 73,298 ha (8.2%) of the archipelago is located within protected areas. The total area of each habitat varies widely.
- To achieve a *baseline* conservation objective of at least 15% across all habitat types would require another 60,939 ha of land.
- Six habitats currently have greater than 15% of their total area already protected.
 - Forested coastal wetlands (60%)
 - Colorado, palm and Elfin forest (54%)
 - Dry limestone forests and serpentine forest (37%)

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

- Marshes and open water habitats (35%)
- Non-calcareous lowland and coastal dry forest (27%)
- Beaches, islets, cliffs, and riparian barrens (22%)

- In contrast, five habitats are conservation-limited, with less than 15% protected
 - Tabonuco and secondary wet forest (11%)
 - Moist limestone (karst) forest (8%)
 - Grassland and shrubland habitats (3%)
 - Urban forest (2%)
 - Non-calcareous moist forest (2%)

Considering avian species richness (regardless of conservation priority level)

- Five habitats harbor more than 40 species
 - Tabonuco and secondary wet forest (48 species)
 - Urban forest (44 species)
 - Beaches, islands, cliffs, and riparian barrens (41 species)
 - Marshes and open water habitats (41 species)
 - Moist limestone (karst) forest (41 species)
- Four habitats have 30-40 species
 - Colorado, palm and Elfin forest (33 species)
 - Dry limestone forest and serpentine forest (36 species)
 - Non-calcareous lowland and coastal dry forest (34 species)
 - Non-calcareous moist forest (33 species)
- And two habitats are the least species rich with 20 or less
 - Forested coastal wetlands (20 species)
 - Grassland and shrubland habitats (12 species)

When species are organized by PIF priority ranking (Tier I only) and habitat together

- Two habitats have more than 20 Tier I species
 - Marshes and open water habitats (27 species)
 - Beaches, islets, cliffs and riparian barrens (27 species)
- Four habitats have 10-20 Tier I species
 - Tabonuco and secondary wet forest (18 species)
 - Moist limestone (karst) forest (15 species)
 - Urban forest (14 species)
 - Dry limestone forest and serpentine forest (11 species)
- Five habitats have less than 10 Tier 1 species
 - Colorado, palm and Elfin forest (9 species)
 - Forested coastal wetlands (9 species)
 - Non-calcareous lowland and coastal dry forest (7 species)
 - Grasslands and shrublands (4 species)
 - Non-calcareous moist forest (2 species)

In the US Virgin Islands

- About 4,547 ha (12.4%) of the archipelago is within protected areas, with widespread variation among islands.
- To achieve a *baseline* conservation objective of at least 15% across all habitat types would require another 975 ha of land.
- Five habitats currently have greater than 15% of their total area already protected
 - Forested coastal wetlands (39%)
 - Non-calcaerous moist forests (35%)

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

- Marshes and open water habitats (29%)
- Beaches, islets, cliffs, and riparian barrens (19%)
- Non-calcareous lowland and coastal dry forest (17%)

- In contrast, three habitats are conservation-limited, with less than 15% protected
 - Dry limestone forest (9%)
 - Grassland and shrubland habitats (7%)
 - Urban forest (1%)

Considering species richness (regardless of conservation priority level)

- One habitat harbors more than 40 species
 - Marshes and open water habitats (44 species)
- Fives habitats have 30-40 species
 - Beaches, islands, cliffs, and riparian barrens (39 species)
 - Non-calcareous lowland and coastal dry forest (25 species)
 - Urban forest (24 species)
 - Non-calcareous moist forest (23 species)
 - Dry limestone forest (23 species)
- And two habitats are the least species rich with 20 or less
 - Forested coastal wetlands (19 species)
 - Grassland and shrubland habitats (7 species)

When species are organized by PIF priority ranking (Tier I only) and habitat together

- Two habitats have more than 20 Tier I species
 - Beaches, islets, cliffs and riparian barrens (24 species)
 - Marshes and open water habitats (20 species)
- And six habitats have less than 10 Tier I species
 - Urban forest (9 species)
 - Forested coastal wetlands (8 species)
 - Dry limestone forest (7 species)
 - Non-calcareous lowland and coastal dry forest (5 species)
 - Non-calcareous moist forest (5 species)
 - Grasslands and shrublands (4 species)

For the region as a whole

- About 77845 ha (8.3%) of Puerto Rico and the USVI lands combined are protected. To achieve a cumulative *baseline* objective of at least 15% across all habitat types would require another 61,914 ha of land.
- The patterns of conservation per habitat type are very similar to those for the separate archipelagos.

Results from our analyses of individual species in both Puerto Rico and the USVI indicate that almost all of the threatened and endangered birds have 15% or more of their predicted habitat already classified as GAP status 1, 2, or 3 protected lands – the two exceptions being the Broad-winged Hawk (*Buteo platypterus brunnescens*; 14%) and Plain Pigeon (*Patagioenas inornata wetmorei*; <2%). Population objectives for endangered forest birds can thus usually be met by maintaining the area and quality of the existing collection of nature reserves or conserving adjacent lands around them. Likewise, vulnerable waterfowl species have significant portions of their predicted habitat already protected, yet many of these landscape features exist as isolated

wetland patches and are limited in total area. Endangered forest birds and waterfowl are excellent indicators of habitat quality and overlap with many other species, but due to restricted population numbers and geographic isolation endangered and threatened species alone are not sufficient to design an effective conservation planning strategy for the majority of the region's birds; the habitat needs of more common birds must be included as well. The bulk of the conservation opportunities for these additional species occur on lands that lack any protective measures (GAP status 4) to prevent conversion to anthropogenic habitat types.

In step with other regional planning efforts of the Atlantic Coast Joint Venture, our purpose with this report is to help develop an effect strategy for the conservation of "all birds across all habitats" within Puerto Rico and the USVI.

The **Goals** of this document are to:

- Highlight important avian species in the region, identify high quality and resilient habitat that meets the needs of priority breeding and migratory birds, and guide planning and management actions so as to maintain or increase populations.

The conservation **Objectives** we aim to promote include:

- Protecting under GAP stewardship status 1, 2, or 3 at least 15% of the land area of each major habitat cover type in Puerto Rico and the USVI, as identified by GAP land cover analysis.
 - 15% protection is only a minimum baseline and should be considered as a region-wide goal.
 - Rare and vulnerable habitats should be relatively more protected, with up to 100% in some cases.
 - Additional evaluation (in some cases with finer resolution mapping) is necessary to establish specific habitat conservation targets for individual islands, taking into consideration the needs of non-avian species as well.
- Protecting under GAP stewardship status 1, 2, or 3 at least 15% of potential habitat for all Tier I priority bird species in the region, as identified by GAP analysis of predicted species distribution.
 - 15% protection is only a minimum baseline and should be considered as a region-wide goal.
 - Critical habitats of rare and vulnerable species should be relatively more protected.
 - Additional evaluation is necessary to establish specific conservation targets for individual species on specific islands.
- Maintaining or improving the stewardship status of existing protected areas and the lands connecting them.
- Reducing fragmentation and mitigating the effects of anthropogenic disturbance on habitat quality, to help isolated bird populations of several different species

traverse a landscape dominated by human influences.

- Integrating bird conservation into a variety of human activities through coordinated planning and education.

The dominant **Strategy** we champion is to:

- Conserve locations of habitat synergy that expand upon protected areas and create convergent habitat linkages among jurisdictions and across public and private lands.

From the perspective of the regional avifaunal community as a whole, Tabonuco and secondary wet forest, moist limestone forest, and to a lesser extent urban forest, grasslands and shrublands, and non-calcareous moist and coastal dry forest all stand out as top priority habitats in which to focus additional conservation efforts. Due to their spatially limited-nature, marshes and open water habitats, forested coastal wetlands, and beaches/islands/cliffs/riparian areas remain as areas of special concern as well.

Considering habitat and species-specific priorities together, important geographic areas and features around which to focus additional conservation efforts include:

- Coastal zones, lagoons, and mangrove forests
- Dry and moist lowland forests
- Guayanilla-Peñuelas Hills
- Habitat corridor from Guánica dry forest through Susúa to Maricao and the Central Cordillera
- Habitat corridor from Río Abajo in northern karst to Caño Tiburones in coastal wetlands.
- Habitat corridor from Toro Negro and Tres Picachos in the Central Cordillera to Río Abajo and Río Encantado in the northern karst
- Lajas Valley and Sierra de Bermeja
- Northern karst belt
- Open water (lakes, reservoirs, and freshwater lagoons)
- Piñones/Torrecillas wetland complex
- Riparian areas connecting upland and interior forests with coastal wetlands
- Sierra de Cayey and Pandura Mountains
- Sierra de Luquillo with lateral connectivity to northern and eastern coastal areas
- Smaller islets and cays
- Upper elevations of the central mountains/hills
- Vieques, Culebra, Mona, St. Thomas, St. John, St. Croix

Priority **Conservation Actions** range from monitoring population trends of some species, to formal research to elucidate habitat requirements and biological interactions, to immediate action for a few critical species in order to protect dwindling populations from disappearing from the region altogether. Specific suggestions for conservation

planners and wildlife managers to consider include the following:

- Protect as much area as possible of rare and critical habitats, up to 100% in extreme cases.
- Maintain and increase acreage of habitat areas throughout the Puerto Rican and USVI Archipelagos in support of federally listed endangered and threatened forest birds, as well as other priority native and migratory species;
- Develop landscape level habitat corridors by linking coastal and adjacent upland areas within a continuous conservation matrix;
- Restore and increase acreage of forested coastal wetlands; protect and restore remaining mangrove communities on both Puerto Rico and the USVI; adopt a “no loss” policy especially for large stands;
- Protect and restore all marshes, open water habitats, and historic lagoons throughout the region, particularly those that are under threat from development or lack of appropriate management; enforce hunting regulations for locally breeding waterfowl undergoing severe declines; investigate the importance of wading birds as indicator species of wetland habitat quality;
- Protect all shorebird salt and mudflat habitats; increase monitoring attention and research on the effects from continuing salt extraction activities;
- Protect, monitor, and appropriately manage all colonial nesting bird sites;
- Conduct monitoring surveys and community level research on vulnerable endemic, obligate, and important migrant species both within and outside of currently protected areas to determine population status and future habitat needs;
- Increase habitat for native and migratory species through a network of well-managed shade-grown coffee farms, polyculture plantations, and urban forest habitats;
- Assess the direct and indirect effects of pollution, development, fragmentation, mosquito control measures, and recreational use on the quantity and quality of wetland and coastal habitats;
- Determine status of and need for conservation attention to the endemic Elfin-woods Warbler (*Setophaga angelae*) and possible promotion of this warbler to federal listed status;
- Determine if subspecies of the Sharp-shinned Hawk (*Accipiter striatus venator*), Loggerhead Kingbird (*Tyrannus caudifasciatus*), Lesser Antillean Pewee

(*Contopus latirostris*), and Antillean Euphonia (*Euphonia musica*) are in fact wholly unique and endemic species.

- Determine status of and need for conservation attention to Puerto Rican subspecies of the Short-eared Owl (*Asio flammeus*) and Grasshopper Sparrow (*Ammodramus savannanum*) in grassland and shrub habitats; restore native grasses on public lands wherever appropriate;
- Consider reintroduction of extirpated species from Puerto Rico and the USVI to historical habitats within those territories where appropriate;
- Assess the effects of the Shiny Cowbird, Pearly-eyed Thrasher (*Margarops fuscatus*), and other exotic predators (e.g., mongoose, rats, monkeys) on native bird populations, and determine areas where control measures would be most effective in stabilizing vulnerable populations;
- Investigate and monitor localized effects of climate change and rising sea levels on coastal zones, mangrove habitats, and upper elevation forests;
- Investigate the importance of isolated tree plantations and urban habitats for the conservation of native and migratory avifauna;
- Minimize communication towers, wind turbines, and other disturbances along ridgelines and other sensitive areas that reduce or fragment natural habitat;
- Develop and adopt comprehensive land use planning for both Puerto Rico and the USVI;
- Improve mapping and refine general habitat conservation objectives beyond the 15% baseline value and identify unique targets specific to each habitat and individual islands within the region, in conjunction with the Caribbean Landscape Conservation Cooperative; and
- Scale-up habitat and population objectives and monitoring protocols that complement efforts throughout the Caribbean and inter-American levels such as via the Atlantic Coast Joint Venture Implementation Plan and the development of a Caribbean colonial waterbird plan.

Successful, on-going protection of birds and their habitats requires a thoughtful approach that incorporates conservation tools, restoration and adaptive management practices, monitoring procedures, and educational outreach – at multiple spatial and temporal scales. Several **Conservation Strategies** to consider include:

- Expand private lands and public engagement programs (e.g., Safe Harbor Program, shade grown coffee incentives via Partners for Fish and Wildlife) to

conserve, restore, and enhance the ecological functions of habitats under private ownership;

- Develop guidelines and sustainable agricultural practices (e.g., soil conservation, riparian buffers) that benefit wildlife and help in the development of biological corridors between natural areas;
- Promote and stimulate management oriented research to develop effective habitat management tools to protect key priority species groups;
- Develop partnerships with local and federal governments (including military) and non-governmental organizations (NGOs) to integrate bird conservation with other natural resource conservation, management, and land use programs such as water and soil conservation, urban development and land use planning/zoning, agricultural activities, management of protected areas, and ecotourism;
- Foster coordination and collaboration among various conservation-oriented agencies, NGOs, land trusts, municipalities, and private landowners, to encourage pooling of resources that enhance opportunities to secure funding through federal land-conservation programs for wetlands (e.g., North American Wetlands Conservation Act grants, National Coastal Wetland Conservation grants, Neotropical Migratory Bird Conservation Act grants, NOAA, EPA, etc.), forests (e.g., Forest Legacy program), and other habitats (e.g., NRCS).
- Collaborate with the Caribbean Landscape Conservation Cooperative's network of researchers, managers, and outreach specialists to develop and communicate sound science-based information to help in the conservation of avian species and habitats;
- Engage citizen scientists in monitoring programs to obtain information on population trends and habitat requirements of high priority species, and to study the effects of habitat management actions and climate change on species distribution across the landscape;
- Develop culturally compatible education programs including the necessary tools and skills to clearly establish the links between bird habitat, human related ecosystem services, and quality of human life; outreach strategies should include development of teacher training workshops, use of electronic technology, and cultivation of partnerships to actively promote and convey bird conservation messages to school children, the general public, the business community, land managers, and decision makers;
- Establish a bird conservation coordinator for Puerto Rico, the USVI, and the rest of the Caribbean to promote the above listed activities in the region and to serve as liaison with institutions in the Caribbean and the US mainland.

Many of these recommendations are based on the examination of predicted distribution models and as such *are intended to guide – not prescribe – opportunities for successful conservation stewardship*. All conclusions presented here should be reviewed by managers prior to implementation, and where necessary modified, re-scaled, and/or generally improved upon by incorporating local expertise and new information, including the anticipated effects of climate change, and the socioeconomic and institutional factors that underlie conservation decisions. Given dynamic environmental conditions, multiple stakeholders and viewpoints, limited finances and resources, and bureaucratic realities, making smart choices about what actions and strategies to employ and where can be accomplished by engaging in a structured decision making process that establishes clear priorities and weighs the pros and cons of alternative solutions. Protecting and enhancing priority wildlife habitat so as to strengthen populations of native and migratory birds throughout the region for present and future generations remains our ultimate aspiration.



Puerto Rican Emerald. Photo credit: Mike Morel

INTRODUCTION

There is a wealth of available knowledge about individual bird species, their habitats, and conservation of select priority sites throughout the US Commonwealth lands located in the Caribbean. To date, however, these materials have not been assembled into a single resource that can provide baseline information at the island-wide scale and facilitate moving forward with a rigorous conservation planning approach. The purpose of this publication is to fill that void, i.e., to develop comprehensive conservation planning priorities for the birds of Puerto Rico and the USVI. The novel elements of this endeavor are twofold: 1) we focus on junctions of convergence among previously existing data sources and biodiversity analyses; and 2) we identify specific, numerical goals and objectives for bird populations in the region and their associated habitats. Our recommendations are based on salient results obtained from an extensive body of related research previously published, jointly with the conclusions reached through our own scientific analysis.

Successful strategic habitat conservation is an adaptive process that integrates biological investigation and planning, conservation design, program implementation, applied research, and monitoring. The integrated parts of biological planning include understanding the ecological context (e.g., threats, limiting factors), selecting focal bird species, setting reasonable population objectives, and defining species-habitat relationships. Conservation design then establishes the habitat area required to meet the population objectives, taking into account the desired landscape configuration as well as information about where the best conservation responses can be expected to be achieved (Grand 2009). In this document we give full treatment to the biological planning component and embark on the beginning stages of conservation design. Future ventures by local conservation agencies will be responsible for making refined habitat decisions and implementing strategies that put the information from this report into practice.

The content of this document is divided among six sections that build one upon the next, and are intended to dovetail with and reinforce the goals and approaches outlined in the Puerto Rico and US Virgin Islands' Comprehensive Wildlife Conservation Strategies (García et al. 2005, Platenberg et al. 2005). The first section encompasses broad environmental details about regional geography and habitats, important historical and current land use patterns, and conservation issues. Section 2 discusses several prominent conservation resources that were relevant to our planning mission and provided complementary recommendations that when combined together helped inform our own conclusions. In Section 3 we present the results of our avifaunal analysis, ranked in tiers by priority conservation scores for each of the species evaluated. Sections 4 and 5 focus on habitats and species, respectively, evaluating each against a minimum baseline conservation objective of 15%. Section 4 identifies the dominant habitat cover types and addresses general ecology, conservation status and threats, associated bird assemblages, and stewardship areas/opportunities relevant to each habitat; this information is useful for practitioners who want to maximize the avian conservation benefit per area of land conserved. Section 5 highlights individual species

by outlining population estimates and objectives, determining which species are habitat limited, and identifying geographic conservation priorities based on an analytic synthesis of relevant data. Lastly, in Section 6 we discuss a suite of protection, management, monitoring, networking, and outreach strategies that can be utilized to help bridge the gap between setting numerical objectives and achieving results. Also included are a series of appendices that elucidate or expand upon several themes referred to in the main body of the text.

A large portion of the habitat analysis we performed for this plan was based on data provided by the Puerto Rico and US Virgin Islands Gap Analysis Programs, comprehensive assemblages of information on the islands' land cover, vertebrate occurrences and natural history information, and land stewardship. GAP data are intended for use at a scale of 1:100,000 or smaller for the purpose of coarse-filter analysis assessing the conservation status of animals and vegetation types over broad geographic extents (Gould et al. 2008a). Our report is aimed at island-wide and regional conservation planning, a dimension to which GAP data are well suited. We do make a number of recommendations for potential conservation opportunities at the local site scale, particularly between existing stewardship areas. In these cases we rely on additional information from other analyses, management reports, and conservation-oriented documents to make priority habitat selections, using GAP data as contextual background.

Although tangible objectives are important, effective conservation planning must also be flexible enough to evolve through time as conditions fluctuate and new data become available. The concepts, numbers, and targets discussed here are not intended to be the final word; indeed, there are still important GAP analysis species and stewardship data to be incorporated for Puerto Rico's colonial seabirds and many migratory songbirds. We anticipate that the recommendations presented here will serve as a blueprint for conserving valuable breeding, migration, and wintering habitat in the region. It is also our hope that this work will help stimulate and guide further debate, inquiry, and rigorous investigation that leads to a refining of goals, better science, and in the end better bird conservation.

SECTION 1: THE PLANNING UNIT

Introduction

Puerto Rico (PR) and the US Virgin Islands (USVI) are part of the West Indies chain, which extends from Florida to Venezuela and separates the Caribbean Sea from the Atlantic Ocean (Figure 1). These tropical islands are located within 17-19° latitude N and 64-68° longitude W, about 1,600 km from Florida and 800 km the coast of South America. The region covered in this plan is comprised of six major oceanic islands, of which Puerto Rico is the largest, and numerous smaller islets and cays. In the paragraphs that follow we discuss the biogeographical setting of Puerto Rico and the USVI separately.



Figure 1: Map of the Caribbean showing the location of Puerto Rico and the US Virgin Islands.

Puerto Rico

Puerto Rico is a small archipelago centered on the geographic coordinates 18°15' N by

66°30' W that includes the main island of Puerto Rico, Vieques, and Culebra to the east, Desecheo, Mona, and Monito to the west, with a considerable numbers of cays dispersed among them. Total land area of all islands is 9,000 km² (Gould et al. 2008a). The first three islands are inhabited by humans; Desecheo, Mona and Monito are wildlife refuges. Puerto Rico became a territory of the United States of America in 1898 after the Spanish-American war. Presently, Puerto Rico is a commonwealth and, under a constitution approved in 1952, has its own government that presides over most internal and external affairs except in issues affecting US national security (Brandeis et al. 2007).

The core of Puerto Rico is comprised of volcanoclastic sediments and dioritic intrusions, flanked by carbonate sediments that spread toward the coast (Scatena 1989). A considerable proportion (22%) of the archipelago's land area has slopes steeper than forty-five degrees. Greater than 50 percent of the land surface is classified as mountainous (Figure 2), almost a quarter of which extends above 300 m. Another 20 percent is characterized by hills, and a relatively flat coastal plain (25%) dominates the low-lying areas. The highest point in the island rises up to 1,338 m near the center of the Cordillera Central, a rugged mountain range that crosses Puerto Rico from east to west. One of the most conspicuous geological features in Puerto Rico is its northern karst region, which comprises approximately 28% of the total main island area. The karst belt covers more than 1,100 km² and supports the greatest terrestrial biodiversity as well as the largest area of continuous forest cover on the island (Gould et al. 2008a).

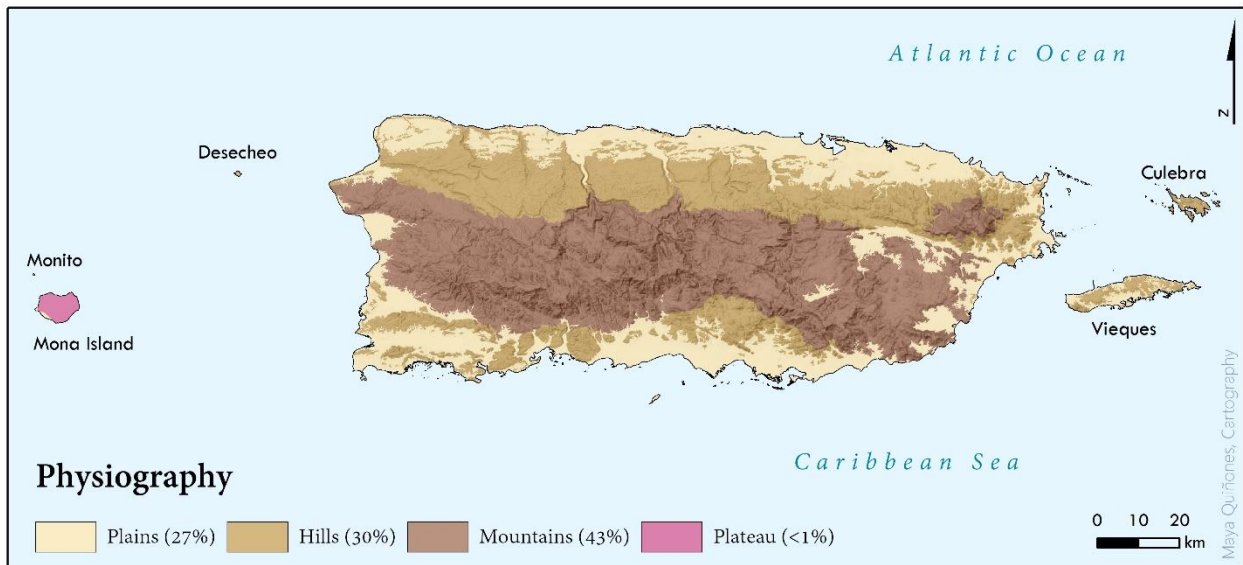


Figure 2: Physiographic regions of Puerto Rico (source: Quiñones et al. 2013).

The topography and geology of Puerto Rico (particularly the Cordillera Central) combined with the north-eastern trade winds have a strong influence on the island's local climate and life zones (Figure 3), which in turn influence plant communities. The northern region is typified by tropical moist and wet forest while the southern region exhibits sub-tropical dry forest vegetation (Ewel and Whitmore 1973). Grasslands and

wetlands abound as well. Regular hurricane disturbance plays a key role in determining forest structure and composition throughout Puerto Rico (Brandeis et al. 2007).

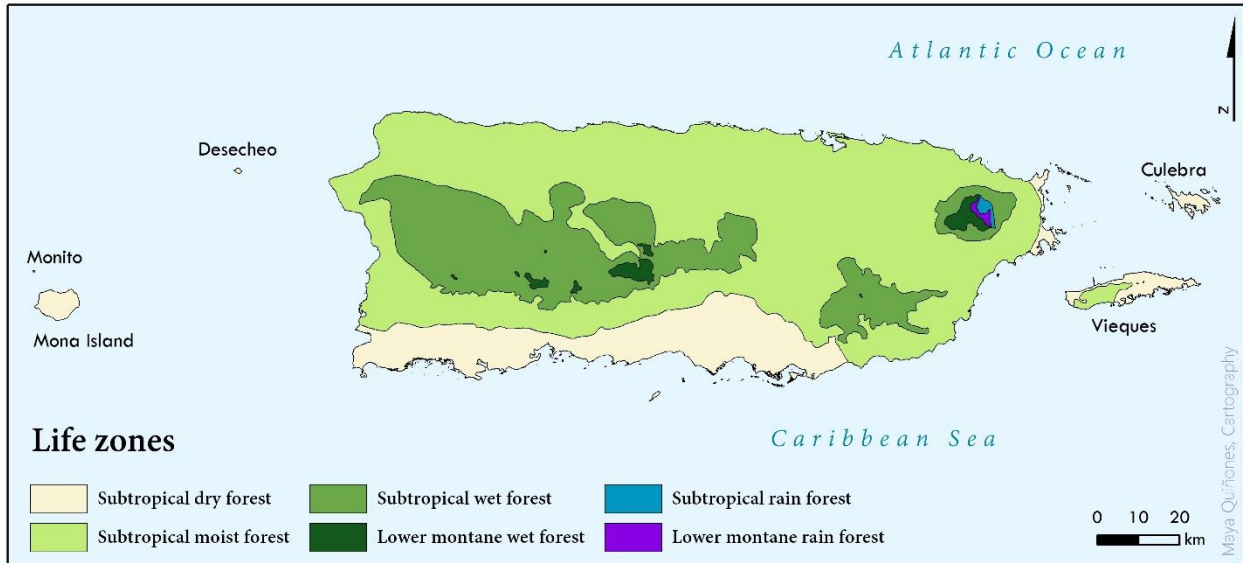


Figure 3: The six most extensive geo-climatic zones in Puerto Rico (source: Ewel and Whitmore 1973).

US Virgin Islands

The USVI are located about 60 km east of Puerto Rico in the northern Caribbean Sea. These Islands comprise another archipelago that includes St. Thomas, St. John, St. Croix, and greater than sixty uninhabited small islets and cays. The three main Islands were bought from Denmark in 1917 by the USA and are now an unincorporated US territory centered at coordinates 18°20' N. by 64°50' W (Brandeis and Oswalt 2007).

Land area in the USVI totals 346 km². The two major islands to the north, St. Thomas (73 km²) and St. John (52 km²), are mountainous with peaks rising to 474 m (the highest in the USVI) on St. Thomas and 392 m on St. John, and with limited flat areas along the coastal plains (Figure 4). The hilly topography of these islands influences weather patterns resulting in moderate amounts of precipitation. During cooler climatic times when sea levels were lower at the end of the last ice age, Puerto Rico and the British Virgin Islands, together with St. Thomas and St. John, were connected as one land mass known as the Puerto Rico Bank, only becoming separated about 8,000 to 10,000 years ago. St. Croix, geographically isolated some 64 km to the south in the deep waters of the Virgin Islands Basin, is a flatter, drier island, with fewer bays and offshore cays (Rankin 2002, Wiley and Vilella 1998). It is larger than St. Thomas and St. John, having a total area of 221 km² and an elevation of 355 m at its highest point. Like Puerto Rico, the US Virgin Islands are volcanic in origin and have soils derived from volcanic and limestone materials, and enjoy a subtropical climate (Rankin 2002, Brandeis and Oswalt, 2007).

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

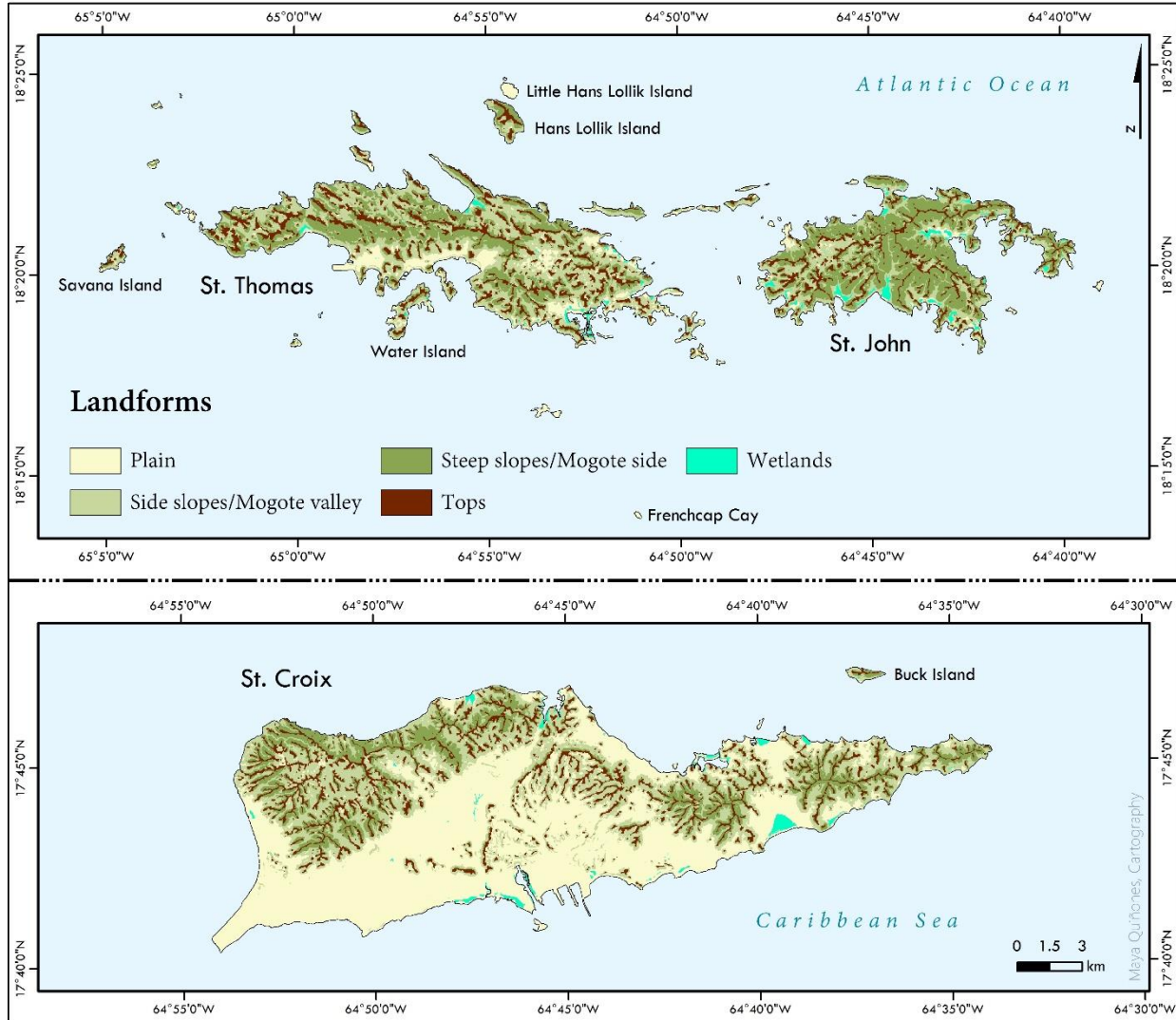


Figure 4: Dominant landforms and their distribution within the US Virgin Islands (source: Martinuzzi et al. 2007).

In contrast to Puerto Rico, lower elevations in the USVI result in relatively limited cooling of the moist trade winds, and therefore less condensation and precipitation (Brandeis and Oswalt 2007). Rainfall averages about 750 mm per year in coastal areas, and up to 1400 mm per year in areas of higher elevation (Wiley and Vilella 1998, Platenberg 2005). Ewel and Whitmore (1973) described two forest zones for the USVI, a subtropical dry zone with littoral shrubs, and a subtropical moist forest zone in small patches along waterways and drainages (Figure 5). A variety of wetlands, grasslands, and coastal zone habitats are present as well (Brandeis and Oswalt 2007). As is typical of Caribbean islands, the USVI are periodically affected by cyclonic disturbances such as hurricanes.

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

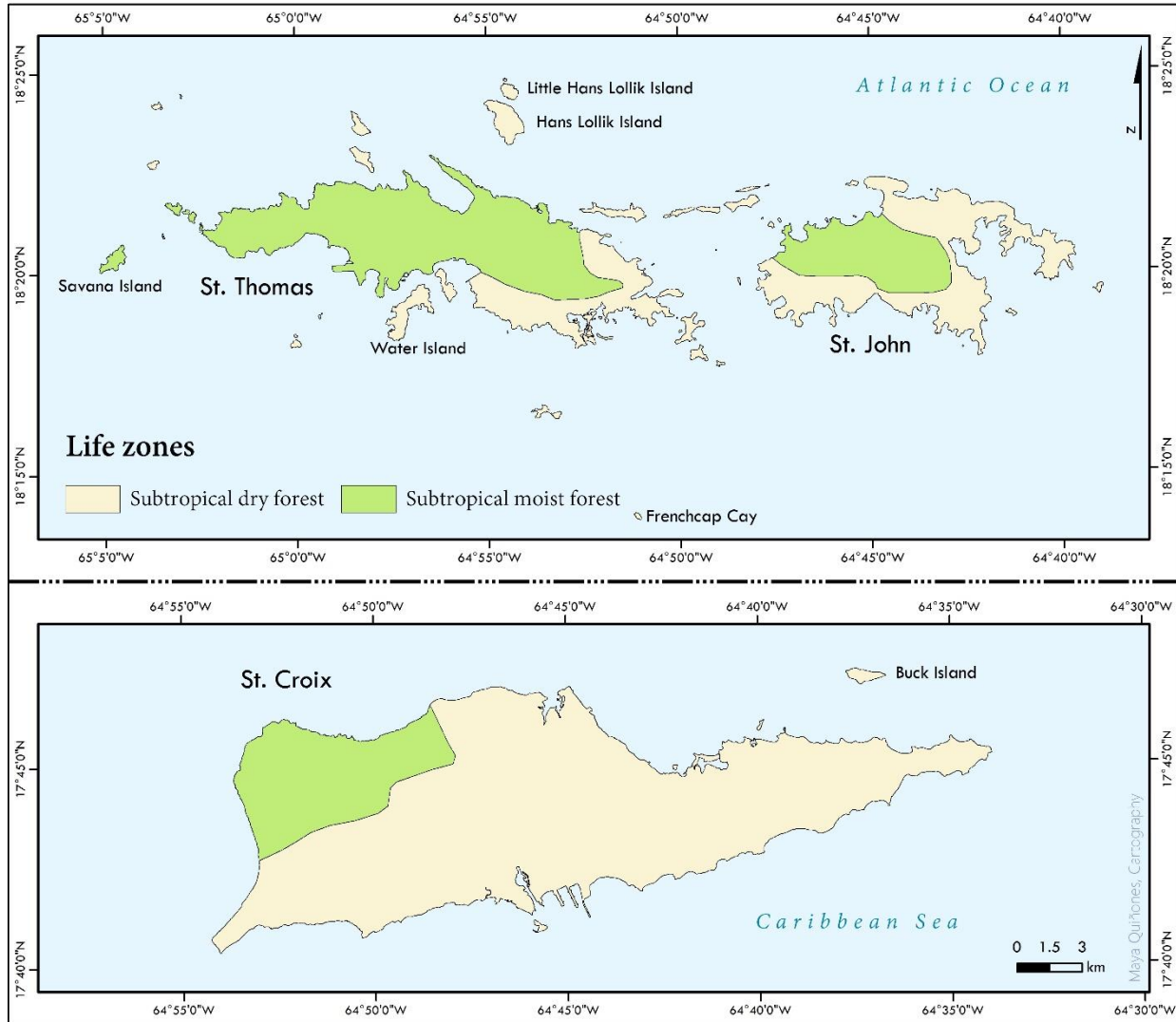


Figure 5: The two major forest zones in the US Virgin Islands (source: Ewel and Whitmore 1973).

Land Cover Overview

The Caribbean is regarded as a hotspot of global biodiversity distinguished by high species richness and endemism (Myers et al. 2000). The number, size, and shape of the islands comprised within this region combined with climate, topography, geological processes, and human activities have produced a tremendous assortment of land cover classes and habitat types. Prior to the 19th century, distinct forest assemblages covered the majority of the land area of Puerto Rico and the USVI (Birdsey and Weaver 1987; Wadsworth 1950). Subsequent forest conversion from agricultural and other land use practices has altered historical land cover patterns and resulted in a contemporary landscape mosaic that includes several dozen distinct cover classes in Puerto Rico and the USVI (Gould et al. 2008a, Gould et al. 2013a). Many of the cover types can be grouped into simplified categories. Figure 6 shows the landscapes of Puerto Rico and the USVI classified into eight broad cover types. Forests, woodlands, and shrublands

dominate in both Puerto Rico and the USVI, with significant portions of the landscape covered by grasslands and anthropogenic urban settings. Together the different cover types are distributed across a wide range of coastal and inland environments, resulting in a diversity of habitat types that serve the distinct needs of the region's avifauna. Those habitats and their associated bird assemblages will receive full attention in Section 4.

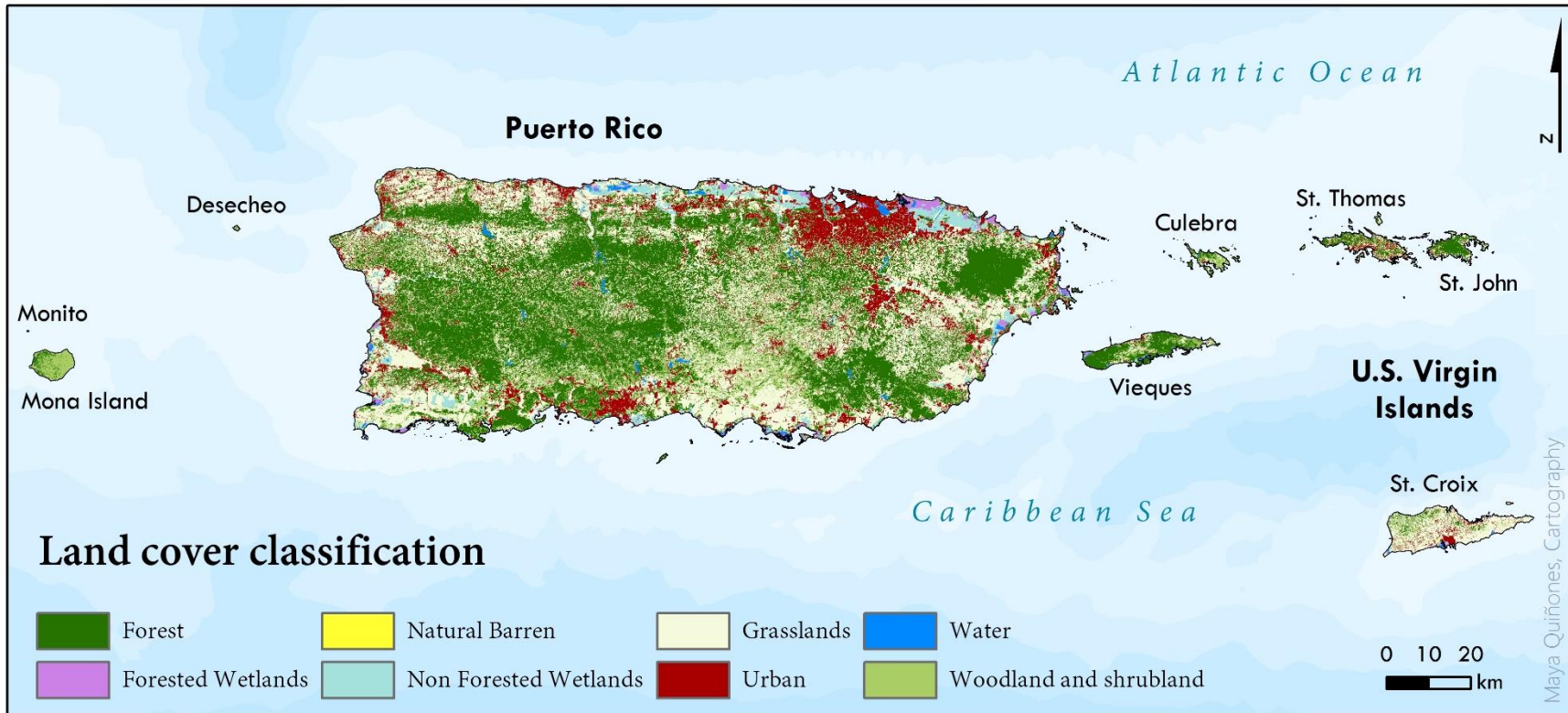


Figure 6: Simplified land cover map of Puerto Rico and the US Virgin Islands. Land cover years represented are 2000 for Puerto Rico (source: Gould et al. 2008a) and 2007 for the USVI (source: Gould et al. 2013a).

Important Considerations for Conservation Design in the 21st Century

In any area inhabited by humans, wildlife conservation competes with human needs and economic interests for limited natural resources. This conflict often changes the quantity and quality of natural habitats and consequently affects the associated wildlife populations, causing detriment to some species and benefitting others. For example, avian species that depend on extensive tracts of mature forest for their survival can be negatively affected by fragmentation of their habitat. On the other hand, species that require shrubby, regenerating growth in open areas at the forest's edge may thrive from land use activities that divide large tracts into smaller parcels (Robbins et al. 1989, Irizarry 2012, Lugo et al. 2012)

The landscapes of Puerto Rico and the USVI have weathered the influence of human activities for many centuries. Over the course of the past 2,500 years that humans have occupied these islands, and particularly in the last 500 years, evolving socio-economic patterns have resulted in variable degrees of habitat transformation. Current land use trends associated with modern development practices continue to alter the face of the landscape and available habitat for avifaunal populations. In addition to past and present land management decisions, climate change is another contemporary factor that affects community composition and structure across different habitat types and will continue to do so throughout this century and beyond. The following paragraphs will briefly touch on these important themes which should be given serious attention by any conservation planning effort.

Historic Land Use Patterns, Habitat Deterioration, and Wildlife Populations

Consider the Puerto Rican archipelago. When Columbus landed in the Americas, Puerto Rico, and indeed all of the West Indian islands, was covered by extensive forests (Wadsworth 1949, 1950, Watts 1987). Despite a considerable number of aboriginals living on the islands at that time, anthropogenic influences were considered localized along coastal and riverine areas, with interior forest ecosystems of remaining largely undisturbed until colonization by the Spaniards during the 16th century (Birdsey and Weaver 1982, Watts 1987). The first colonizing activities were concentrated in the search and exploitation of gold deposits. By the beginning of the 16th century, progressive forest loss commenced with the development of an agrarian society after the gold deposits became exhausted (Watts 1987). Forest destruction was further accelerated with the adoption of "La Cedula de Gracia" by 1815, encouraging increased production of agricultural products by opening the island to international trade (Brash 1987). During the 19th century and the first half of the 20th century the cultivation of cash crops continued its expansion through Puerto Rico reaching well into the mountainous areas (Birdsey and Weaver 1982).

As a result, the increased demands for natural resources lead to the devastation and fragmentation of the mature forests (Figure 7). It is estimated that at the peak of deforestation by 1930, about 6-15% of the surface area of Puerto Rico was covered by forest and less than 1% of the pristine forest remained (Wadsworth 1950, Little et al. 1974, Watts 1987). Most of the forested areas at that time were coffee plantations,

watersheds and secondary growth in the abandoned croplands (Wadsworth 1950). Since the 1940s Puerto Rican forest and woodland acreage (excluding mangroves) has increased considerably to an estimated 53% of the island (Gould et al. 2008a). Changes in land use trends led by a socio-economic transition from an agrarian to an industrialized society have permitted the growth of secondary forest in the formerly cultivated and pastured lands (Wadsworth 1950, Birdsey and Weaver 1982). Much of this reforestation has occurred in mountainous areas with steep slopes that are likely to deter future deforestation and development (Personal communication, F. Wadsworth, 2014).



Figure 7: The height of agricultural production in Puerto Rico coincided with significant deforestation of the island's resources (source: USFS IITF Flickr photo sharing page - <https://www.flickr.com/photos/101115103@N03/14476603378/in/set-72157645295608857>)

Though smaller in geographic scale and with a less diverse range of natural ecosystem types, the landscape of the USVI has likewise been altered by the presence of human populations, including indigenous Arawak and Carib peoples, and later European colonists. What extent of the islands was forested at the time of Columbus' arrival in 1493 is largely a matter of speculation, but early reports and descriptions suggest that pre-colonization activities of native peoples had little influence on the vegetation, which

was primarily subtropical dry forest (Haagensen 1995, Weaver 2006). The rise of plantation agriculture, primarily for sugarcane and cotton in addition to logging for timber, led to significant land clearing in the 18th and 19th centuries (Weaver 2006, Brandeis and Oswalt 2007). Agricultural abandonment and accompanying forest reversion in the USVI began many decades prior to Puerto Rico's similar transition, largely as a result of emancipation of slaves in the mid-1800s, that made sugar production on the islands much less profitable (Rogozinski 2000). Forest cover in the USVI has rebounded considerably in the past century and now comprises greater than 60% of the total land area, including woodlands and shrublands (Gould et al. 2013a); St. John is nearly completely forested, three-quarters of St. Thomas is in forest, and on the flatter terrain of St. Croix where small-scale farming and ranching still persist there is about 50% forest and shrubland cover. Overall the forest stands of the USVI are young and comprised of small diameter stems that reflect the legacies of human land use (Brandeis and Oswalt 2007).

The role of human influence in driving land use patterns through time – and likewise the large-scale composition and abundance of faunal assemblages – is paramount. The generalized habitat deterioration severely affected several native and endemic birds in the region. Forest destruction was an important factor precipitating the extinction of the Culebra race of the Puerto Rican Parrot (*Amazona vittata gracilipes*) and the extirpation of the White-necked Crow (*Corvus leucognaphalus*) (Raffaele 1989, Snyder et al. 1987). The distribution of other species such as the Broad-winged Hawk (*Buteo platypterus brunnescens*), the Sharp-shinned Hawk (*Accipiter striatus venator*), Puerto Rican Tanager (*Nesospingus speculariferus*), and the Puerto Rican Nightjar (*Caprimulgus noctitherus*) became restricted to intact higher mountain forests (Raffaele 1989). Many endemic species such as the Puerto Rican Parrot, the Puerto Rican Nightjar, the Yellow-shouldered Blackbird (*Agelaius xanthomus*), and the Plain Pigeon (*Patagioenas inornata wetmorei*) survive to the present only as a result of intensive recovery efforts and protection of critical habitat.

In total, the extinction of seven (11.6%) native land bird species on Puerto Rico can be attributed to forest conversion (Brash 1987). This relatively low species loss may be explained, in part, by the insular characteristics of Puerto Rico's avifauna. Brash (1987) and Lugo (1988) suggested another explanation emphasizing the role shade coffee and scattered tracts of secondary forest served as refugia, thus ameliorating extinction rates. A sub-species of the Puerto Rican Screech-Owl (*Megascops nudipes newtoni*), reported by Moreno (1995) to be extinct, may also have succumbed to habitat loss from forest clearing in the USVI. As for North American migratory species wintering in Puerto Rico and the USVI, the effects of historical deforestation is not yet known.

Another consequence of forest conversion was the formation of new anthropogenic habitats and the wildlife communities associated with them. For example, habitat conversion has facilitated the establishment and range expansion of exotic species in the region, such as the Shiny Cowbird (*Molothrus bonariensis*), a brood parasite. Shiny Cowbird parasitism is considered a major factor in the decline and endangerment of the Yellow-shouldered Blackbird in Puerto Rico. The Yellow "Golden" Warbler (*Setophaga*

petechia), the Puerto Rican Vireo (*Vireo latimeri*), and the Puerto Rican Oriole (*Icterus portoricensis*) are heavily parasitized by the Shiny Cowbird (Wiley 1982, Wiley et al. 1983, Núñez-García 1988, Perez-Rivera 1986, Faaborg et al., 1997, Woodworth 1997, Woodworth et al. 1998) and their populations may be declining as a consequence. Likewise, direct or indirect effects by introduced diseases and predation by exotic mammals and domesticated cats have also had detrimental effects on bird populations. Raffaele (1989) notes that the endangerment of ground nesters such as the Puerto Rican Nightjar, Short-eared owl, Black Rail, Key West Quail-Dove, and Bridled Quail-Dove were all likely substantially caused by the introduced mongoose (*Herpestes auropunctatus*).

In recent decades, with the decline of agriculture and consequent increase in wooded habitats, the populations of several species of hawks, owls, flycatchers, cuckoos, and other types of forest birds have rebounded, and are perhaps more widespread in the region today than they have been at any other time in the past 60 years (Lugo et al. 2012, Vázquez-Plass and Wunderle 2013). However, land use legacies persist and the avifauna of Puerto Rico has reorganized accordingly. A recent study of Puerto Rico Breeding Bird Survey Data by Acevedo and Restrepo (2008) noted that although endemic and exotic bird species are distributed widely throughout the island, endemic birds abound in closed forest habitats at high elevations, while disturbed lowland open habitats such as pastures and agricultural fields are dominated by exotic species.

Development Trends

Human alteration of habitat is rapidly changing global diversity patterns and nowhere is this more dramatic than in insular habitats (Pimm et al. 1995, Sala et al. 2000) where residents face the challenge of balancing development and forest conservation. As emphasized repeatedly throughout this document, a burgeoning human population and the associated development pressures are primary forces contributing significantly to habitat loss and degradation of wildlife populations in Puerto Rico and the USVI. Modern forest conversion continues in a second cycle where urban development encroaches on regenerated growth, and forested habitats are irreversibly converted into environments hostile to wildlife (Helmer 2004). An analysis of high and low density development in Puerto Rico determined that there are some 95,000 ha of urban/built-up lands, about 60% of which are classified as high-density compact development within urban centers (primarily in the plains), and the remaining 40% being low-density development (predominantly in hills and mountains) that extends outward from urban centers along linear features such as roads (Martinuzzi et al. 2007). Together these developed lands account for more than 10% of Puerto Rico's total land area (Figure 8).

Furthermore, the effects of urban growth and sprawl have not been uniform. Substantial evidence exists confirming that the vegetation and biodiversity of low-lying and coastal areas with fertile soils derived from alluvial deposits in both dry and moist life zones have been preferentially affected by agricultural practices and human settlements (Keel et al. 2005). Helmer (2004) reported that topography, in combination with proximity to and size of existing urban areas, directly affects the ease and cost of land development in Puerto Rico, regardless of its landscape-level ecological

implications. Unprotected lowland zones and surrounding buffer areas are consequently in danger of being lost to development more rapidly than unprotected lands in the hills and mountains. Even low-density development in areas of steep topography can still have significant deleterious consequences in terms of habitat

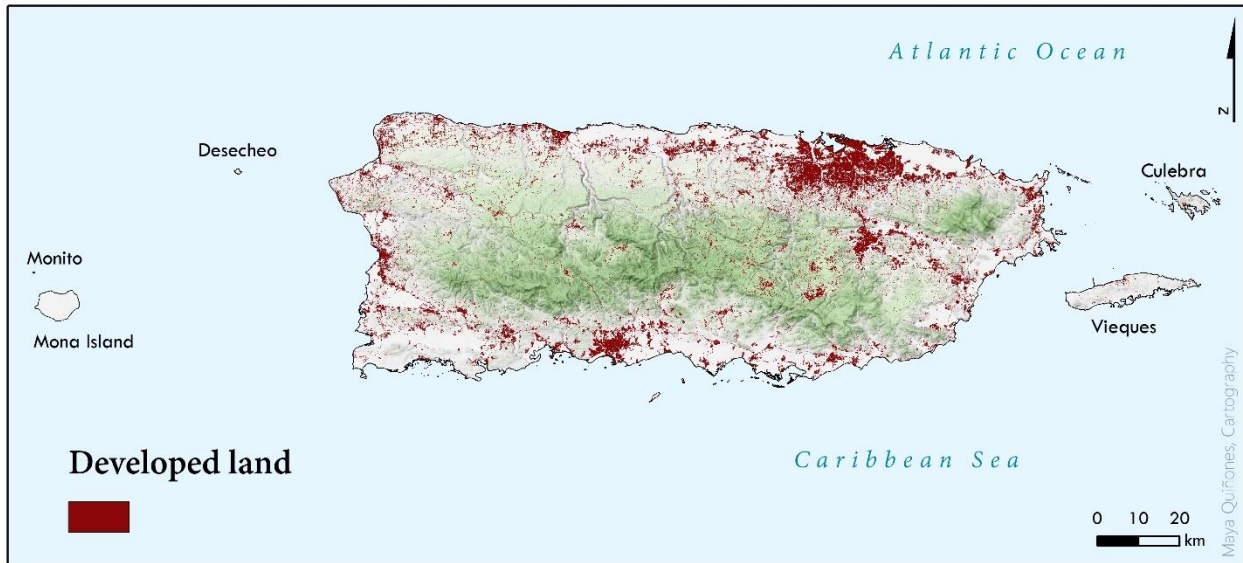


Figure 8: Developed or built up areas (in red) of Puerto Rico (source: Gould et al. 2008a).

destruction and fragmentation. Reduced populations of endemic bird species in lowland settings over the course of the last century can largely be explained by human land use patterns (Acevedo and Restrepo 2008). Such conversion and destruction has negatively affected at least nine bird species in Puerto Rico (Raffaele 1989).

Growing demand to convert land for urban housing and tourism resort development has also created pressure on wildlife habitat in the USVI (Birdlife International 2008), where greater than 11% of the total land area is developed or built up (Figure 9, Gould et al. 2013a). On densely populated St. Thomas, as much as one third of the island is classified as “developed,” with large expanses of the native forests and coastal wetlands now fragmented or replaced by sprawling residential communities, commercial centers, hotels, golf courses, and marinas (Platenberg 2005). Even young forests on abandoned agricultural lands are being cleared for residential and commercial developments (Brandeis and Oswalt 2007). Moreover, the effects of development may potentially be amplified due to the fact that natural ecosystems in the USVI are generally small, highly vulnerable units.

Poorly planned development and agricultural practices have had severe effects on non-forested habitats, exacerbating soil loss and resulting in siltation, pollution, and eutrophication of streams, lagoons, and reservoirs throughout Puerto Rico and the USVI. The draining and filling of freshwater swamps and lagoons has adversely impacted at least 22 bird species (Raffaele 1989). This has been exacerbated by uncontrolled excessive hunting of all six species of breeding ducks and other fresh water swamp forms. Proliferation of tourist and housing facilities, large shopping

centers, and other types of human development affect mangrove forest, littoral shrubs, coastal lagoons, and mud and salt flat habitats. Mangrove and mudflat destruction has detrimentally affected at least 11 species (Raffaele 1989). Degradation of reefs and fisheries from sedimentation, pollution, overfishing, ship collisions, oil spills, and lack of protective legislation have all contributed to declines in seabird populations that feed in coastal waters (Bradley and Norton 2009). Islets important for colonial nesting birds are threatened by increasing human use including tourism, boating, poaching, and the legacy of their use as bombing targets by the US Navy. It is thought that 14 species that depend on these islets for breeding are threatened as a result of these human activities (Raffaele 1989). Despite marked improvements in natural resource protection and conservation planning in Puerto Rico and the USVI, these destructive land use practices continue today, encroaching on the remaining natural and regenerated habitats.

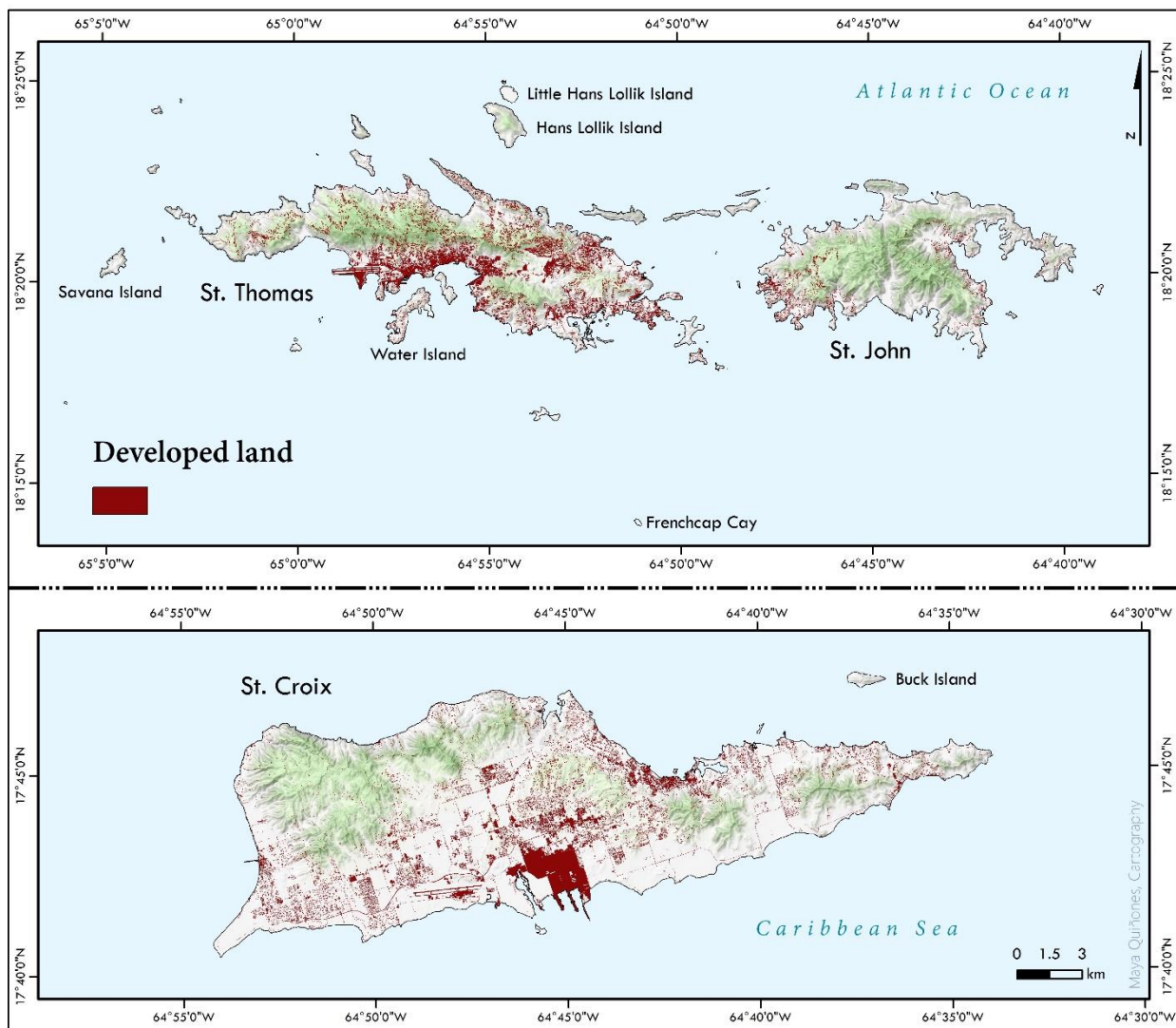


Figure 9: Developed or built up areas (in red) of the US Virgin Islands, including low, medium and high density urban development (source: Gould et al. 2013a).

Climate Change

After land use, climate appears to be the biggest player in driving large-scale composition and abundances of bird assemblages across Puerto Rico (Avevedo and Restrepo 2008). Generally speaking, global environmental change affects species interactions directly and through its effects on altered ecosystem processes (Chapin et al. 2000). Region-wide analyses generated by global circulation models predict an expansion of drier habitats in the Caribbean (Neelin et al. 2006, Campbell et al. 2011). In concert with this long-term drying trend, the frequency and intensity of pulsed rainfall events like hurricanes is anticipated to increase, a product of rising sea surface temperatures in a warming global climate (PRCCC 2013a). Although the current climate models still need further refining in order to be down-scaled and applied to smaller islands, there are several hypotheses that can be postulated from the expected changes in precipitation patterns.

Alterations in climatic patterns will influence vegetation dynamics and the ability of habitats to support avian populations. Species with restricted ranges linked to environments located at the extremes of temperature and precipitation gradients are likely to be affected, as are species that have been pushed toward the edges of their range as a consequence of land conversion (Channell and Lomolino 2000, Staudinger et al. 2013). For example, in the lower montane forests of Puerto Rico, both the Elf-woods Warbler and the Puerto Rican Sharp-Shinned Hawk might be at risk. It is not clear whether these species need specific environmental conditions characteristic of montane habitats, or rather if the biological environment (e.g., fewer congeners, adequate prey) makes high elevation habitats unique for them. Regardless, changing climatic patterns might further restrict their range, alter their prey base, and possibly open the habitat to other species that normally could not dwell there (Delannoy 1997, Anadón-Irizarry 2006). As a result of this restriction and the corresponding interactions among species, reproduction and survival might be compromised, thereby altering the demography of these already vulnerable species. Additionally, the speed of shifts in ranges and phenologies may further complicate matters; Staudinger et al. (2013) reported unequivocally that global climate is changing and having widespread effects on biodiversity throughout the United States at rates faster than were previously documented.

Provided that prevailing winds do not change, the extent of dry forests or forests that share features of dry forests (e.g., excessive evapotranspiration) might increase with climate change, particularly in southern Puerto Rico. This could restrict the range of important staple plant species associated with mesic habitats, like the Sierra Palm, and consequently the ranges of birds dependent on those foods, including the Scaly-naped Pigeon and Puerto Rican Parrot. It is tempting to think that increases in dry forest acreage will automatically benefit all bird species allied with xeric habitats, such as the Puerto Rican Nighthawk and Yellow-shouldered Blackbird, that are restricted primarily to the arid regions along Puerto Rico's southern coast (Sociedad Ornitológica de Puerto Rico 2009a,b, Vilella and González 2009, González 2010). But it is important to also

consider that reproduction and post-fledging survival are uniquely vulnerable vital parameters that are likely to be adversely affected by reduced precipitation. In dry forest communities, fruiting phenology is directly linked with rainfall and reduced precipitation results in limited flowering and fruiting (Faaborg 1982, Cuevas 1995). Results from ongoing studies suggest that limited food supply apparently translates into low avian reproductive activity and emaciated chicks among frugivore and nectivore guilds (Wiewel 2011). Further reductions in water availability will only exacerbate these effects.

In low-lying wetland and coastal areas around the island, species may have to contend with the effect of rising water levels resulting from a warmer climate. An analysis by the Puerto Rico Climate Change Council (PRCCC 2013a) summarized various studies that show trends in rising sea level of at least 1.4mm year⁻¹ for the Caribbean, which is expected to continue and possibly accelerate. Linearly extrapolating current rates forward to 2100 would result in a cumulative sea level rise of at least 0.4 m (Figure 10). Granted that sea level rise may not occur in a linear fashion nor affect all coastal habitats in a uniform manner (PRCCC 2013a) there are several possible scenarios to consider. For estuarine and coastal freshwater swamp environments, the threat of increased inundation periods could result in saltwater intrusion that inhibits ecological processes like recruitment, root development, and seedling survival (López and Kursar 2007) that could lead to some loss of these important wetland ecosystems. Some coastal habitats, such as mangrove forests, may be able to cope with inundation from rising seas through the vertical accretion of peat and landward migration (McKee et al. 2007, McKee 2011, PRCCC 2013b). Even so, landward migration is contingent on there being available geographic space into which to move, which could be limited in Puerto Rico and the USVI by the concentration of human populations and development in coastal areas (Helmer 2004, Platenburg 2005). Coastal salt flats, on the other hand, will likely not be able to migrate inland at the pace of sea level rise, thereby harmfully impacting shorebirds and some wading bird populations. The loss of habitat without any suitable replacement will in turn affect reproduction and overwintering survival rates (Rice et al. 2007, Lombard et al. 2010, PRCCC 2013a,b).

Changes in rainfall patterns and intensity might also have an effect on the quality of coastal habitats; for example, increases in sea water salinity from reduced precipitation frequency could disrupt food webs by inhibiting the development of a healthy prey base (Tripp and Collazo 2003). Lastly, rainfall patterns and their relationship with primary productivity are also significant for seabird populations, particularly in the nutrient-poor waters of the tropics. Primary productivity drives bait fish dynamics, thereby influencing the breeding phenology and reproductive success of inshore and offshore avian feeders (Yoshioka et al. 1985, Gilbes et al. 1996, Collazo et al. 1998, PRCCC 2013b).

In summary, notwithstanding the uncertainty as to the long-term effects of climate fluctuations and their coupling with past and present land use activities, the resultant changes will drive ecosystem processes and influence the populations of birds throughout the region. Given that the ecological and societal consequences of changing biodiversity are largely unknown yet potentially very costly, it would be prudent

to examine non-linearities and thresholds in the responses of ecological and social systems (Chapin et al. 2000), and consider what response strategies could address the most harmful effects of climate change (Grimm et al. 2013). Conservation planning in the 21st century should therefore give serious attention to both social and ecological components interacting at multiple geographic and temporal scales, in the context of changing global climate patterns, and develop methodologies that allow for successful navigation of the social complexities that shape conservation decisions (Ban et al. 2013). Such considerations will be vital in developing timely and appropriate management actions that could boost the resilience and adaptive capacity of imperiled habitats and their associated avifaunal assemblages.

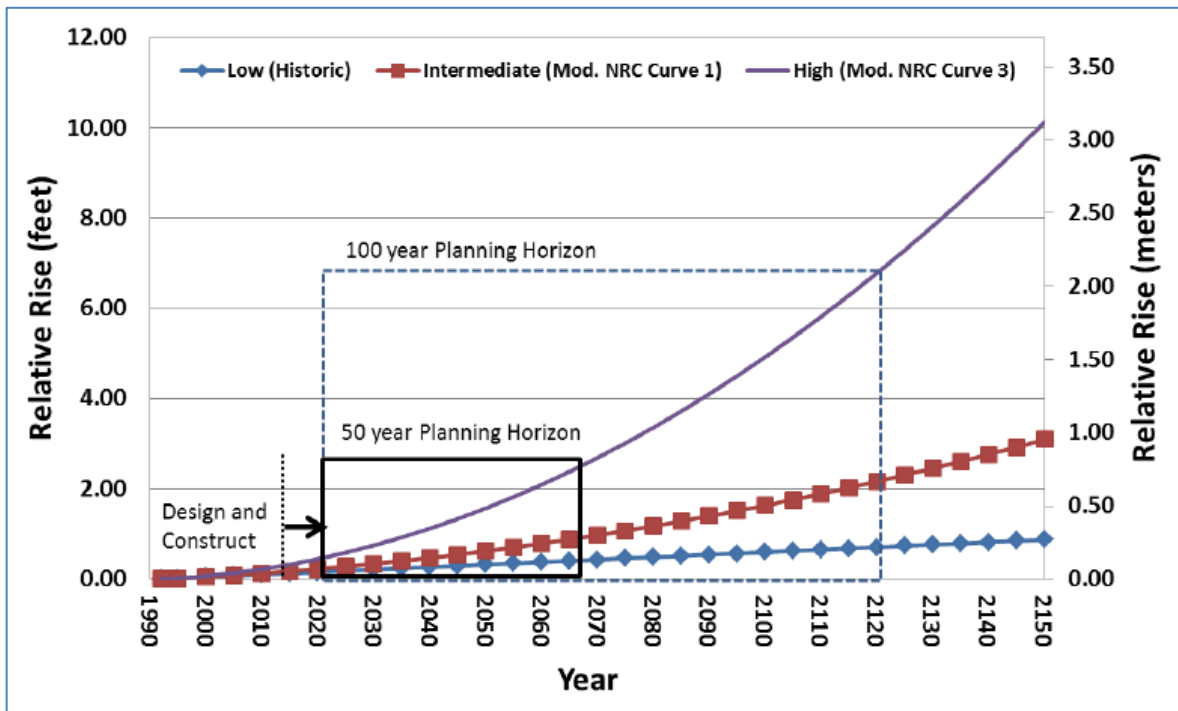


Figure 10: The US Army Corps of Engineers' relative sea level rise scenarios for San Juan, Puerto Rico, computed using the global rate of sea level rise (1.7 mm year⁻¹), NOAA tide gauge data for Puerto Rico (1.65 mm year⁻¹ rise for San Juan since 1962), and the estimated local vertical land movement rates of -0.02 mm year⁻¹. The Figures show a 50 year and 100 year planning horizon for adaptation with sea level rise estimates ranging from 0.07 to 0.57 m (0.20 to 1.87 feet) above current mean sea level by the year 2060 and between 0.14 and 1.70 m (0.40 to 5.59 feet) above current mean sea level by the year 2110 (source: PRCCC 2013a).



Puerto Rican Lizard-Cuckoo. Photo credit: Mike Morel

SECTION 2: PREVIOUS CONSERVATION WORK AND SYNTHESIS

Introduction

Several excellent resources relevant to avian biodiversity conservation in Puerto Rico and the USVI have been produced in recent years. These materials range from individual site level analyses to broad-brush regional conservation approaches. For this plan, we have drawn on this extensive library of research and synthesized key points regarding conservation issues, priority species, habitats, and planning strategies. Although each report is distinct in terms of its scope and scale, in the data analysis techniques employed, and in the associated pros and cons of using the resulting data to generate predictive models, we believe there is innovative value in examining them collectively. By integrating salient details from these existing efforts into a current, comprehensive summary, we can then ascertain major points of convergence where important information is lacking and identify new conservation opportunities for birds throughout the region.

What follows here and in the accompanying appendices is a brief summary of the priority bird species and habitat recommendations for Puerto Rico and the USVI as articulated in several prominent conservation analyses:

- **GAP Analysis Project** (PR: Gould et al. 2008a; USVI: Gould et al. 2013a)
- **Critical Wildlife Areas** (PR: Ventosa-Febles et al. 2005b).
- **Important Bird Areas** (PR and USVI: Birdlife International 2008)
- **Waterfowl Focus Areas** (PR: Atlantic Coast Joint Venture 2005, Ventosa-Febles et al. 2005a)
- **Critical Elements and Areas of Conservation Priority** (DNER 2008)
- **Comprehensive Wildlife Conservation Strategies** (PR: Garcia et al. 2005; USVI: Platenberg et al. 2005)
- **Map 33** (Comer et al. 2005, Varley 2011, Para la Naturaleza 2013)
- **Ecoregional Plan and Caribbean Decision Support System (PR and USVI)** (PR: Keel et al. 2005, Huggins et al. 2007; USVI: Huggins et al. 2007)
- **Model Forest** (Dragoni 2013)
- **Inventory of Breeding Seabirds** (PR: Saliva 2009; USVI: Pierce 2009)
- **US Fish and Wildlife Service Reports** (PR and USVI: USFWS 2007a,b)
- **Breeding Bird Atlas** (PR: Sociedad Ornitológica de Puerto Rico 2009a,b)

We draw on the individual and combined knowledge of these reports to generate the habitat and population objectives presented in this plan. It is worth noting that the academic literature also contains a multitude of individual species analyses that describe geographic distribution and abundance, behavioral ecology, and conservation recommendations. Although we do not refer directly to any of those species-level

studies in this discussion of previous research, the resulting opportunities we present later also depend upon many significant findings reported in such publications.

Gap Analysis Project (PR and USVI)

GAP analysis was developed as a proactive coarse-filter approach to protect biodiversity by determining the degree to which animal species and natural communities are represented in the current mix of conservation lands. Individual species, species-rich areas, and vegetation types that are unrepresented or under-represented in existing management areas are identified using digital map overlays in a Geographic Information System. Those species or communities not well represented are considered conservation “gaps” that may be filled through changes in land management practices. The data and results are then made available to the public to facilitate effective resource through more complete knowledge of the management status of these elements of biodiversity. Thus, GAP is a useful tool for taking a snapshot in time of biological diversity, while also serving as a benchmark for designing landscape conservation approaches and planning and management of biological resources on the ground. GAP analysis is limited in that data are derived from remote sensing and modeling that represents the date of the satellite imagery, and therefore any decisions based on the data must be supported by ground-truthing and more detailed analyses. Nor are GAP data intended to be a substitute for threatened and endangered species listings and detailed biological inventories (Scott et al. 1993, Gould et al. 2008a).

The Puerto Rico and USVI Gap Analysis Projects (PRGAP and USVIGAP) are joint efforts among the Puerto Rico Department of Natural and Environmental Resources (PRDNER), the US Virgin Islands Department of Planning and Natural Resources (DPNR), the US Forest Service International Institute of Tropical Forestry (IITF), the North Carolina Cooperative Fish and Wildlife Research Unit, and the US Geological Survey Biological Resources Division. As of the writing of this report, comprehensive assemblages of spatial information exist for Puerto Rico and the USVI’s land cover, terrestrial vertebrate occurrences, natural history information, and land stewardship (Gould et al. 2008a, 2010b). The GAP analyses provide geographic and ecological information on the status of rare and threatened species, in addition to common species. Two hundred and two vertebrate species have been modeled for Puerto Rico, while the USVI analysis includes 153 species. A GAP analysis of marine and freshwater recreational fish was also modeled for Puerto Rico (Gould et al. 2013b).

Based on known species records from breeding bird surveys provided by the Puerto Rico Ornithological Society (SOPI, as abbreviated in Spanish), PRGAP created species occurrence (1:100,000 scale) maps (Figure 11) showing probability of occurrence for 98 resident, endemic, endangered, and regularly occurring non-accidental terrestrial bird species throughout Puerto Rico and its offshore islands (Appendix A). The spatial occurrences of 25 additional migratory species were subsequently modeled for Puerto Rico, although these species were not reviewed as extensively as in the original analysis (Personal communication, W. Gould, US Forest Service 2013). Predicted habitat distribution maps (Figure 12) integrating information from the vertebrate

database of species ranges and land cover mapping were also generated for the terrestrial resident and migratory species. In the same manner, USVI GAP data, including range maps and predicted distribution, have been generated for 118 terrestrial bird species (Appendix B).

GAP data can also be analyzed for important conservation habitat for functional groups (e.g., waterfowl, wading and shorebirds, or forest birds) or for overall species richness of all modeled bird habitats, i.e., the total number of species that are predicted to potentially occur within an area. Thus, the resulting datasets are useful in addressing a broad range of conservation questions, from single species assessments to biodiversity protection at the landscape scale.

Furthermore, the GAP report analyzed distribution area for each mapped species in conjunction with different categories of land ownership and management status in order to assess the proportion of each species' habitat that is managed for conservation, and thus the likelihood of future threat to a biotic element through habitat conversion. A scale of 1 to 4 was used to denote the relative degree of current maintenance of biodiversity for each tract where a priority species is predicted, with "1" signifying the highest, most permanent level of maintenance, and "4" representing the lowest level of biodiversity management, or unknown status. The four status categories can generally be defined as follows (after Scott et al. 1993; Edwards et al. 1995):

Status 1: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.

Status 2: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive use or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.

Status 3: An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining). It also confers protection to federally listed endangered and threatened species throughout the area.

Status 4: Lack of irrevocable easement or mandate to prevent conversion of natural habitat types to anthropogenic habitat types. Allows for intensive use throughout the tract. Also includes those tracts for which the existence of such restrictions or sufficient information to establish a higher status is unknown.

The characteristics used to determine status include:

- Permanence of protection from conversion of natural land cover to unnatural (human-induced barren, exotic-dominated, arrested succession);
- Relative amount of the tract managed for natural cover;

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

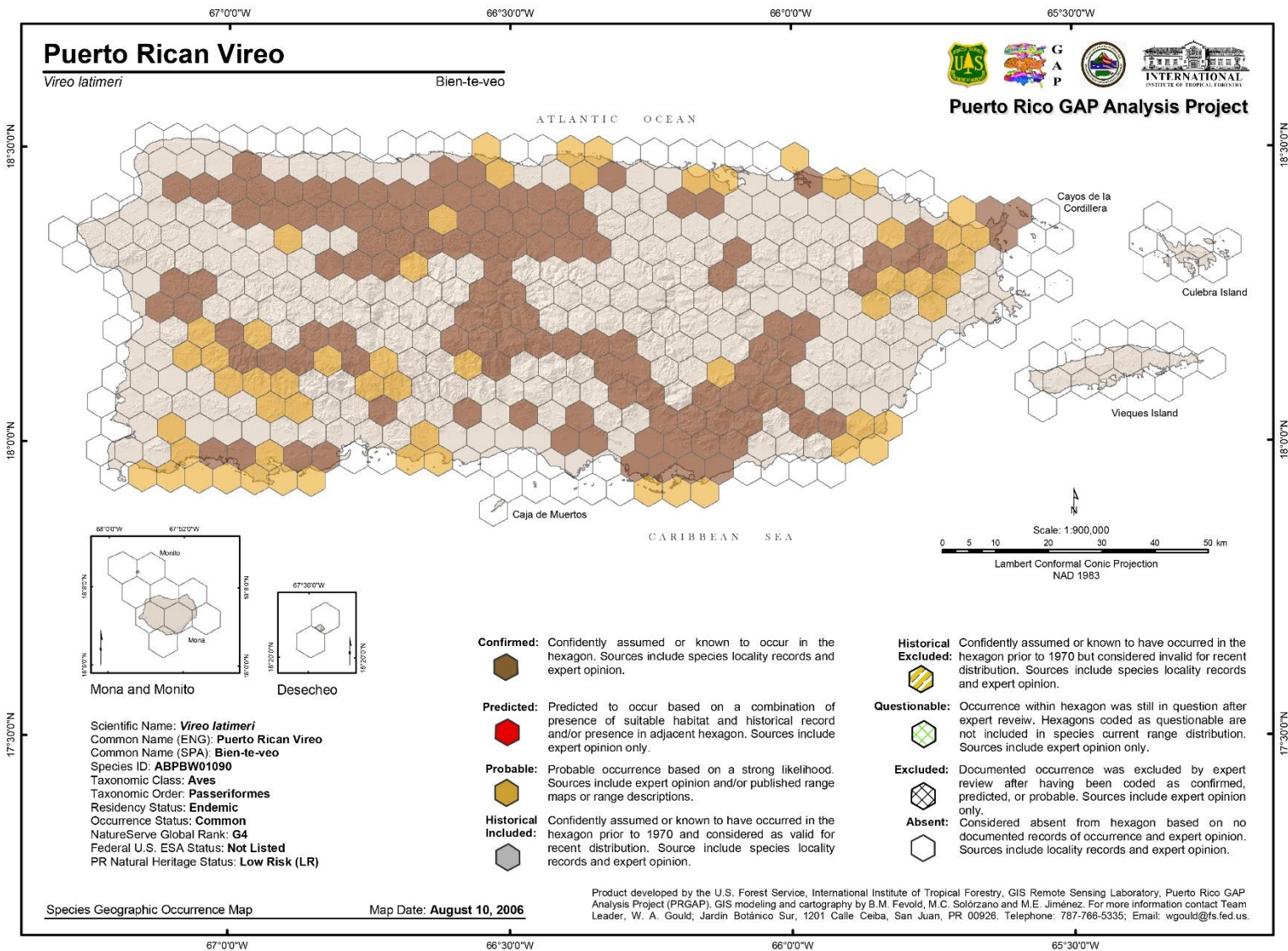


Figure 11: PRGAP Species occurrence map for the Puerto Rican Vireo (source: Gould et al. 2008a).

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

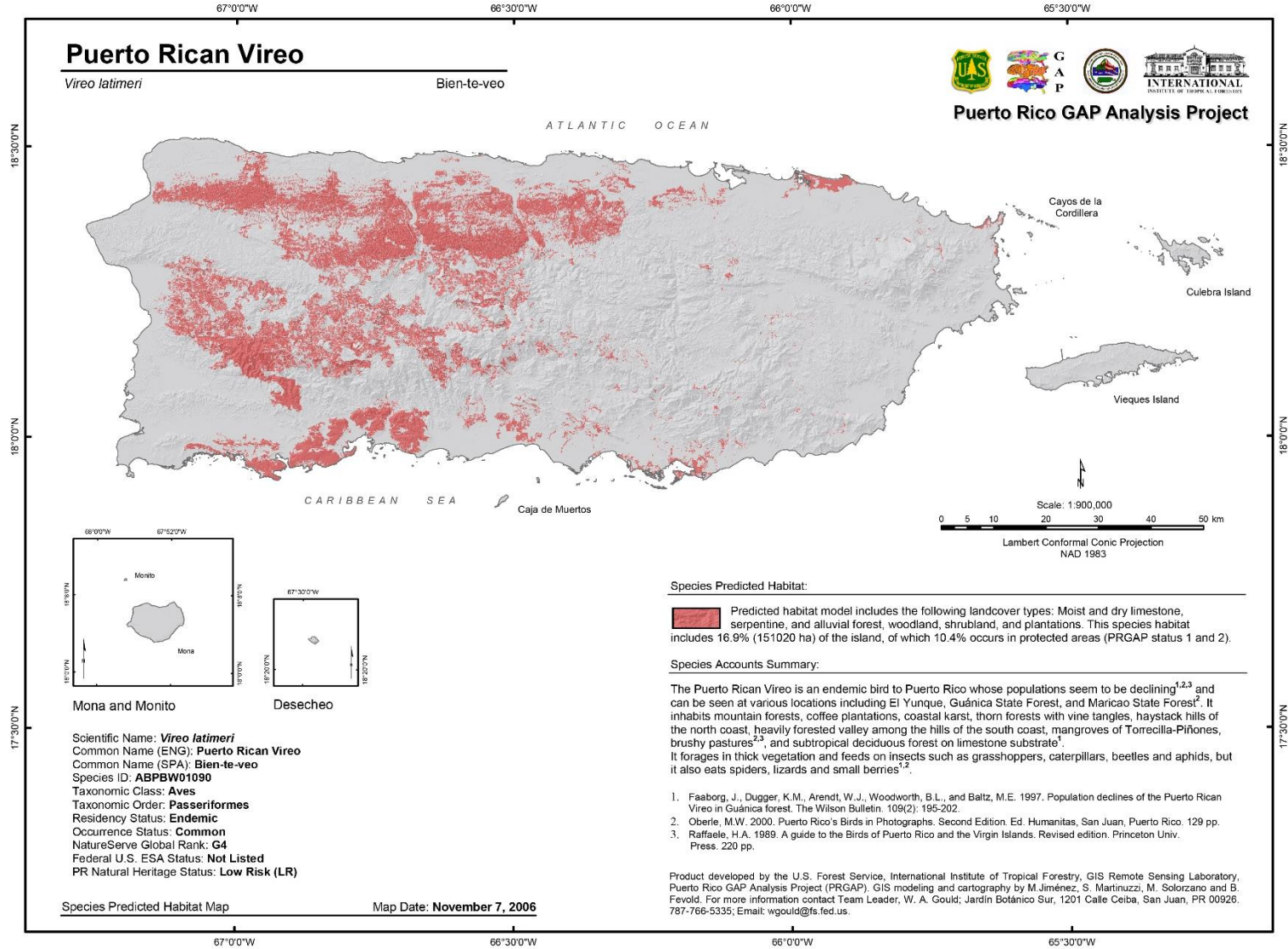


Figure 12: PRGAP Predicted species distribution map for the Puerto Rican Vireo (source: Gould et al. 2008a).

- Inclusiveness of the management, i.e., single feature or species versus all biota; and
- Type of management and degree that it is mandated through legal and institutional arrangements.

As of 2013, 104 terrestrial stewardship areas in Puerto Rico had some management for biodiversity conservation – meaning that they are listed as GAP status 1, 2, or 3 – including federal and commonwealth-managed protected areas and reserves, and private lands (Quiñones et al. 2013, Figure 13). Together these protected areas account for about 8.2% of the island. In the USVI, there are 69 protected areas with GAP status 1, 2, or 3, which together comprise 12.4% of the territory (Gould et al. 2013a, Figure 14). All of these stewardship areas serve as important wildlife habitat for one or more of the bird species included in the GAP analysis. Appendices C and D present GAP data about stewardship areas, their management classes and land area for Puerto Rico and the USVI, respectively.

Using status 1, 2, and 3 areas, PRGAP also generated a map of the distance from protected areas (Quiñones et al. 2013, Figure 15) which is useful when looking for opportunities to create habitat linkages between existing conservation lands and across habitat boundaries.

Many of the habitat and species-specific conservation opportunities presented in this report are based on analysis of predicted distributions using PR and USVI GAP data; further discussion is presented in Sections 4 and 5.

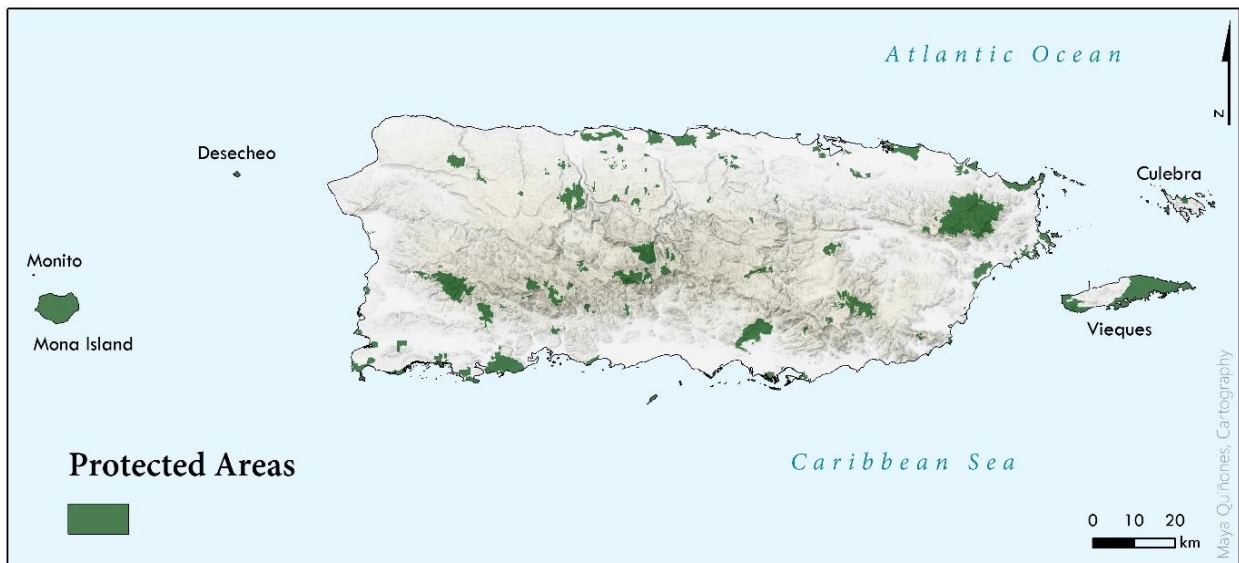


Figure 13: Protected areas of Puerto Rico (source: Quiñones et al. 2013).

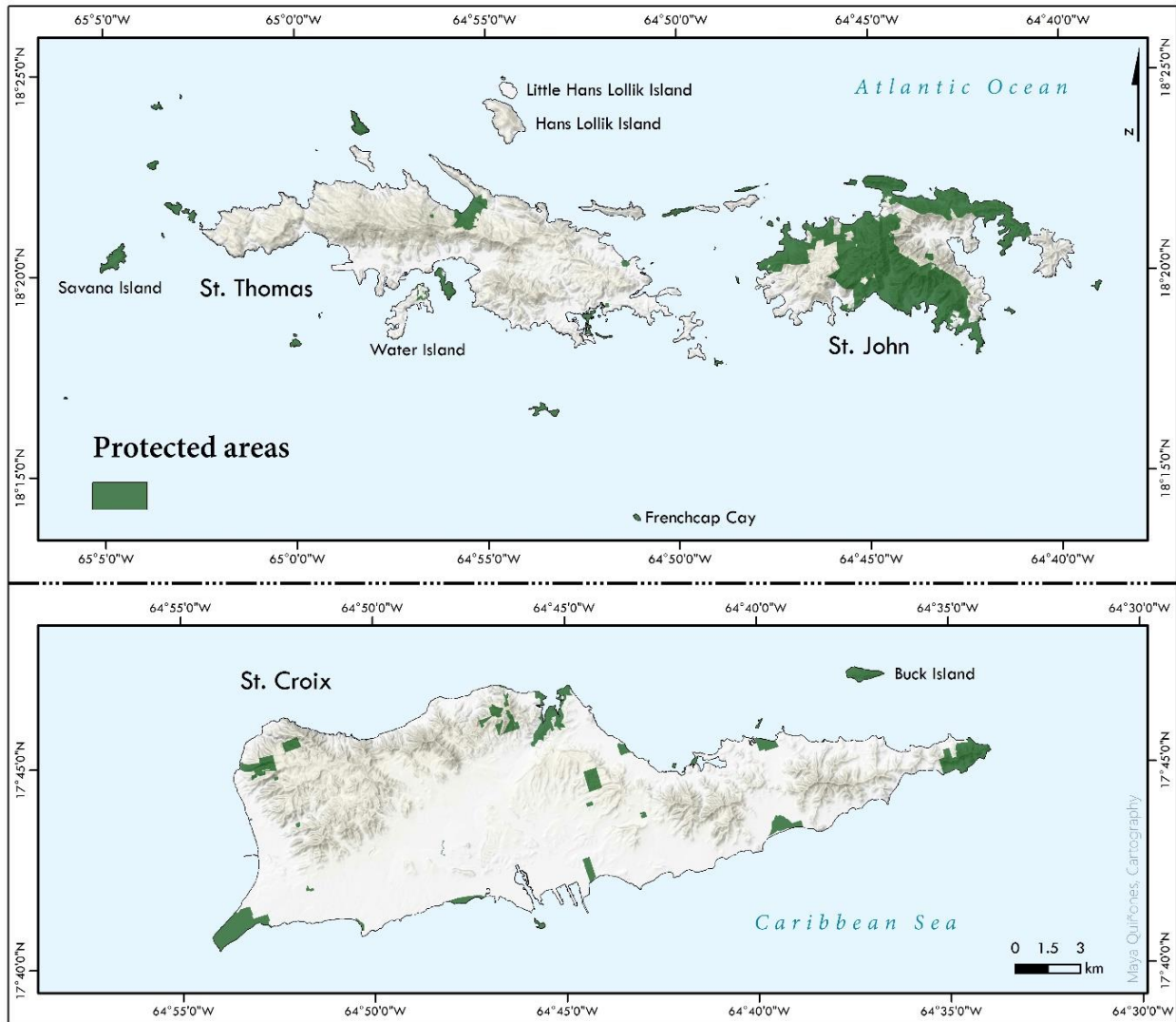


Figure 14: Protected areas of the US Virgin Islands (source: Gould et al. 2013a).

Critical Wildlife Areas (PR)

Bird conservation planning efforts in Puerto Rico extend back to the mid-1970s, with the initial presentation of criteria for “Natural Critical Areas of Puerto Rico,” by Carlos Carrera (Carrera 1974). This concept eventually developed into Critical Wildlife Areas (CWAs) of Puerto Rico (Raffaele and Duffield 1979), which has since undergone several revisions to incorporate new information and update the status of critically threatened or endangered wildlife species associated with a diversity of habitats from summit to sea. The most recent revision was published in 2005 by the PRDNER Terrestrial Resource Division (Ventosa-Febles et al. 2005b).

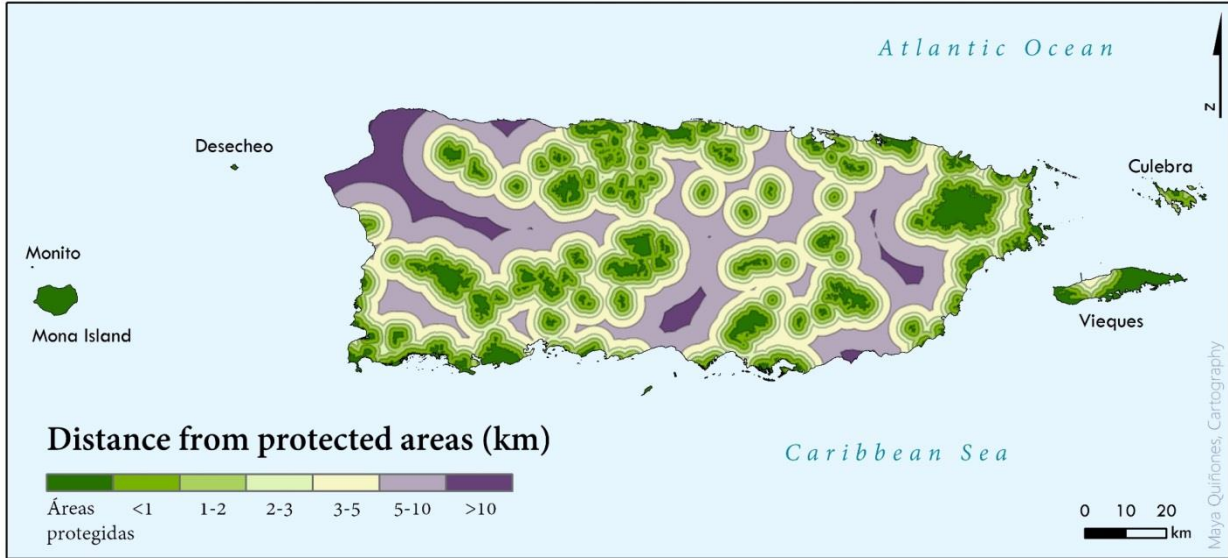


Figure 15: Distance from protected areas of Puerto Rico, illustrating potential habitat linkages (source: Quiñones et al. 2013).

Critical Wildlife Areas are defined as “Any habitat that is indispensable for the survival of a species or group of species” (Moreno and Pérez 1980). Each CWA was evaluated on its potential to serve as faunal habitat given the following criteria:

1. Is there is one or more species unique to the locality and found nowhere else?
2. Is the site of particular importance for breeding, roosting, feeding, or some other behavior even though the organism ranges elsewhere?
3. Is the site a center of abundance for game or endangered species?
4. Does the site have outstanding potential to be developed as (2) or (3) above?

Four additional evaluation criteria were included regarding the presence of species of limited distribution:

1. Species considered Endangered or Threatened under the Federal Endangered Species Act of 1973;
2. Species considered Endangered or Threatened under the 2004 Regulation to Govern the Management of Threatened and Endangered Species in the Commonwealth of Puerto Rico;
3. Species of importance for hunting, even though their hunting is prohibited and do not belong to the above categories;
4. Aquatic, wading and shorebirds, migratory or resident, which largely depend on coastal habitats up to about one kilometer inland.

As a result of this analysis, a total of 87 Critical Wildlife Areas were identified as habitat areas of greatest conservation importance (Figure 16), 81 of which were recognized as critical areas for avian conservation (Appendix E). These 81 areas have a total land cover of 110,360 hectares (12.3% of Puerto Rico’s total land area), and almost half of them include lands with either partial or full private ownership. A wildlife inventory is also listed for each CWA, including important bird species.

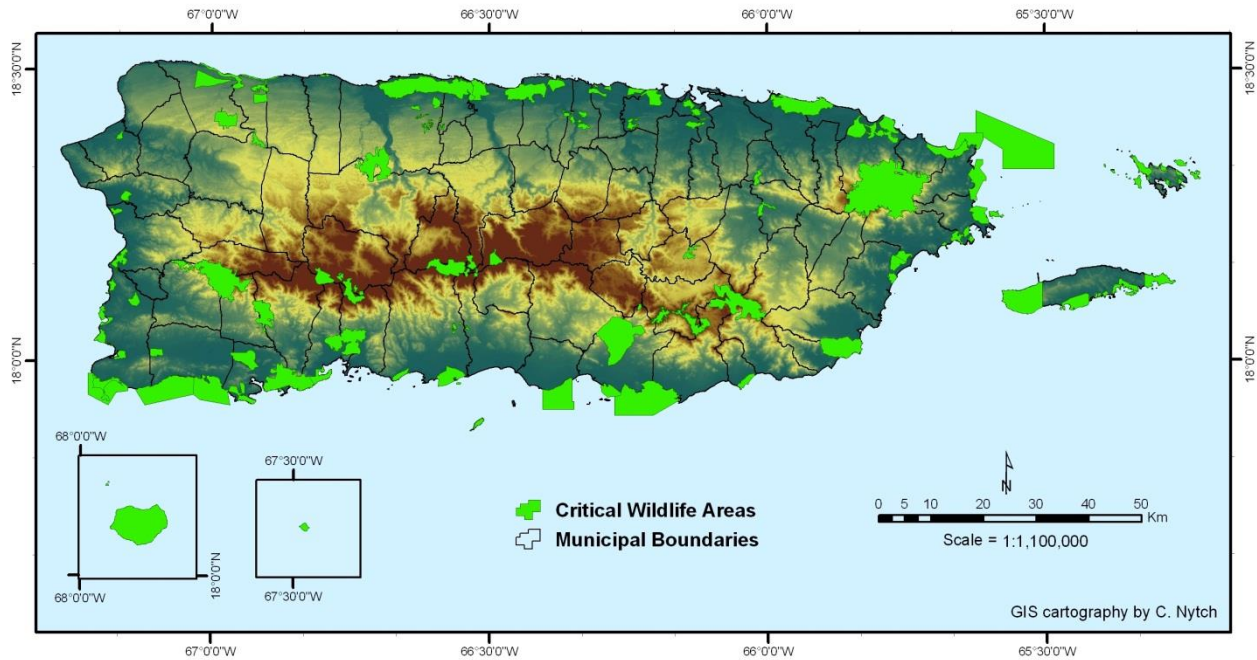


Figure 16: Puerto Rico Critical Wildlife Areas (adapted with permission from Ventosa-Febles et al. 2005b).

Important Bird Areas (PR and USVI)

Important Bird Areas (IBAs) are key sites for global biodiversity conservation, as identified by Birdlife International, using simple, objective, standardized criteria and thresholds. In the report *Important Bird Areas in the Caribbean* (Birdlife International 2008), the authors take a region-wide approach to long-term conservation planning with the aims of saving species, conserving habitats, and empowering people throughout all the islands of the Bahamas, Greater Antilles, Virgin Islands, Cayman Islands, Lesser Antilles, Netherlands Antilles, and Trinidad and Tobago. Specific sites and priority species for each country were established based on guidance from local experts and NGOs.

Important Bird Areas are selected based on criteria from a combination of four decisive categories, briefly summarized here:

1. Presence of species of global conservation concern
 - a. The site regularly holds significant numbers of a globally threatened species, or other species of global conservation concern;
2. Presence of assemblages of restricted-range bird species
 - a. The site is known or thought to hold a significant component of the restricted-range species whose breeding distributions define an Endemic Bird Area or Secondary Bird Area;
3. Presence of assemblages of biome-restricted bird species
 - a. The site is known or thought to hold a significant component of the group of species whose distributions are largely or wholly confined to one biome;
4. Globally important congregations of birds

- a. The site is known or thought to hold, on a regular basis, $\geq 1\%$ of a biogeographic population of a congregatory waterbird species; or
- b. The site is known or thought to hold, on a regular basis, $\geq 1\%$ of the global population of a congregatory seabird or terrestrial species; or
- c. The site is known or thought to hold, on a regular basis, $\geq 20,000$ waterbirds or $\geq 10,000$ pairs of seabirds of one or more species; or
- d. The site is known or thought to exceed thresholds set for migratory species at bottleneck sites.

There is no fixed minimum or maximum size limit for an IBA, and an IBA's boundaries are defined such that, as far as possible:

- It is different in character or habitat or ornithological importance from the surrounding area;
- It exists as an actual or potential protected area, with or without buffer zones, or is an area which can be managed in some way for nature conservation; and
- It is, alone or with other sites, a self-sufficient area which provides all the requirements of the birds, when present, for which it is important.

With the help of SOPI, twenty IBAs (Figure 17) were selected for Puerto Rico, with 52 associated key bird species. Together these IBAs occupy 197,100 ha, about 22% of the Puerto Rican archipelago's total land area. To date, roughly 10% of the total IBA area is under some form of protected status. Appendix F presents key bird species at Important Bird Areas in Puerto Rico. Six of the species identified are globally threatened, 23 are restricted range species, and 28 are congregatory waterbirds or seabirds.

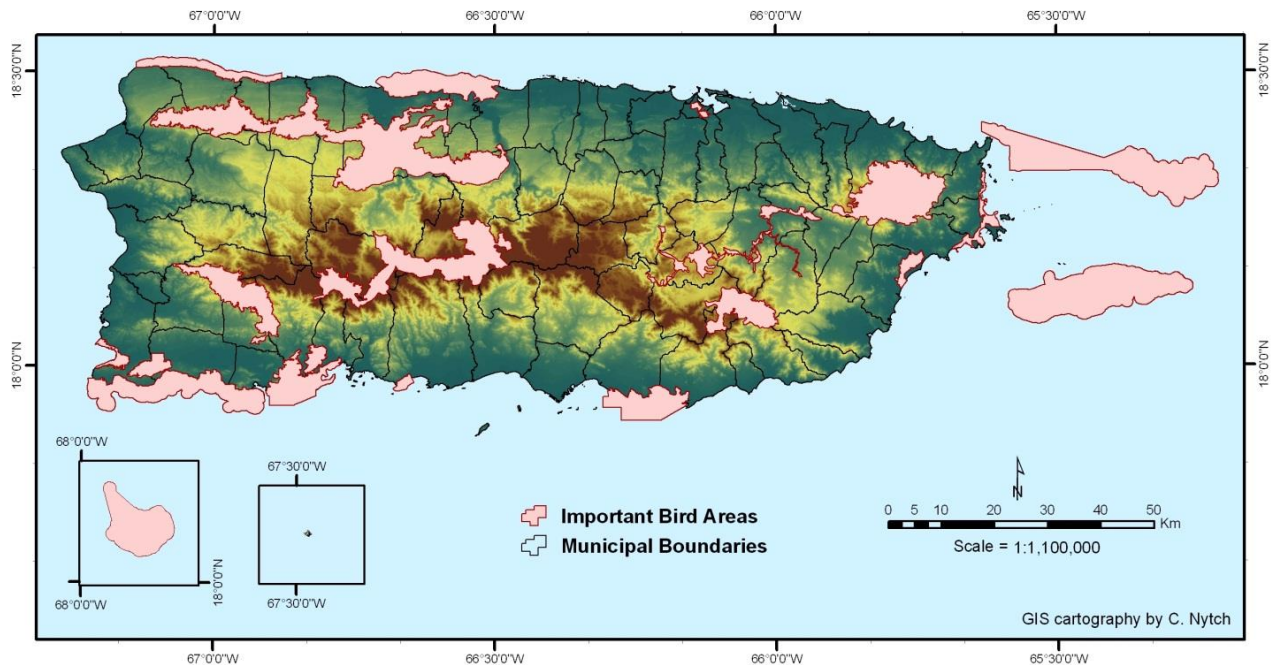


Figure 17: Important Bird Areas in Puerto Rico (adapted with permission from BirdLife International 2008).

There are nine IBAs (Figure 18) identified in the USVI, selected on the basis of 21 key bird species that meet the requisite IBA criteria (Birdlife International 2008). In total, these priority sites occupy 6,200 ha (including both terrestrial and marine areas), approximately 18% of the archipelago. Appendix G presents key bird species at Important Bird Areas in the USVI. Two of these species are globally threatened, seven are restricted range species, and 12 are congregatory waterbirds or seabirds.

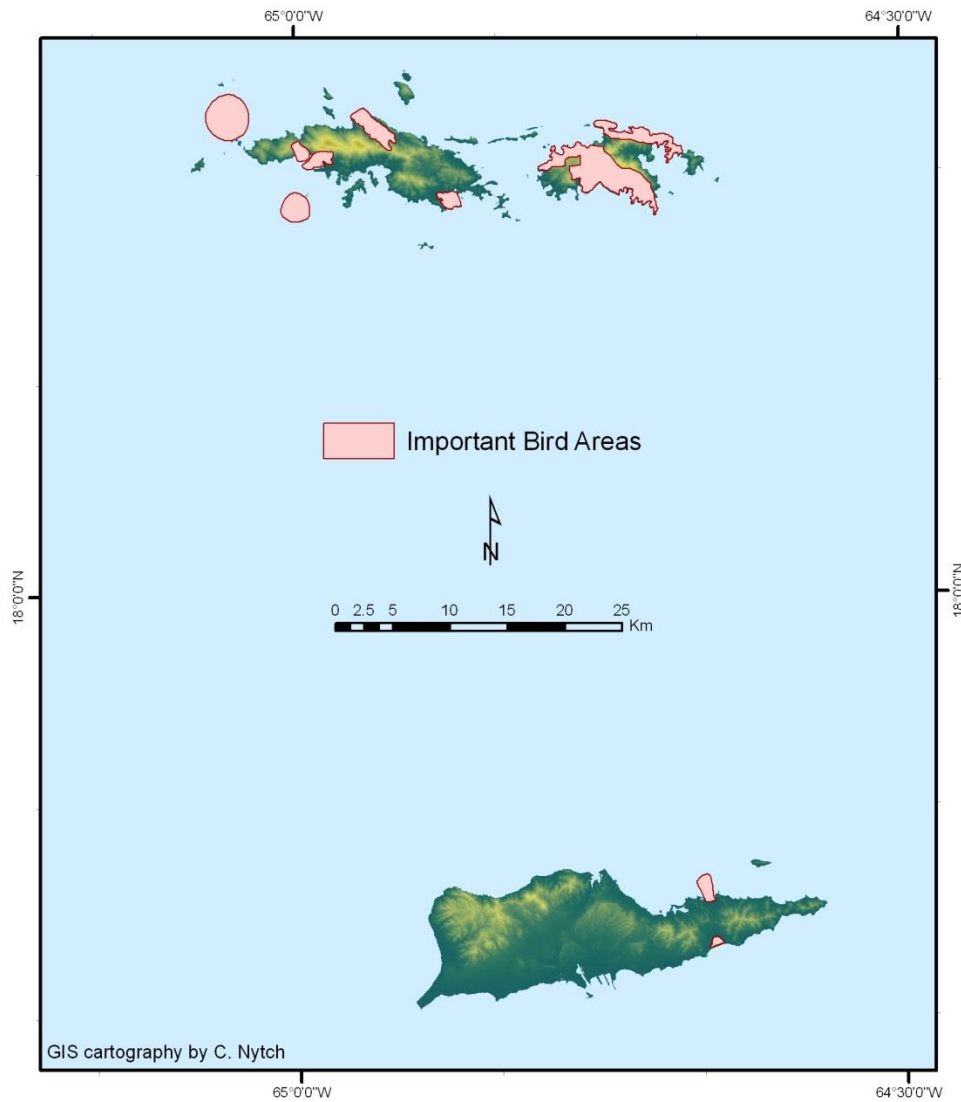


Figure 18: Important Bird Areas in the US Virgin Islands (adapted with permission from Birdlife International 2008).

Waterfowl Focus Areas (PR)

The Atlantic Coast Joint Venture (ACJV), a partnership of conservation organizations and agencies from 18 states and the Commonwealth of Puerto Rico, focuses on the conservation of habitat for native birds in the Atlantic Flyway of the United States from Maine south to Puerto Rico. Since its inception in 1988, the main purpose of the ACJV

has been to develop and maintain a strong scientific foundation for planning, implementing and evaluating conservation actions and to work together to identify and conserve the key breeding, migration and wintering habitats for priority bird species in the Atlantic Flyway.

Originally, the ACJV Implementation Plan concentrated on the conservation of waterfowl and wetlands following the guidelines of the North American Waterfowl Management Plan created in 1986, and most recently updated in 2004. In 2005, the ACJV Waterfowl Implementation Plan was revised to focus on habitats for all migratory birds and to reflect expanded geographic boundaries and updated conservation issues. More specifically, the revised Implementation Plan steps down continental and regional waterfowl population and habitat goals to the ACJV area, presents habitat conservation goals and population indicators, provides current status assessments for waterfowl and their habitats, and updates focus area narratives and maps for each state (Atlantic Coast Joint Venture 2005). Additionally, with the emergence of the North American Bird Conservation Initiative in 1998, the ACJV began ecologically based bird conservation planning at the Bird Conservation Region (BCR) level within the geographic scope of the ACJV. Puerto Rico and the USVI comprise BCR 69 within the geographic scope of the ACJV, and this plan adds greatly to the bird conservation planning needed at the flyway scale for the ACJV.

Delineation of focus areas is the key to efficiently and effectively delivering bird habitat conservation within the ACJV. As described in the Implementation Plan, focus areas are defined as much as possible on ecological/biological rather than political boundaries. Specific criteria for delineating focus areas are as follows. Focus areas should be:

1. Regionally important to one or more life history stages or seasonal-use periods of migratory birds;
2. Developed within the context of landscape-level conservation and biodiversity;
3. Discrete and distinguishable habitats or habitat complexes demonstrating clear ornithological importance;
4. Large enough to supply all the necessary requirements for survival during the season for which it is important, except where small, disjunctive areas are critical to survival and a biological connection is made (Ventosa-Febles et al. 2005a).

The criteria listed above can apply to any group of migratory birds. However, for the revised ACJV Implementation Plan, these criteria were applied only to waterfowl except where the needs of non-waterfowl migratory birds could be met in the context of Waterfowl Focus Areas (WFAs).

With the assistance of staff from PRDNER, twenty sites were recognized as WFAs in Puerto Rico, including Vieques and Culebra Island lagoons as single units (Figure 19).

Focus areas were selected primarily because of the presence of wetlands and lagoons optimal for the establishment of migratory waterfowl and for the massive occurrences of birds using these habitats to feed and roost. Combined, the WFAs cover approximately

28,006 ha (7% of Puerto Rico’s land area), with eight of them located on private land. For each WFA there are descriptions of the area, notes about special recognition (e.g., classification as a Priority Area of Conservation by the PR Natural Heritage Program), and a brief treatment of major threats and conservation recommendations. Breeding, migrating, and wintering waterfowl priority species were identified for each WFA (Appendix H), in addition to other migratory, native, endemic, and exotic bird species reported in the selected areas. There are also estimates of the number of acres protected, restored, or enhanced in each focus area since 2001 (when the ACJV plan was established in Puerto Rico), for wetland and waterfowl conservation, as well as for the remaining acreage (wetland and associated uplands) that still needs to be protected, restored, or enhanced in each focus area to meet wetland and waterfowl conservation goals (Appendix I).

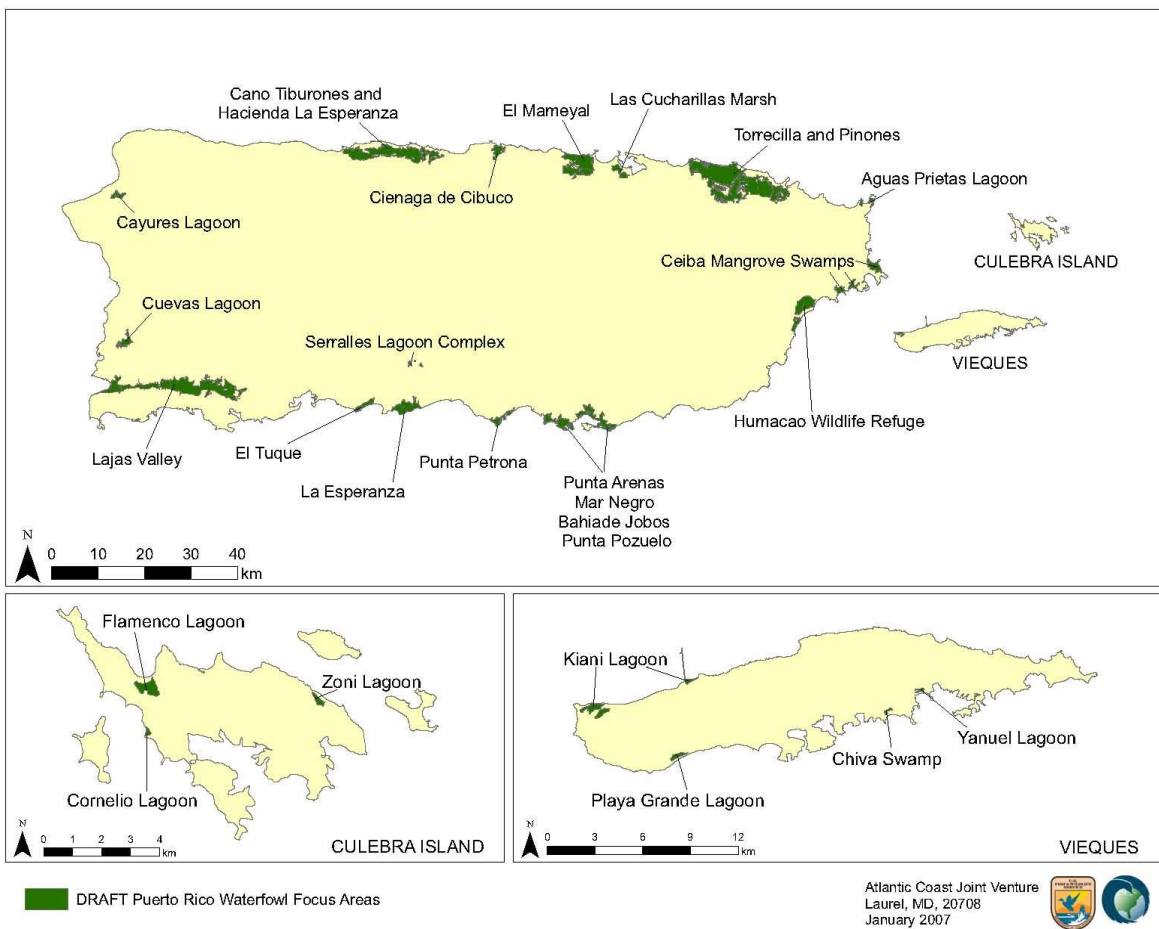


Figure 19: Waterfowl Focus Areas in Puerto Rico (source: www.acjv.org).

Critical Elements and Areas of Conservation Priority (PR)

The Puerto Rico Natural Heritage Program (NHP), a division of PRDNER, compiles and tracks data associated with Critical Elements of Puerto Rico’s flora and fauna, i.e. species that are endemic, rare, or of conservation concern. This NHP dates back to

1988 and the passing of Commonwealth Law No. 150, which approved the creation of a program to identify natural resources, such as species and ecosystems, that should be considered for conservation because of their contribution to biodiversity and because of their importance to the natural heritage for present and future generations. Critical Elements include, but are not limited to, federally or locally listed species. Appendix J lists the 33 bird species that are currently classified as Critical Elements under surveillance by NHP staff (DNER 2008).

Additionally, NHP is responsible for: establishing criteria for commonwealth government acquisition of natural habitats within Puerto Rico; developing a priority list of critical habitats for acquisition; acquiring priority habitats, classifying habitats (e.g., Natural Reserve, Sanctuary, etc.) and transferring them to state control; and developing and coordinating supplementary support, such as funding from NGOs, for habitat acquisition and management. Using Element Occurrence Records for important floral and faunal species, as well as maps, aerial photos, and satellite imagery of natural communities, NHP has thus far identified 96 Areas of Conservation Priority (ACPs; DNER 2008) for protection of ecosystems, biological diversity and ecological corridors, and viable populations of native and vulnerable species (Figure 20). Considerable overlap can be observed among the ACPs and other resources already mentioned, given that the ACPs incorporate data findings from conservation-planning reports such as Critical Wildlife Areas and Waterfowl Focus Areas. Together these ACPs cover 281,876 ha, almost 32% of Puerto Rico's land area. The majority of the ACPs are priority sites for one or more bird species, and based on current Element Occurrence Records, at least 50 ACPs provide habitat for avian Critical Elements (Appendix K).

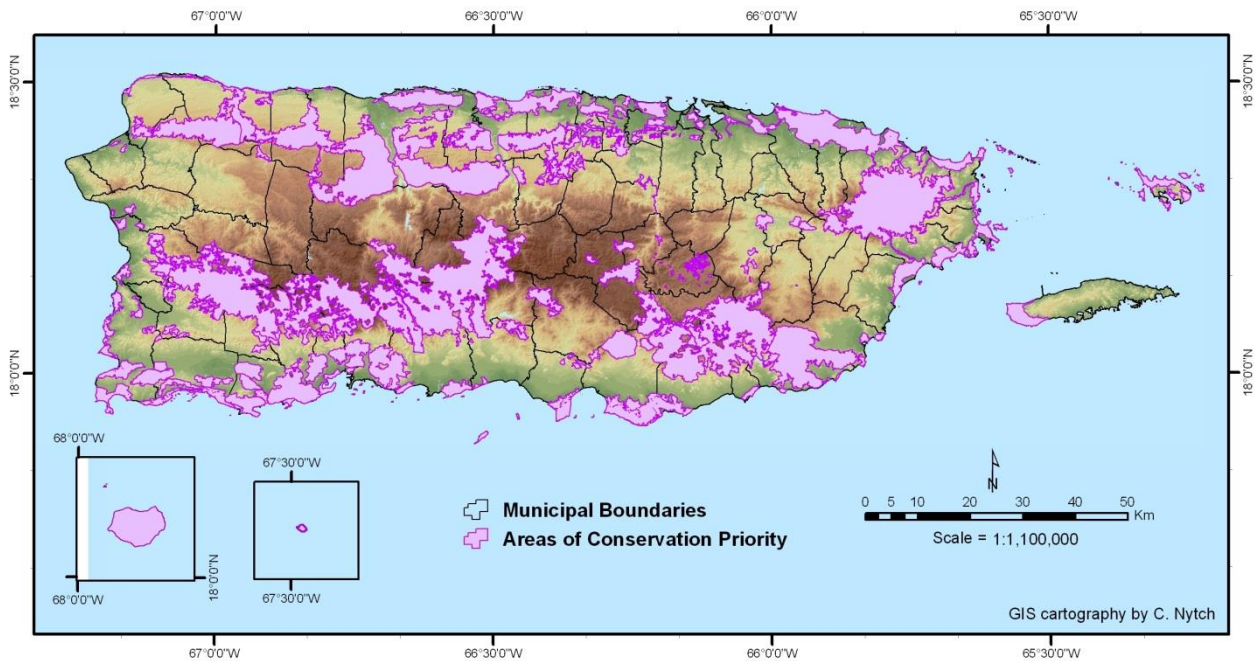


Figure 20: Areas of Conservation Priority for birds in Puerto Rico (adapted with permission from Ventosa et al. 2005b).

Comprehensive Wildlife Conservation Strategies (PR and USVI)

In 2005, the PRDNER, in collaboration with the US Fish and Wildlife Service (USFWS), the International Institute of Tropical Forestry, and Wildlife Restoration published a Comprehensive Wildlife Conservation Strategy (PR-CWCS; García et al. 2005). The goals as put forward in this report are three-fold: 1) Identify the status of fish and wildlife species of greatest conservation need and their habitats; 2) Identify conservation priorities for these species and their habitats; and 3) Establish a regular monitoring process aimed at updating the previous two objectives.

It is anticipated that in addition to helping identify greatest conservation needs and prioritizing efforts, the PR-CWCS will better enable PRDNER to work in partnership with other organizations to address present and future challenges and opportunities, protect and enhance Puerto Rico's fish and wildlife needs, and integrate monitoring and management of game and non-game species.

Included in the PR-CWCS report are 81 bird species recognized as species of greatest conservation need. Priority status was classified according to one of the following five categories, adapted from the International Union for the Conservation of Nature (IUCN) Red List (2009):

- **Critically Endangered (CR)**: A critically endangered species faces an extremely high risk of extinction in the wild in the immediate future.
- **Endangered (EN)**: A species is endangered when it is not CR, but faces a very high risk of extinction in the wild in the near future.
- **Vulnerable (VU)**: A species is vulnerable when it is not CR or EN, but it faces a high risk of extinction in the wild in a foreseeable future.
- **Low Risk (LR)**: A species is at low risk when, after an evaluation, it does not satisfy any of the previous categories (CR, EN, or VU), and it is not Data Deficient.
- **Data Deficient (DD)**: A species falls under this category when there is not enough information for a direct or indirect assessment of its risk of extinction based on its distribution and/or population status. Some aspects of the ecology of a species in this category may be well studied, and its biology might be well known, but appropriate data about its abundance and distribution may be lacking. Therefore, Data Deficient is not a threat category.

Appendix L lists the 81 priority bird species, and their conservation status, as determined by the PR-CWCS.

Prompted by the USFWS, the USVI Department of Fish and Wildlife (DFW) composed a Comprehensive Wildlife Conservation Strategy (USVI-CWCS) in 2005. The USVI-CWCS is a combination of a strategic plan that focuses on the management of commercially or recreationally harvested species, and a wildlife conservation plan concerned with non-harvested wildlife species and their related habitat (Platenberg et al. 2005). Like its Puerto Rican counterpart, it addresses the distribution and

abundance of key wildlife species, the locations of priority habitats, conservation threats, action priorities for habitat conservation, law enforcement, adaptive management and monitoring/assessment strategies, additional research required, and coordination efforts necessary to implement the plan.

The USVI-CWCS identifies 54 priority bird species in total, eight seabirds, 21 waterfowl and shorebirds, and 25 land birds (Appendix M). Each functional group is divided into two groupings: Species of Greatest Concern, and Species of Concern. Breeding ecology, habitat requirements, and priority nesting locations are listed for each species. Also identified are 70 terrestrial protected areas considered of value to wildlife, with a total area of 7,750.5 ha (Appendix N; compare with the USVI GAP in Appendix D). In order to meet the goal of identifying habitat areas of greatest conservation need, both the PR-CWCS and USVI-CWCS draw on relevant data from other pertinent marine and terrestrial reports (e.g., Critical Wildlife Areas, GAP analysis). Several conservation strategies are recommended as well, including enhanced habitat protection via the development of a strong private lands program, strengthening of the existing Natural Heritage Program, monitoring of threatened, endangered, and game species, and adaptive management. The overarching goals of this bird conservation plan, and many of the specific objectives applicable to Puerto Rico and the USVI, are crafted in such a way as to dovetail smoothly with the approaches and strategies laid out in the PR-CWCS and USVI-CWCS.

Map 33 (PR)

NatureServe is a non-profit conservation organization whose mission is to provide the scientific basis for effective conservation action at local, national, and global levels. Via a network of international natural heritage programs NatureServe carries out biological inventories, collecting, managing, and supplying information about rare and endangered plant and animal species and threatened ecosystems to help a broad range of societal stakeholders make informed decisions about managing natural resources (NatureServe 2009).

In 2003, the Puerto Rico Conservation Trust (PRCT), in partnership with the International Institute of Tropical Forestry, the Puerto Rico Natural Heritage Program, the Puerto Rico Department of Natural and Environmental Resources, and The Nature Conservancy contracted NatureServe to carry out a commonwealth-wide assessment of important lands and waters for biodiversity conservation. Similar to some of the goals of the PRGAP analysis, the NatureServe endeavor was designed to provide baseline data at multiple scales and incorporate information relevant to a variety of conservation issues, for subsequent planning and decision making. Those data were integrated into a spatially explicit decision support software program called NatureServe Vista and in 2006 were used to conduct a conservation prioritization analysis that could complement an island-wide land use planning effort (Comer et al. 2005, Varley 2011). Through several iterative phases and the inclusion of updated data regarding habitat and species distribution and ecosystem services NatureServe Vista was used over a period of several years to identify the principal ecosystems and vulnerable species from terrestrial, marine, and freshwater realms in Puerto Rico, their threat levels, and

opportunities for conservation. Although the analysis was not parameterized specifically for avifauna, there were 16 priority bird species included as variables in the conservation model, and thus many of the conclusions are relevant to this discussion (Personal communication, Y. Govender, Puerto Rico Conservation Trust 2013). Several important findings came out of this analysis, including:

- Ecosystems in Puerto Rico are highly fragmented, due to the elaborate network of roads and grey infrastructure throughout the island;
- The lack of an island-wide land use plan and effective implementation of planning codes allows for the conversion of natural cover to development and intense extractive use, reducing the possibility of achieving biodiversity and ecosystem conservation targets;
- Puerto Rico's protected areas are well-positioned in terms of biodiversity conservation, but there are still many habitats that lack adequate protection;
- There are many potential conservation opportunities on the lands directly adjacent to existing protected areas;
- Ecosystems facing the greatest threats from disturbance/conversion are areas of past and present land use in moist lowland forests; dry, semi-deciduous lowland forests; coastal mangroves and estuaries; herbaceous wetlands and riparian zones; coastal dunes and beaches. Ecosystems at higher elevations are generally better protected;
- Mountainous zones, coastal ecosystems, and the riparian corridors that connect the island's interior with the coast are the highest conservation priorities; while mountainous zones are relatively well, both riparian areas and coastal zones are generally under-protected;
- Specific high priority conservation areas include several interior forest reserves: Carite, El Yunque, Maricao, Río Abajo, Toro Negro; and several coastal and marine areas: Loíza/Carolina, the coast of Fajardo-Humacao, Vieques, Culebra and Mona Islands, Aguirre, Guánica, lands to the east of Arecibo, marine areas in the western region of PR;
- Specific priority areas with little protection include: coasts in general, lands around El Yunque and the Central Cordillera, islands such as Vieques and Culebra, the Pandura and Cayey Mountains, and the mountains to the west of Ponce (Comer et al. 2005, Varley 2011).

Taken together, the Vista analyses indicate that at least one-third of Puerto Rico should be conserved in one form or another to maintain the essential ecosystem functions necessary to protect the island's biodiversity. Accordingly the project is now currently known as Mapa 33 (Figure 21), and Para la Naturaleza, a new unit of the PRCT, is working with public and private partners around the island in the strategic areas previously identified (Para la Naturaleza 2013). A recent reparameterization of their model now includes novel elements such as distance from protected areas, distance from water bodies, flood zones, and hydrologic reserves in assessing Puerto Rico's areas of highest ecological value. And in collaboration with the Puerto Rico Planning Board, Mapa 33 aims to develop maps of different conservation scenarios that can be

analyzed based on current and proposed land use (Personal communication, S. Gaztambide, Puerto Rico Conservation Trust 2013).

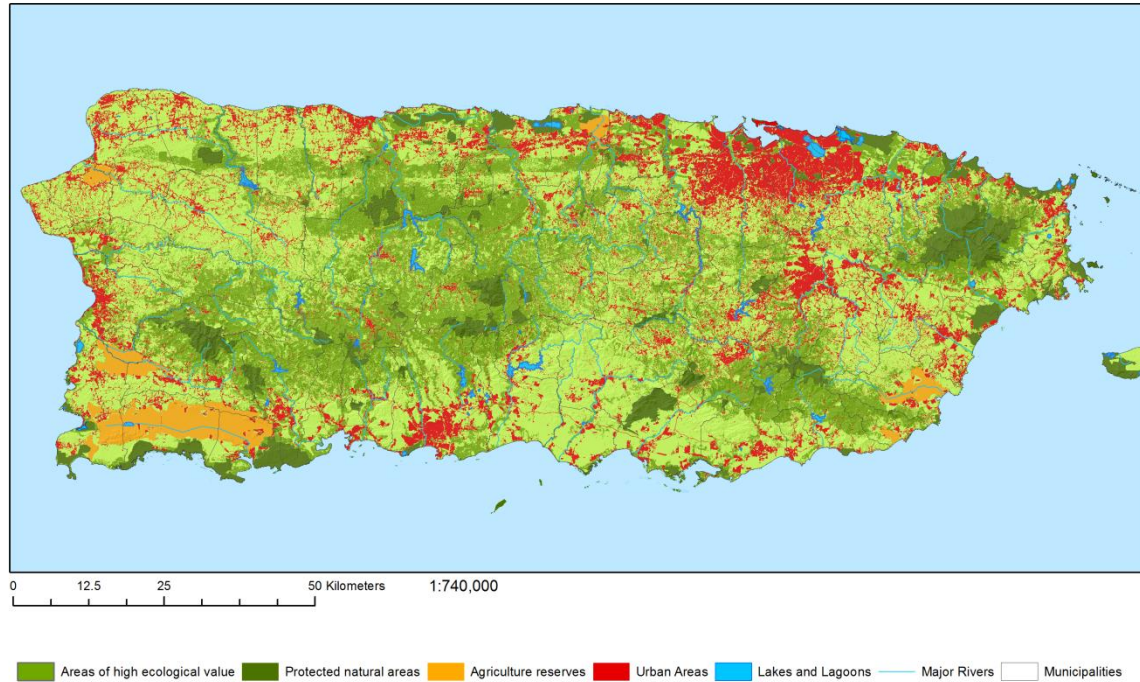


Figure 21: Map 33 showing areas of high ecological value in Puerto Rico (source: Para la Naturaleza 2013).

The Nature Conservancy Ecoregional Plan and Caribbean Decision Support System (PR and USVI)

Building off of the work of NatureServe Vista, in 2005, The Nature Conservancy (TNC) published an ecoregional plan for the terrestrial biodiversity of Puerto Rico and its archipelago, with the purposes of protecting examples of all native ecosystem types across their environmental gradients, maintaining viable populations of all native species in natural patterns of abundance and distribution, and sustaining ecological and evolutionary processes (Keel et al. 2005).

Within the ecoregional plan are several findings relevant to our current discussion of bird conservation in Puerto Rico. Included in the Conservancy's assessment of ecological conditions were several species-level biodiversity targets, namely those rare or threatened species assigned by PRDNER's Natural Heritage Program. Twenty-three of these targets are birds (Appendix O). Using an iterative computer model, experts familiar with Puerto Rican biodiversity calculated viability and current biodiversity health – based on key ecological factors at several sites – of several conservation species considered indicative of particular habitat types. Biodiversity Health (BH) was thus expressed for each target on a scale from 0 to 1, with 1 indicating that key factors were within the natural range of variability and the target is in perfect health. Occurrences

with $BH \leq 0.8$ reliably indicate that less than 50% of a target's key factors are within the natural range of variability, and hence 0.8 was considered the threshold point for poor ecological conditions.

Some of the results of this viability analysis were consistent with PRDNER's conservation status rankings in the PR-CWCS: the Puerto Rican Parrot and White-crowned Pigeon, both of which are Critically Endangered species, scored BH values of 0.77 and 0.73, respectively. Other findings may help fill some persistent information gaps. The Black-throated Blue Warbler, for example, also scored less than 0.8. Since the majority of this species' wintering habitats are encompassed by the Insular Caribbean, the Black-throated Blue Warbler is often considered representative of Neotropical migrants in general. Consequently, a low BH suggests that, overall, the habitats of migrant passerines are lacking in quality, at least for the sites evaluated. The habitats of shorebirds and waders also ranked close to or below the threshold level and may indicate deprived ecological conditions.

Two other germane components of TNC's ecoregional assessment are the fragmentation and connectivity analyses. First, according to an examination of landscape configuration metrics, both dry and moist alluvial habitats are highly fragmented, and the mean patch size of each target area within these habitats is comparatively small. Alluvial environments play an important role in the life cycles of many waterfowl and wading birds, and therefore limited area and poor connectivity between habitat patches could have a detrimental impact on population dynamics. In the connectivity study, the dispersal ability of individual targets or group targets was evaluated based on expert opinion. Interest was focused on identifying least cost paths (i.e., routes with relatively lower levels of difficulty when traversing natural and human-influenced environments) that connected protected areas across the main island of Puerto Rico. Results of the analysis highlighted several regions with a high density of least cost pathways, many of which coincide with the locations of existing forest reserves (Figure 22). One detail that stood out, however, was that the area around Aguas Buenas was an important corridor gap. The size and quality of the Aguas Buenas area and proximity to other target occurrences also suggested that it could play an important role in recruiting new individuals, and functioning as a critical source or sink. Notably, since the publication of TNC's report, the Aguas Buenas Forest Reserve has been established by the Commonwealth of Puerto Rico.

Second, the results of the target viability (which included coarse-filter priorities such as ecosystems and fine-filter targets such as species), fragmentation, and connectivity analyses all contributed to generating a summary portfolio of terrestrial biodiversity objectives for Puerto Rico – which echo the results from NatureServe Vista/Mapa 33. The conclusions of TNC's portfolio assessment suggested that lands be set aside for conservation in several areas: the Aguas Buenas vicinity; the forests east and west of the Rio Abajo Forest Reserve; the forests east of the Guánica Forest Reserve; Culebra; in addition to the expansion of current protected areas in the Cordillera Central and on Vieques.

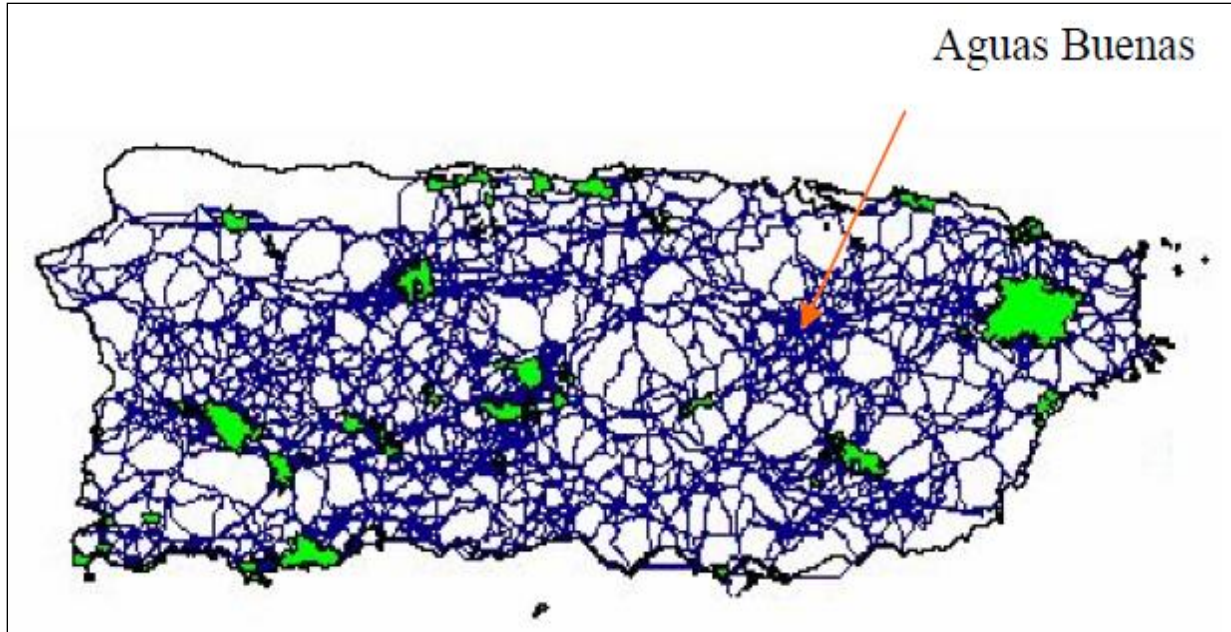


Figure 22: Least cost wildlife connectivity pathways in Puerto Rico (blue lines) with overlaid protected areas (green). At the time of publication, the Aguas Buenas area stood out as an important gap (source: Keel et al. 2005).

Furthermore, in 2007 TNC expanded their biodiversity assessment throughout the region via the Caribbean Decision Support System (CDSS) to aid systematic conservation planning and decision making and to guide conservation strategy development (Huggins et al. 2007). In collaboration with local experts the CDSS generated a portfolio of priority areas that represent the region's biodiversity to achieve regional goals and objectives. As already discussed with respect to the Puerto Rico analysis, the process involved identifying and mapping biodiversity targets, risk factors, and suitability indicators, and analyzing these data to identify priority conservation areas. The conclusions expand upon the results presented for Nature Serve Vista/Mapa 33 and the Ecoregional plan for Puerto Rico, and also include locations in the US Virgin Islands (see Appendices P and Q). Together the conclusions from all the NatureServe/TNC assessments can serve as useful signposts to complement other analyses and inform conservation planning.

Model Forest (PR)

In 2003, the NGO Casa Pueblo, based in Adjuntas, PR, presented to the Puerto Rico Planning board a proposal for the conservation management of sensitive Areas in Adjuntas and Adjacent Municipalities. This plan suggested that the Bosque del Pueblo Forest be integrated into a conserved region of 14,368 hectares located in 10 municipalities throughout the Central Cordillera of Puerto Rico. The majority of this territory includes very steep and non-cultivable land that provide critical wildlife habitat and also harbor the headwaters of important rivers that provide potable water for more than 1 million human inhabitants on the island (Personal communication A. Dragoni and E. Gonzalez, Center for Landscape Conservation 2013). In 2004, the Puerto Rico Planning Board approved Casa Pueblo's proposal with an Executive Order (OE-2004-

80). Subsequently, the management zone was certified as part of the International Model Forest Network, a participatory and collaborative approach to sustainable forest management that incorporates diverse stakeholders and values, and currently includes 19 sites in 11 countries (Besseau et al. 2002).

In conjunction with efforts by several state and federal wildlife partner agencies to establish landscape-scale ecological corridors, the proposed Model Forest conservation area in Puerto Rico has expanded to a megacorridor of approximately 152,150 hectares (Figure 23), based predominantly on the terrestrial ecoregional assessment developed for Puerto Rico by The Nature Conservancy (Keel et al. 2005, see discussion above). The details as to how to implement the conservation and consequent management of such an extensive area are currently under dialogue. If approved, the Model Forest project would: 1) represent the largest conservation district in Puerto Rico, extending across several geoclimatic zones; 2) provide landscape-level habitat connections and promote contiguous forest cover; and 3) establish a novel conservation paradigm in Puerto Rico based on a working/living landscape that incorporates people in the stewardship process – distinct from more traditional approaches of acquiring, depopulating, and excluding people from lands of high ecological value (Personal communication, A. Dragoni, Center for Landscape Conservation 2013). For the purposes of this report, the Model Forest conservation region provides an island-wide look at conservation planning that links existing protected areas and thereby connects important habitat in the central mountains with the northern karst, moist coastal, and southern dry forest zones.

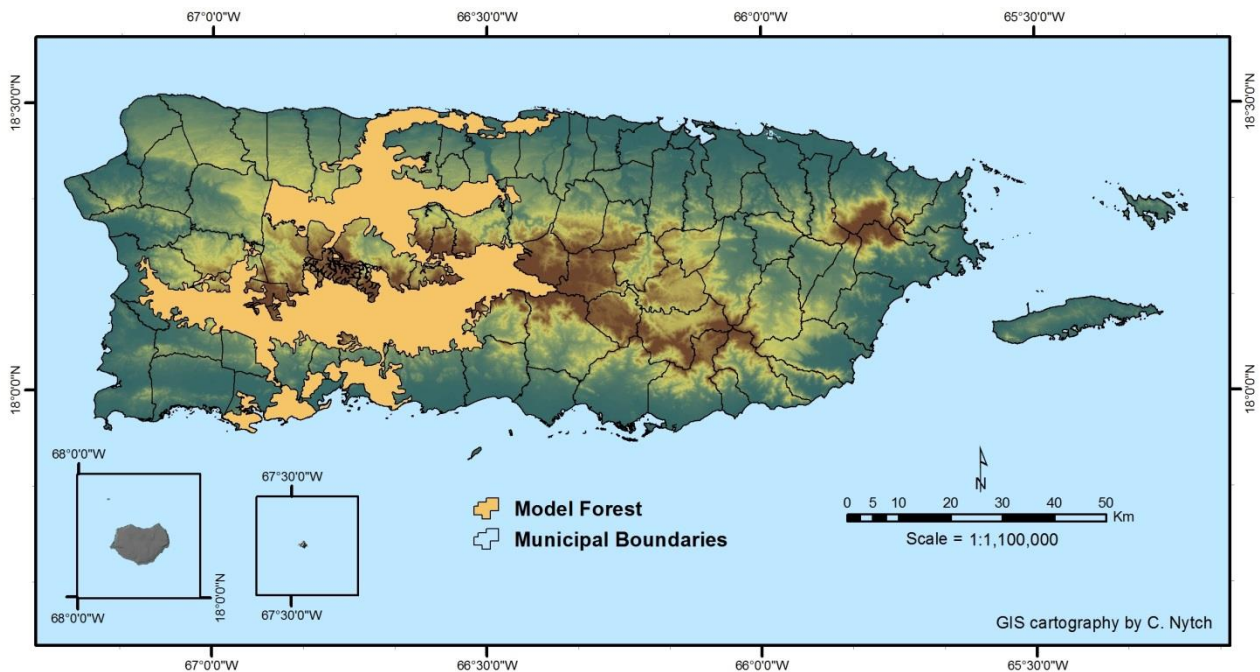


Figure 23: Model Forest proposed megacorridor for landscape-scale conservation (spatial layer provided by A. Dragoni).

Inventory of Breeding Seabirds (PR and USVI)

As part of a regional inventory of Caribbean breeding seabirds, Saliva (2009) provides an updated overview of the status and distribution of Puerto Rico's seabird populations, building on the regional inventories presented a decade ago by Schreiber and Lee (2000). Attention is given to priority species and habitat locations that require protection and habitual monitoring, as well as sites in need of additional surveys. Nesting occurrence on the Puerto Rico mainland and several offshore islets and cays is discussed for sixteen species (Appendix R). The site-specific nature of these accounts provides fine-scale details that accompany coarser analyses at the landscape level.

Pierce (2009) likewise presents an updated synopsis of the status and distribution of the USVI's breeding seabird populations. The majority of important islands on which seabirds nest in this archipelago are small, uninhabited offshore cays difficult to access near St. Thomas and St. John. Some 39 seabird species have been recorded in the USVI, 15 of which breed (Appendix S). Nesting locations and breeding ecology are discussed for each species. As with the seabird inventory for Puerto Rico, these detailed species accounts serve as an excellent resource for refining broader habitat analysis and identifying site-specific conservation opportunities.

The USVI seabird inventory also provides a listing of the ownership status of smaller offshore islands in the USVI (Table 1), information which is essential when making conservation planning decisions for focal bird species.

US Fish and Wildlife Service Reports (PR and USVI)

The USFWS in the Caribbean operates several wildlife refuges, provides ecological habitat management services, and administers recovery programs for endangered species, aligned with the mission to conserve, protect, and enhance fish and wildlife and their habitats. Ten bird species are currently included on the list of endangered and threatened species for Puerto Rico and the USVI (Appendix T), each of which has a species profile detailing listing status, distribution, as well as related documents such as recovery plans and in a few cases critical habitat designations and maps (Figure 24; USFWS 2007a,b). The recovery plans stipulate specific objectives for several priority species recognized in this plan, which in turn provide points of reference for population targets pertinent to other birds associated with the same habitat types. General species distribution data per municipality is also helpful in identifying important conservation areas.

Breeding Bird Atlas (PR)

One final resource worth mentioning is the Breeding Bird Atlas (BBA) of Puerto Rico, which is managed by SOPI in collaboration with the International Institute of Tropical Forestry (SOPI 2009a,b). Similar to PRGAP, the BBA is designed to generate a map of

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Territorial Government (St. Thomas unless otherwise indicated)	Federal Government	Private
Booby Rock (St. John)	<i>National Park Service</i>	Cinnamon Cay
Bovoni Cay	Buck Island (St. Croix)	Current Rock
Capella Island	Cocoloba Cay	Fish Cay
Carval Rock (St. John)	Hassel Island (partial)	Great St. James Island
Cas Cay	Henly Cay	Green Cay (St. Thomas)
Cockroach Cay	Ramgoat Cay	Hans Lollick Island
Congo Cay (St. John)	Rata Cay	Hassel Island (partial)
Cricket Rock	Truck Cay	Inner Brass Island
Dog Island (St. John)	<i>USFWS</i>	Little Hans Lollick Island
Dutchcap Cay	Buck Island (St. Thomas)	Little St. James Island
Flanagan Island (St. John)	Green Cay (St. Croix)	Lovango Cay
Flat Cay and Little Flay Cay	<i>US Dept. of Interior</i>	Mingo Cay
Fenchcap Cay	Water Island (partial)	Patricia Cay
Grass Cay (St. John)	<i>In Dispute</i>	Pelican Cay
Hassel Island (partial)	Ruth Cay	Rotto Cay
Kalkun Cay		Thatch Cay
LeDuck Island (St. John)		Water Island (partial)
Outer Brass Island		Watermelon Cay
Perkins Cay (St. John)		
Protestant Cay (St. Croix)		
Saba Island		
Sail Rock		
Salt Cay		
Savana Island		
Shark Island (St. John)		
Steven Cay (St. John)		
Sula Cay		
Turtledove Cay		
Two Brothers (St. John)		
Water Island (partial)		
West Cay		
Whistling Cay (St. John)		

Table 1: Ownership of offshore islands and cays of the US Virgin Islands (modified from Pierce 2009).

the geographic distribution (based on presence/absence data) of each bird species in Puerto Rico and its satellite islands (Figure 25), and does so by incorporating relevant data from government agencies, NGOs, and volunteer observers such as those that participate in Breeding Bird Surveys throughout the island. Begun in 2005, the Atlas is updated on a periodic basis with new data. The list of species covered by the Atlas can be viewed in Appendix U. Together with GAP data, BBA findings are useful in understanding current patterns of species distribution for endemic, native, exotic, and migratory birds, which serve to inform conservation planning that protects avian biodiversity.

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands



Figure 24: Critical habitat map of the Yellow-shouldered Blackbird (adapted with permission from US Fish and Wildlife Service 2007b).

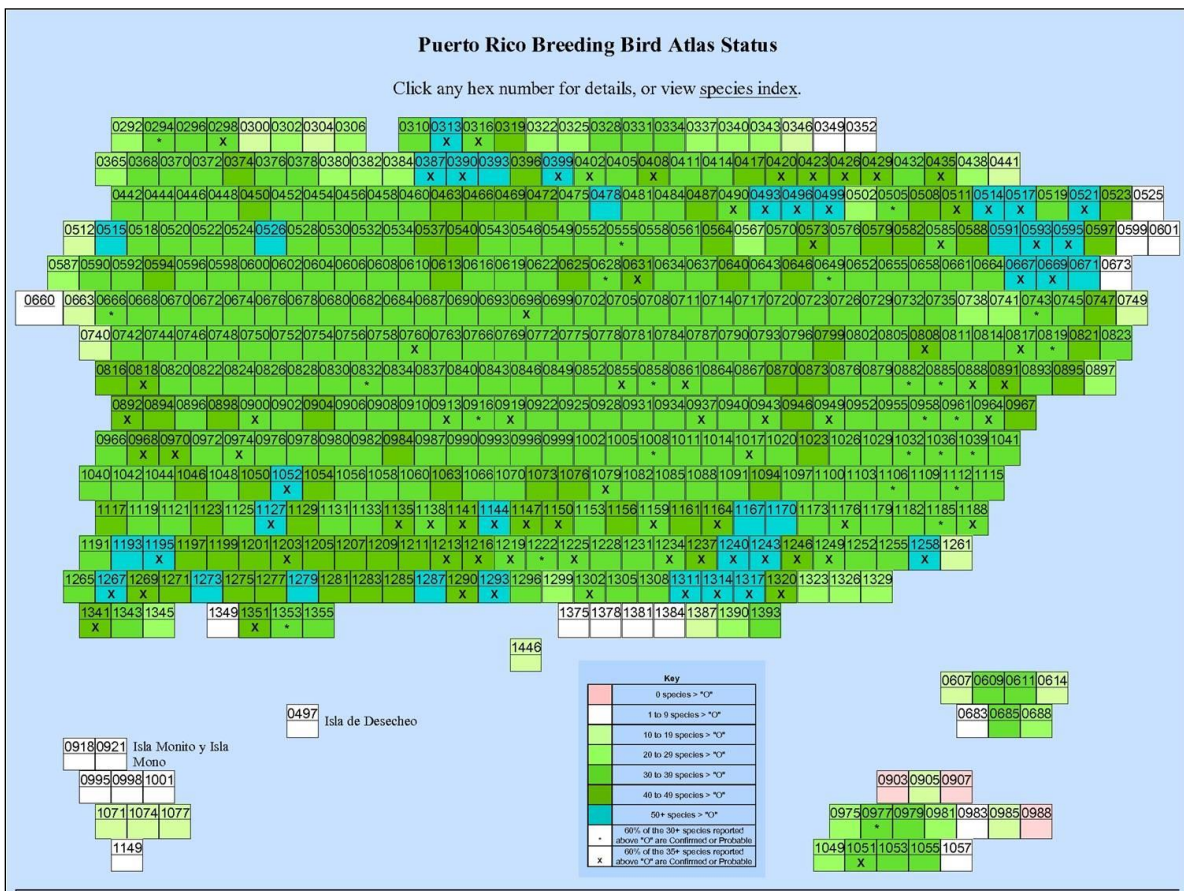


Figure 25: Puerto Rico Breeding Bird Atlas overall status map showing spatial distribution of species abundance (adapted with permission from Sociedad Ornitológica Puertorriqueña Inc. 2009b).

Synthesis

Considered individually, the reports discussed above each highlight important patterns regarding bird priorities in Puerto Rico and the USVI. When they are amalgamated together, the resulting mosaic reveals synergistic landscape-level trends that also warrant consideration for effective, long-term conservation planning. In the following paragraphs we direct our discussion towards a synthesis of the information presented thus far in this section, in order to assess general focal areas on which to concentrate avian conservation efforts. Keep in mind that the conclusions in the following paragraphs are drawn from the integration of previous avian habitat and species conservation work, yet in this report we do not engage in any spatial regression analysis of our own.

Taken together, a total of 222 distinct bird species receive attention in this plan and the Puerto Rico and USVI reports for GAP, CWAs, IBAs, WFAs, Critical Elements, the Puerto Rico and USVI Comprehensive/Critical Wildlife Conservation Strategies, the Ecoregional Assessment Plan and Caribbean Decision Support System, Nature Serve/Map 33, Inventory of Breeding Seabirds, USFWS Reports, and the Breeding Bird Atlas. Our avifaunal prioritization analysis (Section 3) includes 144 of those 222 species, many of which are not included in the other reports. In spite of the varying objectives, habitat classifications, scales of analysis, and evaluation criteria employed by the different studies there is significant overlap of the species highlighted (Appendix V), which emphasizes the convergent nature of these documents and suggests that these priority birds are widely considered worthy of conservation attention.

There are also significant parallels among the suggested priority habitat areas, as is somewhat expected due to the partial overlap of data sources. Particularly revealing are the visual patterns that emerge when these focal areas are grouped together. Figure 26 shows the amalgamation of conservation areas in Puerto Rico and the USVI, as identified by several of the reports discussed above. Viewed in concert with one another, it becomes apparent that areas of conservation priority are concentrated around several geographic features and regions:

- Coastal zones, lagoons, adjacent wetlands, mangrove forests (PR and USVI)
- Open water (lakes, reservoirs, and freshwater lagoons) and riparian areas (PR and USVI)
- Smaller islets and cays (PR and USVI)
- Dry and moist lowland forests (PR and USVI)
- Vieques, Culebra, Mona (PR) and St. Thomas, St. John, St. Croix (USVI)
- Upper elevations of the central mountains/hills (PR and USVI)
- Sierra de Cayey and Pandura Mountains (PR)
- Sierra de Luquillo (PR)
- Northern karst belt (PR)
- Piñones/Torrecillas wetland complex (PR)
- Lajas Valley and Sierra de Bermeja (PR)
- Guayanilla-Peñuelas Hills (PR)

- Habitat corridor from Guánica dry forest through Susúa to Maricao and the Central Cordillera (PR)
- Habitat corridor from Toro Negro and Tres Picachos in the Central Cordillera to Río Abajo and Río Encantado in the northern karst (PR)
- Habitat corridor from Río Abajo in northern karst to Caño Tiburones in coastal wetlands (PR)

Moreover, by adding in the overall species richness data of all (144) modeled bird habitats from PRGAP and USVIGAP (Figure 27), one can see that the combined array of priority habitat areas corresponds well with the core locations identified as having the greatest potential diversity of bird life. Subtracting out the stewardship areas identified by PRGAP as having a conservation status of 1, 2, or 3 allows us to then see the remaining habitat areas of priority concern for birds that currently lack protection and/or management for biodiversity conservation (Figure 27) – and on which future efforts should be focused.

An examination of bird conservation efforts in the region underscores the fact that significant conservation progress has been made to date, particularly in upland

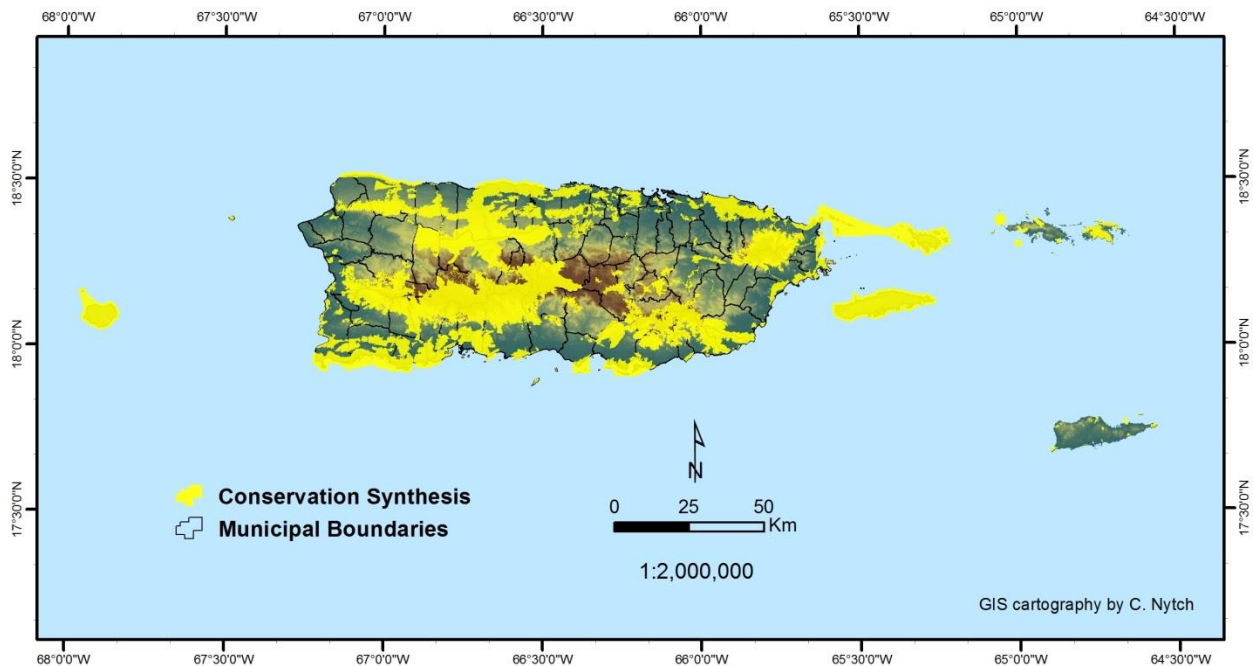


Figure 26: Amalgamated synthesis of Puerto Rico and US Virgin Islands conservation priority habitat areas (yellow) as identified by reports for Critical Wildlife Areas, Important Bird Areas, Areas of Conservation Priority and Avian Critical Elements, Waterfowl Focus Areas, the DNER's Comprehensive Wildlife Conservation Strategy, and Model Forest. Spatial layers for other reports discussed in this section were not available.

protected areas, select coastal and wetland reserves, and on some of the most important islets and keys. Yet the same analysis also exposes a lack of conservation attention in priority areas such as Puerto Rico's northern karst belt, the Lajas Valley, the Sierra de Cayey, and significant portions of the offshore islands in both Puerto Rico and

the USVI. Perhaps more revealing is the conservation picture that emerges when the two archipelagos are considered as a unit. Notably, the current suite of conserved lands is a patchy conglomerate of predominantly isolated efforts with a lack of interconnected wildlife corridors both within each major habitat type and between ecological zones. The upshot is that vital avian conservation planning work remains to be done.

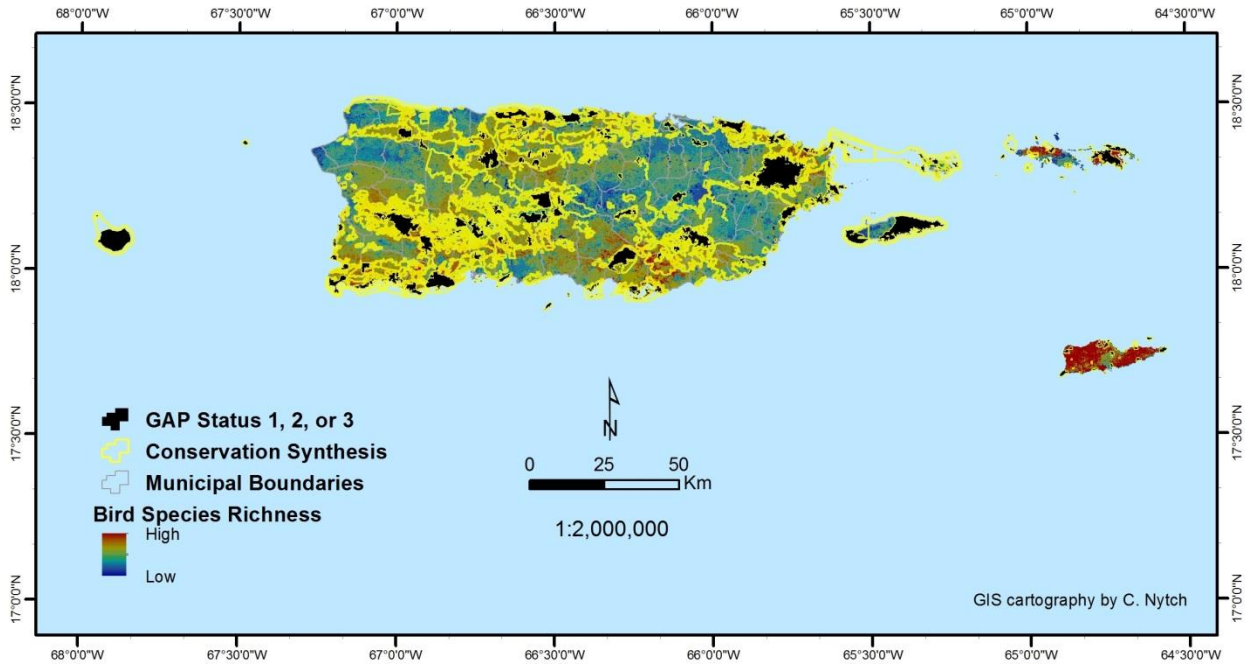


Figure 27: Amalgamated synthesis of Puerto Rico conservation priority habitat areas (yellow outline), species richness values of all modeled bird habitats, and stewardship areas (black patches) classified as status 1, 2, or 3 by the GAP Analysis Project (Gould et al. 2008a, 2013).



Puerto Rican Parrot. Photo credit: Julio Salgado Vélez

SECTION 3: PRIORITIZATION ANALYSIS

Introduction

This section presents our own scientific vetting of priority species of conservation concern in the region, including both the selection methodology used as well as the resulting conservation scores. A brief synopsis of the avifaunal assemblage in Puerto Rico and the USVI is provided first as introduction.

Including vagrants, exotics and fossils, the aggregate number of bird species that have been observed in the region sums to 364 (Personal communication, S. Colón, Sociedad Ornitológica de Puerto Rico 2013). Presently, 276 species are known to occur in Puerto Rico and 210 in the USVI for a total of 284 existing species (Raffaele 1989, Corven 2008, Wunderle and Arendt 2011). These numbers may change in future years as many native forms may be reclassified as species or subspecies on their own. Raffaele (1989) categorized the regional bird species as follows:

- 97 breeding permanent residents (94 in Puerto Rico and 60 in the USVI);
- 11 species that breed and leave (11 in Puerto Rico and 10 in the USVI);
- 134 non-breeding migrants and visitors (134 Puerto Rico and 129 the USVI);
- 31 introduced probable breeders (31 in Puerto Rico and 6 in the USVI);
- 5 introduced possible breeders (same species for both Puerto Rico and the USVI); and
- 1 species recently extirpated from Puerto Rico.

As the numbers indicate, migrant species comprise almost half of the species playing a major role in the ecology of the region. Also noteworthy is the establishment of a high number of exotic species, six of which have been introduced for hunting (Miller and Lugo 2009). As a result of combining both native and exotic species, Puerto Rico supports 85 species of breeding land birds, the greatest number of any West Indian island, and except for Cuba, harbors the second largest total number of species in the region (Raffaele 1989).

The oceanic nature of the islands in the region has resulted in increased endemism. Puerto Rico harbors seventeen endemic bird species, including one endemic genus (*Nesospingus*) represented by a single species, the Puerto Rican Tanager (*Nesospingus speculariferus*), and one family (*Todidae*) shared with the rest of the West Indian islands but found nowhere else. The USVI share two endemic species with Puerto Rico and harbor none of their own (Table 2). Raffaele (1989) considered 51 species to be threatened in the region mostly because of the detrimental effects of habitat alteration. One bird species, the Puerto Rican Parrot, is currently listed as threatened on the IUCN Red List (2009).

SPECIES	COMMON NAME
<i>Amazona vittata</i>	Puerto Rican Parrot
<i>Agelaius xanthomus</i>	Yellow-shouldered Blackbird
<i>Anthracothorax viridis</i>	Green Mango
<i>Caprimulgus noctitherus</i>	Puerto Rican Nightjar
<i>Chlorostilbon maugaeus</i>	Puerto Rico Emerald
<i>Coccyzus vieilloti</i>	Puerto Rican Lizard-Cuckoo
<i>Icterus portoricensis</i>	Puerto Rican Oriole
<i>Loxigilla portoricensis</i>	Puerto Rican Bullfinch
<i>Megascops nudipes</i> *	Puerto Rican Screech-Owl
<i>Melanerpes portoricensis</i>	Puerto Rican Woodpecker
<i>Myiarchus antillarum</i> *	Puerto Rican Flycatcher
<i>Nesospingus speculiferus</i>	Puerto Rican Tanager
<i>Setophaga adelaidae</i>	Adelaide's Warbler
<i>Setophaga angelae</i>	Elfin-woods Warbler
<i>Spindalis portoricensis</i>	Puerto Rican Spindalis
<i>Todus mexicanus</i>	Puerto Rican Tody
<i>Vireo latimeri</i>	Puerto Rican Vireo

Table 2: Endemic bird species in Puerto Rico. Asterisk denotes endemism in both Puerto Rico and the USVI.

Prioritizing Species of Conservation Concern

In this plan, we assigned 144 bird species **priority conservation scores** adopting the Partners in Flight (PIF) prioritization system (Panjabi et al. 2012), which uses biological criteria to assess distinct components of species vulnerability at continental and regional scales and determine a level of conservation importance. The process has evolved and been updated over time (Hunter et al. 1993, Carter et al. 2000, Panjabi et al. 2005, Panjabi et al. 2012), and the assessment procedures have been tested and externally reviewed (Beissinger et al. 2000).

Here we provide a simplified summary of the scoring methodology (a detailed scoring methodology follows Tables 3b). Each species is assigned global scores for six factors, assessing largely independent aspects of vulnerability at the range-wide scale:

- Population Size (PS)
- Breeding Distribution (BD)
- Non-breeding Distribution (ND)
- Threats to Breeding (TB)
- Threats to Non-breeding (TN), and
- Population Trend (PT)

The individual scores reflect the degree of a species' vulnerability (i.e., risk of significant

population decline or rangewide extinction) as a result of that factor, ranging from “1” for low vulnerability to “5” for high vulnerability.

In addition to global scores, PIF assigns region-specific scores for those vulnerability factors that may vary geographically: population trend, threats to breeding and – for species that reside in the region outside the breeding season – threats to the species during the non-breeding season.

The PIF assessment process also considers two measures of area importance: the percentage of global population that occurs in the region of interest during the breeding or non-breeding season, and the relative density (RD) of the species among regions. Different ranking factors are summed for each species to provide a Regional Combined Score (RCS) and indicate species of Continental Concern, Regional Concern, and Stewardship.

All of this information is then integrated to determine levels of conservation importance, which are organized into five conservation tiers and seven action levels needed to effect conservation, which are listed here (with more detail following Tables 3a and 3b):

Tiers:

- I – Conservation concern
- II – Additional stewardship
- III – Additional legal protection
- IV – Additional local or regional interest species
- V – Additional species possibly warranting population control

Action Levels:

- CR = Critical Recovery
- CX = subset of CR, when no populations are presently known
- IM = Immediate Management
- MA = Management Attention
- PR = Planning and Responsibility
- PC = Generic Population Control possibly needed to conserve higher priority species)
- PCL=Local Population Control possibly needed to conserve other higher priority species

Following the PIF assessment scheme we assigned prioritization scores to most of the native and migrant birds known to occur in Puerto Rico and the USVI, which are both situated within the West Indies Bird Conservation Area. Based on these scores we then organized the species into a hierarchical table of conservation tiers and action levels. A

few species do not rank high enough to meet continental or local Watch List¹ criteria and thus do not have a conservation tier nor a score. A comprehensive summary of prioritization scores are presented in Tables 3a and 3b. These scores are helpful in determining which individual species, guilds, and habitats are most in need of conservation attention at continental and regional scales. We included many subspecies and a few isolated populations with unclear taxonomy; for conservation purposes they are treated as species and are referred as such hereafter. The absence of a particular species from our prioritization analysis does not imply that the species is not of concern nor worthy of conservation effort, but rather simply reflects our regional focus on the most vulnerable birds. In most cases addressing the needs of these higher ranking species will also benefit other species within the same habitat.

There are 131 species and 104 species included in each of the Puerto Rico and USVI prioritization analyses, respectively, with 90 species in common. The conservation ranking lists were separated for each country so as to address unique distributions and conservation concerns of some species in the USVI. The Puerto Rican Screech-Owl, for example, scored an RCS of 19 on the Puerto Rico list, and is classified as a Tier II species at the Planning and Responsibility action level, whereas it scored 22 on the USVI list (a subspecies, actually), as a Tier I species at the Critical Recovery (CX subset) level with no currently known populations. Thus the priority assessment emphasizes the need for urgent conservation attention for this species in the USVI.

Because several of the criteria are considered at the local level, endemic and particularly threatened and endangered species almost always score higher than migrant species. It is important to note that these priority scores and conservation levels are intended to serve only as guidance to establish conservation priorities and habitat management practices; almost certainly they will need to be modified according to information and expertise available at the local level, and considered in the context of non-biological factors such as feasibility, cost-effectiveness, political considerations, and the interests and capabilities of participating agencies.

Tables 3a and 3b also include numbers for current population estimates and future objectives (breeding pairs) for the highest priority species and island endemics considered in our analysis. These values are revisited in the discussion of species-specific population and habitat objectives, presented in Section 5.

These scores are helpful in determining which individual species, guilds, and habitats are most in need of conservation attention at continental and regional scales.

¹ Watch List species include those that are most vulnerable at a continental or regional scale (as quantified by ranking criteria) due to a combination of small and declining populations, limited distributions, or high threats.

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Table 3a. Conservation priority rankings of 131 bird species in **PUERTO RICO** (following Panjabi et al. 2012).

Tier	Action Level	RCS	c	Season	R C	C C	S	Fed List	Com List	Endemic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	CR													
I.	CR	25	Puerto Rican Parrot	B, N	x	a	x	E	CE	PR	PR, Culebra (Both 25)	77-137 individuals (Personal communication, I. Llerandi, USFWS 2013)	Extinct on Culebra (1912)	>350

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	CR	25	Puerto Rican Nightjar	B, N	x	a	x	E	E	PR		1,400-2000 individuals (Vilella and Swank 1993); Densities of 1.63 nightjar/ha for 263.3 ha in Gúanica, 0.86 nightjar/ha for 167.8 ha in Susúa, and 0.99-1.40 nightjar/ha for 60.08 ha in El Convento (González 2010)		Establish current population size and update objective; 1,200 pairs (USFWS 1984, 2012)

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	CR	25	Elfin-woods Warbler	B, N	x	a	x	C	VU	PR		610 (Derived from BirdLife International ² 2008)		>1,000
I.	CR	25	Yellow-shouldered Blackbird	B, N	x	a	x	E	E	PR	PR, Mona Is. (Both 25)	<1,000		2000 (Personal communication, R. Lopez, PRDNER 2009)
I.	CR	22	West Indian Whistling-Duck	B, N	x	a			CE	WI		<100		250
I.	CR	22	Masked Booby	B	x	c					WI (25)	175-225 (Saliva 2009)		>500
I.	CR	22	Piping Plover	N	x	a		T				<50 individuals		Maintain current population

² BirdLife population figures represent numbers of individuals (BirdLife International 2008). Where breeding pairs have been derived from BirdLife numbers they have been converted based on the assumption that one pair = three individuals within a population (allowing for non-breeding and immature individuals).

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	CR	21	White-crowned Pigeon	B, N	x	b						<1,000 ³	season closed	2,500
I.	CR	21	Plain Pigeon	B, N	x	a		E	E	GA	PR (25)	> 1,000 (USFWS 2011)	Season closed	2,500
I.	CR	19	Yellow-breasted Crake	B, N	x	b					Hisp.-PR; (25)	<50		>100
I.	CR	18	Masked Duck	B, N	x				E			<50		> 100

³ White-crowned Pigeons have been observed in many municipalities of the Puerto Rico mainland, and extrapolated estimates from PRDNER point count data based on potential habitat availability suggest an average density of 0.053 individuals/ha, a population size ranging from 30,315 to 46,869 individuals, and a population objective of 39,000 pigeons or more. On Mona Island the population size estimate ranges from 3,639 to 15,505 individuals (Rivera-Milan and Martinez, 2012). However, given the low population densities and the fact that the distribution of this species is still highly localized, we (the authors of this report) decided to take a more conservative approach and adopt lower population numbers for this important and rare bird until additional data become available. Nevertheless, the PRDNER's work should be considered as an important source of population revisions/updates in the future.

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	Endemic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	CR	17	Snowy Plover	B, N	x	a					WI (22)	<40		> 100
I.	CR	16	Sharp-shinned Hawk	B, N	x			E	CE		PR (25)	<15 (Personal Communication, F. Vilella, Mississippi State Univ. 2013)	subspecies of the North American Sharp-shinned Hawk	250; determine if is unique, endemic species of its own
I.	CR	16	Broad-winged Hawk	B, N	x			E	CE		PR (25)	<60	subspecies of the Broad-winged Hawk	>60 pairs; > 200 individuals (USFWS 1997)

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	CR	16	Limpkin	B, N	x						Hisp-PR (22)	Unknown	Believed to be extirpated since 1959 (Raffale 1989) but recent sightings and breeding confirmed in northeastern PR (S. Colón, SOPI 2014; Puerto Rico eBird).	Establish population size / Potentially reintroduce
I.	CX													
I.	CX	22	Hispaniolan Parakeet	B, N	x	a				Hisp.-PR	Mona Is. (25)	Extirpated since 1890s	Introduced pops. from Hisp., also of concern	Potentially re-introduce

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	Endemic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	CX	22	White-necked Crow	B, N	x	a		E		Hisp. -PR- VI		Extirpated since 1963	Reintroduction from Hisp. to be considered?	Potentially reintroduce
I.	CX	21	Black Rail	B, N	x	a						Extirpated?	Formerly bred	Establish population size / Potentially reintroduce
I.	CX	18	American Flamingo	B(?), N	x							Extirpated?	Historically bred?	Establish population size / Potentially reintroduce

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	IM													
I.	IM	24	Puerto Rican Vireo	B, N	x	a	x		LC	PR		20,000 – 25,000		> 30,000
I.	IM	23	Caribbean Coot	B, N	x	a			VU	GA		<500		>1,000
I.	IM	21	Antillean Mango	B, N	x					Hisp. -PR- VI	PR-VI (24)	Unknown	Confirm interaction w/ Carib.	Establish population size
I.	IM	20	White-cheeked Pintail	B, N	x	b			VU		WI-n. S. Am. (20)	About 700		>1,500
I.	IM	20	Red-footed Booby	B	x	b					WI (23)	3,000-3,025 (Saliva 2009)		>5,000
I.	IM	20	Magnificent Frigatebird	B	x	c						500-550 (Saliva 2009)		>1,000

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	IM	20	Puerto Rican Oriole	B, N	x	c				GA-Bah.	PR (24)	<2,500		> 5,000
I.	IM	19	Brown Booby	B	x	b					WI (22)	1,650-1700 (Saliva 2009)		>3,500
I.	IM	19	Brown Pelican	B, N	x			E			WI (22)	265-290 (Saliva 2009)		>500
I.	IM	18	Audubon's Shearwater	B	x	b					WI (20)	25-40 (Saliva 2009)		>100
I.	IM	17	Western Sandpiper	N	x	b						Unknown ⁴		Establish population size
I.	IM	16	Ruddy Duck	B, N	x				VU		WI (20)	About 750		> 1,500

⁴ Establishing an accurate population estimate of the Western Sandpiper is difficult due to the tendency of this species to congregate with other, similar-looking Calidrid shorebirds. Nevertheless, the abundance of small Calidrid species is observed to change seasonally. Wunderle et al. (1989) recorded 14,712 Calidrid Sandpipers (Least, Western, Semipalmated, and White-rumped) at Jobos Bay National Estuarine Sanctuary from July, 1985 to June, 1986, representing 65% of all shorebirds tallied during that period. During the fall peak in September 1985 these small “peep” sandpipers accounted for 86% of the shorebirds observed. Similarly, Collazo et al. (1995) calculated the mean seasonal number and relative abundance of the same four species at the Cabo Rojo Salt Flats from 1985 to 1992, with an average annual tally of 2,755 individuals, representing 62% of all shorebirds observed during the study. With respect to the Western Sandpiper in particular, observation of peak fall migration at Jobos Bay in August, 1985 yielded a tally of 71 individuals (Wunderle et al. 1989).

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	IM	15	Red Knot	N	x	c					SEUS-WI nonbr. (18)	Unknown		Establish population size
I.	MA													
I.	MA	20	Red-billed Tropicbird	B	x	a					WI pop. (21)	20-30		>100
I.	MA	19	White-tailed Tropicbird	B	x	b					WI (21)	500-525 (Saliva 2009)		>1,000
I.	MA	19	Semipalmat ed Sandpiper	N	x	b						Unknown		Establish population size
I.	MA	19	Bridled Tern	B	x	c					WI	235-250 (Saliva 2009)		>1,000
I.	MA	18	American Oystercatch er	B, N	x	c						<25		Maintain current population
I.	MA	18	Least Tern	B	x	b						135-150 (Saliva 2009)		>500

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	MA	18	Loggerhead Kingbird	B, N	x					GA-Bah.	PR	Unknown		Establish population size; determine if is unique, endemic species
I.	MA	17	Wilson's Plover	B, N	x	c						<100		200
I.	MA	17	Brown Noddy	B	x						WI	1,230-1,300 (Saliva 2009)		>2,500
I.	MA	17	Roseate Tern	B	x	b		T			WI pop. (23)	935-1,000 (Saliva 2009)	Caribbean subsp.	See Recovery Plan
I.	MA	17	Key West Quail-Dove	B, N	x					GA-Bah.		Unknown ⁵		Establish population size

⁵ The PRDNER has unpublished data from 2009-2012 counts throughout Puerto Rico that could be analyzed to provide a population estimate for the Key West Quail Dove (Personal communication, F. Rivera-Milán, USFWS 2013).

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	MA	17	Black-throated Blue Warbler	N	x					WI nonb r.		Unknown		Establish population size
I.	MA	17	Prothonotary Warbler	N	x	b						Unknown		Establish population size
I.	MA	16	Yellow-crowned Night-Heron	B, N	x							Unknown		Establish population size
I.	MA	16	Lesser Yellowlegs	N	x	b						Unknown		Establish population size
I.	MA	16	Stilt Sandpiper	N	x	b						Unknown		Establish population size
I.	MA	16	Black Swift	B	x	c					WI (20)	< 50		Maintain current population

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	MA	16	Yellow (Golden) Warbler	B, N	x						PR-VI (22)	Unknown	WI endemic “Golden” incipient species?	Establish population size
I.	MA	16	Worm- eating Warbler	N	x	b						Unknown		Establish population size
I.	MA	16	Louisiana Waterthrush	N	x							Unknown		Establish population size
I.	MA	15	American Bittern	N	x							Unknown		Establish population size
I.	MA	15	Solitary Sandpiper	N	x	b						Unknown		Establish population size

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	MA	15	Whimbrel	N	x						Hud. Bay(18)	Unknown		Establish population size
I.	MA	15	Sanderling	N	x	b						Unknown		Establish population size
I.	MA	15	Common Tern	N	x							Unknown		Establish population size
I.	MA	15	Northern Waterthrush	N	x							Unknown		Establish population size
I.	MA	14	Pied-billed Grebe	B, N	x						WI (18)	Unknown		Establish population size
I.	MA	14	Least Bittern	B, N	x							Unknown		Establish population size
I.	MA	14	Purple Gallinule	B, N	x							Unknown		Establish population size

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	MA	14	Ruddy Turnstone	N	x			oral				25-175 individuals (Wunderle et al. 1989, Collazo et al. 1995)		Maintain current population; establish better estimate
I.	MA	14	Least Sandpiper	N	x							Unknown ⁶		Establish population size
I.	MA	14	Chuck-will's-widow	N	x							Unknown		Establish population size

⁶ Establishing an accurate population estimate of the Least Sandpiper is difficult due to the tendency of this species to congregate with other, similar-looking Calidrid shorebirds. Nevertheless, the abundance of small species is observed to change seasonally. Wunderle et al. (1989) recorded 14,712 Calidrid Sandpipers (Least, Western, Semipalmated, and White-rumped) at Jobos Bay Estuary National Research Reserve from July, 1985 to June, 1986, representing 65% of all shorebirds tallied during that period. During the fall peak in September 1985 these small “peep” sandpipers accounted for 86% of the shorebirds observed. Similarly, Collazo et al. (1995) calculated the mean seasonal number and relative abundance of the same four species at the Cabo Rojo Salt Flats from 1985 to 1992, with an average annual tally of 2,755 individuals, representing 62% of all shorebirds observed during the study. With respect to the Least Sandpiper in particular, observation of peak fall migration at Jobos Bay in September, 1985 yielded a tally of 624 individuals (Wunderle et al. 1989).

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	Endemic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	PR													
I.	PR	20	Lesser Antillean Pewee	B, N		c	x			PR-LA	PR (20)	<5,000	PR subsp. probably incipient species	Maintain current population; determine if is unique endemic species
I.	PR	20	Adelaide's Warbler	B, N		c	x			PR		20,000 – 25,000		Maintain current population
I.	PR	18	Clapper Rail	B, N		x					WI (19)	Unknown		Establish population size
I.	PR	18	Antillean Nighthawk	B		c				GA-Bah.		Unknown		Establish population size
I.	PR	17	Mangrove Cuckoo	B, N		b						Unknown		Establish population size
I.	PR	17	Prairie Warbler	N		b				WI-FL nonbr.		Unknown		Establish population size

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	PR	16	Willet	N		b						Unknown		Establish population size
I.	PR	10	Short-eared Owl (Gr. Antilles subsp./sp.)	B, N			s			Cuba - Hisp. -PR	PR	<250	GA probably incipient species	Maintain current population
II.	PR													
II.	PR	19	Puerto Rican Lizard-Cuckoo	B, N			x			PR		<20,000		Maintain current population
II.	PR	19	Puerto Rican Screech-Owl	B, N			x			PR-VI	PR, VI (latter on Vieques and Culebra)	<20,000	VI subsp. may be extirpated , except on Culebra	Maintain current population
II.	PR	19	Green Mango	B, N			x			PR		<20,000		Maintain current population
II.	PR	19	Puerto Rican Emerald	B, N			x			PR		<20,000		Maintain current population

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
II.	PR	19	Puerto Rican Tody	B, N			x			PR		20,000 – 25,000		Maintain current population
II.	PR	19	Puerto Rican Woodpecker	B, N			x			PR		20,000 – 25,000		Maintain current population
II.	PR	19	Puerto Rican Flycatcher	B, N			x			PR-VI		5,000		Maintain current population
II.	PR	19	Puerto Rican Tanager	B, N			x			PR		<20,000		Maintain current population
II.	PR	19	Puerto Rican Spindalis	B, N			x			PR		<50,000		Maintain current population
II.	PR	19	Puerto Rican Bullfinch	B, N			x			PR		30,000 – 37,000		Maintain current population
II.	PR	18	Black-whiskered Vireo	B			x			WI-FL		Unknown		Establish population size

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
II.	PR	17	Scaly-naped Pigeon	B, N			x			GA-LA		75,149 - 100,226 (derived from Rivera-Milán and Martínez 2012)	economically important -hunted	88,000 (derived from Rivera-Milán and Martínez 2012)
II.	PR	17	Caribbean Martin	B			x			GA-LA		Unknown	Nest competition with Yellow-shouldered Blackbird.	Establish population size
II.	PR	16	Caribbean Elaenia	B, N						Cay.-PR-VI LA		Unknown		Establish population size
II.	PR	16	Gray Kingbird	B, N			x			WI-SE US		Unknown		Establish population size
II.	PR	16	Red-legged Thrush	B, N			x			WI	Hisp.-PR	<20,000		Maintain current population

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	Endemic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
II.	PR	16	Antillean Euphonia	B, N			x			GA-LA	PR	<20,000		Maintain current population; determine if is unique endemic species
II.	PR	15	Sooty Tern	B			x				WI	40,500-40,600 (Saliva 2009)	Almost all at Culebra	Maintain current population
II.	PR	15	Zenaida Dove	B, N			x			WI		183,388 - 224,454 (derived from Rivera-Milán and Martínez 2012)	economically important -hunted	> 183,000 (derived from Rivera-Milán and Martínez 2012)
II.	PR	15	Northern Parula	N			x					Unknown		Establish population size
III.			None											

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
IV.	PR													
IV.	PR	17	Bridled Quail-Dove	B, N						PR-VI-LA		Unknown ⁷		Establish population size
IV.	PR	16	Green-throated Carib	B, N						PR-VI-LA		Unknown	Expanding perhaps at expense of Antillean Mango	Establish population size
IV.	PR	16	Antillean Crested Hummingbird	B, N						PR-VI-LA		Unknown		Establish population size

⁷ The PRDNER has unpublished data from 2009-2012 counts throughout Puerto Rico that could be analyzed to provide a population estimate for Bridled Quail-Dove (Personal communication, F. Rivera-Milán, USFWS 2013).

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Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
IV.	PR	15	Sandwich Tern	B								675-700 (Saliva 2009)		Maintain current population
IV.	PR	15	Cave Swallow	B, N							GA	Unknown		Establish population size
IV.	PR	15	Cape May Warbler	N						WI nonb r.		Unknown		Establish population size
IV.	PR	14	Royal Tern	B								10-25 (Saliva 2009)		Maintain current population
IV.	PR	13	Least Grebe	B, N	x						WI (17)	Unknown		Establish population size
IV.	PR	12	Yellow-billed Cuckoo	B								Unknown		Maintain current population
IV.	PR	12	Black-and-white Warbler	N								Unknown		Establish population size
IV.	PR	12	American Redstart	N								Unknown		Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
IV.	PR	11	American Kestrel	B, N							PR-VI-LA	Unknown		Establish population size
IV.	PR	11	Bananaquit	B, N							PR, Vieques-Culebra	Unknown	Latter subsp. also VI (except St. Croix)	Establish population size
IV.	PR	10	White-winged Dove	B, N								110,878 - 226,187 (derived from Rivera-Milán and Martínez 2012)	economically important -hunted; may be outcompeting other doves	< 111,000 (derived from Rivera-Milán and Martínez 2012)
IV.	PR	10	Grasshopper Sparrow (Gr. Antilles subsp./sp.)	B, N			s			GA	PR	<500?	Jamaica, Hisp., and PR subsp. isolated from other subsp.	Maintain current population

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
IV.	PR	7	Mourning Dove	B, N								12,069 - 24,319 (derived from Rivera-Milán and Martínez 2012)	economically important -hunted	> 24,333 (derived from Rivera-Milán and Martínez 2012)
IV.	PR		Fulvous Whistling-Duck	N								Unknown	Recently expanded into PR, but rare today	Establish population size
IV.	PR		Blue-winged Teal	N								Unknown	economically important -hunted	Establish population size
IV.	PR		Gull-billed Tern	N		b						Unknown		Establish population size
IV.	PR		Bicknell's Thrush	N		a				GA nonbr. (most Hisp.)		Unknown	A few may occur in PR every year	Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
V.	PC													
V.	PC	14	Pearly-eyed Thrasher	B, N						Baha mas-PR-VI-L. Antil les		Unknown	Concern over depredatio n of eggs of Puerto Rican Parrots and many other species	Establish population size; Maintain or reduce
V.	PC	9	Shiny Cowbird	B, N								Unknown	Concern over nest parasitism of Yellow-shouldered Blackbird, Puerto Rican Oriole, Puerto Rican Vireo, and Yellow Warbler	Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
V.	PCL													
V.	PCL	12	Laughing Gull	B								1,300-1,400 (Saliva 2009)	Depredation of seabirds	
V.	PCL	11	Peregrine Falcon	N								Unknown	Depredation of seabirds	Establish population size
V.	PCL	10	Red-tailed Hawk	B, N								Unknown	Depredation of Puerto Rican Parrot	Establish population size
		15	Hooded Warbler	N								Unknown		Establish population size
		14	Black-bellied Plover	N								Unknown		Establish population size
		16	Greater Yellowlegs	N								Unknown		Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
		14	Short-billed Dowitcher	N	x	b					Eastern NA (18)	Unknown		Establish population size
		13	Northern Harrier	N								Unknown		Establish population size
		13	Semipalmated Plover	N								Unknown		Establish population size
		13	Pectoral Sandpiper	N								5-20 individuals (Wunderle et al. 1989, Collazo et al. 1995)		Maintain current population; establish better estimate
		13	Wilson's Snipe	N		b						Unknown		Establish population size
		13	Ovenbird	N								Unknown		Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	Endemic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
			American Golden-Plover	N		b						Unknown		Establish population size
			Golden-winged Warbler	N		a						Unknown		Establish population size
			Chestnut-sided Warbler	N								Unknown		Establish population size
			Kentucky Warbler	N		b						Unknown		Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Table 3b: Conservation priority rankings of 104 bird species in the **US VIRGIN ISLANDS** (following Panjabi et al. 2012).

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	Endemic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	CR													
I.	CR	22	Caribbean Coot	B, N	x	a			E	GA		12-24 pairs (Derived from BirdLife International 2008)	extensive mixing with American Coot	Undetermined due to hybridization concerns
I.	CR	22	Puerto Rican Flycatcher	B, N	x				E	PR-VI		extirpated ?	Perhaps a few remain on St. John, less likely St. Thomas, status uncertain on BVI.	Confirm presence; Establish population size
I.	CR	21	Masked Booby	B	x	c			E		WI (25)	45-75 (Pierce 2009)		150

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	Endemic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	CR	20	Magnificent Frigatebird	B	x	c			E			extirpated breeding	500-600 pairs still breed on BVI	Re-establish on USVI
I.	CR	20	Clapper Rail	B, N	x	c			E		WI (22)	Unknown	extirpated on St. Croix, persists only on St. Thomas	Establish population size
I.	CR	20	Antillean Mango	B, N	x				E	Hisp. -PR- VI	PR-VI (22)	extirpated ?	No confirmed recent reports from USVI (now may only remain on St. Thomas); status uncertain in BVI	Confirm presence; Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	CR	16	Least Bittern	B, N	x				E			Unknown		Establish population size
I.	CX													
I.	CX	22	West Indian Whistling-Duck	B, N	x	a			E	WI		extirpated as breed. 1941		Potential re-introduction
I.	CX	22	Puerto Rican Screech-Owl	B, N	x				E	PR-VI	VI (also on Vieques and Culebra; 25)	extirpated ?	VI subsp. may be extirpated, except on Culebra, PR	Confirm presence; Establish population size
I.	CX	22	White-necked Crow	B, N	x	a		E	E	Hisp.-PR-VI		extirpated	St. Croix fossil remains; reintroduce from Hispaniola ?	Potential re-introduction

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	CX	18	American Flamingo	B(?), N	x				E			Unknown	Historically bred? Previous considered conspecific with the Greater Flamingo	Establish population size
I.	IM													
I.	IM	21	Bridled Quail-Dove	B, N	x				T	PR- VI- LA		Unknown		Establish population size
I.	IM	20	White- crowned Pigeon	B, N	x	b			T			<1,000	Season closed; possible squab poaching and rat depredation on offshore cays	2,500
I.	IM	20	Antillean Nighthawk	B	x	c			T	GA- Bah.		<10		50

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	Endemic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	IM	19	Brown Booby	B	x	b					WI (22)	500- 1,000 (Pierce 2009)		2,000
I.	IM	19	Brown Pelican	B, N	x			E	SC		WI (23)	325-425 (Pierce 2009)		>800
I.	IM	18	Audubon's Shearwater	B	x	b			E		WI (20)	20-50 (Pierce 2009)		100
I.	IM	18	White-tailed Tropicbird	B	x	b			T		WI (21)	30-50		100
I.	IM	18	Red-footed Booby	B	x	b			T		WI (27)	100-150 (Pierce 2009)		300
I.	IM	18	Willet	B, N	x	b			T			2		Increase
I.	IM	15	Red Knot	N	x	c			E		SEUS-WI nonbr. (17)	Unknown		Establish population size
I.	MA													
I.	MA	21	Red-billed Tropicbird	B	x	a			SC		WI pop. (22)	225-350 (Derived from BirdLife International 2008)		700

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	MA	18	Roseate Tern	B	x	b		T	SC		WI pop. (24)	500-2,300 (Pierce 2009)	Caribbean subsp.	See Recovery Plan
I.	MA	18	Caribbean Martin	B			x		SC	GA- LA		<20		>50
I.	MA	17	Wilson's Plover	B, N	x	c			SC			<60		>100
I.	MA	17	Brown Noddy	B	x						WI	400-900 (Derived from BirdLife International 2008)		800 – 1,800
I.	MA	17	Prothonotary Warbler	N	x	b			SC			Unknown		Establish population size
I.	MA	16	American Oystercatche r	B, N	x	c			T			<25		Maintain current population
I.	MA	16	Whimbrel	N	x				T		Hud. Bay(19)	Unknown		Establish population size
I.	MA	16	Semipalmate d Sandpiper	N	x	b						Unknown		Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	MA	16	Least Tern	B	x	b			SC			300-600		600-1,200
I.	MA	16	Hooded Warbler	N	x				SC			Unknown		Establish population size
I.	MA	15	Ruddy Duck	B, N	x				SC		WI (19)	<5	never common, recent nesting on St. Croix	Maintain current population
I.	MA	15	Black-bellied Plover	N	x							Unknown		Establish population size
I.	MA	15	Lesser Yellowlegs	N	x	b						Unknown		Establish population size
I.	MA	15	Ruddy Turnstone	N	x							Unknown		Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	MA	15	Stilt Sandpiper	N	x	b						Unknown		Establish population size
I.	MA	15	Yellow (Golden) Warbler	B, N	x						PR-VI (21)	Unknown	WI endemic "Golden" incipient species?	Establish population size
I.	MA	15	Black-throated Blue Warbler	N	x					WI nonbr.		Unknown		Establish population size
I.	MA	15	Louisiana Waterthrush	N	x							Unknown		Establish population size
I.	MA	14	Solitary Sandpiper	N	x	b						Unknown		Establish population size
I.	MA	14	Least Sandpiper	N	x				SC			Unknown		Establish population size
I.	MA	14	Short-billed Dowitcher	N	x	b			SC		Eastern NA (17)	Unknown		Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
I.	MA	14	Chuck-will's-widow	N	x							Unknown		Establish population size
I.	MA	14	Northern Waterthrush	N	x							Unknown		Establish population size
I.	PR													
I.	PR	17	Bridled Tern	B		c					WI	500-1,000		1,000 – 2,000
I.	PR	16	White-cheeked Pintail	B, N		b			SC		WI-n. S. Am. (20)	400-500		Maintain current population
I.	PR	16	Mangrove Cuckoo	B, N		b						Unknown		Establish population size
I.	PR	16	Prairie Warbler	N		b				WI-FL nonbr.		Unknown		Establish population size
I.	PR	13	Little Blue Heron	B, N		b						Unknown		Establish population size
I.	PR	13	Sanderling	N		b						Unknown		Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	Endemic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
II.	PR													
II.	PR	15	Sooty Tern	B			x				WI	20,000-40,000		Maintain current population
III.	PR													
III.	PR	14	Lesser Antillean Bullfinch	B, N					P			Unknown		Establish population size
III.	PR	13	American Coot	B, N					T			<15	extensive mixing with Caribbean Coot	Undetermined due to hybridization concerns
III.	PR	12	Snowy Egret	B					SC			Unknown		Establish population size
III.	PR	11	Least Grebe	B, N					E		WI (15)	<20		Maintain current population
III.	PR	10	Black-crowned Night-Heron	B, N					P			Unknown		Maintain current population

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	Endemic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
III.	PR		Great Blue Heron	B					P			Unknown		Maintain current population
III.	PR		Tricolored Heron	B					P			Unknown		Maintain current population
III.	PR		Snowy Plover	B, N		a			E			extirpated ?	Breeding never well established	Establish population size
III.	PR		Piping Plover	N		a		T				Unknown	several records from St. Croix	Establish population size
IV.	PR													
IV.	PR	17	Antillean Crested Hummingbird	B, N						PR-VI-LA		Unknown		Establish population size
IV.	PR	17	Black-whiskered Vireo	B						WI-FL		Unknown		Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
IV.	PR	16	Scaly-naped Pigeon	B, N						GA- LA		Unknown	economically important-hunted	Establish population size
IV.	PR	16	Caribbean Elaenia	B, N						Cay. -PR- VI, LA		Unknown		Establish population size
IV.	PR	15	Sandwich Tern	B								100 – 1000 (Pierce 2009)		Maintain current population
IV.	PR	15	Zenaida Dove	B, N						WI		Unknown	economically important-hunted	Establish population size
IV.	PR	14	Yellow-crowned Night-Heron	B, N								Unknown		Establish population size
IV.	PR	14	Royal Tern	B								60-150 (Pierce 2009)		Maintain current population
IV.	PR	14	Northern Parula	N								Unknown		Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
IV.	PR	14	Cape May Warbler	N						WI nonb r.		Unknown		Establish population size
IV.	PR	12	American Kestrel	B, N	x						PR-VI-LA (20)	Unknown		Establish population size
IV.	PR	12	Black-and-white Warbler	N								Unknown		Establish population size
IV.	PR	12	Ovenbird	N								Unknown		Establish population size
IV.	PR	11	Pied-billed Grebe	B							WI (15)	Unknown		Establish population size
IV.	PR	11	American Redstart	N								Unknown		Establish population size
IV.	PR	10	White-winged Dove	B, N								Unknown		Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
IV.	PR	10	Bananaquit	B, N							2 subsp	Unknown	1 subsp.end emic to St. Croix	Establish population size
IV.	PR	7	Mourning Dove	B, N								Unknown	economica lly important- hunted	Establish population size
IV.	PR		Gull-billed Tern	N		b			P			Unknown		Establish population size
V.	PC													
V.	PC	17	Green- throated Carib	B, N						PR- VI- LA		Unknown	expanding perhaps at expense of Antillean Mango	Establish population size
V.	PC	14	Pearly-eyed Thrasher	B, N						Baha mas- PR- VI- L. Antil les		Unknown	Egg depredatio n on many other bird species	Maintain or reduce

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
V.	PCL													
V.	PCL	12	Laughing Gull	B					C			2,000-3,000 (Derived from BirdLife International 2008)	Concern over depredation of colonial seabirds	Maintain or reduce
V.	PCL	11	Peregrine Falcon	N					C			Unknown	Concern over depredation of colonial seabirds	Establish population size
V.	PCL	9	Cattle Egret	B, N					C			Unknown	Concern over depredation of endangered St. Croix Ground-Lizard	Establish population size
		16	Gray Kingbird	B, N						WI- SE US		Unknown		Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	Endemic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
		13	Semipalmated Plover	N								Unknown		Establish population size
		13	Greater Yellowlegs	N								Unknown		Establish population size
		13	Western Sandpiper	N		b						Unknown		Establish population size
		13	Pectoral Sandpiper	N								Unknown		Establish population size
		11	Wilson's Snipe	N		b						Unknown		Establish population size
			Blue-winged Teal	N								Unknown	economically important-hunted	Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	Endemic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
			Northern Harrier	N								Unknown		Establish population size
			American Golden-Plover	N		b						Unknown		Establish population size
			Yellow-billed Cuckoo	B								Unknown		Establish population size
			Yellow-bellied Sapsucker	N					P			Unknown		Establish population size
			Blue-winged Warbler	N		c						Unknown		Establish population size
			Chestnut-sided Warbler	N								Unknown		Establish population size
			Yellow-rumped Warbler	N					P			Unknown		Establish population size
			Yellow-throated Warbler	N					P			Unknown		Establish population size

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Tier	Action Level	RCS	Species	Season	R C	C C	S	Fed List	Com List	End emic to:	Subsp. of Interest (RCS)	Est. Pop. Size (pairs, unless otherwise indicated)	Notes	Population Objective (pairs, unless otherwise indicated)
			Palm Warbler	N					P			Unknown		Establish population size
			Worm-eating Warbler	N		b			P			Unknown		Establish population size
			Kentucky Warbler	N		b			P			Unknown		Establish population size
			Common Yellowthroat	N					P			Unknown		Establish population size

Detailed PIF Scoring Methodology

Tier: There are five conservation tiers identified for planning and implementing priorities:

- I=Concern including all species meeting at the regional scale both continental and regional concern criteria, regional concern criteria only, and continental concern only.
- II=Additional Stewardship including all species meeting stewardship criteria not otherwise already identified in Tier I.
- III=Additional Legally Protected (Federal and/or State, Commonwealth, Territory) including all legally protected species not otherwise identified in Tiers I or II.
- IV=Additional Local or Regional Interest Species including all other species not otherwise identified in Tiers I, II, or III, that are of potential local or regional interest such as economically important as hunted or for promoting nature tourism, environmental indicators, subject to depredation concern, peripherally occurring continental concern species, etc.
- V= Additional species possibly warranting population control, including all other species not otherwise identified in Tiers I, II, III, or IV, that pose potential threats to other species via competition or predation.

Action Level: Ultimately the most important factor for identifying priorities is identifying the level of action needed to effect conservation. Action levels, strongly implying conservation priorities when used in combination with regional combined score and percent of population, are identified when meeting following criteria (see below for definitions of factor scores for TB/N [threats breeding or non-breeding] and PT [population trend]):

- CR (Critical Recovery) meets criteria for Regional Concern Species with TB/N=5. Critical recovery actions are needed to prevent likely extirpation or to reintroduce a species that has been extirpated.
- IM (Immediate Management) meets criteria for Regional Concern Species with TB/N=4 and PT=5; subject to high regional threats (TB/N=4) combined with a large population decline (PT=5). Conservation action is needed to reverse or stabilize significant, long-term population declines in species where lack of action may put species at risk of extirpation.
- MA (Management Attention) meets criteria for Regional Concern Species with

TB/N=4 and PT<5, and TB/N=3 and PT=4 or 5; moderate threats (TB/N=3) and undergoing moderate to large declines (PT=4 or 5), OR has high regional threats (TB/N=4) but no large decline (PT<5). Management or other on-the-ground conservation actions are needed to reverse or stabilize significant, long-term population declines where threats are moderate, or to reverse high threats in species that are not presently experiencing steep long-term declines.

- PR (Planning and Responsibility) meets criteria for (1) Continental Concern Species that are not also of Regional Concern; (2) all species meeting criteria for stewardship that are not already also meeting continental or region concern criteria, and (3) many local or regional interest species; long-term Planning and Responsibility actions are needed to ensure that sustainable populations are maintained in regions with high responsibility for these species. Actions often target many species at once, for example long-term multi-species monitoring programs, or broad plans/programs targeting suites of species sharing a habitat.
- PC (Large scale Population Control/Suppression) are species generally considered secure and increasing that may come into conflict with other species of higher conservation concern or other resources of interest.
- PCL (Local Population Control) are species generally listed with action codes MA or PR across the planning region, but locally may be subject to population control measures to alleviate documented economic, environmental, or human health and safety conflicts, but only when economics and conservation implications have been thoroughly considered.

Combined Score (concern and steward): Combined Scores are used to determine species status assessments, especially to indicate level of Continental Concern, Regional Concern, and Stewardship as explained below (the Partners in Flight approach). A species is considered to be of

- Continental Concern (CC) using this formula (see below for definitions of all factor scores PT [population trends], PS [population size], D [distribution size for breeding and non-breeding], and T [threats for breeding and non-breeding]):
- $PT + PS + \text{maximum of } D \text{ (BD or ND)} + \text{maximum of } T \text{ (TB or TN)}$

Species with Combined Scores of (1) 15 or more, (2) 14 with $T_{\text{max}} + PT > 4$, or (3) 13 with $PT = 5$, up to a maximum possible of 20, are identified as of Continental Concern (also referred to as “Watchlist” species). At the continental scale, three types of Continental Concern species are identified as follows: (a) species with multiple concerns, (b) species with high threats and/or declining, and (c) species that are local and/or rare. Those species identified as of Continental Concern have the Continental Combined Score and type of Continental Concern displayed in the yellow (continental) field for this column.

- *Species with multiple causes for concern across their entire range:* These species are considered by many to be of highest continental concern and of highest priority for conservation actions at national and international scales.
- *Moderately abundant or widespread species with declines or high threats:* These species are on the Partners in Flight Watch List primarily because they are declining and/or threatened throughout their range, though still fairly widespread or with moderately large populations.
- *Species with restricted distributions or low population size:* These species are on the Watch List because they are restricted to a small range or have small global populations (often both). Many of these species are not known to be declining or seriously threatened at present, but many others. We recognize that these species with small populations and restricted range are particularly vulnerable to relatively minor changes from current conditions, whether or not their populations are currently in decline.

At the Regional scale of planning (i.e., Southeast U.S., West Indies, etc., each Bird Conservation Region [BCR], and subarea), species are considered to be of Continental Concern only when all the following criteria are met:

- On PIF Continental Watch List (Concern at the Continental Scale)
- Threat Score > 1 at the Regional scale
- 3) RD > 1 at the Regional scale

Notes: Threat Scores are regionally-derived scores in the season of interest (i.e., TB_R for Breeding Species, TN_R for Non-breeding birds);

Species of Continental Concern as well as other species are considered to also be species of Regional Concern (RC) when all of the following criteria are met:

- Regional Combined Score > 13 (out of a possible 25) at the Regional scale
- Threat Score > 3 OR Threat=3 AND PT > 3 at the Regional scale
- RD > 1 at the Regional scale

Notes: Regional Combined Score rules:

Breeding = RD_B + TB_L + PT_B + PS + BD

Non-breeding (Permanent Residents) = RD_B + TN_L + PT_B + PS + ND

Non-breeding (Seasonal Residents) = RD_N + TN_L + PT_G + PS + ND

[additional non-breeding categories may be needed here]

[PT_N when data are available may be used in place of PT_B or PT_G in non-breeding total scores]

Finally, species of Continental and/or Regional Concern or otherwise that have a high proportion of their global population or range within an ecological planning area are

identified as Stewardship (S) species using the following criteria:

- Pct Pop \geq 25% OR [RD = 5 AND Pct Pop \geq 5%]
- Regional Combined Score $>$ 13 (out of a possible 25) at the Regional scale
- Threat Score $>$ 1 at the Regional scale

Notes:

Pct Pop is estimated percent of global population;

For species with at least 25% population in a BCR, Threat $>$ 1 rule can be overridden by the BCR lead to ensure highest responsibility species are not left off, but Threat score remains 1;

For species with at least 25% population in a BCR, threat and total score criteria can be overridden by the BCR lead to ensure highest responsibility species are not omitted, but all scores remain unchanged.

A few additional species with large populations at the regional scale, but representing small percentages of global populations (i.e., species established in temperate North America of otherwise tropical or Eastern Hemispheric distribution), are also identified as of Stewardship responsibility at the regional scale (e.g., Glossy Ibis, Sooty Tern, Brown Noddy).

Factor Scores:

- PT = Population Trend
 - 5 = Definite decrease
 - 4 = Possible decrease
 - 3 = Trend uncertain, No data
 - 2 = Possible increase, stable
 - 1 = Definite increase

PT was derived based on a combination of data sources, principally BBS tempered by local and state datasets for breeding species. For many species of waterbirds and most non-breeding species, usually best professional judgment was used and often based in part on continental trends shown in BBS and/or CBC. Since waterbird trends are often dramatic and not linear, an inspection of trend graphs was often required to make a judgment as to trend score, again tempered by local and state data sets if they existed.

- Significant increase (BBS trend $>$ 1.36% yr⁻¹, $P <$ 0.10, $df >$ 13)
1
- Possible increase ($>$ 0.47 to 1.36% yr⁻¹, $P <$ 0.35, w/ any df)
2a
- Possible increase ($>$ 1.36% yr⁻¹, $0.1 <$ $P <$ 0.35, $df >$ 13)
2a

- Possible increase ($>1.36\% \text{ yr}^{-1}$, $P < 0.10$, $df < 13$)
 - 2a
 - Stable (> -0.54 to $< +0.47\% \text{ yr}^{-1}$, and $UCI < 0.47$ OR $LCI > -0.54$)
 - 2b
 - except when trend is negative and $P < 0.10$ and $LCI < -0.54$, then Possible decrease
 - Trend uncertain ($< -0.54\% \text{ yr}^{-1}$ or $> 0.47\% \text{ yr}^{-1}$ and $P > 0.35$)
 - 3
 - Trend uncertain ($> -0.54\% \text{ yr}^{-1}$ and $< 0.47\% \text{ yr}^{-1}$ and $UCI > 0.47$ and $LCI < -0.54$)
 - 3
 - No data
 - 3
 - Possible decrease (either of next 3 options, but based on 6-13 degrees of freedom)
- 4
- Possible decrease (< -0.54 to $-2.27\% \text{ yr}^{-1}$, $P = 0.0-0.35$)
 - 4
 - Possible decrease ($< -2.27\% \text{ yr}^{-1}$, $0.1 < P < 0.35$)
 - 4
 - Significant decrease ($< -2.27\% \text{ yr}^{-1}$ and $P < 0.10$)
 - 5
- PS=Population Size
 - 5 = Rare (< 50 thousand breeding individuals globally)
 - 4 = Uncommon (50-500 thousand breeding individuals globally)
 - 3 = Fairly Common (500 thousand-5 million breeding individuals globally)
 - 2 = Common (5 million to 50 million breeding individuals globally)
 - 1 = Abundant (50 million + breeding individuals globally)

Population Size was based on best population estimates globally and for waterbirds mostly based on Delany and Scott (2002) and Kushlan et al. (2002).

- TB and TN=Threats Breeding and Threats Non-breeding
 - 5 = Extreme deterioration in the future suitability of breeding/non-breeding conditions is expected; species is in danger of regional extirpation or major range contraction, or has already been extirpated
 - 4 = Severe deterioration in the future suitability of breeding/non-breeding conditions is expected
 - 3 = Slight to moderate decline in the future suitability of breeding/non-breeding conditions is expected
 - 2 = Expected future conditions for breeding/non-breeding populations are expected to remain stable; no known threats
 - 1 = Expected future conditions for breeding/non-breeding populations are enhanced by human activities or land uses; potentially a 'problem' species
- BD and ND=Breeding Distribution and Non-breeding Distribution

5 = Very Local Distribution (<500,000 km², or very restricted coastal areas or interior uplands)

4 = Local Distribution (>500,000 and <1,000,000 km², or <1,600 km of coast)

3 = Moderate Distribution (>1,000,000 and <2,000,000 km², or >1,600 to <5,000 km of coast)

2 = Widespread (>2,000,000 and <4,000,000 km², or >5,000 to <8,000 km of coast)

1 = Very Widespread (>4,000,000 km², or >8,000 km of coast)

- RD=Relative Density (same concept formerly referred to as AI = Area Importance)

5 = Very High relative abundance (~50+% of maximum relative abundance)

4 = High relative abundance (~25-49% of maximum relative abundance)

3 = Moderate relative abundance (~10-24% of maximum relative abundance)

2 = Low relative abundance (~1-9% of maximum relative abundance)

1 = Peripheral, scattered occurrence.

RD reflects the “relative” density (or relative abundance) for each area within the range, scaled against its maximum relative abundance (i.e., the BCR supporting the highest relative abundance).

Federal (US) Endangered Species List

E=Endangered with extinction

T=Threatened with endangerment

C=Candidate where enough information is available to support a listing proposal as either endangered or threatened, but action precluded by higher priority and/or court ordered listing actions.

Commonwealth Protected Species (Puerto Rico uses criteria similar to IUCN criteria)

CE=Critically Endangered

E=Endangered

NT=Near Threatened

VU=Vulnerable

LC=Least Concern

US Virgin Islands Territorial Protected Species

E=Endangered

T=Threatened

SC=Special Concern

P=Peripheral

C=Controlled

Endemic to: Species are identified as endemic (or nearly so), either as native resident or seasonal resident species, to the West Indies (WI; which may include small portions

of SE United States [esp. Florida], Yucatan Peninsula, and/or northern coastlines of South America), Greater Antilles (GA), Greater Antilles-Bahamas (Bah.), Lesser Antilles (LA), Puerto Rico (PR), Puerto Rico-Virgin Islands (VI), Hispaniola (Hisp.)-Puerto Rico, or Hispaniola-Puerto Rico-Virgin Islands, as appropriate.

Subsp. (Subspecies) of Interest (RCS): Subspecies that are identified as of concern (or otherwise of conservation interest, e.g., may represent incipient species) are identified by their distribution within the range of the entire species, and for those taxa meriting regional concern within the area of interest their Regional Concern Score is provided as if the taxa were a full species (i.e., D and PS factor scores are based on the specified taxa's distribution and population size, not on the species as a whole, as is RD factor scores).

Est. Pop. Size (Estimated Population Size): Where data are available (mostly for concern species), estimated population sizes are given for the area of interest.

Notes: Any additional information deemed of conservation interest is given here, including in some cases reasons for status.



Seabirds congregating at the mouth of the Añasco River. Photo credit: Alcides Morales Pérez

SECTION 4: HABITAT DESCRIPTIONS, CONSERVATION OBJECTIVES AND ASSOCIATED SPECIES

Introduction

We have already reviewed species of conservation concern as described in a number of previously published resources (Section 2), and have presented our own avifaunal analysis of priority birds of conservation concern for the region (Section 3). Species prioritization rankings are most useful for identifying and comparing potential conservation opportunities when merged together in habitat-species assemblages. Thus, in this section we integrate our conservation scores with allied habitat areas.

The information in this section is useful for practitioners who want to take a habitat-focused management approach and maximize the avian conservation benefit per area of land conserved. We begin by establishing a general habitat objective (not linked to any particular bird species) and discussing the process by which we assessed habitat spatial extent and overall conservation status. This is followed by a description of the eleven different habitat cover types included in this plan, including general ecology, and the existing extent of conservation stewardship. Using GAP data, we identify stewardship areas relevant to each habitat type, and discuss additional habitat conservation objectives and opportunities, where applicable. We also indicate convergence of our analysis with the bird conservation reports discussed in Section 2 (i.e., by listing CWA; IBA; WFA; ACP; TNC; CWCS; MAPA33; MF; Seabirds, etc.; some convergence is expected because several of the reports incorporate similar baseline data). It is important to note that most of our suggestions are based primarily on an analysis of land cover, and thus do not incorporate potential threats and non-ecological risk factors, nor the needs and aspirations of nearby human communities; that contextual analysis remains to be done prior to making final decisions about priority areas. For each habitat type we also include a list of the associated bird species represented in our prioritization analysis, organized by their conservation tiers and action levels, with brief discussion dedicated to some of the highest priority species. At the end of each habitat description we have included a list of recommended conservation actions and strategies.

Successful conservation must consider the overall biological community in addition to individual populations of species, and thus it is important to set a target for habitat conservation that will allow the habitat to persist and provide the necessary resources for the birds that utilize that ecological space. Internationally accepted conservation goals suggest protecting at least 15% of total land area (Gould et al. 2008a). In Puerto Rico this would require almost doubling the current extent of conserved land, which is at 8.2% (Quiñones et al. 2013), adding another 60,939 ha to the 73,298 ha that are protected. In the USVI about 12.4% of the total land area is protected (Gould et al. 2013a), and thus at first glance only an additional 2.6% or 975 ha are necessary to achieve the broad-brush goal of 15% for the three islands as a whole. However, land

protection is not uniform from one island to the next. For example, while almost 57% of St. John is conserved, less than 6% of land is protected on both St. Thomas and St. Croix (Gould et al. 2013a), and consequently significant conservation additions are still necessary to protect the USVI's habitats on par with regional and global conservation benchmarks. Thus the bulk of Puerto Rico and USVI lands have no management for biodiversity conservation.

Accordingly, one of our major objectives in this plan is to **conserve (or maintain in conservation) at least 15% of the total area of the major habitat cover types that occur in Puerto Rico and the USVI**. This value is a *baseline minimum* and should be considered as a region-wide goal. *Rare and vulnerable habitats should be relatively more protected, with up to 100% in some cases*. Additional evaluation is necessary to establish specific habitat conservation targets for individual habitats on an island by island basis, taking into consideration the needs of non-avian species as well.

Achieving the 15% target first requires knowledge of the total land area for each habitat as well as the extent of habitat currently under conservation protection. To ascertain this we quantified the area and percentage of land per habitat cover type in each of the conservation stewardship classes 1, 2, 3, and 4 (see GAP discussion in Section 3 for status definitions) in Puerto Rico and the USVI separately, as well as the two countries combined. We then identified the cases in which less than 15% of a given habitat is protected under GAP statuses 1, 2, or 3. Finally, we calculated how much additional land area, if any, would be necessary to meet the desired habitat conservation objective of 15% (Tables 6a, 6b, and 6c). Although achieving the 15% habitat objective does not necessarily mean that the needs of every species that uses a given habitat will be met due to variances in population dynamics within and between species at different spatial scales, it is expected to facilitate the success of the community as a whole.

Habitat Overview and Species Assemblages

Habitat types are a dynamic matrix determined by the combined effects of human and natural disturbances through time. Research efforts spanning several decades (Gill 1931; Beard 1949; Dansereau 1966; Little and Wadsworth 1964, Little et al. 1974; Ewel and Whitmore 1973; Forman 1974; Birdsey and Weaver 1982; Acevedo-Rodríguez 1996; Gibney et al. 2000; Helmer 2002; Gould et al. 2008a; Kennaway et al. 2008, Daley 2009, Gould et al. 2013a, Martinuzzi et al. 2013) discuss ecological life zones of Puerto Rico and the USVI, provide reconstructions of the composition of historical vegetation patterns, and describe the current distribution of terrestrial and marine habitats as well as the mechanisms involved in their development. For the purposes of this plan we recognize 11 general habitat cover types (Figures 28, 29a and 29b) that roughly follow the physiognomic vegetation classifications described by Ewel and Whitmore (1973) according to life zones and defining factors such as soils, rainfall, and drainage. To determine the extent of each habitat we grouped GAP land cover class spatial data for Puerto Rico (Gould et al. 2008a) and the USVI (Gould et al. 2013a) into ten initial habitat types. Subsequently we generated one additional habitat category, Urban forest, by identifying and extracting areas within the other categories (excluding

Forested coastal wetlands) that are predominantly developed (greater than 20% developed land surface within a surrounding 1 km radius, following Martinuzzi et al. 2008). Developed land and artificial barrens devoid of vegetation and aquatic habitat were sorted as a separate cover class and their protected area calculated as part of global totals for PR and the USVI, but they are not discussed in detail in the text. The 11 habitat types include forested and non-forested categories as follows:

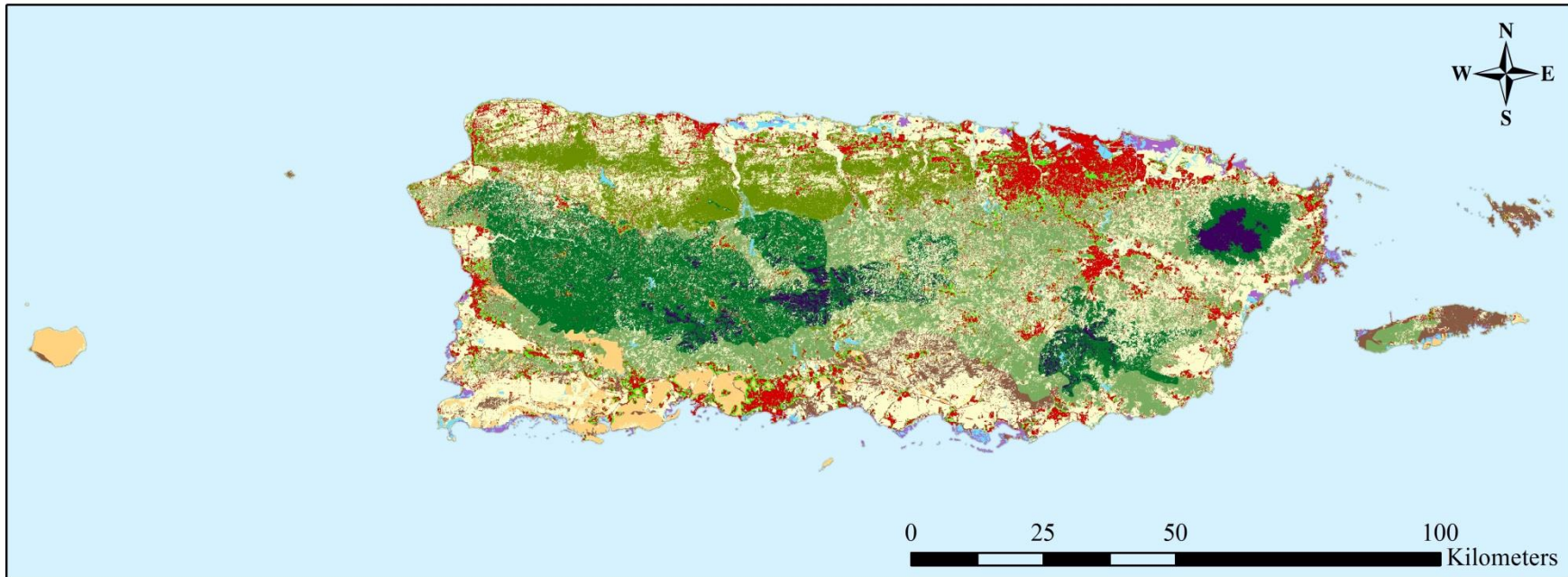
- Colorado, palm and Elfin Forest
- Tabonuco and secondary wet forest
- Moist limestone (karst) forest
- Non-calcareous moist forest
- Dry limestone forest and serpentine forest
- Non-calcareous lowland and coastal dry forest
- Forested coastal wetlands
- Grasslands and shrublands (moist, dry and littoral)
- Marshes and open water habitats
- Beaches, islets, cliffs and riparian barrens
- Urban forest

As a matter of convenience, some habitat types are grouped assemblages. For example, forested coastal wetlands include saline mangrove and freshwater *Pterocarpus* forests, and open water is a generalized habitat group that in reality includes reservoirs, fresh and salt water lagoons and mud flats, and other aquatic features. Whereas all eleven habitats are present in Puerto Rico, Colorado, palm and Elfin forest, as well as Tabonuco and secondary wet forest, moist limestone (karst) forests, serpentine forests, coffee plantations (which are included in the Tabonuco and secondary wet forest habitat type), fresh water lagoons, and large water reservoirs are absent from the USVI.

In the pages that follow, we categorize species assemblages associated with the eleven general habitat cover types identified for the region. For each habitat type we describe the general ecology and habitat status, identify currently designated stewardship areas and the proportion of conserved lands in relation to the baseline objective of 15, and suggest additional conservation opportunities. Stewardship areas per habitat type are listed separately for Puerto Rico and the USVI, with the latter broken down into the three main islands of St. Thomas, St. John, and St. Croix.

Species are also organized separately for Puerto Rico and the USVI, according to conservation tiers and action levels within each habitat, with the highest priority species listed first. Habitat-species associations were based on bird use and the importance of the habitat for the purposes of feeding, maintenance behaviors, and social interactions. Some species are restricted to a single habitat while others are associated with multiple classes. Birds that are associated with more than one habitat type do not necessarily use each habitat in an equivalent manner. Table 4 shows the habitat cover types and

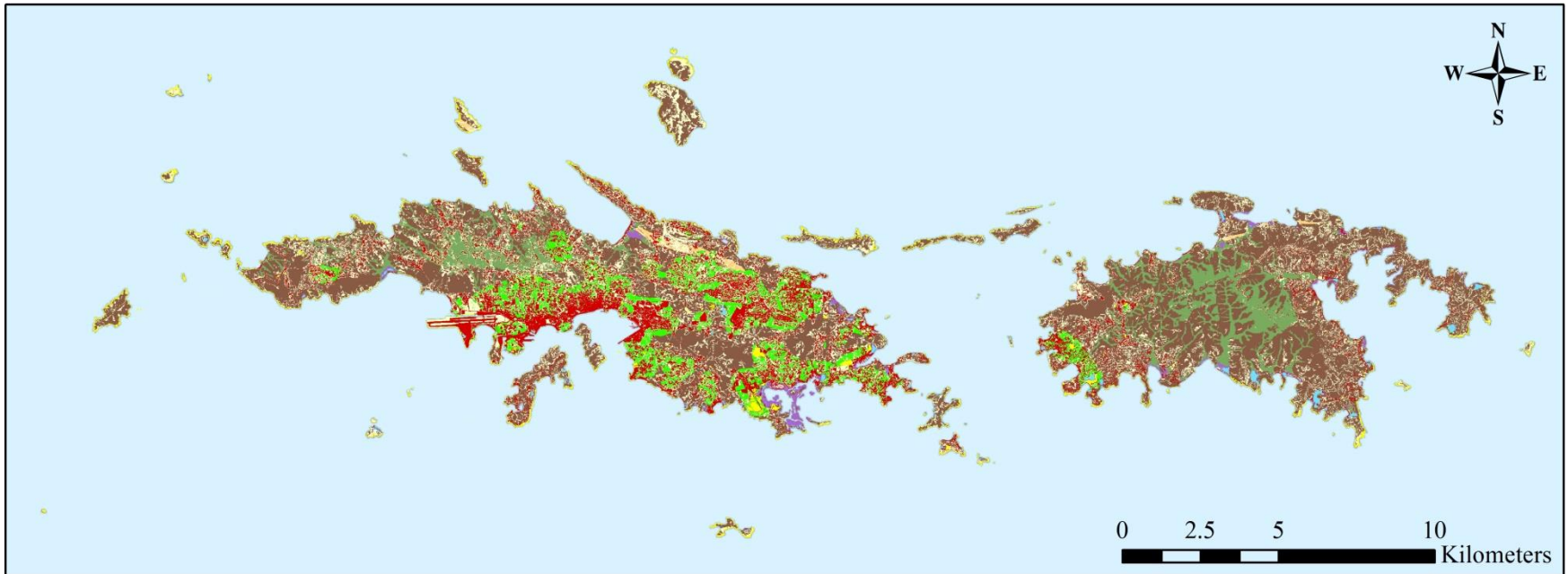
the associated bird species included in our avifaunal analysis, and indicates species for which GAP analysis data are available (125 species in our avifaunal analysis also have been modeled by GAP). Tables 5a and 5b show a summary of species conservation level rankings relative to each habitat cover type in Puerto Rico and the USVI, respectively.







Habitat Cover Type

- | | |
|---|---|
|  Colorado, palm and Elfin Forest |  Marshes and Open Water Habitats |
|  Dry Limestone Forest and Serpentine Forest |  Tabonuco and Secondary Wet Forest |
|  Forested Coastal Wetlands |  Urban Forest |
|  Moist Limestone (karst) Forest |  Beaches, Islets, Cliffs and Riparian Barrens |
|  Non-calcareous Lowland and Coastal Dry Forest |  Grasslands and Shrublands (moist, dry and littoral) |
|  Non-calcareous Moist Forest |  Developed Land and Artificial Barrens |

Figure 28: General habitat cover types on the islands of Puerto Rico, based on vegetation classifications described by Ewel and Whitmore (1973) and land cover classifications from Gould et al. (2008a).

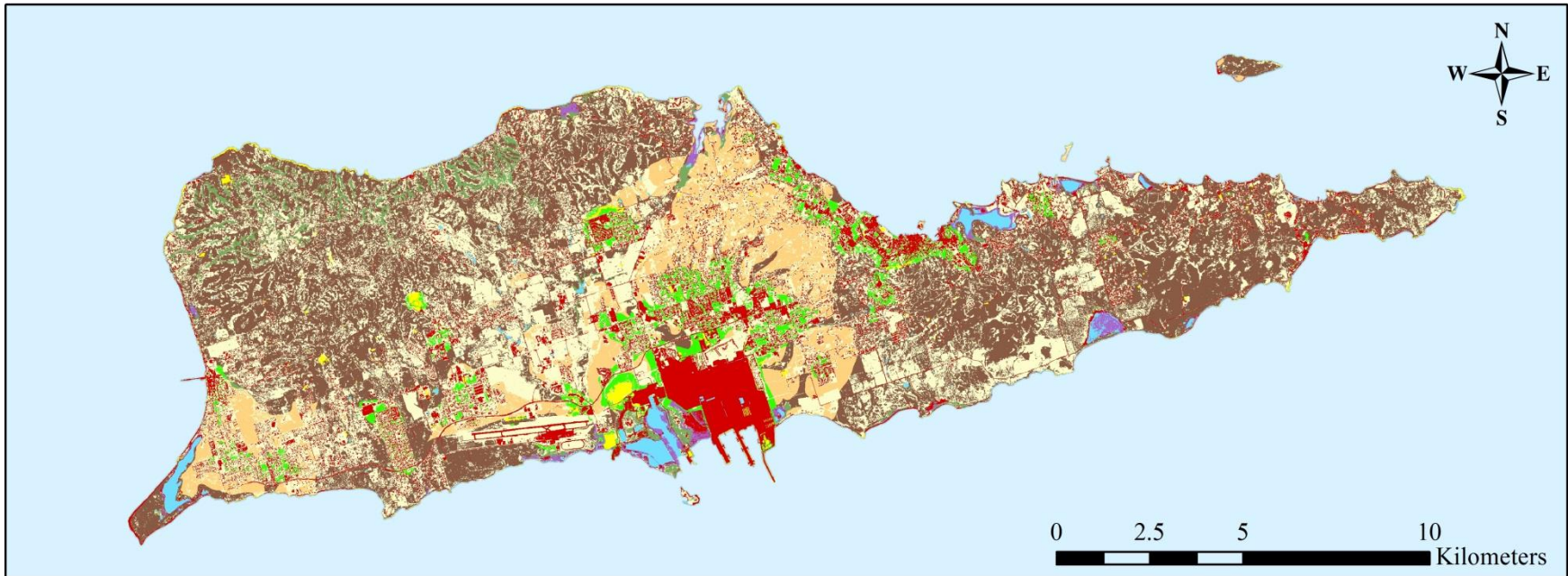


Habitat Cover Type

 Colorado, palm and Elfin Forest*	 Marshes and Open Water Habitats
 Dry Limestone Forest and Serpentine Forest	 Tabonuco and Secondary Wet Forest*
 Forested Coastal Wetlands	 Urban Forest
 Moist Limestone (karst) Forest*	 Beaches, Islets, Cliffs and Riparian Barrens
 Non-calcareous Lowland and Coastal Dry Forest	 Grasslands and Shrublands (moist, dry and littoral)
 Non-calcareous Moist Forest	 Developed Land and Artificial Barrens

* Class names in grey are not present in the USVI.

Figure 29a: General habitat cover types on the US Virgin Islands of St. Thomas and St. John, based on vegetation classifications described by Ewel and Whitmore (1973) and land cover classifications from Gould et al. (2010b).



Habitat Cover Type

- | | |
|---|--|
| Colorado, palm and Elfin Forest* | Marshes and Open Water Habitats |
| Dry Limestone Forest and Serpentine Forest | Tabonuco and Secondary Wet Forest* |
| Forested Coastal Wetlands | Urban Forest |
| Moist Limestone (karst) Forest* | Beaches, Islets, Cliffs and Riparian Barrens |
| Non-calcareous Lowland and Coastal Dry Forest | Grasslands and Shrublands (moist, dry and littoral) |
| Non-calcareous Moist Forest | Developed Land and Artificial Barrens |

* Class names in grey are not present in the USVI.

Figure 29b. General habitat cover types on the US Virgin Island of St. Croix, based on vegetation classifications described by Ewel and Whitmore (1973) and land cover classifications from Gould et al. (2010b).

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Table 4: General habitat cover types and their associated bird species in the prioritization analysis for Puerto Rico and the US Virgin Islands. Species are listed in alphabetical order and an 'X' indicates presence in a given habitat. Asterisks denote species included in the prioritization analysis for either PR (single asterisk), the USVI (double asterisk), or both (triple asterisk). Plus signs denote species for which GAP data are available for only PR (single plus), only the USVI (double plus) or both PR and the USVI (triple plus). Open superscript circles after common names denote species which are believed to be extirpated from the region.

Species * PR prioritization list only (40 species) ** USVI prioritization list only (14 species) *** Both PR & USVI prioritization lists (90 species) + PR GAP analysis only (39 species) ++ USVI GAP analysis only (38 species) +++ Both PR & USVI GAP analyses (48 species)	Common Name	Colorado, palm and Elfin forest (PR only)	Tabonuco and secondary wet forest (PR only)	Moist limestone (karst) forest (PR only)	Non-calcareous moist forest	Dry limestone forest and serpentine forest	Non-calcareous lowland and coastal dry forest	Forested coastal wetlands	Urban forest	Moist, dry and littoral grasslands/ shrubs	Marshes and open water habitats	Beaches, islands, cliffs and riparian barrens
<i>Accipiter striatus venator</i> **	Sharp-shinned Hawk	x	x						x			
<i>Agelaius xanthomus</i> **	Yellow-shouldered Blackbird		x		x	x	x	x				
<i>Amazona vitatta vittata</i> **	Puerto Rican Parrot	x	x	x					x			
<i>Ammodramus savannanum</i> **	Grasshopper Sparrow									x		
<i>Anas bahamiensis</i> *****	White-cheeked Pintail					x				x	x	
<i>Anas discors</i> *****	Blue-winged Teal										x	
<i>Anous stolidus</i> ****	Brown Noddy											x
<i>Anthracothorax dominicus</i> ****	Antillean Mango		x						x	x		
<i>Anthracothorax viridis</i> **	Green Mango	x	x		x				x			
<i>Aramus guarauna</i> *	Limpkin			x								
<i>Aratinga chloroptera</i> **	Hispaniolan Parakeet ^o		x	x					x			
<i>Ardea herodias</i> ****	Great Blue Heron										x	
<i>Arenaria interpres</i> *****	Ruddy Turnstone										x	x
<i>Asio flammeus</i> **	Short-eared Owl									x		
<i>Botaurus lentiginosus</i> *	American Bittern										x	
<i>Bubulcus ibis</i> ****	Cattle Egret							x	x		x	
<i>Buteo jamaicensis</i> **	Red-tailed Hawk	x	x	x	x	x	x		x	x		
<i>Buteo platypterus brunnescens</i> **	Broad-winged Hawk	x	x	x								
<i>Calidris alba</i> *****	Sanderling										x	x
<i>Calidris canutus</i> ****	Red Knot										x	

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Species * PR prioritization list only (40 species) ** USVI prioritization list only (14 species) *** Both PR & USVI prioritization lists (90 species) + PR GAP analysis only (39 species) ** USVI GAP analysis only (38 species) *** Both PR & USVI GAP analyses (48 species)	Common Name	Colorado, palm and Elfin forest (PR only)	Tabonuco and secondary wet forest (PR only)	Moist limestone (karst) forest (PR only)	Non-calcareous moist forest	Dry limestone forest and serpentine forest	Non-calcareous lowland and coastal dry forest	Forested coastal wetlands	Urban forest	Moist, dry and littoral grasslands/ shrubs	Marshes and open water habitats	Beaches, islands, cliffs and riparian barrens
<i>Calidris fuscicollis</i> ***	Yellow-rumped Warbler				X		X	X			X	
<i>Calidris himantopus</i> *****	Stilt Sandpiper										X	
<i>Calidris mauri</i> *****	Western Sandpiper										X	X
<i>Calidris melanotos</i> *****	Pectoral Sandpiper										X	
<i>Calidris minutilla</i> *****	Least Sandpiper										X	X
<i>Calidris pusilla</i> *****	Semipalmated Sandpiper										X	
<i>Caprimulgus carolinensis</i> ***	Chuck-will's-widow	X	X	X								
<i>Caprimulgus noctitherus</i> **	Puerto Rican Nightjar					X						
<i>Catharus bicknelli</i> *	Bicknell's Thrush	X										
<i>Charadrius alexandrinus</i> ***	Snowy Plover										X	X
<i>Charadrius melodus</i> ***	Piping Plover										X	X
<i>Charadrius semipalmatus</i> *****	Semipalmated Plover										X	X
<i>Charadrius wilsonia</i> *****	Wilson's Plover											X
<i>Chlorostilbon maugaeus</i> **	Puerto Rican Emerald	X	X	X	X	X	X		X			
<i>Chordeiles gundlachi</i> *****	Antillean Nighthawk						X			X		
<i>Circus cyaneus</i> ***	Northern Harrier										X	
<i>Coccyzus americanus</i> *****	Yellow-billed Cuckoo					X	X	X				
<i>Coccyzus minor</i> *****	Mangrove Cuckoo		X			X	X	X	X			
<i>Coccyzus vieilloti</i> **	Puerto Rican Lizard-Cuckoo	X	X	X	X	X	X		X			
<i>Coereba flaveola</i> *****	Bananaquit	X	X	X	X	X	X	X	X	X	X	
<i>Contopus latirostris</i> **	Lesser Antillean Pewee			X		X						
<i>Corvus leucognaphalus</i> ***	White-necked Crow°	X	X		X				X			
<i>Cypseloides niger</i> **	Black Swift		X	X				X				

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

<p>Species * PR prioritization list only (40 species) ** USVI prioritization list only (14 species) *** Both PR & USVI prioritization lists (90 species) + PR GAP analysis only (39 species) ** USVI GAP analysis only (38 species) *** Both PR & USVI GAP analyses (48 species)</p>	<p>Common Name</p>	<p>Colorado, palm and Elfin forest (PR only)</p>	<p>Tabonuco and secondary wet forest (PR only)</p>	<p>Moist limestone (karst) forest (PR only)</p>	<p>Non-calcareous moist forest</p>	<p>Dry limestone forest and serpentine forest</p>	<p>Non-calcareous lowland and coastal dry forest</p>	<p>Forested coastal wetlands</p>	<p>Urban forest</p>	<p>Moist, dry and littoral grasslands/ shrubs</p>	<p>Marshes and open water habitats</p>	<p>Beaches, islands, cliffs and riparian barrens</p>
<i>Dendrocygna arborea</i> ***	West Indian Whistling-Duck										X	
<i>Dendrocygna bicolor</i> **	Fulvous Whistling-Duck										X	
<i>Egretta caerulea</i> ***	Little Blue Heron										X	
<i>Egretta thula</i> ***	Snowy Egret										X	
<i>Egretta tricolor</i> ****	Tricolored Heron										X	
<i>Elaenia martinica</i> *****	Caribbean Elaenia					X	X					
<i>Eulampis holosericeus</i> *****	Green-throated Carib				X		X					
<i>Euphonia musica</i> **	Antillean Euphonia	X	X	X	X	X	X		X			
<i>Falco peregrinus tundrius</i> ****	Peregrine Falcon										X	X
<i>Falco sparverius</i> *****	American Kestrel		X	X	X	X	X		X			
<i>Fregata magnificens</i> ****	Magnificent Frigatebird											X
<i>Fulica americana</i> ****	American Coot										X	
<i>Fulica caribaea</i> *****	Caribbean Coot										X	
<i>Gallinago delicata</i> ****	Wilson's Snipe										X	
<i>Gelochelidon nilotica</i> ***	Gull-billed Tern											X
<i>Geothlypis formosus</i> ***	Kentucky Warbler		X		X				X			
<i>Geothlypis trichas</i> ****	Common Yellowthroat										X	
<i>Geotrygon chrysia</i> **	Key West Quail-Dove					X	X					X
<i>Geotrygon mystacea</i> *****	Bridled Quail-Dove			X	X		X					X
<i>Haematopus palliatus</i> ****	American Oystercatcher											X
<i>Helmitheros vermivorus</i> ****	Worm-eating Warbler	X	X	X					X			
<i>Icterus portoricensis</i> **	Puerto Rican Oriole	X	X	X					X			
<i>Ixobrychus exilis</i> ***	Least Bittern										X	
<i>Laterallus jamaicensis</i> *	Black Rail ^o										X	

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

<p>Species * PR prioritization list only (40 species) ** USVI prioritization list only (14 species) *** Both PR & USVI prioritization lists (90 species) + PR GAP analysis only (39 species) ** USVI GAP analysis only (38 species) *** Both PR & USVI GAP analyses (48 species)</p>	<p>Common Name</p>	<p>Colorado, palm and Elfin forest (PR only)</p>	<p>Tabonuco and secondary wet forest (PR only)</p>	<p>Moist limestone (karst) forest (PR only)</p>	<p>Non-calcareous moist forest</p>	<p>Dry limestone forest and serpentine forest</p>	<p>Non-calcareous lowland and coastal dry forest</p>	<p>Forested coastal wetlands</p>	<p>Urban forest</p>	<p>Moist, dry and littoral grasslands/ shrubs</p>	<p>Marshes and open water habitats</p>	<p>Beaches, islands, cliffs and riparian barrens</p>
<i>Leucophaeus atricilla</i> ****	Laughing Gull											X
<i>Limnodromus griseus</i> *****	Short-billed Dowitcher										X	
<i>Lonchura malacca</i> ***	Chestnut-sided Warbler	X	X		X							
<i>Loxigilla noctis</i> ****	Lesser Antillean Bullfinch					X	X					
<i>Loxigilla portoricensis</i> **	Puerto Rican Bullfinch	X	X	X	X	X	X		X			
<i>Margarops fuscatus</i> *****	Pearly-eyed Thrasher	X	X	X	X	X	X	X	X	X		
<i>Megascops nudipes</i> ****	Puerto Rican Screech-Owl	X	X	X	X	X	X		X			
<i>Melanerpes portoricensis</i> **	Puerto Rican Woodpecker	X	X	X	X	X	X	X	X			
<i>Mniotilta varia</i> *****	Black-and-white Warbler	X	X	X								
<i>Molothrus bonariensis</i> **	Shiny Cowbird	X	X	X	X	X	X	X	X	X		
<i>Myiarchus antillarum</i> *****	Puerto Rican Flycatcher		X	X		X		X				
<i>Nesospingus specularis</i> **	Puerto Rican Tanager	X	X						X			
<i>Nomonix dominicus</i> *	Masked Duck										X	
<i>Numenius phaeopus</i> ****	Whimbrel										X	
<i>Nyctanassa violacea</i> *****	Yellow-crowned Night-Heron							X			X	
<i>Nycticorax nycticorax</i> ****	Black-crowned Night-Heron										X	
<i>Onychoprion anaethetus</i> *****	Bridled Tern											X
<i>Orthorhyncus cristatus</i> *****	Antillean Crested Hummingbird				X	X	X					
<i>Oxyura jamaicensis</i> *****	Ruddy Duck										X	
<i>Parkesia motacilla</i> ****	Louisiana Waterthrush		X	X					X			
<i>Parkesia novaboracensis</i> ****	Northern Waterthrush							X				
<i>Parula americana</i> *****	Northern Parula	X	X	X	X	X	X		X			
<i>Patagioenas inornata wetmorei</i> **	Plain Pigeon		X	X					X			

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Species * PR prioritization list only (40 species) ** USVI prioritization list only (14 species) *** Both PR & USVI prioritization lists (90 species) + PR GAP analysis only (39 species) ** USVI GAP analysis only (38 species) *** Both PR & USVI GAP analyses (48 species)	Common Name	Colorado, palm and Elfin forest (PR only)	Tabonuco and secondary wet forest (PR only)	Moist limestone (karst) forest (PR only)	Non-calcareous moist forest	Dry limestone forest and serpentine forest	Non-calcareous lowland and coastal dry forest	Forested coastal wetlands	Urban forest	Moist, dry and littoral grasslands/ shrubs	Marshes and open water habitats	Beaches, islands, cliffs and riparian barrens
<i>Patagioenas leucocephala</i> ****+	White-crowned Pigeon				X	X	X	X				X
<i>Patagioenas squamosa</i> ****+	Scaly-naped Pigeon	X	X	X					X			X
<i>Pelecanus occidentalis</i> ****+	Brown Pelican											X
<i>Petrochelidon fulva</i> **	Cave Swallow								X	X	X	
<i>Phaethon aethereus</i> ****+	Red-billed Tropicbird											X
<i>Phaethon lepturus</i> ****+	White-tailed Tropicbird											X
<i>Phoenicopterus ruber</i> ***	American Flamingo°										X	X
<i>Pluvialis dominica</i> ****+	American Golden-Plover										X	
<i>Pluvialis squatarola</i> ****+	Black-bellied Plover										X	X
<i>Podilymbus podiceps</i> ****+	Pied-billed Grebe										X	
<i>Porphyrio martinica</i> **	Purple Gallinule										X	
<i>Porzana flaviventer</i> **	Yellow-breasted Crake										X	
<i>Progne dominicensis</i> ****+	Caribbean Martin								X	X		
<i>Protonotaria citrea</i> ****+	Prothonotary Warbler							X				
<i>Puffinus iherminieri</i> ****+	Audubon's Shearwater											X
<i>Rallus longirostris</i> ****+	Clapper Rail							X			X	
<i>Seiurus aurocapillus</i> ****+	Ovenbird	X	X	X	X	X	X	X	X			
<i>Setophaga adelaidae</i> **	Adelaide's Warbler			X		X	X					
<i>Setophaga angelae</i> **	Elfin-woods Warbler	X	X									
<i>Setophaga caerulescens</i> ****+	Black-throated Blue Warbler		X	X					X			
<i>Setophaga discolor</i> ****+	Prairie Warbler					X						
<i>Setophaga dominica</i> **	Yellow-throated Warbler				X		X	X				
<i>Setophaga palmarum</i> **	Palm Warbler							X			X	
<i>Setophaga petechia</i> ****+	Yellow (Golden) Warbler					X		X				

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Species * PR prioritization list only (40 species) ** USVI prioritization list only (14 species) *** Both PR & USVI prioritization lists (90 species) + PR GAP analysis only (39 species) ** USVI GAP analysis only (38 species) *** Both PR & USVI GAP analyses (48 species)	Common Name	Colorado, palm and Elfin forest (PR only)	Tabonuco and secondary wet forest (PR only)	Moist limestone (karst) forest (PR only)	Non-calcareous moist forest	Dry limestone forest and serpentine forest	Non-calcareous lowland and coastal dry forest	Forested coastal wetlands	Urban forest	Moist, dry and littoral grasslands/ shrubs	Marshes and open water habitats	Beaches, islands, cliffs and riparian barrens
<i>Setophaga ruticilla</i> ****+	American Redstart	x	x	x	x	x	x	x	x			
<i>Setophaga tigrina</i> *****	Cape May Warbler		x		x				x			
<i>Sphyrapicus varius</i> **	Yellow-bellied Sapsucker					x	x					
<i>Spindalis portoricensis</i> **	Puerto Rican Spindalis	x	x	x	x	x	x		x			
<i>Sterna dougalli</i> *****	Roseate Tern											x
<i>Sterna fuscata</i> ****+	Sooty Tern											x
<i>Sterna hirundo</i> **+	Common Tern											x
<i>Sternula antillarum</i> ****+	Least Tern											x
<i>Sula dactylatra</i> ****+	Masked Booby											x
<i>Sula leucogaster</i> ****+	Brown Booby											x
<i>Sula sula</i> ****+	Red-footed Booby											x
<i>Tachybaptus dominicus</i> *****	Least Grebe										x	
<i>Thalasseus maximus</i> *****	Royal Tern											x
<i>Thalasseus sandvicensis</i> *****	Sandwich Tern											x
<i>Todus mexicanus</i> **	Puerto Rican Tody	x	x	x	x	x	x		x			
<i>Tringa flavipes</i> ****+	Lesser Yellowlegs										x	x
<i>Tringa melanoleuca</i> ****+	Greater Yellowlegs										x	x
<i>Tringa semipalmata</i> *****	Willet										x	x
<i>Tringa solitaria</i> ****+	Solitary Sandpiper										x	x
<i>Turdus plumbeus</i> **	Red-legged Thrush	x	x	x	x	x	x		x			
<i>Tyrannus caudifasciatus</i> **	Loggerhead Kingbird		x	x				x	x			
<i>Tyrannus dominicensis</i> *****	Gray Kingbird		x	x	x	x	x		x	x		
<i>Vermivora chrysoptera</i> *	Golden-winged Warbler	x										
<i>Vermivora pinus</i> **	Blue-winged Warbler					x	x					
<i>Vireo altiloquus</i> *****	Black-whiskered Vireo	x	x	x	x	x	x		x			

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

Species * PR prioritization list only (40 species) ** USVI prioritization list only (14 species) *** Both PR & USVI prioritization lists (90 species) + PR GAP analysis only (39 species) ++ USVI GAP analysis only (38 species) *** Both PR & USVI GAP analyses (48 species)	Common Name	Colorado, palm and Elfin forest (PR only)	Tabonuco and secondary wet forest (PR only)	Moist limestone (karst) forest (PR only)	Non-calcareous moist forest	Dry limestone forest and serpentine forest	Non-calcareous lowland and coastal dry forest	Forested coastal wetlands	Urban forest	Moist, dry and littoral grasslands/ shrubs	Marshes and open water habitats	Beaches, islands, cliffs and riparian barrens
<i>Vireo latimeri</i> **	Puerto Rican Vireo	x	x	x		x	x		x			
<i>Wilsonia citrina</i> ****+	Hooded Warbler		x	x	x			x	x			
<i>Zenaida asiatica</i> *****	White-winged Dove				x		x	x	x			x
<i>Zenaida aurita</i> *****	Zenaida Dove		x	x	x	x	x		x			x
<i>Zenaida macroura</i> ****	Mourning Dove		x	x	x	x	x		x			x

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

PUERTO RICO		Tier I						Tier II						Tier III						Tier IV						Tier V						No Tier
Habitat Cover Type	Total Species	CR/CX	IM	MA	PR	PC	PCL	CR/CX	IM	MA	PR	PC	PCL	CR/CX	IM	MA	PR	PC	PCL	CR/CX	IM	MA	PR	PC	PCL	CR/CX	IM	MA	PR	PC	PCL	
Colorado, palm and Elfin forest	33	5	2	2	-	-	-	-	-	-	14	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	2	1	3
Tabonuco and secondary wet forest	48	8	3	5	2	-	-	-	-	-	17	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	2	1	4	
Moist limestone (karst) forest	41	5	2	5	3	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	2	1	2	
Non-calcareous moist forest	33	2				-	-	-	-	-	14	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	2	1	4	
Dry limestone forest and serpentine forest	36	3	2	2	4	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	2	1	1		
Non-calcareous lowland and coastal dry forest	34	2	1	1	3	-	-	-	-	-	14	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	2	1	1		
Forested coastal wetlands	20	2		5	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	2	-	2		
Urban forest	44	6	3	4	1	-	-	-	-	-	17	-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	2	1	3		
Grasslands and shrublands (moist, dry and littoral)	12		2		2	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	2	1	-		
Marshes and open water habitats	41	7	4	13	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	2	7		
Beaches, islets, cliffs and riparian barrens	41	5	6	15	1	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	2	3		

Table 5a: Summary of conservation level rankings relative to each habitat cover type (developed land and artificial barrens not included) for species included in the prioritization analysis for Puerto Rico. Individual species can occur in more than one habitat type. CR = Critical Recovery; CX = subset of CR, when no populations are presently known; IM = Immediate Management; MA = Management Attention; PR = Planning and Responsibility; PC = Generic Population Control possibly needed to conserve higher priority species; PCL=Local Population Control possibly needed to conserve higher priority species.

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

US VIRGIN ISLANDS		Tier I					Tier II					Tier III					Tier IV					Tier V					No Tier					
Habitat Cover Type	Total Species	CR/CX	IM	MA	PR	PC	PCL	CR/CX	IM	MA	PR	PC	PCL	CR/CX	IM	MA	PR	PC	PCL	CR/CX	IM	MA	PR	PC	PCL	CR/CX	IM	MA	PR	PC	PCL	
Colorado, palm and Elfin forest	N/A																															
Tabonuco and secondary wet forest	N/A																															
Moist limestone (karst) forest	N/A																															
Non-calcareous moist forest	23	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	2	1	4
Dry limestone forest and serpentine forest	23	2	1	1	3	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	10	-	-	-	-	-	-	1	-	3
Non-calcareous lowland and coastal dry forest	25	1	3	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	11	-	-	-	-	-	2	-	6	
Forested coastal wetlands	19	2	1	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	1	1	4	
Urban forest	24	2	1	5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	1	1	3	
Grasslands and shrublands (moist, dry and littoral)	7	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	1	
Marshes and open water habitats	44	5	2	10	3	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	3	-	-	-	-	-	-	2	11	
Beaches, islets, cliffs and riparian barrens	39	3	8	12	1	-	-	-	-	-	1	-	-	-	-	3	-	-	-	-	-	-	6	-	-	-	-	-	-	2	3	

Table 5b: Summary of conservation level rankings relative to each habitat cover type for species included in the prioritization analysis for the US Virgin Islands. Individual species can occur in more than one habitat type. CR = Critical Recovery; CX = subset of CR, when no populations are presently known; IM = Immediate Management; MA = Management Attention; PR = Planning and Responsibility; PC = Generic Population Control possibly needed to conserve higher priority species; PCL=Local Population Control possibly needed to conserve higher priority species.

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

PUERTO RICO							
Habitat Cover Type	Ha total -- protected & not- protected (Status 1-4)	Ha total - - protecte d (Status 1&2&3)	Ha total -- not protected (Status 4)	% of PR -- protected and not- protected (Status 1- 4)	% of PR - - protecte d (Status 1&2&3)	% of PR - - not protecte d (Status 4)	Additional ha needed for 15% objective
Colorado, palm and Elfin forest	17191.89	9266.45	7925.45	1.92	53.9	46.1	0
Tabonuco and secondary wet forest	140470.88	15194.14	125276.74	15.70	10.8	89.2	5876
Moist limestone (karst) forest	67515.37	5488.25	62027.12	7.54	8.1	91.9	4639
Non-calcareous moist forest	149929.47	3612.87	146316.60	16.75	2.4	97.6	18877
Dry limestone forest and serpentine forest	29884.64	11077.00	18807.64	3.34	37.1	62.9	0
Non-calcareous lowland and coastal dry forest	30755.54	8420.60	22334.94	3.44	27.4	72.6	0
Forested coastal wetlands	8960.04	5400.18	3559.86	1.00	60.3	39.7	0
Urban forest	27500.18	673.90	26826.28	3.07	2.5	97.5	3451
Grasslands and shrublands (moist, dry and littoral)	310338.14	9039.06	301299.08	34.68	2.9	97.1	37512
Marshes and open water habitats	12035.75	4217.27	7818.48	1.34	35.0	65.0	0
Beaches, islets, cliffs and riparian barrens	2083.84	456.59	1627.25	0.23	21.9	78.1	0
Developed land and artificial barrens	98246.70	451.40	97795.31	10.98	0.5	99.5	N/A
PR all	894912.41	73297.69	821614.73	100.00	8.2	91.8	60939

Table 6a: Land area (ha) and percentage per habitat cover type in Puerto Rico for protected and non-protected lands together (status 1-4), protected areas only (Gap status 1, 2, and 3), non-protected lands only (status 4), as well as additional hectares of habitat needed to achieve the **baseline minimum** conservation objective of 15%. Greater levels of protection may be necessary for some habitat types. Developed land/artificial barrens devoid of vegetation are included in the table as a separate cover class and their area calculated and included in value totals, but in this report they are not considered as a habitat type to work within for conservation planning purposes.

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

US VIRGIN ISLANDS							
Habitat Cover Type	Ha total -- protected & not- protected (Status 1-4)	Ha total -- protected (Status 1&2&3)	Ha total - - not protected (Status 4)	% of USVI - - protected and not- protected (Status 1- 4)	% of USVI -- protected (Status 1&2&3)	% of USVI -- not protected (Status 4)	Additional ha needed for 15% objective
Colorado, palm and Elfin forest	0.00	0.00	0.00	0.0	0.0	0.0	N/A
Tabonuco and secondary wet forest	0.00	0.00	0.00	0.0	0.0	0.0	N/A
Moist limestone (karst) forest	0.00	0.00	0.00	0.0	0.0	0.0	N/A
Non-calcareous moist forest	1821.66	632.77	1188.89	4.9	34.7	65.3	0
Dry limestone forest and serpentine forest	2062.37	192.35	1870.02	5.6	9.3	90.7	117
Non-calcareous lowland and coastal dry forest	14997.98	2525.8	12472.18	40.7	16.8	83.2	0
Forested coastal wetlands	340.29	132.49	207.8	0.9	38.9	61.1	0
Urban forest	1652.13	16.71	1635.42	4.5	1.0	99.0	231
Grasslands and shrublands (moist, dry and littoral)	10605.28	710.43	9894.85	28.8	6.7	93.3	880
Marshes and open water habitats	412.98	121.71	291.27	1.1	29.5	70.5	0
Beaches, islets, cliffs & riparian barrens	629.66	119.34	510.32	1.7	19.0	81.0	0
Developed land and artificial barrens	4292.76	95.63	4197.13	11.7	2.2	97.8	N/A
USVI all	36815.11	4547.23	32267.88	100.0	12.4	87.6	975

Table 6b: Land area (ha) and percentage per habitat cover type in the US Virgin Islands for protected and non-protected lands together (status 1-4), protected areas only (Gap status 1, 2, and 3), non-protected lands only (status 4), as well as additional hectares of habitat needed to achieve the **baseline minimum** conservation objective of 15%. Greater levels of protection may be necessary for some habitat types. Developed land/artificial barrens devoid of vegetation are included in the table as a separate cover class and their area calculated and included in value totals, but in this report they are not considered as a habitat type to work within for conservation planning purposes.

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

PUERTO RICO & US VIRGIN ISLANDS							
Habitat Cover Type	Ha total -- protected & not-protected (Status 1-4)	Ha total - - protected (Status 1&2&3)	Ha total -- not protected (Status 4)	% of PR & USVI -- protected and not-protected (Status 1-4)	% of PR & USVI -- protected (Status 1&2&3)	% of PR & USVI -- not protected (Status 4)	Additional ha needed for 15% objective
Colorado, palm and Elfin forest	17191.89	9266.45	7925.45	1.85	53.90	46.10	0
Tabonuco and secondary wet forest	140470.88	15194.14	125276.74	15.08	10.82	89.18	5876
Moist limestone (karst) forest	67515.37	5488.25	62027.12	7.25	8.13	91.87	4639
Non-calcareous moist forest	151751.13	4245.64	147505.49	16.29	2.80	97.20	18517
Dry limestone forest and serpentine forest	31947.01	11269.35	20677.66	3.43	35.28	64.72	0
Non-calcareous lowland and coastal dry forest	45753.52	10946.40	34807.12	4.91	23.92	76.08	0
Forested coastal wetlands	9300.33	5532.67	3767.66	1.00	59.49	40.51	0
Urban forest	29152.31	690.61	28461.70	3.13	2.37	97.63	3682
Grasslands and shrublands (moist, dry and littoral)	320943.42	9749.49	311193.93	34.45	3.04	96.96	38392
Marshes and open water habitats	12448.73	4338.98	8109.75	1.34	34.85	65.15	0
Beaches, islets, cliffs & riparian barrens	2713.50	575.93	2137.57	0.29	21.22	78.78	0
Developed land and artificial barrens	102539.46	547.03	101992.44	11.01	0.53	99.47	N/A
PR & USVI all	931727.52	77844.92	853882.61	100.00	8.35	91.65	61914

Table 6c: Land area (ha) and percentage per habitat cover type in the region (Puerto Rico and US Virgin Islands together) for protected and non-protected lands together (status 1-4), protected areas only (Gap status 1, 2, and 3), non-protected lands only (status 4), as well as additional hectares of habitat needed to achieve the **baseline minimum** conservation objective of 15%. Greater levels of protection may be necessary for some habitat types. Developed land/artificial barrens devoid of vegetation are included in the table as a separate cover class and their area calculated and included in value totals, but in this report they are not considered as a habitat type to work within for conservation planning purposes.

Forests and Woodland Habitats

The tropical climate and a high degree of geomorphologic evolution fostered the formation of a medley of forest environments with unique physical, chemical, and biological characteristics that historically covered most of the land masses of Puerto Rico and the USVI. Since colonial times, an assortment of natural and human influences brought about the loss of almost all virgin forests and introduced a host of non-native species that have since naturalized and become a significant part of the floral composition (Wadsworth 1950, Birdsey and Weaver 1982, Acevedo-Rodríguez 1996, Brandeis et al. 2007, Brandeis and Oswalt 2007, Miller and Lugo 2009). Therefore, in a very real sense, almost all of the region's forests are to some degree anthropogenically derived and include a mix of native and introduced species (Martinuzzi et al. 2013). Although affected by various degrees of disturbance, many of the native forest types are represented in public reserves and on private conserved lands.

The majority of Puerto Rico's forest lands are associated with two of the island's dominant physiographic features, the Central Cordillera and Luquillo Mountains. In spite of the physical disconnection between these two mountain chains, and the fact that plant species composition often differs from one range to the next, the same forest types and similar bird species associations can be found within them. Roughly 53% of mainland Puerto Rico is covered in forest, woodland, and shubland (Figure 30, Gould et al. 2008a), much of which is still in the early stages of development (Brandeis et al. 2007). Altogether Puerto Rico contains 21 public forests (including El Yunque National Forest), covering an area of approximately 36,000 ha (Gould et al. 2008a) and administered by the Puerto Rico DNER and the US Forest Service. Public forests are among the country's most valuable resources and were established to protect soil and water resources, conserve forest dependent wildlife species, provide opportunities for recreation and public education, and test silvicultural practices. Presently, commonwealth reserves contain almost all the old-growth forest left in Puerto Rico and include representation of all major natural ecosystems.

In the USVI, more than one-third of land is forested at present (Figure 31, Gould et al. 2013a), the majority of which consists of young regenerating stands (Brandeis and Oswalt 2007). A large proportion of the forested area is contained within commonwealth and federally-conserved lands, most notably Virgin Islands National Park. Well-protected St. John has about 20% mature secondary forest, while only 8% and 3% of St. Thomas and St. Croix, respectively, are mature stands (Brandeis and Oswalt 2007). In both Puerto Rico and the USVI, only the summits of a few mountains and inaccessible ravines were subjected to less human disturbance and, consequently, today exhibit a more advanced stage of successional development. These forested areas served as refugia for native flora and fauna during periods of intense land clearing (Woodbury and Weaver 1987, Colón 1996). Today the forest reserves harbor most of the endemic plant and wildlife species, and serve as critical refuges for many native birds and Neotropical migrant songbirds (Little and Woodbury 1980, Raffaele 1989).

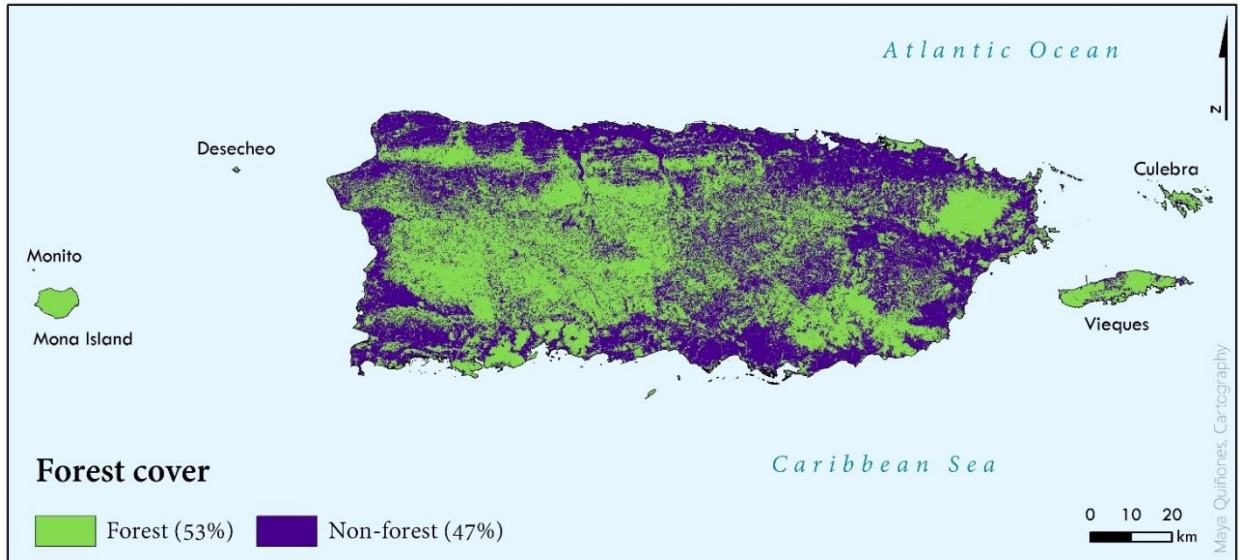


Figure 30: Forest cover on the islands of Puerto Rico, based on 2000 land cover data (source: Gould et al. 2008a).

COLORADO, PALM AND ELFIN FORESTS (PR ONLY)

Ecology and Habitat Status

Palm and cloud forest is located at elevations above 600 m in the Luquillo Mountains (EYNF) and above 900 m in the rest of the Central Cordillera extending to the highest mountain peaks. These forests are characterized primarily by lower montane wet, subtropical rain, and lower montane rain forest (Ewel and Whitmore 1973). Plentiful annual rainfall in this habitat province (in excess of 5,000 mm at the top of EYNF) leads to swampy, nutrient-impooverished soils which support evergreen forest assemblages of relatively limited diversity. Within the lower montane wet forest zone is the Colorado forest type, named for a large reddish-barked canopy tree (*Cyrilla racemiflora*) that grows at upper elevations, and whose hollow trunks serve as nesting sites for the highly endangered Puerto Rican Parrot. Large, open-crowned trees dominate here, with dark, leathery leaves grouped toward the ends of branches. Also in the lower montane wet forest zone, as well as lower montane rain forest, is the cloud forest habitat, found on stable mountaintop peaks. Cloud forest vegetation is characterized by gnarled, evergreen, sclerophyllous trees with canopy heights only reaching seven meters. Epiphyte-laden branches with leaves grouped at the ends are typical as well. Intermixed with cloud forest at high elevations and extending into the subtropical rain forest zone are palm-brake stands, located on steep slopes that exhibit high rates of erosion. The dominant tree here is the sierra palm (*Prestoea montana* var. *acuminata*), which in some locations forms nearly mono-dominant stands (Ewel and Whitmore 1973, Miller and Lugo 2009, PRCCC 2013b).

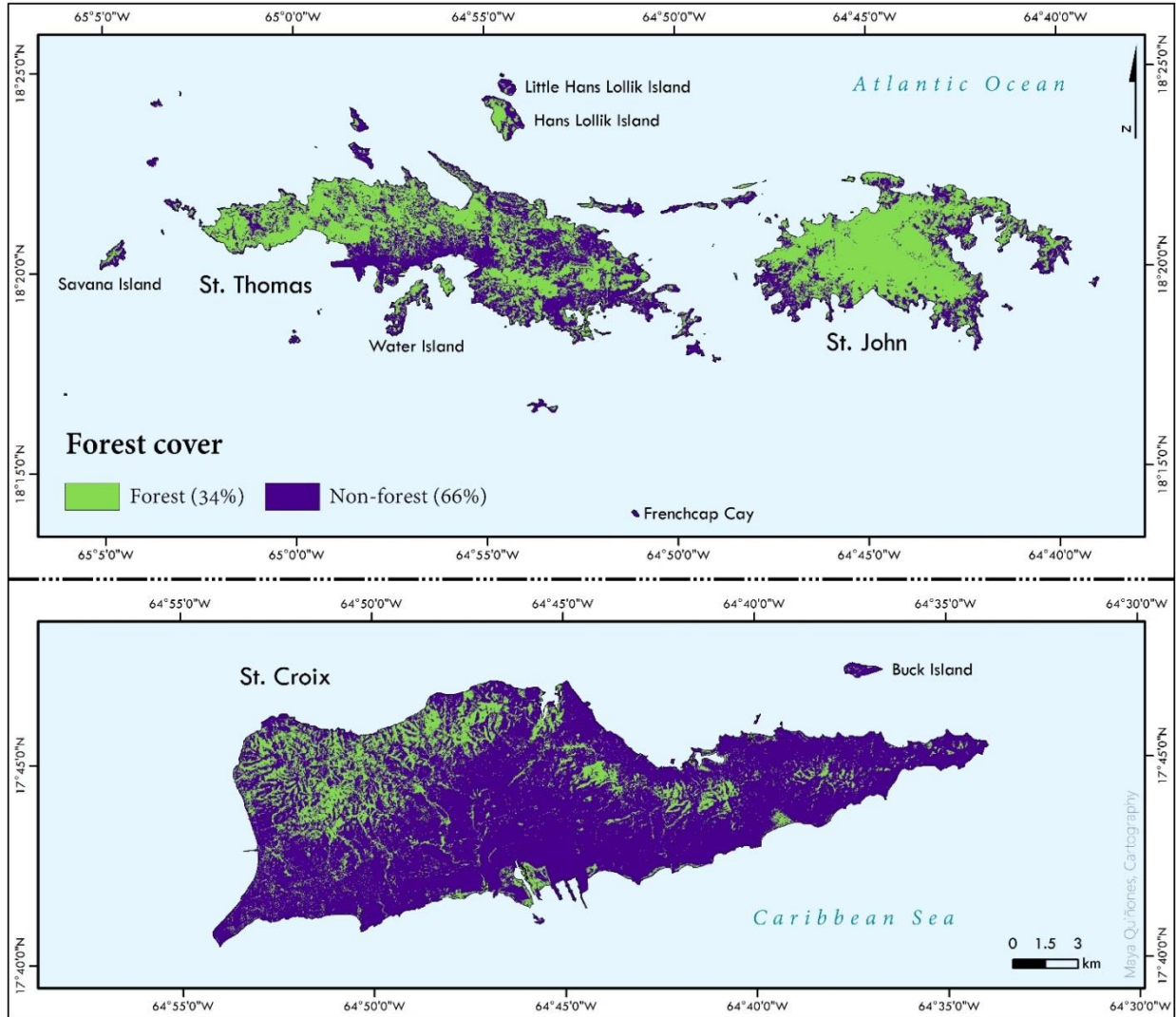


Figure 31: Forest cover on the US Virgin Islands, based on 2007 land cover data (source: Gould et al. 2013a)

PRGAP analysis indicates that Colorado, palm and Elfin forest habitats cover some 17,192 ha (1.9%) of Puerto Rico. Almost 54% of this habitat is protected as class 1, 2, or 3 stewardship lands in commonwealth-owned and legally protected lands, surpassing the 15% objective. The rest is identified as non-stewardship areas under private ownership and management (Table 6a). Despite a significant percentage of Colorado, palm and Elfin forest habitats being conserved, this is a rare and vulnerable habitat subject to both natural and human disturbances, and additional protection (up to 100%) should be considered.

Perhaps the greatest human threat at present comes from the loss of habitat to transmitter and repeater communication towers. The highest mountain peaks are prime locations to situate the towers for greater area coverage, yet the peaks are also the home of some of Puerto Rico's most unique flora and fauna (Gould et al. 2008a, Miller and Lugo 2009). The presence of communication towers results in loss and

fragmentation of palm and cloud forest and also present obstructions and danger to nocturnally migrating birds (Longcore et al. 2012). Another more recent and growing potential threat to forest habitat and wildlife are wind turbines (Erickson et al. 2001, Drewitt and Langston 2006, Smallwood 2007), and any future potential wind turbine construction needs to be carefully planned on mountain ridgelines and elsewhere. Importantly, a considerable portion of Colorado, palm and Elfin forest habitat, particularly throughout the central highlands, is in the hands of private owners and may be affected by changes in land use practices. Thus, even in areas with a high level of conservation protection it is important to consider the injurious effects that surrounding development can have on faunal populations, particularly as more and more individuals are confined to smaller habitat areas. In terms of natural disturbances, changing climatic patterns pose a serious threat to the integrity of upper elevation forest habitats and the faunal species that depend on them. Alterations to environmental and biological conditions may further stress species with already limited ranges (Delannoy 1997, Anadón-Irizarry 2006). Detailed monitoring of climate-related effects on avian populations at fine spatial scales is required. Furthermore, hurricanes can have devastating consequences for cloud forest as demonstrated in 1989 by the effects of hurricane Hugo in the EYNF (Weaver 1999). The unpredictable and periodic nature of destructive cyclonic storms accentuates the need to minimize the detrimental effects of anthropogenic actions on rare cloud forest communities.

Designated stewardship areas that contain Colorado, palm and Elfin forest habitat:

Puerto Rico

- Bosque del Pueblo (Casa Pueblo Foundation);
- Carite Commonwealth Forest (Dept. of Natural and Environmental Resources);
- El Yunque National Forest (US Forest Service);
- Foreman Conservation Easement (Puerto Rico Conservation Trust);
- Jorge Sotomayor del Toro Natural Protected Area (Puerto Rico Conservation Trust);
- Hacienda Buena Vista Natural Protected Area (Puerto Rico Conservation Trust);
- Maricao Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Monte Guilarte Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Olimpia Forest (Casa Pueblo Foundation);
- Tres Picachos Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Toro Negro Commonwealth Forest (Dept. of Natural and Environmental Resources).

Additional habitat conservation opportunities

Based on GAP data, additional conservation opportunities for Colorado, palm, and Elfin forest habitats include expanding existing forest reserves (with the possible exception of

El Yunque National Forest) and conservation of interstitial lands to increase connectivity along the Central Cordillera and provide wildlife corridor linkages between the upper elevation forests from Guilarte to Toro Negro. Similar habitat connections could be realized in the Cayey Mountains the south and west of Carite Commonwealth Forest, incorporating the Cerro El Gato Critical Wildlife Area. These suggestions align with focal area spatial data from CWA; IBA; ACP; TNC; MAPA33; and MF.

Species and Conservation Levels

There are 33 species in our prioritization analysis for Puerto Rico that are associated with Colorado, palm and Elfin forest habitats (Table 4). In particular, about 20-25 individual Puerto Rican Parrots, the only native parrot species under U.S.A. jurisdiction, are presently confined to the EYNF. This population is one of only two populations existing in the wild, the other being some 57-112 individuals present in the Río Abajo Commonwealth Forest since 2006 (Personal communication, I. Llerandi, US Fish and Wildlife Service 2013). Two captive population aviary facilities hold more than 228 individuals (USFWS 2009). Large, mature trees with rotten cavities are required for nesting, the most suitable of which are primarily confined to small patches in upper elevation forests (Raffaele 1989, USFWS 2009). Major threats to the Parrot include competition from and predation by Pearly-eyed Thrashers, Red-tailed Hawks, rats, and the disturbance of mature forest by hurricanes (USFWS 2009).

The Puerto Rican subspecies of Broad-winged and Sharp-shinned Hawks (both listed as federally Endangered in 1994), are two additional endemics confined to contiguous, closed-canopy natural and plantation forests in montane areas (Delannoy 1997). Nesting pairs require a home territory ranging from 40-150 hectares (Oberle 2006). Only about 125 individual Broad-winged Hawks (USFWS 2010) survive in the wild in the upper elevations of Río Abajo and Carite Commonwealth Forests, and EYNF. The analogous nest-site habitat requirements of the Red-tailed Hawk may result in aggressive interactions or even Red-tailed predation on the smaller Broad-winged Hawk (Delannoy and Tossas 2002, Hengstenberg and Vilella 2004, USFWS 2010), though the magnitude of threat from predation is minimal. The present status of the Sharp-shinned Hawk is considered critical and may be on the verge of becoming extinct in Puerto Rico. According to Delannoy (1986) the Sharp-shinned Hawk island-wide population was estimated at 230-250 individuals with the highest number concentrated in Maricao Forest. Recent preliminary results suggest a dramatically reduced island population not exceeding 15 pairs (Personal communication, F. Vilella, Mississippi State Univ. 2013). For the Maricao Forest and surrounding areas there may be ≤ 5 pairs remaining. Furthermore, there are only sporadic reports of isolated individuals in other parts of the island, such as El Yunque (1 individual) and the moist karst forests of north-central Puerto Rico (± 3 individuals). Therefore, the Sharp-shinned Hawk population in and around Maricao appears to have experienced a 90% reduction during the past 28 years. This may be the result of the synergistic effect of multiple factors including structural habitat changes following Hurricane Georges; the progressive abandonment of coffee and timber plantations; progressive demographic problems (high nestling mortality); lack of dispersal ability typical of island populations; and the isolation of

suitable habitat and individuals in small relict fragments along its range. Where relict Sharp-shinned Hawk populations may remain in Puerto Rico is presently unknown (Personal communication, F. Vilella, Mississippi State Univ. 2013). Although currently considered a sub-species, there is some debate as to whether the Puerto Rican Sharp-shinned Hawk is actually its own unique, endemic species, due to its distinctly white ventral parts and its tendency to dominate habitat above 2,000 feet, rather than in coastal areas like other Sharp-shinned Hawks (Personal communication, Sergio Colón, Sociedad Ornitológica de Puerto Rico 2013). If it were its own endemic species the Puerto Rican Sharp-shinned Hawk would likely be eligible for additional local and federal funding to help carry out restoration efforts.

The Elfin-woods Warbler primarily inhabits dwarf forests but can range to lower elevations and other forest types including Colorado and Tabonuco forest in EYNF and podocarpus evergreen forest in Maricao Commonwealth Forest (Personal communication, R. Colón-Merced, US Fish and Wildlife Service 2013). Identified in 1971, this endemic warbler was the latest species discovered in the West Indies (Kepler and Parkes 1972). The Elfin-woods Warbler is rare and in decline in El Yunque, perhaps because of the effects of Hurricane Hugo in 1989 and other tropical storms that have disturbed the forest (Arendt 2013). In the western part of Puerto Rico the species is restricted to the Maricao Commonwealth Forest and adjacent areas. Lower numbers of Elfin-woods Warblers were historically reported in Toro Negro and Carite Commonwealth Forests, yet investigation by Anadón-Irizarry (2006) concluded that the species is no longer present there. Although BirdLife International and SOPI conducted surveys from 2012 to 2013 to try to find the species in the Central Cordillera using a habitat suitability map, none were found (BirdLife International and Sociedad Ornitológica de Puerto Rico 2013). Many aspects of the biology of this warbler are unknown. Thus far, studies have concentrated on the distribution, foraging ecology, and population density of the species (Cruz and Delannoy 1984a, 1984b, Arroyo-Vasquez 1992, Anadón-Irizarry 2006, Delannoy 2007, Colón-Merced 2013). Research by Cruz and Delannoy (1984a) concluded that within the Maricao Commonwealth Forest the Elfin-woods Warbler prefers mature forest with relatively complex habitat structure containing large trees, high basal area of understory trees, low shrub density, and high tree species diversity. Recent data from Colón-Merced (2013) indicates that prey availability does not limit the Elfin-woods Warbler's distribution, but the lack of ecological corridors between the Central Cordillera, Cayey Mountains, and Luquillo Mountains could be a restrictive factor.

High elevation forest with dense stunted vegetation is also important for the Bicknell's Thrush, a Neotropical migrant whose status in Puerto Rico has not been determined. The Worm-eating Warbler is another migrant songbird that winters in palm and cloud forest, though the overall importance of this habitat for the species has not been identified. The White-necked Crow, a regional species of conservation concern, was last officially reported in upper montaine forests in the 1960s (Raffaele 1989) with rumors of sightings into the 1970s. The crow presently constitutes the most recent species extirpation from Puerto Rico.

The Puerto Rican Vireo, although relatively common in Colorado, palm and Elfin forests, is found in low numbers primarily in forest gaps and secondary forests where early succession creates dense understory. Studies conducted in Carite Commonwealth Forest frequently observed Puerto Rican Vireos in forest areas that were regenerating after having been heavily disturbed by hurricane Hugo in 1989, and on mixed forest plantations (Personal communication, F. Núñez-García, US Fish and Wildlife Service 1992). These areas were characterized by patches of close canopy forest intermixed with open areas of short vegetation and high stem density.

Competition with, and parasitism by, non-native species are also factors for priority bird species in the Colorado, palm and Elfin forest habitat. Both the Puerto Rican Oriole and the Puerto Rican Vireo are affected by Shiny Cowbird parasitism, a trend that appears to be more pronounced in selected areas due to uneven distribution of cowbirds throughout Puerto Rico (Woodworth 1999, Collazo and Noble 2008, Tossas 2008). Breeding populations of the Vireo may be protected in dense forests because Shiny Cowbirds do not normally inhabit those areas, although additional study is needed to confirm this hypothesis. The Oriole is a common inhabitant of forest edges whereas the Vireo, with a more fragmented distribution, is mostly a forest-dependent species avoiding open areas, although it uses brushy pastures. Therefore, in terms of habitat change, forest conversion can be beneficial to the Oriole and detrimental to the Vireo. However, the nesting success of both species has been negatively impacted by Shiny Cowbirds (Pérez-Rivera 1986, Faaborg et al. 1997, Woodworth 1997, Woodworth et al. 1998), a species that also benefits from the creation of forest edges and ecotones. At present, Shiny Cowbirds have not been observed in the USVI (Personal communication, C. Lombard, US Fish and Wildlife Service 2013).

The conservation breakdown for the species associated with Colorado, palm and Elfin forest habitats is as follows:

PUERTO RICO

- TIER I
 - 5 Critical Recovery (or CX) species
 - Broad-winged Hawk (*Buteo platypterus brunnescens*)
 - Elfin-woods Warbler (*Setophaga angelae*)
 - Puerto Rican Parrot (*Amazona vittata*)
 - Sharped-shinned Hawk (*Accipiter striatus venator*)
 - White-necked Crow (*Corvus leucognaphalus*)
 - 2 Immediate Management species
 - Puerto Rican Oriole (*Icterus portoricensis*)
 - Puerto Rican Vireo (*Vireo latimeri*)
 - 2 Management Attention species
 - Chuck-will's-widow (*Caprimulgus carolinensis*)
 - Worm-eating Warbler (*Helmitheros vermivorus*)

- TIER II
 - 14 Planning and Responsibility species
 - Antillean Euphonia (*Euphonia musica*)
 - Black-whiskered Vireo (*Vireo altiloquus*)
 - Green Mango (*Anthracothorax viridis*)
 - Northern Parula (*Parula americana*)
 - Puerto Rican Bullfinch (*Loxigilla portoricensis*)
 - Puerto Rican Emerald (*Chlorostilbon maugaeus*)
 - Puerto Rican Lizard-Cuckoo (*Coccyzus vieilloti*)
 - Puerto Rican Screech-Owl (*Megascops nudipes*)
 - Puerto Rican Spindalis (*Spindalis portoricensis*)
 - Puerto Rican Tanager (*Nesospingus speculariferus*)
 - Puerto Rican Tody (*Todus mexicanus*)
 - Puerto Rican Woodpecker (*Melanerpes portoricensis*)
 - Red-legged Thrush (*Turdus plumbeus*)
 - Scaly-naped Pigeon (*Patagioenas squamosa*)

- TIER III
 - None

- TIER IV
 - 4 Planning and Responsibility species
 - American Redstart (*Setophaga ruticilla*)
 - Bananaquit (*Coereba flaveola*)
 - Bicknell's Thrush (*Catharus bicknelli*)
 - Black-and-white Warbler (*Mniotilta varia*)

- TIER V
 - 2 Generic Population Control/Suppression species
 - Pearly-eyed Thrasher (*Margarops fuscatus*)
 - Shiny Cowbird (*Molothrus bonariensis*)
 - 1 Local Population Control species
 - Red-tailed Hawk (*Buteo jamaicensis*)

- NO TIER
 - 3 species not requiring further conservation action
 - Chestnut-sided Warbler (*Lonchura malacca*)
 - Golden-winged Warbler (*Vermivora chrysoptera*)
 - Ovenbird (*Seiurus aurocapillus*)

Recommended Actions and Strategies

- Conserve new habitat area and establish inter-reserve corridor linkages in areas listed above;
- Expand private lands and public engagement initiatives – Safe Harbor Program, shade grown coffee incentives via Partners for Fish and Wildlife;
- Develop guidelines and sustainable agricultural practices (e.g., soil conservation, riparian buffers) that benefit wildlife and help in the development of biological corridors between natural areas;
- Develop guidelines for adaptive management forestry practices that encourage complex canopy structure, good understory development, and fleshy-fruited shrubs and trees;
- Minimize the number of communication towers and wind turbines along ridgelines;
- Improve climate modeling and cloud level monitoring of upper elevation forests and associated species;
- Conduct status assessments for possible promotion of Elfin-woods Warbler to federal listed status; investigate climate change effects on upper elevation habitat;
- Consider reintroduction of extirpated species;
- Conduct monitoring surveys and community level research on endemic species;
- Further investigate and quantify effects of native birds and exotic predators (e.g., Shiny Cowbird, Pearly-eyed Thrasher, mongoose, rats, monkeys) on breeding populations; determine areas where control measures would be most effective in stabilizing vulnerable populations;
- Conduct research regarding population status and habitat requirements of Neotropical migrant species;
- Support strategic partnerships for refuge management, conservation education, land use zoning/planning and habitat protection, community outreach, and ecotourism.

TABONUCO AND SECONDARY WET FORESTS (PR ONLY)

Ecology and Habitat Status

Tabonuco and secondary wet forest are distinguished from Colorado, palm and Elfin forests by elevation, soil conditions, rainfall, and topographic relief. This habitat encompasses subtropical wet forests located between about 400 and 900 m of altitude in the Central Cordillera, and between 150 and 600 m in the Luquillo Mountains (Ewel and Whitmore 1973). Average annual rainfall can vary between 2000-4000 mm, and the weathered soils, derived from volcaniclastic sediments, are susceptible to erosive forces (Ewel and Whitmore 1973). Historically, this subtropical wet forest assemblage was the most diverse and splendid of forests in Puerto Rico, with stratified, closed canopies reaching heights greater than 30 m and containing about 170 tree species

(Little et al. 1974, Birdsey and Weaver 1982, Miller and Lugo 2009), three times as many as are found in the adjacent forest habitats at higher elevations. Many epiphytic bromeliads, ferns, and orchids are also abundant.

Since colonial times, the moist and wet forested zones, and Tabonuco/secondary wet forests in particular, have gone through a cycle of destruction, conversion, and regeneration. Virtually the entire Central Cordillera range was deforested for agricultural purposes and extensive areas were used for the production of shade coffee. Some 4,500 ha in Puerto Rico are continuous, mature secondary forest, and most of the areas surrounding the mature secondary forest were traditionally shade coffee plantations (Franco et al. 1997). Additionally, several other types of cash crops were planted, including sugar cane (Birdsey and Weaver 1982, Franco et al. 1997, Brandeis et al. 2007). As a consequence of inadequate agricultural practices, extensive networks of gullies and rills formed on the hillsides, carrying away valuable topsoil sediments and delivering them directly to the stream channels and eventually polluting water reservoirs (Birdsey and Weaver 1982). Despite the loss of virgin forest cover, traditional coffee cultivation in Puerto Rico consisted of a true agro-forestry system where coffee plants were intermixed with the cultivation of bananas, citric fruits, and native and exotic species of legume shade trees, as well as other minor agricultural products. The structure created by this combination of crop species resembled the native forest it replaced, resulting in a relatively low environmental impact and providing optimal habitat for many native and migratory birds (Brash 1987). Indeed, the majority of Puerto Rican endemic flora and fauna – including birds, amphibians, bats, reptiles, invertebrates, trees, and plant species – is located in montane habitat provinces such as the Tabonuco and secondary wet forest (Miller and Lugo 2009).

Currently, the majority of lands in this habitat zone have been abandoned agriculturally and replaced by secondary forests and thickets (Brandeis et al. 2007), many with increased species richness and novel compositions of plant and animal species (Lugo and Helmer 2004, Lugo 2012). This natural forest regeneration, in concert with the legacies of traditional shade coffee practices, provides complex habitat structure that helps maintain soil fertility and arrest soil loss, thereby protecting important water resources that supply the major water reservoirs situated throughout the island (Miller and Lugo 2009). At the landscape level, forest reversion affords key wildlife corridors between some commonwealth forest reserves and urban areas (Brash 1987, Franco et al. 1997, Miller and Lugo 2009). Therefore, any bird conservation initiative targeting these forests will be relevant to multiple ecosystem functions and human benefits as well.

The regenerated Tabonuco and wet forests are today threatened by development pressures triggered by infrastructure needs to support Puerto Rico's human population. About 45% of the Puerto Rican landmass lies 150 m above the sea level and, as a consequence, a considerable proportion of the human population on the island inhabits this forest zone (Helmer 2004). Thus, the intensity of development for housing, infrastructure, and large, continental-style strip malls and shopping centers is greater here than at higher elevations. Inadequate modern agricultural practices also create

vulnerabilities, resulting in detrimental effects on the wildlife and human-related ecosystem values of the landscape. For example, conversion of traditional shade coffee farms to industrialized sun coffee monoculture plantations has resulted in the loss of habitat for native and migratory bird species (Brash 1987, Borkhataria 1993, Borkhataria et al. 2012) and has likely contributed to the large-scale re-organization of Puerto Rico's bird assemblages (Acevedo and Restrepo 2008). Vital human-related ecosystem services such as soil and water conservation are also diminished with the transition from shade to sun coffee (Brandeis et al. 2007, Miller and Lugo 2009). Other threats to Tabonuco and wet forests come from increased human use for recreational and tourism purposes (Brandeis et al. 2007), and the lack of adequate management of private and public forests to meet resource demands (DNRA 2010).

PRGAP analysis of Tabonuco and secondary wet forests indicates a total habitat area of 140,471 ha (~16% of Puerto Rico), with almost 11% of the land area classified as stewardship class 1, 2, or 3, and the bulk of the land classified as non-stewardship areas. Thus, another 5,877 ha would need to be conserved to reach the 15% objective for this habitat type (Table 6a).

Designated stewardship areas that contain Tabonuco and secondary wet forest habitat:

Puerto Rico

- Bosque del Pueblo (Casa Pueblo Foundation);
- Carite Commonwealth Forest (Dept. of Natural and Environmental Resources);
- El Yunque National Forest (US Forest Service);
- Foreman Conservation Easement (Puerto Rico Conservation Trust);
- Hacienda Buena Vista Natural Protected Area (Puerto Rico Conservation Trust);
- Jorge Sotomayor del Toro Natural Protected Area (Puerto Rico Conservation Trust);
- Maricao Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Monte Guilarte Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Olimpia Forest (Casa Pueblo Foundation);
- Paraiso de las Lunas Natural Protected Area (Puerto Rico Conservation Trust);
- Río Abajo Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Río Encantado Natural Protected Area (Puerto Rico Conservation Trust);
- Río Maricao Natural Protected Area (Puerto Rico Conservation Trust);
- Sierra La Pandura Natural Protected Area (Puerto Rico Conservation Trust);
- Toro Negro Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Tres Picachos Commonwealth Forest (Dept. of Natural and Environmental Resources).

Additional habitat conservation opportunities

As discussed with regards to the Colorado, palm and Elfin forests, GAP data indicate that developing an inter-reserve corridor system along the Central Cordillera and Cayey Mountains would help facilitate movement between important habitat patches, likely improving access to limited resources and reducing isolation of imperiled populations. In the Central Cordillera, conservation opportunities for this habitat extend east from Maricao all the way over to Monte Choca Commonwealth Forest in Corozal. North-south linkages between Bosque del Pueblo, Tres Picachos, and Toro Negro with Río Abajo, Río Encantado, and other areas to the north would help connect habitats and benefit a multitude of species that overlap in moist forests found in both the northern karst region and the Central Cordillera. In the Cayey Mountains the conservation focus should be on private lands to the north, east, and south of Carite Commonwealth Forest, extending towards the Cerro El Gato Critical Wildlife Area the Sierra La Pandura Natural Protected Area. These suggestions align with focal area spatial data from CWA; IBA; ACP; TNC; MAPA33; and MF.

Species and Conservation Levels

Lower montane Tabonuco and secondary wet forests provide habitat for 48 species included in our prioritization analysis for Puerto Rico (Table 4). Although floristically more diverse, secondary forest patches and former shade coffee plantations share similar bird associations with the upper montane forests and may be prime habitat for all the priority species mentioned under Colorado, palm and Elfin forest except for the Bicknell's Thrush that predominates in higher elevation forests. Even the Elfin-woods Warbler, generally considered a higher elevation species, has been reported to range down to lower elevations in the Tabonuco zone of EYNF (Personal communication, R. Colón-Merced, US Fish and Wildlife Service 2013). Present habitat may be marginal for the Sharp-shinned and the Broad-winged Hawks, but forest protection and restoration efforts can provide adequate habitat for these species in Tabonuco and secondary wet forest settings.

The Plain Pigeon survives in moist mountain forest ravines, forest edges, and disturbed habitats of the secondary wet forests where it forages for fruits, berries, buds, and flowers. In the past it was a common species found in coastal regions and open country as well, but due to overhunting and deforestation, predation by birds, cats, and rats, and natural events such as hurricanes, it is now restricted to a few isolated locations in east-central Puerto Rico including Cidra, Cayey, Caguas, Comerío, Aibonito, Aguas Buenas, Gurabo, and San Lorenzo (USFWS 2011). A captive propagation program succeeded in population increases from the 1970s to the late 1990s, but the effects of Hurricane Georges resulted in a density decrease that has only rebounded again since 2008. Plain Pigeon habitat is disappearing to development pressures in east-central Puerto Rico, but detections appear to be increasing outside the traditional center of abundance in montane forests surrounding farms in the karst region (Personal communication, F. Rivera-Milán, USFWS 2013). At present, total abundance of this endangered species within surveyed areas is estimated to be only a few thousand individuals (USFWS 2011, Rivera-Milán and Martínez 2012). Recovery plan objectives call for the establishment of

two distinct populations: the protection of existing Plain Pigeon habitat in Cidra and Cayey; and commitment of the Río Abajo Commonwealth Forest, or its equivalent, as a reintroduction and management site for a second Plain Pigeon population (USFWS 2011).

Another priority bird associated with his habitat type is the Puerto Rican Tanager. In the past century, this species has expanded its range considerably from isolated refugia to occupy several mature forest locations throughout the Tabonuco and lower montane secondary wet forest province, including Toro Negro and Carite Commonwealth Forests, the western mountains surrounding Maricao and Los Tres Picachos Commonwealth Forests, the Sierra de Luquillo, and regenerating forest sites in the Sierra de Cayey. The species is most abundant in dense forest canopy at higher altitudes, although it also occurs locally in secondary forest at middle elevations (Raffaele 1989). The Puerto Rican Tanager is an endemic bird and is the only species in its genus.

Several Neotropical migrant species utilize the Tabonuco and secondary wet forest habitat for their wintering grounds, such as the Cape May and Black-throated Blue Warblers. As is the case with the upper elevation species, more research is still needed to clarify the status of many migrant songbirds in Puerto Rico, as well as the significance of wet forest habitat settings for localized population dynamics.

Tabonuco and secondary wet forest species are classified into the following conservation levels:

PUERTO RICO

- TIER I
 - 8 Critical Recovery (or CX) species
 - Broad-winged Hawk (*Buteo platypterus brunnescens*)
 - Elfin-woods Warbler (*Setophaga angelae*)
 - Hispaniolan Parakeet (*Aratinga chloroptera*)
 - Plain Pigeon (*Patagioenas inornata wetmorei*)
 - Puerto Rican Parrot (*Amazona vittata*)
 - Sharped-shinned Hawk (*Accipiter striatus venator*)
 - White-necked Crow (*Corvus leucognaphalus*)
 - Yellow-shouldered Blackbird (*Agelaius xanthomus*)
 - 3 Immediate Management species
 - Antillean Mango (*Anthracothorax dominicus*)
 - Puerto Rican Oriole (*Icterus portoricensis*)
 - Puerto Rican Vireo (*Vireo latimeri*)
 - 5 Management Attention species
 - Black-throated Blue Warbler (*Setophaga caerulescens*)
 - Chuck-will's-widow (*Caprimulgus carolinensis*)

- Loggerhead Kingbird (*Tyrannus caudifasciatus*)
- Louisiana Waterthrush (*Parkesia motacilla*)
- Worm-eating Warbler (*Helmitheros vermivorus*)
- 2 Planning and Responsibility species
 - Black Swift (*Cypseloides niger*)
 - Mangrove Cuckoo (*Coccyzus minor*)
- TIER II
 - 17 Planning and Responsibility species
 - Antillean Euphonia (*Euphonia musica*)
 - Black-whiskered Vireo (*Vireo altiloquus*)
 - Gray Kingbird (*Tyrannus dominicensis*)
 - Green Mango (*Anthracothorax viridis*)
 - Northern Parula (*Parula americana*)
 - Puerto Rican Bullfinch (*Loxigilla portoricensis*)
 - Puerto Rican Emerald (*Chlorostilbon maugaeus*)
 - Puerto Rican Flycatcher (*Myiarchus antillarum*)
 - Puerto Rican Lizard-Cuckoo (*Coccyzus vieilloti*)
 - Puerto Rican Screech-Owl (*Megascops nudipes*)
 - Puerto Rican Spindalis (*Spindalis portoricensis*)
 - Puerto Rican Tanager (*Nesospingus speculiferus*)
 - Puerto Rican Tody (*Todus mexicanus*)
 - Puerto Rican Woodpecker (*Melanerpes portoricensis*)
 - Red-legged Thrush (*Turdus plumbeus*)
 - Scaly-naped Pigeon (*Patagioenas squamosa*)
 - Zenaida Dove (*Zenaida aurita*)
- TIER III
 - None
- TIER IV
 - 6 Planning and Responsibility species
 - American Kestrel (*Falco sparverius*)
 - American Redstart (*Setophaga ruticilla*)
 - Bananaquit (*Coereba flaveola*)
 - Black-and-white Warbler (*Mniotilta varia*)
 - Cape May Warbler (*Setophaga tigrina*)
 - Mourning Dove (*Zenaida macroura*)
- TIER V

- 2 Generic Population Control/Suppression species
 - Pearly-eyed Thrasher (*Margarops fuscatus*)
 - Shiny Cowbird (*Molothrus bonariensis*)
- 1 Local Population Control species
 - Red-tailed Hawk (*Buteo jamaicensis*)
- NO TIER
 - 4 species not requiring further conservation action
 - Chestnut-sided Warbler (*Lonchura malacca*)
 - Hooded Warbler (*Wilsonia citrine*)
 - Kentucky Warbler (*Geothlypis formosus*)
 - Ovenbird (*Seiurus aurocapillus*)

Recommended Actions and Strategies

- Conserve new habitat area and establish inter-reserve corridor linkages in areas listed above;
- Expand private lands and public engagement initiatives – Safe Harbor Program, shade grown coffee incentives via Partners for Fish and Wildlife;
- Develop guidelines and sustainable agricultural practices (e.g., soil conservation, riparian buffers) that benefit wildlife and help in the development of biological corridors between natural areas;
- Develop guidelines for adaptive management forestry practices that encourage complex canopy structure, good understory development, and fleshy-fruited shrubs and trees;
- Consider reintroduction of extirpated species;
- Conduct monitoring surveys and community level research on endemic species;
- Further investigate and quantify effects of native birds and exotic predators (e.g., Shiny Cowbird, Pearly-eyed Thrasher, mongoose, rats, monkeys) on breeding populations; determine areas where control measures would be most effective in stabilizing vulnerable populations;
- Conduct research regarding population status and habitat requirements of Neotropical migrant species;
- Support strategic partnerships for refuge management, conservation education, land use zoning/planning and habitat protection, community outreach, and ecotourism.

MOIST LIMESTONE (KARST) FORESTS (PR ONLY)

Ecology and Habitat Status

A calcium carbonate-rich substrate is the defining factor that distinguishes moist limestone (karst) habitat from the volcanoclastic soils of the Central Cordillera and

Luquillo Mountains. Between 1000-2200 mm of rain fall annually in this habitat province, which is characteristic of the subtropical moist forest zone (Ewel and Whitmore 1973). In the karst region of Puerto Rico, rainfall is distributed along a north-south gradient with greater precipitation in the higher, southern elevations than in the lower, northern areas (Lugo et al. 2001). The characteristic undulating “haystack-hill” topography of the karst region is overlain by well-weathered soils with widely ranging development and fertility. Excessive drainage on karst summits leads to drier, less developed soils compared with the increased moisture and greater accumulation of alluvial soils that characterize the valley bottoms (Ewel and Whitmore 1973, Birdsey and Weaver 1982, Lugo et al. 2001). The associated forest cover is also highly variable, though generally characterized by an assemblage of evergreen and semi-deciduous trees, including many endemic species (Ewel and Whitmore 1973, Birdsey and Weaver 1982, Miller and Lugo 2009).

Lugo et al. (2001) reported that Puerto Rico’s karst region is home to over 1,300 plant and animals species, including 30 which are listed as threatened and endangered, and many of the endemic species of the region. Considering birds in particular, more than 75 species of Neotropical migrants use karst forest for wintering habitats (Miller and Lugo 2009). Acevedo and Aide (2008) emphasized the high tree species richness and complex structure in the karst forest as important habitat variables associated with relatively high bird species richness.

Apart from its wildlife values, the limestone regions in Puerto Rico are especially important to the island’s water supply, stabilizing the soils in these higher rainfall areas and intercepting cloud-borne moisture (Lugo et al. 2001, Renken et al. 2002, Miller and Lugo 2009). Important aquifers in Puerto Rico include the Río Encantado, one of the longest underground river-cave systems in the world. Nine municipalities in the northwestern part of Puerto Rico depend entirely on terrestrial karst aquifers to supply water for human consumption. Furthermore, Lakes Dos Bocas and Guajataca, the two most important water reservoirs in the central-northwest part of Puerto Rico, are dependent on limestone watersheds (Lugo et al. 2001).

The moist karst forests in Puerto Rico share many of the same land use histories and threats as the Tabonuco and secondary wet forests – almost all forests in this region are regenerated forests on discarded agricultural land (China 1980, Rivera and Aide 1998). However, unlike in the other montane forest areas of the island, most agricultural use of the inland karst belt has been abandoned for several decades, and the density of paved roads and human settlements has not kept pace with other parts of the island. Therefore, the high rate of recovery of the karst forest in conjunction with the rugged topography of the hills makes them largely inaccessible and less suitable for urban use (Acevedo and Aide 2008). This is of particular significance from a conservation perspective; a portion of the rugged, moist karst topography constitutes the most extensive undeveloped forested landscape in Puerto Rico and some of the least disturbed karst forest in the Caribbean (Lugo et al. 2001).

Low-lying coastal limestone regions were also historically cleared for pasturing livestock and cultivating cash crops like pineapple and sugarcane (Brandeis et al. 2007). More recently, lower elevation limestone forests in Puerto Rico have been extensively destroyed by development activities, particularly within the metropolitan and suburban areas (Lugo et al. 2001). Isolated haystack hills and other residual karst forest habitats can still be observed driving westward from San Juan on the major highways, yet road construction and habitat conversion constitutes an ever-increasing threat to both public and private forested habitats in the moist karst region (Lugo et al. 2001). Puerto Rico's Río Abajo Forest, for example, despite being a commonwealth forest reserve, was bisected by the construction of highway PR-10, destroying important habitat of at least five potential Broad-winged Hawk territories (US Fish and Wildlife Service 1997).

Moist limestone (karst) forests cover some 67,516 ha (~7.5%) of Puerto Rico. At present, only about 8% of the island's moist limestone habitat is categorized as GAP status 1, 2 or 3 with the remaining 92% not protected. An additional 4,639 ha are necessary to attain the 15% objective for this habitat type (Table 6a).

Designated stewardship areas that contain moist limestone habitat:

Puerto Rico

- Cambalache Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Camuy Caves Park (Puerto Rico National Parks Company);
- Caño Tiburones Natural Reserve (Dept. of Natural and Environmental Resources);
- El Tallonal (Citizens of the Karst Foundation);
- El Tambor Conservation Easement (Puerto Rico Conservation Trust);
- Finca Guillermeti (Citizens of the Karst Foundation);
- Finca Jose Santiago (Citizens of the Karst Foundation);
- Finca Manati (International Institute for Tropical Forestry);
- Guajataca Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Hacienda La Esperanza Natural Reserve (Puerto Rico Conservation Trust);
- Lake Guajataca Wildlife Refuge (Dept. of Natural and Environmental Resources);
- Mata de Plátano Field Station Natural Reserve (Citizens of the Karst Foundation);
- Río Abajo Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Río Encantado Natural Protected Area (Puerto Rico Conservation Trust);
- Tortuguero Lagoon Natural Reserve (Dept. of Natural and Environmental Resources);
- Vega Commonwealth Forest (Dept. of Natural and Environmental Resources);

- Additional recently acquired lands in the Karst region (Dept. of Natural and Environmental Resources).

Additional habitat conservation opportunities

Based on GAP data, establishing habitat corridor connections from Río Abajo westward to Guajataca Commonwealth Forest and private lands in Barrio Coto (Isabela), as well as eastward to Vega Commonwealth Forest and the Mogotes Río Lajas y Nevárez Critical Wildlife Area is a high conservation priority for the moist limestone region. This would further enhance the quality of a forest matrix that is relatively undisturbed in comparison with other parts of the island. Additional linkages between Río Abajo, Río Encantado and other protected areas in the karst zone with forest reserves directly to the south in the Central Cordillera such as Tres Picachos and Toro Negro would allow for north-south species movement across habitat zones and the accompanying gradients of moisture, elevation, and vegetative composition. These suggestions align with focal area spatial data from CWA; IBA; ACP; TNC; MAPA33; and MF.

Species and Conservation Levels

There are 41 species in our avifaunal analysis that are associated with moist limestone (karst) forests (Table 4). Moist karst forests support populations of 18 of the 25 restricted-range species identified by Birdlife International within the Puerto Rican and Virgin Islands Endemic Bird Area (Birdlife International 2008). A majority of these species are endemics, and the Yellow-shouldered Blackbird and the Puerto Rican Nightjar are the only regional endemic species absent from moist limestone forest habitat. This was not always the case; in previous times moist limestone forests harbored populations of Puerto Rican Nightjars, Puerto Rican Parrots, Puerto Rican Sharp-shinned and Broad-winged Hawks, Limpkins and White-necked Crows (Lugo et al. 2001). Habitat destruction and degradation as well as predation from introduced mammals (i.e., feral cats and mongoose) has restricted the current distribution of these species from their historical ranges, giving the impression of specific habitat associations for birds that actually may have more general requirements or preferences. Yet the intact moist karst forest that is present today provides suitable habitat for restoration efforts (Lugo et al. 2001). Accordingly, the USFWS and the PRDNER identified forested areas within the moist karst forest region as reintroduction sites for the establishment of a second Puerto Rican Parrot population outside of El Yunque National Forest. Released in 2007, there are at present 46-82 wild parrots in the area. Other species for which this type of forest may serve as prime habitat include the Puerto Rican subspecies of Broad-winged and Sharp-shinned Hawks, the Puerto Rican Vireo, the Puerto Rican Oriole, and migrants such as the Worm-eating Warbler and the Black-throated Blue Warbler. Prior to recent sightings in the northeastern part of the country in Canóvanas and Luquillo (Personal communication, S. Colón, SOPI 2014; Puerto Rico eBird), the last reported Limpkins were reported in swampy valleys in the karst forest region of Puerto Rico (it is unknown from the USVI), and this habitat is a priority area for potential reintroduction.

Moist limestone (karst) forest species are classified into the following conservation levels:

PUERTO RICO

- TIER I
 - 5 Critical Recovery (or CX) species
 - Broad-winged Hawk (*Buteo platypterus brunnescens*)
 - Hispaniolan Parakeet (*Aratinga chloroptera*)
 - Limpkin (*Aramus guarauna*)
 - Plain Pigeon (*Patagioenas inornata wetmorei*)
 - Puerto Rican Parrot (*Amazona vittata*)
 - 2 Immediate Management species
 - Puerto Rican Oriole (*Icterus portoricensis*)
 - Puerto Rican Vireo (*Vireo latimeri*)
 - 5 Management Attention species
 - Black-throated Blue Warbler (*Setophaga caerulescens*)
 - Chuck-will's-widow (*Caprimulgus carolinensis*)
 - Loggerhead Kingbird (*Tyrannus caudifasciatus*)
 - Louisiana Waterthrush (*Parkesia motacilla*)
 - Worm-eating Warbler (*Helmitheros vermivorus*)
 - 3 Planning and Responsibility species
 - Adelaide's Warbler (*Setophaga adelaidae*)
 - Black Swift (*Cypseloides niger*)
 - Lesser Antillean Pewee (*Contopus latirostris*)
- TIER II
 - 15 Planning and Responsibility species
 - Antillean Euphonia (*Euphonia musica*)
 - Black-whiskered Vireo (*Vireo altiloquus*)
 - Gray Kingbird (*Tyrannus dominicensis*)
 - Northern Parula (*Parula americana*)
 - Puerto Rican Bullfinch (*Loxigilla portoricensis*)
 - Puerto Rican Emerald (*Chlorostilbon maugaeus*)
 - Puerto Rican Flycatcher (*Myiarchus antillarum*)
 - Puerto Rican Lizard-Cuckoo (*Coccyzus vieilloti*)
 - Puerto Rican Screech-Owl (*Megascops nudipes*)
 - Puerto Rican Spindalis (*Spindalis portoricensis*)
 - Puerto Rican Tody (*Todus mexicanus*)
 - Puerto Rican Woodpecker (*Melanerpes portoricensis*)
 - Red-legged Thrush (*Turdus plumbeus*)
 - Scaly-naped Pigeon (*Patagioenas squamosa*)

- Zenaida Dove (*Zenaida aurita*)
- TIER III
 - None
- TIER IV
 - 6 Planning and Responsibility species
 - American Kestrel (*Falco sparverius*)
 - American Redstart (*Setophaga ruticilla*)
 - Bananaquit (*Coereba flaveola*)
 - Black-and-white Warbler (*Mniotilta varia*)
 - Bridled Quail-Dove (*Geotrygon mystacea*)
 - Mourning Dove (*Zenaida macroura*)
- TIER V
 - 2 Generic Population Control/Suppression species
 - Pearly-eyed Thrasher (*Margarops fuscatus*)
 - Shiny Cowbird (*Molothrus bonariensis*)
 - 1 Local Population Control species
 - Red-tailed Hawk (*Buteo jamaicensis*)
- NO TIER
 - 2 species not requiring further conservation action
 - Hooded Warbler (*Wilsonia citrine*)
 - Ovenbird (*Seiurus aurocapillus*)

Recommended Actions and Strategies

- Conserve new habitat area and establish inter-reserve corridor linkages in areas listed above;
- Expand private lands and public engagement initiatives – Safe Harbor Program;
- Develop guidelines and sustainable agricultural practices (e.g., soil conservation, riparian buffers) that benefit wildlife and help in the development of biological corridors between natural areas;
- Develop guidelines for adaptive management forestry practices that encourage complex canopy structure, good understory development, and fleshy-fruited shrubs and trees;
- Consider reintroduction of extirpated species;
- Conduct monitoring surveys and community level research on endemic species;
- Further investigate and quantify effects of native birds and exotic predators (e.g., Shiny Cowbird, Pearly-eyed Thrasher, mongoose, rats, monkeys) on breeding

populations; determine areas where control measures would be most effective in stabilizing vulnerable populations;

- Conduct research regarding population status and habitat requirements of Neotropical migrant species;
- Support strategic partnerships for refuge management, conservation education, land use zoning/planning and habitat protection, community outreach, and ecotourism.

NON-CALCAREOUS MOIST FORESTS

Ecology and Habitat Status

Non-calcareous moist forests are distinguished from their moist karst counterpart by the lack of limestone and the presence of volcanoclastic or alluvial substrates. In Puerto Rico, this habitat is one of the most abundant and extensive of the forest types, ranging from the coastal plains up to about 150 m on the lower mountain slopes in the Luquillo Mountains, and rising up to several hundred meters in the Central Cordillera. In the USVI these forests extend from coastal gallery assemblages to the mountain tops. Plants and trees found in this forest province are primarily evergreens intermixed with some deciduous species. The occasional coconut palm plantation, situated in low-lying moist areas along the coast, is included in this habitat as well.

The structure of non-calcareous moist forests is stratified with canopy heights of up to 20 m (Ewel and Whitmore 1973, Birdsey and Weaver 1982, Acevedo-Rodríguez 1996). Rainfall is typical of the subtropical moist life zone, and varies from 1000-2200 mm yr⁻¹ depending on elevation and topographic position. These woodlands are primarily secondary forests of mixed native and introduced assemblages (Martinuzzi et al. 2013) regenerating on former pasture or other agricultural lands in Puerto Rico that previously supported crops such as sugarcane, pineapples, and tobacco (Ewel and Whitmore, Miller and Lugo 2009, PRCCC 2013b).

Development is one of the primary threats to this habitat, as most exurban expansion occurs in moist ecological zones over alluvial or volcanic and sedimentary substrates (Helmer 2004). In the USVI, tourism-associated infrastructure and housing facilities have replaced the majority of non-calcareous moist forests, with the exception of the Virgin Islands National Park in St. John. The National Park covers about two-thirds of St. John and contains representations of critical and uncommon habitats for forest and wildlife conservation, including moist forest assemblages in gallery and basin forests, coastal valleys, and upland areas (Acevedo-Rodríguez 1996). Climate change could also be a potential serious stressor. Whereas moist limestone forests exhibit strong moisture gradients that may buffer against changes in temperature and precipitation, increases in dry season length, occasional droughts, or reductions in annual rainfall may significantly reduce growth rates, alter species composition, and increase the likelihood of fire in non-calcareous moist forest habitats (PRCCC 2013b). Increasing storm frequency and severity could lead to increased damage and downed woody

debris, which in combination with drought would enhance fire danger (Gould et al. 2008b).

Altogether there are 151,671 ha of non-calcareous moist forest in the region, 2.7% of which are protected as GAP status 1, 2, or 3 lands. In Puerto Rico there are 149,929 ha, 2.3% of which is protected, and in the USVI there are 1,742 ha, 36% of which is conserved. Thus for the region another 18,649 ha are necessary to reach the 15% objective, in Puerto Rico another 19,020 ha would need to be conserved, while in the USVI the objective has already been met (Tables 6a, 6b, and 6c).

Designated stewardship areas that contain non-calcareous moist forest habitat:

Puerto Rico

- Aguas Buenas Caverns and Cave Systems Natural Reserve (Dept. of Natural and Environmental Resources);
- Belvedere Natural Reserve (Dept. of Natural and Environmental Resources);
- El Buey National Wildlife Refuge (Puerto Rico Conservation Trust);
- Cambalache Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Caño La Boquilla Natural Reserve (Dept. of Natural and Environmental Resources);
- Caño Tiburones Natural Reserve (Dept. of Natural and Environmental Resources);
- Carite Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Ceiba Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Cerrillos Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Cueva del Indio Natural Reserve (Dept. of Natural and Environmental Resources);
- El Rabanal Conservation Easement (Puerto Rico Conservation Trust);
- El Tallonal (Citizens of the Karst Foundation);
- El Yunque National Forest (US Forest Service);
- Finca Guayama (International Institute of Tropical Forestry);
- Finca Shapiro (Puerto Rico Conservation Trust);
- Hacienda Buena Vista Natural Protected Area (Puerto Rico Conservation Trust);
- Hacienda La Esperanza Natural Reserve (Puerto Rico Conservation Trust);
- Ines Maria Mendoza (Yeguas Point) Nature Reserve (Puerto Rico Conservation Trust);
- Jobos Bay Estuary National Research Reserve (Dept. of Natural and Environmental Resources and National Oceanic and Atmospheric Administration);

- Joyuda Lagoon Natural Reserve (Dept. of Natural and Environmental Resources);
- Lago Guajataca Wildlife Refuge (Dept. of Natural and Environmental Resources);
- Lago La Plata Wildlife Refuge (Dept. of Natural and Environmental Resources);
- Lago Luchetti Wildlife Refuge (Dept. of Natural and Environmental Resources);
- Las Cabezas de San Juan Nature Reserve (Puerto Rico Conservation Trust);
- Las Cuevas el Convento Natural Protected Area (Puerto Rico Conservation Trust);
- Las Piedras del Collado Natural Reserve (Dept. of Natural and Environmental Resources);
- Maricao Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Medio Mundo and Daguao Natural Protected Area (Puerto Rico Conservation Trust);
- Monte Choca Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Northeastern Ecological Corridor (Dept. of Natural and Environmental Resources);
- Palmas del Mar Tropical Forest Conservation Easement (Puerto Rico Conservation Trust);
- Pantano de Cibuco Natural Reserve (Dept. of Natural and Environmental Resources);
- Piñones Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Pterocarpus Forest Nature Reserve (Puerto Rico Conservation Trust);
- Pterocarpus Swamp Forest and Mandry and Santa Teresa Lagos Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Tuna Natural Mangrove Reserve (Dept. of Natural and Environmental Resources);
- Ratones Cay Natural Reserve (Dept. of Natural and Environmental Resources);
- Río Abajo Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Río Encantado Natural Protected Area (Puerto Rico Conservation Trust);
- Río Espíritu Santo Natural Reserve (Dept. of Natural and Environmental Resources);
- Río Guaynabo Natural Protected Area (Puerto Rico Conservation Trust);
- San Cristobal Canyon Natural Protected Area (Puerto Rico Conservation Trust);
- Sierra La Pandura Natural Protected Area (Puerto Rico Conservation Trust);
- Sun Bay National Park (Puerto Rico National Parks Company);
- Susúa Commonwealth Forest (Dept. of Natural and Environmental Resources);

- Tortuguero Lagoon Natural Reserve (Dept. of Natural and Environmental Resources);
- Tres Picachos Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Vega Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Vieques Bioluminescent Bay Natural Reserve (Dept. of Natural and Environmental Resources);
- Vieques National Wildlife Refuge (US Fish and Wildlife Service);
- Additional recently acquired lands in the Karst region and Piñones (Dept. of Natural and Environmental Resources).

US Virgin Islands

St. Thomas

- Magen's Bay Preserve (USVI Government and The Nature Conservancy);
- Smith Bay Park (USVI Government);

St. John

- Coral Bay Preserve (The Nature Conservancy);
- Frank Bay Marine Reserve and Wildlife Sanctuary (USVI Government);
- US Virgin Islands National Park (US National Park Service);

St. Croix

- Altona Lagoon Beach Recreation Area (USVI Government);
- Buck Island Reef National Monument (US National Park Service);
- Butler Bay Conservation Easement and Butler Bay Nature Preserve (St. Croix Landmarks Society);
- Caledonia Gut (USVI Government);
- Creque Dam (USVI Government);
- Derick O. Steinmann Memorial Beach (St. Croix Environmental Association);
- East End Marine Park (USVI Government)
- Estate Great Pond (USVI Government);
- Estate Mount Washington Bird Sanctuary (St. Croix Landmarks Society);
- Herman Hill Pond (The Nature Conservancy);
- Long Point Bay (The Nature Conservancy);
- Manning Bay Wetlands (USVI Government);
- Ruth Cay Wildlife Sanctuary (USVI Government);
- Salt River Bay National Historic Park and Ecological Preserve (USVI Government and US National Park Service);
- Sandy Point National Wildlife Refuge (US Fish and Wildlife Service);
- Southgate Coastal Preserve (St. Croix Environmental Association);
- University of the Virgin Islands Wetlands (USVI Government).

Additional habitat conservation opportunities

Due to the extensive geographic range of non-calcareous moist forest habitat throughout Puerto Rico, there is ample opportunity to expand conservation efforts around existing protected areas and improve linkages between isolated patches. Based on GAP data, a top priority is along the southern flank of the Central Cordillera from Maricao eastward over to the Cayey Mountains, incorporating Cerro el Gato Critical Wildlife Area, and continuing southeast down through Yabucoa and Maunabo to the Sierra La Pandura Natural Protected Area. Another focal area is north from Cerillos Commonwealth Forest through Toro Negro over to Río Abajo, thereby connecting non-calcareous moist forest with dry limestone and serpentine forest to the south, as well as upper elevation Colorado, palm, secondary wet, and moist limestone forests to the north. A third opportunity is to pursue conservation linkages from the Central Cordillera near San Cristobal Canyon northeastward across the Cidra River watershed toward Aguas Buenas and around Caguas (both to the north and south across the Route 52 and Route 30 corridors, respectively) over to the Luquillo Mountains and EYNF. Finally, protecting moist forest habitat in low-elevation areas in Rincón, as well as in the municipalities of Naguabo, Ceiba, Fajardo, and Luquillo would benefit many lowland species. In the context of landscape-scale dynamics, protecting lower-lying lands around EYNF would also provide critical elevational connectivity from coastal habitats in the northeast all the way up to cloud forest, helping buffer bird communities from exurban fragmentation in the foothills and from periodic landscape-scale disturbance such as that caused by hurricanes.

In the USVI a good portion of non-calcareous moist forest habitat is well-conserved on St. John in Virgin Islands National Park, yet the other large block of non-calcareous moist forest is located in the gallery forests of the central-western uplands of St. Thomas, an area devoid of stewardship protection and encroached upon from all sides by the pressures of human development. In the absence of active conservation planning, it is possible that much of this remaining forest will be converted to urban habitat. A third area with additional conservation potential is the gallery forests in the northwestern uplands of St. Croix, around Butler Bay Nature Preserve and Conservation Easement, Estate Mount Washington Bird Sanctuary, Creque Dam, Caledonia Gut, and eastward towards Estate Clairmont Park.

These suggestions align with focal area spatial data from CWA; IBA; ACP; TNC; MAPA33; MF; and CWCS.

Species and Conservation Levels

There are 33 species associated with non-calcareous moist forests, all 33 of which are included in our prioritization analysis for Puerto Rico, and 23 which are included in our USVI analysis (Table 4). Many of the same birds that inhabit Tabonuco and secondary wet forests also can be found in adjacent moist forest, though the patchier quality of this habitat is a limiting factor prohibiting species that require large blocks of intact forest cover. The White-necked Crow is a high priority species that was once commonly associated with moist forests and considered a valuable game

bird for the appealing taste of its flesh (Raffaele 1989). Although the Crow has been extirpated from the region since 1963 due to habitat destruction and other pressures, it remains a candidate for potential reintroduction. The White-crowned Pigeon also uses lower elevation moist forests adjacent to coastal swamps, where it occurs very locally due to similar declines from hunting and loss of habitat (Oberle 2006). The Puerto Rican Parrot, Plain Pigeon, and Puerto Rican Nightjar are believed to have inhabited extensive portions the non-calcareous moist forest areas flanking the Central Cordillera and Luquillo Mountains, although the current ranges of these species ranges have been restricted.

Significant portions of the ranges of important native species such as the Black-whiskered Vireo and Antillean Euphonia overlap with non-calcareous moist forest habitat, as do those of many local endemics such as the Green Mango, Puerto Rican Emerald, Puerto Rican Lizard-Cuckoo, Screech-Owl, Spindalis, and Tody. These species have almost certainly benefited from the 20th century decline in agriculture and reversion of forest cover to low and mid-elevation hills throughout the region. Among the Neotropical migrants that winter in the region, non-calcareous moist forest habitat is particularly important for the Northern Parula. Predation of many species by the Pearly-eyed Thrasher and Red-tailed Hawk is of concern in this habitat and throughout the region and deserves management attention to control populations.

Non-calcareous moist forest species are ranked according to the following conservation levels:

PUERTO RICO

- TIER I
 - 2 Critical Recovery (or CX) species
 - White-crowned Pigeon (*Patagioenas leucocephala*)
 - White-necked Crow (*Corvus leucognaphalus*)
- TIER II
 - 14 Planning and Responsibility species
 - Antillean Euphonia (*Euphonia musica*)
 - Black-whiskered Vireo (*Vireo altiloquus*)
 - Gray Kingbird (*Tyrannus dominicensis*)
 - Green Mango (*Anthracothorax viridis*)
 - Northern Parula (*Parula americana*)
 - Puerto Rican Bullfinch (*Loxigilla portoricensis*)
 - Puerto Rican Emerald (*Chlorostilbon maugaeus*)
 - Puerto Rican Lizard-Cuckoo (*Coccyzus vieilloti*)
 - Puerto Rican Screech-Owl (*Megascops nudipes*)
 - Puerto Rican Spindalis (*Spindalis portoricensis*)
 - Puerto Rican Tody (*Todus mexicanus*)

- Puerto Rican Woodpecker (*Melanerpes portoricensis*)
- Red-legged Thrush (*Turdus plumbeus*)
- Zenaida Dove (*Zenaida aurita*)

- TIER III
 - None

- TIER IV
 - 10 Planning and Responsibility species
 - American Kestrel (*Falco sparverius*)
 - American Redstart (*Setophaga ruticilla*)
 - Antillean Crested Hummingbird (*Orthorhyncus cristatus*)
 - Bananaquit (*Coereba flaveola*)
 - Bridled Quail-Dove (*Geotrygon mystacea*)
 - Cape May Warbler (*Setophaga tigrina*)
 - Green-throated Carib (*Eulampis holosericeus*)
 - Mourning Dove (*Zenaida macroura*)
 - White-winged Dove (*Zenaida asiatica*)

- TIER V
 - 2 Generic Population Control/Suppression species
 - Pearly-eyed Thrasher (*Margarops fuscatus*)
 - Shiny Cowbird (*Molothrus bonariensis*)
 - 1 Local Population Control species
 - Red-tailed Hawk (*Buteo jamaicensis*)

- NO TIER
 - 4 species not requiring further conservation action
 - Chestnut-sided Warbler (*Lonchura malacca*)
 - Hooded Warbler (*Wilsonia citrine*)
 - Kentucky Warbler (*Geothlypis formosus*)
 - Ovenbird (*Seiurus aurocapillus*)

US VIRGIN ISLANDS

- TIER I
 - 2 Critical Recovery (or CX) species
 - Puerto Rican Screech-Owl (*Megascops nudipes newtoni*)
 - White-necked Crow (*Corvus leucognaphalus*)
 - 2 Immediate Management species
 - Bridled Quail-Dove (*Geotrygon mystacea*)

- White-crowned Pigeon (*Patagioenas leucocephala*)
- 1 Management Attention species
 - Hooded Warbler (*Wilsonia citrine*)
- TIER II
 - None
- TIER III
 - None
- TIER IV
 - 11 Planning and Responsibility species
 - American Kestrel (*Falco sparverius*)
 - American Redstart (*Setophaga ruticilla*)
 - Antillean Crested Hummingbird (*Orthorhyncus cristatus*)
 - Bananaquit (*Coereba flaveola*)
 - Black-whiskered Vireo (*Vireo altiloquus*)
 - Cape May Warbler (*Setophaga tigrina*)
 - Mourning Dove (*Zenaida macroura*)
 - Northern Parula (*Parula americana*)
 - Ovenbird (*Seiurus aurocapillus*)
 - White-winged Dove (*Zenaida asiatica*)
 - Zenaida Dove (*Zenaida aurita*)
- TIER V
 - 2 Generic Population Control/Suppression species
 - Green-throated Carib (*Eulampis holosericeus*)
 - Pearly-eyed Thrasher (*Margarops fuscatus*)
- NO TIER
 - 5 species not requiring further conservation action
 - Chestnut-sided Warbler (*Lonchura malacca*)
 - Gray Kingbird (*Tyrannus dominicensis*)
 - Kentucky Warbler (*Geothlypis formosus*)
 - Yellow-rumped Warbler (*Calidris fuscicollis*)
 - Yellow-throated Warbler (*Setophaga dominica*)

Recommended Actions and Strategies

- Conserve new habitat area and establish inter-reserve corridor linkages in areas listed above;
- Expand private lands and public engagement initiatives – Safe Harbor Program, shade grown coffee incentives via Partners for Fish and Wildlife;
- Develop guidelines and sustainable agricultural practices (e.g., soil conservation, riparian buffers) that benefit wildlife and help in the development of biological corridors between natural areas;
- Develop guidelines for adaptive management forestry practices that encourage complex canopy structure, good understory development, and fleshy-fruited shrubs and trees;
- Consider reintroduction of extirpated species;
- Conduct monitoring surveys and community level research on endemic species;
- Further investigate and quantify effects of native birds and exotic predators (e.g., Shiny Cowbird, Pearly-eyed Thrasher, mongoose, rats, monkeys) on breeding populations; determine areas where control measures would be most effective in stabilizing vulnerable populations;
- Conduct research regarding population status and habitat requirements of Neotropical migrant species;
- Support strategic partnerships for refuge management, conservation education, land use zoning/planning and habitat protection, community outreach, and ecotourism.

DRY LIMESTONE FORESTS (BOTH PUERTO RICO AND USVI) AND SERPENTINE FORESTS (PUERTO RICO ONLY)

Ecology and Habitat Status

Dry limestone forests are found at low to mid elevations on the south and southwest coasts of Puerto Rico and Primarily on St. Croix in the USVI. As with moist limestone forests, this habitat type is characterized by a calcareous substrate. However, annual rainfall is much lower than in moist habitats, ranging from 600-1100 mm (Ewel and Whitmore 1973), and seasonal patterns of growth and reproduction are synchronized with the availability of water (Ewel and Whitmore 1973, PRCCC 2013b). Excessive drainage of coralline substrates accentuates dry conditions producing unique habitat conditions, including tree and plant species associations better adapted to a xeric environment. Compared with wet forests, dry forests are less complex floristically and structurally (PRCCC 2013b), and are typified by sclerophyllous vegetation that rises up to about 15-20 m in height and has sparse tree crowns (Birdsey and Weaver 1982). Open woodland and semi-deciduous scrubland predominate on rocky outcrops and ridges. Transitioning downslope to the gullies of seasonal waterways and perennial alluvial channels, deeper mesic soils and semi-evergreen associations with closed canopies prevail. In human-modified transitional zones between tropical dry and moist forest habitat, the vegetation more closely resembles savanna woodland with extensive

grass cover and tall, spreading trees distributed sparsely throughout the landscape. Extremely harsh conditions in some coastal areas, resulting from thin soils and excessive wind drying, have given rise to dwarf shrubland communities with many close-growing small stems and limited accumulation of organic debris (Ewel and Whitmore 1973). The Guánica Commonwealth Forest in Puerto Rico has been declared a Biosphere Reserve by the United Nations and noted as one of the best extant examples of subtropical dry forest in the world.

The subtropical dry forest in the region as a whole, including dry limestone forest, has experienced significant fragmentation and land use conversion. In the past, many natural dry forest habitats were cleared for charcoal production, and the land converted to pasture. With the advances of irrigation technologies in Puerto Rico in the 1950s, commercial agriculture became feasible on these lands as well (Ewel and Whitmore 1973). At present, rural and urban human development pressures pose the greatest threat to dry limestone areas in both Puerto Rico and the USVI (Helmer 2004). Additional threats anticipated in coming decades include competition from exotic species and wildfires (PRCCC 2013b), the latter of which are reported to be increasing in the insular Caribbean in dry forest ecosystems for a variety of natural and anthropogenic reasons (Marcus et al. 2008). Anticipated consequences of a warming climate are also of concern. Decreasing moisture availability and increasing concentrations of carbon dioxide could lead to shifts in reproductive phenology and species composition (Cuevas 1995). Meir and Pennington (2011), for instance, reported that the major cause of mortality in seasonally dry forests is hydraulic failure. If seed regeneration is diminished by changes in the seasonality of precipitation, it is probable that regeneration by vegetative sprouting will increase (Murphy and Lugo 1986). Taken together, alterations in species assemblages and successional pathways will affect the breeding success of avian species that depend on fruiting and flowering resources, such as frugivorous birds (Faaborg 1982, Faaborg and Arendt 1992, Dugger et al. 2000, Wiewel 2011, PRCCC 2013b).

Serpentine substrates (which are absent in the USVI), are derived from ultramafic rocks rich in heavy metals, and provide another unique edaphic setting which results in unique vegetative composition with a rich woody flora rich in endemic species (Ewel and Whitmore 1973, Birdsey and Weaver 1982, Miller and Lugo 2009). Serpentine forests straddle the transition zone between subtropical moist and dry lifezones in southwestern Puerto Rico, spanning broad gradients of elevation and precipitation. However, overall serpentine habitats are similar to dry limestone habitat in terms of excessively drained soils and forest structure (Personal communication, W. Gould, US Forest Service 2013). Trees in this habitat type have slender, open-crowns, usually less than 12 m tall, with evergreen and sclerophyllous leaves (Ewel and Whitmore 1973, Birdsey and Weaver 1982). Serpentine forests are geographically limited to Puerto Rico in the Maricao and Susua Commonwealth Forests and, given their conserved status, are fairly well buffered from development pressures. Nevertheless, the reproductive consequences of changing climate patterns are likely to affect serpentine forest communities and bird populations in ways parallel to those of nearby dry limestone habitats.

In Puerto Rico dry limestone and serpentine forest habitat together comprises a

total area of 29,885 ha (about 3.3% of the island), with 37% classified as stewardship class 1, 2, or 3. In the USVI, there are 1,693 ha (about 5% of the land area) of dry limestone forest, 11% of which is conserved. Thus the 15% objective is already met for Puerto Rico, yet another 71 ha are lacking in the USVI. When this habitat is considered at the regional scale for Puerto Rico and the USVI together there are 31,578 ha, 36% of which is conserved, surpassing the 15% objective (Tables 6a, 6b, and 6c).

Designated stewardship areas that contain dry limestone and serpentine forest habitat:

Puerto Rico

- Boquerón Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Boquerón Wildlife Refuge (Dept. of Natural and Environmental Resources);
- Cabo Rojo National Wildlife Refuge (US Fish and Wildlife Service);
- Cajo de Muertos Island Natural Reserve (Dept. of Natural and Environmental Resources);
- Cerro Las Mesas (Puerto Rico Conservation Trust);
- Guánica Commonwealth Forest (Dept. of Natural and Environmental Resources);
- La Parguera Natural Reserve (Puerto Rico Conservation Trust);
- Las Cuevas El Convento Natural Protected Area (Puerto Rico Conservation Trust);
- Laguna Cartagena National Wildlife Refuge (US Fish and Wildlife Service);
- Maricao Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Mona and Monita Island Natural Reserve (Dept. of Natural and Environmental Resources);
- Montes Oscuros Conservation Easement (Puerto Rico Conservation Trust);
- Punta Ballenas Natural Reserve (Puerto Rico Conservation Trust);
- Punta Cucharas Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Guaniquilla Natural Reserve (Puerto Rico Conservation Trust);
- Susúa Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Vieques Bioluminescent Bay Natural Reserve (Dept. of Natural and Environmental Resources);
- Vieques National Wildlife Refuge (US Fish and Wildlife Service).

US Virgin Islands

St. Thomas

- Magen's Bay Preserve (USVI Government and The Nature Conservancy);
- Outer Brass Island Wildlife Sanctuary (USVI Government);

St. John

- US Virgin Islands National Park (US National Park Service);

St. Croix

- Buck Island Reef National Monument (US National Park Service);
- Estate Little Princess (The Nature Conservancy);
- Estate Thomas (US Forest Service);
- Estate Whim (St. Croix Landmarks Society);
- Green Cay National Wildlife Refuge (US Fish and Wildlife Service);
- Protestant Cay Wildlife Sanctuary (USVI Government);
- Ruth Cay Wildlife Sanctuary (USVI Government);
- Salt River Bay National Historic Park and Ecological Preserve (USVI Government and US National Park Service);
- Sandy Point National Wildlife Refuge (US Fish and Wildlife Service);
- Sion Ridge Area (US National Park Service);
- University of the Virgin Islands Wetlands (USVI Government).

Additional habitat conservation opportunities

There is substantial opportunity for forest regeneration in dry limestone environments. An important conservation opportunity for this habitat type in Puerto Rico is to pursue efforts that protect and restore lands in the municipalities of Sabana Grande and Yauco, effectively linking the Guánica and Susúa Commonwealth Forests and continuing northwest to the southern edge of Maricao Commonwealth Forest. A second opportunity is to work eastward on private lands from Guánica towards the Guayanilla Hills, building around the core areas of Las Cuevas el Convento Natural Area. Throughout the Lajas Valley and along the southwestern coast from Guánica to Cabjo Rojo are multiple fragments of dry forest, some already conserved, that could be expanded and linked to create more contiguous habitat; one area in particular to consider is the Guánica Lagoon Critical Wildlife Area.

In the USVI, the majority of dry forest habitat is located in the central hills of St. Croix, west and southwest of Christiansted. Opportunities for habitat conservation include private lands to the south of Estate Clairmont Park and Salt River Bay National Historic Park and Ecological Preserve, and around Estate Thomas and the University of the Virgin Islands Wetlands. In the southwestern corner of the island is another area of dry forest habitat directly adjacent to Sandy Point National Wildlife Refuge and surrounding Estate Whim, portions of which are worthy of consideration for avian conservation purposes. On St. Thomas, there is a small sliver of dry forest habitat extending along Mohogany Run Road on the northern flank of the island, east of Magen's Bay Preserve, the majority of which is unprotected and exposed to fragmentation from urban development. On St. John, most of the dry forest habitat is already conserved within the US Virgin Islands National Park.

These suggestions align with focal area spatial data from CWA; IBA; WFA; ACP; TNC; MAPA33; MF; and CWCS.

Species and Conservation Levels

There are 39 species associated with dry limestone and serpentine forests, with 36 species included in our Puerto Rico analysis, and 23 in our USVI analysis (Table 4). Dry limestone and serpentine forest habitats are home to a broad suite of forest birds, including many restricted range species and at least ten island endemics. Most of the known population of the Critically Endangered Puerto Rican Nightjar survives in the Guánica Commonwealth Forest and adjacent areas. This species requires continuous canopy forest with relatively low development of midstory and understory vegetation (Vilella and Zwank 1993, Vilella 1995). Historically, the species inhabited moist coastal forest that extended to the humid slopes of the central karst region (Wetmore 1919). Studies by Kepler and Kepler (1973) and subsequently by Vilella and Zwank (1993) documented core population of the Nightjar in semi-deciduous and evergreen forested uplands and abandoned plantations in Guánica Forest, Susúa Forest and the Guayanilla Hills region. More recently, updated information on population status, geographic distribution, and habitat requirements have been investigated by Vilella and Gonzalez (2009) and Gonzalez (2010). Some two-thirds of the predicted Nightjar habitat is found within the region encompassed by the municipalities of Guánica, Sabana Grande, Yauco, Guayanilla, Peñuelas and Ponce, with smaller fragments of habitat distributed from Mayagüez south to Cabo Rojo and the Sierra Bermeja, and along the southern coast of the island eastward to Guayama. A considerable proportion of the habitat occupied by Puerto Rican Nightjars (>80%) is under private ownership and is susceptible to changes in land use patterns (Gonzalez 2010, USFWS 2012).

Wiley (1979) studied the biology of White-crowned Pigeons on Mona, a carbonate island of the Puerto Rican archipelago with extensive dry forest habitat. The population of White-crowned Pigeons on Mona is one of the largest found throughout the region, and may include several thousand individuals (Rivera-Milán and Martínez 2012). On the Puerto Rican mainland there are at least another thousand individuals, and almost certainly many more, as it is capable of using coastal and inland habitats and even urban areas. Populations have been observed in the area of San Germán-Hormigueros-Mayagüez in the west, in the northern karst zone, in Loíza (Piñones) in the northeast, and in the Naguabo-Ceiba area on the eastern part of the island. Sporadic records have been recently reported from Cidra and Comerío as well as Guayama (Personal communication, A. Martínez, PRDNER 2013). Still, the White-crowned Pigeon is a species of relatively low numbers with a sparse distribution pattern that requires more data and scrutiny. The distribution of the species suggests that isolation and reduction on hunting pressures are the most important factors determining habitat use and may be responsible for the abundance of the species on Mona. It is possible that dry forests on the Puerto Rican mainland would also function as optimal habitats for the White-crowned Pigeon.

Another high priority species that persists in the forests of Mona Island is the Yellow-shouldered Blackbird, with an estimated population of some 260 individuals (Birdlife International 2008). Differences in nesting habitat and foraging behavior have led some biologists to believe that the population of Yellow-shouldered Blackbirds in Mona may be a separate subspecies from populations on Puerto Rico proper. On Mona, the Yellow-shouldered Blackbird nests in cliff holes and cavities, rather than open mangroves and scrubland trees. Although isolated, this population appears to benefit by the possible inability of Shiny Cowbirds to become established in relevant numbers on the island.

Dry forest may be prime habitat for the Puerto Rican Vireo. However, both Faaborg et al. (1997) and Woodworth et al. (1998) reported frightening declines of the Puerto Rican Vireo population in the Guánica Commonwealth Forest. The high incidence of cowbird nest parasitism may be responsible for the decline of this species. Data Collected by Wiley (1982, 1984, 1985), Wiley et al. (1983), Perez-Rivera (1986), and Nuñez-García (1988) indicated that the nest success was reduced for several species breeding in mangrove as well as interior forest habitats because of heavy cowbird nest parasitism. Additional native species possibly undergoing declines in the Guánica dry forest habitat due to cowbird parasitism are Black-whiskered Vireos and Puerto Rican Flycatchers (Faaborg et al. 1997). Most ecological processes occurring in the forest reserves are determined in part by external factors outside of their socio-political boundaries. For example, the increase in cowbird parasitism may have little to do with local habitat stability in the Guánica dry forest, but rather with overall regional landscape changes. Therefore, biological interactions, perhaps promoted by past and present land management practices that generated novel communities and permitted the establishment of Shiny Cowbirds in the surrounding countryside of southwestern Puerto Rico, may render the otherwise excellent Guánica forest habitat a sink for these and other species parasitized by cowbirds (Cruz et al. 1985, Woodworth 1999).

Migrant species might also be affected by changing ecological patterns in dry forest habitats. Faaborg and Arendt (1992) described population fluctuations and declines of some winter resident warblers in the Guánica forest. Their data collected in the same locations over a period of 18 years revealed constant population declines of Northern Parulas and Prairie Warblers. Analyzing and comparing population patterns of native and migratory species, the researchers concluded that factors outside of the wintering areas (i.e., overall declines, local declines on the breeding grounds, or shifts in wintering ranges) are responsible for the declines of Northern Parulas and Prairie Warblers in the Guánica Forest. The authors also pointed out the need for more information on ecological factors affecting migrant populations in both wintering and breeding areas in order to inform adequate bird conservation planning.

Dry limestone and serpentine forest species are classified into the following conservation levels:

PUERTO RICO

- TIER I

- 3 Critical Recovery (or CX) species
 - Puerto Rican Nightjar (*Caprimulgus noctitherus*)
 - White-crowned Pigeon (*Patagioenas leucocephala*)
 - Yellow-shouldered Blackbird (*Agelaius xanthomus*)
- 2 Immediate Management species
 - Puerto Rican Vireo (*Vireo latimeri*)
 - White-cheeked Pintail (*Anas bahamiensis*)
- 2 Management Attention species
 - Key West Quail-Dove (*Geotrygon chrysia*)
 - Yellow (Golden) Warbler (*Setophaga petechia*)
- 4 Planning and Responsibility species
 - Adelaide's Warbler (*Setophaga adelaidae*)
 - Lesser Antillean Pewee (*Contopus latirostris*)
 - Mangrove Cuckoo (*Coccyzus minor*)
 - Prairie Warbler (*Setophaga discolor*)
- TIER II
 - 15 Planning and Responsibility species
 - Antillean Euphonia (*Euphonia musica*)
 - Black-whiskered Vireo (*Vireo altiloquus*)
 - Caribbean Elaenia (*Elaenia martinica*)
 - Gray Kingbird (*Tyrannus dominicensis*)
 - Northern Parula (*Parula americana*)
 - Puerto Rican Bullfinch (*Loxigilla portoricensis*)
 - Puerto Rican Emerald (*Chlorostilbon maugaeus*)
 - Puerto Rican Flycatcher (*Myiarchus antillarum*)
 - Puerto Rican Lizard-Cuckoo (*Coccyzus vieilloti*)
 - Puerto Rican Screech-Owl (*Megascops nudipes*)
 - Puerto Rican Spindalis (*Spindalis portoricensis*)
 - Puerto Rican Tody (*Todus mexicanus*)
 - Puerto Rican Woodpecker (*Melanerpes portoricensis*)
 - Red-legged Thrush (*Turdus plumbeus*)
 - Zenaida Dove (*Zenaida aurita*)
- TIER III
 - None
- TIER IV
 - 6 Planning and Responsibility species
 - American Kestrel (*Falco sparverius*)
 - American Redstart (*Setophaga ruticilla*)

- Antillean Crested Hummingbird (*Orthorhyncus cristatus*)
- Bananaquit (*Coereba flaveola*)
- Mourning Dove (*Zenaida macroura*)
- Yellow-billed Cuckoo (*Coccyzus americanus*)
- TIER V
 - 2 Generic Population Control/Suppression species
 - Pearly-eyed Thrasher (*Margarops fuscatus*)
 - Shiny Cowbird (*Molothrus bonariensis*)
 - 1 Local Population Control species
 - Red-tailed Hawk (*Buteo jamaicensis*)
- NO TIER
 - 1 species not requiring further conservation action
 - Ovenbird (*Seiurus aurocapillus*)

US VIRGIN ISLANDS

- TIER I
 - 2 Critical Recovery (or CX) species
 - Puerto Rican Flycatcher (*Myiarchus antillarum*)
 - Puerto Rican Screech-Owl (*Megascops nudipes newtoni*)
 - 1 Immediate Management species
 - White-crowned Pigeon (*Patagioenas leucocephala*)
 - 1 Management Attention species
 - Yellow (Golden) Warbler (*Setophaga petechia*)
 - 3 Planning and Responsibility species
 - Mangrove Cuckoo (*Coccyzus minor*)
 - Prairie Warbler (*Setophaga discolor*)
 - White-cheeked Pintail (*Anas bahamiensis*)
- TIER II
 - 1 Planning and Responsibility species
 - Black-whiskered Vireo (*Vireo altiloquus*)
- TIER III
 - 1 Planning and Responsibility species
 - Lesser Antillean Bullfinch (*Loxigilla noctis*)
- TIER IV
 - 10 Planning and Responsibility species

- American Kestrel (*Falco sparverius*)
- American Redstart (*Setophaga ruticilla*)
- Antillean Crested Hummingbird (*Orthorhyncus cristatus*)
- Bananaquit (*Coereba flaveola*)
- Caribbean Elaenia (*Elaenia martinica*)
- Mourning Dove (*Zenaida macroura*)
- Northern Parula (*Parula americana*)
- Ovenbird (*Seiurus aurocapillus*)
- Yellow-billed Cuckoo (*Coccyzus americanus*)
- Zenaida Dove (*Zenaida aurita*)

- TIER V
 - 1 Generic Population Control/Suppression species
 - Pearly-eyed Thrasher (*Margarops fuscatus*)

- NO TIER
 - 3 species not requiring further conservation action
 - Blue-winged Warbler (*Vermivora pinus*)
 - Gray Kingbird (*Tyrannus dominicensis*)
 - Yellow-billed Cuckoo (*Coccyzus americanus*)

Recommended Actions and Strategies

- Conserve new habitat area and establish inter-reserve corridor linkages in areas listed above;
- Expand private lands and public engagement initiatives – Safe Harbor Program;
- Develop guidelines and sustainable agricultural practices (e.g., soil conservation, riparian buffers) that benefit wildlife and help in the development of biological corridors between natural areas;
- Develop guidelines for adaptive management forestry practices that encourage complex canopy structure, good understory development, and fleshy-fruited shrubs and trees;
- Consider reintroduction of extirpated species;
- Conduct monitoring surveys and community level research on endemic species;
- Further investigate and quantify effects of native birds and exotic predators (e.g., Shiny Cowbird, Pearly-eyed Thrasher, mongoose, rats, monkeys) on breeding populations; determine areas where control measures would be most effective in stabilizing vulnerable populations;
- Conduct research regarding population status and habitat requirements of Neotropical migrant species;

- Support strategic partnerships for refuge management, conservation education, land use zoning/planning and habitat protection, community outreach, and ecotourism.

NON-CALCAREOUS LOWLAND AND COASTAL DRY FORESTS

Ecology and Habitat Status

Non-calcareous dry coastal forest habitat is found on volcanic and alluvial substrates on all of the USVI. In Puerto Rico the forest occurs in the northeastern corner in Fajardo, in the foothills of the Central Cordillera in the south-central part of the island, in close proximity to low elevation dry limestone habitats in the southwest, and throughout extensive areas of Vieques and Culebra islands. Rainfall patterns are very similar to those in dry limestone areas (600-1100 mm yr⁻¹), that is to say water is a limiting ecological factor, with a predominant dry period occurring during the winter months. The relatively short vegetation is primarily deciduous, and typically has sparse, spreading crowns and small succulent or leathery leaves. Many species possess thorns or spines and produce hard and durable wood (Ewel and Whitmore 1973, PRCCC 2013b).

Plantations of introduced tree species are a small but important component of lowland dry forest settings in Puerto Rico and the USVI. Mahogany (*Swietenia mahogany*), Caribbean pine (*Pinus caribaea*), and eucalyptus (*Eucalyptus robusta*) have been extensively planted. In Puerto Rico, small plantings of monocultures are dispersed throughout the island on private lands, many of them promoted by government incentives (Birdsey and Weaver 1982, Franco et al. 1997). Both monocultures and intermixed plantings that include other exotic and native species are associated with public forests (Birdsey and Weaver 1982, Francis 1995, Brandeis 2007). Mahogany trees have been extensively planted in the USVI, particularly in Saint Thomas and Saint Croix (Francis 2003, Weaver 2006).

Predominant threats in the dry coastal forest zone also resemble the challenges facing dry limestone habitats. These include fragmentation from agriculture and grazing, fire, introduced species, alterations in flowering and fruiting phenology, successional regeneration pathways, and changes in species assemblages due to moisture availability, and land use conversion for human developments (Ewel and Whitmore 1973, Helmer 2004, PRCCC 2013b). With the lack of an active silviculture market in the region, there are few threats to the stands of plantation trees, and their eventual evolution into mixed assemblages of introduced and native species will likely have more benefits than drawbacks for the avifaunal community.

Another important factor to consider is the rise in sea level that is projected to accompany increased global temperatures associated with climate change, and the effects this will have on coastal dry forest habitat. One anticipated outcome of rising seas and mutable coastal morphology is that mangroves will successfully accrete peat and migrate inland (where human infrastructure is not a barrier), thereby encroaching

on dry forest habitat (McKee et al. 2007, Kerr 2009, Blunden et al. 2011, McKee 2011). If dry forest does not expand into new areas at the same rate it is converted to estuarine habitats, native and migratory birds that rely on dry forest for breeding and overwintering could be at risk (PRCCC 2013b). Rodríguez-Colón (2012), for example, studied North American migrant songbirds that depend on interconnected mangrove and dry forest habitat in Puerto Rico's southern coastal region of Jobos Bay National Estuarine Research Reserve, concluding that these populations will be jeopardized by sea level rise if dry forest habitat is reduced, degraded, or eliminated. Avian populations in other coastal dry forest areas in Puerto Rico may face a similar threat, resulting in compromised reproduction and overwintering survival (Rice et al. 2007, Lombard et al. 2010, Jacobs et al. 2012a, 2012b).

In Puerto Rico, non-calcareous lowland and coastal dry forest comprises 30,756 ha (about 3.4% of the total island), with 27% of the land area classified as stewardship class 1, 2, or 3. Dry forest occupies about 13,795 ha of the USVI (39% of the land area), 18% of which is conserved. For the whole region, 44,550 ha are included in this habitat type, 24% of which is protected. The 15% objective is therefore met for all Puerto Rico, the USVI, and the region (Tables 6a, 6b, and 6c). However, this is a relatively rare and vulnerable habitat type, particularly in Puerto Rico, and a higher conservation target is recommended.

Designated stewardship areas that contain non-calcareous lowland and coastal dry forest habitat:

Puerto Rico

- Aguirre Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Boquerón Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Boquerón Wildlife Refuge (Dept. of Natural and Environmental Resources);
- Cabo Rojo National Wildlife Refuge (US Fish and Wildlife Service);
- Caja de Muertos Island Natural Reserve (Dept. of Natural and Environmental Resources);
- Ceiba Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Desecheo National Wildlife Refuge (US Fish and Wildlife Service);
- Culebra National Wildlife Refuge (US Fish and Wildlife Service);
- El Buey National Wildlife Refuge (Puerto Rico Conservation Trust);
- Guánica Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Jobos Bay Estuary National Research Reserve (Dept. of Natural and Environmental Resources and National Oceanic and Atmospheric Administration);
- La Cordillera Reef Natural Reserve (Dept. of Natural and Environmental Resources);
- Laguna Cartagena National Wildlife Refuge (US Fish and Wildlife Service);

- La Parguera Natural Reserve (Puerto Rico Conservation Trust),
- Las Cabezas de San Juan Natural Reserve (Puerto Rico Conservation Trust);
- Medio Mundo and Daguao Natural Protected Area (Puerto Rico Conservation Trust);
- Mona and Monita Island Natural Reserve (Dept. of Natural and Environmental Resources);
- Montes Oscuras Natural Reserve (Puerto Rico Conservation Trust);
- Palmas del Mar Tropical Forest Conservation Easement (Puerto Rico Conservation Trust);
- Punta Ballenas Natural Reserve (Puerto Rico Conservation Trust);
- Punta Cucharas Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Cucharas Natural Reserve Marine Extension (Dept. of Natural and Environmental Resources);
- Punta Guaniquilla Natural Reserve (Puerto Rico Conservation Trust);
- Punta Petrona Natural Reserve (Dept. of Natural and Environmental Resources);
- Seven Seas Natural Reserve (Dept. of Natural and Environmental Resources);
- Sun Bay National Park (Puerto Rico National Parks Company);
- Vieques Bioluminescent Bay Natural Area (Dept. of Natural and Environmental Resources);
- Vieques National Wildlife Refuge (US Fish and Wildlife Service).

US Virgin Islands

St. Thomas

- Bovoni Cay Wildlife Sanctuary (USVI Government);
- Buck Island National Wildlife Refuge (US Fish and Wildlife Service);
- Capella Island Wildlife Sanctuary (USVI Government);
- Cas Cay Wildlife Sanctuary (USVI Government);
- Cockroach Cay Wildlife Sanctuary (USVI Government);
- Dutchcap Cay Wildlife Sanctuary (USVI Government);
- Fairchild Park (USVI Government);
- Flat Cay Wildlife Sanctuary (USVI Government);
- Frenchcap Cay Wildlife Sanctuary (USVI Government);
- Kalkun Cay Wildlife Sanctuary (USVI Government);
- Leduck Island Wildlife Sanctuary (USVI Government);
- Magen's Bay Preserve (USVI Government and The Nature Conservancy);
- Outer Brass Island Wildlife Sanctuary (USVI Government);
- Saba Island Wildlife Sanctuary (USVI Government);
- Salt Cay Wildlife Sanctuary (USVI Government);

- Savana Island Wildlife Sanctuary (USVI Government);
- Shark Island Wildlife Sanctuary (USVI Government);
- Smith Bay Park (USVI Government);
- Spratt Bay Estates (The Nature Conservancy);
- Turtledove Cay Wildlife Sanctuary (USVI Government);
- West Cay Wildlife Sanctuary (USVI Government);

St. John

- Booby Rock Wildlife Sanctuary (USVI Government);
- Congo Cay Wildlife Sanctuary (USVI Government);
- Coral Bay Preserve (The Nature Conservancy);
- Dog Island Wildlife Sanctuary (USVI Government);
- Flanagan Island Wildlife Sanctuary (USVI Government);
- Frank Bay Marine Reserve and Wildlife Sanctuary (USVI Government);
- Grass Cay Wildlife Sanctuary (USVI Government);
- Steven Cay Wildlife Sanctuary (USVI Government);
- US Virgin Islands National Park (US National Park Service);
- Whistling Cay Wildlife Sanctuary (USVI Government);

St. Croix

- Altona Lagoon Beach Recreation Area (USVI Government);
- Buck Island Reef National Monument (US National Park Service);
- Butler Bay Conservation Easement and Butler Bay Nature Preserve (St. Croix Landmarks Society);
- Caledonia Gut (USVI Government);
- Creque Dam (USVI Government);
- Derick O. Steinmann Memorial Beach (St. Croix Environmental Association);
- East Bay and Point Udall (USVI Government);
- East End Marine Park (USVI Government);
- Estate Adventure Nature Trail (USVI Government);
- Estate Clairmont Park (St. Croix Landmarks Society);
- Estate Great Pond (USVI Government);
- Estate Little La Grange (St. Croix Landmarks Society);
- Estate Little Princess (The Nature Conservancy);
- Estate Mount Washington Bird Sanctuary (St. Croix Landmarks Society);
- Estate Thomas (US Forest Service);
- Estate Whim (St. Croix Landmarks Society);
- Fairleigh Dickinson Territorial Park (USVI Government);
- Herman Hill Pond (The Nature Conservancy);
- Jack and Isaacs Bays Preserve (The Nature Conservancy);
- Long Point Bay (The Nature Conservancy);

- Manning Bay Wetlands (USVI Government);
- Salt River Bay National Historic Park and Ecological Preserve (USVI Government and US National Park Service);
- Sandy Point National Wildlife Refuge (US Fish and Wildlife Service);
- Sion Ridge Area (US National Park Service);
- Southgate Coastal Preserve (St. Croix Environmental Association);
- University of the Virgin Islands (USVI Government).

Additional habitat conservation opportunities

Primary conservation opportunities for non-calcareous lowland and coastal dry forest include private lands in the foothills along the southern flank of the Central Cordillera from the eastern edge of Ponce over to Guayama. The most extensive and connected tracts of this forest habitat are situated in Coamo and Salinas within and around the Montes Oscuros Natural Reserve Camp that abuts Santiago Military Reservation. There is presently a relative paucity of conserved habitat within this part of the island, yet there is potential to create habitat linkages with non-calcareous moist and secondary wet forest habitats in the Central Cordillera to the northwest and north and the Cayey Mountains to the east, through the generation of wildlife corridors from Montes Oscuros to Toro Negro, San Cristobal Canyon, and Carite Commonwealth Forests. Another opportunity is to connect non-calcareous dry forest habitat along the Sierra La Bermeja in the southwest by linking the Cabo Rojo and Laguna Cartagena National Wildlife Refuges and La Parguera Natural Reserve. On the northern side of the Lajas Valley is another band of this habitat that is completely unprotected; however, because it resides along the Route 2 traffic corridor it is of lesser quality from a conservation perspective due to fragmentation. In the northeastern part of the island, extensive coastal urbanization inhibits creating truly connected corridors, but there are opportunities to conserve coastal dry forest around existing stewardship areas such as the Seven Seas Natural Area and Las Cabezas de San Juan Natural Reserve in Fajardo, the Ceiba Commonwealth Forest, and the Medio Mundo y Daguao Natural Protected Area (formerly part of Roosevelt Roads Naval Base). Virtually all of Culebra and more than half of Vieques is dry coastal forest, large portions of which are already protected. Additional conservation efforts could be focused in the largely undeveloped tract of land that spans the north coast of Vieques between the Vieques National Wildlife Refuge and the town of Isabel Segunda. In Culebra, there are conservation opportunities for this habitat type along the northwestern coast adjacent to various parcels of the Culebra National Wildlife Refuge, as well as on privately owned Cayo Norte.

Similar to Culebra and Vieques, the USVI is dominated by non-calcareous lowland and coastal dry forest, with a large portion protected in St. John's Virgin Islands National Park. On St. Thomas there are several scattered parcels of this habitat which reside within the boundaries of protected areas but they are not well connected, the largest being Magen's Bay Preserve. As with the adjacent moist forest habitat, the majority of dry forest communities on St. Thomas are situated on the rugged hills that dominate the center of the island, with human settlements surrounding on all sides in the flatter

coastal lowlands. The physiography itself is the primary factor that has prevented significant development of dry forest habitat thus far. Opportunities for additional conservation efforts in St. Thomas include the southern flank of Crown Mountain west along the Fortuna Road highlands of Fortuna, Klok, and Bordeaux Hills. On the eastern side of the island are unprotected habitat areas situated in the proximity of Flag, Nulliberg, and Langmath Hills. Large portions of Inner Brass, Hans Lollick, Thatch Cay, Mingo Cay, Lovango Cay, Great St. James Island, and Water Island also contain unprotected dry forest habitat. On St. Croix, this dry forest habitat is abundant on the northwestern hills and along the eastern tail of the island, with protected parcels highly dispersed in isolated stewardship areas. Concentrating conservation efforts around and between Butler Bay Nature Preserve and Conservation Easement, Estate Mount Washington Bird Sanctuary, Creque Dam, Caledonia Gut, and Estate Little La Grange in the west, and eastward across Mt. Eagle toward Estate Clairmont Park and Salt River Bay National Historic Park and Ecological Preserve would help connect dry and moist habitats along the western uplands. In the eastern part of the island are good habitat linkage opportunities from East End Marine Park westward across Propsect and Recovery Hills to Herman Hill Pod, and eastward across the ridgelines of Mt. Washington and Sugar Loaf Hill toward Jack and Isaacs Bays Preserve and Fairleigh Dickinson Territorial Park. St. John's non-calcareous lowland and coastal dry forest habitat is largely protected already within the US Virgin Islands National Park, but an additional opportunity exists on East End at Black Rock Hill.

These suggestions align with focal area spatial data from CWA; IBA; WFA; ACP; TNC; MAPA33; MF; and CWCS.

Species and Conservation Levels

Thirty-nine (39) species addressed in our prioritization analysis are associated with non-calcareous lowland and coastal dry forests, with 34 species represented in the Puerto Rico analysis, and 25 in the USVI (Table 4). The species associated with this habitat type overlap considerably with those found in dry limestone habitat and many of the comments discussed above apply here as well. Notable exceptions include endemics such as the Puerto Rican Nightjar and Flycatcher, which are more limited within dry coastal settings to carbonate substrates and areas dominated by grasslands/shrublands. In turn, a few winter winter migrants including Yellow-rumped and Yellow-throated Warblers prefer dry forest and coastal scrub habitat on volcanoclastic soils.

High priority species such as the Yellow-shouldered Blackbird and Puerto Rican Vireo face similar predation pressure from Shiny Cowbird parasitism as they do in dry limestone forests, and managing these species will require a landscape-level approach to controlling Cowbird populations. Moreover, if development, hunting, and predation pressures were to be relieved as they are on isolated locations like Mona Island it is possible that non-calcareous lowland coastal dry forests could serve as core habitat for restored populations of the White-crowned Pigeon.

Non-calcareous lowland and dry coastal forest species have been assigned the following conservation levels:

PUERTO RICO

- TIER I
 - 2 Critical Recovery (or CX) species
 - White-crowned Pigeon (*Patagioenas leucocephala*)
 - Yellow-shouldered Blackbird (*Agelaius xanthomus*)
 - 1 Immediate Management species
 - Puerto Rican Vireo (*Vireo latimeri*)
 - 1 Management Attention species
 - Key West Quail-Dove (*Geotrygon chrysia*)
 - 3 Planning and Responsibility species
 - Adelaide's Warbler (*Setophaga adelaidae*)
 - Antillean Nighthawk (*Chordeiles gundlachi*)
 - Mangrove Cuckoo (*Coccyzus minor*)

- TIER II
 - 14 Planning and Responsibility species
 - Antillean Euphonia (*Euphonia musica*)
 - Black-whiskered Vireo (*Vireo altiloquus*)
 - Caribbean Elaenia (*Elaenia martinica*)
 - Gray Kingbird (*Tyrannus dominicensis*)
 - Northern Parula (*Parula americana*)
 - Puerto Rican Bullfinch (*Loxigilla portoricensis*)
 - Puerto Rican Emerald (*Chlorostilbon maugaeus*)
 - Puerto Rican Lizard-Cuckoo (*Coccyzus vieilloti*)
 - Puerto Rican Screech-Owl (*Megascops nudipes*)
 - Puerto Rican Spindalis (*Spindalis portoricensis*)
 - Puerto Rican Tody (*Todus mexicanus*)
 - Puerto Rican Woodpecker (*Melanerpes portoricensis*)
 - Red-legged Thrush (*Turdus plumbeus*)
 - Zenaida Dove (*Zenaida aurita*)

- TIER III
 - None

- TIER IV
 - 9 Planning and Responsibility species
 - American Kestrel (*Falco sparverius*)
 - American Redstart (*Setophaga ruticilla*)

- Antillean Crested Hummingbird (*Orthorhyncus cristatus*)
- Bananaquit (*Coereba flaveola*)
- Bridled Quail-Dove (*Geotrygon mystacea*)
- Green-throated Carib (*Eulampis holosericeus*)
- Mourning Dove (*Zenaida macroura*)
- White-winged Dove (*Zenaida asiatica*)
- Yellow-billed Cuckoo (*Coccyzus americanus*)

- TIER V
 - 2 Generic Population Control/Suppression species
 - Pearly-eyed Thrasher (*Margarops fuscatus*)
 - Shiny Cowbird (*Molothrus bonariensis*)
 - 1 Local Population Control species
 - Red-tailed Hawk (*Buteo jamaicensis*)

- NO TIER
 - 1 species not requiring further conservation action
 - Ovenbird (*Seiurus aurocapillus*)

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- TIER I
 - 1 Critical Recovery (or CX) species
 - Puerto Rican Screech-Owl (*Megascops nudipes newtoni*)
 - 3 Immediate Management species
 - Antillean Nighthawk (*Chordeiles gundlachii*)
 - Bridled Quail-Dove (*Geotrygon mystacea*)
 - White-crowned Pigeon (*Patagioenas leucocephala*)
 - 1 Planning and Responsibility species
 - Mangrove Cuckoo (*Coccyzus minor*)

- TIER II
 - None

- TIER III
 - 1 Planning and Responsibility species
 - Lesser Antillean Bullfinch (*Loxigilla noctis*)

- TIER IV
 - 11 Planning and Responsibility species

- American Kestrel (*Falco sparverius*)
- American Redstart (*Setophaga ruticilla*)
- Antillean Crested Hummingbird (*Orthorhyncus cristatus*)
- Bananaquit (*Coereba flaveola*)
- Black-whiskered Vireo (*Vireo altiloquus*)
- Caribbean Elaenia (*Elaenia martinica*)
- Mourning Dove (*Zenaida macroura*)
- Northern Parula (*Parula americana*)
- Ovenbird (*Seiurus aurocapillus*)
- White-winged Dove (*Zenaida asiatica*)
- Zenaida Dove (*Zenaida aurita*)

- TIER V
 - 2 Generic Population Control/Suppression species
 - Green-throated Carib (*Eulampis holosericeus*)
 - Pearly-eyed Thrasher (*Margarops fuscatus*)

- NO TIER
 - 6 species not requiring further conservation action
 - Blue-winged Warbler (*Vermivora pinus*)
 - Gray Kingbird (*Tyrannus dominicensis*)
 - Yellow-billed Cuckoo (*Coccyzus americanus*)
 - Yellow-bellied Sapsucker (*Sphyrapicus varius*)
 - Yellow-rumped Warbler (*Calidris fuscicollis*)
 - Yellow-throated Warbler (*Setophaga dominica*)

Recommended Actions and Strategies

- Conserve new habitat area and establish inter-reserve corridor linkages in areas listed above;
- Expand private lands and public engagement initiatives – Safe Harbor Program;
- Develop guidelines and sustainable agricultural practices (e.g., soil conservation, riparian buffers) that benefit wildlife and help in the development of biological corridors between natural areas;
- Develop guidelines for adaptive management forestry practices that encourage complex canopy structure, good understory development, and fleshy-fruited shrubs and trees;
- Consider reintroduction of extirpated species;
- Conduct monitoring surveys and community level research on endemic species;
- Further investigate and quantify effects of native birds and exotic predators (e.g., Shiny Cowbird, Pearly-eyed Thrasher, mongoose, rats, monkeys) on breeding

populations; determine areas where control measures would be most effective in stabilizing vulnerable populations;

- Conduct research regarding population status and habitat requirements of Neotropical migrant species;
- Support strategic partnerships for refuge management, conservation education, land use zoning/planning and habitat protection, community outreach, and ecotourism.

FORESTED COASTAL WETLANDS

Ecology and Habitat Status

In the coastal zone, elevational and hydrologic gradients govern the distribution of vegetative communities. Coastal forested wetlands include mangrove swamps that are regularly flooded by salt or brackish water (PRCCC 2013b), and freshwater *Pterocarpus* swamps that are characterized by intermittently inundated soils produced when rivers overflow their banks and submerge low-lying alluvial valleys (Bacon 1990). We'll consider each of these forested wetlands in turn.

Mangrove Swamps. The plant families that are characteristic of mangrove swamps exhibit adaptive capacities that allow them to colonize and tolerate saline coastal environments (Field 1995, Miller and Lugo 2009). Four tree species dominate the mangrove habitats of Puerto Rico and the USVI: red mangrove (*Rizophora mangle*), black mangrove (*Avicenia germinans*), white mangrove (*Laguncularia racemosa*), and buttonwood (*Conocarpus erectus*). Red mangroves are usually found at land-water edges close to the sea, and the other species are typically found slightly farther inland. In both Puerto Rico and the USVI mangrove forests often form mixed associations characterized by large extensions of black mangrove on tidal-inundated wetlands surrounded by red mangrove (Lugo and Cintrón 1975, Miller and Lugo 2009, PRCCC 2013b). In most cases, mangrove forests are encircled by human development and various types of disturbed habitats including grasslands, shrubs, and successional stages between the two (Martinuzzi et al. 2009, PRCCC 2013b).

Martinuzzi et al. (2009) studied mangrove populations in Puerto Rico in relation to human influences over the course of the past 200 years, with an eye towards better understanding how to conserve and restore mangrove ecosystems. Mangrove extent has waxed and waned in association with changing land use patterns. Following periods of intense decline during the 19th and early 20th century era due to agricultural expansion and urban development projects in the 1960s, the legal protection of all Puerto Rican mangroves in 1972, and a fading sugar cane industry resulted in a significant expansion of mangrove area in recent decades. Through regulations and conservation efforts that have reduced habitat incursions and reinstated natural hydrological conditions, mangrove forest and shrubland throughout the Puerto Rican archipelago have increased to some 8,700 ha (Gould et al. 2008a, PRCCC 2013b). Overall, most of these increases have occurred at rural sites, many of them with some

degree of protective status, while mangrove extent in urban areas has generally stayed the same or declined slightly (Martinuzzi et al. 2009).

Despite this positive growth trend, the current extent of mangroves is significantly lower than the estimated 12,000 ha that existed at the time of European colonization (Martinuzzi et al. 2009, Miller and Lugo 2009), and mangrove forests continue to face challenges. Even with their protected status, there is some evidence to suggest that urbanization can negatively affect mangroves even in the absence of the conversion of large land areas (Lugo 1988). In urban and rural settings alike, the majority of mangroves already exist as small fragments less than 1 ha in size (Martinuzzi et al. 2009). Further fragmentation from roads and pollution resulting from development activities potentially pose serious problems for some mangrove habitats and the wildlife populations that use them, and certainly create additional obstacles for conservation (Lugo 1988, Martinuzzi et al. 2009). Excessive and uncontrolled recreational use of mangroves is also a threat that deserves attention from natural resource managers (Martinuzzi et al. 2009). Other stressors to this habitat include abnormal runoff from impervious surfaces, and the nutrients and sediment that come with it; wood-boring crustaceans that infest mangrove prop roots and weaken their structural support; and oil, which inhibits respiration by mangrove aerial prop roots (Miller and Lugo 2009).

Pollution of mangroves has more insidious but hard to document effects on the associated bird populations and communities. Many contaminants, such as herbicides and insecticides, have the potential to reduce reproductive success and survival of young colonial breeding birds (Fry 1995, Norton 2009). Research indicates that the population of Brown Pelicans nesting in Puerto Rico, although declining, is not suffering for the effects of pesticides as in other continental areas (Collazo et al. 1998). The effect of mosquito control measures used to protect the human population in the area on the mangrove wildlife communities is unknown, but could also play a role in reducing avifaunal populations (Burger 1982).

Considering climate change and projected rises in sea level, the accompanying changes in wetland hydrology and sediment dynamics may also have important consequences for coastal mangrove habitats (Martinuzzi et al. 2009) and avifaunal communities. As discussed in the Puerto Rico Climate Change Council's (2013b) report on ecology and biodiversity, the probable effects from rising sea levels on mangroves include loss of total mangrove areas due to erosion of the seaward margin of the mangroves and loss of protective barriers. However, some mangrove ecosystems may effectively relocate inland and increase in area with the associated saline intrusion into inland freshwater wetlands (PRCCC 2013b) and the vertical accumulation of peat (McKee et al. 2007, McKee 2011). Mangrove community structure is projected to change as well, with black mangrove being replaced by red mangrove, and a possible increase in productivity of the mangrove areas from carbon dioxide fertilization (PRCCCC 2013b). Finally, if hurricanes and rainfall events intensify in the coming decades, this might result in reduced mangrove habitat quality and extent (Martinuzzi et al. 2009), which could adversely affect mangrove ecosystems and the bird populations that depend on them. Notably, Hurricane Hugo in 1989 severely damaged the

mangrove system at the then-Roosevelt Roads Naval Base, with dire consequences for species such as the Yellow-shouldered Blackbird (USFWS 1996). These threats underscore the importance of protecting not only the coastal wetlands themselves but also the surrounding matrix of adjacent habitat in upland forested areas.

***Pterocarpus* Swamps.** *Pterocarpus* swamps are dominated by *Pterocarpus officinalis*, which forms large (up to six feet tall) hollow fin-like roots radiating in different directions. The roots provide extensive bases that support the trees on poorly-drained, soft terrain. In the past, *Pterocarpus* forest occupied Puerto Rico's river floodplains and coastal basins and extended to higher elevations along riparian corridors (Alvarez-Lopez 1990, PRCCC 2013b). Agricultural land clearing in the early 20th century resulted in the elimination of almost all natural occurrences of moist coastal forests in Puerto Rico (Cintrón 1983). Presently, *Pterocarpus* swamps are confined to isolated backwater locations abutting mangrove ecosystems in the northern and eastern parts of Puerto Rico (they are absent in the USVI) at Humacao, Sabana Seca Naval facilities, the Torrecillas Swamp System, Caño Boquilla Natural Reserve, and Dorado Beach Resort Area. The most extensive *Pterocarpus* forests are found connected to the Humacao lagoon system (Eusse and Aide 1999, Rivera-Ocasio et al. 2007). Far from pristine, however, the remaining patches have suffered substantial alterations including fragmentation and introduction of exotic tree species. In the coming decades, development pressure from increasing urbanization and saltwater intrusion from a climatically-driven rise in sea level level pose the greatest threats to this unique ecosystem. As saline levels increase in intertidal zones, *Pterocarpus* seeds cannot germinate as well (Rivera-Ocasio 2007), which could lead to freshwater species being substituted by salt tolerant species such as mangroves.

Wetlands in Puerto Rico and the USVI are currently protected by a series of federal and commonwealth statutes with regulations overseen by several agencies (Miller and Lugo 2009). There are 8,960 ha (1% of the total land area) of forested coastal wetland habitat in Puerto Rico, with 5,330 ha (~60%) classified as stewardship class 1, 2, or 3. This area is almost entirely dominated by mangroves, as only about 261 hectares of *Pterocarpus* forest remain in Puerto Rico. In the USVI, mangrove forests are highly restricted in their distribution, fringing the coastlines in narrow bands that comprise only 340 ha (about 1% of the land area), 39% of which are conserved. Thus there are a total of 9,300 ha of forested wetlands in the region, with roughly 59% protected. The 15% objective is therefore surpassed for wetland habitats (Tables 6a, 6b, and 6c). However, given that this habitat type is both rare and vulnerable, additional conservation (up to 100%) should be considered.

Designated stewardship areas that contain forested coastal wetland habitat:

Puerto Rico

- Aguirre Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Belvedere Natural Reserve (Dept. of Natural and Environmental Resources);

- Belvedere Natural Reserve Marine Extension (Dept. of Natural and Environmental Resources);
- Boquerón Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Boquerón Commonwealth Forest Marine Extension (Dept. of Natural and Environmental Resources);
- Boquerón Wildlife Refuge (Dept. of Natural and Environmental Resources);
- Caja de Muertos Island Natural Reserve (Dept. of Natural and Environmental Resources);
- Cabo Rojo National Wildlife Refuge (US Forest Service);
- Caño La Boquilla Natural Reserve (Dept. of Natural and Environmental Resources);
- Caño Martín Peña Natural Reserva (Dept. of Natural and Environmental Resources);
- Caño Tiburones Natural Reserve (Dept. of Natural and Environmental Resources);
- Ceiba Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Culebra National Wildlife Refuge (US Fish and Wildlife Service);
- Finca Los Frailes (Puerto Rico Conservation Trust);
- Guánica Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Hacienda La Esperanza Natural Reserve (Puerto Rico Conservation Trust);
- Jobos Bay Estuary National Research Reserve (Dept. of Natural and Environmental Resources and National Atmospheric and Oceanic Administration);
- Laguna de Joyuda Natural Reserve (Dept. of Natural and Environmental Resources);
- La Cordillera Reef Natural Reserve (Dept. of Natural and Environmental Resources);
- La Ciénaga Las Cucharillas Natural Reserve (Dept. of Natural and Environmental Resources);
- Laguna Tortuguero Natural Reserve (Dept. of Natural and Environmental Resources);
- La Parguera Natural Reserve (Puerto Rico Conservation Trust);
- Las Cabezas de San Juan Natural Reserve (Puerto Rico Conservation Trust);
- Medio Mundo and Daguao Natural Protected Area (Puerto Rico Conservation Trust);
- Mona and Monita Island Natural Reserve (Dept. of Natural and Environmental Resources);

- Northeastern Ecological Corridor (Dept. of Natural and Environmental Resources);
- Palmas del Mar Tropical Forest Conservation Easement (Puerto Rico Conservation Trust);
- Pantano de Cibuco Natural Reserve (Dept. of Natural and Environmental Resources);
- Piñones Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Pterocarpus Forest Natural Protected Area (Puerto Rico Conservation Trust);
- Pterocarpus Swamp Forest and Mandry and Santa Teresa Lagos Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Ballenas Natural Reserve (Puerto Rico Conservation Trust);
- Punta Cucharas Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Cucharas Natural Reserve Marine Extension;
- Punta Guaniquilla Natural Reserve (Puerto Rico Conservation Trust);
- Petrona Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Tuna Natural Mangrove Reserve (Dept. of Natural and Environmental Resources);
- Río Espíritu Santo Natural Reserve (Dept. of Natural and Environmental Resources);
- Río Espíritu Santo Natural Reserve Marine Extension (Dept. of Natural and Environmental Resources);
- Seven Seas Natural Reserve (Dept. of Natural and Environmental Resources);
- Vieques Bioluminescent Bay Natural Reserve (Dept. of Natural and Environmental Resources);
- Vieques National Wildlife Refuge (US Fish and Wildlife Service);
- Additional recently acquired land in Piñones (Dept. of Natural and Environmental Resources).

US Virgin Islands

St. Thomas

- Bovoni Cay Wildlife Sanctuary (USVI Government);
- Capella Island Wildlife Sanctuary (USVI Government);
- Cas Cay Wildlife Sanctuary (USVI Government);
- Compass Point Pond Marine Reserve and Wildlife Sanctuary (USVI Government);
- Magen's Bay Preserve (USVI Government and The Nature Conservancy);
- Saba Island Wildlife Sanctuary (USVI Government);
- Salt Cay Wildlife Sanctuary (USVI Government);

- Smith Bay Park (USVI Government);

St. John

- Dog Island Wildlife Sanctuary (USVI Government);
- Frank Bay Marine Reserve and Wildlife Sanctuary (USVI Government);
- Leduck Island Wildlife Sanctuary (USVI Government);
- US Virgin Islands National Park (US National Park Service);

St. Croix

- Altona Lagoon Beach Recreation Area (USVI Government);
- Buck Island Reef National Monument (US National Park Service);
- East End Marine Park (USVI Government);
- Estate Great Pond (USVI Government);
- Long Point Bay (The Nature Conservancy);
- Manning Bay Wetlands (USVI Government);
- Salt River Bay National Historic Park and Ecological Preserve (USVI Government and US National Park Service);
- Sandy Point National Wildlife Refuge (US Fish and Wildlife Service);
- Southgate Coastal Preserve (St. Croix Environmental Association);
- University of the Virgin Islands Wetlands (USVI Government).

Additional habitat conservation opportunities

Forested coastal wetlands occur in small patches around Puerto Rico. Even though they are fairly well protected, GAP data indicate that there is additional opportunity to expand conservation areas to include adjacent unprotected habitat. Importantly, many of the guilds of birds that occupy coastal wetlands also utilize upland coastal hills as well. Research by Smith et al. (2008) and Rodriguez (2012) reported that several migratory and resident warbler species in Puerto Rico's coastal wetlands moved at sunrise and sunset between black and red mangrove roosting habitats to feed in adjacent secondary dry forest. Therefore, when thinking about conservation of wetland species we emphasize the value of a landscape-scale strategy that links together the matrix of coastal and inland habitats.

The Torrecillas Swamp complex, located to the east of San Juan in the municipalities of Carolina and Loiza, contains the largest mangrove forest system in Puerto Rico, and includes approximately two dozen hectares of *Pterocarpus* forest as well (Ventosa-Febles et al. 2005b). Within this complex are the Piñones Commonwealth Forest and the Finca Frailes stewardship areas. Immediately west of Piñones is the San Luis Muñoz Marín International Airport and San José Lagoon, around which are several dozen hectares of unconserved mangrove swamp, and to the east of Piñones are a few additional unprotected patches that butt up against the Río Espíritu Santo Natural Reserve in the Baja Swamp and Herrera River Mouth Critical Wildlife Area. Conserving these remaining remnants would secure critical habitat for many coastal and swamp-dwelling birds and other wildlife species -- in the heart of the San Juan metropolitan area. Additional conservation opportunities along the north coast include San Pedro

Swamp at the Sabana Seca Naval Facilities, some of the wetlands on the properties of the Hyatt Dorado Beach Resort, and the coastal wetlands between the Caño Tiburones and Hacienda La Esperanza Nature Reserves. On the east coast, there is unconserved habitat contiguous with Seven Seas Nature Reserve, in addition to several habitat patches between Ceiba Commonwealth Forest, the parcels of Medio Mundo and Daguao Natural Protected Area (formerly Roosevelt Roads Naval Base), and the *Pterocarpus* Forest Natural Protected Area in Humacao. In the south there are habitat opportunities around the Jobos Bay Estuary National Research Reserve and Aguirre Commonwealth Forest in Salinas and Guayama, at Cabuyón Mangrove in Ponce, and at Punta Verraco in Guayanilla. Most of the remaining areas of forested wetlands in the southwestern and western part of the island, as well as those on Vieques and Culebra, are already conserved, thus the emphasis for these areas should be to strengthen existing stewardship protection and improve resilience against land conversion (e.g., by upgrading from GAP status 3 to 2 or 1).

In the USVI, the additional conservation opportunities for coastal wetlands include expanding existing stewardship efforts around Bovoni Cay Wildlife Sanctuary, Compass Point Pond Marine Reserve and Wildlife Sanctuary, and Smith Bay Park on St. Thomas; the mangrove lined lagoons of Fish Bay and Coral Harbor on St. John; and the Altona Lagoon Beach Recreation Area, the shoreline east of Manning Bay Wetlands over to the industrial facilities of Port St. Croix, and the Estate Great Pond saline lagoon on St. Croix. Again, we reiterate that the protection of coastal wetlands in the USVI should occur in tandem with the conservation of adjacent upland habitats upon which many wetland birds depend.

These suggestions align with focal area spatial data from CWA, IBA; WFA; ACP; MAPA33; MF; and CWCS.

Species and Conservation Levels

There are 24 bird species associated with forested coastal wetlands, with 20 species included in our prioritization analysis for Puerto Rico and 19 in the USVI analysis (Table 4). Original bird-habitat associations in the forested coastal wetlands are poorly known because much of the habitat has been destroyed. Yet it is speculated that moist coastal forests were once prime habitat for much of the core forest bird guild, including the Puerto Rican Parrot, Plain Pigeon, Puerto Rican Nightjar, and perhaps the White-necked Crow. Observations in recent decades confirm that the fragmented moist coastal forest in Dorado is one of the most important breeding areas for White-crowned Pigeons in Puerto Rico, a species whose demise may have been facilitated by uncontrolled and excessive hunting in most of the region (Raffaele 1989). Maintaining the moist coastal forest habitats that persist in Puerto Rico and associated islets is therefore vital for the continued success of this species and others associated with it.

Within mangrove swamps in particular, the endangered Yellow-shouldered Blackbird, the Yellow “Golden” Warbler, White-crowned Pigeon, Clapper Rail, and the Northern Waterthrush are all high priority species that depend on this forested wetland habitat.

The Northern Waterthrush also uses mountain streams in the USVI, a habitat occupied by the Louisiana Waterthrush in Puerto Rico. As in other forested habitats, present ecological processes in the mangrove forests largely are influenced by human activities and biological interactions of the surrounding environments. The disturbed areas adjacent to mangrove forests are prime habitat for the Shiny Cowbird. Wiley (1982, 1984, 1985), Wiley et al. (1983), Perez-Rivera (1986), and Nuñez-García (1988) found intensive rates of cowbird parasitism on 11 of the 26 non-raptorial land birds breeding in two large mangrove areas in Puerto Rico. Such impact takes its toll: it is suspected that Shiny Cowbird parasitism has been responsible for the decline and perhaps extirpation of some species in the Caribbean, including the extirpation of the Yellow “Golden” Warbler from Barbados (Bond 1966). As discussed in previous habitat descriptions, the major reason for the decline of the Yellow-shouldered Blackbird in Puerto Rico is also believed to be the reduction of reproductive success caused by Shiny Cowbirds. Heavy parasitism rates have been observed on other priority species present in the mangrove forest, such as the Black-whiskered Vireo, the Puerto Rican Flycatcher, and the Puerto Rican Oriole. Another important biological interaction factors affecting mangrove nesting bird communities is depredation by introduced vermin such as mongoose and cats, and by the Pearly-eyed Thrasher. As Wiley (1979, 1982) pointed out, vermin and Pearly-eyed Thrashers are considered major players in the decline of the Yellow-shouldered Blackbird and the White-crowned Pigeon in Puerto Rico.

Climate and weather have also affected mangrove swamps and their associated species, the Yellow-shouldered Blackbird in particular. Prior to Hurricane Hugo in 1989, the then-Roosevelt Roads Naval Base harbored the second largest known population of Yellow-shouldered Blackbirds on the main island of Puerto Rico. Unfortunately, the hurricane almost obliterated the eastern population of Blackbirds at Roosevelt Roads (USFWS 1996). Incidental observations and Breeding Bird Surveys suggest that the species is still in the western portion of that area where mangrove habitat has rebounded, but the present population size and breeding biology of the species is unknown.

Other very important avian members of mangrove communities are the wading birds (Ardeidae). Herons and egrets are the most important terrestrial predator in the mangrove swamp ecosystem (Miranda and Collazo 1997). These swamps are not only important foraging habitat but also a principal nesting habitat for wading birds. The information regarding herons and egrets’ nesting areas and behavior in Puerto Rico and the USVI is scant. Identification and protection of nesting colonies should be a priority for the conservation of wading birds in the Caribbean.

Forested coastal wetland species are ranked according to the following conservation levels:

PUERTO RICO

- TIER I
 - 2 Critical Recovery (or CX) species
 - White-crowned Pigeon (*Patagioenas leucocephala*)

- Yellow-shouldered Blackbird (*Agelaius xanthomus*)
- 5 Management Attention species
 - Black Swift (*Cypseloides niger*)
 - Loggerhead Kingbird (*Tyrannus caudifasciatus*)
 - Northern Waterthrush (*Parkesia novaboracensis*)
 - Prothonotary Warbler (*Protonotaria citrea*)
 - Yellow (Golden) Warbler (*Setophaga petechia*)
- 2 Planning and Responsibility species
 - Clapper Rail (*Rallus longirostris*)
 - Mangrove Cuckoo (*Coccyzus minor*)
- TIER II
 - 2 Planning and Responsibility species
 - Puerto Rican Flycatcher (*Myiarchus antillarum*)
 - Puerto Rican Woodpecker (*Melanerpes portoricensis*)
- TIER III
 - None
- TIER IV
 - 5 Planning and Responsibility species
 - American Redstart (*Setophaga ruticilla*)
 - Bananaquit (*Coereba flaveola*)
 - Yellow-billed Cuckoo (*Coccyzus americanus*)
 - Yellow-crowned Night Heron (*Nyctanassa violacea*)
 - White-winged Dove (*Zenaida asiatica*)
- TIER V
 - 2 Generic Population Control/Suppression species
 - Pearly-eyed Thrasher (*Margarops fuscatus*)
 - Shiny Cowbird (*Molothrus bonariensis*)
- NO TIER
 - 2 species not requiring further conservation action
 - Hooded Warbler (*Wilsonia citrine*)
 - Ovenbird (*Seiurus aurocapillus*)

US VIRGIN ISLANDS

- TIER I
 - 2 Critical Recovery (or CX) species
 - Clapper Rail (*Rallus longirostris*)

- Puerto Rican Flycatcher (*Myiarchus antillarum*)
- 1 Immediate Management species
 - White-crowned Pigeon (*Patagioenas leucocephala*)
- 4 Management Attention species
 - Hooded Warbler (*Wilsonia citrine*)
 - Northern Waterthrush (*Parkesia novaboracensis*)
 - Prothonotary Warbler (*Protonotaria citrea*)
 - Yellow (Golden) Warbler (*Setophaga petechia*)
- 1 Planning and Responsibility species
 - Mangrove Cuckoo (*Coccyzus minor*)

- TIER II
 - None

- TIER III
 - None

- TIER IV
 - 5 Planning and Responsibility species
 - American Redstart (*Setophaga ruticilla*)
 - Bananaquit (*Coereba flaveola*)
 - Ovenbird (*Seiurus aurocapillus*)
 - White-winged Dove (*Zenaida asiatica*)
 - Yellow-crowned Night Heron (*Nyctanassa violacea*)

- TIER V
 - 1 Generic Population Control/Suppression species
 - Pearly-eyed Thrasher (*Margarops fuscatus*)
 - 1 Local Population Control/Suppression species
 - Cattle Egret (*Bubulcus ibis*)

- NO TIER
 - 4 species not requiring further conservation action
 - Palm Warbler (*Setophaga palmarum*)
 - Yellow-billed Cuckoo (*Coccyzus americanus*)
 - Yellow-rumped Warbler (*Calidris fuscicollis*)
 - Yellow-throated Warbler (*Setophaga dominica*)

Recommended Actions and Strategies

- Restore existing habitat where possible, and improve status of existing stewardship lands;
- Conserve new habitat in areas listed above;
- Adopt a no-loss policy for larger mangrove stands greater than 0.5 ha;
- Determine suitable mangrove forest habitat for Yellow-shouldered Blackbird translocation;
- Conduct monitoring surveys and community level research on vulnerable endemic, obligate, and important migrant species both within and outside of currently protected areas to determine population status and future habitat needs;
- Consider reintroduction of extirpated species;
- Further investigate and quantify effects of native birds and exotic predators (e.g., Shiny Cowbird, Pearly-eyed Thrasher, mongoose, rats, monkeys) on breeding populations; determine areas where control measures would be most effective in stabilizing vulnerable populations;
- Determine need for better law enforcement presence where pigeon hunting may include White-crowned Pigeons;
- Assess the direct and indirect effects of pollution, development and fragmentation, mosquito control measures, and recreational use on the quantity and quality of coastal forest and mangrove habitat and associated faunal populations;
- Investigate localized effects of a warming climate and rising sea levels on mangrove habitats;
- Begin a dialogue with the federal government regarding improved conservation protection on current and former military properties;
- Support strategic partnerships for refuge management, conservation education, land use zoning/planning and habitat protection, community outreach, and ecotourism.

URBAN FORESTS

Ecology and Habitat Status

The bulk of global ecological research has traditionally focused on “pristine” landscapes, biodiversity hotspots, and unpopulated regions (Miller and Hobbs 2002, Martin et al. 2012). In recent years, however, anthropogenically-derived forest habitats in urban and suburban areas have received significant attention, as there has been an intellectual thrust toward understanding and quantifying the role these ecosystems play in maintaining ecosystem functions, providing vital goods and services, improving the quality of human life, and the influences of urban forests on wildlife populations (McDonnell and Pickett 1990, McPherson et al. 1997, Nowak and Dwyer 2007, Nowak et al. 2008, Lugo 2009, Dobbs et al. 2011, Lugo et al. 2012). The effects of anthropogenic activities have extended to most parts of Puerto Rico and the USVI.

Martinuzzi et al. (2013) observed that only a few parts of Puerto Rico contain forest types without introduced species, and these locations are at the highest mountain peaks and areas of land–ocean interface with forested wetlands. Indeed, three-quarters of the island’s forests can be considered as unique assemblages composed of native and introduced species (Martinuzzi et al. 2013). These novel habitats can affect bird species in sundry ways, ranging from the insufficient to advantageous (Blair 1996, Clergeau et al. 1998, Lichstein 2002, Crooks et al. 2004, White et al. 2005).

The urban forest category used in this report was generated by extracting areas within the ten other land cover classes (excluding Forested coastal wetlands) that are predominantly developed (greater than 20% developed land surface within a surrounding 1 km radius, following Martinuzzi et al. 2008). Therefore this habitat type spans a wide range of substrate, moisture, and temperature conditions. Institutional ownership patterns and management structures within the urban forest class are diverse, including municipal parks and other protected areas, as well as public green areas along roadways and forested commercial and residential private lots. Martinuzzi et al. (2013) calculated roughly 6% of Puerto Rico’s forested landscape to be in urban settings. Despite urban forests occupying a relatively small percentage of the total land area, in heavily developed places such as San Juan and Mayagüez in Puerto Rico and Charlotte Amalie in St. Thomas, USVI, these forests provide the only vegetative habitat within a few to many kilometers. It is the distribution of urban forests that makes them ecologically interesting, for they are predominantly situated at lower elevations and often at the transition zone between the wildland-urban interface. For example, there are roughly 27,000 ha of undeveloped greenspace within the southern boundaries of the six municipalities of the greater San Juan metropolitan area (Miller and Lugo 2009). Thus, within the constructed expanses of human communities, these forest patches serve as vegetative oases, replete with a variety of ornamental, fruit, and shade trees that have great value as a wildlife refuge for native species, especially birds, amphibians, and reptiles (Miller and Lugo 2009).

Due to their frequently fragmented nature (Miller and Lugo 2009), novel species composition (Martinuzzi et al. 2013), and the ubiquitous presence of humanity, urban forests support the region’s avifauna in a manner distinct to that of larger intact forest parcels in rural areas. Vázquez-Plass and Wunderle (2013) studied avian distribution along an urban to forest gradient in northeastern Puerto Rico in order to document the response of different species and diet guilds to urbanization. Considering all species together, richness and mean abundance showed an overall increase with urbanization. However, endemic species exhibited a negative association with increased urbanization and a positive association with rural forest cover, indicating less tolerance for the environmental conditions present in urban habitats. Exotic species showed the opposite pattern, i.e., an increase with the degree of urbanization. It is likely that elevation, the geographic distribution of remnant forest patches, and diet requirements are also important factors driving native and exotic species distributions, in addition to urbanization. The response of resident species was mixed, organized by food guild preferences, with insectivores, granivores, and omnivores appearing to be especially adaptable in their use of urban areas. These findings are consistent with previous

studies by Acevedo and Restrepo (2008) and Suárez-Rubio and Thomlinson (2009), which focused on different spatial scales and ranges of habitat within Puerto Rico. They also support more widely observed avian distribution patterns where species that utilize a wide breadth of habitats are generalists pre-adapted for colonizing islands (MacArthur and Wilson 1967, Terborgh and Faaborg 1973) and likely adept at colonizing novel habitats as well.

It is clear that urban forests must be considered when designing conservation strategies for certain groups of birds. Less obvious is the importance of ecological corridors and connection to nearby undeveloped habitats for the reproductive success of bird populations in urban forests. Vázquez Plass and Wunderle (2013) hypothesize that urban parcels alone may not be sufficient for maintaining avian abundance and species richness without being 'rescued' by dispersal from populations within undeveloped areas with excess production of offspring. More research is needed to determine the importance of both isolated tree plantations and urban corridors for native and migratory avifauna. As with the other lowland forest habitats, the principal threat to urban forests is conversion to grey infrastructure for housing and tourism purposes, and fragmentation of ecological corridors (Helmer 2004, Miller and Lugo 2009). Climate change could also have indirect effects on some coastal urban forest lands, through the loss of habitat to rising seas. Future scientific investigation must elucidate imperative management actions or those that should be discouraged in order to improve the quality of urban forest habitats.

In Puerto Rico, urban forest covers 27,500 ha, or about 3% of the total island. Roughly 2.4% of this area is classified as stewardship class 1, 2, or 3. The USVI have 1,652 ha (4.7% of the total land area), with 1% protected. Of the region's combined total of 29,152 ha of urban forest habitat only about 2.3% is conserved. Therefore, another 3,476 ha in Puerto Rico, 231 ha in the USVI, and 3,708 ha in the region as a whole are needed to meet the 15% objective (Tables 6a, 6b, and 6c). There are also municipal forest lands that are conserved to some extent but are not identified as stewardship lands by the GAP analysis. These protected areas further contribute to meeting the conservation objective for urban forest habitat.

Designated stewardship areas that contain urban forest habitat:

Puerto Rico

- Aguas Buenas Caverns and Cave Systems Natural Reserve (Dept. of Natural and Environmental Resources);
- Aguirre Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Antiguo Acueducto de San Juan (Puerto Rico Conservation Trust)
- Belvedere Natural Reserve;
- Cambalache Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Caño Martín Peña Natural Reserve (Dept. of Natural and Environmental Resources);

- Cerrillos Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Doña Inez Mendoza Urban forest (Luis Muñoz Marín Foundation);
- Guánica Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Hacienda la Esperanza Natural Reserve (Puerto Rico Conservation Trust);
- La Ciénaga Las Cucharillas Natural Reserve (Dept. of Natural and Environmental Resources);
- Medio Mundo and Daguao Natural Protected Area (Puerto Rico Conservation Trust);
- Jobos Bay Estuary National Research Reserve (Dept. of Natural and Environmental Resources and National Oceanic and Atmospheric Administration);
- Laguna Tortuguero Natural Reserve (Dept. of Natural and Environmental Resources);
- La Parguera Natural Reserve (Puerto Rico Conservation Trust);
- Northeastern Ecological Corridor (Dept. of Natural and Environmental Resources);
- Nuevo Milenio Urban forest (Dept. of Natural and Environmental Resources);
- Palmas del Mar Tropical Forest Conservation Easement (Puerto Rico Conservation Trust);
- Punta Cucharas Natural Reserve (Dept. of Natural and Environmental Resources);
- Pterocarpus Forest Natural Protected Area (Puerto Rico Conservation Trust);
- Pterocarpus Swamp Forest and Mandry and Santa Teresa Lagunas Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Tuna Natural Mangrove Reserve (Dept. of Natural and Environmental Resources);
- Río Encantado Natural Protected Area (Puerto Rico Conservation Trust);
- Río Guaynabo Natural Protected Area (Puerto Rico Conservation Trust);
- San Patricio Urban forest (Dept. of Natural and Environmental Resources);
- San Juan Ecological Corridor (Transportation Highway Authority);
- Tortuguero Lagoon Natural Reserve (Dept. of Natural and Environmental Resources);
- University of Puerto Rico Botanical Garden (Univ. of Puerto Rico);
- Vega Commonwealth Forest (Dept. of Natural and Environmental Resources).

US Virgin Islands

St. Thomas

- Compass Point Pond Marine Reserve and Wildlife Sanctuary (USVI Government);
- Fairchild Park (USVI Government);

St. John

- US Virgin Islands National Park (US National Park Service);

St. Croix

- Estate Little Princess (The Nature Conservancy);
- Herman Hill Pond (The Nature Conservancy);
- Sion Ridge Area (US National Park Service);
- University of the Virgin Islands Wetlands (USVI Government).

In general, urban forests occur in small patches, scattered amongst human developments and other forested habitats. They are concentrated either at lower elevations in a band that encircles the coastal plains, or in upland areas where the topography is relatively flat. There is little overlap among the location of urban forest habitats and the current array of conserved lands, which is not surprising given that Puerto Rico's ecological research and conservation endeavors have been focused primarily on coastal and inland areas of high biological significance (e.g., EYNF, see Harris et al. 2012).

Additional habitat conservation opportunities

Areas of promise for future conservation efforts include large patches of unprotected urban forest near major metropolitan centers, and parcels that lie in close proximity to existing stewardship lands. The value of these urban green spaces is that they help create much-needed contiguous habitat corridors both within built-up sectors and adjacent forest zones. In Puerto Rico these include features such as Monagas Park and other urban green spaces on the outskirts of the San Juan metropolitan area in Toa Baja, Toa Alta, Bayamón, Guaynabo, San Juan, Trujillo Alto, and south along Route 1 towards Caguas; in Manatí and Vega Baja in the urban lands to the south of the Laguna Tortuguero Natural Reserve, and north and east of Vega Commonwealth Forest; in Arecibo and Barceloneta around Cambalache Commonwealth Forest and Caño Tiburones Natural Reserve to the northwest and Hacienda La Esperanza Natural Reserve to the northeast; the outskirts of the Mayagüez and Hormigueros metropolitan area; in Guánica, Sabana Grande and Yauco, linking the Guánica and Susúa Commonwealth Forests and northwest towards the southern edge of Maricao Commonwealth Forest; in the foothills of Peñuelas and Ponce between Las Cuevas el Convento Natural Protected Area, Punta Cucharas Natural Reserve, Hacienda Buena Vista Natural Reserve, and Cerrillos Commonwealth Forest; in the center of the island in Aibonito, Barranquitas, Comerio, Cidra, Cayey, and Salinas around and between the San Cristobal Canyon Natural Reserve, the Aguas Buenas Caverns and Cave Systems Natural Reserve, Carite Commonwealth Forest, and the Montes Oscuras Conservation easement; along the Route 30 corridor between Caguas and Humacao; and in the low-lying coastal areas along Routes 3 and 53 on the northern and eastern sides of EYNF.

In the USVI, there is a considerable amount of unprotected urban forest habitat on St. Thomas, scattered throughout the central part of the island around Charlotte Amalie and Havensight and points eastward. Conserving some of the lands around Valdemar, Flag, Nulliberg, and Langmath Hills would help connect and buffer areas in adjacent

non-calcareous lowland and dry forest as well as grassland and shrub habitat. On well-protected St. John, conservation opportunities exist in the developed zone around the port of Cruz Bay, where urban forest patches adjoin and buffer both dry and moist forest habitats situated slightly farther inland and extending into the Virgin Islands National Park. In St. Croix, urban forest areas north of the airport around the University of the Virgin Islands and eastward along Centerline Road toward and surrounding Christiansted provide opportunities to link unprotected patches of dry limestone, non-calcareous dry forest, and grassland/shrub habitats.

These suggestions align with focal area spatial data from CWA; IBA; WFA; ACP; MAPA33; MF; and CWCS.

Species and Conservation Levels

In the urban forests, there are 46 associated species which are included in our prioritization analysis, with 44 species represented in Puerto Rico, and 24 species in the USVI analysis (Table 4). All of these species are found in other habitats as well, yet the presence of these species in urban settings perhaps indicates that well-chosen urban flora, aside from their own aesthetic values, can also provide food and shelter for many native and migratory birds. Both the local characteristics of the vegetation within urban habitats and their relation to broader landscape features, including the proximity of large forested areas and developed areas, have been shown to be critical to the structuring of avian communities in urban environments (Melles et al. 2003).

Anthropogenic urban habitats in the region have also facilitated the establishment of many exotic bird species including, among others, at least 11 species of the family Psittacidae and 14 species of sparrows and finches. From a conservation perspective, the rapidly rising number of exotic wildlife established in the region creates concern about the implications (i.e., competition and diseases) for the long-term reproductive success of endemic and endangered species (e.g., the Puerto Rican Parrot). At present, most exotic species have remained confined to disturbed and residential areas and their distributions do not overlap with those of endangered forest birds. Even so, the presence and activities of those new arrivals may render some anthropogenic habitats unsuitable for native species with similar ecological requirements. The trophic position of an introduced animal, particularly a predator, can affect community structure and change native communities drastically (Strauss et al. 2006). Quantitative studies of trophic interactions among native and exotic organisms in novel plant-animal communities such as those found in urban forests are essential to illuminating the mechanisms of community assembly and demographic dynamics (Lugo et al. 2012).

The conservation level rankings of species associated with urban forests are as follows:

PUERTO RICO

- TIER I
 - 6 Critical Recovery (or CX) species

- Broad-winged Hawk (*Buteo platypterus brunnescens*)
- Hispaniolan Parakeet (*Aratinga chloroptera*)
- Plain Pigeon (*Patagioenas inornata wetmorei*)
- Puerto Rican Parrot (*Amazona vittata*)
- Sharped-shinned Hawk (*Accipiter striatus venator*)
- White-necked Crow (*Corvus leucognaphalus*)
- 3 Immediate Management species
 - Antillean Mango (*Anthracothorax dominicus*)
 - Puerto Rican Oriole (*Icterus portoricensis*)
 - Puerto Rican Vireo (*Vireo latimeri*)
- 4 Management Attention species
 - Black-throated Blue Warbler (*Setophaga caerulescens*)
 - Loggerhead Kingbird (*Tyrannus caudifasciatus*)
 - Louisiana Waterthrush (*Parkesia motacilla*)
 - Worm-eating Warbler (*Helmitheros vermivorus*)
- 1 Planning and Responsibility species
 - Mangrove Cuckoo (*Coccyzus minor*)
- TIER II
 - 17 Planning and Responsibility species
 - Antillean Euphonia (*Euphonia musica*)
 - Black-whiskered Vireo (*Vireo altiloquus*)
 - Caribbean Martin (*Progne dominicensis*)
 - Gray Kingbird (*Tyrannus dominicensis*)
 - Green Mango (*Anthracothorax viridis*)
 - Northern Parula (*Parula americana*)
 - Puerto Rican Bullfinch (*Loxigilla portoricensis*)
 - Puerto Rican Emerald (*Chlorostilbon maugaeus*)
 - Puerto Rican Lizard-Cuckoo (*Coccyzus vieilloti*)
 - Puerto Rican Screech-Owl (*Megascops nudipes*)
 - Puerto Rican Spindalis (*Spindalis portoricensis*)
 - Puerto Rican Tanager (*Nesospingus speculiferus*)
 - Puerto Rican Tody (*Todus mexicanus*)
 - Puerto Rican Woodpecker (*Melanerpes portoricensis*)
 - Red-legged Thrush (*Turdus plumbeus*)
 - Scaly-naped Pigeon (*Patagioenas squamosa*)
 - Zenaida Dove (*Zenaida aurita*)
- TIER III
 - None

- TIER IV
 - 7 Planning and Responsibility species
 - American Kestrel (*Falco sparverius*)
 - American Redstart (*Setophaga ruticilla*)
 - Bananaquit (*Coereba flaveola*)
 - Cape May Warbler (*Setophaga tigrina*)
 - Cave Swallow (*Petrochelidon fulva*)
 - Mourning Dove (*Zenaida macroura*)
 - White-winged Dove (*Zenaida asiatica*)
- TIER V
 - 2 Generic Population Control/Suppression species
 - Pearly-eyed Thrasher (*Margarops fuscatus*)
 - Shiny Cowbird (*Molothrus bonariensis*)
 - 1 Local Population Control species
 - Red-tailed Hawk (*Buteo jamaicensis*)
- NO TIER
 - 3 species not requiring further conservation action
 - Kentucky Warbler (*Geothlypis formosus*)
 - Ovenbird (*Seiurus aurocapillus*)
 - Hooded Warbler (*Wilsonia citrine*)

US VIRGIN ISLANDS

- TIER I
 - 2 Critical Recovery (or CX) species
 - White-necked Crow (*Corvus leucognaphalus*)
 - Puerto Rican Screech-Owl (*Megascops nudipes newtoni*)
 - 1 Immediate Management species
 - Bridled Quail-Dove (*Geotrygon mystacea*)
 - 5 Management Attention species
 - American Kestrel (*Falco sparverius*)
 - Black-throated Blue Warbler (*Setophaga caerulescens*)
 - Caribbean Martin (*Progne dominicensis*)
 - Hooded Warbler (*Wilsonia citrine*)
 - Louisiana Waterthrush (*Parkesia motacilla*)
 - 1 Planning and Responsibility species
 - Mangrove Cuckoo (*Coccyzus minor*)
- TIER II

- None
- TIER III
 - None
- TIER IV
 - 10 Planning and Responsibility species
 - American Redstart (*Setophaga ruticilla*)
 - Bananaquit (*Coereba flaveola*)
 - Black-whiskered Vireo (*Vireo altiloquus*)
 - Cape May Warbler (*Setophaga tigrina*)
 - Mourning Dove (*Zenaida macroura*)
 - Northern Parula (*Parula americana*)
 - Ovenbird (*Seiurus aurocapillus*)
 - Scaly-naped Pigeon (*Patagioenas squamosa*)
 - White-winged Dove (*Zenaida asiatica*)
 - Zenaida Dove (*Zenaida aurita*)
- TIER V
 - 1 Generic Population Control/Suppression species
 - Pearly-eyed Thrasher (*Margarops fuscatus*)
 - 1 Local Population Control/Suppression species
 - Cattle Egret (*Bubulcus ibis*)
- NO TIER
 - 3 species not requiring further conservation action
 - Gray Kingbird (*Tyrannus dominicensis*)
 - Kentucky Warbler (*Geothlypis formosus*)
 - Worm-eating Warbler (*Helmitheros vermivorus*)

Recommended Actions and Strategies

- Conserve new habitat area and establish inter-reserve corridor linkages;
- Develop best practices guidelines for adaptive management of forestry practices that encourage complex canopy structure, good understory development, and fleshy-fruited shrubs and trees;
- Expand private lands and public outreach initiatives;
- Investigate the importance of isolated tree plantations and urban habitats for the conservation of native and migratory avifauna;
- Engage municipal leaders in protecting urban greenways and open areas;

- Support strategic community partnerships and education about soil and water resource conservation, biodiversity protection, and backyard wildlife habitats that support native and exotic species.

Non-forested Habitats

Owing to the combined effects of agricultural abandonment, industrialization, and urbanization, significant portions of the landscapes of Puerto Rico and the USVI have reverted to forest (Franco et al. 1997, Rudel 2000, Brandeis et al. 2007, Miller and Lugo 2009). Yet according to GAP data, a mélange of non-forested habitats (developed areas excluded) still account for more than a third of Puerto Rico, with a similar percentage for the USVI. These habitats, in the form of grasslands, wetlands, and natural barrens such as beaches and mudflats, are predominantly distributed throughout coastal regions and inland areas of low to mid elevation. Together they provide valuable habitat for a broad diversity of plants and animals, including several rare and endemic bird species associated with terrestrial and maritime ecosystems. Many of the birds within these habitat types are ground nesting species and are often subjected to increased predation pressures that require conservation management responses, particularly in the USVI where low-lying habitats (forested and non-forested alike) abound.

MOIST, DRY, AND LITTORAL GRASSLANDS/SHRUBS

Ecology and Habitat Status

Grassland and shrub habitats historically were less abundant than forested areas in the region (Wadsworth 1950, Birdsey and Weaver 1982, Franco et al. 1997). As a result of human activities, they are presently among the most common and well-distributed habitats throughout Puerto Rico and the USVI, including old agricultural fields, sugar cane lands, pastured meadows, golf courses, and gardens in residential areas (Gould et al. 2008a, Miller and Lugo 2009, Gould et al. 2013a). While dry grasslands peppered with woody shrub species make up the vast bulk of this general habitat type, there are also seasonally flooded and emergent wetlands dominated by herbaceous vegetation that are coupled with riparian systems and coastal zones. In the USVI there are a few closed shrubland classes that function more as woodlands, and for the purposes of this report they've been classified with forested habitats.

At present, almost all of the existing stewardship lands in Puerto Rico with some level of conservation easement are correlated exclusively with forested habitat of one type or another. Therefore, the vast majority of grassland/shrubland habitat falls on private lands that lack protection to avert conversion. Nor is there strong economic incentive to prevent conversion in the near future. In lowland and coastal settings, urban expansion pressures put grasslands at high risk from development for human communities (Helmer 2004; Acevedo and Restrepo 2008). In the modern economy, many

agricultural lands are worth more as housing projects than as open farmland, a trend which may have harmful consequences for grassland bird populations. Fire, too, is an important concern, particularly in dry grassland and shrubland areas and the surrounding forests where few native woody species are fire-adapted (Wolfe 2009). Both native and exotic grasses are capable of increasing the frequency and intensity of anthropogenic fires which can trigger a decline in native species and overall forest cover (Thaxton et al. 2012). Given contemporary land use and declining economic trends in the agricultural sector, achieving conservation objectives for grassland birds will necessitate engaging landowners with financial mechanisms so as to encourage easements and the adoption of management practices that alleviate disturbance on focal species populations.

In Puerto Rico, moist, dry, and littoral grassland and shrubland habitat covers about 310,338 ha (35% of land area), with only 2.8% classified as stewardship class 1, 2, or 3. In the USVI there are 10,605 ha of this habitat type (30% of the land area), some 6.7% of which is conserved. Taken together, only 2.9% of the 320,943 combined hectares of grass and shrubland habitat that occur in Puerto Rico and the USVI are conserved. To meet the 15% objective, another 37,915 ha are needed for Puerto Rico, 880 ha for the USVI, and 38,796 ha for the region (Tables 6a, 6b, and 6c).

Designated stewardship areas that contain moist, dry, and littoral grassland/shrubland habitat:

Puerto Rico

- Aguas Buenas Caverns and Cave Systems Natural Reserve (Dept. of Natural and Environmental Resources);
- Aguirre Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Antiguo Aceducto de San Juan (Puerto Rico Conservation Trust);
- Belvedere Natural Reserve (Dept. of Natural and Environmental Resources);
- Boquerón Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Boquerón Wildlife Refuge (Dept. of Natural and Environmental Resources);
- Bosque del Pueblo (Casa Pueblo Foundation);
- Cabo Rojo National Wildlife Refuge (US Fish and Wildlife Service);
- Caja de Muertos Island Natural Reserve (Dept. of Natural and Environmental Resources);
- Cambalache Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Camuy River Caves Park (National Parks Company of Puerto Rico);
- Caño La Boquilla Natural Reserve (Dept. of Natural and Environmental Resources);

- Caño Martin Peña Natural Reserve (Dept. of Natural and Environmental Resources);
- Caño Tiburones Natural Reserve (Dept. of Natural and Environmental Resources);
- Carite Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Ceiba Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Cerrillos Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Cerro Las Mesas (Puerto Rico Conservation Trust);
- Culebra National Wildlife Refuge (US Fish and Wildlife Service);
- Desecheo National Wildlife Refuge (US Fish and Wildlife Service);
- Doña Inez Mendoza Urban forest (Luis Muñoz Marín Foundation)
- El Buey National Wildlife Refuge (Puerto Rico Conservation Trust);
- El Rabanal Conservation Easement (Puerto Rico Conservation Trust);
- El Tallonal (Citizens of the Karst Foundation);
- El Tambor Conservation Easement (Puerto Rico Conservation Trust);
- El Yunque National Forest (US Forest Service);
- Finca Guayama (International Institute for Tropical Forestry);
- Finca Guillermeti (Citizens of the Karst Foundation);
- Finca Jose Santiago (Citizens of the Karst Foundation);
- Finca Los Frailes (Puerto Rico Conservation Trust);
- Finca Manati (International Institute for Tropical Forestry);
- Finca Shapiro (Puerto Rico Conservation Trust);
- Foreman Conservation Easement (Puerto Rico Conservation Trust);
- Guajataca Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Guánica Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Hacienda Buena Vista Natural Protected Area (Puerto Rico Conservation Trust);
- Hacienda La Esperanza Natural Reserve (Puerto Rico Conservation Trust);
- Ines Maria Mendoza (Punta Yegua) Natural Area;
- Jobos Bay Estuary National Research Reserve (Dept. of Natural and Environmental Resources and National Oceanic and Atmospheric Administration);
- La Ciénaga Las Cucharillas Natural Reserve (Dept. of Natural and Environmental Resources);
- La Cordillera Reef Natural Reserve (Dept. of Natural and Environmental Resources);
- Lago la Plata Wildlife Refuge (Dept. of Natural and Environmental Resources);
- Lago Guajataca Wildlife Refuge (Dept. of Natural and Environmental Resources);
- Lago Luchetti Wildlife Refuge (Dept. of Natural and Environmental Resources);

- Laguna Cartegena National Wildlife Refuge (US Fish and Wildlife Service);
- Laguna de Joyuda Natural Reserve (Dept. of Natural and Environmental Resources);
- Laguna Tortuguero Natural Reserve (Dept. of Natural and Environmental Resources);
- La Parguera Natural Reserve (Puerto Rico Conservation Trust);
- Las Cabezas de San Juan Natural Area (Puerto Rico Conservation Trust);
- Las Cuevas El Convento Natural Protected Area (Puerto Rico Conservation Trust);
- Las Piedras del Collado Natural Reserve (Dept. of Natural and Environmental Resources);
- Maricao Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Mata de Plátano Field Station Natural Reserve (Citizens of the Karst Foundation);
- Medio Mundo and Daguao Natural Protected Area (Puerto Rico Conservation Trust);
- Mona and Monito Island Natural Reserve (Dept. of Natural and Environmental Resources);
- Monte Choca Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Monte Guilarte Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Montes Oscuras Conservation Easement (Puerto Rico Conservation Trust);
- Nuevo Milenio Urban forest (Dept. of Natural and Environmental Resources);
- Olimpia Forest (Casa Pueblo Foundation);
- Palmas del Mar Tropical Forest Conservation Easement (Puerto Rico Conservation Trust);
- Pantano de Cibuco Natural Reserve (Dept. of Natural and Environmental Resources);
- Pantano de Cibuco Marine Extension Natural Reserve (Dept. of Natural and Environmental Resources);
- Paraiso de las Lunas Natural Protected Area (Puerto Rico Conservation Trust);
- Piñones Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Pterocarpus Forest Nature Reserve (Puerto Rico Conservation Trust);
- Pterocarpus Swamp Forest and Mandry and Santa Teresa Lagos Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Ballenas Natural Reserve (Puerto Rico Conservation Trust);
- Punta Cucharas Natural Reserve (Dept. of Natural and Environmental Resources);

- Punta Cucharas Marine Extension Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Guaniquilla Natural Reserve (Puerto Rico Conservation Trust);
- Punta Petrona Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Tuna Natural Mangrove Reserve (Dept. of Natural and Environmental Resources);
- Río Abajo Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Río Encantado Natural Protected Area (Puerto Rico Conservation Trust);
- Río Espíritu Santo Natural Reserve (Dept. of Natural and Environmental Resources);
- Río Guaynabo Natural Protected Area (Puerto Rico Conservation Trust);
- San Cristobal Canyon Natural Protected Area (Puerto Rico Conservation Trust);
- San Juan Ecological Corridor (Transportation Highway Authority);
- San Patricio Urban forest (Dept. of Natural and Environmental Resources);
- Seven Seas Natural Reserve (Dept. of Natural and Environmental Resources);
- Sierra La Pandura Natural Protected Area (Puerto Rico Conservation Trust);
- Sun Bay National Park (Puerto Rico National Parks Company);
- Susúa Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Toro Negro Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Tres Picachos Commonwealth Forest (Dept. of Natural and Environmental Resources);
- University of Puerto Rico Botanical Garden (Univ. of Puerto Rico);
- Vega Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Vieques Bioluminescent Bay Natural Area (Dept. of Natural and Environmental Resources);
- Vieques National Wildlife Refuge (US Fish and Wildlife Service);
- Additional recently acquired lands in the Karst region and Piñones (Dept. of Natural and Environmental Resources).

US Virgin Islands

St. Thomas

- Bovoni Cay Wildlife Sanctuary (USVI Government);
- Buck Island National Wildlife Refuge (US Fish and Wildlife Service);
- Capella Island Wildlife Sanctuary (USVI Government);
- Cas Cay Wildlife Sanctuary (USVI Government);
- Cockroach Cay Wildlife Sanctuary (USVI Government);
- Compass Point Pond Marine Reserve and Wildlife Sanctuary (USVI Government);

- Dutchcap Cay Wildlife Sanctuary (USVI Government);
- Fairchild Park (USVI Government);
- Flat cay Wildlife Sanctuary (USVI Government);
- Frenchcap Cay Wildlife Sanctuary (USVI Government);
- Kalkun Cay Wildlife Sanctuary (USVI Government);
- Magen's Bay Preserve (USVI Government and The Nature Conservancy);
- Outer Brass Island Wildlife Sanctuary (USVI Government);
- Saba Island Wildlife Sanctuary (USVI Government);
- Salt Cay Wildlife Sanctuary (USVI Government);
- Savana Island Wildlife Sanctuary (USVI Government);
- Shark Island Wildlife Sanctuary (USVI Government);
- Smith Bay Park (USVI Government);
- Spratt Bay Estates (The Nature Conservancy);
- Sula Cay Wildlife Sanctuary (USVI Government);
- Turtledove Cay Wildlife Sanctuary (USVI Government);
- West Cay Wildlife Sanctuary (USVI Government);

St. John

- Congo Cay Wildlife Sanctuary (USVI Government);
- Coral Bay Preserve (The Nature Conservancy);
- Dog Island Wildlife Sanctuary (USVI Government);
- Flanagan Island Wildlife Sanctuary (USVI Government);
- Grass Cay Wildlife Sanctuary (USVI Government);
- Leduck Island Wildlife Sanctuary (USVI Government);
- Steven Cay Wildlife Sanctuary (USVI Government);
- US Virgin Islands National Park (US National Park Service);
- Whistling Cay Wildlife Sanctuary (USVI Government);

St. Croix

- Altona Lagoon Beach Recreation Area (USVI Government);
- Buck Island Reef National Monument (US National Park Service);
- Butler Bay Conservation Easement and Butler Bay Nature Preserve (St. Croix Landmarks Society);
- Caledonia Gut (USVI Government);
- Creque Dam (USVI Government);
- Derick O. Steinmann Memorial Beach (St. Croix Environmental Association);
- East Bay and Point Udall (USVI Government);
- East End Marine Park (USVI Government);
- Estate Adventure Nature Trail (USVI Government);
- Estate Clairmont Park (St. Croix Landmarks Society);
- Estate Great Pond (USVI Government);

- Estate Little La Grange (St. Croix Landmarks Society);
- Estate Little Princess (The Nature Conservancy);
- Estate Mount Washington Bird Sanctuary (St. Croix Landmarks Society);
- Estate Thomas (US Forest Service);
- Estate Whim (St. Croix Landmarks Society);
- Fairleigh Dickinson Territorial Park (USVI Government);
- Green Cay National Wildlife Refuge (US Fish and Wildlife Service);
- Herman Hill Pond (The Nature Conservancy);
- Jack and Isaacs Bays Preserve (The Nature Conservancy);
- Long Point Bay (The Nature Conservancy);
- Manning Bay Wetlands (USVI Government);
- Protestant Cay Wildlife Sanctuary (USVI Government);
- Ruth Cay Wildlife Sanctuary (USVI Government);
- Salt River Bay National Historic Park and Ecological Preserve (USVI Government and US National Park Service);
- Sandy Point National Wildlife Refuge (US Fish and Wildlife Service);
- Sion Ridge Area (US National Park Service);
- Southgate Coastal Preserve (St. Croix Environmental Association);
- University of the Virgin Islands Wetlands (USVI Government).

Additional habitat conservation opportunities

Grassland/shrubland habitat is found throughout Puerto Rico at all elevations, but it is more dominant and contiguous in low-lying valleys and coastal plains. As with other habitat types, the key opportunities include expanding conservation protection around existing natural areas and establishing corridors among them and between adjacent habitat types. High priority conservation areas include linkages in the north between Caño Tiburones, Hacienda La Esperanza, Cambalache Commonwealth Forest, Laguna Tortuguero, and Pantano de Cibuco Natural Reserves; in the northeast between Torrecillas Swamp System, the Río Espíritu Santo Natural Reserve, and the Northeast Ecological Corridor; in the foothills of EYNF; in the east between Humacao Natural Reserve and Ceiba Commonwealth Forest; in the southeast the extensive area between Montes Oscuras Natural Reserve, Aguirre Commonwealth Forest and Jobos Bay; in the southwest in the Lajas Valley between Guánica Commonwealth Forest, Guánica Lagoon, Boquerón Wildlife Refuge, and the Laguna Cartagena and Cabo Rojo National Wildlife Refuges; in the west the lands surrounding Caño La Boquilla Natural Reserve; in the northwest surrounding the Barrio Coto, Barrio Cocos, and Belleca Creek Critical Wildlife Areas; and in the Central Cordillera the shrublands between Susúa, Maricao, Guilarte, and Bosque del Pueblo. There are also large swaths of grassland and shrub habitat that are relatively isolated from current protected areas, but could be considered as targets for future conservation endeavors. These include lands within and surrounding the Yabucoa Valley; southwest of Montes Oscuras heading toward Punta Petrona Natural Reserve in Santa Isabel; the Route 2 corridor between

Mayagüez, Hormigueros, and San Germán; the Route 30 corridor between Humacao and Caguas; and in the northwestern karst near Guajataca Commonwealth Forest and Lake Guajataca Wildlife Refuge. On the western side of Vieques, around Dewey, and along the northeast coast of Culebra, protecting grasses and shrubland would help build continuity with nearby moist and dry noncalcareous lowland forest habitat.

In the USVI, grassland and shrubland habitat is fairly uniformly distributed in small patches across all three islands and many of the smaller cays, with the exception of Virgin Island National Park on St. John. Just as is the case for Vieques and Culebra in Puerto Rico, efforts to protect grasses and shrubs in conjunction with adjacent moist and dry noncalcareous lowland forest habitats would provide spatial continuity that would benefit the USVI's avifauna. On St. Thomas, some of the larger patches of this habitat occur on the lands around the airport and the University of the Virgin Islands, as well as on the north side in Lovenlund, and on Inner Brass Island and Thatch Cay. On St. John, the area around Caneel Bay Resort heading toward Hawksnest Point is the largest patch of grass/shrubland habitat. On St. Croix, grasses and shrublands are more abundant than on the other two islands. Large patches that are ecologically most suitable for conservation purposes occur in close proximity to the airport and landfill, the University of the Virgin Islands Agriculture Experiment Station, and surrounding lands managed by the USVI Department of Agriculture, from the University of the Virgin Islands Wetlands eastward along the south coast over to East End Marine Park, and northward from there to Southgate Coastal Preserve.

These suggestions align with focal area spatial data from CWA; IBA; WFA; ACP; MAPA33; MF; and CWCS.

Species and Conservation Levels

Many of the grasslands and shrub areas are characterized by exotic flora and fauna. Because these habitats were limited in the historical landscape of the region, relatively few native bird species are considered associated with them. **There are 12 species in our prioritization analysis that are associated with grassland and shrub habitats. All 12 of these species are represented in Puerto Rico, and 7 species are included in the USVI analysis (Table 4).** In Puerto Rico and the USVI, the Grasshopper Sparrow and Short-eared Owl are two of only a small handful of native species that are allied exclusively with grassland/shrub habitats. While Grasshopper Sparrows prefer areas of tall grasses, Short-eared Owls use more diverse habitats including open fields, short grasses, and marshlands. These habitat types increased in the region as forest was originally cleared for agricultural purposes, and then later as fields were abandoned after industrialization. Many grassland habitats were created and are maintained by the cattle industry including the introduction of exotic grass species to improve pastures. However, the factors involved in limiting the distributions of the Grasshopper Sparrow and the Short-eared Owl have not been determined. Competition with introduced exotics may be affecting the distribution of the Grasshopper Sparrow (Raffaele 1989) while, as a ground nester, the Short-eared Owl may be limited by depredation by exotic mammals in some areas (Oberle 2006). Aggressive predator species such as the Shiny

Cowbird (PR only) and Pearly-eyed Thrasher also inhabit grasslands and agricultural areas (Raffaele 1989) and may pose similar problems to those presented in other habitats.

Many other associated species such as the Antillean Nighthawk and Caribbean Martin use grasslands and shrubs for feeding and/or breeding purposes but the importance of these habitats on the species' life histories still need to be investigated. Though not directly associated with grasslands, the Yellow-shouldered Blackbird is an endemic Puerto Rican species known to forage on shrub habitats in addition to agricultural areas neighboring its primary habitat in forested coastal wetlands and dry forest settings. The White-cheeked Pintail also makes incursions into wet grasslands adjacent to coastal swamps. Regarding migrants, the Bobolink, although uncommon, visits the grasslands of Puerto Rico and the USVI in the fall (Raffaele 1989).

In the USVI shrubs are important habitats for the locally vulnerable Antillean Mango. Although once an abundant hummingbird throughout the Virgin Islands, there have not been any recently confirmed reports of this species and it may now only remain on St. Thomas or be extirpated altogether (Personal communication, D. McNair, USVIDFW 2004). Its current status on the British Virgin Islands is unknown. The decline of this species has coincided with the range expansion of the Green-throated Carib (Raffaele 1989). The absence of overlap between the ranges of these two species in Puerto Rico suggests that competition may be an important factor limiting their distributions.

As mentioned above, grasslands and shrub habitats harbor many of the introduced exotic species in the region, particularly finches of the families Fringillidae (two species), Ploceidae (three species), and Estrildidae (eight species). Of note, the exotic Red Siskin has been so heavily collected for the pet trade from its native range in South America that it is endangered, or perhaps even extirpated, from its ancestral land, making the Puerto Rican inhabitants the only known wild population in the world (Raffaele 1989). This species has a very limited distribution inhabiting fairly thick shrubby habitats in a few dry hills in Puerto Rico. The conservation of the Red Siskin may pose several interesting and controversial issues in terms of the management of exotics and conservation of endangered species.

Moist, dry, and littoral grassland/shrubland species' conservation level rankings are as follows:

PUERTO RICO

- TIER I
 - 2 Immediate Management species
 - Antillean Mango (*Anthracothorax dominicus*)
 - White-cheeked Pintail (*Anas bahamiensis*)
 - 2 Planning and Responsibility species
 - Antillean Nighthawk (*Chordeiles gundlachi*)
 - Short-eared Owl (*Asio flammeus*)

- TIER II
 - 2 Planning and Responsibility species
 - Caribbean Martin (*Progne dominicensis*)
 - Gray Kingbird (*Tyrannus dominicensis*)

- TIER III
 - None

- TIER IV
 - 3 Planning and Responsibility species
 - Bananaquit (*Coereba flaveola*)
 - Cave Swallow (*Petrochelidon fulva*)
 - Grasshopper Sparrow (*Ammodramus savannanum*)

- TIER V
 - 2 Generic Population Control/Suppression species
 - Pearly-eyed Thrasher (*Margarops fuscatus*)
 - Shiny Cowbird (*Molothrus bonariensis*)
 - 1 Local Population Control species
 - Red-tailed Hawk (*Buteo jamaicensis*)

US VIRGIN ISLANDS

- TIER I
 - 1 Critical Recovery (or CX) species
 - Antillean Mango (*Anthracothorax dominicus*)
 - 1 Immediate Management species
 - Antillean Nighthawk (*Chordeiles gundlachi*)
 - 1 Management Attention species
 - Caribbean Martin (*Progne dominicensis*)
 - 1 Planning and Responsibility species
 - White-cheeked Pintail (*Anas bahamiensis*)

- TIER II
 - None

- TIER III
 - None

- TIER IV
 - 1 Planning and Responsibility species

- Bananaquit (*Coereba flaveola*)
- TIER V
 - 1 Generic Population Control/Suppression species
 - Pearly-eyed Thrasher (*Margarops fuscatus*)
- NO TIER
 - 1 species not requiring further conservation action
 - Gray Kingbird (*Tyrannus dominicensis*)

Recommended Actions and Strategies

- Conduct monitoring surveys on important native, exotic, and migrant bird species to determine population and future habitat needs;
- Investigate the effects of competition from introduced exotic birds and predation by exotic mammals on the spatial distribution of focal species;
- Assess the effects of secondary forest regeneration and fragmentation of open habitats on grassland birds;
- Improve status of existing stewardship lands and consider establishing inter-reserve corridor linkages in areas listed above;
- Expand private lands and public engagement initiatives – Safe Harbor Program, Partners for Fish and Wildlife, economic incentives for maintaining open fields and reduced haying during breeding periods;
- Develop guidelines for sustainable agricultural management practices that benefit grass and shrubland avifauna and help in the development of biological corridors and buffer zones between natural areas;
- Begin a dialogue with the federal government regarding improved conservation protection on current and former military properties;
- Support strategic partnerships for refuge management, conservation education, land use zoning/planning and habitat protection, community outreach, and ecotourism.

MARSHES AND OPEN WATER HABITATS

Ecology and Habitat Status

This habitat category includes lakes, fresh, brackish, and saltwater lagoons, salt flats and mudflats, water reservoirs, and the permanently marshy vegetation surrounding them. Puerto Rico and the USVI do not have any natural lakes that are productive for use by waterfowl, a result of the islands' physiography. Although there are many human-engineered reservoirs that were created for irrigation, community water supplies, and electric power generation (Ventosa-Febles et al. 2005b, Miller and Lugo 2009), they are deep and often have steep shorelines, making them generally unsuitable for many short-legged waterfowl species (Ventosa-Febles et al. 2005a). The shallow lagoons,

which span a range of salinities from fresh to brackish to hypersaline waters, provide the best habitat for a variety of native and migratory shorebirds in both Puerto Rico and the USVI, and also provide critical nursery habitat for many other freshwater, estuarine and marine organisms (PRCCC 2013b).

The total area of wetland complex habitats in Puerto Rico today has diminished since the advent of European settlement, when a system of some 50 freshwater lagoons extended throughout the island (Cólón 1982). Losses are attributed to draining, dredging, siltation, pollution, and erosion from deforestation of surrounding hills and mountainsides (Raffaele 1989, Miller and Lugo 2009, Weaver and Schwagerl 2009, PRCCC 2013b). The Gúanica and Anegado lagoons in the southwest, and the Humacao lagoon in the east, for example, were among the biggest natural freshwater wetlands in Puerto Rico, and provided habitat for a variety of fish and crustaceans, as well as a long list of native and migratory waterfowl. In the 1950s, water was diverted from these lagoons to support the development of agriculture. In the case of the Gúanica Lagoon, which was diverted to supply water to the Lajas Valley, the wetland was effectively drained (Ventosa-Febles et al. 2005b). Similarly, the largest and most important lagoon on St. Croix, Krause Lagoon, was filled to facilitate industrial expansion in the 1960s (Birdlife International 2008), although there are still remnant areas that are used by a diversity of birds (Personal communication, C. Lombard, US Fish and Wildlife Service 2014).

Ironically, agriculture also spurred the expansion of new habitat for wetland birds, through the creation of ponds for livestock and irrigation to supplement diversions from natural lagoons. Some of these man-made ponds, particularly in the southern part of Puerto Rico, continue to serve as critical habitat for diving waterfowl and other migrant species (Ventosa-Febles et al. 2005a). In recent decades, the economic shift from agriculture to an industrial society has placed added pressure on coastal wetlands through their conversion to new housing and tourism developments (Díaz and Lilyestrom 2010). Thus, many farm ponds and the species that have come to depend on them are presently at risk of being lost to ex-urban expansion (Ventosa-Febles et al. 2005a). At the same time, the restoration of wetland hydrology on previously drained agricultural lands has led to an increase of emergent and inundated freshwater wetlands (Helmer 2004). In an odd twist of fate, engineered wetlands on golf courses appear to be serving at least a locally important role in providing open water habitat for some native and migrant bird species (Personal communication, J. Wunderle, US Forest Service 2012).

Some of the persisting natural freshwater lagoons in Puerto Rico and the USVI are now being lost to eutrophication; the Laguna Cartegena in the vicinity of Lajas, considered one of the most important habitats for migratory waterfowl in the 1960s, has suffered from weedy vegetation that impedes the normal flow of water and restricts nesting and feeding for waterfowl (Ventosa-Febles et al. 2005b). As for coastal lagoons and mudflats, the Cabo Rojo Salt Flats (part of the Cabo Rojo National Wildlife Refuge) is one of the most important areas in the region; over 20,000 shorebirds (including Neotropical migrants) congregate there on an annual basis (BirdLife International),

including more than 5.3% of the world population of the tenuirostris subspecies of Snowy Plover and 2.5% of the world population of Wilson's Plover (WHSRN 2013). In 2010, the Salt Flats were designated as a Site of Regional Importance under the Western Hemisphere Shorebird Reserve Network, the first and only site in the Caribbean. In northern Puerto Rico, some of the best known and most sensitive coastal lagoons are located within the San Juan Bay Estuary System, including the Condado, San José, Torrecillas, and Piñones Lagoons (PRCCC 2013b). These coastal wetlands have been identified as important staging areas for dozens of migratory shorebirds (Collazo et al. 1995), yet development, contamination from stormwater, pollutants, sedimentation, and human recreational uses threaten their integrity (PRCCC 2013b). In the USVI, for example, Thomas and Devine (2005) illustrated how erosion of upland sediments into low-lying salt ponds resulted in their filling and transformation into dry land. Climate change will potentially affect coastal lagoons as well, via rising sea level, altered tidal regimes, and fluctuations in water quality (including, salinity, nutrients, and sedimentation). As with mangrove ecosystems, low-lying, shallow littoral lagoons may be able to migrate landward along gentle coastlines, providing that there is undeveloped habitat into which to move. However, landward migration might not be fast enough to prevent inundation, resulting in the loss of important wetland habitats (PRCCC 2013b). Changes in water temperature could likewise influence the availability of food and have detrimental effects on the reproductive cycles of crustaceans and fish (PRCCC 2013b), which in turn would increase the vulnerability of overwintering shorebirds and wading birds (Rice et al. 2007, Lombard et al. 2010). Furthermore, unpredictable changes in food availability have been shown to increase mortality of adults and chicks (Finney et al. 1999) and induce nest abandonment and displacement into less optimal habitat (Schreiber 2002, PRCCC 2013b).

In Puerto Rico, there are 12,036 ha of marsh and open water habitat (1.3% of total land area), of which almost 35% is classified as GAP stewardship status 1, 2, or 3. In the USVI, there are 413 ha (1.2% of land area), 29.5% of which is protected. And for Puerto Rico and the USVI together there are 12,449 ha, with 34.5% conserved. The 15% objective is met for this habitat type, both for Puerto Rico and the USVI separately, as well as the region as a whole (Tables 6a, 6b, and 6c). However, given that this habitat type is both rare and vulnerable, additional conservation (up to 100%) should be considered. It is also important to note that throughout the region there are numerous small ponds that provide important habitat for wading birds, yet due to the 15 m resolution of the GAP pixel data, many of these habitat features did not show up in the GAP analysis and therefore were not considered in this report.

Designated stewardship areas that contain marshes and open water habitats:

Puerto Rico

- Aguas Buenas Caverns and Cave Systems Natural Reserve (Dept. of Natural and Environmental Resources);
- Aguirre Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Belvedere Natural Reserve (Dept. of Natural and Environmental Resources);

- Boquerón Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Boquerón Wildlife Refuge (Dept. of Natural and Environmental Resources);
- Cabo Rojo National Wildlife Refuge (US Fish and Wildlife Service);
- Caja de Muerto Island Natural Reserve (Dept. of Natural and Environmental Resources);
- Caño La Boquilla Natural Reserve (Dept. of Natural and Environmental Resources);
- Caño Martin Peña Natural Reserve (Dept. of Natural and Environmental Resources);
- Caño Tiburones Natural Reserve (Dept. of Natural and Environmental Resources);
- Ceiba Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Cerrillos Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Culebra National Wildlife Refuge (US Fish and Wildlife Service);
- Finca Los Frailes (Puerto Rico Conservation Trust);
- Guánica Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Hacienda La Esperanza Natural Reserve (Puerto Rico Conservation Trust);
- Jobos Bay Estuary National Research Reserve (Dept. of Natural and Environmental Resources and National Oceanic and Atmospheric Administration);
- La Ciénaga Las Cucharillas Natural Reserve (Dept. of Natural and Environmental Resources);
- La Cordillera Reef Natural Reserve (Dept. of Natural and Environmental Resources);
- Lago Guajataca Wildlife Refuge (Dept. of Natural and Environmental Resources);
- Lago La Plata Wildlife Refuge (Dept. of Natural and Environmental Resources);
- Lago Luchetti Wildlife Refuge (Dept. of Natural and Environmental Resources);
- Laguna Cartegena National Wildlife Refuge (US Fish and Wildlife Service);
- Laguna de Joyuda Natural Reserve (Dept. of Natural and Environmental Resources);
- Laguna Tortuguero Natural Reserve (Dept. of Natural and Environmental Resources);
- La Parguera Natural Reserve (Puerto Rico Conservation Trust);
- Las Cabezas de San Juan Natural Area (Puerto Rico Conservation Trust);
- Mata de Plátano Field Station Natural Reserve (Citizens of the Karst Foundation);

- Medio Mundo and Daguao Natural Protected Area (Puerto Rico Conservation Trust);
- Northeast Ecological Corridor (Dept. of Natural and Environmental Resources);
- Palmas del Mar Tropical Forest Conservation Easement (Puerto Rico Conservation Trust);
- Pantano de Cibuco Natural Reserve (Dept. of Natural and Environmental Resources);
- Piñones Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Pterocarpus Forest Nature Reserve (Puerto Rico Conservation Trust);
- Pterocarpus Swamp Forest and Mandry and Santa Teresa Lakes Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Ballenas Natural Reserve (Puerto Rico Conservation Trust);
- Punta Cucharas Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Cucharas Marine Extension Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Guaniquilla Natural Reserve (Puerto Rico Conservation Trust);
- Punta Petrona Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Tuna Natural Mangrove Reserve (Dept. of Natural and Environmental Resources);
- Río Espíritu Santo Natural Reserve (Dept. of Natural and Environmental Resources);
- San Cristobal Canyon Natural Protected Area (Puerto Rico Conservation Trust);
- University of Puerto Rico Botanical Garden (Dept. of Natural and Environmental Resources);
- Vieques Bioluminescent Bay Natural Area (Dept. of Natural and Environmental Resources);
- Vieques National Wildlife Refuge (US Fish and Wildlife Service);
- Additional recently acquired lands in Piñones.

US Virgin Islands

St. Thomas

- Bovoni Cay Wildlife Sanctuary (USVI Government);
- Buck Island National Wildlife Refuge (US Fish and Wildlife Service);
- Capella Island Wildlife Sanctuary (USVI Government);
- Cas Cay Wildlife Sanctuary (USVI Government);
- Compass Point Pond Marine Reserve and Wildlife Sanctuary (USVI Government);
- Flat Cay Wildlife Sanctuary (USVI Government);
- Saba Island Wildlife Sanctuary (USVI Government);

- Salt Cay Wildlife Sanctuary (USVI Government);
- Savana Island Wildlife Sanctuary (USVI Government);
- Smith Bay Park (USVI Government);
- West Cay Wildlife Sanctuary (USVI Government);
- Whistling Cay Wildlife Sanctuary (USVI Government);

St. John

- Dog Island Wildlife Sanctuary (USVI Government);
- Flanagan Island Wildlife Sanctuary (USVI Government);
- Frank Bay Marine Reserve and Wildlife Sanctuary (USVI Government);
- Leduck Island Wildlife Sanctuary (USVI Government);
- Steven Cay Wildlife Sanctuary (USVI Government);
- US Virgin Islands National Park (US National Park Service);

St. Croix

- Altona Lagoon Beach Recreation Area (USVI Government);
- Buck Island Reef National Monument (US National Park Service);
- Butler Bay Nature Preserve (St. Croix Landmarks Society);
- Creque Dam (USVI Government);
- East End Marine Park (USVI Government);
- Estate Great Pond (USVI Government);
- Herman Hill Pond (The Nature Conservancy);
- Jack and Isaacs Bays Preserve (The Nature Conservancy);
- Manning Bay Wetlands (USVI Government);
- Ruth Cay Wildlife Sanctuary (USVI Government);
- Salt River Bay National Historic Park and Ecological Preserve (USVI Government and US National Park Service);
- Sandy Point National Wildlife Refuge (US Fish and Wildlife Service);
- Southgate Coastal Preserve (St. Croix Environmental Association);
- University of the Virgin Islands Wetlands (USVI Government).

Additional habitat conservation opportunities

Although marshes and open water habitats are generally well protected in Puerto Rico and the USVI, they are relatively isolated and spatially limited, in a manner similar to forested coastal wetlands. Therefore, in order to prevent the attrition and possible extirpation of vulnerable waterfowl and shorebird species in the region, continued protection of already conserved wetland areas is imperative. Furthermore, there are still some important habitat gaps where conservation efforts could improve, which would help meet the population objectives for individual species. Many of the sites that support migratory waterfowl also are conservation priorities for long and short-legged native wading birds.

In addition to restoring degraded wetland habitats on currently protected lands, key areas in Puerto Rico on which to focus additional conservation efforts for this habitat type are Cabuyón Mangrove in Ponce; Cuevas Lagoon in Cabo Rojo; remnants of the Guánica Lagoon in Lajas; Laguna Aguas Prietas in Fajardo; Lago Dos Bocas in Arecibo and Utuado; Lago Caonillas in Utuado; Lago Cidra in Cidra; Lago Guayo between Adjuntas and Lares; Lagos Loíza, Bairoa, and Carraízo in Caguas, Gurabo, and Trujillo Alto; Lago Garzas in Adjuntas; Lago Toa Vaca in Villalba; Lago Guayabal in Juana Diaz and Villalba; Lago Patillas in Patillas; Lago Carite in Guayama; Punta Arenas and Mar Negro in Salinas; Serrallés Lagoon Complex in Juana Diaz and Ponce; Punta Arenas in Salinas, Punta Verraco in Guayanilla; San José Lagoon in San Juan; Sabana Seca Naval Base in Toa Baja between Caño Tiburones and Hacienda La Esperanza Natural Reserves in Arecibo and Barceloneta; between Laguna Tortuguero and Pantano Cibuco Natural Reserves in Manatí and Vega Baja; in and around the Torrecillas Swamp/Piñones Commonwealth Forest/Finca Los Frailes complex in Carolina and Loiza; Flamenco, Cornelius, and Zoni Lagoons in Culebra; as well as the riparian edges of several major waterways, notably the Río Grande de Loíza, Río de la Plata, Río Grande de Arecibo, Río Grande de Añasco, Río Grande de Manatí, Gurabo River and the Río Espíritu Santo and Río Mameyes in Río Grande.

In the USVI, the marsh and open water habitats are very small in size and many are already associated with current protected areas. In St. Thomas, conservation opportunities are present at Perseverance Bay, Salt Pond, the Estate Hoffman and Humane Society Ponds, Red Hook Salt Pond, Water Island, and Great St. James Island. Marsh and open water habitat opportunities on St. John include Small Pond and Southside Pond. On St. Croix, the remnant wetlands of Krause Lagoon to the east of the industrial Container Port and the Harvey Channel are potential habitat restoration targets, and include both large salt flats that are at times inundated with water and other areas that have shallow and deep water through most of the year (Personal communication, C. Lombard, US Fish and Wildlife Service 2014).

Wetland habitat conservation should be coupled with several research initiatives as well, given that most marshbirds and native waterfowl are poorly surveyed. These include assessing the degree of depredation on nesting populations; determining disturbance tolerance levels, primarily for human-related development, contaminants, and recreation; and determining the factors influencing seasonal prey diversity and abundance among both natural and managed habitats. For example, long-legged wading birds are presumed to be important indicators of wetlands, but no comprehensive standardized survey now exists for this group to test this presumption. Increased monitoring attention and research on the effects from continuing salt extraction activities in key areas like the Cabo Rojo National Wildlife Refuge are also necessary to ensure optimal habitat conditions into the future.

These suggestions align with focal area spatial data from CWA; IBA; WFA; ACP; MAPA33; MF; and CWCS.

Finally, due to the migratory nature of many waterbird species, there is a need to develop more detailed habitat and population objectives at the regional and inter-American levels. The ACJV has met this challenge by updating and expanding its implementation plan to reflect the geographic boundaries and conservation issues of the birds incorporated in the Atlantic Flyway from Maine to Puerto Rico. Similarly, a colonial waterbird plan would help develop objectives for populations throughout the Caribbean and may improve upon the existing monitoring protocols established by the International Shorebird Survey.

Species and Conservation Levels

There are 51 species in our prioritization analysis that are associated with marshes and open water habitats. 41 of these species are represented in Puerto Rico, and 44 species are included in the USVI analysis (Table 4). Wetland habitats are essential for the life history of rails, their allies, and other waterfowl throughout the Caribbean. The Caribbean Coot, a native and once abundant species in at least Puerto Rico (though possibly always rare in the USVI) requires flooded areas with relatively high grassy vegetation, preferring *Paspalum spp.* and *Typha spp.* as nesting substrates. Ruddy Ducks and Yellow-breasted Crakes also have similar habitat requirements although Crakes prefer freshwater marshes with short grass borders over open ponds. Another species of conservation concern, the Black Rail, inhabits wet grassy areas in salt and freshwater environments. This species is believed to have been extirpated from Puerto Rico as a result of predation pressure from the mongoose (Raffaele 1989).

The regionally endemic and highly vulnerable West Indian Whistling-Duck has wider habitat preferences as compared with the Caribbean Coot, using both fresh and saltwater lagoons for roosting and foraging habitats. West Indian Whistling-Ducks prefer tree and palm stumps to build their nests, sometimes well away from wetlands. In addition, the White-cheeked Pintail and Masked Duck are important native species, and considered vulnerable in the Caribbean. Both species have a very limited extent in Puerto Rico, being confined to coastal swamp areas of Ceiba, Naguabo, and Humacao, and the saltwater ponds on Culebra and Vieques. Together these native waterfowl species share their habitat with at least eight species of popularly hunted migratory waterfowl birds: Blue-winged Teal, Green-winged Teal, Northern Pintail, Mallard, Ring-necked Duck, Hooded Merganser, Lesser Scaup, and Northern Shoveler.

Marshes and open water habitats provide foraging habitat for colonial nesting wading birds, while the surrounding mangroves and other forested wetlands afford important nesting sites. Although widespread and abundant – and generally not considered of high global conservation priority – long-legged wading birds are always species of local conservation interest as good indicators of wetland habitat quality. Yellow-crowned Night Herons, Little Blue Herons, Tricolored Herons, and Snowy Egrets are common, permanent residents, and are ubiquitous throughout Puerto Rico and the USVI, either solitary or in flocks. Important short-legged congregatory shorebirds include the Semipalmated Sandpiper and the Stilt Sandpiper, which together inhabit the spectrum of shallow to slightly deeper water in open, saline, marshy habitats, often typically

associated with mudflats and mangrove systems.

The conservation level rankings of species associated with marshes and open water habitats are as follows:

PUERTO RICO

- TIER I
 - 7 Critical Recovery (or CX) species
 - Black Rail (*Laterallus jamaicensis*)
 - American Flamingo (*Phoenicopterus ruber*)
 - Masked Duck (*Nomonyx dominicus*)
 - Piping Plover (*Charadrius melodus*)
 - Snowy Plover (*Charadrius alexandrinus*)
 - West Indian Whistling Duck (*Dendrocygna arborea*)
 - Yellow-breasted Crake (*Porzana flaviventer*)
 - 4 Immediate Management species
 - Caribbean Coot (*Fulica caribaea*)
 - Red Knot (*Calidris canutus*)
 - Ruddy Duck (*Oxyura jamaicensis*)
 - Western Sandpiper (*Calidris mauri*)
 - 13 Management Attention species
 - American Bittern (*Botaurus lentiginosus*)
 - Least Bittern (*Ixobrychus exilis*)
 - Least Sandpiper (*Calidris minutilla*)
 - Lesser Yellowlegs (*Tringa flavipes*)
 - Pied-billed Grebe (*Podilymbus podiceps*)
 - Purple Gallinule (*Porphyrio martinica*)
 - Ruddy Turnstone (*Arenaria interpres*)
 - Sanderling (*Calidris alba*)
 - Semipalmated Sandpiper (*Calidris pusilla*)
 - Solitary Sandpiper (*Tringa solitaria*)
 - Stilt Sandpiper (*Calidris himantopus*)
 - Whimbrel (*Numenius phaeopus*)
 - Yellow-crowned Night Heron (*Nyctanassa violacea*)
 - 3 Planning and Responsibility species
 - Clapper Rail (*Rallus longirostris*)
 - White-cheeked Pintail (*Anas bahamiensis*)
 - Willet (*Tringa semipalmata*)
- TIER II
 - None

- TIER III
 - None

- TIER IV
 - 5 Planning and Responsibility species
 - Bananaquit (*Coereba flaveola*)
 - Blue-winged Teal (*Anas discors*)
 - Cave Swallow (*Petrochelidon fulva*)
 - Fulvous Whistling-Duck (*Dendrocygna bicolor*)
 - Least Grebe (*Tachybaptus dominicus*)

- TIER V
 - 2 Local Population Control species
 - Peregrine Falcon (*Falco peregrinus tundrius*)
 - Great Yellowlegs (*Tringa flavipes*)

- NO TIER
 - 7 species not requiring further conservation action
 - American Golden-Plover (*Vermivora chrysoptera*)
 - Black-bellied Plover (*Pluvialis squatarola*)
 - Northern Harrier (*Circus cyaneus*)
 - Pectoral Sandpiper (*Calidris melanotos*)
 - Semipalmated Plover (*Charadrius semipalmatus*)
 - Short-billed Dowitcher (*Limnodromus griseus*)
 - Wilson's Snipe (*Gallinago delicata*)

US VIRGIN ISLANDS

- TIER I
 - 5 Critical Recovery (or CX) species
 - Caribbean Coot (*Fulica caribaea*)
 - Clapper Rail (*Rallus longirostris*)
 - American Flamingo (*Phoenicopterus ruber*)
 - Least Bittern (*Ixobrychus exilis*)
 - West Indian Whistling Duck (*Dendrocygna arborea*)
 - 2 Immediate Management species
 - Red Knot (*Calidris canutus*)
 - Willet (*Tringa semipalmata*)
 - 10 Management Attention species
 - Black-bellied Plover (*Pluvialis squatarola*)

- Least Sandpiper (*Calidris minutilla*)
- Lesser Yellowlegs (*Tringa flavipes*)
- Ruddy Duck (*Oxyura jamaicensis*)
- Ruddy Turnstone (*Arenaria interpres*)
- Semipalmated Sandpiper (*Calidris pusilla*)
- Short-billed Dowitcher (*Limnodromus griseus*)
- Solitary Sandpiper (*Tringa solitaria*)
- Stilt Sandpiper (*Calidris himantopus*)
- Whimbrel (*Numenius phaeopus*)
- 3 Planning and Responsibility species
 - Little Blue Heron (*Egretta caerulea*)
 - Sanderling (*Calidris alba*)
 - White-cheeked Pintail (*Anas bahamiensis*)
- TIER II
 - None
- TIER III
 - 8 Planning and Responsibility species
 - American Coot (*Fulica americana*)
 - Black-crowned Night-Heron (*Nycticorax nycticorax*)
 - Great Blue Heron (*Ardea Herodias*)
 - Least Grebe (*Tachybaptus dominicus*)
 - Piping Plover (*Charadrius melodus*)
 - Snowy Egret (*Egretta thula*)
 - Snowy Plover (*Charadrius alexandrinus*)
 - Tricolored Heron (*Egretta tricolor*)
- TIER IV
 - 3 Planning and Responsibility species
 - Bananaquit (*Coereba flaveola*)
 - Pied-billed Grebe (*Podilymbus podiceps*)
 - Yellow-crowned Night Heron (*Nyctanassa violacea*)
- TIER V
 - 2 Local Population Control species
 - Cattle Egret (*Bubulcus ibis*)
 - Peregrine Falcon (*Falco peregrinus tundrius*)
- NO TIER
 - 11 species not requiring further conservation action

- American Golden-Plover (*Vermivora chrysoptera*)
- Blue-winged Teal (*Anas discors*)
- Common Yellowthroat (*Geothlypis trichas*)
- Greater Yellowlegs (*Tringa melanoleuca*)
- Northern Harrier (*Circus cyaneus*)
- Palm Warbler (*Setophaga palmarum*)
- Pectoral Sandpiper (*Calidris melanotos*)
- Semipalmated Plover (*Charadrius semipalmatus*)
- Western Sandpiper (*Calidris mauri*)
- Wilson's Snipe (*Gallinago delicata*)
- Yellow-rumped Warbler (*Calidris fuscicollis*)

Recommended Actions and Strategies

- Conduct monitoring surveys on important native and migrant bird species to determine population status, and future habitat needs;
- Improve status of existing stewardship lands, conserve new additional wetland areas classified as status 3 or 4, and consider establishing habitat linkages;
- Improve mapping to supplement GAP data with sub-15 m pixel spatial analyses of open water habitats and account for small yet important landscape features.
- Assess the effects of urban development patterns (including associated pollution and recreation), and hunting on wetland habitats and bird populations;
- Assess the degree to which depredation inhibits successful reproduction of nesting populations;
- Determine the factors influencing seasonal prey diversity and abundance among both natural and managed wetland habitats;
- Investigate the importance of long-legged wading birds as indicator species of wetland habitat quality;
- Assess localized effects of a warming climate and rising sea levels on coastal wetland habitats;
- Develop guidelines for sustainable agricultural management practices that reduce soil erosion, wetland siltation, draining and ditching, and eutrophication of aquatic resources;
- Monitor the effects on shorebird habitat quality from continued salt extraction in the Cabo Rojo National Wildlife Refuge;
- Restore degraded wetland habitats by controlling or removing non-native weedy vegetation from choked waterways;
- Consider restoration of historic lagoons (e.g., Guánica and Anegado);
- Expand private lands and public engagement initiatives – Safe Harbor Program, Partners for Fish and Wildlife, economic incentives for maintaining and restoring wetlands;
- Begin a dialogue with the federal government regarding improved conservation protection on current and former military properties;

- Support strategic partnerships for refuge management, conservation education, land use zoning/planning, habitat protection, community outreach, and ecotourism;
- Improve law enforcement presence in areas and during times where hunting may stress locally breeding waterfowl;
- Scale-up habitat and population objectives and monitoring protocols that complement efforts throughout the Caribbean and inter-American levels via the Atlantic Coast Joint Venture Implementation Plan, and the development of a Caribbean colonial waterbird plan;
- Develop local and regional monitoring protocols that may complement the International Shorebird Survey;
- Review and encourage implementation of the US Clean Water Action Plan.

BEACHES, ISLETS, CLIFFS, AND RIPARIAN BARRENS

Ecology and Habitat Status

In Puerto Rico and the USVI there are more than 1000 miles of coastline, several hundred beaches, and scores of islets and small cays (PRCCC 2013b). There are also many miles of bare shoreline along inland rivers. Collectively these geographic features account for just a fraction of Puerto Rico and the USVI's total land areas. However, bare beaches and non-vegetated riparian areas, rocky shores, rock crevices on cliffs, carbonate or volcanic rocks and cays, and cave entrances by the sea provide key sites for roosting, foraging, staging, or breeding of shorebirds and colonial seabirds – the latter of which spend most of their time in coastal or open ocean waters feeding but must return to land to reproduce (PRCCC 2013b). Very few seabirds actually nest on the main islands; most prefer instead isolated islets devoid of ground predators (Saliva 2009), making these relatively limited geographic features all the more important for the seabird community.

Compared to land birds, seabird breeding sites tend to be more vulnerable to environmental stressors such as storms, predators, habitat modification, and anthropogenic influences. This is a consequence of a prolonged period of nest occupancy, the concentration of complete regional populations in a few sites, and their relatively low reproductive output which leads to a slow recovery from disturbance (Schreiber and Lee 2000). From a global conservation perspective, the status of seabirds has been lower and declined more rapidly in the past two decades than many other threatened bird groups (Croxall et al. 2012). Disruption, fragmentation, and decline of seabird populations have resulted from a suite of environmental and human-induced changes (Burger and Gochfeld 1994).

Historically, colonial nesting seabird populations in the region have been negatively affected by poaching and collection of eggs, though the present levels of these pressures has diminished with improved regulation and public awareness (Saliva 2009). Despite declines in egg harvesting, many islets are challenged by different types of human stressors, including boating, swimming, the use of all-terrain vehicles and other

types of recreation (Norton 2009, Pierce 2009, Saliva 2009). These and other development-related pressures have rendered many of the available islets unsuitable for colonial nesting birds. Several other prominent ecological issues affect these habitats and their associated seabird populations, many of them the result of anthropogenic actions. Overfishing leads to depletion of critical seabird food resources (Norton 2009), while heavy metals (e.g., cadmium), such as those found in polluted waters where seabirds feed, are reported to bioaccumulate in species such as the Bridled Tern on Culebra Island (Burger and Gochfeld 1994). Nest depredation from exotic mammals (e.g., cats, dogs, mongoose, rats, monkeys, pigs, goats) and native animal species such as land crabs and Laughing Gulls weakens reproductive success (Norton 2009, Pierce 2009, Saliva 2009). Some species are in need of direct management intervention to remove harmful vegetation (e.g., for Roseate Terns), or construct nesting shelters (e.g., for White-tailed Tropicbirds) in order to ensure survival in certain locations (Pierce 2009, Saliva 2009).

As for climate stressors on shorebirds and seabirds, there are many expected indirect effects, as discussed in the PRCCC report (2013b) on ecology and biodiversity. Among the most salient, sea level rise will result in the submersion of low elevation cays (ranging from two to about six meters above sea level) that serve as important migration stopovers for resting and replenishing energy stores. As has been observed previously on small islets off the southern coast of Puerto Rico, the loss of these cays could result in seabird displacement into marginal habitat that could increase predation risks and/or nest abandonment and chick mortality. Changes in rainfall patterns and intensity might also have an effect on the quality of coastal habitats by altering salinity and ocean acidification, thereby disrupting food webs and the prey base upon which seabird populations depend (Tripp and Collazo 2003).

As evinced in the previous paragraphs, there is a clear need for continued investigation into the ecology of coastal shorebirds and colonial seabirds throughout the region. In some cases, simple observations of nesting presence or absence, without detail about numbers of breeding pairs or fledged chicks, may suffice and would reduce research-related disturbances to colonies. On the other hand, the identification of possible local stressors and monitoring responses to local management efforts may justify more detailed data collection efforts. In all cases, interpretations must be made in light of birds moving from one colony site to another, both locally and perhaps regionally. In addition to gathering new information, communicating key messages to the public is an essential element of protecting and managing shorebird and seabird habitats. Community outreach via strategic partnerships – geared towards engaging citizens in developing increased awareness, pride, and responsibility for coastal resources and avifauna – can help assuage and perhaps even reverse the damaging impacts of human beings on roosting and nesting colonies.

In Puerto Rico there are 2,084 ha (0.2% of total land area) of beaches, islets, cliffs, and riparian barrens, of which a little more than 20% is protected as stewardship class 1, 2, or 3. The USVI has 630 ha of this habitat type (1.8% of land area) with 19% conserved. Of the 2,714 total ha that are present in PR and the USVI

combined, 20% are protected. The 15% objective is therefore met for this habitat at all geographic levels (Tables 6a, 6b, and 6c). Yet given its relative rarity, additional conservation (up to 100%) should be considered. As with marshes and open water habitats, there are numerous small beaches, islets, cliffs, and riparian barrens that fall below the 15 m resolution of the GAP pixel data, and therefore were not considered in this report.

Designated stewardship areas that contain beaches, islets, cliffs, and riparian barrens habitat (both coastal and inland):

Puerto Rico

- Aguirre Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Boquerón Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Cabo Rojo National Wildlife Refuge, (US Fish and Wildlife Service);
- Caja de Muertos Island Natural Reserve (Dept. of Natural and Environmental Resources);
- Caño La Boquilla Natural Reserve (Dept. of Natural and Environmental Resources);
- Cayo Ratones Natural Reserve (Dept. of Natural and Environmental Resources);
- Ceiba Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Cerrillos Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Culebra National Wildlife Refuge (US Fish and Wildlife Service);
- Cueva del Indio Natural Reserve (Dept. of Natural and Environmental Resources);
- Desecheo National Wildlife Refuge (US Fish and Wildlife Service);
- El Buey National Wildlife Refuge (Puerto Rico Conservation Trust);
- El Yunque National Forest (US Forest Service);
- Guánica Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Hacienda La Esperanza Natural Reserve (Puerto Rico Conservation Trust);
- Hacienda La Esperanza Marine Extension Natural Reserve (Dept. of Natural and Environmental Resources);
- Ines Maria Mendoza (Yeguas Point) Nature Reserve (Puerto Rico Conservation Trust);
- Jobos Bay Estuary National Research Reserve (Dept. of Natural and Environmental Resources and National Oceanic and Atmospheric Administration);
- La Cordillera Reef Natural Reserve (Dept. of Natural and Environmental Resources);
- Laguna Tortuguero Natural Reserve (Dept. of Natural and Environmental Resources);

- La Parguera Natural Reserve (Puerto Rico Conservation Trust);
- Las Cabezas de San Juan Natural Area (Puerto Rico Conservation Trust);
- Mona and Monita Island Natural Reserve (Dept. of Natural and Environmental Resources);
- Medio Mundo and Daguao Natural Protected Area (Puerto Rico Conservation Trust);
- Northeast Ecological Corridor (Dept. of Natural and Environmental Resources);
- Palmas del mar Tropical Forest Conservation Easement (Puerto Rico Conservation Trust);
- Pantano de Cibuco Natural Reserve (Dept. of Natural and Environmental Resources);
- Pantano de Cibuco Marine Extension Natural Reserve (Dept. of Natural and Environmental Resources);
- Piñones Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Pterocarpus Swamp Forest and Mandry and Santa Teresa Lagos Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Ballenas Natural Reserve (Puerto Rico Conservation Trust);
- Punta Cucharas Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Cucharas Marine Extension Natural Reserve (Dept. of Natural and Environmental Resources);
- Punta Guaniquilla Natural Reserve (Puerto Rico Conservation Trust);
- Punta Tuna Natural Mangrove Reserve (Dept. of Natural and Environmental Resources);
- Río Espíritu Santo Natural Reserve (Dept. of Natural and Environmental Resources);
- San Cristobal Canyon Natural Protected Area (Puerto Rico Conservation Trust);
- Seven Seas Natural Reserve (Dept. of Natural and Environmental Resources);
- Sun Bay National Park (Puerto Rico National Parks Company);
- Tres Picachos Commonwealth Forest (Dept. of Natural and Environmental Resources);
- Vieques Bioluminescent Bay Natural Reserve (Dept. of Natural and Environmental Resources);
- Vieques National Wildlife Refuge (US Fish and Wildlife);
- Additional recently acquired lands in Piñones.

US Virgin Islands

St. Thomas

- Buck Island National Wildlife Refuge (US Fish and Wildlife Service);

- Capella Island Wildlife Sanctuary (USVI Government);
- Cas Cay Wildlife Sanctuary (USVI Government);
- Cockroach Cay Wildlife Sanctuary (USVI Government);
- Cricket Rock Wildlife Sanctuary (USVI Government);
- Dutchcap Cay Wildlife Sanctuary (USVI Government);
- Flat Cay Wildlife Sanctuary (USVI Government);
- Frenchcap Cay Wildlife Sanctuary (USVI Government);
- Kalkun Cay Wildlife Sanctuary (USVI Government);
- Little St. Thomas (The Nature Conservancy);
- Magen's Bay Preserve (USVI Government and The Nature Conservancy);
- Outer Brass Island Wildlife Sanctuary (USVI Government);
- Saba Island Wildlife Sanctuary (USVI Government);
- Sail Rock Wildlife Sanctuary (USVI Government);
- Salt Cay Wildlife Sanctuary (USVI Government);
- Savana Island Wildlife Sanctuary (USVI Government);
- Spratt Bay Estates (The Nature Conservancy);
- Sula Cay Wildlife Sanctuary (USVI Government);
- Turtledove Cay Wildlife Sanctuary (USVI Government);
- West Cay Wildlife Sanctuary (USVI Government);

St. John

- Booby Rock Wildlife Sanctuary (USVI Government);
- Carval Rock Wildlife Sanctuary (USVI Government);
- Congo Cay Wildlife Sanctuary (USVI Government);
- Dog Island Wildlife Sanctuary (USVI Government);
- Flanagan Island Wildlife Sanctuary (USVI Government);
- Grass Cay Wildlife Sanctuary (USVI Government);
- Leduck Island Wildlife Sanctuary (USVI Government);
- Perkins Cay Wildlife Sanctuary (USVI Government);
- Shark Island Wildlife Sanctuary (USVI Government);
- Steven Cay Wildlife Sanctuary (USVI Government);
- Two Brothers (USVI Government);
- US Virgin Islands National Park (US National Park Service);
- Whistling Cay Wildlife Sanctuary (USVI Government);

St. Croix

- Altona Lagoon Beach Recreation Area (USVI Government);
- Buck Island Reef National Monument (US National Park Service);
- Butler Bay Nature Preserve (St. Croix Landmarks Society);
- Creque Dam (USVI Government);
- East Bay and Point Udall (USVI Government);

- Estate Clairmont Park (St. Croix Landmarks Society);
- Green Cay National Wildlife Refuge (US Fish and Wildlife Service);
- Jack and Isaacs Bays Preserve (The Nature Conservancy);
- Long Point Bay (The Nature Conservancy);
- Manning Bay Wetlands (USVI Government);
- Protestant Cay Wildlife Sanctuary (USVI Government);
- Salt River Bay National Historic Park and Ecological Preserve (USVI Government and US National Park Service);
- Sandy Point National Wildlife Refuge (US Fish and Wildlife Service);
- Southgate Coastal Preserve (St. Croix Environmental Association);
- University of the Virgin Islands Wetlands (USVI Government).

Additional habitat conservation opportunities

For many of the seabird species that inhabit the region, significant habitat conservation feats have already been accomplished, affording good to excellent protection to the areas where breeding populations have been confirmed. Indeed, the majority of seabird colonies in Puerto Rico and the USVI are situated in lands protected by the commonwealth or federal governments. Nevertheless, there is still a group of beaches, islets, cliffs, and barren riparian areas that are as of yet unprotected and, due to their proximity to other conserved areas and/or relatively minimal influence from human development, provide good opportunities for future conservation endeavors. These include the shoreline directly east of the Torrecillas Swamp Complex and Piñones Commonwealth Forest that stretches toward Loiza; between the Northeast Ecological Corridor and Seven Seas Natural Reserve; the coastline just south of the Pterocarpus Swamp Forest and Mandry and Santa Teresa Lagos Natural Reserve in Humacao; Punta Guayanés in Yabucoa, south of the Palmas del Mar Conservation Easement; between Ines Maria Mendoza (Punta Yegua) and Punta Tuna Natural Reserves; the shoreline between Aguirre Commonwealth Forest in Guayama and Palmas Pond in Arroyo; Punta Verraco in Guayanilla; from the Cabjo Rojo National Wildlife Refuge north along the coast to Boquerón Wildlife Refuge; from Caño La Boquilla Natural Reserve north towards the Añasco Balneario and on to Punta Cadena in Rincón; the northwest cliffs of Aguadilla at Punta Borinquen south of Ramey Air Base; along the Quebradilla Cliffs eastward over to the Guajataca Balneario; the coastline north of the Caño Tiburones Natural Reserve and adjacent to the Cueva del Indio Natural Reserve, and from there eastward towards Hacienda La Esperanza and Laguna Tortuguero Natural Reserves; the coastline north of the Pantano de Cibuco Natural Reserve in Vega Baja; north of the Sabana Seca Naval Facilities between Punta Boca Juana and Punta Salinas in Dorado and Toa Baja; in Vieques along the north coast from the Vieques National Wildlife Refuge to the airport; and in Culebra the non-protected stretches of coastline in the northwest part of the island that are interspersed with the holdings of the Culebra National Wildlife Refuge. Another opportunity in Culebra is privately owned Cayo Norte, of significant area (~125 ha). This site is a good candidate for collaborating with landowners to carry out seabird research and perhaps attempt to broker a future conservation agreement.

Inland opportunities for conservation of riparian barrens in Puerto Rico exist along the Río La Plata Lago La Plata and Comerio Dam; along the Río Grande de Loiza in San Lorenzo and Juncos, and north of Lago Loiza in Trujillo Alto; along the Río Fajardo; north of the Lago Patillas along the Río Grande de Patillas; along the Río Niguá and Río Majada south of Camp Santiago Army Base in Salinas; along the Río Coamo in Coamo and Santa Isabel; along the Río Jacaguas in Ponce and Juana Diaz; along the Río Guayanilla; along the Río Guanajibo in San Germán and Sabana Grande; and north of Lago Caonillas along the Río Caonillas, as well as to the south along the Río Grande de Jayuya.

In the USVI, there is a considerable portion of the coastline that is unprotected yet could potentially serve as important habitat for shorebirds and colonial seabirds. On St. Thomas, this includes the Western, Tropaco, Peterborg, Mosquito and Long Point peninsulas. Inner Brass, Little St. James Island, Water Island, and Mingo Cay represent conservation opportunities as well, and these islands have all been identified by Pierce (2009) as locations with confirmed nesting colonies of colonial seabirds. On St. John, the Fish Bay Peninsula and the coastline from Pond Bay over to East End Bay are two areas of beach habitat to consider. On St. Croix there is a conservation opportunity along the northwestern coast from Hams Bay eastward to the Carambola Beach Resort and Spa.

These suggestions align with focal area spatial data from CWA; IBA; WFA; ACP; TNC; MAPA33; MF; CWCS; and Seabirds.

One other small cay worthy of mention is Navassa Island, an uninhabited island of about 5 km² located in the Caribbean Sea about 35 miles west of the Tiburon Peninsula of Haiti. Famous for the guano deposits that were extracted in the latter half of the 19th century, today the island is claimed as an unincorporated territory of the United States, which administers it through the USFWS. Maintaining Navassa Island in conservation as a National Wildlife Refuge is a priority for the native wildlife, including large seabird colonies with Magnificent Frigatebirds and over 5,000 nesting Red-footed Boobies (USFWS 2013).

Species and Conservation Levels

41 species in our prioritization analysis are associated with beaches, islets, cliffs, and riparian barren habitats. All 41 of these species are represented in Puerto Rico, and 39 species are included in the USVI analysis (Table 4).

The specific importance of Puerto Rico and the USVI for Caribbean seabirds cannot be over emphasized. For most regional species, at least 10% of all Caribbean/West Indian nesting pairs are found in colonies here. For some species, as much as 25% of all Caribbean/West Indian nesting pairs occurs in this area (Schreiber and Lee 2000). Puerto Rico and its adjacent islands are inhabited by 16 species of breeding seabirds, five of which are residents throughout the year (Saliva 2009). Fifteen seabird species

breed in the USVI (Pierce 2009). Medium to long-term monitoring of several species affords a detailed look at population dynamics through time and space. Among the highest priority species, Boobies (Masked, Red-footed, and Brown), Audubon's Shearwaters, White-tailed Tropicbirds, Magnificent Frigatebirds, Brown Pelicans (until recently, listed as federally endangered), and Roseate Terns (federally threatened) breed colonially in select areas throughout both Puerto Rico and USVI. There are also several other species which are of at least local conservation interest, such as the Red-billed Tropicbird, Bridled Tern, and Brown Noddy. The main breeding populations of Roseate Terns are located on the USVI and the Parguera Cays off the coast of southwestern Puerto Rico. The other species nest primarily in the islets off the eastern shore of Puerto Rico near Vieques and Culebra, and Mona and Monito islands to the west. Important breeding colonies of the Brown Pelican and the White-tailed Tropicbird can also be found at a few inaccessible rocky coastal areas on the Puerto Rico mainland.

Notably, islands and cliffs also comprise part of the habitat of many pigeons and doves. Culebra, for instance, harbors sizeable populations of Zenaida doves, among other species, and many offshore cays in the USVI serve as important columbid nesting sites (Personal communication, C. Lombard, US Fish and Wildlife Service 2014).

Isolation from most human disturbances and outright development is perhaps the most important feature of beaches, islets, and cliff habitats for all breeding seabirds. Yearly fluctuations in the number of nesting pairs and nesting success at different sites is primarily associated with variability in prey availability and high winds or storms (Saliva 2009). Even so, two observed causes of seabird decline at multiple locations in both Puerto Rico and the USVI are predation by introduced mammals and human disturbance (Personal communication, J. Saliva and C. Lombard, US Fish and Wildlife Service 2012), issues requiring persistent management attention.

Species associated with beaches, islets, cliffs, and riparian barren habitats have the following conservation level rankings:

PUERTO RICO

- TIER I
 - 5 Critical Recovery (or CX) species
 - American Flamingo (*Phoenicopterus ruber*)
 - Masked Booby (*Sula dactylatra*)
 - Piping Plover (*Charadrius melodus*)
 - Snowy Plover (*Charadrius alexandrinus*)
 - White-crowned Pigeon (*Patagioenas leucocephala*)
 - 6 Immediate Management species
 - Audubon's Shearwater (*Puffinus iherminieri*)
 - Brown Booby (*Sula leucogaster*)
 - Brown Pelican (*Pelecanus occidentalis*)

- Magnificent Frigatebird (*Fregata magnificens*)
- Red-footed Booby (*Sula sula*)
- Western Sandpiper (*Calidris mauri*)
- 15 Management Attention species
 - American Oystercatcher (*Haematopus palliatus*)
 - Bridled Tern (*Onychoprion anaethetus*)
 - Brown Noddy (*Anous stolidus*)
 - Common Tern (*Sterna hirundo*)
 - Key West Quail-Dove (*Geotrygon chrysis*)
 - Least Sandpiper (*Calidris minutilla*)
 - Lesser Yellowlegs (*Tringa flavipes*)
 - Least Tern (*Sternula antillarum*)
 - Red-billed Tropicbird (*Phaethon aethereus*)
 - Roseate Tern (*Sterna dougallii dougallii*)
 - Ruddy Turnstone (*Arenaria interpres*)
 - Sanderling (*Calidris alba*)
 - Solitary Sandpiper (*Tringa solitaria*)
 - White-tailed Tropicbird (*Phaethon lepturus*)
 - Wilson's Plover (*Charadrius wilsonia*)
- 1 Planning and Responsibility species
 - Willet (*Tringa semipalmata*)
- TIER II
 - 3 Planning and Responsibility species
 - Sooty Tern (*Sterna fuscata*)
 - Scaly-naped Pigeon (*Patagioenas squamosa*)
 - Zenaida Dove (*Zenaida aurita*)
- TIER III
 - None
- TIER IV
 - 6 Planning and Responsibility species
 - Bridled Quail-Dove (*Geotrygon mystacea*)
 - Gull-billed Tern (*Gelochelidon nilotica*)
 - Mourning Dove (*Zenaida macroura*)
 - Royal Tern (*Thalasseus maximus*)
 - Sandwich Tern (*Thalasseus sandvicensis*)
 - White-winged Dove (*Zenaida asiatica*)
- TIER V

- 2 Local Population Control species
 - Laughing Gull (*Leucophaeus atricilla*)
 - Peregrine Falcon (*Falco peregrinus tundrius*)
- NO TIER
 - 3 species not requiring further conservation action
 - Black-bellied Plover (*Pluvialis squatarola*)
 - Greater Yellowlegs (*Tringa melanoleuca*)
 - Semipalmated Plover (*Charadrius semipalmatus*)

US VIRGIN ISLANDS

- TIER I
 - 3 Critical Recovery (or CX) species
 - American Flamingo (*Phoenicopterus ruber*)
 - Masked Booby (*Sula dactylatra*)
 - Magnificent Frigatebird (*Fregata magnificens*)
 - 8 Immediate Management species
 - Audubon's Shearwater (*Puffinus iherminieri*)
 - Bridled Quail-Dove (*Geotrygon mystacea*)
 - Brown Booby (*Sula leucogaster*)
 - Brown Pelican (*Pelecanus occidentalis*)
 - Red-footed Booby (*Sula sula*)
 - White-crowned Pigeon (*Patagioenas leucocephala*)
 - White-tailed Tropicbird (*Phaethon lepturus*)
 - Willet (*Tringa semipalmata*)
 - 12 Management Attention species
 - American Oystercatcher (*Haematopus palliatus*)
 - Black-bellied Plover (*Pluvialis squatarola*)
 - Brown Noddy (*Anous stolidus*)
 - Least Sandpiper (*Calidris minutilla*)
 - Lesser Yellowlegs (*Tringa flavipes*)
 - Least Tern (*Sternula antillarum*)
 - Red-billed Tropicbird (*Phaethon aethereus*)
 - Roseate Tern (*Sterna dougalli*)
 - Ruddy Turnstone (*Arenaria interpres*)
 - Sanderling (*Calidris alba*)
 - Solitary Sandpiper (*Tringa solitaria*)
 - Wilson's plover (*Charadrius wilsonia*)
 - 1 Planning and Responsibility species
 - Bridled Tern (*Onychoprion anaethetus*)

- TIER II
 - 1 Planning and Responsibility species
 - Sooty Tern (*Sterna fuscata*)

- TIER III
 - 3 Planning and Responsibility species
 - Gull-billed Tern (*Gelochelidon nilotica*)
 - Piping Plover (*Charadrius melodus*)
 - Snowy Plover (*Charadrius alexandrines*)

- TIER IV
 - 6 Planning and Responsibility species
 - Mourning Dove (*Zenaida macroura*)
 - Royal Tern (*Thalasseus maximus*)
 - Sandwich Tern (*Thalasseus sandvicensis*)
 - Scaly-naped Pigeon (*Patagioenas squamosa*)
 - White-winged Dove (*Zenaida asiatica*)
 - Zenaida Dove (*Zenaida aurita*)

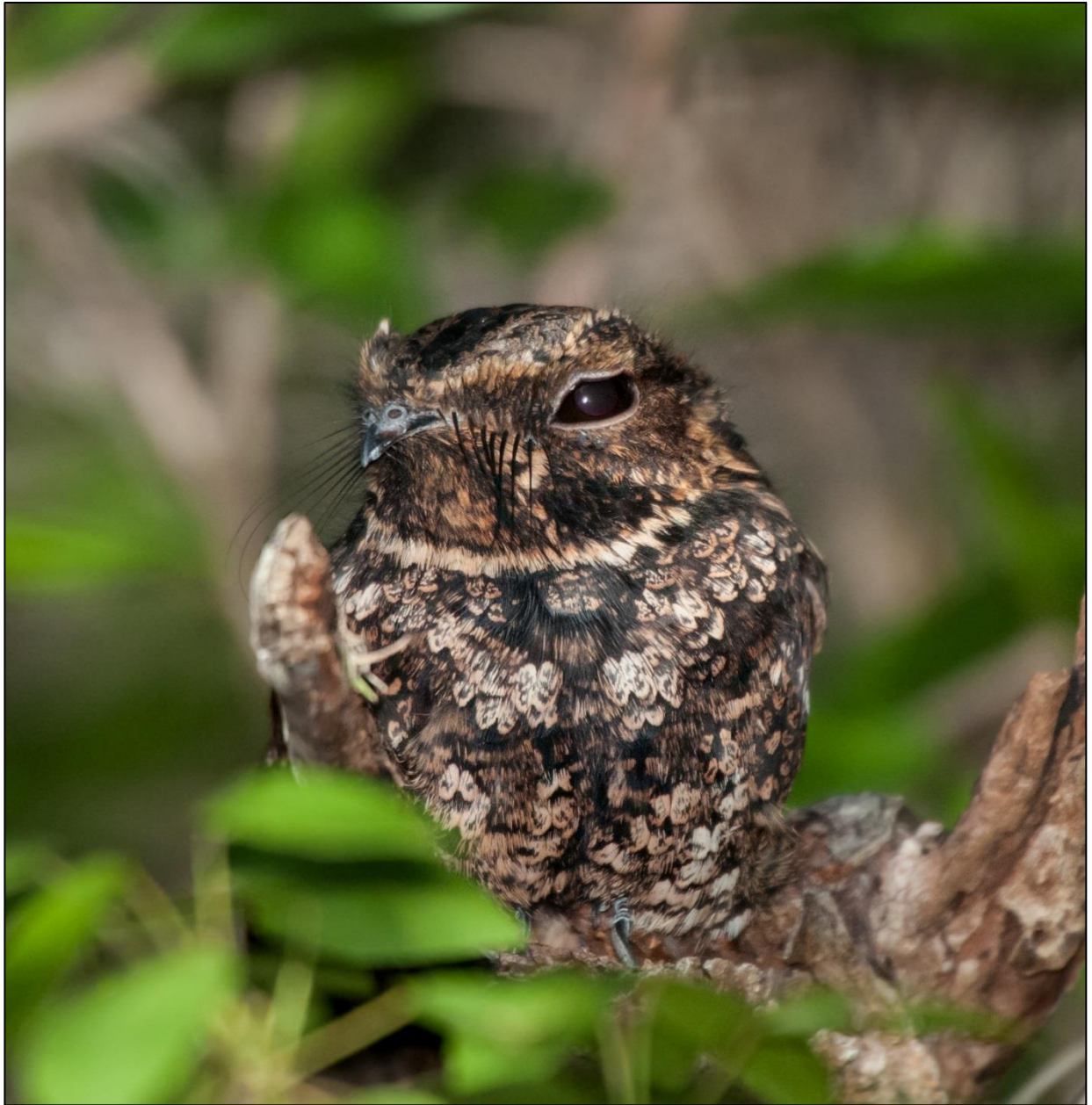
- TIER V
 - 2 Local Population Control species
 - Laughing Gull (*Leucophaeus atricilla*)
 - Peregrine Falcon (*Falco peregrinus tundrius*)

- NO TIER
 - 3 species not requiring further conservation action
 - Greater Yellowlegs (*Tringa melanoleuca*)
 - Semipalmated Plover (*Charadrius semipalmatus*)
 - Western Sandpiper (*Calidris mauri*)

Recommended Actions and Strategies

- Conduct monitoring surveys on priority colonial seabird species to determine population and breeding status, and future habitat needs;
- Maintain or improve status of existing stewardship lands, and conserve new additional seabird habitat areas classified as status 3 or 4;
- Improve mapping to supplement GAP data with sub-15 m pixel spatial analyses of beaches, islets, cliffs, and riparian barrens and account for small yet important habitat features;

- Reevaluate conservation habitat objectives for seabirds once GAP data are available;
- Remove harmful vegetation and construct nesting shelters as necessary in order to restore and protect seabird habitat;
- Assess the effects of human stressors on seabird habitats and populations, including pollution, boating, swimming, other types of recreation, overfishing, and poaching;
- Assess the degree to which depredation from exotic mammals and native species inhibits successful reproduction of nesting populations;
- Expand private lands and public engagement initiatives to conserve private islands that provide important seabird habitat (e.g., Cayo Norte, Culebra);
- Investigate localized effects of a warming climate and rising sea levels on seabird habitats;
- Support strategic partnerships with coastal communities, educational institutions, and media outlets for enhanced habitat protection, land use zoning/planning, and management, community outreach and awareness, ecotourism, and communication about important seabird conservation issues;
- Develop detailed habitat and population objectives at the regional level that account for colony migration, such as a Caribbean colonial waterbird plan;
- Develop best practices for low-disturbance local and regional monitoring protocols that complement the International Shorebird Survey.



Puerto Rican Nightjar. Photo credit: Mike Morel

SECTION 5: SPECIES-SPECIFIC POPULATION AND HABITAT OBJECTIVES

Introduction

In Section 4 we presented the dominant habitat types and associated species assemblages distributed throughout Puerto Rico and the USVI, with a focus on identifying habitat-specific conservation objectives that are intended to broadly benefit many different bird species. Here in Section 5 we sharpen the lens to consider population and habitat objectives particular to individual species, and identify geographic locations where conservation or restoration activities could be focused. Thus, ***the information in this section is useful for practitioners who want to take a species-level management approach toward avian conservation.*** Of course, conservation objectives for individual species can be used in concert with habitat-level objectives to achieve both species and community-level targets simultaneously. As in previous sections of this report, we discuss conservation objectives for Puerto Rico and the USVI separately.

We generated population estimates and future objectives (breeding pairs, unless otherwise indicated) for the highest priority native, migrant, and island endemic species considered in our analysis, based on current vulnerability assessments, population figures, and habitat densities available in the scientific literature, in concert with recommendations from Fish and Wildlife Species Recovery Reports, and from personal communication with local experts. The population objectives are intended as **long-term, lower thresholds, to be achieved or surpassed in the time span of the next 20 to 25 years**. For several species, population estimates have not been determined and the immediate objective in this case is to establish the current population size. Nevertheless, in many cases the values assigned to higher priority species can be used to derive population objectives for lower ranking species within the same habitat type. For a list of species organized by habitat see Table 4 in Section 4.

When establishing species-specific habitat objectives, it is important to consider whether or not the current suite of protected areas can meet the population objectives we define. Answering this straightforward question is rather complicated. Exactly how much area is required for any given species is difficult to assess because the functional relationships between size, configuration, and connectivity of available habitat and the benefits for associated species are not always clear (Schwartz 1999, Hierfl 2008). Sufficient data from past conservation status surveys in Puerto Rico and the USVI are available for several threatened and endangered populations, but additional scientific investigation is necessary to obtain information on distribution and habitat requirements for many other species, especially during critical stages of the life cycle (e.g., breeding).

Nonetheless, general habitat objectives can be correlated with desired population figures and GAP predicted distribution data to establish general habitat objectives for most of the threatened and endangered birds, terrestrial residents, many of the colonial

shorebirds, and a few of the migratory species included in our prioritization analysis. These conclusions can be corroborated with external recommendations, such as those reviewed in Section 2, and used to identify specific geographic locations in which conservation and recovery efforts should be considered. Species-specific population objectives are presented below, as well as in Tables 3a and 3b (Section 3) in conjunction with prioritization scores.

As with the general habitat objectives presented in Section 4, **we suggest protecting a minimum of 15% of each species' predicted habitat**, assuming this amount of conserved area (or more) would substantially benefit avifaunal feeding, maintenance behaviors, and social interactions. *This target is only a baseline and should be considered as a region-wide goal. Obligatory habitats for rare and vulnerable species should be relatively more protected, with up to 100% in some cases.* Additional evaluation is necessary to establish specific habitat conservation targets for individual species on an island by island basis. Thus, **the habitat objectives we recommended here imply maintaining any currently conserved habitat, and indicate either 1) how much additional area of land is necessary to meet the 15% threshold (i.e., the species is habitat limited); 2) in the event the 15% objective is already realized, the total additional land area (GAP status 4) recognized as potential habitat within which conservation and restoration efforts could be focused; or 3) a lack of data to make an informed judgment.** Again, the 15% target is only a minimum, and meeting or exceeding this value does not preclude the need for additional conservation efforts.

Because these objectives are based on predicted distribution models, they are not irrefutable. Furthermore, not every location is of equal value. The habitat objectives in this report say nothing about the actual quality of the habitat, biological interactions, nor the social and institutional context in which it is situated. Consequently, as with the priority scores, these objectives are meant to guide, not prescribe, and must be adapted and adjusted by managers using on-the-ground data to determine which areas provide the best opportunities for successful conservation actions.

In the following pages we outline the population and habitat objectives for Puerto Rico and the USVI bird species included in our analysis, organized by conservation tier and action level. Regional Combined Scores (RCS; see Section 3 for explanation) are included for the most vulnerable species. Based on GAP data we present the area and percentage of predicted habitat conserved as stewardship class 1, 2, or 3 lands, the additional habitat required to achieve the 15% objective, and the total potential habitat available classified as GAP status 4 (see Section 3 for GAP status definitions). For birds that are ranked as Tier I species and listed at Critical Recovery or Immediate Management action levels we build upon GAP predicted habitat data, where available, and the island-scale synthesis observations presented in Section 2 to suggest geographic focal areas in which to direct conservation efforts. Managers whose focus is on species ranked as Tier I Management Attention or Planning and Responsibility, or Tier II, III, or IV should refer to the focal areas suggested for higher ranking species. Likewise, the appendices provide multiple tables with data from various avian

conservation reports, including a full set of predicted distribution maps for all 125 species in our analysis for which GAP data exist. Together these resources can be used in developing conservation focal area priorities for species not addressed in this section.

Puerto Rico GAP data for most migratory and maritime birds are not currently available, indicating a need for further study. For those species lacking predicted habitat distributions we supplement with data from other expert resources. For example, colony surveys and interviews with local residents have confirmed where most existing foraging, roosting, and nesting sites are located for most seabird species; this information is essential for continuing to ensure the well-being of seabird populations at known breeding sites. Therefore, the following habitat recommendations for Puerto Rico seabird species are predominately based on research summarized by Saliva (2009). As additional GAP data becomes available, we will be able to combine modeled habitat opportunities with the wealth of field data and identify new priority habitat locations for future conservation endeavors. As for the USVI, GAP data exist for all fifteen of the known breeding seabird species.

PUERTO RICO

- **TIER I**

- 19 Critical Recovery (or CX) species

- **Puerto Rican Parrot** (*Amazona vittata*); RCS=25

- Population Estimate: 77-137 individuals (20-25 individuals in El Yunque National Forest and 57-112 individuals Río Abajo Commonwealth Forest; Personal communication, I. Llerandi, USFWS 2013).

- Population Objective: 350 pairs

- Habitat types: Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Urban forest

- GAP 1, 2, & 3: 5,479 ha (97.0%)

- Additional GAP 1, 2, & 3 needed for 15%: 0 ha

- Total GAP 4 available: 169 ha

- Conservation opportunities: *The Puerto Rican Parrot is registered as a federally Endangered Species and is listed as a Critically Endangered species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). The Recovery Plan for the Puerto Rican Parrot does not include specific population objectives but rather calls for wild populations in the Luquillo Mountains and northwestern karst region with population sizes yet to be determined that exhibit vital parameters consistent with a trajectory towards population. Also stipulated is the reintroduction or creation of at least a third wild population in a suitable forested area in the island. The population objective we include here (350 pairs) was reached in consultation with experts and with the intention of aligning with the criteria listed in the Recovery Plan. Nearly the entire habitat area predicted by GAP*

for the Parrot is already protected in El Yunque National Forest and Río Abajo Commonwealth Forest. A potential third reintroduction area is being investigated in Maricao Commonwealth Forest (Personal communication, I. Llerandi, USFWS 2013). These are the three best areas in which to continue restoration efforts for this species.

- **Puerto Rican Nightjar** (*Caprimulgus noctitherus*): RCS=25
 - Population Estimate: 1,400 – 2,000 male individuals (Vilella and Zwank 1993); Densities of 1.63 nightjar/ha for 263.3 ha in Guánica Forest, 0.86 nightjar/ha for 167.8 ha in Susúa Forest, and 0.99-1.40 nightjar/ha for 60.08 ha in El Convento Caves Natural Protected Area (González 2010)
 - Population Objective: Establish current population size and update objective. 1,200 pairs (600 breeding pairs in Guánica Commonwealth Forest, 400 breeding pairs in the Guayanilla-Tallaboa area, and 200 breeding pairs in Susúa Commonwealth Forest) was the objective established by the USFWS (1984, 2012)
 - Habitat types: Dry limestone forest and serpentine forest
 - GAP 1, 2, & 3: 3,812 ha (24.7%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 11,599 ha
 - Conservation opportunities: The Puerto Rican Nightjar is registered as a federally Endangered Species and is listed as an Endangered species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). Gonzalez's (2010) landscape model predicted Nightjar habitat to be 21,878 ha, considerably greater than that estimated by PRGAP, and extends habitat beyond the southwestern region of the island to include from Mayagüez to Cabo Rojo, and areas along the southern coast over to Guayama. Some 4,059 ha (18.6%) of this predicted habitat occurs within protected areas, and 81.4% of predicted Nightjar habitat is located on private land. Therefore, long-term protection of privately owned habitat is a priority for long-term protection and eventual delisting of the species (Diaz 1983, Gonzalez 2010). Priority conservation areas include the Guayanilla-Peñuelas-Ponce region, and specifically the land around Las Cuevas El Convento Natural Reserve in the Guayanilla Hills, as well as lands adjacent to Guánica Forest. Together these would buffer areas of core Nightjar populations and provide for habitat corridors. Additional consideration should be given to conserving and restoring smaller, fragmented forest patches of habitat in southeastern areas of the island (Gonzalez 2010, USFWS 2012).

- **Elfin-woods Warbler** (*Setophaga angelae*); RCS=25
 - Population Estimate: 610 pairs (derived from BirdLife International 2008)
 - Population Objective: > 1,000 pairs
 - Habitat types: Colorado, palm and Elfin Forest, Tabonuco and secondary wet forest
 - GAP 1, 2, & 3: 7,177 ha (50.5%)

- Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 7,046 ha
 - Conservation opportunities: *The Elfin-woods Warbler is listed as a Vulnerable species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). Even though half of the Elfin-woods Warbler's predicted habitat is already conserved, the area is very limited and within that potential area confirmed populations are sparse. We recommend conserving as much remaining habitat as possible to ensure the survival of this species. Cloud forest habitat in the Luquillo Mountains and Maricao Forest is secure, yet as the conspicuous absence of this warbler at Carite and Toro Negro Forests indicates (Anadón-Irizarry 2006, BirdLife International 2013), the presence of suitable habitat is no guarantee that the bird populations will persist, especially in light of changing climate patterns. Detailed research about nesting habitat and breeding biology is still thus critically needed. New conservation opportunities for this species exist in the privately held lands surrounding Toro Negro, Tres Picachos, and Guilarte Commonwealth Forests in the Central Cordillera and in the Cayey Mountains around Carite Commonwealth Forest. Developing an inter-reserve corridor system linking these forest areas would help facilitate movement between important habitat patches, likely improving access to limited resources and reducing isolation of imperiled populations (Colón-Merced 2013).*
- **Yellow-Shouldered Blackbird** (*Agelaius xanthomus*); RCS=25
- Population Estimate: < 1,000 pairs
 - Population Objective: 2,000 pairs (Personal communication, R. Lopez, PRDNER 2009)
 - Habitat types: *Tabonuco and secondary wet forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands;*
 - GAP 1, 2, & 3: 14,940 (24.5%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 46,133 ha
 - Conservation opportunities: *The Yellow-shouldered Blackbird is registered as a federally Endangered Species and is listed as an Endangered species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). Almost a quarter of the Blackbird's potential habitat area is already protected including several coastal areas in commonwealth forests and reserves located around Puerto Rico. Yet at present, populations of the Yellow-shouldered Blackbird are restricted to only a few isolated mainland locations, and Mona Island. Positive effects of present management on the Yellow-shouldered Blackbird have been documented (see Collazo et al. 1995, USFWS 1996) and are allowing this species to reach recovery at least in southwestern Puerto Rico. Intensive management, including cowbird removal, from Yellow-shouldered Blackbird nesting areas has resulted in increases in the Cabo Rojo population. Existing Blackbird*

populations in and around Cabo Rojo, La Parguera, Jobos Bay, and on Mona Island could be used to establish new populations within existing protected areas such as the Caño Tiburones Natural Reserve, Cuevas el Convento Natural Protected Area in the Guayanilla Hills, Guánica Commonwealth Forest, Las Cabezas de San Juan Natural Reserve in Fajardo, Montes Oscuros Conservation Easement (Salinas), the Río Espíritu Santo Natural Area in Río Grande, and Torrecillas Swamp Complex/Piñones Commonwealth Forest (Carolina and Loiza). The lands of the former Roosevelt Roads Naval Base (now Medio Mundo and Dagua Natural Protected Area) in Ceiba are also a possibility for translocation efforts from the Cabo Rojo, Jobos, and Mona populations; first, though, basic surveys are needed to determine the status of the Yellow-shouldered Blackbird at this site. Two additional areas to consider for reintroduction/restoration that presently do not have any level of protection are San Pedro Swamp at Sabana Seca Naval Station in Toa Baja, and the Guánica Lagoon (Lajas).

▪ **West Indian Whistling-Duck** (*Dendrocygna arborea*); RCS=22

- Population Estimate: < 100 pairs
- Population Objective: 250 pairs
- Habitat types: Marshes and open water habitats
- GAP 1, 2, & 3: 5,518 ha (49.3%)
- Additional GAP 1, 2, & 3 needed for 15%: 0 ha
- Total GAP 4 available: 5,666 ha
- Conservation opportunities: *The West Indian Whistling Duck is listed as a Critically Endangered species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). Currently, greater than 15% of the predicted distribution of the West Indian Whistling-Duck is protected, yet marshes and open water habitats are relatively isolated and spatially limited in Puerto Rico and warrant conservation attention. Currently protected habitat in reserves such as Caño Tiburones, Ciénaga Las Cucharillas, Laguna Cartagena National Wildlife Refuge, Laguna Tortuguero Natural Reserve, Pantano de Cibuco Natural Reserve, and Pterocarpus Swamp Forest and Mandry and Santa Teresa Lagunas Natural Reserve should be maintained.*

Key areas in and around which to consider additional conservation efforts (according to GAP predicted habitat analysis) are Boquerón Commonwealth Forest, Boquerón Wildlife Refuge (Cabo Rojo), Cabo Rojo National Wildlife Refuge, Carrizales Mangroves (Hatillo), Ceiba Commonwealth Forest, Hyatt Dorado Beach Resort, San Pedro Swamp at Sabana Seca Naval Station (Toa Baja), El Mameyal wetland west of San Pedro Swamp (Dorado), Medio Mundo y Dagao Natural Protected Area (formerly Roosevelt Roads Naval Station), Piñones Commonwealth Forest and the Torrecillas Swamp Complex (Carolina and Loiza), the San José Lagoon (San Juan), Río Espíritu Santo Natural Reserve (Río Grande), Seven Seas Natural Reserve

(Aguas Prietas Lagoon, Fajardo), and Vieques National Wildlife Refuge (Kiani Lagoon, Chiva Swamp). Habitat linkages should also be considered between Finca Belvedere and the Laguna de Joyuda Natural Reserves in Cabo Rojo, and connecting Caño Tiburones (Arecibo) and Hacienda La Esperanza (Manatí) Natural Reserves. Given the wider habitat preferences of the West Indian Whistling-Duck – which overlap with other species but also include saltwater lagoons – protecting significant portions of its predicted habitat would simultaneously serve to conserve habitat for other high priority native and migratory waterfowl, such as the Ruddy Duck, Masked Duck, White-cheeked Pintail, and Yellow-breasted Crane.

- **Masked Booby** (*Sula dactylatra*); RCS=22
 - Population Estimate: 175-225 pairs (Saliva 2009)
 - Population Objective: > 500 pairs
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: *The Masked Booby is listed as a Data Deficient species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). Breeding is limited to Alcarraza Island in the Culebra Archipelago and the island of Monito, both of which are protected sites (Saliva 2009). It has nesting habits similar to the Brown Booby, preferring open spaces on the ground among herbaceous vegetation or exposed in areas of jagged volcanic rock. Priorities for conservation include maintaining or improving the status of currently protected areas, securing similar habitat on nearby unprotected islets, and controlling predation from introduced mammals, particularly rats. Future GAP analysis is necessary for this species in Puerto Rico.*

- **Piping Plover** (*Charadrius melodus*); RCS=22
 - Population Estimate: < 50 individuals
 - Population Objective: Maintain current population
 - Habitat types: Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: *The Piping Plover is registered as a federally Threatened species and listed as a Critically Endangered species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). Prime habitat areas for the Piping Plover currently under conservation protection are the salt flats at Cabo Rojo National Wildlife Refuge (Personal communication, A. Morales-Pérez and S. Colón, Puerto Rico Ornithological Society (Sociedad Ornitológica de Puerto Rico 2013).*

This species is also observed at the mouths of the Camuy and Añasco Rivers (Personal communication, A. Morales-Pérez, Sociedad Ornitológica de Puerto Rico 2013) Other predicted habitat includes Ciénaga Las Cucharillas Natural Reserve (Cataño), the Northeast Ecological Corridor (Luquillo), and the Río Espíritu Santo Natural Reserve in Río Grande. Priorities for conservation are maintaining or improving the conservation status at existing stewardship areas and securing similar habitat on sandy or gravel beaches or shoals along the water's edge in the active tide zone. Future GAP analysis is necessary for this species in Puerto Rico.

▪ **White-crowned Pigeon** (*Patagioenas leucocephala*); RCS=21

- Population Estimate: < 1,000 pairs
- Population Objective: 2,500 pairs
- Habitat types: *Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands*
- GAP 1, 2, & 3: 6,806 ha (47%)
- Additional GAP 1, 2, & 3 needed for 15%: 0 ha
- Total GAP 4 available: 7,683 ha
- Conservation opportunities: *The White-crowned Pigeon is listed as a Data Deficient species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (García et al. 2005). Robust populations have been confirmed at very few locations, amounting to only a few hundred hectares of total habitat. The actual distribution of the species suggests that isolation and reduction on hunting pressures are the most important factors determining habitat use and may be responsible for the abundance of the species on Mona Island. Therefore, although it is promising that almost half the White-crowned Pigeon's predicted habitat is protected, 15% appears to be much too low of a habitat objective for the conservation of healthy population dynamics. Achieving the population objective of 2,500 pairs may necessitate the protection of most if not all of this bird's GAP Status 4 habitat. Currently protected habitat in stewardship areas such as Boquerón Commonwealth Forest, Cabo Rojo National Wildlife Refuge, Ciénaga Las Cucharillas (Cataño), Caño Tiburones (Arecibo) and Pantano de Cibuco (Vega Baja) Natural Areas, Culebra National Wildlife Refuge (Los Caños and Puerto del Manglar) Pterocarpus Swamp Forest and Mandry and Santa Teresa Lagos Natural Reserve (Humacao), and Vieques National Wildlife Refuge (Kiani, Playa Grande, Yanuel Lagoons, Ensenada Honda Mangrove, Chiva Swamp, Tapón Bay) should be maintained.*

Key areas in and around which to focus additional efforts are the Aguirre Commonwealth Forest and Jobos Bay Estuary National Research Reserve (Guayama and Salinas), Boquerón Commonwealth Forest – Guanajibo Mangroves Segment (Mayagüez), Boquerón Wildlife Refuge (Cabo Rojo), Cabuyón Mangroves in Ponce, Caño Tiburones Natural Reserve, the Hyatt Dorado Beach Resort, San Pedro Swamp at Sabana Seca Naval Station

(Toa Baja), Hacienda La Esperanza Natural Reserve (Manatí), Ceiba Commonwealth Forest, Medio Mundo y Dagao Natural Protected Area (formerly Roosevelt Roads Naval Station), Pterocarpus Forest Nature Reserve, Piñones Commonwealth Forest and the Torrecillas Swamp Complex (Carolina and Loiza), San José Lagoon (San Juan), Baja Swamp and Herrera River Mouth (west of Río Espíritu Santo Natural Reserve in Río Grande), Seven Seas Natural Reserve (Fajardo), Flamenco Lagoon (Culebra) and on Vieques at Ferros Bay, Mosquito Bay, and Sombe Bay. Habitat linkages should be considered between the Laguna de Joyuda, Finca Belvedere, and Punta Guaniquilla Natural Reserves and Boquerón Wildlife Refuge; between Pterocarpus Forest Nature Reserve, Ceiba Commonwealth Forest, and Medio Mundo y Dagao Natural Protected Area; between the Río Espíritu Santo Natural Reserve and Northeast Ecological Corridor, and between Caño Tiburones and Hacienda La Esperanza Natural Reserves.

- **Plain Pigeon** (*Patagioenas inornata wetmorei*); RCS=21
 - Population Estimate: < 1,000 pairs (Derived from USFWS 2011)
 - Population Objective: 2,500 pairs
 - Habitat types: *Tabonuco* and secondary wet forest; Moist limestone (karst) forest; Urban forest
 - GAP 1, 2, & 3: 4,371 ha (1.4%)
 - Additional GAP 1, 2, & 3 needed for 15%: 41,642 ha
 - Total GAP 4 available: 302,384 ha
 - Conservation opportunities: *The Plain Pigeon is registered as a federally Endangered species and listed as an Endangered species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). Dating back to 1982, the Recovery Plan for this bird calls for at least two distinct populations, each consisting of at least 250 nesting pairs (U.S. Fish and Wildlife Service 1982). Though recovery criteria have not been officially met, more recent reports (Ventosa-Febles et al. 2005b, Birdlife International 2008) suggest that populations of Plain Pigeons may at present be approaching those numbers. Considering that significant portions of suitable habitat fall on private lands in a fragmented landscape, we suggest a minimum of 2,500 breeding pairs an appropriate population target for the long-term success of this species in a fragmented landscape. The GAP potential habitat of the Plain Pigeon is quite large, yet only a small sliver of this area is conserved, including stewardship areas managed by federal, commonwealth, and non-profit entities. Accomplishing the 15% habitat objective for the Plain Pigeon is a rather unattainable, given land ownership demographics; for the time being, a conservation target of 5% (~11,000 ha) of the predicted habitat is more realistic.*

Extending conservation easements and natural resource management efforts to the forested land around and between Carite Commonwealth Forest, Aguas Buenas Caverns and Cave Systems Natural Reserve, and

San Cristobal Canyon Natural Protected Area, would be an important stride towards helping restore primary Plain Pigeon habitat in the east-central municipalities of Aguas Buenas, Aibonito, Caguas, Carite, Cidra, and Comerio. If the Plain Pigeon continues to increase its range eastward as in recent years (USFWS 2011) private lands in Gurabo and San Lorenzo should be considered as well. Another opportunity is to develop habitat linkages in the karst region where Plain Pigeon detections have been recently made (Rivera-Milán and Martínez 2012), from Río Abajo Commonwealth Forest toward Mata de Plátano Field Station, Cambalache Commonwealth Forest, and Caño Tiburones Natural Reserve in Arecibo, and southeast toward Tres Picachos Commonwealth Forest in the Central Cordillera. These connectivity efforts would meet the Recovery Plan's call for a reintroduction and management site for a second, disjoint Plain Pigeon population.

- **Yellow-breasted Crake** (*Porzana flaviventer*); RCS=19
 - Population Estimate: < 50 pairs
 - Population Objective: > 100 pairs
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: 517 ha (62.5)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 310 ha
 - Conservation opportunities: *The Yellow-breasted Crake is listed as a Data Deficient species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). Given the extremely limited extent of suitable habitat and the high priority of this species, we recommend conserving as much habitat area as possible. In addition to maintaining currently protected areas in Caño Tiburones Natural Reserve (Arecibo) and Laguna Cartagena National Wildlife Refuge (Cabo Rojo), key locations around which to focus additional efforts for the Yellow-breasted Crake are wetland areas between the Pterocarpus Swamp Forest and Mandry and Santa Teresa Lagunas Natural Reserve (Humacao), between the Laguna Tortuguero and Pantano de Cibuco Natural Reserve (Vega Baja), the Guánica Lagoon (Lajas), Boquerón Commonwealth Forest – Guanajibo Mangroves Segment (Mayagüez), and in isolated wetland patches on the agricultural land between the Boquerón Wildlife Refuge and Laguna Cartagena.*

- **Masked Duck** (*Nomonyx dominicus*); RCS=18
 - Population Estimate: < 50 pairs
 - Population Objective: > 100 pairs
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available

- Conservation opportunities: *The Masked Duck is listed as an Endangered species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (García et al. 2005). It is a rare, permanent resident with a very limited extent in Puerto Rico. It prefers coastal freshwater ponds with floating vegetation, though will also utilize saltwater lagoons (Raffaele 1989). Many of the areas it is known to inhabit are already protected, and these should be maintained: Boquerón Wildlife Refuge (Cabo Rojo), Caja de Muertos Natural Area (Ponce), Caño Tiburones Natural Area (Arecibo), Ciénaga Las Cucharillas Natural Area (Cataño), Hacienda La Esperanza Natural Area (Manatí), Laguna Cartagena National Wildlife Refuge (Cabo Rojo), Northeast Ecological Corridor (Luquillo), Pterocarpus Forest Nature Reserve (Humacao), the Torrecillas Swamp Complex/Piñones Commonwealth Forest (Carolina and Loiza), and Vieques National Wildlife Refuge (Anones, Kiani, Matías, Playa Grande, and Yanuel Lagoons, Chiva Swamp, Ensenada Honda Mangrove) should remain protected.*

Additional conservation opportunities exist for this high priority species in and around Baja Swamp and Herrera River Mouth Critical Wildlife Area (west of the Río Espíritu Santo Natural Reserve), Cornelius Lagoon (Culebra), Cuevas lagoon (Cabo Rojo), Cayures Swamp/Central Coloso (Aguada), Palmas Pond (Arroyo), and on Vieques at Ferros Bay, Mosquito Bay, and Sombe Bay. The Masked Duck shares habitat with several species of popularly hunted migratory waterfowl, including Blue-winged Teal, Green-winged Teal, Northern Pintail, Mallard, Ring-necked Duck, Hooded Merganser, Lesser Scaup, and Northern Shoveler. Therefore, protecting significant portions of its predicted habitat would likewise benefit other species as well. Future GAP analysis is necessary for the Masked Duck in Puerto Rico.

- **Snowy Plover** (*Charadrius alexandrinus*); RCS=17
 - Population Estimate: < 40 pairs
 - Population Objective: > 100 pairs
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: *The Snowy Plover is listed as a Critically Endangered species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (García et al. 2005). It is an uncommon and extremely localized resident in Puerto Rico, with its primary breeding habitat within the salt flats and lagoons in Cabo Rojo (Raffaele 1989, BirdLife International 2008). It has also been recently observed at beaches and coastal flats along the western and northwestern coasts; more specifically, the mouths of the Río Camuy and Río Añasco are two important stop-over sites during annual migration (Personal communication, A. Morales-Pérez and S. Colón, Sociedad Ornitológica de Puerto Rico 2013). Ventosa-Febles*

and others (2005b) and reported the Snowy Plover within select areas of the Northeast Ecological Corridor. Maintaining or improving the protected status of these areas is a high priority, as is determining other key habitat locations. Future GAP analysis is necessary for this species in Puerto Rico.

- **Sharped-shinned Hawk** (*Accipiter striatus venator*); RCS=16
 - Population Estimate: < 15 pairs. Preliminary results from a current study suggest ≤ 5 pairs remaining in the Maricao Forest and surrounding areas. Sporadic reports of isolated individuals occur in other parts of the island: El Yunque (1 individual) and the moist karst forests of north-central Puerto Rico (± 3 individuals) (Personal communication, F. Vilella, Mississippi State Univ. 2013). A pair was recently observed at Cerro Maravilla in the Central Cordillera (Personal communication, S. Colón, Sociedad Ornitológica de Puerto Rico 2013).
 - Population Objective: 250 pairs (USFWS 1997)
 - Habitat types: Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Urban forest
 - GAP 1, 2, & 3: 20,647 ha (24.4%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 63,941 ha
 - Conservation opportunities: The present status of the Puerto Rican Sharp-shinned Hawk (SSHA) is critical. It is registered as a federally Endangered species (subspecies of the North American Sharp-shinned Hawk) and listed as a Critically Endangered species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). We closely follow the population goal established in the species' Recovery Plan, though it should be noted that this plan lacks a recent review and updated information. The last formal population estimates were made in 1991, four years before the species was listed. Furthermore, SSHA estimates at that time were limited to protected areas; little to no information exists for this species on private lands. Recent, unpublished surveys suggest a dramatically reduced island population (Personal communication, F. Vilella, Mississippi State Univ. 2013). One priority is to determine if the Puerto Rican Sharp-shinned Hawk is actually its own unique, endemic species. Its distinctly white ventral parts and its tendency to dominate habitat above 2,000 feet, rather than in coastal areas like other Sharp-shinned Hawks suggest that it may be distinct (Personal communication, S. Colón, Sociedad Ornitológica de Puerto Rico 2013). If it were its own endemic species the Puerto Rican Sharp-shinned Hawk would likely be eligible for additional local and federal funding to help carry out restoration efforts.

Almost a quarter of predicted Sharp-shinned habitat is protected and should remain unmodified. The SSHA, as well as the populations of myriad birds associated with mountain forests in Puerto Rico, may benefit from expansion of existing forest reserves (with the possible exception of the El

Yunque National Forest), in addition to increased connectivity between these protected areas. One key opportunity is to develop wildlife corridor linkages along the Central Cordillera between the upper elevation forests at Bosque del Pueblo, Guilarte, Hacienda Buena Vista Natural Protected Area, Maricao, Olimpia, Susúa, Toro Negro, and Tres Picachos. Similar habitat connections could be realized in the Cayey Mountains to the west and south of Carite Commonwealth Forest. Larger island-scale conservation design could in turn help connect these distinct habitat hot spots. Nevertheless, a fine scale habitat approach that identifies direct conservation responses for this species is a major information gap. Likewise, it is important to account for the potentially detrimental effects of severe climatic events on habitat structure along the SSHA geographic distribution. Hurricane Georges, for instance, moved across the central mountain range of Puerto Rico causing major disturbance to the Maricao Forest area. Research is needed on vegetation structure and forest succession of abandoned coffee plantations and unmanaged timber plantations and the effects on SSHA populations, especially in Maricao Forest and its surroundings where large areas of coffee and timber plantations were abandoned/unmanaged starting in the mid-1990's. Secondary growth forest may lack the structural characteristics the hawk requires, which would significantly reduce the total area of suitable habitat available (Personal communication, F. Vilella, Mississippi State Univ. 2013).

- **Broad-winged Hawk** (*Buteo platypterus brunnescens*); RCS=16
 - Population Estimate: < 60 pairs
 - Population Objective: > 60 pairs (20 breeding pairs each in El Yunque National Forest, Carite Commonwealth Forest, and Río Abajo Forest, respectively, and 200 individuals island-wide; USFWS 1997, 2010b)
 - Habitat types: Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest
 - GAP 1, 2, & 3: 25,966 ha (13.8%)
 - Additional GAP 1, 2, & 3 needed for 15%: 2,302 ha
 - Total GAP 4 available: 162,485 ha
 - Conservation opportunities: *The Puerto Rican Broad-winged Hawk is registered as a federally Endangered species and is listed as a Critically Endangered species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). We refer to the population goal established in the Recovery Plan for this species. Conservation priorities include developing habitat linkages in the Central Cordillera between Bosque del Pueblo, Guilarte, Maricao, Olimpia, Susúa, Toro Negro, Tres Picachos, and eastward to the Canyon San Cristobal Natural Area; expanding conservation protection at mid-level elevations in the Cayey Mountains around Carite Commonwealth Forest and in the Luquillo Mountains around El Yunque National Forest to buffer core populations at higher elevations; and developing habitat connections in the northern karst region around Río Abajo and Cambalache Commonwealth Forests, parts of*

the Río Encantado Natural Protected Area, and Mata de Plátano Field Station. Establishing north-south linkages between Bosque del Pueblo, Tres Picachos, and Toro Negro with Río Abajo and Río Encantado would help connect habitats and benefit not only the Broad-winged Hawk but also a multitude of species that overlap in wet and moist forests found in both the northern karst zone and the Central Cordillera.

- **Hispaniolan Parakeet** (*Psittacara chloroptera*); RCS=22
 - Population Estimate: Extirpated since 1890s
 - Population Objective: Potentially reintroduce
 - Habitat types: Tabonuco and secondary wet forest; Moist limestone (karst) forest; Urban forest
 - GAP 1, 2, & 3: 5,437 ha (100%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 0 ha
 - Conservation opportunities: The Hispaniolan Parakeet, endemic to Hispaniola and introduced to Puerto Rico, has been documented in recent decades in small non-breeding flocks around Mayagüez, San Germán, and Lares where it prefers hills and lower mountain slopes (Raffaele 1989). A Mona Island subspecies (*Psittacara chloroptera maugei*) is of primary interest from a conservation perspective, though it is believed to have been extirpated in the 1890s. Possible reintroduction to Mona is the priority for this species.

- **White-necked Crow** (*Corvus leucognaphalus*); RCS=22
 - Population Estimate: Extirpated since 1963
 - Population Objective: Potentially reintroduce
 - Habitat types: Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Non-calcareous moist forest; Urban forest
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: The White-necked Crow, a federally registered Endangered species, has been extirpated from Puerto Rico since 1963. Reintroduction of birds from Hispaniola to the Luquillo Mountains is worthy of consideration by wildlife conservation managers. Moist coastal areas may also serve as a potential reintroduction habitat for this species; see Section 4 for discussion of potential habitat locations. Future GAP analysis is necessary for this species in Puerto Rico.

- **Black Rail** (*Laterallus jamaicensis*); RCS=21
 - Population Estimate: Extirpated?
 - Population Objective: Establish population size; Potentially reintroduce
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available

- Total GAP 4 available: *Not available*
- Conservation opportunities: *The Black Rail is listed as a Data Deficient species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). Once a breeding resident, the Black Rail is now thought to be extirpated from Puerto Rico as a result of predation pressure from the mongoose (Raffaele 1989). This species should be considered for possible reintroduction in wet grassy areas associated with salt or fresh water environments. For specific habitat recommendations refer to other Rallidae with similar preferences such as the Yellow-breasted Crake and Caribbean Coot. Future GAP analysis is necessary for the Black Rail in Puerto Rico.*

- **American Flamingo** (*Phoenicopterus ruber*); RCS=18
 - Population Estimate: *Extirpated?*
 - Population Objective: *Establish population size; Potentially reintroduce*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *American Flamingos are only accidental visitors to the region, though there were formerly resident populations in Puerto Rico reported from the Boquerón salt flats, the Loíza River, and the islands of Vieques and Culebra (Raffaele 1989). This species should be considered for possible reintroduction in shallow lagoons and coastal estuaries in historic locations. Future GAP analysis is necessary for this species in Puerto Rico.*

- **Limpkin** (*Aramus guarauna*); RCS=16
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size; Potentially reintroduce*
 - Habitat types: *Moist limestone (karst) forest*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *The Limpkin is listed as a Critically Endangered species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). Once a more abundant component of the Puerto Rican avifauna, the Limpkin was believed to be extirpated in 1959, following a final sighting at Lake Loíza near Caguas (Raffaele 1959). Speculation persisted over the ensuing decades that the species may have persisted in the swampy valleys near Río Abajo Commonwealth Forest. Recent sightings in 2013 and 2014 have confirmed that the Limpkin is still alive and breeding in Puerto Rico, with observations made in the northern part of the island in the Northeast Ecological Corridor, Canóvanas near the Wal-Mart shopping plaza, and at Lago de la Plata (Personal communication, S. Colón,*

Sociedad Ornitológica de Puerto Rico 2014; Puerto Rico eBird). Future investigation is greatly needed to determine the population status of this very rare species, and explore additional sites for possible reintroduction. GAP analysis is also necessary for this species in Puerto Rico

○ 13 Immediate Management species

▪ **Puerto Rican Vireo** (*Vireo latimeri*); RCS=24

- Population Estimate: 20,000 – 25,000 pairs
- Population Objective: > 30,000 pairs
- Habitat types: Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest Moist limestone (karst) forest; Dry limestone forest and serpentine forest Non-calcareous lowland and coastal dry forest; Urban forest
- GAP 1, 2, & 3: 15,810 ha (10.5%)
- Additional GAP 1, 2, & 3 needed for 15%: 6,843 ha
- Total GAP 4 available: 135,210 ha
- Conservation opportunities: *The Puerto Rican Vireo is listed as a Vulnerable species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). Large portions of the Puerto Rican Vireo's predicted and confirmed habitat fall within more than a dozen conserved areas located throughout the western part of Puerto Rico, and continued protection of these sites is essential. Additional opportunities lie in expanding buffer zones around existing stewardship areas and developing habitat corridors between them. These include better linking Boquerón Commonwealth Forest with La Paguera Natural Reserve (Cabo Rojo and Lajas), Guánica Commonwealth Forest, and the Guayanilla-Peñuelas Hills region around Las Cuevas El Convento Natural Reserve; linking across the Central Cordillera from Maricao to Toro Negro and Tres Picachos Commonwealth forests; between Jobos Bay Reserve and Aguirre Commonwealth Forest in Salinas; and in the northern karst zone from Río Abajo westward toward Guajataca Commonwealth Forest and eastward through the Río Encantado Natural Protected Area and Cambalache Commonwealth Forest in Arecibo over to Vega Commonwealth Forest in Vega Alta. North-south linkages from Guánica through Susúa to Maricao Commonwealth Forest, from Tres Picachos and Toro Negro to Río Encantado and Río Abajo Commonwealth Forests, and from Guilarte and Bosque del Pueblo to Río Abajo would ensure island-wide habitat connectivity.*

Meeting the habitat objectives of the Vireo should also benefit other endemic bird species in dry and moist forest habitats on both limestone and volcanic substrates, such as the Puerto Rican Flycatcher, Puerto Rican Tanager, and the Adelaide's Warbler. However, conservation alone is not enough; close monitoring and status surveys of Puerto Rican Vireo populations – to determine source areas and optimal habitat characteristics,

and assess the effects of habitat loss and brood parasitism by Shiny Cowbirds (see Section 4 for further discussion) – is necessary to better inform conservation planning efforts. Likewise, more information on the range and movements and habitat use of Shiny Cowbirds can help develop management schemes to protect the Vireo and other parasitized species.

- **Caribbean Coot** (*Fulica caribaea*); RCS=23
 - Population Estimate: < 500 pairs
 - Population Objective: > 1,000 pairs
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: 498 ha (44.1%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 632 ha
 - Conservation opportunities: *The Caribbean Coot is listed as a Vulnerable species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). The limited nature of freshwater marshes in Puerto Rico makes it imperative to maintain current stewardship areas and conserve as much additional habitat as possible for the Coot. Protected status should be maintained in the following stewardship areas, many of which have been confirmed as important habitat for this species: Boquerón Commonwealth Forest (Cabo Rojo), Boquerón Wildlife Refuge (Cabo Rojo), Caño Tiburones Natural Area (Arecibo), Cerrillos Commonwealth Forest (Ponce), Hacienda La Esperanza Natural Reserve (Manatí), Lago Guajataca Wildlife Refuge (San Sebastian), Laguna Cartagena National Wildlife Refuge (Cabo Rojo), Laguna Tortuguero Natural Reserve (Manatí and Vega Baja), Pterocarpus Swamp Forest and Mandry and Santa Teresa Lagunas Natural Reserve (Humacao), Sabanetas Swamp/Caño Boquilla (Mayagüez) and Vieques National Wildlife Refuge (Anones, Matías, Playa Grande, and Yanuel Lagoons, Chiva Swamp, and Ensenada Honda Mangrove)*

Principal opportunities for additional conservation occur at Cayures Swamp/Central Coloso (Aguada), Lago Bairoa (Gurabo), Lago Las Curias (San Juan), Lago Loíza (Trujillo Alto), Lago Melania (Guayama), lagoons south of Rt. 187 and west of Baja Swamp in Loíza, Laguna Mata Redonda and other lakes on the property of the Hyatt Dorado Beach Resort south of Rt. 693, on the grounds of the St. Regis Bahia Beach Resort adjacent to the Río Espíritu Santo Natural Reserve (Río Grande), Palmas Pond (Arroyo), Pozo Hondo Swamp and the mouth of the Río Hondo (Añasco), the Serrallés Lagoon Complex (Ponce and Juana Diaz), isolated wetland patches on the agricultural land between the Boquerón Wildlife Refuge and the Laguna Cartagena National Wildlife Refuge, Flamenco and Zoni Lagoons (Culebra), and on Vieques at Ferros Bay, Mosquito Bay, and Sombe Bay.

Antillean Mango (*Anthracothorax dominicus*); RCS=21

- Population Estimate: *Unknown*
- Population Objective: *Establish population size*
- Habitat types: *Tabonuco and secondary wet forest; Moist, Dry and Littoral Grasslands/Shrubs; Urban forest*
- GAP 1, 2, & 3: *17,874 ha (3.5%)*
- Additional GAP 1, 2, & 3 needed for 15%: *58,372 ha*
- Total GAP 4 available: *490,430 ha*
- Conservation opportunities: *The Antillean Mango is listed as a Data Deficient species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). It has a restricted range (sensu BirdLife International) and is confined to the Caribbean. Potential habitat within Puerto Rico is quite extensive, encompassing just about any area within the mainland or its accompanying islands where grassland and shrublands dominate (except Vieques and Culebra), and even reaching upward into secondary wet forest areas in the hills surrounding the Central Cordillera, Sierra de Cayey, and Sierra de Luquillo. Locations where the Mango has been detected include most of the currently protected areas, yet additional opportunities remain, notably by expanding around existing natural areas and establishing corridors among them. Competition from the Green Mango is believed to be responsible for decline of the Antillean Mango in eastern Puerto Rico (Raffaele 1989), and more investigation of the habitat interactions of these two species is necessary to better inform conservation planning strategies.*

There are several high priority conservation areas for managers to consider where incorporating private lands between reserves would benefit the Antillean Mango and many other associated species. These include: in the northwest between Lago Guajataca (San Sebastian), Camuy Caves Park, Río Abajo Commonwealth Forest (Arecibo and Utuado), and Mata de Plátano Field Station (Arecibo); in the north between Cambalache Commonwealth Forest (Arecibo), Hacienda La Esperanza Natural Reserve (Manatí), Laguna Tortuguero Natural Reserve (Mantaí and Vega Baja) and Vega Commonwealth Forest (Vega Alta); in the San Juan Metropolitan area between the Ciénaga Las Cucharillas Natural Reserve (Cataño), Caño Martín Peña (San Juan), and the Nuevo Milenio and San Patricio Urban forests (San Juan); in the northeast between Torrecillas Swamp System (Carolina and Loiza), the Río Espíritu Santo Natural Reserve (Río Grande), the Northeast Ecological Corridor (Luquillo) and Seven Seas the lands located between Ceiba Commonwealth Forest Forest and Medio Mundo and Daguao Natural Protected Area; in the southeast between Sierra La Pandura Natural Protected Area, Punta Tuna Natural Mangrove Reserve (Maunabo) and the Ines María Mendoza (Punta Yegua) Natural Area (Yabucoa); in the south-central region the area between Montes Oscuras Natural Reserve, Carite Commonwealth Forest, Finca Guayama, Canyon San Cristobal Natural Area, and Aguas Buenas Caverns and Cave Systems

Natural Reserve Forest; in the southwest in the Guayanilla Hills around Las Cuevas El Convento Natural Protected Area; from Guánica Commonwealth Forest northward to Susúa and Maricao Commonwealth Forests and Lago Luchetti Wildlife Refuge (Yauco); in the Lajas Valley between Guánica Commonwealth Forest, La Parguera, Laguna Cartagena, and Cabo Rojo National Wildlife Refuge; in the west between Boquerón Wildlife Refuge, Punta Guaniquilla, Finca Belvedere, and Laguna de Joyuda Natural Reserves. There is also a large swath of unprotected habitat between the Central Cordillera and the northern karst zone that could be addressed by developing north-south habitat connections such as those proposed for the Broad-winged Hawk.

▪ **White-cheeked Pintail** (*Anas bahamiensis*); RCS=20

- Population Estimate: 700 pairs
- Population Objective: > 1,500 pairs
- Habitat types: Dry limestone forest and serpentine forest; Moist, Dry and Littoral Grasslands/Shrubs; Marshes and open water habitats
- GAP 1, 2, & 3: 2,834 ha (62.2%)
- Additional GAP 1, 2, & 3 needed for 15%: 0 ha
- Total GAP 4 available: 1,722 ha
- Conservation opportunities: *The White-cheeked Pintail is listed as a Vulnerable species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). As with other waterfowl species, conserving as much habitat as possible is a priority for the Pintail. Protected status should be maintained in the following stewardship areas, many of which are used by the White-cheeked Pintail for feeding, roosting, or nesting purposes: Aguirre Commonwealth Forest (Laguna Pozuelo, Cayos Caribe, Salinas and Guayama), Boquerón Commonwealth Forest, Boquerón Wildlife Refuge, Cabo Rojo National Wildlife Refuge (Candelario and Fraternidad Lagoons), Caño Martin Peña, Ceiba Commonwealth Forest, Ciénaga Las Cucharillas, Culebra National Wildlife Refuge (Brava Lagoon, Los Caños, Puerto del Manglar), Finca Belvedere Natural Reserve (Cabo Rojo), Guánica Commonwealth Forest (San Jacinto Salt Flats and Tamarindo Lagoon), Jobos Bay Estuary National Research Reserve (Mar Negro), La Cordillera Reef Natural Reserve (Fajardo), Laguna de Joyuda Natural Reserve in Cabo Rojo, Laguna Cartagena National Wildlife Refuge, Las Cabezas de San Juan Natural Reserve (Laguna Grande), Medio Mundo and Daguao Natural Protected Area (formerly Roosevelt Roads, Ceiba), Northeast Ecological Corridor, Pantano de Cibuco (Vega Baja), Pterocarpus Forest Nature Reserve (Humacao), Pterocarpus Swamp Forest and Mandry and Santa Teresa Lakes Natural Reserve (Humacao), Punta Ballenas Natural Reserve (Guánica), Punta Cucharas Natural Reserve (Laguna Las Salinas, Ponce), Punta Guaniquilla Natural Reserve (Cabo Rojo), Punta Petrona Natural Reserve (Santa Isabel), Río Espíritu Santo Natural Reserve (Río Grande), and the wetlands on the Palma del Mar Resort in Humacao, and Vieques National Wildlife Refuge (Anones, Kiani, Matías, Playa*

Grande, and Yanuel Lagoons, Chiva Swamp and Tapón Bay, Ensenada Honda Mangrove).

Additional conservation opportunities include habitat in and around Cabuyón Mangroves (Ponce), the mouth of the Río Coamo in Santa Isabel, Cayo Barco off the Coast of Salinas near Jobos Bay and Cayos Caribes, Cornelius, Flamenco, Maillux, and Zoni Lagoons and Los Caños Mangroves (Culebra), Cuevas Lagoon (Cabo Rojo), Ferros Bay, Mosquito Bay, and Sombe Bay (Vieques), Guánica Lagoon (Lajas), Punta Arenas in Salinas, Laguna Aguas Prietas (near Seven Seas Natural Area, Fajardo), Torrecillas Swamp System/Piñones Commonwealth Forest, San José Lagoon, Suarez Canal, and San Pedro Swamp (Toa Baja). Habitat linkages should also be considered between Caño Tiburones and Hacienda La Esperanza Natural Reserves.

- **Red-footed Booby** (*Sula sula*); RCS=20
 - Population Estimate: 3,000 – 3,025 pairs (Saliva 2009)
 - Population Objective: > 5,000 pairs
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: *The Red-footed Booby is listed as a Data Deficient species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). It is a year-round resident of the Culebra Archipelago, but nesting is very limited and only occurs intermittently on Cayos Geniquí, which is protected. It is also found on Mona and Monito Island Natural Reserves, where it is the most abundant seabird (Saliva 2009). An important breeding colony also exists on Navassa Island off the coast of Haiti. Priorities for conservation include maintaining or improving the status of currently protected areas, securing similar habitat on nearby unprotected islets with established vegetation (the Red-footed Booby prefers to nest in trees), and controlling predation from introduced mammals. One opportunity is to reintroduce boobies to Desecheo Island, where former colonies of the Redfoot persisted until habitat degradation and introduced mammals destructively impacted breeding (Saliva 2009); eradication of cats, monkeys, and goats would have to be completed first. Future GAP analysis is necessary for this species in Puerto Rico.*

- **Magnificent Frigatebird** (*Fregata magnificens*); RCS=20
 - Population Estimate: 500 – 550 pairs (Saliva 2009)
 - Population Objective: > 1,000 pairs
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available

- Conservation opportunities: *The Magnificent Frigatebird is listed as a Data Deficient species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). It is a common, permanent resident of Puerto Rico, ranging far afield for feeding purposes and hovering over shorelines throughout the archipelago as well as points inland. However, this species only nests on the protected island of Monito where they are free of disturbances from humans and potential predators. Roosting occurs on some of the islands of the Cordillera Reef Natural Reserve off the coast of Fajardo, but no nesting has been observed (Saliva 2009). Priorities for conservation include maintaining or improving the status of currently protected areas and securing similar habitat on other remote islets. Desecheo Island, a former Frigatebird nesting ground, is a good opportunity for reintroduction, once the eradication of introduced monkeys, cats, and goats is complete (Saliva 2009). Another former nesting site, the Parguera Cays (Saliva 2009), may be worth considering for reintroduction as well. Future GAP analysis is necessary for this species in Puerto Rico.*

- **Puerto Rican Oriole (*Icterus portoricensis*); RCS=20**
 - Population Estimate: < 2,500 pairs
 - Population Objective: > 5,000 pairs
 - Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Urban forest*
 - GAP 1, 2, & 3: 35,942 ha (9.25%)
 - Additional GAP 1, 2, & 3 needed for 15%: 22,845 ha
 - Total GAP 4 available: 355,970 ha
 - Conservation opportunities: *The Puerto Rican Oriole is listed as a Data Deficient species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). Its predicted habitat extends across moist and wet forest zones throughout the main island, encompassing more than twenty designated stewardship areas from the coastal zone to mid-elevations. Primary opportunities involve developing conservation buffers around currently protected forest reserves such that they allow for habitat linkages between natural reserves. These include improving conservation on private lands between Guánica Commonwealth Forest to the northwest with Susúa and Maricao Forests, and to the northeast towards Las Cuevas el Convento Natural Protected Area in the Guayanilla Hills, Hacienda Buena Vista Natural Area and Cerrillos Commonwealth Forest in Ponce; in the northern karst zone from Río Abajo westward toward Guajataca Commonwealth Forest, northward toward Mata de Plátano Field Station, and eastward through the Río Encantado Natural Protected Area and Cambalache Commonwealth forest over to Vega Commonwealth Forest; between the Montes Oscuras Conservation Eastment and Finca Guayama in Salinas; between Carite Commonwealth Forest, San Cristobal Canyon, and Aguas Buenas Caverns and Cave Systems Natural Reserve, and between Carite and the Sierra de Pandura Natural Protected Area; and in the foothills along the western, northern, and eastern flanks of El Yunque*

down toward the coast. By focusing on island-wide habitat connectivity for a high priority species such as the Puerto Rican Oriole, many other island endemics will also benefit, including the Puerto Rican Bullfinch, Puerto Rican Flycatcher, Puerto Rican Screech-Owl, Puerto Rican Spindalis, Puerto Rican Tody, Puerto Rican Vireo, and the Puerto Rican Woodpecker.

As is the case with the Puerto Rican Vireo, populations of the Puerto Rican Oriole may be severely affected by Shiny Cowbird parasitism (See section 4 for further discussion). While it is known that both the Shiny Cowbird and the Oriole have similar habitat requirements, the species distribution of the Oriole combined with its cryptic nesting habits make studies of habitat requirements difficult in moist and rain forests. Thus, information on prime breeding habitat characteristics and identification of source areas for the Oriole are still needed. Additional study of Shiny Cowbird distribution and habitat use will help inform planning and management actions to control this species.

- **Brown Booby** (*Sula leucogaster*); RCS=19
 - Population Estimate: 1,650 – 1,700 pairs (Saliva 2009)
 - Population Objective: > 3,500 pairs
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: The Brown Booby is listed as a Data Deficient species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). Brown Booby nesting habits are similar to those of the Masked Booby. There is a large colony on the Cordillera Reef Natural Reserve off the coast of Fajardo, where some 600 pairs lay eggs directly on the jagged surface of hard volcanic rock (Saliva 2009). It also nests in open spaces among vegetation in the Culebra Archipelago on Cayos Geniquí and to a lesser extent Alcarraza Island. Two additional nesting locations are the island natural reserves of Mona and Monito (Saliva 2009). Raffaele (1989) reported that Brown Boobies are known to roost in Cabo Rojo near the lighthouse and Las Croabas in Fajardo, but no breeding has been observed at either of these sites. Priorities for conservation include maintaining or improving the status of currently protected areas, securing similar habitat on nearby unprotected islets, and controlling predation from introduced mammals, particularly rats. Desecheo once hosted a large colony of Brown Boobies (Saliva 2009) and this remote island could serve as a potential reintroduction site following the eradication of predatory mammals. Future GAP analysis is necessary for this species in Puerto Rico.

- **Brown Pelican** (*Pelecanus occidentalis*); RCS=19
 - Population Estimate: 265 – 290 pairs (Saliva 2009)
 - Population Objective: > 500 pairs

- Habitat types: *Beaches, islets, cliffs and riparian barrens*
- GAP 1, 2, & 3: *10,173 ha (31.6%)*
- Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
- Total GAP 4 available: *22,027 ha*
- Conservation opportunities: *The Brown Pelican was previously registered as a federally Endangered species but has been delisted rangewide due to recovery. It is listed as an Endangered species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). Brown Pelicans are known to roost at various sites around Puerto Rico, but there are only a few locations where it currently nests on the mainland: the Northwest Cliffs of Aguadilla (not protected), in Añasco Bay (not protected), and Isla del Frío (protected) off the southeast coast of Ponce (Raffaele 1989, Saliva 2009). Other breeding sites at offshore islands include the Isla Ratones (protected) off the coast of Cabo Rojo, where the species has responded favorably to the restriction of public access, and the Montalva Cays (protected) near Guánica. One of the Montalva Cays, Cayo Don Luis, is considered the most important nesting area for the Brown Pelican in Puerto Rico (Saliva 2009). In recent decades the Pelican was reported to nest at Cayo Morrillitos, part of the protected Caja de Muertos complex off the coast of Ponce, but breeding has not been observed since the mid-1990s. In the Vieques Archipelago there is an important Brown Pelican colony located on the vegetated islet of Cayo Conejo, also protected (Saliva 2009). Other important conserved areas utilized by the Brown Pelican for feeding and roosting include Aguirre Commonwealth Forest (Guayama and Salinas), Caño Tiburones Natural Reserve (Arecibo), Boquerón Commonwealth Forest (Cabo Rojo), Boqueron Wildlife Refuge (Cabo Rojo), Cabo Rojo National Wildlife Refuge, Caño La Boquilla Natural Reserve (Añasco), Ceiba Commonwealth Forest, Ciénaga Las Cucharillas Natural Reserve (Cataño), Caño Martín Peña (San Juan), Culebra National Wildlife Refuge, Finca Belvedere Natural Reserve, Jobos Bay National Estuarine Research Reserve (Salinas), Lago la Plata Wildlife Refuge (Toa Alta), Laguna de Joyuda Natural Reserve (Cabo Rojo), Laguna Tortuguero Natural Reserve, La Parguera Natural Reserve (Lajas), Las Cabezas de San Juan Natural Area (Fajardo), Medio Mundo and Daguao Natural Protected Area (formerly Roosevelt Roads, Ceiba), Mona and Monito Islands, Pantano de Cibuco Natural Reserve (Vega Baja), Pterocarpus Forest Nature Reserve (Humacao), Pterocarpus Swamp Forest and Mandry and Santa Teresa Lagunas Natural Reserve (Humacao), Punta Cucharas Natural Reserve (Ponce), Punta Guaniquilla Natural Reserve (Cabo Rojo), Punta Petrona (Santa Isabel), Torrecillas Swamp Complex/Piñones Commonwealth Forest (Carolina & Loiza), Seven Seas Natural Area (Fajardo), Río Espíritu Santo Natural Reserve (Río Grande), and Vieques National Wildlife Refuge.*

In addition to maintaining the stewardship areas listed above, opportunities for additional conservation should be focused around protecting the

Northwest Cliffs of Aguadilla and the stretch of coastline between Mayagüez and Añasco where the Brown Pelican is known to breed. Continual monitoring of foraging populations at Caja de Muertos is also recommended. Other potential conservation sites that coincide with the Pelican's predicted distribution include: Baja Swamp and Herrera River Mouth west of Río Espíritu Santo Natural Reserve, Cabuyón Mangrove (Ponce), Carrizales Mangroves (Hatillo), Cayures Swamp (Aguada), Cuevas Lagoon (Cabo Rojo), El Mameyal wetland west of San Pedro Swamp, Guajataca Cliffs, Lago Patillas, Palmas Pond (Arroyo), Pozo Hondo Swamp (Añasco), Punta Arenas west of Jobos Bay (Salinas), Punta Verraco and Punta Ventana (Guayanilla), San José Lagoon, San Pedro Swamp at Sabana Seca Naval Facilities, Serrallés Lagoon Complex (Ponce and Juan Díaz). Important habitat linkages could be developed between Caño Tiburones and Hacienda La Esperanza Natural Reserve; between the Palmas del Mar Tropical Forest Conservation Easement, Pterocarpus Forest Nature Reserve (Humacao), Pterocarpus Swamp Forest and Mandry and Santa Teresa Lagunas Natural Reserve (Humacao), Medio Mundo and Daguao Natural Protected Area, and Ceiba Commonwealth Forest; between the Northeast Ecological Corridor and Seven Seas Natural Reserve; and between Boquerón Wildlife Refuge, Punta Guaniquilla, Finca Belvedere, and the Laguna de Joyuda Natural Reserve.

- **Audubon's Shearwater** (*Puffinus iherminieri*); RCS=18
 - Population Estimate: 25 – 40 pairs (Saliva 2009)
 - Population Objective: > 100 pairs
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: *The Audubon's Shearwater is listed as a Critically Endangered species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). This species nests on several small cays in the Culebra Archipelago, including Alcarraza Island, Cayos del Agua, Yerba, Lobito, Luis Peña, and Matojo, and probably Cayos Lobo, Ratón, and Isla Culebrita as well (Saliva 2009). Most of these cays are included within the Culebra National Wildlife Refuge and their protected status should be maintained. Nesting habits of the Shearwater include digging deep burrows near thick vegetation or seeking shelter beneath large rocks, and site fidelity is very strong. It is possible that following destruction of nest sites from storms and other natural phenomena some pairs of Audubon's Shearwater have moved to other cays but this has yet to be confirmed (Saliva 2009). Privately owned Cayo Norte is one islet of significant islets (~125 ha) around Culebra that has not been surveyed for the Shearwater, nor is it included within the existing conservation zone. This site is a good candidate for collaborating with landowners to carry out seabird research on the Shearwater and other species and perhaps*

establish a future conservation agreement. Future GAP analysis is necessary for this species in Puerto Rico.

▪ **Western Sandpiper** (*Calidris mauri*); RCS=17

- Population Estimate: *Unknown. Frequently occurs with and difficult to distinguish from other small Calidrid Sandpipers. Wunderle et al. (1989) recorded 14,712 Calidrids (Least, Western, Semipalmated, and White-rumped Sandpipers) at Jobos Bay in 1985-1986 representing 65% of all shorebirds. During the fall peak in September 1985 Calidrids accounted for 86% of the shorebirds observed at Jobos Bay, and Western Sandpipers yielded a maximum of 71 individuals (Wunderle et al. 1989). Collazo et al. (1995) calculated an average annual tally of 2,755 Calidrid individuals at the Cabo Rojo Salt Flats, representing 62% of all shorebirds observed during the study.*
- Population Objective: *Establish population size and maintain*
- Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
- GAP 1, 2, & 3: *2,984 ha (38.9%)*
- Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
- Total GAP 4 available: *4,681 ha*
- Conservation opportunities: *The Western Sandpiper is a common fall migrant and rare or uncommon in the winter and spring (Wunderle et al. 1989). It frequents mudflats. Much of its potential habitat is found within the following protected areas, several of which have been verified as important habitat resources for this species: Aguirre Commonwealth Forest (Guayama and Salinas), Boquerón Wildlife Refuge (Cabo Rojo), Boquerón Commonwealth Forest (Cabo Rojo), Cabo Rojo National Wildlife Refuge, Caño Tiburones Natural Reserve (Arecibo), Finca Belvedere Natural Reserve (Cabo Rojo), Hacienda La Esperanza Natural Reserve (Manatí), Jobos Bay National Estuarine Research Reserve (Salinas), Laguna de Joyuda Natural Reserve (Cabo Rojo), Las Cabezas de San Juan, Northeast Ecological Corridor (Luquillo), and Punta Cucharas Natural Reserve (Ponce). Although almost forty percent of the Western Sandpiper's predicted habitat is conserved in Puerto Rico, lagoons and salt ponds are relatively limited features across the landscape, and additional conservation would better secure essential sites for roosting and feeding. Opportunities include Aguas Prietas Lagoon (Fajardo), Cabuyón Mangrove (Ponce), Punta Arenas west of Jobos Bay (Salinas), and linking habitat between Boquerón Wildlife Refuge and the Boquerón Commonwealth Forest – Guanajibo Mangroves Segment, as well as between Caño Tiburones, Hacienda La Esperanza, and Cambalache Commonwealth Forest.*

▪ **Ruddy Duck** (*Oxyura jamaicensis*); RCS=16

- Population Estimate: *750 pairs*
- Population Objective: *> 1,500 pairs*
- Habitat types: *Marshes and open water habitats*

- GAP 1, 2, & 3: 3,622 ha (52.9%)
- Additional GAP 1, 2, & 3 needed for 15%: 0 ha
- Total GAP 4 available: 3,219 ha
- Conservation opportunities: *The Ruddy Duck is listed as a Vulnerable species by the Puerto Rico Comprehensive Wildlife Conservation Strategy (Garcia et al. 2005). It is a common yet local resident in Puerto Rico, and has habitat preferences similar to the Masked Duck, preferring freshwater ponds (Raffaele 1989). Its predicted habitat includes the following protected areas, several of which have been confirmed as important wetland areas for this species: Baja Swamp and Herrera River Mouth (Río Grande), Ciénaga Las Cucharillas (Cataño), Boquerón Commonwealth Forest (Cabo Rojo), Boquerón Wildlife Refuge (Cabo Rojo), Caja de Muertos Complex (Ponce), Caño La Boquilla Natural Reserve (Mayagüez), Caño Tiburones Natural Reserve (Arecibo), Cerrillos Commonwealth Forest (Ponce), Cuevas Lagoon (Cabo Rojo), Hacienda La Esperanza Natural Reserve (Manatí), Jobos Bay and Punta Pozuelo, Guayama and Salinas, Lago Guajataca (San Sebastian), Laguna Cartagena National Wildlife Refuge (Cabo Rojo), Laguna de Joyuda (Cabo Rojo), Laguna Tortuguero (Manatí and Vega Baja), Las Cabezas de San Juan Natural Reserve (Laguna Grande, Fajardo), Northeast Ecological Corridor (Luquillo), Palmas Pond (Arroyo) Punta Guaniquilla (Cabo Rojo), Punta Petrona (Santa Isabel), Medio Mundo and Daguao Natural Protected Area (formerly Roosevelt Roads, Ceiba), Pantano de Cibuco (Vega Baja), Pterocarpus Forest Nature Reserve (Humacao), Pterocarpus Swamp Forest and Mandry and Santa Teresa Lagunas Natural Reserve (Humacao), and Vieques National Wildlife Refuge (Kiani and Playa Grande Lagoons, and Chivas Swamp).*

Conserving as much habitat as possible is a priority for Ruddy Duck and other high priority waterfowl. Additional opportunities include Cayures Swamp (Añasco), Fort Buchanan Pond (Bayamón), Guánica Lagoon (Lajas), Lago Guayabal and Lago Toa Vaca in Villalba, Lago Patillas, Laguna Aguas Prietas (adjacent to Seven Seas Natural Reserve, Fajardo), Pozo Hondo Swamp (Añasco), Punta Arenas (Salinas), San José Lagoon (San Juan), San Pedro Swamp at the Sabana Seca Naval Facilities (Toa Baja), Serrallés Lagoon Complex (Ponce and Juana Diaz), and at Cornelius, Flamenco, and Zoni Lagoons on Culebra. Habitat linkages should also be considered between the Laguna Tortuguero and Patano de Cibuco Natural Reserves, and between Caño Tiburones and Hacienda La Esperanza Natural Reserves.

- **Red Knot** (*Calidris canutus*); RCS=15
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available

- Total GAP 4 available: *Not available*
- Conservation opportunities: *The Puerto Rico Comprehensive Wildlife Conservation Strategy (García et al. 2005) lists the Red Knot as a Data Deficient species of conservation priority due to a suspected reduction in population number and range. Sandy tidal flats are prime habitat for this species, the most important of which are located along the coast of Piñones Commonwealth Forest (Carolina), Pantano de Cibuco (Vega Baja), and the mouth of Río Camuy (Personal communication, S. Colón and A. Morales-Pérez, Sociedad Ornitológica de Puerto Rico 2013). To a lesser extent, the salt flats at Cabo Rojo National Wildlife Refuge are also utilized. Other stewardship areas with similar habitat include Aguirre Commonwealth Forest (Guayama and Salinas), Boquerón Commonwealth Forest (Cabo Rojo), Boquerón Wildlife Refuge (Cabo Rojo), Finca Belvedere Natural Reserve (Cabo Rojo), Guánica Commonwealth Forest (San Jacinto Salt Flats, Tamarindo Lagoon), Hacienda La esperanza Natural Reserve (Manatí), Jobos Bay Estuary National Research Reserve (Salinas), Cayo Icacos of La Cordillera Reef Natural Reserve (Fajardo), Laguna de Joyuda Natural Reserve (Cabo Rojo), Medio Mundo and Daguao Natural Protected Area (formerly Roosevelt Roads, Ceiba), Piñones Commonwealth Forest (Loiza), and Punta Guaniquilla Natural Reserve (Cabo Rojo).*

There are also additional opportunities for protection of sandy tidal flats at Carrizales Mangroves (Hatillo), Punta Arenas (Salinas), Punta Verraco (Guayanilla), the coastline north of Caño Tiburones Natural Reserve and east of the Cueva del Indio Natural Reserve in Arecibo, and the coastline between the Northeast Ecological Corridor and Seven Seas Natural Reserve. Future GAP analysis is necessary for this species in Puerto Rico.

○ 32 Management Attention species

- **Red-billed Tropicbird** (*Phaethon aethereus*); RCS=20
 - Population Estimate: 20 – 30 pairs
 - Population Objective: > 100 pairs
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **White-tailed Tropicbird** (*Phaethon lepturus*); RCS=19
 - Population Estimate: 500 – 525 pairs (Saliva 2009)
 - Population Objective: > 1,000 pairs
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*

- Conservation opportunities: *Refer to higher ranking species within habitat*
- **Semipalmated Sandpiper** (*Calidris pusilla*); RCS=19
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *1,770 ha (47.0%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *1,994 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Bridled Tern** (*Onychoprion anaethetus*); RCS=19
 - Population Estimate: *235 – 250 pairs (Saliva 2009)*
 - Population Objective: *> 1,000 pairs*
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *1,770 ha (47.0%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *1,994 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **American Oystercatcher** (*Haematopus palliatus*); RCS=18
 - Population Estimate: *< 25 pairs*
 - Population Objective: *Maintain current population*
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Least Tern** (*Sternula antillarum*); RCS=18
 - Population Estimate: *135 – 150 (Saliva 2009)*
 - Population Objective: *> 500 pairs*
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Loggerhead Kingbird** (*Tyrannus caudifasciatus*); RCS=18
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Tabonuco and secondary wet forest; Moist limestone (karst) forest; Forested coastal wetlands; Urban forest*
 - GAP 1, 2, & 3: *14,510 ha (4.2%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *37,008 ha*
 - Total GAP 4 available: *328,942 ha*

- Conservation opportunities: Refer to higher ranking species within habitat; determine if is unique, endemic species.
- **Wilson's Plover** (*Charadrius wilsonia*); RCS=17
 - Population Estimate: < 100 pairs
 - Population Objective: 200 pairs
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: 6,041 ha (49.1%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 6,262 ha
 - Conservation opportunities: Refer to higher ranking species within habitat
- **Brown Noddy** (*Anous stolidus*); RCS=17
 - Population Estimate: 1,230 – 1,300 pairs (Saliva 2009)
 - Population Objective: > 2,500 pairs
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: Refer to higher ranking species within habitat
- **Roseate Tern** (*Sterna dougallii dougallii*); RCS=17
 - Population Estimate: 935 – 1,000 (Saliva 2009)
 - Population Objective: The Roseate Tern is registered as a federally Threatened species. Objective, measureable population criteria have not been established by the Recovery Plan for this sub-species. See USFWS 2010a for delisting criteria
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: Refer to the Recovery Plan and higher ranking species within habitat for conservation opportunities.
- **Key West Quail-Dove** (*Geotrygon chrysie*); RCS=17
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Dry limestone forest and serpentine forest
Non-calcareous lowland and coastal dry forest
 - GAP 1, 2, & 3: 9,295 ha (22.4%)
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: 32,188 ha
 - Conservation opportunities: Refer to higher ranking species within habitat
- **Black-throated Blue Warbler** (*Setophaga caerulescens*); RCS=17
 - Population Estimate: Unknown

- Population Objective: *Establish population size*
 - Habitat types: *Tabonuco and secondary wet forest; Moist limestone (karst) forest; Urban forest*
 - GAP 1, 2, & 3: *3,371 ha (2.2%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *19,734*
 - Total GAP 4 available: *150,658 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Prothonotary Warbler** (*Protonotaria citrea*); RCS=17
- Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Forested coastal wetlands*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Yellow-crowned Night-Heron** (*Nyctanassa violacea*); RCS=16
- Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Forested coastal wetlands*
 - GAP 1, 2, & 3: *8,545 ha (37.0%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *14,573 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Lesser Yellowlegs** (*Tringa flavipes*); RCS=16
- Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Stilt Sandpiper** (*Calidris himantopus*); RCS=16
- Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *4,944 ha (67.4%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *2,395 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Black Swift** (*Cypseloides niger*); RCS=16
 - Population Estimate: < 50 pairs
 - Population Objective: *Maintain current population*
 - Habitat types: *Tabonuco and secondary wet forest; Moist limestone (karst) forest; Forested coastal wetlands*
 - GAP 1, 2, & 3: 16,944 ha (26.1%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 47,874 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Yellow (Golden) Warbler** (*Setophaga petechia*); RCS=16
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Dry limestone forest and serpentine forest; Forested coastal wetlands*
 - GAP 1, 2, & 3: 5,513 ha (44.8%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 6,783 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Worm-eating Warbler** (*Helmitheros vermivorus*); RCS=16
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Urban forest*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Louisiana Waterthrush** (*Parkesia motacilla*); RCS=16
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Tabonuco and secondary wet forest; Moist limestone (karst) forest; Urban forest*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **American Bittern** (*Botaurus lentiginosus*); RCS=15
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *Not available*

- Additional GAP 1, 2, & 3 needed for 15%: *Not available*
- Total GAP 4 available: *Not available*
- Conservation opportunities: *Refer to higher ranking species within habitat*

- **Solitary Sandpiper** (*Tringa solitaria*); RCS=15
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Whimbrel** (*Numenius phaeopus*); RCS=15
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Sanderling** (*Calidris alba*); RCS=15
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *1,277 ha (48.7%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *1,344 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Common Tern** (*Sterna hirundo*); RCS=15
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Northern Waterthrush** (*Parkesia novaboracensis*); RCS=15
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Forested coastal wetlands*

- GAP 1, 2, & 3: *Not available*
- Additional GAP 1, 2, & 3 needed for 15%: *Not available*
- Total GAP 4 available: *Not available*
- Conservation opportunities: *Refer to higher ranking species within habitat*

- **Pied-billed Grebe** (*Podilymbus podiceps*); RCS=14
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *1,258 ha (46.7%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *1,437 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Least Bittern** (*Ixobrychus exilis*); RCS=14
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *921 ha (32.5%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *1,909 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Purple Gallinule** (*Porphyrio martinica*); RCS=14
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *137 ha (85.4%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *23 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Ruddy Turnstone** (*Arenaria interpres*); RCS=14
 - Population Estimate: *25-175 individuals (from Wunderle et al. 1989, Collazo et al. 1995)*
 - Population Objective: *Maintain current population; establish better estimate*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *1,407 ha (48.7%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *1,481 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Least Sandpiper** (*Calidris minutilla*); RCS=14
 - Population Estimate: *Unknown. Frequently occurs with and difficult to distinguish from other small Calidrid Sandpipers. Wunderle et al. (1989)*

recorded 14,712 Calidrids (Least, Western, Semipalmated, and White-rumped Sandpipers) at Jobos Bay in 1985-1986 representing 65% of all shorebirds; during the fall peak in September 1985 Calidrids accounted for 86% of the shorebirds observed. Collazo et al. (1995) calculated an average annual tally of 2,755 Calidrid individuals at the Cabo Rojo Salt Flats, representing 62% of all shorebirds observed during the study. Observation of peak fall migration of Least Sandpipers at Jobos Bay in September, 1985 yielded a tally of 624 individuals (Wunderle et al. 1989).

- Population Objective: *Establish population size and maintain*
- Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
- GAP 1, 2, & 3: *2,559 ha (18.9%)*
- Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
- Total GAP 4 available: *10,947 ha*
- Conservation opportunities: *Refer to higher ranking species within habitat. The Least Sandpiper is abundant at Jobos Bay Estuary National Research Reserve and the Cabjo Rojo National Wildlife Refuge. At Jobos Bay it is a very common fall migrant with large flocks present on the Jobos Bay salt flats and smaller flocks on the mud flats from late July through early October. It is an uncommon winter resident and spring migrant (Wunderle et al. 1989).*

▪ **Chuck-will's-widow** (*Caprimulgus carolinensis*); RCS=14

- Population Estimate: *Unknown*
- Population Objective: *Establish population size*
- Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest Moist limestone (karst) forest*
- GAP 1, 2, & 3: *Not available*
- Additional GAP 1, 2, & 3 needed for 15%: *Not available*
- Total GAP 4 available: *Not available*
- Conservation opportunities: *Refer to higher ranking species within habitat*

○ 7 Planning and Responsibility species

▪ **Lesser Antillean Pewee** (*Contopus latirostris*); RCS=20

- Population Estimate: *< 5,000 pairs*
- Population Objective: *Maintain current population*
- Habitat types: *Moist limestone (karst) forest; Dry limestone forest and serpentine forest*
- GAP 1, 2, & 3: *13,704 ha (8.1%)*
- Additional GAP 1, 2, & 3 needed for 15%: *11,661 ha*
- Total GAP 4 available: *155,396 ha*
- Conservation opportunities: *Refer to higher ranking species within habitat; determine if is unique, endemic species*

- **Adelaide's Warbler** (*Setophaga adelaidae*); RCS=20
 - Population Estimate: 20,000 – 25,000 pairs
 - Population Objective: Maintain current population
 - Habitat types: Moist limestone (karst) forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest
 - GAP 1, 2, & 3: 3,541 ha (9.9%)
 - Additional GAP 1, 2, & 3 needed for 15%: 1,800 ha
 - Total GAP 4 available: 32,063 ha
 - Conservation opportunities: Refer to higher ranking species within habitat; in addition to mainland areas in dry and moist forest habitats on limestone and volcanic substrates, the Adelaide's Warbler is abundant in Vieques, and also found on Culebra, Culebrita, and on St. Thomas in the USVI (Personal communication, S. Colón, Sociedad Ornitológica de Puerto Rico 2013).

- **Clapper Rail** (*Rallus longirostris*); RCS=18
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Forested coastal wetlands; Marshes and open water habitats
 - GAP 1, 2, & 3: 5,201 ha (46.8%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 5,916 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Antillean Nighthawk** (*Chordeiles gundlachi*); RCS=18
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Non-calcareous lowland and coastal dry forest; Moist, Dry and Littoral Grasslands/Shrubs
 - GAP 1, 2, & 3: 18,085 ha (10.5%)
 - Additional GAP 1, 2, & 3 needed for 15%: 7,826 ha
 - Total GAP 4 available: 154,654 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Mangrove Cuckoo** (*Coccyzus minor*); RCS=17
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Tabonuco and secondary wet forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands; Urban forest
 - GAP 1, 2, & 3: 29,192 ha (11.8%)
 - Additional GAP 1, 2, & 3 needed for 15%: 7,934 ha
 - Total GAP 4 available: 218,310 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Prairie Warbler** (*Setophaga discolor*); RCS=17

- Population Estimate: *Unknown*
- Population Objective: *Establish population size*
- Habitat types: *Dry limestone forest and serpentine forest*
- GAP 1, 2, & 3: *5,932 ha (7.9%)*
- Additional GAP 1, 2, & 3 needed for 15%: *5,266 ha*
- Total GAP 4 available: *68,719 ha*
- Conservation opportunities: *Refer to higher ranking species within habitat*

- **Willet** (*Tringa semipalmata*); RCS=16
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *1,784 ha (45.5%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *2,140 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Short-eared Owl** (Gr. Antilles subsp./sp.; *Asio flammeus*); RCS=10
 - Population Estimate: *< 250 pairs*
 - Population Objective: *Maintain current population*
 - Habitat types: *Moist, Dry and Littoral Grasslands/Shrubs*
 - GAP 1, 2, & 3: *21,884 ha (12.3%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *4,702 ha*
 - Total GAP 4 available: *155,356 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **TIER II (Puerto Rico)**
 - 20 Planning and Responsibility species
 - **Puerto Rican Lizard-Cuckoo** (*Coccyzus vieilloti*); RCS=19
 - Population Estimate: *< 20,000 pairs*
 - Population Objective: *Maintain current population*
 - Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Urban forest*
 - GAP 1, 2, & 3: *32,088 ha (9.2%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *20,379 ha*
 - Total GAP 4 available: *317,691 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

 - **Puerto Rican Screech-Owl** (*Megascops nudipes*); RCS=19
 - Population Estimate: *< 20,000 pairs*
 - Population Objective: *Maintain current population*

- Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Urban forest*
- GAP 1, 2, & 3: 42,549 ha (9.3%)
- Additional GAP 1, 2, & 3 needed for 15%: 25,815 ha
- Total GAP 4 available: 413,202 ha
- Conservation opportunities: *Refer to higher ranking species within habitat*

- **Green Mango** (*Anthracothorax viridis*); RCS=19
 - Population Estimate: < 20,000 pairs
 - Population Objective: *Maintain current population*
 - Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Non-calcareous moist forest; Urban forest*
 - GAP 1, 2, & 3: 32,321 ha (7.7%)
 - Additional GAP 1, 2, & 3 needed for 15%: 30,612 ha
 - Total GAP 4 available: 387,233 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Puerto Rican Emerald** (*Chlorostilbon maugaeus*); RCS=19
 - Population Estimate: < 20,000 pairs
 - Population Objective: *Maintain current population*
 - Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Urban forest*
 - GAP 1, 2, & 3: 34,806 ha (10.6%)
 - Additional GAP 1, 2, & 3 needed for 15%: 14,368 ha
 - Total GAP 4 available: 293,019 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Puerto Rican Tody** (*Todus mexicanus*); RCS=19
 - Population Estimate: < 20,000 – 25,000 pairs
 - Population Objective: *Maintain current population*
 - Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Urban forest*
 - GAP 1, 2, & 3: 37,662 ha (9.9%)
 - Additional GAP 1, 2, & 3 needed for 15%: 19,232 ha
 - Total GAP 4 available: 341,634 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Puerto Rican Woodpecker** (*Melanerpes portoricensis*); RCS=19
 - Population Estimate: 20,000 – 25,000 pairs
 - Population Objective: *Maintain current population*

- Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands; Urban forest*
- GAP 1, 2, & 3: 48,228 ha (10.4%)
- Additional GAP 1, 2, & 3 needed for 15%: 21,298 ha
- Total GAP 4 available: 415,278 ha
- Conservation opportunities: *Refer to higher ranking species within habitat*

- **Puerto Rican Flycatcher** (*Myiarchus antillarum*); RCS=19
 - Population Estimate: 5,000 pairs
 - Population Objective: *Maintain current population*
 - Habitat types: *Tabonuco and secondary wet forest; Moist limestone (karst) forest; Dry limestone forest and serpentine forest; Forested coastal wetlands*
 - GAP 1, 2, & 3: 45,453 ha (11.1%)
 - Additional GAP 1, 2, & 3 needed for 15%: 16,006 ha
 - Total GAP 4 available: 364,276 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Puerto Rican Tanager** (*Nesospingus speculiferus*); RCS=19
 - Population Estimate: < 20,000 pairs
 - Population Objective: *Maintain current population*
 - Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Urban forest*
 - GAP 1, 2, & 3: 24,186 ha (14.9%)
 - Additional GAP 1, 2, & 3 needed for 15%: 49 ha
 - Total GAP 4 available: 137,381 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Puerto Rican Spindalis** (*Spindalis portoricensis*); RCS=19
 - Population Estimate: < 50,000 pairs
 - Population Objective: *Maintain current population*
 - Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Urban forest*
 - GAP 1, 2, & 3: 37,691 ha (8.7%)
 - Additional GAP 1, 2, & 3 needed for 15%: 27,373 ha
 - Total GAP 4 available: 396,072 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Puerto Rican Bullfinch** (*Loxigilla portoricensis*); RCS=19
 - Population Estimate: 30,000 – 37,000 pairs
 - Population Objective: *Maintain current population*

- Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Urban forest*
- GAP 1, 2, & 3: 29,126 ha (13.8%)
- Additional GAP 1, 2, & 3 needed for 15%: 2,495 ha
- Total GAP 4 available: 181,680 ha
- Conservation opportunities: *Refer to higher ranking species within habitat*

- **Black-whiskered Vireo** (*Vireo altiloquus*); RCS=18
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Urban forest*
 - GAP 1, 2, & 3: 41,308 ha (7.6%)
 - Additional GAP 1, 2, & 3 needed for 15%: 39,954 ha
 - Total GAP 4 available: 500,437 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Scaly-naped Pigeon** (*Patagioenas squamosa*); RCS=17
 - Population Estimate: *< 20,000 pairs*
 - Population Objective: *Maintain current population*
 - Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Urban forest*
 - GAP 1, 2, & 3: 44,193 ha (10.8%)
 - Additional GAP 1, 2, & 3 needed for 15%: 17,136 ha
 - Total GAP 4 available: 364,670 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Caribbean Martin** (*Progne dominicensis*); RCS=17
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist, Dry and Littoral Grasslands/Shrubs; Urban forest*
 - GAP 1, 2, & 3: 2,822 ha (2.6%)
 - Additional GAP 1, 2, & 3 needed for 15%: 13,664 ha
 - Total GAP 4 available: 107,087 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Caribbean Elaenia** (*Elaenia martinica*); RCS=16
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest*

- GAP 1, 2, & 3: 11,154 ha (37.3%)
- Additional GAP 1, 2, & 3 needed for 15%: 0 ha
- Total GAP 4 available: 18,758 ha
- Conservation opportunities: Refer to higher ranking species within habitat

- **Gray Kingbird** (*Tyrannus dominicensis*); RCS=16
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Moist, Dry and Littoral Grasslands/Shrubs; Urban forest
 - GAP 1, 2, & 3: 28,997 ha (4.0%)
 - Additional GAP 1, 2, & 3 needed for 15%: 79,818 ha
 - Total GAP 4 available: 696,435 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Red-legged Thrush** (*Turdus plumbeus*); RCS=16
 - Population Estimate: < 20,000 pairs
 - Population Objective: Maintain current population
 - Habitat types: Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Urban forest
 - GAP 1, 2, & 3: 38,622 ha (10.1%)
 - Additional GAP 1, 2, & 3 needed for 15%: 18,526 ha
 - Total GAP 4 available: 342,362 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Antillean Euphonia** (*Euphonia musica*); RCS=16
 - Population Estimate: < 20,000 pairs
 - Population Objective: Maintain current population
 - Habitat types: Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Urban forest
 - GAP 1, 2, & 3: 27,323 ha (17.9%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 125,473 ha
 - Conservation opportunities: Refer to higher ranking species within habitat; determine if is unique endemic species

- **Sooty Tern** (*Sterna fuscata*); RCS=15
 - Population Estimate: 40,500 – 40,600 pairs (Saliva 2009)
 - Population Objective: Maintain current population
 - Habitat types: Beaches, islets, cliffs and riparian barrens

- GAP 1, 2, & 3: *Not available*
- Additional GAP 1, 2, & 3 needed for 15%: *Not available*
- Total GAP 4 available: *Not available*
- Conservation opportunities: *Refer to higher ranking species within habitat*

- **Zenaida Dove** (*Zenaida aurita*); RCS=15
 - Population Estimate: 183,388 – 224,454 pairs (Derived from
 - Population Objective: > 183,000 pairs (Derived from Rivera-Milán and Martínez 2012)
 - Habitat types: *Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Urban forest*
 - GAP 1, 2, & 3: 33,990 ha (5.9%)
 - Additional GAP 1, 2, & 3 needed for 15%: 51,851 ha
 - Total GAP 4 available: 538,284 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat; this is a highly abundant and widespread species whose population has remained stable in Puerto Rico since 1986. The bag limits of Zenaida Doves were reduced (no more than 10 per day) to relieve hunting pressure (Personal communication, F. Rivera-Milán, USFWS 2013).*

- **Northern Parula** (*Parula americana*); RCS=15
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Urban forest*
 - GAP 1, 2, & 3: 6,121 ha (10.0%)
 - Additional GAP 1, 2, & 3 needed for 15%: 3,069 ha
 - Total GAP 4 available: 55,150 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **TIER III (Puerto Rico)**
 - None

- **TIER IV (Puerto Rico)**
 - 20 Planning and Responsibility species
 - **Bridled Quail-Dove** (*Geotrygon mystacea*); RCS=17
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest; Non-calcareous moist forest; Non-calcareous lowland and coastal dry forest*
 - GAP 1, 2, & 3: 9,295 ha (22.4%)

- Additional GAP 1, 2, & 3 needed for 15%: 0 ha
- Total GAP 4 available: 32,188 ha
- Conservation opportunities: Refer to higher ranking species within habitat. The Bridled Quail-Dove remains rare, with Cambalache Commonwealth Forest being one of the few areas in which a few individuals have been observed in recent years (Personal communication, F. Rivera-Milán, USFWS 2013).

- **Green-throated Carib** (*Eulampis holosericeus*); RCS=16
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Non-calcareous moist forest; Non-calcareous lowland and coastal dry forest
 - GAP 1, 2, & 3: 7,300 ha (10.3%)
 - Additional GAP 1, 2, & 3 needed for 15%: 3,361 ha
 - Total GAP 4 available: 63,773 ha
 - Conservation opportunities: Refer to higher ranking species within habitat; determine status of competitive interaction with Antillean Mango.

- **Antillean Crested Hummingbird** (*Orthorhyncus cristatus*); RCS=16
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest
 - GAP 1, 2, & 3: 16,623 ha (17.6%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 77,849 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Sandwich Tern** (*Thalasseus sandvicensis*); RCS=15
 - Population Estimate: 675 – 700 pairs (Saliva 2009)
 - Population Objective: Maintain current population
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Cave Swallow** (*Petrochelidon fulva*); RCS=15
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Moist, Dry and Littoral Grasslands/Shrubs; Marshes and open water habitats; Urban forest
 - GAP 1, 2, & 3: 25,374 ha (4.6%)
 - Additional GAP 1, 2, & 3 needed for 15%: 57,683 ha
 - Total GAP 4 available: 528,343 ha

- Conservation opportunities: Refer to higher ranking species within habitat
- **Cape May Warbler** (*Setophaga tigrina*); RCS=15
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Tabonuco and secondary wet forest; Urban forest
 - GAP 1, 2, & 3: 4,259 ha (16.9%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 20,997 ha
 - Conservation opportunities: Refer to higher ranking species within habitat
- **Royal Tern** (*Thalasseus maximus*); RCS=14
 - Population Estimate: 10 – 25 pairs (Saliva 2009)
 - Population Objective: Maintain current population
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: Refer to higher ranking species within habitat
- **Least Grebe** (*Tachybaptus dominicus*); RCS=13
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: 91 ha (26.6%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 250 ha
 - Conservation opportunities: Refer to higher ranking species within habitat
- **Yellow-billed Cuckoo** (*Coccyzus americanus*); RCS=12
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands
 - GAP 1, 2, & 3: 11,939 ha (40.7%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 17,410 ha
 - Conservation opportunities: Refer to higher ranking species within habitat
- **Black-and-white Warbler** (*Mniotilta varia*); RCS=12
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest
 - GAP 1, 2, & 3: 5,199 ha (16.7%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha

- Total GAP 4 available: 25,978 ha
- Conservation opportunities: Refer to higher ranking species within habitat

- **American Redstart** (*Setophaga ruticilla*); RCS=12
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands; Urban forest
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: Refer to higher ranking species within habitat

- **American Kestrel** (*Falco sparverius*); RCS=11
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Urban forest
 - GAP 1, 2, & 3: 12,653 (7.9%)
 - Additional GAP 1, 2, & 3 needed for 15%: 11,227 ha
 - Total GAP 4 available: 146,543 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Bananaquit** (*Coereba flaveola*); RCS=11
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands; Moist, Dry and Littoral Grasslands/Shrubs; Marshes and open water habitats; Urban forest
 - GAP 1, 2, & 3: 49,316 (9.2%)
 - Additional GAP 1, 2, & 3 needed for 15%: 30,863 ha
 - Total GAP 4 available: 485,208 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **White-winged Dove** (*Zenaida asiatica*); RCS=10
 - Population Estimate: 110,878 - 226,187 (Derived from Rivera-Milán and Martínez 2012)
 - Population Objective: < 111,000 pairs (Derived from Rivera-Milán and Martínez 2012)
 - Habitat types: Non-calcareous moist forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands; Urban forest

- GAP 1, 2, & 3: 44,725 ha (9.2%)
- Additional GAP 1, 2, & 3 needed for 15%: 28,424 ha
- Total GAP 4 available: 442,931 ha
- Conservation opportunities: Refer to higher ranking species within habitat. This is the most abundant and widespread among the columbids in PR and may be outcompeting other doves. The bag limit of doves in the aggregate was increased to 20 per day to put more hunting pressure on White-winged Doves. Continued hunting pressure will help attain the desired population objective (Personal communication, F. Rivera-Milán, USFWS 2013).

Grasshopper Sparrow (Gr. Antilles subsp./sp.; *Ammodramus savannanum*); RCS=10

- Population Estimate: < 500 pairs
- Population Objective: Maintain current population
- Habitat types: Moist, Dry and Littoral Grasslands/Shrubs
- GAP 1, 2, & 3: 6,087 ha (5.5%)
- Additional GAP 1, 2, & 3 needed for 15%: 10,546 ha
- Total GAP 4 available: 104,799 ha
- Conservation opportunities: Refer to higher ranking species within habitat

▪ **Mourning Dove** (*Zenaida macroura*); RCS=7

- Population Estimate: Unknown
- Population Objective: Establish population size
- Habitat types: Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Urban forest
- GAP 1, 2, & 3: 26,216 ha (9.8%)
- Additional GAP 1, 2, & 3 needed for 15%: 13,971 ha
- Total GAP 4 available: 241,696 ha
- Conservation opportunities: Refer to higher ranking species within habitat. Among the three dove game species the Mourning Dove seems to have the most restricted distribution; although individuals can be observed throughout the life zones, the species is rare in urban areas and is locally abundant in agricultural areas surrounded by dry forest patches dominated by trees such as *Prosopis* and *Pithecellobium*. Hunting pressure on the Mourning Dove continues to be high, in spite of the fact that the bag limit for this species was reduced to 3 per day. Movements of this species between the Dominican Republic and Puerto Rico are suspected but Mourning Doves are rarely detected in Mona Island, and no identification bands have been recovered from individuals banded in Puerto Rico and hunted in the Dominican Republic or vice versa (Personal communication, F. Rivera-Milán, USFWS 2013).

▪ **Fulvous Whistling-Duck** (*Dendrocygna bicolor*)

- Population Estimate: Unknown
- Population Objective: Establish population size

- Habitat types: *Marshes and open water habitats*
- GAP 1, 2, & 3: *11,425 ha (38.6%)*
- Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
- Total GAP 4 available: *18,182 ha*
- Conservation opportunities: *Refer to higher ranking species within habitat*

- **Blue-winged Teal** (*Anas discors*)
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *4,515 ha (54.9%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *3,703 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Gull-billed Tern** (*Gelochelidon nilotica*)
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Bicknell's Thrush** (*Catharus bicknelli*)
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Colorado, palm and Elfin Forest*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **TIER V (Puerto Rico)**
 - 2 Generic Population Control species
 - **Pearly-eyed Thrasher** (*Margarops fuscatus*); RCS=14
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands; Moist, Dry and Littoral Grasslands/Shrubs; Urban forest*
 - GAP 1, 2, & 3: *52,147 ha (8.2%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *43,662*

- Total GAP 4 available: 586,582 ha
- Conservation opportunities: Address depredation of eggs of Puerto Rican Parrots and many other species.

- **Shiny Cowbird** (*Molothrus bonariensis*); RCS=9
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands, Moist, Dry and Littoral Grasslands/Shrubs; Urban forest
 - GAP 1, 2, & 3: 9,955 ha (2.5%)
 - Additional GAP 1, 2, & 3 needed for 15%: 49,413 ha
 - Total GAP 4 available: 385,833 ha
 - Conservation opportunities: Address nest parasitism of Yellow-shouldered Blackbird, Puerto Rican Oriole, Puerto Rican Vireo, and Yellow Warbler.

- 3 Local Population Control species
 - **Laughing Gull** (*Leucophaeus atricilla*); RCS=12
 - Population Estimate: 1,300 – 1,400 pairs (Saliva 2009)
 - Population Objective: Maintain current population
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: Refer to higher ranking species within habitat

 - **Peregrine Falcon** (*Falco peregrinus tundrius*); RCS=11
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: Refer to higher ranking species within habitat

 - **Red-tailed Hawk** (*Buteo jamaicensis*); RCS=10
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Moist, Dry and Littoral Grasslands/Shrubs; Urban forest

- GAP 1, 2, & 3: 64,033 ha (7.3%)
- Additional GAP 1, 2, & 3 needed for 15%: 67,080 ha
- Total GAP 4 available: 810,054 ha
- Conservation opportunities: Refer to higher ranking species within habitat

- **NO TIER (Puerto Rico)**

- 13 species not requiring further conservation action

- **Hooded Warbler** (*Wilsonia citrine*); RCS=15

- Population Estimate: Unknown
- Population Objective: Establish population size
- Habitat types: Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Forested coastal wetlands; Urban forest
- GAP 1, 2, & 3: Not available
- Additional GAP 1, 2, & 3 needed for 15%: Not available
- Total GAP 4 available: Not available
- Conservation opportunities: Refer to higher ranking species within habitat

- **Black-bellied Plover** (*Pluvialis squatarola*); RCS=14

- Population Estimate: Unknown
- Population Objective: Establish population size
- Habitat types: Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens
- GAP 1, 2, & 3: 6,014 ha (53.0%)
- Additional GAP 1, 2, & 3 needed for 15%: 0 ha
- Total GAP 4 available: 5,342 ha
- Conservation opportunities: Refer to higher ranking species within habitat

- **Greater Yellowlegs** (*Tringa melanoleuca*); RCS=16

- Population Estimate: Unknown
- Population Objective: Establish population size
- Habitat types: Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens
- GAP 1, 2, & 3: Not available
- Additional GAP 1, 2, & 3 needed for 15%: Not available
- Total GAP 4 available: Not available
- Conservation opportunities: Refer to higher ranking species within habitat

- **Short-billed Dowitcher** (*Limnodromus griseus*); RCS=14

- Population Estimate: Unknown
- Population Objective: Establish population size
- Habitat types: Marshes and open water habitats
- GAP 1, 2, & 3: 6,405 ha (35%)
- Additional GAP 1, 2, & 3 needed for 15%: 0 ha
- Total GAP 4 available: 18,237 ha
- Conservation opportunities: Refer to higher ranking species within habitat

- **Northern Harrier** (*Circus cyaneus*); RCS=13
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Semipalmated Plover** (*Charadrius semipalmatus*); RCS=13
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *5,774 ha (24.6%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *17,710 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Pectoral Sandpiper** (*Calidris melanotos*); RCS=13
 - Population Estimate: *5-20 individuals (from Wunderle et al. 1989; Collazo et al. 1995)*
 - Population Objective: *Maintain current population; establish better estimate*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *5,111 ha (11.1%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *1,828 ha*
 - Total GAP 4 available: *41,151 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Wilson's Snipe** (*Gallinago delicata*); RCS=13
 - Population Estimate:
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Ovenbird** (*Seiurus aurocapillus*); RCS=13
 - Population Estimate:
 - Population Objective: *Establish population size*
 - Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest; Moist limestone (karst) forest; Non-calcareous moist forest; Dry limestone forest and serpentine forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands; Urban forest*

- GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
-
- **American Golden-Plover** (*Pluvialis dominica*); RCS=n/a
 - Population Estimate:
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
-
- **Golden-winged Warbler** (*Vermivora chrysoptera*); RCS=n/a
 - Population Estimate:
 - Population Objective: *Establish population size*
 - Habitat types: *Colorado, palm and Elfin Forest*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
-
- **Chestnut-sided Warbler** (*Lonchura malacca*); RCS=n/a
 - Population Estimate:
 - Population Objective: *Establish population size*
 - Habitat types: *Colorado, palm and Elfin Forest; Tabonuco and secondary wet forest*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
-
- **Kentucky Warbler** (*Geothlypis formosus*); RCS=n/a
 - Population Estimate:
 - Population Objective: *Establish population size*
 - Habitat types: *Tabonuco and secondary wet forest; Non-calcareous moist forest; Urban forest*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

US VIRGIN ISLANDS

- TIER I

- 11 Critical Recovery (or CX) species

- **Caribbean Coot** (*Fulica caribaea*); RCS=22

- Population Estimate: 12 – 24 pairs (Derived from BirdLife International 2008)
- Population Objective: Undetermined due to hybridization concerns (With American Coot)
- Habitat types: Marshes and open water habitats
- GAP 1, 2, & 3: 28 ha (14.4%)
- Additional GAP 1, 2, & 3 needed for 15%: 1.3 ha
- Total GAP 4 available: 168 ha
- Conservation opportunities: The Caribbean Coot is listed as Locally Endangered and a species of Greatest Concern according to the USVI Comprehensive Wildlife Conservation Strategy and Near-Threatened by BirdLife International (2008). Habitat for this species is extremely limited in the USVI, and the Caribbean Coot is only rarely seen. The most important habitat area is Southgate Coastal Preserve on St. Croix (McNair 2006). Other protected areas that coincide with its predicted habitat are Bovoni Cay Wildlife Sanctuary and Benner Bay Pond at Compass Point Pond Wildlife Sanctuary on St. Thomas; Small Pond within the Frank Bay Wildlife Sanctuary, as well as Reef Bay Sugar Factory wetlands and Salt Pond within the US Virgin Islands National Park on St. John; and Altona Lagoon, Manning Bay Wetlands, Salt River Bay Ecological Preserve, and the University of the Virgin Islands Wetlands on St. Croix. Additional opportunities for conservation for the Coot include Benner Bay Pond, Bolongo Bay Salt Pond, Bovoni Bay Salt Pond, and several ponds around Mangrove Lagoon and on Patricia Cay in St. Thomas; the ponds located near the Westin Resort and private villas on Chocolate Hole in St. John; and Coakley Bay lagoon, Fredensborg Pond, Robin Bay lagoon, scattered ponds in Lower Love and Jealousy, and potentially the Harvey Channel at the Container Port on St. Croix. There is concern about hybridization between Caribbean and American Coots in the USVI (see McNair 2006), and the extent of this mixing and its effect on the individual populations needs to be addressed in tandem with any related conservation efforts.

- **Puerto Rican Flycatcher** (*Myiarchus antillarum*); RCS=22

- Population Estimate: Extirpated?
- Population Objective: Confirm presence; Establish population size
- Habitat types: Dry Limestone Forest; Forested coastal wetlands
- GAP 1, 2, & 3: 2,457 ha (60.9%)
- Additional GAP 1, 2, & 3 needed for 15%: 0 ha
- Total GAP 4 available: 1,577 ha
- Conservation opportunities: The Puerto Rican Flycatcher is rarely observed in the USVI these days, though perhaps a few remain on St. John (BirdLife

International 2008). It is considered a Locally Endangered species of Greatest Concern (Platenberg et al. 2005). Clarifying the population status of this species is the first step toward engaging in future conservation activity. The only suitable habitat for the Flycatcher is on St. John, including mangrove borders, arid scrub forest, and moist gallery forests throughout the island. The majority of this species' predicted habitat falls within the protected area of the US Virgin Islands National Park, though the wooded areas on private land bordering the park are also potential conservation targets.

▪ **Masked Booby** (*Sula dactylatra*); RCS=21

- Population Estimate: 45 – 75 pairs (Pierce 2009)
- Population Objective: 150 pairs
- Habitat types: Beaches, islets, cliffs and riparian barrens
- GAP 1, 2, & 3: 19 ha (100%)
- Additional GAP 1, 2, & 3 needed for 15%: 0 ha
- Total GAP 4 available: 0 ha
- Conservation opportunities: *The Masked Booby is the least common of the three Bobby species in the USVI, and it prefers open areas with low vegetation or bare ground on which to nest (Pierce 2009). It is listed as Locally Endangered and a species of Greatest Concern according to the USVI Comprehensive Wildlife Conservation Strategy (Platenberg et al. 2005). Nesting locations are limited to Cockroach Cay and Sula Cay off the northwest coast of St. Thomas, both of which are protected areas. Frenchcap Cay, some 8 km off the southeast coast of St. Thomas, is also a potential habitat site that is conserved; transfer of Masked Booby eggs to Brown Booby nests on that island as part of a cross-fostering experiment resulted in limited breeding success in the 1990s (Pierce 2009). Raffaele (1989) reported the Masked Booby near the Tobago Cays to the north of St. Thomas, and a reintroduction attempt is worth considering there as well. Predation by introduced mammals is a concern for the Masked Booby and many other ground-nesting seabirds and pests must be removed from any potential reintroduction sites.*

▪ **Magnificent Frigatebird** (*Fregata magnificens*); RCS=20

- Population Estimate: Extirpated breeding (Pierce 2009)
- Population Objective: Reestablish breeding
- Habitat types: Beaches, islets, cliffs and riparian barrens
- GAP 1, 2, & 3: 493 ha (40.4%)
- Additional GAP 1, 2, & 3 needed for 15%: 0 ha
- Total GAP 4 available: 728 ha
- Conservation opportunities: *The Magnificent Frigatebird is listed as Locally Endangered and a species of Greatest Concern in the USVI Comprehensive Wildlife Conservation Strategy (Platenberg et al. 2005). This species does not currently nest on any cays within the USVI, but it does feed and roost there and is commonly seen flying high in the sky over*

the archipelago. At present the closest extant colony of the Frigatebird is in the British Virgin Islands (Pierce 2009), and another at the remote island of Monito in the Puerto Rican archipelago (Saliva 2009). However, colonies of the Magnificent Frigatebird historically nested on Dutchcap Cay (Pierce 2009) and on Tabago Island and George Dog Cay (Raffaele 1989), and all of these locations are possible sites for reintroduction.

Important non-breeding habitat for the Frigatebird as predicted by GAP occurs at several protected areas, including Bovoni and Cas Cay Wildlife Sanctuaries, Brewer's Bay, and Magen's Bay Preserve on St. Thomas; at multiple shoreline locations around the Virgin Islands National Park and on Grass Cay and Whistling Cay Wildlife Sanctuaries in St. John; and at Buck Island Reef National Monument, Butler Bay Nature Preserve, East End Marine Park and Estate Great Pond, Green Cay National Wildlife Refuge, Manning Bay Wetlands, Protestant Cay Wildlife Sanctuary, Ruth Cay Wildlife Sanctuary, Salt River Bay Ecological Preserve, Sandy Point National Wildlife Refuge, and Southgate Coastal Preserve on St. Croix. Additional conservation opportunities include unprotected shoreline areas throughout the archipelago, but in particular around Bovoni and Jersey Bays in St. Thomas; the shoreline of Lovango and Mingo Cays, Coral Bay, Great Cruz Bay, Rendezvous Bay, Round Bay on St. John; and from Canegarden Bay east to Rod Bay in St. Croix.

▪ **Clapper Rail** (*Rallus longirostris*); RCS=20

- Population Estimate: Unknown
- Population Objective: Establish population size
- Habitat types: Forested coastal wetlands; Marshes and open water habitats
- GAP 1, 2, & 3: 23 ha (35.5%)
- Additional GAP 1, 2, & 3 needed for 15%: 0 ha
- Total GAP 4 available: 42 ha
- Conservation opportunities: The Clapper Rail is listed as Locally Endangered and a species of Greatest Concern in the USVI Comprehensive Wildlife Conservation Strategy (Platenberg et al. 2005). It is extremely localized in the USVI, having been extirpated from St. Croix and currently persisting only in mangrove swamp areas on St. Thomas. The status of its population is unknown and establishing the population size of this species is critical to developing an appropriate conservation strategy. Only a few protected areas overlap with the Clapper Rail's predicted habitat, namely Bovoni Cay, Cass Cay, and Compass Point Wildlife Sanctuaries. Additional conservation opportunities occur close nearby, encircling the forested coastal wetlands of Mangrove Lagoon and Patricia Cay.

▪ **Antillean Mango** (*Anthracothorax dominicus*); RCS=20

- Population Estimate: Extirpated?
- Population Objective: Confirm presence; Establish population size
- Habitat types: Moist, Dry and Littoral Grasslands/Shrubs; Urban forest

- GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *The USVI Comprehensive Wildlife Conservation Strategy lists the Antillean Mango as a Locally Endangered species of Greatest Concern (Platenberg et al. 2005). This species may be extirpated from the USVI, with the possible exception of St. Thomas (Personal communication, D. McNair USVIDFW 2004), though there have not been any recent sightings; its current status in the British Virgin Islands is unknown. The Mango's decline, both in the USVI and Puerto Rico, has been largely attributed to competition from the Green-throated Carib which has recently expanded its range into the coastal plain throughout the region (Raffaele 1989). A top priority, therefore, is to determine the population status of the Antillean Mango and investigate its habitat interactions with other species. Future GAP analysis of this species is necessary in the USVI. For habitat suggestions as to possible reintroduction locations see the discussion of grassland/shrubland and urban forest conservation opportunities in Section 4.*
- **Least Bittern** (*Ixobrychus exilis*); RCS=16
- Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *The USVI Comprehensive Wildlife Conservation Strategy lists the Least Bittern as a Locally Endangered species of Greatest Concern (Platenberg et al. 2005), and there is question as to whether or not this species has been extirpated from the archipelago altogether. Determining the Bittern's population status is a priority. Possible reintroduction to freshwater swamps and mangrove channels should be considered as well. For potential reintroduction/conservation opportunities see the habitat locations discussed for the Caribbean Coot. Future GAP analysis of this species is necessary in the USVI.*
- **West Indian Whistling-Duck** (*Dendrocygna arborea*); RCS=18
- Population Estimate: *Extirpated*
 - Population Objective: *Potential reintroduction*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *The West Indian Whistling Duck is listed as a Locally Endangered species of Greatest Concern (Platenberg et al. 2005) that has been extirpated from the USVI. Historically it was a common*

breeding resident throughout the region (Raffaele 1989), and it should be considered for reintroduction. This species was observed in St. Croix at Carambola (2 individuals) in 2002, in Manning Bay Wetlands (1 individual) from October, 2011 to June, 2012, and Southgate Coastal Preserve (1 individual) in March, 2012 (Personal communication, C. Lombard, US Fish and Wildlife Service 2014). For additional reintroduction/conservation opportunities see the habitat locations discussed for the Clapper Rail and Caribbean Coot and the discussion of forested coastal wetlands in Section 4. Future GAP analysis of this species is necessary in the USVI.

▪ **Puerto Rican Screech-Owl** (*Megascops nudipes newtoni*)

- Population Estimate: *Extirpated?*
- Population Objective: *Confirm presence; Establish population size*
- Habitat types: *Non-calcareous moist forest; Dry Limestone Forest; Non-calcareous lowland and coastal dry forest; Urban forest*
- GAP 1, 2, & 3: *Not available*
- Additional GAP 1, 2, & 3 needed for 15%: *Not available*
- Total GAP 4 available: *Not available*
- Conservation opportunities: *The Virgin Islands subspecies of the Puerto Rican Screech-Owl is listed as a Locally Endangered species of Greatest Concern (Platenberg et al. 2005). It formerly occurred in both the US and British Virgin Islands but is now thought to be extirpated from the USVI, and perhaps altogether extinct, with the possible exception of a few individuals on Culebra. This subspecies is distinct from the birds on the main island of Puerto Rico, which remain common. Determining the population status of the Screech-Owl in the USVI is the top conservation priority, followed by potential reintroduction from the Puerto Rican mainland. For potential reintroduction/conservation opportunities see the discussions of non-calcareous moist forest, dry Limestone forest, non-calcareous lowland and coastal dry forest, and urban forest in Section 4. Future GAP analysis of this species is necessary in the USVI.*

▪ **White-necked Crow** (*Corvus leucognasphalus*); RCS=22

- Population Estimate: *Extirpated*
- Population Objective: *Potential reintroduction*
- Habitat types: *Non-calcareous moist forest; Urban forest*
- GAP 1, 2, & 3: *Not available*
- Additional GAP 1, 2, & 3 needed for 15%: *Not available*
- Total GAP 4 available: *Not available*
- Conservation opportunities: *The White-necked Crow is registered as a federally Endangered species and a Locally Endangered species of Greatest Concern (Platenberg et al. 2005) that has been extirpated from the USVI. Fossil remains have been found on St. Croix (Raffaele 1989) and reintroduction of birds from Hispaniola should be considered as a conservation priority. See Section 4 for discussion of potential habitat locations. Future GAP analysis is necessary for this species in the USVI.*

- **American Flamingo** (*Phoenicopterus ruber*); RCS=18
 - Population Estimate: *Unknown*
 - Population Objective: *Potential reintroduction*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *The American Flamingo is listed as a Locally Endangered species of Greatest Concern (Platenberg et al. 2005). The current status of Flamingos in the USVI is unknown and needs to be determined, though there were formerly resident populations on St. Thomas and St. Croix (Raffaele 1989). One individual was observed at various wetland sites in St. Croix during 2012 and 2013 (Personal communication, C. Lombard, US Fish and Wildlife Service 2014). This species should be considered for possible reintroduction in shallow lagoons and coastal estuaries in historic locations. See Section 4 for a discussion of potential habitat locations. Future GAP analysis is necessary for the American Flamingo in the USVI.*

- 10 Immediate Management species
 - **Bridled Quail-Dove** (*Geotrygon mystacea*); RCS=21
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Non-calcareous moist forest; Non-calcareous lowland and coastal dry forest*
 - GAP 1, 2, & 3: *1,027 ha (48.0%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *1,111 ha*
 - Conservation opportunities: *The Bridled Quail-Dove is listed as a Locally Threatened species of Greatest Concern in the USVI (Platenberg et al. 2005). Raffaele (1989) reported that it is a common resident in the larger Virgin Islands where dense forests with thick undergrowth dominate, though its current population size in the USVI is unknown and needs to be determined. GAP analysis and BirdLife International (2008) indicate the majority of the predicted distribution of the Bridled Quail-Dove to be on St. John within the moist and dry non-calcareous forest habitat of the Virgin Islands National Park. The forested hills directly adjacent to the park to the east of Southside Rd, and to the east of Bordeaux Mountain Rd are two non-conserved areas that also provide good habitat for this species. On St. Croix, Bridled Quail-Dove predicted habitat is restricted to the rugged northwestern hills north of Mahogany Rd and eastward along the coastline to about Cane Bay. Three protected areas fall within this area, Caledonia Gut, Butler Bay Nature Preserve and Conservation Easement, and Creque*

Dam, around which additional conservation opportunities could be developed. Because the Bridled Quail-Dove nests close to the ground it is susceptible to uncontrolled predation by exotic mammals (e.g., mongoose) and domesticated cats.

- **White-crowned Pigeon** (*Patagioenas leucocephala*); RCS=20
 - Population Estimate: < 1,000 pairs; extrapolated estimates from PRDNER point count data suggest an average density of 0.053 individuals/ha and a population size ranging from 30,315 to 46,869 individuals on the Puerto Rico mainland. On Mona Island the population size estimate ranges from 3,639 to 15,505 individuals (Rivera-Milan and Martinez, 2012). However, given the low population densities and the fact that the distribution of this species is still highly localized, we adopt more conservative population numbers for this important and rare bird until additional data become available. Nevertheless, the PRDNER's work should be considered as an important source of population revisions/updates in the future.
 - Population Objective: 2,500 pairs
 - Habitat types: Non-calcareous moist forest; Dry Limestone Forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands
 - GAP 1, 2, & 3: 3,578 ha (20.0%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 14,345 ha
 - Conservation opportunities: The White-crowned Pigeon is listed as a Locally Threatened species of Greatest Concern by the USVI Comprehensive Wildlife Conservation Strategy (Platenberg et al. 2005), and a Near-Threatened species by BirdLife International (2008). Historically an abundant breeding bird in the region, at present the species is uncommon on the larger, more heavily populated Virgin Islands and with the most abundant populations in the mangrove forests of smaller, less-disturbed islands (Raffaele 1989). Estate Great Pond, on St. Croix, is recognized as an important habitat location for the White-crowned Pigeon, with several dozen pairs breeding in the mangroves in recent years (Birdlife International 2008). Other important breeding sites on St. Croix include Buck Island, Green Cay, Protestant Cay, and Ruth Island. Fly-in roost counts performed at this latter site in 2013 had a high count of 2,932 individuals on July 16 (Personal communication, C. Lombard, US Fish and Wildlife Service 2014). Additional protected areas that coincide with predicted habitat for this species include Butler Bay Nature Preserve and Conservation Easement, Caledonia Gut, Creque Dam, East End Marine Park, Estate Clairmont Park, Estate Little LaGrane, Estate Little Princess, Estate Thomas, Fairleigh Dickinson Territorial Park, Jack and Isaacs Bays Preserve, Long Point Bay, Manning Bay Wetlands, Salt River Ecological Preserve, Sandy Point National Wildlife Refuge, Southgate Coastal Preserve, and the University of the Virgin Islands Wetlands in St. Croix; Bovoni Cay Wildlife Sanctuary, Cas Cay Wildlife Sanctuary, Compass Point Wildlife Sanctuary, Fairchild Park, Magen's Bay Preserve, and Savana Island Wildlife Sanctuary on St.

Thomas; and Leduck Island Wildlife Sanctuary, US Virgin Islands National Park, and Whistling Cay Wildlife Sanctuary in St. John.

Potential conservation opportunities are present on the north-central part of St. Thomas, from Magen's Bay westward toward Neltjeberg Bay and north of Crown Mountain Rd, and eastward on either side of Skyline Drive over to about Mandahl Point, and on the eastern side of the island south of the Wheymouth Rhymer Highway/Smith Bay Rd; in St. John, essentially all the forested area outside of Virginia Island National Park, and on St. Croix the forested area in the northwest part of the island, in the central area around Estate Thomas, and in the east around Prospect Hill and Seven Hills.

- **Antillean Nighthawk** (*Chordeiles gundlachii*); RCS=20
 - Population Estimate: < 10 pairs
 - Population Objective: 50 pairs
 - Habitat types: Non-calcareous lowland and coastal dry forest; Moist, Dry and Littoral Grasslands/Shrubs
 - GAP 1, 2, & 3: 41 ha (0.8%)
 - Additional GAP 1, 2, & 3 needed for 15%: 684 ha
 - Total GAP 4 available: 4,792 ha
 - Conservation opportunities: *The Antillean Nighthawk is listed as a Locally Threatened species of Greatest Concern by the USVI Comprehensive Wildlife Conservation Strategy (Platenberg et al. 2005). It is an uncommon summer resident and breeding bird in the USVI (Raffaele 1989). Its predicted habitat only occurs in St. Croix, where coastal dry forest and shrubland abound. Conserved areas that coincide with the Antillean Nighthawk's distribution include portions of Creque Dam, Estate Adventure Nature Trail, Estate Little LaGrange, Ruth Cay Wildlife Sanctuary, and the University of the Virgin Islands Wetlands. Additional conservation opportunities are restricted to the dry coastal forest and shrubland areas in northwest St. Croix between Mahogany and Scenic Roads, and in south-central St. Croix from Queen Cross Street east and northward to about Midland Rd, and from there southwest toward Cathrines Rest and Manchenil Bay, with the exception of the heavily built-up area around the Container Port.*

- **Brown Booby** (*Sula leucogaster*); RCS=19
 - Population Estimate: 500 – 1,000 pairs (Pierce 2009)
 - Population Objective: 2,000 pairs
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: 150 ha (62.6%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 89 ha
 - Conservation opportunities: *The Brown Booby is the most common and widely distributed sulid in the USVI, with sizeable breeding colonies on five protected cays: Cockroach Cay, Dutchcap Cay, Frenchcap Cay, Kalkun*

Cay, and Sula Island, and a few nesting pairs on Cricket Cay and Sail Rock as well (BirdLife International 2008, Pierce 2009). *Brown Booby nesting habits are similar to those of the Masked Booby, preferring open areas on ground. The disruptive effects of tropical storms and predation by Peregrine Falcons have been reported as two threats to the breeding populations of the Brown Booby, especially on Frenchcap Cay, where the largest colony resides in the USVI archipelago (Pierce 2009). Other protected areas that overlap with Brown Booby predicted habitat for nesting, feeding, and roosting include Booby Rock, Flat Cay, Outer Brass Island, Saba Island, and Turtledove Cay in St. Thomas; Congo Cay, Grass Cay, Henley Cay, Leduck Island, Perkins Cay, Ramgoat Cay, Steven Cay, Trunk Cay, and Whistling Cay in St. John; and Buck Island, Green Cay, Ruth Cay, and select portions of Sandy Point National Wildlife Refuge in St. Croix. Additional non-conserved locations with potential for the Brown Booby include Inner Brass Island, Peterborg and Tropoco Peninsulas, and Perseverance Bay in St. Thomas; Cinnamon Cay, Lovango and Mingo Cays, most of the outer coastline from Contant Point southeast toward Dittlif Point, and Harbor Point, Sabbath Point, and Hansen Bay on St. John; and the northwest coastline of St. Croix between Hams Bay and Maroon Hole, at North Star and Cane Bay, and at Canegarden Bay near the UVI Wetlands on the south coast.*

- **Brown Pelican** (*Pelecanus occidentalis*); RCS=19
 - Population Estimate: 325 – 425 pairs (Pierce 2009)
 - Population Objective: > 800 pairs
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: 665 ha (38.4%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 1,066 ha
 - Conservation opportunities: *The Brown Pelican was previously registered as a federally Endangered species but has been delisted rangewide due to recovery. It is listed as a species of Local Special Concern by the USVI Comprehensive Wildlife Conservation Strategy (Platenberg et al. 2005). The species breeds in colonies of various sizes at Dutchcap Cay and occasionally Hans Lollick Island on St. Thomas, Congo Cay, Mary's Point, Whistling Cay, and sporadically on Watermelon Cay, St. John, and on Buck Island and sometimes Green Cay, St. Croix (BirdLife International 2008, Pierce 2009) – all of which are protected except for Hans Lollick Island. Nesting populations of the Brown Pelican have experienced declines in recent decades (USFWS 1986), and two possible causes of pelican decline could be rat predation and human disturbance which have been observed in both Puerto Rico and the USVI (Personal communication, J. Saliva and C. Lombard, US Fish and Wildlife Service 2012). In addition to the locations listed above, predicted habitat for the Brown Pelican occurs at the following stewardship areas: Bovoni Cay, Cas Cay, Cockroach Cay, Compass Point Pond, Flat Cay, Magen's Bay Preserve, Outer Brass Island, Saba Island,*

Sail Rock, and Turtledove Cay on St. Thomas; Booby Rock, Henley Cay, Leduck Island, Ramgoat Cay, Steven Cay, and Trunk Cay on St. John; and Altona Lagoon, Buck Island, East End Marine Park, Estate Great Pond, Estate Little Princess, Long Point Bay, Manning Bay Wetlands, Ruth Cay, Salt River Bay, Sandy Point, Southgate Coastal Preserve, and the UVI Wetlands in St. Croix.

Additional locations with conservation potential for the Brown Pelican include most of the shoreline throughout the USVI archipelago, in particular Brewer's and Perserverance Bays, Bovoni Bay, Hans Lollick and Little Hans Lollick Islands, Inner Brass Island, Mangrove Lagoon, the shoreline of Magen's Bay from Tropoco Point to Peterborg Peninsula in St. Thomas; Cinnamon, Lovango, and Mingo Cays, Great Cruz Bay, Hansen Bay, Johnson Bay, Long Bay, and Rendezvous Bay in St. John; and the shoreline between Altona Beach and Southgate Coastal Preserve, Coakley Bay and Lagoon, the shoreline near Robin Bay and Lagoon, the remnants of Krause Lagoon and Harvey Channel at the Container Port, and along North Shore Rd near Crab Pond in St. Croix.

- **Audubon's Shearwater** (*Puffinus iherminieri*); RCS=18
 - Population Estimate: 20 – 50 pairs (Pierce 2009)
 - Population Objective: 100 pairs
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: 33 ha (99.1%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: < 1 ha
 - Conservation opportunities: The Audubon's Shearwater is listed as a Locally Endangered species of Greatest Concern by the USVI Comprehensive Wildlife Conservation Strategy (Platenberg et al. 2005). It is the only species of petrel, shearwater, or storm-petrel that breeds in the USVI, with five colonies located in St. Thomas on the protected islets of Cockroach, Flat, Frenchcap, and Sula Cays and Saba Island. Shearwater predation of adults and chicks by Peregrine Falcons has been reported on Frenchcap Cay (Pierce 2009). It is believed that breeding probably occurs on all islands with suitable habitat, though this has not been confirmed due to the difficulty of finding nesting burrows hidden in burrows or cliff crevices (Pierce 2009). Other conserved areas that coincide with Audubon's Shearwater predicted habitat include Dutchcap and Turtledove Cays, also off the coast of St. Thomas. GAP analysis does not indicate any additional habitat areas on St. John or St. Croix.

- **White-tailed Tropicbird** (*Phaethon lepturus*); RCS=18
 - Population Estimate: 30 – 50 pairs (Pierce 2009)
 - Population Objective: 100 pairs
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: 160 ha (51.6%)

- Additional GAP 1, 2, & 3 needed for 15%: 0 ha
- Total GAP 4 available: 150 ha
- Conservation opportunities: *The White-tailed Tropicbird is listed as a Locally Threatened species of Greatest Concern by the USVI Comprehensive Wildlife Conservation Strategy (Platenberg et al. 2005). Breeding areas in the USVI include Congo Cay (St. John), Hans Lollick Island and Water Island off the coast of St. Thomas, and select cliffs of the south shore of St. Croix (Pierce 2009). Only Congo Cay and the Pratt Bay Estates on Water Island are protected and the rest of Water Island and the other places are potential locations for additional conservation activities. In the mid-Twentieth century there were more than a dozen pairs nesting on Cas Cay in St. John, (Nichols 1943, Pierce 2009), but the population has since declined and that islet is no longer an active breeding site; it is currently protected and worth considering as a potential site for reintroduction.*

Other protected areas that coincide with White-tailed Tropicbird predicted habitat are Coccoloba Cay, Cockroach Cay, Dog Island, Dutchcap Cay, Flat Cay, Frenchcap Cay, Hassel Island, Kalkun Cay, Little St. Thomas Island, Outer Brass Island, Saba Island, Salt Cay, Savana Island, Turtledove Cay, and West Cay in St. Thomas; and Booby Rock, Henley, Ramgoat, Steven, Trunk, and Whistling Cays, along with select shoreline areas around the Virgin Island National Park in St. John. Additional predicted habitat areas for this species that are not conserved include Great St. James, Inner Brass, Little Hans Lollick, and Little St. James Islands as well as Botany Point, Compass Point, Dorothea Point, Long Point, Mosquito Point, Ray Point, and Regis Point on St. Thomas; Cinnamon, Lovango and Mingo Cays, plus Blasbalg Point, Boatman Point, Bovocoap Point, Contant Point, Ditliff Point, and Maria Bluff in southeastern St. John; and on the south coast of St. Croix at Vagthus Point.

- **Red-footed Booby** (*Sula sula*); RCS=18
 - Population Estimate: 100 – 150 pairs (Pierce 2009)
 - Population Objective: 300 pairs (Pierce 2009)
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: 73 ha (98.1%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 1 ha
 - Conservation opportunities: *The Red-footed Booby is listed as a Locally Threatened species of Greatest Concern by the USVI Comprehensive Wildlife Conservation Strategy (Platenberg et al. 2005). It is smaller than the Masked and Brown Boobies that breed in the USVI, and prefers trees for nesting sites (Pierce 2009). Red-footed Booby breeding has been reported in recent decades at the protected islets of Dutchcap and Frenchcap Cays off St. Thomas (Raffaele 1989), but presently the only active breeding colony for this species is Dutchcap Cay. Pierce (2009) reports that the Frenchcap Cay colony was likely abandoned due to the loss*

of habitat from hurricane disturbance. A third, historical colony at Sula Cay (also currently protected) was lost when the US military destroyed nesting trees (Pierce 1996, 2009). Red-footed Booby re-introduction should be considered at both Frenchcap and Sula Cays following the restoration of suitable nesting sites. Additional potential habitat for this species is relatively limited. Other protected areas that coincide with predicted habitat for the Red-footed Booby include Cockroach Cay in St. Thomas; and on St. John, Congo, Grass, Henley, and Ramgoat Cays, and from Turtle Bay along the shoreline of Hawksnest Point and Bay over to Denis Bay in the Virgin Islands National Park. Additional predicted habitat areas that are not conserved are located on portions of Lovango and Mingo Cays off the northwest coast of St. John.

- **Willet** (*Tringa semipalmata*); RCS=18
 - Population Estimate: 2 pairs
 - Population Objective: Increase population (no specific objective established)
 - Habitat types: Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: 90 ha (26.2%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 254 ha
 - Conservation opportunities: The Willet is listed as a Locally Threatened species of Greatest Concern by the USVI Comprehensive Wildlife Conservation Strategy (Platenberg et al. 2005). Raffaele (1989) reported that most birds recorded in the archipelago are migrants, with abundances ranging from rare to common on St. Croix depending on the time of year, very uncommon on St. Thomas, and rare on St. John year-round. A single willet nest has been observed during summer months in most recent years at Ruth Cay of the coast of St. Croix (Personal communication, C. Lombard, US Fish and Wildlife Service 2014). GAP predicted habitat for the Willet coincides with several protected areas on St. Croix: Altona Lagoon, East End Marine Park, Estate Great Pond, Manning Bay Wetlands, Ruth Cay Wildlife Sanctuary, Sandy Point National Wildlife Refuge, Southgate Coastal Preserve, and the UVI wetlands. Maintaining and where possible expanding conservation efforts around these locations are the top priorities for this species. There are a few additional non-conserved areas on St. Croix that intersect with predicted habitat for the Willet: the remnants of Krause Lagoon around the Container Port, Coakley Bay Lagoon, Prune Bay Lagoon, and Robin Bay Lagoon.

- **Red Knot** (*Calidris canutus*); RCS=15
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: 17 ha (13.6%)
 - Additional GAP 1, 2, & 3 needed for 15%: 2 ha

- Total GAP 4 available: 110 ha
- Conservation opportunities: *The Red Knot is a Locally Endangered species of Greatest Concern by the USVI Comprehensive Wildlife Conservation Strategy (Platenberg et al. 2005). It is a rare but regular visitor to sandy tidal flats on St. Croix, and extremely rare on other Virgin Islands (Raffaele 1989). Predicted habitat for the Red Knot is sparse and coincides with only a handful of protected areas on St. Croix: Manning Bay Wetlands, Sandy Point National Wildlife Refuge, and Southgate Coastal Preserve. The priority for this species is to maintain or improve the protected status of these areas. Three additional non-conserved areas to consider as conservation opportunities for the Red Knot are Coakley Bay Lagoon, Prune Bay lagoon, and the remnants of Krause Lagoon around the Container Port.*
- 24 Management Attention species
 - **Red-billed Tropicbird** (*Phaethon aethereus*); RCS=21
 - Population Estimate: 225 – 350 pairs (Pierce 2009)
 - Population Objective: 700 pairs
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: 180 ha (58.4%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 128 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*
 - **Roseate Tern** (*Sterna dougallii dougallii*); RCS=18
 - Population Estimate: 500 – 2,300 pairs (Pierce 2009)
 - Population Objective: *The Roseate Tern is registered as a federally Threatened species. Objective, measureable population criteria have not been established by the Recovery Plan for this sub-species. See USFWS 2010a for delisting criteria.*
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: 35 ha (54.1%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 30 ha
 - Conservation opportunities: *Refer to the Recovery Plan and higher ranking species within habitat for conservation opportunities.*
 - **Caribbean Martin** (*Progne dominicensis*); RCS=18
 - Population Estimate: < 20 pairs
 - Population Objective: > 50 pairs
 - Habitat types: *Moist, Dry and Littoral Grasslands/Shrubs; Urban forest*
 - GAP 1, 2, & 3: 198 ha (3.2%)
 - Additional GAP 1, 2, & 3 needed for 15%: 720 ha
 - Total GAP 4 available: 5,921 ha

- **Wilson's Plover** (*Charadrius wilsonia*); RCS=17
 - Population Estimate: < 60 pairs
 - Population Objective: > 100 pairs
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: 195 ha (37.8%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 322 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Brown Noddy** (*Anous stolidus*); RCS=17
 - Population Estimate: 400 – 900 pairs (Pierce 2009)
 - Population Objective: > 800 – 1,800 pairs
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: 195 ha (37.8%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 322 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Prothonotary Warbler** (*Protonotaria citrea*); RCS=17
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Forested coastal wetlands
 - GAP 1, 2, & 3: 1,213 ha (34.0%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 2,354 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **American Oystercatcher** (*Haematopus palliatus*) ; RCS=16
 - Population Estimate: < 25 pairs
 - Population Objective: Maintain current population
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: 101 ha (38.0%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 165 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Whimbrel** (*Numenius phaeopus*); RCS=16
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: 152 ha (14.0%)
 - Additional GAP 1, 2, & 3 needed for 15%: 11 ha
 - Total GAP 4 available: 931 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Semipalmated Sandpiper** (*Calidris pusilla*); RCS=16

- Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *254 ha (21.4%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *936 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Least Tern** (*Sternula antillarum*); RCS=16
- Population Estimate: *300 – 600 pairs (Pierce 2009)*
 - Population Objective: *600 – 1,200 pairs*
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *87 ha (30.3%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *201 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Hooded Warbler** (*Wilsonia citrine*); RCS=16
- Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest; Non-calcareous moist forest; Forested coastal wetlands; Urban forest*
 - GAP 1, 2, & 3: *2,464 ha (42.5%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *3,335 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Ruddy Duck** (*Oxyura jamaicensis*); RCS=15
- Population Estimate: *< 5 pairs*
 - Population Objective: *Maintain current population*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *25 ha (64.6%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *14 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Black-bellied Plover** (*Pluvialis squatarola*); RCS=15
- Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *129 ha (10.5%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *55 ha*
 - Total GAP 4 available: *1,096 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Lesser Yellowlegs** (*Tringa flavipes*); RCS=15
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *215 ha (30.6%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *489 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Ruddy Turnstone** (*Arenaria interpres*); RCS=15
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *180 ha (49.7%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *181 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Stilt Sandpiper** (*Calidris himantopus*); RCS=15
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *233 ha (30.5%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *532 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Yellow (Golden) Warbler** (*Setophaga petechia*); RCS=15
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Dry Limestone Forest; Forested coastal wetlands*
 - GAP 1, 2, & 3: *370 ha (37.0%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *630 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Black-throated Blue Warbler** (*Setophaga caerulescens*); RCS=15
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest; Urban forest*
 - GAP 1, 2, & 3: *2,373 ha (52.6%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *2,136 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Louisiana Waterthrush** (*Parkesia motacilla*); RCS=15
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest; Urban forest*
 - GAP 1, 2, & 3: *348 ha (61.4%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *219 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Solitary Sandpiper** (*Tringa solitaria*); RCS=14
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *2 ha (1.8%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *12 ha*
 - Total GAP 4 available: *87 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Least Sandpiper** (*Calidris minutilla*); RCS=14
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *124 ha (23.4%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *405 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Short-billed Dowitcher** (*Limnodromus griseus*); RCS=14
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *106 ha (17.6%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *539 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Chuck-will's-widow** (*Caprimulgus carolinensis*); RCS=14
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*

- Conservation opportunities: *Refer to higher ranking species within habitat*
- **Northern Waterthrush** (*Parkesia novaboracensis*); RCS=14
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Forested coastal wetlands*
 - GAP 1, 2, & 3: *768 ha (37.6%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *1,271 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- 6 Planning and Responsibility species
 - **Bridled Tern** (*Onychoprion anaethetus*); RCS=17
 - Population Estimate: *500 – 1,000 pairs (Pierce 2009)*
 - Population Objective: *1,000 – 2,000 pairs*
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *58 ha (77.5%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *17 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
 - **White-cheeked Pintail** (*Anas bahamiensis*); RCS=16
 - Population Estimate: *400 – 500 pairs*
 - Population Objective: *Maintain current population*
 - Habitat types: *Dry Limestone Forest; Moist, Dry and Littoral Grasslands/Shrubs; Marshes and open water habitats*
 - GAP 1, 2, & 3: *249 ha (35.2%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *457 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
 - **Mangrove Cuckoo** (*Coccyzus minor*); RCS=16
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Dry Limestone Forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands; Urban forest*
 - GAP 1, 2, & 3: *3,280 ha (19.0%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *14,001 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
 - **Prairie Warbler** (*Setophaga discolor*); RCS=16
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Dry Limestone Forest*

- GAP 1, 2, & 3: 2,148 ha (14.3%)
- Additional GAP 1, 2, & 3 needed for 15%: 101 ha
- Total GAP 4 available: 12,843 ha
- Conservation opportunities: Refer to higher ranking species within habitat

- **Little Blue Heron** (*Egretta caerulea*); RCS=13
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: 344 ha (30.0%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 803 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Sanderling** (*Calidris alba*); RCS=13
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: 96 ha (49.4%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 98 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **TIER II (USVI)**
 - 1 Planning and Responsibility species
 - **Sooty Tern** (*Sterna fuscata*); RCS=15
 - Population Estimate: 20,000 – 40,000 pairs
 - Population Objective: Maintain current population
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: 9 ha (76.5%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 3 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **TIER III (USVI)**
 - 9 Planning and Responsibility species
 - **Lesser Antillean Bullfinch** (*Loxigilla noctis*); RCS=14
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Dry Limestone Forest; Non-calcareous lowland and coastal dry forest
 - GAP 1, 2, & 3: 2,421 ha (25.5%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha

- Total GAP 4 available: 7,078 ha
- Conservation opportunities: Refer to higher ranking species within habitat

- **American Coot** (*Fulica americana*); RCS=13
 - Population Estimate: < 15 pairs
 - Population Objective: Undetermined due to hybridization concerns (with Caribbean Coot)
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: 81 ha (22.4%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 282 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Snowy Egret** (*Egretta thula*); RCS=12
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: 410 ha (28.9%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 1,006 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Least Grebe** (*Tachybaptus dominicus*); RCS=11
 - Population Estimate: < 20 pairs
 - Population Objective: Maintain current population
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: 272 ha (34.1%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 527 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Black-crowned Night-Heron** (*Nycticorax nycticorax*); RCS=10
 - Population Estimate: < 20 pairs
 - Population Objective: Maintain current population
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: 646 ha (39.5%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 991 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Great Blue Heron** (*Ardea Herodias*); RCS=n/a
 - Population Estimate: < 5 pairs
 - Population Objective: Maintain current population
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: 370 ha (37.6%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha

- Total GAP 4 available: 613 ha
- Conservation opportunities: Refer to higher ranking species within habitat

- **Tricolored Heron** (*Egretta tricolor*); RCS=n/a
 - Population Estimate: < 5 pairs
 - Population Objective: Maintain current population
 - Habitat types: Marshes and open water habitats
 - GAP 1, 2, & 3: 337 ha (34.4%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 641 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Snowy Plover** (*Charadrius alexandrinus*); RCS=n/a
 - Population Estimate: Extirpated?
 - Population Objective: Establish population size
 - Habitat types: Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Piping Plover** (*Charadrius melodus*); RCS=n/a
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: Not available
 - Additional GAP 1, 2, & 3 needed for 15%: Not available
 - Total GAP 4 available: Not available
 - Conservation opportunities: Refer to higher ranking species within habitat

- **TIER IV (USVI)**
 - 19 Planning and Responsibility species
 - **Antillean Crested Hummingbird** (*Orthorhyncus cristatus*); RCS=17
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Non-calcareous moist forest; Dry Limestone Forest; Non-calcareous lowland and coastal dry forest
 - GAP 1, 2, & 3: 2,569 ha (13.1%)
 - Additional GAP 1, 2, & 3 needed for 15%: 380 ha
 - Total GAP 4 available: 17,093 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Black-whiskered Vireo** (*Vireo altiloquus*); RCS=17
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest; Non-calcareous moist forest; Dry Limestone Forest; Non-calcareous lowland and coastal dry forest; Urban forest*
 - GAP 1, 2, & 3: *2,930 ha (22.8%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *9,940 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Scaly-naped Pigeon** (*Patagioenas squamosa*); RCS=16
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest; Urban forest*
 - GAP 1, 2, & 3: *3,520 ha (17.1%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *17,020 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Caribbean Elaenia** (*Elaenia martinica*); RCS=16
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Dry Limestone Forest; Non-calcareous lowland and coastal dry forest*
 - GAP 1, 2, & 3: *2,531 ha (16.6%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *12,749 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Sandwich Tern** (*Thalasseus sandvicensis*); RCS=15
 - Population Estimate: *100 – 1,000 pairs (Pierce 2009)*
 - Population Objective: *Maintain current population*
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *70 ha (35.6%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *127 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Zenaida Dove** (*Zenaida aurita*); RCS=15
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest; Non-calcareous moist forest; Dry Limestone Forest; Non-calcareous lowland and coastal dry forest; Urban forest*
 - GAP 1, 2, & 3: *2,649 ha (9.2%)*

- Additional GAP 1, 2, & 3 needed for 15%: 1,689 ha
- Total GAP 4 available: 26,271 ha
- Conservation opportunities: Refer to higher ranking species within habitat

- **Yellow-crowned Night-Heron** (*Nyctanassa violacea*); RCS=14
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Forested coastal wetlands; Marshes and open water habitats
 - GAP 1, 2, & 3: 777 ha (39.4%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 1,195 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Royal Tern** (*Thalasseus maximus*); RCS=14
 - Population Estimate: 60 – 150 pairs (Pierce 2009)
 - Population Objective: Maintain current population
 - Habitat types: Beaches, islets, cliffs and riparian barrens
 - GAP 1, 2, & 3: 132 ha (46.2%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 154 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Northern Parula** (*Parula americana*); RCS=14
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Moist limestone (karst) forest; Non-calcareous moist forest; Dry Limestone Forest; Non-calcareous lowland and coastal dry forest; Urban forest
 - GAP 1, 2, & 3: 3,054 ha (21.7%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 10,984 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **Cape May Warbler** (*Setophaga tigrina*); RCS=14
 - Population Estimate: Unknown
 - Population Objective: Establish population size
 - Habitat types: Non-calcareous moist forest; Urban forest
 - GAP 1, 2, & 3: 1,904 ha (19.4%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 7,902 ha
 - Conservation opportunities: Refer to higher ranking species within habitat

- **American Kestrel** (*Falco sparverius*); RCS=12
 - Population Estimate: Unknown
 - Population Objective: Establish population size

- Habitat types: *Moist limestone (karst) forest; Non-calcareous moist forest; Dry Limestone Forest; Non-calcareous lowland and coastal dry forest; Urban forest*
- GAP 1, 2, & 3: 3,115 ha (14.3%)
- Additional GAP 1, 2, & 3 needed for 15%: 145 ha
- Total GAP 4 available: 18,618 ha
- Conservation opportunities: *Refer to higher ranking species within habitat*

- **Black-and-white Warbler** (*Mniotilta varia*); RCS=12
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest*
 - GAP 1, 2, & 3: 2,981 ha (29.5%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 7,124 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Ovenbird** (*Seiurus aurocapillus*); RCS=12
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest; Non-calcareous moist forest; Dry Limestone Forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands; Urban forest*
 - GAP 1, 2, & 3: 2,041 ha (39.4%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 3,140 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Pied-billed Grebe** (*Podilymbus podiceps*); RCS=11
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: 57 ha (27.1%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 154 ha
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **American Redstart** (*Setophaga ruticilla*); RCS=11
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest; Non-calcareous moist forest; Dry Limestone Forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands; Urban forest*
 - GAP 1, 2, & 3: 630 ha (35.7%)
 - Additional GAP 1, 2, & 3 needed for 15%: 0 ha
 - Total GAP 4 available: 1,135 ha

- Conservation opportunities: *Refer to higher ranking species within habitat*
- **White-winged Dove** (*Zenaida asiatica*); RCS=10
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Non-calcareous moist forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands; Urban forest*
 - GAP 1, 2, & 3: *2,078 ha (10.2%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *985 ha*
 - Total GAP 4 available: *18,342 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Bananaquit** (*Coereba flaveola*); RCS=10
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest; Non-calcareous moist forest; Dry Limestone Forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands; Moist, Dry and Littoral Grasslands/Shrubs; Marshes and open water habitats; Urban forest*
 - GAP 1, 2, & 3: *3,705 ha (15.6%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *20,024 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Mourning Dove** (*Zenaida macroura*); RCS=7
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest; Non-calcareous moist forest; Dry Limestone Forest; Non-calcareous lowland and coastal dry forest; Urban forest*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Gull-billed Tern** (*Gelochelidon nilotica*); RCS=n/a
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **TIER V (USVI)**
 - 2 Generic Population Control species

- **Green-throated Carib** (*Eulampis holosericeus*); RCS=17
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Non-calcareous moist forest; Non-calcareous lowland and coastal dry forest*
 - GAP 1, 2, & 3: *1,036 ha (17.8%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *4,786 ha*
 - Conservation opportunities: *Determine status of competitive interaction with Antillean Mango.*

- **Pearly-eyed Thrasher** (*Margarops fuscatus*); RCS=14
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size; Maintain or reduce*
 - Habitat types: *Moist limestone (karst) forest; Non-calcareous moist forest; Dry Limestone Forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands; Moist, Dry and Littoral Grasslands/Shrubs; Urban forest*
 - GAP 1, 2, & 3: *3,453 ha (13.1%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *504 ha*
 - Total GAP 4 available: *22,926 ha*
 - Conservation opportunities: *Address depredation of eggs of colonial nesting and many other species.*

- 3 Local Population Control species
 - **Laughing Gull** (*Leucophaeus atricilla*); RCS=12
 - Population Estimate: *1,500 – 3,000 pairs (Derived from BirdLife International 2008)*
 - Population Objective: *Determine population size; Maintain or reduce*
 - Habitat types: *Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *272 ha (34.1%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *527 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

 - **Peregrine Falcon** (*Falco peregrinus tundrius*); RCS=11
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *1,618 ha (12.6%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *304 ha*
 - Total GAP 4 available: *11,191 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Cattle Egret** (*Bubulcus ibis*); RCS=9
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Forested coastal wetlands; Marshes and open water habitats; Urban forest*
 - GAP 1, 2, & 3: *485 ha (3.2%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *1,756 ha*
 - Total GAP 4 available: *14,447 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **NO TIER (USVI)**
 - 19 species not requiring further conservation action
 - **Gray Kingbird** (*Tyrannus dominicensis*); RCS=16
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest; Non-calcareous moist forest; Dry Limestone Forest; Non-calcareous lowland and coastal dry forest; Moist, Dry and Littoral Grasslands/Shrubs; Urban forest*
 - GAP 1, 2, & 3: *2,666 ha (10.0%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *1,349 ha*
 - Total GAP 4 available: *24,100 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

 - **Semipalmated Plover** (*Charadrius semipalmatus*); RCS=13
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *137 ha (31.4%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *300 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

 - **Greater Yellowlegs** (*Tringa melanoleuca*); RCS=13
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *71 ha (23.6%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *229 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

 - **Western Sandpiper** (*Calidris mauri*); RCS=13

- Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats; Beaches, islets, cliffs and riparian barrens*
 - GAP 1, 2, & 3: *172 ha (32.7%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *355 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Pectoral Sandpiper** (*Calidris melanotos*); RCS=13
- Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *25 ha (8.5%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *20 ha*
 - Total GAP 4 available: *270 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Wilson's Snipe** (*Gallinago delicata*); RCS=11
- Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *27 ha (15.6%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *148 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Blue-winged Teal** (*Anas discors*); RCS=n/a
- Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *209 ha (27.4%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *554 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Northern Harrier** (*Circus cyaneus*); RCS=n/a
- Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **American Golden-Plover** (*Pluvialis dominica*); RCS=n/a
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *98 ha (12.5%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *20 ha*
 - Total GAP 4 available: *688 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Yellow-billed Cuckoo** (*Coccyzus americanus*); RCS=n/a
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Dry Limestone Forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands*
 - GAP 1, 2, & 3: *146 ha (9.6%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *83 ha*
 - Total GAP 4 available: *1,378 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Yellow-bellied Sapsucker** (*Sphyrapicus varius*); RCS=n/a
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Dry Limestone Forest; Non-calcareous lowland and coastal dry forest*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Blue-winged Warbler** (*Vermivora pinus*); RCS=n/a
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Dry Limestone Forest; Non-calcareous lowland and coastal dry forest*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*

- **Chestnut-sided Warbler** (*Lonchura malacca*); RCS=n/a
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Non-calcareous moist forest*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*

- Conservation opportunities: *Refer to higher ranking species within habitat*
- **Yellow-rumped Warbler** (*Calidris fuscicollis*); RCS=n/a
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Non-calcareous moist forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands; Marshes and open water habitats*
 - GAP 1, 2, & 3: *3,014 ha (27.3%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *8,013 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Yellow-throated Warbler** (*Setophaga dominica*); RCS=n/a
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Non-calcareous moist forest; Non-calcareous lowland and coastal dry forest; Forested coastal wetlands*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Palm Warbler** (*Setophaga palmarum*); RCS=n/a
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Forested coastal wetlands; Marshes and open water habitats*
 - GAP 1, 2, & 3: *Not available*
 - Additional GAP 1, 2, & 3 needed for 15%: *Not available*
 - Total GAP 4 available: *Not available*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Worm-eating Warbler** (*Helmitheros vermivorus*); RCS=n/a
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Moist limestone (karst) forest; Urban forest*
 - GAP 1, 2, & 3: *2,351 ha (44.3%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *2,960 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*
- **Kentucky Warbler** (*Geothlypis formosus*); RCS=n/a
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Non-calcareous moist forest; Urban forest*
 - GAP 1, 2, & 3: *Not available*

- Additional GAP 1, 2, & 3 needed for 15%: *Not available*
- Total GAP 4 available: *Not available*
- Conservation opportunities: *Refer to higher ranking species within habitat*

- **Common Yellowthroat (*Geothlypis trichas*); RCS=n/a**
 - Population Estimate: *Unknown*
 - Population Objective: *Establish population size*
 - Habitat types: *Marshes and open water habitats*
 - GAP 1, 2, & 3: *89 ha (19.2%)*
 - Additional GAP 1, 2, & 3 needed for 15%: *0 ha*
 - Total GAP 4 available: *372 ha*
 - Conservation opportunities: *Refer to higher ranking species within habitat*



White-crowned Pigeon. Photo credit: Mike Morel

SECTION 6: CONSERVATION STRATEGIES

Successful, on-going protection of birds and their habitats requires a thoughtful strategy that incorporates conservation tools, restoration and adaptive management practices, monitoring procedures, and educational outreach – in essence, the integration of bird conservation into a variety of human activities and planning processes. It also entails awareness of and adherence to some basic rules of systems ecology. Owing to the dynamic nature of natural environments, static conservation planning that cannot adjust to changing conditions is doomed to fail over the long haul. Strategic conservation planning recognizes this primary condition of flux and embraces adaptive flexibility though time as a guiding principle. A high degree of uncertainty is also characteristic of natural systems, due to the presence of many non-linear relationships occurring at multiple spatio-temporal scales. Conservation in the 21st century must attempt to account for far-ranging and amalgamated influences that we cannot yet foresee, perhaps the most pressing and severe of which will be induced by changing climate patterns. An effective strategic approach for Puerto Rico's and the USVI birds in the 21st century must therefore aim to promote resilient avian habitats and communities, that is, systems that tend to maintain their ecological integrity when subjected to disturbance and return relatively quickly to a balanced state (Holling 1973).

Theoretical and applied ecology research from the past several decades indicates that the actions most valuable in fostering resiliency include conserving biological diversity, sustaining essential ecosystem processes, diminishing anthropogenic stresses on the environment such as habitat fragmentation and degradation, and strengthening functional buffers and connectivity among habitat blocks and fragmented patches to provide movement of species and processes (Markham and Malcolm 1996). Moving beyond the boundaries of existing conservation lands to protect the biological richness and functional traits of less pristine areas in between is also recommended. To the extent possible all the conservation eggs, so to speak, should not be placed in one basket. The redundancy that results from selecting several suitable areas allows for added staying power in the face of isolated or provincial disturbances. Connecting these sites through a network of habitat corridors further enables species movement across the landscape, which can also bolster populations' resilience to altered environments. Regarding this last point, research shows that connectivity not only links existing habitat but actually adds complexity to ecological systems. Bodin et al. (2006) and Bodin and Norberg (2007), for example, illustrated how small, fragmented habitat patches within greater clusters of patches can have a disproportionately high importance on large-scale processes such as pollination and seed-dispersal. Taken together these strategies help maximize an ecosystem's ability to cope with change.

In the paragraphs that follow, we explore various tools and tactics for putting a conservation strategy into practice in Puerto Rico and the USVI. There are multiple agencies and organizations within and external to the Caribbean whose missions align with one or more avian conservation tools at various spatial scales, and we discuss several of these institutions and their potential to help achieve specific objectives. Notably, the Atlantic Coast Joint Venture (ACJV), a forum for partners to coordinate and

improve the effectiveness of bird habitat conservation planning, delivery, and evaluation in the Atlantic Flyway, is dedicated to supporting all of the elements discussed in this section. These include providing a structure that facilitates bird conservation partnerships at multiple scales, leveraging funding, enhancing communication, utilizing a sound biological foundation to assess the status and needs of species, relating species and habitat priorities to specific geographic areas and projects, and evaluating the effects of conservation actions (ACJV 2005). Researchers, practitioners, and policy makers alike should therefore consider the ACJV as a fundamental resource when engaging in any element of avian conservation planning or management within the region.

Regulatory Legal Frameworks

Some habitats are protected by natural mechanisms; steep slopes, dense forest cover, and other geographic features make them inaccessible and hinder their conversion to anthropogenic settings. Yet those naturally resistant sites are relatively rare. Conservation-friendly policy is therefore an important component of comprehensive wildlife planning that extends protection to more vulnerable habitats and their allied species. In both Puerto Rico and the USVI, several legal instruments exist to protect natural resources. Perhaps most important for Puerto Rico is Law No. 241, The New Wildlife Law of Puerto Rico, established in 1999, and several amendments that have been passed in subsequent years. The New Wildlife Law confers protective status on the wildlife species of Puerto Rico and their associated habitats. The accompanying Regulation for Management of Vulnerable and Endangered Species (No. 6765) and Regulation for the Management of Wildlife, Exotic Species and Hunting in the Commonwealth of Puerto Rico (No. 6766) provide the policy framework for the conservation and management of important wildlife species, the mechanisms for the mitigation of natural habitat modification, and regulation to control hunting and the introduction of exotic species. The agency charged with implementing these regulations is the PRDNER, which was created in 1972. In the USVI, the Virgin Islands Indigenous and Endangered Species Act (1999) is the prime article of local legislation that applies to wildlife protection. Both Puerto Rico and the USVI must abide by federal laws including the Endangered Species Act (1972), and Migratory Bird Treaty Act (1918). Collectively these articles of public policy form the legal foundation upon which monitoring of threatened and endangered species, management of game species, permitting for scientific investigations and educational programs, and stewardship actions such as designating critical habitat for conservation and protection are based. The Comprehensive Wildlife Conservation Strategies for both Puerto Rico and the USVI include provisions for revamping regulatory mechanisms so as to better protect endangered and threatened species against habitat destruction or modification.

Enforcement is equally imperative in order to put the spirit of the law into practice. Results vary depending on sites and species. The Puerto Rican Parrot has virtually disappeared (partly as a consequence of population decline due to hunting and collection), while illegal hunting is a continuous threat to both native and migratory waterfowl and has diminished species like the Caribbean Coot. Although the hunting season is outside the typical peak breeding period for vulnerable species, additional law

enforcement presence is deemed necessary to ensure that West Indian Whistling-Ducks, White-cheeked Pintails, Ruddy Ducks, and other waterfowl are not shot during legal hunting. With the proper funding, enhanced enforcement, and community outreach and cooperation, the written word of commonwealth and federal laws can potentially be manifested as powerful tools in the field to protect valuable avian resources.

Land Acquisition

The most efficient and enforceable method for conserving wildlife habitats in general and bird species in particular is the acquisition and subsequent conservation stewardship of priority lands. To date, a great majority of the conservation activity in the region has been accomplished by either the federal or commonwealth governments, with about 10% and 11% of stewardship lands being managed by nongovernmental agencies and private entities in Puerto Rico and the USVI, respectively (Gould et al. 2013a, Quiñones et al. 2013). Government agencies like the Natural Heritage Program are vital for tracking critical species, identifying lands for conservation, and establishing conservation priorities for acquisition. But the government alone cannot (and should not) shoulder the financial burden of protecting all key avifaunal targets, nor the management responsibilities that come along with conservation stewardship. A majority of the conservation opportunities discussed in this report are classified as status 4 lands, many of which fall under private ownership. Our goal in these instances is to safeguard such lands from conversion to anthropogenic habitat types and arrange them in a pattern that maximizes hypothesized "functionality" (e.g., connected or close to existing reserves) for our focal species. Conserving all potential priority habitats formally through a government protected area designation is simply not feasible, given Puerto Rico's high population density (1,115 persons per square mile), extensive land use and private ownership, the high costs of acquiring productive land, and the limited funding resources available for conservation purposes. Non-governmental organizations, for-profit enterprises, citizens' groups, and private landowners also have a fundamental part to play.

A particularly effective protection tool is the conservation easement, a legal instrument that allows private entities to restrict in perpetuity certain activities on a property such as development for real estate, commercial, or industrial uses. In turn land owners often receive significant tax advantages from commonwealth and federal governments. Three of the primary private entities that have used easement provisions for the purposes of ensuring habitat integrity and protecting vulnerable species in Puerto Rico are the Puerto Rico Conservation Trust (PRCT), Citizens of the Karst, and the Casa Pueblo Foundation. In the USVI, the Islands Resources Foundation, the St. Croix Environmental Association, and The Nature Conservancy have served similar roles in acquiring and protecting important biodiversity hotspots. Achieving many of the objectives set forth in this report, particularly those concerned with linking habitats through strategic wildlife corridors, will likely require a proliferation of easement structures on private lands that conserve a multiplicity of landscape elements including agricultural settings, waterways, and forested areas. Coordinating these efforts among distinct entities is essential. To that end, habitat conservation partnerships like the

Atlantic Coast Joint Venture (ACJV) are well-positioned to help leverage resources from federal and regional habitat conservation agencies and organizations in order to implement easements and a variety of other protection strategies at the landscape and regional levels.

Private Lands Programs

In some cases, conservation and management objectives may be best served through private lands programs that provide effective alternatives by developing partnerships with landowners for habitat conservation and restoration. Although private lands can be heavily fragmented by human infrastructure and barriers to migration, small habitat patches can potentially serve as important refugia and linkage corridors for species of concern (Shafer 1995). Present forest ownership and land use distribution in Puerto Rico and the USVI provide superb opportunities for private lands initiatives, and at a localized scale. For example, in Puerto Rico many secondary forests are located on private lands where steep slopes are a significant deterrent to future deforestation and development, and hence are well suited for conservation purposes. Already, the PRDNER and USFWS have begun to implement the Safe Harbor Program, whereby landowners are encouraged to voluntarily manage habitat for the Puerto Rican Plain Pigeon. Site-focused agreements like this are aimed at supporting recovery efforts of imperiled birds by increasing the amount of available habitat, and facilitating the ability of DNER to monitor and manage species of concern (García et al. 2005).

Within working landscapes, the US Department of Agriculture (USDA) agencies, commonwealth natural resource and agricultural services, and local extension agencies work with farmers and landowners to provide financial incentives and technical training that can yield outstanding benefits for Puerto Rico's avifaunal communities. One especially promising opportunity for conservation on private lands is the Partners for Fish and Wildlife Program, administered by the USFWS in concert with the PRDNER, Department of Agriculture, and the USVI Division of Fish and Wildlife. Since 2003 the Partners Program has been the leading agency proposing and conducting private lands restoration projects in the Caribbean, sponsoring and managing projects pertaining to tropical forest restoration, conversion of sun coffee back to shade coffee agro-ecosystems, and restoration of wetlands and natural stream processes. Such public-private collaborations also occasionally have a multiplier effect, wherein landowners convey the message to neighbors to become partners, thereby enhancing the effect of conservation in surrounding areas (Personal communication, S. Padrón, US Fish and Wildlife Service 2009).

Preserving adequate expanses of upper and lower cordillera and karst forests helps create many small refugia that provide critical habitat and can assure connectivity among several natural reserves, objectives that coincide directly with Puerto Rico's Comprehensive Wildlife Conservation Strategy. Strategic maintenance of present secondary forest and shade coffee plantations in the karst region, for example, can assure wildlife corridors among five commonwealth forest reserves including the Río Abajo Forest where a second Puerto Rican parrot wild population was established in 2006. Furthermore, improved forest connectivity will offer suitable habitat for the Broad-

winged and Sharp-shinned Hawks, in addition to many other native, endemic, and migratory bird species. A robust private lands program, together with aptly-sited government projects (e.g., the recently acquired Tres Picachos Commonwealth Forest) and NGO-sponsored conservation projects (e.g., the Río Encantado Natural Protected Area), may provide the necessary impetus and tools to achieve the desired degree of landscape connectivity and habitat maintenance.

Military Lands

Several of the habitat areas identified as priority locations, especially those situated in coastal regions, occur on lands belonging to the US Military. According to GAP data (Gould et al. 2008a) most of these properties lack management for biodiversity conservation. Owing to their possession by the federal government, there is not necessarily an immediate risk of these lands being converted by development projects; even in the case of bases that are no longer active, the expensive costs and legal issues involved in cleaning up a former military site serve as mitigating factors that temper the pace at which military facilities can be transferred to the private domain. Nevertheless, for both decommissioned and active sites it is worth engaging military leadership in conversations to discuss the conservation of important natural resources (avian or otherwise) on bases located in Puerto Rico. Meeting this challenge will require detailed planning and coordination with a variety of individuals and agencies from both the commonwealth and federal governments. Specific opportunities include training military personnel to carry out adaptive land management practices that promote the health of priority populations. Another option is enter into an inter-agency agreement that confers monitoring and management rights to an external institution, like the USFWS or PRDNER. There is promising precedent that collaborative conversion and protection is possible, as large tracts of the former Roosevelt Roads Naval Station were recently transferred to the PRCT and Medio Mundo and Daguao Natural Protected Area was created. Such collaboration not only positively impacts wildlife communities locally, but could also serve as a model for similar environmental management situations around the globe.

Research, Monitoring, and Adaptive Management

Part and parcel of the conservation stewardship process is ongoing investigation and monitoring, in a cycle of adaptive management. Monitoring is important for providing baseline information prior to deciding on the appropriate course of management action; it is critical for evaluating how well management actions meet desired objectives; and in an adaptive management setting, monitoring provides the feedback loop for better understanding the system and improving models and management strategies (Lyons et al. 2008).

Such management requires a willingness to intervene in the system, when deemed appropriate. For example, while forest protection is often interpreted as the reduction of disturbances in natural areas, there is abundant literature to support the hypothesis that disturbance is essential to the development of forest ecosystem structure, function, and habitat (see Attiwill 1994 for a review). Low level and intermediate management

regimes based on an ecological understanding of natural disturbance (e.g., forest thinning to produce canopy openings) may be important adaptive management tools to create habitat for understory bird species in mountainous areas. Reduction of basal area in some dense forests can stimulate the understory growth as well as increase the size of desired tree species resulting in augmented habitat heterogeneity. Managed habitats can produce food and provide shelter to several endemic and migrant species. Other efforts can be tailored to the focal birds and habitat objectives discussed in Section 6, such as the enhancement of cavities to create Puerto Rican Parrot nesting sites, the restoration of isolated mangroves to create White-crowned Pigeon habitat, impounding fields or removing nuisance vegetation to manipulate wetland water levels for waterbirds, protection from nest predators for nesting seabirds, and creating canopy openings near Puerto Rican Vireo nesting areas. Developing and updating management plans for all stewardship areas is a central component of the routine maintenance necessary to minimize further habitat deterioration or enhance restoration efforts that translate into healthier bird populations throughout Puerto Rico and the USVI.

As discussed previously, we did not engage in our own process of spatial multivariate regression analysis to arrive at conclusions for individual species and habitats. Therefore, additional investigation using species distribution modeling software like MaxEnt (Phillips et al. 2010) and conservation prioritization software like MARXAN (Ball et al. 2009) that incorporate threats, risk factors, and suitability indicators particular to individual species, as well as other environmental and socio-economic constraints, could help refine many of the broader recommendations provided in this report. The basic purpose of such tools is to identify a system of conservation areas that maximizes long-term conservation of biodiversity (Ferrier 2002). Ultimately, however, the results of any analysis remain to be evaluated via targeted monitoring and measurement in order to assess the effects they have on the bird populations they are intended to protect and enhance. Site-scale research on vegetation structure and forest succession that occurs from human disturbance and climate change, and the responses of target species to management actions will fill major information gaps and help refine conservation strategies.

For shorebird, seabird, and endangered and threatened populations, significant monitoring practices are already underway. The PRDNER, USFWS, US Department of Agriculture, National Park Service, US Geological Survey, University of Puerto Rico, North Carolina State University, Mississippi State University, the Puerto Rico Ornithology Society, The Nature Conservancy, Puerto Rico Conservation Trust, the Island Resources Foundation, Clean Islands International, the Audubon Society, the Virgin Islands Resource and Conservation Development Council, and the Society for the Conservation and Study of Caribbean Birds, among others, are already involved in research activities that help assess the status of priority species and their habitats, and emphasize important management interventions. As is the case with habitat management, there may also be an opportunity to enlist support from the federal government in carrying out monitoring procedures and analytical investigation on military lands.

Further research is necessary for most high priority species and other species of greatest conservation need, to fill in important gaps regarding population numbers, breeding ecology, important habitats, and inter-species interactions, such as those pertaining to Neotropical migrant birds in Puerto Rico and the USVI. Concerning the interactions between introduced species and native populations, it is imperative that a holistic approach be considered when weighing management alternatives. One way to obtain detailed information of this nature is through empirical landscape level studies of habitat requirements. Unfortunately, these approaches are often costly and time consuming, and there is no guarantee that they will result in effective management actions. A sensible alternative is to design site-specific management-monitoring studies to assess the practicalities of local management and monitoring constraints and measure the effectiveness of experimental schemes (Regan et al. 2008). These projects can be constructed at a small scale that will not affect the overall conservation of the species in case the manipulations are proven inadequate (e.g., selective removal of trees to create forest gaps, low disturbance silvicultural treatments). Overall habitat protection combined with localized experimental habitat manipulations followed by adequate monitoring can provide valuable insights for the development of more extensive management applications at broader spatio-temporal scales.

Monitoring of the effects of management actions at the community level can also help stretch valuable conservation dollars for the benefit of dwindling populations. Take, for instance, the issue of managing introduced, aggressive bird species. Yellow-shouldered Blackbird and Yellow “Golden” Warbler nests are known to be parasitized by Shiny Cowbirds (Wiley 1982, Núñez-García 1988). Managing exotic species via direct methods of trapping and removal may be effective, yet they are also likely to be expensive and labor intensive. Monitoring populations of affected species may help pinpoint key management leverage points and action levels, and consequently avoid the need for more intensive and costly measures.

As referred to in Section 1, research on climate change and the consequences for wildlife communities must also be a central priority. Tracking changing climate patterns and attempting to correlate them with effects on habitats and priority species’ populations will help identify critical scenarios as well as opportunities for mitigation and adaptation. Generation and application of novel mapping tools and robust mid- to long-term models that step-down regional climate predictions to local scales will further enhance the ability to develop effective planning initiatives. Equally important is a thorough assessment of what technical, economic, and institutional barriers exist to impede the implementation of response strategies (Grimm et al. 2013).

Integrated Conservation Stewardship

For the sake of convenience and clarity, we present much of the information in this report in discrete packets – discussing population objectives and conservation priority sites according to individual species or habitat cover types. In reality, however, none of the individual species we highlight nor their habitats exist as isolated components; rather they are integrated members of a complex and dynamic system and must be

treated as such. In order to identify geographic areas for focusing conservation efforts, we sought out convergent locations of habitat synergy, i.e., areas that build upon the suite of existing protected lands and create linkage corridors for the movement and flow of individual birds of several different species between key habitats and population centers. We also considered the habitat needs of the highest ranked species in our prioritization analysis, with the assumption that by addressing these species managers can also cover many of the needs of lower ranking species sharing those habitats. As an outcome of this approach, expanding protected habitat and improving wildlife corridors in the Cordillera Central, for instance, will likely serve the needs of raptors like the Sharp-shinned Hawk, native and migrant songbirds like the Puerto Rican Oriole and Black-throated Blue Warbler, and endemic species such as the Elfin-woods Warbler and Puerto Rican Vireo. Similarly, conserving lands adjacent to and between the most important stretches of mangrove forest and coastal wetlands will support endangered species like the Yellow-shouldered Blackbird, wading birds including the Yellow-crowned Night Heron, native and migratory waterfowl like the West Indian Whistling-Duck and Blue-winged Teal, and congregatory shorebirds such as the Semipalmated Sandpiper.

Beyond choosing priority sites, however, management strategies and actions designed to respond to the needs of a particular species of concern should also consider other valuable wildlife and seek to protect and restore ecological functions. A good general rule of thumb, especially in light of future climate-change scenarios and potentially shifting vegetation patterns, is to plan and manage collaboratively for interactions across scales (e.g., populations, communities, ecosystems, landscapes, regions, continents), taking into account ecological thresholds and sources of uncertainty (Poiani et al. 2000, Chen et al. 2005), and recognizing that macroscale processes shape and respond to local processes of biological, geophysical, and sociocultural natures (Heffernan et al. 2014). Management of the endangered Puerto Rican Parrot, for example, requires the enhancement of existing natural tree cavities to the dimensions of those preferred by the nesting pairs in an otherwise healthy tropical forest. By extension, the structure of vegetation at the landscape scale can create habitat for a complete guild of forest bird species and other taxa. As indicated previously, traditional cultivation of shade coffee in Puerto Rico played a critical role in generating positive feedbacks that promoted the conservation of forest wildlife species during the peak of deforestation. Innovative landscape management and conservation initiatives to support continued regeneration of secondary forests throughout Puerto Rico are expected to result in the expansion of forest cover and biodiversity at previously degraded sites, which in turn will allow for important ecological functions that enhance both wildlife and human communities (Lugo 2004, Lugo and Helmer 2004).

We must remember to not only look within and between wildlife communities, but also across them, to observe where planning for one population's needs results in choices that are deleterious for others. Thinking at multiple systematic levels is again advisable in this situation. The conservation of woodland habitats, for example, may appear at odds with the needs of grassland birds. An initial assessment would seem to suggest that the choice is simply an "either/or" decision. When we take a step back and employ

a broader planning methodology that comprises local and regional dimensions, however, this dichotomy dissolves. At the island-wide or regional scale there is likely the prospect for a “both/and” resolution that allows for conditions of the two perspectives to be satisfied. Furthermore, an open-minded approach to the ecological roles of introduced species is warranted when setting conservation priorities. While some of the impacts of non-native species have been well documented, large knowledge gaps still remain, particularly with regard to the risks associated with altering ecosystem level dynamics of novel food webs (Lugo et al. 2012). Therefore, eradication of introduced species, although a viable option, should be carefully considered within a broader, integrated ecological context.

Beyond ecological considerations, there are multiple challenges that repeatedly arise over land use, such as whether a particular parcel would be best left in a natural state for conservation purposes or converted to an anthropogenic habitat. Just as the biological communities we seek to conserve do not exist in isolation, wildlife conservation must take into consideration agricultural, urban and industrial development, and other human economic activities. Put simply, conservation planning needs to be expanded to include social considerations. Ban et al. (2013) advocates an integrated methodology that links conservation planning with an interdisciplinary social-ecological systems framework (e.g., Ostrom 2009). The rationale for this approach is clear. Many natural resources upon which birds depend are divided and managed along economic, political, and legal frontiers. Conservation strategies must reflect and work within the confines of these boundaries and adjust to their plasticity through time. Moreover, transparently tailoring conservation plans to the attitudes and values of stakeholders can help navigate the social complexities that underlie conservation decisions (Ban et al. 2013). Including local human communities in the planning process helps illuminate alternative viewpoints, clarify complex trade-offs between conservation and other social objectives, generate mutually agreed upon priorities, and results in actions that are more likely to achieve and sustain conservation goals (Ban et al. 2009, Ban et al. 2013).

Of primary importance to the health of avian fauna in the region is the revision and subsequent adoption of a Comprehensive Land Use Plan for Puerto Rico (PRLUP), as many of the 78 municipalities currently have the authority to prepare individual land use plans. The Act for the Land Use Plan of the Commonwealth of Puerto Rico (Public Law 550, 2004) requires an island-wide plan with specific zoning classifications for development and resource conservation, growth boundaries, and sustainable land use policies that match the socioeconomic and physical development to the cultural and geographic features of the island. Although a plan was drafted by the Puerto Rico Planning Board in 2005, subsequent ineffective implementation stalled further progress for several years. A new plan for Puerto Rico was drafted in early 2014 but this recent version has also met serious criticism and as of the writing of this document has not been approved. A proposed Comprehensive Land and Water Use Plan for the USVI (Bill No. 25-0209) has also yet to be adopted. If ever approved these plans will be instrumental resources for fine-tuning avifaunal habitat priorities and realizing conservation objectives.

Going up a level, establishing a Caribbean working group within the Southeastern Coastal Plains-Caribbean Region of the US Shorebird Conservation Plan would also be a worthwhile endeavor. This team would be responsible for identifying regional needs for research, monitoring, and conservation planning, assessing which products and services of the National Shorebird Education and Outreach Plan are appropriate for the Caribbean, and helping implement important action steps. Strategic planning in the Caribbean can likewise be nested within a broader network of stewardship initiatives that operate at the habitat, landscape, and regional levels, starting with the ACJV's Implementation Plan, discussed in Section 2. Many key actions outlined in the Environmental Protection Agency's (EPA) Clean Water Action Plan are also applicable to bird conservation planning in Puerto Rico and the USVI. At least 63 of the 111 key action elements in the EPA's Clean Water Action Plan (CWAP) have direct implications for bird conservation. Numerous CWAP elements do not need any alterations to incorporate bird conservation; others need only minor modifications; and still other components do not have direct implications but can provide important information and indirect benefits. A second opportunity for integration is possible between the Federal and Commonwealth Departments of Agriculture. US Department of Agriculture conservation programs such as the Conservation Reserve Program and Environmental Quality Incentive Program could promote the development of sustainable agricultural practices (e.g., shade coffee) that benefit avian populations. It is likely that similar bird conservation implications can be identified or incorporated in action plans for soil, forest, and even clean air conservation in the region.

Outreach, Public Education, and Strategic Partnerships

The ongoing social, cultural, technological, economic, and daily survival requirements of human populations will continue to put pressure on natural resources and critical bird habitats. Therefore, communicating wildlife values and needs to government officials, private landowners, and the general public is essential in order to achieve conservation goals. To accomplish this, multilevel outreach and conservation education targeting government and NGOs, land managers, farmers, school children, hunting groups, and the general public must be woven into all conservation programs. Specific conservation education objectives need to be designed to stress the ecological importance relative to each habitat-species association. For example, the roles that mangrove swamps play as essential habitats for endangered birds and fisheries in Puerto Rico and the USVI are poorly known to most of the general public.

Clearly establishing links between bird conservation and the conservation of other ecosystem services more tangible to human communities is also important (Ban et al. 2013). Outreach programs and products will be most effective if they address priority issues that resonate with the concerns of local audiences. Thus, education campaigns carried out in coordination with local agencies can help promote the conservation of mangrove habitats for the benefit of wildlife species, while at the same time emphasizing principal connections with human experience and priorities, such as the valuable protection mangroves offer against storm surges and coastal erosion (Spalding et al. 1996, UNEP 2007). In the cases of montane and anthropogenic forests, intensive

outreach is needed to promote agricultural practices compatible with bird conservation and environmental health. Information on the benefits of shade coffee and mixed forest plantations with unmanaged understory must be compiled and made available to farmers and government agencies. And with regard to colonial seabirds, helping the public understand the importance of seabirds as indicators of the overall health of marine environments is a fundamental concern. In essence, emphasizing the subjective relationship of human-nature interactions promotes understanding and motivates alternative management actions.

Achieving these educational goals will require identification and training of institutional partners, securing appropriate technological resources, hiring media professionals to help develop, reproduce, and distribute outreach materials, and cooperation of local experts to assure accuracy of the messages. Collaboration with the public education system is a vital link for conveying conservation messages to children and young adults, and by extension, their families. Training workshops, together with the necessary didactic tools can be developed and provided to teachers. Another level of education should target older audiences and particularly private land owners. These efforts need the involvement at the level of neighborhoods and municipalities, and can be combined with government private lands initiatives. If properly engaged, community advocates can serve as citizen scientists and valuable spokespersons to enforce existing policy devices and champion new legislation. A third educational priority is to develop outreach strategies to target government and non-governmental institutions including influential decision makers.

Fortunately there are many excellent institutions available and willing to engage in partnerships for conservation management and education at one level or another. In Puerto Rico, the PRDNER, USFWS, SOPI, the PRCT, and the University of Puerto Rico can be enlisted as valuable outreach associates capable of working toward multiple objectives at diverse scales. For example, the Partners for Fish and Wildlife Program teams up with schools and recreational facilities to create outdoor classrooms and enhance wildlife habitat – effectively merging management with community education. Similarly, Para La Naturaleza, a unit of the PRCT, has a wide range of educational offerings and citizen science monitoring programs associated with the natural areas they conserve throughout Puerto Rico. Several quality teaching materials have already been produced as well. The Society for the Conservation and Study of Caribbean Birds has undertaken many educational initiatives encompassed under the West Indian Whistling-Duck and Wetlands Conservation Project (Sorenson et al. 2004). Included in this project are a Ducks of the West Indies hunter identification card, West Indian Whistling-Duck conservation buttons and coloring books, a wetlands education resource book, and a wetlands education slide show and puppet show kit, all of which are available in both English and Spanish.

To address the issues of environmental awareness and lack of adequate management of some wildlife preserves, partnerships with local and federal government and NGOs can be developed. The alleviation of human disturbances at active colonial nest sites, to take one example, will call for a blend of outreach to develop awareness and public

buy-in, in concert with the disciplined presence of law enforcement officials, especially on federal and commonwealth lands set aside for conservation purposes. Already in Puerto Rico partnerships between the USFWS, the PRDNER, and universities on the US mainland are contributing to the understanding and design of management practices to be used in both wildlife reserves and private lands. For instance, two recent projects were designed in cooperation with the above mentioned agencies, the North Carolina State University, and the University of Florida to investigate habitat use and bird productivity in different types of montane forest including moist non-calcareous and limestone forests, shade coffee and mixed tree plantations. The results of these studies have been used to identify important habitat components required by native breeding species and the associated migrant birds, and testify to the value of organizational partnerships in helping achieve common conservation goals. Another project designed in cooperation with the Mississippi State University is managing wetland habitat in a PRDNER wildlife reserve to restore historical ecosystem functions and water bird habitats. Information produced as a result of this research and management projects will help the PRDNER design management plans and strategies for their conservation areas. Similar partnerships can be developed to address environmental education, training, and other human related wildlife issues.

Strategic partnerships also aid in identifying areas of opportunity, avoiding duplicity of efforts, and providing important resources for long term management of conservation areas. This last point is critical, especially given the limited availability of funding sources and intense competition to acquire them. Strong relationships among private non-profit organizations, academic institutions, federal and commonwealth government agencies, and the for-profit entities can help moderate the restrictive effects of budget deficits by leveraging affiliate financial and human resources to conduct research, monitor populations, protect vital habitats, maintain infrastructure and equipment, and implement public outreach programs.

When designed well, collaborative conservation alliances are reciprocal in nature. Eco-tourism relationships forged with the local business community can both conserve critical wildlife habitat while also serving the long-term interests of the tourist industry. On golf courses, for instance, the Audubon Society has taken a lead role, linking conservation with human recreation by establishing best management practices to protect nearby wetlands. To reduce potential nutrient or pesticide contamination of water sources and detrimental effects on native and migratory waterfowl, the Audubon Cooperative Sanctuary Program for Golf assists golf courses in their efforts to blend environmentally responsible maintenance practices into greens operations. These efforts benefit wildlife populations and also help generate positive publicity and niche-market tourist revenue.

Finally, no outreach strategy for communicating essential material about avian populations would be complete without utilizing and contributing to key online resources and databases, including those maintained by the ACJV, eBird, SOPI, BirdLife International, Western Atlantic Shorebird Association, and the Puerto Rico and USVI Departments of Natural Resources web pages. In addition to serving as repositories of

avian information and sightings in the region, they also provide useful education tools for delivering information to a variety of audiences.

Structured Decision Making

Finally, there is the challenging work of deciding what particular tools to employ and strategies to implement, and where to put them into action. Though all habitats have inherent value and the potential to function as areas of conservation importance, not every location is of identical rank. In the first place, ecosystems are not evenly distributed across a given land area; the diverse mélange of natural systems encountered in Puerto Rico and the USVI is a complex fusion of topographic, geologic, climatic, and anthropogenic factors. It follows, then, that species are also not equally distributed across the landscape. And of course, as a corollary of natural habitat availability, biological interactions, and human influences, some species are relatively abundant while others are uncommon or even rare and threatened. Nor are all species similarly affected by the same conservation threats. The negative impacts that draining wetlands can have on waterbird populations may actually benefit several species of grassland birds. Furthermore, conservation issues vary through space and time. Seventy-five years ago the primary conservation concern in Puerto Rico was land clearing for the benefit of agriculture. Today, urban development pressures and changing climatic patterns top the list of threats facing wildlife communities. Regional conservation planning must seek to balance all of these fluid and at times incongruous issues in a dynamic equilibrium in order to develop adequate models that can guide strategic decisions and actions.

In an ideal conservation-oriented world, the best remaining habitats would be available for protection, the relevant landowners and public parties would be willing to protect them, the fundamental legal and political structures would be in place to execute such measures, and the necessary financial resources would be on hand to carry out the program implementation process and subsequent resource management. In reality, it is rather uncommon that any one of these conditions is met, let alone all four. As discussed in previous paragraphs, there are multiple stakeholders (e.g., conservationists, entrepreneurs, political leaders, residents, funding institutions) with a diversity of viewpoints (ecological, economical, political, social, financial), most if not all of which must be taken into consideration when making conservation decisions. Many of the factors that make for good bird habitat, such as the proximity to wetland coastal resources for shorebirds, may also make that land valuable for residential development, agriculture, or industrial purposes like a port. Finances, feasibility, time, and bureaucratic realities can place restrictive constraints on conservation design and management activities. The end result is that conservation choices and tradeoffs must often be made.

Fortunately, there are effective and efficient methodologies to guide the way, and help make the tough decisions at every fork in the conservation road. Designing landscapes for sustainable bird populations can be achieved through a structured decision making process that identifies outlines a hierarchy of clearly identified priorities and robust

management strategies, deliberated within the context of larger landscape patterns (Moore and Runge 2012). Structured decision making can be applied to evaluating multiple policies and actions from a variety of fields in the natural and social sciences (Triantaphyllou 2000). The specifics of that process go beyond the focus of this report, and will not be discussed in detail. The point is that following a thoughtful methodology for “making smart choices” (Grand 2009) is as essential as the choices themselves. We encourage that such a process be implemented in Puerto Rico and the USVI for deciding what approaches and practices are best suited to promoting the well-being of avifauna and critical habitats throughout the region.

This concludes the main body of the report. What follows are a series of appendices that provide supplemental material to augment what has been presented in previous sections.



Yellow-shouldered Blackbird. Photo credit: Mike Morel

APPENDICES

Appendix A: Puerto Rico GAP Vertebrate Species Report

To view this report, access the links available on the Puerto Rico Terrestrial GAP website:

<http://prgap.org/projects/puerto-rico-terrestrial-gap/>

Appendix B: US Virgin Islands GAP Vertebrate Species Report

To view this report, access the link available through the CLCC Data Center Interactive Map website:

https://s3.amazonaws.com/IndividualGISdata/PDFs/USVI_FINAL_REPORT.pdf

Appendix C: Terrestrial protected areas (GAP status 1, 2, or 3) in Puerto Rico indicating the management class (Federal, Commonwealth, Nongovernmental, or Private) and total number of hectares (source: Quiñones et al. 2013).

Protected Area	Management Class	Area (ha)
Adjuntas People's Forest	Non-Governmental	370.12
Aguas Buenas Caverns and Cave Systems Natural Reserve	Commonwealth	709.33
Aguirre State Forest	Commonwealth	429.32
Ballenas Point Natural Reserve	Non-Governmental	98.86
Belvedere Natural Reserve	Commonwealth	104.06
Belvedere Natural Reserve Marine Extent	Commonwealth	10.88
Boqueron State Forest	Commonwealth	663.41
Boqueron State Forest Marine Extent	Commonwealth	1.67
Boqueron Wildlife Refuge	Commonwealth	235.44
Cabo Rojo National Wildlife Refuge	Federal	758.48
Caja de Muertos Island Natural Reserve	Commonwealth	183.90
Cambalache State Forest	Commonwealth	631.75
Camuy River Caves Park	Commonwealth	104.40
Cano La Boquilla Natural Reserve	Commonwealth	51.98
Cano Martin Pena Natural Reserve	Commonwealth	141.37
Cano Tiburones Natural Reserve	Commonwealth	1495.81
Carite State Forest	Commonwealth	2699.50
Cartagena Lagoon National Wildlife Refuge	Federal	423.41
Ceiba State Forest	Non-Governmental	115.73
Cerrillos State Forest	Commonwealth	219.70
Cibuco Swamp Natural Reserve	Commonwealth	380.87
Cibuco Swamp Natural Reserve Marine Extent	Commonwealth	1.01
Conservation Easement El Rabanal	Non-Governmental	6.37
Conservation Easement El Tambor	Non-Governmental	90.17
Conservation Easement Foreman	Non-Governmental	13.99
Conservation Easement Montes Oscuros	Non-Governmental	3057.00
Conservation Easement Palmas del Mar Tropical Forest	Non-Governmental	43.44
Cueva del Indio Natural Reserve	Commonwealth	4.04
Cueva del Indio Natural Reserve Marine Extent	Commonwealth	0.23
Culebra National Wildlife Refuge	Federal	624.08
Desecheo National Wildlife Refuge	Federal	126.50
Dona Ines Mendoza Urban Forest	Non-Governmental	99.47
El Buey National Wildlife Refuge	Non-Governmental	322.68
El Convento Caves Natural Protected Area	Non-Governmental	259.31

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El Tallonal	Non-Governmental	104.06
El Yunque National Forest	Federal	11428.93
Encantado River Natural Protected Area	Non-Governmental	642.30
Espiritu Santo River Natural Reserve	Commonwealth	749.47
Espiritu Santo River Natural Reserve Marine Extent	Commonwealth	0.80
Guajataca State Forest	Commonwealth	954.71
Guanica State Forest	Commonwealth	3762.48
Guaniquilla Point Natural Reserve	Non-Governmental	165.72
Guaynabo River Natural Protected Area	Non-Governmental	8.38
Guillermeti property	Non-Governmental	195.02
Hacienda Buena Vista Natural Protected Area	Non-Governmental	228.35
Hacienda La Esperanza Natural Reserve	Non-Governmental	917.87
Hacienda La Esperanza Natural Reserve Marine Extent	Commonwealth	1.20
Ines Maria Mendoza (Yeguas Point) Nature Reserve	Non-Governmental	123.83
Jobos Bay Estuary National Research Reserve	Commonwealth	607.44
Jorge Sotomayor del Toro Natural Protected Area	Non-Governmental	16.12
Jose Santiago Property	Non-Governmental	12.71
Joyuda Lagoon Natural Reserve	Commonwealth	178.42
La Cienaga Las Cucharillas Natural Reserve	Commonwealth	395.50
La Cordillera Reef Natural Reserve	Commonwealth	144.32
La Olimpia Forest	Non-Governmental	185.50
La Parguera Natural Reserve	Non-Governmental	671.52
La Parguera Natural Reserve	Commonwealth	79.56
Lago Guajataca Wildlife Refuge	Commonwealth	272.43
Lago La Plata Wildlife Refuge	Commonwealth	86.91
Lago Luchetti Wildlife Refuge	Commonwealth	93.83
Las Cabezas de San Juan Natural Reserve	Non-Governmental	227.27
Las Mesas Peak	Non-Governmental	5.60
Las Piedras del Collado Natural Reserve	Commonwealth	8.16
Los Frailes property	Non-Governmental	270.88
Maricao River Natural Protected Area	Non-Governmental	40.29
Maricao State Forest	Commonwealth	4103.11
Mata de Platano Field Station Natural Reserve	Non-Governmental	42.91
Medio Mundo y Daguao Natural Protected Area	Non-Governmental	1343.68
Mona and Monito Island Natural Reserve	Commonwealth	5575.13
Monte Choca State Forest	Commonwealth	99.43
Monte Guilarte State Forest	Commonwealth	1766.05
Northeast Ecological Corridor	Commonwealth	1111.61
Nuevo Milenio Urban Forest	Commonwealth	175.81
Old San Juan Aquaduct	Non-Governmental	3.56
Pandura Range Natural Protected Area	Non-Governmental	124.56

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Paraiso de las Lunas Natural Protected Area	Non-Governmental	5.26
Petrona Point Natural Reserve	Commonwealth	215.63
Pinones State Forest	Commonwealth	777.78
Pterocarpus Forest Natural Protected Area	Non-Governmental	11.13
Pterocarpus Forest Nature Reserve	Non-Governmental	301.11
Pterocarpus Swamp Forest and Mandry and Santa Teresa Lakes Natural Reserve	Commonwealth	922.34
Punta Cucharas Natural Reserve	Commonwealth	287.33
Punta Cucharas Natural Reserve Marine Extent	Commonwealth	7.10
Ratones Cay Natural Reserve	Commonwealth	0.46
Recently aquired land by the IITF	Federal	170.34
Recently aquired land in Pi±ones	Commonwealth	518.79
Recently aquired land in the Karst region	Commonwealth	251.84
Rio Abajo State Forest	Commonwealth	2283.78
San Cristobal Canyon Natural Protected Area	Non-Governmental	581.74
San Juan Ecological Corridor	Commonwealth	19.66
San Patricio Urban Forest	Commonwealth	39.95
Seven Seas Natural Reserve	Commonwealth	82.95
Shapiro property	Non-Governmental	2.24
Sun Bay National Park	Commonwealth	22.29
Susua State Forest	Commonwealth	1297.91
Toro Negro State Forest	Commonwealth	2762.92
Tortuguero Lagoon Natural Reserve	Commonwealth	1266.83
Tres Picachos State Forest	Commonwealth	2097.43
Tuna Point Natural Mangrove Reserve	Commonwealth	49.01
University of Puerto Rico Botanical Garden	Commonwealth	121.29
Vega State Forest	Commonwealth	481.53
Vieques Bioluminescent Bay Natural Reserve	Commonwealth	484.11
Vieques Bioluminescent Bay Natural Reserve	Commonwealth	10.31
Vieques National Wildlife Refuge	Federal	7114.77
TOTAL		73591.6*

**This total area value differs slightly from the total presented in Table 6a due to variable geographic information systems (GIS) methodologies used for calculating protected areas.*

Appendix D: Terrestrial protected areas (GAP status 1, 2, or 3) in the US Virgin Islands indicating the management class (Federal, Commonwealth, Nongovernmental, or Private) and total number of hectares (source: Gould et al. 2013a).

Protected Area	Management Class	Area (ha)
Altona Lagoon Beach Recreation Area	VI Government	6.91
Booby Rock Wildlife Sanctuary	VI Government	0.26
Bovoni Cay Wildlife Sanctuary	VI Government	22.27
Buck Island National Wildlife Refuge	Federal	18.68
Buck Island Reef National Monument	Federal	70.45
Butler Bay Conservation Easment	NGO	37.06
Butler Bay Nature Preserve	NGO	46.61
Caledonia Gut	VI Government	36.47
Capella Island Wildlife Sanctuary	VI Government	9.37
Carval Rock Wildlife Sanctuary	VI Government	0.33
Cas Cay Wildlife Sanctuary	VI Government	5.78
Cockroach Cay Wildlife Sanctuary	VI Government	8.27
Compass Point Pond Marine Reserve and Wildlife Sanctuary	VI Government	3.79
Congo Cay Wildlife Sanctuary	VI Government	10.21
Coral Bay Preserve	NGO	10.05
Creque Dam	VI Government	3.07
Cricket Rock Wildlife Sanctuary	VI Government	0.98
Derick O. Steinmann Memorial Beach	NGO	0.80
Dog Island Wildlife Sanctuary	VI Government	5.30
Dutchcap Cay Wildlife Sanctuary	VI Government	13.16
East Bay and Point Udall	VI Government	54.26
East End Marine Park	VI Government	55.14
Estate Adventure Nature Trail	VI Civil Society	2.93
Estate Clairmont Park	NGO	95.64
Estate Great Pond	VI Government	12.93
Estate Little La Grange	NGO	3.79
Estate Little Princess	NGO	19.39
Estate Mount Washington Bird Sanctuary	NGO	7.99
Estate Thomas	Federal	59.99
Estate Whim	NGO	5.00
Fairchild Park	VI Government	2.79
Fairleigh Dickinson Territorial Park	VI Government	32.45
Flanagan Island Wildlife Sanctuary	VI Government	8.55
Flat Cay Wildlife Sanctuary	VI Government	1.10
Frank Bay Marine Reserve and Wildlife Sanctuary	VI Government	0.89
Frenchcap Cay Wildlife Sanctuary	VI Government	6.28

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Grass Cay Wildlife Sanctuary	VI Government	22.47
Green Cay National Wildlife Refuge	Federal	4.38
Herman Hill Pond	NGO	6.46
Jack and Isaacs Bays Preserve	NGO	121.05
Kalkun Cay Wildlife Sanctuary	VI Government	1.53
Leduck Island Wildlife Sanctuary	VI Government	5.75
Little St. Thomas	NGO	0.30
Long Point Bay	NGO	8.03
Magen's Bay Preserve	VI Government	31.11
Magen's Bay Preserve	NGO	50.98
Magen's Bay Preserve	VI Government	44.82
Manning Bay Wetlands	VI Government	29.97
Outer Brass Island Wildlife Sanctuary	VI Government	43.81
Perkins Cay Wildlife Sanctuary	VI Government	0.22
Protestant Cay Wildlife Sanctuary	VI Government	2.72
Ruth Cay Wildlife Sanctuary	VI Government	10.25
Saba Island Wildlife Sanctuary	VI Government	12.67
Sail Rock Wildlife Sanctuary	VI Government	1.09
Salt Cay Wildlife Sanctuary	VI Government	23.95
Salt River Bay National Historic Park and Ecological Preserve	Federal / VI Government	166.68
Sandy Point National Wildlife Refuge	Federal	212.78
Savana Island Wildlife Sanctuary	VI Government	70.64
Shark Island Wildlife Sanctuary	VI Government	0.44
Sion Ridge Area (Park Service Warehouse)	Federal	5.79
Smith Bay Park	VI Government	8.60
Southgate Coastal Preserve	NGO	41.97
Spratt Bay Estates	NGO	12.24
Steven Cay Wildlife Sanctuary	VI Government	2.09
Sula Cay Wildlife Sanctuary	VI Government	1.04
Turtledove Cay Wildlife Sanctuary	VI Government	1.68
Two Brothers	VI Government	0.15
US Virgin Islands National Park	Federal	2875.25
UVI Wetlands	VI Government	34.99
West Cay Wildlife Sanctuary	VI Government	16.72
Whistling Cay Wildlife Sanctuary	VI Government	8.31
TOTAL		4559.9*

**This total area value differs slightly from the total presented in Table 6b due to variable geographic information systems (GIS) methodologies used for calculating protected areas.*

Appendix E: Puerto Rico Critical Wildlife Areas recognized as important sites for avian conservation (81 total), and their associated bird species of conservation concern (adapted with permission from Ventosa-Febles et al. 2005). Numbers correspond to listing given in the CWA report.

Critical Wildlife Area	Critically Endangered, Endangered and Vulnerable Bird Species
1 - Las Cucharillas Marsh, Cataño	Puerto Rican Oriole- <i>Icterus portoricensis</i> Brown Pelican- <i>Pelecanus occidentalis</i> Caribbean Coot- <i>Fulica caribaea</i> Grasshopper Sparrow- <i>Ammodramus savannarum</i> Masked Duck- <i>Nomonyx dominicus</i> Peregrine Falcon- <i>Falco peregrinus</i> Piping Plover- <i>Charadrius melodus</i> Puerto Rican Vireo- <i>Vireo latimeri</i> Ruddy Duck- <i>Oxyura jamaicensis</i> West Indian Whistling-Duck- <i>Dendrocygna arborea</i> White-cheeked Pintail- <i>Anas bahamensis</i> Yellow-shouldered Blackbird- <i>Agelaius xanthomus</i>
2 - Buchanan Haystack Hills and Fort Buchanan Pond	Puerto Rican Oriole- <i>Icterus portoricensis</i> Ruddy Duck- <i>Oxyura jamaicensis</i>
3 - Torrecillas-Piñones-Vacia Talega Swamp, Carolina-Canóvanas-Loíza	Puerto Rican Oriole- <i>Icterus portoricensis</i> Brown Pelican- <i>Pelecanus occidentalis</i> Caribbean Coot- <i>Fulica caribaea</i> Least Tern- <i>Sterna antillarum</i> Masked Duck- <i>Nomonyx dominicus</i> West Indian Whistling-Duck- <i>Dendrocygna arborea</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i> Yellow-shouldered Blackbird- <i>Agelaius xanthomus</i>
4 - Barrio Borinquen, Trujillo Alto Lake, Bairoa La 25 and Gurabo River Mouth, Trujillo Alto-Caguas-Gurabo	Caribbean Coot- <i>Fulica caribaea</i> Least Grebe- <i>Tachybaptus dominicus</i> Puerto Rican Plain Pigeon- <i>Patagioenas inornata</i> West Indian Whistling-Duck- <i>Dendrocygna arborea</i>
5 - Baja Swamp and Herrera River Mouth, Río Grande	Masked Duck- <i>Nomonyx dominicus</i> Ruddy duck- <i>Oxyura jamaicensis</i> West Indian Whistling-Duck- <i>Dendrocygna arborea</i> White cheeked pintail- <i>Anas bahamensis</i>
6 - Ensenada Comezón and Espíritu Santo River, Río Grande	Brown Pelican- <i>Pelecanus occidentalis</i> Caribbean Coot- <i>Fulica caribaea</i> Piping Plover- <i>Charadrius melodus</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>

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8- Luquillo Mountains	Broad-winged Hawk- <i>Buteo platypterus</i> Puerto Rican Parrot- <i>Amazona vittata</i> Puerto Rican Vireo- <i>Vireo latimeri</i> Sharp-shinned Hawk- <i>Accipiter striatus</i>
9 - San Miguel, La Paulina and El Convento Natural Area, Luquillo-Fajardo	Puerto Rican Oriole- <i>Icterus portoricensis</i> Brown Pelican- <i>Pelecanus occidentalis</i> Caribbean Coot- <i>Fulica caribaea</i> Grasshopper Sparrow- <i>Ammodramus savannarum</i> Least Grebe- <i>Tachybaptus dominicus</i> Least Tern- <i>Sterna antillarum</i> Masked Duck- <i>Nomonyx dominicus</i> Piping Plover- <i>Charadrius melodus</i> Puerto Rican Plain Pigeon- <i>Patagioenas inornata</i> Puerto Rican Vireo- <i>Vireo latimeri</i> Roseate Tern- <i>Sterna dougallii dougallii</i> Ruddy Duck- <i>Oxyura jamaicensis</i> Snowy Plover- <i>Charadrius alexandrinus</i> West Indian Whistling-Duck- <i>Dendrocygna arborea</i> White-cheeked Pintail- <i>Anas bahamensis</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>
10 - Laguna Grande, Laguna Aguas Prietas and Adjacent Area, Fajardo	Brown Pelican- <i>Pelecanus occidentalis</i> Caribbean Coot- <i>Fulica caribaea</i> Ruddy Duck- <i>Oxyura jamaicensis</i> White-cheeked Pintail- <i>Anas bahamensis</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>
11 - Fajardo Coast Line	Yellow-shouldered Blackbird- <i>Agelaius xanthomus</i>
12 - La Cordillera Natural Reserve, Fajardo	Brown Pelican- <i>Pelecanus occidentalis</i> Roseate Tern- <i>Sterna dougallii dougallii</i> White-cheeked Pintail- <i>Anas bahamensis</i>
13 - Flamenco Peninsula, Culebra	Roseate Tern- <i>Sterna dougallii dougallii</i>
14 - Flamenco Lagoon, Culebra	Caribbean Coot- <i>Fulica caribaea</i> Least Grebe- <i>Tachybaptus dominicus</i> Ruddy Duck- <i>Oxyura jamaicensis</i> White-cheeked Pintail- <i>Anas bahamensis</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>
15 - Cornelio Lagoon, Culebra	Brown Pelican- <i>Pelecanus occidentalis</i> Masked Duck- <i>Nomonyx dominicus</i> Ruddy Duck- <i>Oxyura jamaicensis</i> White-cheeked Pintail- <i>Anas bahamensis</i>

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19 - Larga Beach and Zoní Lagoon, Culebra	Brown Pelican- <i>Pelecanus occidentalis</i> Caribbean Coot- <i>Fulica caribaea</i> Peregrine Falcon- <i>Falco peregrinus</i> Ruddy Duck- <i>Oxyura jamaicensis</i> White-cheeked Pintail- <i>Anas bahamensis</i>
20 - Maillux Pond, Culebra	White-cheeked Pintail- <i>Anas bahamensis</i>
21 - Puerto del Manglar Inlet and Mangroves, Culebra	Brown Pelican- <i>Pelecanus occidentalis</i> Roseate Tern- <i>Sterna dougallii dougallii</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>
22 - Los Caños Mangroves, Culebra	White-cheeked Pintail- <i>Anas bahamensis</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>
23 - Cementerio Bay, Culebra	White-crowned Pigeon- <i>Patagioenas leucocephala</i>
24 - Culebra's Surroundings Cays	Roseate Tern- <i>Sterna dougallii dougallii</i>
25 - Vieques West Coast, Vieques	West Indian Whistling-Duck- <i>Dendrocygna arborea</i> White-cheeked Pintail- <i>Anas bahamensis</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>
- Kiani Lagoon, Vieques	Brown Pelican- <i>Pelecanus occidentalis</i> Ruddy Duck- <i>Oxyura jamaicensis</i> West Indian Whistling-Duck- <i>Dendrocygna arborea</i> White-cheeked Pintail- <i>Anas bahamensis</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>
- Playa Grande Lagoon, Vieques	Ruddy Duck- <i>Oxyura jamaicensis</i> White-cheeked Pintail- <i>Anas bahamensis</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>
27 - Yanuel Lagoon, South Vieques	White-cheeked Pintail- <i>Anas bahamensis</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>
28 - Chiva Swamp, South Vieques	Least Tern- <i>Sterna antillarum</i> White-cheeked Pintail- <i>Anas bahamensis</i>
29 - Tapón Bay, South Vieques	White-cheeked Pintail- <i>Anas bahamensis</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>
30 - Ferro Bay, Mosquito Bay and Sombe Bay, South Vieques	Brown Pelican- <i>Pelecanus occidentalis</i> Peregrine Falcon- <i>Falco peregrinus</i> White cheeked pintail- <i>Anas bahamensis</i>
31 - East Tip of Vieques and Conejo Cay	Brown Pelican- <i>Pelecanus occidentalis</i> Roseate Tern- <i>Sterna dougallii dougallii</i> White-cheeked Pintail- <i>Anas bahamensis</i>
32 - Former Roosevelt Roads Naval Station, Ceiba	Brown Pelican- <i>Pelecanus occidentalis</i> Least Grebe- <i>Tachybaptus dominicus</i> Ruddy Duck- <i>Oxyura jamaicensis</i> West Indian Whistling-Duck- <i>Dendrocygna arborea</i> White-cheeked Pintail- <i>Anas bahamensis</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i> Yellow-shouldered Blackbird- <i>Agelaius xanthomus</i>

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33 - Ceiba State Forest	Brown Pelican- <i>Pelecanus occidentalis</i> Yellow-shouldered Blackbird- <i>Agelaius xanthomus</i>
34 - Humacao Natural Reserve, Humacao	Brown pelican- <i>Pelecanus occidentalis</i> Caribbean Coot- <i>Fulica caribaea</i> Least Grebe- <i>Tachybaptus dominicus</i> Least Tern- <i>Sterna antillarum</i> Masked Duck- <i>Nomonyx dominicus</i> Peregrine Falcon- <i>Falco peregrinus</i> Ruddy Duck- <i>Oxyura jamaicensis</i> West Indian Whistling-Duck- <i>Dendrocygna arborea</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i> Yellow-breasted Crake- <i>Porzana flaviventer</i>
35 - Pandura Mountain Range, Yabucoa-Maunabo	Puerto Rican Oriole- <i>Icterus portoricensis</i> Brown Pelican- <i>Pelecanus occidentalis</i> Puerto Rican Plain Pigeon- <i>Patagioenas inornata</i> Puerto Rican Vireo- <i>Vireo latimeri</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>
36 - Palmas Pond, Arroyo	Brown Pelican- <i>Pelecanus occidentalis</i> Caribbean Coot- <i>Fulica caribaea</i> Least Tern- <i>Sterna antillarum</i> Masked Duck- <i>Nomonyx dominicus</i> Ruddy Duck- <i>Oxyura jamaicensis</i>
37 - Carite State Forest, Cayey	Puerto Rican Oriole- <i>Icterus portoricensis</i> Broad-winged Hawk- <i>Buteo platypterus</i> Elfin-woods Warbler- <i>Setophaga angelae</i> Key West Quail-Dove- <i>Geotrygon chrysia</i> Puerto Rican Vireo- <i>Vireo latimeri</i> Sharp-shinned Hawk- <i>Accipiter striatus</i>
39 - Cidra Lake, Cidra	Puerto Rican Plain Pigeon- <i>Patagioenas inornata</i>
40 - Aguirre State Forest, Punta Pozuelo, Cayos Caribes, Cayos La Barca and Mar Negro, Guayama-Salinas	Puerto Rican Oriole- <i>Icterus portoricensis</i> Brown Pelican- <i>Pelecanus occidentalis</i> Grasshopper Sparrow- <i>Ammodramus savannarum</i> Least Grebe- <i>Tachybaptus dominicus</i> Least Tern- <i>Sterna antillarum</i> Peregrine Falcon- <i>Falco peregrinus</i> Puerto Rican Plain Pigeon- <i>Patagioenas inornata</i> Puerto Rican Vireo- <i>Vireo latimeri</i> Roseate Tern- <i>Sterna dougallii dougallii</i> White-cheeked Pintail- <i>Anas bahamensis</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>

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41 - Punta Arenas, Salinas	Brown Pelican- <i>Pelecanus occidentalis</i> White-cheeked Pintail- <i>Anas bahamensis</i>
42 - Salinas Training Area, Salinas	Puerto Rican Oriole- <i>Icterus portoricensis</i> Key West Quail-Dove- <i>Geotrygon chrysia</i>
43 - Punta Petrona Mangroves and Caracoles Cay, Santa Isabel	Brown Pelican- <i>Pelecanus occidentalis</i> Ruddy Duck- <i>Oxyura jamaicensis</i> White-cheeked Pintail- <i>Anas bahamensis</i>
44 - Cabuyón Mangroves and Fríos Cay, Ponce	Brown Pelican- <i>Pelecanus occidentalis</i> Caribbean Coot- <i>Fulica caribaea</i> Grasshopper Sparrow- <i>Ammodramus savannarum</i> Snowy Plover- <i>Charadrius alexandrinus</i> White-cheeked Pintail- <i>Anas bahamensis</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>
45 - Caja de Muertos Complex, Santa Isabel, Juana Díaz-Ponce	Brown Pelican- <i>Pelecanus occidentalis</i> Least Tern- <i>Sterna antillarum</i> Peregrine Falcon- <i>Falco peregrinus</i> Roseate Tern- <i>Sterna dougallii dougallii</i>
46 - Serrallés Lagoons Complex, Juana Díaz-Ponce	Puerto Rican Oriole- <i>Icterus portoricensis</i> Brown Pelican- <i>Pelecanus occidentalis</i> Caribbean Coot- <i>Fulica caribaea</i> Least Grebe- <i>Tachybaptus dominicus</i> Ruddy Duck- <i>Oxyura jamaicensis</i>
47 - Toro Negro State Forest, Ciales-Jayuya-Ponce-Juana Díaz-Orocovis	Puerto Rican Oriole- <i>Icterus portoricensis</i> Puerto Rican Vireo- <i>Vireo latimeri</i> Sharp-shinned Hawk- <i>Accipiter striatus</i>
48 - Las Salinas Lagoon / El Tuque, Ponce	Puerto Rican Oriole- <i>Icterus portoricensis</i> Brown Pelican- <i>Pelecanus occidentalis</i> Peregrine Falcon- <i>Falco peregrinus</i> Puerto Rican Vireo- <i>Vireo latimeri</i> White-cheeked Pintail- <i>Anas bahamensis</i>
49 - Monte Guilarte State Forest, Adjuntas-Guayanilla-Peñuelas-Yauco	Puerto Rican Oriole- <i>Icterus portoricensis</i> Key West Quail-Dove- <i>Geotrygon chrysia</i> Puerto Rican Vireo- <i>Vireo latimeri</i> Sharp-shinned Hawk- <i>Accipiter striatus</i>
50 - Punta Verraco, Cerro Toro and Punta Ventana, Guayanilla	Brown Pelican- <i>Pelecanus occidentalis</i> Puerto Rican nightjar- <i>Caprimulgus noctitherus</i>
51 - Guayanilla Hills, Guayanilla	Puerto Rican nightjar- <i>Caprimulgus noctitherus</i>
52 - Guánica Lagoon, Guánica-Lajas	Puerto Rican nightjar- <i>Caprimulgus noctitherus</i> Ruddy Duck- <i>Oxyura jamaicensis</i> West Indian Whistling-Duck- <i>Dendrocygna arborea</i> White-cheeked Pintail- <i>Anas bahamensis</i> Yellow-breasted Crake- <i>Porzana flaviventer</i>

Avian Conservation Planning Priorities for Puerto Rico and the US Virgin Islands

<p>53 - Guánica State Forest and Adjacent Lands, Guánica-Yauco</p>	<p>Puerto Rican Oriole-<i>Icterus portoricensis</i> Bridled Quail-Dove-<i>Geotrygon mystacea</i> Key West Quail-Dove-<i>Geotrygon chrysia</i> Puerto Rican nightjar-<i>Caprimulgus noctitherus</i> Puerto Rican Vireo-<i>Vireo latimeri</i> White-crowned Pigeon-<i>Patagioenas leucocephala</i></p>
<p>54 - San Jacinto Salt Flats and Tamarindo Lagoon, Guánica</p>	<p>Brown Pelican-<i>Pelecanus occidentalis</i> Roseate Tern-<i>Sterna dougallii dougallii</i> White-cheeked Pintail-<i>Anas bahamensis</i></p>
<p>55 - Susúa State Forest and Adjacent Lands, Yauco-Sabana Grande</p>	<p>Puerto Rican Oriole-<i>Icterus portoricensis</i> Key West Quail-Dove-<i>Geotrygon chrysia</i> Puerto Rican nightjar-<i>Caprimulgus noctitherus</i> Puerto Rican Vireo-<i>Vireo latimeri</i></p>
<p>56 - La Parguera Natural Reserve, Lajas</p>	<p>Brown Pelican-<i>Pelecanus occidentalis</i> Least Tern-<i>Sterna antillarum</i> Puerto Rican nightjar-<i>Caprimulgus noctitherus</i> Puerto Rican Vireo-<i>Vireo latimeri</i> Yellow-shouldered Blackbird-<i>Agelaius xanthomus</i></p>
<p>57 - Cartagena Lagoon, Lajas</p>	<p>Puerto Rican Oriole-<i>Icterus portoricensis</i> Broad-winged Hawk-<i>Buteo platypterus</i> Caribbean Coot-<i>Fulica caribaea</i> Grasshopper Sparrow-<i>Ammondramus savannarum</i> Key West Quail-Dove-<i>Geotrygon chrysia</i> Least Grebe-<i>Tachybaptus dominicus</i> Least Tern-<i>Sterna antillarum</i> Masked Duck-<i>Nomonyx dominicus</i> Peregrine Falcon-<i>Falco peregrinus</i> Puerto Rican Vireo-<i>Vireo latimeri</i> Ruddy Duck-<i>Oxyura jamaicensis</i> West Indian Whistling-Duck-<i>Dendrocygna arborea</i> White-cheeked Pintail-<i>Anas bahamensis</i> White-crowned Pigeon-<i>Patagioenas leucocephala</i> Yellow-breasted Crake-<i>Porzana flaviventer</i> Yellow-shouldered Blackbird-<i>Agelaius xanthomus</i></p>
<p>58 - Boquerón State Forest, Cabo Rojo</p>	<p>Puerto Rican Oriole-<i>Icterus portoricensis</i> Brown Pelican-<i>Pelecanus occidentalis</i> Caribbean Coot-<i>Fulica caribaea</i> Grasshopper Sparrow-<i>Ammondramus savannarum</i> Least Tern-<i>Sterna antillarum</i> Piping Plover-<i>Charadrius melodus</i> Ruddy Duck-<i>Oxyura jamaicensis</i> West Indian Whistling-Duck-<i>Dendrocygna arborea</i></p>

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<p>58 – Boquerón State Forest, Cabo Rojo (continued)</p>	<p>White-cheeked Pintail-<i>Anas bahamensis</i> White-crowned Pigeon-<i>Patagioenas leucocephala</i> Yellow-breasted Crake-<i>Porzana flaviventer</i> Yellow-shouldered Blackbird-<i>Agelaius xanthomus</i></p>
<p>59 - Boquerón Wildlife Refuge, Cabo Rojo</p>	<p>Puerto Rican Oriole-<i>Icterus portoricensis</i> Brown Pelican-<i>Pelecanus occidentalis</i> Caribbean Coot-<i>Fulica caribaea</i> Grasshopper Sparrow-<i>Ammodramus savannarum</i> Least Grebe-<i>Tachybaptus dominicus</i> Masked Duck-<i>Nomonyx dominicus</i> Peregrine Falcon-<i>Falco peregrinus</i> Ruddy Duck-<i>Oxyura jamaicensis</i> West Indian Whistling-Duck-<i>Dendrocygna arborea</i> White-cheeked Pintail-<i>Anas bahamensis</i> White-crowned Pigeon-<i>Patagioenas leucocephala</i> Yellow-shouldered Blackbird-<i>Agelaius xanthomus</i></p>
<p>60 - Cabo Rojo Salt Flats and Adjacent Areas, Cabo Rojo</p>	<p>Least Tern-<i>Sterna antillarum</i> Piping Plover-<i>Charadrius melodus</i> Roseate Tern-<i>Sterna dougallii dougallii</i> Snowy Plover-<i>Charadrius alexandrinus</i> White-cheeked Pintail-<i>Anas bahamensis</i> Yellow-shouldered Blackbird-<i>Agelaius xanthomus</i></p>
<p>61 - Punta Guaniquilla Natural Reserve, Cabo Rojo</p>	<p>Brown Pelican-<i>Pelecanus occidentalis</i> Least Grebe-<i>Tachybaptus dominicus</i> Least Tern-<i>Sterna antillarum</i> Peregrine Falcon-<i>Falco peregrinus</i> Ruddy Duck-<i>Oxyura jamaicensis</i> West Indian Whistling-Duck-<i>Dendrocygna arborea</i> White-cheeked Pintail-<i>Anas bahamensis</i></p>
<p>62 - Joyuda Lagoon Natural Reserve, Cabo Rojo</p>	<p>Puerto Rican Oriole-<i>Icterus portoricensis</i> Brown Pelican-<i>Pelecanus occidentalis</i> Ruddy Duck-<i>Oxyura jamaicensis</i></p>
<p>63 - Cuevas Lagoon, Cabo Rojo</p>	<p>Masked Duck-<i>Nomonyx dominicus</i> Ruddy Duck-<i>Oxyura jamaicensis</i> White-cheeked Pintail-<i>Anas bahamensis</i></p>
<p>64 - Sabanetas Swamp/Caño Boquilla, Mayagüez</p>	<p>Puerto Rican Oriole-<i>Icterus portoricensis</i> Brown Pelican-<i>Pelecanus occidentalis</i> Caribbean Coot-<i>Fulica caribaea</i> Least Tern-<i>Sterna antillarum</i> Roseate Tern-<i>Sterna dougallii dougallii</i> West Indian Whistling-Duck-<i>Dendrocygna arborea</i></p>

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65 - Maricao State Forest, Mayagüez-San Germán-Maricao-Sabana Grande	<p>Puerto Rican Oriole-<i>Icterus portoricensis</i></p> <p>Broad-winged Hawk-<i>Buteo platypterus</i></p> <p>Puerto Rican Vireo-<i>Vireo latimeri</i></p> <p>Sharp-shinned Hawk-<i>Accipiter striatus</i></p> <p>White-crowned Pigeon-<i>Patagioenas leucocephala</i></p>
66 - Mona Island	<p>Key West Quail-Dove-<i>Geotrygon chrysia</i></p> <p>Peregrine Falcon-<i>Falco peregrinus</i></p> <p>Sharp-shinned Hawk-<i>Accipiter striatus</i></p> <p>West Indian Whistling-Duck-<i>Dendrocygna arborea</i></p> <p>White-crowned Pigeon-<i>Patagioenas leucocephala</i></p> <p>Yellow-shouldered Blackbird-<i>Agelaius xanthomus</i></p>
67 - Monito Island	<p>Brown Pelican-<i>Pelecanus occidentalis</i></p> <p>Yellow-shouldered Blackbird-<i>Agelaius xanthomus</i></p>
68 - Pozo Hondo Swamp, Añasco	<p>West Indian Whistling-Duck-<i>Dendrocygna arborea</i></p>
69 - Cayures Swamp/Central Coloso, Aguada	<p>Brown Pelican-<i>Pelecanus occidentalis</i></p> <p>Caribbean Coot-<i>Fulica caribaea</i></p> <p>Masked Duck-<i>Nomonyx dominicus</i></p> <p>West Indian Whistling-Duck-<i>Dendrocygna arborea</i></p>
70 - Desecheo Island	<p>Brown Pelican-<i>Pelecanus occidentalis</i></p> <p>Peregrine Falcon-<i>Falco peregrinus</i></p> <p>White-crowned Pigeon-<i>Patagioenas leucocephala</i></p>
72 - Guajataca Cliffs, Isabela-Quebradillas-Camuy	<p>White-tailed Tropicbird-<i>Phaeton aethereus</i> (nesting)</p> <p>Bridled Tern-<i>Sterna anaethetus</i> (nesting)</p>
73 - Guajataca State Forest, Isabela	<p>Puerto Rican Oriole-<i>Icterus portoricensis</i></p> <p>Bridled Quail-Dove-<i>Geotrygon mystacea</i></p> <p>Key West Quail-Dove-<i>Geotrygon chrysia</i></p> <p>Puerto Rican Vireo-<i>Vireo latimeri</i></p> <p>Sharp-shinned Hawk-<i>Accipiter striatus</i></p> <p>White-crowned Pigeon-<i>Patagioenas leucocephala</i></p>
74 - Guajataca Lake, Isabela-San Sebastián-Camuy-Quebradillas	<p>Puerto Rican Oriole-<i>Icterus portoricensis</i></p> <p>Broad-winged Hawk-<i>Buteo platypterus</i></p> <p>Brown Pelican-<i>Pelecanus occidentalis</i></p> <p>Caribbean Coot-<i>Fulica caribaea</i></p> <p>Key West Quail-Dove-<i>Geotrygon chrysia</i></p> <p>Puerto Rican Vireo-<i>Vireo latimeri</i></p> <p>Ruddy Duck-<i>Oxyura jamaicensis</i></p> <p>White-crowned Pigeon-<i>Patagioenas leucocephala</i></p>
76 - Carrizales Mangroves, Hatillo	<p>Brown Pelican-<i>Pelecanus occidentalis</i></p> <p>Grasshopper Sparrow-<i>Ammodramus savannarum</i></p> <p>Least Grebe-<i>Tachybaptus dominicus</i></p> <p>West Indian Whistling-Duck-<i>Dendrocygna arborea</i></p>

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<p>77 - Tiburones Swamp and La Tembladera Pond, Arecibo</p>	<p>Puerto Rican Oriole-<i>Icterus portoricensis</i> Brown Pelican-<i>Pelecanus occidentalis</i> Caribbean Coot-<i>Fulica caribaea</i> Grasshopper Sparrow-<i>Ammodramus savannarum</i> Key West Quail-Dove-<i>Geotrygon chrysia</i> Least Grebe-<i>Tachybaptus dominicus</i> Least Tern-<i>Sterna antillarum</i> Masked Duck-<i>Nomonyx dominicus</i> Peregrine Falcon-<i>Falco peregrinus</i> Roseate Tern-<i>Sterna dougallii dougallii</i> Ruddy Duck-<i>Oxyura jamaicensis</i> West Indian Whistling-Duck-<i>Dendrocygna arborea</i> White-cheeked Pintail-<i>Anas bahamensis</i> White-crowned Pigeon-<i>Patagioenas leucocephala</i> Yellow-shouldered Blackbird-<i>Agelaius xanthomus</i></p>
<p>78 - Cambalache State Forest, Arecibo-Barceloneta</p>	<p>Puerto Rican Oriole-<i>Icterus portoricensis</i> Puerto Rican Vireo-<i>Vireo latimeri</i></p>
<p>79 - Rio Abajo State Forest, Arecibo-Utuado</p>	<p>Puerto Rican Oriole-<i>Icterus portoricensis</i> Broad-winged Hawk-<i>Buteo platypterus</i> Puerto Rican Vireo-<i>Vireo latimeri</i> White-crowned Pigeon-<i>Patagioenas leucocephala</i></p>
<p>80 - Hacienda La Esperanza Natural Reserve, Manatí</p>	<p>Puerto Rican Oriole-<i>Icterus portoricensis</i> Brown Pelican-<i>Pelecanus occidentalis</i> Caribbean Coot-<i>Fulica caribaea</i> Grasshopper Sparrow-<i>Ammodramus savannarum</i> Masked Duck-<i>Nomonyx dominicus</i> Peregrine Falcon-<i>Falco peregrinus</i> Puerto Rican Vireo-<i>Vireo latimeri</i> Roseate Tern-<i>Sterna dougallii dougallii</i> Ruddy Duck-<i>Oxyura jamaicensis</i> West Indian Whistling-Duck-<i>Dendrocygna arborea</i> White-cheeked Pintail-<i>Anas bahamensis</i> White-crowned Pigeon-<i>Patagioenas leucocephala</i></p>
<p>81- Tortuguero Lagoon, Cabo Caribe Swamp and Rica Lake, Manatí-Vega Baja</p>	<p>Bridled Quail-Dove-<i>Geotrygon mystacea</i> Brown Pelican-<i>Pelecanus occidentalis</i> Caribbean Coot-<i>Fulica caribaea</i> Key West Quail-Dove-<i>Geotrygon chrysia</i> Least Grebe-<i>Tachybaptus dominicus</i> Ruddy Duck-<i>Oxyura jamaicensis</i> West Indian Whistling-Duck-<i>Dendrocygna arborea</i> White-crowned Pigeon-<i>Patagioenas leucocephala</i> Yellow-breasted Crane-<i>Porzana flaviventer</i></p>

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82 - Cibuco Swamp, Vega Baja	Brown Pelican- <i>Pelecanus occidentalis</i> Least Grebe- <i>Tachybaptus dominicus</i> Peregrine Falcon- <i>Falco peregrinus</i> Puerto Rican Vireo- <i>Vireo latimeri</i> Roseate Tern- <i>Sterna dougallii dougallii</i> Ruddy Duck- <i>Oxyura jamaicensis</i> West Indian Whistling-Duck- <i>Dendrocygna arborea</i> White-cheeked Pintail- <i>Anas bahamensis</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>
83 - Vega State Forest, Vega Baja-Vega Alta	Puerto Rican Oriole- <i>Icterus portoricensis</i> Key West Quail-Dove- <i>Geotrygon chrysia</i> Puerto Rican Vireo- <i>Vireo latimeri</i>
84 - Lakes and Forests of Dorado, Dorado	Brown Pelican- <i>Pelecanus occidentalis</i> Caribbean Coot- <i>Fulica caribaea</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>
85 - Mogotes Río Lajas y Nevárez, Dorado-Toa Baja	Key West Quail-Dove- <i>Geotrygon chrysia</i>
86 - El Mameyal, Dorado	West Indian whistling duck- <i>Dendrocygna arborea</i>
87 - San Pedro Swamp, Toa Baja	West Indian whistling duck- <i>Dendrocygna arborea</i> White-crowned Pigeon- <i>Patagioenas leucocephala</i>

Appendix F: Key bird species at Important Bird Areas in Puerto Rico (adapted with permission from BirdLife International 2008).

IMPORTANT BIRD AREAS

CR = Critically Endangered
 EN = Endangered
 VU = Vulnerable
 NT = Near Threatened
 CB = Congregatory Birds
 RR = Restricted-range Birds
 "•" denotes that a species occurs in criteria-triggering numbers at a particular IBA

Key Bird Species		Criteria	Mona and Monito	Acantilados del Noroeste	Karso del Norte	Caño Tiburones	Maricao and Susúa	Guaniquilla and Boquerón	Sierra Bermeja and Laguna Cartegena	Suroeste	Karso del Sur	Cordillera Central	Salinas de Punta Cucharas	Ciénaga Las Cucharillas	Bahía de Jobs	Este Central	Carite	El Yunque	Humacao	Ceiba and Naguabo	Culebra	Vieques
			EN, CB	RR, CB	CR, RR	VU, RR, CB	CR, RR	EN, RR	CR, RR	CR, RR, CB	CR, RR, CB	RR	RR, CB	VU, RR	EN, RR, CB	NT, RR	NT, RR	CR, RR	NT, RR	RR	CB	RR, CB
<i>Dendrocygna arborea</i>	West Indian Whistling-Duck	VU				•			•					•					•			
<i>Nomonyx dominicus</i>	Masked Duck	CB				•																
<i>Phaethon lepturus</i>	White-tailed Tropicbird	CB		•																		
<i>Fregata magnificens</i>	Magnificent Frigatebird	CB	•																			
<i>Pelecanus occidentalis</i>	Brown Pelican	CB								•												•
<i>Sula dactylatra</i>	Masked Booby	CB	•																			
<i>Sula sula</i>	Red-footed Booby	CB	•																			
<i>Sula leucogaster</i>	Brown Booby	CB	•																		•	
<i>Himantopus mexicanus</i>	Black-necked Stilt	CB								•					•							
<i>Pluvialis squatarola</i>	Black-bellied Plover	CB								•					•							
<i>Charadrius semipalmatus</i>	Semipalmated Plover	CB								•					•							
<i>Charadrius wilsonia</i>	Wilson's Plover	CB								•					•							
<i>Charadrius alexandrinus</i>	Snowy Plover	CB								•												

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Key Bird Species		Criteria	Mona and Monito	Acatilados del Noroeste	Karso del Norte	Caño Tiburones	Maricao and Susúa	Guaniquilla and Boquerón	Sierra Bermeja and Laguna Cartegena	Suroeste	Karso del Sur	Cordillera Central	Salinas de Punta Cucharas	Ciénaga Las Cucharillas	Bahía de Jobos	Este Central	Carite	El Yunque	Humacao	Ceiba and Naguabo	Culebra	Vieques
			EN, CB	RR, CB	CR, RR	VU, RR, CB	CR, RR	EN, RR	CR, RR	CR, RR, CB	CR, RR, CB	RR	RR, CB	VU, RR	EN, RR, CB	NT, RR	NT, RR	CR, RR	NT, RR	RR	CB	RR, CB
<i>Limnodromus</i>	Short-billed Dowitcher	CB													•							
<i>Tringa melanoleuca</i>	Greater Yellowlegs	CB													•							
<i>Tringa flavipes</i>	Lesser Yellowlegs	CB								•					•							
<i>Arenaria interpres</i>	Ruddy Turnstone	CB								•					•							
<i>Calidris pusilla</i>	Semipalmated Sandpiper	CB								•					•							
<i>Calidris mauri</i>	Western Sandpiper	CB								•					•							
<i>Calidris minutilla</i>	Least Sandpiper	CB								•					•							
<i>Calidris fuscicollis</i>	White-rumped Sandpiper	CB								•												
<i>Calidris melanotos</i>	Pectoral Sandpiper	CB								•												
<i>Calidris himantopus</i>	Stilt Sandpiper	CB								•					•							
<i>Sterna maxima</i>	Royal Tern	CB																			•	
<i>Sterna sandvicensis</i>	Sandwich Tern	CB								•												
<i>Sterna dougallii dougallii</i>	Roseate Tern	CB				•				•	•											
<i>Sterna antillarum</i>	Least Tern	CB											•									
<i>Sterna fuscata</i>	Sooty Tern	CB																			•	
<i>Anous Stolidus</i>	Brown Noddy	CB																			•	
<i>Patagioenas</i>	Plain Pigeon	NT														•	•					
<i>Geotrygon</i>	Bridled Quail-Dove	RR																				•
<i>Amazona vittata</i>	Puerto Rican Parrot	CR, RR			•													•				

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			Mona and Monito	Acañilados del Noroeste	Karso del Norte	Caño Tiburones	Maricao and Susúa	Guaniquilla and Boquerón	Sierra Bermeja and Laguna Cartegena	Suroeste	Karso del Sur	Cordillera Central	Salinas de Punta Cucharas	Ciénaga Las Cucharillas	Bahía de Jobos	Este Central	Carite	El Yunque	Humacao	Ceiba and Naguabo	Culebra	Vieques
Key Bird Species		Criteria	EN, CB	RR, CB	CR, RR	VU, RR, CB	CR, RR	EN, RR	CR, RR	CR, RR, CB	CR, RR, CB	RR	RR, CB	VU, RR	EN, RR, CB	NT, RR	NT, RR	CR, RR	NT, RR	RR	CB	RR, CB
<i>Coccyzus vieilloti</i>	Puerto Rican Lizard-cuckoo	RR		•	•	•	•		•	•	•	•				•	•	•	•	•		
<i>Megascops nudipes</i>	Puerto Rican Screech-owl	RR		•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•		•
<i>Caprimulgus</i>	Puerto Rican Nightjar	CR, RR					•		•	•	•	•										
<i>Anthracothorax dominicus</i>	Antillean Mango	RR		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
<i>Anthracothorax viridis</i>	Green Mango	RR		•	•		•	•	•	•	•	•	•			•	•	•				
<i>Eulampis holosericeus</i>	Green-throated Carib	RR			•	•					•		•	•	•	•		•	•	•		•
<i>Orthorhyncus cristatus</i>	Antillean Crested Hummingbird	RR									•				•	•		•	•	•		•
<i>Chlorostilbon maugaeus</i>	Puerto Rican Emerald	RR		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
<i>Todus mexicanus</i>	Puerto Rican Tody	RR		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
<i>Melanerpes portoricensis</i>	Puerto Rican Woodpecker	RR		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•
<i>Contopus latirostris</i>	Lesser Antillean Pewee	RR		•	•		•	•	•	•	•	•	•			•	•			•		
<i>Elaenia martinica</i>	Caribbean Elaenia	RR						•	•	•	•	•			•					•		•
<i>Myiarchus antillarum</i>	Puerto Rican Flycatcher	RR		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•
<i>Vireo latimeri</i>	Puerto Rican Vireo	RR		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
<i>Margarops fuscatus</i>	Pearly-eyed Thrasher	RR		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•
<i>Setophaga adelaidae</i>	Adelaide's Warbler	RR		•	•	•	•	•	•	•	•	•	•		•				•	•		•
<i>Setophaga angelae</i>	Elfin-woods Warbler	VU, RR					•											•				

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"•" denotes that a species occurs in criteria-triggering numbers at a particular IBA

			Mona and Monito	Acantilados del Noroeste	Karso del Norte	Caño Tiburones	Maricao and Susúa	Guaniquilla and Boquerón	Sierra Bermeja and Laguna Cartegena	Suroeste	Karso del Sur	Cordillera Central	Salinas de Punta Cucharas	Ciénaga Las Cucharillas	Bahía de Jobos	Este Central	Carite	El Yunque	Humacao	Ceiba and Naguabo	Culebra	Vieques
Key Bird Species	Criteria		EN, CB	RR, CB	CR, RR	VU, RR, CB	CR, RR	EN, RR	CR, RR	CR, RR, CB	CR, RR, CB	RR	RR, CB	VU, RR	EN, RR, CB	NT, RR	NT, RR	CR, RR	NT, RR	RR	CB	RR, CB
<i>Agelaius xanthomus</i>	Yellow-shouldered Blackbird	EN, RR	•					•	•	•					•							
<i>Loxigilla portoricensis</i>	Puerto Rican Bullfinch	RR		•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	
<i>Nesospingus speculiferus</i>	Puerto Rican Tanager	RR			•		•					•				•	•	•				
<i>Spindalis portoricensis</i>	Puerto Rican Spindalis	RR		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
<i>Euphonia musica</i>	Antillean Euphonia	RR		•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	

Appendix G: Key bird species at Important Bird Areas in the US Virgin Islands (adapted with permission from BirdLife International 2008).

USVI IMPORTANT BIRD AREAS

NT=Near Threatened

CB=Congregatory Birds

RR = Restricted-range Birds

"•" denotes that a species occurs in
criteria-triggering numbers at a particular IBA

			Northwest Cays	Perserverance Bay Lagoons	John Brewer's Bay	Saba Island and Cays	Magens Bay	Mangrove Lagoon	St. John	Southgate and Green Cay	Great Pond
Key Bird Species		Criteria	CB	RR	RR	CB	RR	RR	RR, CB	NT, RR, CB	NT, RR, CB
<i>Phaethon aethereus</i>	Red-billed Tropicbird		•								
<i>Pelecanus occidentalis</i>	Brown Pelican	CB	•					•	•		
<i>Sula dactylatra</i>	Masked Booby	CB	•								
<i>Sula leucogaster</i>	Brown Booby	CB	•								
<i>Fulica caribaea</i>	Caribbean Coot									•	
<i>Larus atricilla</i>	Laughing Gull					•				•	
<i>Sterna maxima</i>	Royal Tern	CB				•				•	
<i>Sterna sandvicensis</i>	Sandwich Tern	CB				•					
<i>Sterna dougalli dougalli</i>	Roseate Tern	CB				•					
<i>Sterna antillarum</i>	Least Tern	CB								•	•
<i>Sterna anaethetus</i>	Bridled Tern					•					
<i>Sterna fuscata</i>	Sooty Tern	CB				•					
<i>Anous Stolidus</i>	Brown Noddy	CB				•					
<i>Patagioenas leucocephala</i>	White-crowned Pigeon	NT									•
<i>Geotrygon mystacea</i>	Bridled Quail-Dove	RR						•			
<i>Eulampis holosericeus</i>	Green-throated Carib	RR		•	•		•	•	•	•	•
<i>Orthorhyncus cristatus</i>	Antillean Crested Hummingbird	RR		•	•		•	•	•	•	•
<i>Elaenia martinica</i>	Caribbean Elaenia	RR					•	•	•	•	•
<i>Myiarchus antillarum</i>	Puerto Rican Flycatcher	RR						•			
<i>Margarops fuscatus</i>	Pearly-eyed Thrasher	RR		•	•		•	•	•	•	
<i>Loxigilla noctis</i>	Lesser Antillean Bullfinch							•	•		

Appendix H: Puerto Rico Waterfowl Focus Areas and their associated waterfowl priority species (adapted with permission from Ventosa-Febles et al. 2005a).

Waterfowl Focus Areas	Priority Waterfowl Species
1 - Caño Tiburones Natural Reserve, Arecibo	American Wigeon - <i>Anas americana</i> Black-bellied Whistling-Duck - <i>Dendrocygna autumnalis</i> Blue-winged Teal - <i>Anas discors</i> Canvasback - <i>Aythya valisineria</i> Cinnamon Teal - <i>Anas cyanoptera</i> Fulvous Whistling Duck - <i>Dendrocygna bicolor</i> Green-winged Teal - <i>Anas crecca</i> Hooded Merganser - <i>Lophodytes cucullatus</i> Lesser Scaup - <i>Aythya affinis</i> Mallard Duck - <i>Anas platyrhynchos</i> Masked Duck - <i>Nomonyx dominicus</i> Muscovy Duck - <i>Cairina moschata</i> Northern Pintail - <i>Anas acuta</i> Northern Shoveler - <i>Anas clypeata</i> Ring-necked Duck - <i>Aythya collaris</i> Ruddy Duck - <i>Oxyura jamaicensis</i> Snow Goose - <i>Chen caerulescens</i> West Indian Whistling-Duck - <i>Dendrocygna arborea</i> White-cheeked Pintail - <i>Anas bahamensis</i>
2 - Hacienda La Esperanza Natural Reserve, Manatí	American Wigeon - <i>Anas americana</i> Blue-winged Teal - <i>Anas discors</i> Fulvous Whistling Duck - <i>Dendrocygna bicolor</i> Green-winged Teal - <i>Anas crecca</i> Lesser Scaup - <i>Aythya affinis</i>

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	<p>Ring-necked Duck - <i>Aythya collaris</i> Ruddy Duck - <i>Oxyura jamaicensis</i> West Indian Whistling-Duck - <i>Dendrocygna arborea</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
3 - Cibuco Swamp, Vega Baja	<p>Blue-winged Teal - <i>Anas discors</i> Fulvous Whistling Duck - <i>Dendrocygna bicolor</i> Green-winged Teal - <i>Anas crecca</i> Lesser Scaup - <i>Aythya affinis</i> Ring-necked Duck - <i>Aythya collaris</i> Ruddy Duck - <i>Oxyura jamaicensis</i> West Indian Whistling-Duck - <i>Dendrocygna arborea</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
4 - El Mameyal, Dorado	<p>Blue-winged Teal - <i>Anas discors</i> West Indian Whistling-Duck - <i>Dendrocygna arborea</i></p>
5 - Las Cucharillas Marsh, Cataño-Bayamón-Guaynabo	<p>American Black Duck - <i>Anas rubripes</i> American Wigeon - <i>Anas americana</i> Blue-winged Teal - <i>Anas discors</i> Green-winged Teal - <i>Anas crecca</i> Lesser Scaup - <i>Aythya affinis</i> Masked Duck - <i>Nomonyx dominicus</i> Northern Shoveler - <i>Anas clypeata</i> Ring-necked Duck - <i>Aythya collaris</i> Ruddy Duck - <i>Oxyura jamaicensis</i> West Indian Whistling-Duck - <i>Dendrocygna arborea</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
6 - Torrecillas Lagoon, Loíza	<p>American Wigeon - <i>Anas americana</i> Blue-winged Teal - <i>Anas discors</i> Fulvous Whistling Duck - <i>Dendrocygna bicolor</i> Green-winged Teal - <i>Anas crecca</i> Hooded Merganser - <i>Lophodytes cucullatus</i> Lesser Scaup - <i>Aythya affinis</i></p>

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	<p>Masked Duck - <i>Nomonyx dominicus</i> Northern Pintail - <i>Anas acuta</i> Ring-necked Duck - <i>Aythya collaris</i> Ruddy Duck - <i>Oxyura jamaicensis</i> West Indian Whistling-Duck - <i>Dendrocygna arborea</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
7 - Aguas Prietas Lagoon, Fajardo	<p>Blue-winged Teal - <i>Anas discors</i> Green-winged Teal - <i>Anas crecca</i> Ruddy Duck - <i>Oxyura jamaicensis</i> West Indian Whistling-Duck - <i>Dendrocygna arborea</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
8 - Ceiba Mangrove Forest and Lagoons (Roosevelt Roads)	<p>Blue-winged Teal - <i>Anas discors</i> Green-winged Teal - <i>Anas crecca</i> Lesser Scaup - <i>Aythya affinis</i> Ruddy Duck - <i>Oxyura jamaicensis</i> West Indian Whistling-Duck - <i>Dendrocygna arborea</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
9 - Culebra Island Lagoons - Flamenco Lagoon	<p>Green-winged Teal - <i>Anas crecca</i> Ruddy Duck - <i>Oxyura jamaicensis</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
9 - Culebra Island Lagoons - Zoni Lagoon	<p>Ruddy Duck - <i>Oxyura jamaicensis</i></p>
9 - Culebra Island Lagoons - Cornelio Lagoon	<p>Blue-winged Teal - <i>Anas discors</i> Ruddy Duck - <i>Oxyura jamaicensis</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
10 - Vieques Island Lagoons -- Kiani Lagoon Complex	<p>Blue-winged Teal - <i>Anas discors</i> Ruddy Duck - <i>Oxyura jamaicensis</i> West Indian Whistling-Duck - <i>Dendrocygna arborea</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
10 - Vieques Island Lagoons -- Playa Grande Lagoon	<p>Blue-winged Teal - <i>Anas discors</i></p>

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	<p>Ruddy Duck - <i>Oxyura jamaicensis</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
<p>10 - Vieques Island Lagoons -- Chivas Swamp, Vieques</p>	<p>Blue-winged Teal - <i>Anas discors</i> Ruddy Duck - <i>Oxyura jamaicensis</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
<p>10 - Vieques Island Lagoons -- Yanuel Lagoon, Vieques</p>	<p>Blue-winged Teal - <i>Anas discors</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
<p>11- Humacao Wildlife Refuge</p>	<p>American Black Duck - <i>Anas rubripes</i> American Wigeon - <i>Anas americana</i> Black-bellied Whistling-Duck - <i>Dendrocygna autumnalis</i> Blue-winged Teal - <i>Anas discors</i> Canvasback - <i>Aythya valisineria</i> Green-winged Teal - <i>Anas crecca</i> Hooded Merganser - <i>Lophodytes cucullatus</i> Lesser Scaup - <i>Aythya affinis</i> Masked Duck - <i>Nomonyx dominicus</i> Northern Pintail - <i>Anas acuta</i> Northern Shoveler - <i>Anas clypeata</i> Ring-necked Duck - <i>Aythya collaris</i> Ruddy Duck - <i>Oxyura jamaicensis</i> Snow Goose - <i>Chen caerulescens</i> Trumpeter Swan - <i>Cygnus buccinator</i> West Indian Whistling-Duck - <i>Dendrocygna arborea</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
<p>12 - Punta Arenas, Mar Negro, Bahía de Jobos and Punta Pozuelo, Guayama and Salinas</p>	<p>American Black Duck - <i>Anas rubripes</i></p>

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	<p>Blue-winged Teal - <i>Anas discors</i> Green-winged Teal - <i>Anas crecca</i> Ruddy Duck - <i>Oxyura jamaicensis</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
13 - Punta Petrona, Santa Isabel	<p>Blue-winged Teal - <i>Anas discors</i> Green-winged Teal - <i>Anas crecca</i> Ruddy Duck - <i>Oxyura jamaicensis</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
14 - El Tuque/Punta Cucharas/Salinas Lagoon, Ponce	<p>Blue-winged Teal - <i>Anas discors</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
15 - La Esperanza/Cabuyón Mangroves, Ponce	<p>Blue-winged Teal - <i>Anas discors</i> Green-winged Teal - <i>Anas crecca</i> Lesser Scaup - <i>Aythya affinis</i> Ring-necked Duck - <i>Aythya collaris</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
16 - Serrallés Lagoons Complex, Ponce	<p>Mallard Duck - <i>Anas platyrhynchos</i> Lesser Scaup - <i>Aythya affinis</i> Ruddy Duck - <i>Oxyura jamaicensis</i></p>
17 - Cartagena Lagoon, Lajas	<p>American Black Duck - <i>Anas rubripes</i> American Wigeon - <i>Anas americana</i> Blue-winged Teal - <i>Anas discors</i> Fulvous Whistling Duck - <i>Dendrocygna bicolor</i> Gray breasted tree duck - <i>Dendrocygna autumnalis</i> Green-winged Teal - <i>Anas crecca</i> Lesser Scaup - <i>Aythya affinis</i> Northern Pintail - <i>Anas acuta</i> Northern Shoveler - <i>Anas clypeata</i> Ring-necked Duck - <i>Aythya collaris</i> Ruddy Duck - <i>Oxyura jamaicensis</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
18 - Boquerón Wildlife Refuge, Cabo Rojo	<p>American Wigeon - <i>Anas americana</i> Blue-winged Teal - <i>Anas discors</i></p>

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	<p>Fulvous Whistling Duck - <i>Dendrocygna bicolor</i> Green-winged Teal - <i>Anas crecca</i> Lesser Scaup - <i>Aythya affinis</i> Northern Pintail - <i>Anas acuta</i> Northern Shoveler - <i>Anas clypeata</i> Ring-necked Duck - <i>Aythya collaris</i> Ruddy Duck - <i>Oxyura jamaicensis</i> West Indian Whistling-Duck - <i>Dendrocygna arborea</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
19 - Cuevas Lagoon, Cabo Rojo	<p>Blue-winged Teal - <i>Anas discors</i> Green-winged Teal - <i>Anas crecca</i> Lesser Scaup - <i>Aythya affinis</i> Masked Duck - <i>Nomonyx dominicus</i> Northern Shoveler - <i>Anas clypeata</i></p>
19 - Cuevas Lagoon, Cabo Rojo (continued)	<p>Ring-necked Duck - <i>Aythya collaris</i> Ruddy Duck - <i>Oxyura jamaicensis</i> White-cheeked Pintail - <i>Anas bahamensis</i></p>
20 - Cayures, Anasco	<p>Blue-winged Teal - <i>Anas discors</i> Lesser Scaup - <i>Aythya affinis</i> Mallard Duck - <i>Anas platyrhynchos</i> Masked Duck - <i>Nomonyx dominicus</i> Ring-necked Duck - <i>Aythya collaris</i> Ruddy Duck - <i>Oxyura jamaicensis</i> West Indian Whistling-Duck - <i>Dendrocygna arborea</i></p>

Appendix I: Protected, Restored or Enhanced Acreage in Puerto Rico Waterfowl Focus Areas (source: Ventosa-Febles et al. 2005a).

Focus Area	Since 2001	Goal	Total
Caño Tiburones	2731	3000	5731
Hacienda La Esperanza	0	658	658
Cibuco Swamp	0	1008	1008
El Mameyal	0	1014	1014
Las Cucharillas Marsh	977	1236	2213
Torrecillas Lagoon	0	3996	3996
Aguas Prietas Lagoon	0	462	462
Ceiba Mangrove Forest and Lagoons (Roosevelt Roads)	0	786	786
Culebra Lagoons - Flamenco	0	175	175
Culebra Lagoons - Zoni	0	31	31
Culebra Lagoons - Cornelius	0	10	10
Vieques Lagoons - Kiani	4201	362	4563
Vieques Lagoons - Playa Grande	920	164	1084
Vieques Lagoons - Chivas and Yanuel	1352	230	1582
Humacao Wildlife Refuge	278	486	764
Punta Arenas, Mar Negro, Bahía de Jobos and Punta Pozuelo	0	13120	13120
Punta Petrona	0	460	460
El Tuque/Punta Cucharas/Salinas Lagoon	0	729	729
La Esperanza/Cabuyón Mangroves	0	3346	3346
Serrallés Lagoons Complex	0	512	512
Cartagena Lagoon	291	429	720
Boquerón Wildlife Refuge	14	454	468
Cuevas Lagoon	0	701	701
Cayures	0	283	28

Appendix J: Puerto Rico Areas of Conservation Priority and associated Avian Critical Elements (based on available Element Occurrence Records), as identified by the PR Natural History Program (adapted from DNER 2008).

Area of Conservation Priority	Avian Critical Element	
	Species Name	Common Name
Bahía Ballena	<i>Agelaius xanthomus</i>	Yellow-shouldered Blackbird
	<i>Caprimulgus noctitherus</i>	Puerto Rican Nightjar
	<i>Sterna antillarum</i>	Least Tern
Bahía Montalva	<i>Pelecanus occidentalis</i>	Brown Pelican
	<i>Sterna antillarum</i>	Least Tern
	<i>Sterna dougallii dougallii</i>	Roseate Tern
Bajura	--*	--
Barrio Pasto	--	--
Bosque Costero de Dorado	<i>Pelecanus occidentalis</i>	Brown Pelican
Bosque de San Patricio	--	--
Bosque Urbano	--	--
Bosques de Ucar	--	--
Cabezas de San Juan	--	--
Caliza Los Peñones	--	--
Caño Boquilla	<i>Dendrocygna arborea</i>	West Indian Whistling-duck
Caño Corazones	<i>Pelecanus occidentalis</i>	Brown Pelican
	<i>Porzana flaviventer</i>	Yellow-breasted Crake
Caño La Puente	--	--
Caño Martín Peña, Laguna San José	<i>Agelaius xanthomus</i>	Yellow-shouldered Blackbird
	<i>Pelecanus occidentalis</i>	Brown Pelican
	<i>Sterna antillarum</i>	Least Tern
	<i>Sterna dougallii dougallii</i>	Roseate Tern
Caño Tiburones	<i>Dendrocygna arborea</i>	West Indian Whistling-duck
	<i>Falco peregrinus anatum</i>	American Peregrine Falcon
	<i>Fulica caribaea</i>	Caribbean Coot
	<i>Oxyura dominica</i>	Masked Duck

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	<i>Oxyura jamaicensis</i>	Ruddy Duck
Cañón Las Bocas	--	--
Cañón San Cristobal	--	--
Cayo Berbería y Reserva Natural Isla Caja de Muerto	<i>Pelecanus occidentalis</i> <i>Fulica caribaea</i> <i>Oxyura dominica</i> <i>Oxyura jamaicensis</i>	Brown Pelican Caribbean Coot Masked Duck Ruddy Duck
Cerro Cuevas	--	--
Cerro Las Mesas	--	--
Charca La Tembladera	--	--
Ciénaga Las Cucharillas	<i>Falco peregrinus anatum</i> <i>Oxyura jamaicensis</i>	American Peregrine Falcon Ruddy Duck
Ciénaga Prieta	<i>Dendrocygna arborea</i> <i>Pelecanus occidentalis</i>	West Indian Whistling-duck Brown Pelican
Ciénaga San Pedro y Sector El Caracol	<i>Columba leucocephala</i> <i>Pelecanus occidentalis</i>	White-crowned Pigeon Brown Pelican
Cordillera Central	<i>Accipiter striatus venator</i> <i>Buteo platypterus brunnescens</i> <i>Caprimulgus noctitherus</i>	Sharp-shinned Hawk Broad-winged Hawk Puerto Rican Nightjar
Corredor Ecológico del Noreste	<i>Chlorostilbon maugaeus</i> <i>Dendrocygna arborea</i> <i>Falco peregrinus anatum</i> <i>Fulica caribaea</i> <i>Nesospingus speculiferus</i> <i>Oxyura dominica</i> <i>Sterna antillarum</i> <i>Tachybaptus dominicus</i>	Puerto Rican Emerald West Indian Whistling-duck American Peregrine Falcon Caribbean Coot Puerto Rican Tanager Masked Duck Least Tern Least Grebe
Cuevas de Aguas Buenas	--	--
Culebra	<i>Anas bahamensis</i> <i>Columba leucocephala</i>	White-cheeked Pintail White-crowned Pigeon

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	<i>Fulica caribaea</i>	Caribbean Coot
	<i>Oxyura dominica</i>	Masked Duck
	<i>Oxyura jamaicensis</i>	Ruddy Duck
	<i>Pelecanus occidentalis</i>	Brown Pelican
	<i>Sterna dougallii dougallii</i>	Roseate Tern
	<i>Tachybaptus dominicus</i>	Least Grebe
El Yunque	<i>Accipiter striatus venator</i>	Sharp-shinned Hawk
	<i>Agelaius xanthomus</i>	Yellow-shouldered Blackbird
	<i>Amazona vittata</i>	Puerto Rican Parrot
	<i>Anas bahamensis</i>	White-cheeked Pintail
	<i>Anthracothorax viridis</i>	Green Mango
	<i>Buteo platypterus brunnescens</i>	Broad-winged Hawk
	<i>Chlorostilbon maugaeus</i>	Puerto Rican Emerald
	<i>Columba leucocephala</i>	White-crowned Pigeon
	<i>Setophaga angelae</i>	Elfin-woods Warbler
	<i>Falco peregrinus anatum</i>	American Peregrine Falcon
	<i>Loxigilla portoricensis</i>	Puerto Rican Bullfinch
	<i>Melanerpes portoricensis</i>	Puerto Rican Woodpecker
	<i>Myiarchus antillarum</i>	Puerto Rican Flycatcher
	<i>Nesospingus speculiferus</i>	Puerto Rican Tanager
	<i>Oxyura jamaicensis</i>	Ruddy Duck
	<i>Todus mexicanus</i>	Puerto Rican Tody
Estuario Bahía de Guánica	<i>Pelecanus occidentalis</i>	Brown Pelican
Estuario Río La Plata	--	--
Finca La Jungla	<i>Sterna antillarum</i>	Least Tern
Guajón	--	--
Guajón - Sierras de Panduras y Guardarraya	--	--
Hábitat Coquí Dorado	<i>Tachybaptus dominicus</i>	Least Grebe
Hábitat Coquí Llanero	<i>Columba leucocephala</i>	White-crowned Pigeon
Hábitat del Guabairo	<i>Agelaius xanthomus</i>	Yellow-shouldered Blackbird
	<i>Caprimulgus noctitherus</i>	Puerto Rican Nightjar

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	<i>Sterna antillarum</i>	Least Tern
Hábitat Paloma Sabanera	<i>Columba inornata wetmorei</i> <i>Tachybaptus dominicus</i>	Plain Pigeon Least Grebe
Hábitat Sapo Concho	--	--
Hábitat Sapo concho sur central	--	--
Hacienda La Esperanza	--	--
Humedales Costeros de Yabucoa	--	--
Humedales de Cayures	<i>Dendrocygna arborea</i> <i>Oxyura dominica</i> <i>Oxyura jamaicensis</i>	West Indian Whistling-duck Masked Duck Ruddy Duck
Humedales de La Parguera	<i>Caprimulgus noctitherus</i> <i>Pelecanus occidentalis</i> <i>Sterna antillarum</i>	Puerto Rican Nightjar Brown Pelican Least Tern
Humedales Laguna Cuevas	<i>Dendrocygna arborea</i>	West Indian Whistling-duck
Humedales Sur Dorado	--	--
Humedales, Desfiladeros y Bosques Costeros	--	--
Isla Desecheo	--	--
Islas de Mona y Monito	<i>Agelaius xanthomus</i> <i>Falco peregrinus anatum</i>	Yellow-shouldered Blackbird American Peregrine Falcon
Islotes y Cayos	<i>Dendrocygna arborea</i> <i>Pelecanus occidentalis</i>	West Indian Whistling-duck Brown Pelican
Joyudas - Lagunas Cabo Rojo	<i>Agelaius xanthomus</i> <i>Anas bahamensis</i> <i>Caprimulgus noctitherus</i> <i>Charadrius alexandrinus tenuirostris</i> <i>Charadrius melodus</i> <i>Dendrocygna arborea</i> <i>Falco peregrinus anatum</i> <i>Fregata magnificens</i>	Yellow-shouldered Blackbird White-cheeked Pintail Puerto Rican Nightjar Snowy Plover Piping Plover West Indian Whistling-duck American Peregrine Falcon Magnificent Frigatebird

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	<i>Fulica caribaea</i>	Caribbean Coot
Joyudas - Lagunas Cabo Rojo (continued)	<i>Loxigilla portoricensis</i> <i>Melanerpes portoricensis</i> <i>Myiarchus antillarum</i> <i>Oxyura jamaicensis</i> <i>Pelecanus occidentalis</i>	Puerto Rican Bullfinch Puerto Rican Woodpecker Puerto Rican Flycatcher Ruddy Duck Brown Pelican
Joyudas - Lagunas Cabo Rojo (continued)	<i>Porzana flaviventer</i> <i>Sterna antillarum</i> <i>Tachybaptus dominicus</i> <i>Todus mexicanus</i>	Yellow-breasted Crake Least Tern Least Grebe Puerto Rican Tody
Karzo Arrozal-Biáfara	--	--
Karzo del Noroeste	<i>Accipiter striatus venator</i> <i>Dendrocygna arborea</i> <i>Oxyura dominica</i> <i>Oxyura jamaicensis</i>	Sharp-shinned Hawk West Indian Whistling-duck Masked Duck Ruddy Duck
Karzo del Norte	<i>Dendrocygna arborea</i>	West Indian Whistling-duck
Karzo Río Abajo	<i>Buteo platypterus brunnescens</i> <i>Columba inornata wetmorei</i>	Broad-winged Hawk Plain Pigeon
Karzo Río Camuy	--	--
Lagos Serralles	<i>Fulica caribaea</i> <i>Oxyura jamaicensis</i> <i>Tachybaptus dominicus</i>	Caribbean Coot Ruddy Duck Least Grebe
Laguna Cartagena	<i>Agelaius xanthomus</i> <i>Caprimulgus noctitherus</i> <i>Dendrocygna arborea</i> <i>Falco peregrinus anatum</i> <i>Fulica caribaea</i> <i>Oxyura jamaicensis</i> <i>Porzana flaviventer</i> <i>Tachybaptus dominicus</i>	Yellow-shouldered Blackbird Puerto Rican Nightjar West Indian Whistling-duck American Peregrine Falcon Caribbean Coot Ruddy Duck Yellow-breasted Crake Least Grebe

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Laguna Guánica	--	--
Laguna Puerto Nuevo	<i>Porzana flaviventer</i>	Yellow-breasted Crake
Laguna Tortuguero, Cabo Caribe	<i>Columba leucocephala</i> <i>Dendrocygna arborea</i> <i>Fulica caribaea</i> <i>Oxyura jamaicensis</i> <i>Pelecanus occidentalis</i> <i>Porzana flaviventer</i> <i>Sterna dougallii dougallii</i> <i>Tachybaptus dominicus</i>	White-crowned Pigeon West Indian Whistling-duck Caribbean Coot Ruddy Duck Brown Pelican Yellow-breasted Crake Roseate Tern Least Grebe
Lagunas de Arroyo	--	--
Lagunas de Humacao	<i>Dendrocygna arborea</i> <i>Falco peregrinus anatum</i> <i>Fulica caribaea</i> <i>Oxyura dominica</i> <i>Oxyura jamaicensis</i> <i>Pelecanus occidentalis</i> <i>Tachybaptus dominicus</i>	West Indian Whistling-duck American Peregrine Falcon Caribbean Coot Masked Duck Ruddy Duck Brown Pelican Least Grebe
Lliveras - Punta Verraco	<i>Agelaius xanthomus</i> <i>Caprimulgus noctitherus</i> <i>Pelecanus occidentalis</i>	Yellow-shouldered Blackbird Puerto Rican Nightjar Brown Pelican
Manglar Cerromar	--	--
Manglar de Carrizales	<i>Tachybaptus dominicus</i>	Least Grebe
Megareserva del Karzo	--	--
Mogotes Río Lajas y Nevarez	--	--
Monte La Torrecilla	--	--
Pantano Pozo Hondo	--	--
Peñón Brusi	--	--
Piedras Chiquitas	<i>Columba inornata wetmorei</i>	Plain Pigeon
Piedras del Collado	--	--
Piñones-Río Mameyes	<i>Agelaius xanthomus</i>	Yellow-shouldered Blackbird

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	<i>Anthracothorax viridis</i>	Green Mango
	<i>Chlorostilbon maugaeus</i>	Puerto Rican Emerald
	<i>Columba leucocephala</i>	White-crowned Pigeon
	<i>Dendrocygna arborea</i>	West Indian Whistling-duck
	<i>Falco peregrinus anatum</i>	American Peregrine Falcon
	<i>Loxigilla portoricensis</i>	Puerto Rican Bullfinch
	<i>Melanerpes portoricensis</i>	Puerto Rican Woodpecker
	<i>Myiarchus antillarum</i>	Puerto Rican Flycatcher
	<i>Nesospingus speculariferus</i>	Puerto Rican Tanager
	<i>Pelecanus occidentalis</i>	Brown Pelican
	<i>Saurothera vieilloti</i>	Puerto Rican Lizard-cuckoo
	<i>Sterna antillarum</i>	Least Tern
	<i>Todus mexicanus</i>	Puerto Rican Tody
Playa California	--	--
Playa de Fajardo - Cayo Algodones	<i>Agelaius xanthomus</i>	Yellow-shouldered Blackbird
	<i>Anas bahamensis</i>	White-cheeked Pintail
	<i>Columba leucocephala</i>	White-crowned Pigeon
	<i>Dendrocygna arborea</i>	West Indian Whistling-duck
	<i>Pelecanus occidentalis</i>	Brown Pelican
	<i>Tachybaptus dominicus</i>	Least Grebe
Pterocarpus Luquillo	<i>Anthracothorax viridis</i>	Green Mango
	<i>Chlorostilbon maugaeus</i>	Puerto Rican Emerald
	<i>Columba leucocephala</i>	White-crowned Pigeon
	<i>Setophaga angelae</i>	Elfin-woods Warbler
	<i>Falco peregrinus anatum</i>	American Peregrine Falcon
	<i>Loxigilla portoricensis</i>	Puerto Rican Bullfinch
	<i>Melanerpes portoricensis</i>	Puerto Rican Woodpecker
	<i>Myiarchus antillarum</i>	Puerto Rican Flycatcher
	<i>Nesospingus speculariferus</i>	Puerto Rican Tanager
	<i>Saurothera vieilloti</i>	Puerto Rican Lizard-cuckoo
	<i>Todus mexicanus</i>	Puerto Rican Tody
Pterocarpus y Humedales Bo.	<i>Dendrocygna arborea</i>	West Indian Whistling-duck

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Sabanetas		
Punta Cabuyones	<i>Pelecanus occidentalis</i> <i>Sterna antillarum</i>	Brown Pelican Least Tern
Punta Cucharas	--	--
Punta Guayanés	--	--
Punta Petrona	<i>Pelecanus occidentalis</i>	Brown Pelican
Punta Pozuelo	<i>Sterna antillarum</i>	Least Tern
Punta Tuna	--	--
Punta Viento	--	--
Punta Yeguas	--	--
Quebrada Bellaca	--	--
Refugio de Vida Silvestre Lago La Plata	--	--
Refugio de Vida Silvestre Lago Luchetti	--	--
Refugio de Vida Silvestre Lago Guajataca	--	--
Región Montañosa BE Carite	<i>Accipiter striatus venator</i> <i>Buteo platypterus brunnescens</i> <i>Columba inornata wetmorei</i> <i>Oxyura jamaicensis</i> <i>Tachybaptus dominicus</i>	Sharp-shinned Hawk Broad-winged Hawk Plain Pigeon Ruddy Duck Least Grebe
Reserva Natural Cueva del Indio	<i>Falco peregrinus anatum</i>	American Peregrine Falcon
Reserva Natural La Cordillera	<i>Agelaius xanthomus</i> <i>Anas bahamensis</i> <i>Fregata magnificens</i> <i>Pelecanus occidentalis</i>	Yellow-shouldered Blackbird White-cheeked Pintail Magnificent Frigatebird Brown Pelican
Río Guajataca y Desfiladeros	--	--
Sierra Bermeja	<i>Caprimulgus noctitherus</i>	Puerto Rican Nightjar
Vieques	<i>Dendrocygna arborea</i> <i>Fulica caribaea</i>	West Indian Whistling-duck Caribbean Coot

Appendix K: Puerto Rico Comprehensive Wildlife Conservation Strategy conservation category for 81 species of birds
CR=Critically Endangered; DD=Data Deficient; EN=Endangered; LR=Low Risk; VU=Vulnerable (adapted with permission from Garcia et al. 2005).

Species	Common Name	CWCS Conservation Category
Accipiter striatus venator	Sharp-shinned Hawk	CR
Amazona vitatta vittata	Puerto Rican Parrot	CR
Ammodramus savannanum	Grasshopper Sparrow	DD
Anas bahamensis	White-cheeked Pintail	VU
Angelaius xanthomus	Yellow-shouldered	EN
Anous stolidus	Brown Noddy	DD
Anthracothorax dominicus	Antillean Mango	DD
Anthracothorax viridis	Green Mango	DD
Aramus guarauna	Limpkin	CR
Asio flammeus	Short-eared Owl	DD
Buteo platypterus	Broad-winged Hawk	CR
Calidris canutus	Red Knot	DD
Calidris himantopus	Stilt Sandpiper	DD
Caprimulgus noctitherus	Puerto Rican Nightjar	EN
Carduelis cucullata	Red Siskin	DD
Charadrius alexandrinus	Snowy Plover	CR
Charadrius melodus	Piping Plover	CR
Charadrius wilsonia	Wilson's Plover	CR
Chlorostilbon maugaeus	Puerto Rican Emerald	DD
Coccyzus minor	Mangrove Cuckoo	DD
Contopus portoricensis	Puerto Rican (Lesser	DD
Cypseloides niger	Black Swift	DD
Dendrocygna arborea	West Indian Whistling-Duck	CR
Setophaga adelaidae	Adelaide's Warbler	DD
Setophaga angelae	Elfin-woods Warbler	VU
Setophaga caerulescens	Black-throated Blue Warbler	DD
Setophaga discolor	Prairie Warbler	DD

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Setophaga petechia	Yellow Warbler	VU
Dolichonyx oryzivorus	Bobolink	DD
Egretta rufescens	Reddish Egret	DD
Elaenia martinica	Caribbean Elaenia	DD
Eulampis holosericeus	Green-throated Carib	DD
Euphonia musica	Antillean Euphonia	DD
Falco peregrinus tundrius	Peregrine Falcon	CR
Fregata magnificens	Magnificent Frigatebird	DD
Fulica caribaea	Caribbean Coot	VU
Geothlypis trichas	Common Yellowthroat	DD
Geotrygon chrysia	Key-West Quail Dove	DD
Geotrygon montana	Ruddy Quail Dove	DD
Geotrygon mystacea	Bridled Quail Dove	DD
Haematopus palliatus	American Oystercatcher	LR
Icterus portoricensis	Puerto Rican Oriole	DD
Ixobrychus exilis	Least Bittern	DD
Laterallus jamaicensis	Black Rail	DD
Loxigilla portoricensis	Puerto Rican Bullfinch	DD
Margarops fuscatus	Puerto Rican Screech Owl	DD
Melanerpes portoricensis	Puerto Rican Woodpecker	DD
Mniotilta varia	Black and White Warbler	DD
Myiarchus antillarum	Puerto Rican Flycatcher	DD
Nesospingus speculiferus	Puerto Rican Tanager	DD
Nomonix dominicus	Masked Duck	EN
Numenius phaeopus	Whimbrel (Hudsonian)	LR
Orthorhyncus cristatus	Antillean Crested	DD
Oxyura jamaicensis	Ruddy Duck	VU
Parula Americana	Northern Parula	DD
Patagioenas inornata	Plain Pigeon	EN
Patagioenas leucocephala	White-crowned Pigeon	DD
Pelecanus occidentalis	Brown Pelican	EN
Petrochelidon fulva	Cave Swallow	DD
Phaethon aethereus	Red-billed Tropicbird	DD

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Phaethon lepturus	White-tailed Tropicbird	DD
Podilymbus podiceps	Pied-billed Grebe	DD
Porzana flaviventer	Yellow-breasted Crake	DD
Puffinus iherminieri	Audubon's Shearwater	CR
Rallus longirostris	Clapper Rail	DD
Saurothera vieilloti	Puerto Rican Lizard-Cuckoo	DD
Seiurus aurocapillus	Ovenbird	DD
Seiurus motacilla	Louisiana Waterthrush	DD
Seiurus novaboracensis	Northern Waterthrush	DD
Setophaga ruticilla	American Redstart	DD
Spindalis portoricensis	Puerto Rican Spindalis	DD
Sterna antillarum	Least Tern	DD
Sterna dougalli	Roseate Tern	VU
Sula dacylatra	Masked Booby	DD
Sula leucogaster	Brown Booby	DD
Sula sula	Red-footed Booby	DD
Tachybaptus dominicus	Least Grebe	DD
Todus mexicanus	Puerto Rican Tody	DD
Tyrannus caudifasciatus	Loggerhead Kingbird	DD
Vireo altiloquus	Black-whiskered Vireo	DD
Vireo latimeri	Puerto Rican Vireo	VU

Appendix L: US Virgin Islands Critical Wildlife Conservation Strategy priority species of concern (adapted from Platenberg et al. 2005).

SEABIRDS				WATERFOWL, MARSHBIRDS & SHOREBIRDS			
Species	Common Name			Species	Common Name		
Species of Greatest Concern				Species of Greatest Concern			
<i>Puffinus lherminieri</i>	Audubon's Shearwater	LE	GC	<i>Dendrocygna arborea</i>	West Indian Whistling-Duck	LE	GC
<i>Phaethon lepturus</i>	White-tailed Tropicbird	LT (LE)	GC	<i>Tachybaptus dominicus</i>	Least Grebe	LE	GC
<i>Sula dactylatra</i>	Masked Booby	LE	GC	<i>Ixobrychus exilis</i>	Least Bittern	LE	GC/EX
<i>Sula sula</i>	Red-footed Booby	LT	GC	<i>Phoenicopterus ruber</i>	Greater Flamingo	LE	GC
<i>Fregata magnificens</i>	Magnificent Frigatebird	LE	GC	<i>Rallus longirostris</i>	Clapper Rail	LE	GC
				<i>Fulica americana</i>	American Coot	LT	GC
Species of Concern				<i>Fulica caribaea</i>	Caribbean Coot	LE	GC
<i>Phaethon aethereus</i>	Red-billed Tropicbird	LSC	C	<i>Haematopus palliatus</i>	American Oystercatcher	LT	GC
<i>Pelecanus occidentalis</i>	Brown Pelican	FE, LSC	C	<i>Charadrius alexandrinus</i>	Snowy Plover	LE	GC
<i>Sterna dougallii dougallii</i>	Roseate Tern	FT, LSC	SC	<i>Calidris canutus</i>	Red Knot	LE	GC
<i>Sterna antillarum</i>	Least Tern	LSC (LE)	C	<i>Numenius phaeopus</i>	Whimbrel	LT	GC
<i>Sterna nilotica</i>	Gull-billed Tern	LP	C	<i>Catoptrophorus semipalmatus</i>	Willet	LT (LE)	GC
				Species of Concern			
				<i>Anas bahamensis</i>	White-cheeked Pintail	LSC (LE)	C
				<i>Oxyura jamaicensis</i>	Ruddy Duck	LSC (LE)	C
				<i>Egretta thula</i>	Snowy Egret	LSC (LE)	SC
				<i>Nycticorax nycticorax</i>	Black-crowned Night Heron	LSC (LE)	C
				<i>Egretta tricolor</i>	Tricolored Heron	LP	C
				<i>Ardea herodias</i>	Great Blue Heron	LP (LE)	LC
				<i>Charadrius wilsonia</i>	Wilson's Plover	LSC	C
				<i>Calidris minutilla</i>	Least Sandpiper	LSC	C
				<i>Limnodromus griseus</i>	Short-billed Dowitcher	LSC	C

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LANDBIRDS			
Species	Common Name		
Species of Greatest Concern			
<i>Patagioenas leucocephala</i>	White-crowned Pigeon	LT (LE)	GC
<i>Geotrygon mystacea</i>	Bridled Quail-Dove	LT (LE)	GC
<i>Megascops nudipes</i>	Puerto Rican Screech-Owl	LE	GC/EX
<i>Chordeiles gundlachi</i>	Antillean Nighthawk	LT (LE)	GC
<i>Anthracothorax dominicus</i>	Antillean Mango	LE	GC/EX
<i>Myiarchus antillarum</i>	Puerto Rican Flycatcher	LE	GC
<i>Corvus leucognaphalus</i>	White-necked Crow	FE, LE	GC/EX
Species of Concern			
<i>Falco peregrinus</i>	Peregrine Falcon	LSC	C
<i>Coccyzus americanus</i>	Yellow-billed Cuckoo	LP	C
<i>Sphyrapicus varius</i>	Yellow-bellied Sapsucker	LP	SC
<i>Progne dominicensis</i>	Caribbean Martin	LSC	GC
<i>Setophaga coronata</i>	Yellow-rumped Warbler	LP	C
<i>Setophaga dominica</i>	Yellow-throated Warbler	LP	SC
<i>Setophaga palmarum</i>	Palm Warbler	LP	SC
<i>Protonotaria citrea</i>	Prothonotary Warbler	LSC	C
<i>Helmitheros vermivorum</i>	Worm-eating Warbler	LP	C
<i>Seiurus motacilla</i>	Louisiana Waterthrush	LP	C
<i>Oporornis formosus</i>	Kentucky Warbler	LP	C
<i>Geothlypis trichas</i>	Common Yellowthroat	LP	C
<i>Wilsonia citrina</i>	Hooded Warbler	LSC	C
<i>Loxigilla noctis</i>	Lesser Antillean Bullfinch	LP	C
Introduced Species of Management Concern			
<i>Pavo cristatus</i>	Common Peafowl		IM
<i>Numida meleagris</i>	Helmeted Guineafowl		IM
<i>Columba livia</i>	Rock Pigeon	LNP	IM
<i>Passer domesticus</i>	House Sparrow	LNP	IM

Statutory Status = legal protection afforded by USFWS Endangered Species Act or VI Endangered and Indigenous Species Act (status under the existing territorial legislation is shown in parenthesis where different from the proposed revised status). **FE** = Federally Endangered. **FT** = Federally Threatened. **LE** = Locally Endangered. **LT** = Locally Threatened. **LSC** = Local Special Concern. **LDD** = Locally Data Deficient. **LCP** = Locally Peripheral. **LCT** = Locally Controlled. **LNP** = Locally Not Protected (Exotics).

Management Concern = Species requiring management actions within USVI. **GC** = Species of Greatest Concern; those species requiring significant research, monitoring, and/or restorative effort for populations and/or habitats to recover populations sufficient to ensure long-term sustainability. **C** = Species of Concern; species requiring research, monitoring, and/or restorative efforts for populations and/or habitats to maintain population levels to ensure long-term sustainability. **LC** = Species of Lesser Concern; species that would benefit from research, monitoring, or restorative efforts for populations or habitats to maintain current population levels. **I** = Introduced species; species requiring monitoring to determine impact and distribution spread. **IM** = Introduced species of management concern; non-native species requiring research, monitoring, and control to reduce impacts on native species. **EX** = Extirpated; species no longer present within the USVI.

**Appendix M. Protected areas of wildlife value within the US Virgin Islands
(adapted from Platenberg et al. 2005).**

PRESERVE	OWNERSHIP	SIZE (HA)
St. Thomas		
Little St. Thomas	TNC	2.4
Magen's Bay Preserve	TNC, VI, MBA	129.1
Total St. Thomas		131.5 ha
St. John		
VI National Park (includes marine areas)	NPS	5944.6
Coral Bay Preserve	TNC	8.8
Nancy Spire Nature Preserve	IRF	17.9
Total St. John		5971.3 ha
St. Croix		
Butler Bay Nature Preserve	LS	91.0
Caledonia Gut	VI	39.1
Creque Dam	VI	2.3
East Bay and Point Udall	VI	54.4
Estate Adventure Nature Trail	VI	2.5
Estate Barren Spot	SEA	0.2
Estate Barren Spot Wetlands	UVI	19.0
Estate Great Pond	VI	5.9
Estate Little La Grange	LS	?
Estate Little Princess	TNC	10.0
Estate Mount Washington Bird Sanctuary	LS	8.8
Estate Prosperity Beachfront	SEA	0.1
Estate Thomas	USFS	59.6
Estate Whim	LS	4.8
Herman Hill	TNC	6.6
Jack and Isaacs Bays Preserve, East End Marine Park	TNC	110.8
Long Point	TNC	20.2
Long Point and Cotton Garden	VI	69.6
Salt River Bay National Historic Park and Ecological Preserve	VI, NPS	410.8
Salt River, Estate Montpellier	TNC	0.2
Sandy Point National Wildlife Refuge	USFWS-NWR	145.7
Sion Ridge	NPS	9.0
Southgate Pond	SEA	40.1
Spring Garden	VI	28.7
Total St. Croix		1188.2 ha

PRESERVE	OWNERSHIP	SIZE (HA)
Off-shore Cays – St. Thomas / St. John		
Booby Rock	VI	0.2
Bovoni Cay	VI	22.3
Buck Island	USFWS-NWR	16.8
Capella Island	VI	8.9
Carval Rock	VI	0.2
Cas Cay	VI	6.0
Cockroach Cay	VI	7.7
Cocolobo Cay	NPS	0.4
Congo Cay	VI	10.6
Cricket Rock	VI	1.0
Dog Island	VI	4.9
Dutchcap Cay	VI	12.9
Flanagan Island	VI	8.7
Flat Cay	VI	1.2
Frenchcap Cay	VI	4.2
Grass Cay	VI	19.7
Hassel Island	NPS	56.5*
Henley Cay	NPS	4.6
Kalkun Cay	VI	1.4
Leduck Island	VI	5.7
Outer Brass Island	VI	43.7
Perkins Cay	VI	0.2
Ramgoat Cay	NPS	1.0
Rata Cay	NPS	0.2
Saba Island	VI	12.3
Sail Rock	VI	0.7
Salt Cay	VI	22.5
Savana Island	VI	70.3
Shark Island	VI	0.5
Spratt Bay Estates, Water Island	TNC	12.9
Steven Cay	VI	0.8
Sula Cay	VI	0.8
Trunk Cay	NPS	0.4
Turtledove Cay	VI	1.5
Two Brothers	VI	0.1
West Cay	VI	16.3
Whistling Cay	VI	0.5
Total off-shore cays St. Thomas/St. John		378.7 ha
Off-shore Cays – St. Croix		
Buck Island Reef National Monument	NPS	72.7

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Green Cay	USFWS-NWR	5.2
Protestant Cay	VI	2.9
Total off-shore cays St. Croix		80.8
TOTAL		7750.5 ha

Appendix N: Puerto Rico avian faunal species targets and Biodiversity Health (BH), as described in The Nature Conservancy's Caribbean Ecoregional Assessment, and based on PRDNER rare and threatened species data (adapted from Keel et al. 2005). Occurrences with BH \leq 0.8 reliably indicate that less than 50% of a target's key factors are within the natural range of variability, and hence 0.8 is considered the threshold point for poor ecological conditions.

Species	Common Name	BH Value
<i>Accipiter striatus venator</i>	Sharp-shinned Hawk	N/A
<i>Agelaius xanthomus</i>	Yellow-shouldered Blackbird	N/A
<i>Amazona vittata</i>	Puerto Rican Parrot	0.77
<i>Anas bahamensis</i>	White-cheeked Pintail	N/A
<i>Anthracothorax viridis</i>	Green Mango	N/A
<i>Buteo platypterus brunescens</i>	Broad-shouldered Hawk	N/A
<i>Charadrius alexandrinus</i>	Snowy Plover	N/A
<i>Charadrius wilsonia</i>	Wilson's Plover	0.78
<i>Columba inornata wetmorei</i>	Plain Pigeon	N/A
<i>Columba leucocephala</i>	White-crowned Pigeon	0.73
<i>Dendrocygna arborea</i>	West Indian Whistling Duck	0.92
<i>Setophaga angelae</i>	Elfin-woods Warbler	N/A
<i>Setophaga caerulescens</i>	Black-throated Blue Warbler	0.84
<i>Fulica caribaea</i>	Caribbean Coot	N/A
<i>Loxigilla portoricensis</i>	Puerto Rican Bullfinch	N/A
<i>Melanerpes portoricensis</i>	Puerto Rican Woodpecker	N/A
<i>Myiarchus antillarum</i>	Puerto Rican Flycatcher	N/A
<i>Neospingus speculariferus</i>	Puerto Rican Tanager	N/A
<i>Oxyura dominica</i>	Masked Duck	N/A
<i>Oxyura jamaicensis</i>	Ruddy Duck	N/A
<i>Porzana flaviventer</i>	Yellow-breasted Crake	0.94
<i>Sterna antillarum</i>	Least Tern	N/A
<i>Tachybaptus dominicus</i>	Least Grebe	N/A

Appendix O: The Nature Conservancy's Nested Vegetation (based on Helmer et al. 2002) and Faunal Targets within Ecoregional Targets of the Conservation Assessment of the Insular Caribbean (adapted from Huggins et al. 2007).

Puerto Rican Dry Forest Ecoregion on volcanic, sedimentary and alluvial substrates

Nested vegetation communities:

- Lowland dry semideciduous forest
- Lowland dry semideciduous woodland/shrubland
- Lowland dry mixed evergreen drought-deciduous shrubland with succulents

Nested avian targets:

- *Caprimulgus noctitherus* (Puerto Rican Nightjar)

Puerto Rican Dry Forests on limestone substrate

Nested vegetation communities:

- Lowland dry semideciduous forest
- Lowland dry semideciduous woodland/shrubland
- Lowland dry mixed evergreen drought-deciduous shrubland with succulents

Nested avian targets:

- *Caprimulgus noctitherus* (Puerto Rican Nightjar)
- *Agelaius xanthomus* (Yellow-shouldered Blackbird)

Puerto Rican Moist Forests on volcanic, sedimentary and alluvial substrates

Nested vegetation communities:

- Lowland moist seasonal evergreen forest
- Lowland moist seasonal evergreen forest/shrub
- Lowland moist semi-deciduous forest
- Submontane wet evergreen forest
- Submontane and lower montane wet evergreen sclerophyllous forest
- Submontane and lower montane wet evergreen sclerophyllous forest/shrub
- Submontane and lower montane wet evergreen forest/shrub and active/abandoned shade coffee
- Lower montane wet evergreen forest - tall cloud forest
- Lower montane wet evergreen forest - mixed palm and elfin cloud forest
- Lower montane wet evergreen forest - elfin cloud forest

Nested avian targets:

- *Accipiter striatus venator* (Puerto Rican Sharp-shinned Hawk)
- *Amazona vittata vittata* (Puerto Rican Parrot)
- *Anthracothorax viridis* (Green Mango)
- *Buteo platypterus brunnescens* (Puerto Rican Broad-winged Hawk)
- *Chlorostilbon maugaeus* (Puerto Rican Emerald)
- *Columba inornata wetmorei* (Puerto Rican Plain Pigeon)
- *Columba leucocephala* (White-crowned Pigeon)
- *Setophaga angelae* (Elfin-woods Warbler)
- *Dendrocygna arborea* (West Indian Whistling Duck)
- *Falco peregrinus* (Peregrine Falcon)

- *Melanerpes portoricensis* (Puerto Rican Woodpecker)
- *Myiarchus antillarum* (Puerto Rican Flycatcher)
- *Saurothera vieilloti* (Puerto Rican Lizard-Cuckoo)

Puerto Rican Moist Forests on limestone substrate:

Nested vegetation communities:

- Lowland moist semi-deciduous forest
- Lowland moist semi-deciduous forest/shrub
- Lowland moist seasonal evergreen forest
- Lowland moist seasonal evergreen forest/shrub

Nested avian targets:

- *Accipiter striatus venator* (Puerto Rican Sharp-shinned Hawk)
- *Caprimulgus noctitherus* (Puerto Rican Nightjar)
- *Melanerpes portoricensis* (Puerto Rican Woodpecker)
- *Buteo platypterus brunnescens* (Puerto Rican Broad-winged Hawk)
- *Myiarchus antillarum* (Puerto Rican Flycatcher)

Puerto Rican Moist Forests on ultramafic substrate

Nested vegetation communities:

- Lowland dry and moist, mixed seasonal evergreen sclerophyllous forest
- Submontane and lower montane wet evergreen forest/shrub and active/abandoned shade coffee.

Nested avian targets:

- *Caprimulgus noctitherus* (Puerto Rican Nightjar)
- *Accipiter striatus venator* (Puerto Rican Sharp-shinned Hawk)

Appendix P: The Nature Conservancy's Terrestrial Conservation target areas as identified by the Conservation Assessment of the Insular Caribbean (adapted from Huggins et al. 2007).

Country	Conservation Area	Principle Ecoregion
Puerto Rico	N of Cordillera Jaicoa	Rican Moist Forests Ecoregion
Puerto Rico	Rio Abajo Forest Reserve	Puerto Rican Moist Forests Ecoregion
Puerto Rico	Vega Forest Reserve	Puerto Rican Moist Forests Ecoregion
Puerto Rico	Caribbean National Forest extending W to Aguas Buenas and S to Carite Forest Reserve	Puerto Rican Moist Forests Ecoregion
Puerto Rico	Canal Luis Pena Nature Reserve and Wildlife Refuge	Puerto Rican Dry Forests Ecoregion
Puerto Rico	Mona y Monito Nature Reserve	Puerto Rican Dry Forests Ecoregion
Puerto Rico	Maricao Forest Reserve	Puerto Rican Moist Forests Ecoregion
Puerto Rico	Toro Negro Forest Reserve, Tres Picachos Forest Reserve, and Cerillos Forest Reserve	Puerto Rican Moist Forests Ecoregion
Puerto Rico	Cabo Rojo Wildlife Refuge, Boqueron Wildlife Refuge and Guanica Forest Reserve	Puerto Rican Dry Forests Ecoregion
Puerto Rico	Punta Petrona Nature Reserve	Puerto Rican Dry Forests Ecoregion
Puerto Rico	Vieques Nature Reserve	Puerto Rican Dry Forests Ecoregion
Lesser Antilles	Virgin Islands National Park	Leeward Islands Moist Forests Ecoregion, Caribbean Shrublands Ecoregion
Lesser Antilles	Land areas of East End Marine Park	Caribbean Shrublands Ecoregion

Appendix Q: Seabirds breeding in Puerto Rico and adjacent islands as of 2004 (adapted with permission from Saliva 2009).

Species	Nesting Pairs	Confirmed or Probable Nesting Sites
Audubon's Shearwater	25-40	Culebra Archipelago
White-tailed Tropicbird	500-525	Puerto Rico main island, Culebra Archipelago, Caja de Muertos, Mona and Monito
Red-billed Tropicbird	20-30	Culebra Archipelago
Masked Booby	175-225	Culebra Archipelago, Monito
Brown Booby	1,650-1,700	Cordillera Cays, Mona and Monito
Red-footed Booby	3,000-3,025	Culebra Archipelago, Mona and Monito
Brown Pelican	265-290	Puerto Rico main island, Vieques, Caja de Muertos, Montalva Cays, Isla Ratones
Magnificent Frigatebird	500-550	Mona and Monito
Laughing Gull	1,300-1,400	Cordillera Cays, Culebra Archipelago, Mona and Monito
Brown Noddy	1,230-1,300	Cordillera Cays, Culebra Archipelago, Mona and Monito
Sooty Tern	40,500-40,600	Cordillera Cays, Culebra Archipelago, Mona and Monito
Bridled Tern	235-250	Puerto Rico main island, Northwest Cays, Culebra Archipelago, Mona and Monito
Least Tern	135-150	Puerto Rico main island, Vieques, Cayo Guayanilla
Roseate Tern	935-1,000	Northwest Cays, Culebra Archipelago, Vieques, Cayo Guayanilla, Parguera Cays,
Royal Tern	10-25	Culebra Archipelago
Sandwich Tern*	675-700	Cordillera Cays, Culebra Archipelago, Parguera Cays
Cayenne Tern*	5-10	Culebra Archipelago, Parguera Cays

* One species, two subspecies counted separately.

Appendix R: Estimate of seabirds breeding in the U.S. Virgin Islands (adapted with permission from Pierce 2009).

Species	Nesting Pairs	Confirmed or Probable Nesting Sites
Audubon's Shearwater	25-?	Booby Rock, Buck Island, Capella Island, Carval Rock, Cockroach Cay, Congo Cay, Cricket Rock, Dutchcap Cay, Flanagan Island, Flat Cay, Frenchcap Cap, Hans Lollick Island, Kalkun Cay, Outer Brass Island, Pelican Cay, Saba Island, Turtledove Cay
White-tailed Tropicbird	30-?	Carval Rock, Cas Cay, Congo Cay, Cricket Rock, Dutchcap Cay, Grass Cay, Hans Lollick Island, Hassel Island, Mingo Cay, Outer Brass Island, Savana Island, Water Island
Red-billed Tropicbird	225-350	Buck Island (St. Thomas), Capella Island, Carval Rock, Cas Cay, Cockroach Cay, Congo Cay, Cricket Rock, Dog Island, Dutchcap Cay, Flanagan Island, Flat Cay, Frenchcap Cay, Grass cay, Great St. James Island, Hans Lollick Island, Hassel Island, Inner Brass Island, Kalkun Cay, LeDuck Island, Little Hans Lollick Island, Little St. James Island, Mingo Cay, Outer Brass Island, Saba Island, Sail Rock, Savana Island, Shark Island, Sula Cay, Turtledove Cay, Two Brothers, Water Island, Whistling Cay
Masked Booby	45-75	Cockroach Cay, Frenchcap Cay, Sula Cay
Brown Booby	5,000-1,000	Cockroach Cay, Cricket Rock, Dutchcap Cay, Frenchcap Cay, Kalkun Cay, Sula Cay
Red-footed Booby	100-150	Dutchcap Cay, Frenchcap Cay
Brown Pelican	325-425	Buck Island (St. Croix), Congo Cay, Dutchcap Cay, Green Cay (St. Croix), Hans Lollick Island, Inner Brass Island, Mary's Point St. John, Watermelon Cay, Whistling Cay
Laughing Gull	2,000-3,000	Booby Rock, Buck Island (St. Thomas), Capella Island, Congo Cay, Current Rock, Dog Island, Dutchcap Cay, Flanagan Island, Flat Cay, Frenchcap Cay, Grass Cay, Great St. James Island, Henley Cay, Inner Brass Island, Kalkun Cay, LeDuck Island, Little Hans Lollick Island, Little St. James Island, Mingo Cay, Outer Brass Island, Pelican Cay, Ramgoat Cay, Rata Cay, Saba Island, Shark Island, Steven Cay, Turtledove Cay
Brown Noddy	400-900	Carval Rock, Cockroach Cay, Congo Cay, Cricket Rock, Flat Cay, Frenchcap Cay, Kalkun Cay, Saba Island, Turtledove Cay
Sooty Tern	20,000-40,000?	Buck Island (St. Thomas), Dog Island, Flat Cay, Frenchcap Cay, Little Hans Lollick Island, Saba Island, Turtledove Cay

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Bridled Tern	500-1,000	Booby Rock, Carval Rock, Cockroach Cay, Congo Cay, Cricket Rock, Flanagan Island, Flat Cay, Frenchcap Cay, Kalkun Cay, Little Hans Lollick Island, Saba Island, Shark Island, Two Brothers
Least Tern	300-600	Buck Island (St. Croix), Ruth Cay, St. Croix proper, Saltpond Bay St. John,
Roseate Tern	500-2,300	Booby Rock, Carval Rock, Congo Cay, Cricket Rock, Dog Island, Flanagan Island, Flat Cay, Kalkun Cay, LeDuck Island, Pelican Cay, Ramgoat Cay, Rata Cay, Turtledove Cay
Royal Tern	60-150	Flat Cay, Pelican Cay, Saba Island, Turtledove Cay
Sandwich Tern	100-1,000	Flat Cay, Little Hans Lollick Island, Pelican Cay, Turtledove Cay

Appendix S: US Fish and Wildlife Threatened and Endangered species and distributions in Puerto Rico and the U.S. Virgin Islands (adapted with permission from US Fish and Wildlife Service 2007b).

Species	Status	Municipalities (both Puerto Rico and the USVI)	Habitat Areas
<i>Accipiter striatus venator</i> / <i>Sharp-shinned Hawk</i>	E	Adjuntas, Barranquitas, Cayey, Ceiba, Ciales, Corozal, Fajardo, Florida, Guayama, Jayuya, Las Marias, Las Piedras, Luquillo, Maricao, Naguabo, Orocovis, Patillas, Peñuelas, Ponce, Quebradillas, Río Grande, Sabana Grande, San German, San Lorenzo, Utuado, Yauco	Monte Guilarte Commonwealth Forest, Río Abajo Commonwealth Forest, Carite Commonwealth Forest, El Yunque National Forest, Toro Negro Commonwealth Forest, Maricao Commonwealth Forest
<i>Agelaius xanthomus</i> / <i>Yellow-shouldered Blackbird</i>	E	Cabo Rojo, Carolina, Ceiba, Fajardo, Guánica, Guayama, Guaynabo, Lajas, Manatí, Mayagüez, Mona Island, Monito Island, Río Grande, Salinas, San German, San Juan, Vieques	Coastal forest
<i>Amazona vittata vittata</i> / <i>Puerto Rican Parrot</i>	E	Arecibo, Canóvanas, Ceiba, Fajardo, Las Piedras, Luquillo, Naguabo, Río Grande, Utuado	Río Abajo Commonwealth Forest, El Yunque National Forest
<i>Buteo platypterus brunnescens</i> / <i>Broad-winged Hawk</i>	E	Adjuntas, Arecibo, Barranquitas, Camuy, Canóvanas, Cayey, Ceiba, Ciales, Corozal, Fajardo, Florida, Guayama, Hatillo, Jayuya, Las Piedras, Luquillo, Naguabo, Orocovis, Patillas, Ponce, Río Grande, Sabana Grande, San German, San Lorenzo, Utuado	Monte Guilarte Commonwealth Forest, Río Abajo Commonwealth Forest, Carite Commonwealth Forest, El Yunque National Forest, Toro Negro Commonwealth Forest, Maricao Commonwealth Forest
<i>Caprimulgus noctitherus</i> / <i>Puerto Rican Nightjar</i>	E	Cabo Rojo, Guánica, Guayanilla, Lajas, Peñuelas, Ponce, Sabana Grande, Yauco	Coastal forest, Guánica Commonwealth Forest, Guayanilla hills, Susúa Commonwealth Forest

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<i>Charadrius melodus</i> / <i>Piping Plover</i>	T	Cabo Rojo, Fajardo, Guánica, Guayama, Guayanilla, Lajas, Luquillo, Ponce, Salinas, St. Thomas	Coastal zones
<i>Corvus leucognaphalus</i> / <i>White-necked Crow</i>	E	Extirpated	--
<i>Patagioenas inornata wetmorei</i> / <i>Plain Pigeon</i>	E	Aguadilla, Aguas Buenas, Aibonito, Barranquitas, Bayamón, Cabo Rojo, Caguas, Cayey, Ciales, Cidra, Comerio, Corozal, Guayama, Guaynabo, Gurabo, Jayuya, Juncos, Las Piedras, Orocovis, Ponce, Río Grande, Salinas, San Lorenzo, San Sebastian, Utuado	Lower montane forest and riparian habitats
<i>Pelecanus occidentalis</i> / <i>Brown Pelican</i>	E	Aguada, Aguadilla, Añasco, Arecibo, Arroyo, Barceloneta, Cabo Rojo, Caguas, Camuy, Canóvanas, Carolina, Cataño, Ceiba, Corozal, Culebra, Dorado, Fajardo, Guánica, Guayama, Guayanilla, Guaynabo, Gurabo, Hatillo, Humacao, Isabela, Juana Díaz, Lajas, Loíza, Luquillo, Manatí, Maunabo, Mayagüez, Mona Island, Monito Island, Naguabo, Naranjito, Patillas, Peñuelas, Ponce, Quebradillas, Rincón, Río Grande, Salinas, San Juan, Santa Isabel, Toa Alta, Toa Baja, Trujillo Alto, Utuado, Vega Alta, Vega Baja, Vieques, Yabucoa, Yauco, St. Croix, St. John, St. Thomas	Coastal zones, Inland waterbodies, Lago Dos Bocas, Lago La Plata, , Lago Luchetti, Río Grande de Loiza
<i>Sterna dougallii dougallii</i> / <i>Roseate Tern</i>	T	Añasco, Arecibo, Barceloneta, Corozal, Culebra, Guánica, Guayanilla, Lajas, Manatí, Peñuelas, Ponce, Vieques, St. John, St. Thomas,	Coastal areas and offshore cays

E=Endangered species; T=Threatened species

Appendix T: Puerto Rico Breeding Bird Atlas species index (adapted with permission from Sociedad Ornitológica Puertorriqueña Inc. 2009a).

Species	Common Name
<i>Accipiter striatus venator</i>	Sharp-shinned Hawk
<i>Agelaius xanthomus</i>	Yellow-shouldered Blackbird
<i>Amandava amandava</i>	Red Avadavat
<i>Amazona albifrons</i>	White-fronted Parrot
<i>Amazona amazonica</i>	Orange-winged Parrot
<i>Amazona ventralis</i>	Hispaniolian Parrot
<i>Amazona viridigenalis</i>	Red-crowned Parrot
<i>Amazona vittata</i>	Puerto Rican Parrot
<i>Ammodramus savannarum</i>	Grasshopper Sparrow
<i>Anas bahamensis</i>	White-cheeked Pintail
<i>Anous minutus</i>	Black Noddy
<i>Anous stolidus</i>	Brown Noddy
<i>Anthracothorax dominicus</i>	Antillean Mango
<i>Anthracothorax viridis</i>	Green Mango
<i>Ara ararauna</i>	Blue-and-yellow Macaw
<i>Aratinga canicularis</i>	Orange-fronted Parakeet
<i>Aratinga erythrogenys</i>	Red-masked Parakeet
<i>Ardea alba</i>	Great Egret
<i>Asio flammeus</i>	Short-eared Owl
<i>Brotogeris versicolurus</i>	White-winged Parakeet
<i>Bubulcus ibis</i>	Cattle Egret
<i>Buteo jamaicensis</i>	Red-tailed Hawk
<i>Buteo platypterus brunnescens</i>	Broad-winged Hawk
<i>Butorides virescens</i>	Green Heron
<i>Caprimulgus noctitherus</i>	Puerto Rican Nightjar
<i>Cathartes aura</i>	Turkey Vulture
<i>Tringa semipalmata</i>	Willet
<i>Charadrius alexandrinus</i>	Snowy Plover
<i>Charadrius vociferus</i>	Killdeer
<i>Charadrius wilsonia</i>	Wilson's Plover
<i>Chlorostilbon maugaeus</i>	Puerto Rican Emerald
<i>Chordeiles gundlachii</i>	Antillean Nighthawk
<i>Coccyzus americanus</i>	Yellow-billed Cuckoo
<i>Coccyzus minor</i>	Mangrove Cuckoo
<i>Coereba flaveola</i>	Bananaquit
<i>Columba livia</i>	Rock Pigeon
<i>Columbina passerina</i>	Common Ground-Dove

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<i>Contopus latirostris</i>	Lesser Antillean Pewee
<i>Crotophaga ani</i>	Smooth-billed Ani
<i>Cypseloides niger</i>	Black Swift
<i>Dendrocygna arborea</i>	West Indian Whistling-Duck
<i>Setophaga adelaidae</i>	Adelaide's Warbler
<i>Setophaga angelae</i>	Elfin Woods Warbler
<i>Setophaga petechia</i>	Yellow Warbler
<i>Egretta caerulea</i>	Little Blue Heron
<i>Egretta thula</i>	Snowy Egret
<i>Egretta tricolor</i>	Tricolored Heron
<i>Elaenia martinica</i>	Caribbean Elaenia
<i>Estrilda melpoda</i>	Orange-cheeked Waxbill
<i>Eudocimus albus</i>	White Ibis
<i>Eulampis holosericeus</i>	Green-throated Carib
<i>Euodice malabarica</i>	Indian Silverbill
<i>Euphonia musica</i>	Antillean Euphonia
<i>Euplectes afer</i>	Yellow-crowned Bishop
<i>Euplectes franciscanus</i>	Orange Bishop
<i>Falco sparverius</i>	American Kestrel
<i>Fregata magnificens</i>	Magnificent Frigatebird
<i>Fulica americana</i>	American Coot
<i>Fulica caribaea</i>	Caribbean Coot
<i>Gallinula chloropus</i>	Common Moorhen
<i>Geotrygon chrysia</i>	Key West Quail-Dove
<i>Geotrygon montana</i>	Ruddy Quail-Dove
<i>Geotrygon mystacea</i>	Bridled Quail-Dove
<i>Haematopus palliatus</i>	American Oystercatcher
<i>Himantopus mexicanus</i>	Black-necked Stilt
<i>Icterus portoricensis</i>	Puerto Rican Oriole
<i>Ixobrychus exilis</i>	Least Bittern
<i>Leucophaeus atricilla</i>	Laughing Gull
<i>Lonchura cucullata</i>	Bronze Mannikin
<i>Lonchura malacca</i>	Chestnut Mannikin
<i>Lonchura punctulata</i>	Nutmeg Mannikin
<i>Loxigilla portoricensis</i>	Puerto Rican Bullfinch
<i>Margarops fuscatus</i>	Pearly-eyed Thrasher
<i>Megascops nudipes</i>	Puerto Rican Screech-Owl
<i>Melanerpes portoricensis</i>	Puerto Rican Woodpecker
<i>Mimus polyglottos</i>	Northern Mockingbird
<i>Molothrus bonariensis</i>	Shiny Cowbird
<i>Myiarchus antillarum</i>	Puerto Rican Flycatcher

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<i>Myiopsitta monachus</i>	Monk Parakeet
<i>Nesospingus speculiferus</i>	Puerto Rican Tanager
<i>Nomonyx dominicus</i>)	Masked Duck
<i>Nyctanassa violacea</i>	Yellow-crowned Night-Heron
<i>Nycticorax nycticorax</i>	Black-crowned Night-Heron
<i>Onychoprion anaethetus</i>	Bridled Tern
<i>Onychoprion fuscatus</i>	Sooty Tern
<i>Orthorhyncus cristatus</i>	Antillean Crested Hummingbird
<i>Oxyura jamaicensis</i>	Ruddy Duck
<i>Padda oryzivora</i>	Java Sparrow
<i>Passer domesticus</i>	House Sparrow
<i>Patagioenas inornata</i>	Plain Pigeon
<i>Patagioenas leucocephala</i>	White-crowned Pigeon
<i>Patagioenas squamosa</i>	Scaly-naped Pigeon
<i>Pelecanus occidentalis</i>	Brown Pelican
<i>Petrochelidon fulva</i>	Cave Swallow
<i>Phaethon aethereus</i>	Red-billed Tropicbird
<i>Phaethon lepturus</i>	White-tailed Tropicbird
<i>Plegadis falcinellus</i>	Glossy Ibis
<i>Podilymbus podiceps</i>	Pied-billed Grebe
<i>Porphyrio martinica</i>	Purple Gallinule
<i>Porzana flaviventer</i>	Yellow-breasted Crake
<i>Progne dominicensis</i>	Caribbean Martin
<i>Puffinus lherminieri</i>	Audubon's Shearwater
<i>Quiscalus niger</i>	Greater Antillean Grackle
<i>Rallus longirostris</i>	Clapper Rail
<i>Saurothera vieilloti</i>	Puerto Rican Lizard-Cuckoo
<i>Sicalis flaveola</i>	Saffron Finch
<i>Spindalis portoricensis</i>	Puerto Rican Spindalis
<i>Sterna dougallii dougallii</i>	Roseate Tern
<i>Sternula antillarum</i>	Least Tern
<i>Streptopelia decaocto</i>	Eurasian Collared-Dove
<i>Streptopelia risoria</i>	Ringed Turtle-Dove
<i>Sturnus vulgaris</i>	European Starling
<i>Sula dactylatra</i>	Masked Booby
<i>Sula leucogaster</i>	Brown Booby
<i>Sula sula</i>	Red-footed Booby
<i>Tachybaptus dominicus</i>	Least Grebe
<i>Thalasseus maximus</i>	Royal Tern
<i>Thalasseus sandvicensis</i>	Sandwich Tern
<i>Tiaris bicolor</i>	Black-faced Grassquit

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<i>Tiaris olivacea</i>	Yellow-faced Grassquit
<i>Todus mexicanus</i>	Puerto Rican Tody
<i>Turdus plumbeus</i>	Red-legged Thrush
<i>Tyrannus caudifasciatus</i>	Loggerhead Kingbird
<i>Tyrannus dominicensis</i>	Gray Kingbird
<i>Vidua macroura</i>	Pin-tailed Whydah
<i>Vireo altiloquus</i>	Black-whiskered Vireo
<i>Vireo latimeri</i>	Puerto Rican Vireo
<i>Zenaida asiatica</i>	White-winged Dove
<i>Zenaida aurita</i>	Zenaida Dove
<i>Zenaida macroura</i>	Mourning Dove

Appendix U: Synthesis of focal bird species for Puerto Rico and the US Virgin Islands included in this plan (A) and reports for PR GAP (B) and USVI GAP (C) Analysis Projects, Critical Wildlife Areas (D), PR (E) and USVI (F) Important Bird Areas, Waterfowl Focus Areas (G), Critical Elements (H), PR (I) and USVI (J) Comprehensive Wildlife Conservation Strategies, Ecoregional Assessment & Caribbean Decision Support System (K), PR (L) and USVI (M) Inventories of Breeding Seabirds, Caribbean Threatened and Endangered Species (N), and the Puerto Rico Breeding Bird Atlas (O).

SPECIES (222 total)	COMMON NAME	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
<i>Accipiter striatus venator</i>	Sharp-shinned Hawk	x	x		x				x	x		x			x	x
<i>Actitis macularia</i>	Spotted Sandpiper		x	x												
<i>Agelaius xanthomus</i>	Yellow-shouldered Blackbird	x	x		x	x			x	x		x			x	x
<i>Amandava amandava</i>	Red Avadavat															x
<i>Amazona ventralis</i>	Hispaniolan Parrot		x													x
<i>Amazona viridigenalis</i>	Red-crowned Parrot															x
<i>Amazona vitatta vittata</i>	Puerto Rican Parrot	x	x		x	x			x	x		x			x	x
<i>Ammodramus savannanum</i>	Grasshopper Sparrow	x	x		x				x	x						x
<i>Anas bahamensis</i>	White-cheeked Pintail	x	x	x	x			x	x	x	x	x				x
<i>Anas acuta</i>	Northern Pintail							x								
<i>Anas americana</i>	American Wigeon			x				x								
<i>Anas clypeata</i>	Northern Shoveler							x								
<i>Anas crecca</i>	Green-winged Teal			x												
<i>Anas crecca</i>	Green-winged Teal							x								
<i>Anas cyanoptera</i>	Cinnamon Teal							x								
<i>Anas discors</i>	Blue-winged Teal	x	x	x				x								
<i>Anas platyrhynchos</i>	Mallard Duck							x								
<i>Anas rubripes</i>	American Black Duck							x								
<i>Anous stolidus</i>	Brown Noddy	x	x	x		x	x			x			x	x		x
<i>Anthracothorax dominicus</i>	Antillean Mango	x	x			x				x	x					x
<i>Anthracothorax viridis</i>	Green Mango	x	x			x			x	x		x				x
<i>Ara ararauna</i>	Blue-and-yellow Macaw															x
<i>Aramus guarauna</i>	Limpkin	x							x	x						

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<i>Aratinga canicularis</i>	Orange-fronted Parakeet		x												x
<i>Aratinga chloroptera</i>	Hispaniolan Parakeet	x	x												
<i>Aratinga erythrogastra</i>	Red-masked Parakeet														x
<i>Aratinga pertinax</i>	Brown-throated Parakeet		x												
<i>Ardea alba</i>	Great Egret		x	x											x
<i>Ardea herodias</i>	Great Blue Heron	x	x	x						x					
<i>Arenaria interpres</i>	Ruddy Turnstone	x	x	x		x									
<i>Asio flammeus</i>	Short-eared Owl	x	x							x					x
<i>Aythya affinis</i>	Lesser Scaup			x				x							
<i>Aythya collaris</i>	Ring-necked Duck			x				x							
<i>Aythya valisineria</i>	Canvasback							x							
<i>Botaurus lentiginosus</i>	American Bittern	x													
<i>Brotogeris versicolurus</i>	White-winged Parakeet														x
<i>Bubulcus ibis</i>	Cattle Egret	x	x	x											x
<i>Buteo jamaicensis</i>	Red-tailed Hawk	x	x	x											x
<i>Buteo platypterus brunnescens</i>	Broad-winged Hawk	x	x		x					x		x		x	x
<i>Butorides virescens</i>	Green Heron		x	x											x
<i>Cairina moschata</i>	Muscovy Duck							x							
<i>Calidris alba</i>	Sanderling	x	x	x											
<i>Calidris canutus</i>	Red Knot	x		x						x	x				
<i>Calidris fuscicollis</i>	White-rumped Sandpiper			x		x									
<i>Calidris himantopus</i>	Stilt Sandpiper	x	x	x		x				x					
<i>Calidris mauri</i>	Western Sandpiper	x	x	x		x									
<i>Calidris melanotos</i>	Pectoral Sandpiper	x	x	x		x									
<i>Calidris minutilla</i>	Least Sandpiper	x	x	x		x					x				
<i>Calidris pusilla</i>	Semipalmated Sandpiper	x	x	x		x									
<i>Caprimulgus carolinensis</i>	Chuck-will's-widow	x								x					
<i>Caprimulgus noctitherus</i>	Puerto Rican Nightjar	x	x		x	x					x		x		x
<i>Carduelis cucullata</i>	Red Siskin		x							x	x				
<i>Cathartes aura</i>	Turkey Vulture		x												x
<i>Catharus bicknelli</i>	Bicknell's Thrush	x													

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<i>Ceryle alcyon</i>	<i>Belted Kingfisher</i>		x	x											
<i>Charadrius alexandrinus</i>	<i>Snowy Plover</i>	x			x	x			x	x	x	x			x
<i>Charadrius melodus</i>	<i>Piping Plover</i>	x			x				x	x				x	
<i>Charadrius semipalmatus</i>	<i>Semipalmated Plover</i>	x	x	x		x									
<i>Charadrius vociferus</i>	<i>Killdeer</i>		x	x											x
<i>Charadrius wilsonia</i>	<i>Wilson's Plover</i>	x	x	x		x			x	x	x	x			x
<i>Chen caerulescens</i>	<i>Snow Goose</i>							x							
<i>Chlidonias niger</i>	<i>Black Tern</i>		x												
<i>Chlorostilbon maugaeus</i>	<i>Puerto Rican Emerald</i>	x	x			x				x		x			x
<i>Chordeiles gundlachii</i>	<i>Antillean Nighthawk</i>	x	x	x							x				x
<i>Circus cyaneus</i>	<i>Northern Harrier</i>	x													
<i>Coccyzus americanus</i>	<i>Yellow-billed Cuckoo</i>	x	x	x							x				x
<i>Coccyzus minor</i>	<i>Mangrove Cuckoo</i>	x	x	x						x					x
<i>Coereba flaveola</i>	<i>Bananaquit</i>	x	x	x											x
<i>Columba livia</i>	<i>Rock Pigeon</i>			x											x
<i>Columbina passerina</i>	<i>Common Ground-Dove</i>		x	x											x
<i>Contopus portoricensis</i>	<i>Lesser Antillean Pewee</i>	x	x			x				x					x
<i>Corvus leucognaphalus</i>	<i>White-necked Crow</i>	x									x			x	
<i>Crotophaga ani</i>	<i>Smooth-billed Ani</i>		x	x											x
<i>Cygnus buccinator</i>	<i>Trumpeter Swamp</i>							x							
<i>Cypseloides niger</i>	<i>Black Swift</i>	x	x							x					x
<i>Dendrocygna arborea</i>	<i>West Indian Whistling-Duck</i>	x	x		x	x		x	x	x	x	x			x
<i>Dendrocygna autumnalis</i>	<i>Black-bellied Whistling-Duck</i>							x							
<i>Dendrocygna bicolor</i>	<i>Fulvous Whistling-Duck</i>	x	x					x							
<i>Setophaga adelaidae</i>	<i>Adelaide's Warbler</i>	x	x			x				x					x
<i>Setophaga angelae</i>	<i>Elfin-woods Warbler</i>	x	x			x			x	x		x			x
<i>Setophaga caerulescens</i>	<i>Black-throated Blue Warbler</i>	x	x	x					x	x		x			
<i>Setophaga coronata</i>	<i>Yellow-rumped Warbler</i>	x		x							x				
<i>Setophaga discolor</i>	<i>Prairie Warbler</i>	x	x	x						x					
<i>Setophaga dominica</i>	<i>Yellow-throated Warbler</i>	x									x				

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<i>Setophaga magnolia</i>	<i>Magnolia Warbler</i>			x										
<i>Setophaga palmarum</i>	<i>Palm Warbler</i>	x								x				
<i>Setophaga pensylvanica</i>	<i>Chestnut-sided Warbler</i>	x												
<i>Setophaga petechia</i>	<i>Yellow (Golden) Warbler</i>	x	x	x					x	x				x
<i>Setophaga striata</i>	<i>Blackpoll Warbler</i>		x	x										
<i>Setophaga tigrina</i>	<i>Cape May Warbler</i>	x	x	x										
<i>Setophaga virens</i>	<i>Black-throated Green Warbler</i>			x										
<i>Dolichonyx oryzivorus</i>	<i>Bobolink</i>									x				
<i>Egretta caerulea</i>	<i>Little Blue Heron</i>	x	x	x										x
<i>Egretta rufescens</i>	<i>Reddish Egret</i>									x				
<i>Egretta thula</i>	<i>Snowy Egret</i>	x	x	x							x			x
<i>Egretta tricolor</i>	<i>Tricolored Heron</i>	x	x	x							x			x
<i>Elaenia martinica</i>	<i>Caribbean Elaenia</i>	x	x	x		x	x				x			x
<i>Estrilda melpoda</i>	<i>Orange-cheeked Waxbill</i>		x											x
<i>Estrilda troglodytes</i>	<i>Black-rumped Waxbill</i>		x											
<i>Eudocimus albus</i>	<i>White Ibis</i>													x
<i>Eulampis holosericeus</i>	<i>Green-throated Carib</i>	x	x	x		x	x				x			x
<i>Euodice malabarica</i>	<i>Indian Silverbill</i>													x
<i>Euphonia musica</i>	<i>Antillean Euphonia</i>	x	x			x					x			x
<i>Euplectes afer</i>	<i>Yellow-crowned Bishop</i>		x											x
<i>Euplectes franciscanus</i>	<i>Orange Bishop</i>		x											x
<i>Falco columbarius</i>	<i>Merlin</i>			x										
<i>Falco peregrinus</i>	<i>Peregrine Falcon</i>	x		x	x				x	x	x	x		
<i>Falco sparverius</i>	<i>American Kestrel</i>	x	x	x										x
<i>Fregata magnificens</i>	<i>Magnificent Frigatebird</i>	x		x		x				x	x		x	x
<i>Fulica americana</i>	<i>American Coot</i>	x	x	x							x			x
<i>Fulica caribaea</i>	<i>Caribbean Coot</i>	x	x	x	x		x		x	x	x	x		x
<i>Gallinago delicata</i>	<i>Wilson's Snipe</i>	x		x										
<i>Gallinula chloropus</i>	<i>Common Moorhen</i>		x	x										x
<i>Gelochelidon nilotica</i>	<i>Gull-billed Tern</i>	x									x			
<i>Geothlypis formosa</i>	<i>Kentucky Warbler</i>	x									x			

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<i>Geothlypis trichas</i>	<i>Common Yellowthroat</i>	x	x	x					x	x				
<i>Geotrygon chrysia</i>	<i>Key West Quail-Dove</i>	x	x		x			x	x					x
<i>Geotrygon montana</i>	<i>Ruddy Quail-Dove</i>		x						x					x
<i>Geotrygon mystacea</i>	<i>Bridled Quail-Dove</i>	x	x	x	x	x	x		x	x	x			x
<i>Haematopus palliatus</i>	<i>American Oystercatcher</i>	x		x					x	x				x
<i>Helmitheros vermivorus</i>	<i>Worm-eating Warbler</i>	x		x						x				
<i>Himantopus mexicanus</i>	<i>Black-necked Stilt</i>		x	x		x								x
<i>Hirundo rustica</i>	<i>Barn Swallow</i>		x	x										
<i>Icterus icterus</i>	<i>Troupial</i>													x
<i>Icterus portoricensis</i>	<i>Puerto Rican Oriole</i>	x	x		x			x	x					x
<i>Ixobrychus exilis</i>	<i>Least Bittern</i>	x	x						x	x				x
<i>Larus delawarensis</i>	<i>Ring-billed Gull</i>		x											
<i>Laterallus jamaicensis</i>	<i>Black Rail</i>	x							x					
<i>Leucophaeus atricilla</i>	<i>Laughing Gull</i>	x		x		x						x	x	x
<i>Limnodromus griseus</i>	<i>Short-billed Dowitcher</i>	x	x	x		x				x				
<i>Lonchura cucullata</i>	<i>Bronze Mannikin</i>		x											x
<i>Lonchura malabarica</i>	<i>Warbling Silverbill</i>		x											
<i>Lonchura malacca</i>	<i>Chestnut Mannikin</i>		x											x
<i>Lonchura punctulata</i>	<i>Nutmeg Mannikin</i>		x											x
<i>Lophodytes cucullatus</i>	<i>Hooded Merganser</i>						x							
<i>Loxigilla noctis</i>	<i>Lesser Antillean Bullfinch</i>	x		x		x				x				
<i>Loxigilla portoricensis</i>	<i>Puerto Rican Bullfinch</i>	x	x			x			x		x			x
<i>Margarops fuscatus</i>	<i>Pearly-eyed Thrasher</i>	x	x	x		x	x							x
<i>Megascops nudipes</i>	<i>Puerto Rican Screech-Owl</i>	x	x			x			x	x	x			x
<i>Melanerpes portoricensis</i>	<i>Puerto Rican Woodpecker</i>	x	x			x			x		x			x
<i>Mimus polyglottos</i>	<i>Northern Mockingbird</i>		x	x										x
<i>Mniotilta varia</i>	<i>Black-and-white Warbler</i>	x	x	x					x					
<i>Molothrus bonariensis</i>	<i>Shiny Cowbird</i>	x	x	x										x
<i>Myiarchus antillarum</i>	<i>Puerto Rican Flycatcher</i>	x	x	x		x	x		x	x	x			x
<i>Myiopsitta monachus</i>	<i>Monk Parakeet</i>													x
<i>Nesospingus speculiferus</i>	<i>Puerto Rican Tanager</i>	x	x			x			x		x			x

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<i>Nomonyx dominicus</i>	<i>Masked Duck</i>	x			x	x		x	x	x		x				x
<i>Numenius phaeopus</i>	<i>Whimbrel</i>	x		x						x	x					
<i>Numida meleagris</i>	<i>Helmeted Guineafowl</i>										x					
<i>Nyctanassa violacea</i>	<i>Yellow-crowned Night-Heron</i>	x	x	x												x
<i>Nycticorax nycticorax</i>	<i>Black-crowned Night-Heron</i>	x	x	x							x					x
<i>Onychoprion anaethetus</i>	<i>Bridled Tern</i>	x		x	x		x						x	x		x
<i>Onychoprion fuscatus</i>	<i>Sooty Tern</i>	x		x		x	x						x	x		x
<i>Orthorhyncus cristatus</i>	<i>Antillean Crested Hummingbird</i>	x	x	x		x	x			x						x
<i>Oxyura jamaicensis</i>	<i>Ruddy Duck</i>	x	x	x	x			x	x	x	x	x				x
<i>Padda oryzivora</i>	<i>Java Sparrow</i>															x
<i>Pandion haliaetus</i>	<i>Osprey</i>		x	x												
<i>Parula americana</i>	<i>Northern Parula</i>	x	x	x						x						
<i>Passer domesticus</i>	<i>House Sparrow</i>			x												x
<i>Passerina cyanea</i>	<i>Indigo Bunting</i>			x												
<i>Patagioenas inornata wetmorei</i>	<i>Plain Pigeon</i>	x	x		x	x			x	x		x			x	x
<i>Patagioenas leucocephala</i>	<i>White-crowned Pigeon</i>	x	x	x	x		x		x	x	x	x				x
<i>Patagioenas squamosa</i>	<i>Scaly-naped Pigeon</i>	x	x	x												x
<i>Pavo cristatus</i>	<i>Common Peafowl</i>										x					
<i>Pelecanus occidentalis</i>	<i>Brown Pelican</i>	x	x	x	x	x	x		x	x	x		x	x	x	x
<i>Petrochelidon fulva</i>	<i>Cave Swallow</i>	x	x							x						x
<i>Petrochelidon pyrrhonota</i>	<i>Cliff Swallow</i>			x												
<i>Phaethon aethereus</i>	<i>Red-billed Tropicbird</i>	x		x			x			x	x		x	x		x
<i>Phaethon lepturus</i>	<i>White-tailed Tropicbird</i>	x		x	x	x				x	x		x	x		x
<i>Phoenicopus roseus</i>	<i>Greater Flamingo</i>	x									x					
<i>Plegadis falcinellus</i>	<i>Glossy Ibis</i>															x
<i>Pluvialis dominica</i>	<i>American Golden-Plover</i>	x		x												
<i>Pluvialis squatarola</i>	<i>Black-bellied Plover</i>	x	x	x		x										
<i>Podilymbus podiceps</i>	<i>Pied-billed Grebe</i>	x	x	x						x						x
<i>Porphyrio martinica</i>	<i>Purple Gallinule</i>	x	x	x												x
<i>Porzana carolina</i>	<i>Sora</i>			x												

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<i>Porzana flaviventer</i>	<i>Yellow-breasted Crane</i>	x	x		x				x	x		x				x
<i>Progne dominicensis</i>	<i>Caribbean Martin</i>	x	x	x						x						x
<i>Protonotaria citrea</i>	<i>Prothonotary Warbler</i>	x		x						x						
<i>Puffinus iherminieri</i>	<i>Audubon's Shearwater</i>	x		x					x	x	x		x	x		x
<i>Quiscalus niger</i>	<i>Greater Antillean Grackle</i>		x													x
<i>Rallus longirostris</i>	<i>Clapper Rail</i>	x	x	x						x	x					x
<i>Riparia riparia</i>	<i>Bank Swallow</i>			x												
<i>Saurothera vieilloti</i>	<i>Puerto Rican Lizard-Cuckoo</i>	x	x			x				x		x				x
<i>Seiurus aurocapillus</i>	<i>Ovenbird</i>	x		x						x						
<i>Seiurus motacilla</i>	<i>Louisiana Waterthrush</i>	x		x						x	x					
<i>Seiurus novaboracensis</i>	<i>Northern Waterthrush</i>	x		x						x						
<i>Setophaga ruticilla</i>	<i>American Redstart</i>	x		x						x						
<i>Sicalis flaveola</i>	<i>Saffron Finch</i>															x
<i>Sphyrapicus varius</i>	<i>Yellow-bellied Sapsucker</i>	x									x					
<i>Spindalis portoricensis</i>	<i>Puerto Rican Spindalis</i>	x	x			x				x						x
<i>Sterna antillarum</i>	<i>Least Tern</i>	x		x	x	x	x		x	x	x	x	x	x		x
<i>Sterna dougalli dougallii</i>	<i>Roseate Tern</i>	x		x	x	x	x		x	x	x		x	x	x	x
<i>Sterna hirundo</i>	<i>Common Tern</i>	x		x	x											
<i>Streptopelia decaocto</i>	<i>Eurasian Collared-Dove</i>															x
<i>Streptopelia risoria</i>	<i>Ringed Turtle-Dove</i>															x
<i>Sturnus vulgaris</i>	<i>European Starling</i>															x
<i>Sula dacylatra</i>	<i>Masked Booby</i>	x		x		x	x			x	x		x	x		x
<i>Sula leucogaster</i>	<i>Brown Booby</i>	x	x	x		x	x			x			x	x		x
<i>Sula sula</i>	<i>Red-footed Booby</i>	x		x		x				x	x		x	x		x
<i>Tachybaptus dominicus</i>	<i>Least Grebe</i>	x	x	x	x				x	x	x	x				x
<i>Thalasseus maximus</i>	<i>Royal Tern</i>	x		x		x	x						x	x		x
<i>Thalasseus sandvicensis</i>	<i>Sandwich Tern</i>	x		x		x	x						x	x		x
<i>Tiaris bicolor</i>	<i>Black-faced Grassquit</i>		x	x												x
<i>Tiaris olivaceus</i>	<i>Yellow-faced Grassquit</i>		x													x
<i>Todus mexicanus</i>	<i>Puerto Rican Tody</i>	x	x			x				x						x
<i>Tringa flavipes</i>	<i>Lesser Yellowlegs</i>	x		x		x										

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<i>Tringa melanoleuca</i>	Greater Yellowlegs	x		x		x											
<i>Tringa semipalmata</i>	Willet	x	x	x							x						x
<i>Tringa solitaria</i>	Solitary Sandpiper	x		x													
<i>Turdus plumbeus</i>	Red-legged Thrush	x	x														x
<i>Tyrannus caudifasciatus</i>	Loggerhead Kingbird	x	x							x							x
<i>Tyrannus dominicensis</i>	Gray Kingbird	x	x	x													x
<i>Vermivora chrysoptera</i>	Golden-winged Warbler	x															
<i>Vermivora pinus</i>	Blue-winged Warbler	x															
<i>Vidua macroura</i>	Pin-tailed Whydah																x
<i>Vireo altiloquus</i>	Black-whiskered Vireo	x	x	x						x							x
<i>Vireo latimeri</i>	Puerto Rican Vireo	x	x		x	x			x	x							x
<i>Wilsonia citrina</i>	Hooded Warbler	x		x							x						
<i>Zenaida asiatica</i>	White-winged Dove	x	x	x													x
<i>Zenaida aurita</i>	Zenaida Dove	x	x	x													x
<i>Zenaida macroura</i>	Mourning Dove	x	x														x
Totals		144	123	118	28	54	21	21	33	81	54	27	16	15	10	128	

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